Chapter 7

Salt Management Plan Policy Issues and Options

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7.1 Introduction

From the earliest phases of the Salt Management Plan it was evident that there were multiple, oftentimes competing variables involved in developing workable salt management strategies. The primary variables were groundwater quality, overall delivered water quality, localized (east-west) delivered water quality, and costs. For example, relatively low-cost strategies could be designed that would offset all current salt loading and thereby maintain groundwater quality, but that would result in degraded (higher TDS) delivered water quality. Other strategies could be developed that would maintain both groundwater and delivered water quality, but that would increase costs. Finally, strategies could be developed that would improve both groundwater and delivered water quality, but that would be considerably more expensive to implement.

As discussed in Section 2.2 (and the 1987 Zone 7 Groundwater Management Policy), Zone 7 historic operational rules did not explicitly address salt loading, groundwater quality, delivered water quality, or the equivalency of water quality delivered to customers. With an eye towards the future in developing this SMP, Zone 7 staff sought to identify strategies that could concurrently provide a sustainable water supply, sustainable delivered water quality, and sustainable groundwater quality, at reasonable costs.

To help narrow the range of potential strategies to investigate, and ultimately to recommend to the Zone 7 Board for adoption, additional policy alternatives were developed within the Zone 7 Groundwater Management Advisory Committee (GMAC) and the retailer based Technical Advisory Group (TAG). This chapter summarizes the policy options and recommendations developed through multiple meetings with the TAG and GMAC regarding:

- The extent and timeframe over which net salt loading should be reduced
- Balancing delivered water quality and salt management goals
- East-west delivered water quality equivalency goals
- Control and ownership of injected RO recycled water

Net salt loading reduction is a fundamental, long-term policy issue. The delivered water quality policy issues presented here are in the more limited context of what could be accomplished with potential near-term facilities. Longer term and system-wide water quality issues are being addressed through Zone 7's Water Quality Master Plan. RO recycled water policy issues are also longer term issues given the Zone 7 Board decision to defer support of such injection projects until such time as there is a greater level of public acceptability.

Consensus recommendations were reached on the first three bulleted topics above and are summarized in this chapter. Considerable information was presented and discussions held regarding use and management of RO recycled water. While from a technical standpoint the TAG and GMAC endorsed the proposed use, the groups concluded that further work, beyond the scope of this SMP, was required to determine the best approach(es) acceptable to involved agencies and the public for any RO recycled water that might be injected into the groundwater basin in the future. The basic issues discussed and some potential options regarding blending and ownership are presented at the end of this chapter.

Salt management cost allocation policy issues and options were also developed in coordination with the TAG and GMAC. Results are presented in Chapter 11.

7.2 Four Fundamental Salt Management Options

The most fundamental salt management policy issue involves determining the extent to which the on-going accumulation of salts in the groundwater basin should be reduced. This can also be expressed as whether groundwater mineral quality (TDS) should be allowed to continue to degrade, be maintained at current levels, be improved, or some combination of these options depending on other constraints. This fundamental policy issue is essential to provide a foundation for subsequent more technical decisions regarding selection of the type, size, timing, and location of salt management strategies to implement.

Of relevance to selection of one of the four fundamental salt management options presented below is the Basin Plan guidance (p. 4-23) that the SMP define "a project or set of projects" that will:

- Minimize the current trend toward increasing main basin groundwater salinity due to subsurface groundwater inflow or natural recharge.
- Fully mitigate the effects of salt loading due to water recycling on the main basin groundwater resource.
- Ensure that water imports and water recycling will not contribute to the degradation of groundwater quality.
- Protect groundwater beneficial uses.

Also of relevance to this policy issue is the RWQCB Basin Plan 500 mg/L TDS groundwater quality objective (WQO) for the main basin, based on the USEPA and California DHS drinking water secondary Maximum Contaminant Level (SMCL) value for potable supplies.

Four potential policy options and their resultant impacts on groundwater quality relative to the 500 mg/L standard are shown schematically in Figure 7.1 and are defined below:

1. Maintain status quo
2. Maintain status quo until a trigger or regulatory limit is reached
3. Stabilize groundwater quality at current quality
4. Improve groundwater quality

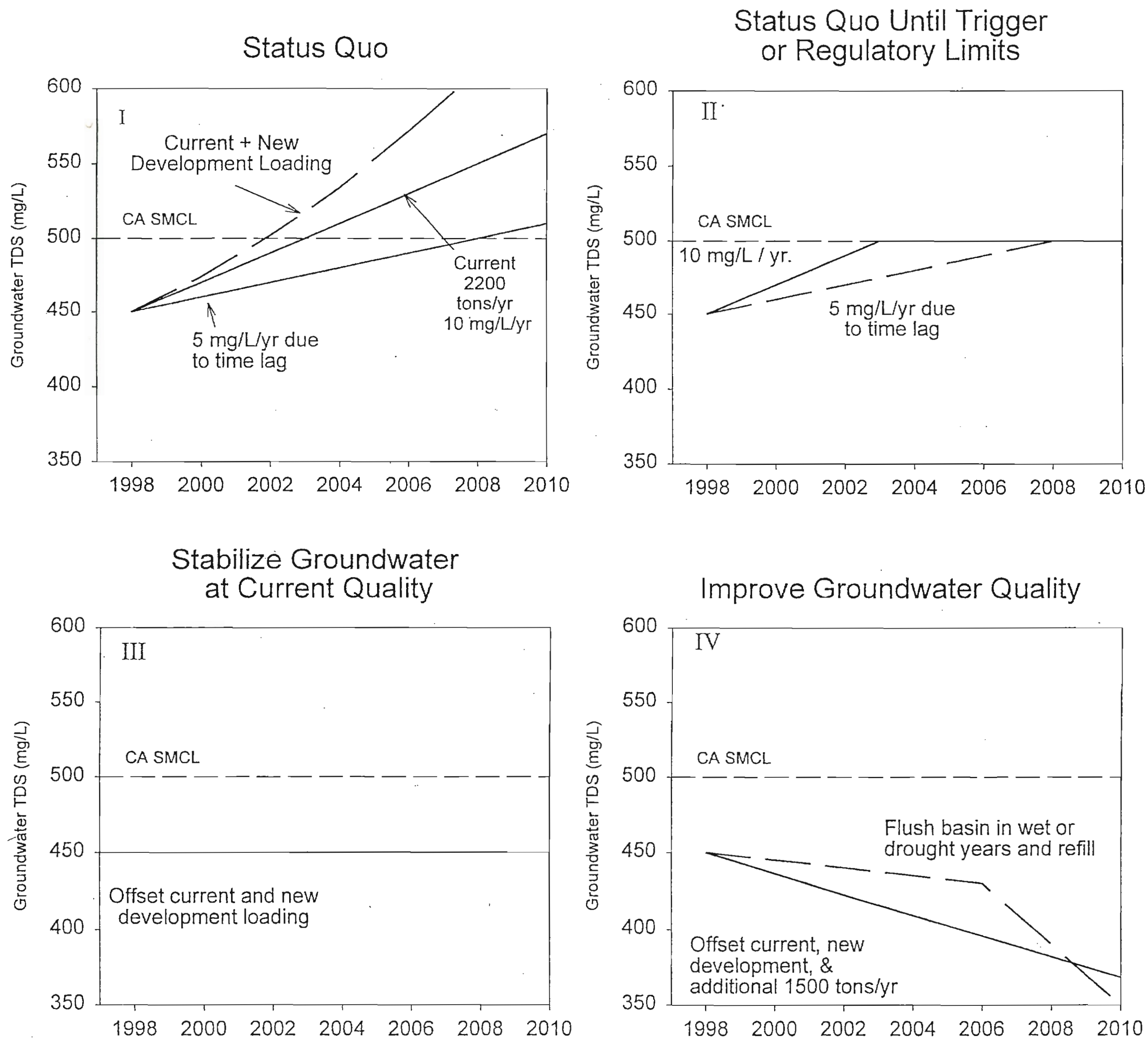
Option 1: Maintain Status Quo—This option (as illustrated in the upper left hand quadrant of Figure 7.1), shows the resultant calculated impacts on groundwater quality if the policy choice is to maintain historic basin management practices. Maintaining this practice is predicted to result in an on-going average basin-wide TDS increase of 8-10 mg/L per year at the current steady-state average salt loading of 2200 tons per year. The lower line in this graph illustrates how average groundwater TDS concentrations, under these annual salt loadings, could thus increase from 450 to 500 mg/L in as soon as five years. As described later in this chapter and in more detail in Chapter 9, annual salt loading is projected to increase substantially and non-linearly, as mining exports decrease around 2003 and urban and agricultural development and associated irrigation increase. The upper dashed line in this graph schematically illustrates the more rapid projected increase in groundwater TDS if salt loading were to increase linearly to the predicted 5400 tons per year by the year 2010.

Option 2: Maintain Status Quo until Trigger or Regulatory Limit Reached--This option (upper right hand quadrant) illustrates the conceptual impacts of delaying implementation of any salt management measures. The assumption here is that it would be acceptable to allow overall average groundwater TDS to increase from 450 to potentially 500 mg/L, at which time measures would then be taken to offset all additional future salt loading and thereby maintain groundwater quality at the secondary MCL of 500 mg/L TDS. The upper solid line illustrates that under average rainfall conditions and at current long-term average salt loading levels (2200 tons/year or 8-10 mg/L/year) calculated groundwater quality could reach the 500 mg/L TDS Basin Plan and DHS SMCL level in as soon as five years. The lower dashed line shows that it would take 10 years to reach 500 mg/L if due to lag time and/or attenuation, accumulated salt were to move at a rate of 5 mg/L/yr instead of the mass balance calculated 10 mg/L/year from the upper to lower aquifers. This lower rate is close to the long-term rate measured in the Bernal subbasin.

Option 3: Stabilize Groundwater at Current Quality—This option (lower left hand quadrant) assumes that measures would be implemented immediately to offset all the existing (2200 tons/year) salt loading plus all new salt loading that occurred each year due to new urban and agricultural development, increased recycled water use, or other sources. As a practical matter, it would likely take at least a few years to initiate significant salt management strategies. TDS would therefore continue to increase until the strategies were fully operational and equilibrium established. Rather than a straight line, this option might actually look more like Option 2 unless the salt removal capacity of the initial strategies

FIGURE 7.1

Fundamental Salt Management Policy Options and Resultant Main Basin Groundwater Quality



were significantly increased, or additional strategies were implemented, to offset the accumulated net salt loading from the years between decision and operation.

Option 4: Improve Groundwater Quality—This Option (lower right hand quadrant) assumes that a policy decision is made to improve groundwater from the current long-term average 450 mg/L level. The upper dashed line illustrates what might occur if it were decided to offset all current and future salt loading plus a small amount more each year. The steep drop in the line illustrates what might occur if, for example, several very wet years in a row occurred and large volumes of low TDS water were recharged and high TDS water pumped from the basin. Alternatively, the same effect could occur if a drought occurred, when existing high TDS water had to be pumped from the basin to meet demands, and then the basin was refilled with low TDS surface water.

GMAC and TAG Recommendations—The GMAC and TAG reviewed the four fundamental salt management strategies and each arrived at similar conclusions. Option 1 was rejected as non-responsive to the goals of the SMP and allowing unacceptable degradation of the groundwater supply and ultimately of delivered water quality. Similar concerns were expressed about Option 2. Option 3 was recommended as a minimum, with a goal of moving towards Option 4 when conditions permitted. As an example, when excess (surplus) high-quality surface water is available, it would be desirable to recharge ("flush") the basin with more than the minimum amount required to offset calculated salt loading and thereby more rapidly improve groundwater quality. Option 3 was supported with the presumption, based on the planning level cost information provided, that it could be achieved at a reasonable cost.

It was also recommended that salt loading reduction targets be set on a long-term basis, e.g., measured over a five-year period, to provide maximum flexibility and cost effectiveness. For example, less salt might be removed during a drought year when there may not be any available low-cost (or potentially any) water to artificially recharge to meet salt management conjunctive use goals. Similarly, it was recommended not to degrade delivered water quality (see below) solely to meet an annual salt removal goal.

7.3 Options in Balancing Salt Management and Delivered Water Quality Goals

Once a fundamental salt management option from Section 7.1 is selected there are multiple individual salt management measures that can be implemented (see Chapter 8), singly or in combination, to achieve the desired salt loading reduction. The individual strategies selected and how they are implemented will have differing impacts on delivered water quality. Therefore, overall delivered water quality policy goals also need to be established to help guide selection and use of the most appropriate salt management strategies. This section presents four basic policy options and narrative goals regarding how Zone 7 could manage its overall system operation to balance salt loading and the resultant delivered water quality impacts:

1. Maintain Status Quo
2. Improve Delivered Water Quality Through Future ASR Well Use
3. Operate to Achieve Salt Loading Goal Independent of Delivered Water Quality
4. Maintain/Improve Delivered Water Quality within Salt Loading Goals

Option 1: Maintain Status Quo—Option 1 represents the historic basin management strategy where the goals are for Zone 7 to deliver the maximum volume of surface water whenever possible and to use the groundwater basin only for peaking or when SBA supply is otherwise not available. This option results in a long-term annual average delivered water blend of approximately 85% imported surface water and 15% groundwater. Delivered water quality will therefore primarily remain a function of available surface water quality. With currently available facilities, this option provides the highest overall quality (lowest TDS) water delivered at Zone 7 turnouts. However, without offsetting salt loading, groundwater TDS levels and thus delivered water TDS levels will continue to proportionately increase.

Option 2: Improve Delivered Water Quality Through Future ASR Well Use—
Option 2 represents the case where Zone 7 would redirect more SBA water from stream recharge to the treatment plants and then after treatment inject it via ASR wells during low demand periods. The injected water would be extracted during summer months to meet peak demand. As available, excess treated water could also be injected and stored to create "bubbles" available to meet future peak and drought demand. The option could provide the best possible and least variable Zone 7 delivered water quality. However, groundwater quality outside of areas used by Zone 7 for ASR injection would degrade at a faster rate than in Option I. Groundwater pumped by Cal Water and Pleasanton would increase in TDS over time to the extent that artificial stream recharge previously directing lower TDS SBA water towards their wells was reduced. In addition, Zone 7's recent experience with ASR injection at its Hopyard wellfield suggests that ASR may not be a viable long-term option.

Option 3: Achieve Salt Loading Goal Independent of Delivered Water Quality—
Under Option 3, achieving the target salt loading goal would be a higher priority operating rule than maximizing delivered water quality. If, for example, a "No net salt loading to the main basin" goal were adopted, available facilities would be operated so that no net salt loading would be consistently attained and the water quality resulting from those operating conditions would be delivered to the turnouts. With currently available facilities, Option 3 would require increased groundwater pumping and recharge and reduced surface water deliveries (i.e., the mirror image of Option 1). Delivered water TDS levels would immediately increase, particularly in the western portion of the service area where the majority of wells are currently located. Over time, groundwater TDS levels would decrease.

Option 4: Maintain/Improve Delivered Water Quality within Salt Loading Goals—
Option 4 places a higher priority on delivered water quality goals than on salt loading

goals. It is similar to Option 3 except that a "trigger" level would be placed on delivered water quality, at which point salt management measures such as groundwater pumping that increase delivered water TDS would be reduced or terminated until TDS levels dropped below the trigger level. For example, during dry and drought periods imported surface water TDS levels may increase to a point where it was no longer possible to "blend down" pumped groundwater TDS and stay below the delivered water quality trigger.

Under Option 4, Zone 7 delivered water TDS levels could be maintained or improved while achieving salt loading goals a greater proportion of the time (although at increased costs) if adequately sized and appropriately located wellhead demineralization facilities were available for operation (see chapters 8-10).

GMAC and TAG Recommendation—The GMAC and TAG recommended Option 4, with the understanding that salt loading goals would be set to be achieved long-term, perhaps over a five-year time period. In dry years, for example, when it was not possible to achieve the goal without compromising delivered water quality, a salt "debt" would be accrued. When conditions permitted, as during a wet year, additional salt reduction measures would be implemented to offset the accrued salt debt.

7.4 East-West Delivered Water Quality Equivalency Options

A somewhat more narrow policy issue regards the extent to which measures should be implemented by Zone 7 and/or others to provide equivalent delivered water quality to customers. This policy issue impacts decisions on the siting, sizing, and manner of operating existing and proposed wells and demineralization facilities. Three options include:

1. Continue historic practices
2. Provide equivalent water quality at Zone 7 turnouts
3. Provide equivalent water quality at end-use points

Option 1: Continue Historic Practices—Historic operational practices result in a relatively low TDS in delivered water at Zone 7 turnouts, being a blend of approximately 85% imported surface water and 15% groundwater in average and wet water years (see Chapter 4). Customers in the east, closer to the water treatment plants, typically receive a higher percentage of treated surface water and, therefore, lower TDS water than customers in the western part of service areas. Zone 7 wells are used to meet peaking demand and when inadequate SBA water is available. This strategy generally results in minimum distribution system and well pumping costs for Zone 7. Delivered water quality varies seasonally and annually, primarily as a function of SBA water quality, and secondarily for well pumping and water routing decisions. Changes in relative blends can cause consumer complaints.

Pleasanton and Cal Water control operation of their wells. Customers near the Cal Water and Pleasanton wellfields receive higher percentage blends of groundwater (see Figure 4.14). During summer months, some customers may receive almost all groundwater.

Option 2: Provide Equivalent Quality Water at Zone 7 Turnouts—Under this option, Zone 7 would alter operation of its existing facilities and construct new facilities as needed so that all turnouts would receive equivalent and less variable water quality. Equivalent could be defined on a seasonal (best available) basis or on an annual average basis depending on the water quality goals selected.

This approach could be achievable long-term depending on results of the Well Master Plan and decisions regarding siting, timing, and operation of new Zone 7 wells. If ASR well operation had proven reliable, 100% ASR well operation might achieve the objective without a significant increase in delivered water TDS. In the near-term, the only way to achieve this goal would be for Zone 7 to significantly reduce surface water deliveries; increase groundwater pumping; and construct additional distribution system pumping, blending, and intertie facilities to route more groundwater from wellfields in the west to customers in the east.

Delivered water quality could degrade for many consumers due to the increased percentage groundwater pumping unless wellhead demineralization and/or a large amount of ASR well operation were implemented (by Zone 7 or the retailers). There would be potentially significant costs for additional distribution system pumping and blending. This could be done as a first step towards the more extreme equivalent end use delivered water quality goal (Option 3).

Option 3: Provide Equivalent Quality Water at End Use Points—This option would include the same features as Option 2, plus Zone 7 would need to coordinate valley-wide pumping and distribution system operations with Cal Water and Pleasanton so that all end use points would receive equivalent (and less variable) water quality. This option could entail significant costs beyond those for Option 2 for additional blending and/or wellhead demineralization facilities. There would also be significant institutional coordination issues to address.

GMAC and TAG Recommendation—The GMAC and TAG recommended that Zone 7 pursue an approach between Option 1 and 2. There was no support for spending public funds to "pump water in circles" and not improving water quality, versus spending funds for water quality improvement projects such as wellhead demineralization. It was recommended that Zone 7 consider Option 2 as a long-term goal and attempt were feasible to site new wells and facilities where they would contribute towards the goal of more equivalent delivered water quality.

7.5 TDS Concentration Effects on Consumer Acceptability and Costs

To provide background information regarding setting TDS (mineral) goals or guidelines for delivered water quality, a literature search was conducted and a technical memorandum prepared summarizing available information on consumer acceptability of, and indirect or "penalty" costs associated with, varying levels of TDS and hardness in delivered water. That memorandum and an AWWA1990 TDS standards review paper are included at the end of this report in Reference L. Key issues are presented in this section.

California Mineral Taste Survey—In the late 1960's and early 1970's the California Mineral Taste survey (CMTS) was conducted to formulate a rationale for evaluating and recommending standards governing mineral content in drinking water. The research had three specific aims: 1) To relate the TDS in domestic water to consumer evaluation of taste quality by a taste scale rating (TSR) procedure; 2) To relate TDS in domestic water to the out-of-pocket monthly penalty cost aggregate incurred because of minerals in water; and 3) To relate TDS in domestic water to the amount consumers would be willing to pay more per month for improved quality.

This major research effort was composed of thirteen separate studies. Three of the thirteen studies were performed to establish the relationship between taste evaluation and mineral content. One of these three studies was performed in a controlled laboratory environment using a taste panel to obtain ratings of taste quality. The second study surveyed 29 communities and 1700 respondents. The final study investigated 15 urban water service areas and the relationship between mineral content, taste quality, income level, and bottled water consumption of 1500 consumers. Results from the third study are based on data from Oakland, San Francisco, San Jose, Sacramento, Los Angeles, and San Diego ("Consumer Evaluation of the Cost and Quality of Domestic Water", 1976, UC Davis Water Resources Center).

Customer Satisfaction—From the various surveys, regression equations were developed relating consumer taste scale rating results to mineral content in drinking water. A pooled regression equation using 4,940 data points from the surveys demonstrated that there was a linear relationship between increasing TDS and decreasing taste quality (palatability) of water. This relationship was then used to develop five qualitative TDS potability (acceptability) grades based on specified percentages of respondents rating their water below neutral on the CMTS Taste Quality Rating Scale. A neutral rating on the Taste Quality Rating Scale meant that the consumer perceived the water to have neither good nor bad taste ("This water has a neutral taste").

The "excellent" category corresponded to 0-15 percent of consumers rating their water below neutral; the "good" category corresponded to 16-25 percent of consumers rating their water below neutral; the "fair" category corresponded to 26-35 percent of consumers rating their water below neutral; the "poor" category corresponded to 36-45 percent of consumers rating their water below neutral; and the "unacceptable" category corresponded to greater than 45 percent of consumers rating their water below neutral. The TDS concentrations associated with those percentages are shown in Table 7.1. It should be noted that these discrete grades are superimposed on a continuous (linear) relationship. Additionally, it should be realized that the subdivisions between grades were to some degree arbitrary. Therefore, TDS values corresponding to or near boundary percentages should not be considered significantly different than each other simply because they correspond to different grades (i.e., 80 vs 81 mg/L, 450 vs 451 mg/L, etc.).

Table 7.1
Recommended TDS Standards Based on Pooled CMTS Data

Potability	Excellent	Good	Fair	Poor	Unacceptable
Grade	A	B	C	D	F
Percent below Neutral[1]	0-15	16-25	26-35	36-45	46-100
TDS mg/L	<=80	81-450	451-760	761-1020	>1021

[1]Percent below neutral on the Taste Quality Rating Scale

Customer satisfaction with the taste and palatability of drinking water, is less straightforward than the research summarized above indicates. Practical palatability is also related to habit, "training" of the palate, and individual preferences, in addition to those factors noted above.

Results from another CMTS study indicated that anions rather than cations exert the major differential effect on taste of drinking water. That study reported that among anions, taste quality was least degraded by bicarbonate (HCO_3), next least by sulfate (SO_4), then by chloride (Cl), and most by carbonate (CO_3). Temperature was found to have a small and mixed effect on the taste of mineralized water samples.

Care needs taken in extrapolating the above results to the Zone 7 service area where delivered water quality can vary by season, location, and on the relative amount of surface versus groundwater delivered. Variability in source water blends has been reported to be a more significant determinant of consumer acceptability (or lack thereof) than the actual TDS or hardness level.

The CMTS equations were used to present the percentage of customers rating the water below "neutral" by 50 and 100 mg/L increments of TDS from 50 to 900 mg/L. Table 7.2 shows that between 200 and 500 mg/L TDS, the percentage of consumers who would rate their water below neutral increases by approximately 1.5 percent for each increase of 50 mg/L TDS. These ratings assume that all consumers would be supplied with the same water supply.

Table 7.2
Summary of TDS and the Percentage of Customers Rating Their Water Below Neutral on the Taste Quality Rating Scale[1]

TDS mg/L	Potability Grade[2]	Percent Rating Below Neutral [3]
50	A	14.5
100		15.6
200		18.0
250		19.3
300	B	20.7
350		22.0
400		23.5
450		25.0
500		26.5
600		29.8
700	C	33.1
800		36.7
900		40.3

[1] Based on CMTS Methodology
[2] Based on Reference [5]
[3] Percentage of Consumers Likely to Rate Their Water Below Neutral on the Taste Quality Rating Scale

For comparative purposes the annual average TDS of Zone 7 deliveries between 1972 and 1996 ranged from 250 mg/L to 440 mg/L. If Zone 7 customers respond as did those in the CMTS, the percentage of consumers likely to rate their water as having below neutral taste would have ranged from approximately 17 to 25 percent, respectively. Actual water quality will vary more than indicated by the annual averages given the variability discussed above.

Costs Associated with Changing TDS—There are a number of indirect consumer costs (penalty costs) which may be associated with increased TDS or hardness levels in drinking water. Increased costs include, but are not limited to, the costs of bottled water for drinking and non-drinking purposes, monthly costs of operating a water softener, water softener additives, shortened life-span of water heaters and other appliances using water due to corrosion, additional soap and cleaning supplies, and additional plumbing repairs. The 1982 Zone 7 Wastewater Management Plan indicated that a reasonable penalty cost for increased salinity could be estimated as $30/AF per 100 mg/L TDS increase per year. This can be interpreted as a $15 penalty per household per year for each increase of 100 mg/L in delivered water (assuming 0.5 AF/household/year).

Limited literature is available on consumer costs associated with TDS and hardness levels. A salinity management study conducted for the Metropolitan Water District of Southern California estimated about $750 million in overall service area annual economic damages at current salinity levels to users of Colorado River Water. The estimates varied with the blend of Colorado River supply with other supplies, ranging from $50-$110 per household per year. Residential damages due to salinity included in the estimate were the reduced life spans of plumbing facilities and appliances using water, increased cleaning costs, home water treatment systems, and the purchase of bottled water. The report also documented damages to water and wastewater utilities and industrial users due to increased salinity.

The CMTS research found that the "fair" taste of tap water associated with a TDS of 500 mg/L would cause an estimated 25% of consumers to purchase bottled water for consumption. The research found that TDS and taste scale ratings correlated with bottled water use, but average per capita yearly income did not.

GMAC Taste Test Results—The GMAC conducted a one-time informal taste test of groundwater (from Hopyard 1 well) blended with distilled water to provide a six sample TDS range from 0 to 360 mg/L. Results varied by participant and showed no significant pattern of preference over this TDS range.

7.6 RO Recycled Water Blending and Ownership

Preliminary discussions were held regarding Livermore and DSRSD members of the TAG during development of this SMP regarding RO recycled water injection and impacts on basin management. Discussions focused on identifying alternative approaches for complying with Title 22 blending water requirements; potential joint use of injection facilities; and ownership options for injected water, recycled water, and associated salt credits. The discussions were put on hold in late 1998 prior to reaching agreement on specific recommendations. The intent of this section is to capture the range of options and associated rationale discussed for use if at some point in the future it is deemed acceptable for some form of RO recycled water injection project to proceed.

Treated Water Injection Options—To meet its long-term operational goals of maintaining sustainable delivered water quality and groundwater quality, Zone 7 needs additional groundwater recharge and related facilities. Zone 7 has suspended future construction of aquifer storage and recovery (ASR) wells. ASR wells would help maintain or improve delivered water quality but would not beneficially affect groundwater quality or the basin salt balance during normal operation, nor was recent testing of the process at the Hopyard wellfield considered successful.

Injection of treated surface water into the main groundwater basin and withdrawal downgradient by Zone 7 production wells (i.e., conjunctive use) can improve groundwater quality and the basin salt balance. Depending on the proximity of the injection and extraction wells, the zone of higher quality (lower TDS) groundwater created would over some period of time reach the extraction well(s) and improve extracted groundwater quality and, thereby, delivered water quality.

One near-term salt management strategy (see Chapter 8) is for Zone 7 to begin to shift its water resources management strategy towards more conjunctive use and reduced delivery of surface water. More SBA water could be redirected to stream recharge or more treated water redirected to injection well recharge. Alternatively, treated water could be injected in cooperation with Livermore and/or DSRSD via unused well capacity. Further study would be required before these alternatives might be implemented.

Blending Water Source and Injection Options—The Livermore Advanced Water Reclamation Facility (AWRF) and DSRSD Clean Water Revival Project (CWR) were both designed with the future goal of injecting RO recycled water into the main groundwater basin to increase the local water supply, improve groundwater quality, and increase wastewater disposal capacity.

For such recycled water groundwater injection projects, the proposed Title 22 groundwater recharge criteria states that 1) extracted groundwater never contain more than 50% recycled water, 2) potable wells be prohibited within 2,000 feet of any recycled water injection well, and 3) recycled water remain a minimum of one year underground before extraction. The 2,000 foot and one-year retention time restriction zones could be complied with by the two projects as proposed. The 2,000-foot radius is the more restrictive of the two requirements given that it was estimated to take up to several years for recycled water to move that far from either the AWRF or CWR proposed injection sites.

To comply with the Title 22 50% maximum extracted recycled water requirement, Zone 7 would need to track the movement of any injected recycled water to ensure that no groundwater with greater than 50% recycled water was extracted from new or existing wells and used for potable purposes. While this is feasible with appropriately placed monitoring wells and with the proposed noble gas tracer addition, it adds considerable complexity to the modeling, monitoring program and well restriction program requirements. If such injection projects were to proceed in the future, Zone 7 proposed to work cooperatively with the cities and water purveyors to monitor and ensure compliance with this requirement in part through negotiation and implementation of an injection/blending water agreement.

The CWR and AWRF groundwater injection facilities have excess injection capacity for redundancy and/or to allow for seasonal operation at higher capacities. In the proposed CWR implementation plan, CWR, during the initial five years of operation, would only inject a maximum of 1,000 afa versus the design capacity of 2,500 afa. If suitable institutional arrangements could be negotiated, Zone 7 could potentially meet some of its needs for additional recharge capacity and salt loading reduction by using the excess capacity of these facilities, when available, to inject treated surface water into the groundwater basin.

As an example, under an injection/blending agreement, Zone 7 could provide treated surface water and be allowed to inject it using the CWR facilities up to the maximum excess capacity of these facilities. If RO recycled water injection were to proceed in the future, Zone 7 could also potentially commit to injecting, for example, on a five-year average basis, an amount equal to that injected by the recycled water injection projects to meet the Title 22 50% blending requirements. This could be accomplished via in-well mixing or potentially by injection into a relatively nearby downgradient well.

The mode of operation could provide some operational flexibility to Zone 7 and by meeting the intent of the Title 22 50% blending requirement in the vicinity of the recycled water injection wells, it could potentially reduce the extent and cost of groundwater monitoring and modeling required to track the injected recycled water. The well restriction program would also be greatly simplified, only having to address the 2,000-foot radius area around the recycled water injection wells (i.e., there would be no zones of greater than 50% injected recycled water present). Local groundwater mineral quality would also improve more, and a larger salt removal credit generated by recharging/blending with low TDS surface water versus proposed CWR blending and recharging with high TDS groundwater.

Blending Water Cost and Ownership Options—There are several potential blending water cost and ownership options. One of the simplest, from a water inventory standpoint, would be for Zone 7 to continue to "own" the treated surface water used as blending water. Zone 7 could commit to providing excess (surplus) treated surface water for injection and blending in the vicinity of the recycled water recharge projects. In this scenario, Zone 7 would view the blending water as just one more part of its many other groundwater recharge operations conducted for sustainable basin management.

Zone 7 marginal treated water costs are about $20/AF. Zone 7 could provide 100% blending for what it would cost to pump groundwater (at $60/AF) for a 33% blend. One Zone 7 option would be to provide blending water at no cost to Livermore and/or DSRSD and simply meld the $20/AF cost into its overall basin management costs. A related decision in this case would involve whether Zone 7 would in return for the free or marginal cost blending water be eligible for some of the salt loading credits resulting from the project. Alternatively, DSRSD or Livermore could purchase blending water from Zone 7 (at a rate to be determined) and be allowed to pump an equivalent amount of groundwater (perhaps minus agreed upon basin losses) elsewhere via an increased Independent Quota.

Injected RO Recycled Water Ownership Options—Cost (value) and ownership options for injected RO recycled water were addressed independently of blending water issues given the additional complexities involved. Two preliminary options would be for DSRSD and Livermore to retain ownership or for them to transfer ownership, under yet to be determined conditions, to Zone 7.

From a basin management standpoint an argument can be made that it would be simpler to have one entity controlling what is recharged and where and to also be responsible for tracking and managing the basin inventory and salt balance.

Ownership of the salt credits generated by such projects could be linked to ownership of the recycled water or not (see Section 11.7). Conceivably the water could be sold (for a lower price) and the salt credits retained by the original owner. Many pricing strategies are possible. Zone 7 executed an agreement with Livermore to purchase RO recycled water produced over a five-year period at $500/AF up to a maximum of $2 million.

Zone 7 will be reviewing overall basin management relative to the use of the Chain of Lakes. The Chain of Lakes could provide additional options for capturing, storing, and recharging waters from various sources, including recycled water. Given these uncertainties, it might be prudent and expedient to consider negotiating short-term rather than long-term contracts.

As discussed further in chapters 11 and 12, additional discussions beyond the scope of this near-term SMP will need to be held to select mutually acceptable strategies for accommodating increased RO and non-RO recycled water use in the valley.