Memorandum

Airy Krich-Brinton
Jeannette Sager
Mike Trouchon
Rachel Warren
707 4th Street, Suite 200
Davis, CA 95616
530.753.6400
530.753.7030 fax
airyk@LWA.com
jeannettes@LWA.com
miket@LWA.com
rachelw@LWA.com

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TO: Betty Yee, CVRWQCB
Debbie Webster, CVCWA

COPY TO: Tom Grovhoug

SUBJECT: **Technical Evaluation of a Variance Policy and Interim Salinity Program for the Central Valley Region**

I. INTRODUCTION

The management of salts in the surface water and groundwater of the Central Valley has been a central focus of the water quality control plans (Basin Plans) for the Sacramento-San Joaquin and Tulare basins since their adoption in 1975. The management of salts is also a primary issue in the Bay-Delta Plan that is adopted and implemented by the State Water Resources Control Board. Salts management is needed to protect municipal and agricultural beneficial uses and to avoid long-term increases in salt levels to detrimental levels in soils and waters of the Central Valley.

The Central Valley Regional Water Quality Control Board (Central Valley Water Board) and State Water Resources Control Board (SWRCB or State Water Board), working with a stakeholder coalition, are developing a comprehensive salinity and nutrient management plan for the Central Valley. The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is a strategic initiative to address salinity and nitrates in the surface water and groundwater of the valley. The long-term plan developed under CV-SALTS will identify effective and efficient management and regulation of major sources of salts and nitrates. The SWRCB is also in the process of reviewing and possibly revising existing salinity standards for the Sacramento-San Joaquin Bay-Delta.

A serious issue exists regarding the adoption of final effluent limits for salts in three recent National Pollutant Discharge Elimination System (NPDES) permits in the Delta for the communities of Tracy, Stockton and Manteca. These effluent limits, which were derived without the benefit of knowing the ultimate CV-SALTS or Bay-Delta standards determinations and may not, in fact, be consistent with those future outcomes, are placing these communities in an untenable compliance position. In each instance, the effluent limits are unattainable through any means short of reverse osmosis treatment of a portion of the total effluent discharged from the community. Other communities with NPDES permits face similar situations and similar concerns. Concern also exists that problematic effluent limits for salts are being or will be required in other permits, in the form of Waste Discharge Requirements (WDRs) in the Central Valley (e.g. City of Fresno). The need exists to implement regulatory approaches that result in requirements which are consistent with the management plans being developed under CV-SALTS and in the State Water Board's Bay-Delta Plan and which are commensurate with the water quality benefits that can be achieved through reasonable management actions by Central Valley communities.

The Central Valley Water Board has examined alternative mechanisms to address situations such as the one described above, where discharger compliance with water quality standards is currently infeasible, and where changes in those standards and/or the implementation of those standards are in development. An interim salinity program, which includes a water quality standards variance policy applicable to surface waters and a case-by-case exception for effluent limits in WDRs, would provide a necessary short-term regulatory tool while long-term holistic solutions and revised standards and effluent limits are under development.

For surface waters, United States Environmental Protection Agency (USEPA) guidance indicates that a water quality standards variance has been and can be used to provide a mechanism by which NPDES permits can be written where discharger compliance with the underlying water quality standards is demonstrated to be infeasible at the present time within the meaning of 40 CFR 131.10(g) (US EPA, 1998). The justification for a variance policy applicable to surface waters contained within this memorandum is based on consideration of the factors specified in 40 CFR 131.10(g).

This memorandum provides the technical evaluation of a variance policy and interim salinity program and is organized as follows:

II. SUMMARY OF EFFLUENT QUALITY OF AFFECTED NPDES AND WDR PERMITTEES

The NPDES permittees that are examined in this evaluation and would be affected by a salinity variance (applicable to surface water dischargers) include the City of Tracy, the City of Stockton, and the City of Manteca. The WDR permittee evaluated herein for a case-by-case effluent limit exception is the City of Fresno. In this section, a summary of the respective effluent quality for each of these permittees is provided in the form of summary statistics for effluent electrical conductivity (EC) and total dissolved solids (TDS) concentrations.

a. Effluent Quality: City of Tracy Wastewater Treatment Plant

Summary statistics for the City of Tracy's Wastewater Treatment Plant (WWTP) effluent EC and TDS concentrations are shown in **Table 1**.

Table 1: Summary of City of Tracy WWTP Effluent EC and TDS (March 2009 to March 2011).

	Average Monthly EC (µmhos/cm)		Average Monthly TDS (mg/L)	
Statistic	**Apr 1 – Aug 31 (limit 700)**	**Sep 1 – Mar 31 (limit 1000)**	**Apr 1 – Aug 31**	**Sep 1 – Mar 31**
Maximum	1317	1290	780	746
Minimum	1092	1068	651	628
Average	1223	1169	716	673
Standard deviation	80	68	48	32

b. Effluent Quality: City of Stockton Regional Wastewater Control Facility

Summary statistics for the City of Stockton's Regional Wastewater Control Facility (RWCF) effluent EC and TDS concentrations are shown in **Table 2** and **Table 3**.

Table 2: Summary of City of Stockton RWCF Effluent EC (October 2006 to April 2011).

	Average Monthly EC (µmhos/cm)		
Statistic	**Apr 1 – Aug 31 (limit 700)**	**Sep 1 – Mar 31 (limit 1000)**	**Annual Average EC (limit 1300[(1)] µmhos/cm)**
Maximum	1214	1192	1228
Minimum	995	892	1054
Average	1111	1026	1167
Standard deviation	48	68	68

Note:

1. Order No. R5-2008-0154 includes a final, provisional, annual average performance-based effluent limitation of 1300 µmhos/cm for EC to protect the receiving water from further salinity degradation based on the highest annual average RWCF effluent concentration. This effluent limitation will remain in effect as long as the City of Stockton implements the provisional requirements to submit and implement a Salinity Plan. If the City fails to implement these provisional requirements, then the Order requires the Discharger to comply with the Bay-Delta Plan seasonal monthly average EC effluent limits of 700 µmhos/cm (April through August) and 1000 µmhos/cm (September through March).

Table 3: Summary of City of Stockton RWCF Effluent TDS (October 2006 to April 2011).

Statistic	Average Monthly TDS (mg/L) Apr 1 – Aug 31	Average Monthly TDS (mg/L) Sep 1 – Mar 31	Annual Average TDS (mg/L)
Maximum	723	704	660
Minimum	585	514	629
Average	656	608	639
Standard deviation	35	47	11

c. Effluent Quality: City of Manteca Wastewater Quality Control Facility

Summary statistics for the City of Manteca's Wastewater Quality Control Facility (WQCF) effluent EC and TDS concentrations are shown in **Table 4**.

Table 4: Summary of City of Manteca WQCF Effluent EC and TDS between 9/2007 – 3/2011.

	Average Monthly EC (µmhos/cm)		Average Monthly TDS (mg/L)	
Statistic	Apr 1 – Aug 31 (limit 700)	Sep 1 – Mar 31 (limit 1000)	Apr 1 – Aug 31	Sep 1 – Mar 31
Maximum	843	827	499	503
Minimum	696	667	335	375
Average	763	741	455	437
Standard deviation	40	40	39	36

d. Effluent Quality: Cities of Fresno and Clovis (Fresno-Clovis) Metropolitan Regional Wastewater Reclamation Facility

Summary statistics for the Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility (RWRF) effluent EC and TDS concentrations are shown in **Table 5**.

Table 5: Summary of Fresno-Clovis Metropolitan RWRF Effluent EC between 1/2005 – 3/2011 and TDS between 1/2006 – 3/2011.

Statistic	Average Monthly EC (µmhos/cm)	EC Source Water-Based Limit[1] (µmhos/cm)	Average Monthly TDS (mg/L)
Maximum	969	799	495
Minimum	742	766	390
Average	827	781	446
Standard deviation	53	10	24

Note:

1. Calculated per Waste Discharge Requirements Order No. 5-01-254: "The monthly average EC of the discharge, shall not exceed the flow-weighted average EC of the source water plus 500 µmhos/cm, or a maximum of 900 µmhos/cm, whichever is less. The flow-weighted average for the source water shall be a moving average for the most recent twelve months." The source water-based limit was calculated for each month beginning in December 2005 (i.e., using January 2005-December 2005 data). See **Table 6.**

III. DESCRIPTION OF COMPLIANCE ISSUE

This section contains a description of the current and future compliance issues facing each community evaluated, and the ability of each to meet effluent limits for electrical conductivity through means other than reverse osmosis, including potential or implemented source control, new surface water supplies, or other methods. The current permit requirements for these dischargers are presented in **Table 6**.

Table 6: Summary of Current Permit Requirements for Salinity for Select Central Valley Dischargers.

Regulated Entity	NPDES Permit Order No.	Final Effluent Limitations for EC (µmhos/cm)			State Water Board Remand Order
		Annual Average	Monthly Average	Maximum	
City of Tracy	R5-2007-0036	N/A	700 (Apr 1 – Aug 31) 1,000 (Sep 1 – Mar 31)	N/A	WQ 2009-0003
City of Stockton	R5-2008-0154	1,300	700 (Apr 1 – Aug 31) 1,000 (Sep 1 – Mar 31)	N/A	WQ 2009-0012
City of Manteca	R5-2009-0095	N/A	700 (Apr 1 – Aug 31) 1,000 (Sep 1 – Mar 31)	N/A	None
City of Fresno	5-01-254	N/A	N/A	Most stringent of source water flow-weighted 12-month moving average EC plus 500, or 900[a]	None

Notes:
N/A = Not applicable
a. Summary statistics for the calculations of source water EC plus 500 for each month, based on the most recent 12 months, are included in **Table 5** for the time period indicated.

a. Compliance Issue: City of Tracy Wastewater Treatment Plant

The City of Tracy WWTP is currently discharging pursuant to Order No. R5-2007-0036 and NPDES Permit No. CA0079154 (CRWQCB, Central Valley Region, 2007). Final effluent limitations for EC consistent with those in the Bay-Delta Plan are delineated in Section IV.A.1.i. of that Order; however, they are only effective if the City of Tracy does not submit a Salinity Plan or fails to implement such a Salinity Plan in a timely manner after it is approved. That is, if the City of Tracy submits and implements an approved Salinity Plan, no enforceable final effluent limitations for EC are specified.

Petitions were filed with the State Water Board requesting review of this Order. In response to some of the objections raised by one of several petitioners (California Sportfishing Protection Alliance (CALSPA)), the State Water Board issued a remand order (Order WQ 2009-0003, dated May 19, 2009) (CSWRCB, 2009a) that addressed, among other issues, the final effluent limitations for EC. This remand order requires the Central Valley Water Board to amend Order No. R5-2007-0036 “to include a final effluent limitation for EC in compliance with the objectives in the Bay-Delta Plan, and, if appropriate, initiate a water quality planning process” to achieve compliance without the need for reverse osmosis. The State Water Board suggested that the following be considered when evaluating “interim” planning options to resolve the salinity problem for the City of Tracy, although it does not comment on the appropriateness of any of these options:

- City of Tracy salt reduction study
- TMDL for EC in Old River
- Site-specific objectives in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Sacramento-San Joaquin Basin Plan)
- Request to State Water Board for amendment to the Bay-Delta Plan
- Outcomes from CV-SALTS
- Near-term planning options:
    - Variances
    - Site-specific objectives
    - Policy allowing offsets

The State Water Board also suggested that if an interim planning option is pursued, both short- and long-term management strategies should be implemented. In Order WQ 2009-0003, the State Water Board acknowledged that “while salts present a difficult long-term management challenge, they are more amenable to interim planning solutions than bioaccumulative or toxic pollutants” (p. 10, footnote 17). In other words, the water quality impacts associated with salt concentrations tend to be chronic rather than acute and manifest in the long-term rather than the short-term. The implication is that approval of one of the interim approaches suggested above may be easier for salts than for other pollutants.

The City of Tracy contested SWRCB Order No. WQ 2009-0003 in Sacramento County Superior Court. On May 10, 2011, the court issued a Final Statement of Decision requiring the SWRCB to reconsider and revise Order No. WQ 2009-0003. Additionally, a Judgment Granting Peremptory Writ of Mandamus was issued on June 1, 2011 (*City of Tracy vs. State Water Resources Control Board*, 2011). The outcome of the SWRCB’s reconsideration and revision is pending. The City of Tracy WWTP monthly average effluent EC and permit limits are presented in **Figure 1**. It can be seen that, although effluent EC levels have decreased during the timeframe shown, all of the monthly average values measured since January 2006 have exceeded the AMEL of 700 µmhos/cm between April 1 to August 31 and 1000 µmhos/cm between September 1 to March 31.

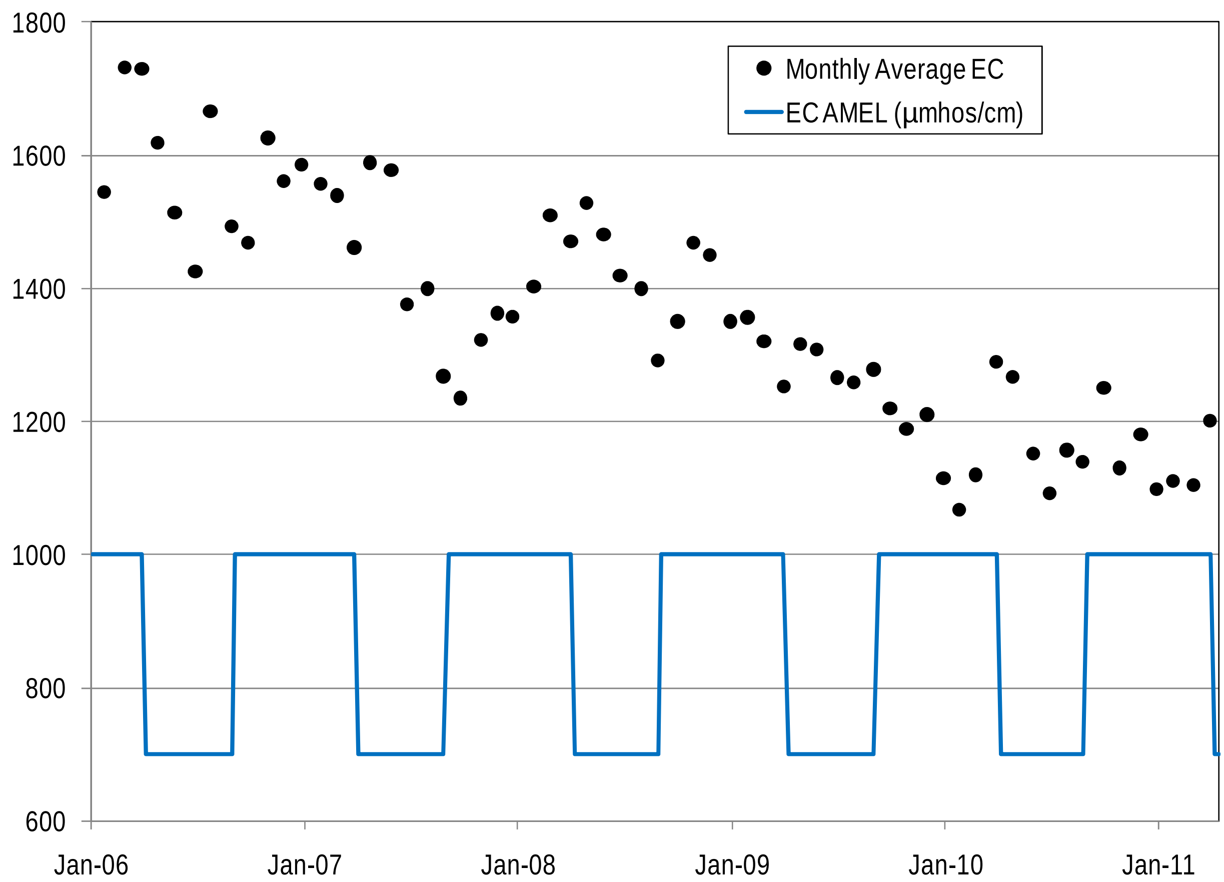

Figure 1: City of Tracy WWTP: Electrical Conductivity Concentrations and Effluent Limits.

b. Compliance Issue: City of Stockton Regional Wastewater Control Facility

The City of Stockton RWCF is subject to waste discharge requirements as promulgated by the Central Valley Water Board in Order No. R5-2008-0154 (CRWQCB, Central Valley Region, 2008). Final effluent limitations for EC consistent with those in the Bay-Delta Plan are delineated in Section IV.A.1.j. of this Order; however, as with Order No. R5-2007-0036 (for the City of Tracy), these limits are only effective if the City of Stockton does not submit a Salinity Plan or fails to implement such a Salinity Plan in a timely manner after it is approved. That is, if the City of Stockton submits and implements an approved Salinity Plan, no enforceable final effluent limitations for EC are specified. The Order also contains a performance-based requirement – an annual average limit of 1,300 µmhos/cm. The City of Stockton is requesting a salinity variance to temporarily suspend the requirement for submittal and implementation of a Salinity Plan and to avoid the requirement to comply with the EC objectives contained in the Bay-Delta Plan.

Petitions were filed with the State Water Board in November 2008 requesting review of this Order. In response, the State Water Board issued a remand order (Order WQ 2009-0012, dated October 6, 2009) (CSWRCB, 2009b) that addressed, among other issues, the final effluent limitations for EC. In the discussion, the State Water Board references Order WQ 2009-0003 (City of Tracy) and reiterates that the manner in which the final effluent limitations were incorporated into both permits was "inappropriate and improper". In response to the City of Stockton's challenge of all provisions regarding EC and salinity reduction, the State Water Board states that reduction of salinity is both appropriate and necessary. The State Water Board also notes that the City of Stockton may be able to comply with the performance-based annual average limit of 1,300 µmhos/cm during the winter. The remand order requires the Central Valley Water Board to revise the final effluent limitation for EC in Order No. R5-2008-0154 "so that they are not contingent on submission of and compliance with a salinity plan". The City of Stockton RWCF monthly average effluent EC and permit limits are presented in **Figure 2**.

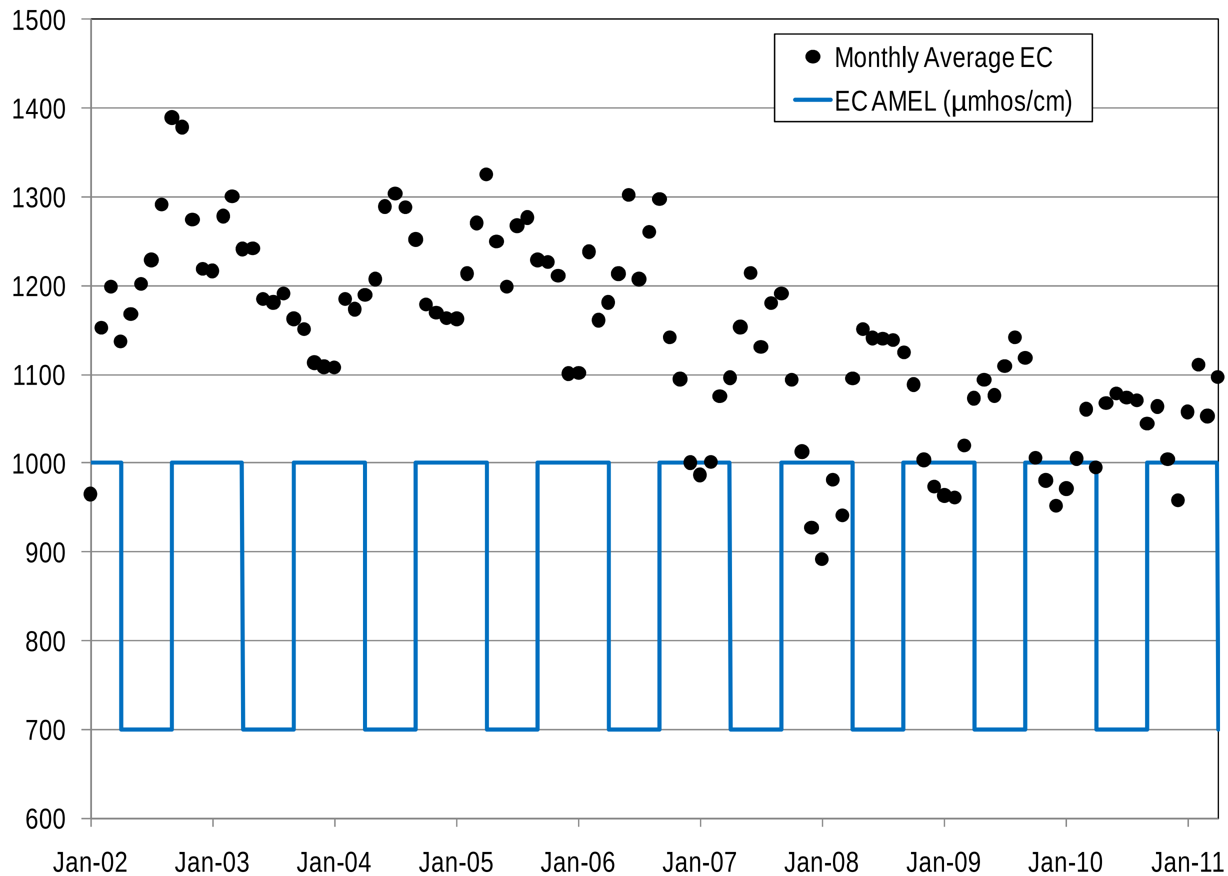

Figure 2: City of Stockton RWCF: Electrical Conductivity Concentrations and Effluent Limits.

c. Compliance Issue: City of Manteca Wastewater Quality Control Facility

The City of Manteca WQCF is subject to waste discharge requirements as promulgated by the Central Valley Water Board in Order No. R5-2009-0095 (CRWQCB, Central Valley Region, 2009). This Order contains final effluent limitations for EC consistent with the salinity objectives in the Bay-Delta Plan for the southern Sacramento-San Joaquin Delta for the protection of agricultural irrigation uses (Order No. R5-2009-0095, Section IV.A.). The final effluent limits vary seasonally from 700 µmhos/cm (April 1 to August 31) to 1000 µmhos/cm (September 1 to March 31). Time Schedule Order No. R5-2009-0096, containing a non-seasonal interim effluent limitation of 1000 µmhos/cm and a time schedule for achieving compliance with the final effluent limitations, was also issued by the Central Valley Water Board.

The City of Manteca filed a Petition for Review with the State Water Board, challenging certain provisions of Order No. R5-2009-0095 and the Time Schedule Order, and concurrently requested a stay of the 700 µmhos/cm seasonal (April 1 to August 31) effluent limit, as well as the Time Schedule Order. The stay was requested to provide time for the State Water Board to act on the petition. The State Water Board denied the stay request on February 26, 2010. The City of Manteca appealed the denial, and the courts upheld the appeal. The State Water Board withdrew its denial of the stay request on December 14, 2010. However, the stay was accepted only for the final effluent limitation of 700 µmhos/cm, not the Time Schedule Order.

In 2005, the State Water Board issued the City of Manteca Order WQ 2005-0005 (SWRCB, 2005), which contained a discussion of the salinity situation. The State Water Board asserts:

> In the present case, the record indicates that the 700 µmhos/cm EC receiving water objective for April through August in the southern Delta frequently is not met, and that requiring the City to comply with an effluent limitation of 700 µmhos/cm EC would not significantly change the EC of water in the southern Delta area. In addition, the State Water Board's 1991 and 1995 Delta Plans, Revised Water Right Decision 1641, and State Water Board Resolution No. 2004-0062 all establish that the intended implementation program for meeting the 700 µmhos/cm EC objective was based primarily upon providing increased flows, possible construction of salinity barriers, and reducing the salt load entering the San Joaquin River from irrigation return flows and groundwater. (p. 13)

The City of Manteca WQCF monthly average effluent EC and permit limits are presented in **Figure 3**.

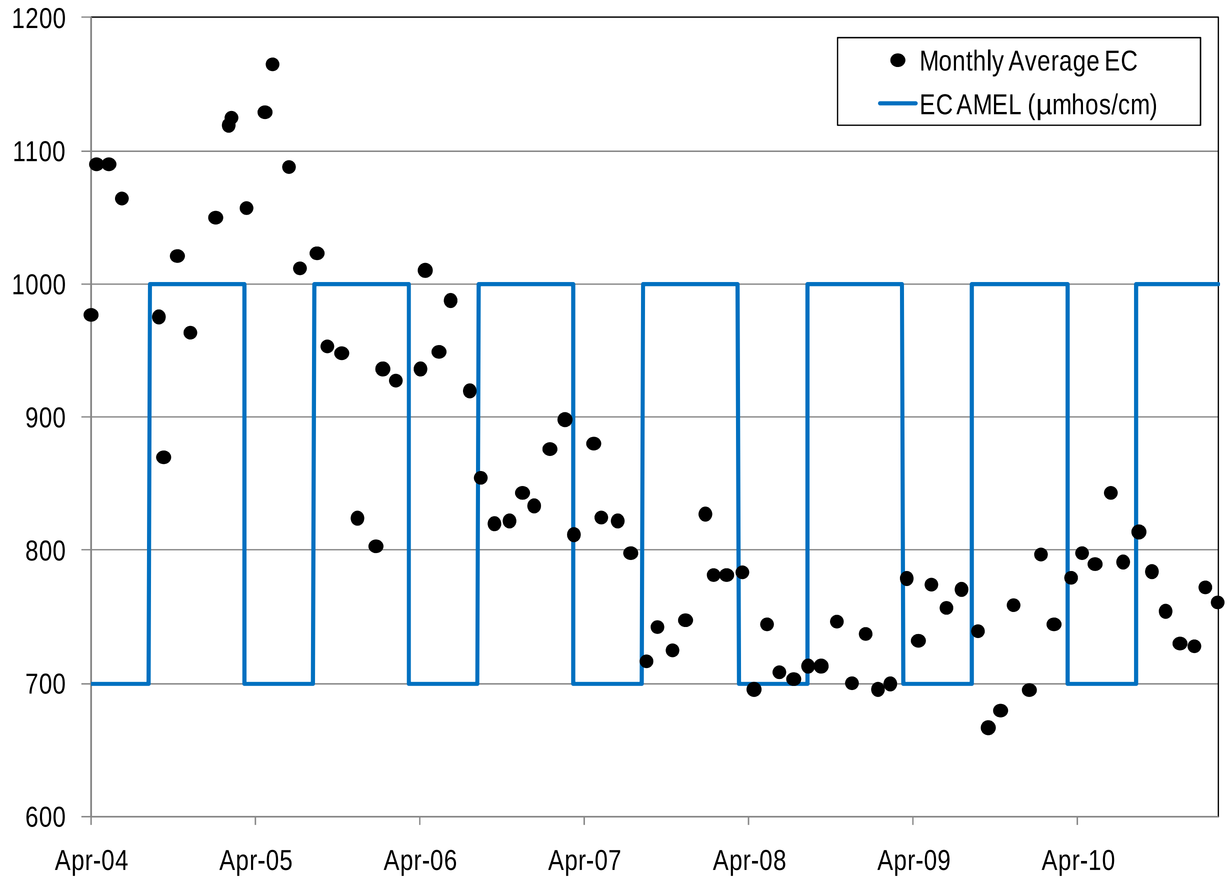

Figure 3: City of Manteca WQCF: Electrical Conductivity Concentrations and Effluent Limits.

d. Compliance Issue: Cities of Fresno and Clovis (Fresno-Clovis) Metropolitan Regional Wastewater Reclamation Facility

The Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility (RWRF) is subject to waste discharge requirements as promulgated by the Central Valley Water Board in Order No. 5-01-254 (CRWQCB, Central Valley Region, 2002). This Order contains both final effluent limits and specifications for discharge to groundwater. Final effluent limitations for EC are as follows:

> The monthly average EC of the discharge, shall not exceed the flow-weighted average EC of the source water plus 500 µmhos/cm, or a maximum of 900 µmhos/cm, whichever is less. The flow-weighted average for the source water shall be a moving average for the most recent twelve months. (Section B.4.)

The specifications regarding discharges from the RWRF to groundwater are as follows:

> G. Groundwater Limitations. Release of waste constituents from any storage, treatment, or disposal component associated with the RWRF shall not, in combination with other sources of the waste constituents, cause groundwater

under and beyond the RWRF and discharge area(s) to exceed any of the following: [. . .]

2. Constituent concentrations listed below or natural background concentration, whichever is greater: [EC limitation is specified in table as 990 µmhos/cm.] (Section G.2.)

The Fresno-Clovis Metropolitan RWRF monthly average effluent EC and narrative permit limits are shown in **Figure 4**.

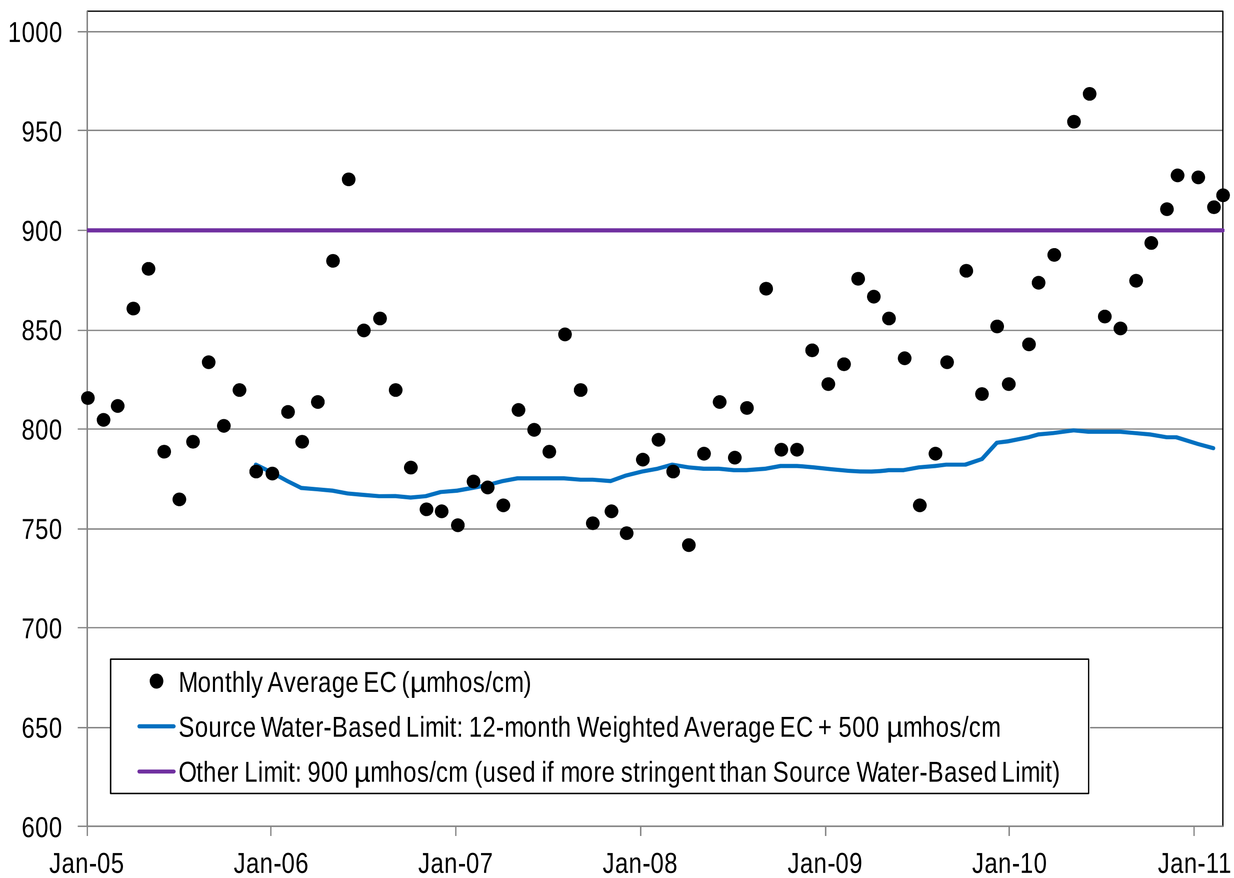

Figure 4: Fresno-Clovis Metropolitan RWRF: Electrical Conductivity Concentrations and Effluent Limits.

IV. SUMMARY OF SOURCE CONTROL PROGRAMS

This section contains a summary of the source control programs that have been implemented and the effectiveness of those programs.

a. Source Control: City of Tracy Wastewater Treatment Plant

Source control information for the City of Tracy was taken from the memorandum *Infeasibility Analysis and Compliance Schedule Justification in Support of a Time Schedule Order for the City of Tracy Wastewater Treatment Plant and NPDES Permit Modifications*, dated September 20, 2010 (City of Tracy, 2010), and from Steve Bayley, City of Tracy Deputy Director for Public Works (Bayley, 2011).

Concentrations of EC in the WWTP effluent have steadily decreased in recent years due to source control efforts, as shown in **Figure 5**. By implementing changes to water supply and industrial source control practices, the City of Tracy has achieved a 25% reduction in WWTP effluent EC, from average monthly levels of 1580 µmhos/cm prior to 2007, to 1191 µmhos/cm in more recent years (March 2009 – April 2011).

i. Water Supply Source Control

In the 1980s, the City of Tracy recognized that the continued use of increasingly mineralized native groundwater was degrading the quality of potable water delivered to its customers. The City Council adopted a policy in 1993, as part of the City's General Plan, stating that use of the native groundwater was to be reduced and the groundwater reserved for emergency purposes. At the same time, City staff evaluated the possibility of utilizing Sierra snowmelt water as a potable water source. In 1995, the City Council approved participation in the water supply project, in conjunction with the South San Joaquin Irrigation District and three other participating cities. This project included the construction of a drinking water treatment plant and approximately 40 miles of pipeline. The project cost was approximately $150 million. The City of Tracy's portion of this cost was $50 million. The City of Tracy funded the project through increased water rates and assessment districts.

In 2005, construction of the project was completed and water deliveries commenced. The City of Tracy began heavily utilizing the new water supply because of its high quality. In 2010, native groundwater usage was reduced to 600 acre-feet, or 3% of the potable water supply. Ultimately, substituting the low salinity Stanislaus River snowmelt water (average TDS of 60 mg/L) for the native groundwater (average TDS from 700 to 800 mg/L) has resulted in a significant reduction in the salinity of the City of Tracy's wastewater effluent.

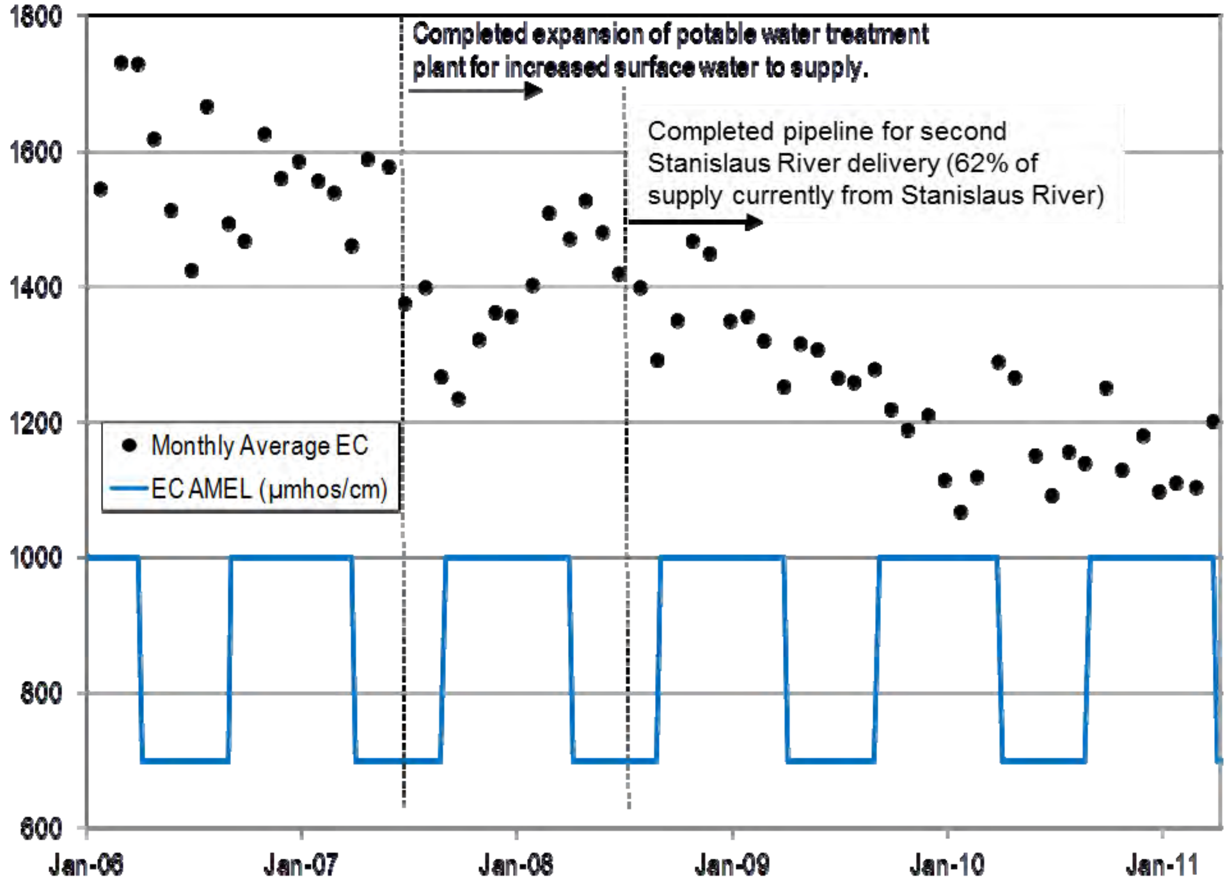

Figure 5: City of Tracy WWTP EC Control Program Implementation Results.

The chronology of the City of Tracy's water supply source control actions is as follows:

- **1995:** The City initiated a project to bring South San Joaquin Irrigation District's Stanislaus River water through 40 miles of pipeline to Tracy.
- **2001:** The City entered into long-term agreements to purchase additional surface water from the Delta-Mendota Canal (DMC) to replace groundwater.
- **2002:** The City began designing an expansion to the potable water treatment plant to process the additional DMC surface water.
- **2004:** Surface water from the DMC became available.
- **2005:** Delivery of surface water from the South San Joaquin Irrigation District's Stanislaus River supply commenced in September. A pilot project to store surplus surface water supplies in the Semitropic Water Storage District in Kern County was successful. The City prepared the environmental documentation to allow permanent storage.
- **2007:** The City completed an expansion to the potable water treatment plant to process the additional DMC surface water.

- **2008:** The City completed construction of a transmission pipeline allowing Stanislaus River water deliveries to a second location within Tracy. Sixty-two percent (62%) of the City's water supply is now from Stanislaus River water.
- **2010:** The City completed construction of an Aquifer Storage and Recovery (ASR) well and received approval from the RWQCB in December 2010 to perform pilot tests on injection of drinking water into the groundwater basin.
- **2011:** The City completed Year-1 of the pilot project where it injected into and then extracted from the groundwater basin 250 acre-ft of drinking water. The pumping of native groundwater was limited to 1.7% of the City's total potable water supply (Bayley, 2012).
- **2012:** The City completed Year-2 of the pilot program where it injected 700 acre-ft of drinking water into the groundwater basin, and is currently extracting the last of the injected water. The City prepared, circulated, and adopted a Negative Declaration under the California Environmental Quality Act (CEQA) for a permanent ASR Program.

  In 2012, the City received approval for long-term water storage in the Semitropic Water Storage District. The City is allowed to store up to 10,500 acre-ft and currently has 6,100 acre-ft in storage. The City also approved a second Negative Declaration under CEQA in 2012 for the Tracy Desalination and Green Energy Project. This project is proceeding towards permitting and construction. When operational, the project should reduce total dissolved solids (salinity) in the City's treated wastewater by approximately 80 mg/L from its current concentration.

In 2005, the City of Tracy acquired surface water sources to replace groundwater in their potable water supply system. These sources include the South San Joaquin Irrigation District's Stanislaus River water and water from the Delta-Mendota Canal (DMC) (City of Tracy, 2010). The quality of the DMC water is monitored by the Department of Water Resources Municipal Water Quality Investigations (DWR-MWQI) program at several locations. The average concentrations of EC and TDS are 416 µmhos/cm and 230 mg/L, respectively, as measured between 1994 and 1999 at the DMC water intake at Lindeman Road. More recent EC data collected by the Central Valley Water Board at the DMC off Highway 4 (upstream of Lindemann Road) from March 2009 through February 2010 shows a similar average EC concentration of 423 µmhos/cm (CRWQCB, Central Valley Region, 2010). The quality of the Stanislaus River water is monitored by the United States Geological Survey (USGS) at several locations. The average concentration of EC is 119 µmhos/cm, as measured between 1992 and 2008 in the Stanislaus River at Caswell State Park near Ripon.

The addition of surface water sources has reduced the City of Tracy's groundwater usage from 7,176 acre-feet in 2004 to 314 acre-feet in 2011, resulting in a reduction of approximately 6,800 tons of salt per year (Bayley, 2012). This change has also decreased the need for residential salt-based self-regenerating water softeners that contribute additional salinity to the WWTP. As a result of these efforts, the City has observed a decrease in the salinity of the WWTP effluent and found that as older self-regenerating water softeners fail they are not being replaced by the City's residents due to the high quality of the City's potable water supply (Bayley, 2012).

ii. Industrial Source Control/Pretreatment Program

Leprino Foods Company (Leprino) is the only industrial facility in the City of Tracy WWTP service area. Leprino produces cheese and whey products. The City of Tracy and Leprino have worked together for more than 30 years on mutually beneficial solutions to wastewater treatment challenges, including reducing salinity loadings. Between 2006 and 2008, Leprino's TDS daily loading to the WWTP was reduced by approximately 20% through source loading reductions. Leprino has achieved source reductions by implementing numerous best management practices in its plant operations, all of which are designed to make efficient use of incoming raw materials, ingredients, and cleaning chemicals, thus minimizing discharges to the wastewater collection system. In 2008, Leprino contributed approximately 10% of the total TDS influent loading to the WWTP. As the quality of the City of Tracy's water supply improves, further reductions in the TDS/EC contributions from the Leprino plant effluent are expected (City of Tracy, 2010).

b. Source Control: City of Stockton Regional Wastewater Control Facility

Source control information for the City of Stockton was taken from the *City of Stockton Regional Wastewater Control Facility Salinity Plan*, in the section "Source Control Estimates and Methods of Load Reduction" (RBI, 2009).

i. Water Supply Source Control

The City of Stockton's current water supply has three sources: groundwater from wells owned by the City of Stockton, groundwater delivered by California Water Service Company, and surface water delivered by the Stockton East Water District. The surface water supply originates from the Stanislaus and Calaveras Rivers. The groundwater supply has naturally higher salinity levels than the surface water. In 2009, the groundwater sources had an average TDS concentration of 303 mg/L (City of Stockton wells) and 292 mg/L (California Water Service wells), compared to 82 mg/L in the surface water. Similarly, average EC levels in groundwater were 448 µmhos/cm (City of Stockton wells) and 425 µmhos/cm (California Water Service wells), compared to 132 µmhos/cm in the surface water (RBI, 2009).

In 2008, approximately 63 million gallons per day (MGD) of water were delivered from the three sources: 9 MGD from City of Stockton wells (14%), 8 MGD from California Water Service wells (13%), and 46 MGD from Stockton East Water District surface water (73%). The total load contributed by the water supply varies seasonally, according to the proportion of each water supply source used. A summary of the characteristics of the City of Stockton's water supply is provided in **Table 7**.

The City of Stockton recently completed construction of the Delta Water Supply Project (DWSP) as a new, supplemental water supply. The DWSP will augment local groundwater and existing surface water supplies to meet the City's water demands. The DWSP's surface water component includes a new water intake facility on the San Joaquin River. The DWSP's groundwater component includes injecting treated Delta surface water into the groundwater aquifer for later extraction during periods of restricted surface water supply.

Table 7: Characteristics of the City of Stockton Water Supply (RBI, 2009).

Supply Source	Average EC (µmhos/cm)	Average TDS (mg/L)	Average Flow (2008, MGD)	Average TDS Load (lbs/day)
City of Stockton Wells	448	303	9	23,471
California Water Service Wells	425	292	8	19,804
Stockton East Water District (surface water)	132	82	46	31,462
Weighted average	216	141	N/A	N/A
Total	N/A	N/A	**63**	**74,737**

Note:
N/A = Not applicable

Phase 1 of the DWSP (2012-2015) is designed to meet the water supply needs of full development anticipated to occur by the year 2015 under the City of Stockton's current 1990 General Plan. Phase 1 of the DWSP became operational in June 2012 and will provide approximately 27% of Stockton's water supply. The second and third phases of the DWSP (2015-2030 and 2031-2050) will involve expansions of the Water Treatment Plant, increased DWSP pumping and water use to meet increased City of Stockton Metropolitan Area (COSMA) demands, and groundwater injection and recovery.

The chronology of the COSMA water supply source control actions is as follows:

- **2008-2012:** 73% of COSMA's water supply is from surface water sources and the remaining 27% is from groundwater sources (RBI, 2009).
- **2012-2015:** Phase I of the DWSP. During Phase I, the aim will be to source as much water supply from surface waters as possible, with up to 27% of the total supply sourced from the SWSP diverted surface waters and 73% of the total supply from other surface water sources. Groundwater use will be minimized during Phase I, so as to allow the aquifers to recharge (RBI, 2009).
- **2015-2030:** Phase II of the DWSP. During Phase 2, the amount of groundwater contributing to the overall supply will gradually increase (RBI, 2009).
- **2031-2050:** Phase III of the DWSP. By 2050, it is estimated that approximately 21% (during wet years) to 35% (during dry years) of the total water supply will be sourced from groundwater (RBI, 2009).

Average salinity levels in DWSP raw water are expected to be lower than the average levels in existing COSMA groundwater supplies. San Joaquin River/Stockton Deep Water Ship Channel data collected by the City of Stockton shows that the average wet water year (WY) type TDS concentration was 173 mg/L (WY 2005-2006) and the average dry water year type TDS concentration was 196 mg/L (WY 2004). During WYs 2007 and 2008, both critical dry years, the average TDS concentration was 203 mg/L. These concentrations are lower than the average 2008 TDS concentrations in the City of Stockton's groundwater wells and the California Water

Service groundwater wells of 303 mg/L and 292 mg/L, respectively. Therefore, operation of the DWSP is expected to reduce water supply salinity contributions to the RWCF (RBI, 2009).

ii. Industrial Source Control/Pretreatment Program

The City of Stockton provides discharge permits to Significant Industrial Users (SIUs) through its industrial pretreatment program to regulate and control the discharge of salinity to the RWCF. Discharge permits for new SIUs contain an interim TDS concentration limit of 1000 mg/L as a daily maximum and an interim loading limit in pounds per month. The loading limit is based on an average TDS concentration limit of 800 mg/L and the permitted flow for that SIU (RBI, 2009).

iii. Facility Processes

The City of Stockton has replaced alum with polyaluminum chloride at the RWCF as a means to reduce the need for caustic during the treatment process. Some caustic is still used on occasion to optimize performance of nitrifying biotowers. These adjustments have led to an overall slight reduction in effluent EC levels, as described by the City of Stockton RWCF Chief Plant Operator (Garcia, 2012).

c. Source Control: City of Manteca Wastewater Quality Control Facility

Source control information for the City of Manteca was taken from the *Electrical Conductivity Pollution Prevention Plan for the City of Manteca Wastewater Quality Control Facility*, in the section “Source Control Feasibility, Strategies, and Reductions” (LWA, 2010), and from a telephone conversation with Phil Govea, City of Manteca Public Works Deputy Director – Engineering (Govea, 2011).

Concentrations of EC in the WQCF effluent have decreased in recent years due to source control efforts, as shown in **Figure 6**. By implementing changes to water supply and industrial source control practices, the City of Manteca has achieved an approximate 32% reduction in WQCF monthly average effluent EC. The mean of the monthly average effluent EC values prior to 2005 was approximately 1100 µmhos/cm, and this has been reduced to 749 µmhos/cm for the period September 2007 – March 2011 (City of Manteca, 2009b). The average influent EC concentration in 2009 (used as the current influent concentration in Manteca’s Pollution Prevention Plan (PPP) (LWA, 2010) was 733 µmhos/cm.

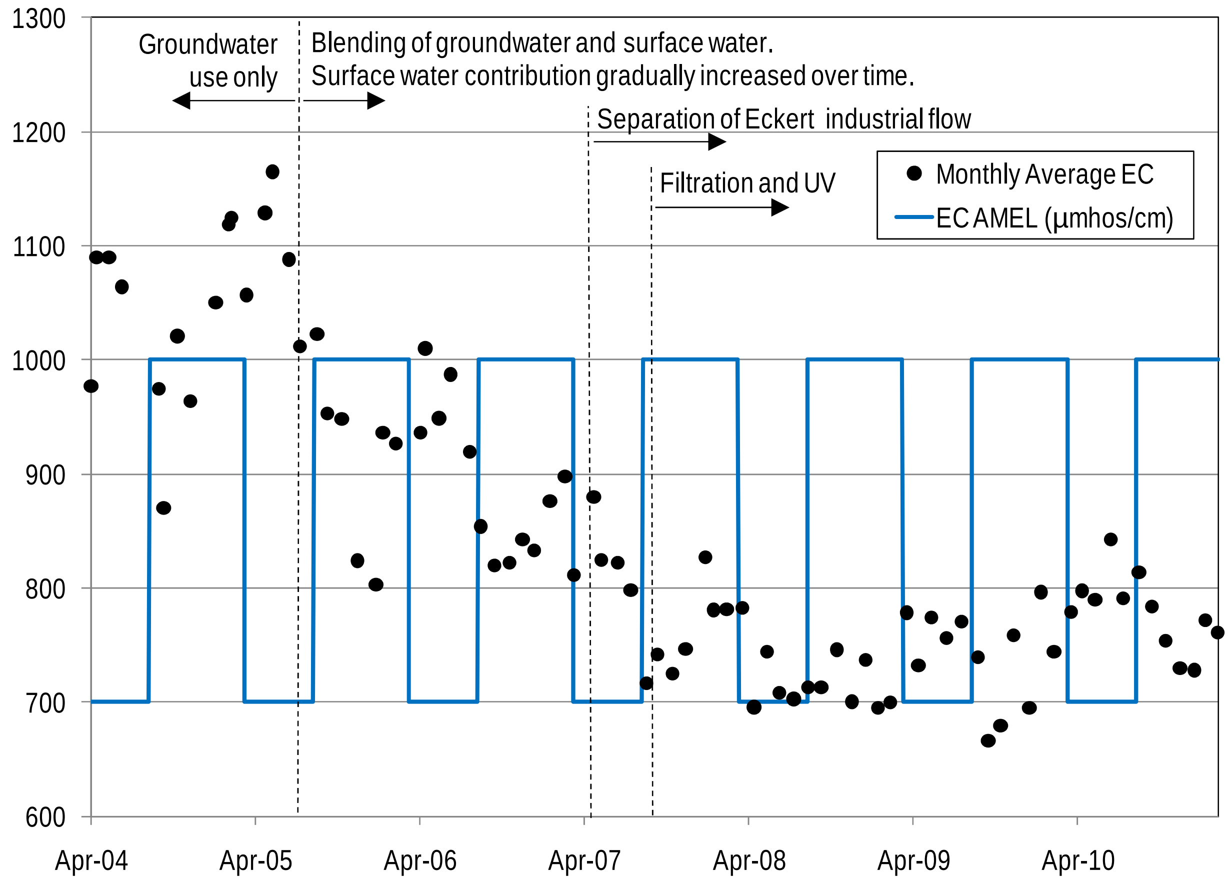

Figure 6: City of Manteca WQCF EC Control Program Implementation Results.

i. Water Supply Source Control

The decrease in WQCF effluent EC levels is largely due to the City of Manteca's commitment to improve the WQCF effluent quality through a series of operational changes and a significant investment in a new water supply. The City of Manteca participated in the water supply project with the City of Tracy, in conjunction with the South San Joaquin Irrigation District and two other participating cities. The project cost was approximately $150 million. The City of Manteca was responsible for about 40% of this cost (approximately $60 million). The City of Manteca funded the project through the sale of bonds. In 2005, construction of the project was completed, and water deliveries commenced.

Over the past seven years, the City of Manteca has reduced the overall percentage of groundwater used as source water by replacing a portion of the water supply with surface water (LWA, 2012). The groundwater has naturally higher levels of salinity (283 – 378 mg/L TDS and 397-561 µmhos/cm EC) than surface water supplies (71-186 mg/L TDS and 117 – 172 µmhos/cm EC) (City of Manteca, 2012). The chronology of the City of Manteca's water supply source control actions is as follows:

- **2004:** Prior to 2005, 100% of the City of Manteca's source water was supplied by groundwater (LWA, 2012).

- **July 2005:** The City of Manteca began substituting a portion of its groundwater supply with surface water from the South San Joaquin Irrigation District water plant. In 2005, 25% of the City's water supply was sourced from surface water; 75% of total supply was sourced from groundwater (LWA, 2012).
- **2005-2009:** The proportional contribution of surface water to the City of Manteca's water supply steadily increased to 50% (LWA, 2012).
- **2009:** 50% of total water supply came from surface water (LWA, 2012). This proportion is expected to remain constant (City of Manteca, 2009b).

Due to constraints in its existing distribution system and in the operation of groundwater wells, the City cannot yet use its entire allotment of SSJID surface water. In the future, as the City grows and the water distribution system expands with it, the City will use more of its allotted surface water, but the current ratio of approximately 50% surface water and 50% groundwater is expected to remain unchanged in the near-term (LWA, 2010).

ii. Industrial Source Control/Pretreatment Program

The City of Manteca constructed the Industrial Pipeline System to eliminate EC (salinity) discharged to the WQCF by the City of Manteca's largest industrial discharger, Eckert Cold Storage (Eckert). The Industrial Pipeline System has been fully operational since April 2007. It diverts Eckert's food-processing wastes to direct application on agricultural fields (City of Manteca, 2009b). Other food-processing industries are most likely the largest industrial sources of EC (salinity). If current industrial loads were reduced by 90% through the pretreatment program and no other source control measures were enacted, the projected average influent EC levels would be reduced to 725 µmhos/cm. Based on the small contribution to total influent loading from current industrial sources, even a 90% reduction is insufficient to achieve the seasonal AMEL of 700 µmhos/cm (LWA, 2010).

iii. Pollution Prevention Program

The City of Manteca developed a PPP that contains an effectiveness evaluation for pollution prevention strategies aimed at limiting and/or reducing EC levels in the WQCF influent (LWA, 2010). These strategies are specifically aimed at residential brine-discharging water softeners. Banning new brine-discharging water softeners could potentially result in an influent EC decrease of 3 µmhos/cm, from 733 to 730 µmhos/cm. That ban in combination with an upgrade of existing brine-discharging water softeners to higher efficiency models could result in an influent EC decrease to 720 µmhos/cm. The ban and encouragement to remove existing brine-discharging water softeners could result in an influent EC decrease to 716 µmhos/cm. None of these source control activities would result in EC levels below the 700 µmhos/cm seasonal AMEL. A survey of water softener use would be conducted before any of these actions are implemented by the City.

It was shown in the PPP that if the industrial pretreatment program reduced industrial sources by 90%, the pollution prevention program banned new brine-discharging water softeners and 50% of existing brine-discharging water softeners were removed, and commercial dischargers responsible for above-average contributions of EC were required to implement BMPs (after a commercial source identification study), the resulting average influent EC concentration would still be greater than the 700 µmhos/cm seasonal AMEL, at 708 µmhos/cm (LWA, 2010).

iv. *Facility Upgrades*

The City of Manteca replaced the WQCF's existing chlorine contact tank with tertiary filtration and UV disinfection, which appeared to contribute to a slight reduction in effluent EC levels; however, this reduction was not considered significant, nor was it distinguishable from the normal variability observed in the concentrations of this parameter in the City's effluent (City of Manteca, 2009b).

d. Source Control: Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility

Source control information for the City of Fresno was taken from the *Fresno/Clovis Regional Wastewater Reclamation Facilities' Best Practicable Treatment and Control Comprehensive Evaluation* report, in the section "Source Control for Reduction of RWRF Influent Salinity" (Carollo, 2009).

i. *Water Supply Source Control*

The City of Fresno plans to bring a new 70 MGD surface water treatment plant (SWTP) online by 2014 and also double the capacity of the existing SWTP. This would increase the City of Fresno's surface water supply from 30 MGD (current capacity) to 140 MGD by 2025. Available surface water has lower salt concentrations than local groundwater, and the increased use of surface water will lower the total amount of salt that enters the RWRF (Carollo, 2009) because average TDS concentration in the surface water supply is generally less than 15 mg/L compared with 218 mg/L in groundwater (Lau-Staggs, 2012).

The chronology of the City of Fresno's water supply source control actions is as follows:

- **2008:** Surface water provided 12% of Fresno's potable water demand. Average concentrations of salinity measured in municipal supply water were 309 µmhos/cm as EC and 219 mg/L as TDS (City of Fresno Water Division, 2009).
- **Current:** The TDS concentration of the surface water supply is 15 mg/L compared with 218 mg/L in groundwater (Lau-Staggs, 2012). The City of Fresno's water supply system receives treated surface water from water delivered directly from the Sierra to the Surface Water Treatment Facility (SWTF). Precipitation and snow melt from the Sierra Nevada Mountains run into the Kings and San Joaquin rivers. These water sources are available through the City of Fresno's federal Central Valley Project contract and Fresno Irrigation District entitlements. Water from either of these surface water supply sources is currently delivered to the SWTF via the Enterprise Canal, a 25-mile circuitous, open channel that runs through agricultural and urban areas. The SWTF supplies Fresno with about 20 MGD. During peak demand, the SWTF provides approximately 15% of Fresno's potable water. During low demand, the SWTF provides over 30% of Fresno's potable water (City of Fresno, 2011).
- **Near Future:** Construction of a 5-mile pressurized pipeline directly from the Friant-Kern canal to the SWTF is planned. The pipeline will provide raw water quality enhancements, additional public health protection, and adequate hydraulic head to operate the SWTF without supplemental lift. After the pipeline is completed, the Enterprise Canal will become a secondary source of surface water supply for the City (City of Fresno, 2011).

- **2014:** The City of Fresno plans to bring a new 70 MGD surface water treatment plant (SWTP) online and double the capacity of the existing SWTP.
- **2025:** The new SWTP will increase the City of Fresno's surface water supply from 30 MGD (current capacity) to 140 MGD. The increased use of surface water in place of groundwater will lower the total amount of salt that enters the RWRF.

ii. Industrial Source Control/Pretreatment Program

In 1996, the RWRF staff developed and implemented an "EC Source Control Program" for industrial users to voluntarily reduce or maintain current levels of electrical conductivity. Salt audits were performed at all permitted industrial user facilities to determine which process areas could undergo waste minimization or process changes to reduce the amount of salt discharged to the RWRF. Facilities using water softeners were required to ensure the most efficient use of salt-containing products. Facilities replacing water softeners were asked to install salt-free or on-demand systems. Industrial users are regularly informed of current salinity issues in the Central Valley.

In 2008, the City of Fresno updated the Fresno Municipal Code to provide legal authority to require Best Management Practices (BMPs) implementation by industrial and commercial dischargers. BMPs can reduce the quantity of salt discharged during internal operations. Additionally, the City of Fresno has the authority to impose a numeric local limit on one or more salinity constituents through its industrial Pretreatment Program. Instituting a local limit on salinity would involve several steps and could take five to ten years to be fully implemented, assuming all facilities were in compliance (Carollo, 2009).

iii. Residential Source Control

Residential discharges contain lower salt concentrations than industrial discharges; however, residential flow is much higher, resulting in larger salt loadings to the RWRF. Salt reduction from residential sources requires public education on the impacts salt-producing products and actions such as detergents, soaps, salt-based water softeners, other household cleaners, and food-processing habits.

The City of Fresno's salinity outreach program, which began in 2007, promotes residential waste minimization through the "Salt is Serious" campaign. This campaign aims to reduce the domestic use of water, salt-containing products, and water softeners. In May 2008, the City of Fresno was selected by the National Association of Clean Water Agencies as a recipient of its National Environmental Achievement Award for Public Information Education in recognition of the campaign, which has included television commercials in English and Spanish on local and cable television channels (aired until October, 2007), radio spots in English, Spanish, and Hmong, distribution of promotional material at the local Home and Garden Show, and an insert in residential utility bills urging homeowners to disconnect their water softeners. Newspaper inserts are planned for the future.

Controlling the discharge of sodium from self-regenerating water softeners (SRWS) would reduce salinity in the RWRF effluent. Based on typical data gathered from other California cities, residential use of SRWS is estimated to account for approximately 7% of the TDS influent load to the RWRF (Carollo, 2009). If all SRWS in the City of Fresno were eliminated, RWRF influent salinity levels could be reduced by approximately 35 mg/L of TDS, or 65 µmhos/cm of EC (Carollo, 2009).

A voluntary, incentive-based SRWS removal program would cost approximately $15 million if accomplished through a rebate program where residents were paid $500 each to disconnect their SRWS. The City of Fresno could also update its building code to prohibit builders from installing plumbing connections for water softeners in new homes unless specifically requested by the homebuyer. In these cases, it is likely that the maximum possible salinity reduction would not be realized for 12 or more years, based on the useful life of SRWS and the time needed to implement programs targeting residential audiences (Carollo, 2009). Increasing the percentage of surface water in the water supply will act to reduce the need for SRWS.

e. Source Control Summary

By implementing changes to water supply and industrial source control practices, two entities have achieved reductions in effluent EC concentrations. The City of Tracy has achieved a 25% reduction in WWTP effluent EC, from average monthly levels of 1580 µmhos/cm prior to 2007, to 1191 µmhos/cm in more recent years (March 2009 – April 2011). The City of Manteca has achieved an approximate 32% reduction in WQCF monthly average effluent EC.

The City of Stockton recently completed construction of the Delta Water Supply Project (DWSP) as a new, supplemental surface water supply. The DWSP will augment local groundwater and existing surface water supplies to meet the City of Stockton's water demands. Phase 1 of the DWSP became operational in June 2012 and will provide approximately 27% of Stockton's water supply. Average salinity levels in DWSP raw water are expected to be lower than the average levels in existing groundwater supplies; therefore, operation of the DWSP is expected to reduce water supply salinity contributions to the City of Stockton RWCF (RBI, 2009). By implementing changes to water supply and industrial and residential source control practices, the City of Fresno also expects to reduce salinity levels in RWRF effluent; however, no specific percent reduction has been estimated.

V. WATER QUALITY IMPACTS ANALYSIS

This section contains a description of the water quality impacts associated with implementation of either a variance for three Delta communities (Tracy, Stockton and Manteca) or a case-by-case exception for the City of Fresno. In each case, the water quality impact would be a delay in water quality changes in downstream receiving water quality (three (Delta communities) and any other Delta surface water discharges), or down-gradient groundwater quality (City of Fresno). The incremental water quality changes described in this section represent the difference between current ambient water quality and a future condition that would occur if the communities in question implemented reverse osmosis (RO) treatment of a portion of their total discharge (at full permitted discharge capacity) as a means to meet final effluent limits for EC in their current permits.

a. Effect of Establishing Variance Policy and Granting Variance for Three Delta Communities

If a water quality standards variance was implemented for the three Delta communities described in the preceding sections, the net effect would be to delay further action to design and construct new RO treatment facilities to achieve compliance with existing final effluent limits for EC. This would produce an associated delay in any change in ambient water quality in the Delta associated with the discharge from the three communities. Given the fact that variances are approved in five-year increments as part of the NPDES permitting process, the probable minimum delay in question would be five years. However, given the pace and complexity of the ongoing efforts to re-examine and potentially modify the EC water quality objectives in the Delta, it is plausible to project up to a ten-year period to resolve the uncertainty regarding these objectives. This timeline is consistent with the master SNMP covering the entire Central Valley (CV-SNMP) that is being developed by CV-SALTS for Central Valley Water Board review in May 2014. The CV-SNMP is anticipated to be adopted as a Basin Plan Amendment in 2015. Local-scale management of salinity would then follow in subsequent years according to the guidelines established in the CV-SNMP. As a result, the temporary delay in a change in ambient water quality associated with the implementation of a salinity objective variance in the Delta is projected to be in the range of five to ten years.

Although adding RO treatment systems to each of the facilities would result in higher quality final effluent, doing so is not likely to result in a measurable improvement (i.e., lowering) of EC levels in the receiving water, as reported by a 2007 DWR study. A modeling evaluation was completed for the City of Tracy and Mountain House Community Services District that examined impacts of discharges from these facilities on receiving water EC concentrations (DWR, 2007). The Department of Water Resources (DWR) Delta Simulation Model 2 (DSM2) model was used to predict the resulting effluent volume fractions, and the receiving water and effluent volume fractions were each weighted with the appropriate EC concentration, thus allowing the change in EC (from upstream to downstream of the discharge) to be estimated. It was concluded that, in the worst-case scenario, the City of Tracy WWTP discharge “made up a small portion of the difference between actual measured EC upstream and downstream of the discharge, so it was assumed that the remainder of the increases must have been caused by ‘other sources’ of EC (e.g., agricultural activities, shallow groundwater discharge to receiving waters)”, and increases due to the City of Tracy WWTP discharge “were about an order of magnitude less than the ‘other sources’” (DWR, 2007). In addition, RO or other salt removal technologies necessary to meet potential water quality based effluent limits (WQBELs) for EC were considered. It was concluded that "requiring WQBELs, compared to limiting the discharge to current levels, did not provide substantial reductions in [receiving water] EC" (DWR, 2007).

i. Surface Water Quality Impact Calculations

i.1 Cities of Stockton and Manteca

The near-field[1] water quality impacts assessment evaluates the effect of a short-term variance from meeting final effluent limits for EC, as compared to a future condition where the communities treat a portion of their total discharge with RO in order to meet final effluent limits. Because each treatment facility currently produces treated effluent having unique EC and TDS concentrations (see **Section II**) based on the levels of these parameters present in their influents and the particular treatment processes employed by each facility, each treatment plant would need to treat a different percentage of their total discharge with a split-stream RO treatment process in order to meet final effluent limits for EC. Near-field effects of the implementation of RO treatment on receiving water quality will occur at a relatively short distance (1 -2 miles) downstream of a discharger's outfall where treated effluent and ambient river water are reasonably well-mixed. Downstream receiving water EC levels without RO implementation (i.e., current condition) are calculated to estimate the future (five to ten years) ambient water quality with the granting of a salinity variance. Comparing estimated future water quality with RO treatment to water quality that would result from the granting of a salinity variance – in essence, no change from the current condition – shows the impact of granting a variance for a five to ten year period.

Near-field water quality impacts for EC are estimated for the cities of Stockton and Manteca using the following four parameters which characterize treatment plant effluent and receiving water quality:

1. Treatment plant effluent EC concentration with and without RO treatment;

2. Average upstream receiving water EC concentration;

3. Permitted treatment plant effluent flow rate at build-out;

4. Average upstream receiving water flow.

The estimated near-field water quality impacts were calculated using the following mass balance equation:

$$C_{downstream} = \frac{\left((C_{upstream})(Q_{upstream})\right) + \left((C_{eff})(Q_{eff} \times 1.55)\right)}{\left(Q_{upstream} + (Q_{eff} \times 1.55)\right)}$$

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[1] Near-field water quality impacts refer to localized impacts just downstream of the discharge that occur before effluent and receiving water are completely mixed.

Where: $C_{downstream}$ = Downstream receiving water EC concentration

$C_{upstream}$ = Upstream receiving water EC concentration

C_{eff} = Treatment plan effluent EC concentration

$Q_{upstream}$ = Upstream receiving water flow (cfs)

Q_{eff} = Treatment plant effluent flow (MGD)

i.2 City of Tracy

Near- field and regional water quality impacts due to the implementation of RO treatment for the City of Tracy's discharge were calculated using the methodology developed in the DWR DSM2 modeling evaluation of the City of Tracy and Mountain House Community Services District (MHCSD) discharges to the south Delta (DWR, 2007). In the original DWR study, the DSM2 model was used to estimate daily average wastewater volume fractions at 14 south Delta locations for Tracy and MHCSD. In the current analysis, modeled volume fraction data for four south Delta locations were used in the following equation to estimate the increase in ambient receiving water EC concentration at a specific location due to the City of Tracy's effluent:

$$C_{downstream} = (C_{eff} - C_{upstream})\left(\frac{Volume\ Fraction}{100}\right)\left(\frac{Q_{eff\ actual}}{Q_{eff\ total}}\right)$$

Where: $C_{downstream}$ = Downstream receiving water EC increase above upstream EC concentration

C_{eff} = Treatment plan effluent EC concentration

$C_{upstream}$ = Upstream receiving water EC concentration

$Q_{eff\ actual}$ = Treatment plant effluent flow under specific discharge scenario (MGD)

$Q_{eff\ total}$ = Treatment plant effluent flow at permitted capacity (MGD)

In addition to assessing the near-field change in EC just downstream of the Tracy discharge with implementation of RO treatment, the above equation was also used to estimate changes in ambient EC concentrations at the following regional Decision 1641 (D-1641) salinity compliance locations:

- Old River at Tracy Road Bridge
- Old River at Middle River
- San Joaquin River at Brandt Bridge

i.3 WQ Impact Calculation Assumptions

Current average effluent EC concentration from April 1 through August 31 and future effluent EC concentration with RO treatment (designed to meet the final EC effluent limit of 700 µmhos/cm) were used to estimate existing and future impacts, respectively, of treatment plant effluent on downstream receiving water quality. A treatment plant's average effluent EC concentration from April 1 through August 31 was used in the analysis because it is greater than the average effluent EC concentration observed from September 1 through March 31, and the former concentration would be used as a design criterion for the proper sizing of a RO treatment facility. Average upstream receiving water EC concentrations were calculated using data collected at a treatment plant's RSW-001 monitoring location. The average is used for the receiving water because the analysis is strictly based on evaluating the change in receiving water quality. Ambient RSW-001 concentrations serve as the basis for comparing the magnitude of future change in receiving water quality due to the granting of a salinity variance as compared to implementation of RO treatment. The current permitted capacities of the Stockton (55 MGD average dry weather flow (ADWF)) and Manteca (17.5 MGD ADWF) facilities were used for estimating water quality impacts because impacts would be greatest at these flow rates, and hence represent a worst case condition when the facilities discharge at their permitted capacities. For the City of Tracy water quality impacts analysis, $Q_{eff\ actual}$ and $Q_{eff\ total}$ were both set to 16 MGD (ADWF) as this flow rate would be the permitted capacity of the facility at a future point in time when RO treatment would be implemented.

ii. Results and Analysis

The incremental, near-field water quality changes in ambient EC concentrations estimated to occur with implementation of partial RO treatment at the cities of Tracy, Stockton, and Manteca are shown in **Table 8**. These estimates are described as "Future Baseline with RO" as they describe a future ambient water quality condition with implementation of RO by the three Delta communities. Also shown in **Table 8** are estimates of future ambient water quality with the granting of a salinity variance. These estimates are described as "Future WQ with Variance". Regional or far-field changes in ambient EC concentrations estimated to occur with implementation of partial RO treatment at the Tracy WWTP and the granting of a salinity variance for the City are presented in **Table 9**.

With regard to near-field changes in EC concentrations in receiving waters downstream of the three subject discharges (see **Table 8**), they are estimated to range from 0.31 percent (Manteca WQCF during dry/below normal water years) to 2.68 percent (Tracy WWTP under high Delta exports). These slight increases in near-field ambient EC concentrations associated with the granting of a salinity variance are not significant, but are above those calculated for each of the Delta communities with construction and operation of RO facilities to achieve compliance with an EC objective of 700[2] µmhos/cm. Note that this analysis presumes that the existing water quality objective of 700 µmhos/cm, and the effluent limits derived from such an objective will be retained in the future. As detailed elsewhere, this outcome is uncertain. The future ambient water quality estimated to occur as the result of granting a salinity variance represents a delayed minor improvement in water quality as estimated for the future condition with implementation of RO.

The incremental, far-field water quality changes presented in **Table 9** show that the benefit of RO treatment of a portion of the Tracy WWTP discharge to lower EC levels in the receiving water is quickly diminished beyond a short distance downstream of the WWTP outfall. The DWR DSM2 modeling evaluation assumed that the South Delta Improvement Project's (SDIP) permanent flow control structures (gates) would be in place at several locations in the south Delta by the time the WWTP was granted a permitted capacity of 16 MGD (ADWF). With the

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[2] Note that RO treatment will be designed to meet 700 µmhos/cm effluent limitation using a 25% safety factor to address the range of influent EC concentrations observed at the treatment facility.

permanent gates in place, no WWTP effluent is anticipated to reach the D-1641 salinity compliance locations in Middle River at Mowery Bridge or the San Joaquin River at Brandt Bridge. As such, the DMS2 model estimates no change (0.00%) in ambient EC concentrations at these two locations, as shown in **Table 9**. This information suggests that the RO treatment of the City of Tracy's discharge to meet a final EC effluent limit of 700 µmhos/cm will have only a slight localized effect on Old River EC concentrations and will have no impact on the control of salts in the south Delta.

Table 8: Summary of Incremental, Near-Field Water Quality Changes Associated with the Implementation of Partial RO Treatment and the Granting of a Salinity Variance for Three Delta Dischargers.

	Average Upstream Receiving Water EC (µmhos/cm)	Receiving Water Flow (cfs)	Average Facility Effluent EC (µmhos/cm)	Facility Discharge (MGD)	Estimated Downstream Receiving Water EC (µmhos/cm)	Estimated % Change in Downstream EC[1]
TRACY WWTP						
Low Delta Export						
Future Baseline with RO	688[2]	[3]	700	16	689	
Future WQ with Variance	688	[3]	1,223[4]	16	706	**2.44%**
High Delta Export						
Future Baseline with RO	688	[3]	700	16	689	
Future WQ with Variance	688	[3]	1,223	16	708	**2.68%**
STOCKTON RWCF						
Future Baseline with RO	521[5]	3076[6]	700	55	526	
Future WQ with Variance	521	3076	1,111[7]	55	537	**2.06%**
MANTECA WQCF						
Dry/Below Normal WY						
Future Baseline with RO	424[8]	1250[9]	700	17.5	430	
Future WQ with Variance	424	1250	763[10]	17.5	431	**0.31%**
Critical Water year						
Future Baseline with RO	424	600[9]	700	17.5	436	
Future WQ with Variance	424	600	763	17.5	439	**0.62%**

Notes:
1. Change resulting from implementation of RO and compliance with 700 µmhos/cm final effluent limit.
2. Old River upstream EC is the average of data collected at the Tracy WWTP R-1 station from 2007 to 2010.
3. Downstream ambient concentrations were calculated using the DSM2 model completed for the City of Tracy and Mountain House CSD (DWR, 2007), high export and low export scenarios, summer (August) assumption.
4. Tracy WWTP effluent EC is the average of data collected from 2009 to 2010, summer months only (April-August).
5. San Joaquin River upstream EC is the average of data collected at the Stockton WQCF R-1 station from 2007 to 2011.
6. San Joaquin River harmonic flow from USGS gauge 11304810 – San Joaquin River at Garwood Bridge (near Stockton) from March 1998 – March 2009.
7. Stockton WQCF effluent EC is the average of data collected from 2007 to 2011, summer months only (April-August).
8. San Joaquin River upstream EC is the average of data collected at the Manteca WQCF R-1 station from 2010 to 2011.
9. San Joaquin River flow near Manteca is taken from the City of Manteca Thermal Plan Exception Analysis Final Report (LWA, 2006).
10. Manteca WQCF effluent EC is the average of data collected from 2008 to 2011, summer months only (April-August).

Table 9: Summary of DWR DSM2-Modeled, Incremental, Far-Field Water Quality Changes Associated with Implementation of Partial RO Treatment at the Tracy WWTP and the Granting of a Salinity Variance.

Location (moving downstream)	Low Delta Export			High Delta Export		
	Estimated Ambient EC		Est. % EC Change	Estimated Ambient EC		Est. % EC Change
	Baseline with RO	With Variance		Baseline with RO	With Variance	
D/S of Tracy WWTP Discharge	689	706	2.44	689	708	2.68
Old River at Tracy Rd. Bridge	688	699	1.47	688	689	0.08
Old River at Middle River	688	688	0.00	688	688	0.00
SJR at Brandt Bridge	688	688	0.00	688	688	0.00

DSM2 Model input:
Effluent permitted flow: 16 MGD
Current effluent EC level: 1223 µmhos/cm
Current ambient EC level: 688.23 µmhos/cm
River flows were determined through modeling.

The estimated percent change in EC concentrations in downstream receiving waters presented in **Table 8** and **Table 9** were calculated based on each discharger providing RO treatment to only a portion of its discharge to produce a blended effluent that would meet a final EC effluent limit of 700 µmhos/cm. If the dischargers were to treat their entire effluent flow with RO, the resulting estimated changes in downstream ambient EC concentrations would still be small, ranging for 3.63 percent (Manteca WQCF during dry/below normal water years) to 7.27 percent (Manteca WQCF during critical water years), as shown in **Table 10**.

Because the methodologies, assumptions, and available data used in estimating changes in downstream EC concentrations with implementation of RO treatment varied for each of the three Delta dischargers, further discussion of the underlying information used in these analyses is warranted as a means to explain how the estimated water quality impacts relate to broader salinity concerns in the Delta.

Table 10: Summary of Incremental, Near-Field Water Quality Changes Associated with the Implementation of Full RO Treatment and the Granting of a Salinity Variance for Three Delta Dischargers.

	Average Upstream Receiving Water EC (µmhos/cm)	Receiving Water Flow (cfs)	Average Facility Effluent EC (µmhos/cm)	Facility Discharge (MGD)	Estimated Downstream Receiving Water EC (µmhos/cm)	Estimated % Change in Downstream EC(1)
TRACY WWTP						
Low Delta Export						
Future Baseline (with RO)	688(2)	(3)	39(4)	16	667	
Future WQ with Variance	688	(3)	1,223(5)	16	706	**5.52%**
High Delta Export						
Future Baseline (with RO)	688	(3)	39(4)	16	665	
Future WQ with Variance	688	(3)	1,223(5)	16	708	**6.06%**
STOCKTON RWCF						
Future Baseline (with RO)	521(6)	3076(7)	36(4)	55	508	
Future WQ with Variance	521	3076	1,111(8)	55	537	**5.40%**
MANTECA WQCF						
Dry/Below Normal WY						
Future Baseline (with RO)	424(9)	1250(10)	25(4)	17.5	416	
Future WQ with Variance	424	1250	763(11)	17.5	431	**3.63%**
Critical Water year						
Future Baseline (with RO)	424	600(9)	25(4)	17.5	407	
Future WQ with Variance	424	600	763	17.5	439	**7.27%**

Notes:

1. Change resulting from implementation of RO and compliance with 700 µmhos/cm final effluent limit.
2. Old River upstream EC is the average of data collected at the Tracy WWTP R-1 station from 2007 to 2010.
3. Downstream ambient concentrations were calculated using the DSM2 model completed for the City of Tracy and Mountain House CSD (DWR, 2007), high export and low export scenarios, summer (August) assumption.
4. Average effluent EC with RO treatment of a facility's entire discharge is based on percent salt rejection of the RO process and average TDS concentration of the facility from April through August.
5. Tracy WWTP effluent EC is the average of data collected from 2009 to 2010, summer months only (April-August).
6. San Joaquin River upstream EC is the average of data collected at the Stockton WQCF R-1 station from 2007 to 2011.
7. San Joaquin River harmonic flow from USGS gauge 11304810 – San Joaquin River at Garwood Bridge (near Stockton) from March 1998 – March 2009.
8. Stockton WQCF effluent EC is the average of data collected from 2007 to 2011, summer months only (April-August).
9. San Joaquin River upstream EC is the average of data collected at the Manteca WQCF R-1 station from 2010 to 2011.
10. San Joaquin River flow near Manteca is taken from the City of Manteca Thermal Plan Exception Analysis Final Report (LWA, 2006).
11. Manteca WQCF effluent EC is the average of data collected from 2008 to 2011, summer months only (April-August).

ii.1 Tracy WWTP WQ Impacts Analysis

The current water quality impacts analysis performed for the City of Tracy WWTP (**Table 8, Table 9**) was based on the 2007 DSM2 model evaluation performed by DWR (DWR, 2007). The 2007 evaluation was overseen by a stakeholder group that included representatives from the City of Tracy, MHCSD, South Delta Water Agency, California Sportfishing Protection Alliance, DWR, and the Central Valley Water Board. The stakeholder group selected modeling assumptions and input parameters that would represent appropriate and reasonable worst-case water quality scenarios in the south Delta when running the DSM2 model. These assumptions and input parameters included:

- 1985 tide data from the south Delta that included two neap tides in the tidal cycle in August, which would represent a worst-case condition when flows are critically low and agricultural use in very high. The low flushing affect of neap tides causes agricultural return water and wastewater flows to build up in south Delta channels resulting in elevated salinity.
- High and low export pumping scenarios:
  - High Export Pumping: SWP = 6,800 cfs, CVP = 4,600 cfs
  - Low Export Pumping: SWP = 1,500 cfs, CVP – 1,000 cfs
- San Joaquin River flow rate of 1,000 cfs at Vernalis.
- SDIP permanent gates in place to represent future conditions.

Based on the above assumptions and input parameters, the results of the 2007 DWR model evaluation and the current water quality impacts analysis are conservative. Percent change in near-field and far-field receiving water EC concentrations under less critical conditions would be smaller than those presented in **Table 8** and **Table 9** for the City of Tracy WWTP discharge. **Table 8** and **Table 9** were used to create **Figure 7** through **Figure 10**, in which the estimated near- and far-field changes in downstream receiving water EC concentrations under low and high Delta export conditions with implementation of partial RO treatment at the WWTP are shown. The estimated changes in EC with RO treatment represent slight decreases (0.0% - 2.66%) in EC levels as compared to those estimated for the future with variance condition.

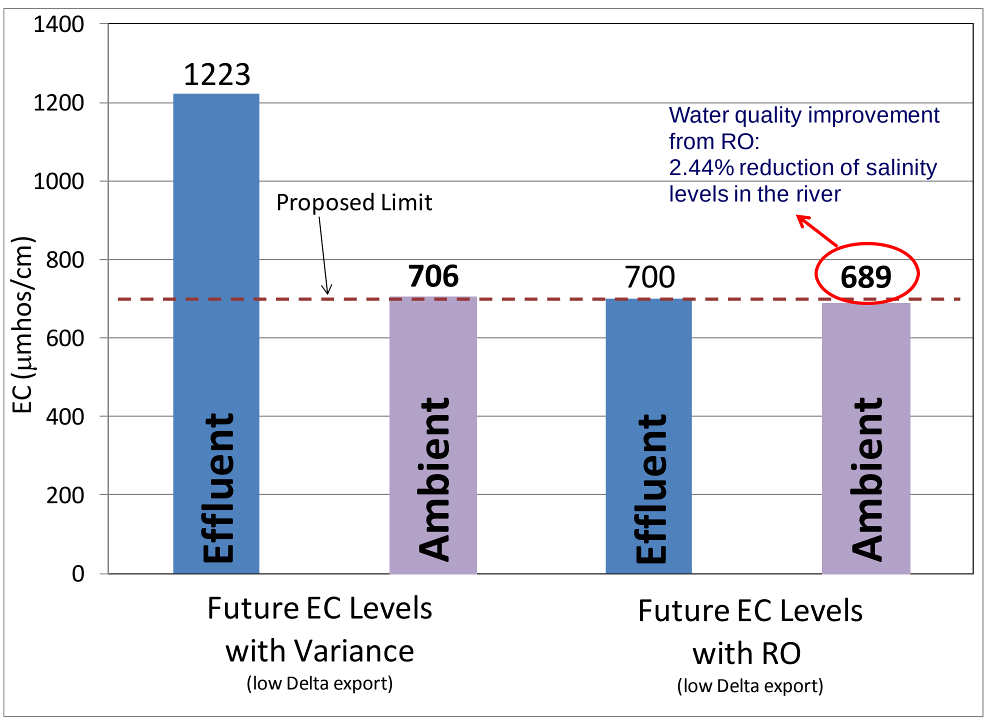

Figure 7: City of Tracy WWTP – Future Incremental Near-Field Water Quality Changes Associated with Implementation of RO Treatment under Low Delta Export Conditions.

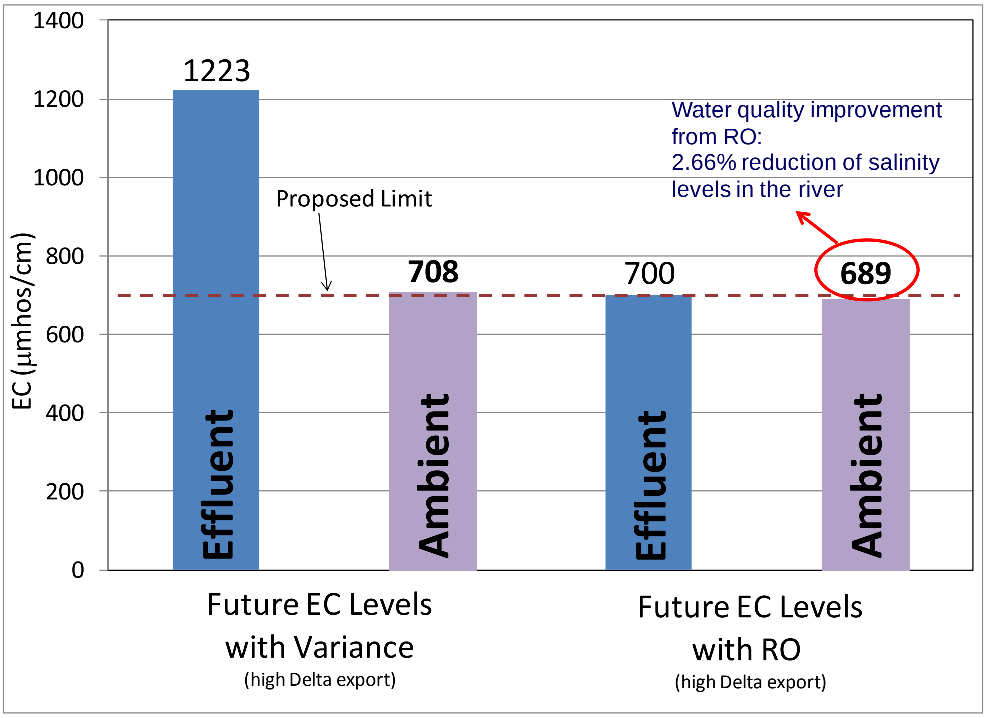

Figure 8: City of Tracy WWTP – Future Incremental Near-Field Water Quality Changes Associated with Implementation of RO Treatment under High Delta Export Conditions.

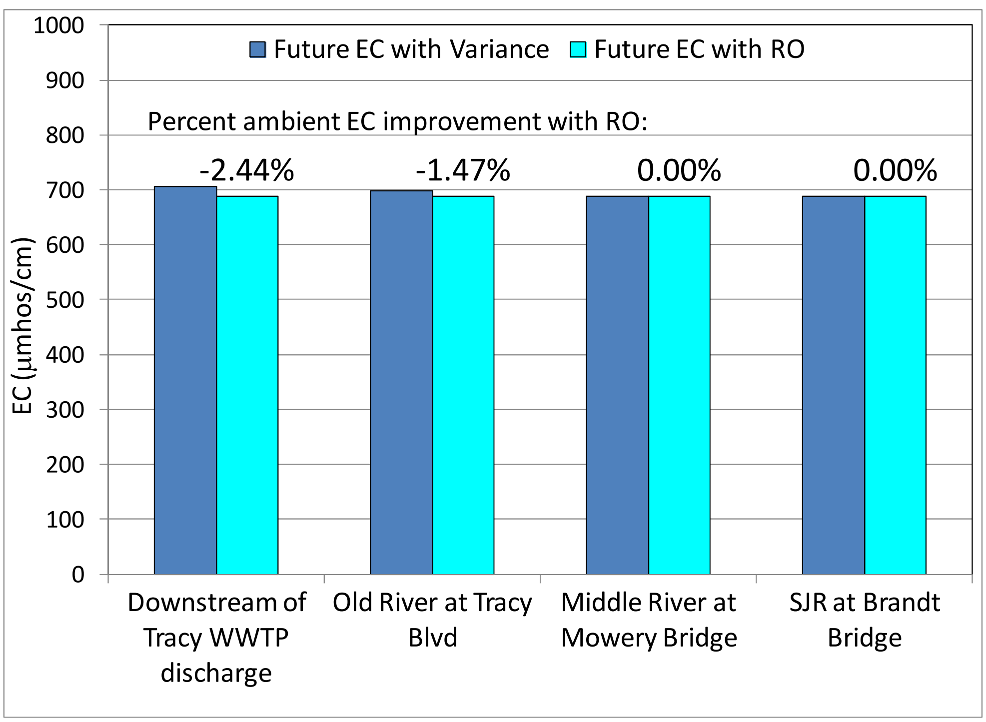

Figure 9: City of Tracy WWTP – Future Incremental Far-Field Water Quality Changes Associated with Implementation of RO Treatment under Low Delta Export Conditions.

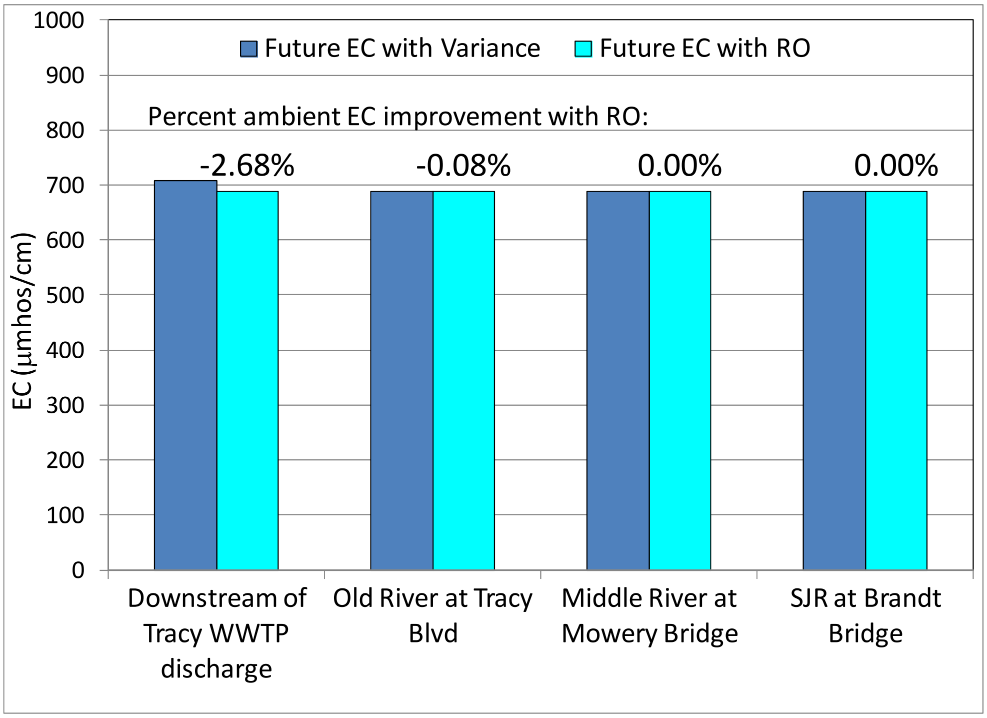

Figure 10: City of Tracy WWTP – Future Incremental Far-Field Water Quality Changes Associated with Implementation of RO Treatment under High Delta Export Conditions.

ii.2 Stockton RWCF WQ Impacts Analysis

The near-field water quality impacts estimated for the City of Stockton RWCF with implementation of partial RO treatment of the City's discharge and the granting of a salinity variance are based on a simple mass balance equation. The Stockton analysis used a less conservative receiving water flow rate than used for the Tracy and Manteca's analyses. However, the San Joaquin River harmonic mean flow (March 1998 – March 2008[3]) used in the Stockton analysis is arguably a more appropriate flow rate to use than a critical low flow, for example, as it represents a long-term average flow condition that should be used when estimating water quality impacts of pollutants whose long-term, cumulative mass loadings create impacts on downstream water quality, such as salts. The harmonic mean flow is used by the Central Valley Water Board to evaluate long-term dilution of wastewater discharges. The harmonic mean estimates the average dilution ratio (i.e., 1/flow) of a stream. Very high flows provide high dilution of wastewater effluent, but doubling the flow reduces the effluent concentrations in the river by a factor of 2. The harmonic mean discounts the dilution value of very high flows, and emphasizes periods of lower flow when effluent concentrations are relatively high. The estimated, near-field percent change in EC concentration (2.06% decrease) calculated for the San Joaquin River downstream of the WQCF discharge with implementation of partial RO treatment at the WWQF is shown in **Table 8** and **Figure 11**. The 2.06% change represents a slight decrease in EC levels as compared to those estimated for the future with variance condition.

[3] The period March 1998 through March 2008 did include three Wet water years, two Above Normal water years, three Dry water years, one Below Normal water year, and two Critical water years.

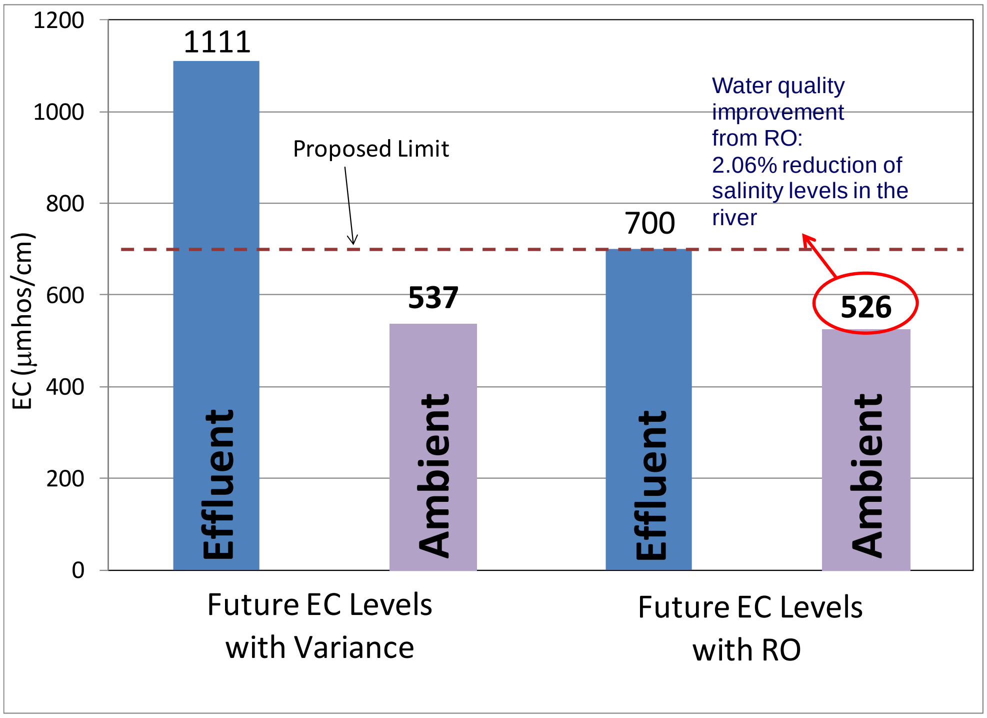

Figure 11: City of Stockton RWCF – Future Incremental Near-Field Water Quality Changes Associated with Implementation of RO Treatment.

ii.3 Manteca WQCF WQ Impacts Analysis

Similar to the Stockton analysis described above, the near-field water quality impacts estimated for the City of Manteca WQCF with implementation of partial RO treatment of the City's discharge and the granting of a salinity variance are based on a simple mass balance equation. However, due to the availability of San Joaquin River at Vernalis flows estimated for critical (600 cfs) and dry/below normal (1250 cfs) water year types (LWA, 2006), these more conservative flow rates were used in the current water quality impacts analysis. The use of these more conservative flow rates parallels the use of the 1985 flow data used in the DWR DSM2 modeling evaluation of the Tracy WWTP discharge. Similar to the Tracy analysis, the percent change in near-field receiving water EC concentrations for the City of Manteca under less critical flow conditions would be smaller than those presented in **Table 8** and **Figure 12** and **Figure 13** for the WQCF discharge. Because the percent change in EC concentrations estimated using the more conservative San Joaquin River at Vernalis flow rates ranged from 0.31% (dry/below normal water years) to 0.62% (critical water years), the use of a long-term average flow rate, such as the harmonic mean, would provide an even smaller, future, incremental, near-field percent change in downstream receiving water EC concentration with implementation of partial RO treatment when compared to a future with variance condition.

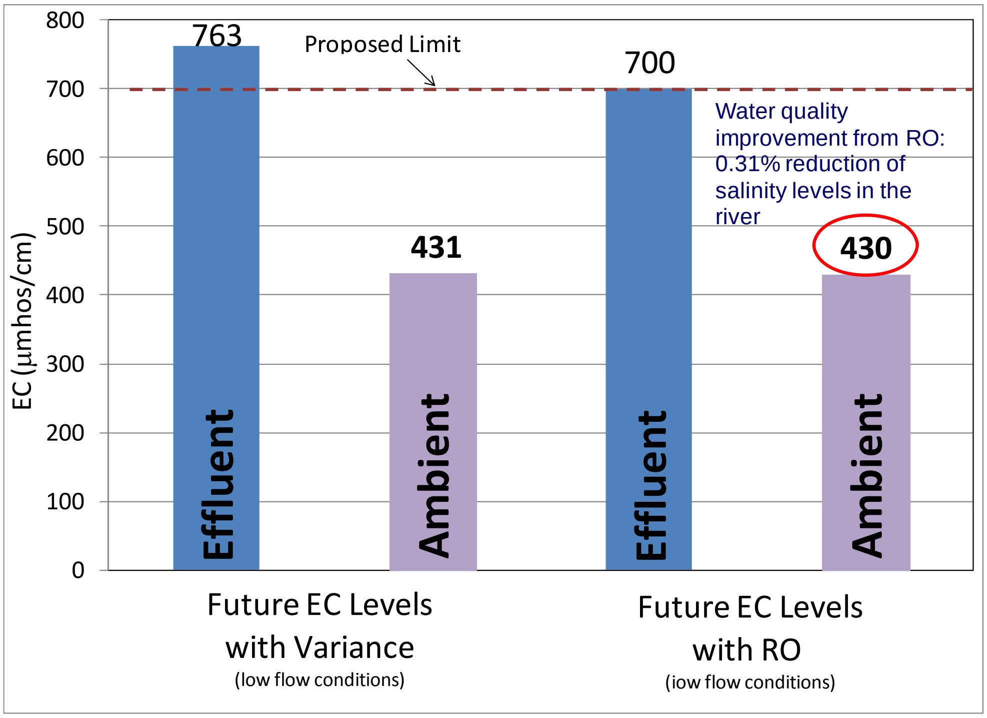

Figure 12: City of Manteca WQCF – Future Incremental Near-Field Water Quality Changes Associated with Implementation of RO Treatment under Dry/Below Normal Water Year Conditions.

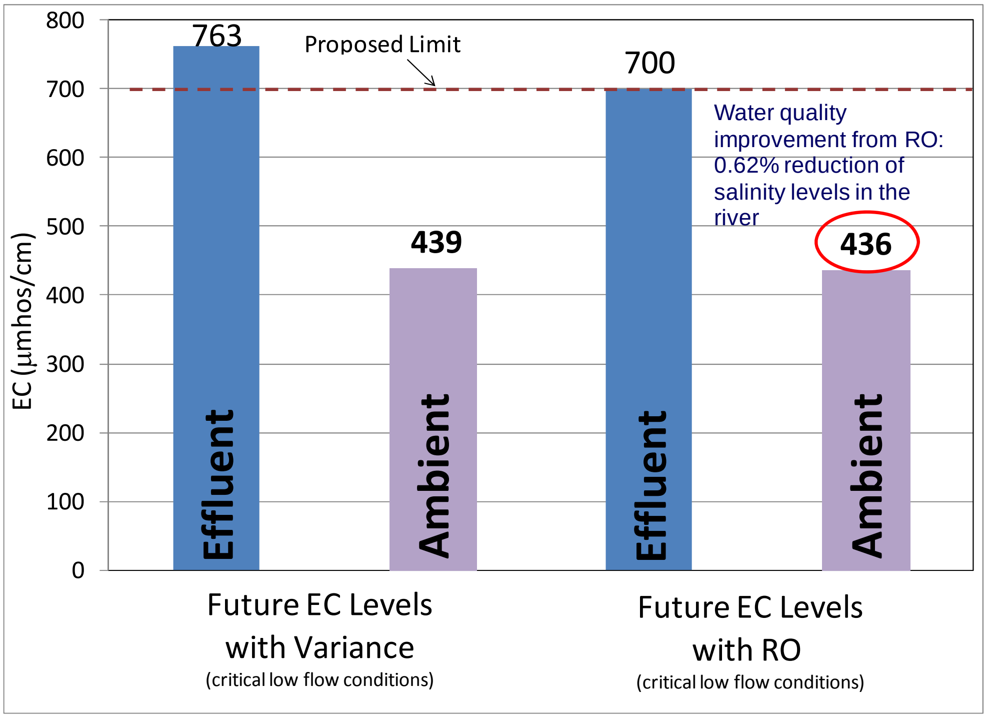

Figure 13: City of Manteca WQCF – Future Incremental Near-Field Water Quality Changes Associated with Implementation of RO Treatment under Critical Water Year Conditions.

iii. Assessment of Variance Effects on San Joaquin River Flow Requirements

Under State Water Board Decision 1641, the United States Bureau of Reclamation (USBR) is obligated to meet salinity objectives in the San Joaquin River at Vernalis. The salinity objectives at Vernalis are seasonal, with a 1000 µmhos/cm 30-day running average of mean daily EC from September 1 through April 29, and a 700 µmhos/cm 30-day running average of mean daily EC from April 30 through August 31. The primary tool used by USBR for meeting salinity objectives at Vernalis is the release of water from New Melones Reservoir into the Stanislaus River to affect salinity conditions at Vernalis.

The concern exists that salinity changes in the Delta resulting from a variance from salinity effluent limits for the communities of Tracy, Stockton and/or Manteca will impact flow releases by the USBR. The issue is twofold: (a) whether, in the absence of a variance, USBR could reduce the amount of flow it releases to meet salinity objectives, or (b) whether the variance would allow increased levels of salinity in the Delta which would increase the obligations of the USBR to release more water.

At issue is whether the releases by USBR are driven by salinity levels at Vernalis (at the rim of the Delta and outside the influence of the wastewater discharges) or by salinity levels at interior locations in the Delta.

In April 2011, the USBR released a report titled "Special Study: Evaluation of Dilution Flow to Meet Interior South Delta Water Quality Objectives" (USBR, 2011). The report was prepared to meet requirements of Water Rights Order 2010-002 issued by the SWRCB in January 2010. The Order required the Department of Water Resources (DWR) and USBR to study the feasibility of controlling salinity through various measures, including increasing flows in the San Joaquin River. The purpose of the April 2011 report was to evaluate the feasibility of meeting interior south Delta water quality objectives through increased San Joaquin River flows.

The evaluation documented in the April 2011 report occurred in three phases: (1) exploration of the relationship between salinity at Vernalis on the San Joaquin River and salinity at the locations in the south Delta where salinity objectives exist, (2) evaluation of the range of additional San Joaquin River flows at Vernalis that would be needed to meet the interior south Delta salinity objectives, and (3) an evaluation of the availability of those additional flows.

As stated on page 8 of the report: "Reclamation has been operating the Central Valley Project (CVP) to meet the Vernalis salinity objective since the mid 1990's. The report continues, "…the 30-day running average of salinity at Vernalis is calculated every day and operations are conducted to meet the 30-day running average that is lower than the objective. This operation uses a "salinity buffer" – an operational salinity goal at Vernalis that is lower than the salinity objective in order to ensure compliance with the objective." (USBR, 2011).

The report examined the history of compliance with south Delta salinity objectives for the water years 2000 through 2010. The locations for the south Delta objectives are:

- San Joaquin River at Vernalis (Station C-10)
- Old River at Middle River (Union Island; Station C-8)
- San Joaquin River at Brandt Bridge (Station C-6)
- Old River at Tracy Road Bridge (Station P-12)

As shown in Table 1 on page 10 of the report, the compliance history (in terms of percent exceedance on a monthly basis) at each location for the period examined was: (a) San Joaquin River at Vernalis (0%); (b) Old River at Middle River (37%); (c) San Joaquin River at Brandt Bridge (14%); and (d) Union Island (13%) (USBR, 2011). This information shows that USBR has been very effective in its management of salinity at Vernalis through flow releases to the San Joaquin, but that such management has not resulted in compliance with salinity objectives at interior locations of the Delta.

In Table 9 on page 32 of the report, USBR determined the salinity levels at Vernalis that would be required to consistently achieve the existing salinity objectives at the three interior south Delta locations. As shown in the table, achievement of salinity objectives at Old River at Tracy Road Bridge is the controlling condition. The table indicates that compliance with the 700 µmhos/cm objective during the irrigation season at that location would require a salinity level of 298 µmhos/cm at Vernalis. Compliance with the 1000 µmhos/cm objective at that location would require a salinity level of 531 µmhos/cm at Vernalis. After examining the magnitude of San Joaquin River flows required to achieve these salinity levels at Vernalis, the USBR analysis suggests that such an approach would require an unreasonable amount of water (in the range of 1 to 2 million acre-feet in dry years)(page 46). The USBR analysis shows that the largest volumes or water are required during the driest seasons and years when it is least likely to be available (page 40) (USBR, 2011).

The SWRCB has not issued a formal response to the April 2011 USBR report. Given the conclusions of the report, it appears unlikely that a shift from the current practice of using the Vernalis station and Vernalis objectives as the basis for San Joaquin flow requirements will occur. Unless such a change were to occur, the effect of minor salinity changes in the interior Delta associated with implementation of a salinity variance for wastewater discharges is not expected to have an effect on San Joaquin River flow requirements impacting the USBR and its users.

Information provided in a February 2012 report prepared by the SWRCB titled *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* supports a finding that the management of wastewater effluent discharges will not have a significant effect on South Delta salinity conditions (CSWRCB, 2012). On page 4-7 of the subject report, it is stated that:

> "Salinity levels in the southern Delta are affected primarily by the salinity of water flowing into the southern Delta from the SJR near Vernalis and evapoconcentration of salt in water that is diverted from and discharged back into the southern Delta channels for agricultural purposes. Point sources of salt in the southern Delta have a small overall salinity effect." (CSWRCB, 2012).

On page 4-10 of the same report, it is noted that:

> "DSM2 modeling was conducted by a stakeholder group including DWR in 2007 to better understand the salinity impacts of the new and expanded discharges from the City of Tracy and Mountain House Community Services District wastewater treatment plants. The model analysis concluded that the City of Tracy discharge under reasonable worst case conditions has limited impacts on the salinity problem in the southern Delta as compared to other sources of salinity in the area…" (CSWRCB, 2012)

Combined with the water quality impact analysis provided above, and the findings of the April 2011 USBR report which point to continued reliance on salinity at Vernalis for USBR operations, it is reasonable to conclude that the implementation of a variance for Delta communities will not affect San Joaquin River flow requirements that exist for the USBR under Decision 1641 or other State Water Board authorities.

b. Effect of Granting a Case-by-Case Effluent Limit Exception for the City of Fresno

As with the Delta communities, if a case-by-case effluent limit exception was granted for the City of Fresno, the net effect would be to delay further action to design and construct new RO treatment facilities to achieve compliance with existing final effluent limits for EC. This would produce an associated delay in any change in groundwater quality down-gradient of the percolation ponds.

The temporary delay in improvement to ambient water quality associated with the granting of a case-by-case effluent limit exception is projected to be in the range of five to ten years. This time period is reasonable given the pace and complexity of the ongoing efforts to develop a comprehensive Salt and Nutrient Management Plan (SNMP) for the Central Valley (see Appendix A). Currently, a master SNMP covering the entire Central Valley (CV-SNMP) is being developed for Central Valley Water Board review in May 2014, with anticipated adoption as a Basin Plan Amendment in 2015. Local-scale management of salinity would then be determined at this future time according to the guidelines established in the CV-SNMP.

i. Groundwater Quality Impact Calculations

A simple spreadsheet batch-reactor mixing model was used to estimate resulting EC concentrations over a 10-year period in a subsection of the aquifer underlying the Fresno-Clovis Metropolitan RWRF percolation ponds due to contribution of RWRF discharges based on (1) current effluent EC concentrations and (2) EC concentrations from effluent treated to the 766 µmhos/cm effluent limit using microfiltration (MF) and RO. The 766 µmhos/cm target effluent limit was derived from the City's source water EC plus 500 µmhos/cm EC effluent limit, where average EC concentration in the City's source water was estimated to be 266 µmhos/cm.

A mass balance was computed based on background groundwater flow through a representative cross-sectional area of influence and total effluent flow discharged from the RWRF. Volumes were assumed to be fully and evenly mixed over one-year periods, which is consistent with travel times and mixing volumes discussed in Appendix M of the Fresno BPTC Evalution (Carollo, 2009). This approach results in steady-state conditions, meaning that for each one-year mixing period, background groundwater and effluent EC concentrations are assumed to remain constant.

The aquifer underlying the percolation ponds is approximately 275 feet thick, with a thick confining layer present at 275 feet below ground surface (ft bgs) (Appendix M of the Fresno BPTC Evaluation (Carollo, 2009)). Past reports indicate that effluent does not likely migrate downwards below this confining layer. Depth to water is approximately 40-50 ft bgs.

Predicted groundwater impacts from wastewater discharges were calculated using the following equation:

$$C_{GWdown} = (V_{GW} * C_{GWup} + V_{RWRF} * C_{RWRF}) / (V_{GW} + V_{RWRF})$$

Where: C_{GWdown} = Average EC Concentration in Upper Aquifer down-gradient of RWRF percolation ponds (µmhos/cm)

V_{GW} = Volume of groundwater flow beneath RWRF area of influence (L/yr)

C_{GWup} = Average EC Concentration in up-gradient (background) groundwater (µmhos/cm)

V_{RWRF} = Volume of pond effluent discharge (L/yr)

C_{RWRF} = Average EC Concentration in pond effluent discharge (µmhos/cm)

For the purpose of this analysis, mixing is assumed to be confined to the upper, saturated 225 feet of the aquifer, which is divided into two layers based on typical screened intervals of monitoring wells in the vicinity of the RWRF ponds:

- Layer A – 50 to 100 ft bgs
- Layer B – 100 to 275 ft bgs

The total groundwater flow into the study area (V_{GW}) was calculated using Darcy's Equation and appropriate hydraulic parameters for the study site, as summarized below and in **Table 11**.

Darcy's Equation:

$$Q = KAi$$

Where: $Q = V_{GW}$ = total subsurface flow mixing with the effluent (ft^3/yr)

K = Upper Aquifer hydraulic conductivity (ft/yr)

A = cross-sectional area of mixing (ft^2)

i = hydraulic gradient (ft/ft)

Table 11: Groundwater Flow Parameters Used in the Mixing Model

Parameter	Units	Value
Hydraulic Conductivity, *K*	ft/day	131
Cross-sectional Area, *A*	ft^2	7,164,000
Hydraulic Gradient, *i*	ft/ft	0.005

Hydraulic Conductivity (K): Given a transmissivity (*T*) and a saturated thickness of an aquifer (*b*), hydraulic conductivity (*K*) can be calculated using the equation $T = Kb$ (Freeze and Cherry, 1979). Representative values for transmissivity (*T*) and saturated thickness (*b*) in Layers A and B were calculated by Kenneth D. Schmidt and Associates (KDSA) and documented in the memo titled *Fresno Clovis RWRF BPTC Legacy Issues*, dated 11/20/2007, and included as Appendix M of the Fresno BPTC Evaluation (Carollo, 2009). On page 7 of the memo, KDSA assumed a transmissivity (*T*) of 55,000 gallons per day (gpd) for the shallow zone (Layer A) (i.e. b=50 ft), and a transmissivity (*T*) of 145,000 gpd for the deep zone (Layer B) (i.e. b=175 ft). Using the equation $T=Kb$, the hydraulic conductivities for Layer A and Layer B were calculated to be 147 ft/day and 114 ft/day, respectively. As an approximation of the overall hydraulic conductivity for flow moving laterally through Layers A and B, the arithmetic average was computed (131 ft/day) and used in the mixing model (see **Table 11)**. Note that the mixing model assumes vertical mixing through Layers A and B is complete and instantaneous.

Cross-sectional area (A): Groundwater flows predominantly to the southwest in the Kings River groundwater basin (DWR-Bulletin 118, 2003) and in the vicinity of the RWRF with an area of elevated groundwater levels underneath the percolation ponds (see **Figure 14**). It is conservatively assumed (based on water level contours and plume boundary estimates in) that the majority of the effluent mixes within a 1.5 mile area of influence on either side of the percolation ponds perpendicular to the southwest groundwater flow direction. Thus the cross-sectional area (*A*) perpendicular to groundwater flow was calculated assuming a 225 ft saturated thickness of the aquifer (i.e. saturated thickness of Layers A and B combined) by a 1.5 mile radius on either side of the percolation ponds (which extend approximately 3 miles perpendicular to the southwest groundwater flow direction). The cross-sectional area used in the mixing model (see **Table 11)** was calculated as follows:

$$
\begin{aligned}
\textit{Cross-sectional area } (A) &= 225 \text{ ft} * (1.5 \text{ mile} + 3 \text{ mile} + 1.5 \text{ mile}) \\
&= 225 \text{ ft} * (7920 \text{ ft} + 16{,}000 \text{ ft} + 7920 \text{ ft}) \\
&= 225 \text{ ft} * 31{,}840 \text{ ft} \\
&= 7{,}164{,}000 \text{ ft}^2
\end{aligned}
$$

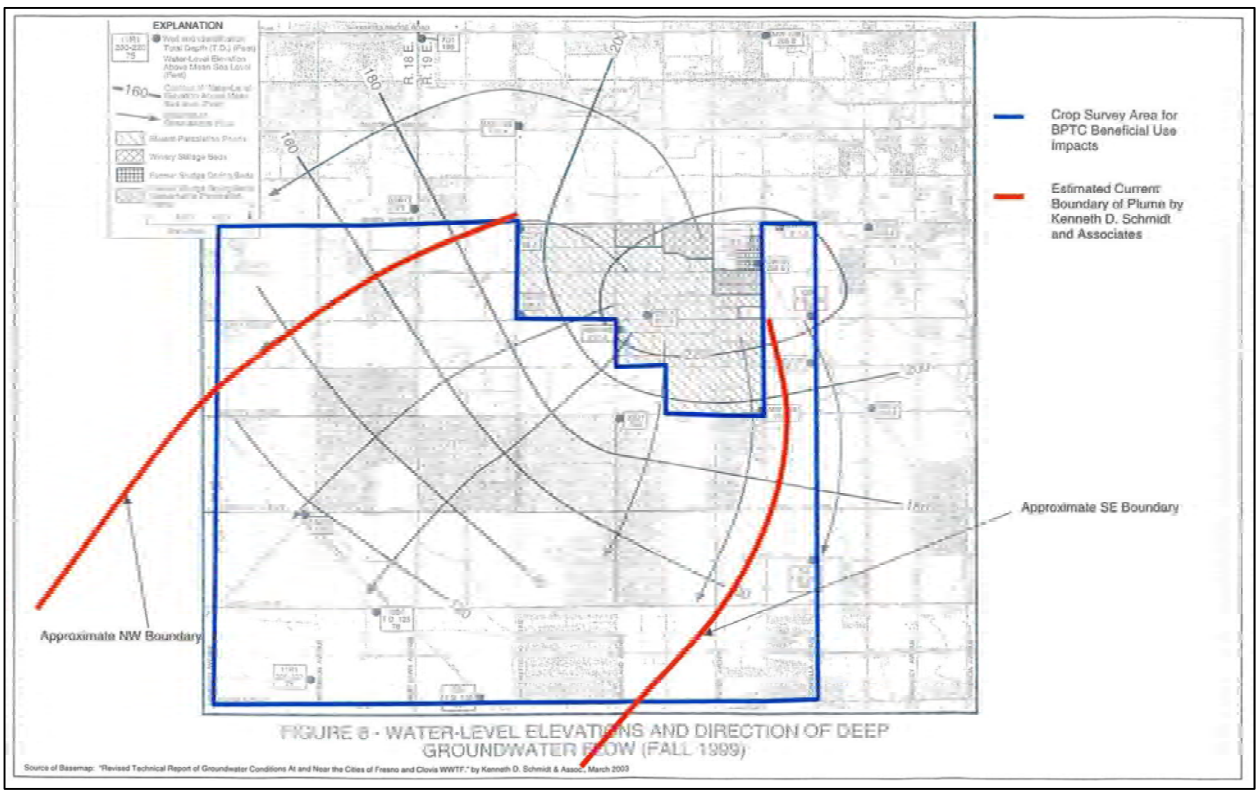

Figure 14: Groundwater Level Elevations and Flow Direction in the Vicinity of the Fresno-Clovis Metropolitan RWRF (Carollo, 2009).

Hydraulic Gradient (i): Average lateral hydraulic gradients beneath the percolation ponds are given for the shallow (Layer A) and deep (Layer B) aquifer zones on page 6 of the memo by Kenneth D. Schmidt and Associates (KDSA), titled *Fresno Clovis RWRF BPTC Legacy Issues*, dated 11/20/2007, and included as Appendix M of the Fresno BPTC Evaluation (Carollo, 2009). The average hydraulic gradient for Layer A is given in the memo as 20 feet per mile, which corresponds to 0.004 ft/ft. The average hydraulic gradient for Layer B is given in the memo as 30 feet per mile, which corresponds to 0.006 ft/ft. For purposes of this analysis, the average hydraulic gradient between Layer A and Layer B (0.005 ft/ft) was used in the mixing model (see **Table 11**).

The change in groundwater concentrations due to effluent discharge (C_{GWdown}) was evaluated for the upper 225 feet of the aquifer underlying the percolation ponds for two scenarios:

1. A simulation representing conditions if a portion of effluent is treated with MF/RO.
2. A simulation representing projected conditions if the case-by-case effluent limit exception were granted (i.e. no treatment with MF/RO)

For both simulations, the current influent flow to the RWRF of 70 MGD was used to represent V_{RWRF}, and is assumed to remain constant over the 10-year simulation time.[4] Although about 5% of the total effluent outflow is applied as irrigation water to nearby fields, and about 12% of effluent discharged to the percolation ponds is lost to evaporation (Resolution No. R5-2002-0254-A01 Amending WDR Order No. R5-2001-254 for Fresno-Clovis Metropolitan RWRF), this analysis conservatively assumes that all mass discharged from the RWRF percolates to groundwater. In the irrigation areas, salts tend to concentrate in the shallow aquifer due to evapoconcentration in the soil root zone and subsequent leaching. In the percolation ponds, a small portion of salts may precipitate out before infiltration into the subsurface though this effect is minimized due to high percolation rates. Additional dilution that could result from precipitation is considered negligible and is not incorporated into the mixing model.

The following assumptions were made in this analysis:

- The only sources of EC into the groundwater system are from background groundwater flow and discharge from the RWRF.
- Concentrations are constant during each one-year mixing period.
- The simulation was run for 10 consecutive one-year mixing periods.
- Mass inputs from the RWRF mix fully and completely through the upper saturated 225 feet of the aquifer.
- Apparent degradation in background groundwater concentrations is incorporated into the mixing model.
- Evaporation and precipitation are not incorporated into the mixing model.

[4] The average influent flow between March 2010 and February 2011 at the RWRF was 67 MGD, measured as monthly total flow divided by the number of days per month. It is assumed that the influent flow is equivalent to the effluent flow.

i.1 Effluent Concentrations (C_{RWRF})

The recent history of salinity concentrations and loadings for the Fresno-Clovis Metropolitan RWRF is shown in **Figure 15**.

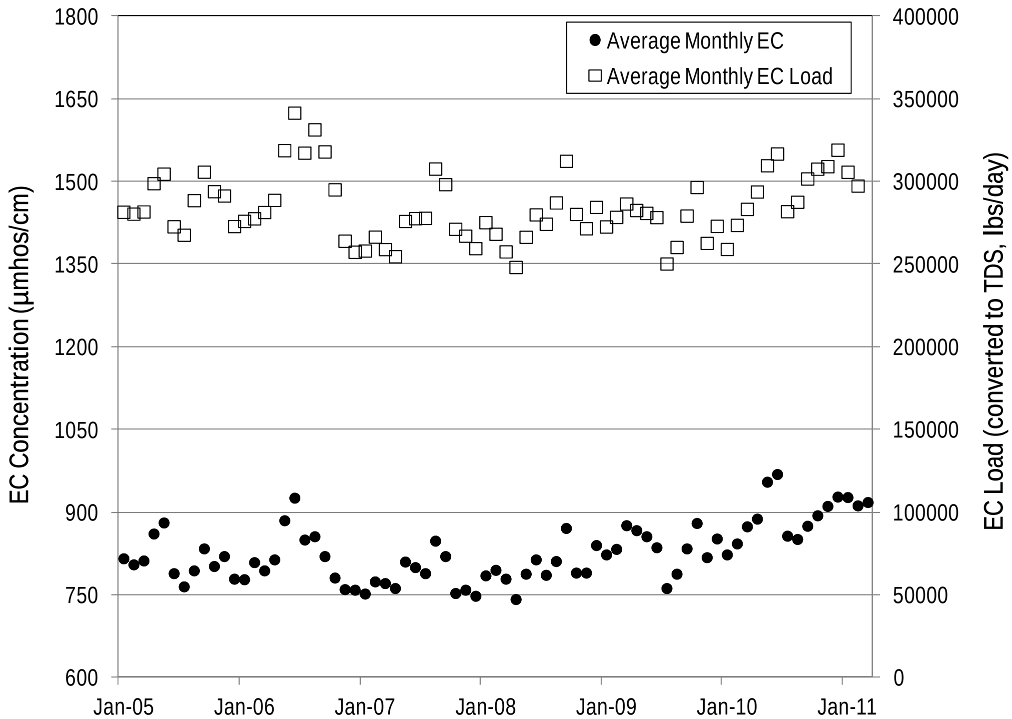

Figure 15: Fresno-Clovis Metropolitan RWRF – EC Concentrations and Equivalent TDS Loadings (Jan 2005 – Feb 2011).

Average effluent concentrations (C_{RWRF}) for each scenario are provided in **Table 12**. From December 2005 through February 2011, effluent concentrations ranged from 742 to 969 µmhos/cm, with an average of 827 µmhos/cm. For the scenario in which a portion of the effluent is treated with MF/RO, it is assumed that an appropriate portion of effluent will be treated with MF/RO to meet a target EC concentration of 766 µmhos/cm.

Table 12: Average Effluent EC Concentrations and Corresponding Volume of Effluent Requiring MF/RO Treatment to Reach 766 µmhos/cm Effluent Limitation.

Scenario	Average Effluent EC (µmhos/cm)
Conditions with a portion of effluent treated with MF/RO	766
Conditions if the case-by-case effluent limit exception were granted (i.e. no treatment with MF/RO)	827 (1)

Note:

1. These averages were derived from Fresno-Clovis Metropolitan RWRF effluent data (December 2005 – February 2011).

i.2 Background Groundwater Concentrations (C_{GWup})

Two sets of up-gradient monitoring wells are monitored regularly: MW-10A and 10B and MW-16A and 16 B (see **Figure 16**). Though previous reports on the study area considered MW-16A and MW-16B to be up-gradient wells, these wells exhibit concentrations much higher than the other up-gradient wells, indicating that MW-16A and MW-16B may be in the area of influence of the RWRF Ponds.

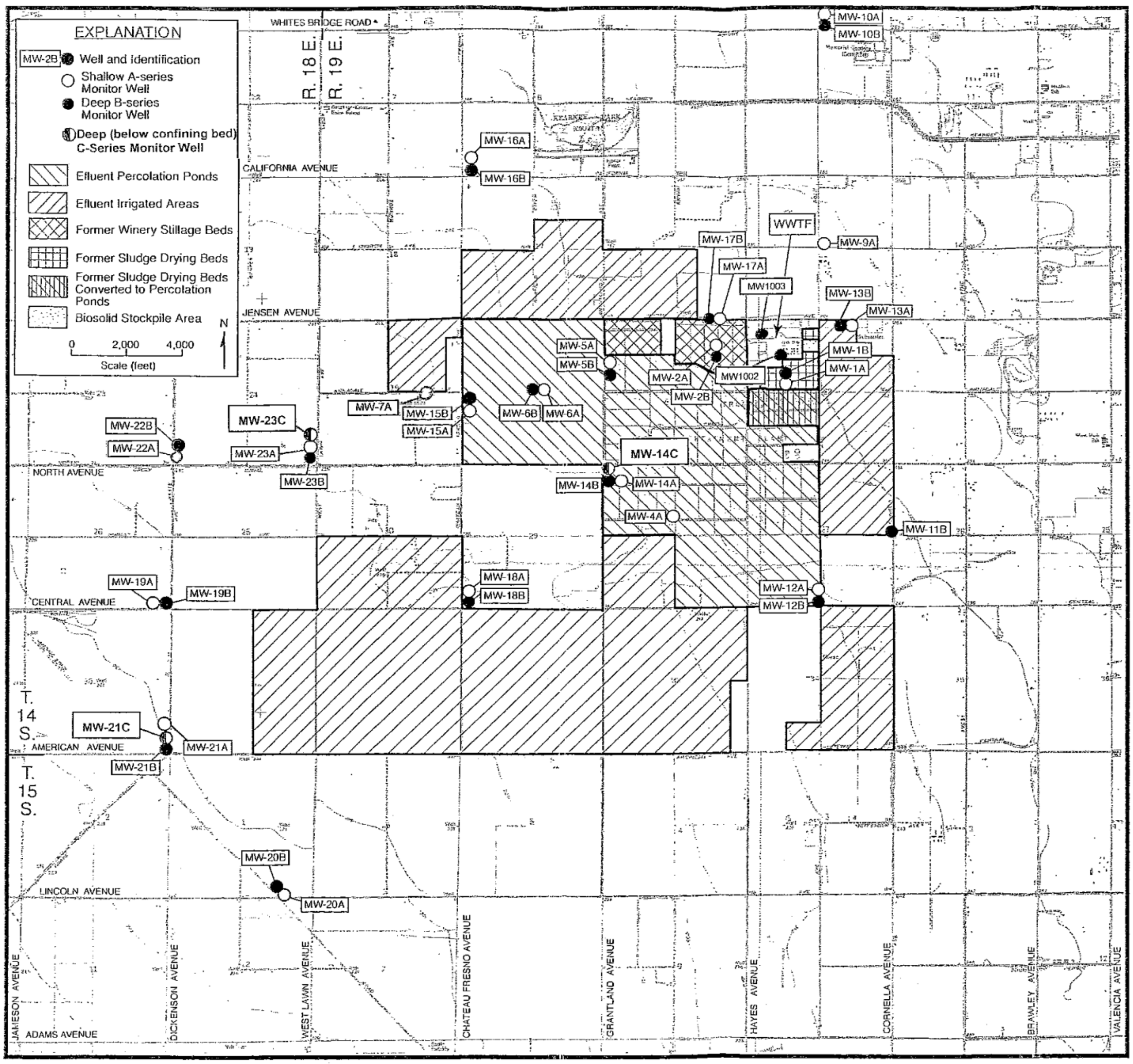

Figure 16: Fresno-Clovis Metropolitan RWRF Facilities and Monitoring Well Network (taken from Appendix I of the Fresno BPTC Evaluation (Carollo, 2009)).

Background groundwater EC levels (C_{GWup}) were thus derived based on observed concentrations (provided by the City of Fresno) in the two wells furthest up-gradient from the RWRF (MW-10A and MW-10B). Well MW-10A is screened from 74 – 94 ft bgs and is assumed to represent the shallowest groundwater concentrations in layer A (less than 100 ft bgs) whereas MW-10B is screened from 148 – 168 ft bgs and is assumed to represent deeper concentrations in layer B (100 – 275 ft bgs). Based on data from up-gradient wells MW-10A and MW-10B, background groundwater EC concentrations appear to be increasing with time, with strong linear trends evident in both shallow and deep up-gradient wells (see **Figure 17** and **Figure 18**).

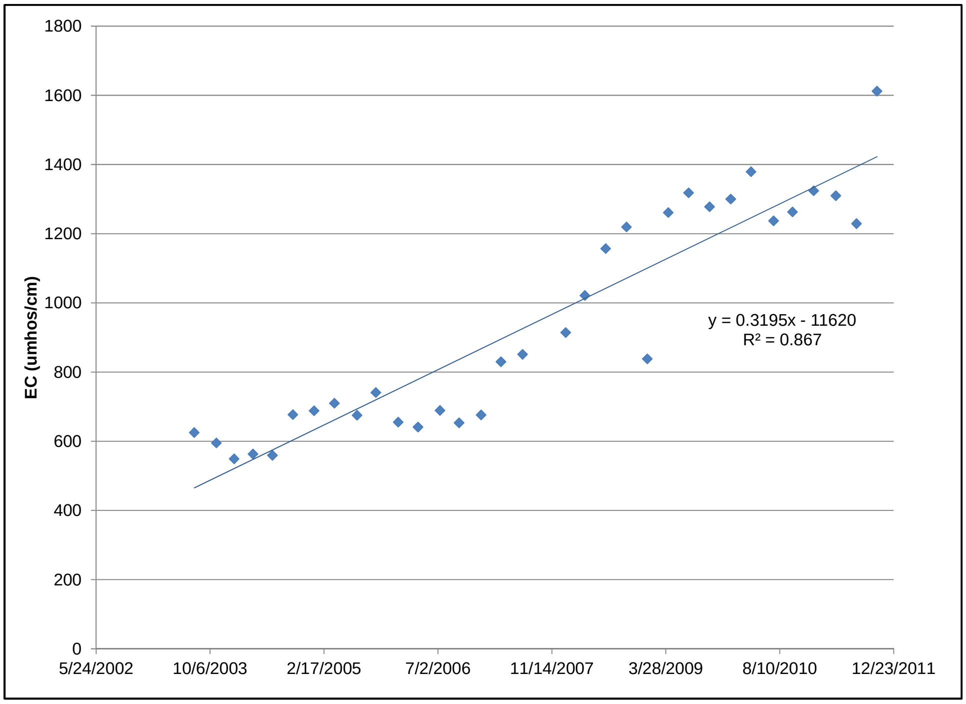

Figure 17: Layer A (< 100 ft bgs) Up-gradient Groundwater Concentrations, 2003 – 2011 (MW-10A).

Though groundwater quality in the Layer B up-gradient well (MW-10B) appears to be degrading, current EC concentrations in this well still fall within the low range of typical EC levels of the Kings Groundwater Sub-basin (DWR-Bulletin 118, 2003) and are less than RWRF effluent concentrations. In contrast, shallow up-gradient wells in Layer A (MW-10A) exhibit EC concentrations that are greater than the maximum RWRF effluent concentrations.

The degradation of the up-gradient groundwater quality and the high shallow up-gradient EC concentrations indicate that there are likely additional salinity sources contributing to degradation to overall groundwater quality in the basin. Degradation of background groundwater in the vicinity of the RWRF due to other sources such as nearby irrigated agricultural lands, or existing and past dairy operations, has been documented (Appendix M of the Fresno BPTC Evaluation (Carollo, 2009); Resolution No. R5-2002-0254-A01 Amending WDR Order No. R5-2001-254 for Fresno-Clovis Metropolitan RWRF). Due to the presence of these other salinity sources, the City of Fresno WDR indicates that the RWRF discharge shall not, in combination with other sources of salinity, cause the groundwater down-gradient of the discharge area to exceed an interim groundwater objective (990 µmhos/cm) or the natural background concentration, whichever is greater.

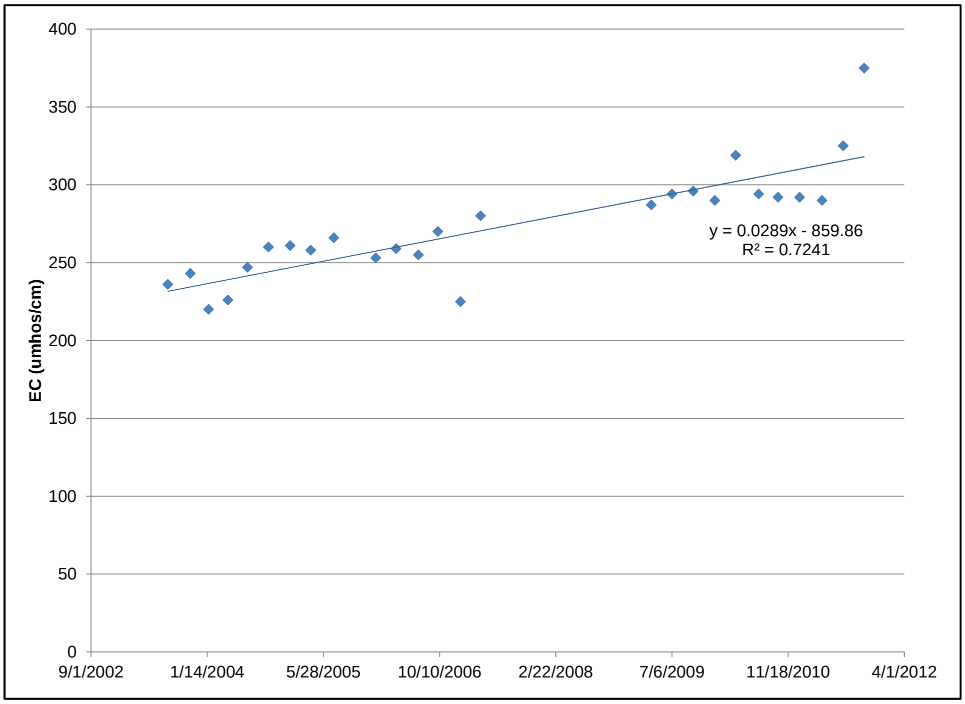

Figure 18: Layer B (100 – 275 ft bgs) Up-gradient Groundwater Concentrations, 2003 – 2011 (MW-10B).

For this reason, an approximation of the trend in background concentrations was incorporated into the mixing model. Based on the trend of degradation, the linear regression equations shown in **Figure 17** and **Figure 18** were used to estimate future background groundwater concentrations over the next 10 years. Overall background quality is estimated via a weighted average of concentrations in layers A and B. Background groundwater concentrations for each future one-year mixing period considered in the analysis are provided in **Table 13**. Though it is not known if the degradation rate observed in these two wells is representative of the overall trend of background groundwater degradation in the vicinity of the RWRF, this analysis incorporates the best available information on background quality and allows for evaluation of the impacts of discharge from the RWRF in combination of other sources of salinity in the vicinity.

Table 13: Projected Background Groundwater EC Concentrations from 2011 through 2021.

Time Period	Background EC[1] (µmhos/cm)
1 Year	566
2 Year	600
3 Year	635
4 Year	669
5 Year	703
6 Year	737
7 Year	771
8 Year	806
9 Year	840
10 year	874

Note:
1. Overall background concentrations estimated via a weighted average of concentrations in upper aquifer layers A and B.

ii. Results and Analysis

ii.1 Resulting Groundwater Quality Due to RWRF Discharge

Projected, future, down-gradient groundwater quality assuming partial MF/RO treatment versus projected, future, down-gradient groundwater quality assuming the case-by-case exception is granted is summarized in **Table 14**.

Table 14: Projected Future Down-gradient Groundwater Quality (1)

Time-Period	Projected DG GW Quality with MF/RO Treatment (µmhos/cm)(2)	Projected DG GW Quality if Case-by-Case Exception is Granted (µmhos/cm)(3)	% Increase in DG GW Quality If Case-by-Case Exception is Granted
Year 1	699	740	+6%
Year 2	711	751	+6%
Year 3	722	763	+6%
Year 4	734	774	+6%
Year 5	745	786	+5%
Year 6	756	797	+5%
Year 7	768	808	+5%
Year 8	779	820	+5%
Year 9	791	831	+5%
Year 10	802	843	+5%

Note:
1. Assumes effluent volume of 70 MGD for both scenarios and all mixing periods
2. Assumes that a portion of effluent will be treated with MF/RO to result in average EC effluent concentrations of 766 µmhos/cm for all mixing periods.
3. Assumes no MF/RO treatment; average effluent quality is assumed to be equal to the 5-year average, i.e., 827 µmhos/cm for all mixing periods.

If the case-by case exception is granted, down-gradient groundwater concentrations over the next five years are projected to range between 740 and 786 µmhos/cm. Due to projected degradation in background groundwater (see **Table 13**), concentrations in down-gradient groundwater are expected to increase to 843 µmhos/cm after 10 years. Granting of a case-by-case effluent limit exception is estimated to result in a 5-6% increase in EC concentrations in groundwater down-gradient of the percolation ponds compared to down-gradient groundwater concentrations that are estimated to result from implementation of MF/RO. Note that if the effluent volume were to increase at later times up to the design capacity of 88 MGD, the resulting concentrations for each scenario would differ by less than 1%.

c. Water Quality Impacts Analysis Conclusions

i. Delta Communities

Requiring the cities of Tracy, Stockton, and Manteca to meet a final EC effluent limit of 700 µmhos/cm that is contained in each of their NPDES permits would provide little to no reduction in EC concentrations measured in downstream receiving waters. The analyses above show that implementation of RO treatment to remove salts from a portion of a discharger's effluent in order to meet a final EC effluent limit of 700 µmhos/cm would reduce near-field downstream receiving water EC concentrations from 0.31% (City of Manteca WQCF during a critical water year) to 2.66% (City of Tracy WWTP during high Delta exports). With regard to the City of Tracy, the one discharger where far-field water quality impacts were able to be evaluated, the benefit to the receiving water of removing salts from the WWTP effluent rapidly diminishes with distance from the discharge point. Whereas it is estimated that partial RO treatment of Tracy's effluent would result in a small 2.44% (low Delta export condition) to 2.68% (high Delta export condition) lowering in EC levels just downstream of the WWTP outfall, implementation of the same level of RO treatment would only impart a 0.08% (high Delta export condition) to 1.47% (low Delta export condition) decrease in receiving water EC concentrations in Old River at Tracy Road Bridge (a D-1641 salinity compliance station), a location approximately 4.25 miles downstream of the Tracy discharge. The DWR DSM2 model estimates that there would be no change in EC at two other D-1641 salinity compliance locations – Old River at Middle River and San Joaquin River at Brandt Bridge – due to the assumed permanent installation of SDIP salinity control gates that would prevent Tracy WWTP effluent from reaching these far-field locations.

The water quality impacts analyses performed for all three Delta dischargers show that wastewater treatment controls (RO treatment of a portion of a facility's effluent) will only have very limited localized impacts on the reduction of salts in receiving waters and will not act to appreciably lower salts in the south Delta due to the relatively large salinity inputs contributed by the San Joaquin River and the evapoconcentration affect that agricultural practices have on water withdrawn from and returned to the south Delta. Conversely, the granting of a salinity variance for each of the Delta communities would have only have very limited localized impacts on the addition of salts to receiving waters. In effect, the granting of a salinity variance represents a delay in the slight improvement in water quality that would occur with future implementation of RO treatment as a means to comply with a final EC effluent limit of 700 µmhos/cm.

Requiring wastewater treatment plants to provide RO treatment for a portion of their discharge will not achieve the April 1 through August 31 700 µmhos/cm Bay-Delta Plan water quality objective for EC in the south Delta. With regard to the City of Tracy discharge, even full RO treatment of its effluent would not be sufficient to bring ambient EC concentrations in the south Delta into compliance with the 700 µmhos/cm EC objective because the City's contribution to the overall salt load is too small to affect a change in regional EC concentrations. The Stockton RWCF and Manteca WQCF are situated at the periphery of the south Delta and discharge treated effluent to the San Joaquin River at locations where the ambient receiving water EC concentration typically meets the April 1 through August 31 700 µmhos/cm EC objective as a 30-day running average (refer to the average upstream and estimated downstream receiving water EC concentrations for the two facilities listed in **Table 10**. The addition of full RO treatment at these two facilities would have a small positive impact on near-field salt concentrations, but would not affect regional ambient receiving water compliance with the April 1 through August 31 700 µmhos/cm Bay-Delta Plan water quality objective for EC in the south Delta.

Furthermore, as stated in the 2011 USBR report, the effect of minor salinity changes in the interior Delta associated with implementation of a salinity variance for wastewater discharges is not expected to have an effect on San Joaquin River flow requirements impacting the USBR and its users. Salinity levels in the south Delta are largely driven by the salinity of water in the San Joaquin River near Vernalis that flows into the south Delta and the salts contributed by agricultural practices within the region. Point source impacts from wastewater treatment facilities contribute little to the salinity levels measured in the south Delta.

ii. City of Fresno

Results from the water quality impacts analysis indicate that granting a case-by-case effluent limit exception to the City of Fresno RWRF is not expected to result in significant impacts to groundwater quality. Granting of the case-by-case effluent limit exception is estimated to result in an increase of just 4 – 6% in down-gradient groundwater quality over the baseline scenario, which assumes treatment of a portion of effluent with MF/RO to achieve a final effluent quality for EC of 766 µmhos/cm.

VI. 40 CFR 131.10(G) ANALYSIS

a. 40 CFR 131.10(g) Background

To gain approval for a water quality standards variance for a discharge to surface waters, USEPA guidance states that a showing should be made that the variance is consistent with 40 CFR 131.10(g).

The 40 CFR 131.10(g) analysis contained herein considers three Central Valley NPDES permittees as case studies. The City of Tracy WWTP, the City of Stockton RWCF, and the City of Manteca WQCF all discharge treated effluent to the Sacramento-San Joaquin Delta and are all subject to NPDES permit waste discharge requirements as promulgated by the Central Valley Water Board, including final effluent limitations for EC derived from water quality objectives contained in the Bay-Delta Plan.[5] These NPDES permittees cannot consistently meet these EC (salinity) limitations. All three facilities have implemented significant salinity source control efforts, including obtaining additional surface water supplies and/or requiring industrial source control and pretreatment, which have resulted in decreases in effluent EC concentrations over time as compared to historic levels. However, as described in this memorandum, these efforts are not projected to be adequate to result in consistent compliance with final effluent limitations for EC for any of the three communities.

United States Environmental Protection Agency (USEPA) guidance indicates that a water quality standards variance has been and can be used to provide a mechanism by which NPDES permits can be written where discharger compliance with the effluent limits derived from underlying water quality standards is demonstrated to be infeasible at the present time within the meaning of 40 CFR 131.10(g). For NPDES permittees, USEPA guidance notes that a variance provides a "bridge" if additional data or analysis is needed before the state or tribe can make a determination whether the designated use or water quality standard is not attainable and should be modified (U.S. EPA, 1994). A variance can also provide a mechanism that bridges the gap between time schedules allowed under state laws and compliance schedules allowed under federal laws.

To make the case for a variance, USEPA guidance indicates that a demonstration is needed that compliance with effluent limits derived from water quality standards is infeasible due to at least one of the following six factors:

> Sec. 131.10 Designation of uses. [. . .] (g) States may remove a designated use which is not an existing use, as defined in Sec. 131.3, or establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible because:
>
> (1) Naturally occurring pollutant concentrations prevent the attainment of the use; or
>
> (2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent

[5] 700 µmhos/cm from April 1 to August 31 and 1,000 µmhos/cm from September 1 to March 31, as a monthly average

discharges without violating State water conservation requirements to enable uses to be met; or

(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or

(5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

(6) Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact. (40 CFR 131.10(g))

This analysis addresses two of the above six factors for the case study communities. Those are the third factor ((40 CFR 131.10(g)(4)), i.e., that human caused conditions prevent the attainment of the use and cannot be remedied by actions by the case study communities, and the sixth factor ((40 CFR 131.10(g)(6)), i.e., controls more stringent that otherwise required under the Clean Water Act by the case study communities would result in substantial and widespread economic and social impact.

b. Approach to Analysis

Each of the two 40 CFR 131.10(g) factors addressed in the current salinity variance analysis require an individual examination to demonstrate that compliance with effluent limits derived from water quality standards is infeasible for the three Delta communities. The Factor 3 analysis requires an explanation as to why human caused conditions prevent the attainment of the use (via non-compliance with water quality standards), whereas the Factor 6 analysis requires a demonstration that compliance with water quality standards would result in substantial and widespread economic and social impacts in a community. The Factor 6 analysis requires use of USEPA economic guidance to make the substantial and widespread determination.

USEPA developed and periodically updates guidance on how to determine if the capital and operations and maintenance (O&M) costs of pollution control will have a substantial and widespread economic impact on a community (U.S. EPA, 1995). The 1995 *Interim Economic Guidance for Water Quality Standards – Workbook* (USEPA Economic Guidance) was used in the Factor 6 analysis as a means to consider the cost of implementing RO treatment at the three Delta wastewater treatment facilities under study and estimating the change in socioeconomic conditions in a community that would occur as a result of implementing RO treatment of a portion of a dischargers effluent for the purpose of complying with a final EC effluent limit of 700 µmhos/cm.

The USEPA Economic Guidance describes a series of steps and decision points in a process that leads to the demonstration of substantial and widespread socioeconomic impacts related to implementation of pollution controls necessary to meet water quality standards. The five steps in the USEPA Economic Guidance process used to determine the magnitude of socioeconomic impacts on a community include the following:

- Calculate the annual cost of pollution control
- Calculate total annual pollution control costs per household
- Calculate and evaluate the Municipal Preliminary Screener Score
- Apply the Secondary Test
- Assess where the community falls in the Substantial Impacts Matrix

c. 40 CFR 131.10(g)(3) (Factor 3) Analysis

The third of the six factors to be considered under 40 CFR 131.10(g) is:

> "Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place"

For the analysis of the third factor under 40 CFR 131.10(g), key questions are (1) whether conditions preventing the attainment of the South Delta agricultural use are human caused, (2) whether those conditions can be remedied to achieve South Delta objectives, and, similarly, (3) whether, as a result of implementing measures to attain water quality-based effluent limits, the South Delta water quality objectives will be attained.

It is acknowledged that various human caused conditions, i.e. the diking of the Delta for agriculture and for development, the modification of flows to the Delta through construction of dams and diversions, construction and operation of the Central Valley Project (CVP) and State Water Project (SWP), agricultural return flows to the Delta, and municipal discharges, all have contributed to the existing salinity condition in the South Delta, to greater or lesser degrees.

i. Background to Factor 3 Analysis

In assessing the past efforts to achieve compliance with water quality objectives for salinity (EC) in the south Delta to protect designated agricultural uses, the following historical background (Kyler, 2011a; Kyler, 2011b) is important.

During a twelve year period from 1958 to 1970, the SWRCB adopted six decisions approving permits for various components of the federal CVP operated by the US Bureau of Reclamation. In those approvals, the State Water Board reserved jurisdiction to revisit water quality requirements, including salinity requirements, in future actions. In 1967, the State Water Board adopted decision D-1275, approving permits for the Department of Water Resources to operate the SWP and conditioning the permits on meeting agricultural salinity standards at several Delta locations. In 1973, the State Water Board (in decision D-1422) approved permits for USBR's New Melones Reservoir on the Stanislaus River. The State Board conditioned the permits on meeting total dissolved solids of 833 µmhos/cm EC at Vernalis on the San Joaquin River.

In 1978, the State Water Board approved decision D-1485, the water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Delta estuary. In that plan, the State Board established the agricultural salinity objectives that are currently in effect in the south Delta. The belief at the time of adoption of the plan was that the construction of physical facilities to provide adequate circulation and substitute supplies would be the practical solution for achievement of south Delta EC objectives. In 1991, the State Water Board adopted a water quality control plan for salinity for the Bay-Delta which established a staged implementation for attainment of the south Delta salinity objectives. The implementation plan acknowledged ongoing negotiations between DWR, USBR and the South Delta Water Agency.

In the period 1995 to 1998, the State Water Board amended the Water Rights permits for DWR and USBR for the SWP and CVP, respectively. The State Water Board required USBR to release water from New Melones Reservoir to comply with the EC objectives at Vernalis. In 2000, the State Board adopted decision D-1641 in which it assigned sole responsibility for meeting the Vernalis EC objectives to USBR and assigned joint responsibility to USBR and DWR to meet the EC objectives at three interior Delta locations. In 2006, the State Water Board adopted the current version of the Bay-Delta Plan, making minimal changes to the salinity provisions of the 1995 Bay-Delta Plan. The State Water Board committed to begin a process to evaluate San Joaquin River flow and south Delta salinity objectives as part of its ongoing process to revise the Bay-Delta Plan.

In October 2011, the State Board released a Technical Report on the Scientific Basis for Alternative San Joaquin River Flow Objectives for the Protection of Fish and Wildlife Beneficial Uses and Water Quality Objectives for the Protection of Southern Delta Agricultural Beneficial Uses and the Program of Implementation for those Objectives for independent peer review (CSWRCB, 2011).

Key facts regarding attainment of the south Delta agricultural objectives for EC are as follows:

(1) The EC water quality objectives for the interior south Delta locations have not been consistently achieved since 1978, when the first version of the objectives was adopted (CSWRCB, 2011).
(2) The State Water Board and other parties have repeatedly acknowledged that the management measures to attain the south Delta EC objectives are a combination of (a) flow releases into the San Joaquin River to attain objectives at Vernalis, (b) installation of physical facilities (pumps and barriers) in the south Delta, and (c) operation of the SWP and CVP projects (CSWRCB, 2011).
(3) The feasibility of attaining the south Delta EC objectives has been the subject of ongoing study and negotiation for over three decades. An April 2011 feasibility study by the USBR addressed this question and concluded that the attainment of EC objectives at interior south Delta locations through increased dilution flows in the San Joaquin River would require an unreasonable, and likely unavailable, volume of water (USBR, 2011). The April 2011 report also showed that USBR has established a consistent record of complying with the EC objectives at Vernalis.
(4) Recent studies sponsored by the State Water Board, including a 2010 report by Hoffman (Hoffman, 2010), indicate that higher salinity objectives than the existing objectives could still be protective of agricultural beneficial uses.
(5) Recent studies by the State Water Board and the USBR indicate that municipal wastewater effluent discharges in the Delta constitute a small percentage of the salt load entering from upstream. A 2007 stakeholder study of the City of Tracy discharge conducted by the Department of Water Resources, the Central Valley Water Board, and

the City of Tracy, concluded that the City's discharge has limited impacts on the salinity problem in the southern Delta (DWR, 2007).

In addition to the above, a major planning effort, the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) must be recognized. CV-SALTS is a strategic initiative to address problems with salinity and nitrates in the groundwater and surface waters of the Central Valley by developing a long-term management plan. See **Appendix A** for a detailed description and summary of the CV SALTS Initiative. CV-SALTS is expected to include regulatory approaches that result in requirements for salinity and nitrates which are commensurate with the water quality benefits that can be achieved through reasonable management actions by Central Valley communities and others. Ultimately, CV-SALTS will determine management strategies for important sources to protect and maintain water quality in the Central Valley. The need exists to set current permit limits at a level that protects water quality but that does not compel the irretrievable commitment of major resources in advance of completion of the CV-SALTS plan.

CV-SALTS is examining various regulatory modifications to be included in a Basin Plan amendment, including establishment of appropriate designated uses in some water bodies and modifications of water quality objectives in other water bodies. CV-SALTS is currently modifying its five-year work plan (CV-SALTS, 2012c) to include such actions. The timing for completion of possible changes in water quality objectives or in salinity management strategies will be 2016, at the earliest.

With both the Basin Plan and Bay-Delta Plan salinity objectives in a state of potential flux, the current effluent limits in NPDES permits for the three communities in question are similarly in flux. If objectives are relaxed from the current levels, the effluent limits would change to reflect those modifications. A plausible future outcome is that changes in water quality objectives and implementation of salinity control activities by dischargers would result in effluent limits that do not require additional salt-specific treatment at a wastewater treatment facility.

ii. Factor 3 Analysis

As described in the Background section above, efforts to achieve the EC objectives originally established in 1978 and refined in 1995 and 2000 have been intensively examined, but have not yielded a clear solution. Those efforts have focused primarily on flow control in the San Joaquin River at Vernalis as a means to achieve the objectives.

Recent studies (the April 2011 study by USBR and the October 2011 study by the State Water Board) indicate that attainment of the south Delta EC objectives through flow control is not feasible, and that attainment of the existing objectives is likely not required to attain the desired use (i.e. 100 percent yield of salt tolerant crops (dry beans and alfalfa) during essentially all conditions).

An emerging consensus is that the control of wastewater discharges will have little impact on the attainment of south Delta EC objectives, given the small contribution of those discharges to the overall salt loading. The October 2011 State Water Board report supports this consensus.

d. 40 CFR 131.10(g)(6) (Factor 6) Analysis

Under 40 CFR 131.10(g), one of the six factors that can form the basis for USEPA approval of a variance (Factor No. 6) is if "controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact." Sections 301(b) and 306 of the Clean Water Act impose specific technology-based requirements (e.g., the requirement of secondary treatment for all publicly owned treatment works (POTW)). In essence, this factor describes water quality-based requirements that go beyond the federal secondary requirement. The water quality-based effluent limits for EC represent controls more stringent than secondary treatment.

The following analysis addresses the economic and social impacts of constructing and operating treatment facilities to meet the effluent limits derived from south Delta EC standards. As a preliminary step, the treatment requirements and cost of treatment will be determined. Information is provided in this memorandum that demonstrates that reverse osmosis treatment of a portion of each discharge is the only remaining means to achieve compliance with effluent limits for salinity. Each of the communities in question has already implemented significant steps to control salinity through pollution prevention, source control, and water supply changes.

The approach utilizes information contained in the 1995 USEPA *Interim Economic Guidance for Water Quality Standards* as a basis for the analysis (U.S. EPA, 1995). First, the costs of achieving compliance with existing effluent limits derived from current south Delta EC objectives will be established. The primary screening tool described in the USEPA Economic Guidance document – the Municipal Preliminary Screener – will then be used to assess the affordability of new treatment facilities required to meet water quality-based effluent limits for salinity in the Delta. The outcome of the Municipal Preliminary Screener analysis will be used to determine whether the new treatment costs are substantial in lieu of performing the Secondary Test described in the guidance document. Next, an evaluation will be made of local socioeconomic factors to assess the widespread nature of the economic impact. Finally, as allowed under USEPA guidance, the environmental benefit associated with the construction and operation of the new treatment facilities (e.g. changes in ambient water quality and impact on beneficial uses) will be evaluated. This information will be used, in aggregate, to assess whether existing water quality objectives would be attained in the south Delta and whether near-term economic investment in RO treatment by the local communities is warranted.

i. Cost of Achieving Effluent Limits

If the affected NPDES permittees are required to meet effluent limits derived from south Delta EC objectives, the engineering evaluations presented in Section V of this memorandum indicate that RO systems will be needed to treat a portion of each facility's effluent RO treatment technology allows for the consistent removal of inorganic molecules and ions, such as salts and trace minerals, from wastewater that has already been treated using the existing facility processes. A portion of the total effluent flow for each community would be treated using RO and blended with non-RO-treated effluent to reduce the overall salinity of the effluent and thereby meet the specified limit(s). The RO process creates concentrated brine waste (at a magnitude of 15 to 20 percent of the total volume of effluent flow treated) that may require additional treatment prior to disposal. Microfiltration (MF) prior to RO was not considered in the current cost estimates for the Delta surface water dischargers (Tracy, Stockton, Manteca) because existing treatment processes at each of the three subject facilities includes filtration.

Planning level estimates of the capital and O&M costs associated with implementation of RO treatment to meet the more stringent 700 µmhos/cm effluent limit (April 1 – August 31) for electrical conductivity for the three affected NPDES permittees are provided in **Table 15**.

Table 15: Planning Level Cost Estimates for Reverse Osmosis (RO) Treatment.

Discharger	RO Treatment (MGD) required to meet 700 µmhos/cm EC Limit[1]	Cost ($ Million)				
		Capital[2,3]	Annualized Capital[4]	Annual O&M[2]	Total Annual[5]	Present Worth[6,7]
City of Tracy	11.9	67.0	4.5	6.6	11.1	166
City of Stockton	37.5	211	14.1	20.9	35.0	523
City of Manteca	7.1	40.0	2.7	3.9	6.6	99

Notes:

1. Effluent flow requiring RO treatment to meet a 700 µmhos/cm EC effluent limitation using a 25% safety factor to address the range of influent EC concentrations observed for the facility.
2. Capital and O&M costs developed using: Memorandum: Modification of Flow Basis for Treatment Train Costs as Previously Presented in the "Advanced Treatment Alternatives for the Sacramento Regional Wastewater Treatment Plant" (Carollo, March 2009). (Carollo, 2010)
3. Treatment costs include engineering, administrative, legal, and contingency. All costs in June 2012 dollars (ENRCCI 9838). The ENRCCI for Sacramento, CA (9838) was estimated by taking the average ENRCCI for the U.S. 20 Cities (i.e., 20-City Average) and the ENRCCI for San Francisco, CA.
4. Annualized capital costs developed using a 30-year amortization period and 5.25 percent interest rate.
5. Total Annual Cost = Annualized Capital Cost + Annual O&M Cost.
6. Present worth represents the summation of the capital construction cost plus the capitalized annual operation and maintenance cost based on a 30-year planning period and 5.25 percent interest rate.
7. Due to the recent bankruptcy of the City of Stockton, it may not be able to receive an interest rate as low as 5.25 percent, and therefore the actual cost of implementing RO treatment may be greater than shown in the above table.

Construction and operation of RO facilities would require a significant amount of capital and long-term O&M costs; the actual cost to each facility will vary depending on the portion of the total flow requiring treatment in order to meet the final effluent limit(s) for salinity. Estimated construction capital costs range from $40 to $211 million, and estimated O&M costs range from $3.9 to $20.9 million. Estimated total annual costs range from $6.6 to $35 million, and present worth values for construction and operation of RO facilities range from $99 to $523 million.

The operation of RO treatment systems would also significantly increase the energy demand for each facility, requiring potentially greater power distribution system capacity, back-up power generating capacity, and/or power grid connection capacity (West Yost Associates, 2011).[6] RO is an extremely energy-intensive process, and increased energy demand would result in a subsequent expansion of greenhouse gas emissions and the carbon footprint of each facility. A summary of the potential increased carbon footprint associated with the operation of RO treatment systems is included in **Table 16**. The greenhouse gas emission estimates provided in **Table 16** are in addition to those emissions currently generated by each facility.

Brine disposal alternatives include crystallization and land disposal, evaporation/containment ponds, piping or trucking liquid brine for off-site disposal, or deep-well injection. For

[6] The cost of expanding local/regional electricity infrastructure due to increased energy demand from a wastewater treatment plant is not considered in the RO treatment cost estimates provided in **Table 15** because the cost of infrastructure expansion would typically be assumed by the power provider and offset by utility rate increases.

communities in the Central Valley, which are located significant distances from the ocean or other suitable disposal sites, liquid brine transport is not cost-effective. The volumes of brine generated at the community level are problematic for deep-well injection. The most viable alternatives are crystallization and disposal (a high energy process) and use of evaporation/containment ponds (a land-intensive option), each of which represent an irretrievable commitment of resources. The RO treatment costs provided in **Table 15** include the cost of thermal brine concentration, crystallization, and land disposal.

Table 16. Additional Greenhouse Gas Emission Associated with the Operation of RO Treatment Systems.

Discharger	Effluent Treated with RO (MGD)	Estimated Daily Electricity Usage for RO Treatment (kWh)[1]	Estimated Daily CO_2 Emissions (lbs)[2] per kWh Consumed	Estimated Daily CO_2 Emissions (metric tons)	Estimated Annual CO_2 Emissions (metric tons)
City of Tracy	11.9	130,900	106,029	48.1	17,554
City of Stockton	37.5	412,500	334,125	151.6	55,318
City of Manteca	7.1	78,100	66,064	30.0	10,938

Notes:
1. Daily power usage based on estimate of 11,000 kWh consumed per million gallons treated with RO (Carollo, 2007).
2. CO2 emissions based on 0.81 lbs of CO2 produced per kWh of electricity consumed (CCAR, 2007).

ii. Affordability Analysis of Achieving Effluent Limits

Once new pollution control costs are estimated for a community, EPA Economic Guidance requires the performance of a preliminary test to determine the affordability of these pollution controls costs to a community to quickly identify costs that are not likely to cause substantial financial impacts to the community. This preliminary test is used to calculate a value called the Municipal Preliminary Screener (MPS). The MPS is calculated by dividing the average total pollution control cost per household by the median household income within a community. The total average pollution control cost per household includes the cost of *existing* wastewater and stormwater control plus the cost of *future* wastewater control due to implementation of additional pollution control measures (i.e., RO treatment to meet final effluent limit for EC). These costs, other pertinent information, and MPS values are provided in **Table 17** for each of the three Delta dischargers.

Table 17: Municipal Preliminary Screener Values Calculated for Delta Dischargers.

Discharger	Current Monthly Sewer Fee	Planning Level Estimated Monthly RO Treatment Fee[1]	Monthly Stormwater Control Fee	Avg Annual Total Pollution Control Cost Per Household	Median Household Income[2]	Municipal Preliminary Screener
City of Tracy	$34.10[3]	$29.77	$1.20	$780.85	$67,105	1.164
City of Stockton	$40.67[3]	$17.50	$2.10	$723.21	$44,310	1.632
City of Manteca	$43.30	$8.83	---	$625.51	$53,037	1.179

Notes:

1. Fee based on portion of total RO treatment costs to be paid by residential ratepayers.
2. MHI taken from U.S. Census Bureau, 2011 American Community Survey. Available online at American Fact Finder: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.
3. Current monthly sewer fee includes scheduled near-term fee increase.

EPA Economic Guidance provides three thresholds by which to compare the calculated MPS value: a value less than 1, a value between 1 and 2, and a value greater than 2. A MPS value of less than 1 is interpreted as representing new pollution control costs that will not cause a substantial economic hardship on households in a community. A MPS value between 1 and 2 is interpreted as representing new pollution control costs that are expected to produce mid-range economic impacts on households in the community. Finally, a MPS value greater than 2 is interpreted as representing new pollution control costs that may place an unreasonable financial burden on many of the households within the community. As shown in **Table 17**, the MPS values calculated for the three Delta dischargers are all greater than 1 and indicate that the cost of adding RO treatment to these facilities would produce mid-range economic impacts within each community. The MPS value calculated for each community was used to make a determination that the cost of RO treatment would produce substantial economic hardship to ratepayers in each community in light of existing economic conditions in each city, and more generally, in San Joaquin County and the Central Valley. The current analysis did not employ the Secondary Test for determination of substantial impacts provided in the EPA Economic Guidance. A discussion of current economic conditions in the subject cities and the interrelatedness of their economies is provided in the following subsection.

An important set of numbers presented in **Table 17** is the planning level costs of RO treatment estimated for each city. These monthly RO treatment fees – or salinity reduction costs – range from $8.83 for households in the City of Manteca to $29.77 for households in the City of Tracy. These costs signify *de facto* decreases in the disposable personal income (DPI) available to each household in a community. DPI represents "after tax" income and is available to households for spending and saving. A loss in DPI can affect the health of local and regional economies due to the something called the economic multiplier effect. Multipliers describe the response of an economy to a stimulus that produces an increase (positive stimulus) or decrease (negative stimulus) in demand or production. Every time there is either an injection or removal of demand into the circular flow of commerce within or between economies there is likely to be a multiplier effect. This is because an increase or decrease in spending leads to an increase or decrease in incomes within an economy, whether the spending occurs at the corporate, small business, institutional, or individual levels.

iii. Economic Impacts of Achieving Effluent Limits

The determination that the cost to the three Delta communities to implement RO treatment to meet final EC limits would impose substantial economic impacts on the households in each of the three cities is based on the MPS values calculated for each community, as well as the current economic conditions endured by each city. The Central Valley, which includes San Joaquin County, and within it the cities of Tracy, Stockton, and Manteca, has been one of the hardest hit regions in the State by the *Great Recession*. While official measures define the recession as lasting from December 2007 until June 2009, the Central Valley's economy has struggled well past the technical end date of the economic downturn and continues to lag behind the economies of other regions in the State (PPIC, 2011). **Table 18** presents labor market information for the three Delta communities, San Joaquin County, and California for the month of June 2012. The unemployment rates for Stockton, Manteca, and San Joaquin County exceed the State average of 10.7%. Only the City of Tracy has an unemployment rate less that the State's average.

The Central Valley, along with the Central Coast region, had the highest percentage of families with low incomes before the recession, and continues to maintain this distinction post-recession. Median household income fell 15.6% in the Central Valley from 2006 to 2010 compared to a 10.4% decrease experienced statewide (PPIC, 2011). The depressed economies of Central Valley cities and the associated decreases in household incomes have forced municipal governments to reduce services, while at the same time increase the cost to ratepayers of the services still offered. A prolonged fiscal crisis prompted the City of Stockton to file for bankruptcy on June 28, 2012, as a means to seek protection from its creditors and restructure its debt. The present economic conditions experienced by the residents of the cities of Tracy, Stockton, and Manteca would only be exacerbated by an increase in the total pollution control costs paid by households if these costs were increased to pay for RO treatment. Under these current depressed economic conditions, the financial impact to households required to pay for RO treatment would be substantial.

Table 18: Unemployment Rates for Select Central Valley Cities and San Joaquin County – June 2012

Area	Labor Force	Unemployment	Unemployment Rate (%)
City of Tracy	33,900	3,100	9.3
City of Stockton	129,900	23,200	17.9
City of Manteca	28,400	3,700	12.9
San Joaquin County	308,300	45,700	14.8
California	18,444,600	1,972,400	10.7

Notes:

All data in above table taken from Employment Development Department Labor Market Information web site (http://www.labormarketinfo.edd.ca.gov./), State of California.

The substantial economic impacts that would be endured by cities required to implement RO treatment would also exist as widespread economic impacts due to the interrelated nature of the economies of Central Valley cities. The economic multiplier effect discussed above exists within a local economy and between economies, whether they are at the city, county, or regional level. A decrease in DPI due to increased pollution control costs results in a decrease in spending on goods and services, which results in a decrease in demand for goods and services. A decrease in demand affects employment as fewer workers are needed to meet the decreased demand. A loss or reduction in employment at the household level translates into a further reduction in DPI. A loss, whether in dollars or jobs, is linked to a reduction in DPI due to an increased sewer fee required to pay for RO treatment. All communities possess somewhat unique spending habits as a whole, and a reduction in DPI has different consequences for some economic sectors[7] as compared to others depending on the community in which the reduction in DPI occurs. A substantial economic impact becomes a widespread economic impact when the multiplier or ripple effect of decreased spending occurs within or between economies. Compliance with a final EC effluent limit of 700 µmhos/cm for the cities of Tracy, Stockton, and Manteca would affect economic conditions with each city and would affect the flow of goods and services between these cities and other cities in the Central Valley. For these reasons, the additional pollution control costs and economic impacts associated with RO treatment would be both substantial and widespread for the affected Delta communities.

iv. Factor 6 Analysis

In **Section V** of this memorandum, an analysis is performed to examine the water quality impacts of improved effluent quality by the cities of Tracy, Stockton, and Manteca (i.e. resulting from RO treatment to achieve the effluent limits derived from the existing south Delta salinity objective of 700 µmhos/cm). That analysis demonstrated that those water quality impacts are minor. This outcome is consistent with the 2007 stakeholder study by DWR, Central Valley Water Board, and City of Tracy which determined that the City of Tracy discharge has limited impact on south Delta salinity levels (DWR, 2007). This outcome is also consistent with the findings of a February 2012 report by the State Water Board, which found that wastewater effluent discharges in the south Delta composed only a small percentage of the salts loads that entered the south Delta, and therefore, would not be expected to have a significant impact on ambient salinity levels, if reduced (CSWRCB, 2012).

As shown in **Figure 7** through **Figure 13**, the water quality "benefit" of meeting the existing effluent limits for EC is relatively small in each of the three case examples. The incremental changes shown in these figures are arguably at a level that would not be measured in ongoing EC monitoring in the Delta and would therefore not have an effect on water releases from upstream reservoirs or in Delta export operations, each of which rely on EC measurements in the Delta.

The construction of RO facilities to treat a portion of the effluent flow in each community will result in improved effluent quality in terms of the concentrations of other constituents in the effluent. However, it must be noted that such reductions are not otherwise required under the NPDES permits for each community, and that the benefits associated with the reductions that would occur are not obvious since a receiving water meeting a salinity standard before implementation of RO treatment by a POTW would continue to meet the salinity standard after RO treatment and a water body not meeting a salinity standard before RO treatment would still not meet the salinity standard after RO treatment.

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[7] A sector represents an economic activity that produces goods and/or services. Fruit farming, natural gas distribution, real estate, food service, and medical practices, to name a few, all represent economic activities, and hence sectors in an economy.

In the sections above, information is provided pertaining to (a) the uncertainty of water quality objectives that form the basis for current effluent limitations in NPDES permits and the historical difficulty in meeting those objectives through non-NPDES measures, (b) the incremental ambient water quality changes associated with compliance with those limits for three Central Valley communities, and (c) the resource commitment (i.e., cost, energy, carbon footprint) associated with the RO treatment needed to comply with current effluent limits. In reaching a determination of whether granting a variance would avoid substantial and widespread economic and social impacts, clearly the information in (c) is fundamental. The information provided in (a) and (b) provides context for determining the overall benefit of complying with existing effluent limits.

The “substantial” aspect of the determination relates to the costs (which translate to increased rates to residents of the three communities, and associated socioeconomic impacts of reduced DPI or discretionary income), energy consumption, greenhouse gas emission increases, and potential additional environmental and socioeconomic impacts associated with brine disposal activities. As shown in **Table 15**, the capital and annual costs of the RO facilities needed to comply with existing effluent limits for EC are substantial in each of the three communities that have been evaluated.

The “widespread” aspect of the determination relates to regional and population-level effects of the economic impact. The three example communities considered in the analysis represent a significant portion of the urban development area in the Delta, both in terms of areal extent and population. This regional economic impact is reasonably judged to be widespread due to the size and interconnectedness of these local economies within San Joaquin County. It is likely that other smaller Delta communities (e.g., Mountain House Community Services District, Ironhouse Sanitary District, and the City of Rio Vista) would also deem it appropriate to request approval of a variance to avoid RO treatment requirements. Requiring other communities to implement RO treatment of a portion of their effluent to meet effluent limits for EC would only add to the “widespread” nature of the impact.

e. 40 CFR 131.10(g) Conclusions

As detailed above, the proposed variance from EC water quality standards is justified under 40 CFR 131.10(g)(3), given the uncertainty of future water quality standards for salinity (i.e., the need for effluent quality improvements) and the inability of the three case study communities to affect attainment of either current or future salinity standards in the south Delta. The three case studies are also useful in supporting a finding that 40 CFR 131.10(g)(6) requirements are fulfilled, given the high capital and O&M costs and energy usage associated with the requisite RO treatment facilities to comply with existing effluent limits for EC, the economic impacts of such added Clean Water Act costs on the case study communities, and the small water quality improvements that would result from RO treatment. The additional pollution control costs for providing RO treatment by the subject communities would cause substantial and widespread economic impacts within each community and within the regional economy.

The case studies are also useful in demonstrating that similar conclusions would be reached for other Central Valley communities, and that a variance from EC water quality standards over the next five to ten years would be appropriate for those dischargers.

VII. ANTIDEGRADATION ANALYSIS

The Clean Water Act, the Bay-Delta Plan, the Sacramento-San Joaquin Basin Plan, and the Tulare Lake Basin Plan require that actions taken that affect water quality comply with federal and State antidegradation policies. In taking the action of establishing a variance policy and implementing an interim salinity program in the Central Valley, including case-by-case exceptions to effluent limits in WDRs, consistency with these policies must be ensured. An assessment of consistency with federal and State antidegradation policies is provided in this section using the case examples for the three Delta communities (Tracy, Stockton, and Manteca) to assess the effect of implementing the EC water quality standards variance and using the City of Fresno to assess the effects of implementing a case-by-case exception to the Tulare Basin Plan effluent limit provision.

a. Federal Antidegradation Policy and Guidance

The federal Clean Water Act (CWA) requires states to adopt, with United States Environmental Protection Agency (U.S. EPA) approval, water quality standards applicable to all intrastate waters (33 U.S.C. § 1313). U.S. EPA regulations also require state water quality standard submittals to include an antidegradation policy to protect beneficial uses and prevent further degradation of high quality waters (33 U.S.C. § 1313(d)(4)(B); 40 C.F.R. § 131.12). In general, the federal antidegradation policy emphasizes the maintenance of existing ambient conditions. The federal antidegradation policy considers lowering of water quality to be allowable in some cases, including those where the costs of control would cause widespread and substantial economic and social impacts.

The federal antidegradation policy is designed to protect existing uses and the level of water quality necessary to protect existing uses, and provide protection for higher quality and outstanding national water resources. The federal policy directs states to adopt a statewide policy that includes the following primary provisions.

(1) Existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Where the quality of waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after the full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control

(3) Where high quality waters constitute an outstanding National resource, such as water of National and State parks and wildlife refuges and waters

of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with Section 316 of the Act. (40 C.F.R. § 131.12)

Based on guidance developed by U.S. EPA, Region 9 (*Guidance on Implementing the Antidegradation Provisions of 40 C.F.R. § 131.12* (U.S. EPA, 1987) and guidance issued by the State Water Resources Control Board (SWRCB or State Water Board) with regard to application of the Federal Antidegradation Policy (Memorandum from William R. Attwater to Regional Board Executive Officers *Federal Antidegradation Policy* (Attwater, 1987)) application of the federal antidegradation policy is triggered by a lowering, or potential lowering, of surface water quality. Because the salinity variance may potentially lower surface water quality, the federal antidegradation policy applies.

The Sacramento River, the San Joaquin River, Tulare Lake, and the San Francisco Bay/Sacramento-San Joaquin Delta Estuary are not designated outstanding natural resource waters; therefore, the receiving waters are not subject to that portion of the federal policy. The application to other portions of the policy is determined on a constituent-by-constituent basis. For water bodies that do not presently attain water quality standards, permitted discharges must maintain existing water quality.

For waters with water quality that is better than necessary to support beneficial uses, a permitted discharge may not lower water quality unless such lowering is necessary to accommodate important economic or social development. In August 2005, U.S. EPA issued a memorandum discussing antidegradation reviews and significance thresholds (Memorandum from Ephraim S. King, Director, Office of Science and Technology, U.S. EPA, Office of Water to Water Management Division Directors, Regions 1-10 (King, 2005). As discussed in the memorandum, an intent of the policy "is to maintain and protect high quality waters and not to allow for any degradation beyond a *de minimis* level without having made a demonstration, with opportunity for public input, that such lowering is necessary and important" (King, 2005). U.S. EPA has determined that the significance threshold of a 10% reduction in available assimilative capacity is "workable and protective in identifying those significant lowering of water quality that should receive a full . . . antidegradation review, including public participation" (King, 2005). This determination by U.S. EPA is helpful in establishing the magnitude of water quality change that is considered to be of significant interest in the antidegradation analysis.

b. State Antidegradation Policy and Guidance

The State's antidegradation policy is embodied in SWRCB Resolution 68-16. In general, the State's antidegradation policy emphasizes the protection of high quality waters. Such protection is bounded by actions that are consistent with the maximum benefit to the people of the State and best practicable treatment and control of the discharge.

i. Resolution 68-16

The State issued its antidegradation policy in 1968 to protect and maintain existing water quality in California. The State's Resolution 68-16 is interpreted to incorporate the federal antidegradation policy and satisfies the federal regulation requiring states to adopt their own antidegradation policies. It states, in part:

> (1) Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial uses of such water and will not result in water quality less than that prescribed in the policies.
>
> (2) Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality water will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained. (Resolution 68-16)

ii. Administrative Procedures Update 90-004

SWRCB issued guidance (APU 90-004) to all Regional Water Boards in 1990 regarding the implementation of State and federal antidegradation policies in NPDES permits. Using this guidance, Regional Water Boards are to determine if an NPDES discharge is consistent with the intent and purpose of the State and federal antidegradation policies. APU 90-004 provides Regional Water Boards with guidance on the appropriate level of analysis that may be necessary, distinguishing between the need for a "simple" antidegradation analysis and a "complete" antidegradation analysis. If it is determined that a simple analysis is not appropriate based on the estimated level of impact of a discharge, then a more rigorous analysis – a complete analysis – is appropriate. A primary focus of an antidegradation analysis is the determination of whether and the degree to which water quality is lowered. This determination greatly influences the level of analysis required and the level of scrutiny applied to the "balancing test" – that is, whether the discharge is necessary to accommodate important economic and social development, and whether a water quality change is consistent with the maximum benefit to the people of the State.

An antidegradation analysis must address the following questions stated in SWRCB APU 90-004 to maintain consistency with State and federal antidegradation policies.

- Whether a reduction in water quality will be spatially localized or limited with respect to the water body; e.g., confined to the mixing zone;
- Whether a discharge of treated effluent will produce minor effects which will not result in a significant reduction of water quality;
- Whether a discharge of treated effluent has been approved in a General Plan, or similar growth and development policy document, and has been adequately subjected to the environmental analysis required in an environmental impact report (EIR) required under CEQA; and
- Whether the proposed project is consistent with the maximum benefit to the people of the State.

c. Approach to Antidegradation Analysis

The antidegradation analysis described in this memorandum evaluates first whether current ambient water quality will be degraded if Tracy, Stockton, Manteca, and Fresno continue current operations. The analysis next evaluates the incremental change in water quality from current ambient conditions that would occur if the same communities installed reverse osmosis treatment facilities to meet effluent limits in their current permits. The analysis also includes an assessment of the economic and greenhouse gas impacts resulting from the treatment required to meet existing effluent limits if a variance policy or case-by-case exception is not granted. This information is included to address whether the implementation of a variance or case-by-case exception would be consistent with the maximum benefit of the people of the State provision of the State non-degradation policy.

d. Analysis of Changes to Current Ambient Water Quality

Under federal and State antidegradation policies, changes to existing ambient concentration is often the typical concern. For the communities in question, implementation of a variance would not measurably affect current water quality, since the discharges in question currently exist and contribute to the current ambient condition, and the loadings in effluent are not increasing. As an example, the recent history of salinity loadings for the City of Tracy WWTP, City of Stockton RWCF, and the City of Manteca WQCF are shown in **Figure 19** through **Figure 21**, respectively. Since loadings are not projected to increase during the period of the variance, the action to establish and implement the specific variances in question for Tracy, Stockton, and Manteca would not be projected to degrade current ambient water quality. Current ambient water quality downstream of these three dischargers would remain the same under a salinity variance as it is today. For the City of Fresno RWRF, salinity concentrations in effluent have been relatively stable over the last five years as shown in **Figure 15** in **Section V**, and are not projected to increase over the next 10 years. However, since the background groundwater concentrations are increasing (see Figure 17: Layer A (< 100 ft bgs) Up-gradient Groundwater Concentrations, 2003 – 2011 (MW-10A).**Figure 17 - Figure** 18 in **Section V**), it is anticipated that the quality of discharge will become better than the quality of background groundwater and therefore will no longer degrade ambient groundwater quality (**Table 14** in **Section V**).

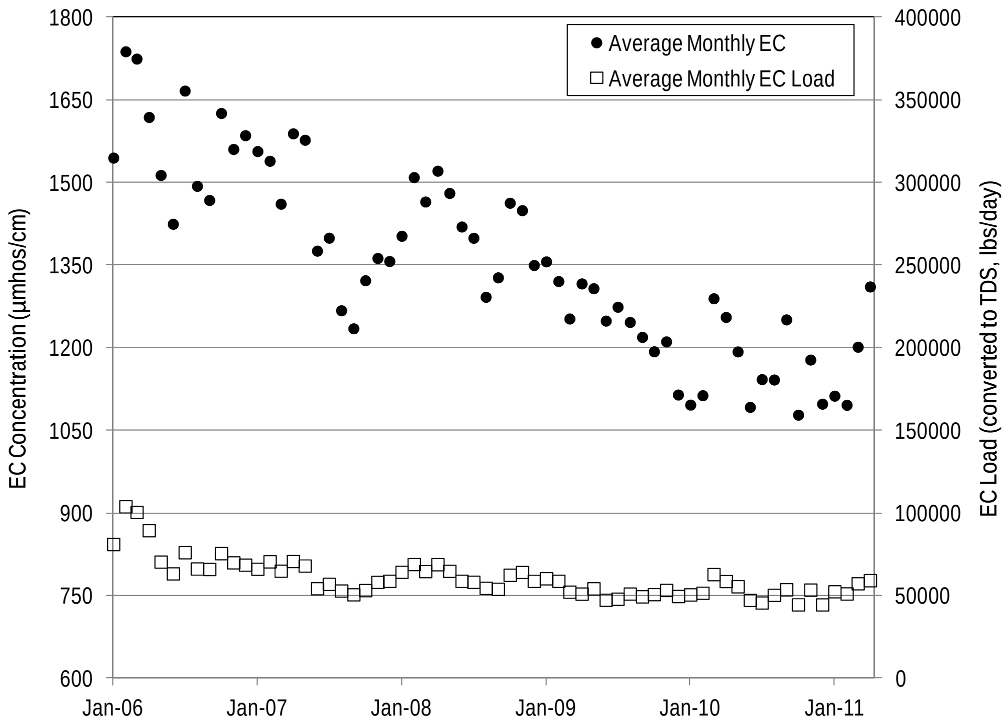

Figure 19: City of Tracy WWTP: EC Concentrations and Equivalent TDS Loadings.

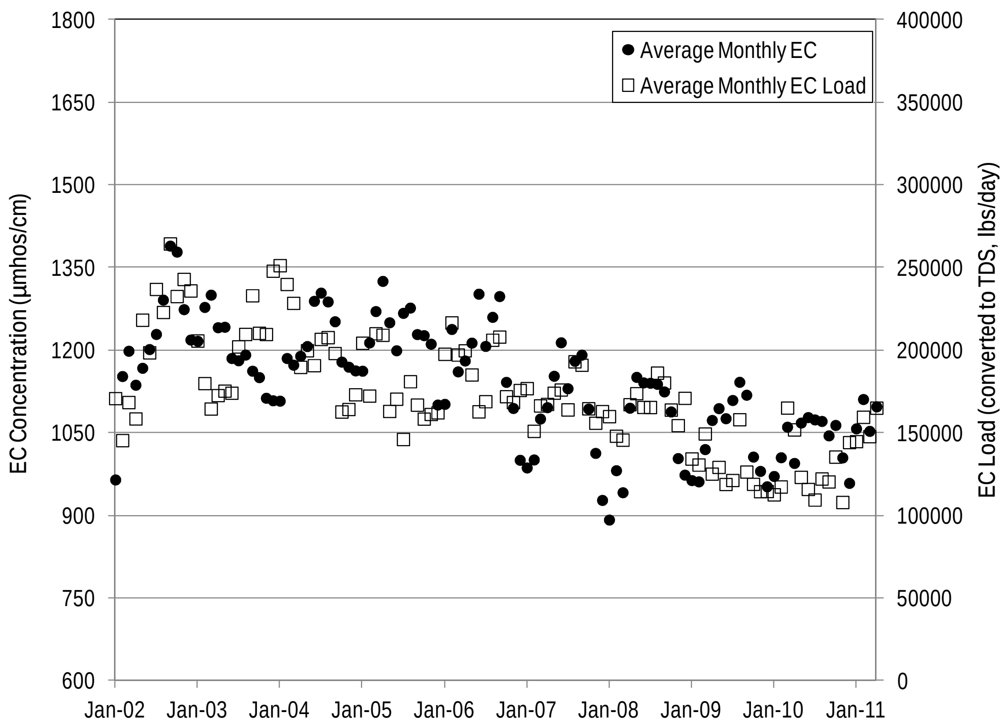

Figure 20: City of Stockton RWCF: EC Concentrations and Equivalent TDS Loadings.

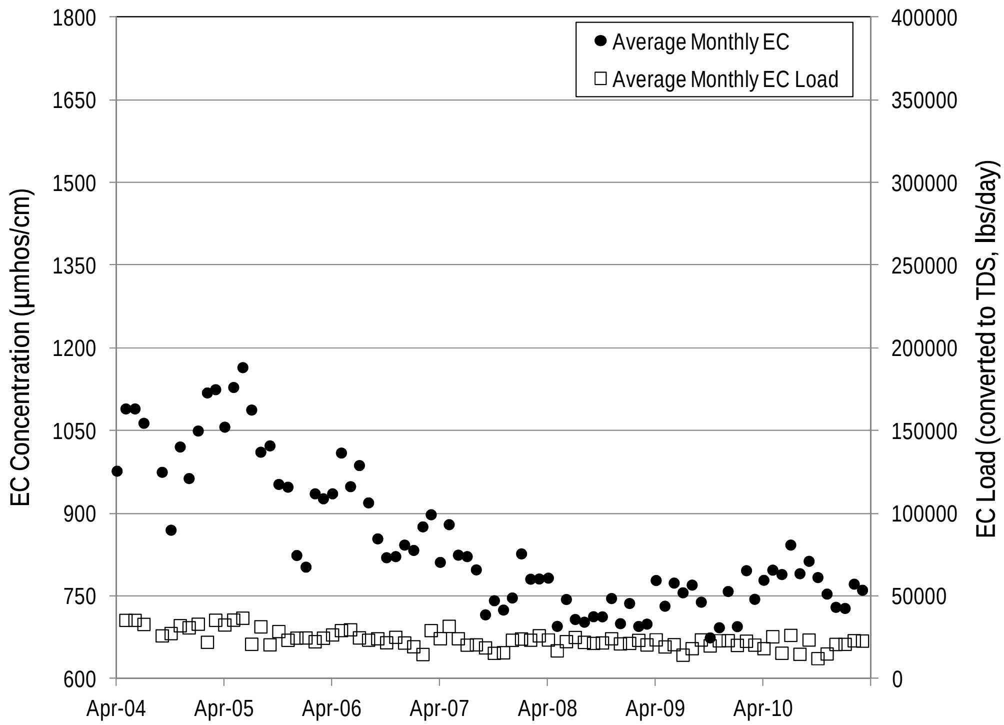

Figure 21: City of Manteca WQCF: EC Concentrations and Equivalent TDS Loadings.

As a measure to ensure that current ambient water quality would not be degraded during the period that a variance or case-by-case exception would be implemented, dischargers will be given performance-based effluent limitations for their discharges. **Table 19** contains performance-based effluent limitations for EC and TDS calculated for the three Delta communities and the City of Fresno. These performance-based effluent limitations were calculated using the following rules employed by the Central Valley Water Board in setting performance-based limits in other Central Valley permits:

> "Where there are ten sampling data points or more, sampling and laboratory variability is accounted for by establishing interim limits that are based on normally distributed data where 99.9% of the data points will lie within 3.3 standard deviations of the mean (Basic Statistical Methods for Engineers and Scientists, Kennedy and Neville, Harper and Row). Therefore, the interim limitations in this Order are established as the mean plus 3.3 standard deviations of the available data. In situations where the observed maximum effluent concentration (MEC) exceeds the 99.9%, the MEC is used as the interim limit." (Taken from City of Modesto WQCF Order No. R5-2008-0059, page F-60).

In the present analysis, performance-based average monthly effluent limits for electrical conductivity and total dissolved solids were calculated following the above method. The effluent EC and TDS datasets for the cities of Tracy (March 2009 to March 2011), Stockton (October 2006 to April 2011), Manteca (September 2007 to August 2011), and Fresno (January 2005 to March 2011) were compiled and the means and standard deviations calculated. All datasets had more than 10 data points and only one none of the MECs exceeded the calculated limits. The performance-based limits shown in **Table 19** were calculated using available data and could be recalculated, as necessary, using more recent data as they become available.

Table 19: Performance-Based Average Monthly Effluent Limitations for EC and TDS Calculated for Three Delta Dischargers and the City of Fresno.

Parameter	MEC	Mean	Std. Dev.	Number of Samples	Performance-Based AMEL
Electrical Conductivity (µmhos/cm)					
Tracy WWTP	1418	1192	98	110	1495
Stockton WQCF	1254	1059	84	248	1320
Manteca WQCF	861	744	51	109	900
City of Fresno RWRF	969(1)	827	53	75	991
Total Dissolved Solids (mg/L)					
Tracy WWTP	856	689	61	111	878
Stockton WQCF	743	627	54	248	795
Manteca WQCF	503	446	35	58	555
City of Fresno RWRF	495(1)	446	24	63	520

Note:

1. Only monthly average data were available, so the MEC is the maximum average monthly value and the number of samples is the number of monthly averages.

e. Antidegradation Analysis of Implementing Variance and Case-by-case Exception

The water quality baseline examined in this analysis is the ambient water quality that would exist under the current permitted discharges for the case study communities. The current permitted condition presumes compliance with effluent limits at the maximum permitted discharge. In this instance, implementation of a variance may delay, by five to ten years (the anticipated term of a variance or exception), changes in water quality that would otherwise happen if communities installed new RO treatment facilities to achieve existing EC effluent limits. It should be noted that the realization of these impacts presumes that those communities would immediately design and build RO facilities during the five- to ten-year period variance period, rather than exercising their legal rights to question such action. In fact, each of the communities in question has exercised this legal option in reaction to adoption of their current NPDES permits. It should also be noted that no other similarly situated POTWs in the Central Valley or Delta have been required to install reverse osmosis facilities to meet NPDES or WDR requirements for EC.

i. Cities of Tracy, Stockton and Manteca – Antidegradation Analysis Applicable to Variance

The incremental water quality changes associated with the addition of RO treatment facilities for the City of Tracy WWTP, City of Stockton, and the City of Manteca WQCF were assessed in **Section V**. It was determined that the near-field decreases in current ambient water quality associated with the construction and operation of RO treatment facilities to achieve compliance with effluent limits derived from an EC objective of 700 µmhos/cm are not significant, with ambient salinity changes ranging from 0.31% to 2.68% at the locations examined, depending on the water year type or Delta export condition. These larger, near-field, incremental changes are localized; as revealed by the far-field water quality impacts analyses performed for the City of Tracy WWTP. The Tracy far-field analysis estimated changes in EC levels ranging from 0.0% to 1.47% depending on distance downstream from the discharge and Delta export condition. These changes are not significant in magnitude and likely not measurable.

These incremental changes reflect the short-term water quality impact of implementing salinity variances in the Delta in the form of an unrealized beneficial change over the period of the variance. Another way of viewing the slight incremental increases in near-field EC concentrations with the granting of variances is that they represent a short-term delay in achieving a slight improvement in water quality. The actual achievement of a slight improvement in water quality is dependent upon the cities of Tracy, Stockton, and Manteca implementing RO treatment of a portion of their discharge. Until such advanced treatment is implemented, current ambient water quality would not be degraded, nor would current beneficial uses be harmed, with continued discharge from the three facilities under a salinity variance. The very small magnitude of impacts on ambient water quality associated with these municipal discharges are consistent with the recent findings of the State Water Board's February 2012 Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives (page 4-11) (CSWRCB, 2012).

ii. City of Fresno – Antidegradation Analysis Applicable to Case-by-Case Exception

Results from the water quality impacts section were evaluated in conjunction with current groundwater objectives and beneficial uses to determine if granting of a case-by-case effluent limit exception would be consistent with the state groundwater antidegradation policy in Resolution 68-16.

The results from the water quality impacts section indicate that if the case-by case exception is granted, down-gradient groundwater concentrations over the next 10 years are projected to range between 740 and 843 µmhos/cm, which are concentrations that are protective of the most stringent beneficial uses and meet current groundwater quality objectives (see **Table 20**). Granting of the case-by-case exception is estimated to result in a 4 – 6% increase in down-gradient groundwater concentrations as compared to down-gradient concentrations resulting from discharge of effluent partially treated with MF/RO.

Since beans, which are highly sensitive to salts, are not a dominant crop in the vicinity of the RWRF, the site-specific Grattan thresholds are more appropriate for the protection of agricultural uses for the RWRF area than are the Ayers and Westcot thresholds (Corollo, 2009). The WDR interim groundwater objective for EC (990 µmhos/cm[8]) is intended to protect crops sensitive to salinity when using sprinkler irrigation, such as grapes, and was based on maintaining 100 percent yields for crops other than beans (Resolution No. R5-2002-0254-A01 Amending WDR Order No. R5-2001-254 for Fresno-Clovis Metropolitan RWRF).

It should be noted that this 4 – 6% increase in down-gradient groundwater quality does not adversely impact beneficial uses or cause down-gradient groundwater quality to exceed any water quality objectives. Therefore, requiring implementation of MF/RO would be an extremely

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[8] The interim groundwater objective was calculated by applying a 10 percent concentration factor to the maximum EC effluent limit of 900 µmhos/cm

costly (see next section) treatment measure that would be unlikely to result in significant improvements to groundwater quality or beneficial uses in the vicinity of the RWRF.

Table 20: Beneficial Uses and Groundwater Objectives in the Tulare Basin.

Source	Beneficial Use	EC Objective (μmhos/cm)
WDR Interim Groundwater Objective	AGR	990
Ayers and Westcot (1985)	AGR(1)	700
	AGR(2)	700 – 3,000
Grattan Site-Specific Thresholds (2005)	AGR	1,400
Title 22	MUN	900, 1600(3)

Notes:

1. No restrictions on use.
2. Slight to moderate restrictions on use.
3. Secondary MCLs: recommended and upper limits.

CV Salts is currently developing a Central Valley-wide Salt and Nutrient Management Plan that will provide policy guidance for salt management in the Central Valley. As part of this valley-wide management plan, revised antidegradation requirements or guidance for determining case-by-case exceptions may be developed to best manage future salt loading in the Tulare Basin sometime within the next 10 years.

As this analysis has shown, the degradation associated with granting a case-by-case effluent limit exception is consistent with the requirements of Resolution 68-16, and it is thus recommended that, until new guidelines are developed by CV Salts for management of salts in Tulare Basin, a case-by-case effluent exception should be granted to the City of Fresno RWRF.

iii. Socioeconomic Impacts of Not Granting Variances

The EPA Economic Guidance referenced earlier in **Section V** addresses antidegradation specifically and requires that a project proponent demonstrate that important economic or social development would be prevented unless lower water quality is allowed. The guidance also states that an economic analysis must demonstrate that (a) the discharger would face substantial financial impacts due to the costs of the necessary pollution controls (i.e., a demonstration of "substantial impacts"), and (b) the affected community will bear significant adverse impacts if the discharger is required to meet existing or proposed water quality standards (i.e., a demonstration of "widespread impacts"). An important point to make regarding the granting of a salinity variance for the three Delta communities is that the granting of variances will not degrade current water quality conditions in the Delta, rather such a granting will delay a future slight water quality improvement that would be achieved when the dischargers add RO treatment to their existing facilities to meet final effluent limits for EC contained in their NPDES permits. Furthermore, socioeconomic impacts within the affected communities will result not from the granting of variances, but from the cost of adding RO treatment. To this end, the affected communities will experience socioeconomic impacts as a result of not granting a variance.

The first component of an antidegradation analysis, the assessment of projected water quality impacts due to a proposed action, is presented in **Section V**. The second component of an antidegradation analysis, an assessment of the costs and benefits of maintaining existing water quality in receiving waters is presented in **Section VI** as part of the CFR 131.10(g) analysis. Planning level estimates of the capital and operations and maintenance (O&M) costs associated with implementation of RO treatment to meet the more stringent 700 µmhos/cm effluent limit (April 1 – August 31) for electrical conductivity for the three affected surface water dischargers is provided in **Table 21**.

Table 21: Planning Level Cost Estimates for Implementation of Reverse Osmosis (RO) Treatment by Three Delta Dischargers.

Discharger	RO Treatment (MGD) required to meet 700 µmhos/cm EC Limit[1]	Cost ($ Million)				
		Capital[2,3]	Annualized Capital[4]	Annual O&M[2,3]	Total Annual[5]	Present Worth[6]
City of Tracy	11.9	67.0	4.5	6.6	11.1	166
City of Stockton	37.5	211	14.1	20.9	35.0	523
City of Manteca	7.1	40.0	2.7	3.9	6.6	99

Notes:

1. Effluent flow requiring RO treatment to meet a 700 µmhos/cm EC effluent limitation using a 25% safety factor to address the range of influent EC concentrations observed for the facility.
2. Capital and O&M costs developed using: Project Memorandum: Modification of Flow Basis for Treatment Train Costs as Previously Presented in the "Advanced Treatment Alternatives for the Sacramento Regional Wastewater Treatment Plant" (Carollo, March 2009). (Carollo, 2010)
3. Treatment costs include engineering, administrative, legal, and contingency. All costs in June 2012 dollars (ENRCCI 9838). The ENRCCI for Sacramento, CA (9838) was estimated by taking the average ENRCCI for the U.S. 20 Cities (i.e., 20-City Average) and the ENRCCI for San Francisco, CA.
4. Annualized capital costs developed using a 30-year amortization period and 5.25 percent interest rate.
5. Total Annual Cost = Annualized Capital Cost + Annual O&M Cost.
6. Present worth represents the summation of the capital construction cost plus the capitalized annual operation and maintenance cost based on a 30-year planning period and 5.25 percent interest rate.

Construction and operation of RO facilities would require significant capital and long-term costs; the actual cost to each facility will vary depending on the portion of the total flow requiring treatment in order to meet the final effluent limit(s) for salinity. Estimated construction capital costs range from $40.0 to $211 million, and estimated O&M costs range from $3.9 to $20.9 million. Estimated total annual costs range from $6.6 to $35.0 million, and present worth values from construction and operation and maintenance of these facilities range from $99 to $523 million.

As discussed earlier in **Section VI**, the operation of treatment systems that include RO processes would significantly increase the energy demand for each facility, requiring potentially greater power distribution system capacity, back-up power generating capacity, and/or power grid connection capacity. Because RO is an extremely energy-intensive process, increased energy demand would result in a subsequent expansion of greenhouse gas emissions and the carbon footprint of each facility. A summary of the potential increased carbon footprint associated with the operation of these treatment systems is included as **Table 22**.

Table 22: Additional Greenhouse Gas Emission Associated with the Operation of RO Treatment Systems for Three Delta Dischargers.

Discharger	Effluent Treated with RO (MGD)	Estimated Daily Electricity Usage (kWh)[1]	Estimated Daily CO_2 Emissions		Estimated Annual CO_2 Emissions (metric tons)
			lbs/day[2]	metric tons/day[2]	
City of Tracy	11.9	130,900	106,029	48.1	17,554
City of Stockton	37.5	412,500	334,125	151.6	55,318
City of Manteca	7.1	78,100	66,064	30.0	10,938

Notes:
1. Daily power usage based on estimate of 11,000 kWh consumed per million gallons treated with RO (Carollo, 2007).
2. CO2 emissions based on 0.81 lbs of CO2 produced per kWh of electricity consumed (CCAR, 2007).

The RO treatment costs provided in **Table 21** include the cost of thermal brine concentration, crystallization, and land disposal in a traditional landfill. However, if additional treatment of brine waste is needed to accommodate disposal in a traditional landfill, then ultimate RO treatment costs could exceed those presented in **Table 21**. To this end, the costs of advanced treatment presented in **Table 21** represent a low end estimate of the actual financial impacts potentially endured by communities required to implement advanced treatment of their wastewater because the costs do not include the cost of any additional advanced treatment that might be required to render brine waste suitable for disposal in a traditional landfill. As discussed in **Section VI**, these financial impacts are determined to be “substantial” for each affected community.

As discussed in **Section VI**, the current economic conditions experienced by Central Valley communities as a result of the national economic downturn caused by the Great Recession has left these communities more economically challenged than many other areas of the state (see **Table 18**). The additional pollution control costs associated with RO treatment needed to meet final effluent limits for EC included in current NPDES permits would only add to the financial burdens of all households within these communities. Due to the interrelated nature of economies within and between communities in a region, a reduction in disposable personal income (DPI) that would result from higher sewer rates needed to pay for the cost of RO treatment would have a ripple effect on the demand for goods and services within and between communities. A reduction in DPI would cause a change in the spending habits of households within communities that would lead to losses in income and employment. For this reason, requiring communities to construct and operate RO facilities to achieve compliance with EC objectives would constitute a “widespread” economic impact.

The difference in south Delta water quality that would result from the granting of a salinity variance for three Delta surface water dischargers compared to water quality that would be achieved with the implementation of RO treatment to meet final effluent limit objectives for EC is essentially *de minimis*. Furthermore, the granting of a variance would not result in a lowering of current ambient water quality. The granting of a variance would only act to delay a future slight improvement in south Delta water quality by a five- to ten-year period. Therefore, the critical comparison to be made between the granting of a variance and requiring the implementation of RO treatment is a balancing of the slight improvement – at whatever point in time it occurred – in south Delta water quality against the environmental impacts (energy consumption and greenhouse gas emissions) and socioeconomic impacts of RO treatment. The estimated magnitude of the improvement in south Delta water quality as a result of RO treatment does not justify the environmental or socioeconomic expense of achieving such an improvement in water quality. The most beneficial outcome would be the implementation of regulatory approaches that result in requirements which are consistent with the management plans being developed under CV-SALTS and in the State Water Board's Bay-Delta Plan and which are commensurate with the water quality benefits that can be achieved through reasonable management actions by Central Valley communities.

iv. Socioeconomic Impacts of Not Granting a Case-by-Case Exception

The granting of a case-by-case effluent limit exception for the City of Fresno's land discharge does not require the City to consult the EPA Economic Guidance and demonstrate that important economic or social development would be prevented unless lower water quality is allowed because the granting of a case-by-case exception for a land discharge is not subject to the 40 CFR 131.10(g) requirements that must be met to gain approval for a water quality standards variance for a discharge to surface waters. However, it is important to discuss that the City would endure economic hardships if it was required to implement MF/RO treatment of its effluent to meet final effluent limits for EC contained in its WDR. Similar to the granting of salinity variances for surface water dischargers described above, the granting of a case-by-case exception for the City of Fresno will not degrade current groundwater quality conditions, rather it will delay a future slight groundwater quality improvement that would be achieved when the City added MF/RO treatment to its existing facility to meet the final effluent limit for EC in its WDR. Additionally, socioeconomic impacts to the City of Fresno will not occur with the granting of a case-by-case exception, rather such impacts will occur if the City is required to implement MF/RO treatment of its effluent.

Similar to the socioeconomic impacts analyses conducted for the three Delta surface water dischargers, planning level estimates of the capital and operations and maintenance (O&M) costs associated with implementation of MF/RO treatment to meet the City's source water EC plus 500 µmhos/cm EC effluent limit were calculated and are presented in **Table 23**. It was determined that the City would need to meet a 766 µmhos/cm EC effluent limitation and this figure was used to estimate MF/RO treatment capacity needed to treat a portion of RWRF flow that would produce a blended effluent that would meet the EC effluent limitation. As shown in **Table 23**, construction and operation of MF/RO facilities would require significant capital and long-term costs to meet the City's final effluent limit for salinity. The estimated construction capital cost is $363 million, with an annual O&M cost of $27.5 million. The repayment of loans to fund construction of MF/RO facilities would result in an annualized capital cost of $24.3, for a total annual cost of $51.8 million to be paid by RWRF ratepayers.

Table 23: Planning Level Cost Estimates for Implementation of Microfiltration (MF) and Reverse Osmosis (RO) Treatment at the Fresno-Clovis RWRF.

Discharger	MF/RO Treatment (MGD) required to meet 766 µmhos/cm EC Limit[1]	Cost ($ Million)				
		Capital[2,3]	Annualized Capital[4]	Annual O&M[2,3]	Total Annual[5]	Present Worth[6]
City of Fresno	34.6	363	24.3	27.5	51.8	774

Notes:

1. The Fresno-Clovis RWRF currently does not include filtration in its treatment process, and therefore the costs presented above include the costs of both microfiltration and reverse osmosis. Effluent flow requiring MF/RO treatment designed to meet a 766 µmhos/cm EC effluent limitation using a 25% safety factor to address the range of influent EC concentrations observed for the facility.
2. Capital and O&M costs developed using: Project Memorandum: Modification of Flow Basis for Treatment Train Costs as Previously Presented in the "Advanced Treatment Alternatives for the Sacramento Regional Wastewater Treatment Plant" (Carollo, March 2009). (Carollo, 2010)
3. Treatment costs include engineering, administrative, legal, and contingency. All costs in June 2012 dollars (ENRCCI 9838). The ENRCCI for Sacramento, CA (9838) was estimated by taking the average ENRCCI for the U.S. 20 Cities (i.e., 20-City Average) and the ENRCCI for San Francisco, CA.
4. Annualized capital costs developed using a 30-year amortization period and 5.25 percent interest rate.
5. Total Annual Cost = Annualized Capital Cost + Annual O&M Cost.
6. Present worth represents the summation of the capital construction cost plus the capitalized annual operation and maintenance cost based on a 30-year planning period and 5.25 percent interest rate.

As discussed above for the three Delta surface water dischargers, the operation of energy intensive treatment processes, such as MF and RO, dramatically increases the carbon footprint of a wastewater treatment facility. **Table 24** presents estimates for daily electricity usage and CO_2 emissions that would occur with implementation of MF/RO treatment at the Fresno-Clovis RWRF. It is estimated that an additional 51,040 metric tons of CO_2 would be emitted by the RWRF on an annual basis with operation of MF/RO facilities. The estimates shown in **Table 24** are in addition to the electricity usage and CO_2 emissions already occurring with operation of existing RWRF treatment facilities. As discussed earlier, increased energy demand by a wastewater treatment facility can potentially require parallel expansion of power distribution systems. While the costs of utility infrastructure expansion are often absorbed by the energy provider, these costs are offset by rate increases to ratepayers.

Table 24: Additional Greenhouse Gas Emission Associated with the Operation of MF/RO Treatment Systems at the Fresno-Clovis RWRF.

Discharger	Effluent Treated with MF/RO (MGD)	Estimated Daily Electricity Usage		Estimated Daily CO_2 Emissions		Estimated Annual CO_2 Emissions (metric tons)
		MF Treatment (kWh)[1]	RO Treatment (kWh)[2]	lbs/day[3]	metric tons/day[3]	
City of Fresno	34.6	3,460	380,600	308,286	139.8	51,040

Notes:

1. Daily power usage based on estimate of 100 kWh consumed per million gallons treated with MF (AWWARF, 2008).
2. Daily power usage based on estimate of 11,000 kWh consumed per million gallons treated with RO (Carollo, 2007).
3. CO2 emissions based on 0.81 lbs of CO2 produced per kWh of electricity consumed (CCAR, 2007).

The MF/RO treatment costs provided in **Table 23** include the cost of thermal brine concentration, crystallization, and land disposal in a traditional landfill. However, if additional treatment of brine waste is needed to accommodate disposal in a traditional landfill, then ultimate MF/RO treatment costs could exceed those presented in **Table 23**. To this end, the costs of advanced treatment for the City of Fresno presented in **Table 23** represent a low end estimate of the actual financial impacts potentially endured by City if required to implement advanced treatment of its wastewater because the costs do not include the cost of any additional advanced treatment that might be required to render brine waste suitable for disposal in a traditional landfill.

The City of Fresno has experienced economic hardships in recent years similar to those experienced by other Central Valley communities, and these communities have been hit harder by the Great Recession than many other areas in the state. In line with the labor force information provided in **Table 18** for the three Delta dischargers, the City of Fresno posted a 14.3% unemployment rate for the month of June 2012, which was one percentage point lower than that of Fresno County[9]. The additional pollution control costs associated with MF/RO treatment needed to meet final effluent limits for EC included in the City's current WDR would only add to the financial burdens of all households within the community. Due to the interrelated nature of economies within and between communities in a region, a reduction in disposable personal income (DPI) that would result from higher sewer rates needed to pay for the cost of MF/RO treatment would have a ripple effect on the demand for goods and services within the City of Fresno and between communities in the region. A reduction in DPI would cause a change in the spending habits of households within the City that would lead to losses in income and employment.

The difference in groundwater quality that would result from the granting of a case-by-case exception to EC limits for the City of Fresno compared to groundwater quality that would be achieved with the implementation of MF/RO treatment to meet final effluent limit objectives for EC is essentially *de minimis*. Furthermore, the granting of a case-by-case exception would not result in a lowering of current ambient groundwater quality. The granting of a case-by-case exception would only act to delay a future slight improvement in groundwater quality by a five- to ten-year period. Therefore, the critical comparison to be made between the granting of a case-by-case exception and requiring the implementation of MF/RO treatment is a balancing of the slight improvement – at whatever point in time it occurred – in groundwater quality against the environmental impacts (energy consumption and greenhouse gas emissions) and socioeconomic impacts of MF/RO treatment. The estimated magnitude of the improvement in groundwater quality as a result of MF/RO treatment does not justify the environmental or socioeconomic expense of achieving such an improvement in groundwater quality. The most beneficial outcome would be the implementation of regulatory approaches that result in requirements which are consistent with the management plans being developed under CV-SALTS which are commensurate with the water quality benefits that can be achieved through reasonable management actions by Central Valley communities.

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[9] Data obtained from Employment Development Department Labor Market Information web site (http://www.labormarketinfo.edd.ca.gov./), State of California.

f. Antidegradation Analysis Conclusions

The following findings are derived from the analysis presented above.

- No ambient water quality effects would result from implementation of an EC water quality standards variance in the Delta or a case-by-case exception to the Tulare Lake effluent limits. Small, incremental changes in water quality associated with compliance with existing effluent limits would be delayed through implementation of a variance policy and/or case-by-case exception. The magnitude of the delays and the water quality changes are not sufficient to cause consistency issues with the federal and State antidegradation policies.
- No change in the attainment of beneficial uses would occur with implementation of the proposed variances or case-by-case exceptions.
- Significant costs would be required to comply with existing effluent limits for EC, leading to widespread and substantial economic effects in affected communities, as described in **Section VI**.
- Construction and operation of RO treatment facilities to meet EC limits is a poor investment of resources, given the lack of water quality improvement that would result and the uncertainty regarding the future water quality standards and Basin Plan provisions that would support such limits.
- For the short period of effect of a variance or case-by-case exception, it is to the maximum benefit to the people of the State to implement such proposed actions, in lieu of forcing construction and operation of RO treatment facilities.

The above findings support a conclusion that establishment and implementation of a variance from EC water quality standards or a case-by-case exception to the EC effluent limits specified in the Tulare Lake Basin Plan are consistent with the federal and State antidegradation policies.

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Appendix A: Summary and Description of CV-SALTS Initiative

This appendix contains a summary and description of the Central Valley Salinity Alternatives for Long Term Sustainability (CV-SALTS) initiative, including goals and objectives, actively involved stakeholders, accomplishments to date, the proposed schedule, and sources of funding. Information in this appendix is sourced from CV-SALTS 2012a, CV-SALTS 2012b, and CV-SALTS 2012c. Additional information can be found online at the CV-SALTS web-site: http://cvsalinity.org/.

a. Summary of CV-SALTS Goals and Objectives

The CV-SALTS initiative is a stakeholder-led process to establish a long-term policy framework for salt and nitrate management for the Central Valley, to be developed and implemented through amendments to the three water quality control plans within the Central Valley Water Board's jurisdictional area: the Sacramento-San Joaquin Basin Plan, the Tulare Lake Basin Plan, and the Bay-Delta Plan. The effort focuses on a Central Valley Water Board basin plan amendment process that will result in the development of a Salt and Nitrate Management Plan for the Central Valley, as well as other changes to the basin plans (e.g., beneficial uses, standards, implementation plans). Per the *CV-SALTS – Strategy and Framework* document *CV-SALTS, 2012b), the basin plan amendment process will establish:

- A revised regulatory structure (Beneficial Uses [BU] and Water Quality Objectives [WQO]) and policies to facilitate salt and nitrate management;
- Policies and procedures to evaluate compliance with Basin Plan uses and objectives and provide the regulatory flexibility needed to make salt and nitrate management decisions at the appropriate geographic or management scale; and
- The basis for short and long-term management of salt and nitrate across the Central Valley at appropriate geographic scales.

The CV-SALTS initiative is the primary mechanism by which the Central Valley Water Board will conduct the necessary studies, research and develop technical and scientific reports to develop all components of the basin plan amendment, and implement the Central Valley Salt and Nitrate Management Plan once it is adopted. The necessary work includes data collection, database development, modeling, monitoring, research, studies, and pilot project study programs.

b. Actively Involved CV-SALTS Stakeholders

The Central Valley Salt and Nitrate Management Plan is being developed through a stakeholder process. Due to the complexity and far-reaching impacts of the Salt and Nitrate Management Plan, the Central Valley Water Board has determined that any and all users of Central Valley waters, within and outside of the Central Valley Water Board's jurisdictional area, are considered to be stakeholders for this Salt and Nitrate Management Plan. The Central Valley Water Board believes all stakeholders should be closely involved in the development of basin plan amendments that could affect the use designation and quality of Central Valley waters.

The Central Valley Salinity Coalition (CVSC) is a non-profit coalition of public agencies, businesses, associations, and other members which was formed in July 2008 to integrate and augment the efforts of the CV-SALTS Initiative. A Memorandum of Agreement and standing rules describe the working commitments of the Central Valley Water Board, State Water Board, and CVSC in the development and implementation of CV-SALTS. The purpose of the organization is to govern and organize the efforts needed to plan, develop and implement the Central Valley Salt and Nitrate Management Plan (Central Valley Salinity Coalition, 2009).

CVSC currently consists of 667 members, including, but not limited to, the following (*denotes Board of Directors participation):

- California League of Food Processors*
- California Rice Commission*
- California Association of Sanitation Agencies*
- Central Valley Clean Water Agencies*
- City of Manteca*
- City of Modesto*
- City of Stockton*
- City of Tracy*
- City of Vacaville*
- City of Fresno*
- County of San Joaquin*
- Discovery Bay CSD
- East San Joaquin Water Quality Coalition*
- Iron House Sanitary District
- LA County Sanitation District
- Pacific Water Quality Association
- Sacramento Regional County Sanitation District*
- San Joaquin River Group Authority*
- San Joaquin Valley Drainage Authority*
- Stockton East Water District*
- The Wine Institute*
- Tulare Lake Drainage and Water Districts*
- Western Plant Health Association*
- Western United Dairymen

c. Overview of CV-SALTS Accomplishments

Since its inception, CV-SALTS has accomplished several tasks, either as stakeholder committee projects or as contracted elements. Stakeholder-driven efforts have included the following:

- Knowledge Gained Subcommittee review of two salt source identification and interaction studies, the Salinity Source Pilot Study and the Turlock Basin Salinity Study, comprising 14% of the Central Valley (i.e., the Sacramento, San Joaquin, and Tulare Basins);
- Knowledge Gained Subcommittee Guidance for future Salinity Identification Studies;
- Interim and Subsequent Salinity Project Funding Plan;
- Management Practices Subcommittee Guidance for Development of a Salt and Nitrate BMP Toolbox;
- Technical recommendations regarding use of modeling tools to develop site specific salinity objectives;
- Scoped salinity and nitrate water quality criteria review for stock watering; and
- Draft revised Chapter 18 (Salt and Salinity Management) for the California Water Plan.

In addition, contract-supported efforts have included the following:

- GIS database and beneficial use maps for the Central Valley and Delta;
- Scoped salinity and nitrate water quality criteria review for aquatic life; and
- Improved functionality of the CV-SALTS website.

During 2010-2011, the CV-SALTS Executive Committee has focused on the development of a more robust project policy and framework, as well as retooling the initial project scope and Work Plan accordingly. This work builds off of the projects completed to date and is a critical element to guide future CV-SALTS activities. Discussions have been focused on appropriate beneficial use designation in both surface and groundwater (primarily for municipal/domestic supply and agricultural irrigation/stock watering), with future meetings scheduled to review appropriate salt and nitrate water quality objectives related to beneficial uses, consideration of the antidegradation policy, and options available to amend current basin plan language.

d. CV-SALTS Draft Timeline for Completion of Work

The deadline for development of the Central Valley Salt and Nitrate Management Plan is May 14, 2014, which satisfies the State Water Board's Recycled Water Policy. In February 2012, CV-SALTS approved a 5-Year Work Plan and strategy framework.

The current schedule for the Basin Plan amendment process and the development of the Central Valley Salt and Nitrate Management Plan (CV-SNMP) is as follows:

- **September 2012 – March 2013:**
    - Policy discussions on beneficial uses and appropriate water quality objectives, including criteria for "incidental" MUN, default values for crop protection and leaching fractions for use with salinity models, and guidance for determining the most limiting crop within a sub-basin
    - Complete initial conceptual model (ICM) of salt and nitrate source/interaction
    - Begin Phase 2 of CV-SNMP

- Complete upgrades to Central Valley beneficial use and water quality objective geospatial database

- **April 2013 – May 2014:**
  - Complete Phase 2 and Phase 3 of Central Valley SNMP
  - Complete technical studies for archetypes
  - Identify management alternatives
  - CEQA scoping session(s); Finalize CEQA Equivalent Documentation; hold Public Meetings
  - Finalize and submit Central Valley Salt and Nitrate Management Plan (CV-SNMP)
  - Initiate draft basin plan amendment language
- **June 2014 – May 2015:** Final regulatory approval process, Prepare Final CV-SNMP, Board Adoption of Final CV-SNMP
- **May 2015 – Future:** Long-term CV-SNMP regional implementation

e. Sources of CV-SALTS Funding and Expenditures

On March 17, 2009, the State Water Board adopted a resolution allocating $1.2 million from the Cleanup and Abatement Account to the Central Valley Water Board in support of the development of a salinity and nutrient management plan for the Central Valley. This funding will be used to support a Salinity and Nitrate Objective and Beneficial Use Study Project, which will establish a model using existing, reliable, and usable data from regions and water bodies within the Central Valley. This model will then be used to establish beneficial uses and objectives for regions where little or no data exists. Of the $1.2 million in Cleanup and Abatement Account funding provided through Resolution #2009-0023, all funding has been obligated to contracts. As of September 2011, $250,000 has been expended.

An additional $3.8 million in Cleanup and Abatement funding will be available to support continued tasks in the implementation of the CV-SALTS work plan. Funding is also provided through CVSC member contributions and various in-kind services contributions. CVSC members have provided over $1 million in financial contributions through membership fees. CVSC members and other organizations have also provided studies, grants and other support for the CV-SALTS effort totaling more than $570,000.

Appendix B: Summary of Alternative Regulatory Approaches

USEPA and Central Valley Water Board staff requested a summary of the advantages and disadvantages of alternative regulatory approaches to variance program to resolve the current NPDES permitting dilemma concerning salinity in the Central Valley. Several alternatives were previously assessed within a document entitled "Preliminary Evaluation of Alternative Regulatory Options", submitted May 13, 2010, to the Central Valley Water Board as an attachment to the document, "NPDES and Waste Discharge Requirement Permitting Dilemma regarding Effluent Limits for Salts in the Central Valley". The preliminary conclusion drawn from the evaluation was that variances may offer the best near-term option to address the current permitting dilemma.

One of the NPDES permittees in question, the City of Tracy WWTP, is subject to waste discharge requirements as promulgated by the Central Valley Water Board in Order No. R5-2007-0036 (CRWQCB, Central Valley Region, 2007). Final effluent limitations for EC consistent with those in the Bay-Delta Plan are delineated in Section IV.A.1.i. of that Order; however, they are only effective if the City of Tracy does not submit a Salinity Plan or fails to implement such a Salinity Plan in a timely manner after it is approved. That is, if the City of Tracy submits and implements an approved Salinity Plan, no enforceable final effluent limitations for EC are specified.

Petitions were filed with the State Water Board requesting review of this Order. In response to some of the objections raised by one of several petitioners (California Sportfishing Protection Alliance (CALSPA)), the State Water Board issued a remand order (Order WQ 2009-0003, dated May 19, 2009) (CSWRCB, 2009a) that addressed, among other issues, the final effluent limitations for EC. This remand order requires the Central Valley Water Board to amend Order No. R5-2007-0036 "to include a final effluent limitation for EC in compliance with the objectives in the Bay-Delta Plan, and, if appropriate, initiate a water quality planning process" to achieve compliance without the need for reverse osmosis. The State Water Board suggested that the following be considered when evaluating "interim" planning options to resolve the salinity problem for the City of Tracy, although it does not comment on the appropriateness of any of these options:

- City of Tracy salt reduction study
- TMDL for EC in Old River
- Site-specific objectives in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Sacramento-San Joaquin Basin Plan)
- Request to State Water Board for amendment to the Bay-Delta Plan
- Outcomes from CV-SALTS
- Near-term planning options:
    - Variances
    - Site-specific objectives

- Policy allowing offsets

The State Water Board also suggested that if this route is taken, both short- and long-term management strategies should be implemented. In Order WQ 2009-0003, the State Water Board acknowledged that "while salts present a difficult long-term management challenge, they are more amenable to interim planning solutions than bioaccumulative or toxic pollutants" (p. 10, footnote 17). In other words, the water quality impacts associated with salt concentrations tend to be chronic rather than acute and manifest in the long-term rather than the short-term. The implication is that approval of one of the interim approaches suggested above may be easier for salts than for other pollutants.

The possible solutions to the salinity problem vary depending on whether the impacted discharge is to surface waters (subject to NPDES permits), or to land (subject to WDRs). For dischargers subject to NPDES permits, the concept of utilizing a water quality standards variance to promote productive actions in the management of salts and to avoid unreasonable permit compliance problems in the Central Valley has been identified. For land dischargers, the concept of developing a procedure for issuing case-by-case exceptions from meeting salt requirements has also been identified. It is useful for the Central Valley Water Board to have a mechanism to address the situation where discharger compliance with water quality standards is infeasible at the present time and changes in those standards and/or the implementation of those standards is being evaluated.