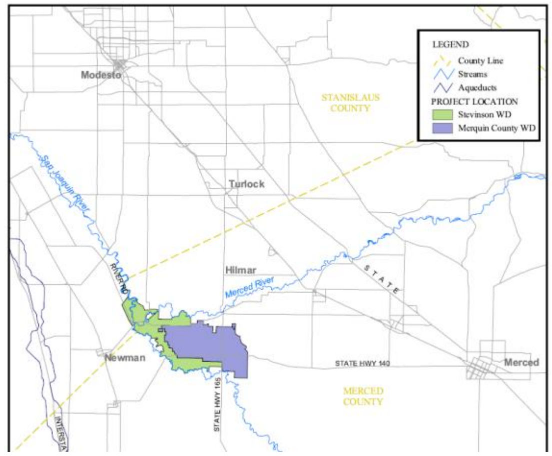
Section 8

Stevinson Water District Study Area

Figure 8-1. Location of Stevinson Water District & the Merquin County Water District (SWD 2005).



8.1 Introduction and Overview

The Stevinson Water District (SWD) is located in Merced County, near the confluence of the Merced and San Joaquin Rivers (Figure 8-1). SWD provides irrigation water to 7,560 acres of land within the district boundaries and to 1,340 acres of land outside of the boundaries. In addition, SWD also delivers surface water to the neigboring Merquin County Water District (MCWD) to irigate 6,000 acres of land (SWD 2005). To augment the water deliveries from SWD, MCWD uses groundwater from private wells (SWD 2006). Water trasnsportation is achieved through 66,900 feet of earthen ditches throughout the district, which is a significant source of seepage to groundwater.

High salinity in this region results from saline groundwater and soils. Both SWD and MCWD are downslope from the adjacent Merced Irrigation District, and combined with inflows from the adjacent rivers and deep percolation from irrigated lands, results in a high groundwater table (at depths between 3 to 22 feet below ground surface and with TDS concentrations ranging from 500 to 2,000 mg/L [SWD 2004 and 2005]). To address the salinity problems, SWD and MCWD developed an Integrated Water Resources Plan (IWRP), which identifies actions to manage and conserve agricultural water. Developed in 2003 and submitted in 2005 to the CaliforniaDepartment of Water Resources (DWR), the IWRP's measures include "lateral piping, drainage management, agricultural water conservation, groundwater monitoring, and conjunctive management programs" (SWD 2006).

8.2 Problem Statement

Poor drainage throughout SWD combined with high seepage from earthen ditches has resulted in significant agricultural water losses, a high groundwater table, and limited available cropping options for farmers. In addition, the highly saline soils in the area cause concentrated salt levels in the groundwater, reducing crop yields as a result. The Stevinson study area specifically looks at conserving water supplies and addressing agricultural drainage related salinity issues by reducing seepage, managing drainage through a series of artificial wetlands, and implementing other ancillary facilities as well as other water management actions included in the IWRP.

8.3 Study Area Attributes

8.3.1 Hydrology Attributes

On average, the region receives an average of 11.23 inches of precipitation per year (National Oceanic and Atmospheric Administration [NOAA] 2013). Rainfall is seasonal with the majority of precipitation occurring between November and April.

Water for SWD is diverted from the Merced River and delivered to agricultural land through the East Side Canal (Figure 8-1). Irrigation return flows from the study area are discharged into the San Joaquin River.

8.3.2 Land Cover Attributes

Located in Merced County, the SWD and MCWD are primarily comprised of agricultural lands and the unincorporated town of Stevinson. The primary industry in the area is dairy while the primary crops include alfalfa and corn, which support the dairies (SWD 2006).

8.3.3 Institutional, Economic & Regulatory Attributes

The economy of the SWD is predominantly agricultural. The impacts of salinity on irrigated agriculture economic production are primarily related to the availability of drainage services, soil salinity, and groundwater conditions. Irrigated agriculture in an area with salinity issues, such as the Central Valley, is driven by economic factors such as application of improved technology, availability of labor and other resources, demand for commodities, and production. Improved efficiency in irrigation and drainage reuse are examples of technological innovations that have improved crop yields in recent years (Howitt et al 2009). Future production of irrigated agriculture operations will be impacted by the reliability of high quality water supplies, potential climate change impacts, future policies impacting the agricultural sector, and increasing crop production in other countries (Howitt et al 2009).

8.4 Sources of Salt in the Stevinson Water District

The main sources of salt entering the study area are from water supplies for irrigation which is obtained from both deep groundwater wells and surface water.

Groundwater

Groundwater, which is produced from aquifers between 30 to 210 feet below ground, has typical total dissolved solids (TDS) concentrations ranging from 300 to 1,300 mg/L.

Surface Water

Both the Merced River and the East Side Canal, which is used to deliver Merced River water to agricultural land, have low salinity. Salinity in the Merced River has an average TDS of 44.8 mg/L while the East Side Canal has a TDS of 64 mg/L.

8.5 Integrated Water Resources Plan

The IWRP was designed with the primary goals of conserving water and thereby improving water supply reliability and reducing water quality impacts of agricultural drainage water discharges to the San Joaquin River . The IWRP consists of several projects aimed at achieving these goals including installation of lateral pipelines and artificial wetland management. These projects are discussed below in more detail.

8.5.1 Lateral Pipelines

The original water conveyance system for SWD and MCWD primarily consists of earthen ditches that move water via gravity. Both districts have flat topography with an average slope of 0.1% generally towards the southwest. The earthen ditches are a significant source of seepage into an already shallow perched groundwater table which in turn increases the soil salinity and reduces crop production. It is estimated that seepage associated with these earthen ditches is approximately 2,940 acre-feet/year (ac-ft/yr) (SWD 2006). Water lost to seepage collects salt from the saline soils which ultimately mixes with the shallow, saline groundwater further degrading its quality. The groundwater table is sloped towards the San Joaquin River and most likely contributes to the base flow in the river. SWD estimated that 60 to 70 percent of the seepage in the area will eventually discharge to the San Joaquin River (SWD 2005).

To reduce water volume water losses as a result of seepage, the IWRP proposed the Lateral Canal Pipelining Project which converts approximately 20,000 linear feet out of a total 66,900 linear feet of open earthen canals to pipelines ranging in diameters from 30 to 36 inches (SWD 2005). By installing the pipelines, the SWD and MCWD reduce water losses from evaporation and evapotranspiration (through vegetation along the bank) as well as seepage losses. The conserved water would be used to supply regional uses and would substitute for diverted water from tributaries to the San Joaquin River. The reduction in seepage is expected to "increase" flows of good quality water in the San Joaquin River and reduce the salt load entering the San Joaquin River and ultimately the Delta.

Performance

Table 8-1 summarizes the estimated reduction in water losses and corresponding salt loads expected from implementation of the *Lateral Canal Pipelining Project* (SWD 2005).

Table 8-1. Reduction in Water Losses and Corresponding Salt Load Decreases as a Result of Lateral Canal Pipelining Project (SWD 2005)

Description	Volume (ac-ft/yr)	Resulting Decrease in Salt Loads (tons/year)
Reduced Groundwater Return Flows into the San Joaquin River	705	75[1]
Reduced Withdrawals from the San Joaquin River System	1,130	21[2]
Net Increase in Flow and Reduced Salt Load in the Delta (Mostly Occurring in the Summer)	425	54

Notes:

[1] Assumes an average groundwater TDS of 600 mg/L.

[2] Assumes an average surface water TDS of 100 mg/L.

8.5.2 Artificial Wetlands

As of 2006, SWD retained agricultural runoff in a 20 acre shallow, artificial wetland called Big Bottom Lake located between Highway 140 and the San Joaquin River. Water levels, controlled by a weir located at Turner Slough, were wetland water discharged into the slough and ultimately was carried to the San Joaquin River via a 48-inch pipe. During the summer, water levels in the wetland were typically raised, retaining agricultural drainage, and were lowered during the fall.

The IWRP proposed the Agricultural Drainage Control Project to enhance the existing wetland at Big Bottom Lake and construct an additional new wetland to improve the SWD's capacity to store drainage and storm water. This project would connect the wetlands through pipelines and control structures. The new wetlands would be converted from 34 acres of existing upland habitat (Figure 8-2). The new wetland would add capacity to store existing agricultural drainage water, with estimated

TDS concentrations averaging 600 mg/L, and allow the flexibility of releasing this water to the San Joaquin River at times of high assimilative capacity (SWD 2006 & 2010).

Performance

Some of the salinity goals for the Agricultural Drainage Control Project were stated to be:

- *Reduce loadings of TDS, boron, nitrogen, phosphorous, and sediment associated with agricultural drainage to the San Joaquin River.*
- *Control the timing of agricultural drainage discharges so that the loadings coincide with periods of high flow.*
- *Create a groundwater mound to obstruct intrusion of saline groundwater from the Westside of the San Joaquin Valley* (SWD 2010).

Through a monitoring system implemented throughout both wetlands, SWD determined that nitrogen and phosphorus were reduced through vegetation uptake, and sediment loading was reduced through deposition in the wetlands. As a result of evaporation in the system, TDS increased in concentration, however the total salt loading (tons per year) remained the similar throughout the system. Through installed control structures, wetland releases have occurred during high flows in the San Joaquin River. The monitoring results did not provide any conclusive evidence that the project impacted local groundwater elevations (SWD 2010).

8.6 Cost of Implementation

As described in Table 8-2, the cost of implementation for both projects was documented by SWD (2005 & 2010).

Table 8-1. Estimated Project Costs (SWD 2005 & 2010)

Project	Capital Cost	Annual Operation & Maintenance Cost (O&M)
Lateral Canal Pipelines Project	$1,003,200[1]	$13,700[1]
Agricultural Drainage Control Project	$497,553[2]	Unknown[3]

Notes:

[1] In 2005 Dollars

[2] In 2010 Dollars

[3] SWD 2010 did not indicate that there were any O&M costs associated with the project.

In 2007, the State Water Resources Control Board, under Proposition 50, provided $603,300 in grant money for the Agricultural Drainage Control Project (CALFED Bay-Delta Program 2007). The costs for the Lateral Pipeline were shared with between SWD ($107,200) and the State of California through a grant ($896,000).

8.7 Salt Capacity

Salt capacity is intended to be an estimate of the limiting capacity of each salt study accumulation area to assess the likelihood of achieving long-term sustainable conditions within the Central Valley. The salinity issues addressed by the SWD are primarily source control solutions. These solutions either prevent or reduce the volume of saline groundwater from entering the San Joaquin River(through the Lateral Canal Pipelining Project), or release saline agricultural drainage water during times of high assimilative capacity in the river (through the Agricultural Drainage Control Project). However, this study area does not remove salt, although they reduce salt entering into the water district by conserving water supplies salt is still entering into the district and infiltrating (through agricultural drainage) into the groundwater below. As described above, this groundwater will eventually migrate downslope towards to the San Joaquin River, providing a source of the river's base flow. As such, an evaluation of the long-term capacity for accumulation and disposal of salt loads in this Study Area will be required.

8.8 Institutional and Regulatory Barriers

The programs described in the IWRP would need to adhere to the various applicable federal and state programs. Compliance with these regulations, such as WDRs and TMDLs issued by the Central Valley RWQCB, could potentially become a barrier to implementation. As mentioned above (8.7 Salt Capacity) the future regulatory climate has the likely chance to become a barrier in implementation of such a project as regulations against salinity impacts to groundwater and surface water become more stringent.

To be expanded further as a result of discussions with the Central Valley RWQCB.

8.9 Screening Level Analysis of Long-Term Sustainability

This section will be drafted as part of Task 1.4 and will be included in the Task 1.4 TM and Task 1.5 Phase 1 Report.

8.10 References

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