Chapter 12

Near-Term Salt Management Strategies and Implementation Plan

Chapter 12

Chapter 12

Near-Term Salt Management Strategies and Implementation Plan

12.1 Introduction

Chapter 9 presented 15 salt management strategies designed for year 2010 conditions based on several criteria including the ability to fully offset year 2010 projected salt loading of 5,400 tons/year. Of all the strategies only Strategy 15, a combination of conjunctive use and 5,000 AF of high TDS shallow groundwater wellhead demineralization (WHD), successfully passed all the feasibility screening criteria (Section 9.6). More detailed modeling analysis (Chapter 10) confirmed that Strategy 15 would provide the projected benefits to groundwater and delivered water quality.

Zone 7 staff, in consultation with the GAMC and TAG, decided in early 1999 to develop a revised set of salt management strategies that could be implemented near-term (defined as year 2000-2002) versus in 2010. These near-term strategies were based on those previously identified and screened as feasible for 2010 conditions (Section 9.6) but were scaled down for current 2,200 tons/year loading conditions. Letter suffixes (e.g., 15A) are used to differentiate variations on the same basic strategy.

Several additional 2010 strategies had also passed all the feasibility screens (technical, timing and water quality) except for public and institutional acceptability. If varying degrees of regulatory and/or perception barriers could be overcome, at least some of these strategies could also potentially be implemented sooner than 2010. A selected group of what appeared to be the more promising of these strategies were also scaled down to current 2,200 tons/year loading conditions and called potential near-term strategies (Section 12.3).

The unit O&M costs and salt removal capability assumptions used to develop these near-term strategies were the same as described in detail in Section 8.14. Table 12.1 and Figure 12.1 (as first presented in Chapter 8) are reproduced here for reference when reviewing the near-term and potential near-term strategies presented in this chapter.

From the set of near-term strategies, Zone 7 staff, in consultation with the TAG and GMAC, developed a recommended near-term implementation plan (Section 12.4). That plan included recommended policy goals and a three-year phased implementation of increased conjunctive use, wellhead demineralization, and potential demonstration scale

Table 12.1

INDIVIDUAL SALT MANAGEMENT STRATEGIES
UNIT O&M COSTS AND REMOVALS PER 1,000 AF

Salt Management Strategy	O&M Costs to Implement 1,000 AF	Unit O&M Cost Components (*)	Gross Salt Removed (tons/TAF)	Net Salt Removed (tons/TAF)	Net Salt Removal Cost ($/ton)
I. Conjunctive Use (450 mg/L pumpage)					
A. Stream recharge (250 mg/L untreated)	$40,000	(1-2)	270	200	$200
B. Well recharge (250 mg/L treated)	$60,000	(1)	270	200	$300
II. RO Recycled water (to 100 mg/L)					
A. RO Stream recharge or Injection	$60,000	(1)	480	410	$146
III. Wellhead Demineralization					
A. Shallow wells (1,000 to 100 mg/L)	$444,000	(3+4+6)	1220	1000	$444
B. Deep wells (450 to 100 mg/L)	$444,000	(3+4+6)	470	250	$1,776
IV. Seasonal Groundwater Export to Creeks					
A. Army wells (1,000 mg/L)	$110,000	(5+6)	1360	1020	$108
B. Bernal (800 mg/L)	$110,000	(5+6)	1090	750	$147
C. Dublin (1,000 mg/L)	$110,000	(5+6)	1360	1020	$108
D. Excess mining pumpage (600 mg/L)	$110,000	(5+6)	820	470	$234
E. Basin outflow (700 mg/L)	$70,000	(6)	950	610	$115
v. Continuous Groundwater export on arroyos by Zone 7					
A. Zone 7 export on AV (500 mg/L)* * *	$290,000	(1.5(1)+7))	680	340	$853
B. Zone 7 export on AM (500 mg/L)* * *	$260,000	(1+7)	680	340	$765

AF = Acre-feet
GW = Groundwater
SW = Surface water
TAF = Thousand AF
O&M = Operations & Maintenance
RO = Reverse Osmosis

(*) Unit O&M Costs

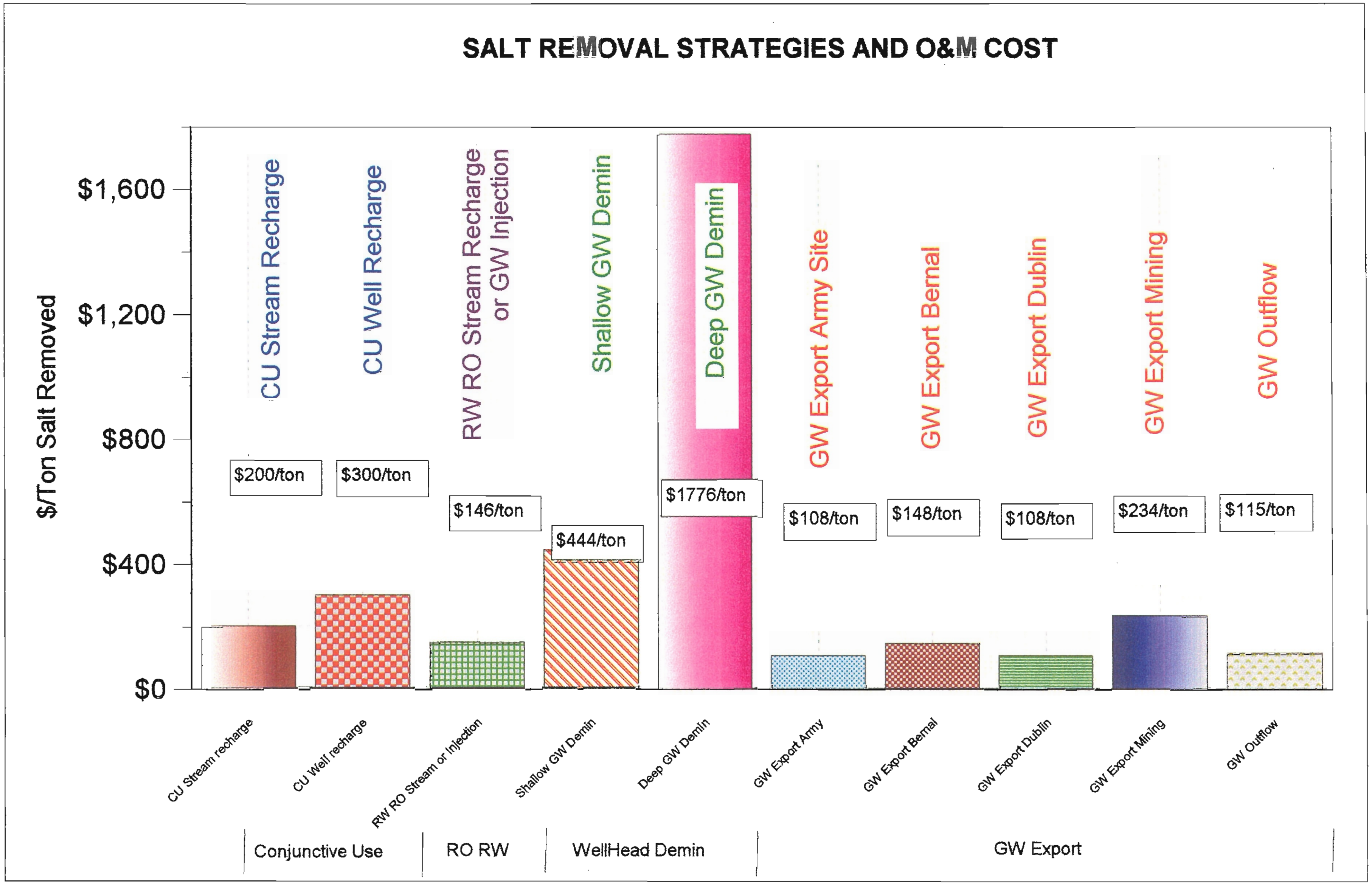
Description	$/AF
1. GW Pumping	$60
2. SW Treatment Plant	$20
3. Reverse Osmosis	$400
4. Brine Disposal Cost	$30 (**)
5. Shallow GW Pumping	$40
6. Replacement Water	$70
7.Estimated Annual Entitlement paymen	$200

(**) $150/AF LAVWMA pumping cost & 0.2 AF brine production and 0.2 AF replacement water per 1 AF demin.

(***) The cost does not include the conveyance capacity cost and entitlement purchase cost.

Net removal reflects replacement water TDS and pumpage/ salts reapplied over main basin.

FIGURE 12.1



06/26/02

RO recycled water stream recharge. The plan also identified how annual salt management decisions would be made via an adaptive management process and integrated into Zone 7's existing Annual Operations Plans.

This chapter concludes (Section 12.5) with a discussion of recommended next steps towards selecting strategies and cost allocation measures to address future salt loading, and towards facilitating implementation of potential near-term strategies such as seasonal groundwater export.

12.2 Near-Term Salt Management Strategies

From the 2010 strategies (Chapter 9), Zone 7 staff developed seven near-term salt management strategies that were believed feasible to begin to implement during the 2000-2002 time period (Table 12.2). Values in Table 12.2 were calculated as if the strategies were to be implemented under projected year 2000 loadings, treated water deliveries, and costs (see Table 12.2 footnotes).

For example, Strategy 5A in Table 12.2 is a scaled down version of Strategy 5 listed in Table 9.1 for 2010 conditions. Strategy 15A for year 2000 is derived from Strategy 15 for 2010 conditions. Therefore, most of the assumptions applicable to strategies 5 and 15 are also applicable to strategies 5A and 15A. None of the strategies presented in Table 12.2 for the 2000-2002 period include any demineralized recycled water injection.

These seven individual and composite year 2000 strategies are compared in figures 12.2 and 12.3. Figure 12.2 presents four parallel series of bar charts. The first (uppermost) bar chart series presents the surface water to groundwater volume ratio of Zone 7 deliveries under each of the seven strategies. The second graph presents each strategy's resultant minimum and maximum monthly average TDS (of the 12 monthly averages), and the overall annual average TDS of Zone 7 deliveries (i.e., three bars per strategy). The third graph presents the annual average salt loading (in tons) remaining after implementation of each strategy. The fourth (bottom) graph presents the incremental O&M cost per acre-foot of Zone 7 deliveries (i.e., increase in treated water rates attributable to salt management).

One of the recommended salt management goals from Chapter 7 was to equalize delivered water quality to all retailers to the greatest extent practicable. Figure 12.3 compares the annual average TDS of Zone 7 deliveries to individual retailers under Status Quo operations (Strategy 1A) versus under two recommended composite strategies. Each near-term strategy shown in Figures 12.2 and 12.3 is described below.

Table 12.2
NEAR TERM SALT MANAGEMENT STRATEGIES

STRATEGY NO.	NAME	POLICY OPTION	NET SALT LOADING TONS/YR	NET INCREASE IN GW TDS mg/l/year	Projected GW TDS after 10 yrs mg/l	TDS OF ZONE 7 DELIVERIES mg/l	ZONE 7 INCREMENTAL OPERATIONAL COSTS PER YEAR	PER ACRE-FOOT OF TW DELIVERY	% Rate Increase
		Long - Term Average							
Status Quo 1A	Year 2000 Status Quo (no demineralized RW injection)	I	2200	7	520	300	$0	$0	0.0%
Conj. Use 5A	Minimum Conjuctive Use 3000 AF (Stoneridge well - no GW demin)	II	1600	5	500	310	$120,000	$4	0.8%
6A	Major Conjuctive Use 11,000 AF (zero out salt balance)	III	0	0	450	350	$680,000	$20	3.8%
Wellhead Demin 15A	2200 AF Demin GW Pumpage (1000 mg/L to 100 mg/L)	III	0	0	450	280	$976,800	$29	5.5%
COMPOSITE OF 5A AND 15A	Minimum Conjuctive Use (3000 AF/Y) and 1500 AF/Y Demin GW PUMPAGE	III	0	0	450	300	$786,000	$23	4.4%
COMPOSITE OF 5A, 15 A AND 17A (17A Ref. Table 12.2)	Minimum Conjuctive Use (3000 AF/Y) and 1300 AF/Y Demin GW PUMPAGE 840 AF (Livermore) RW RO Stream Recharge	II	0	0	450	300	$714,000	$21	4.0%
6A PLUS 15A	Major Conjuctive Use (11000 AF/Y) and 2200 AF/Y Demin GW PUMPAGE	IV	-2100	-7	380	330	$1,656,800	$49	9.3%

Assumptions:

1) *Zone 7 TW delivery of 33,500 AF and UTW of 7300 AF (Year 2000)*
2) *Base TW rate of $528 / AF for year 1999.*
3) *Incremental cost spread only to Zone 7 Treated water deliveries.*
4) *GW TDS of 450 mg/l and SW TDS 270 mg/l (Historic average at PPWTP)*
5) *GW Demin capacity at 2200 AF/Y (180 af/ month for 12 months)*

Status Quo (Strategy 1A)

The first (left most) bar shown on each of the series of graphs in figures 12.2 and 12.3 represents the Status Quo strategy, defined as continuing with historic basin management operational criteria. Under this strategy, Zone 7's annual average deliveries would be a blend of about 85% surface water and 15% groundwater. The annual average TDS of Zone 7's blended deliveries would be about 300 mg/l. The annual average salt loading to the main basin would remain at about 2,200 tons. Since it does not require any changes in operations, there would be no incremental costs.

Net Result: This strategy minimizes operational costs but it fails to achieve the other salt management plan goals.

Minimum Conjunctive Use (Strategy 5A)

The second bar from the left shown on Figure 12.2 represents the minimum conjunctive use with no wellhead demineralization strategy (5A in Table 12.2). Under this strategy the annual average groundwater pumpage volume would be 3,000 AF more than under the Status Quo and Zone 7's annual average deliveries would be a blend of about 75% surface water and 25% groundwater. The annual average TDS of Zone 7's blended deliveries would be about 10 mg/l higher than under the Status Quo. The annual average salt loading to the main basin would be reduced to about 1,500 tons. The incremental operational cost would be about \$4/AF of Zone 7's treated water deliveries or \$2/household/year (assuming 0.5 AF/household/year usage).

Net Result: This strategy reduces the salt loading by about 700 tons/year (31%) but it increases the annual average TDS of Zone 7 deliveries by about 3%. The 0.8% incremental operational cost is minimal relative to the 1999 treated water rate of \$528/AF.

Major Conjunctive Use (Strategy 6A)

The third bar from the left shown on Figure 12.2 represents the major conjunctive use with no wellhead demineralization strategy (6A in Table 12.2). Under this strategy the annual average groundwater pumpage volume would be 11,000 AF more than under the Status Quo and Zone 7's annual average deliveries would be a blend of about 52% surface water and 48% groundwater. The annual average TDS of Zone 7's blended deliveries would be about 50 mg/l higher than under the Status Quo. Net annual average salt loading to the main basin would be essentially eliminated. The incremental annual operational cost would be about \$20/AF of Zone 7's treated water deliveries or \$10/household/year. This strategy achieves the salt neutral, zero net loading goal (Fundamental Policy III in Chapter 7), but does not meet the goals of maintaining/improving and equalizing east/west delivered water quality.

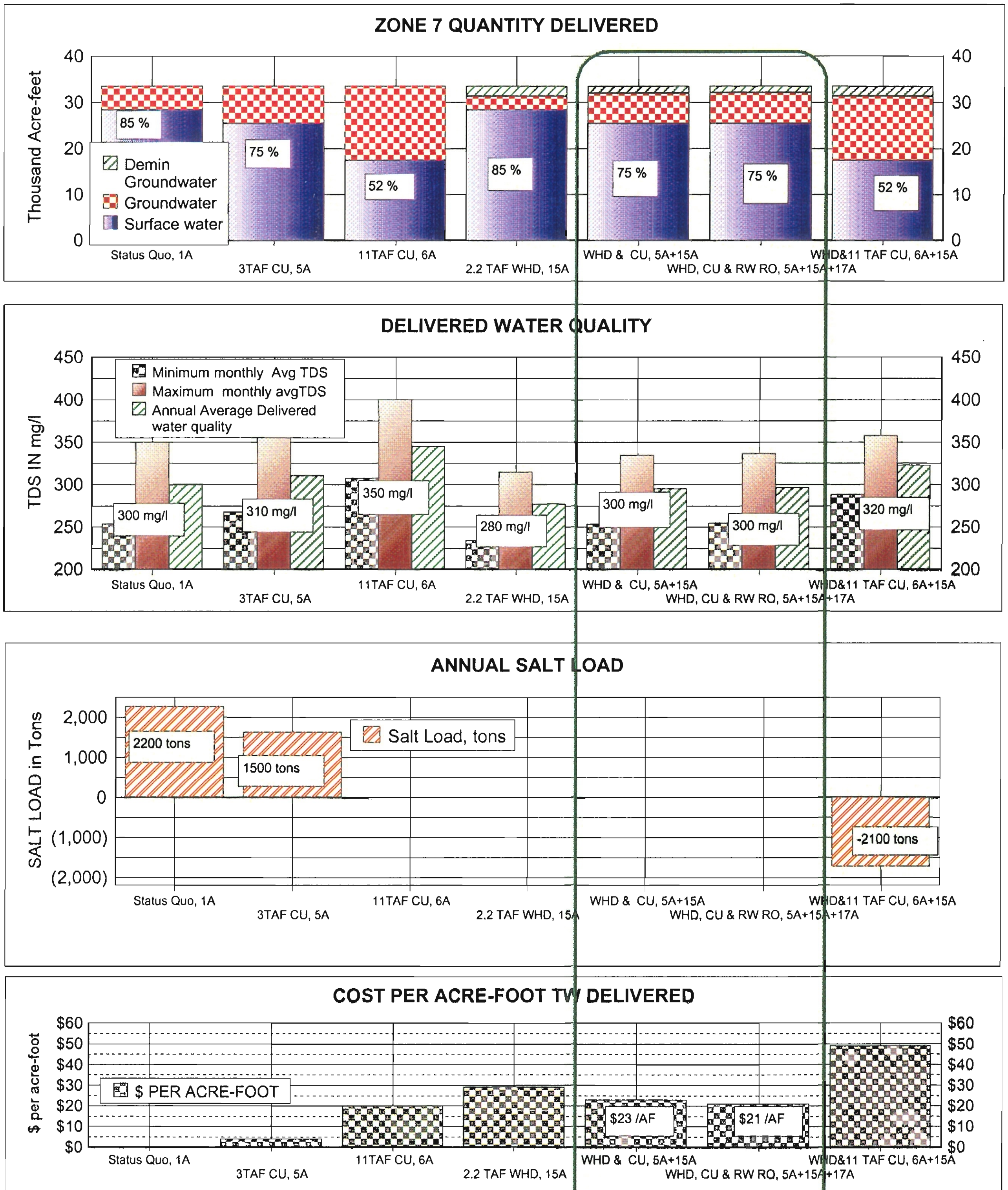
Net Result: This is the minimum cost strategy that is salt neutral. It would significantly increase the TDS of Zone 7 deliveries, particularly to the west side of the valley contrary to other salt management goals.

Wellhead Demineralization (Strategy 15A)

The fourth bar from the left shown on Figure 12.2 represents the high TDS shallow groundwater wellhead demineralization (wellhead RO) strategy (15A in Table 12.2). Under this salt neutral strategy the annual average groundwater pumpage volume would be the same as under the Status Quo and Zone 7's annual average deliveries would remain a blend of about 85% surface water and 15% groundwater. About 2,200 AF/year of groundwater would be pumped from new high TDS shallow wells and demineralized from the ambient level of about 1,000 mg/L to 100 mg/L. The low TDS demineralized water would be delivered to the distribution system near the Mocho and/or Hopyard well fields and blended in-line with other higher TDS groundwater to chemically neutralize the low TDS/alkalinity water and yield a TDS equivalent to that provided elsewhere in the Zone 7 distribution system.

Figure 12.2

COMPARISON OF STRATEGIES FOR 2000-2002 IMPLEMENTATION



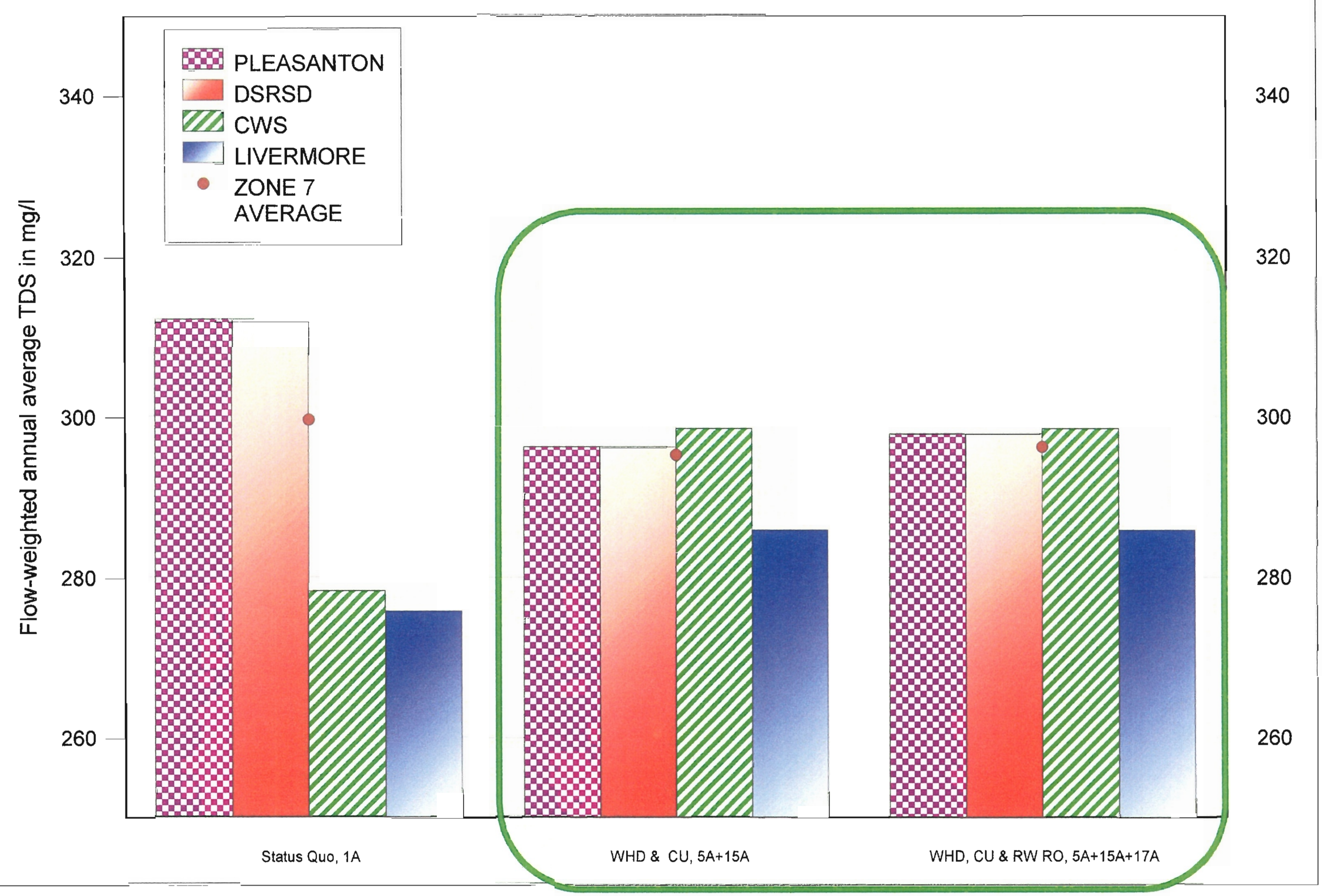
CU = CONJUNCTIVE USE, WHD= WELL HEAD DEMINERALIZATION
RW RO= RECYCLED WASTE WATER RO, PENDING PUBLIC ACCEPTANCE
AF= ACRE-FEET, TAF=THOUSAND ACRE-FEET

Most economical that meet salt loading and delivered water TDS goals.

RECOMMENDED STRATEGIES

Figure 12.3

Annual Average TDS Delivered to Retailers
Under Historic and Proposed 2000-2002 Operating Conditions



NOTE:

1) Assuming that 75% of the time the Stoneridge pumpage will be diverted to East (to CWS & Livermore) by closing rate control valve in X-valley pipeline.

2) Assuming that all the other GW pumpage (GW, WHD & ASR) is delivered to Pleasanton and DSRSD (prorated by delivery amount) .

3) Assumes Stoneridge pumpage at 400 mg/l and all other Zone 7 pumpage at 450 mg/l, Well Head Demineralization to 100 mg/l.

Figure 12.3

As described in Chapter 8, for this strategy to be viable, it has been assumed that institutional arrangements could be worked out whereby concentrated brine would be exported to the Bay via the LAVWMA/EBDA pipelines and outfall. The annual average TDS of Zone 7's blended deliveries under Strategy 15A would be about 20 mg/l lower than under the Status Quo. The incremental operational cost would be about $29/AF of Zone 7's treated water deliveries or $14.50/household/year.

Net Result: This is a salt neutral strategy that would also decrease the TDS of blended Zone 7 deliveries particularly to the western side of the valley. It is the highest cost of the near-term salt neutral strategies.

Composite of Minimum Conjunctive Use and Wellhead Demineralization (Composite of Strategies 5A and 15A)

The fifth bar from the left shown on Figure 12.2 and the middle bar cluster shown on Figure 12.3 represent the composite strategy of 3,000 AF/year conjunctive use and 1,500 AF/year shallow groundwater wellhead demineralization (wellhead RO). Under this strategy the annual average groundwater pumpage volume is 3,000 AF higher than under the Status Quo and Zone 7's annual average deliveries would be a blend of about 75% surface water and 25% groundwater. About 1,500 AF (versus 2,200 AF for Strategy 15A alone) of new shallow groundwater pumpage would be demineralized from 1,000 mg/l to 100 mg/l, blended in-line and delivered to customers as under Strategy 15A. Concentrated brine is similarly assumed to be exported via LAVWMA.

The incremental annual operational cost would be about $23/AF of Zone 7's treated water deliveries or about $11.50/household/year. Under this salt neutral strategy the annual average TDS of Zone 7's blended deliveries would be about the same as under the Status Quo. However, it would moderately decrease the TDS of deliveries to the west side of the valley and thereby help equalize the TDS of deliveries to retailers (Figure 12.3). It does not require any significant additional facilities other than those previously planned and budgeted for in the Zone 7 capital improvement program. This composite strategy approach does not preclude the use of other more cost-effective strategies if they become available (e.g., seasonal groundwater export). Other strategies could be incorporated by reducing the volume of groundwater demineralized. This issue is addressed in more detail in the Section 12.5 discussion of SMP adaptive management.

Net Result: This is the most economical near-term strategy that satisfies all the salt management criteria.

Composite of Minimum Conjunctive Use, Wellhead Demineralization and RO Recycled Water Stream Recharge (Composite of Strategies 5A, 15A and 17A)

The sixth bar from the left on Figure 12.2 and the third cluster from the left on Figure 12.3 represent the composite strategy of 3,000 AF of conjunctive use, 1,300 AF of wellhead demineralization and 840 AF/year of Livermore RO recycled water stream recharge (during summer months only) in the Arroyo Mocho near Isabel Avenue. The 840 AF/year represents the maximum production of the existing Livermore 0.75 mgd RO facility. Recharge of this full amount assumes temporary winter storage of about half this volume (e.g., in Chain of Lakes Lake G).

This salt neutral composite strategy is similar to the previous one (5A plus 15A) except that about 300 tons/year of salt removal would be provided by the RO recycled water stream recharge (Strategy 17A), replacing 200 AF/year of the higher unit cost wellhead demineralization. Costs would therefore be slightly less, about $21/AF versus $23/AF of Zone 7's treated water deliveries.

In September 1998, the Zone 7 Board passed a resolution regarding DSRSD's CWR project requiring demonstrated public acceptance prior to supporting any RO recycled water injection projects. Following this resolution, staff from Zone 7, DSRSD and Livermore started investigating alternative strategies to make use of demineralized recycled water. One of the several alternatives investigated was to augment the existing artificial stream recharge on the Arroyo Mocho with demineralized recycled water produced by the Livermore and/or DSRSD RO plants. (This RO stream recharge strategy and its potential riparian corridor environmental enhancement benefits plus a "phased injection" alternative are described in more detail in SMP Section 8.9).

Strategy 17A is presented as a standalone "potential near-term" project in Section 12.3 and Table 12.4. It is included here as part of this near-term composite strategy since RO recycled water stream recharge was perceived to be potentially more acceptable to the public than direct injection into the basin. Some of the perceived positive attributes include the additional treatment "barrier" provided by streambed percolation, the potential environmental enhancement benefits resulting from the release to the Arroyo, the demonstration scale size of the project, and the availability of an existing recycled water pipeline extending from the Livermore facility south along Isabel Avenue to the Arroyo Mocho.

Net Result: This strategy could satisfy all the salt management criteria and would be slightly less expensive compared to the previous composite strategy (5A and 15A). If the RO recycled water stream recharge component did not occur or were delayed, the amount of wellhead demineralization included would need to be increased 200 AF/year and this strategy would effectively become the same as the prior strategy.

Composite of Major Conjunctive Use and Wellhead Demineralization (Composite of 6A and 15A)

The seventh bar from the left shown on Figure 12.2 represents the composite strategy of 11,000 AF/year of conjunctive use plus 2,200 AF/year of wellhead demineralization. This strategy was included since it uses the estimated maximum available stream recharge capacity and the maximum estimated wellhead demineralization facility design capacity. Under this strategy the annual average groundwater pumpage volume is 11,000 AF higher than under the Status Quo and Zone 7's annual average deliveries would be a blend of about 52% surface water and 48% groundwater. About 2,200 AF of shallow groundwater pumpage would be demineralized, blended in-line, and delivered primarily to customers in the western portion of the valley. The demineralization brine is assumed to be exported via LAVWMA.

This strategy would reverse the annual average salt loading to the main basin to about 2,100 tons. However, the annual average TDS of Zone 7's blended deliveries would be about 330 mg/L or 30 mg/l higher than under the Status Quo. The incremental operational cost would be about $49/AF of Zone 7's treated water deliveries or $24.50/household/year.

Net Result: Groundwater quality would improve most rapidly under this strategy but delivered water quality would degrade. This was the highest cost near-term strategy evaluated.

12.3 Potential Near-Term Strategies

Several year 2010 strategies passed all the feasibility screens (technical, timing and water quality) except for public and institutional acceptability. If various non-technical barriers could be overcome, at least some of these could potentially be implemented near-term (see screening discussion in Section 9.6). A selected group of these 2010 strategies, scaled down for current 2,200 tons/year loading conditions, are presented here as "potential" near-term strategies. Some of the individual strategies have limited salt removal capabilities and would need to be used in conjunction with other strategies to fully offset existing salt loading (i.e., a composite strategy).

Table 12.3 summarizes the key statistics for 11 potential near-term salt management strategies based on: a CalFed Delta Fix, RO recycled water injection, seasonal groundwater export, Lake G recycled water storage and irrigation, and RO recycled water stream recharge. The relative performance of seven selected individual and composite potential near-term strategies are compared in four parallel series of comparative bar charts (Figure 12.4).

As described above and similar to Figure 12.2, the first bar chart presents the surface water to groundwater ratio of Zone 7 deliveries. The second graph presents each strategy's resultant average monthly minimum, maximum and annual average Zone 7 delivered water TDS in mg/L. The third graph presents the annual average salt loading in tons after implementation of each strategy. The fourth graph presents the incremental O&M cost per acre-foot of Zone 7 deliveries (i.e., increase in treated water rates attributable to salt management).

Table 12.3
POTENTIAL NEAR-TERM SALT MANAGEMENT STRATEGIES

		Long - Term Average							
			NET SALT LOADING TONS/YR	NET INCREASE IN GW TDS mg/l/year	Projected GW TDS after 10 yrs mg/l	TDS OF ZONE 7 DELIVERIES mg/l	ZONE 7 INCREMENTAL OPERATIONAL COSTS		
STRATEGY NO.	NAME	POLICY OPTION					PER YEAR	PER ACRE-FOOT OF TW DELIVERY	% Rate Increase
2	DELTA FIX 100 mg/l SBA water quality	III	0	0	450	160	$0	$0	0.0%
RO RW INJECTION 11D	3640 AF RO RW Injection & 500 AF RO GW Pumpage (1000 mg/L to 100 mg/L)	III	0	0	450	310	$440,400	$13	2.5%
GW Export 13B	2000 GPM GW Pumpage (1000 mg/L) to Creek when Laguna flow > 100 cfs (250 AF/Y Long Term Average, 30days@2000gpm)	II	1950	7	520	310	$27,500	$1	0.2%
13C	2000 GPM GW Pumpage (1000 mg/L) to Creek when Laguna flow > 50 cfs (400 AF/Y Long Term Average, 45days@2000gpm)	II	1800	6	510	310	$44,000	$1	0.2%
13D	2000 GPM GW Pumpage (1000 mg/L) to Creek when Laguna flow > 25 cfs (700 AF/Y Long Term Average, 80days@2000gpm)	II	1500	5	500	310	$77,000	$2	0.4%
Lake G RW 16A	Lake G Wet Weather RW Storage of 1800 af, Ag/Fringe Basin Irrigation or LAVWMA Export	I	2200	7	520	305	$0	$0	0.0%
16B	Lake G Wet Weather RW Storage of 1800 af, for Urban/Main Basin Irrigation	II	1700	6	510	305	$0	$0	0.0%
16C	Strategy 16A plus 2200 AF Demin GW Pumpage (1000 to 100 mg/L)	III	0	0	450	280	$976,800	$29	5.5%
16D	Strategy 16B plus 1700 af Demin GW Pumpage (1000 to 100 mg/L)	III	0	0	450	285	$754,800	$23	4.4%
RW RO Conj. Use 17A	840 AF (Livermore) RO RW Summer Stream Recharge on Arroyo Mocho (Lake G Winter Storage)	II	1900	6	510	305	$50,400	$2	0.4%
17B	3640 AF (Liv & DSRSD)) RO RW Summer Stream Recharge on Arroyo Mocho (Lake G Winter Storage)	II	700	2	470	315	$218,400	$7	1.3%

Assumptions:

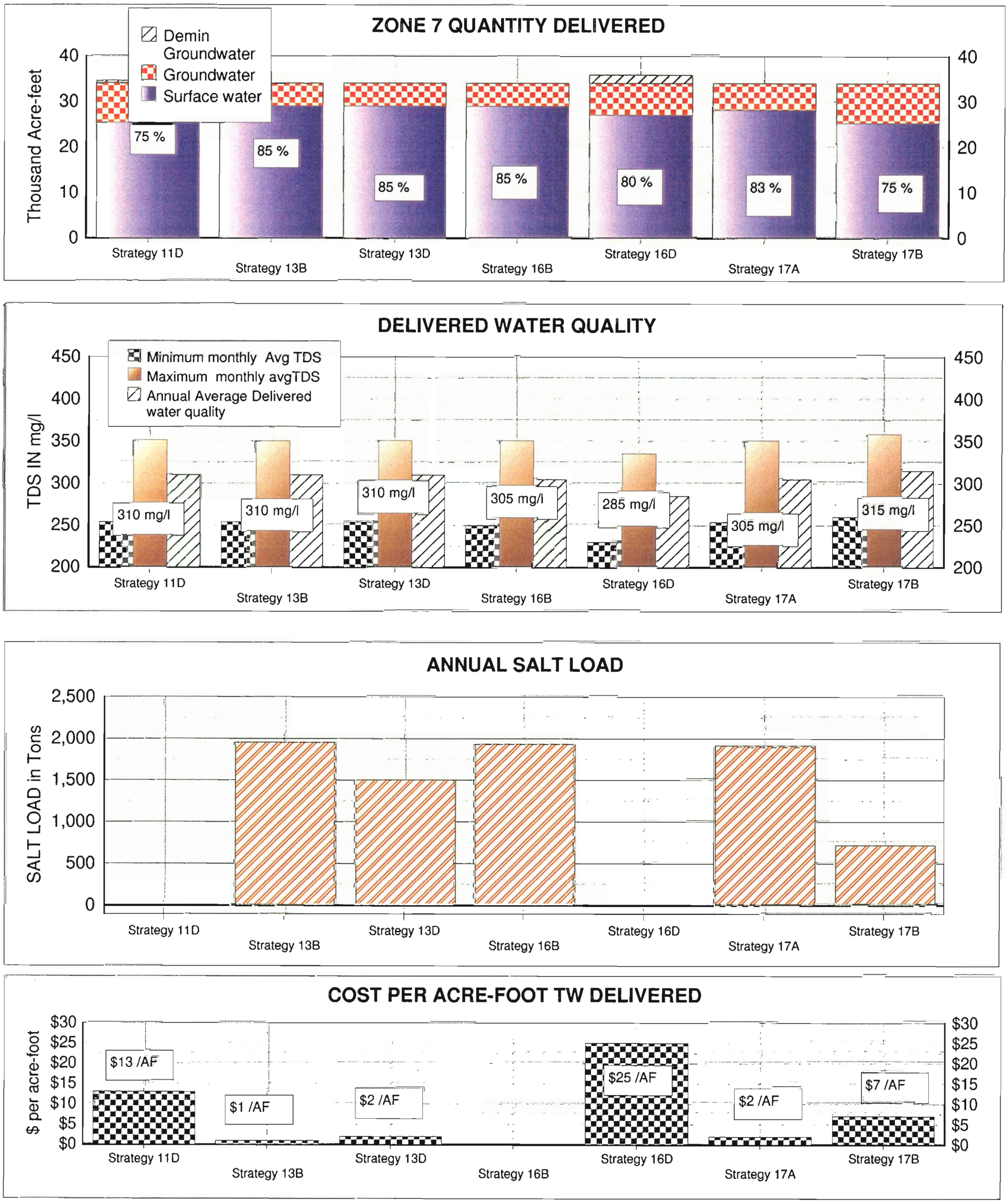
1) Zone 7 TW delivery of 33,500 AF and UTW of 7300 AF (Year 2000)
2) Base TW rate of $528 / AF for year 1999.
3) Incremental cost spread only to Zone 7 Treated water deliveries.
4) GW TDS of 450 mg/l and SW TDS 270 mg/l (Historic average at PPWTP)
5) GW Demin capacity at 2200 AF/Y (180 af/ month for 12 months)

Delta Fix (Strategy 2)

The "Delta fix" near-term strategy (described in Section 8.12) assumes that political will, public support, and funding would come together to support improvements to State Water Project facilities and operations regarding release and conveyance of water through the Delta. Under some of the improved conveyance alternatives the TDS of deliveries from

Figure 12.4

POTENTIAL NEAR-TERM SALT MANAGEMENT STRATEGIES



the State Water Project could decrease to about 100 mg/L. This strategy is also included here since it would be representative of conditions that may exist absent a "Delta fix" but resulting from a series of wet years. Given that imported surface water (270 mg/L long-term average TDS) has historically represented 85% of Zone 7 deliveries, this "Delta fix" would significantly decrease salt loading from irrigation and artificial recharge. This strategy would not require any Zone 7 operational changes over the Status Quo (Strategy 1A in Table 12.2).

Under this strategy Zone 7's annual average deliveries would be a blend of 85% surface water and 15% groundwater. The annual average TDS of Zone 7's blended deliveries would be about 160 mg/L (140 mg/l lower than under the Status Quo). The annual average salt loading to the main basin would be eliminated. There would be no incremental operational cost. The main drawback to this strategy is that it is not under Zone 7 control and therefore the timing and feasibility remain uncertain.

Net Result: This strategy would eliminate the 2,200 tons/year salt loading and decrease the annual average TDS of Zone 7 deliveries by about 50% with no increase in operational costs.

Composite of RO Recycled Water Injection and Wellhead Demineralization (11D)

The year 2010 Strategy 11 series projects (Table 9.1) all included 6,000 AF/year of RO recycled water injection. This potential near-term Strategy 11D (which presumes that public acceptability were attained) would reduce the RO recycled water injection to the 3,640 AF/year combined design capacities of the existing DSRSD Clean Water Revival (CWR) RO project (2,800 AF/year) and the Livermore Advanced Water Reclamation Plant (AWRP) RO project (840 AF/year). Also, included is 500 AF/year of high TDS shallow groundwater pumpage and demineralization since this is needed to fully offset the remainder of the 2,200 tons/year of salt loading not offset by the RO recycled water injection alone. As is common to all the strategies in this SMP using wellhead demineralization, the demineralized groundwater would be blended in-line, and delivered primarily to customers in the western portion of the valley, with the brine assumed to be exported via LAVWMA.

The first (leftmost) bar shown on Figure 12.4 represents the performance of this RO recycled water injection and wellhead demineralization strategy (Strategy 11D in Table 12.2). Zone 7's annual average deliveries would be a blend of about 75% surface water and 25% groundwater. The annual average TDS of Zone 7's blended deliveries would be about 10 mg/l higher than under the Status Quo. Annual average net salt loading to the main basin would be eliminated. The incremental operational cost would be about \$13/AF of Zone 7's treated water deliveries or \$6.50/household/year.

Net Result: This is a relatively low cost, salt neutral strategy. It would slightly (10 mg/L) increase the TDS of blended deliveries. As noted previously, additional demonstration of public support would be required before this strategy could proceed. Phased injection (Section 8.9) and/or ASR well injection with subsequent extraction for irrigation (see year 2010 strategies 14 and 14A) have been proposed as potential modifications to improve public acceptability. ASR well operation (Section 8.6), with recycled or treated water, provides limited salt removal benefits.

Seasonal Groundwater Export (13B, 13C & 13D)

Under these seasonal groundwater export near-term strategies (13B, 13C, and 13D in Table 12.3) it is assumed that high TDS (1,000 mg/L) shallow groundwater would be pumped into the arroyos in areas where the water would be conveyed out of the valley and not recharge and impact the main basin. As described in Section 8.10, this pumpage would be scheduled to occur only during specified wet weather flow periods and in a manner to minimize potential impacts to ACWD recharge operations. The three strategies each assume pumpage at a rate of 2,000 gpm during days when Arroyo de la Laguna flow rates exceed specified values.

Under Strategy 13B the high TDS groundwater would be pumped only when flow in the Arroyo de la Laguna was over 100 cfs. Based on historic flow records, there would be an average of 30 days/year when flow would be over 100 cfs. These conditions would allow groundwater export of 250 AF/year (30 days, 24 hours/day @ 2,000 gpm). Under Strategy 13C, pumpage would occur when flows exceeded 50 cfs (45 days/year allowing an average groundwater export of 400 AF/year). Under Strategy 13D, pumpage would occur when flows exceeded 25 cfs (80 days/year allowing an average groundwater export of 700 AF/year). The year 2010 strategies 13 and 13A had assumed much greater volumes would be pumped (3.6 and 1.5 TAF/year, respectively.)

TDS measurements in the Arroyo de la Laguna show that background concentrations increase from around 200 mg/L at high flows (~1,000 cfs) to nearly 1,000 mg/L at low (~10 cfs) flows. Figure 12.5 shows the relatively small change in stream TDS that would result from the pumpage of 1,000 mg/L TDS under the above three Strategies. At high streamflow there is considerable dilution and at low flows the background TDS would approach or exceed the pumped groundwater TDS.

These seasonal groundwater strategies would require various yet-to-be negotiated institutional and operational agreements with ACWD. Zone 7 or another responsible party may also be required to obtain an NPDES permit for such pumpage from the RWQCB.

The second and third bars from the left on Figure 12.4 represent the performance of two of the seasonal groundwater export strategies (13B and 13D). Under these two strategies, Zone 7's annual average deliveries would be a blend of about 85% surface water and 15%

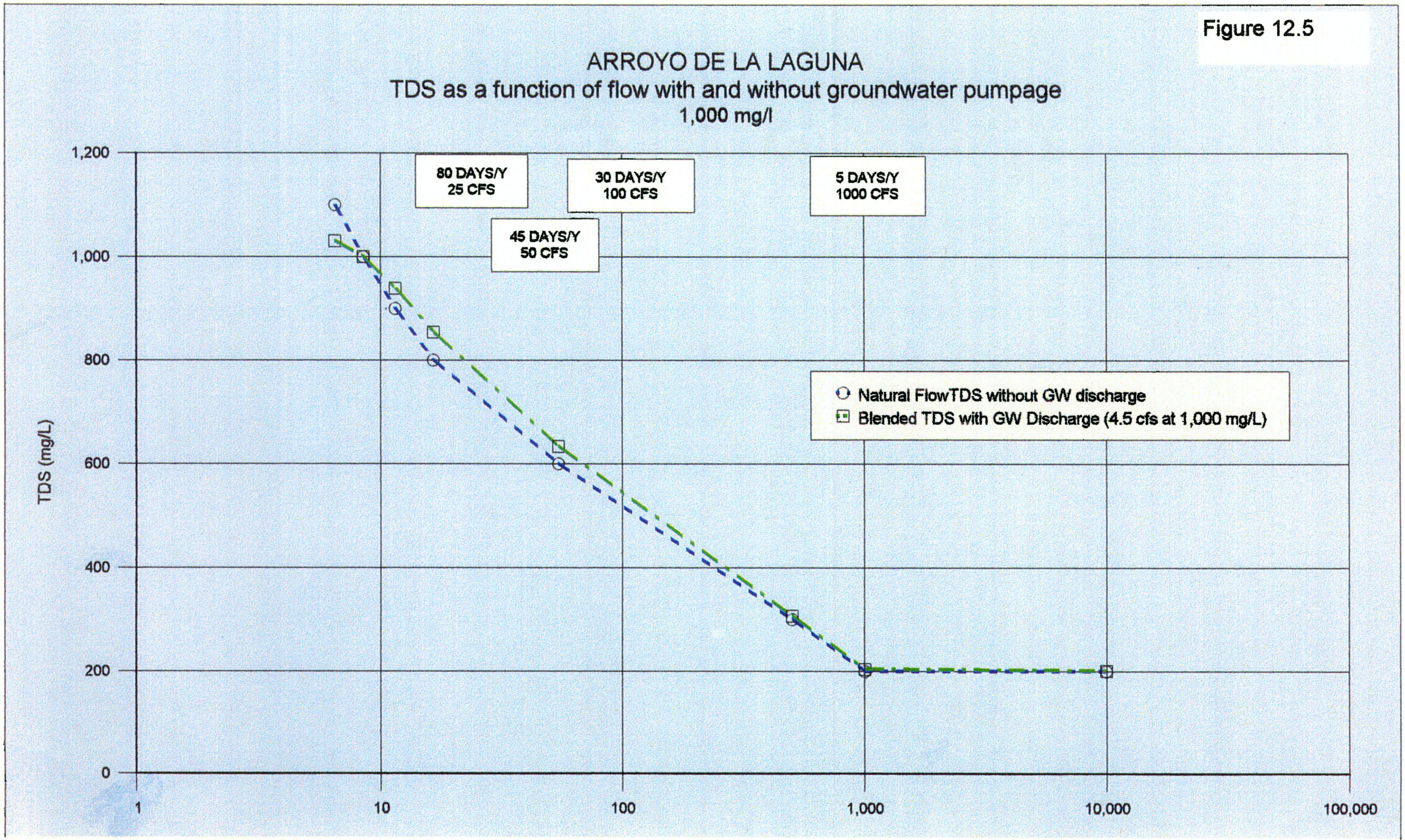


Figure 12.5
ARROYO DE LA LAGUNA
TDS as a function of flow with and without groundwater pumpage
1,000 mg/l
80 DAYS/Y 25 CFS
45 DAYS/Y 50 CFS
30 DAYS/Y 100 CFS
5 DAYS/Y 1000 CFS
Natural FlowTDS without GW discharge
Blended TDS with GW Discharge (4.5 cfs at 1,000 mg/L)
TDS (mg/L)
1,200
1,000
800
600
400
200
0
1
10
100
1,000
10,000
100,000

26-June-2002

groundwater (the same as under the Status Quo). The annual average TDS of Zone 7's blended deliveries would also be same as the Status Quo.

Annual average net salt loading to the main basin would be reduced by 250, 400 and 700 tons/year for strategies 13B, 13C and 13D, respectively. There would be a small incremental operational cost of $1-$2/AF of Zone 7's treated water deliveries or $0.50-$1.00/household/year.

Net Result: These are low-cost salt removal strategies that would not impact delivered water quality TDS positively or negatively. These strategies would decrease net salt loading but their maximum salt removal capability is limited.

Wet Weather RO Recycled Water Winter Storage and Dry Weather Irrigation Composite Strategy (16A & 16B)

These near-term Strategy 16 series were developed as a potential storage pond based alternative to groundwater injection (Strategy 11 series) or ASR injection and extraction (Strategy 14 series) of RO recycled water. Multiple other variations of these strategies would also be possible depending on future decisions about recycled water demands, uses, storage location and LAVWMA operations. These "16 Series" strategies assume that the DSRSD and Livermore RO recycled water facilities would be operated during six wet weather months (e.g., November through April) at their maximum combined production capacity (3,640 AF/year). This strategy would reduce wet weather demands on the LAVWMA export pipeline system, would provide additional demineralized recycled water for dry weather irrigation (directly or blended with higher TDS water(s)), and would increase salt removal from the basin.

The 1,800 AF of RO recycled water produced during the six wet weather months would be stored in a recycled water (or possibly multi-use untreated water) storage facility. In these "16 Series" examples it has been assumed that Lake G would be available and suitable for this purpose. The same assumptions would apply if another lake were used. It has further been assumed that RO recycled water would be required for this purpose, given the Lake's location above the main basin, even though Lake G is clay lined. Additional hydrogeological investigation and communication with involved agencies would be necessary to determine if the clay liner were adequate so that non-demineralized recycled water could also be stored in Lake G. Storage facilities other than Lake G could also be constructed above or outside the main basin to serve this purpose.

Strategy 16A (Table 12.3) assumes that the 1,800 AF of RO recycled water stored in Lake G would be used for irrigation in fringe basin areas or exported through the LAVWMA pipeline during dry weather months. This strategy would provide no salt removal or Zone 7 delivered water quality benefits since salt loading from irrigation in the fringe basins does not impact (reach) the main basin (with a few minor exceptions—see Section

11.2). However, all these Strategy 16s, through their recycled water use would serve to increase the local water supply by 1,800 AF/year and reduce peak summer demands.

Strategy 16B (shown as the fourth bar from the left on Figure 12.4), assumes that the stored RO recycled water would be used for urban irrigation above the main basin. Under this strategy, main basin salt loading would decrease by almost 500 tons/year due to the assumed irrigation with 100 mg/L TDS RO recycled water instead of 320 mg/L TDS Zone 7 treated water. Zone 7 delivered water quality would remain the same as under the Status Quo. As with all the RO recycled water strategies, is has been assumed that recycled water production and distribution costs would be borne by the recycled water producers so that there would be no incremental operational costs to Zone 7.

Net Result: Strategies 16A and B would allow maximum use of the CWR and Livermore RO facilities by providing winter storage. Strategy 16A would have no impact on salt loading, Zone 7 delivered water quality or Zone 7 incremental operational costs. Strategy 16B would decrease salt loading by about 23% and would not affect Zone 7 delivered water quality or increase operational costs.

Wet Weather RO Recycled Water Winter Storage and Wellhead Demineralization Composite Strategy (16C & 16D)

Strategy 16C was designed to be a salt neutral composite of Strategy 16A plus enough wellhead demineralization to fully offset the remaining salt loading. Since Strategy 16A does not provide any salt removal benefits, 2,200 AF/year groundwater would need to be pumped from new high TDS shallow wells and demineralized from 1,000 mg/L to 100 mg/L to make this a salt neutral strategy (i.e., this effectively becomes the same as Strategy 15A). As is common to all the strategies in this SMP using wellhead demineralization, the demineralized groundwater would be blended in-line, and delivered primarily to customers in the western portion of the valley, with the brine assumed to be exported via LAVWMA.

The annual average TDS of Zone 7's blended deliveries would be about 20 mg/l lower than under the Status Quo. The incremental operational cost would be about $29/AF of Zone 7's treated water deliveries or $14.50/household/year. All the benefits and increase in operational costs in this strategy would be from the wellhead demineralization since Strategy 16C provides no benefits other than winter storage for RO recycled water.

Strategy 16D is a salt neutral composite of Strategy 16B plus 1,700 AF/year of wellhead demineralization to offset the remaining net salt loading. Strategy 16D (fifth bar from the left on Figure 12.4) is similar to 16C except that it requires 500 AF/year less wellhead demineralization and is accordingly less expensive. Under this strategy, Zone 7's annual average deliveries would be a blend of about 80% surface water and 20% groundwater. The annual average TDS of Zone 7's blended deliveries would be about 15 mg/l lower than under the Status Quo. The incremental operational cost would be about \$23/AF of Zone 7's treated water deliveries or \$11.50/household/year.

Net Result: Both strategies 16C and 16D are salt neutral strategies that slightly improve the TDS of blended deliveries, particularly that of deliveries to the western side of the valley. Strategy 16D is about 20% less expensive than Strategy 16C due to the zero cost salt removal assumed from irrigation with 100 mg/L TDS RO recycled water.

RO Recycled Water Summer Stream Recharge with Winter Lake G Storage (17A & 17B)

Strategies 17A and 17B both assume full-capacity year-round operation of the two existing RO recycled water facilities with winter storage in Lake G (or an equivalent facility). The same assumptions as to recycled water production and storage for the Strategy 16 series also apply to these Strategy 17 series. The difference is that during summer months the RO recycled water produced, plus that stored in Lake G, would be released into the Arroyo Mocho to recharge the groundwater basin (see Section 8.9 for more details) instead of being used for irrigation.

Under Strategy 17A (Table 12.3), 420 AF/year of RO recycled water from the Livermore RO facility would be stored in Lake G during the six winter months. This water would be pumped from Lake G and recharged on the Arroyo Mocho during summer months along with the 420 AF of summer RO recycled water production. Groundwater pumpage (450 mg/L) by Zone 7 and/or the owner of the recharged RO recycled water would be increased by 840 AF/year above the Status Quo to accommodate the increased stream recharge.

Under Strategy 17A (sixth bar from the left in Figure 12.4), Zone 7's annual average deliveries would be a blend of 83% surface water and 17 % groundwater and blended deliveries would be about 5 mg/L higher than under the Status Quo. The annual average salt loading to the main basin would be reduced to about 1,900 tons. The incremental operational cost would be about \$2/AF of Zone 7's treated water deliveries or \$1/household/year.

Net Result: This strategy would reduce the salt loading by about 300 tons/year, but increase the annual average TDS of Zone 7 deliveries by about 2%. The incremental operational cost would be minimal (0.4%).

Under Strategy 17B, half the combined maximum annual production (1,820 AF/year) of RO recycled water from the CWR and Livermore RO facilities would be stored in Lake G during the six wet weather months. The RO water would be pumped from Lake G and recharged on the Arroyo Mocho during summer months along with the 1,820 AF of summer RO recycled water production. Zone 7 and/or independent quota groundwater pumpage would be increased by 3,640 AF/year to offset the increased stream recharge.

Under Strategy 17B (seventh bar from the left in Figure 12.4), Zone 7's annual average deliveries would be a blend of 75% surface water and 25 % groundwater. The annual average TDS of Zone 7's blended deliveries would be about 15 mg/l higher than under the Status Quo. The annual average salt loading to the main basin would be reduced to about 700 tons. The incremental operational cost would be about $7/AF of Zone 7's treated water deliveries or $3.50/household/year.

Net Result: This strategy would reduce the salt loading by about 1,500 tons/year, but increase the annual average TDS of Zone 7 deliveries by about 5%. The incremental operational cost would be low (1.3%).

12.4 Adaptive Salt Management Via Annual Operations Plan

Section 2.2 described how Zone 7 manages water deliveries in accordance with its historic water operations planning program that consists of the following three major components:

1. Five-Year Demand Projections and DWR Delivery Schedule
2. Annual Water Supply and Storage Probability Analysis (Water Supply Forecast)
3. Monthly Water Operations Plan (MWOP)

The Water Supply Forecast is prepared in December of each year for the following calendar year. The Water Supply Forecast shows how Zone 7 would operate to make full deliveries under a wide range of hydrologic conditions ranging from critically dry to extremely wet.

The Water Supply Forecast addresses water management decisions on an annual basis. The Monthly Water Operations Plan addresses water management decisions on a monthly basis. Each year in July, Zone 7 prepares preliminary versions of the Monthly Water Operations Plans for the following three years. In September of each year, these three-year Monthly Water Operations Plans are updated to reflect the latest demand requests from Zone 7 contractors and are used for preparing the DWR water delivery schedules. In January of each year, the Monthly Water Operations Plan for the current year is updated with more accurate DWR water supply projections for most probable conditions. In April of each year, after DWR has announced the firm rest-of-year deliveries, Zone 7 develops a Monthly Water Operations Working Plan. This Monthly plan is then updated monthly for the rest of the year with actual year-to-date data and as such reflects adjustments made to meet water operational objectives.

The primary goal of the historic operations plan was to minimize O&M costs by delivering the maximum amount of surface water and pumping groundwater only to supplement surface water supplies during peak demand and drought periods. This historic operations plan successfully provided sustainable water supply at minimum O&M cost but did not address salt loading, groundwater quality, or delivered water quality.

It is proposed that the Water Operations Plan be expanded to incorporate the SMP goals and an adaptive management approach to selecting the combination of salt management strategies to be implemented in a given year. Over time, it is expected that additional strategies may become available (e.g., seasonal groundwater export) and Zone 7 will need to decide what is the optimum combination of strategies to use in a given year. Multiple variables will need to be balanced in making this decision, and the variables will likely change year by year, hence the need for an adaptive management approach.

Adaptive management is "learning by doing." The CALFED Bay Delta Program defined adaptive management as a science-based process whereby the possible solutions to prioritized problems are implemented, monitored, and evaluated and then either are repeated or evolve into the next round of testing.

Figure 12.6 presents the schematic of the proposed adaptive management approach to developing an annual operations plan each year. This approach requires input in four major areas: 1) Policy directives (bottom box), 2) Salt loading tracking (top box), 3) Available salt management strategies (right box) and 4) Available resources and demand (left box).

Policy directives would include items such as Zone 7 Board decisions and guidance that there should not be any long-term average net salt loading to the groundwater basin and to maintain or improve delivered water mineral quality.

Available resources and demand factors include assessing the water supply, demand and groundwater storage conditions at the beginning of each year. This basically represents the information tracked and processed by the historic operations plan.

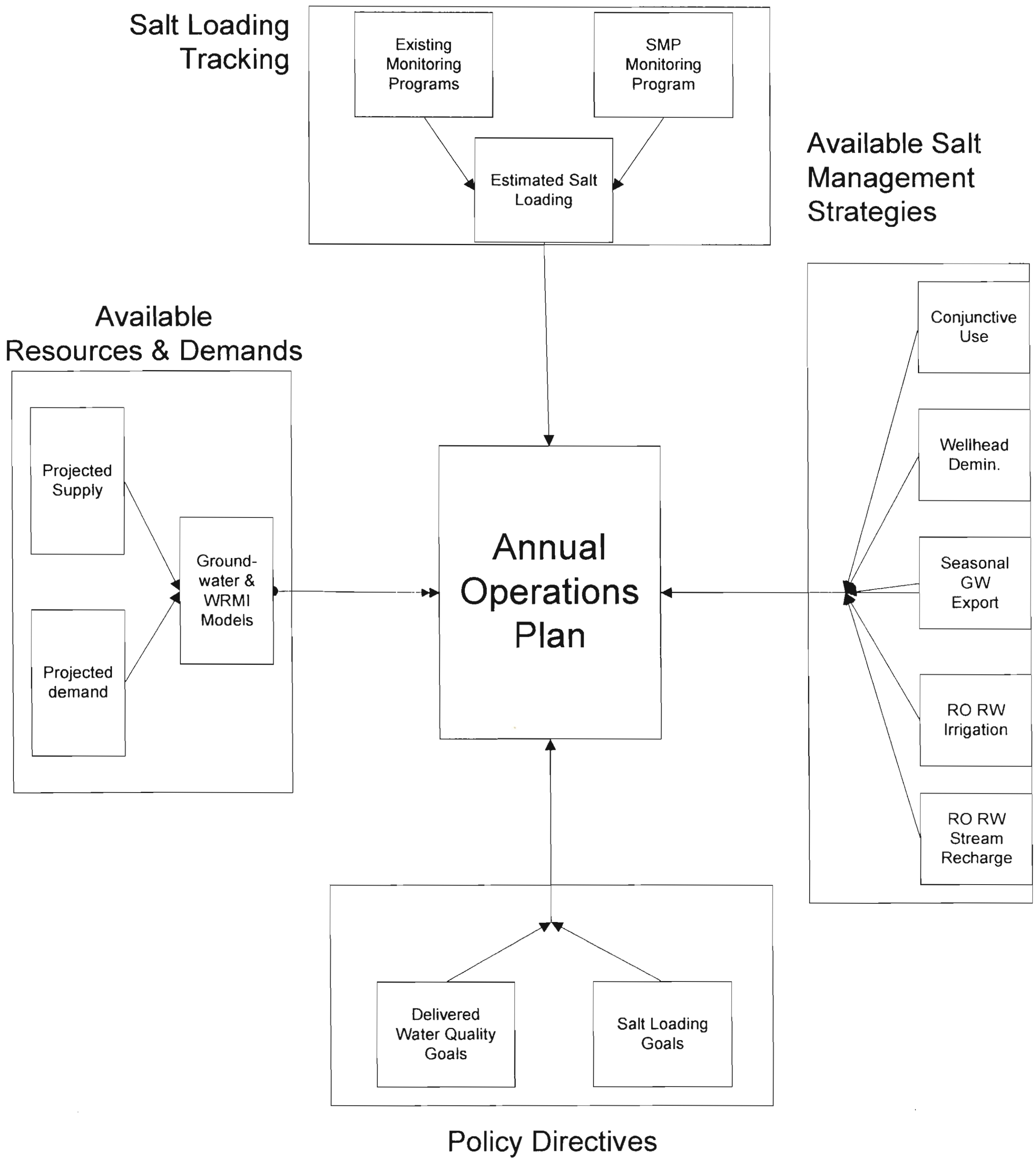
Salt loading tracking factors includes data and information collected from the various monitoring programs. The existing monitoring program is sufficient for tracking salt loading from existing sources and for existing land use conditions. Future land use changes and any increased use of recycled water will require additional monitoring to track the resultant salt loading, as described in chapter 6. The Salt Management Monitoring Program (SMMP) will facilitate tracking salt removal progress and will provide the information needed to calculate the annual salt removal targets for inclusion in the operations plan.

Available salt management strategies represent all the available salt removal tools and their relative removal capacities. The number and type are expected to increase over time (tables 12.2 and 12.3), and the facilities could be owned and operated by Zone 7 or by others.

The various factors such as current and projected salt loading, relative salt removal costs ($/ton removed), impacts on delivered water quality, and water supply conditions would be evaluated together and the best possible solution that would balance the competing salt

Figure 12.6

Schematic of Salt Management Annual Operations Plan



e:\projects\smp\report\fig12-6
6/26/2002

management goals would be incorporated into the annual operations plan. In some years this decision may require groundwater modeling.

One possible outcome of the adaptive management process may be to decide to not implement any salt removal measures in a given year and to accrue a salt deficit with the intent that it would be offset in future years. This may be the case in the early years of the SMP, when there will be relatively few strategies to select from (e.g., conjunctive use). This outcome could also be the case during droughts when demineralization facilities might not be operated to conserve the water that would otherwise be lost as brine. A similar decision to limit or not operate demineralization facilities might be made during periods of limited power supply and/or high cost power. Conversely, under, for example, very favorable water supply conditions, Zone 7 could choose to implement extra salt removal measures.

Another example of adaptive management decision-making would be whether to operate wellhead demineralization facilities at a constant rate year round (assuming adequate LAVWMA wet weather disposal capacity) or to operate at higher rates, for example, just during the April to October period. The intent of the latter approach would be to produce more low TDS water during the summer months (when more groundwater is pumped) to help reduce both the delivered water TDS and seasonal variability in TDS.

Figure 12.7 shows the impacts on delivered water quality (thick line, bottom graph) under a constant-rate year-round mode of demineralization operation. The groundwater TDS shown is the flow weighted average concentration of the ambient 450 mg/L groundwater pumped and the demineralized groundwater pumped. Figure 12.8 shows the results when demineralization production is limited to April-October and both groundwater pumping and demineralization production is varied to attempt to keep delivered water TDS as constant as possible. Both strategies result in an annual average delivered water blend of 5% demineralized groundwater, 20% non-demineralized groundwater, and 75% surface water.

In this example, the resultant annual average delivered water TDS is the same (300 mg/L) under both operation plans, but there is slightly less variation in month-to-month average TDS under the variable operations plan (Figure 12.8). The beneficial impacts on TDS and variability would become more significant if additional demineralization was available and if less groundwater was assumed to be pumped during summer months.

12.5 Phased Near-Term SMP Implementation

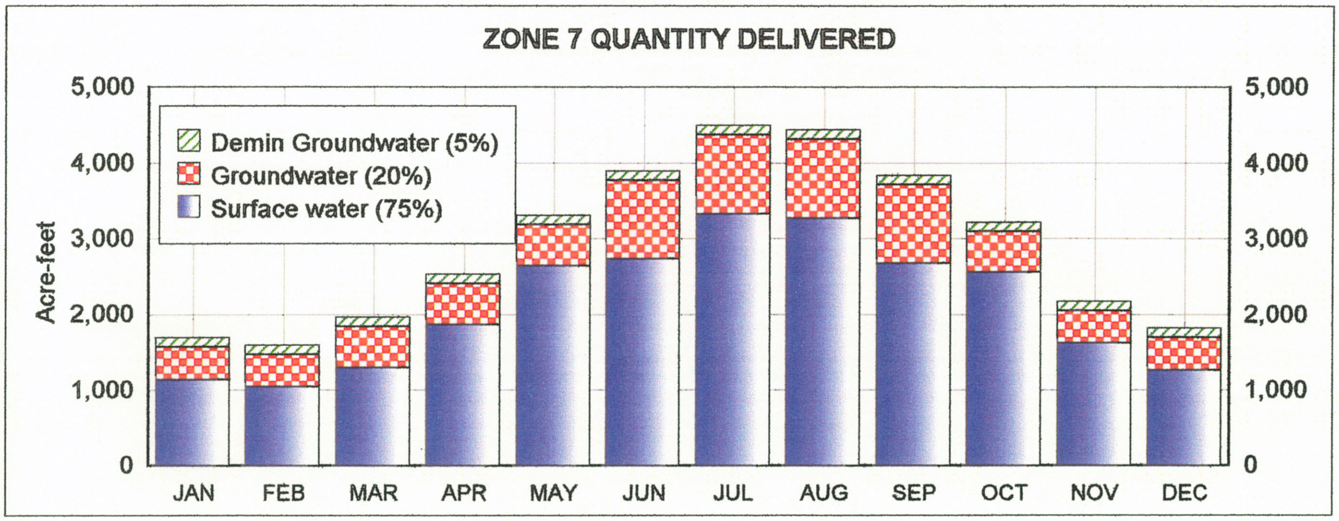
During 1998, Zone 7 staff obtained considerable input from the TAG and other interested parties on the SMP. Extensive comments on SMP implementation were provided by the DSRSD, Pleasanton, Livermore, and Cal Water senior water/wastewater and public works managers at an SMP workshop held on September 3, 1998. Table 12.4 summarizes the highlights and recommended actions from that meeting. (Detailed meeting notes are

Figure 12.7

Year 2000 Steady State Salt Loading

WELL HEAD DEMINERALIZATION 1.5 TAF AND CONJUNCTIVE USE 3 TAF

DEMINERALIZATION PRODUCTION EVENLY DISTRIBUTED FOR 12 MONTHS



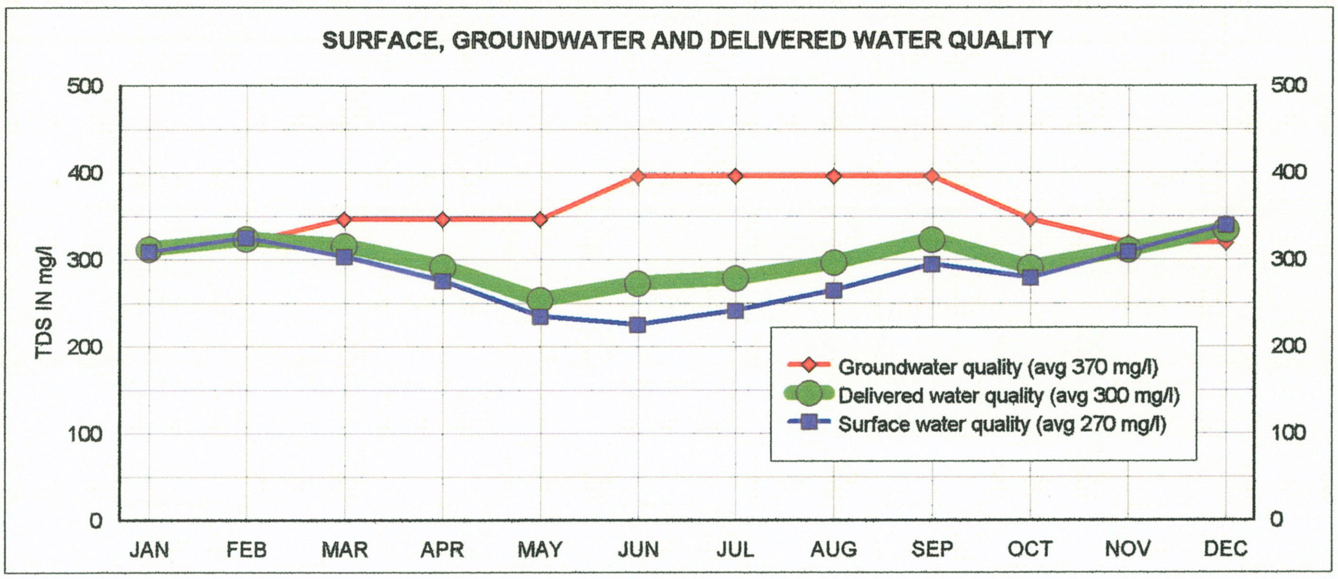
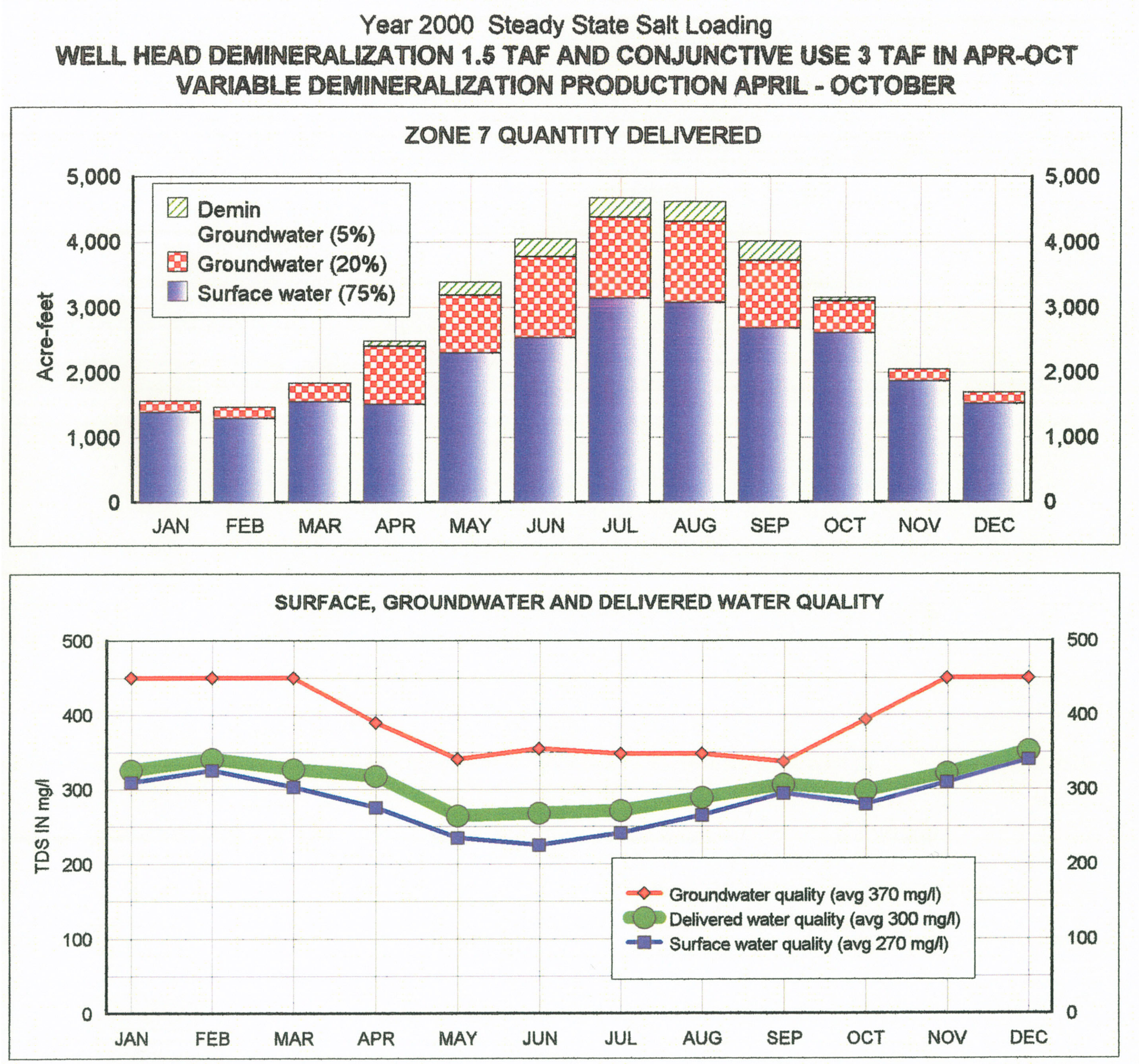


Figure 12.8



Year 2000 Steady State Salt Loading
WELL HEAD DEMINERALIZATION 1.5 TAF AND CONJUNCTIVE USE 3 TAF IN APR-OCT
VARIABLE DEMINERALIZATION PRODUCTION APRIL - OCTOBER
ZONE 7 QUANTITY DELIVERED
Acre-feet
5,000
4,000
3,000
2,000
1,000
0
Demin Groundwater (5%)
Groundwater (20%)
Surface water (75%)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SURFACE, GROUNDWATER AND DELIVERED WATER QUALITY
TDS IN mg/l
500
400
300
200
100
0
Groundwater quality (avg 370 mg/l)
Delivered water quality (avg 300 mg/l)
Surface water quality (avg 270 mg/l)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

included in Reference Q). The managers supported raising Zone 7 water rates and to begin implementing salt management activities including wellhead demineralization.

During the first half of 1999, Zone 7 staff, in consultation with the TAG and Zone 7 managers, identified a recommended set of Salt Management Plan goals and strategies for inclusion in a phased near-term implementation plan. This plan was intended to serve as a roadmap for how Zone 7 would proceed towards incorporating salt management strategies into routine operations.

SMP Goals

Key SMP policy issues and options were presented in Chapter 7. Based on that information, the following SMP policies (1999) and goals were recommended for Zone 7 adoption and inclusion in the annual operations plan:

- Offset the current (1999) 2,200 tons per year of salt loading plus approximately 50 tons per year of current projected annual increase.
- Maintain or improve groundwater mineral quality.
- Maintain or improve delivered water quality.
- Provide comparable delivered water quality to all retailers.
- Provide a mechanism for full management of all salt loading associated with recycled water use.
- Minimize total operational and maintenance costs through an adaptive management process.

Near-Term Composite Strategy

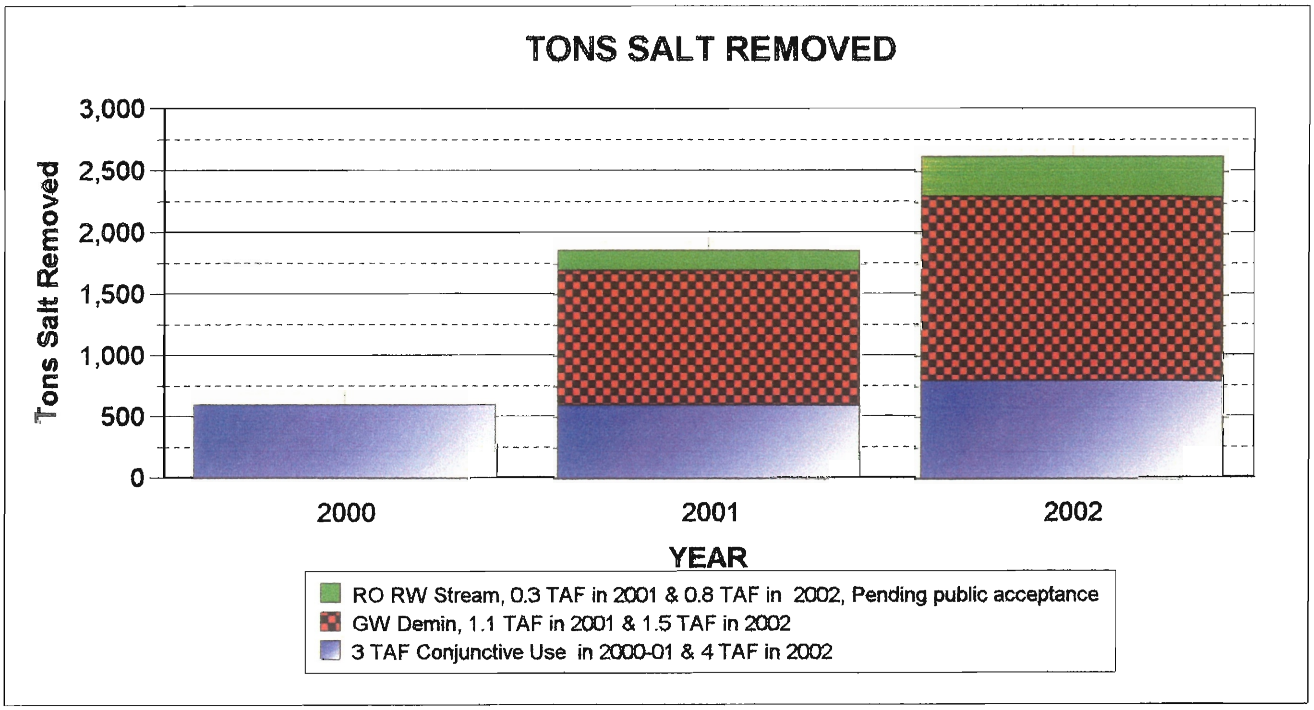
Section 12.2 presented strategies that could be implemented, or begin to be implemented, in the first year of the SMP, which is assumed to be 2000 (as envisioned in early to mid-1999). Based on that information, the apparent best near-term strategy to achieve the multiple SMP goals listed above appeared to be the composite of conjunctive use and wellhead demineralization, with possibly summertime stream recharge of RO recycled water (pending public acceptance). This strategy is represented in the circled fifth and sixth from the left bars on Figure 12.2 and second and third from the left bar clusters on Figure 12.3. These correspond to the two composite strategies 5A plus 15A and 5A plus 15A plus 17a in Table 12.2, respectively.

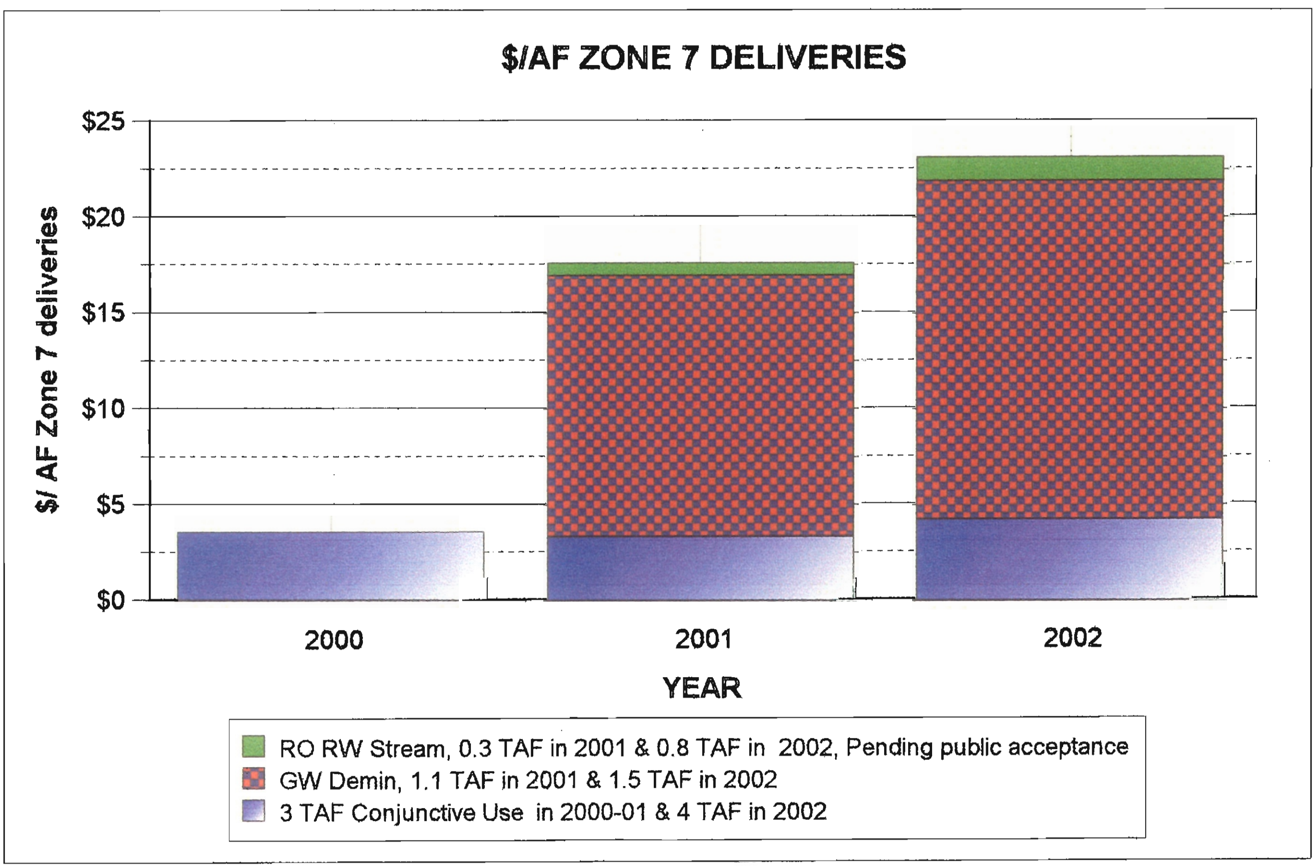
It is recognized that additional planning, public and agency "buy-in," design, and construction work are required before wellhead demineralization and RO recycled water stream recharge could physically by initiated. Figure 12.9 presents a proposed phased implementation plan for the calendar years 2000-2002. The first bar graph (top) shows tons of salt removed each year and the second bar graph (bottom) show the incremental operational cost per acre-foot of Zone 7's treated water deliveries. The graphs show the

37433.4620486111

Figure 12.9

PROPOSED SALT MANAGEMENT PLAN FOR 2000-02 AND O&M COST





current loading of 2,200 tons/year in 2000 and the projected 200 tons/year increase to 2,600 tons/year in 2002.

Year 2000—The only SMP action that could be initiated in 2000 would be a limited increase in conjunctive use (i.e., Strategy 5A). Figure 12.9 assumes that in the year 2000 conjunctive use would be increased by more pumping of the Stoneridge well. In a partial response to the goal of providing comparable delivered water quality to all retailers, to the extent possible the groundwater would be delivered to the east side of the Zone 7 distribution system. Pumping 3,000 AF of groundwater in excess of that needed for peaking would remove about 600 tons of salt and would increase treated water costs by about $3/AF.

Year 2001—The middle bar in Figure 12.9 illustrates a situation where by mid-2001 a nominal 3 mgd wellhead demineralization facility would be in operation and Livermore would have obtained the approvals necessary to begin recharging RO recycled water during summer months in the Arroyo Mocho east of Isabel Avenue. Having these facilities operational during the last half of 2001 would allow about 1,100 AF of high TDS groundwater to be demineralized (e.g., at the Camp Parks well site) and blended into the western portion of the distribution system and about 300 AF of RO recycled water to be recharged. These actions plus continuation of the 3,000 AF of conjunctive use pumping begun in 2000 would remove about 1,800 tons of salt and would increase treated water costs by about $17/AF. As of 2004, only the conjunctive use component of the salt management strategies was implemented.

Year 2002—The projected year 2002 strategy shown in the third bar in Figure 12.9 uses the same facilities as in 2001 except that they are assumed to be available for a full 12 months of operation instead of the six months available during 2001. This strategy would pump 4,000 AF of groundwater for conjunctive use, demineralize about 1,500 AF of high TDS groundwater, and recharge about 840 AF of RO recycled water in the Arroyo Mocho during the summer (Livermore RO design capacity with winter storage). This strategy would remove about 2,600 tons of salt and would increase treated water costs by about $23/AF. If RO recycled water stream recharge was not conducted, wellhead demineralization would need to be increased to 1,800 AF/year.

Zone 7 Board Near-Term Implementation Plan Approval

The above phased near-term implementation plan was presented to and approved by the Zone 7 Board of Directors on August 18, 1999 by Resolution No. 99-2068. The tables and figures illustrating the plan contained in this chapter are essentially the same as those presented to the Board. The resolution stated the Board's support for the proposed Salt Management Program Implementation Plan and for inclusion of the above six policy goals in the Zone 7 annual operations plan. The resolution also authorized the Zone 7 General Manager to proceed with the recommended year 2000-2002 Salt Management Implementation Plan.

Interim Implementation Plan Options for 2004-08

During 2000-2003, only the conjunctive use component of the approved implementation plan was implemented. The wellhead demineralization facility that was scheduled to be completed by 2001-2002, has been delayed and it is now projected to be completed by 2008. Zone 7 has the following two options during this interim period:

1) Continue the increased conjunctive use by increasing the annual groundwater to surface water ratio from 15% to about 20%. This will reduce the salt load by about 1,000 tons/year but it will deliver higher mineral content water to all retailers. Pleasanton and DSRSD deliveries would be impacted more than Livermore and CWS. If the retailers were accepting of this option, Zone 7 could continue this partial implementation approach until the wellhead demineralization facilities are completed.

2) Discontinue increased conjunctive use until the wellhead demineralization facility is available (2008). Under this option, groundwater pumpage would be limited to the pumping required to meet peak demands.

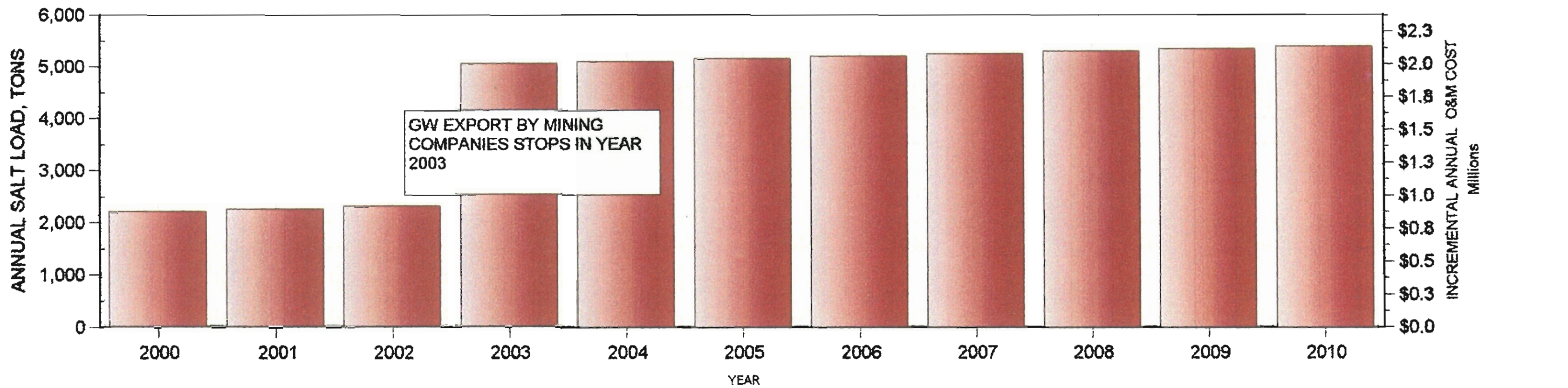
12.6 Future Salt Loading and SMP Next Steps

Main basin salt loading has been projected to increase from the current (1998) 2,200 tons/year to 5,400 tons/year by 2010 or sooner (Section 8.9). The upper graph in Figure 12.10 presents projected future annual salt loading 2000 through 2010. This graph shows salt load in tons on the left y-axis and annual incremental annual O&M cost on the right y-axis. The costs shown are based on one strategy and reflect the potential annual operation and maintenance (O&M) costs to fully offset each year's loading, assuming use of shallow well demineralization (1 to 4 TAF/Y) and conjunctive use (3 to 7 TAF/Y). Under any other strategy or combination strategies, the costs would differ.

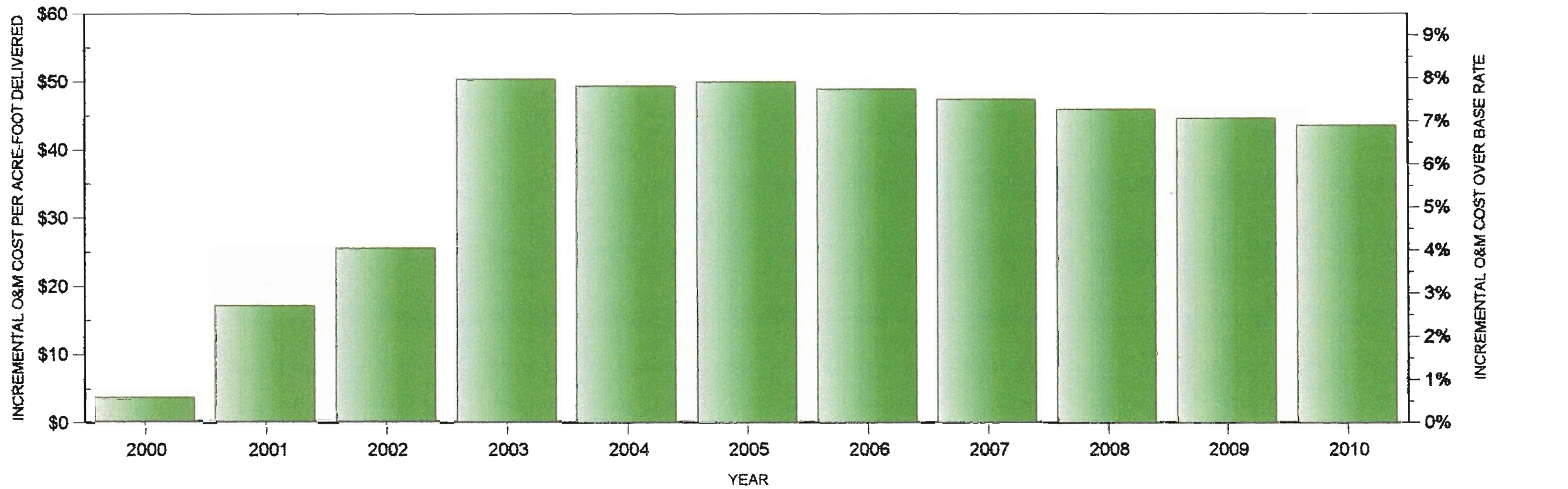
The bottom graph shows the incremental O&M cost per acre-foot of Zone 7 treated water deliveries on the left y-axis. The right y-axis shows this cost as a percentage over the base total treated water rate. For years 2000 - 2002, the incremental cost would increase from about $3/AF/year (first bar on bottom graph of Figure 12.10) or $1.50/houseold/year to about $25/AF/year (left y-axis) or $12.50/houseold/year. That would be an increase of about 5% (right y-axis) over the Zone 7 1998 base treated water rate ($528/AF).

A major change occurred in year 2002 with the cessation of the majority of the water and salt exports by the gravel-mining companies. To remain salt neutral, the salt management plan would need to be expanded to offset the additional 2,800 tons/year. To do so would cause the incremental operational costs to increase by about $50/AF of Zone 7 treated water deliveries over base treated water rates. After 2003, the increase in salt loading is projected to be gradual, about 50 tons/year or 500 tons by 2010 due primarily to increased urban and agricultural development related irrigation.

Figure 12.10
FUTURE ANNUAL SALT LOAD & REMOVAL COST (2)



O&M COST PER ACRE-FEET (normalized for annual Zone 7 treated water deliveries)



NOTE: *1) Salt load calculation does not include:*

a) The impacts of increased future subsurface inflows due to increased agriculture irrigation outside the main basin.

b) The incremental increase in salt loading due to recycled water irrigation over the main basin.

2) Salt removal cost is based upon removal by Shallow Well GW Demin (1 - 4 Taf/y) and Conjunctive use (3 - 7 Taf/y) . For any other tool or the combination of tools, the cost will change.

26-Jun-02

Zone 7 treated water deliveries are projected to increase each year successively at least through 2010, increasing the base volume upon which to distribute the increased O&M costs. Therefore, the incremental operational cost for salt management in 2010 would stabilize at around $45/AF/year (left y-axis). This would represent about 8% of the Zone 7 1998 base treated water rate (right y-axis). If any of the other lower cost salt removal strategies become available in future, they would be integrated into the annual operations plan as part of the SMP adaptive management process and operational costs could be less.

These future salt loading estimates do not include impacts to the main basin of potential increased future subsurface inflow due to increased agriculture irrigation outside the main basin (to be tracked via proposed Salt Management Monitoring Program—see Chapter 6). However, the potential loadings due to increases in such subsurface flow are believed to be minimal due to the various geologic barriers between the fringe and main basin (as described in Chapter 3). The estimates shown in Figure 12.10 also do not include any incremental increase in salt loading due to new or retrofit recycled water irrigation projects impacting the main basin. New and/or expanded salt management strategies and facilities will need to be implemented to offset these future potential salt sources to comply with the SMP goal of fully offsetting net salt loading.

SMP Next Steps

Zone 7 began implementing the SMP in 2000 by increasing conjunctive use (Strategy 5A). Zone 7 has wellhead demineralization facilities scheduled within its Capital Improvement Program (CIP). Further planning studies have been conducted that verified the feasibility of shallow groundwater demineralization as described in this SMP. Those studies also investigated in more detail alternative sites for the demineralization facilities. A well master plan is being conducted that will in part also evaluate in more detail sites for shallow groundwater wells. Negotiations are continuing with DSRSD and Livermore on use of the LAVWMA facilities for brine disposal. Zone 7 has completed a Water Quality Master Plan. The SMP goals and operations have been integrated into and coordinated with the Water Quality Master Plan goals.

Zone 7 is continuing discussions with untreated water and recycled water users and purveyors on equitable ways of offsetting salt loading from those projects. Given enough public support, Zone 7 and Livermore could begin to look in more detail into summertime stream recharge with demineralized recycled water in the Arroyo Mocho near Isabel Avenue (strategies 17A and 17B).

Zone 7 will be continuing discussions with ACWD on possible operational agreements that would identify conditions under which it would be acceptable for Zone 7 to conduct seasonal groundwater export of high TDS groundwater (strategies 13B, 13C, 13D). Zone 7 will contact the RWQCB to determine what type of permit, if any, would be required for this activity.

Following Zone 7 management approval, this SMP will be submitted to the RWQCB staff to document how Zone 7 manages the groundwater basin to maintain sustainable water supply and water quality.

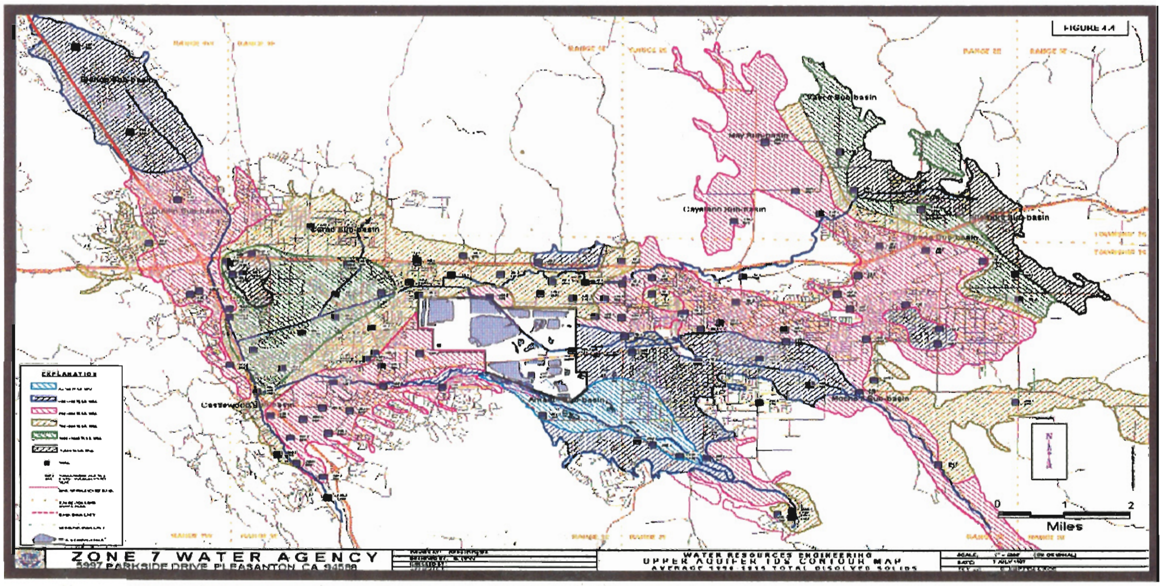
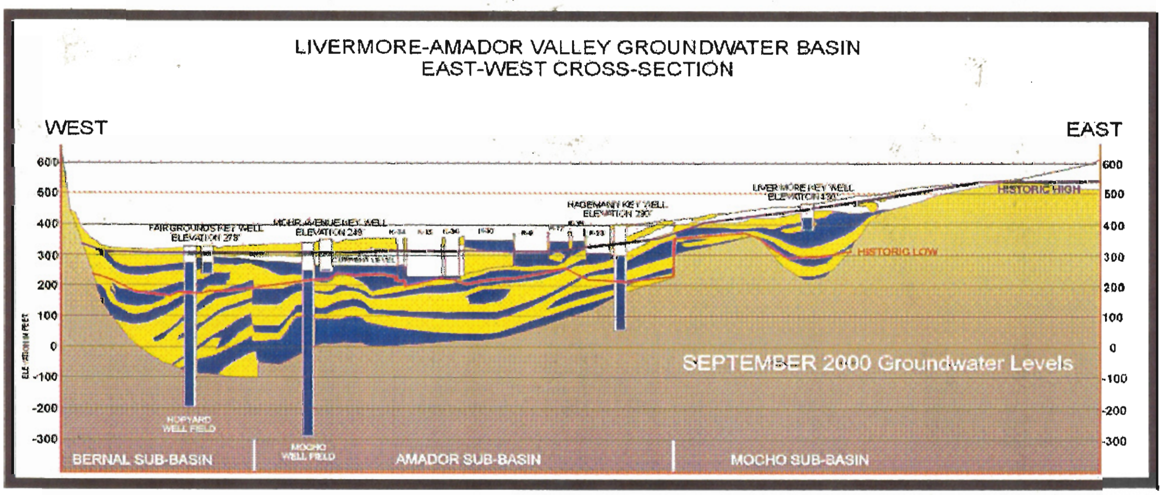


FIGURE 4.4
EXPLANATION
Miles
ZONE 7 WATER AGENCY
5997 PARKSIDE DRIVE PLEASANTON CA 94588



LIVERMORE-AMADOR VALLEY GROUNDWATER BASIN
EAST-WEST CROSS-SECTION
WEST
EAST
FAIRGROUNDS KEY WELL ELEVATION 273'
MOHR AVENUE KEY WELL ELEVATION 249'
HAGEMANN KEY WELL ELEVATION 290'
LIVERMORE KEY WELL ELEVATION 380'
HISTORIC HIGH
HISTORIC LOW
SEPTEMBER 2000 Groundwater Levels
HOPYARD WELL FIELD
MOCHO WELL FIELD
BERNAL SUB-BASIN
AMADOR SUB-BASIN
MOCHO SUB-BASIN
600
500
400
300
200
100
0
-100
-200
-300

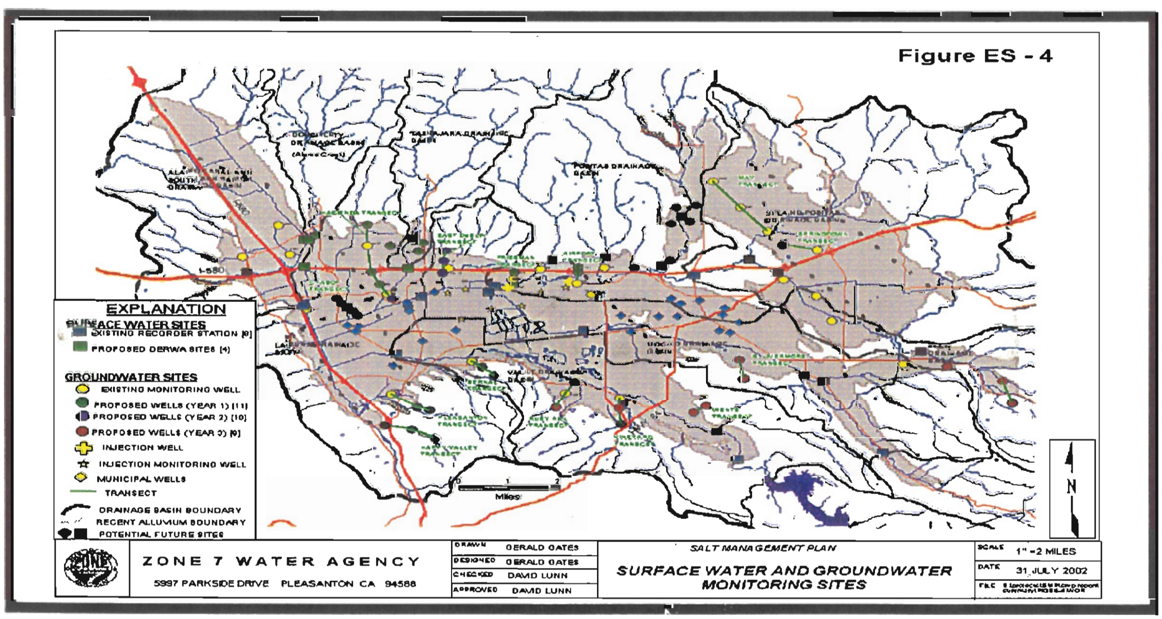


Figure ES - 4
EXPLANATION
SURFACE WATER SITES
EXISTING RECORDER STATION (8)
PROPOSED DERWA SITES (4)
GROUNDWATER SITES
EXISTING MONITORING WELL
PROPOSED WELLS (YEAR 1) (11)
PROPOSED WELLS (YEAR 2) (10)
PROPOSED WELLS (YEAR 3) (9)
INJECTION WELL
INJECTION MONITORING WELL
MUNICIPAL WELLS
TRANSECT
DRAINAGE BASIN BOUNDARY
RECENT ALLUVIUM BOUNDARY
POTENTIAL FUTURE SITES
Miles
N
ZONE 7 WATER AGENCY
5997 PARKSIDE DRIVE PLEASANTON CA 94588
DRAWN GERALD GATES
DESIGNED GERALD GATES
CHECKED DAVID LUNN
APPROVED DAVID LUNN
SALT MANAGEMENT PLAN
SURFACE WATER AND GROUNDWATER MONITORING SITES
SCALE 1" = 2 MILES
DATE 31 JULY 2002