BACKGROUND DOCUMENT ON SAN JOAQUIN RIVER SALINITY

SAN JOAQUIN RIVER BASIN

Water supply and irrigation development in the San Joaquin Valley and the Valley hydrologic and geologic characteristics are the principal reasons the Valley struggles with salinity management. The San Joaquin Valley is actually made up of two distinct and different hydrologic basins; the San Joaquin River Basin and the Tulare Lake Basin (Figure 1). The Tulare Lake Basin is a closed basin south of the San Joaquin River Basin and water only flows into the San Joaquin River Basin during high flood events. The San Joaquin River Basin on the other hand has an outlet to the Ocean. The San Joaquin River Basin (Basin) includes the entire area drained by the San Joaquin River. The San Joaquin River Basin drains 35,000 km^3 (13,513 mi^2) before it flows into the Sacramento-San Joaquin Delta near the town of Vernalis. The Merced, Tuolumne and Stanislaus rivers are the three major tributaries that join the mainstream San Joaquin from the east before it flows into the Delta.

The San Joaquin River Basin is made up of three primary geologic zones; the western flank of the Sierra Nevada Mountains, the eastern flank of the Coast Range Mountains and the valley floor. The Sierra Nevada Mountains ring the eastern side of the valley floor and rise in elevation to over 4,000 m (13,000 ft). The Coast Range that lines the western edge of the Basin is much lower in elevation up to 1,830 m (6,000 ft). The valley floor lies between these two mountain ranges.

The San Joaquin River flows from the Sierra Nevada Mountains onto the valley floor near Fresno in an east to west direction. Near the valley trough, the River makes an abrupt turn north and flows 160 km (100 mi) to the Sacramento-San Joaquin Delta. At the point where it turns north, the San Joaquin River essentially divides the valley floor into an east and west side. There are only intermittent flows from the eastern flank of the Coast Range.

The Sierra Nevada Mountains are the primary source of both the valley's water supply and the alluvial material that forms the eastern side of the valley floor and along the San Joaquin River as it moves through the valley trough. The Coast Range provides the alluvial material for a major portion of the western side of the River.

The geology of each of these mountain ranges has had a marked influence on the valley floor sediments and salinity. The granitic deposits from the drainage of the western slope of the Sierra Nevada Mountains have created large alluvial fans of low-salinity, well sorted gravels and sands on the eastern side of the Basin. This has resulted in coarse-textured alluvial material on the eastside of the San Joaquin River on the valley floor that is low in natural salinity. This coarse-textured material becomes finer as these alluvial deposits move toward the valley trough. In contrast, the Coast Range is made up of Jurassic and Cretaceous sandstones and shales of marine origin. These are known to be high in salt.

The predominant storm track for the Central Valley is west to east from the Pacific Ocean. This makes the eastern side of the Coast Range (the portion making up the western side of the San Joaquin River Basin) a rain shadow of lower rainfall. In contrast, the western slopes of the high-altitude Sierra Nevada Mountains receive considerably more precipitation than the eastern side of the Sierra Nevada. The lower rainfall on the western side of the San Joaquin River Basin has resulted in poorly sorted sediments that, as a general rule, are of lower permeability and higher salinity when compared to those on the eastside.

SAN JOAQUIN RIVER BASIN HYDROLOGIC CHARACTERISTICS

Typical of a Mediterranean climate, precipitation in the watershed varies annually, seasonally as well as by watershed elevation. Precipitation in the Basin ranges from as little as 5 inches/year on the valley floor to over 80 inches/year at the higher elevations of the Sierra Nevada (USGS, 1998). Most of the precipitation falls in the late fall, winter and early spring periods with a prolonged dry period in the remainder of the year. Precipitation is predominately snow above 4 -5,000 feet elevation with rain in the middle and lower elevations of the Sierra Nevada and Coast Range. As a result, natural hydrology reflects a mixed runoff regime, dominated by winter-spring rainfall runoff and spring-summer snowmelt runoff (McBain and Trush, 2002). Snowmelt runoff generates a majority of the flow volume from the watershed with little runoff contributed from the western side of the Basin in the rain shadow of the Coast Range.

Winter or spring rain-on-snow events likely contributed the largest instantaneous flow events and played a major role in channel forming processes while the snow melt period was probably the longest prolonged flow periods and contributed to overbank inundation and high water tables thus creating a vast floodplain and wetland habitat that supported large populations of fish and wildlife (McBain and Trush, 2002).

EARLY WATER DEVELOPMENT

The San Joaquin River Basin prior to 1850 was devoted largely to rain-fed grain and cattle production. Irrigation development began sporadically in the decade following the 1850s when individual farmers made diversions to lands lying immediately adjacent to the perennial eastside streams. Most of these areas were already natural overflow lands that had been used for pasture prior to that time (DWR, 1965). Most diversions during this period were made as water was available in the river for diversion.

Construction of the railroad through the San Joaquin Valley from 1869-1875 increased the demand for more intensive cultivation, as markets in the larger coastal cities were thus accessible to valley farmers. Large-scale irrigation began in the valley around 1870 and by 1880 almost 81,000 ha (200,000 ac) were planted to cereals and alfalfa in the San Joaquin Valley (includes both the San Joaquin River and Tulare Lake Basins) (DWR, 1931). Development was generally on the eastern side of the valley and proceeded from east to west across the valley, although some lands along the valley trough were irrigated during this period. Significant production began on the western side of the valley in 1872 when the San Joaquin River was diverted through the Miller and Lux canal system west of Fresno near where the San Joaquin River turns north when it reaches the valley trough (DWR, 1965).

By the 1890s and early 1900s sizeable areas in the trough of the Basin were being forced out of production by salt accumulation and shallow water tables. Early irrigation practices involved the intentional over-irrigation of fields to raise the local water table so that subsurface water would be available to crops during a portion of the dry summer season when river flows were too low for efficient diversions. Much of this land lay idle until the 1920s when development of reliable electric pumps and the energy to power them accelerated the expansion of irrigated agriculture by making available the vast ground water resources under the valley floor. This ground water pumping lowered the water table in many areas (SWRCB, 1977 and Ogden, 1988) and allowed for adequate leaching of salts, especially near the valley trough and the western side of the San Joaquin River Basin.

SURFACE WATER DEVELOPMENT

Present day hydrology is dominated by irrigation storage, irrigation delivery, and flood control releases. Water resources development in the San Joaquin River Basin began shortly after the discovery of gold and consisted of small-scale diversions to mining districts followed by diversions to riparian users for agricultural uses adjacent to the perennial streams. Few large scale storage and diversions projects were considered prior to 1915 as the valley was focused on groundwater development. By 1915 there were 11 storage reservoirs developed on the mainstream San Joaquin River and the three large eastside tributaries (Stanislaus, Tuolumne and Merced). These facilities however only captured 1-2% of the total runoff and likely did not have the capacity to significantly reduce the volume of spring snowmelt run-off. It is not clear whether they were large enough to reduce instream flows in the late summer and early fall, a period when very low flows occurred in the mainstream San Joaquin River and the three eastside tributaries.

Beginning about 1920, large-scale water storage and diversions were planned and developed by cooperative ventures of individual landowners, municipalities and by local water agencies to extend water deliveries to additional land, provide municipal water supplies and provide hydroelectric power. Between 1923 and 1926, large-scale storage projects were completed on all three of the eastside tributaries (Stanislaus, Tuolumne, and Merced) significantly altering seasonal flow patterns. Similar water storage projects were developed on the mainstream San Joaquin River upstream of the valley floor but these were done primarily for hydropower production rather than for irrigation.

By 1940, the San Joaquin Valley (both the San Joaquin River and Tulare Lake Basins) had over 1,420,000 ha (3,500,000 ac) under irrigation, largely using ground water. Declining ground water elevations and the desire of land owners to bring new land into production and the desire of the United States government to expand population settlement in the western part of the nation led to the formulation of federally sponsored and licensed flood control dams as well as plans for a large-scale water resource development project called the Central Valley Project (CVP). A major component of the CVP was to import water from Northern California into the San Joaquin Valley via diversion from the Sacramento-San Joaquin Delta. This lead to the construction of Friant Dam on the mainstream San Joaquin River in 1941 as part of the federal CVP. Friant Dam diverted a major portion of the natural flow of the mainstem San Joaquin River south into the Tulare Lake Basin. Water users along the middle and lower San Joaquin River exchanged their existing water rights to divert San Joaquin River water for water supplied from the Delta via the Delta – Mendota Canal (DMC), a major component of the federal CVP.

A good discussion of the history of surface water development on the main stream San Joaquin River and the three eastside tributaries is presented in Chapter 5 (Water Resources Development) of Cain et al., 2003. Chapter 5 of that report is included as an appendix to this write-up.

Development of Salinity Problems in the San Joaquin River Basin

Three components led to the salinity issues in the San Joaquin River Basin. The first was the exchange of high quality snow melt water from the San Joaquin River for more reliable, but poorer quality (saltier) water imported from the Delta. The exchange resulted in the recirculation of water in San Joaquin Valley as the Delta exports incorporate a large percentage of the flow and salt in the LSJR which is re-exported to the San Joaquin River Basin. The second component was the intensification of irrigation on the upslope salt-laden soils on the western side of the San Joaquin River that were formed from the marine formations of the eastern flank of the Coast Range Mountains. The third component is that much of the western side of the San Joaquin Valley, like much of the Central Valley, is underlain by a shallow clay layer that obstructs vertical movement of irrigation water. As salts and minerals from surface soils are leached into the groundwater, this clay layer obstructs the downward flow of water and the water table rises to within a few feet of the surface and into the root zone. This this water is removed by constructed subsurface drains and is ultimately returned to the LSJR. The intensified irrigation quickly lead to high water tables and soil salinity issues in both the new lands being brought under irrigation and the lands previously supplied with San Joaquin River water.

Major salt and drainage problems began to develop along the San Joaquin River as the new lands were being supplied with surface water for the first time. These lands had previously been irrigated with groundwater. Pumping of groundwater for irrigation from 1920 to 1950 drew the water table down as much as 200 feet in areas along the westside of the San Joaquin River (Belitz and Heimes, 1990). Declining water tables were causing high pumping costs, land subsidence and farmers were finding poorer quality water as water tables continued to decline. These issues created a desire for new surface water supplies. As soon as the surface water supplies arrived via the DMC of the federal CVP, ground water pumping was minimized or abandoned. The result was that the water table began to rise in the areas being provided with DMC surface water.

Many of these salinity and drainage issues should have been considered in the original CVP project designs. Salt management however was not included in any of these early plans. As late as 1949, the U. S. Bureau of Reclamation's (USBR) Comprehensive Report on Planned Water Resources (USBR, 1949) made no mention of salt management (SWRCB, 1977). The only official reference to the problem was contained in the following 1946 comment by the U. S. Department of Agriculture on the draft report, which stated:

> "*The plan does not discuss drainage or include costs relative to constructing or operating drainage systems. In the light of experience with lands that have been irrigated, we feel that properly integrated plans for drainage should be made a part of any proposed new irrigation development plans"* (SWRCB, 1977).

No consideration of drainage was taken during the development and implementation of the Delta Mendota Canal (DMC) and the lands it serves. The first consideration of salt management occurred in the 1950s and 1960s, as a large – scale water development project began for other lands on the western side of the San Joaquin River and Tulare Lake Basins. The 1955 Feasibility Report for the San Luis Unit of the CVP, which was to be in the western side of the Valley in both the San Joaquin River Basin and Tulare Lake Basin, recognized the need for drainage and proposed an interceptor drain for the Unit (USBR, 1955). In addition, a California Department of Water Resources (DWR) report to the California Legislature recommended the State study a "*comprehensive master drainage works system*" for the valley. The California State Water Plan prepared by DWR included the concept of a Valley Master Drain (DWR, 1957).

USE OF THE SAN JOAQUIIN RIVER FOR DRAINAGE AND SALINITY CONTROL

Neither of these drainage efforts ever moved to full completion but final planning and implementation of the surface water supply portion of the federal San Luis Unit of the CVP and the State Water Project moved forward to completion. Each was authorized in 1960 and began delivering Northern California water to agricultural lands on the western side of the San Joaquin River Basin and the Tulare Lake Basin in 1968. A portion of the water supply went to new lands not presently irrigated by the Delta Mendota Canal (DMC) or it intensified irrigation on lands already being served by the DMC.

As soon as the first water arrived from the DMC, farmers on the western side of the San Joaquin River Basin began to experience rising water tables and related salinity problems. Farmers began to install on-farm subsurface drainage systems and renovate existing open drainage ditches in the early to mid 1950s, soon after the initial deliveries of water from the DMC. Development of the on-farm drainage systems and collector drains was essentially complete by the mid to late 1970s (Johnston et al., 2011). Total drained area in the San Joaquin River Basin was about 25,000 ha (60,000 acres).

The only outlet for the drainage water from the Grassland sub-basin was the San Joaquin River through Mud and Salt Sloughs on the western side of the San Joaquin River. Outlets for drainage downstream of the Grassland sub-basin was primarily direct discharges to the San Joaquin River. Drainage flows to the San Joaquin River increased as implementation of on-farm drainage systems increased. This increase occurred just as the flow in the River upstream of Mud and Salt Sloughs was decreasing as diversions were increasing at Friant Dam for irrigation of the eastern side of the Tulare Lake Basin and eastern Madera County. These two actions occurring simultaneously resulted in a significant degradation of the River and prompted a declaration by the California Legislature in 1961 that the River was impaired and that no further impairment shall occur and this declaration was made part of the California Water Code (CWC § 12230 – 12232). According to Water Code §12230, "Legislative Findings and Declarations" for the San Joaquin River:

> "*The Legislature hereby finds and declares that a serious problem of water quality exists in the San Joaquin River between the junction of the San Joaquin River and the Merced River and the junction of the San Joaquin River with Middle River; that by virtue of the nature and causes of the problem and its effect upon water supplies in the Sacramento-San Joaquin Delta, it is a matter of statewide interest and is the responsibility of the State to determine an equitable and feasible solution to this problem.*"

According to Water Code §12231, "State Policy: Diversions of Water from San Joaquin River and Tributaries":

> "*It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the San Joaquin River and its tributaries to which the users along the portion of the San Joaquin River described in Section 12230 are entitled.*"

According to Water Code §12232, "Duty of State Agencies Not to Cause Degradation of Quality of Water":

> "*The State Water Resources Control Board, the State Department of Water Resources, the California Water Commission, and any other agency of the state having jurisdiction, shall do nothing, in connection with their responsibilities, to cause further significant degradation of the quality of water in that portion of the San Joaquin River described in Section 12230*."

These three Water Code sections, adopted in 1961 only say the San Joaquin River has "a serious water quality" problem that the State should not allow to get any worse and should undertake actions to improve it. These Water Code sections do not describe the type of water quality problem or the severity, says nothing about salt or boron, and makes no factual findings regarding salinity or boron. The salinity problem on the river however has been implied as the primary reason for the addition of these sections in the Water Code. It is not clear whether these Water Code sections would apply to the CVP, because the permits for the CVP were issued before their effective date.

PLANNING FOR WATER QUALITY CONTROL ON THE SAN JOAQUIN RIVER

During the late 1960s, the Central Valley Regional Water Quality Control Board developed several provisional water quality control policies for the San Joaquin River which included water quality objectives for salinity for the three tributaries and the main stream San Joaquin River (CVRWQCB, 1967; CVRWQCB, 1968; CVRWQCB, 1969a; CVRWQCB, 1969b). These provisional policies were never adopted by the Board as the Porter Cologne Water Quality Control Act (PC Act) and the Clean Water Act (CWA) were eminent and required a broader Basin Planning effort that would supersede these provisional policies. During the Basin Planning effort in 1972-1974 under the PC Act and the CWA, the salinity problem on the San Joaquin River was noted as significant. The 1975 Basin Plan for the San Joaquin River watershed recommended the construction of a separate collection and discharge drain for the subsurface drainage water to isolate it from the River system as the only feasible way to improve San Joaquin River water quality.

The federal government had already begun to move forward on construction of a drainage facility and by 1975 had completed 192 km (120 mi) of collector drains and the first 136 km (85 mi) of what was to have been a valley wide drain. It was completed from a point near Five Points in the Tulare Lake Basin to Kesterson Reservoir in the Grassland watershed in the San Joaquin River Basin.

Even though portions of the main valley-wide drain were being completed, the farmers in the west side of the San Joaquin River Basin were faced with a dilemma. The dilemma had to do with access to the drain. The Basin Plan called for use of an isolated facility, however the farmers in the Grassland sub-basin and areas to the north on the west side of the San Joaquin

River Basin did not have access to the drainage facility and had no other option than to continue to use the San Joaquin River as the outlet for its drainage water and salt as there was no planned capacity for these drainers in the federal facility. The drain was being constructed for the San Luis Unit of the CVP which was primarily in the western portion of the Tulare Lake Basin.

Beginning in the early 1950s and continuing for almost three decades, CVP farmers in the Grassland watershed on the westside of the San Joaquin River Basin discharged their surface and subsurface drainage water into channels that led to the San Joaquin River. A large percentage of this water was captured by down slope wildlife refuge managers, prior to the drainage water entering the river. The captured drainage water was combined with other water supplies and used to maintain portions of a 40,500 ha (100,000 acre) wetland area within the Grassland watershed. This wetland area represented one of the largest remaining contiguous wintering waterfowl habitats on the Pacific Flyway.

There were additional subsurface drainage systems installed along the western side of the San Joaquin River from near the town of Newman downstream to near Tracy. All of these tile drainage systems discharged directly to the San Joaquin River without flowing through wetland areas as was the case in the Grassland watershed. As with the tile drainage systems in the Grassland watershed, most of these drains were developed and installed by the mid to late 1970s (Chilcott et al., 1988).

FOCUS ON SALINITY MANAGEMENT CHANGES

The central focus of water management in the Grassland watershed and in the Lower San Joaquin River from the initial development of the CVP through the early 1980s had been on salt and salinity management. The discovery of selenium impacts at Kesterson Reservoir in the early 1980s changed this focus entirely. Findings at Kesterson Reservoir showed that subsurface drainage water containing elevated levels of the trace element selenium impaired sensitive waterfowl. A check of the drainage water entering the Grassland wetlands and the San Joaquin River via Mud and Salt Sloughs also showed elevated levels of selenium. Based on this information, the Grassland refuge managers discontinued the use of blended selenium-laden drainage water and bypassed the subsurface and surface drainage flows directly to the San

Joaquin River. As a result of the bypass, selenium and salt loads likely increased as well as changed in the time that the salt loads entered the river. As a result of these diversions, the selenium loads to the San Joaquin River between 1984 and 1985 likely increased from about 1,180 kg (2,600 lbs) to 4,180 kg (9,200 lbs) per year, an increase of over 300 percent (SWRCB, 1986).

This dramatic change in the discharge pattern into the river prompted the regulatory agencies to begin the process of establishing water quality objectives for the River to protect downstream beneficial uses and to develop a regulatory program to limit the selenium loads in the drainage water discharges.

In February 1985, the State Water Board adopted Order WQ 85-1 to deal with the selenium problems in the San Joaquin River Basin. This Order addressed the waterfowl problems at Kesterson Reservoir arising from selenium laden subsurface agricultural drainage water being discharged into this facility from the federal San Luis Unit of the CVP. In the Order, the State Water Board also expressed concern over the discharge of similar type of water into the Grassland wetlands and the San Joaquin River from lands not part of the San Luis unit of the CVP. Of particular concern to the State Water Board was the serious lack of data on the quality and quantity of agricultural return flows being discharged to the Grassland wetlands and the San Joaquin River. The State Water Board directed the formation of the San Joaquin River Basin Technical Committee, made up of State Water Board and Central Valley Water Board staffs. The Technical Committee was tasked to investigate water quality concerns in the San Joaquin River Basin related to agricultural drainage and to report back to the State Water Board on specific components of a Basin Plan Amendment including:

1. Proposed water quality objectives for the San Joaquin River Basin,
2. Proposed effluent limitations for agricultural drainage discharges in the Basin to achieve these objectives, and
3. A proposal to regulate these discharges including developing an estimate of the total cost of the proposed regulatory program and identify potential sources of financing.

ERA OF REGULATORY CONTROL

The San Joaquin River Technical Committee report was accepted by the State Water Board in August 1987. The Technical Committee Report focused on selenium although recognizing that salt and salinity control on the San Joaquin River remained the longer-term issues. The Technical Committee report formed the basis for the first of two Basin Plan Amendments related to regulation of agricultural drainage.

In 1988, the Central Valley Water Board adopted the first of two Basin Plan Amendments to regulate agricultural subsurface drainage from the Grassland watershed. In addition to water quality objectives for selenium and boron, the amendment established several policy actions including:

- The control of selenium in the drainage water was set as the first priority rather than salinity;
- The San Joaquin River could continue to be used to remove salts from the basin provided water quality objectives for selenium were met;
- Any further increase in drainage water discharges to the San Joaquin River from the Grassland watershed were prohibited until load levels were shown to be within the water quality objectives;
- Regulation of discharges would be pursued on a regional basis rather than at individual farms;
- Reuse of drainage water would be encouraged; and
- A separate and isolated valley wide facility to take drainage water out of the basin would continue to be promoted as the best long-term alternative for salinity management.

This regulatory action in 1988 focused implementation on improved on-farm efficiency to reduce deep percolation thus reducing selenium and salt mobilization into the drainage water. This action was consistent with the recommendations of the San Joaquin River Technical Committee report. Immediately following the Basin Plan Amendment, extended drought conditions led to significant improvements in irrigation efficiencies within the Grassland watershed. The result was that discharges of selenium to the San Joaquin River were cut in half and the amount of selenium in the river water improved significantly (Karkoski, 1994; CVRWQCB, 1996). However, the selenium concentration in the internal channels in the Grassland watershed, that were dominated by these drainage flows, did not improve and in fact water quality in the channels deteriorated as a result of water conservation and improved irrigation efficiency. The end result was a significant reduction in drainage flows but concentrations of selenium in the drainage water increased in the interior channels of the Grassland sub-basin although the total load of selenium to the San Joaquin River was reduced.

Recognizing how effective the program was toward reducing selenium, the State Water Board in adopting the 1991 Bay-Delta Water Quality Control Plan for Salinity (Report 91-15WR) by Resolution 91-34, directed the Regional Board to undertake a similar reduction for salt. Specifically the plan called for:

> "*Upon Adoption of this Plan, the State Board will request the Central Valley Regional Board to develop and adopt a salt-load reduction program. The goal of this initial program will be to reduce annual salt-loads discharged to the San Joaquin River by at least 10 percent and to adjust the timing of salt discharges from low flow to high flow periods. During the Water Rights Phase of these proceedings, the Regional Board should discuss how it intends to implement this program (for example, drainage operations plans and best management practices).*
>
> *The goal of this program shall be to reduce the salt load discharged to the San Joaquin River by at least 10 percent. This amount should be achieved by increasing the irrigation efficiency on the west side of the San Joaquin River Basin to a target level of 73 percent with a five percent leaching fraction as recommended by the Agricultural Water Conservation Workgroup. This should reduce the annual subsurface drainage from tile drained portions of the west side by about 40 percent as envisioned by the State Board's Technical Committee and the San Joaquin Valley Drainage Program (see EDF, 11, V-13-20 and San Joaquin Valley Drainage Program, 1990). Since about 25 percent of the annual San Joaquin River salt load is from the west side subsurface drainage, this drainage reduction amounts to a 10 percent reduction in annual San Joaquin River salt load (0.40 x 0.25 = 0.10) based on State Board staff modeling results (see EDF, 11,*

Appendix C). Annual salt loads could be further decreased by reducing and recycling tailwater discharges to the San Joaquin River from the west side.

In addition to the annual reduction in salt load, it would also be possible to adjust the timing of salt load discharge from the west side of the San Joaquin River Basin through storage of drainage flows (see Pickett and Kratzer, 1988). The need for dilution flows from the east side of the San Joaquin River Basin to meet seasonal water quality standards in the southern Delta would be reduced.

The salt load reduction policy, which would help to protect beneficial uses in the southern Delta, should be achieved through development of best management practices and waste discharge requirements for non-point source dischargers. The Central Valley Regional Board should present the policy to the State Board no later than the Water Right Phase of the proceedings. If adequate progress is not being made, the State Board will proceed under its authorities."

It was thought that the drainage operations plan and best management practices that were being implemented in the Grassland watershed would accomplish both the selenium reduction envisioned by the Regional Board's 1988 Basin Plan Amendment and the salt reduction envisioned by the State Board 1991 Bay-Delta Water Quality Control Plan (91-15WR). With the return of the wetter cycles after 1993 and a full water supply to each farm, the total load of selenium discharged returned to the 1988 levels, indicating that the irrigation efficiency improvements alone would not provide a long-term solution. Since the focus was on selenium, no one determined whether the salt load reductions accomplished during this period were continuing to be achieved after the full water supply returned. One of the major problems with the approach taken by the regulatory agencies was that the farmer had no control or knowledge over how their actions impacted water quality downstream of their individual farming operation.

It was found that, like the Imperial Valley, as irrigation efficiency improved, there was a significant reduction in the subsurface drainage flows, but also a significant reduction in the high quality surface runoff (irrigation tailwater) and operational spills from individual farms that previously diluted the agricultural subsurface drainage flows. The result was that the discharge from the individual farms was smaller, the total load of selenium and salt were reduced but the concentrations of salt and selenium in the return flows increased significantly as flow was now dominated by the poor quality subsurface drainage. At the district or larger level, improvements in how water is distributed and managed were also being made. However, the result of these actions was that operational spills and on-farm losses that previously had been available for dilution of the subsurface drainage water discharges were also no longer available. There did not appear to be any connection between the two operations, one at the farm level and one at the district level, nor was there any connection between these operations, flows in the collection channels, and River flows available for dilution. A more coordinated effort would be required.

The lack of compliance with selenium water quality objectives prompted the regulatory agencies to reconsider the direction established in 1988. To be consistent with the State Water Board direction in the 1985 WQ 85-1 Report on controlling agricultural drainage, the Central Valley Water Board focused on the three-step process to manage selenium as outlined in the 1990 San Joaquin Valley Drainage Program (SJVDP, 1990). The first step was to minimize selenium mobilization from the irrigated area, the second was to capture and reuse the selenium laden drainage water to the maximum extent possible and the final step was to isolate, treat and/or dispose of the remaining selenium-laden water. The latter was to be done under Waste Discharge Requirements.

The regulatory agencies established a new approach for these nonpoint source selenium discharges in 1996. The new focus continued source control efforts including improved distribution and delivery efficiency, improved on-farm efficiency and continued off-farm reuse of drainage water but expanded their efforts on controlling the final collected discharge runoff. The new focus would be done under a formal Waste Discharge Requirement (State equivalent of a federal NPDES permit for a surface water discharge) with monthly and annual load limits to specific water bodies. Because the mechanisms for controlling selenium were not well understood, the use of such a permit was not intended to be at each individual farm but rather at the final discharge point from the Grassland watershed. The permit would be issued to a responsible entity that would have the administrative power to implement the load limitations and control the discharge of the drainage water to the San Joaquin River.

The Central Valley Water Board in 1988 established that they would regulate selenium as a first priority. The 1996 program again focused on selenium reduction but recognized that salinity was the long-term issue on the San Joaquin River. The 1996 Basin Plan Amendment for selenium called for significant reduction in drainage water discharges through implementation of the Grassland Bypass Project (CVRWQCB, 1996). This Project was implemented in 1995 and continues today. It was also expected that the Grassland Bypass Project would also result in salt load reductions. Testimony to the State Water Board during the implementation phase of the 1995 Bay-Delta Plan showed that between 1995 and 1997, the Grassland Bypass Project had decreased salt discharges by 100,000 tons per year. Recent information provided by the Central Valley Water Board has shown that the Grassland Bypass Project has reduced salt loads to the San Joaquin River by 182,000 tons per year since its implementation in 1995.

SHIFT OF FOCUS TO SALINITY CONTROL

In 1976, the LSJR was placed on the CWA Section 303(d) list of impaired water due to elevated concentrations of salt and boron. The basis for the listing was that since the 1940s, mean annual salt concentrations in the LSJR at the Delta Boundary at Airport Way Bridge (Vernalis) had doubled and boron levels have increased significantly. Water quality monitoring data collected by the Central Valley Water Board and others indicated that water quality objectives for salinity and boron were frequently exceeded in the LSJR during certain times of the year and under certain flow regimes.

In May 1991, water quality objectives for salinity (electrical conductivity, total dissolved solids and chloride) in the San Joaquin River near Vernalis were adopted by the State Water Board as part of the Bay-Delta Water Quality Control Plan review. Again in 1998, the State Water Board placed the San Joaquin River on the federal Clean Water Act (CWA) section 303(d) list as impaired by salinity, based on a Central Valley Water Board recommendation. CWA section 303(d)(1)(C) requires a State to establish a Total Maximum Daily Load (TMDL) for any pollutant causing an impairment of a beneficial uses and/or non-attainment of an adopted water quality objective. A TMDL is a numerical calculation and allocation of the total loading capacity that a water body can assimilate, considering seasonal variations and a margin of safety, and still attain a water quality objective. A TMDL includes one or more numerical targets that represent attainment of the standards. A numerical target may equal the applicable numerical water quality objective. Adoption of a TMDL for salt and boron under State Law requires the development of a program of implementation to reduce salt and boron loading to levels needed to achieve a water quality objective. The development and adoption of a TMDL therefore must be done as a revision to the Water Quality Control Plan (Basin Plan).

A technical TMDL report for salt and boron in the LSJR titled "Total Maximum Daily Load for Salinity and Boron in the Lower San Joaquin River" was developed in July 2004 and a final TMDL staff report was completed in September 2004. The TMDL report, which uses an updated unit of measurement for electrical conductivity (EC) of µS/cm (equivalent to the µmhos/cm (1,000 µmhos/cm = 1.0mmhos/cm), states:

> "*Water quality data collected during water years 1986 to 1998 indicates that the non-irrigation season salinity objective of 1,000 µS/cm (Sept 1st – March 31st) was exceeded 11 percent of the time and the irrigation season salinity objective of 700 µS/cm (April 1st – August 31st) was exceeded 49 percent of the time at the Airport Way Bridge near Vernalis. Consequently the river does not fully support all of its designated beneficial uses.*"

The report included a calculated base waste load allocation and load allocation for point and nonpoint sources and includes all the CWA required elements of a TMDL, including; (1) a problem statement that describes the water body being addressed and reasons for the impairment; (2) numeric targets that set quantifiable end-points that the TMDL seeks to achieve; (3) a source analysis that identifies and describes the significant sources of pollutant loadings to the LSJR; (4) loading capacity of the water body; and (5) allocation of loads. A series of technical TMDL reports for salt and boron in the LSJR were developed as part of the TMDL development process (CVRWQCB, 2004a; CVRWQCB, 2004b; CVRWQCB, 2004c; CVRWQCB, 2004d; CVRWQCB, 2004e; CVRWQCB, 2004f; CVRWQCB, 2004g; CVRWQCB, 2004h; CVRWQCB, 2004i; CVRWQCB, 2004j; CVRWQCB, 2004k; CVRWQCB, 2004l).

In September 2004, the Central Valley Water Board adopted, by Resolution R5-2004-0108, a Basin Plan Amendment for the Control of Salt and Boron Discharges into the Lower San Joaquin River. In November 2005, the State Water Board approved, by Resolution 2005-0087, the Basin Plan Amendment establishing a TMDL, regulating the loading of salt and boron in the LSJR for the purposes of attaining the South Delta salinity objective at Vernalis that was adopted by State Water Board Resolution 91-34 for the Bay-Delta Plan. The Basin Plan Amendment anticipated that salinity and boron objectives for the San Joaquin River upstream of Vernalis would be developed and provided a schedule for their development.

The Basin Plan Amendment provided two alternatives for compliance with the TMDL load allocations. The first was the traditional approach, which consists of discharging no more than the load allocations allowed. The second approach recognized that, because significantly more salt is imported into, and mobilized and generated in the basin than is exported, the traditional approach would result in a build-up of salt in soil and groundwater in the basin. Therefore, TMDL compliance was allowed through participation in a real time water quality management program, whose purpose would be to export the maximum amount of salt from the basin while still meeting the water quality objectives.

PROTECTION OF DOWNSTREAM WATER QUALITY

California Water Code §12230-12232, in addition to recognizing the salinity problems in the San Joaquin River, recognized that salinity on the San Joaquin River also impacted beneficial uses in the South Delta. In February 1961, the State Water Rights Board (predecessor to the State Water Board) adopted Water Rights Decision 990 (D-990), which approved a water right permit for the USBR for the federal CVP. This order did not have any water quality standards attached to it. D-990 did however recognize the problem of salinity intrusion into the Delta and reserved jurisdiction to revise or formulate additional terms and conditions regarding salinity control in the water right permit being issued to the USBR or any permit issued to DWR for the proposed State Water Project.

In 1965, various interested parties, including the USBR and DWR, reached agreement on water quality criteria for the Delta (1965 criteria). The 1965 criteria did not govern electrical conductivity, but set applicable levels for chloride, one of several ions used to measure salinity at that time. Two years later, in 1967, under State Water Board Decision 1275 (D-1275), which approved the water rights for the State Water Project (SWRCB, 1967), the State Water Board adopted the1965 criteria as the first South Delta salinity standards for protection of irrigated agriculture. They qualified the permit by stating that it was subject to the 1965 criteria insofar as the criteria did not conflict with the other terms and conditions of the permit.

Shortly thereafter, the Federal Water Pollution Control Act required each state to establish water quality standards applicable to interstate waters by June 30, 1967. Consistent with the requirements of the federal legislation, on June 23, 1967, the State Water Quality Control Board (predecessor to the State Water Board) submitted to the Secretary of the Interior a statement of policy for the control of water quality in California's interstate waters, including the Delta.

In July 1968, the federal government expressed concern that the State's water quality control policy for the Delta did not adequately protect beneficial uses and proposed some supplemental water quality objectives for chloride and total dissolved solids concentrations. In response to the federal government’s comments and growing concerns for Delta water quality, the State Water Board, in 1968, subsequently adopted Resolution 68-17 which defined a revised water quality control policy for the Delta.

The federal government approved the revised policy, but indicated its approval was given based upon a commitment from the State Water Board to consider supplemental salinity standards. In accordance with its commitment made in Resolution 68-17, the State Water Board conducted hearings in 1969 and supplemental salinity standards were adopted by D-1379 in 1971. State Water Board D-1379 required the Central Valley Project and State Water Project to meet these water quality objectives, although D-1379 was later stayed as a result of litigation. The principal issue of the litigation was the jurisdiction of the State to condition water rights of federal projects. Thus the conditions of D-1275 remained in effect.

To ensure a consistent policy direction, the State Water Board began hearings in 1973 on proposed supplemental water quality objectives for the Delta. By Resolution 73-16, the State Water Board adopted a "Water Quality Control Plan Supplementing State Water Quality Control Policies for Sacramento-San Joaquin Delta". The plan set salinity standards based on chloride.

The State Water Board eventually required the United States Bureau of Reclamation (USBR) to meet a salinity objective of 500 parts per million (ppm or often referred to as milligrams per liter (mg/L)), at Vernalis when it adopted D-1422 and D-1616, the decisions issuing permits for New Melones Reservoir. The USBR, under its agreement with the Central Valley Water Board, was to release up to 70,000 acre-feet of water in any one year, as required, to maintain a mean monthly TDS concentration in the San Joaquin River below the mouth of the Stanislaus River (at Vernalis) at less than 500 ppm (mg/L) and also maintain at least five ppm (mg/L) of dissolved oxygen (DO) in the Stanislaus River.

The State Water Board reviewed and updated the South Delta salinity objective in 1978. During the 1978 review, the State Water Board focused on two salinity issues. The first was their conclusion that salinity intrusion is a major water quality factor affecting beneficial uses of Delta water. Therefore the discussion on water quality conditions in the entire Delta was restricted to salinity intrusion.

Board documents state that the extent of salinity intrusion into the Delta is determined by the relative magnitude of the opposing forces of tidal action and Delta outflows and therefore beneficial uses of the Delta water are dependent upon adequate outflow of freshwater to repel seawater intrusion and provide suitable habitat for fish and wildlife. The Board determined the major factors affecting Delta outflows were natural runoff, the regulatory effects of upstream developments, and the SWP and CVP water project pumping. Thus the Board found that salinity in the Delta is directly influenced by the operations of the CVP and SWP water pumping.

The second salinity issue was the direct impact on South Delta agriculture. They focused on two salt-sensitive crops grown in the South Delta – beans for the irrigation season and alfalfa for the rest of the year. It was thought that if the salinity of the irrigation water was sufficient to protect these crops, then the salinity of the applied water would not be a limiting factor for other, less salt-sensitive crops grown in the south Delta. As such, the basis for any South Delta salinity objective was to be the perceived maximum threshold salinity of irrigation water able to maintain 100% yield potential for beans and alfalfa. It was noted, however, that crop yields can vary by 10% due solely to variations in weather, seeds, field conditions, farming practices, and countless other variables.

The State Water Board adopted an amendment to the Water Quality Control Plan in August 1978 (known as the Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh (1978 Delta Plan)) establishing new water quality objectives for salinity in the Southern Delta. The amendment set the following EC objectives for the Southern Delta; an EC objective of 700 micromhos per centimeter (700 µmhos/cm or 0.7 mmhos/cm) from April 1 through August 31, to protect beans during the summer irrigation season, and an EC objective of 1,000 micromhos per centimeter (µmhos/cm) from September 1 through March 31, to protect alfalfa during the winter irrigation season. The State Board envisioned that these objectives would be achieved by controlling water quantity/flow through conditions on the water rights permits issued to USBR and DWR.

Sacramento County Superior Court stated after review of D-1485 that “Accordingly, while the Board may have set EC objectives for locations in the southern Delta, it expressly stated that such objectives were "to become effective only upon the completion of suitable circulation and water supply facilities". In the meantime, the Board concluded that the "Vernalis objective" contained in the Sacramento-San Joaquin Delta Basin
(Basin 5B) Plan should be used as the interim water quality standard for the southern Delta. Thus when the State Water Board adopted D-1485 in August 1978, they essentially continued the salinity objectives at Vernalis as established under D-1422. The State Water Board also committed to conducting a review of the 1978 Delta Plan within 10 years.

In conjunction with the 1978 Delta Plan, the State Water Board also exercised its earlier reservation of jurisdiction over the USBR and DWR water right permits for the CVP and SWP by adopting Water Rights Decision 1485 (D-1485). In D-1485, the State Water Board amended the water rights permits held by the USBR and DWR for the CVP and SWP projects, exercising the Board's reserved jurisdiction to establish or revise the terms and conditions of those permits for salinity control. D-1485 amended the permits to include, as terms and conditions of the CVP and SWP permits, the same water quality objectives adopted in the 1978 Delta Plan to protect beneficial uses of the Delta (except for the southern Delta).

Consistent with the 1978 Delta Plan, D-1485 did not incorporate the southern Delta EC objectives into the terms or conditions of the CVP or SWP permits. The State Water Board concluded that there was no evidence that the CVP and SWP facilities were having any direct impact on water quality conditions in the southern Delta. Thus, the State Water Board did not incorporate into its decision any specific provisions for protection of agriculture in the southern Delta.

As in the 1978 Delta Plan, the State Water Board noted that negotiations were then ongoing between the operators of the water projects and the South Delta Water Agency concerning the construction of physical facilities to meet the established water quality objectives in the southern Delta. The Board concluded that if the negotiations did not result in an agreement, or if the water projects are otherwise determined to have an effect on water quality in the southern Delta, the State Water Board would use its reserved jurisdiction to amend the terms and conditions of the CVP and SWP permits as appropriate.

A number of parties filed mandamus petitions challenging the 1978 Delta Plan and D-1485. The trial court found the State Water Board's water quality objectives inadequate and issued a writ of mandate commanding the State Water Board to reconsider the Plan.

On appeal, the appellate court concluded that modification of the water projects' permits to implement the water quality objectives was a proper exercise of the State Water Board's water rights authority. However, in establishing objectives that protect only Delta water users, the court concluded that the State Water Board had too narrowly defined the scope of its duty and power to provide water quality protection. Because the Board already had announced its intention to establish new and revised water quality objectives, the appellate court determined that remand to the State Water Board would serve no useful purpose and, as a result, D-1485 remained in effect.

In short, the principal focus of both the 1978 Delta Plan and D-1485 was on the effects of the state and federal water projects on the Delta.

As discussed earlier, in February 1985, the State Water Board adopted WQ Order 85-1 to deal with the selenium problems in the San Joaquin River Basin. Pursuant to WQ Order 85-1, a technical committee prepared a report in 1987 on the San Joaquin River and Delta water quality and recommendations for the control of agricultural discharges, which was adopted pursuant to State Water Board Resolution 87-78 (State Water Board Order No. 85-1 Technical Report, "Regulation of Agricultural Drainage to the San Joaquin River" ("WQO 85-1 Technical Report")). Increasing salinity caused by this subsurface agriculture drainage had long been a major concern in the Lower San Joaquin River (LSJR) Basin.

Furthermore, the 1975 Basin Plan had acknowledged water quality concerns caused by EC and classified the LSJR from Lander Avenue to below Vernalis a "water quality limited segment" due to excessive salinity. Therefore, the Technical Committee included salt among the "constituents of concern" in their review of the LSJR Basin. In developing water quality objectives, the Technical Committee requested the State Water Board's Division of Water Quality to prepare water quality criteria which would prevent excessive selenium bioaccumulation and protect beneficial uses from direct toxicity caused by selenium, salt and other salinity constituents. For the agricultural beneficial use, the Technical Committee adopted recommendations previously developed by a University of California Committee of Consultants in 1974 for boron, molybdenum, selenium, and salinity. This Committee of Consultants was made up of specialists from the University of California with knowledge of salinity and salinity and toxicity impacts on irrigated agriculture.

The WQ 85-1 Technical Committee, based on the UC Committee of Consultants recommendations, used a criterion of 700 µmhos/cm (equivalent to 0.7 mmhos/cm) as this would fully protect all crops in the LSJR Basin and in the South Delta. According to the Committee's recommendations:

> "*An EC of 0.7 mmhos/cm permits production of a11 crops on all soils with adequate drainage in the San Joaquin River Basin and downstream in the southern Delta. Salinity levels above this require special cropping or water management techniques. Above an EC of 3.0 mmhos/cm (about 2,000 mg/l TDS) water quality is generally too poor to support agriculture.*"

The WQ 85-1 Technical Committee also studied the soils and cropping patterns in other areas of the LSJR Basin and made more specific recommendations for such areas. For the segment from the Lander Avenue Bridge on the LSJR down to the Hills Ferry Road Bridge, just above the Merced River inflow, the technical committee recommended an EC objective of 3,000 µmhos/cm:

> "*In Salt Slough and areas of the San Joaquin River downstream to Hills Ferry there are only a few agricultural diversions. These diversions are for the irrigation of pasture which is very salt tolerant. Historical maximum salinity concentrations in Salt Slough are typically as high as or higher than 3.0 mmhos/cm EC. An objective of 3.0 mmhos/cm EC supports the existing uses in Salt Slough and areas downstream to Hills Ferry consistent with the historic water quality and present agricultural practices.   Therefore, an objective of 3.0 mmhos/cm EC is recommended as the water quality objective for this limited area*."

For the San Joaquin River segment from Hills Ferry to Vernalis, the Technical Committee recommended an objective of 1,000 µmhos/cm:

> "*The Regional Board staff has evaluated the soil types and crops that are grown using diversions from the San Joaquin River in the areas immediately downstream of Hills Ferry.   They have determined that a water quality objective of 1.0 mmhos/cm EC (about 620 mg/l TDS) would provide reasonable protection to these crops on the soils in this area.*"

In July 1987, the State Water Board began proceedings to reexamine and revise (if necessary) the existing water quality objectives for the Bay-Delta Estuary including objectives for salinity. In May 1991, the State Water Board, pursuant to Resolution No 91-34, adopted a revised Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1991 Bay-Delta Plan). The 1991 Bay-Delta Plan included water quality objectives for salinity (EC), dissolved oxygen and temperature. Objectives for salinity (EC) were to be implemented over time in the southern Delta at Vernalis and three other specified locations; San Joaquin River at

Brandt Bridge, Old River near Middle River and Old River at the Tracy Road Bridge. The Plan included objectives for EC of 700 µmhos/cm as a 30-day running average for the irrigation season (April 1st – August 31st) and 1,000 µmhos/cm as a 30-day running average for the non-irrigation season (September 1st – March 31st). The revised objectives for salinity in the San Joaquin River at Vernalis were consistent with the WQ 85-1 Technical Committee recommendations. No EC objectives for the LSJR upstream of Vernalis were adopted.

Because negotiations regarding the construction of permanent barriers never were completed, as contemplated in the 1978 Delta Plan, the 1991 Bay-Delta Plan provided for a staged implementation of EC objectives in the southern Delta. D-1422 initially imposed a 500mg/l mean monthly Total Dissolved Solids (all year) standard, measured at Vernalis. However, the 1991 Bay-Delta Plan specified that the EC objective of 0.7 mmhos/cm during the summer irrigation season, and 1.0 mmhos/cm during the winter irrigation season, were to be implemented no later than 1996.

The following footnote regarding the 1996 compliance date appears in Sacramento County Superior Court Decision 34-2009-80000392:

> *According to State Water Board's Resolution 2006-0098, the 1991 Bay-Delta Plan required implementation of the EC objectives at Vernalis and Brandt Bridge by 1994, and required implementation of the EC objectives at Old River (near Middle River and at Tracy Road Bridge by 1996, unless a three-party agreement was reached among DWR, USBR, and South Delta Water Agency. However, the language of the 1991 Bay-Delta Plan is not entirely consistent with this interpretation. For example, one section of the Plan required the EC objectives to be implemented no later than 1994, with six identified compliance monitoring stations (namely, the San Joaquin River at Vernalis, Brandt Bridge, and Mossdale, Old River near Middle River and at Tracy Road Bridge, and Middle River at Howard Road Bridge). While the Mossdale and Middle River monitoring locations are mentioned in footnotes to the table of water quality objectives, and in the implementation plan, they are not mentioned in the text of the discussion of the water quality objectives. Further, although the Plan speaks of three distinct stages, there does not appear to be any meaningful difference between stage 2 and stage 3*

In 1994, the State Water Board commenced a series of public workshops to review and revise the 1991 Bay-Delta Plan. The workshops culminated in the State Water Board adoption, in 1995, of an amended "Water Quality Control Plan for Salinity for San Francisco Bay/Sacramento-San Joaquin Delta Estuary" (1995 Bay-Delta Plan). The 1995 Bay-Delta Plan indicates that the water quality objectives for salinity are unchanged from the 1991 Bay-Delta Plan, except that the 1995 Plan further delayed, until December 31, 1997, the effective date of the EC objectives for the southern Delta compliance stations on Old River.

The 1995 Bay-Delta Plan provides that most of the water quality objectives in the Plan will be implemented by assigning responsibilities to water rights holders because the factors to be controlled were primarily related to flows and diversions. The Plan specifically provides that implementation of the southern Delta EC objectives will be accomplished through the release of adequate flows to the San Joaquin River and control of saline agricultural drainage to the San Joaquin River and its tributaries. The State Water Board indicated that it would consider, in a future water right proceeding, the nature and extent of water rights holders' responsibilities to meet the objectives in the Plan.

In 1997, the State Water Board issued a notice of public hearing for the water rights proceeding in which they would allocate responsibility for implementing the objectives in the 1995 Bay-Delta Plan. Ultimately, in 1999, the State Water Board adopted Water Rights Decision 1641 (D-1641). In March 2000, following consideration of various petitions for reconsideration, the State Water Board issued a revised D-1641 pursuant to Order WR 2000-02.

The revised D-1641 was an effort by the State Water Board to allocate responsibility for meeting the southern Delta salinity objective set forth in the 1995 Bay-Delta Plan. The 1995 Bay-Delta Plan included salinity objectives for the San Joaquin River (at Vernalis and Brandt Bridge) and Old River (near Middle River and at Tracy Road Bridge). As of 2000, USBR was required (at least temporarily) to meet the Vernalis salinity objective in the 1995 Bay-Delta Plan pursuant to Order WR 98-09. However, no regulatory requirement was in place to assign responsibility for meeting the objectives at the other three locations.

In the revised D-1641, the State Water Board concluded that the salinity problem at Vernalis was the sole responsibility of the USBR. The basis of this decision was that 1) the USBR had cut off high quality flows at Friant Dam, 2) had provided higher salinity water to the Westside lands in lieu of the upstream higher quality flows and had not provided drainage water management for the subsurface drainage flows entering the San Joaquin River from the Grassland watershed. Based on the evidence presented at the hearing, the State Water Board found the salinity objective at Vernalis could not be met with releases solely from New Melones Reservoir. The SWRCB gave the USBR substantial latitude in choosing how it would meet the South Delta EC Objective, but nevertheless imposed the obligation for meeting it on the USBR. The State Water Board concluded that, by reducing the assimilative capacity of the river, the CVP is the "principal cause" of concentrations exceeding the salinity objectives at Vernalis. Therefore, the revised D-1641 amended the CVP permits to require USBR to meet the 1995 Bay-Delta Plan salinity objectives at Vernalis.

In addition, the 1995 (Bay Delta Plan) and revised D-1641 directed the Central Valley Water Board to:

1) Continue its salt load reduction program, initiated in response to adoption of the 1995 Bay Delta Plan which asked for a reduction in annual salt loads to the San Joaquin River by at least 10 percent and to adjust the timing of discharges from low flow to high flow periods, and
2) Promptly develop and adopt salinity objectives and a program of implementation for the main stem of the San Joaquin River upstream of Vernalis.

The State Water Board concluded that water quality in the southern Delta downstream of Vernalis is influenced by San Joaquin River inflow; tidal action; diversions of water by the SWP, CVP, and local water users; agricultural return flows; and channel capacity. The State Water Board concluded that DWR and USBR are partially responsible for salinity problems in the southern Delta because of hydrologic changes caused by export pumping. Therefore, the revised D-1641 amended the export permits of DWR and USBR to require the projects to take actions to achieve construction of permanent barriers (e.g., gates, weirs or wingdams) to enhance water levels and circulation in the southern Delta, by April 1, 2005.

Until April 1, 2005, the revised D-1641 required DWR and USBR to meet an EC objective of 1.0 mmhos/cm. After April 1, 2005, DWR and USBR would be required to meet all the southern Delta EC objectives, including the 0.7 mmhos/cm objective, except that if permanent barriers are constructed and an acceptable operations plan is prepared, the 0.7 EC objective would be replaced by the 1.0 EC objective. Thus, under the revised D-1641, the full 1995 Bay-Delta Plan EC objectives were not applicable to DWR and USBR until (at the earliest) April 1, 2005.

By 2005, the USBR and DWR had not constructed the permanent barriers contemplated by the revised D-1641. Thus, as of April 1, 2005, USBR and DWR were required to meet the southern Delta salinity objectives of 0.7 mmhos/cm EC during the summer irrigation season and 1.0 mmhos/cm EC during the winter irrigation season. The State Water Board has since taken the position that the revised D-1641 did not require SWP to meet the salinity objectives at Vernalis.

In December of 2006, the State Board adopted an amended "Water Quality Control Plan for Salinity for San Francisco Bay/Sacramento-San Joaquin Delta Estuary" (2006 Bay-Delta Plan), amending the Water Quality Control Plan originally adopted in 1978 and subsequently amended in 1991 and 1995. Although the 2006 Bay-Delta Plan amended the program of implementation to achieve the salinity objectives, in the view of the State Water Board, the 2006 amendments did not make any substantive changes to the objectives themselves. According to the State Water Board, the 2006 Bay-Delta Plan did not change the agricultural beneficial uses, or the salinity objectives to protect such uses.

During the Plan review, the State Water Board received comments regarding whether it should modify the southern Delta EC objectives for the protection of agricultural beneficial uses. The Plan states that there is a need for an updated independent scientific investigation to address whether the agricultural beneficial uses in the southern Delta reasonably would be protected at higher salinity levels. The State Water Board concluded, however, that it did not have adequate evidence to support changes in the EC objectives as part of the 2006 Bay-Delta Plan amendments. The State Water Board indicated that it would receive additional information on the objectives and their program of implementation beginning in 2007.

The State Water Board did make what it characterized as "minor" changes to the table of the EC objectives for agricultural beneficial uses in the southern Delta [Table 2]. Specifically, Footnote 5 of Table 2 in the 1995 Bay-Delta Plan stated that the 0.7 mmhos/cm EC objective would be implemented at the two Old River sites by December 31, 1997. Because USBR and DWR were required by virtue of the revised D-1641 to meet both the 0.7 mmhos/cm and 1.0 mmhos/cm EC objectives at these sites as of April 1, 2005, the State Water Board deleted Footnote 5 from the Bay-Delta Plan as obsolete. The State Water Board also deleted a statement in Table 2 of the 1995 Bay-Delta Plan regarding the possible implementation of a three party contract among DWR, USBR, and SDWA.

Prior to 2006, the programs of implementation for the Bay-Delta Plan focused on the federal and state agencies that oversee the CVP and SWP, but the State Water Board noted that it would use its Clean Water Act section 401 water quality certification authority in “appropriate cases”. In regard to the southern Delta agricultural salinity objectives, the 1995 Bay-Delta Plan indicated that implementation of the objectives would be accomplished primarily through the release of flows to the San Joaquin River at Vernalis and by control of saline agricultural drainage to the San Joaquin River and its tributaries.

In the 2006 Bay-Delta Plan, the State Water Board stated that elevated salinity in the southern Delta is caused by a "multitude of factors," including low flows, irrigation return flows, subsurface accretions of groundwater, tidal actions, diversions of water by the SWP, CVP, and local water users, channel capacity, local discharges of land-derived salts, and municipal discharges. Therefore, the State Water Board stated that implementation of the southern Delta salinity objectives will require a mix of water right actions and water quality control measures, including dilution flows, regulation of water diversions, pollutant discharge controls, improvements in water circulation, and long-term implementation of best management practices to control saline discharges.

The Plan notes that the State Water Board already has conditioned the water rights of the USBR upon implementation of the salinity objectives on the San Joaquin River at Vernalis, and the water rights of the DWR and USBR upon implementation of the salinity objectives at three other (interior) compliance stations; the San Joaquin River at Brandt Bridge, Old River at Middle River, and Old River at Tracy Road Bridge. The Plan further notes that salinity objectives also are being implemented through various non-water right actions, including the San Joaquin Salinity Control Program and the Central Valley Regional Board Basin Plan Amendment for salt and boron discharges in the San Joaquin River.

The Plan provides that to achieve the southern Delta salinity objectives, the State Water Board also could require dilution flow releases from non-SWP/CVP reservoirs or use measures that affect circulation of water in the southern Delta (such as permanent operational gates). In addition, to reduce salinity in the southern Delta, the Plan provides that the Central Valley Regional Board shall implement Total Maximum Daily Load (TMDL) and shall impose discharge controls on in-Delta discharges of salts by agricultural, domestic, and municipal dischargers.

For the first time, the State Board's program of implementation for the southern Delta salinity objectives specifically required pollutant discharge controls on in-Delta discharges of salts. Prior to 2006, the Bay-Delta Plan indicated that implementation of the objectives would be accomplished primarily through the release of flows by water right holders and, to a lesser extent, by control of agricultural discharges.

REFERENCES

McBain and Trush, 2002. San Joaquin Background Report. Prepared for the Bay-Delta Authority as Part of the San Joaquin Basin Ecological Flow Analysis Prepared by the Natural Heritage Institute, August 2003.

California Department of Water Resources (DWR). 1965. San Joaquin Valley Drainage Investigation – San Joaquin Master Drain. Department of Water Resources Bulletin No.127.

California Department of Water Resources (DWR). 1931. San Joaquin River Basin. Division of Water Resources Bulletin No.29 prepared as part of the Reports on the State Water Plan.

California State Water Resources Control Board (SWRCB). 1977. San Joaquin Valley Interagency Drainage Program Environmental Assessment – Phase I. Prepared for the California State Water Resources Control Board by Environmental Impact Planning Corporation.

Ogden, G. R. 1988. Agricultural Land Use and Wildlife in the San Joaquin Valley, 1769-1930: An Overview. SOLO Heritage Research. San Joaquin Valley Drainage Program, U.S. Department of Interior. Sacramento, California.

Cain, J.R., Walkling, R.P., Beamish, S., Cheng, E., Cutter, E., and M Wickland. 2003. San Joaquin Basin Ecological Flow Analysis. Prepared for the Bay-Delta Authority by the Natural Heritage Institute, Berkeley, California.

Belitz, K. and F.J. Heimes. 1990. Character and Evolution of Ground-Water flow System in the Central Part of the Western San Joaquin Valley, California. USGS Water-Supply Paper 2348.

United States Department of Interior (USBR). 1949. Central Valley Basin: Comprehensive Report on Planned Water Resources Development in the Central Valley. United States Bureau of Reclamation. Sacramento, CA.

United States Department of Interior (USBR). 1955. Feasibility Report for the San Luis Unit, Central Valley Project. United States Bureau of Reclamation. Sacramento, CA.

California Department of Water Resources (DWR). 1957. California Water Plan. Department of Water Resources Bulletin No. 3-35.

Johnston, W. R., Westcot, D.W. and M. Delamore. 2011. San Joaquin Valley: A Case Study. In Agricultural Salinity Assessment and Management (2nd Edition). ASCE Manual and Report on Engineering Practice No 71 (W.W. Wallender and K. Tanji, editors).

California State Water Resources Control Board (SWRCB). 1986. Regulation of Agricultural Drainage to the San Joaquin River; final Report by the SWRCB Order 85-1 Technical Committee.

Karkoski, J. 1994. A Total Monthly Load Model for the San Joaquin River. California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB). 1996. Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Agricultural Subsurface Drainage Discharges: Staff Report. California Regional Water Quality Control Board, Central Valley Region.

San Joaquin Valley Drainage Program (SJVDP). 1990. A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, California: Final Report of the San Joaquin Valley Drainage Program. U. S. Department of Interior and California Resources Agency. Sacramento, CA.

Central Valley Regional Water Quality Control Board (CVRWQCB). 1967. Tentative Policy for Lower San Joaquin River Water Quality Objectives Below Friant Dam to Vernalis. November 1967 Staff Report. California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB). 1968. Tentative Water Quality Control Policy for the Stanislaus River From Tulloch Dam to the Mouth and for the San Joaquin River From Maze Road Bridge to Durham Ferry Road Bridge. October 1968 Staff Report. California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB). 1969a. Provisional Water Quality Control Policy for the San Joaquin River From Friant Dam to Fremont Ford. October 1969 Staff Report. California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB). 1969b. Tentative Water Quality Control Policy for the Tuolumne River From New Don Pedro Dam to the Mouth and for the San Joaquin River From Grayson Road Bridge to Maze Road Bridge. February 1969 Staff Report. California Regional Water Quality Control Board, Central Valley Region.

Chilcott, J.E., Westcot, D.W., Werner, K., and Belden, K.K. 1988. Water Quality Survey of Tile Drainage Discharges in the San Joaquin River Basin, California. California Regional Water Quality Control Board, Central Valley Region. Sacramento, California.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004a. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Final Staff Report. 112 pp. California Regional Water Quality Control Board, Central Valley Region. September 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004b. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix 1: Technical TMDL Report. 98 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004c. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix 2: Methods for Reducing Salt and Boron Concentrations in the Lower San Joaquin River. 6 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004d. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix 3: Evaluation of Control Option Consistency with Applicable Laws and Policies. 15 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004e. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix 4: Economic Analysis for the Implementation of a Control Program for Salt and Boron Discharges to the Lower San Joaquin River. 52 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004f. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix A: TMDL Methods and Data Sources. 61 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004g. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix B: Geographic Information System Processing Information and Metadata Summary. 143 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004h. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix C: Municipal and Industrial Salt Loads. 160 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004i. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix D: Background Salt and Boron Loading. 53 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004j. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix E: Alternative Methods for Calculating Salt Loading from the Northwest Side of the Lower San Joaquin River Sub-Area. 15 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004k. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix F: DWRSIM Flow Data from CALFED Study 771 Used to Develop Load Allocations, Delta Mendota Canal Delivery Allocations, and Lower San Joaquin

River Diversion Allocations. 158 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2004l. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River; Draft Final Staff Report, Appendix G: Linkage Analysis Flows, Salt Loads, Electrical Conductivity, and Boron Concentrations. 22 pp. California Regional Water Quality Control Board, Central Valley Region. July 2004.

Superior Court of California, County of Sacramento (Superior Court), 2011. Final Statement of Decision in the Case of City of Tracy v. California State Water Resources Control Board. Case Number 34-2009-80000392, dated May 10, 2011. 47 pages.