Water Management Plan

(5 Year Update)

Prepared By
PACHECO WATER DISTRICT
52027 West Althea Avenue
Firebaugh, California 93622

DECEMBER 2010

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Section 1: Description of the District

District Name: **Pacheco Water District**

Contact Name: **Juan Cadena**

Title: **Drainage Coordinator**

Telephone: **(209)364-6136**

E-mail: **jcadena@panochewd.org**

Web Address _____

A. History

1. Date district formed: **1953** *Date of first Reclamation contract*: **1967**
Original size (acres): **2,590** *Current year (last complete calendar year)*: **9-16-10**

2. Current size, population, and irrigated acres

	(enter data year)
Size (acres)	**4974.5**
Population served	**None**
Irrigated acres	**4,242**

3. Water supplies received in current year

Water Source	*2009*
Federal urban water (Tbl 1)	
Federal agricultural water (Tbl 1)	**5,575 acre feet**
State water (Tbl 1)	
Other Wholesaler (define) (Tbl 1)	
Local surface water (Tbl 1)	
CCID	**4,597 acre feet**
District ground water (Tbl 2)	**1,490 acre feet**
Banked water (Tbl 1)	
Transferred water (Tbl 6)	
Recycled water (Tbl 3)	
Other (define) (Tbl 1)	
Total	**11,662**

4. Annual entitlement under each right and/or contract

	AF	*Source*	*Contract #*	*Availability period(s)*
Reclamation Urban AF/Y				
Reclamation Agriculture AF/Y				
Other AF/Y	**10,080**	**USBR**		**South of Delta Allocation**
Other AF/Y	**4,597**	**CCID**		**See history above**

5. *Anticipated land-use changes*
   None anticipated within next 5 years.

6. *Cropping patterns (Agricultural only)*

   List of current crops (crops with 5% or less of total acreage) can be combined in the 'Other' category.

Original Plan (2001)		*Previous Plan (2008)*		*Current Plan*	
Crop Name	*Acres*	*Crop Name*	*Acres*	*Crop Name*	*Acres*
Melons	**1284**	**Melons**	**1273**	**Melons**	**1475**
Tomatoes	**1563**	**Tomatoes**	**1191**	**Tomatoes**	**1074**
Cotton	**460**	**Cotton**	**240**	**Cotton**	**549**
Asparagus	**456**	**Asparagus**	**456**	**Asparagus**	**364**
Almonds	**175**	**Almonds**	**175**	**Almonds**	**358**
Wheat	**607**	**Wheat**	**461**	**Wheat**	**260**
Onions	**194**	**Safflower**	**365**	**Other (<5%)**	**299**
Other (<5%)	**162**	**Other (<5%)**	**173**		
Total	**4901**	*Total*	**4334**	*Total*	**4080**

(See Planner, Chapter 2, Appendix A for list of crop names)

7. *Major irrigation methods (by acreage) (Agricultural only)*

Original Plan (2007)		*Previous Plan (2008)*		*Current Plan*	
Irrigation Method	*Acres*	*Irrigation Method*	*Acres*	*Irrigation Method*	*Acres*
Drip	**1629**	**Drip**	**3036**	**Drip**	**3292**
Flood	**0**	**Flood**	**0**	**Flood**	**0**
Furrow	**2665**	**Furrow**	**472**	**Furrow**	**528**
Sprinkler	**607**	**Sprinkler**	**826**	**Sprinkler**	**260**
Other		**Other**		**Other**	**0**
Total	**4901**	*Total*	**4334**	*Total*	**4080**

(See Planner, Chapter 2, Appendix A for list of irrigation system types)

B. Location and Facilities

See **Figure 1** for points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, conveyance system, storage facilities, operational loss recovery system, wells, and water quality monitoring locations

1. *Incoming flow locations and measurement methods*

Location Name	*Physical Location*	*Type of Measurement Device*	*Accuracy*
San Luis Canal MP 89.66 LA		**Propeller Meter**	**2% +/-**
San Luis Canal MP 89.66 LB		**Propeller Meter**	**2% +/-**
San Luis Canal MP 89.66 LA		**Propeller Meter**	**2% +/-**
San Luis Canal MP 89.67 LB		**Propeller Meter**	**2% +/-**

2. *2010 Agricultural Conveyance System*

Miles Unlined - Canal	*Miles Lined - Canal*	*Miles Piped*	*Miles - Other*
11.80	**9.96**	**1.00**	

3 *2010 Urban Distribution System-* **No Urban System**

Miles AC Pipe	*Miles Steel Pipe*	*Miles Cast Iron Pipe*	*Miles - Other*

4. *Storage facilities (tanks, reservoirs, regulating reservoirs)*

Name	*Type*	*Capacity (AF)*	*Distribution or Spill*
Pacheco reservoir	**Reservoir**	**450**	**Store drainage water**

5. *List of Storage facilities*

In 1995, to improve water conservation and facilitate drain water management, the District constructed a 450 AF reservoir to store recovered drainage water for regulation and reuse. The location is shown in Figure 2.

6. *Description of the agricultural spill recovery system*

Agricultural tail water is recycled on-farm as required by District Resolution 97-11, attached as Exhibit 1. Operational spill is collected in downstream delivery laterals and recirculated.

7. *Agricultural delivery system operation (check all that apply)*

On-demand	*Scheduled*	*Rotation*	*Other (describe)*
	Applicable		

8. *Restrictions on water source(s)*

Source	*Restriction*	*Cause of Restriction*	*Effect on Operations*
Contractor's Water	**Must use entire allocations**	**CVP Delta Diversion**	**Supply uncertainty**
Contractor's Water	**24 hour lead time for water orders**	**San Luis Canal Operations**	**Reduces delivery Flexibility**

9. *Proposed changes or additions to facilities and operations for the next 5 years*

Lining of District laterals to reduce seepage losses, provided funding can be secured.

C. Topography and Soils

1. *Topography of the district and its impact on water operations and management*

The topography in the district varies from moderately sloping to mild sloping lands. The lands in the District have been mechanically leveled to decrease field slope and to provide uniformly sloping fields to improve irrigation uniformity and efficiency. The topography does not limit the ability to efficiently apply irrigation water.

2. *District soil association map (Agricultural only)*
   See Figure 3
3. *Agricultural limitations resulting from soil problems (Agricultural only)*
   None

D. Climate

1. *General climate of the district service area*

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
Avg Precip.	**1.40**	**1.44**	**0.85**	**0.58**	**0.21**	**0.02**	**0**	**0.01**	**0.05**	**0.45**	**0.63**	**0.82**	**6.45**
Avg Temp.	**45.9**	**50.5**	**55.2**	**59.3**	**66.9**	**72.8**	**76.7**	**74.6**	**70.7**	**61.6**	**52.1**	**45.3**	**61.0**
Max. Temp.	**55.0**	**60.9**	**67.0**	**72.1**	**81.1**	**88.3**	**93.2**	**91.4**	**86.7**	**76.1**	**64.3**	**55.9**	**74.3**
Min. Temp	**37.8**	**40.8**	**42.8**	**45.6**	**51.2**	**56.2**	**60.2**	**58.8**	**55.3**	**48.0**	**40.6**	**36.0**	**47.8**
ETo	**1.16**	**1.96**	**4.08**	**5.60**	**7.68**	**8.53**	**8.44**	**7.37**	**5.72**	**3.94**	**2.02**	**1.25**	**4.81**

Weather station ID **Panoche #124** *Data period: Year* **1/1/1998** *to Year* **12/31/2009**

Average wind velocity **5.0** *Average annual frost-free days:* **30**

2. *Impact of microclimates on water management within the service area*
   No microclimates exist in the District.

E. Natural and Cultural Resources

1. *Natural resource areas within the service area*

Name	*Estimated Acres*	*Description*
NONE		

2. *Description of district management of these resources in the past or present*
   No past or present management.

3. *Recreational and/or cultural resources areas within the service area*

Name	*Estimated Acres*	*Description*
NONE		

F. Operating Rules and Regulations

1. *Operating rules and regulations*
   The Water Delivery Rules are attached as Exhibit 2.

2. *Water allocation policy (Agricultural only)*
   See Water Delivery Rules: Rule 11

3. *Official and actual lead times necessary for water orders and shut-off (Agricultural only)*
Official lead time is 24 hrs for the orders on and off. Actual times may vary depending on need and canal capability. Ditch tenders can be flexible if, in their judgment, an early off or on can be handled by the canal system.

4. *Policies regarding return flows (surface and subsurface drainage from farms) and outflow*
Surface water is not allowed to leave farm boundaries as stated in Pacheco Water District Resolution 97-11. Subsurface drain water is captured, stored, recirculated and used within the District, or discharged. Subsurface water is discharged into the San Luis Drain under a waste discharge permit issued to the SLDMWA. Allocation of the drainage water discharge permit and reuse are shared among the various Grassland drainage areas. Flow and load sharing arrangement with the other Grassland area farmers provides the means to reuse drainage water in the SJRIP.

5. *Policies on water transfers by the district and its customers*
See the Pacheco Water District Transfer Policies 10-30-01, attached as Exhibit 3

G. Water Measurement, Pricing, and Billing

1. Agricultural Customers

a. *Number of farms* **16**

b. *Number of delivery points (turnouts and connections)* **29**

c. *Number of delivery points serving more than one farm* **0**

d. *Number of measured delivery points (meters and measurement devices)* **29**

e. *Percentage of delivered water that was measured at a delivery point* **100%**

f. *Delivery point measurement device table (Agricultural only)*

Measurement Type	*Number*	*Accuracy (+/- %)*	*Reading Frequency (Days)*	*Calibration Frequency (Months)*	*Maintenance Frequency (Months)*
Orifices					
Propeller meter	**29**	**+/- 2%**	**Daily**	**Yearly, All Meters**	**12**
Weirs					
Flumes					
Venturi					
Metered gates					
Acoustic doppler					
Other (define)					
Total					

2. Urban Customers

a. *Total number of connections* **0**

b. *Total number of metered connections*_____

c. *Total number of connections not billed by quantity* _____

d. *Percentage of water that was measured at delivery point* _____

e. *Percentage of delivered water that was billed by quantity* _____

f. *Measurement device table*

Meter Size and Type	*Number*	*Accuracy (+/-percentage)*	*Reading Frequency (Days)*	*Calibration Frequency (Months)*	*Maintenance Frequency (Months)*
5/8-3/4"					
1"					
1 ½"					
2"					
3"					
4"					
6"					
8"					
10"					
Compound					
Turbo					
Other (define)					
Total					

3. Agriculture and Urban Customers

a. *Current year agriculture and /or urban water charges - including rate structures and billing frequency*
See attached document in Exhibit 5: Water Rates and Land Assessment Charges. Copies of typical water bills and a drainage bill are attached in Exhibit 6 Annual charges collected from customers (2009)

Fixed Charges			
Charges ($ unit)	*Charge units ($/acre), ($/customer) etc.*	*Units billed during year (acres, customer) etc.*	*$ collected ($ times units)*
$41.96	**4974.5**	**4974.5 Acres**	**$208,730.02**
$29.40	**4242.5**	**4242.5 Acres**	**$124,729.50**

Volumetric charges			
Charges ($ unit)	*Charge units ($/AF), ($/HCF), etc.*	*Units billed during year (AF, HCF) etc.*	*$ collected ($ times units)*

149.35	**5,575**	**5,575 AF**	**$832,626.25**
131.72	**5,304**	**5,304 AF**	**$698,642.88**

See Attachment D, District Sample Bills

b. Water-use data accounting procedures

The District utilized the water resource management software called STORM, as shown Exhibit 7. This software has the capability of managing all water transactions including allocations, orders, transfers, deliveries, ect. and most financial transactions including billing, cash receipts, and accounts receivable. Other key features the software offers are parcel management (section, township, range, acres, ect.), name management (landowners or leasing information), and field management (crop, irrigation method, land classification ect.). All water records are kept on computer backup files stored in a secured vault.

H. Water Shortage Allocation Policies

1. *Current year water shortage policies or shortage response plan - specifying how reduced water supplies are allocated*
   See Water Delivery Rule: Rule 11.

2. *Current year policies that address wasteful use of water and enforcement methods*
   See Water Delivery Rule: Rule 26.

Section 2: Inventory of Water Resources

A. Surface Water Supply

1. *Acre-foot amounts of surface water delivered to the water purveyor by each of the purveyor's sources*
   See Table 1.

2. *Amount of water delivered to the district by each of the district sources for the last 10 years*
   See Table 8.

B. Ground Water Supply

1. *Acre-foot amounts of ground water pumped and delivered by the district*
   2009 groundwater deliveries were 1490 acre feet. Groundwater quality within the District is poor and it is not a preferred water source. Groundwater is used only when surface supplies are insufficient.

2. *Ground water basin(s) that underlies the service area*

Name	*Size (Square Miles)*	*Usable Capacity (AF)*	*Safe Yield (AF/Y)*
San Joaquin Basin-DAU 216	**13,500**	**80,000,000**	**60% -est.**

3. *Map of district-operated wells and managed ground water recharge areas*
   The District owns and operates two wells. See Figure 4.

4. *Description of conjunctive use of surface and ground water*
   None. Groundwater within the District is of poor quality and used only when surface supplies are insufficient.

5. *Ground Water Management Plan*
   Pacheco Water District is an agency in the Southern Delta-Mendota Canal service area. San Luis Delta-Mendota Water Authority adopted an AB 3030 Groundwater Management Plan on December 17, 1996 and the District is a participating agency with that plan. See document attached in Exhibit 8.

6. *Ground Water Banking Plan*
   The District does not participate in a ground-water banking plan.

C. Other Water Supplies

1. *"Other" water used as part of the water supply*
   NONE

D. Source Water Quality Monitoring Practices

1. *Potable Water Quality (Urban only)* ***N/A***

2. *Agricultural water quality concerns*: *Yes* **X** *No* _____
(If yes, describe)
Salinity or total dissolved solids (TDS) of the water delivered to the users is the primary concern. TDS of irrigation water (measured by EC) delivered to the laterals is checked twice a day after blending of fresh water and drainage water, when the amount of drain water recirculated changes. The District maintains the TDS of the blended supply below 800 mg/L. Water quality of source supply is checked by neighboring Panoche Water District. There is no formal District surface water monitoring, since the supply is from the San Luis Canal portion of the CVP. Water quality data are furnished to the water users upon request. Data on the amount of water delivered to each field is also available in the District office and is checked daily by many of the water users.

Annual water quality report is attached in Exhibit 9.

3. *Description of the agricultural water quality testing program and the role of each participant, including the district, in the program*
Current water quality monitoring programs for surface water (San Luis Canal water monitored daily by Panoche Water District)

4. *Current water quality monitoring programs for surface water by source (Agricultural only)*

Analyses Performed	*Frequency*	*Concentration Range*	*Average*
TDS	**Daily readings**	**200 to 450 mg/l**	**405 mg/l**
Boron	**Monthly**	**0.1 to 0.2 mg/l**	**0.2 mg/l**

Current water quality monitoring programs for groundwater by source (Agricultural only)

Analyses Performed	*Frequency*	*Concentration Range*	*Average*
N/A			

E. Water Uses within the District

1. *Agricultural*
See Table 5

2. *Types of irrigation systems used for each crop in current year*

Crop name	*Total Acres*	*Level Basin - acres*	*Furrow - acres*	*Sprinkler - acres*	*Low Volume - acres*	*Multiple methods -acres*
Melons	**1475**		**103**		**1372**	
Tomatoes	**1074**		**150**		**924**	
Cotton	**549**		**275**		**274**	
Asparagus	**364**				**364**	
Almonds	**358**				**358**	
Wheat	**260**			**260**		

3. *Urban use by customer type in current year.* **N/A**

Customer Type	*Number of Connections*	*AF*
Single-family		
Multi-family		
Commercial		
Industrial		
Institutional		
Landscape irrigation		
Wholesale		
Recycled		
Other (specify)		
Other (specify)		
Other (specify)		
Unaccounted for		
Total		

4. Urban Wastewater Collection/Treatment Systems serving the service area – ***N/A***

Treatment Plant	*Treatment Level (1, 2, 3)*	*AF*	*Disposal to / uses*
N/A			
	Total		
Total discharged to ocean and/or saline sink			

5. Ground water recharge/management in current year (Table 6)

Recharge Area	*Method of Recharge*	*AF*	*Method of Retrieval*
N/A			
	Total		

6. Transfers and exchanges into or out of the service area in current year (Table 6)

From Whom	*To Whom*	*AF*	*Use*
PAC	**SLWD**	**80**	**Agriculture**
PWD	**PAC**	**202**	**Agriculture**
PWD	**PAC**	**75**	**Agriculture**
PWD	**PAC**	**75**	**Agriculture**
PWD	**PAC**	**40**	**Agriculture**
PWD	**PAC**	**75**	**Agriculture**
PWD	**PAC**	**35**	**Agriculture**
PWD	**PAC**	**190**	**Agriculture**
PWD	**PAC**	**42**	**Agriculture**

7. Trades, wheeling, wet/dry year exchanges, banking or other transactions in current year

(Table 6)

From Whom	*To Whom*	*AF*	*Use*

8. *Other uses of water in current year N/A*

Other Uses	*AF*

F. Outflow from the District (Agricultural only)

Districts included in the drainage problem area, as identified in "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley (September 1990)," should also complete Water Inventory Table 7 and Appendix B (include in plan as Attachment L)

See Facilities Map, Attachment A, for the location of surface and subsurface outflow points, outflow measurement points, outflow water-quality testing locations

1. *Surface and subsurface drain/outflow in current year*

Outflow point	*Location description*	*AF*	*Type of measurement*	*Accuracy (%)*	*% of total outflow*	*Acres drained*
	Subsurface flows	**1,645**	**Meter**	**+/- 2%**	**100%**	**4080**

Outflow point	*Where the outflow goes (drain, river or other location)*	*Type Reuse (if known)*
	San Joaquin River Quality Improvement Project	**Reuse – Irrigation of Salt Tolerant Crops**
	Grassland Bypass Project – Discharge to the San Luis Drain	**Discharge**

2. *Description of the Outflow (surface and subsurface) water quality testing program and the role of each participant in the program*
   All tile sumps and discharge volumes are metered and reported monthly to the Board of Directors. See attachment in Exhibit 10. The EC, Selenium, and Boron concentrations for the tile sumps and discharge are analyzed monthly. The discharge is commingled with discharges from other districts in the drainage area and either reused on the San Joaquin River Improvement Project (SJRIP) or discharged to San Luis Drain through the Grassland Bypass Project. Exhibit 11 is a sample of selenium monitoring at the drain outlet.

3. *Outflow (surface drainage & spill) Quality Testing Program*

Analyses Performed	*Frequency*	*Concentration Range*	*Average*	*Reuse limitation?*
EC	**Monthly**	**5,000-7,000 µmho/cm**	**5,420 umho/cm**	**Unsuitable for all crops**
Selenium	**Monthly**	**50-200 ug/L**	**94 ug/L**	**NONE**
Boron	**Monthly**	**4-8 ug/L**	**5.9ug/L**	**Unsuitable for all crops**

4. *Provide a brief discussion of the District's involvement in Central Valley Regional Water Quality Control Board programs or requirements for remediating or monitoring any contaminants that would significantly degrade water quality in the receiving surface waters.*

Pacheco Water District is located within the Grassland Drainage Area, which is a 100,000 acre region that is regulated by a Total Maximum Monthly Load (TMML) program for selenium discharge through the Grassland Bypass Project and includes an extensive monitoring program. Regulation and enforcement of that TMML is performed by the Central Valley Regional Water Quality Control Board. As a stakeholder participant in that program, the District has implemented a number of actions to minimize its drainage discharges, including:

- **No tailwater discharge policy. The District aggressively enforces a district-wide prohibition of surface irrigation runoff (tailwater). Al growers are required eliminate or recirculate their surface runoff.**
- **Recirculation of subsurface drain water. To the extent possible, the District recirculates subsurface drain water back into the irrigation system, reducing the volume of drainage that leaves the District.**
- **Encouragement of high-efficiency irrigation systems. High-efficiency irrigation methods (such as subsurface drip and micro-sprinklers) reduce deep percolation which reduces the volume of subsurface drain water. When possible, the District offers low-interest loans to growers to facilitate their installation.**
- **Implementation of the Westside Regional Drainage Plan. The Westside Regional Drainage Plan was developed by the districts within the Grassland Drainage Area and other stakeholders to provide an ultimate solution to subsurface drainage discharges from the region. Pacheco Water District is participating in the implementation of that plan.**

G. Water Accounting (Inventory)

1. *Water Supplies Quantified*

   a. *Surface water supplies, imported and originating within the service area, by month (Table 1)*
   b. *Ground water extracted by the district, by month (Table 2)*
   c. *Effective precipitation by crop (Table 5)*
   d. *Estimated annual ground water extracted by non-district parties (Table 2)*
   e. *Recycled urban wastewater, by month (Table 3)* **N/A**
   f. *Other supplies, by month (Table 1)* **N/A**

2. *Water Used Quantified*

   a. *Agricultural conveyance losses, including seepage, evaporation, and operational spills in canal systems (Table 4) or*
      Urban leaks, breaks and flushing/fire uses in piped systems (Table 4)
   b. *Consumptive use by riparian vegetation or environmental use (Table 6)* **N/A**
   c. *Applied irrigation water - crop ET, water used for leaching/cultural practices (e.g., frost protection, soil reclamation, etc.) (Table 5)*
   d. *Urban water use (Table 6)*
   e. *Ground water recharge (Table 6)* **N/A**
   f. *Water exchanges and transfers and out-of-district banking* (**See Section 2, E.6**)
   g. *Estimated deep percolation within the service area (Ag. Table 6)*
   h. *Flows to perched water table or saline sink (Ag. Table 7)*
   i. *Outflow water leaving the district (Table 6)*
   j. *Other*

3. *Overall Water Inventory*
   a. *Table 6*

H. Assess Quantifiable Objectives:

Identify the Quantifiable Objectives that apply to the District (Planner, chapter 10) and provide a short narrative describing past, present and future plans that address the CALFED Water Use Efficiency Program goals identified for the District.

QO #	*QO Description*	*Past, Present & Future Plans*
106	**Decrease flows to Salt Sinks to increase water supplies for beneficial uses.**	**PWD encourages growers to modernize their irrigation systems to increase efficiency and reduce deep percolation. PWD is pursuing funding to install lining in canals, laterals and regulating reservoirs.**
109	**Provide Long-term diversion flexibility to increase the water supply for beneficial uses.**	**PWD encourages growers to modernize their irrigation systems to increase efficiency and has provided funding assistance to this end. PWD is also pursuing funding to upgrade water delivery infrastructure to reduce seepage losses and increase system reliability.**
93	**Reduce Group A Pesticides to enhance and maintain beneficial uses of water.**	**Growers within PWD no longer use Group A pesticides.**
95,96,98	**Reduce native constituents to enhance and maintain beneficial uses of water.**	**PWD has participated in the Grassland Bypass Project since its inception to manage and reduce discharges of subsurface drain water. Through a combination of irrigation system and distribution facilities improvements, drainage reuse, and ultimately treatment, PWD expects to eventually eliminate drainage discharges from the district.**
97,99, 100,101	**Reduce Pesticides to enhance and maintain beneficial uses of water.**	**Growers within PWD follow appropriate management practices to minimize drift and discharge of pesticides. PWD has also**

		implemented a "no tailwater" policy, which prohibits growers from discharging tailwater and prevents pesticides from leaving the district through surface runoff.
102,103, 104	**Reduce salinity to enhance and maintain beneficial uses of water**	**PWD encourages growers to modernize their irrigation systems to increase efficiency and reduce deep percolation and the subsequent production of saline drainwater. PWD has provided funding assistance to growers for irrigation systems improvements. PWD is pursuing funding to install lining in canals, laterals and regulating reservoirs. Additionally, PWD participates in the Grassland Bypass Project to manage and reduce discharges of subsurface drain water. Through a combination of irrigation system and distribution facilities improvements, drainage reuse, and ultimately treatment, PWD expects to eventually eliminate drainage discharges from the district.**

Section 3: Best Management Practices (BMPs) for Agricultural Contractors

A. Critical Agricultural BMPs

1. *Measure the volume of water delivered by the district to each turnout with devices that are operated and maintained to a reasonable degree of accuracy, under most conditions, to +/- 6%*

Number of turnouts that are unmeasured or do not meet the standards listed above: **0**

Number of measurement devices installed last year: **0**

Number of measurement devices installed this year: **0**

Number of measurement devices to be installed next year: **0**

Types of Measurement Devices Being Installed	*Accuracy*	*Total Installed During Current Year*
Propeller (NS-OF 32)	**+/- 2%**	**0**

2. *Designate a water conservation coordinator to develop and implement the Plan and develop progress reports*

Name: **Juan Cadena** *Title:* **Drainage Coordinator**

Address: **52027 W. Althea Ave, Firebaugh, CA. 93622**

Telephone: **(209) 364-6136** *E-mail:* **jcadena@panochewd.org**

3. *Provide or support the availability of water management services to water users,* **Notices of District Education Programs and Services Available to Customers.**

   a. *On-Farm Evaluations* **See Exhibit 13**

   1) On farm irrigation and drainage system evaluations using a mobile lab type assessment

	Total in district	*# surveyed last year*	*# surveyed in current year*	*# projected for next year*	*# projected 2nd yr in future*
Irrigated acres	**4,242**				
Number of farms	**16**	**0**	**0**	**2**	**2**

The District will send a notice at the beginning of the irrigation season included with their monthly billing.

   2) Timely field and crop-specific water delivery information to the water user

b. *Real-time and normal irrigation scheduling and crop ET information*

The District provides weather station data and promotes the use of CIMIS data. The District informs the grower's via U.S. mail and email, about the availability of the data in the District office. The District also promotes the use of Westlands Water District (WWD) website for irrigation scheduling and WWD web link (https://cs.westlandswater.org/resources/wtrcon/guide/tfoawx.htm)

See attached document in Exhibit 12.

c. *Surface, ground, and drainage water quantity and quality data provided to water users*

Electrical conductivity (EC) of the water in the delivery system is checked twice daily during the irrigation season when recirculating drainage water, and the results are furnished upon request to the water users. Data on the amount of water delivered to each field is also available in the District office and is checked daily by many of the water users. Subsurface drainage flow is measured with propeller meters on each pump discharge and tabulated monthly. EC, selenium, and boron concentrations of each tile sump as well as the District's discharge point are checked monthly. In the fall of 1996, the District became a participating agency in the Grassland Bypass Project, which routed it's drainage, along with that of seven other district, to the San Luis Drain and ultimately the San Joaquin River. This discharge is subject to comprehensive water quality and biological monitoring and must comply with waste discharge requirements regulated by the Central Valley Regional Water Quality Control Board.

d. *Agricultural water management educational programs and materials for farmers, staff, and the public*

See attached document in Exhibit 13.

District Water Conservation Library. The District maintains a library of literature regarding crop water use, irrigation management practices, and basic irrigation science acquired through public sources such as the UC Extension Service. This literature is available in the District office to be reviewed by water users.

Irrigation Seminars and Short Course. The District notifies its water users of seminars and workshops sponsored by various public agencies, such as Cal-Poly/SLO Irrigation Training and Research Center. The objective of the seminars and short-courses is to inform water users of current research or methods of improved irrigation and drainage reduction techniques. Notifications to water users take place at least two times per year.

District-Sponsored Seminars. As an ongoing water conservation activity, the District's Water Conservation coordinator meets with growers one-on-one or in small groups to discuss irrigation management principles either in classroom or field situations. This allows focused attention to specific management methods and questions.

Grassland Area Farmers Meeting. As the need to minimize and regulate subsurface drainage becomes paramount, it is crucial to keep the landowners, water users,

staff, and the public informed of the current circumstances including any changes in policy. The District strongly promotes attending any of the public meetings pertaining to drainage.

<u>Employee Training.</u> Employees attend training and seminars on various topics, such as pumps, and basic pipeline hydraulics classes. The objected is to help the water user with on farm situations regarding pumps and pipeline hydraulics upon request.

The focus for the future is to involve more irrigation foreman and field workers in the educational opportunities.

4. *Pricing structure - based at least in part on quantity delivered*
   Describe the quantity-based water pricing structure, the cost per acre-foot, and when it became effective.

   District water charges are based in part on quantity delivered. (Copies typical water bills are attached in Exhibit 6.)

5. *Evaluate and describe the need for changes in policies of the institutions to which the district is subject*

   1) **Reclamation's annual CVP allocations are announced too late in the year for growers to effectively plan and optimize their water use. CVP water allocations need to be announced no later than January 31st of each year.**
   2) **The District's CVP contract requires it to use all of it's annual allocation or lose the water. Additional carry-over flexibility would improve the growers' ability to plan and increase water use efficiency.**

6. *Evaluate and improve efficiencies of district pumps*
   Describe the program to evaluate and improve the efficiencies of the contractor's pumps.

   Lift pumps for drainage water recirculation are tested every year and tile drainage pumps are tested every other year. USBR pays half of the cost and the District pays the remaining cost of testing.

B. Exemptible BMPs for Agricultural Contractors

(See Planner, Chapter 2, Appendix C for examples of exemptible conditions)

1. *Facilitate alternative land use*

   The District provides for alternate use of land for management of subsurface drainage water through their participation in the SJRIP. In this project, lands have been

purchased and converted from traditional agriculture to irrigation of salt tolerant crops with subsurface drainage water. This program has resulted in a substantial reduction in drainage water discharge to the San Joaquin River improving the water quality in the river.

2. *Facilitate use of available recycled urban wastewater that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to crops or soils*

Sources of Recycled Urban Waste Water	*AF/Y Available*	*AF/Y Currently Used in District*
No Urban waste water available.		

3. *Facilitate the financing of capital improvements for on-farm irrigation systems*

Funding source Programs	*How provide assistance*
Low interest loans, grants	**DWR, USBR, SWRCB, SRF**

The District has pursued low interest loans made available through the State of California State Revolving Fund (SRF) and Agricultural Drainage Loan Program (ADLP). These programs provide low interest loans to the District which, in turn, are provided to land owners for irrigation system improvements. Growers have improved irrigation methods on 1663 acres. Additionally, the District can help growers apply for funding through other assistance programs such as the NRCS EQIP program. The District is still pursuing low interest loans, and grants.

4. *Incentive pricing*

The District has implemented separate tiered pricing for pre-irrigation as regulated in the District Resolution 96-16. This program is still ingoing. See attachment Exhibit 14.

5. *a) Line or pipe ditches and canals*

The District completed a seepage study in 2000 and updated the study in 2002. This study demonstrated that it is economically feasible to concrete line the existing earth lined laterals. The District continues to seek funding through DWR, USBR, and SWRCB. The District plans to line irrigation laterals when funding is available. See Exhibit 15

Canal/Lateral (Reach)	*Type of Improvement*	*Number of Miles in Reach*	*Estimated Seepage (AF/Y)*	*Accomplished/ Planned Date*
Pond 7	**Lining**	**0.17**	**37**	**To be completed when financially feasible.**
Lateral 3	**Lining**	**3.1**	**407**	
Lateral 4	**Lining**	**1.0**	**47**	
Lateral 5	**Lining**	**3.0**	**272**	
Lateral 6	**Lining**	**3.5**	**387**	

b) Construct regulatory reservoirs

The District's irrigation system includes a terminal reservoir which captures water at the end of the system and returns it to the main lift canal for reintegration into the irrigation system. This system is not independently monitored.

Reservoir Name	*Annual Spill in Section (AF/Y)*	*Estimated Spill Recovery (AF/Y)*	*Accomplished/ Planned Date*

6. *Increase flexibility in water ordering by, and delivery to, water users*

The District Provides flexibility within the constraints of the water delivery system and for water orders off the San Luis Canal. The District allows flexible on and off time when the system allows.

7. *Construct and operate district spill and tailwater recovery systems*

This BMP is not applicable to the District, since all spills is captured and reused and tailwater must be stored and recirculated on-farm.

8. *Plan to measure outflow.*

Total # of outflow (surface) locations/points **0**
Total # of outflow (subsurface) locations/points **0**
Total # of measured outflow points **0**
Percentage of total outflow (volume) measured during report year **0**

Identify locations, prioritize, determine best measurement method/cost, submit funding proposal

Location & Priority	*Estimated cost (in $1,000s)*				
	2009	*2010*	*2011*	*2012*	*2013*

9. *Optimize conjunctive use of surface and ground water*

Groundwater is not a preferred source of water and is used only when surface supplies are insufficient. The District does not have a conjunctive use policy.

10. *Automate canal structures*

The District's conveyance system captures and returns operational spill. Automation of canal structures would provide limited benefit.

11. *Facilitate or promote water customer pump testing and evaluation*

See Exhibit 16, Notices of District Education Programs and Services Available to Customers

The water conservation coordinator meets with growers and advises them of:

1) **The benefits of keeping pump efficiency high;**
2) **The SLDMWA pump evaluation program;**
3) **The program is currently at no customer cost**

12. Mapping

The District has evaluated GIS software along with other mapping software and has determined that, because of the size of the District, the cost of the software, and the staff training required to effectively use it, implementation of a GIS program is not an appropriate use of District resources at this time.

GIS maps	*Estimated cost (in $1,000s)*				
	2009	*2010*	*2011*	*2012*	*2013*
Layer 1 – Distribution system	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 2 – Drainage system	**$0**	**$0**	**$0**	**$0**	**$0**
Suggested layers:					
Layer 3 – Ground water information	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 4 – Soils map	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 5 – Natural & cultural resources	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 6 – Problem areas	**$0**	**$0**	**$0**	**$0**	**$0**

C. Provide a 3-Year Budget for Implementing BMPs

1. Amount actually spent during current year.

BMP #		*BMP Name*	*Actual Expenditure (not including staff time)*	*Staff Hours*
A	*1*	*Measurement*	**$0**	**80**
	2	*Conservation staff*	**$0**	**20**
	3	*On-farm evaluation /water delivery info*	**$300**	**15**
		Irrigation Scheduling	$0	10
		Water quality	**$2600**	**35**
		Agricultural Education Program	**$600**	**20**
	4	*Quantity pricing*	**$0**	**0**
	5	*Policy changes*	**$0**	**0**
	6	*Contractor's pumps*	**$13,100**	**20**
B	*1*	*Alternative land use*	**$0**	**0**
	2	*Urban recycled water use (continued)*	**$0**	**0**
	3	*Financing of on-farm improvements*	**$0**	**0**
	4	*Incentive pricing*	**$0**	**0**
	5	*Line or pipe canals/install reservoirs*	**$0**	**0**

6	*Increase delivery flexibility*	**$0**	**0**
7	*District spill/tailwater recovery systems*	**$0**	**0**
8	*Measure outflow*	**$0**	**20**
9	*Optimize conjunctive use*	**$0**	**0**
10	*Automate canal structures*	**$0**	**0**
11	*Customer pump testing*	**$300**	**0**
12	*Mapping*	**$0**	**25**
	Total	**$16900**	**245**

2. *Projected budget summary for the next year.*

BMP #		*BMP Name*	*Budgeted Expenditure (not including staff time)*	*Staff Hours*
A	1	*Measurement*	**$0**	**80**
	2	*Conservation staff*	**$0**	**10**
	3	*On-farm evaluations/water delivery info*	**$300**	**15**
		Irrigation Scheduling	**$0**	**10**
		Water quality	**$2800**	**35**
		Agricultural Education Program	**$600**	**20**
	4	*Quantity pricing*	**$0**	**0**
	5	*Policy changes*	**$0**	**0**
	6	*Contractor's pumps*	**$15000**	**30**
B	1	*Alternative land use*	**$0**	**0**
	2	*Urban recycled water use*	**$0**	**0**
	3	*Financing of on-farm improvements*	**$0**	**0**
	4	*Incentive pricing*	**$0**	**0**
	5	*Line or pipe canals/install reservoirs*	**$0**	**0**
	6	*Increase delivery flexibility*	**$0**	**0**
	7	*District spill/tailwater recovery systems*	**$0**	**0**
	8	*Measure outflow*	**$0**	**0**
	9	*Optimize conjunctive use*	**$0**	**0**
	10	*Automate canal structures*	**$0**	**0**
	11	*Customer pump testing*	**$300**	**0**
	12	*Mapping*	**$0**	**30**
		Total	**$19000**	**230**

3. *Projected budget summary for 3rd year.*

BMP #		*BMP Name*	*Budgeted Expenditure (not including staff time)*	*Staff Hours*
A	1	*Measurement*	**$0**	**80**
	2	*Conservation staff*	**$0**	**10**
	3	*On-farm evaluations/water delivery info*	**$300**	**15**
		Irrigation Scheduling	**$0**	**10**
		(continued)		
		Water quality	**$2800**	**35**
		Agricultural Education Program	**$600**	**20**
	4	*Quantity pricing*	**$0**	**0**
	5	*Policy changes*	**$0**	**0**

	6	*Contractor's pumps*	**$15000**	**30**

BMP #		*BMP Name*	*Budgeted Expenditure (not including staff time)*	*Staff Hours*
B	*1*	*Alternative land use*	**$0**	**0**
	2	*Urban recycled water use*	**$0**	**0**
	3	*Financing of on-farm improvements*	**$0**	**0**
	4	*Incentive pricing*	**$0**	**0**
	5	*Line or pipe canals/install reservoirs*	**$0**	**0**
	6	*Increase delivery flexibility*	**$0**	**0**
	7	*District spill/tailwater recovery systems*	**$0**	**0**
	8	*Measure outflow*	**$0**	**0**
	9	*Optimize conjunctive use*	**$0**	**0**
	10	*Automate canal structures*	**$0**	**0**
	11	*Customer pump testing*	**$300**	**0**
	12	*Mapping*	**$0**	**30**
		Total	**$19000**	**230**

Enter data year here: 2009

Table 1
Surface Water Supply

2009 Month	**Federal Ag Water** (acre-feet)	**Federal Non-Ag Water** (acre-feet)	**State Water** (acre-feet)	**CCID** (acre-feet)	**Other (undefine)** (acre-feet)	**Upslope Drain Water** (acre-feet)	**Total** (acre-feet)
METHOD	M1			M1			
January	17			168			185
February				310			310
March	80			624			704
April				910			910
May	350			1,611			1,961
June	1,197			748			1,945
July	1,681						1,681
August	908						908
September	766						766
October	182			132			314
November	298			94			392
December	96						96
Total	5,575			4,597			10,172

Note: Quantity of transferred in water is included in Federal Ag. Water.

Enter data year here: 2009

Table 2
Ground Water Supply

2009	District Groundwater	Private Groundwater
Month		
METHOD	**(acre-feet)**	***(acre-feet)**
January	0	0
February	0	0
March	0	0
April	0	0
May	258.45	0
June	578.42	0
July	652.83	0
August	0	0
September	0	0
October	0	0
November	0	0
December	0	0
Total	1489.7	0

Enter data year here: 2009

Table 3

Total District Water Supply

2009 Month	**Surface Water** (acre-feet)	**Groundwater** (acre-feet)	**Recycled Water** (acre-feet)	**Total Water Supply** (acre-feet)
METHOD	M1	Meter		
January	185	0	0	185
February	310	0	0	310
March	704	0	0	704
April	910	0	0	910
May	1,961	258	0	2,219
June	1,945	578	0	2,524
July	1,681	653	0	2,334
August	908	0	0	908
September	766	0	0	766
October	314	0	0	314
November	392	0	0	392
December	96	0	0	96
	10,172	1,490		11,662

Table 4
Distribution System

Canal, lateral, reach, reservoir	Length/size (Feet or AF)	Surface Area (square feet)	Seepage acre-feet	Precipitation acre-feet	Evaporation acre-feet	Spillage acre-feet	Total acre-feet
Main Dist. Dith-Earth	900	36,000	135	0.4	5	0	140
Main Dist. Dith-Lined	5,700	85,500	12	0.8	11	0	22
Lateral 2 - Earth	2,000	80,000	53	0.8	5	0	57
Lateral 2 - Lined	9,800	147,000	20	1.5	12	0	31
Lateral 3 - Earth	16,000	640,000	407	6.3	30	0	431
Lateral 4 - Lined	12,000	180,000	25	1.8	15	0	38
Lateral 4 - Earth	5,800	232,000	47	2.3	10	0	55
Lateral 5 - Lined	3,900	58,500	10	0.6	5	0	14
Lateral 5 - Earth	15,800	632,000	272	6.2	30	0	296
Lateral 6 - Earth	18,500	740,000	387	7.3	35	0	415
Lateral 7 - Lined	7,000	105,000	15	1.0	10	0	24
Field 620 -Lined	2,600	39,000	5	0.4	5	0	10
Field 618 -Lined	2,000	30,000	5	0.3	2	0	7
Field 614 -Lined	2,000	30,000	5	0.3	2	0	7
Field 516 -Lined	2,000	80,000	53	0.8	5	0	57
Field 401 -Lined	3,700	55,500	8	0.5	7	0	14
Field 308 -Earth	1,300	52,000	35	0.5	3	0	37
Field 308 -Lined	1,300	19,500	3	0.2	2	0	5
Field 204 -Lined	2,600	39,000	5	0.4	5	0	10
Total	114,900	3,281,000	1,502	32	199	0	1,670

Table 5
Surface Water Supply

Crop	Area	Crop ET	Leaching Requirement	Cultural Practice	Effective Precipitation	Shallow Groundwater	Apple. Crop Water use
	(acre-feet)	(AF/Ac)	(AF/Ac)	(AF/Ac)	(AF/Ac)	(AF/Ac)	(acre-feet)
Melons (early)	365	1.15	0.075	0.50	0.03	0.00	619
Melons (mid)	745	1.27	0.075	0.50	0.02	0.00	1,360
Melons (late)	365	1.06	0.075	0.50	0.00	0.00	597
Tomatoes	1,074	2.08	0.140	0.50	0.01	0.00	2,911
Cotton	549	2.43	0.052	0.50	0.03	0.00	1,621
Asparagus	364	3.84	0.099	0.00	0.27	0.00	1,336
Almonds (3rd leaf)	182	2.51	0.120	0.00	0.16	0.00	450
Almonds (1st leaf)	176	0.78	0.120	0.00	0.16	0.00	130
Wheat	260	1.91	0.029	0.00	0.26	0.00	437
							0
							0
Crop Acres	4,080						9,458

Table 6
System Water Budget

Water Into Distribution			11,662
Riparian ET	(Distribution and Drain)	Minus	0
Groundwater Recharge	(Intentional, Ponds, Injection)	Minus	0
Seepage	Table 4	Minus	1,502
Evaporation	Table 4	Minus	199
Spillage	Table 4	Minus	0
Non-Ag Deliveries	Federal and Non-Federal	Minus	0
Theoretical Water Available for Sale to Ag Customers			
Compare the above Line with the next Line to Help find Omissions			9,961
2009 Actual Agriculture Water Sales		From District Sales Records	9,726
Private GroundWater	Table 2	Plus	0
Crop Water Needs	Table 5	Minus	9,458
Drain Water Outflow	(Tail & Tile Not Recycle)	Minus	
Ag tail Water Pumped back into Distribution System		Minus	
Percolation from Agricultural Land		(Calculated)	268

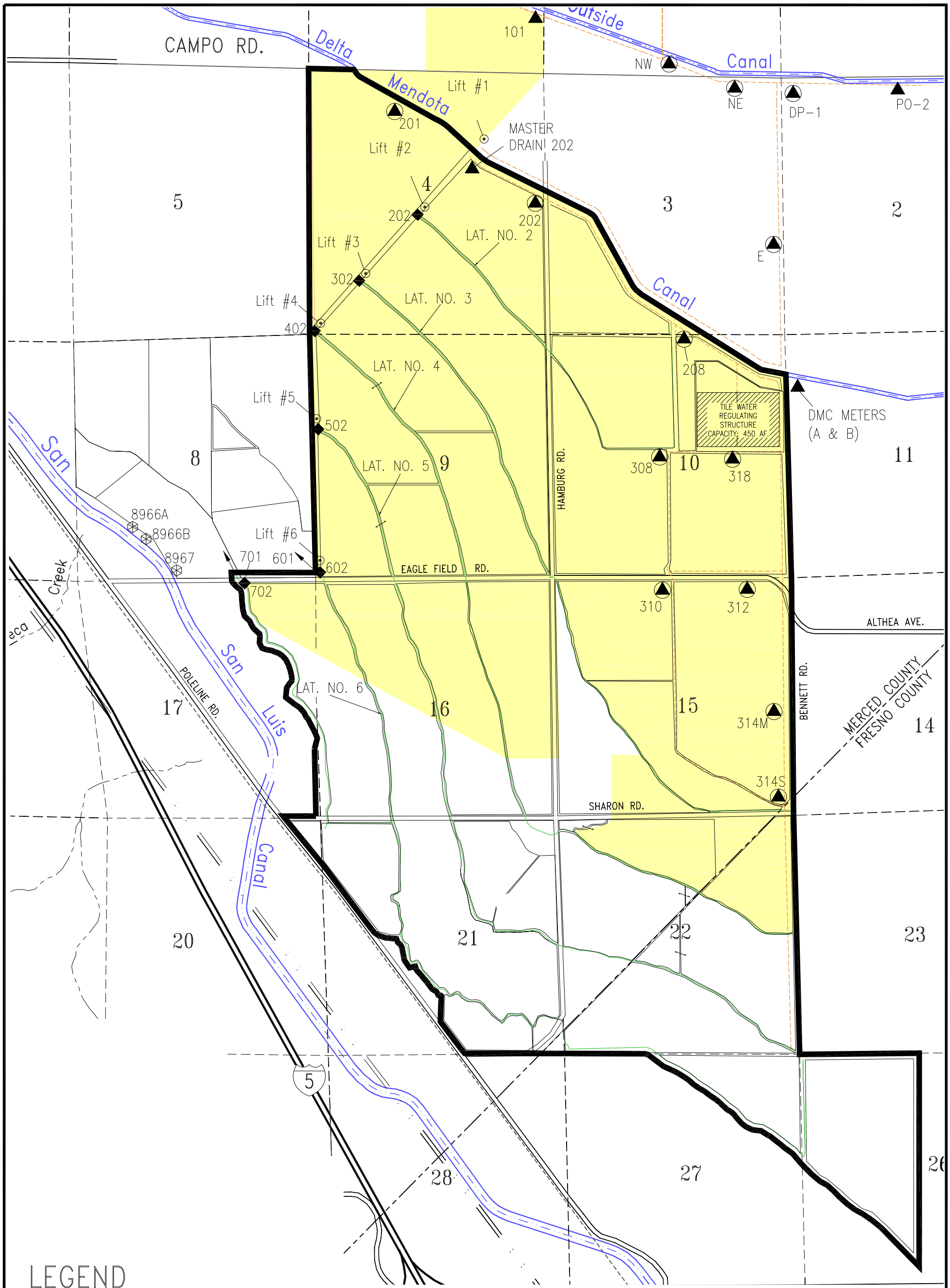
Table 7
Influence on Ground Water and Saline Sink

	Flows or Acres (AF or Ac)
Deep Percolation from fields+Seepage+Groundwater =Theoretical influence on ground water storage from district operations	1,770
Estimated actual change in ground water storage, accounting for subsurface conditions (estimated from water table and basin data)	
Irrigated Acres (from Table 5)	4080
Irrigated acres over a perched water table	4080
irrigated acres draining to saline sink	4080
Portion of percolation from ag flowing to a perched water table	1,770
Portion of percolation from ag flowing to a saline sink	1770
Portion of On-Farm Drain Water flowing to a perched water table/saline sink	268
Portion of Dist. Sys. Seep/leaks/spills to perched water table/saline sink	1,502

Table 8
Annual Water Quantities Delivered Under Each Right or Contract

YEAR	Federal Ag Water	Federal Non-Ag Water	State Water	CCID	Other (undefine)	Total
	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)
2000	6552	0	0	5,524		12,076
2001	4939	0	0	5,005		9,944
2002	7056	0	0	5,362		12,418
2003	7560	0	0	3,877		11,437
2004	7,056	0	0	5,292		12,348
2005	9,072	0	0	3,444		12,516
2006	10,080	0	0	1,626		11,706
2007	5,040	0	0	3,216		8,256
2008	4,032	0	0	4,879		8,911
2009	1,008	0	0	4,597		5,605
Total	62,395	0	0	42,822		105,217
Average	6,240	0	0	4,282		10,522

EXHIBIT 1



LEGEND

Pacheco W.D. Boundary

Canals

Irrigation Laterals

Meters @ Lateral Headworks

Pumps or Pump Stations

Customer Turnouts

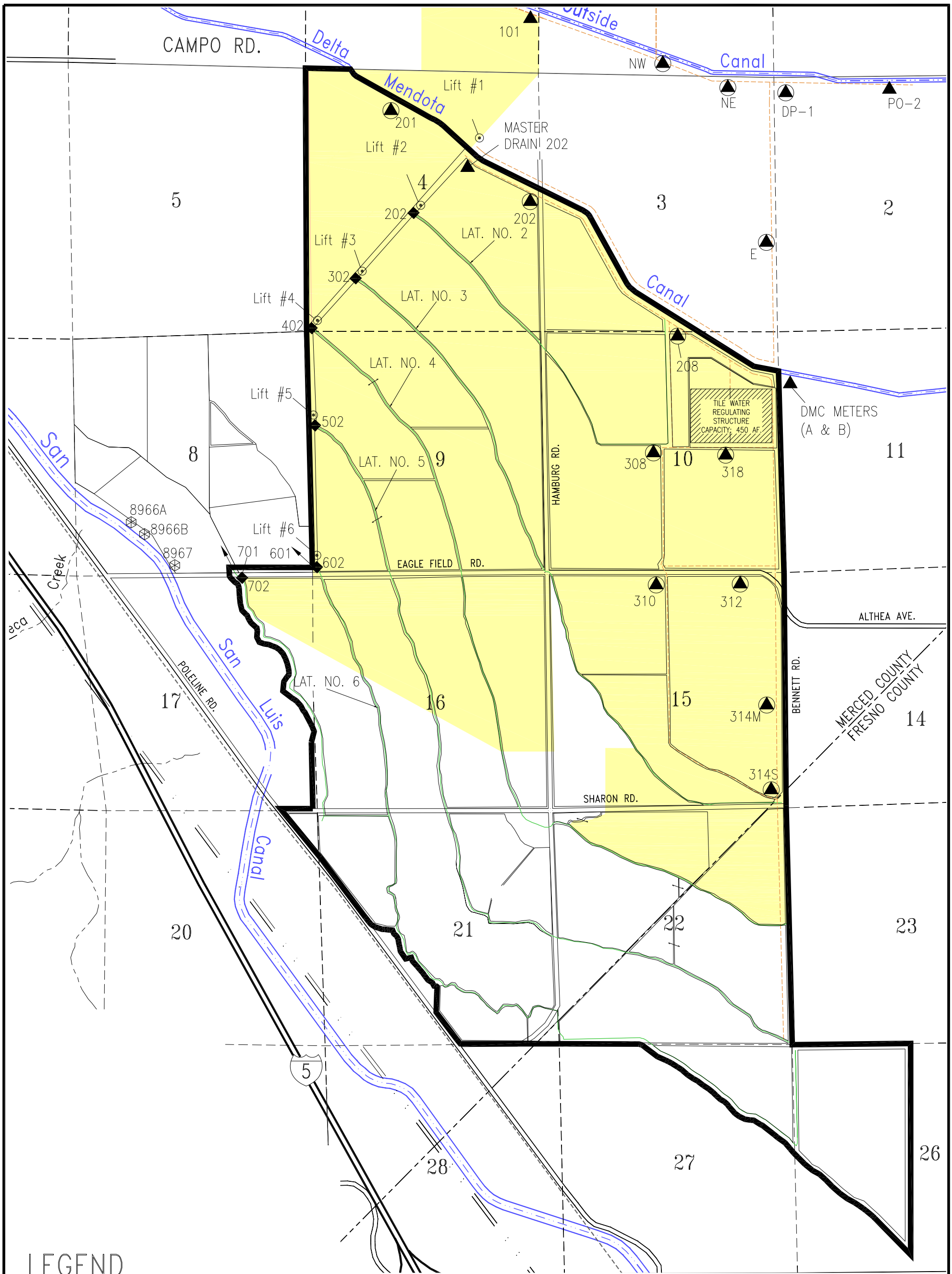
PACHECO WATER DISTRICT

FIREBAUGH CALIFORNIA

WATER DISTRIBUTION

MARCH 2010

FIGURE 1



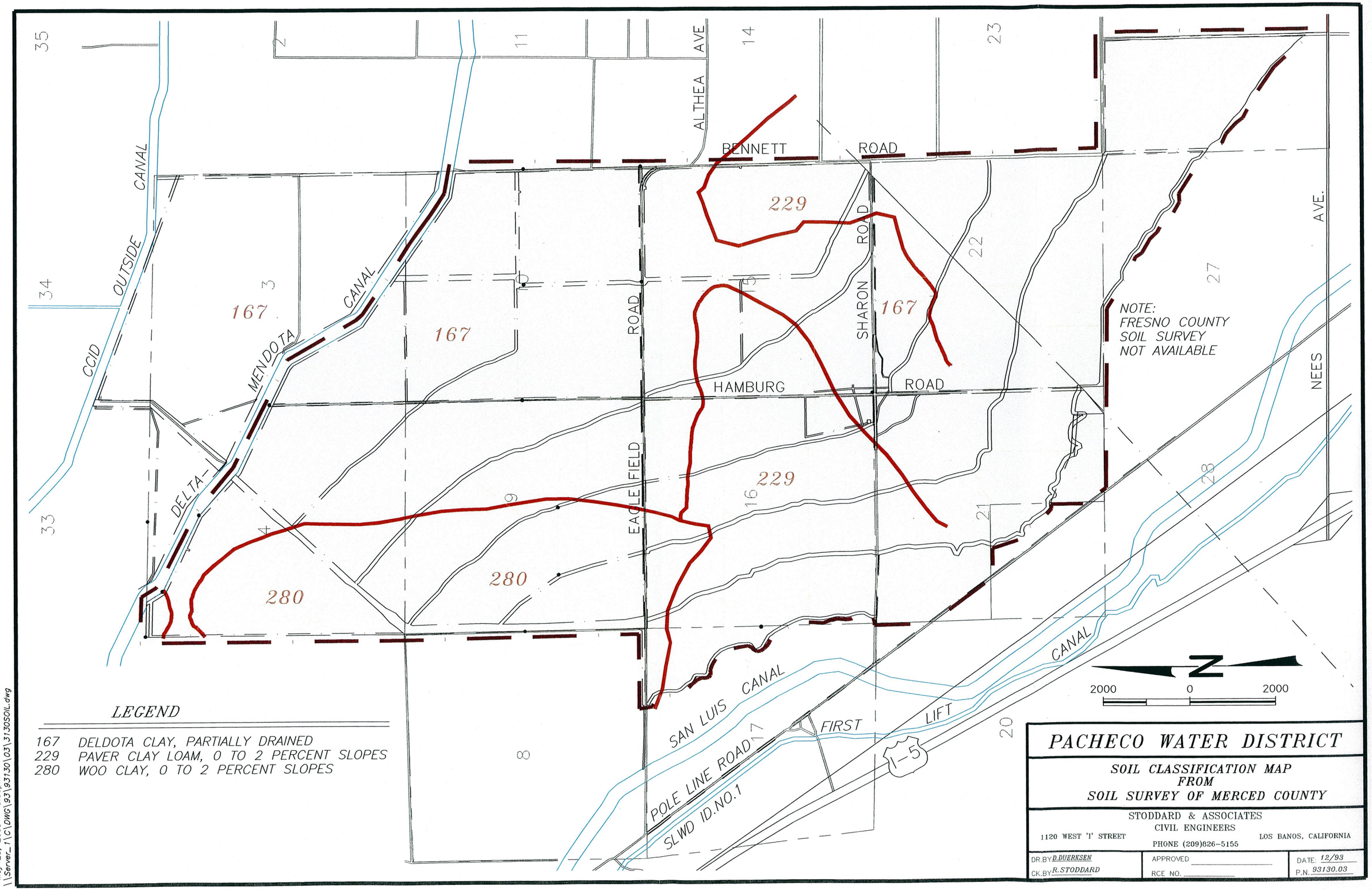
PACHECO WATER DISTRICT

FIREBAUGH CALIFORNIA

WATER DRAINAGE SYSTEM

OCTOBER 2010

FIGURE 2


35
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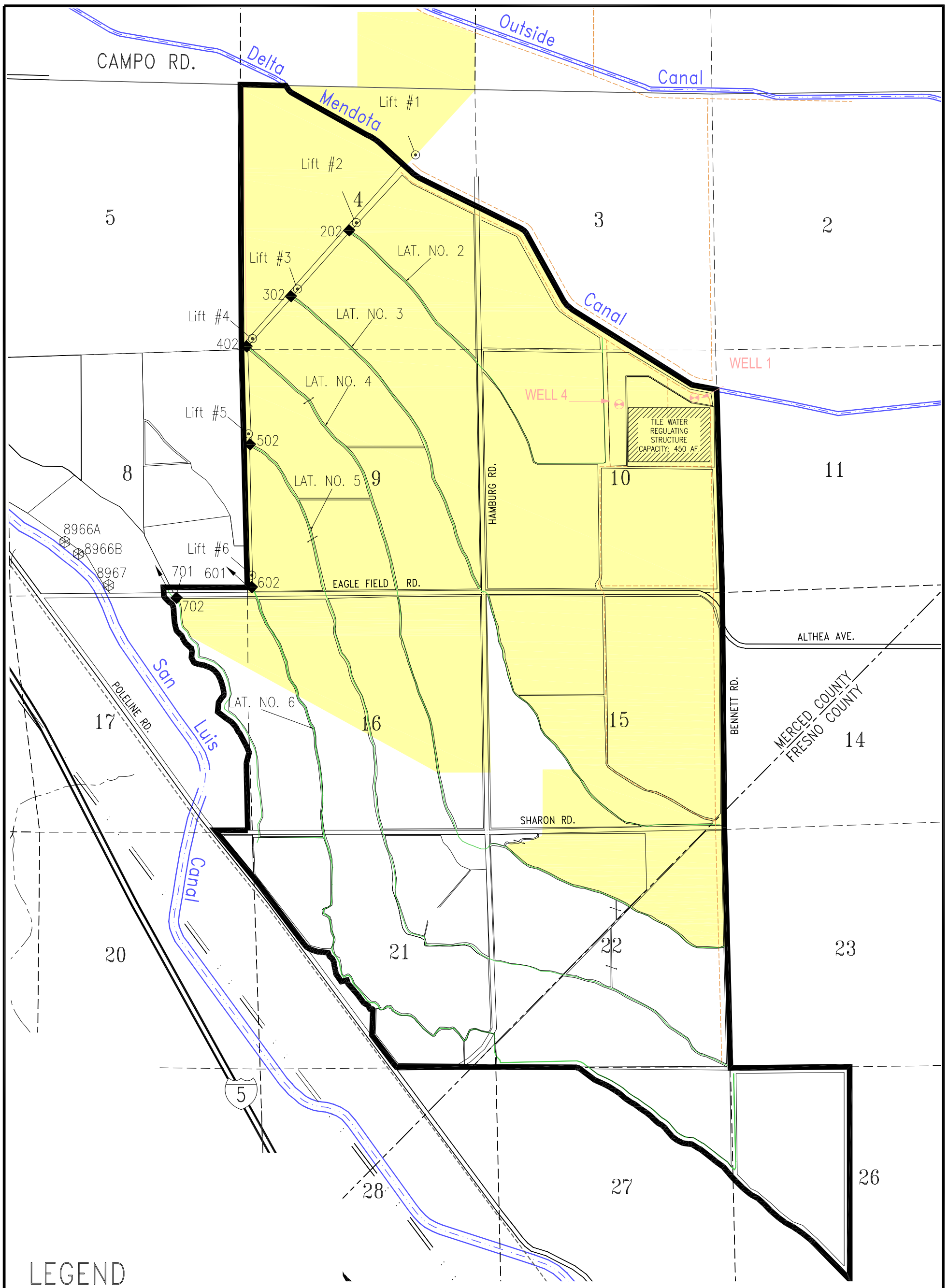
4
3
10
15
ALTHEA AVE
BENNETT ROAD
SHARON ROAD
HAMBURG ROAD
EAGLE FIELD ROAD
NEES AVE.
CCID OUTSIDE CANAL
MENDOTA CANAL
DELTA
SAN LUIS CANAL
POLE LINE ROAD
SLWD ID.NO.1
FIRST LIFT CANAL
I-5
167
229
280
NOTE:
FRESNO COUNTY
SOIL SURVEY
NOT AVAILABLE
2000 0 2000
LEGEND
167 DELDOTA CLAY, PARTIALLY DRAINED
229 PAVER CLAY LOAM, 0 TO 2 PERCENT SLOPES
280 WOO CLAY, 0 TO 2 PERCENT SLOPES
PACHECO WATER DISTRICT
SOIL CLASSIFICATION MAP
FROM
SOIL SURVEY OF MERCED COUNTY
STODDARD & ASSOCIATES
CIVIL ENGINEERS
1120 WEST 'I' STREET
LOS BANOS, CALIFORNIA
PHONE (209)826-5155
DR.BY D.DUERKSEN
CK.BY R.STODDARD
APPROVED
RCE NO.
DATE: 12/93
P.N. 93130.03
May 25, 2005 - 3:36pm
\\Server_1\C\DWG\93\93130\03\3130SOIL.dwg



LEGEND

Pacheco W.D. Boundary

Canals

Irrigation Laterals

District Well

PACHECO WATER DISTRICT

FIREBAUGH CALIFORNIA

WATER DISTRIBUTION

MARCH 2010

FIGURE 4

EXHIBIT 2

PACHECO WATER DISTRICT

TAILWATER POLICY

Adopted by the Board of Directors August 20, 1997

Tailwater (surface drainage) has historically been allowed to drain from grower fields into District-owned conveyance facilities and has been reused in portions of the District, while the majority of tilewater (subsurface drainage) has historically been discharged out of the District. In order to meet water quality objectives and to protect its drainage outlet, the District must now recirculate a large portion of the tilewater that is generated because of restrictions placed on subsurface drainage discharges. The District recently constructed a Distribution and Drainage System Improvement Project to allow storage and recirculation of this tilewater. However, use of the system to recirculate tailwater reduces the capacity to manage tilewater and increases operating costs. In addition, on-farm efforts to increase irrigation efficiency are essential to help reduce the amount of tilewater which is generated. In order to effectively manage drainage water and maximize the efficiency of recirculating drainage water through the Distribution and Drainage System Improvement Project while increasing grower awareness of water management, the following policy is adopted:

> Effective April 1, 1998, tailwater (surface drainage) will not be allowed to drain from a grower field into District-owned conveyance facilities. All tailwater discharge pipes will be removed from the District-owned conveyance facilities on April 1, 1998, or as soon as practical thereafter. All growers will be required to store and recirculate their tailwater on-farm. The only exceptions would be for unique situations where the District has entered into a specific agreement with the landowner to accept tailwater discharge into the District system.
>
> To assist landowners and growers in making the transition, the District will provide suggested tailwater return system layouts, upon request. Low-interest loan funding for purchase of tailwater return system equipment is available to the extent of remaining funds in the District's State Revolving Fund Loan for water conservation equipment leases on a first come, first served basis.

EXHIBIT "A"

PACHECO WATER DISTRICT

RESOLUTION 97-11

RESOLUTION ADOPTING TAILWATER POLICY

WHEREAS, the Board of Directors of the Pacheco Water District (the "Board" and the "District," respectively) has established the Pacheco Water District Water Delivery Rules (Revised October 16, 1996)(the "Water Delivery Rules"); and

WHEREAS, Rule 16 (a) provides: "Surface return flows shall not be discharged into District-owned conveyance or storage facilities except as permitted by policies of the District establishing terms and conditions for acceptance of such flows, or as permitted by specific agreements with the District. . ."' and

WHEREAS, the Board has considered that certain policy on the discharge of surface return flows into the District conveyance or storage facilities entitled, "Tailwater Policy," attached hereto as Exhibit "A" and by this reference incorporated herein as though fully set forth; and

WHEREAS, implementation of the Tailwater Policy attached hereto as Exhibit "A" is with respect to the public affairs of the District and in the best interest thereof.

NOW, THEREFORE, BE IT RESOLVED AS FOLLOWS:

Section 1: The Board hereby finds and declares that the statements, findings and determinations of the District set forth in the recitals above are true and correct.

Section 2: The Board hereby approves and adopts that certain Tailwater Policy attached hereto as Exhibit "A" as the District policy on the discharge of surface return flows into District conveyance or storage facilities, such policy to supersede all prior policies of the District on the discharge of such surface return flows.

Section 3: This resolution is not intended to supersede the authority retained by the Board under Rule 16(a) of the Water Delivery Rules to enter into specific agreements with District landowners or water users to deal with emergency or unique requirements for the discharge of surface return flows into the District system.

Section 4: This resolution shall take effect immediately.

PASSED, APPROVED AND ADOPTED this 20th day of August 1997.

Sig Sanchez

SIG SANCHEZ, President

Rule 3
TAMPERING AND DAMAGE TO DISTRICT FACILITIES

Manipulation of District weirs, turnouts, meters and other structures is forbidden, unless permission is given by the ditch tender or other authorized employees of the District. Cutting canal or ditch banks and/or placing dams or other obstructions in District-owned canals or ditches is prohibited.

Removal of dirt from, or other use, of District-owned property such as, but not limited to, the utilization of the canal bank on which to turn farm equipment, the placing of toe ditches, drainage ditches, fences, trees or other crops, pumping plants, structures or other obstructions upon the District's right-of-way is also prohibited unless done with specific permission of the District.

Water users shall not permit their livestock to feed or trespass upon the rights-of-way of District-owned canals, drains or ditches except with specific permission of the District. In cases where it is necessary to cross the right-of-way or to move livestock from one point to another along District rights-of-way, permission to use rights-of-way for that purpose must be obtained from the Manager in advance. Any damage done to canal or ditch banks in using them for a roadway, whether moving livestock, farming equipment, or other vehicles, shall be the responsibility of those making such use of the property. If it is found necessary for the District to repair such damage, those responsible therefor shall pay all costs of such repairs.

PACHECO WATER DISTRICT
A CALIFORNIA WATER DISTRICT

WATER DELIVERY RULES
(Revised October 16, 1996)

Rule 1
MANAGEMENT

The operation and maintenance of the distribution system of the District shall be under the exclusive control of the Manager, acting under policies set by the Board of Directors.

The Manager shall employ such ditch tenders and other personnel as may be required and authorized by the Board of Directors for the operation, maintenance and improvement of the system.

Rule 2
CONTROL OF WORKS

All diversion works, canals, ditches, turnouts, meters and other structures belonging to the District will be operated and maintained by the District, and their control and operation will be under the exclusive control of the authorized agents of the District. Only duly appointed District representatives shall have the authority to open, adjust, or close regulation gates or valves controlling the delivery of water. The location and number of gates for the distribution of water from the District's canals and the manner of delivery therefrom, so far as to secure safe and efficient operation thereof, shall be determined by the Manager of the District, subject to the approval of the Board of Directors of the District.

Rule 4
LIABILITY FOR DAMAGE

(a) The District will not be liable for any damage caused by the negligence or carelessness of any water user in the use of water.

(b) The District shall not assume or incur any liability for the maintenance or repair of privately owned canals, gates, pumps or other appurtenances.

Rule 5
TRESPASS ON DISTRICT PROPERTY

Any water user or any other individual entering upon District property does so at his own risk.

Rule 6

DEFINITION OF CLASS I, CLASS II & CLASS III WATER

For purposes of these rules, water shall be divided into three categories, as follows:

(1) CLASS I water shall be any and all water delivered to the District pursuant to its water service contract with the United States (Contract No. 6-07-20-W0469), and any amendments or contracts subsequent thereto;

(2) CLASS II water shall be all water delivered to the District by the Central California Irrigation District, its successors or assigns, pursuant to Railroad Commission Decision No. 36691, and any subsequent agreements or decisions supplemental or amendatory thereto; and

(3) CLASS III water shall be all water supplies of the

District which are not CLASS I or CLASS II supplies. CLASS III water will be allocated on a prorated basis to those who apply and agree to pay for such water; water charges for CLASS III water depend upon its cost to the District and are in addition to amounts charged for CLASS I and CLASS II.

Rule 7

APPLICATION FOR WATER

(a) At the beginning of each irrigation season the Manager shall obtain from each water user a written application for water on forms to be furnished by the District, specifying the number of acres the water user expects to irrigate, the kind of crops, and the number of acres to be devoted to each crop and projected water usage by month as nearly as can be determined, and such other information as the Manager may require to enable him properly to plan for scheduling and distribution of water.

(b) The District hereby adopts the form of Application for Water, marked Exhibit "A", attached hereto, and hereby approves and adopts all the terms and provisions thereof as part and parcel of these Water Delivery Rules.

Rule 8
CHARGES FOR WATER, MATERIALS AND SERVICE

Charges for water, administration, materials and services, including the transportation of non-District water, will be fixed, and the date or dates of payment of the same shall be determined by the Board of Directors. Such charges are in addition to any

standby charges or assessments levied by the Board of Directors under the provisions of the Water Code.

Rule 8A
METHOD OF PAYMENT OF WATER CHARGES

(a) On or before March 1st of each year, or such alternate date as may be fixed by the Board of Directors from time to time, each landowner or water user desiring water for the ensuing water year, shall file at the District's office application for water on the form approved by the District as set forth in Rule 7. An advance allocation deposit for payment for water shall be made as follows: The first installment shall accompany the application and shall equal one-half (1/2) of the cost of all CLASS I and CLASS II water being ordered thereunder, together with an added sum per acre foot to be set each year by the Board of Directors, which added sum shall be deposited in the general fund; the second installment shall contain identical amounts and shall be paid to the District on June 1st of each year, or such alternate date as the District may require.

(b) All obligations for water, and all obligations which are incidental thereto or to the delivery of water, shall constitute a debt owed by the landowner to the District, and shall be secured by a lien against the land upon which such water is used. In the event any owner of land within the District shall lease all or a portion of such land, such lessee shall be jointly and severally liable with the landowner for all obligations incurred in connection with water used upon said premises, and the District

will, upon request by the landowner, mail copies of all billings for water and incidental charges to such lessee, but such action shall not in any manner release the landowner from the obligation to pay for such water in the event the lessee fails so to do.

(c) Monthly billings shall be mailed to water users in the District for overhead, electricity and such other incidental expenses as shall be involved in the purchase, sale and distribution of irrigation water in the District. Such billings shall become delinquent fifteen (15) days after the date of invoice, and if not paid within said time, a notice of delinquency shall be mailed to the landowner. If payment is not received on or before the 10th day after the date of such delinquent notice, the District may impose penalties and interest and close and lock such water user's gate, and thereafter all delivery of water shall be withheld until such delinquent obligations have been paid in full. Further, in case of such default, all payments for such items shall be made in advance for the remainder of said crop year, upon an estimated monthly basis.

(d) In the event any water user shall order more CLASS I or CLASS III water than the water user shall use for any calendar year, the water user shall be required to pay for the amount ordered, unless the District is able to sell or transfer said water to other parties or otherwise obtain relief from the District's obligation to pay for such water.

(e) No irrigation water shall be used upon any land within the District unless such land is entitled to receive irrigation

water under the contract between the United States and Pacheco Water District providing for water service, and the landowner and lessee(s) have filed all forms and provided all information required by the Bureau of Reclamation. Such forms are due March 1 of each year.

(f) In the event any landowner or water user within the District shall fail to apply for the landowner's or water user's full entitlement of CLASS I water, or shall fail to deposit the sum of money required for all classes of water required to accompany such application as herein and in said application provided, the landowner or water user shall thereupon waive the landowner's or water user's right to receive such full entitlement, and such water not applied for shall be redistributed on a prorated basis to those District landowners or water users who request and pay for additional water; in the event an insufficient number of District water users request enough additional water to utilize such landowner's or water user's Class I supply, the landowner and water user shall remain liable to pay for such water unless the District can transfer or sell such water or otherwise obtain relief from the District's obligation to pay for such water.

Rule 9
UNPAID CHARGES AND REFUSAL OF SERVICE

A penalty of 10% shall be added to and become a part of all charges for water, materials and services remaining unpaid as of 5:00 p.m., on the fifteenth day following billing by the District. Effective January 1, 1983, the amount of any unpaid water charge

shall bear interest at the rate of ten per cent (10%) per annum commencing on the fifteenth day following billing by the District.

If in the judgment of the Manager, extenuating circumstances justify the waiver of any portion of the interest or 10% penalty provided for in this Rule, he shall document such waiver on a form approved by the Board of Directors of the District, which waiver shall become effective only upon approval by either the President or Vice-President of the said Board.

Because of the fact that landowners are ultimately responsible to the District for all unpaid bills incurred by themselves or tenants, the Manager shall notify all landowners of all outstanding bills against their particular property as soon as practical after delinquency. However, failure to so notify the landowner will not eliminate the ultimate legal responsibility of the landowner for such payment.

The District reserves the right to refuse or discontinue services to any water user who is in default in the payment of any District assessment or charge of any nature, and also to any land on which any such payment is delinquent in accordance with the Water Code of the State of California.

All claims for overcharges or errors must be made in writing and filed with the District within thirty days from the date the bill is received.

Rule 10
DELIVERY OF WATER

(a) Water will be delivered as equitably as possible.

(b) Requests for delivery of water should be made to District personnel by 10:00 a.m. at least 2 days prior to the date water is wanted. However, water will be delivered on requests made less than 2 days before the date water is wanted, provided water is available and deliveries can be made without interference with other users and without undue waste or undue manipulation of weirs and gates. Water orders for Sundays and Mondays should be submitted to the District by 10:00 a.m. on the preceding Friday.

(c) In order to provide timely service and to minimize waste of water, District personnel must be given a 24 hour shutoff notice. Shorter notice of shutoff is acceptable in emergencies.

(d) Unless specifically authorized by District personnel, water users will be required to use water continuously and at a constant rate day and night until irrigation is completed and without waste at any time.

(e) The normal start time, shut-off time, and time for making flow-rate changes shall be between 7:30 and 8:30 a.m. The normal irrigation set-time shall be 24 hours. To promote efficient water management shorter set times or other change times will be allowed with prior notice to and approval by District personnel.

Rule 11
BASIS OF ALLOCATION AND SHORTAGE OF WATER

(a) Each water user shall be entitled to his proportionate share of the quantity of water available in accordance with the provisions of the Water Code of the State of California.

(b) In the event that during any irrigation season there is

an anticipated shortage of water, or an actual shortage of water occurs, the District will pro-rate the available supply among all water users according to their irrigable acres within the District.

(c) The district reserves the right to suspend service during any period of time when it is necessary to take water out of the canals for cleaning or other maintenance, repair or reconstruction work required.

(d) In the event the District is unable to deliver water at the full flow rate requested by a water user, either because of a constraint in the delivery capabilities of the system or because the total water requests exceed the system's delivery capacity, then deliveries will be reduced proportionately to all water users affected by the capacity limitations until such time as capacity problems no longer exist.

Rule 12

POINT OF DELIVERY

All measurements and deliveries of water shall be made at the point where the District has located a turnout and meter. The District shall install and operate a controlled outlet box or turnout as provided for in Rule 2. The time of delivery will start when the water flows through the turnout and meter and expire when said turnout is closed. Exceptions to this rule may be made by the District to fit operating conditions in unusual circumstances.

Rule 13
UNAUTHORIZED TAKING OF WATER

Persons interfering with the regulation of water in the canals or ditches of the District are liable to criminal prosecution. If any person takes water without permission of the Watermaster or ditch tender, he shall not only be subject to criminal prosecution, but shall forfeit his right to water.

Rule 14
TRANSPORTATION OF WELL AND/OR PRIVATE WATER

The Board of Directors reserves the right to adopt such policies on the transportation of well and/or private owned waters through District owned canals and ditches as may be to the best interest of the District and its water users. The District may charge an appropriate administrative fee for any such transportation services.

Rule 15
OWNERSHIP OF WATER

All water in District owned canals, drains or ditches, regardless of source, except water being transported therein by permission of the District per Rule 14, is District water and is subject to diversion and use by the District.

Rule 16
DRAINAGE MANAGEMENT

(a) Surface return flows shall not be discharged into District-owned conveyance or storage facilities except as permitted by policies of the District establishing terms and conditions for acceptance of such flows, or as permitted by specific agreements

with the District; all such flows discharged into the District system shall be subject to resale by the District without compensation to the discharging water user.

(b) Subsurface drainage flows shall not be discharged into the distribution system of the District and may be discharged into District-owned subsurface drainage conveyance or storage facilities only in accordance with policies of the District establishing terms and conditions for acceptance of such flows, or in accordance with specific agreements with the District; all such flows discharged into the District system shall be subject to resale by the District without compensation to the discharging water user.

Rule 17

ACCESS TO LAND

The authorized agents or employees of the District shall have free access at all times to all lands irrigated from the District system for the purpose of examining any ditches, laterals or drains serving such lands and/or the flow of water therein, for the purpose of ascertaining the acreage of crops on lands irrigated or to be irrigated, or for any other District purposes.

Rule 18
NUISANCES

No material or substance of any nature, and particularly those that are or may become offensive to the senses or injurious to health or which do or may injuriously affect the quality of water, obstruct the flow of water, or result in the scattering of seeds or

noxious weeds, plants or grasses, shall be placed or dumped in any ditch or on any right-of-way of the District, or be placed or left so as to roll, slide, flow or be washed or blown into any ditch or on any right-of-way. Any violation of this rule will subject the offender to criminal prosecution. All employees of the District shall promptly report any violation of this rule, and the water users of the District are especially urged to cooperate in its enforcement.

Rule 19
COMPLAINTS OF WATER USERS

Complaints of any kind against the District or any of its personnel should be made in writing to the Manager of the District promptly after the acts complained of have occurred. Water users shall have the right to refer any complaints in writing or in person to the Board of the Directors of the District.

Rule 20
STOCK WATER

The District shall not be required to furnish water for the exclusive purpose of watering stock.

Rule 21
PUMPING AND PIPELINES

All water users pumping water from the District's facilities and conveying water by means of pipelines or closed conduits shall be governed in all respects by these Water Delivery Rules applicable to water users under gravity ditch service. Pumping is done at the user's risk and the District, its officers and

employees, assumes no liability for damages to pumping equipment or to pipelines or other damages as a result of turbulent water, shortage or excess of water, or other causes.

Rule 22
EFFICIENT WATER MANAGEMENT

It is the policy of the District to promote the efficient management of water for purposes of maximizing the District's limited water resource and of reducing drainage. Specific policies of the Board adopted from time to time to implement this Rule 22, including but not limited to, any policies establishing tiered water pricing, shall be appended hereto, whereupon they are by this reference incorporated herein; upon notice to the water users of such incorporation, the water user's failure to comply with the policies shall be subject to enforcement in accordance with the terms of these rules as well as in accordance with such specific policies.

Rule 23
PENALTY FOR NON-COMPLIANCE

Refusal to comply with the requirements hereof, or transgression of any of the foregoing Water Delivery Rules, or any interference with the discharge of the duties of any employee of the District, shall be sufficient cause for shutting off the water, and water will not again be furnished until full-compliance has been made with all requirements hereof.

Rule 24
CHANGES IN RULES

The Board of Directors reserves the right to change these Water Delivery Rules by majority action of the Board at any regular or special meeting, by adopting an appropriate resolution and incorporating such resolution in the minutes of the District, a public record. Publication and dissemination of such changes by the printing of revised Water Delivery Rules will be limited to economically feasible intervals as determined by the Board.

There shall be maintained at the office of the District, a loose leaf master of these Rules including all changes made by the Board of Directors, which copy will be open to inspection at any time during normal office hours of the District.

Rule 25
DISTRICT NOT LIABLE FOR DAMAGES FOR WATER QUANTITY OR QUALITY

(a) The District makes no guarantees as to the quantity of water per acre available from the District. Neither the District, the Board of Directors, its officers, agents or employees, shall be liable for any loss or damage which may occur as the result of terminating or shutting off water service in accordance with the provisions of these Water Delivery Rules, for the reduction in allocation of available water during periods of water shortage, suspension of service for maintenance, reconstruction or repair, or for capacity limitations, nor for taking any other action provided for by the District's Water Service Contract with the Bureau of Reclamation, the By-Laws of the District, these Water

Delivery Rules, or any other laws, rules or regulations applicable to the District.

(b) The operation and maintenance of District facilities, including District facilities for blending and re-circulating subsurface drainage water and surface water, shall be performed in such manner as is practical to maintain water quality of a level acceptable for the crops grown within the District. The District makes no warranties whatever as to the quality of water furnished by the District, and the District, its Board of Directors, agents or employees shall not be liable therefor.

Rule 26
WASTE OF WATER

It is the policy of the District that all water delivered through District facilities be put to beneficial use as required by Article XIV, Section 3 of the California Constitution, and any wasteful use of water will occasion the immediate suspension of water delivery service until the violation is corrected.

Adopted June 14, 1981

Revised February 4, 1986, January 12, 1994, Revised and Restated October 16, 1996.

Kevin Johansen

KEVIN JOHANSEN, SECRETARY

PACHECO WATER DISTRICT
APPLICATION FOR WATER

YEAR: _____ CLASS I* ALLOCATION: _____ AF

ANNUAL DEPOSIT $_____AF CLASS II** ALLOCATION: _____ AF

CLASS I and II WATER APPLIED FOR:

_____ AF IRRIGATION WATER FOR _____ CROP ACRES

_____ AF DOMESTIC WATER

CLASS III*** WATER REQUESTED, if available: AF

FIELD DESIGNATION/CROP/ACREAGE (List for each field): _____

_____

_____

LANDOWNER NAME: _____

WATER USER NAME: _____

CROP LENDER: _____

1. The undersigned hereby make application with Pacheco Water District for delivery of water during the above shown year on the above shown fields. The undersigned shall be obligated to pay for the allocated amount of CLASS I water, unless the District is able to sell or transfer amounts not used to other parties.

2. This application is due on _____, and must be accompanied by one half the annual deposit. Payment for the second half of the annual deposit shall be due by _____. Failure to deposit said sums shall constitute a waiver of the undersigned's right to receive the allocation indicated above, and such water shall be redistributed on a prorated basis to all other District water users who request and pay for such additional water.

3. The undersigned acknowledge receipt of a copy of the District's Water Delivery rules (Revised September 11, 1996) and agree that all water will be delivered in accordance with those rules, California State Law, and any modification of such rules or policies as may be adopted by the District's Board of Directors. The undersigned further agrees to observe all of such rules as a condition to delivery of water.

4. The undersigned Landowner and water user jointly and severally agree to pay all assessments, water charges, standby charges, drainage service fees, and miscellaneous fees and costs established by the District for water deliveries during the above year to the above fields together with interest and penalties as a result of delinquencies in accordance with the Water Delivery Rules. The undersigned further jointly and severally agree to pay any costs of collection of these charges, including reasonable attorneys' fees.

5. All billings by the District shall be sent to:

DATED: _____

WATER USER: _____

ADDRESS: _____

_____

LANDOWNER: _____

ADDRESS: _____

_____

Accepted: PACHECO WATER DISTRICT

By_____

*CLASS I water is all water delivered by the United States pursuant to the District's water service contract; the CLASS I allocation is subject to adjustment during each year.

**CLASS II water is water delivered by CCID pursuant to the Railroad Commission Decision and is available September 15 of each year through June 15 of the following year, except that during periods of water shortage, delivery is also restricted during the period from September 15 through October 15 and from May 15 to June 15.

***CLASS III water is water acquired from any other sources and is allocated on a prorated basis to those who apply and agree to pay for such water; water charges for CLASS III water depend upon its cost to the District and are in addition to amounts charged for CLASS I and CLASS II water.

EXHIBIT 3

PACHECO					
METER INVENTORY					TOTALIZER
Location	MAKE/MODEL	SERIAL NUMBER	I.D.	A/B GEAR	GEARS
318	OF-12	750113	18	22/34	24L-/35LL
D-802	OF-12	770329	24	30/27	24L-/35LL
D-602	OF-12	770613	30	33/24	32H/35P
D-601	OF-12	770616	30	47/16	22C/48C
D-702	OF-12	770617	24	35/28	24L-/35LL
310-B	OF-12	790865	15	24/36	22C/48C
PACHECO PONDS DISCHARGE	OF-12	790871	30	31/33	33LL/24L-
7B	OF-12	811089	33	28/33	9+/49E
D-801	OF-12	811101	18	24/37	24L-/35LL
312/314	OF-12	811102	18	29/34	22C/48C
306	OF-12	811103	15	25/37	22C/48C
402	OF-12	811104	15	24/35	22C/48C
310-B	OF-12	811107	15	25/37	22C/48C
7A	OF-12	821001	33	28/33	9+/49E
D-701	OF-12	851606	30	42/19	24L-/35LL
202-M-DRAIN	ML-19	852438	24		40T/21S
SUMP 314-S	LP-31	892923	8		10UZ/46UZ
SUMP 310	LP-31	892924	12		20S/41T
616	ML-20	900334	18	41/22	11/48U
89.66-B	OF-12	902161	30	16/42	14/51K
89.66-A	OF-12	902162	30	25/34	33LL/24L
SUMP 208	LP-31	913376	6		33J/27D
SUMP 312	LP-31	913378	6		33J/27D
SUMP 201	LP-31	913379	6		33J/27D
SUMP 314-M	LP-31	913380	8		45C/20-
SUMP 308	LP-31	913381	8		45C/20-
SUMP 101	LP-31	913382	10		15+/44F
SUMP 202	LP-31	913642	10		16/45F
608-A	LP-32	934914	10	21/41	14/51K
708	OF-12	940128	15	25/35	22C/48C
620-B	OF-12	952074	15	23/33	22C/48C
620-A	OF-12	952088	18	22/35	24L-/35LL
PACHECO PONDS	ML-04	953319	20	20/38	32H/35P
D-302-1	VF-30	954910	20	15/42	33LL/24L-
201-1	VF-30	954911	14	29/32	14/51K
D-202-1	VF-30	954913	20	25/34	24L-/35LL
D-502-1	OF-12	954914	30	38/26	32H/35P
401-1	OF-12	954918	18	26/29	22C/48C
D-402-1	OF-12	954919	30	38/26	32H/35P
DMC-A	OF-12	963660	24	40/22	22C/48C
PUMP TO LAT.6	LP-32	964176	12	20/44	22C/48C
LIFT PUMP 4	ML-20	970918	24	23/39	31a+/27g+
LIFT PUMP 5	ML-20	970919	24	23/37	31a+/27g+
LIFT PUMP 3	ML-20	970920	24	25/39	31a+/27g+
LIFT PUMP 2	ML-20	970921	30	24/36	46rr/25rr
89.67	OF-12	972372	26	21/38	33LL/24L
NEW DITCH-603	OF-12	973994	48	29/33	X11Z/X30Z
520	OF-12	992434	24	34/30	24L-/35LL
PACHECO-SPILL	OF-12	994288	18	24/37	24L-/35LL
SUMP 208	LP-32	20023850	10	16/43	X11Z/X30Z
Port. Mtr.#1	LP-32	20031806	10	15/43	X11Z/X30Z
Port. Mtr.#2	LP-32	20031807	10	15/42	X11Z/X30Z
Port. Mtr.#3	LP-32	20040857	10	17/47	X11Z/X30Z
Port. Mtr.#4	LP-32	20040858	10	17/47	X11Z/X30Z
202	TR06-1-30	20052429	12	25/38	15/49K
310-A	LP-32	20062784	10.25	24/34	10+/49U
406	LP-32	20062785	10.25	25/36	10+/49U
506	LP-32	20070263	10.25	25/36	45T/22S+
614	LP-32	20070788	12.39	25/37	15/49K
514	LP-32	20071071	12.39	25/37	15-/49K
SUMP 202	LP-32	20080672	7.75	18/41	33T/18S

EXHIBIT 5

PACHECO WATER DISTRICT

A California Water District

52027 WEST ALTHEA, FIREBAUGH, CA 93622 • TELEPHONE (209) 364-6136 • FAX (209) 364-6122

07/16/2009

WATER RATES AND LAND ASSESSMENT CHARGES

WATER YEAR 2009: JANUARY 1, 2009 – DECEMBER 31, 2009

2009 WATER SUPPLY

The Bureau of Reclamation has officially made a 10% allocation. The USBR water allocation to all growers as of the beginning of WY 2009 will be .23 AF/AC.

WATER COST

A) USBR: Composed of U.S.B.R. water rates and the San Luis and Delta Mendota Water Authority self-funding rates. The water cost is assessed per the water users allocation in two installments.
B) CCID: Composed of CCID water rates, the San Luis and Delta Mendota Water Authority self-funding rates, and the USBR Transportation rate. The total cost of the delivered water, including O&M, is collected monthly as used.

OPERATION AND MAINTENANCE

Pacheco's cost to operate and maintain District facilities. It's collected based on monthly usage.

RESTORATION

The U.S.B.R. restoration rate is collected based on monthly usage. The Bureau reviews the rate in September of each year, and could make an adjustment effective October 1, 2009. Notice will be given if the rate changes.

U.S.B.R. HAMMER CLAUSE

The Board of Directors approved non-collection of the Hammer Clause.

DELIVERED WATER RATE: ($/AF)

(Rates subject to change-Based on decreased water supply, water availability, and costs)

	USBR	CCID	Yuba	ExChg	Supl. Well
WATER COST	$ 30.08	$ 10.19	$ 300.00	$ 355.00	$ 00.00
OPER. & MAINT.	$ 69.30	$ 69.30	$ 69.30	$ 69.30	$ 69.30
USBR RESTORATION	$ 9.56	$ 00.00	$ 00.00	$ 00.00	$ 00.00
USBR Transportation	$ 00.00	$ 16.83	$ 00.00	$ 00.00	$ 00.00
SLDMWA RATE	$ 40.41	$ 35.40	$ 00.00	$ 00.00	$ 00.00
TOTAL	**$ 149.35**	**$ 131.72**	**$ 369.30**	**$ 424.30**	**$ 69.30**

DRAINAGE ASSESSMENT: $ 41.96 per acre

Pacheco's cost to operate and maintain District drainage facilities. The assessment is billed in two equal installments with the first half being billed this year in June.

RECIRCULATION SYSTEM LOAN REPAYMENT: $ 29.40 per acre

Pacheco's cost to build the recirculation system with a loan from the State Water Resources Control Board. The charge is assessed on a per acre basis and will be billed to all landowners in August, 2009. The final loan payment on the project will be in WY 2014.

President - John Hoover Vice President - Aaron Barcellos
Treasurer - George Delgado
Director - Berj Moosekian Director - Joe Del Bosque, Jr.

EXHIBIT 6

PACHECO WATER DISTRICT

DEPOSIT BILLING - FIRST INSTALLMENT
2009-10 10% USBR ALLOCATION DEPOSIT

Barcellos, Et Al.

17599 South Ward Road
Los Banos, CA 93635

May 07, 2009

Invoice # **2660**

Account # **70003**

Assessor's Parcel Number	Acres	Deposit ($/acre)	Deposit ($/parcel)
090-130-050	248.90	$ 40.00	$9,956.00
090-130-051	135.30	$ 40.00	$5,412.00
090-140-041	104.40	$ 40.00	$4,176.00
090-140-042	123.50	$ 40.00	$4,940.00
TOTAL	612.10		$24,484.00

Due Date: May 27, 2009

If you have any questions regarding this invoice, please feel free to contact V. Manuel Cardoza at (209) 364-6136 for assistance.

PACHECO WATER DISTRICT
2009 SRF RECIRCULATION REPAYMENT

Barcellos, Et Al.
17599 South Ward Road
Los Banos, CA 93635

September 01, 2009

Invoice # **2833**

Account # **70003**

Assessor's Parcel Number	Description	Cost Per Acre	Acres	Assessment Charge
090-130-050	SRF-Recirculation Repayment	29.40	248.90	$7,317.66
090-130-051	SRF-Recirculation Repayment	29.40	135.30	$3,977.82
090-140-041	SRF-Recirculation Repayment	29.40	104.40	$3,069.36
090-140-042	SRF-Recirculation Repayment	29.40	123.50	$3,630.90
				$17,995.74

Due Date: **September 30, 2009**

If you have any questions regarding this invoice, please feel free to contact
V. Manuel Cardoza at (209) 364-6136 for assistance.

PACHECO WATER DISTRICT

2009 1st INSTALLMENT DRAINAGE SERVICE FEE

Barcellos, Et Al.
17599 South Ward Road
Los Banos, CA 93635

July 17, 2009

Invoice # **2754**

Account # **70003**

Assessor's Parcel Number	Description	Cost Per Acre	Acres	Assessment Charge
088-180-031	Drainage Service Fee	20.98	85.00	$1,783.30
090-130-046	Drainage Service Fee	20.98	59.00	$1,237.82
090-130-050	Drainage Service Fee	20.98	248.90	$5,221.92
090-130-051	Drainage Service Fee	20.98	135.30	$2,838.59
090-140-041	Drainage Service Fee	20.98	104.40	$2,190.31
090-140-042	Drainage Service Fee	20.98	123.50	$2,591.03
				$15,862.97

Due Date: **August 06, 2009**

If you have any questions regarding this invoice, please feel free to contact
Manuel Cardoza at (209) 364-6136 for assistance.

PACHECO WATER DISTRICT
FINAL WATER ALLOCATION BILLING
2009-10 WATER YEAR

Invoice # **2736**

Barcellos, Et Al.
17599 South Ward Road
Los Banos, CA 93635

Bill Date **07/16/09**
Due Date **07/16/09**
Account # **70003**

Assessor's Parcel Number	Acres	Water Category	Allocation (ac-ft)	Rate ($/ac-ft)	Total Water Cost	Deposit Billed	Balance Due
088-180-031	0.00	WC0001	0.00	$ 70.49	$ 0.00	$ 0.00	**$ 0.00**
090-130-046	0.00	WC0001	0.00	$ 70.49	$ 0.00	$ 0.00	**$ 0.00**
090-130-050	248.90	WC0001	58.42	$ 70.49	$ 4,118.03	$ (9,956.00)	**$ (5,837.97)**
090-130-051	135.30	WC0001	31.75	$ 70.49	$ 2,238.06	$ (5,412.00)	**$ (3,173.94)**
090-140-041	104.40	WC0001	24.50	$ 70.49	$ 1,727.00	$ (4,176.00)	**$ (2,449.00)**
090-140-042	123.50	WC0001	28.99	$ 70.49	$ 2,043.51	$ (4,940.00)	**$ (2,896.49)**
	612.10		143.66		$ 10,126.60	$ (24,484.00)	**$ (14,357.40)**

If you have any questions regarding this invoice, please feel free to contact V. Manuel Cardoza at the District offfice.

*Panoche Water District * 52027 West Althea Avenue * Firebaugh, CA 93622 * (209) 364-6136*

PACHECO WATER DISTRICT
WATER USAGE BILLING

MAY BILLING

May 31, 2009

Barcellos, Et Al.
17599 South Ward Road
Los Banos, CA 93635

Invoice # **2711**

Account # **70003**

Water Rate		Quantity (ac-ft)	Unit Cost	Cost
Description	Code			
DISTRICT O&M CHARGE	WR0001	173.43	$54.00	$9,365.22
				$9,365.22

Due Date: June 27, 2009

If you have any questions regarding this invoice please call
V. Manuel Cardoza at (209) 364-6136 for assistance.

EXHIBIT 7

Chapter 1 - Brief History of STORM

In order to use STORM, it is helpful to know how the program came to fruition. With the help of several water districts, STORM was designed with water districts specifically in mind.

STORM is a water resource management software designed to facilitate all aspects of water management and accounting. STORM was created to meet the specific needs of water and irrigation districts through a partnership between APS and several California water agencies. STORM is Windows based and Year 2000 compliant. APS has worked hard to make STORM flexible so that it will change and grow with you.

Product Inception

San Luis Water District ("SLWD"), consisting of approximately 55,000 acres, and Panoche Water District ("PWD"), consisting of approximately 38,000 acres, are located on the west side of the San Joaquin Valley. Both districts have water service contracts with the U.S. Bureau of Reclamation ("Bureau").

Shortages in the districts' water supply began occurring in 1990 as a result of drought conditions. The drought conditions were exacerbated during the next several years due to regulatory impacts associated with the federal Endangered Species Act, the federal Clean Water Act, the Central Valley Project Improvement Act, and other state and federal regulations.

Water shortages resulted in the districts having to implement and modify policies affecting both water and financial operations. For example, prior to water shortages, the districts' primary water function was to meter deliveries to water users and to bill accordingly. Water shortages forced the districts to formally allocate the limited supply. In addition, shortages resulted in significantly more water transfers and introduced many additional types or categories of water, each with unique associated costs.

At this time, SLWD was using custom software for its water and financial transactions. However, this software needed significant modifications to accommodate the numerous additional water and financial features needed. In addition, the software was

written for an IBM System 36 computer, and SLWD desired software that would operate under the Windows environment on a PC-based network. PWD was using an internally developed DOS-based database system on a stand-alone personal computer to manage many of its water and financial transactions. PWD desired professionally developed software and, like SLWD, wanted to move to a PC-based network.

Due to the similarities between SLWD and PWD, the districts decided in 1994 to jointly fund the development of custom software to meet their needs. In general, the districts wanted the software to manage all water transactions (allocations, orders, transfers, deliveries, etc.) and most financial transactions (billings, cash receipts, and accounts receivable). A separate accounting program would be used to handle general ledger, accounts payable, and payroll transactions. In addition, the districts also desired features to facilitate the management of parcel, name, field, and turnout information.

It was decided that SLWD would take the lead in developing, testing, and implementing the software. A description of the desired features and functions was developed and bids for programming were solicited. Advanced Professional Services ("APS") was hired in August of 1995 to begin development of the software. SLWD began using the developed software in March of 1996. The district's contract with APS was considered complete in December of 1997, and PWD began using the software in March of 1998. The districts sold the rights to the program to APS. APS named the software "STORM" and began marketing the product in 1998. STORM has continued to evolve and many additional features have been added to accommodate the needs of other districts that have purchased the product.

STORMS initial feature set

With STORM, users are able to accomplish several different tasks within the same program. Essentially, the program comes in three sections. These sections are as follows:

- Water Management Transactions
- Land Management Transactions
- Financial Transactions
- Other Key Features

Following is brief introductions of what each of these sections contribute to STORM. SLWD and PWD are used as the examples but by no means are the standard for water districts. Since STORM is so flexible, many different water districts with many different needs can take full advantage of the many features within the STORM program. These features are explained further from within the rest of this manual.

Water Transactions

Water Orders - STORM tracks orders placed by growers based on district determined criteria such as account, turnout, field, date, time, desited flow rate, and irrigation method. A lockout feature is incorporated which prevents the placing of an order to a particular account, turnout, field, or entire portion of the district's delivery system. A user-defined message can be linked to each lockout to explain the reason for the lockout. The projected deliveries for any future date can be calculated using the available order information. PWD uses this feature to produce daily reports for the field employees that operate their water delivery system to inform them of which turnouts should be open and the desited flow rate. STORM allows, but does not require, order information to be the basis for water deliveries. This will allow STORM to accommodate districts with both open, closed and mixed distribution systems.

Water Deliveries -STORM includes a water delivery feature that allows the entry of meter readings and calculates the water delivery based on the most recent meter reading. This calculated delivery can be overridden in the event that there is a meter stoppage or problem. Water deliveries through a particular turnout are distributed to one or more water users. Water order information is available to assist in this distributed. STORM also accommodates the entry of delivery information based on measurement methods other than meters. The water delivery feature allows, but does not require, identification of the particular water category being delivered. Some districts identify the water category as part of the water usage billing process rather than as part of the water delivery process.

Source Deliveries/Orders – A water "source" is defined as any location where water is delivered to or through a district distribution facility. A classic example is a district pumping plant that takes water from a Bureau canal. STORM allows the actual quantity of water delivered through the source to be entered. Also, the quantity of water ordered by the district for each source can be entered. These functions allow the district to compare its orders against actual deliveries to determine the accuracy of its orders. In addition, actual source deliveries can be compared to the deliveries made to water users in order to determine the extent of water losses in the district's distribution system.

Transfers - Both SLWD and PWD handle a large number of water transfers, either among growers within the district or from and to other growers outside the district. STORM includes a water transaction feature that maintains the water balance for each specific category of water available for a particular account. Certain STORM functions, such as water allocations and water usage billings, automatically enter information into the water transaction table. Manual entries can be made to handle water transfers or any miscellaneous adjustments that are required.

Water Allocations - STORM is designed to allocate a particular category of water to either landowners or water users based on either field or parcel data and based on either total or irrigable acreage. The process allows water to be allocated to a specific group of fields or parcels based on code information that is linked to those fields or parcels. For example, SLWD receives both agricultural and municipal and industrial ("M&I) water from the Bureau. SLWD defines a separate water category for each of these water types since they have different Bureau costs. The process allows SLWD to allocate agricultural water to only those parcels that have been coded as agricultural. The process provides tremendous flexibility in allocating not only the districts' Bureau supply but also other types of available water that may be associated with only certain property.

Financial Transactions

Billing – There are four main types of billing: assessment(land based water usage, leases, loans), water, water usage, and miscellaneous. STORM allows billing codes to be defined for the various billing types. Specific debit and credit general ledger accounts are tied to each billing code. The particular unit cost for each code can be defined for a specific time period to accommodate rate changes over time. Assessment billing codes are linked to parcels and can be defined as a rate per parcel, per acre, or per $100 of assessed value. A billing code can be applied to only a portion of the acreage for a particular parcel. SLWD has instances where a certain assessment charge is only applicable to a portion of a parcel while other assessment charges are applicable to the entire acreage. The ability to define a particular acreage for each charge provides maximum flexibility to the assessment billing process. The assessment billing process

can handle up to twelve installments and can assign invoice numbers to each parcel or to each landowner.

SLWD and PWD's water billing consists of the collection of the Bureau cost of water. Since the districts are required to pay for this water approximately two months in advance of delivery, the districts collect the Bureau water costs from customers in advance to prevent cash flow difficulties. The Bureau begins making water supply projections on February 15th of each year and updates these projections at least monthly thereafter until the water supply is finalized. The dynamics associated with water exports from the Delta delays the finalization of a water supply until as late as June in certain years. The changing water supply situation may also result in changes to the water rate. The problem of needing advance payment but not knowing the specific quantity and/or price of water until several months into the water year is addressed by both SLWD and PWD through the use of a Water Allocation Deposit Billing. This billing consists of a charge per acre for eligible property. SLWD sends this billing in January and makes it due by March 1, the beginning of the water year. Failure to pay by this date results in the loss of the water allocation for that year. A Water Allocation Billing is mailed later in the year after the actual water allocation and prices are known. This billing details the actual water allocation per parcel, the unit cost of the water, the total water cost per parcel, and the remaining water cost per parcel taking into account the Water Allocation Deposit Billing. The Water Allocation Billing for SLWD is due by July 1.

Both SLWD and PWD generate monthly water usage billings. SLWD has an extremely complicated pricing structure. SLWD has many different categories of water, each of which has one or more unique associated charges. In addition, a portion of SLWD is served by district-owned distribution facilities while the remainder is served from private distribution facilities connected directly to Bureau canals. SLWD has chosen to separate administrative costs from operation and maintenance costs associated with the district-owned distribution system. Administrative costs are allocated to all water users with SLWD, while operation and maintenance costs are allocated only to water users served from district distribution facilities. To further complicate matters, the portion of SLWD served from district distribution facilities is separated into three improvement districts, each of which has a unique operation and maintenance charge.

STORM was designed so that water rates could be linked to one or more of the following variables: water user, turnout, water category, field, and date range. This provides the flexibility to handle very complex billing needs. Links can be very general. For example, a particular water rate could be linked to a water category. The result would be that that rate would be charged whenever that water category is delivered, regardless of where or to whom the water was delivered. However, very specific and complex situations can also be handled. A rate could be established that would only be applicable when a particular water category is delivered to a particular field through a particular turnout during a specific time period. SLWD has approximately 40 different

water rates. At this time, SLWD has linked these rates to only water categories, water turnouts, or a combination thereof. SLWD's complex rate and billing structure results in over 7,500 possible combinations of water rate, water category, and turnout.

For SLWD, the water usage billing is where the particular water category of delivered water is determined. The water delivery process only identifies the quantity of water delivered. The water usage billing process determines what category was delivered. This is accomplished by comparing the actual water delivered to a particular water user, to the types and quantities of water categories that are currently on that water user's account, and to the above-mentioned file containing possible water rate combinations. A linear optimization process is used to analyze this date and categorize the actual water delivered so that the resulting bill represents the least-cost billing for each different water user. This process has been very beneficial to SLWD water users. Prior to the implementation of STORM, SLWD water users needed to inform the district of the priority of water use for their various water categories. The complex rate structure made if very difficult for water users to determine how they wanted to prioritize their water categories. Being able to assure water users that a least-cost analysis is automatically being formed as part of the water usage billing has significantly reduced the amount of time spent by both water users and SLWD regarding the water usage process. STORM allows the optimization process to be over-ridden on either the district, water user, or field level by entering a specific priority of water category usage. STORM is also designed to handle all types of miscellaneous billing that may be needed. SLWD uses this feature to handle billing adjustments that may be required or to bill for things like specific equipment or labor expenses that are not addressed through the other types of billing.

STORM has functions to calculate penalty and/or interest charges on delinquent billings. Both simple and compound interest calculations can be handled.

Cash Receipts – STORM has a very efficient cash receipts function that allows a receipt to be allocated to a particular account, a particular billing associated with that account, or to a specific charge within a given billing.

Accounts Receivable – The billing and cash receipts functions result in the ability to monitor the accounts receivable status of landowners and water users. This information is referenced by other functions of STORM to provide warning messages if delinquencies exist. For example, the water order feature can be formatted to check for delinquent charges. SLWD has found this feature very helpful in implementing the district's policy that water will not be delivered to water users that have delinquent charges.

Other Key Features

There are several other key features of STORM that greatly enhance the ability to manage district operations. Following is a brief summary of some of these features.

Parcel Management – Information such as section, township, range, total acres, irrigable acres, county, assessed valuation, ownership and leasing information, turnouts water service is received from, and other information can be linked to parcels. Of particular benefit to SLWD is the parcel code feature. This consists of the ability to define any unique characteristic as a separate code and to link this code to any parcels that have that characteristic. SLWD has defined codes for things such as inclusion in an improvement district, whether or not a parcel is eligible to receive a water allocation, and whether a parcel receives agricultural or M&I service. Parcel codes allow detailed analysis of parcel information by allowing the grouping of related parcels through user-defined criteria. Parcel codes provide tremendous analysis opportunities that are limited only by the creativity of the user.

Name Management – In addition to standard information such as address and unlimited telephone numbers, this feature also provides a quick reference for other information associated with a particular name. Ownership and leasing information is readily available as are the turnouts that are available to that account and the current water order status of those turnouts. The easy access of this information has made district staff much more efficient in responding to customer inquiries. As with parcels, name codes can be defined to group various accounts that have a common characteristic. An added feature is the ability to use these name codes in combination with parcel codes and ownership and leasing information to generate mailing lists. There are many occasions where correspondence needs to be sent to only a particular group of customers. This feature makes it very easy to generate a mailing list, for example, for all water users within a particular improvement district.

Field Management – STORM allows water user-defined field information to be entered into the system. Field information includes data such as crop, irrigation method, acreage, land classification, etc. The ability to enter field information allows water orders and deliveries to be tracked to another level of detail. Both SLWD and PWD are in the process of transitioning to a situation where field information will be required from water users in order to place water orders. The use of this feature will allow SLWD and PWD to analyze water use efficiency on a field basis. Current plans are to add a tier feature to STORM that would allow the application of tiered water rates on a crop-specific basis. Again field codes can be defined as desired.

EXHIBIT 8

GROUNDWATER MANAGEMENT PLAN FOR THE SOUTHERN AGENCIES IN THE DELTA-MENDOTA CANAL SERVICE AREA

OCTOBER 1996

GROUNDWATER MANAGEMENT PLAN FOR THE SOUTHERN AGENCIES IN THE DELTA-MENDOTA CANAL SERVICE AREA

Prepared For:

SAN LUIS & DELTA-MENDOTA
WATER AUTHORITY
Post Office Box 2157
Los Banos, California 93635

Prepared By:

STODDARD & ASSOCIATES
CIVIL ENGINEERS
1120 West I Street, Suite C
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OCTOBER 1996

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DEFINITIONS

AB 3030	Groundwater Management Act, Assembly Bill 3030
CIMIS	California Irrigation Management System
CU	Crop Water Use
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DMC	Delta-Mendota Canal
DOHS	Department of Health Services
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
E_P	Effective Precipitation
EPA	U.S. Environmental Protection Agency
ET_c	Evapotranspiration of an Individual Crop
ET_o	Monthly Reference Evapotranspiration
GMA	Groundwater Management Area
GMP	Groundwater Management Plan
HSA	Hydrologic Study Area
K_c	Monthly Crop Coefficient
mg/L	Milligrams Per Liter
RWQCB	Regional Water Quality Control Board
SLDMWA	San Luis & Delta-Mendota Water Authority
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
µg/L	Micrograms Per Liter
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
WPP	Wellhead Protection Program

GROUNDWATER MANAGEMENT PLAN FOR THE SOUTHERN AGENCIES IN THE DELTA-MENDOTA CANAL SERVICE AREA

I. INTRODUCTION

The Groundwater Management Act, Assembly Bill 3030 (AB 3030), signed into law in 1992, establishes provisions to allow local water agencies to develop and implement groundwater management plans (GMP). The act applies to the groundwater basins identified in the Department of Water Resources (DWR) Bulletin 118-80. The water conservation guidelines prepared by the U.S. Bureau of Reclamation (USBR) to meet the requirements of the Central Valley Project Improvement Act (CVPIA) mandate that the federal water contractors prepare GMPs in accordance with AB 3030 or similar authority. There are twelve elements listed in Section 10753.7 of AB 3030 that may be included in the GMP. These twelve elements form a basic list of data collection and actions that may be undertaken under the act.

The water needed for agricultural production and municipal and industrial uses in the Groundwater Management Area (GMA) is obtained from three sources. The first source is imported surface water diverted from the Delta-Mendota and San Luis Canals under the Central Valley Project (CVP). The second source is groundwater that is used primarily for industrial purposes, for rural domestic needs, and for agricultural production when the surface water supplies are either not available or are insufficient to meet the crop demand. The third source is non-CVP water transferred into the basin, such as that which had been available through the State Water Bank.

Much of the land in the GMA was initially developed for agriculture based on pumped groundwater. Contracts for surface water supplies from the CVP became

available during the 1950's and were for quantities of water "supplemental" to existing groundwater. Over time, irrigators in the GMA came to rely entirely on these supplemental surface water supplies. During recent drought conditions, the CVP surface water supply was reduced by approximately 60 percent of what was being delivered prior to 1989. The reduction of the imported surface water supply prompted many water users to depend more heavily on groundwater. The increased groundwater pumping resulted in the lowering of groundwater levels, which focused attention on the potential impacts of the increased pumping and the interrelationship between surface water and groundwater.

This GMP is a part of the ongoing efforts by the San Luis & Delta-Mendota Water Authority (SLDMWA) and the participating districts to manage the limited groundwater resources within the subbasin. There are three aspects of groundwater management that will be especially important in the GMA: protecting and making available the groundwater resource for water users in the GMA that rely on the groundwater resource as part of their water supply; determining whether or not groundwater can be exported on a sustained basis for use outside the subbasin to meet demands of other water supply-limited areas in California and, if so, the quantity limits or other conditions that must be met to avoid adverse impacts; and determining the feasibility of groundwater pumping to manage the shallow groundwater table. Within the GMA groundwater is used by direct application, by pumping into district water conveyance facilities, and by pumping into the Delta-Mendota Canal (DMC) for conveyance and storage. Heavy pumping during drought periods can result in water quality degradation of the receiving waters and land subsidence. An important aspect of this GMP will be gaining a better understanding of the aquifers and development of operating parameters to protect against adverse impacts.

The districts within the GMA have engaged in and will continue to reserve operational flexibility to engage in transfers of water supply to any qualified purchasers of water in circumstances where shortages of water cause the potential for hardship in other areas of the region or state which have access to federal water project facilities and where the districts have a surplus of water supply conserved by

programs benefiting their landowners and water users. Prior to undertaking any program, the districts will evaluate any adverse economic or environmental impact of a water transfer program, which may include but not be limited to management and determination of groundwater storage capacity and use of such capacity in a conjunctive manner with surface water supplies, in order to assist other areas in need of water in addition to landowners within the districts and to the benefit of the districts and its landowners, as long as such programs do not:

1. Exceed the safe annual yield of the aquifer;

2. Result in conditions of overdraft or otherwise fail to comply with provisions of California Water Code Section 1745.10; and,

3. Result in uncompensated adverse impacts upon landowners affected by the program.

Another important aspect of the GMP will be analyzing the feasibility of groundwater pumping from the upper (unconfined) zone as a strategy for management of shallow groundwater tables, a major problem in much of the GMA. Studies by the U.S. Geological Survey (USGS) concluded that increased pumping of groundwater from both the confined and semiconfined zones, together with reduced deep percolation, is an effective strategy for management of the water table and reducing drain flow. The San Joaquin Valley Drainage Program (SJVDP) also identified groundwater pumping from the upper (unconfined) zone as a strategy for management of shallow groundwater tables. However, the USGS found that the effectiveness of groundwater pumping was constrained by the poor quality groundwater in the unconfined zone and the potential for aquifer compaction (subsidence) in the confined zone. The SJVDP did not analyze the feasibility of pumping to manage the water table, but did conclude that pumping would have to be surplus to need by as much as ten-fold to maintain target water levels. Factors that will need to be examined for the feasibility of this strategy include constraints on out-of-basin disposal of saline water, crop water quality requirements, and potential compaction problems.

Implementation of this GMP will provide the means for collection of the necessary groundwater monitoring data and the assessment of pumping impacts such that sustained use of groundwater can be optimized and benefits of shallow groundwater management can be achieved without adverse impacts. Optimizing groundwater use is the basic goal of groundwater management. Proper management of groundwater requires knowledge of the availability, distribution, depletion, and replenishment of the groundwater resource. Without such knowledge, the effect of past activities and predictions of effects of future activities on the groundwater basin cannot be adequately evaluated.

This report documents the characteristics of the groundwater basin, summarizes the existing groundwater management activities in the GMA, identifies potential groundwater problem areas, develops the relative elements of the GMP, and provides recommendations for the plan implementation.

II. GROUNDWATER MANAGEMENT AREA

The DWR, in cooperation with the State Water Resources Control Board (SWRCB) and the USGS, identified ten hydrologic study areas (HSA's) in California (DWR, 1980). The HSA's were defined on the basis of geological and hydrological conditions with consideration of political boundary lines, whenever practical (Figure 1). The San Joaquin and Tulare Lake HSA's were further divided into separate subbasins largely based on political considerations for groundwater management purposes (Figure 2).

The area included in this GMP is the southwestern portion of the Delta-Mendota basin of the San Joaquin HSA (Figure 2) and covers portions of Merced and Fresno Counties. The northern boundary of the groundwater management area is generally along the DMC, and the southeastern boundary is the northwestern boundary of the Westlands Water District. The GMA is bounded by the Coast Ranges on the southwest. Merced County has no plans of preparing a groundwater management plan for the county; rather, they will rely on the local water and irrigation districts in the county to provide the local management of groundwater. Fresno County is in the process of preparing a policy level AB 3030 plan, which will specify broad based goals under each plan element and will stress cooperation with district plans.

The GMA includes the following water districts: Broadview, Eagle Field, Mercy Springs, Oro Loma, Pacheco, Panoche, San Luis and Widren. Water is used for agricultural production, with a minor amount used for incidental municipal and industrial use. The GMA is a portion of the Central and Southern Subbasins defined in Stoddard & Associates (1996a) and encompasses approximately 120,000 acres.

III. HYDROGEOLOGIC CHARACTERISTICS OF THE GMA

The aquifers of the GMA consist of unconsolidated sediments derived primarily from the Coast Ranges. The area is underlain by the Pleistocene Corcoran Clay Member of the Tulare Formation, which is a lacustrine deposit that divides the aquifer system vertically into an upper semiconfined zone and a lower confined zone (Davis and DeWiest, 1966). The unconsolidated sediments taper towards the Coast Ranges and the Corcoran Clay crops out sporadically on the west margin of the valley.

In the semiconfined zone, the sediments consist of beds, lenses, and tongues of clay, sand, and gravel, and form most of the sedimentary material deposited west of the San Joaquin River (Hotchkiss, 1972). Although there are no distinct continuous aquifers or aquitards within the alluvium, the term "semiconfined" is used to emphasize the cumulative effect of the vertically distributed fine-grained materials. The confined zone underlies the confining Corcoran Clay stratum and is similar to the semiconfined zone in texture and composition. It extends downward from the base of the Corcoran Clay to the base of fresh water mapped by Page (1971).

The elevation to which water rises in a well that taps a semiconfined zone is the water table. The elevation of the water table represented by the static groundwater levels in wells completed to shallower depths may not be the same as the static levels in deeper wells. This is due to numerous fine-grained beds of variable thickness that exist in the semiconfined zone, as discussed above. These fine-grained sediments restrict the vertical movement of water. The elevation to which water rises in a well that taps a confined aquifer is its potentiometric surface. The potentiometric surface in a confined aquifer is an imaginary surface representing the confined aquifer pressure.

The horizontal groundwater flow direction in the semiconfined zone is northeast, towards the San Joaquin River from the Coast Ranges, typically causing subsurface outflow across the defined GMA boundary. In the confined zone beneath the Corcoran Clay, water tends to move southwesterly into the GMA.

Historically, irrigation of lands in the GMA accounts for most of the recharge of the semiconfined zone through seepage losses occurring in irrigation water conveyance channels and by deep percolation of applied water. Other sources of recharge include seepage from canals and creeks. Occasional recharge may enter the GMA from the Coast Ranges to the west, but is not well quantified. Recharge to the lower confined zone occurs primarily from leakance from the unconfined zone through the Corcoran Clay and a variable amount of inflow from the east. Groundwater pumping from below the Corcoran Clay increases the leakance through the clay layer and subsurface inflow. Groundwater pumping in the northern and southern portions of the GMA occurs primarily from above the Corcoran Clay. In the central portion of the GMA, pumping is primarily from below the Corcoran Clay.

IV. CURRENT GROUNDWATER MANAGEMENT ACTIVITIES

During recent years, there have been several groundwater management activities in the GMA undertaken by various agencies and individuals to protect the groundwater resources. These activities include a detailed hydrologic study conducted by the SLDMWA, a plan for management of deep well pumping into the DMC, and the water conservation plans and practices adopted by various member agencies.

The SLDMWA has completed a detailed hydrologic analysis to study the water supply conditions and impacts due to changes in the water supply (Stoddard & Associates, 1996a and 1996b). Over the 1986 through 1993 study period, surface water supplies were near normal from 1986 through 1989, and then were drastically decreased by reductions in CVP water allocations from 1990 to 1992. The reduction in supply prompted corresponding increases in groundwater pumping. The DMC was used to convey groundwater and numerous wells were constructed, concentrated in various areas along the canal. The study area covered most of the service area of the DMC. The hydrologic analysis was divided into two phases. The objectives of Phase 1 were: 1) determine the annual water supply and demand components and the change in groundwater storage; 2) assess the impact of reduction in CVP water supply on the hydrologic basin; and, 3) demonstrate the relative influence of various components of water supply and demand on the basin water balance. The objectives of Phase 2 of the study were: 1) develop groundwater models of identified areas of concern; 2) simulate groundwater flow patterns caused by multiple wells pumping into the DMC; and, 3) identify the potential impacts of the resulting cones of depression.

An extension of the hydrologic study was the development of a plan to manage the deep well pumping into the DMC. The hydrologic study and experiences of the pumping that occurred in 1994 made it evident that management of groundwater conditions is necessary to preclude any adverse impacts on the aquifer. Based upon the locations and depths of wells, five management areas south of Check 13 at the DMC and one management area north of Check 13 were established. Details of the study can be found in Stoddard & Associates (1996c).

A predictive model was also developed to estimate potential water development from the wells located south of Check 13. The purpose of the model was to predict deep well groundwater pumping into the DMC with varying mean monthly DMC background salinity, boron and selenium, and allocate pumping periods to individual wells based on well water quality (Stoddard & Associates, 1995).

Individual water districts in the GMA have also been putting effort into increasing water use efficiency to preserve their water resources. All the districts in the GMA have completed water conservation plans pursuant to the CVPIA. In these plans, water conservation practices have been identified to maximize beneficial use of the water supply. Practices include better irrigation management, physical improvements, and institutional adjustments. Irrigation management practices include on-farm water management and district water accounting, use of efficient irrigation methods, and on-farm irrigation system evaluations. Physical improvements include lining of canals, replacement of unlined ditches with pipeline conveyance systems, and improvement of on-farm irrigation technology. Institutional adjustments include improvements in communication and cooperative work among districts, water users, and state and federal agencies, and facilitating the financing of on-farm capital improvements. Other practices that have been instituted by the districts include installation of flow measuring devices, modification of distribution facilities to increase the flexibility of water deliveries, and changes in the water fee structure to provide incentive for more efficient use of water.

Water conservation measures that improve irrigation efficiency reduce the amount of water percolated beyond the root zone. The reduction of deep percolation is very beneficial in the GMA due to the poorly drained soils and the poor quality of the underlying groundwater. As noted, simulation of water table response to management alternatives by the USGS has shown that reduction in recharge coupled with groundwater pumping is an effective strategy for water table control. The water conservation plans have helped the districts identify the opportunities for better irrigation water utilization. The drainers have hired a Regional Drainage Coordinator who has been working with the districts to prepare

and implement drain water management plans and develop programs to meet discharge requirements. Programs being considered for farm-level source control include: tiered water pricing, revised on-farm tailwater policy, and farm-level water allotments. These programs will promote on-farm water conservation and, ultimately, will reduce deep percolation. This GMP will fill in the gap to provide for total water resources management in the GMA.

V. GMA Water Quality

Groundwater in the GMA occurs in two zones: the upper semiconfined zone and the lower confined zone separated by the Corcoran Clay. Chemical analysis of groundwater in the wells along the DMC has been submitted to the SLDMWA annually by the well owners since 1991. The wells tap both the semiconfined and confined zones in a narrow band along the DMC. The chemical analyses indicate that groundwater quality in both zones is highly variable and is affected by different irrigation and natural sources of recharge, and the geochemical nature of the sediments. The distribution of various constituents in the two zones shows little similarity.

The 1994 DMC water quality analyses indicate that in the semiconfined zone of the northern part of the GMA, total dissolved solids (TDS) concentrations range from 560 to 1,300 mg/L, boron concentrations range from 0.5 to 2.1 mg/L, sulfate concentrations range from 65 to 230 mg/L, and the selenium concentrations were below the detection limit of 1 μg/L. In the semiconfined zone of the southern part of the GMA, the concentrations of these constituents are relatively high. TDS concentrations range between 1,200 and 1,800 mg/L, boron concentrations range between 1.1 and 3.1 mg/L, sulfate concentrations range between 460 and 1,200 mg/L, and selenium concentrations range from less than detectable to 5 μg/L.

In the confined zone of the central part of the GMA, TDS concentrations range between 1,000 and 1,800 mg/L, boron concentrations range from 1.9 to 3.85 mg/L, sulfate concentrations range from 470 to 720 mg/L, and selenium concentrations range from less than detectable to 6 μg/L. Groundwater quality data in both the semiconfined zone and the confined zone in the GMA are sparse; therefore, a definitive groundwater quality picture of the portions of the GMA away from the DMC is lacking. Groundwater quality of the semiconfined and the confined zones in these areas can be expected to vary from the concentration ranges given above, due to variation in geochemical nature of sediments and different agricultural practices. The lack of current groundwater quality information available

in the GMA demonstrates the need to establish a groundwater quality monitoring program in the GMA.

VI. POTENTIAL GROUNDWATER RESOURCE PROBLEM AREAS

This section documents potential groundwater resource problems in the GMA identified by member agencies. The initial groundwater management activities should be prioritized and directed towards addressing problem areas before any impacts to the groundwater basin occur.

A. GROUNDWATER EXPORT

Drought conditions and restrictions on Delta export pumping have reduced the imported surface water supply to the San Joaquin Valley. Various arrangements for transfers of water supplies have evolved to match the limited water supply to water demand. Some of these transfers involve pumping of groundwater into the DMC for conveyance and use in other areas. The water has been conveyed through the federal CVP facilities under the authority of Warren Act Contracts issued between the USBR and various water districts for conveyance of non-project water on a year-to-year basis.

The major concerns that arose from the increase in groundwater pumping are land subsidence and degradation of the water quality in the DMC. The concentrated pumping, especially from the confined zone, causes deep cones of depression to form. As the pressure in the aquifer decreases, its ability to support the overburden also decreases and compaction of the aquifer results. The western San Joaquin Valley is known to be an area very susceptible to aquifer compaction. Both the Central California Irrigation District and the DWR have reported accelerated subsidence coinciding with the reduction in imported water supplies and the increase in regional groundwater pumping, including the pumping under Warren Act Contracts.

The groundwater pumped into the DMC, being of significantly poorer quality than the water in the DMC, reduces the quality of water in the DMC. Degradation occurs primarily due to increases in salinity (TDS) and boron. Increases must be limited so that the canal water quality does not limit

beneficial use either by significantly affecting crops, soil salinity levels, or drainage requirements. The management plan for the DMC groundwater pumping was prepared to address these issues and develop management strategies to avoid significant adverse impacts (Stoddard & Associates, 1996c).

B. SHALLOW WATER TABLE MANAGEMENT

Shallow groundwater levels in much of the GMA require the installation of subsurface drainage systems to collect the shallow groundwater, so the water table does not extend into crop root zones. Historically, the drainage water was moved through the grasslands to the San Joaquin River. Since September 23, 1966, the drainage water has discharged to the San Joaquin River via the San Luis Drain and Mud Slough. The drainage water contains salts and minerals, such as selenium, that can degrade the quality of the water in the river.

To remove the drain water from the water supply channels to bypass the wetlands, the draining entities under the SLDMWA proposed using the San Luis Drain to convey the drainage water from a point near the southerly tip of the Grassland Water District, Milepost 105.72 on the San Luis Drain. The drainage water is conveyed approximately 28 miles in the drain to the northern terminus at Milepost 78.65. At this point, the drainage water is to be discharged an additional 6 miles to the San Joaquin River. An agreement for use of the drain was executed between the USBR and the SLDMWA on November 3, 1995. The term of the agreement is for a maximum of 5 years and is designed to terminate in 2 years (after the date that the drain is first used), if commitments specified in the "*Finding of No Significant Impact*" are not met. The Basin Plan Amendments adopted by the RWQCB call for issuance of Waste Discharge Permits, including monthly selenium load limits that will significantly limit drain water discharge. Continuance of the discharge is predicated on reduction in drainage flows through reduction in deep percolation and lowering of water table elevations.

Shallow groundwater management is a priority within the GMA. Opportunities to pump groundwater for shallow groundwater management purposes must be investigated. The effectiveness and feasibility of such a strategy may be negated by limited disposal capability, configurations of irrigation water conveyance systems relative to well locations, and maintenance of acceptable irrigation water quality.

VII. GMA WATER BALANCE

This section estimates the components of inflow and outflow to understand the relative influence of the components of water supply and water demand on the change in groundwater storage. Storage changes are calculated by actual changes in the water table fluctuations that occurred over the study period.

Elements of water supply include water imported through canals, diversions from rivers and creeks, effective precipitation, seepage water from canals and creeks flowing through the GMA, and subsurface water moving into the GMA. Elements of water demand include crop consumptive use, urban water use, surface and subsurface outflow, and water exported out of the GMA.

The difference between the sum of the elements of water supply and the sum of the elements of water demand should equal the change in groundwater storage. Most of the supply and demand components cannot be or have not been measured; thus, the magnitude of the various components are best estimates using standard procedures. Since the assessment of groundwater storage change is on a spring to spring basis, the changes in soil moisture are assumed negligible.

In the following paragraphs, the various components of inflow and outflow are discussed and quantified for certain intervals of the study period. The selected intervals are 1986-1989, 1990-1992, and 1993-1994. By examining various intervals, the relationship of the components in the water resource balance are better understood.

- **Water Supply Components**

1. SURFACE WATER SUPPLY

The two sources of surface water supply in the GMA are the imported supply delivered via the DMC or San Luis Canal and local surface water supply or inflow. A district's water supply is augmented from time to time by transfers of project and non-project water into the district. The supplies may be diminished at other times by drought and by transfers of water from the

district. Since the water supplies vary and demands change depending on local climatic conditions, cropping patterns, etc., these transfers are necessary to balance water supplies with water demands among various districts from year to year.

Surface water supply data for the participating districts were either provided by the district's staff or were obtained from the water utilization reports of the districts. Table 1 presents the GMA water supply trends established from the data.

Table 1

Surface Water Supply Ac. Ft./Yr.			
Interval	Imported Water Supply	Other Surface Sources	Total Surface Supply
1986-1989	270,000	10,000	280,000
1990-1992	119,000	12,000	131,000
1993	130,000	4,000	134,000
1994	196,000	6,000	202,000

2. EFFECTIVE PRECIPITATION

Effective precipitation (E_P) is defined as the amount of rain that is either stored in the soil to be used by crops or contributes to groundwater recharge. E_P is equal to total rainfall less evaporation from the soil surface. For this mass balance calculation, E_P is calculated at 60% of the total annual rainfall (DWR, 1989). This procedure may slightly over-estimate the amount of rainfall that is effective. The soil has to be ready to adsorb the moisture for leaching and/or hold the moisture in the root zone for plant utilization. Due to the arid conditions within the basin, the amount of precipitation that actually recharges the basin is small.

Monthly rainfall records for the California Irrigation Management Information System (CIMIS) Station No. 40, Mendota Dam site, were obtained from the CIMIS data base in Sacramento. The estimated annual E_P in the GMA is given in Table 2.

Table 2

Effective Precipitation Ac. Ft./Yr.	
1986-1989	38,000
1990-1992	26,000
1993	49,000
1994	27,000

3. SEEPAGE LOSSES FROM CANALS AND CREEKS

Two major canals, the DMC and the San Luis Canal, extend through the GMA. Even though these canals are concrete lined, there is some seepage where the concrete lining is cracked, which contributes to recharge of the semiconfined aquifer. The recharge due to these canals was estimated based on estimated unit seepage rates (DWR, 1991), wetted perimeter (DWR, 1991 and USBR, 1950), number of operating days (DWR, 1991), and the length of the canals extending through the basin.

There are three westside creeks that flow into the GMA: Los Banos Creek, Little Panoche Creek, and Ortigalita Creek. Of these, only Los Banos Creek maintains a channel to the San Joaquin River and contributes significant flow to the basin. Flow of Los Banos Creek has been regulated by the Los Banos Detention Dam since 1966. Annual releases in Los Banos Creek were obtained from the DWR, Los Banos. The seepage losses from the creek were calculated as 60% of the annual flows (Hotchkiss and Balding, 1971). The remaining creeks flow very intermittently and contribute very little water to the system. These creeks are not gauged, so flow records are unavailable. Seepage losses from these creeks into the GMA are estimated at 500 acre feet during normal years. Losses for the other years were estimated from the annual flow variations measured in Los Banos Creek. Seepage

losses are a very minor portion of basin inflow. Estimates of the total seepage loss from canals and creeks are given in Table 3.

Table 3

Seepage Losses of Canals and Creeks Ac. Ft./Yr.	
1986-1989	8,000
1990-1992	5,000
1993	16,000
1994	6,000

4. SUBSURFACE INFLOW

Subsurface inflow across the boundaries of the GMA is the amount of water moving laterally into the basin. Review of regional groundwater flow patterns (Figures 4, 5, and 6) show the unconfined groundwater gradient sloping from southwest to northeast. For the purposes of this water balance, subsurface inflow is assumed to be zero due to the southwest to northeast gradient and the lack of a significant source of water west of the GMA.

Subsurface inflow may occur across the other boundaries in the deeper zones (zones that are below the Corcoran Clay layer and zones immediately above the layer), induced mainly by deep well pumping inside the boundary of the GMA. The amount of subsurface inflow induced by the pumping is shown as a negative of the subsurface outflow in Table 9.

- **Water Demand Components**

1. ANNUAL CROP CONSUMPTIVE USE

The annual crop water use (CU) of an individual crop in acre feet is estimated by multiplying the annual evapotranspiration of an individual crop in feet (Et_c) by the irrigated acreage of that crop. The annual ET_c for each crop or group of crops was obtained by summarizing the product of monthly

reference evapotranspiration (ET_o) reported by CIMIS and the monthly crop coefficient (K_c) values. The total annual consumptive use for each district is the sum of the annual CU for each crop.

In this study, ET_o values were obtained from the CIMIS weather data base in Sacramento for Station No. 40, Mendota Dam site. Missing monthly ET_o data for the stations were estimated (U.C., 1992). Monthly K_c's were taken from various sources including DWR published values (DWR, 1975) and Jensen, et al. (1990). The same monthly K_c values were used for all the districts in the GMA, assuming that any variability in monthly K_c values has negligible significance on the overall crop water use.

District cropping patterns were taken from "Crop Production and Water Utilization Reports" over the 1986 to 1994 period. These are the reports filed annually with the USBR by each district. In order to standardize the reporting of crop information, some of the crops were grouped together. The representative crop demands over the chosen time intervals are given in Table 4.

Table 4

Crop Water Demand Ac. Ft./Yr.	
1986-1989	274,000
1990-1992	223,000
1993	245,000
1994	289,000

2. INCIDENTAL WATER USE

Incidental water use is the quantity of water consumed annually for industrial and domestic use within the GMA. The GMA land use is primarily agricultural; therefore the incidental water use is very small. The annual incidental water use was obtained from various districts in the GMA. Table 5 sets forth the incidental water use trends over the study period.

Table 5

Incidental Water Demand Ac. Ft./Yr.	
1986-1989	1,000
1990-1992	1,000
1993	1,000
1994	1,000

3. GROUNDWATER PUMPING INTO THE DMC

Groundwater pumped into the DMC is used both inside and outside of the GMA. In the GMA water balance, the water pumped into the DMC is considered as basin outflow. The portion of this water that is delivered back into the GMA is included in the CVP water delivery quantities; thus only the net export is a component of outflow. Table 6 presents the trends of groundwater pumping into the DMC over the study period.

Table 6

Groundwater Pumping into the DMC Ac. Ft./Yr.	
1986-1989	0
1990-1992	21,000
1993	27,000
1994	32,000

4. RETURN FLOW

Return flow is surface flow from the basin consisting of farm tailwater, district operational spill, and subsurface drainage water. Data on return flow volumes are sparse. The volume of return flow was either provided by districts or was calculated based on 10% of the surface supply. The return flows given in Table 7 are the best estimates of the trends in return flows over the study period.

Table 7

Return Flow Trends Ac. Ft./Yr.	
1986-1989	46,000
1990-1992	20,000
1993	24,000
1994	28,000

5. SUBSURFACE OUTFLOW

Subsurface outflow may occur laterally along the eastern boundary of the GMA. The lateral subsurface outflow is proportional to the horizontal hydraulic gradient, permeability of the porous media and the cross-sectional area of the flow path.

Subsurface outflow is the least accurate term in the water balance calculation. Hotchkiss and Balding (1971) estimate subsurface outflow in the Tracy-Dos Palos area at 240,000 acre feet per year. It appears from their information that, under full water supply conditions, subsurface outflow from the GMA is on the order of 50,000 acre feet per year.

- **Change in Groundwater Storage**

The specific yield method was used to compute storage changes over the study period. It is based on the principle that changes in groundwater storage are reflected by fluctuation in the level of the groundwater table. The data required to calculate changes in groundwater storage (acre feet) by this method are changes in groundwater levels (feet), specific yield of the geological formation (unitless fraction), and the area over which the change in groundwater levels applies (acres). The groundwater level measurements used in this study were annual spring water level measurement in unconfined

wells. The unconfined well data from 1986 through 1994 were obtained from the DWR and the USBR.

Water surface contour maps and volume calculations were made using a computer program that produces grid-based contouring, volume computations, and graphical output. The gridding method, known as Kriging, was used to interpolate between data points. Volumes were calculated using the trapezoidal rule and multiplying by the average specific yield of the aquifer determined from DWR data on estimated specific yields developed for each quarter township.

Maps indicating lines of equal elevation of water in wells for the springs of 1986, 1990, and 1993 are given in Figures 4 through 6. Maps delineating lines of equal change of water level in wells from 1986 to 1990, from 1990 to 1993, and from 1993 to 1994 are given in Figures 7 through 9, respectively.

Average water level changes and changes in groundwater storage in the GMA for the study period are given in Table 8. The results indicate that during the 1986-1990 and 1993-1994 study intervals, water levels rose in the basin. But from 1990-1993, water levels declined throughout the study area.

Table 8

Change In Groundwater Storage Using Specific Yield Method				
Study Interval	Average Change In Water Level (feet)	Change In Storage (ac-feet)	Average Storage Change/Yr	Cumulative Change In Storage (ac-feet)
1986-1990	+1.2	+16,000	+4,000	+16,000
1990-1993	-6.3	-83,000	-28,000	-67,000
1993-1994	+2.2	+29,000	+29,000	-38,000

Note: (-ve) indicates decrease and (+ve) indicates increase.

The average change in storage over the 8-year study period is -5,000 acre feet. Recognizing that rainfall over the study period was significantly less than average, the GMA was in near hydrologic balance for the period.

VIII. GMA WATER BALANCE SUMMARY

Having quantified the trends of the various inflow and outflow components of the water resource balance and estimated the change in storage based on changes in groundwater levels, the water resources balance over the various study intervals was developed.

For the first three intervals, all of the components less subsurface outflow were used to calculate the amount of subsurface outflow needed to complete the water resources balance. For the 1994 balance, water level data necessary to compute the change in storage was not available, so the subsurface outflow during 1994 could not be calculated. The GMA water resources balance for various intervals is presented in Table 9.

Table 9

GMA Water Resources Balance
Units of Acre Feet Per Year

Inflow Components				
Study Interval	Surface Water	Precip.	Seepage	Total Inflow
1986-90	280,000	38,000	8,000	326,000
1990-93	131,000	26,000	5,000	162,000
1993	134,000	49,000	16,000	199,000
1994	202,000	27,000	6,000	235,000

Outflow Components						
Study Interval	Crop Demand	Urban Demand	DMC Pumping	Return Flow	Subsurface Outflow	Total Outflow
1986-90	274,000	1,000	0	46,000	1,000	322,000
1990-93	223,000	1,000	21,000	20,000	-75,000	190,000
1993	245,000	1,000	27,000	24,000	-127,000	170,000
1994	289,000	1,000	32,000	28,000	ND 1/	ND

1/ Data not available.

Change in Storage (Inflow - Outflow)	
Study Interval	Net Change
1986-90	+4,000
1990-93	-28,000
1993-94	+29,000
1994	ND

The following observations can be drawn from the water resources balance.

1. As a result of the drought impact that began in 1990, surface water supply to the basin dropped approximately 150,000 acre feet.

2. While 1993 was a relatively wet year, low CVP supplies in 1993 meant continuance of the drought conditions into and through 1994.

3. Subsurface outflow computed from the other water balance components indicates a reversal in the subsurface outflow gradient due to the increased pumping in the GMA. This trend appears reasonable due to the increased pumping activity after 1989.

4. Comparison of the water balance components of the GMA to those of the Southern Subbasin in Stoddard (1996a) supports the finding of subsurface inflows from the east.

5. Under projected future average CVP water supply conditions (calculated based on 60% of the contract supply), the total surface water supply of the GMA will be 170,000 acre feet per year, which is insufficient to meet the average annual crop demand of 250,000 to 290,000 acre feet per year.

6. Under reduced CVP water supply conditions, growers will likely depend upon groundwater pumping to meet the demand, resulting in inducement of subsurface inflow. The estimated amount of subsurface inflow required under the reduced CVP supply will be in the range of 50,000 to 65,000 acre feet per year.

7. Further evaluation over a longer hydrologic period is needed to confirm the above observations.

Figures 10 and 11 graphically depict the components of water supply before and after the drop in surface supply.

IX. ESTIMATES OF BASIN-WIDE GROUNDWATER PUMPING AND BASIN SUSTAINABLE YIELD

The water resources balance can be utilized to develop estimates of groundwater pumping that occurred in the GMA and the average sustainable yield of the groundwater basin. The amount of groundwater pumping is estimated by two methods. The first method involves estimating the applied water requirement and subtracting the amount of surface water that has been supplied. The second method utilizes the components of inflow and outflow to the aquifer to estimate net aquifer recharge, which subtracted from the change in storage presents an estimate of water extracted from the aquifer. A certain percentage of groundwater pumped returns as groundwater recharge. This component of recharge cannot be quantified and is assumed zero; therefore the amount of pumping estimated by the second method will likely be somewhat less than that which actually occurred.

Table 10 presents the estimates of basin-wide groundwater pumping utilizing these two methods. These estimates indicate that pumping was on the order of 110,000 acre feet per year prior to the drop off in surface water supply. The pumping increased after the decrease in supply and was on the order of 180,000 to 200,000 acre feet per year. Comparing these pumping amounts with the corresponding surface supplies suggests that under an average of 60% CVP water supply conditions, average groundwater pumping would be around 165,000 acre feet, assuming that current cropping patterns are maintained.

Table 10

Estimates of Basin-Wide Annual Groundwater Pumping

Period	Applied Water Method 1/	Recharge Less Change In Storage Method 2/
Full CVP Supply 1986 - 1989	113,000	111,000
Restricted CVP Supply 1990 - 1992	197,000	164,000
1993-94	193,000	177,000

Table 10 *(Continued)*

Estimates of Basin-Wide Annual Groundwater Pumping

1/ $$\text{Pumping} = \left(\frac{CU - E_P}{.6}\right) - SW$$

2/ $$\text{Pumping} = \left(SW + E_P - CL\right)\left(1 - IE\right) + CL + CCL - \Delta S - SO$$

Where

CU	=	Crop Consumptive Use
E_P	=	Effective Precipitation
IE	=	Irrigation Efficiency
CL	=	Conveyance Losses (Seepage)
CCL	=	Seepage From Canals and Creeks
SO	=	Subsurface Outflow
SW	=	Surface Water
ΔS	=	Change in Storage

Sustainable yield is defined as the estimated pumping adjusted by the change in storage. By this formula, the sustainable yield of the basin prior to the water supply reduction is estimated at approximately 115,000 acre feet. During the drought period, sustainable yield increased to about 155,000 acre feet. The water resources balance suggests that the lowering of groundwater levels, due to the groundwater withdrawals, induces the subsurface inflow into the GMA and, therefore, increases the GMA sustainable yield.

It must be recognized that these conclusions are based on the available data utilized to construct the water resources balance and does not rely on any actual pumping data or verification of the amounts of subsurface outflow. The pumping estimates appear high, especially for the full CVP water supply period. This may be due to a combination of use of higher than actual crop consumptive use values and cropped acreage, and lower than actual irrigation efficiency and surface water diversion amounts. Further evaluation would be necessary to substantiate the findings.

X. ELEMENTS OF THE GROUNDWATER MANAGEMENT PLAN

Section 10753.7 of AB 3030 provides a listing of twelve elements or components that may be included in a groundwater management plan. The following paragraphs discuss how each of the elements relate to groundwater conditions in the GMA and what policies or actions may be appropriate by the participating districts for protecting the sustainability of the groundwater, in terms of both quantity and quality.

A. THE CONTROL OF SALINE WATER INTRUSION

Good quality groundwater can be permanently degraded if poorer quality groundwater migrates into aquifer zones containing better quality water. Such degradation has the potential to render the groundwater unsuitable for some uses, particularly domestic water use. In the GMA, saline water intrusion does not occur from an ocean or saltwater body; instead, it results from naturally occurring salts present in the soil, from salts imported with surface water, and from other activities on the land surface.

When water is applied for irrigation purposes, plants consume the water for plant growth leaving the salts in the soil profile. Water is applied to crops in amounts in excess of the crop consumptive use requirement, so there is sufficient water that will move downward and carry these salts beyond the crop root zone. This water carries with it not only the salts imported with the water supply, but also naturally occurring salts that are dissolved from the soil particles as the water moves downward. Without a means to remove the accumulated salts, the salts remain in the basin and ultimately increase the salinity of the groundwater. Chemical fertilizers used in agricultural production and percolation of effluent from waste treatment facilities also contribute salts to the groundwater basin.

Due to the nature of the processes, shallower groundwater is the first to degrade and a vertical water quality gradient is established, with the poorer quality water in the upper zones and the better quality water in the deeper zones. In the GMA, the best quality water occurs in the deeper unconfined zones or in the confined zone below the Corcoran Clay. The depth to the

base of the fresh water zone, defined as a total dissolved solids level of 2,000 mg/L is estimated to be about 1,000 feet below ground level.

While these are regional trends, variations in soil conditions, soil types, geologic structure, irrigation practices, and irrigation water quality have resulted in zones of differing water quality throughout the GMA. It is expected that there are areas where the shallow groundwater is quite poor and overlies very good quality groundwater, areas where the quality of upper and lower zones are of similar quality, and adjacent areas where the quality of water differs. In any of these situations where poor quality water is adjacent to high quality water, reversing the hydraulic gradient or steepening of the hydraulic gradient may cause the poor quality groundwater to migrate and degrade the better quality groundwater.

It is recognized that there is slow groundwater quality degradation occurring due to the regional downward movement of surface salts. The downward migration is accelerated due to increased groundwater pumping. During the 1976-1977 and 1986-1992 drought periods there was substantial increases in groundwater pumping that probably accelerated water quality degradation.

Due to the imported surface water supply and the marginal quality of the groundwater, agricultural users utilize groundwater only as a supplemental supply, drawing on it during times of drought and using it in combination by blending or in rotation with surface water for crop irrigation. Rural residents also rely on groundwater for their domestic water supply source. These residents are scattered throughout the GMA.

To maximize the sustainability of the groundwater basin, knowledge of the various water quality zones and groundwater flow patterns is necessary. Once this information is gained, groundwater management techniques can be evaluated to protect zones of high water quality so that the beneficial uses are protected. Typically, such a program would include the following elements:

1. Establish a network of monitoring wells completed to various depths in the semiconfined zone and the confined zone.

2. Wells should be monitored annually for salinity, nitrates, selenium, boron, and other constituents which may be of concern.

3. Identify areas where water quality monitoring and groundwater flow patterns suggest a high probability of water quality degradation.

4. Identify zones of marginal quality water that can be used in conjunction with surface water to increase water supply to reduce migration of saline water and lower groundwater levels.

5. Identify water management measures that may be employed to minimize the degradation.

6. Cooperate in programs aimed at providing a means to export salts out of the GMA via some type of drainage program to increase the longevity of the groundwater basin.

B. IDENTIFICATION AND MANAGEMENT OF WELLHEAD PROTECTION AREAS AND RECHARGE AREAS

The Federal Wellhead Protection Program (WPP) established by Section 1428 of the Safe Drinking Water Act Amendments of 1986 is designed to protect groundwater resources of public drinking water from contamination, to minimize the need for costly treatment to meet drinking water standards. A Wellhead Protection Area, as defined by the 1986 Amendments, is *"the surface and subsurface area surrounding a water well or well field supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water or well field."* Under the act, states are required to develop a U.S. Environmental Protection Agency (EPA) approved WPP. To date, California has no formal state-mandated program, but instead relies on local agencies to plan and implement programs under AB 3030. In California, a public water system is defined as any system that serves 15 or more connections or 25 or more persons for

greater than 60 days each year. Large farm housing complexes and the Oro Loma School fall under this category. A comprehensive WPP for Merced County has been prepared under the County Department of Public Health, Division of Environmental Health.

In the GMA, the primary source of recharge is from percolation of excess irrigation water. Incidental sources include seepage losses from canals and ditches and from the westside streams that flow intermittently during the rainfall season. Protection of recharge areas is realized by protecting groundwater from contamination from surface sources, which can either occur through percolation of contaminants to the groundwater table or, more directly, via wells that have been improperly constructed or developed.

Regulation of waste disposal is a function of the State of California, administered by the RWQCB or the Department of Toxic Substances Control (DTSC)). The participating districts will rely on continued regulation by the state; however, the participating districts will provide assistance to the RWQCB and DTSC by identifying areas that are the most susceptible to groundwater contamination.

To protect recharge areas, the participating districts should review applications for Waste Discharge Permits within and adjoining their boundaries that have the potential to degrade groundwater. Such waste disposal systems include disposal of dairy wastes, disposal of industrial wastes, sewage treatment plant effluent disposal, septic tanks, and solid waste disposal. Environmental documents for such facilities and Tentative Waste Discharge Permits issued by the RWQCB should be closely reviewed such that appropriate monitoring and mitigation measures are developed to preclude the possibility of migration of pollutants from the disposal sites. Participating districts should be on the lookout for existing and proposed land use activities that have the potential to degrade groundwater, so that appropriate action can be taken.

In development of a WPP the following elements must be included:

1. Locate the public water supply wells and identify the aquifer zones tapped by each well.

2. From the groundwater level monitoring plan (Element G), determine groundwater flow directions in the vicinity of each public water supply well.

3. Assist in the development of site specific well construction and abandonment programs to minimize contamination migration (Elements D & I).

4. Define capture zones for all public water supply wells and identify potential pollution sources within each capture zone.

5. Coordinate with appropriate state and local agencies in the regulation and permitting of activities that may pose a contamination threat to groundwater within public water supply well capture zones.

C. REGULATING CONTAMINANTS MIGRATION IN GROUNDWATER

Contaminants in this section are those that result from improper application, storage or disposal of petroleum products, solvents, pesticides, fertilizers and other chemicals used by industry, and are distinguished from the salinity degradation that is addressed in Element A. The participating districts' role in protecting groundwater from contamination by point sources will be supporting the RWQCB, which holds the primary responsibility for enforcing water quality regulations, and the respective counties who oversee soil and groundwater cleanup activities from leaking underground storage tanks and other point source contamination. The participating districts will assist in understanding the hydrogeology of the GMA, the vertical and lateral groundwater flow directions, and groundwater quality based on their groundwater monitoring activities. The participating districts shall make the appropriate regulating agency aware of changes in groundwater quality, which may indicate that point source contamination is occurring.

D. THE ADMINISTRATION OF WELL ABANDONMENT AND WELL DESTRUCTION PROGRAM

State regulations require that wells that are no longer useful or abandoned be properly destroyed so that they do not act as conduits for mixing of groundwater of differing quality. Non-pumped wells are a much greater threat than pumped wells, since pumping normally quickly removes contaminants that may have migrated during idle periods. In gravel packed wells, the gravel pack as well as the casing itself can act as a conduit for mixing and potential contamination.

Permits are required from the applicable county or city for abandonment of wells within their jurisdiction. For public water supply wells, additional requirements may be prescribed by the State Department of Health Services (DOHS). Permit fees are normally required. The participating districts will rely on continued administration of the well abandonment and destruction program by the permitting agencies.

The participating districts' role in well abandonment and destruction will be to provide the counties with the available groundwater data, assist in identifying locations of operating and abandoned wells, and advising well owners of why proper well destruction is important for protection of water quality.

E. MITIGATION OF GROUNDWATER OVERDRAFT

According to the DWR definition, overdraft occurs when continuation of present water management practices would probably result in significant adverse overdraft related impact upon environmental, social, or economic conditions at a local, regional, or state level. Long-term depletion of storage can cause several problems, including land subsidence, degradation of groundwater quality, and increased pumping costs. Overdraft is distinguished from aquifer dewatering, which may be beneficial in some areas of the GMA subject to shallow groundwater conditions, since simulations of groundwater

pumping have shown it to be effective in managing shallow groundwater. Some portions of the GMA may experience overdraft, while other portions have drainage conditions where aquifer dewatering may be beneficial.

Based on the basin's water balance calculations for the GMA over the 1986 through 1993 period summarized in Section VIII, it is estimated that the total surface water required to meet the water demand in the subbasin is approximately 326,000 acre feet. The imported surface water supply is the primary surface water source serving the GMA. There is also a very small amount available as local surface water supply. When CVP water supplies drop below 326,000 acre feet, groundwater pumping supplements the surface supply. This groundwater pumping induces subsurface inflow from the adjoining subbasin. If water supplies drop to levels where the basin inflow cannot be sustained, overdraft or aquifer dewatering will result.

Under full CVP water supply conditions in the GMA and assuming no significant change in demand, the basin is not in a condition of overdraft. Under the future projection of an average of 60% of CVP supply, groundwater pumping is estimated to approach 165,000 acre feet per year, and overdraft may occur depending on the sustainability of subsurface inflow on the order of 60,000 acre feet per year. Through planned water resource management, surface and water supply deficits should be offset by optimizing groundwater pumping to maximize groundwater tables and to minimize overdraft.

The prerequisite to implementation of an overdraft mitigation program is to monitor groundwater levels (Element G). Monitoring of groundwater levels and water quality is necessary to identify areas of overdraft and to determine the effects of groundwater pumping. Monitoring will allow the overdraft to be quantified, which is needed to evaluate means to control the overdraft. Curtailing overdraft usually requires increase or redistribution of basin water supplies or reducing the amount of pumping. If pumping is taking

place to purposely dewater an aquifer, the monitoring is needed to evaluate the effectiveness of the program.

Once groundwater trends are known and overdraft identified, a responsive overdraft mitigation program can be developed around the following components:

1. Quantify the average annual overdraft.

2. Determine the potential for significant adverse impact due to the overdraft.

3. Formulate a plan to mitigate the impact and a strategy for plan implementation.

F. REPLENISHMENT OF GROUNDWATER EXTRACTED BY WATER PRODUCERS

The hydrologic balance suggests that lowering the groundwater levels increases sustainable yield, since subsurface inflow is induced by pumping in the confined zone which counteracts the water extracted. More data and analysis is needed to confirm this finding and to determine the level of pumping that can be sustained without overdraft. Due to the aquifer and water quality characteristics and the limited water supply, artificial recharge is not practical in the GMA.

G. MONITORING OF GROUNDWATER LEVELS AND STORAGE

The purposes of a groundwater level monitoring program are to identify areas of overdraft and provide information that will allow computation of changes in groundwater storage to determine net recharge or depletion. Groundwater level monitoring is essential to understand the impact on aquifer storage due to changes in basin inflow and outflow components and in pumping activities. Mapping of groundwater levels depicts the direction of groundwater movement and the hydraulic gradient necessary for

quantifying groundwater flow and verifying estimates of subsurface outflow. Monitoring and mapping should be done independently in the unconfined and confined zones.

Participating districts will cooperatively develop a comprehensive groundwater level monitoring plan for the GMA, so that there is a coordinated effort of data acquisition and compilation. An adequate monitoring well network must include representative wells that tap particular aquifer zones in the GMA. Basic elements of the plan would include:

1. Determine the network of monitoring wells to be included in the program to monitor water level changes in the different aquifer zones.

2. Compile the necessary data on the monitoring wells (e.g., location, depth, driller's logs, E-logs, casing elevation, ground surface elevation).

3. Establish the frequency of the water level monitoring.

4. Inventory active wells and determine annual pumping amounts.

5. Develop a standardized data collection method.

6. Tabulation of data and groundwater mapping.

7. Interpretation and dissemination of results.

H. FACILITATING CONJUNCTIVE USE OPERATIONS

Conjunctive use of groundwater and surface water typically occurs when the surface water supply varies from year to year and there is useable groundwater and groundwater storage available. In years when the surface supply is greater than the water demand, water in excess of the crop demand

is brought into the basin and recharged, either directly by operation of recharge facilities or indirectly by over-irrigation to increase percolation.

Conjunctive use in the traditional sense is not a viable water resource management strategy within the GMA. This is due to the fact that artificial recharge is not practiced in the GMA, due to the aquifer and water quality characteristics and the limited water supply. Groundwater underlying most of the GMA is of marginal to poor quality for agricultural use due to high levels of salinity and boron. Aquifer characteristics are such that there is an absence of available storage capacity in the aquifer system. As discussed in Section VI, management of the shallow groundwater is necessary to maintain shallow groundwater levels below root zones to prevent crop damage. Pumping of groundwater for shallow groundwater management purposes must be investigated.

The water resources balance in the GMA suggests that with the anticipated reductions in CVP water supply delivery and absent the availability of other surface supplies, the average groundwater extractions will be in the 165,000 acre feet range.

In the case of this GMA, the conjunctive use plan must include management and redistribution of surface water supply to avoid conditions of localized overdraft, along with shallow water table groundwater management, as pumping of groundwater must continue to the foreseeable future to meet basin water demand.

Supplemental groundwater use occurs through direct application of water on the overlying land, pumping into district distribution systems to augment district supply, and pumping into the DMC for conveyance and storage in federal facilities under Warren Act Contracts. As described in Section VI, this pumping resulted in adverse impacts of land subsidence and DMC water quality degradation. As a result, the USBR determined, as of

May 29, 1996, that a thorough environmental assessment, performed under the National Environmental Protection Act, would be necessary before pumping into the DMC could continue. The USBR recommended that the environmental assessment be prepared to address a long-term program for conveying groundwater in the DMC, rather than trying to address pumping programs on an annual basis.

The environmental assessment must include evaluation of a no action alternative to discuss use of groundwater directly on adjacent fields and use of other surface water supplies available through transfers, in order to demonstrate that pumping of groundwater into the DMC is an economical and sensible source of supplemental water. The program must also consider the SLDMWA's basic goal of maximizing the availability of water to their member agencies and the varied need for groundwater among the districts participating in the GMP. A priority in implementation of the AB 3030 plan will be further refinement of the management of pumping groundwater into the DMC, so that an environmental assessment can be prepared that will contain necessary monitoring and mitigation measures to avoid significant adverse impact. A necessary element will be defining the quantities of groundwater to be pumped under different levels of surface water supply availability, which is necessary to evaluate impacts over the long term as required by the USBR. The current guidelines for management of pumping of groundwater into the DMC should be modified to address pumping over the long term. The environmental assessment, including mitigation measures and descriptions of the monitoring program must be prepared and shall be released for public review and comment.

Most, if not all, of the controversial aspects of the project, primarily concerns about DMC water quality degradation and subsidence, must be resolved before the USBR will be comfortable in making a finding of no significant impact and signing long-term Warren Act Contracts for the participating districts. The districts have been working closely with the

Exchange Contractors, who are the recipients of the groundwater pumped into the DMC, and with the Central California Irrigation District to address subsidence of their Outside Canal in the vicinity of the concentrated deep well pumping. Securing long-term Warren Act Contracts for pumping groundwater into the DMC will be a high priority groundwater management activity.

To be able to make good water management decisions on the use of groundwater to supplement the surface water supply, the dynamics of the groundwater basin must be better understood. This knowledge will be gained through the monitoring programs defined in Elements A and G, which will be used to assess the effect of water management efforts and design programs to optimize basin yield.

There is, nonetheless, a need to monitor aquifer responses to groundwater pumping, as is currently being done by the SLDMWA along the DMC, to avoid adverse impacts due to pumping. As localized overdraft has occurred, the supply is replaced by groundwater inflow primarily from below the Corcoran Clay. Replacement water could also come from occasional transfers of additional surface water supplies into the GMA to balance the long-term supply with demand, resulting in "in lieu" recharge of the aquifer. Because of the area's susceptibility to subsidence, frequent transfer is preferred to heavy pumping and depletion, and pumping should in zones which effect a beneficial water table response.

I. WELL CONSTRUCTION

Improperly constructed wells can establish pathways for pollutants to enter from surface drainage and can cause mixing of water between aquifers of differing quality. Sections 13700 through 13806 of the California Water Code require proper construction of wells. Standards of well construction are specified in DWR Bulletins 74-81 and 74-90.

The counties within the GMA have the fiduciary responsibility to enforce well construction standards. A well construction permit is required to drill a new well or to modify an existing well. Well Driller's Reports must be filed with the DWR and the respective counties. Merced and Fresno Counties, encompassing the GMA, have adopted the DWR standards.

Because of their responsibility to enforce standards for construction and abandonment of wells and for issuance of drinking water permits for small water systems, the environmental health divisions of the respective counties maintain records on wells and groundwater quality. The records maintained by the various counties should be supplemented with data on water levels and groundwater quality collected by the participating districts to identify locations susceptible to intermixing of aquifer zones of varying water quality. The information would be used to establish specifications for well construction and destruction to optimize well water quality and minimize mixing of water between zones of varying water quality.

Better understanding of the subsurface geology and water quality is needed to define the confining beds between aquifer zones. Site specific hydrogeologic investigations may be needed to support well designs and should be submitted with the proposed well designs to obtain the well drilling permit.

It is proposed that authority over well construction remain with the respective counties and cities. The participating districts should request that the counties supply them with copies of well permits, logs, and studies to assist in their groundwater management activities.

J. CONSTRUCTION AND OPERATION OF GROUNDWATER MANAGEMENT FACILITIES

Groundwater management plans can include projects that protect the quality of groundwater and assure that the quantity of groundwater in storage is managed to meet long-term demand. The facilities that can aid in efficient management of groundwater resources include groundwater contamination clean-up projects and groundwater extraction projects for water table control.

As knowledge is gained through implementation of the GMP elements, specific projects may be identified and evaluated. It is premature to list potential projects at this time.

K. RELATIONSHIPS WITH STATE AND FEDERAL REGULATING AGENCIES

Establishing effective working relationships with the various state agencies (DWR, SWRCB, DOHS, RWQCB, and DTSC) and federal agencies (USBR, USGS, and EPA) is important for water resources management to be efficient and effective. The participating districts value the information and guidance provided by these agencies and should collaborate with the appropriate state and federal agencies in well data collection, studies and findings, and in establishing effective data exchange and communication strategies.

L. REVIEW OF LAND USE PLANS TO ASSESS RISK OF GROUNDWATER CONTAMINATION

Land use planning is used by counties and cities for regulation of land uses within their jurisdiction to create a quality of life and to achieve compatibility between man's activities and the environment. It is a very effective method to mitigate impacts of changes in land use on groundwater quantity and quality. Current land use in the GMA is agricultural, with some agricultural related industry. Other land uses may be proposed that would have the potential to impact groundwater quality. The participating district should review proposed land use changes within their jurisdiction to determine if the potential for contamination exists and consult with the appropriate state or federal agency to provide groundwater data and request appropriate mitigation measures to avoid impacts to water quality.

XI. IMPLEMENTATION OF THE GROUNDWATER MANAGEMENT PLAN

Groundwater management plan implementation entails development of programs through cooperative efforts of the districts involved in the groundwater management plan. Implementation of some aspects of the plan may require considerable expenditures and formulas must be developed to allocate costs among the districts participating in the plan. Implementation of regional groundwater management plans are ultimately less costly than implementation of plans by individual agencies, but the implementation strategy is complicated since participating districts have varied reliance on the groundwater resource. The priorities for implementation of the various elements of the groundwater management plan will vary from district to district. The potential benefits of regional planning within a common groundwater basin or subbasin far outweigh the difficulties of plan implementation. The joining together of districts increases the opportunities for water resource management.

All participating districts are federal water service contract holders, with the CVP water supply their primary source of surface water. In quantifying the water supply needs of these districts, the USBR considered the groundwater unusable or of very limited availability due to generally poor quality.

With the restriction of moving water south of the Delta, it is forecast that the average CVP water delivery will be 60% of the contract amounts. This reduction in surface water supply has forced the water users to pump groundwater in most years to meet the water demand. As pointed out in the opening discussion in this report, implementation of the GMA will provide the necessary groundwater monitoring and assessments of pumping impacts to optimize groundwater pumping in the GMA.

With consideration given to the reliance upon groundwater by the participating districts and the varying importance of the groundwater management elements, the recommended implementation strategy is as follows:

1. After public review and consideration of comments received, the final plan is adopted by each participating district.

2. The SLDMWA will coordinate plan implementation among the participating districts.

3. A plan implementation committee made up of representatives of each participating district will meet periodically to guide and coordinate activities. This committee may be combined with the existing Steering Committee, which oversees the activities of the SLDMWA associated with pumping of wells into the DMC. The first work of the committee will be to develop rules and regulations pursuant to Water Code Section 10753.8 to be adopted by each district.

4. With consideration given to the identified problem areas, the committee shall establish a priority list for management actions. For example, a determination will be made on how groundwater levels and water quality information will be collected, who is responsible for collecting the information, and how the information will be compiled and analyzed.

5. Management activity groups will be formed of those participating districts interested in implementing certain elements of the groundwater management plan to identify specific management actions, develop budgets, apportion costs, and conduct environmental review of proposed projects.

6. An annual summary would be prepared to describe the management activity that has taken place for each plan element and used to keep participating districts and the SLDMWA abreast of the groups' activities.

This implementation strategy is expected to be refined as necessary by the management committee.

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FIGURES

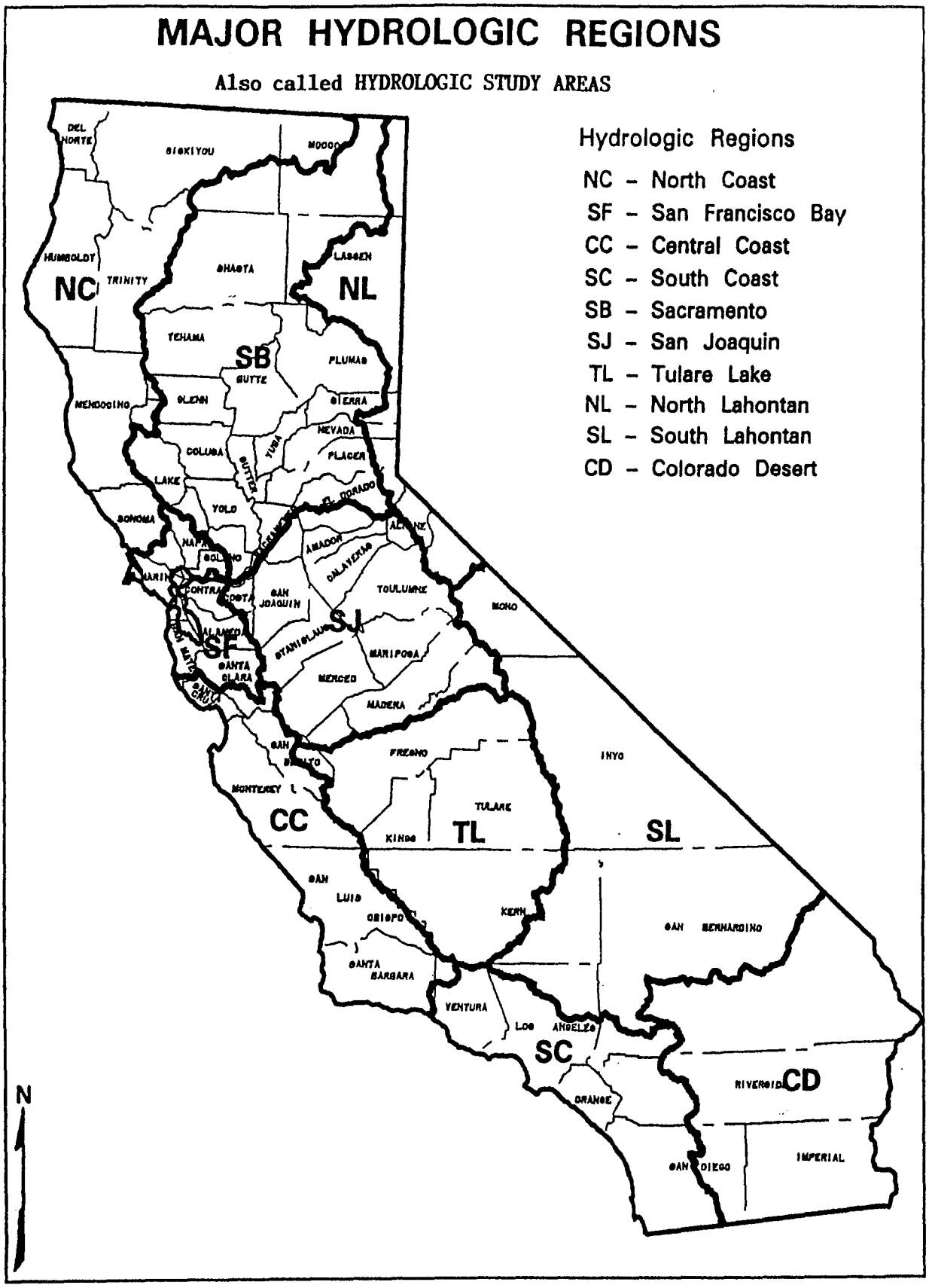


Figure 1. Hydrologic Study Areas, California (from Hauge, 1992)

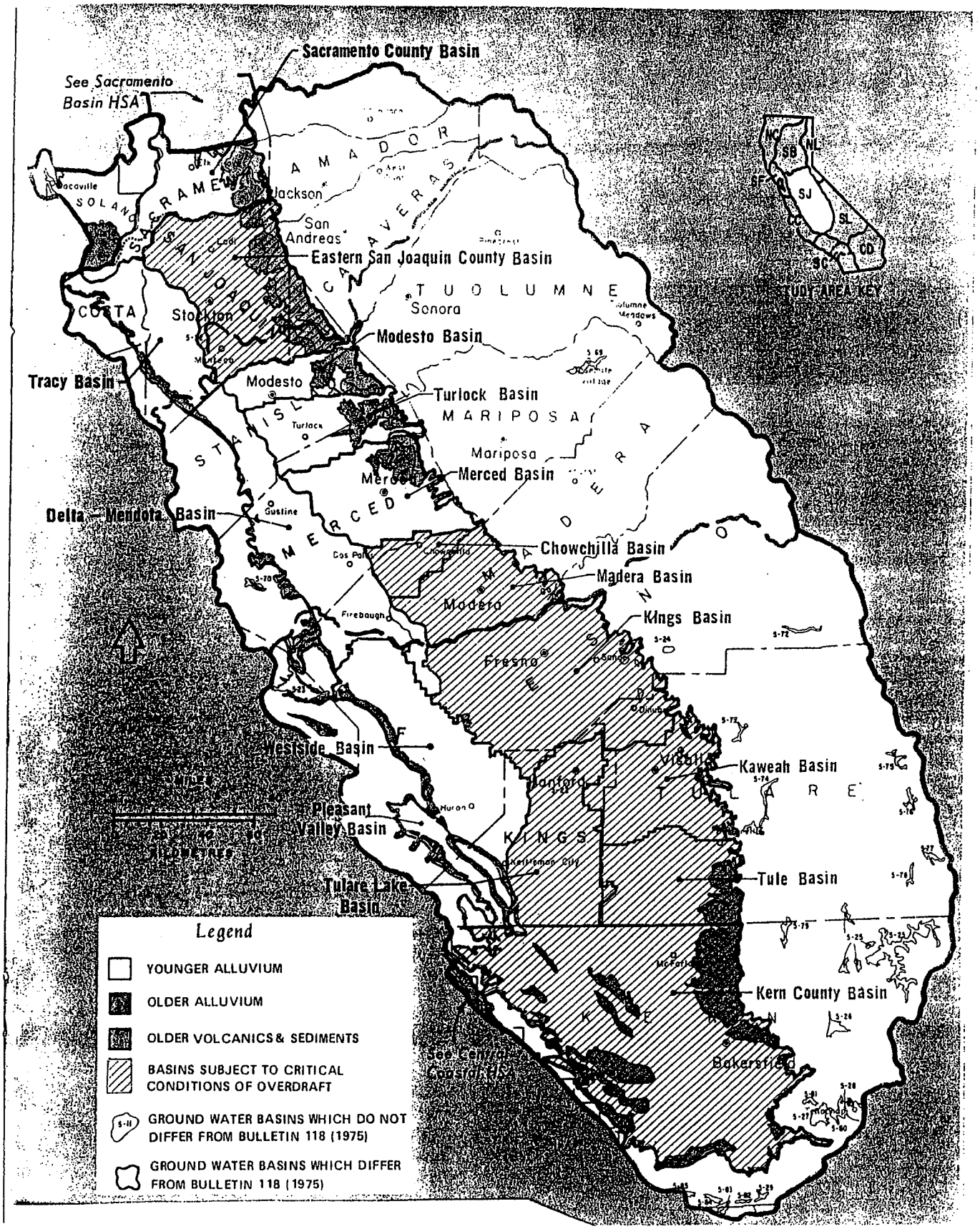


Figure 2. Groundwater Basins, San Joaquin Hydrologic Study Area, California (from DWR, 1980)

GROUNDWATER MANAGEMENT AREA

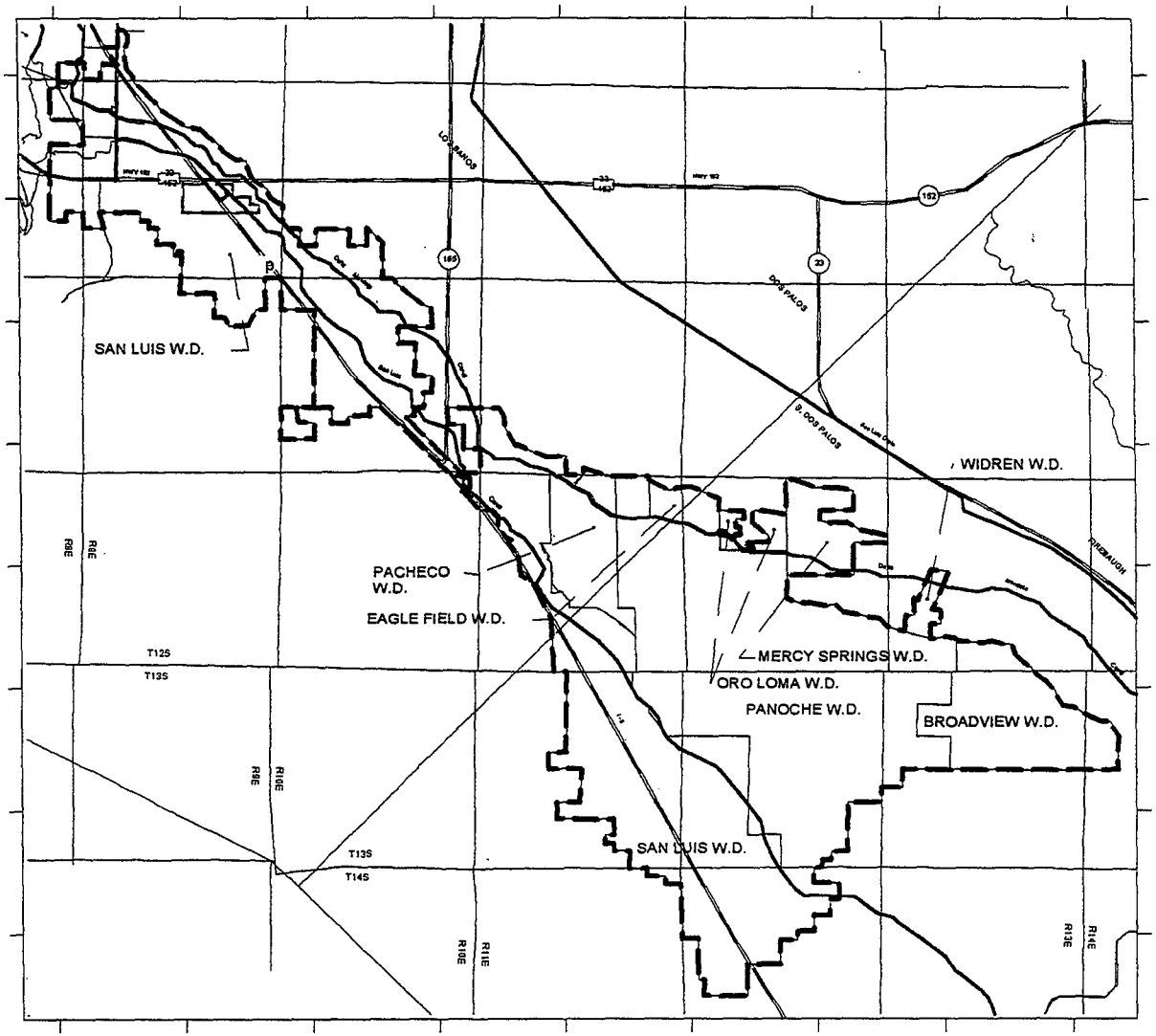


Figure 3. Boundary of the Groundwater Management Area.

SPRING 1986

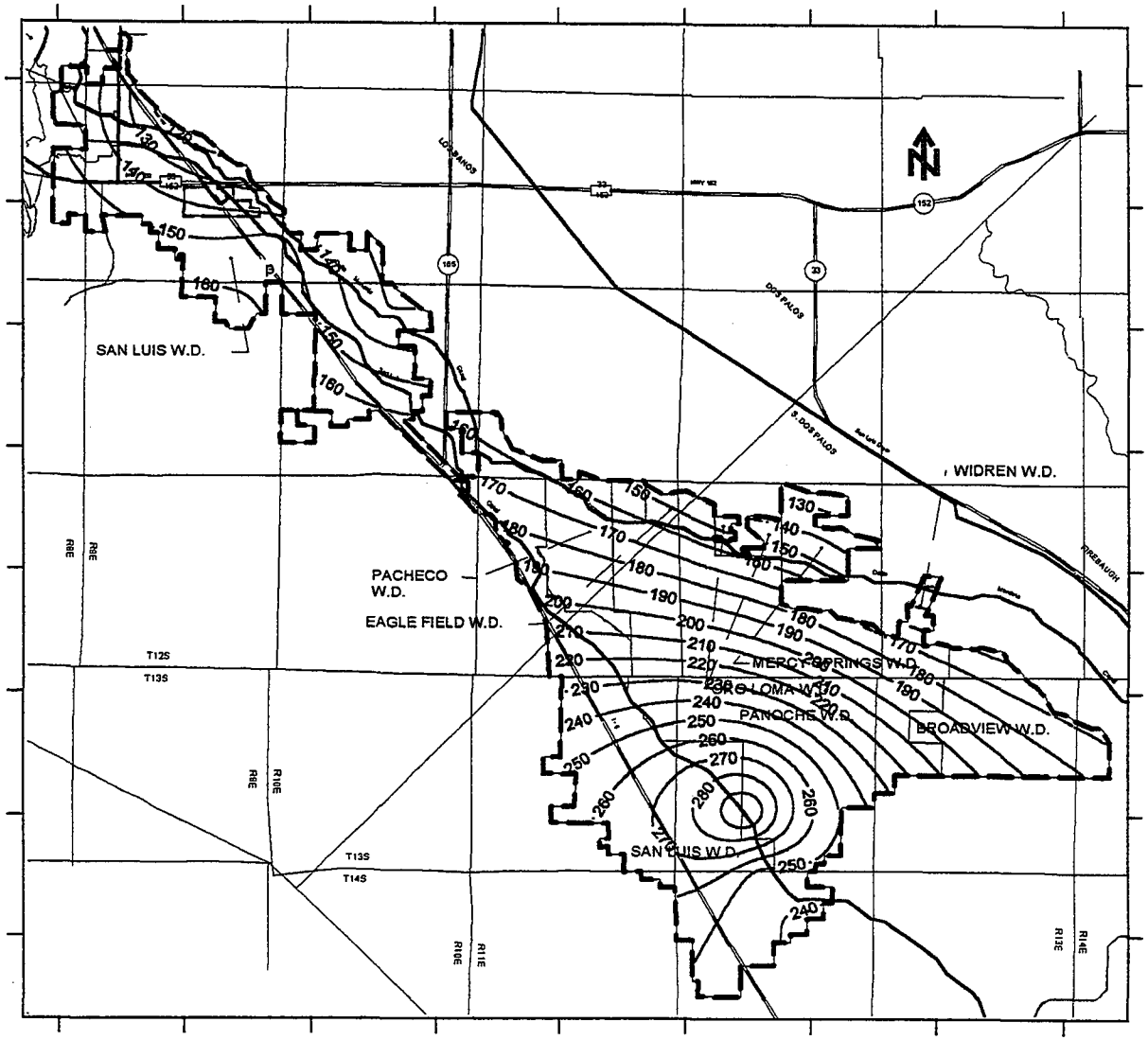


Figure 4. Unconfined Groundwater Levels (feet), Spring 1986.

SPRING 1990

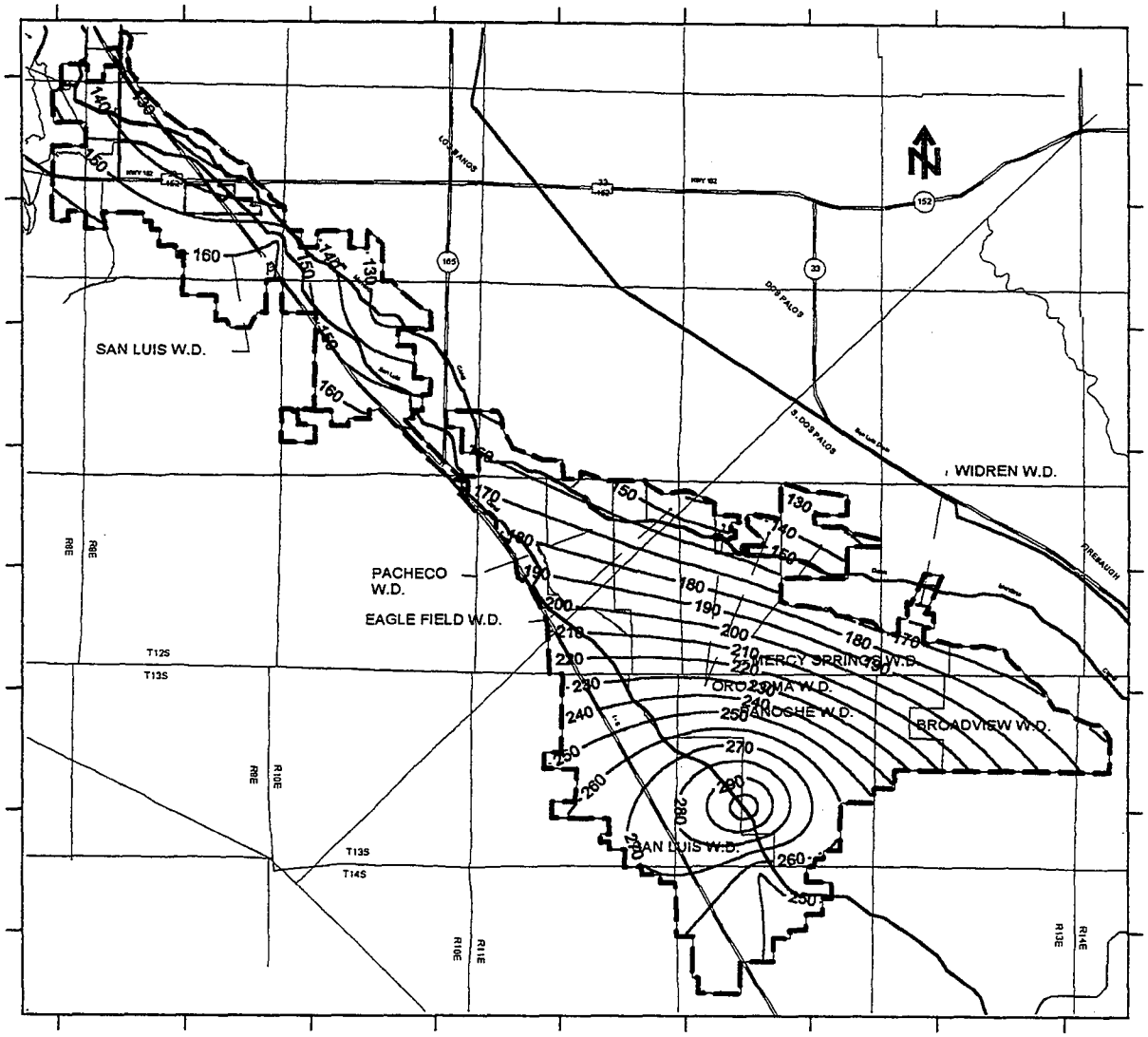


Figure 5. Unconfined Groundwater Levels (feet), Spring 1990.

SPRING 1994

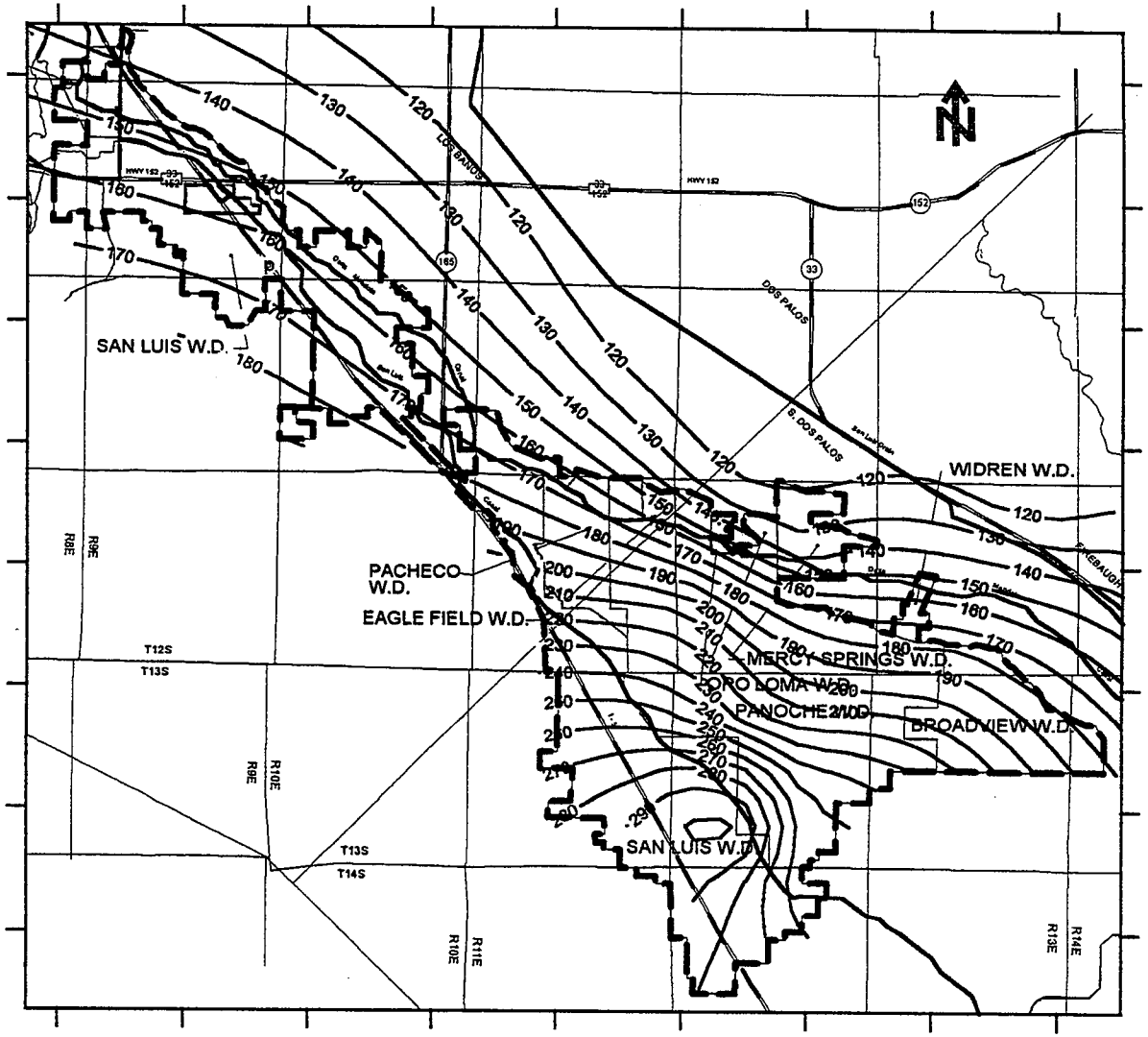


Figure 6. Unconfined Groundwater Levels (feet), Spring 1994.

SPRING 1986 - SPRING 1990

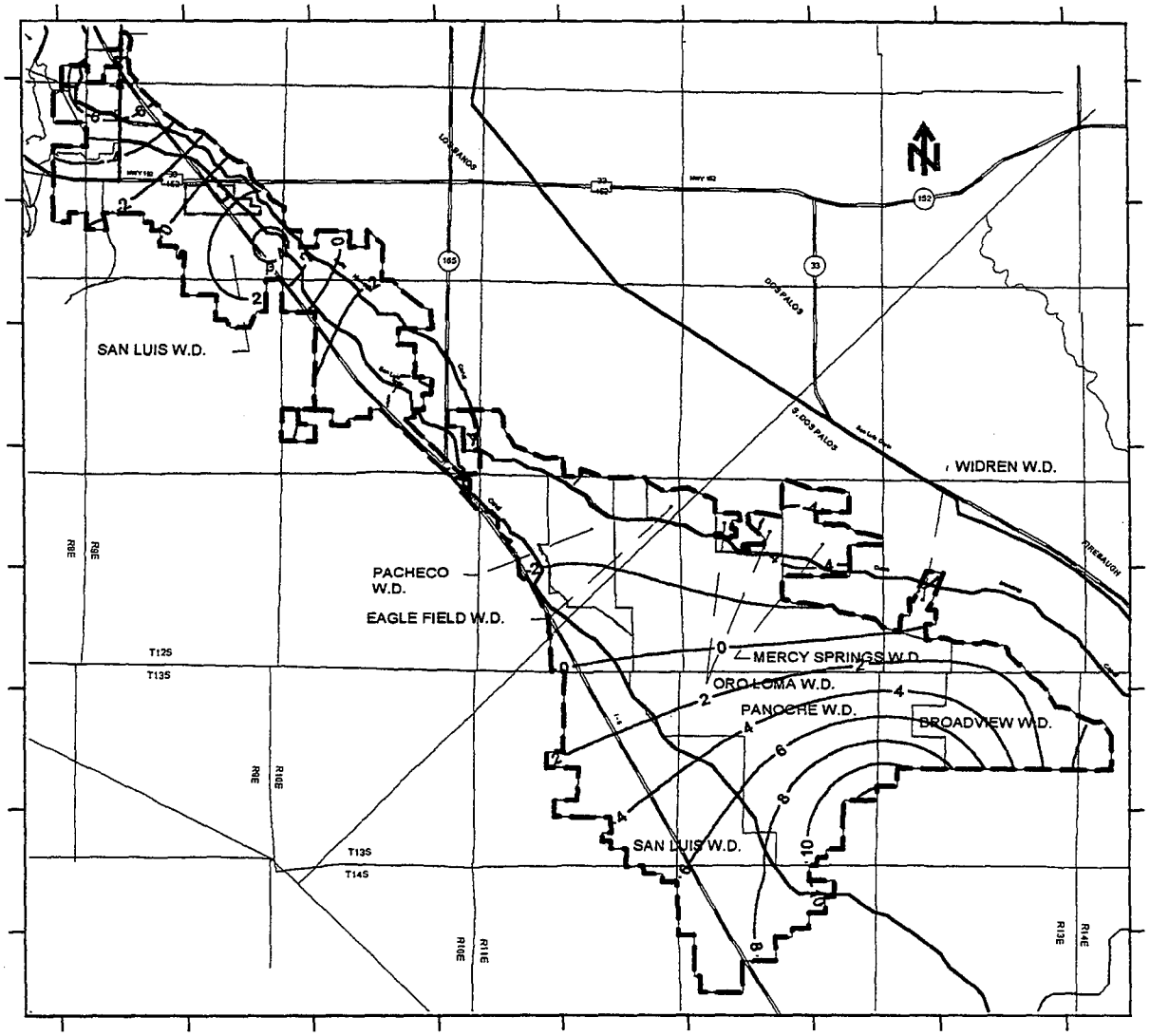


Figure 7. Unconfined Groundwater Level Change (feet), 1986 -1990.

SPRING 1990 - SPRING 1993

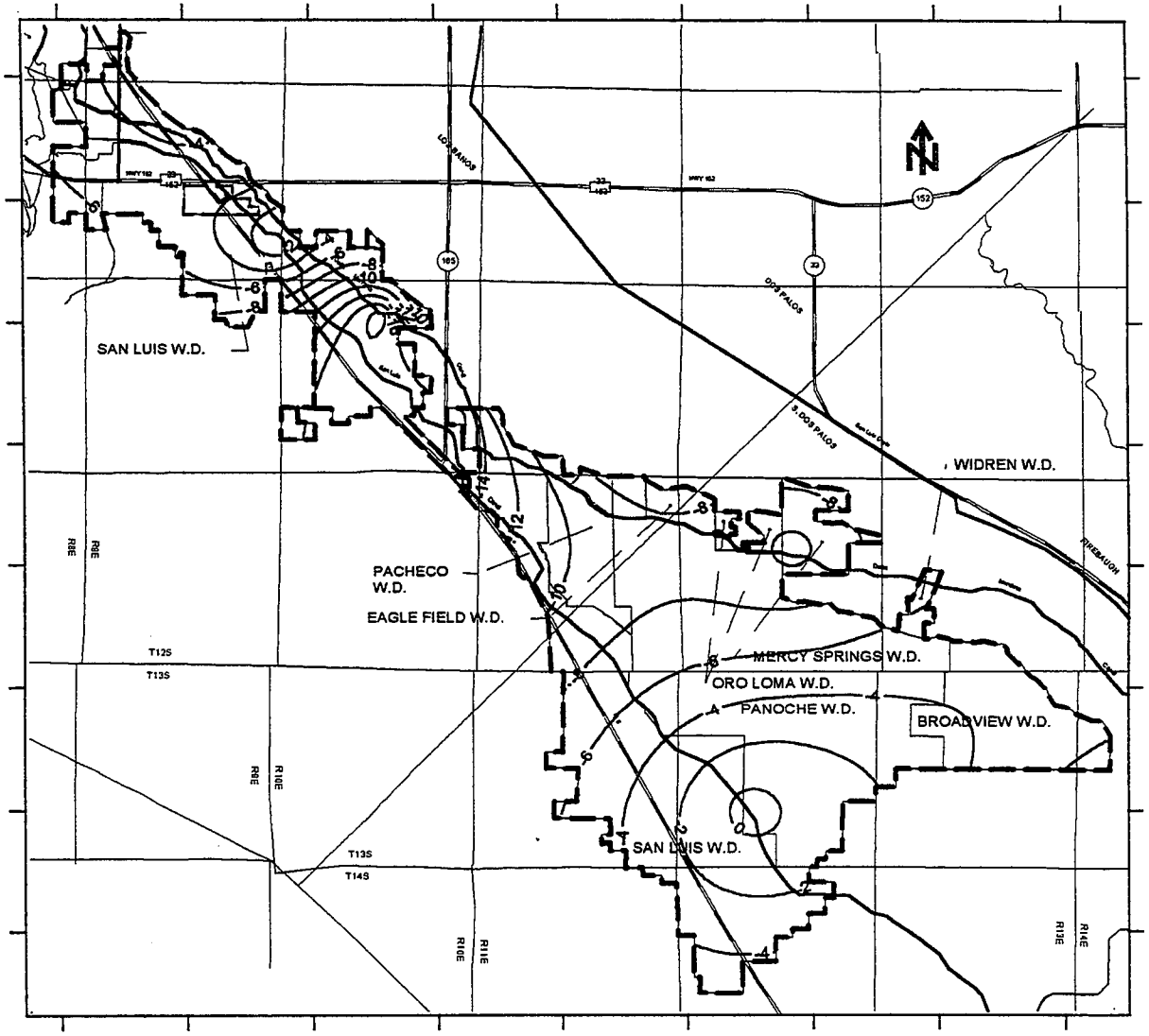


Figure 8. Unconfined Groundwater Level Change (feet), 1990 -1993.

SPRING 1993 - SPRING 1994

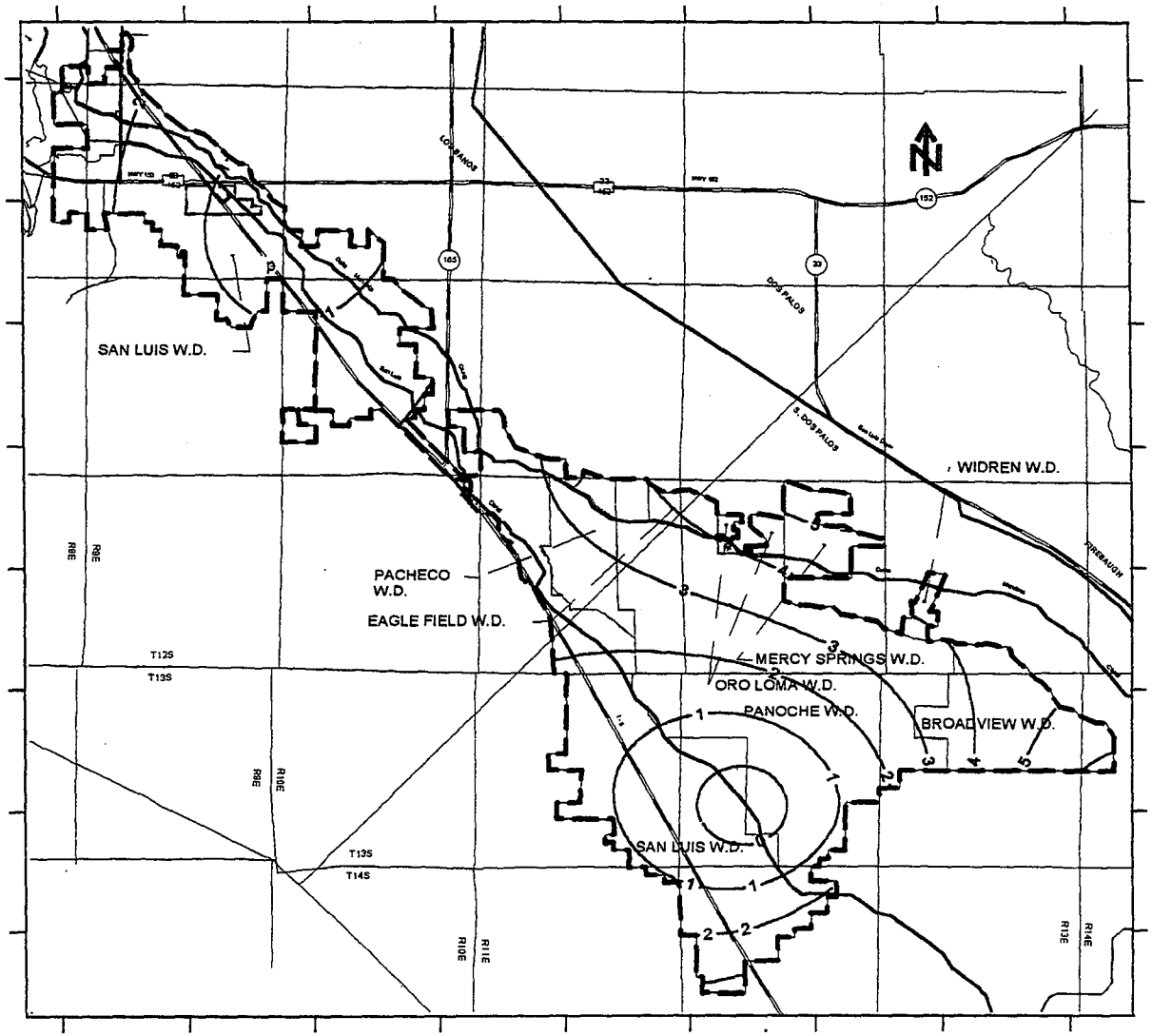
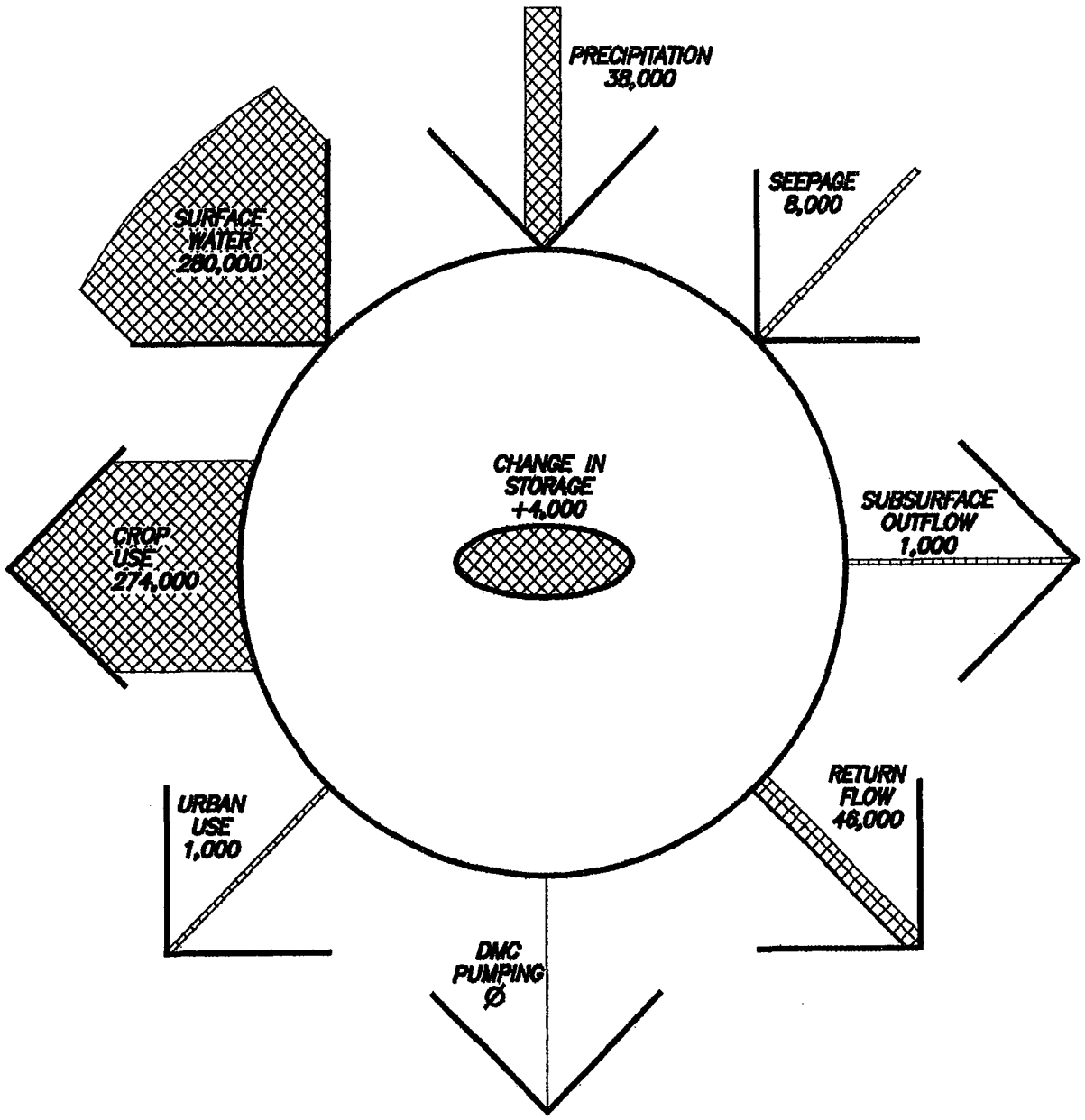


Figure 9. Unconfined Groundwater Level Change (feet), 1993 -1994.

Figure 10

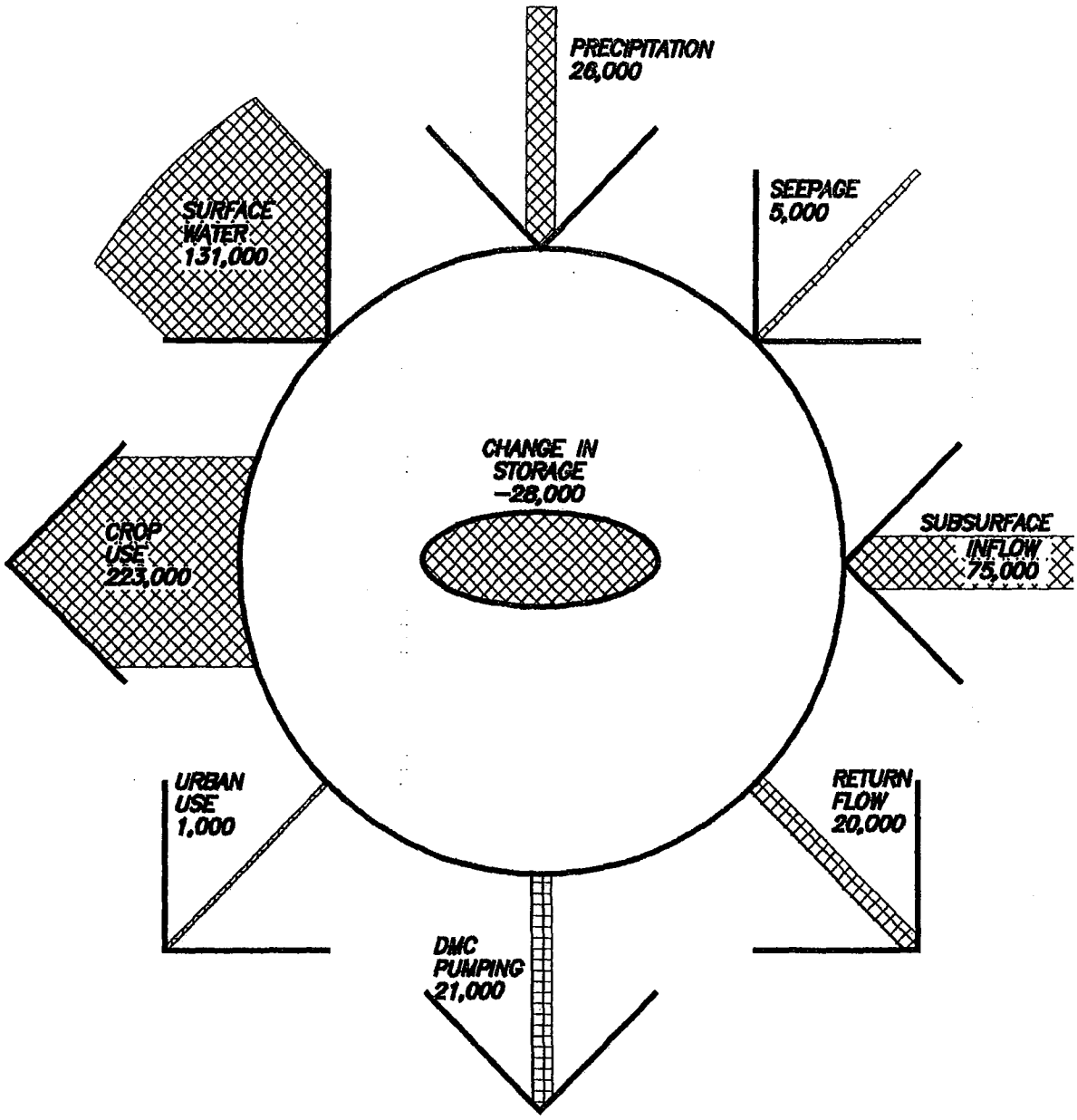


ANNUAL WATER RESOURCE BALANCE

FULL SURFACE WATER SUPPLY

(UNITS OF ACRE FEET)

Figure 11



ANNUAL WATER RESOURCE BALANCE

RESTRICTED SURFACE WATER SUPPLY

(UNITS OF ACRE FEET)

EXHIBIT 9

PANOCHE WATER DISTRICT
IRRIGATION WATER QUALITY

SLC RTO	ALKALINITY CaCO3 mg/L	BICARBONATE CaCO3 mg/L	BORON B mg/L	CALCIUM Ca mg/L	CARBONATE CaCO3 mg/L	CHLORIDE Cl mg/L	CONDUCTIVITY EC umho/cm	TDS EC*0.7 PPM	HYDROXIDE CaCO3 mg/L	MAGNESIUM Mg mg/L	NITRATE NO3 mg/L	PERCENT SODIUM %	Ph STD	POTASSIUM K mg/L	SELENIUM Se. PPB	SODIUM Na mg/L	SULFATE SO4 mg/L
2/18/2003	76	76	0.70	49	ND	85	800	560	ND	20	19	50	8.2	2	14	95	160
3/1/2003	96	96	0.50	40	ND	64	640	448	ND	18	14	48	7.5	3	10	74	120
3/18/2003	80	80	1.50	84	ND	160	1500	1050	ND	36	44	55	8.3	2	46	200	400
4/1/2003	80	80	0.70	49	ND	87	860	602	ND	24	19	52	7.8	2	18	110	180
4/15/2003	86	86	1.10	66	ND	120	1200	840	ND	30	31	55	7.8	3	35	160	290
5/1/2003	84	84	0.40	38	ND	92	740	518	ND	21	12	53	8.2	4	9	93	110
5/15/2003	86	86	0.70	53	ND	110	960	672	ND	24	20	53	7.6	3	19	120	180
6/2/2003	84	84	0.60	46	ND	95	800	560	ND	22	13	51	7.7	3	10	100	150
6/16/2003	80	80	0.90	61	ND	120	1000	700	ND	24	26	53	7.7	3	19	130	230
7/2/2003	76	76	0.60	47	ND	87	800	560	ND	21	19	52	7.8	3	8	100	170
7/15/2003	76	76	0.80	48	ND	95	820	574	ND	20	18	51	8.2	2	17	98	180
8/1/2003	76	76	0.80	51	ND	100	890	623	ND	22	19	52	8.0	3	17	110	190
8/15/2003	66	66	0.60	39	ND	74	680	476	ND	16	13	52	7.9	2	14	80	140
9/2/2003	68	61	0.50	35	6.4	74	630	441	ND	16	10	53	8.7	2	12	80	120
2/13/2004	96	96	0.70	48	ND	85	800	560	ND	21	18	50	8.0	3	12	95	170
3/16/2004	78	78	0.40	36	ND	65	650	455	ND	16	15	50	7.9	3	11	71	110
4/22/2004	92	92	0.80	54	ND	130	1000	700	ND	25	26	54	8.2	3.0	16	130	230
5/24/2004	84	84	0.20	24	ND	73	490	343	ND	15	4	51	8.1	3	ND	59	42
6/28/2004	90	90	0.70	48	ND	110	900	630	ND	23	17	53	8.1	3	12	110	180
7/29/2004	72	72	0.60	37	ND	88	700	490	ND	18	14	54	8.1	3	10	92	130
5/23/2005	86	86	0.50	36	ND	96	720	504	ND	18	13	53	8.0	3	8	88	130
6/1/2005	58	58	0.40	28	ND	60	550	385	ND	13	8	54	7.8	2	6	69	120
7/1/2005	66	66	0.80	44	ND	83	780	546	ND	17	22	55	8.1	ND	16	100	200
8/1/2005	84	80	0.60	40	4	90	830	581	ND	18	19	55	8.4	2	15	99	170
7/12/2006	65	65	0.55	32	ND	72	660	462	ND	14	14	54	8.1	2.2	12	77	140
6/20/2007	87	82	0.51	37	5.1	97	740	518	ND	17	12	53	8.4	2.9	8.9	87	120
7/18/2007	81	81	1.20	60	ND	120	1100	770	ND	24	33	55	8.2	2.3	27	140	280
8/20/2007	75	75	0.92	47	ND	140	1000	700	ND	22	24	57	8.2	2.9	19	130	220
5/29/2008	79	79	0.20	24	ND	88	560	392	ND	15	3.9	53	8.2	3.3	ND	66	54
6/18/2008	81	81	0.30	28	ND	99	640	448	ND	17	5.6	53	8.3	3.5	ND	76	71
7/16/2008	79	79	0.37	27	ND	83	620	434	ND	8.4	55	55	8.3	2.9	7.7	75	91
6/9/2009	97	97	0.28	28	ND	110	690	483	ND	18	4.1	54	8.3	3.8	ND	80	63
7/14/2009	96	96	0.75	29	B	73	790	470	ND	18	ND	61	8.2	2.6	3.6	110	180

EXHIBIT 10

Pacheco Water District
Summary of Estimated Selenium Loads at Each Sump,
in Pounds Per Week

****PRELIMINARY DRAFT****
****WILL BE REVISED****

Estimated Load	314-S	314-M	312	310	308	318	208	202	201	Estimated Total Se Load
Calendar Year 2009										
January	0.68	2.72	4.55	2.90	0.77	1.48	4.51	2.86	3.02	23.49
February	4.99	4.60	11.89	8.66	3.10	2.40	12.31	9.78	3.99	61.72
March	7.02	11.51	21.42	14.54	5.36	10.97	12.04	7.84	8.62	99.32
April	7.44	8.62	41.45	31.62	12.24	26.17	27.48	24.23	22.13	201.39
May	4.58	8.82	19.18	19.10	11.04	18.90	17.49	24.37	17.62	141.11
June	3.79	3.22	23.80	19.35	18.10	22.96	26.26	35.12	24.05	176.64
July	4.60	7.02	38.30	39.02	18.40	32.58	55.42	70.89	38.21	304.44
August	2.32	8.03	7.01	10.95	6.79	10.83	21.25	30.57	6.05	103.81
September	1.83	6.30	5.33	8.37	3.62	7.38	11.70	12.32	3.90	60.74
October	1.29	11.27	9.89	13.74	5.86	13.18	19.44	17.06	6.85	98.59
November	1.23	5.19	4.77	6.97	1.94	5.10	8.48	8.53	4.00	46.19
December	1.22	6.70	7.85	7.60	2.30	6.26	9.14	9.19	5.60	55.85
Total	41.0	84.0	195.4	182.8	89.5	158.2	225.5	252.8	144.0	1373.3

Note: Sump 101 Load includes Sump 201 Load.

EXHIBIT 11

PACHECO DRAINAGE DISTRICT
SELENIUM LOADS AND TARGETS

MONTH	YR 4			2005		YR 5			2006		YR 6			2007		YR 7			2008		YR 8			2009	
	PRECIP 12.9"			USBR 85%		PRECIP 9.7"			USBR 100%		PRECIP 3.8"			USBR 50%		PRECIP 3.9"			USBR 40%		PRECIP 4.1"			USBR 10%	
	Lbs	TARG	% RED	DIFF	+OR-	Lbs	TARG	% RED	DIFF	+OR-	Lbs	TARG	% RED	DIFF	+OR-	Lbs	TARG	% RED	DIFF	+OR-	Lbs	TARG	% RED	DIFF	+OR-
JAN	16	16	-38%	0	0%	16	16	0%	0	0%	27	27	69%	0	0%	25	25	-7%	0	0%	21	21	-16%	0	0%
FEB	38	38	-5%	0	0%	38	38	0%	0	0%	30	30	-21%	0	0%	28	28	-7%	0	0%	21	21	-25%	0	0%
MAR	38	38	-21%	0	0%	38	38	0%	0	0%	30	30	-21%	0	0%	28	28	-7%	0	0%	21	21	-25%	0	0%
APR	21	39	3%	-18	-46%	39	39	0%	0	0%	32	32	-18%	0	0%	29	29	-9%	0	0%	22	22	-24%	0	0%
MAY	39	39	15%	0	0%	38	39	0%	-1	-3%	32	32	-18%	0	0%	29	29	-9%	0	0%	23	23	-21%	0	0%
JUN	18	27	-4%	-9	-33%	27	27	0%	0	0%	14	14	-48%	0	0%	13	13	-7%	0	0%	11	11	-15%	0	0%
JUL	19	27	-4%	-8	-30%	27	27	0%	0	0%	14	14	-48%	0	0%	13	13	-7%	0	0%	11	11	-15%	0	0%
AUG	28	28	8%	0	0%	28	28	0%	0	0%	15	15	-46%	0	0%	14	14	-7%	0	0%	11	11	-21%	0	0%
SEP	26	26	13%	0	0%	26	26	0%	0	0%	15	17	-35%	-2	-12%	16	16	-6%	0	0%	12	12	-25%	0	0%
OCT	23	25	9%	-2	-8%	24	25	0%	-1	-4%	17	17	-32%	0	0%	15	15	-12%	0	0%	12	12	-20%	0	0%
NOV	19	25	9%	-6	-24%	23	25	0%	-2	-8%	17	17	-32%	0	0%	15	15	-12%	0	0%	12	12	-20%	0	0%
DEC	13	16	-30%	-3	-19%	14	16	0%	-2	-13%	27	27	69%	0	0%	25	25	-7%	0	0%	21	21	-16%	0	0%
TOTAL	298					338					270					250					198				
TARGET	344			4%	LESS	344			0%	LESS	272			21%	LESS	250			8%	LESS	198			21%	LESS
+OR-	-13%					-2%					-1%					0%					0%				

THESE NUMBERS INCLUDE DEDUCTIONS FROM THE SAN JOAQUIN RIVER IMPROVEMENT PROJECT

EXHIBIT 12

CIMIS (California Irrigation Management Information System)

Monthly Report

Rendered in ENGLISH Units.
January 1, 2009 - December 31, 2009
Printed on September 8, 2011
See the bottom of this report for a legend for all flag values.

San Joaquin Valley - Panoche - #124

Month Year	Tot ETo (in)	Tot Precip (in)	Avg Sol Rad (Ly/Day)	Avg Vap Pres (mBars)	Avg Max Air Tmp (F)	Avg Min Air Tmp (F)	Avg Air Tmp (F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Dew Point (F)	Avg Wind Speed (mph)	Avg Soil Temp (F)
Jan 2009	1.55 K	1.36	228	8.3	57.8	34.9 L	45.5 L	94 K	60 K	79 L	39.3 L	3.2	46.6
Feb 2009	1.97 K	1.27	282	9.7	60.5	41.0	50.4	92	57	77	43.3	4.1	50.4
Mar 2009	4.83	0.23	481 K	8.4 K	66.9	41.8 K	54.9	78	39	57 K	39.2 K	6.0 K	54.4
Apr 2009	6.56 K	0.06 K	601 K	8.2 K	73.7	44.9 K	60.2	69	29	46 K	38.4 K	6.7 K	58.0
May 2009	8.34	0.12	679 K	11.9	85.1 K	55.0 K	70.7	73	29	47	48.4	6.3	66.9
Jun 2009	8.40	0.00	758 L	12.9	85.3	55.7 K	71.2	76	31	50	51.1	5.5	71.0
Jul 2009	9.57	0.00	774 K	13.8	94.2	60.0	77.1	68	26	44	52.8	5.6 K	74.8
Aug 2009	8.66	0.00	684 K	12.6 K	93.2	59.4 K	76.5	65	24	41 K	50.4 K	5.5 K	73.2
Sep 2009	6.92	0.02 K	577 K	11.6 K	91.0 K	58.7 L	75.1 L	61 K	23 K	39 L	48.1 L	5.2 K	71.5 L
Oct 2009	4.52	0.17	426 K	10.2 K	74.3	48.2 K	61.8	72	36	53 K	43.1 K	5.7 K	61.1
Nov 2009	2.54 K	0.04 K	308 K	8.0 K	65.8	38.1 K	51.6 K	79 K	40 K	60	38.1	4.1 K	53.0 K
Dec 2009	1.25 K	0.00 K	204 K	8.7 K	54.8	37.9 K	45.7 K	92 K	63 K	81	40.2	3.8 K	47.9 K
Totals/Avgs	65.11	3.27	500	10.4	75.2	48.0	61.7	77	38	56	44.4	5.1	60.7

M - All Daily Values Missing
K - One or More Daily Values Flagged
J - One or More Daily Values Missing
L - Missing and Flagged Daily Values

W/sq.m = Ly/day/2.065	inches * 25.4 = mm	C = 5/9 * (F - 32)
m/s = mph * 0.447	kPa = mBars * 0.1	

EXHIBIT 13

Marcos

From: Charles Burt <cburt@calpoly.edu>
Sent: Tuesday, January 15, 2008 8:42 AM
To: Marcos Hedrick
Subject: Visits with growers this coming Tuesday

Marcos -

Would it be possible to meet with some drip growers on Tuesday,Jan 22?
I could be there at 8 am, since I'll be driving down from Yuba City the night before. Based on what we talked over in your office, the plan would be to go out and take a look at the field layout, including the filtration, chemical injection, and valves. If there are any questions the farmers have, I could try to answer them. If I have some observations that I think might help, I'd point those out.

I really don't know how it would go, but as we discussed, it's worth a try. I doubt that we would need more than about 2 hours/farmer.

Thanks.
--
Charles M. Burt, Ph.D., P.E., D.WRE
Professor, BioResource and Agricultural Engr.
Chairman, Irrigation Training and Research Center (ITRC) California Polytechnic State University (Cal Poly) San Luis Obispo, CA 93407-0730 cburt@calpoly.edu ITRC main office: 805-756-2434
fax: 805-756-2433
Burt office: 805-756-2379
cell: 805-748-3863
www.itrc.org

Marcos

From: Susanne Gartner <sgartner@calpoly.edu>
Sent: Friday, December 21, 2007 8:31 AM
To: unlisted-recipients:; no To-header on input
Cc: Susanne Gartner (sgartner@calpoly.edu)
Subject: "Drip and Micro Irrigation Design and Management" - 3rd Edition is now available
Attachments: Table of Contents.pdf

"Drip and Micro Irrigation Design and Management for Trees, Vines, and Field Crops"
3rd Edition - just released
Cost: $95, plus tax and shipping

The 3rd Edition of the book "Drip and Micro Irrigation Design and Management for Trees, Vines, and Field Crops" is now available. This new edition is about 50% longer than the previous version, with many more photos and figures. The book covers design and management issues that are not found in any other books. For more information, visit our website: http://www.itrc.org/publications.htm

The table of contents can be viewed by opening the attached pdf file. You will need Adobe Acrobat Reader to access the file. (The free program can be downloaded from the following website: http://www.adobe.com/products/acrobat/readstep2.html.)

Susanne Gartner
Irrigation Training and Research Center (ITRC) BioResource and Agricultural Engineering Dept.
California Polytechnic State University
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Pump Training – March 2-4, 2010
Sponsor: USBR Mid-Pacific Region

PUMPS I, Mar. 2: Basic pumps course covering types; terms; curves; pumps in series and parallel; system curves; TDH computations; efficiency; WHP, BHP, input HP; pump selection; trimming impellers; common pump questions and answers.

PUMPS II, Mar. 3-4: Class covering advanced topics such as: NPSH, submersible pumps; well screens and well development, shaft losses, shaft sizing; maintenance and troubleshooting; adjustable seed drive (ASD) basics; variable frequency drive (VFD) basics; retrofitting VFDs on existing motors; affinity laws for variable speed operation; estimating savings from VFDs; hands-on ASD applications; power factor correction; inlet and sump design.

Irrigation District School of Irrigation Winter 2010
Sponsor: USBR Mid-Pacific Region

ITRC is providing several training and educational opportunities for staff, engineers, and board members of agricultural irrigation districts, as well as water operators. These classes utilize the excellent indoor and outdoor facilities at Cal Poly.

Water Operator Classes	1st session	2nd session
FLOW MEASUREMENT – General & Pipeline	Jan. 12, 2010	Feb. 23, 2010
FLOW MEASUREMENT – Canals	Jan. 13, 2010	Feb. 24, 2010
CANAL OPERATION	Jan. 14, 2010	Feb. 25, 2010

Ag Irrigation System Evaluation Short Course - June 2010
Sponsor: DWR

ISE I: Theory and Laboratory Practice of Evaluations. This 2½-day course will be held **June 14-16, 2010**. The class combines classroom (50%) and outdoor laboratory (50%) activities. Efficiency definitions and techniques of evaluation are emphasized, ranging from how to take a pressure measurement to what specific measurements are needed for the evaluation of six distinct irrigation methods (furrow, border strip, hand move/side roll sprinkler, linear move sprinkler, undertree sprinkler, and drip/micro). The course is not mathematically oriented, since the calculations are manipulated by the new and revised Cal Poly/DWR expert system Irrigation Evaluation programs.

ISE II: San Joaquin Valley Field Evaluations of Drip/Micro Systems. This 2½-day class, held on **June 16-18, 2010**, travels to the San Joaquin Valley and performs the entire evaluations on 2 fields. Emphasis is on performing the field evaluations for drip and microspray irrigation systems on trees/vines. This class allows for more extensive field training to help with the comprehension of the materials from Class 1.

Drip Irrigation Workshop – February 11, 2010
Sponsor: Southern California Edison, AgTAC

This ½ day class is done to coincide with the World Ag Expo in Tulare. The class is designed for growers interested in drip irrigation. Topics covered include product selection, filter requirements, remote data collection, and energy requirements.

Irrigation District – Custom Classes

In addition to the classes offered throughout the year, the ITRC can provide training specifically tailored to the needs of individual districts or companies. For example, in the past, we have offered modified classes in flow measurement, canal operation, SCADA and drip irrigation.

For more information, please contact:
Dr. Stuart Styles, sstyles@calpoly.edu

SCADA
February 9-12, 2010
Sponsor: USBR Mid-Pacific Region
NEW MATERIAL

Training for individuals involved in planning, designing, installing, operating and maintaining SCADA systems. The four-day long class will introduce participants to more advanced SCADA topics and give them the opportunity to test their skills in the electronics lab at Cal Poly's BioResource and Agricultural Engineering Dept. Recent applications with **ClearSCADA** HMI will be highlighted. The class will also offer specialized topics on automation performance.

The lab has 10 complete SCADA work stations, allowing for unprecedented "hands-on" electronic training. The knowledge gained from the class will help make the participants better able to understand, plan, design, install, manage, and maintain the telemetry systems that have become so important to improving the efficient use of water and power in agriculture.

Monday	Tuesday	Wednesday	Thursday	Friday
2	3	4 Basic Soil, Plant & Water Relationships	5 Irrigation Scheduling, Salinity & Drainage	6 Irrigation Scheduling, Salinity, & Drainage Certification Exam
9 Basic Pipeline Hydraulics I	10 Basic Pipeline Hydraulics II	11 Pumps I	12 Pumps II Chemigation	13 Pumps II Row Crop Drip Irrigation
16 Drip/Micro Irrigation Design	17 Drip/Micro Irrigation Design	18 Drip/Micro Irrigation Design	19	20

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IRRIGATION TRAINING AND RESEARCH CENTER
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San Luis Obispo, CA 93407
Phone: (805) 756-2434
FAX: (805) 756-2433
www.itrc.org Contact: Dr. Burt cburt@calpoly.edu

Summer Irrigation Evaluation Program
Drip/Micro Irrigation Systems

Funded by the US Bureau of Reclamation, Water Conservation Office (Fresno)
Supported by local Irrigation/Water Districts

What the student team does:

- Spends about 1 day in the field taking measurements of pressures, flows, and make observations of the filtration, chemical injection, etc.
- Inputs data into the Cal Poly ITRC Irrigation Evaluation Programs, examines field data.
- Prints out the data, results, and recommendations
- Sets up an appointment with the farmer to review the information.

The type of information provided:
The Cal Poly ITRC Irrigation Evaluation Programs provide:

- The Distribution Uniformity (DU) of the irrigation system. **The DU is a measure of how evenly the irrigation water is applied to plants throughout a field.**
- The causes of non-uniformity. For example, the program will tell a farmer what percentage of the non-uniformity is due to plugging, what percentage is due to pressure differences, etc.
- Recommendations on how to improve that specific system's performance.

Who gets the information:

- The farmer
- The irrigation district (but without any farmer's name or address)
- The USBR (but without any farmer's name or address)
- Cal Poly ITRC

The obligation by the farmer:

- There is no fee; it is completely funded by the USBR
- The farmer must agree to have someone show the students the field, explain the layout, and start and stop the pump on the agreed-upon date and at the agreed-upon time.
- If the system is a subsurface drip system, the farmer must provide workers with shovels to uncover tape in 3 locations, about 30' per location.
- The farmer must be willing to take the time to sit down and go over the results (about 30 minutes).

Why participate?

- Irrigation systems cost money to operate, and their performance has a huge impact on yield and yield quality. Older systems need to be checked out just as automobiles do. Sometimes they need a tune-up; sometimes they don't. This evaluation lets a farmer know if a tune-up is needed, and what types of things can be done.
- On the average, we find that the DU of drip/micro systems is about 0.76 (out of a perfect 1.00), whereas reasonably attainable values are about 0.92 for drip/micro systems. If you can shift from a DU of 0.76 to a DU of about 0.92, the ratio of (maximum/minimum) water applied to different plants throughout a field will shift from about (2/1) to about (1.2/1).
- Farmers should expect a high DU from a new irrigation system. This program allows farmers to verify the quality of a new system that might have been recently purchased.

PACHECO WATER DISTRICT

RESOLUTION NO. 96-16

RESOLUTION ESTABLISHING AND IMPLEMENTING
PRE-IRRIGATION TIERED WATER PRICING PROGRAM

WHEREAS, the Board of Directors of the Pacheco Water District (the "Board" and the "District," respectively) adopted resolutions 88-1 and 89-3, establishing tiered water charges; and

WHEREAS, since 1989 there have been significantly changed circumstances affecting the District's water supply and its management of drainage, including but not limited to the District's participation in the Grassland Bypass Project to utilize a portion of the San Luis Drain and new Basin Plan Amendments adopted by the Regional Water Quality Control Board, both of which impose selenium load reduction requirements; and

WHEREAS, the Board has been advised by its drainage consultants that the single most effective step it can take to reduce subsurface drainage is the prevention of excessive deep percolation, in particular in the pre-irrigation season; and

WHEREAS, the Board has considered that certain Pacheco Water District Pre-Irrigation Tiered Pricing Program, which is designed to provide district farmers with incentives to reduce excessive deep percolation by limiting the water available for irrigation of bare ground at the District's base water rate to .75 acre foot per acre, and pricing water over .75 acre foot per acre utilized for pre-irrigation at a higher rate.

NOW, THEREFORE, BE IT RESOLVED, AS FOLLOWS:

Section 1. The facts stated in the recitals above are true and correct, and the Board so finds and determined.

Section 2. The Board hereby adopts the Pacheco Water District Pre-Irrigation Tiered Pricing Program, effective immediately, as an emergency measure to reduce excessive deep percolation, as follows:

a. A pre-irrigation tier is hereby set at 9 inches, or 0.75 acre foot per acre. All water delivered to bare ground will be subject to the pre-irrigation tier.

b. All water delivered within the pre-irrigation tier on or before December 31, 1996, will be priced at the base rate fixed for the 1996 Fiscal Year, or $78.00 per acre foot, and all water delivered within the pre-irrigation tier after December 31, 1996, will be priced at the base rate fixed for the applicable fiscal year.

c. All water delivered to bare ground in excess of the pre-irrigation tier of 9 inches, or 0.75 acre foot per acre, will be priced at 1-1/2 times the applicable base rate for that fiscal year; prior to January 1, 1997, the pre-irrigation excess tier rate shall be $117 per acre foot.

Section 3. Resolutions 88-1 and 89-3 are hereby superseded and replaced with this Pacheco Water District Pre-Irrigation Tiered Pricing Program, and by such other and further Tiered Pricing Programs as the Board may adopt from time to time.

Section 4. This Resolution shall be effectively immediately.

PASSED AND ADOPTED this 16th day of October, 1996.

DAVID DERMER, PRESIDENT

ATTEST:

KEVIN JOHANSEN, SECRETARY

* * * *

I hereby certify that the foregoing is a true and correct copy of a resolution duly adopted by the PACHECO WATER DISTRICT, a California Water District, at an adjourned regular meeting of the Board of Directors duly called and held at the office of the District on the 16th of October, 1996.

KEVIN JOHANSEN, SECRETARY
PACHECO WATER DISTRICT

EXHIBIT 15

PACHECO WATER DISTRICT
SEEPAGE STUDY

LATERALS 3, 4, 5, 6,
& POND #7

Prepared For:

PACHECO WATER DISTRICT
52027 West Althea
Firebaugh, Ca 93622

Prepared By:

STODDARD & ASSOCIATES
CIVIL ENGINEERS
1120 West I Street, Suite C
Los Banos, California 93635

MARCH 2000

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PACHECO WATER DISTRICT
SEEPAGE STUDY

LATERALS 3, 4, 5, 6,
&
POND #7

I. OBJECTIVE

1. The purpose of this study is to quantify the water loss resulting from canal seepage throughout Lateral 3, Lateral 4, Lateral 5, Lateral 6, and Pond #7 in Pacheco Water District (the District) and to assess the viability of replacement of the earth channels with concrete ditch. A map of the study area can be found in Figure 1, Appendix A.

II. DATA ANALYSIS

1. Seepage tests were conducted on four test ponds by District employees, pursuant to guidelines given by Stoddard & Associates. The raw data supplied by the District can be found in Appendix B.

2. Unit seepage rates for each of the four test ponds were calculated based on the data supplied by the District. Two "calculated" unit seepage rates (short and long duration) were determined based on staff gage readings over a fixed time period and cross section geometry. "Metered" unit seepage rates were also computed based on the amount of water required to fill the canal to the original staff gage reading and the cross section geometry of the channel.

3. Water lost by evaporation during the test periods ranged from 0.02 to 0.08 inches per day as measured at the Los Banos CIMIS Station. This is less than 5% of the water lost during the tests and assumed negligible.

4. As seen on the USDA SCS soils map (Figure 2, Appendix A), the four laterals and Pond 7 lie over a variety of soil types including Deldota Clay (167), Woo Clay (280), Paver Clay Loam (229), and Lost Hills Clay Loam (Lf). These soils all have characteristically slow permeability rates (USDA, 1956; USDA, 1990). Test ponds were located such that individual unit seepage rates for soil types 280 and 229 were represented, as well as combined unit rates for soils types 280/229 and 229/167.

5. Due to the significant variability in wetted perimeters along each of the 4 laterals, District employees obtained cross-section data every half-mile. Cross section data were provided every 100 feet along Pond #7. These data were needed when applying the unit seepage rates to the entire lengths of the laterals.

6. The appropriate unit rates were applied to each lateral according to the soil types present, and the resultant was the total loss due to seepage per year in each lateral.

III. FINDINGS

1. The data from the seepage tests (Table 1, Appendix C) presents the lowest unit seepage rate in Test Pond #7 (43.0 ft^3/ft^2-yr; soil type 229), followed by Test Pond Lateral 5 (61.3 ft^3/ft^2-yr; soil type 229/280), then Test Pond Lateral 3 (95.2 ft^3/ft^2-yr; soil type 280), and finally Test Pond Lateral 6 (113.5 ft^3/ft^2-yr; soil type 229/167) with the highest unit seepage. The seepage rate for Pond #7 was adjusted to reflect an operating water level two feet higher than the water level during the seepage test.

2. Since there was no ponding test in soil type Lf, the unit rate for the adjacent soil type, 229, was assumed to be representative.

3. Assuming the ponds are in use 240 days out of the year, Lateral 3's annual seepage is estimated at 407 AF per year, Lateral 4 loses an estimated 47 AF per year, Lateral 5's annual seepage is 272 AF per year, Lateral 6's seepage was 387 AF per year, while Pond 7 was 37 AF per year. These results can be found in Column 1, Table 7, Appendix C.

IV. RECOMMENDATIONS

1. Installing concrete lined ditch to replace earthen water distribution systems is the most economical alternative to alleviate canal seepage. This process requires backfilling the existing canal with compacted fill prior to the construction of the new concrete ditch. Connection to any existing structures and pipes will also be a necessary project component. Construction cost estimates for the design and installation of the concrete lining for Lateral 3, Lateral 4, Lateral, 5, Lateral 6, and Pond #7 can be found in Appendix C, Table 2, 3, 4, 5, and 6 respectively. The project cost for Lateral 3 has been estimated at $380,982, Lateral 4 $98,346, Lateral 5 $396,931, Lateral 6 $509,869, and Pond 7 has been estimated at $154,750. As a result of Pond 7's short distance, the unit cost for the installation of the concrete ditch is much higher than that of the other four laterals. This cost is mainly attributed to mobilization of the equipment.

2. An analysis was performed to determine if the proposed concrete lining is cost effective, assuming the water conservation benefits to be only the savings in the cost of the water at current rates, a drainage water reduction benefit, and miscellaneous operating costs. The analysis does not include the benefit of the avoided cost of the conserved water on the open market. Annual costs resulting from the loss of supply water ($59.95/AF), drainage costs (estimated by the

District @ $70/AF), miscellaneous costs for bank and aquatic week control, and other miscellaneous operating costs associated with the earthen channels were estimated. The annual payment for the concrete ditch (assuming a life of 20 years and a 7% annual percentage rate) was then compared to the annual cost of water loss. Analysis of Lateral 3 yielded an annual savings of approximately $2,700 per year, while Lateral 4, 5, 6, and Pond 7 resulted in an added expenses of approximately $4,800, $11,700, $11,400, and $11,000 per year respectively. Benefit to cost ratios are 1.07:1 for Lateral 3, 0.49:1 for Lateral 4, 0.69:1 for Lateral 5, 0.76:1 for Lateral 6, and 0.24:1 for Pond 7. These calculations can be found in Appendix C, Table 7.

3. Under the stated assumptions, the analysis suggests that installing concrete lining in Lateral 3 is an economically viable alternative. The lining of Laterals 4, 5, 6, and Pond 7 demonstrate considerable added expense under the stated assumptions. However, anticipated increases in water cost, decrease in reliability of supply, the value of water on the open market, and the likely increase in drainage limitations also need to be considered when determining whether or not to pursue the lining projects. The District should give due consideration to these factors.

REFERENCES

United States. Department of Agriculture, Soil Conservation Service. Soils Survey of Merced County, California, Western Part. Washington: GPO, 1990.

United States. Department of Agriculture, Soil Conservation Service. Soil Survey, Mendota Area, California. Series 1940, No. 18. Washington: GPO, 1956.

FIGURES

1"=2000'

PACHECO WATER DISTRICT-SOILS MAP

REACHES INCLUDED IN THE STUDY

FIGURE 2

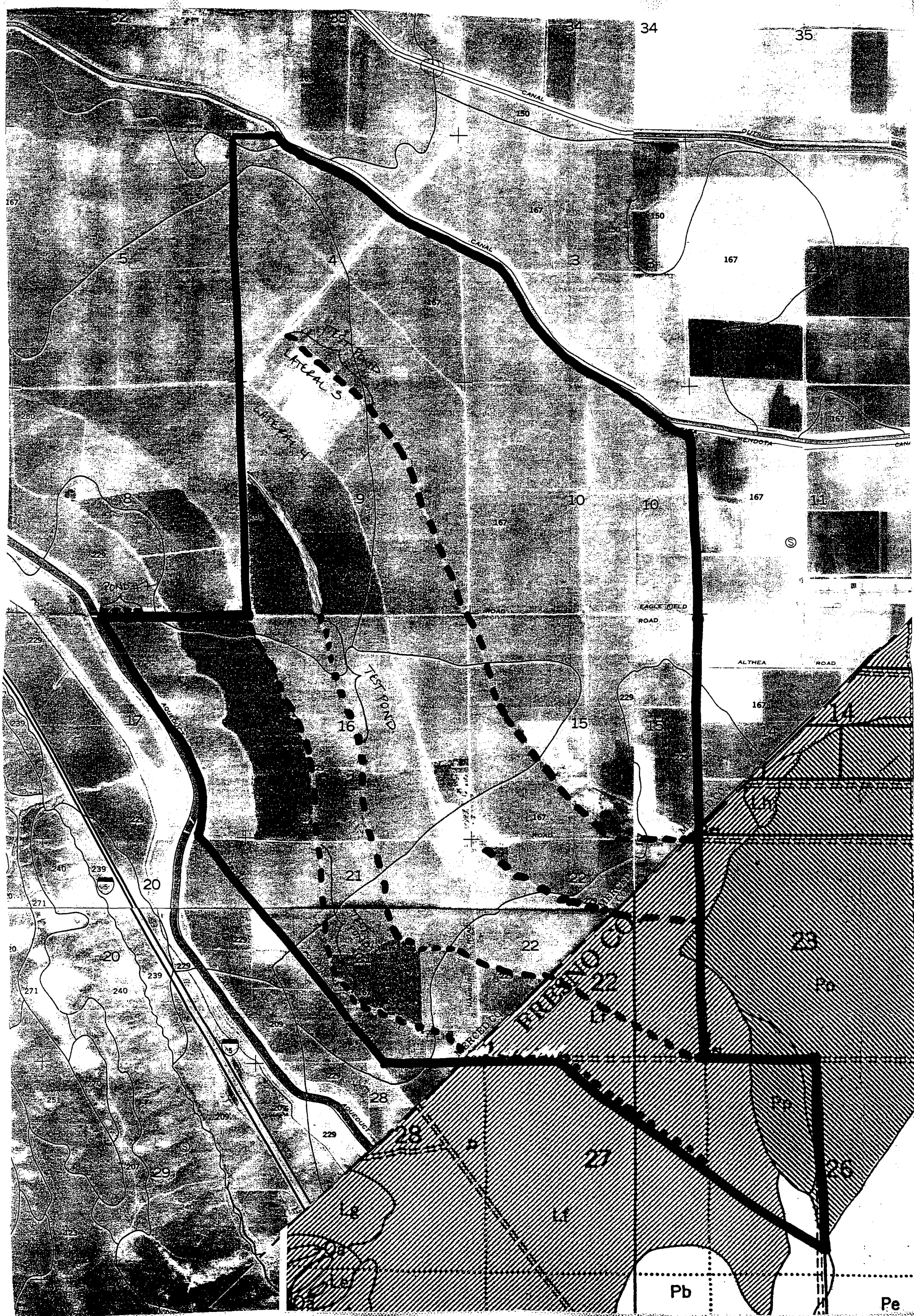
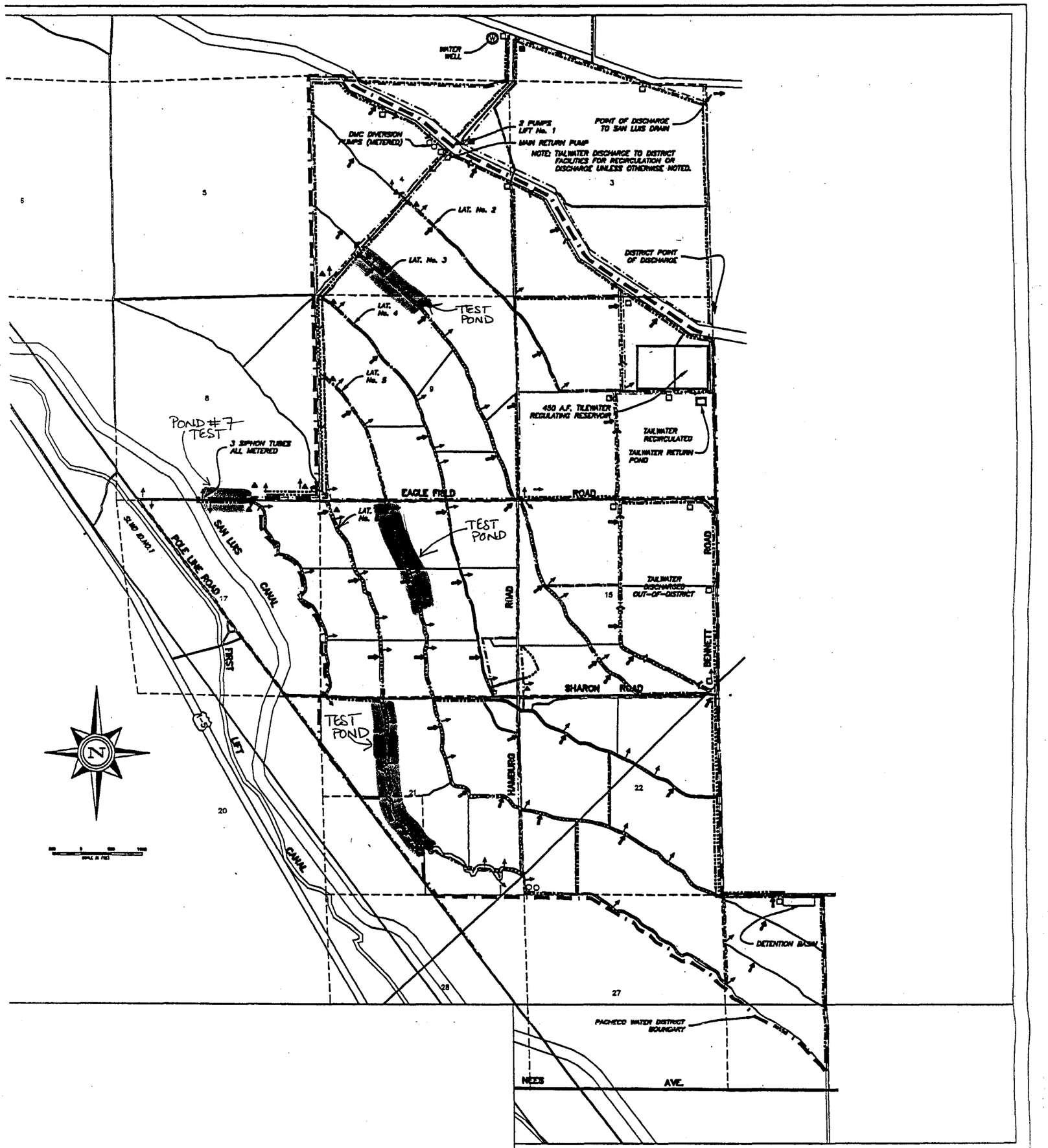


FIGURE 1



STODDARD & ASSOCIATES
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS

PACHECO WATER DISTRICT

WATER DISTRIBUTION AND DRAINAGE FACILITIES

JUNE 1999

RAW DATA

PACHECO WATER DISTRICT

Location: CATERAC #3

Before you begin the seepage test fill the canal to normal operating level for 2-3 days.

Pond Length: ~~775 ft x 14 ft W x 13" H~~ 2534 FT

Read staff gauge every 2 hrs for 8 hrs every day

date: 11/15/99

Fill pond to high mark, time: 7:50

Meter reading: 1024.67 1025.16

	time	gauge
1	7:50	5.20
2	9:50	5.14
3	11:50	5.12
4	1:50	5.11
5	3:50	5.02

520

date: 11-13-99

Fill pond to high mark, time: 5.44

Meter reading: 1025.16 1025.56 520

	time	gauge
1	6:46	4.80
2	8:46	5.22
3	10:46	5.18
4	12:46	5:14
5	2:46	5.10

4.08 low point before fill

date: 11/14/99

Fill pond to high mark, time: 5:32 5.20

Meter reading: 1025.79

	time	gauge
1	5:32	4.82
2	6:12	5.04
3	8:12	5.09
4	10:12	5.0
5	12:12	4.98

low point before fill

Fill pond to high mark, time: 6:30

Meter reading: 1026.12

	time	gauge
1	6:30	4.68
2	8:30	5.01
3	10:30	5.0
4	12:30	4.98
5	2:30	4.96

520 low point before fill

date: _____

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge
1		
2		
3		
4		
5		

date: _____

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge
1		
2		
3		
4		
5		

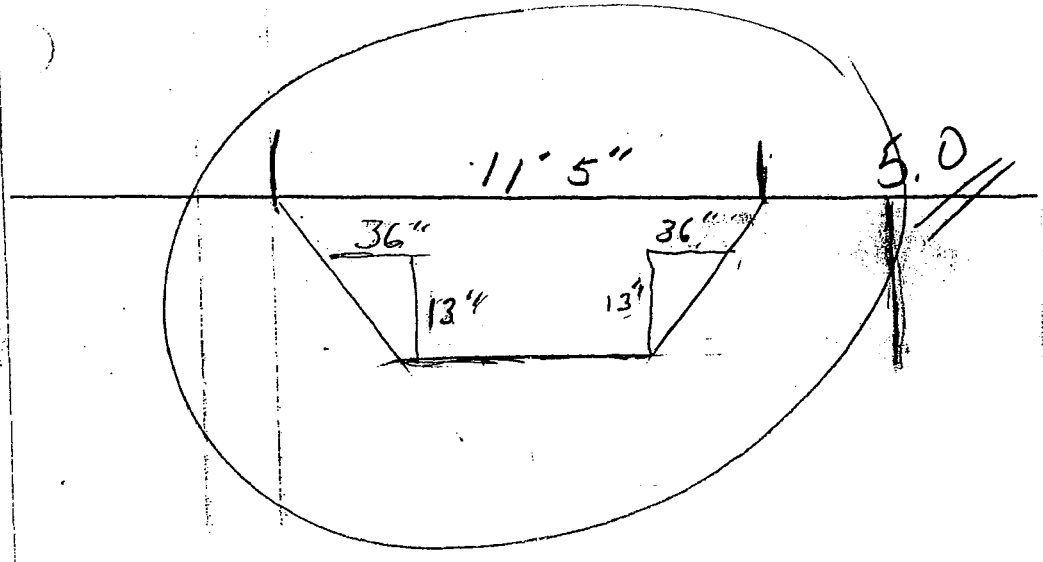
F:MH/SEEPAGE-TEST-FORM

LATERAL 3 TEST POND

D 302 Pachuco Water Dist

11-18-99

2534' Long



1/8/00 EVERY 1/2 MILE STARTING 1/2 MILE DOWNSTREAM

# 4	# 3
	8'
	TEST POND ↑ 8'
5'	5'
↑ 4"	
	10'
3'	↑ 6"
	5'
4'	8'
↑ 6"	↑ 4"
3'	5'
	8'
	↑ 12"
	4'
	8'
	↑ 9"
	5'
	6' 4"
	↑ 6"
	4'

PACHECO WATER DISTRICT

Location: LATERAL #5

Before you begin the seepage test fill the canal to normal operating level for 2-3 days.

Pond Length: ~~775 ft x 11 ft W x 13 H~~ 3000'

Read staff gauge every 2 hrs for 8 hrs every day

date: 12-8-99

Fill pond to high mark, time: 2:15 AM 4.50

Meter reading: 1027.29

	time	gauge
1	9:15	4.46
2	11:15	4.40
3	1:15	4.40
4	3:15	4:39
5		

date: 12-9-99

Fill pond to high mark, time: 7:05 4.50

Meter reading: 1027.29

	time	gauge	
1	6:45 AM	4.22	low point before fill
2	10:05	4.47	
3	12:05	4.44	
4	2:05	4.42	
5	4:05	4.40	

date: 12-10-99

Fill pond to high mark, time: 7:52 4.50

Meter reading: 1027.56

	time	gauge	
1	6:25	4.22	low point before fill
2	9:52	4.47	
3	11:52	4.45	
4	1:52	4.41	
5	3:52	4.39	

date: _____

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge
1	6:30	4.22
2		
3		
4		
5		

low point before fill

4.50

date: _____

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge
1		
2		
3		
4		
5		

date: _____

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge
1		
2		
3		
4		
5		

F:MH/SEEPAGE-TEST-FORM

296-01

EVERY ½ MILE STARTING ½ MILE DOWNSTREAM

1/19/00

5

13' 5"
↑ 22"
4'

TEST POND

11'
↑ 4"
5'

9
↑ 13"
4'

10'
↑ 13"
5'

8'
↑ 12"
4'

PACHECO WATER DISTRICT

Location: D 610 Lateral #6

Before you begin the seepage test fill the canal to normal operating level for 2-3 days.

Pond Length: ~~775 ft x 14 ft W x 13" H~~ 3,520 FT

Read staff gauge every 2 hrs for 8 hrs every day

11-5-99

1021.33

Fill pond to high mark, time: 7:30 AM

Meter reading: 1021.55

	time	gauge
1	7:30 AM	4.80
2	9:30	4.72
3	11:30	4.70
4	1:30	4.66
5	3:30	4.61

date: 11-8-99

1022.91

Fill pond to high mark, time: 8:00 AM 4.80

Meter reading: 1022.91

	time	gauge	
1	6:30	4.30	low point before fill
2	10:00	4.70	
3	12:00	4.66	
4	2:00	4.62	
5	4:00	4.58	

low point 4.30

11-9-99

date: _____

1021.55

Fill pond to high mark, time: 9:35 AM 4.80

Meter reading: 1022.07

	time	gauge	
1	7:00 AM	4.31	low point before fill
2	11:35	4.74	
3	1:35	4.70	
4	3:35	4.66	
5	5:35	4.62	

date: 11-7-99

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge	
1	10:00 AM	4.30	low point
2			
3			
4			
5			

date: _____

Fill pond to high mark, time: 7:20 AM 4.80

Meter reading: 1022.43

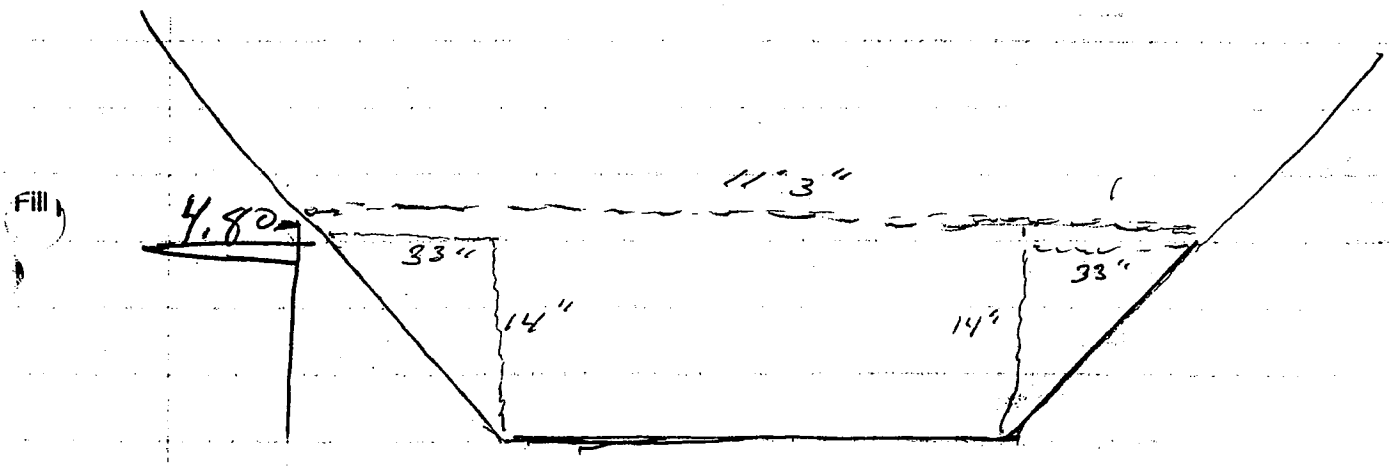
	time	gauge	
1	6:20 AM	4.38	low point before fill
2	9:20	4.70	
3	11:20	4.62	
4	1:20	4.60	
5	3:20	4.56	

Fill pond to high mark, time: _____

Meter reading: _____

	time	gauge
1		
2		
3		
4		
5		

LATERAL #6



3

EVERY 1/2 MILE STARTING 1/19/00 1/2 MILE DOWN.

6

17' 6"
22"
5'

14' 7"
22"
5' 7"

12' 7"
24'
5'

TEST POND

12'
15"
5'

14'
20"
6'

10' 5"
22"
4'

9'
19"
4'

PACHECO WATER DISTRICT

Location: #7 Pond

Before you begin the seepage test fill the canal to normal operating level for 2-3 days.

Pond Length: ~~775 ft x 14 ft W x 13" H~~ 790 x 31

Read staff gauge every 2 hrs for 8 hrs every day

12-16-99 H 5.70

date: 12-18-99

Fill pond to high mark, time: 10:50 AM

Fill pond to high mark, time: _____

Meter reading: 53229.6

Meter reading: _____

	time	gauge
1	10:50	5.71
2	12:50	5.70
3	2:50	5.68
4	4:50	5.65
5	6:50	5.64

	time	gauge	
1	8:00	5.56	low point before fill
2			
3			
4			
5			

date: 12-17-99

date: _____

Fill pond to high mark, time: 7:30 AM

Fill pond to high mark, time: _____

Meter reading: 53229.7

Meter reading: _____

H-Mark 5.72

	time	gauge	
1	6:50 AM	5.55	low point before fill
2	9:30	5.71	
3	11:30	5.70	
4	1:30	5.67	
5	3:30	5.66	

	time	gauge
1		
2		
3		
4		
5		

date: 12-18-99

date: _____

Fill pond to high mark, time: 7:30

Fill pond to high mark, time: _____

Meter reading: 53229.8

Meter reading: _____

H Mark 5.72

	time	gauge	
1	7:00	5.60	low point before fill
2	9:30	5.71	
3	11:30	5.69	
4	1:30	5.67	
5	3:30	5.66	

	time	gauge
1		
2		
3		
4		
5		

WATER ~~[illegible]~~ DEPTH = 3' INCREMENTS / Pacheco Water Dist

31' 2" – TOP WIDTH @ WATER SURFACE.

S. Side – EAST

1	12.5"	28"	43.25"	46.25"	57"	48.25	26.75	20"	
	(1.04)	(2.33)	(3.60)	(3.85)	(4.75)	(4.02)	(2.23)	(1.67)	

100°

31' 1"

2	19.25	41"	55"	75.25	70"	63"	51.75	38.75	32"
	(1.60)	(3.41)	(4.58)	(6.27)	(5.83)	(5.25)	(4.31)	(3.23)	(2.67)

31' 4"

3	3"	17"	34"	41"	43"	53"	65.5	63.75	45"	23.5
	(0.25)	(1.42)	(2.83)	(3.42)	(3.58)	(4.42)	(5.45)	(5.31)	(3.75)	(1.96)

27' 7"

4	19"	36"	36.75	59.25	62"	47.75	16.75	5"
	(1.58)	(3.0)	(3.06)	(4.94)	(5.17)	(3.98)	(1.40)	(0.42)

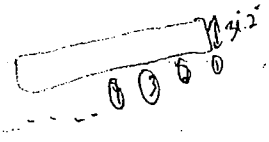
27' 8"

5	17"	31"	36.75	43.25	59.25	62"	47.75	16.25
	(1.4)	(2.58)	(3.06)	(3.60)	(4.94)	(5.17)	(3.98)	(1.35)

? TOP WIDTH?

6	27.25"	46"	66.75"	58.25"	37"	18.5"	15.25"	
	(2.27)	(3.83)	(5.57)	(4.85)	(3.08)	(1.54)	(1.27)	

~~#~~ 6	13,390'
# 5	15,980'
# 3	16.390'
Pond #7	900'



POND #7

TABLES

3/15/00

TABLE 1

PACHECO WD - SEEPAGE STUDY

	TEST POND SEEPAGE RATES PER LINEAR FOOT (ft^3/ft-hr)			TEST POND UNIT SEEPAGE RATES (ft^3/ft^2-yr)*			
	CALCULATED			CALCULATED			
	SHORT DURATION	LONG DURATION	METERED	SHORT DURATION	LONG DURATION	METERED	AVERAGE OF LONG DURATION & METERED
LATERAL 3							
TEST 1	0.25	0.19	0.31	122.0	92.7	151.3	—
TEST 2	0.12	0.17	0.17	58.6	83.0	83.0	—
TEST 3	0.35	0.21	0.23	170.8	102.5	112.3	—
TEST 4	0.32	NA	NA	156.2	NA	NA	—
AVERAGE (2,3,4)	0.26	0.19	0.20	128.5	92.7	97.6	95.2
LATERAL 5							
TEST 1	0.12	0.13	0.00	49.0	53.1	0.0	—
TEST 2	0.12	0.14	0.18	49.0	57.2	73.5	—
TEST 3	0.13	NA	0.14	53.1	NA	57.2	—
AVERAGE (2,3)	0.13	0.14	0.16	51.1	57.2	65.4	61.3
LATERAL 6							
TEST 1	0.26	0.21	0.27	126.9	102.5	131.8	—
TEST 2	0.25	0.22	0.23	122.0	107.4	112.3	—
TEST 3	0.32	0.22	0.26	156.2	107.4	126.9	—
TEST 4	0.30	0.22	NA	146.4	107.4	NA	—
AVERAGE (2,3,4)	0.29	0.22	0.25	141.6	107.4	119.6	113.5
POND #7 **							
TEST 1	0.34	0.38	0.36	53.3	59.9	56.5	—
TEST 2	0.23	0.24	0.31	36.1	38.2	48.6	—
TEST 3	0.23	0.23	NA	36.1	36.7	NA	—
AVERAGE (2,3)	0.23	0.24	0.31	36.1	37.5	48.6	43.0

* Yearly seepage rates are based on a 240 day year.

**These data were altered to reflect the actual operating water level, (2 feet higher than level during ponding test)

TABLE 2

PRELIMINARY CONSTRUCTION COST ESTIMATE

BY: S. FRETWELL *DATE:* 4-Jan-00 *DISTRICT:* PACHECO WATER DISTRICT
PROJECT: LATERAL 3 *Project Element:* CONCRETE DITCH LINING

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	INSTALLED UNIT COST	TOTAL INSTALLED COST	COST SUBTOTAL	COST TOTAL
1	COMPACTED FILL	16,390	L.F.	$ 6.29	$ 103,105		
2	CONCRETE DITCH	16,390	L.F.	$ 12	$ 196,680		
3	TIE IN TO EXISTING STRUCTURES				$ 5,000		
	SUBTOTAL					$ 304,785	
	Contingency, Engineering, etc. @ 25%					$ 76,196	
	ESTIMATED PROJECT COST						***$ 380,982***

TABLE 3

PRELIMINARY CONSTRUCTION COST ESTIMATE

BY: S. FRETWELL *DATE:* 4-Jan-00 *DISTRICT:* PACHECO WATER DISTRICT
PROJECT: LATERAL 4 *Project Element:* CONCRETE DITCH LINING

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	INSTALLED UNIT COST	TOTAL INSTALLED COST	COST SUBTOTAL	COST TOTAL
1	COMPACTED FILL	5,280	L.F.	$ 2.43	$ 12,817		
2	CONCRETE DITCH	5,280	L.F.	$ 12	$ 63,360		
3	TIE IN TO EXISTING STRUCTURES				$ 2,500		
	SUBTOTAL					$ 78,677	
	Contingency, Engineering, etc. @ 25%					$ 19,669	
	ESTIMATED PROJECT COST						***$ 98,346***

TABLE 4

PRELIMINARY CONSTRUCTION COST ESTIMATE

BY: S. FRETWELL *DATE:* 4-Jan-00 *DISTRICT:* PACHECO WATER DISTRICT
PROJECT: LATERAL 5 *Project Element:* CONCRETE DITCH LINING

ITEM NO.	DESCRIPTION		QUANTITY	UNITS	INSTALLED UNIT COST	TOTAL INSTALLED COST	COST SUBTOTAL	COST TOTAL
1	COMPACTED FILL		15,980	L.F.	$ 7.56	$ 120,785		
2	CONCRETE DITCH		15,980	L.F.	$ 12	$ 191,760		
3	TIE IN TO EXISTING STRUCTURES					$ 5,000		
	SUBTOTAL						$ 317,545	
	Contingency, Engineering, etc. @	25%					$ 79,386	
	ESTIMATED PROJECT COST							***$ 396,931***

TABLE 5

PRELIMINARY CONSTRUCTION COST ESTIMATE

BY: S. FRETWELL *DATE:* 4-Jan-00 *DISTRICT:* PACHECO WATER DISTRICT
PROJECT: LATERAL 6 *Project Element:* CONCRETE DITCH LINING

ITEM NO.	DESCRIPTION		QUANTITY	UNITS	INSTALLED UNIT COST	TOTAL INSTALLED COST	COST SUBTOTAL	COST TOTAL
1	COMPACTED FILL		18,390	L.F.	$ 9.91	$ 182,215		
2	CONCRETE DITCH		18,390	L.F.	$ 12	$ 220,680		
3	TIE IN TO EXISTING STRUCTURES					$ 5,000		
	SUBTOTAL						$ 407,895	
	Contingency, Engineering, etc. @	25%					$ 101,974	
	ESTIMATED PROJECT COST							***$ 509,869***

TABLE 6

PRELIMINARY CONSTRUCTION COST ESTIMATE

BY: S. FRETWELL *DATE:* 4-Jan-00 *DISTRICT:* PACHECO WATER DISTRICT

PROJECT: POND # 7 *Project Element:* CONCRETE DITCH LINING

ITEM NO.	DESCRIPTION		QUANTITY	UNITS	INSTALLED UNIT COST	TOTAL INSTALLED COST	COST SUBTOTAL	COST TOTAL
1	COMPACTED FILL		900	L.F.	$ 67.00	$ 60,300		
2	CONCRETE DITCH		900	L.F.	$ 65	$ 58,500		
3	TIE IN TO EXISTING STRUCTURES					$ 5,000		
	SUBTOTAL						$ 123,800	
	Contingency, Engineering, etc. @	25%					$ 30,950	
	ESTIMATED PROJECT COST							***$ 154,750***

$75.80 OSBK
$63.00 CCID

TABLE 7

3/14/00

PACHECO WD - SEEPAGE STUDY

	EARTHEN DITCH							CONCRETE DITCH	
	YEARLY SEEPAGE @ 240 DAYS (AF)	ANNUAL WATER COST @ $59.95/AF	ANNUAL DRAINAGE COST 50% @$70/AF	ANNUAL OPERATING COST	TOTAL ANNUAL COST	PRESENT VALUE n=20 % = 0.07		TOTAL CAPITAL COST	ANNUAL PAYMENT n=20 % = 0.07
LATERAL 3	407	$24,373	$14,229	$2,000	$38,602	$408,953		$380,982	$35,962
LATERAL 4	47	$2,847	$1,662	$1,000	$4,510	$47,776		$98,346	$9,283
LATERAL 5	272	$16,302	$9,517	$2,000	$25,819	$273,528		$396,931	$37,467
LATERAL 6	387	$23,180	$13,533	$2,000	$36,713	$388,942		$509,869	$48,128
POND # 7	37	$2,243	$1,310	$1,000	$3,553	$37,642		$154,750	$14,607
	1.5D								

BENEFIT COST RATIO:

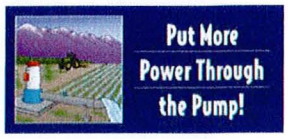
LATERAL 3=	1.07 TO 1
LATERAL 4=	0.49 TO 1
LATERAL 5=	0.69 TO 1
LATERAL 6=	0.76 TO 1
POND 7=	0.24 TO 1

EXHIBIT 16

Pacific Gas and Electric Company®

Advanced Pumping Efficiency Program

Helping California...



Policies and Procedures Manual

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The information in this Policies and Procedures manual is current as of January 6, 2011. The Advanced Pumping Efficiency Program (APEP) may be modified or terminated at any time. Please contact the main APEP Program Office for up-to-date information, especially if you are applying for an incentive for a pump retrofit/replacement project. The APEP Program Office can be contacted by calling toll free, 1 (800) 845-6038. You may also log on to the APEP web site at www.pumpefficiency.org for more information and a knowledge-base for pumping efficiency.

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IMPORTANT!
California consumers are not obligated to purchase any full fee service or other service not funded by this program. This program is funded by California utility ratepayers under the auspices of the California Public Utilities Commission.

Los consumidores en California no estan obligados a comprar servicios completos o adicionales que no esten cubiertos bajo este programa. Este programa esta financiado por los usuarios de servicios públicos en California bajo la jurisdiccion de la Comisión de Servicios Públicos de California.