Water Quality Progress Report

Lower San Joaquin River – Selenium

(*Approved 2002*)

WATER QUALITY STATUS

- TMDL targets achieved
- Conditions improving
- Improvement needed
- Data inconclusive

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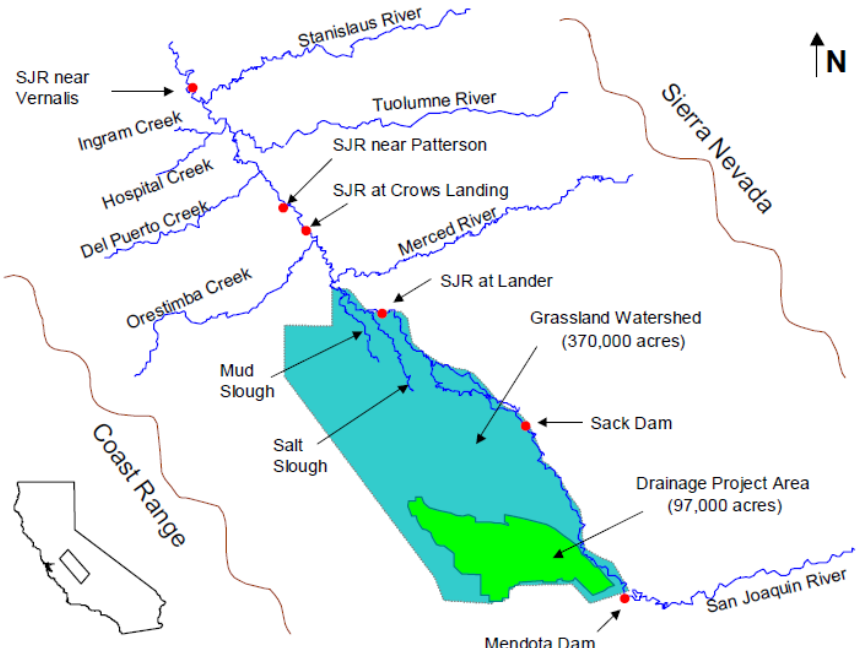
Total Maximum Daily Load (TMDL) Summary

Waterbody – The San Joaquin River (SJR) begins in the Sierra Nevada Mountains and eventually joins the Sacramento River in the Sacramento-San Joaquin Delta. Mud (north) and Salt sloughs are tributaries to the lower SJR that drain the 370,000 Grassland Watershed (see map below). The main stem of the SJR is over 300 miles long and drains approximately 13,500 square miles. A portion of the lower SJR in Merced County was listed as impaired for selenium. This 50 mile segment, from the confluence with the Salt Slough to the Airport Way Bridge near Vernalis, drains approximately 2.9 million acres. In 2010, several segments of the SJR were delisted for selenium, including the three segments downstream of the Merced River (Merced River to the Tuolumne River, Tuolumne River to the Stanislaus River, and the Stanislaus River to the Delta). The SJR from Mud Slough (north) to the Merced River (a 9-mile stretch) and the last 6 miles of Mud Slough (north) are the focus of ongoing selenium control programs.



Lower San Joaquin River Basin

Water Quality Goals

According to the water quality objectives, **Selenium** is not to exceed a four-day average concentration of 5 parts per billion (ppb or micrograms per liter [µg/L]) in Mud Slough (north) and the lower SJR from Sack Dam to Vernalis (the boundary of the Sacramento-San Joaquin Delta) to protect waterfowl. In addition, instantaneous maximum concentrations apply and vary by water body segment. Specifically, an instantaneous maximum concentration of 20 ppb applies for selenium in Mud Slough (north) and the SJR from Sack Dam to the mouth of the Merced River, while the instantaneous maximum concentration for the SJR from the mouth of the Merced River to Vernalis is 12 ppb (Resolution No. 96-147).

Targeted Attainment Date – The TMDL included an incremental compliance time schedule that varied by water year and water body segment. The 5 µg/L four-day average water quality objective had to be met in the lower SJR downstream of the Merced River during above normal and wet water years by October 1, 2005. During critical, dry, and below normal water years the same objective had to be met in the same segment by October 1, 2010. Upstream, from the Sack Dam to the Merced River and for the Mud Slough (north), the 5 µg/L four-day average water quality objective was to have been met by October 1, 2010; however, a more recent Basin Plan amendment extended the compliance date to December 31, 2019 for the Mud Slough (north) and the SJR from the Mud Slough confluence to the Merced River (this amendment also removed the previous performance goals and replaced them with a 15 ppb monthly mean to be met by December 31, 2015).

Water Quality Impairment – Selenium is a bioaccumulative trace element that is an essential nutrient for animals; however, ingestion of too much selenium can be toxic to sensitive species. Selenium can be mobilized and accumulated through the food chain, causing adverse growth and reproductive effects in both fish and birds. Elevated concentrations of selenium have been linked to deformities and deaths of aquatic birds.

The Central Valley Regional Water Quality Control Board (Central Valley Water Board) has monitored selenium levels in the Grassland Watershed and the lower SJR since 1985. These monitoring data confirmed high selenium concentrations in the lower SJR and other water bodies within the watershed. The source of the elevated concentrations was traced to subsurface drainage from the Drainage Project Area (DPA). The elevated selenium concentrations were above the selenium criteria being proposed by the U.S. Fish and Wildlife Service to protect waterfowl; therefore, in 1988, the San Joaquin River was added to the California List of Impaired Waterbodies.

Pollutant Sources – The soils on the west side of the lower SJR Basin are derived from rocks of marine origin in the Coast Range, which are naturally high in salts and selenium. The soluble salts and selenium have historically migrated with groundwater to the valley floor where it resides in an unconfined, shallow groundwater layer above the Corcoran Clay Layer. Irrigation is necessary for nearly all crops grown commercially in the watershed and causes the groundwater to rise. Subsurface drainage, specifically from tile drains in the DPA, is produced when farmers drain the salty groundwater from the root zone to protect their crops. These land use practices accelerate the movement of selenium from groundwater to surface water. Selenium concentrations in tile drainage from the DPA is significantly higher than tile drainage from areas outside of the Grassland Watershed.

Before October 1996, subsurface agricultural drainage water (tile drainage) and surface runoff (irrigation tail water) from the Grassland Watershed was discharged to the SJR through Salt Slough and/or Mud Slough (north). The same channels that carried agricultural drainage were also used to supply freshwater to area wetlands. The drainage was historically comingled with freshwater to augment limited supplies. Periodically elevated selenium concentrations were subsequently measured in the channels and marshes. The Grassland Bypass Project, which began in September 1996, diverts subsurface agricultural water from the DPA out of the Grassland Water District supply channels via the San Luis Drain. This drainage is released to Mud Slough (north) about six miles upstream of the confluence with the SJR. Routing water from the San Luis Drain to Mud Slough (north) removed this drainage from Salt Slough and 75 miles of wetland channels.

Subsurface tile drainage from the DPA is the primary source of selenium in the Grassland Watershed and to the lower SJR and Mud Slough (north), which are located downstream. In addition to the subsurface drainage, sources of selenium include surface agricultural return flows, wetland discharges, groundwater accretions, and tributary inflows. These sources contribute selenium; however, concentrations associated with these secondary sources are lower than those from the subsurface agricultural drainage. The DPA, which is only 2 percent of the flow volume in the SJR near Vernalis, contributes 88 percent of the selenium load, on average, via Mud Slough (north) while the other sources contribute the remaining load to the lower SJR.

Loading Capacity and Allocations – The loading capacity is the maximum amount of a contaminant or stressor that can be assimilated in a waterbody without exceeding the TMDL numeric targets (equal to the water quality

objectives for this TMDL). The selenium loading capacity and source allocations in this TMDL are reported as monthly selenium loads for different flow conditions. The TMDL identified only nonpoint sources of selenium; therefore, there are no wasteload allocations assigned. All load allocations are assigned to the DPA based on critical flow conditions at Crows Landing on the lower SJR. The loading capacity is based upon meeting the 5 µg/L four-day average water quality objective in the lower SJR downstream of the Merced River (at the Crows Landing compliance point). The loading capacity was separated into a margin of safety, a background load, and a load allocation to the DPA and these values vary by season and water year type. The monthly load allocations to the DPA are presented below by water year type.

Drainage Project Area Monthly Load Allocations (pounds)												
Water Year Type	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Critical	151	93	92	101	105	69	70	75	57	55	55	152
Dry/Below Normal	319	185	184	193	197	130	131	137	235	233	233	319
Above Normal	398	472	472	490	497	212	214	225	264	260	260	398
Wet	211	488	488	506	512	354	356	366	332	328	328	211

A schedule for compliance with selenium water quality objectives in the SJR was developed, with full compliance expected by October 2010. Compliance is implemented through waste discharge requirements (WDR) that progressively reduce the allowable load. Implementation of Phase I and Phase II of the Grassland Bypass Project (which were regulated by WDRs) resulted in attainment of the water quality objectives in the SJR downstream of the Merced River before October 2010. To allow for additional time to complete drainage control projects, the Central Valley Water Board passed a basin plan amendment to extend the date for meeting the selenium objective in Mud Slough (north) and the SJR from Mud Slough confluence to the Merced River until 2019 (link). In addition, the Use Agreement between the U.S. Bureau of Reclamation and the San Luis and Delta Mendota Water Authority was finalized in December 2009 for the continued use of the San Luis Drain through 2019. Revised WDRs and a revised monitoring and reporting program are under development by the Central Valley Water Board (see http://www.waterboards.ca.gov/centralvalley/water_issues/grassland_bypass/ for the latest information). These WDRs will be consistent with the basin plan amendment and consider the conditions and requirements in the Use Agreement.

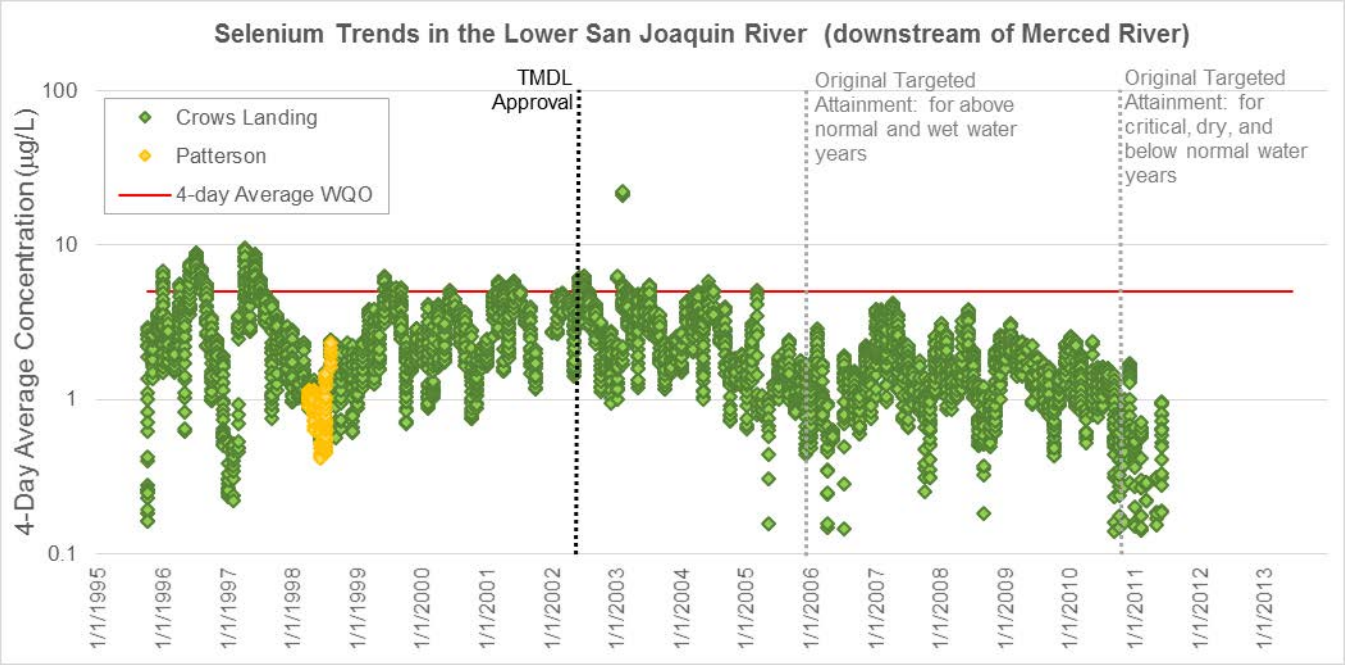
Is Water Quality Improving?

Water quality has improved in the SJR through controlled and regulated progressive reductions in selenium loads. Selenium now consistently meets the four-day average water quality objective of 5 µg/L below the Merced River.

The graph below shows selenium concentrations at two stations on the lower SJR downstream of the Merced River that had daily, composite data (note: the available daily data were summarized to the 4-day average concentration for comparison with the water quality objective). This graph uses a logarithmic scale to represent the data to better illustrate the distribution of concentrations. Data are consistently below the 4-day average water quality objective and are generally centered just above 1 µg/L. The high values in early 2003 are associated with an extremely high measurement on a single day, which may be an error in the dataset. The most recent exceedance of the four-day average objective was in March 2005. Targeted compliance for this stretch of the river was in October 2005 for above normal and wet years and October 2010 for critical, dry, and below normal years in the original Basin Plan amendment. According to the available monitoring data, the targeted compliance dates for the SJR downstream of the Merced River were achieved as four-day average concentrations have been below 5 µg/L since March 2005.

Monitoring will continue through a multi-agency agreement to ensure that selenium objectives continue to be met in the SJR downstream of the Merced River. Data were not available for Mud Slough (north) or the SJR between Mud Slough (north) and the Merced River; however, compliance for these segments has been extended to December 31, 2019 (Resolution No. R5-2010-0046). Additional monitoring is needed to demonstrate that

progress is being made towards the water quality objectives and performance goals presented in Resolution No. R5-2010-0046.



TMDL Progress – Implementation activities and milestones

Implementation Activity	Target Date	Status	Progress Details
Attainment of the 4-day average 5 µg/L water quality objective: • Lower SJR downstream of the Merced River during above normal and wet water years • Lower SJR downstream of the Merced River during critical, dry, and below normal water years • Mud Slough (north) and Lower SJR from the Sack Dam to the Merced River • Mud Slough (north) and the SJR from the Mud Slough confluence to the Merced River	10/01/2005 10/01/ 2010 10/01/ 2010 12/31/2019 (revised)	Complete/ Ongoing	• Data show that selenium concentrations in the Lower San Joaquin River are consistently meeting the four-day average 5 µg/L water quality objective since 2005. • The compliance schedule was revised to December 31, 2019 for Mud Slough (north) and the SJR from Mud Slough to the Merced River in Resolution No. R5-2010-0046 (link).

Implementation Activity	Target Date	Status	Progress Details
The Basin Plan contains a **prohibition of discharge** of agricultural subsurface drainage water to: • SJR from Sack Dam to Mud Slough (north) • Mud Slough (north) and the SJR from the Mud Slough confluence to the Merced River	10/01/ 2010 12/31/2019	Complete/ Ongoing	• This prohibition was adopted in a Basin Plan Amendment for the Control of Subsurface Drainage Discharges (Resolution No. R5-2010-0046). Discharge from subsurface agricultural drainage is prohibited, unless water quality objectives are being met (link).
Tile drainage from the DPA rerouted through the **Grasslands Bypass Structure** (portion of the former San Luis Drain) and away from the Grassland wetlands.	10/01/1996	Complete	• Beginning in September 1996 Grassland Bypass began operating (link). This consolidated the subsurface drainage from DPA into a single channel that discharges into the Mud Slough (north) via the San Luis Drain. This removed the DPA drainage from approximately 90 miles of canals that supply water to wetland habitat and facilitated the development of Waste Discharge Requirements.
Waste discharge requirements for the Grassland Bypass Project, which require progressive load reductions.	None specified	Complete/ Ongoing	• Phase I of the project regulated by Order No. 98-171. • Phase II regulated by Order No. 5-01-234 (link) • Revised WDRs and a revised monitoring and reporting program are under development by the Central Valley Water Board (link)
Grassland Area Farmers are conducting regional, district, and farm level activities to reduce selenium loads to meet water quality objectives or cease discharge.	12/31/2019	In Progress	• Update to the Long Term Drainage Management Plan by the San Luis and Delta-Mendota Water Authority provides information on these efforts (link)

What Next?

Water quality goals are currently being achieved. The U.S. Environmental Protection Agency (EPA) is intending to propose new water quality criteria for the protection of aquatic life and wildlife for San Francisco Bay and the Delta by June 2016. These criteria will likely be more stringent than existing criteria for the estuary. When the new criteria are finalized, selenium loads from upstream water bodies, stormwater, and groundwater may need to be reviewed for consistency with downstream water quality standards.

Information Source Documents

- **Total Maximum Daily Load (TMDL) for Selenium in the Lower San Joaquin River** (link)
- **EPA Approval Letter for the TMDL and Checklist** (link)
- **Loads of Salt, Boron, and Selenium in the Grassland Watershed and Lower San Joaquin River**, October 1985 to September 1995, California Regional Water Quality Control Board, Central Valley Region (executive summary link; raw data link)
- **Review of Selenium Concentrations in Wetland Water Supply Channels in the Grassland Watershed** (Water Year 1998 link; Water Years 1999 and 2000 link)
- **Basin Plan Amendment for the Control of Subsurface Drainage Discharges** (State Water Board Resolution 96-078), effective January 10, 1997
- **Central Valley RWQCB Resolution** – Amending the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins to Address the Control of Agricultural Subsurface Drainage, Resolution No. 96-147 (link)
- **Central Valley RWQCB Resolution** – Amending the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Selenium in the Lower San Joaquin River Basin, Resolution No. R5-2010-0046 (link and staff report)
- **Waste Discharge Requirements for San Luis & Delta Mendota Water Authority and United States Department of the Interior Bureau of Reclamation, Grassland Bypass Project (Phase II)** (link)
- **Revised Monitoring and Reporting Program No. 5-01-234 for San Luis & Delta Mendota Water Authority and United States Department of the Interior Bureau of Reclamation, Grassland Bypass Project (Phase II)** (link)
- **October 2014 Draft Waste Discharge Requirements and Monitoring and Reporting Program for Growers in the Grassland Drainage Area** (link; full description of the status and documentation is available at: http://www.waterboards.ca.gov/centralvalley/water_issues/grassland_bypass/)
- **Grassland Bypass Project Central Valley RWQCB website** (link)
- **Grassland Bypass Project, Summary Reports** (link)
- **Grassland Bypass Project U.S. Bureau of Reclamation website** (link)
- **2010-2019 Use Agreement between U.S. Bureau of Reclamation and the San Luis and Delta-Mendota Water Authority** (link)
- **A Storm Event Plan for Operating the Grassland Bypass Project**, Grassland Area Farmers and San Luis & Delta-Mendota Water Authority, 1997 (link)
- **A Total Maximum Monthly Load Model for the San Joaquin River**, June 1994 (link)