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Managing Water in the West

Recirculation Pilot Study Final Report

Stanislaus County, California
Mid-Pacific Region

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Recirculation Pilot Study Final Report

Stanislaus County, California
Mid-Pacific Region

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Contents

TABLES

FIGURES

Introduction

The United States Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR), in collaboration with other federal and state, and local water agencies, conducted a limited and extensively monitored pilot study on the effects of using Central Valley Project (CVP) water pumped from the Sacramento-San Joaquin Delta into the Newman Wasteway (Wasteway) and the San Joaquin River via the Delta Mendota Canal (DMC), a concept known as recirculation. The pilot study was intended to monitor water quality, flow, and salinity in the Wasteway and the San Joaquin River during a small-scale (250 to 300 cfs) and short-term (30 days or less) implementation of recirculation. This report documents the monitoring, data assessment, and findings of the Pilot Recirculation Study conducted in August 2004.

Background

The need for additional data about the possible benefits and effects of recirculation to improve flow and water quality in the San Joaquin River is identified in State Water Resources Control Board (SWRCB) Water Right Decision 1641 (D-1641). Recirculation has been broadly discussed as a potentially useful tool to help improve overall flow and water quality in the San Joaquin River basin.

Purpose

The purpose of the pilot study was to evaluate the effects of recirculation on flow and water quality, to provide necessary and additional information of such effects to the SWRCB, pursuant to D-1641, and to support the efforts of the San Joaquin River Water Quality Management Group (SJRWQMG). An opportunity existed during summer 2004 to perform a recirculation pilot study which allowed all parties to better evaluate the practicability of a more extensive or long-term recirculation program.

The study was designed to provide valuable information about the utility of recirculation as a tool to meet the Vernalis water quality objectives for agriculture beneficial uses and for fish and wildlife beneficial uses. This report documents the potential flow losses associated with recirculation, the possible water quality effects and sediment transport resulting from increased discharges from the Newman Wasteway, and the ability to improve water quality in the San Joaquin River at Vernalis and generally upstream of the confluence with the Stanislaus River. At the onset it was assumed that implementation of the pilot study would provide incidental benefits to agriculture and water quality resulting from increased flows and elevated water levels during very low flow condition on the San Joaquin River.

Pilot Study Objectives

The objectives of the recirculation pilot study were to:

- Evaluate the effects of recirculation and to provide information of such effects to the SWRCB, pursuant to Water Rights Decision D-1641.
- Provide valuable water quality information through extensive monitoring and collection of water quality data and subsequent analysis, evaluation, and reporting of data results that can be used by the San Joaquin River Water Quality Management Group.
- Measure and analyze changes in the quality of recirculated water as it is conveyed from the DMC through the Newman Wasteway and into the San Joaquin River.
- Monitor changes in stage, flow, and salinity in the San Joaquin River from the convergence of the Newman Wasteway and the San Joaquin River downstream to Vernalis.
- Document flow and power production losses associated with the recirculation of Central Valley Project (CVP) water from the DMC to the San Joaquin River.
- Monitor operations to avoid adverse impacts to special status fish species.

Project Description

The Newman Wasteway (Wasteway) flows from west to east with its headgate on the DMC, just upstream of Check 10 at milepost 54.38. The Wasteway is 8.2 miles long with the upper 1.5 miles concrete lined and the remainder unlined. The capacity of the Wasteway channel is 4,300 cfs, but the existing average flow is only 50 to 75 cfs from agricultural drainage. Twice a month a pulse flow of 500 cfs is sent down the Wasteway for 5 minutes to clear accumulated sediment away from the headgates. The terminus of the Wasteway is at the San Joaquin River; 1.24 miles upstream of the Merced River confluence (see Figure 1). The recirculation pilot study diverted a flow of up to 300 cfs from the DMC into the Wasteway between August 19 and 30, 2004. The water traveled down the San Joaquin River into the Delta. This volume of water released to the San Joaquin River was then available for recapture at the Tracy Pumping Plant and return into the DMC, where the water could potentially again recirculate through the CVP system. An additional component of this project was the use of the Joint Point of Diversion (JPOD) at Banks Pumping Plant. It was anticipated that JPOD would be necessary to regain the CVP export and conveyance capacity used during the study, thus eliminating risks to San Luis Reservoir low point or south of Delta CVP contract allocations. Therefore, State Board approval for the use of JPOD to facilitate implementation of the recirculation pilot study was secured (see Appendix E). During the pilot study, flows and a suite of water quality constituents were measured and analyzed.

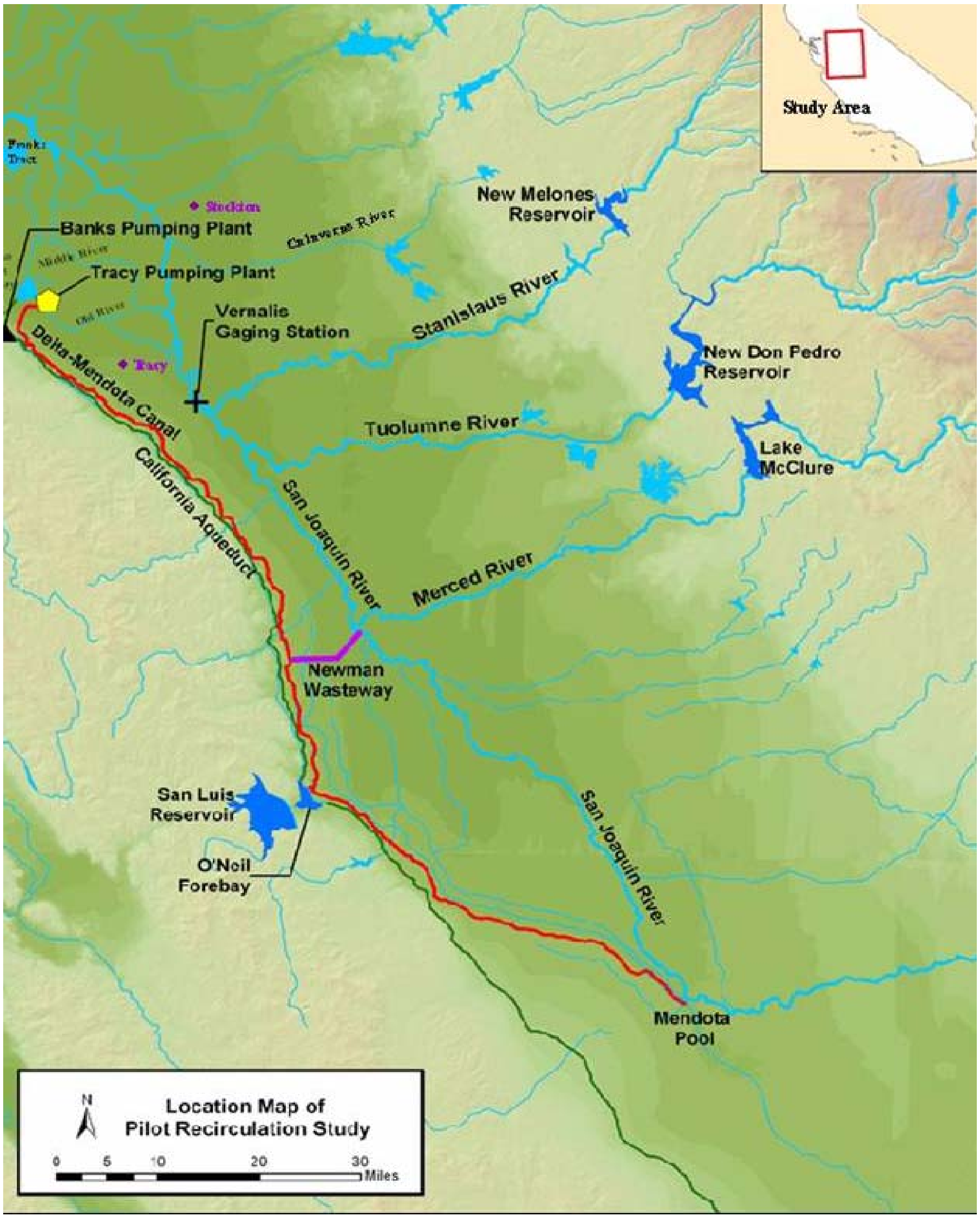

Figure 1. Project Area Map

Water Quality Monitoring

One objective of the pilot study was to determine how water quality is affected as water moves from the DMC through the Newman Wasteway into the San Joaquin River. A water quality monitoring plan was developed and approved in consultation with the Central Valley Regional Water Quality Control Board (CVRWQCB) prior to implementation of the pilot study. Water quality and fish toxicity impacts from possible mobilization of sediment and contaminants from past and current agricultural drainage into the Wasteway was of particular concern in the design of the monitoring program. Information on the "first flush" of water through the Newman Wasteway is of particular concern because the flood wave displaces resident water in the Wasteway and can scour accumulated sediment. This resident water is associated with groundwater seepage and agriculture drainage and may have a high contaminant and organic carbon load. The biochemical oxygen demand of this first flush may also be sufficiently high to affect dissolved oxygen levels in the San Joaquin River. The frequency of monitoring was designed to be more intensive during the first few days of the initial flush and then taper off for the duration of the pilot study.

Water quality samples were collected from four locations during the pilot study. DMC water was tracked and sampled at two sites along the Wasteway, just downstream of the DMC and just upstream of its discharge point into the San Joaquin River. Water in the river was sampled at a location about 500 feet upstream of the Wasteway discharge point and downstream where the Wasteway water mixes with San Joaquin River water, upstream of the confluence of the Merced River. Flow rates were determined in the Wasteway to estimate the travel time from the DMC to the San Joaquin River.

When water was initially released into the Wasteway, water samples were collected in the DMC at the Wasteway headgate to measure background water quality before mixing with resident water in the Wasteway. Flow measurements were made downstream of the headgate and at the terminus of the Wasteway to determine Wasteway added constituent levels. Additionally, measurements of water temperature, electrical conductivity (EC), and turbidity were performed every 30 minutes for the first 18 hours of the study and were used as water quality indicators, in addition to the flow measurements, to determine when the leading edge of the flushed water reached the Wasteway terminus. Table 1 summarizes the water quality parameters monitored and the frequency of sampling during the pilot study.

Flow and Salinity Monitoring

Using the existing real-time gage network locations along the San Joaquin River, it was possible to monitor the changes in stage, flow, and salinity caused by the pilot study operations. Data was collected from the network of real-time stations operated by DWR along the river and major tributaries. Other data was provided by United States Geological Survey (USGS) and local water districts. Flow and salinity data for the San Joaquin River were obtained from USGS measurements at Mud Slough near Gustine and the San Joaquin River at Fremont Ford (Hwy

140). Data was also collected for the river reach extending from just upstream of the discharge point of the Newman Wasteway downstream to Vernalis. The monitoring network utilized for flow and salinity monitoring used data available through the California Data Exchange Center (CDEC), data downloaded from two major riparian diverters, and gauging stations operated by Reclamation.

Table 1. Water Quality Parameters and Sampling Frequency

	Sampling Frequency	
Parameters of Concern	NW & SJR upstream	NW & SJR downstream
Physical Parameters:		
Flow	NW: Approx every 2 hrs until stable then once per day SJR: CDEC	NW: Approx every 2 hrs until stable then once per day SJR: CDEC
Temperature Electrical Conductivity (EC) Dissolved Oxygen (DO) Turbidity	Day 1-3:every 6 hrs Day 4-12: once per day	Day 1: every 30 min Day 2-3: every 6 hrs Day 4-12: once per day
Inorganic Chemicals & Biological Parameters:		
Nitrate + Nitrite TKN Ammonia Total Phosphorus Orthophosphate Chlorophyll-a Total Suspended Solids (TSS) Total Organic Carbon (TOC) Biochemical Oxygen Demand (BOD) Boron Selenium Metals Hardness	Day 1-3: every 6 hrs Day 4-5: once per day Day 12	Day 1: time 0 and composite of samples collected every 30 min for 0-6 hrs, 6-12 hrs, and 12-18 hrs Day 2-3: every 6 hrs Day 4-5: once per day Day 12
Organic Chemicals:		
Organochlorine Pesticides Organophosphate Pesticides Carbamate Pesticides Triazine Pesticides Phenoxy Acid Pesticides	Day 1: time 0	Day 1: time 0 and composite of samples collected every 30 min for 0-6 hrs, 6-12 hrs, and 12-18 hrs
Other Parameters:		
Acute Toxicity		NW: 0, 12, and 18 hrs SJR: 0:30, 12:30 and 18:30 hrs
E. Coli		NW: 0, 3, 4, and 8 hrs SJR: 2, 3:30, 4:30, and 6 hrs

NW = Newman Wasteway SJR = San Joaquin River CDEC = CA Data Exchange Center

The real-time monitoring network established by the Water Quality Subcommittee of the San Joaquin River Management Program provided hourly data for the recirculation pilot study (Table 2). These stations are currently all telemetered to CDEC with the exception of Maze Road.

Table 2. San Joaquin River Monitoring Network Stations

Station ID	Station Name or Description	Agency	Real Time Status	Stage	Flow	EC	Temp
SJS	SJR near Stevenson	DWR	CDEC	1	1	1	1
SSH	Salt Slough at Hwy 165 near Stevenson	USGS	CDEC	1	1	1	1
MSG	Mud Slough near Gustine	USGS	CDEC	1	1	1	1
FFB	SJR at Fremont Ford	USGS	CDEC	1	1	1	1
MST	Merced River near Stevinson	DWR	CDEC	1	1	1	1
NEW	SJR near Newman	USGS	CDEC	1	1		
OCL	Orestimba Creek at River Road	USGS	CDEC	1	1	1	1
SCL	SJR at Crows Landing Bridge	USGS	CDEC	1	1	1	1
SJP	SJR at Patterson Bridge	DWR	CDEC	1	1	1	1
DPC	Del Puerto Creek near Patterson	USGS	None	1	1	1	1
MOD	Tuolumne River at Modesto	USGS	CDEC	1	1	1	1
RIP	Stanislaus River at Ripon	USGS	CDEC	1	1	1	1
MZR	SJR at Maze Road Bridge	DWR	None	2	2	2	2
VNS	SJR near Vernalis	DWR/ USBR	CDEC	1	1	1	1

DWR = Department of Water Resources USGS = United States Geological Survey
USBR = United States Bureau of Reclamation CDEC = California Data Exchange Center
1= existing site with telemetry, 2 = existing site, no telemetry

Fish Monitoring

Potential impacts to fish are a key concern of any recirculation action. Ideally, a study of recirculation would fully evaluate all the areas of concern outlined in D-1641 and subsequent investigations of the concept of recirculation. However, given the timing, scope, and magnitude of this study, organizing a meaningful suite of monitoring programs to measure the response of fish to recirculation was not possible. Future tests or studies will be designed to specifically address fish issues.

Although the study did not provide much data about the interrelationship of fish migration and recirculation operation, it was an ideal time to conduct a study focusing on the water quality impacts of a recirculation project. Based on the determination of Reclamation and DWR and discussions with fishery agencies, the operation of the recirculation pilot study posed no adverse impacts to fish species. The study team used the systems and criteria outlined in the Joint Point Fishery Protection Plan and closely watched on-going monitoring of Delta fisheries for signs of negative effects of the recirculation pilot study. Had the study team deemed that the conditions of the study were posing a risk to protected Delta and San Joaquin River watershed fish species, the pilot study would have been suspended. Toxicity testing in the Wasteway and River was used to assess the potential water quality impact of recirculation on San Joaquin River fish.

Impacts to Contractors

It was the intent of Reclamation and DWR that the pilot study not affect CVP water contractors financially, nor should the study ultimately diminish CVP water deliveries south of the Delta or reduce export capacity at the Delta-export facilities. It is recognized that any long-term recirculation project could have significant impacts to water users dependent on Delta export facilities, and that recirculation projects would be limited to the use of excess capacity at these facilities.

Reclamation negotiated with DWR and other agencies to share and minimize costs of the pilot study as much as possible. Because the pilot study was short term, Reclamation treated the costs as federal non-reimbursable.

Public Involvement

While coordinating the scope of this study, stakeholders raised a number of issues that warranted close consideration before implementing the study. Many of these concerns are addressed by the monitoring programs developed with assistance from the CVRWQCB, and agreements between Reclamation and DWR regarding operations of the projects during the study.

The two primary concerns were protection of fish species, both in the San Joaquin River and in the Delta, and possible impacts to water supplies that may impact CVP/SWP water contractors south of the Delta export facilities and agricultural diverters in the south Delta. These concerns were alleviated by scheduling the pilot study during a non-critical time for protected fish species and contractor assurances to replace any water losses with north of Delta CVP/SWP water supplies.

Monitoring and Reporting

The study objective was to monitor how water quality was affected as it moved from the DMC through the Wasteway to the River, with particular attention on the "first flush" of water.

Assessment of the data from the recirculation pilot study focused on data that exceeds any numeric values intended to protect beneficial uses set forth in the "Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins" by the CVRWQCB. Goals that were also used in this assessment were derived from the CVRWQCB's Compilation of Water Quality Goals, August 2003 edition, including the U.S. Environmental Protection Agency (EPA) ambient freshwater water quality criteria.

Quality Assurance Plan

A quality assurance plan (QA plan) for the water quality monitoring program was prepared in early August 2004 and approved by the CVRWQCB. The QA plan identified the sampling schedule, sampling locations, water quality parameters, collection methods, sample handling and custody requirements, and analytical methods. Additionally, the QA plan specified the reporting limits and acceptance criteria for each water quality parameter. The QA plan is included in Appendix A.

Water Quality Monitoring Results

A suite of inorganic, organic, and physical parameters were measured to assess the potential changes in water quality in the Newman Wasteway and impacts to the San Joaquin River as a result of recirculating CVP water. Parameters assessed include heavy metals and trace elements, nutrients, and organic chemicals (PCBs, agricultural compounds including organochlorines, organophosphates, triazines, carbamates, and phenoxy acids), bacteriological and biological indicators. Since individual metal measurements do not take into account potential synergistic or additive effects, acute toxicity testing was also conducted.

Significant results of the water quality monitoring are summarized below. Details and full results of the Initial Data Assessment Report are included in Appendix B, and the results of the quality assurance activities are reported in the Quality Assurance Summary Report in Appendix C.

Acute Toxicity

The objective of toxicity testing is to test the adverse effects of effluents on receiving waters by observing the survival of the test organisms over a 96 hour exposure period. A test fails if the survival is less than 90% or is significantly different from the control survival (which must be greater than or equal to 90%). Two test organisms were used fathead minnow (*Pimephales promelias*) and water flea (*Ceriodaphnia dubia*).

Two samples failed the 90% survival criteria with *C. dubia*. Both were collected from the Wasteway downstream site and were undiluted for the test. The sample collected on August 19, 2004 at 6:00 am (prior to any flushing in the Wasteway) had a 70% survival of the test population (control = 90%). The sample collected on August 20, 2004 at midnight (when effluent was near maximum flow at 250 cfs) had an 80% survival (control = 100%). The sample collected in the period between the two failing samples (August 19, 2004 at 6:10 pm) passed.

All tests using *P. promelias* as well as all samples taken from the River passed with equal to or greater than 90% survival.

BOD, Nitrate + Nitrite as N, and Orthophosphate

Although there are no specific numeric limits for biological oxygen demand (BOD), nitrate, nitrite as N, or orthophosphate are important indicators of algal growth. Algal growth and decay can have profound impacts on dissolved oxygen levels which are of concern in the Lower San Joaquin River.

BOD and the combined nitrate and nitrite as N concentrations in the San Joaquin River downstream of the confluence of the Wasteway were reduced during the recirculation study. BOD average decreased from 6.0 to 4.2 mg/L. Average N concentrations were reduced from 1.7 to 1.2 mg/L. This reduction in River BOD and N concentrations was due to the dilution effect from the water introduced through the Wasteway. With the exception of the initial flush of the resident water in the Wasteway, orthophosphate concentrations were at or near the detection limit of 0.03 mg/L in all samples at all sites, thus orthophosphate was not significantly affected by recirculation.

Total Boron

Boron concentrations in the water samples entering the Wasteway from the DMC were low, generally below 200 µg/L. Water exiting the Wasteway had elevated boron concentration during the initial 12 hour flush period, and then decreased to the levels in the DMC water. Average concentrations of boron in the River were reduced by 40% as a result of recirculated flows (Figure 2).

The CVRWQCB set the maximum concentration objective for boron in the River at 2,000 µg/L. The compliance location for this objective is between the confluence with the Merced River and Vernalis, which is downstream of the study area. The agricultural water quality limit for boron is much lower; 700 µg/L. No samples exceeded the basin plan objective during the study. The DMC water circulated through the Wasteway was well below, while River water was well above the agricultural objective. Introduction of DMC water through the Wasteway improved the San Joaquin River downstream concentrations to levels that met the agricultural limit.

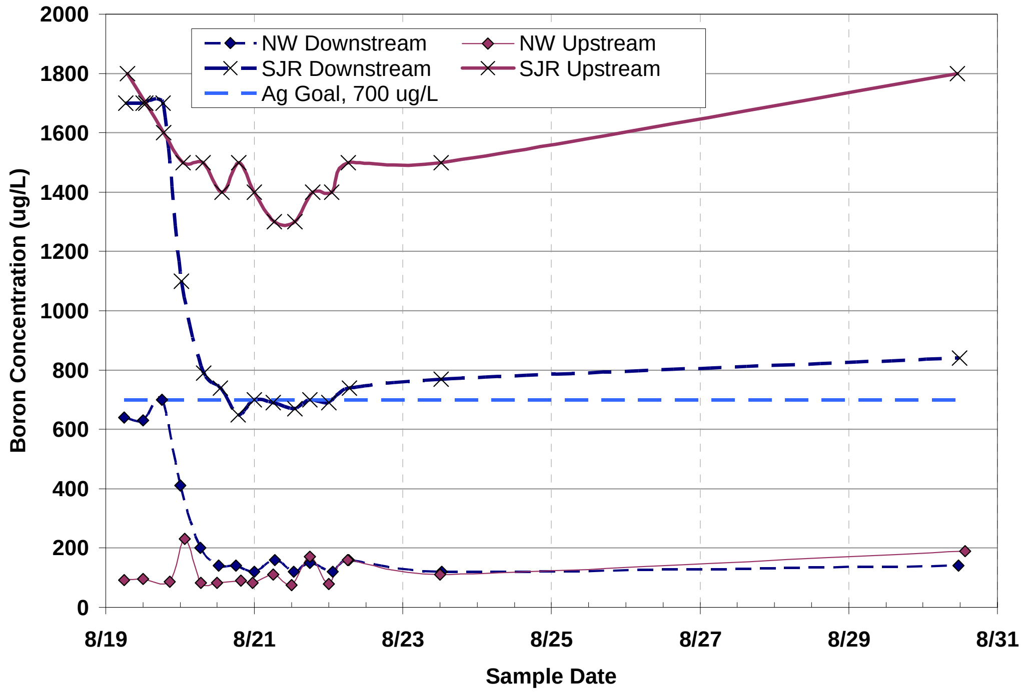

Figure 2. Boron Concentrations during the Recirculation Pilot Study

Dissolved Metals

Water samples were analyzed for 14 different dissolved metals. The CVRWQCB basin plan has no specific objectives for any of the metals analyzed, so other water quality objectives were used for data comparison. For antimony, arsenic, beryllium, and thallium concentrations, the stricter of the California Department of Health Services (DHS) and EPA maximum contaminant levels (MCLs) for possible sources of municipal water in the San Joaquin River were used. The stricter of the EPA's California Toxics Rule (CTR) criteria and National Ambient Water Quality Criteria (NAWQC) to protect freshwater aquatic life were used for aluminum, cadmium, chromium III, copper, lead, mercury, nickel, silver, and zinc. Magnesium was analyzed for the purpose of assessing hardness, and therefore, does not have a water quality objective.

Toxicity of seven metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) is affected by the hardness of the receiving waters as well as parameter concentration. Consequently, the water quality objectives set by EPA vary depending upon receiving water hardness. For the purpose of determining the metals water quality objectives, the lowest and most conservative hardness value measured during the pilot study (220 mg/L) was used.

Of the 14 dissolved metals included in the analysis, only five had concentrations consistently above the reporting limits. Those metals are discussed below. Beryllium, cadmium, and thallium were not detected above their respective reporting limits in any of the samples. Antimony, chromium III, lead, mercury, silver and zinc were generally at or below their respective reporting limits and when detected were well below water quality limits. Details on the water quality testing can be found in Appendix B.

Aluminum

The concentration of aluminum in the Wasteway upstream site averaged 44.6 µg/L. The average at the end of the Wasteway was 28.2 µg/L. The higher levels of aluminum in the Wasteway caused the average River levels to increase from 8.9 to 18.2 µg/L (Figure 3). Matrix interference in the environmental samples made it difficult for the laboratory to obtain consistent reproducible results for concentrations below 50 µg/L. Due to the limited number of valid data points, it would be difficult to give a definitive assessment for aluminum. However, keeping the uncertainty of the data in mind, all of the valid data points were below the 87 µg/L NAWQC objective for aquatic life.

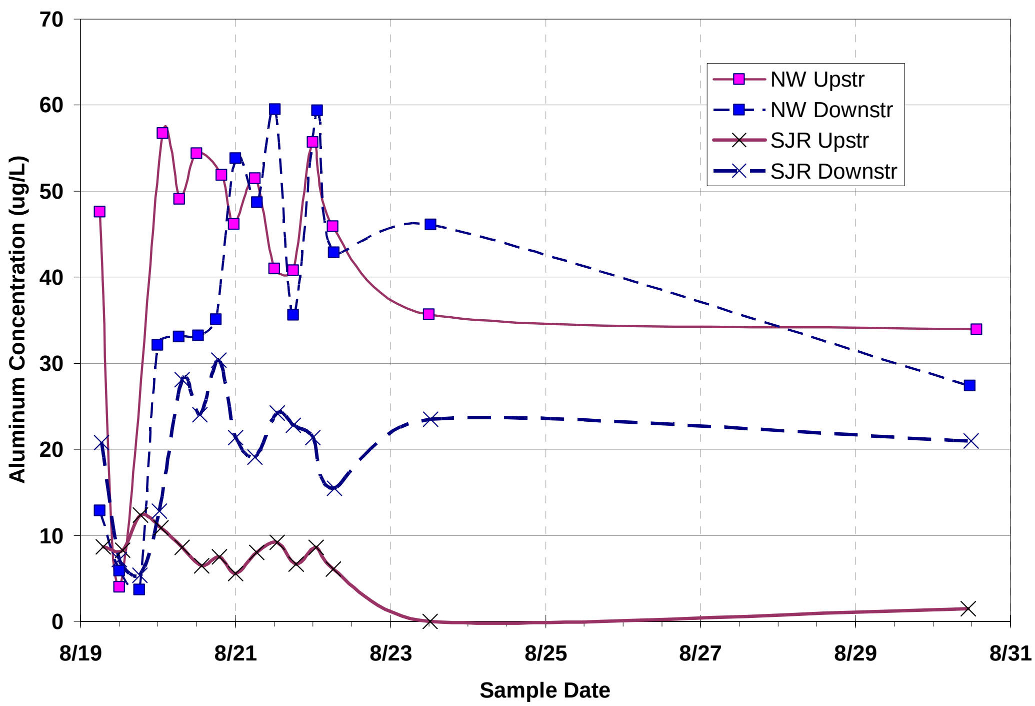

Figure 3. Aluminum Concentrations during the Recirculation Pilot Study

Arsenic

Arsenic was present in the water in both the San Joaquin River and in the Newman Wasteway. The arsenic MCL is 10 µg/L. Average levels at the River upstream site were 5.4 µg/L, whereas levels at the upstream Wasteway location averaged 2.4 µg/L. Water exiting the Newman Wasteway had a higher arsenic concentration during the first 12 hours of the study, and then decreased to a concentration comparable to the water entering the Wasteway. The River downstream site averaged 3.6 µg/L. Thus, recirculation flows caused a dilution of this metal in the River (Figure 4).

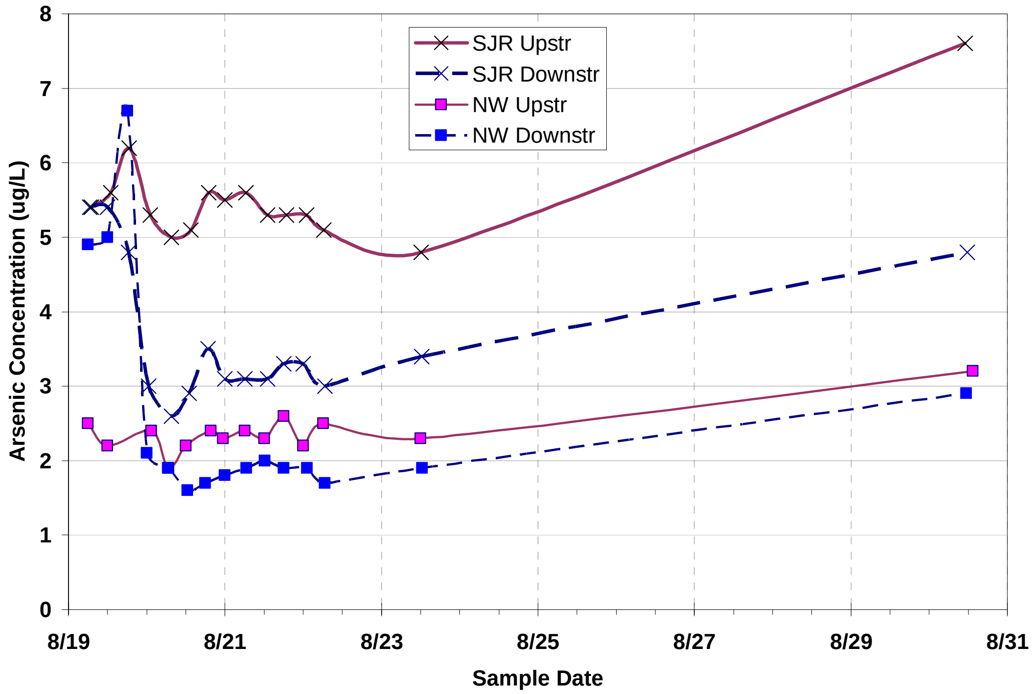

Figure 4. Arsenic Concentrations during the Recirculation Pilot Study

Copper

The CTR and NAWQC criterion to protect freshwater aquatic life is 18 µg/L and is the most stringent standard to protect beneficial uses of the River. Copper levels in the River were reduced by half with the introduction of the recirculated water. DMC water flowing into the Newman Wasteway had an average copper concentration of 1.6 µg/L and an average concentration of 1.3 µg/L exiting the Wasteway. Average copper at the River upstream site was 4.4 µg/L, but dropped to 2.6 µg/L in the River downstream from the Wasteway as a result of the dilution (Figure 5).

Magnesium

Dissolved magnesium is a mineral that, along with calcium, is a main contributor to hardness in water. Hardness is not a health concern, but it can be a nuisance because of mineral buildup on plumbing fixtures. Magnesium concentrations in the Wasteway dropped by approximately 70% during the first 24 hours of the study, and then were roughly equivalent to the water entering the Wasteway from the DMC. Concentrations in the River were reduced by approximately 30% as a result of the recirculated water (Figure 6).

Nickel

Water exiting the Newman Wasteway had a higher nickel concentration during the first 12 hours of the study than the water entering the Wasteway. Although the concentration decreased significantly, the nickel concentration remained higher in the water that passed through the Wasteway. The average concentration of nickel in the River decreased from 4.5 µg/L upstream to 3.2 µg/L downstream as a result of the recirculated water (Figure 7). All of the samples were well below the 100 ug/L criterion set by the CTR and NAWQC to protect freshwater aquatic life.

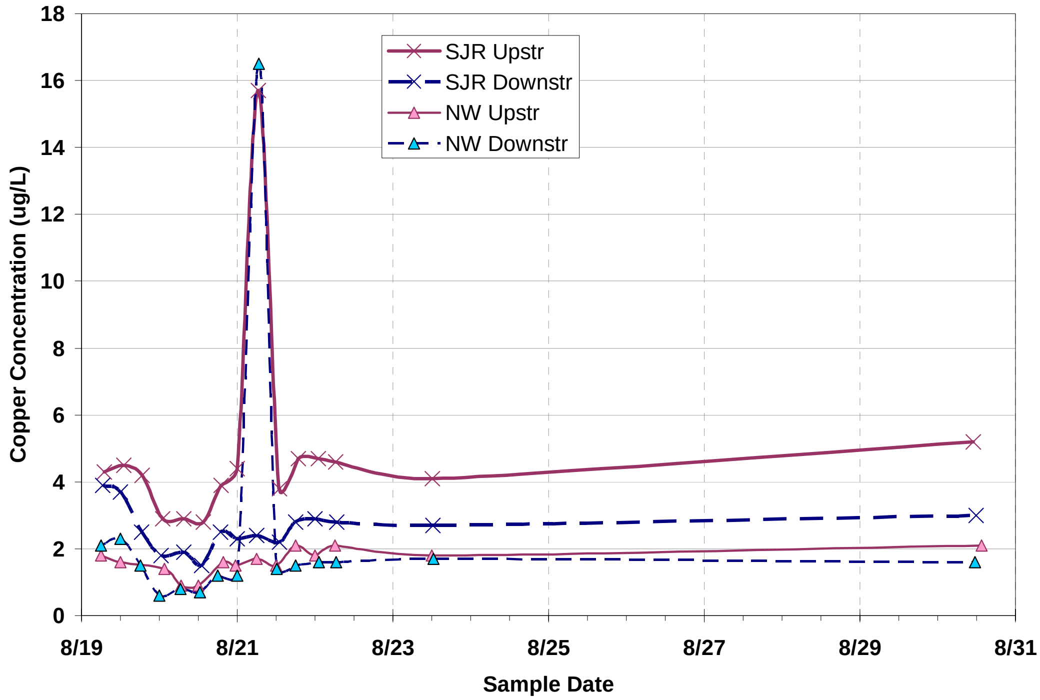

Figure 5. Copper Concentrations during the Recirculation Pilot Study

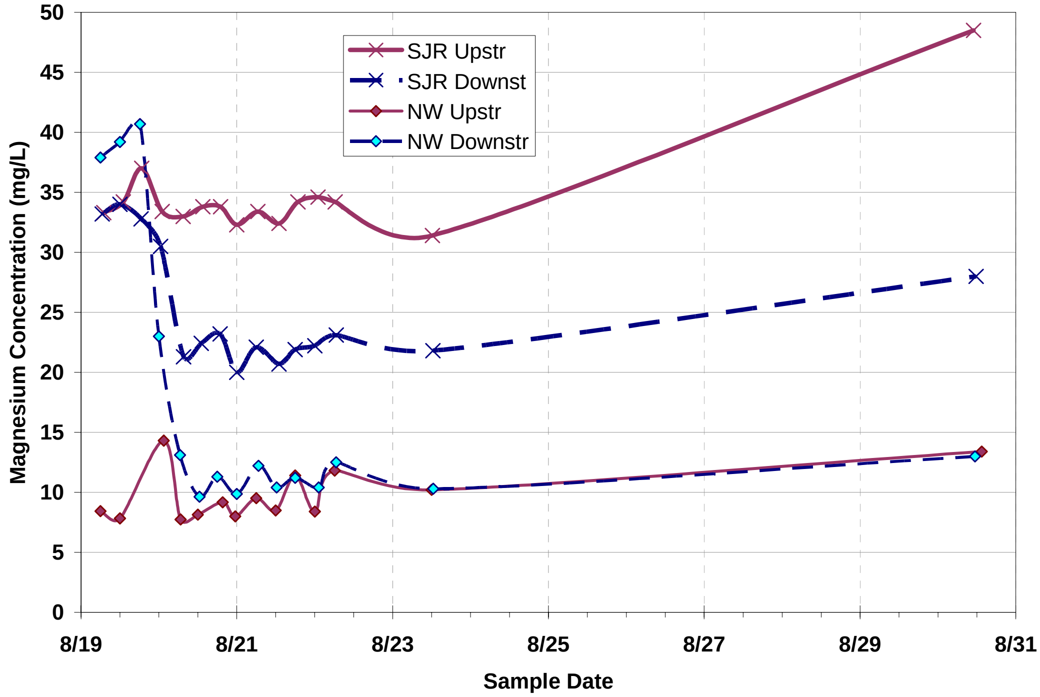

Figure 6. Magnesium Concentrations during the Recirculation Pilot Study

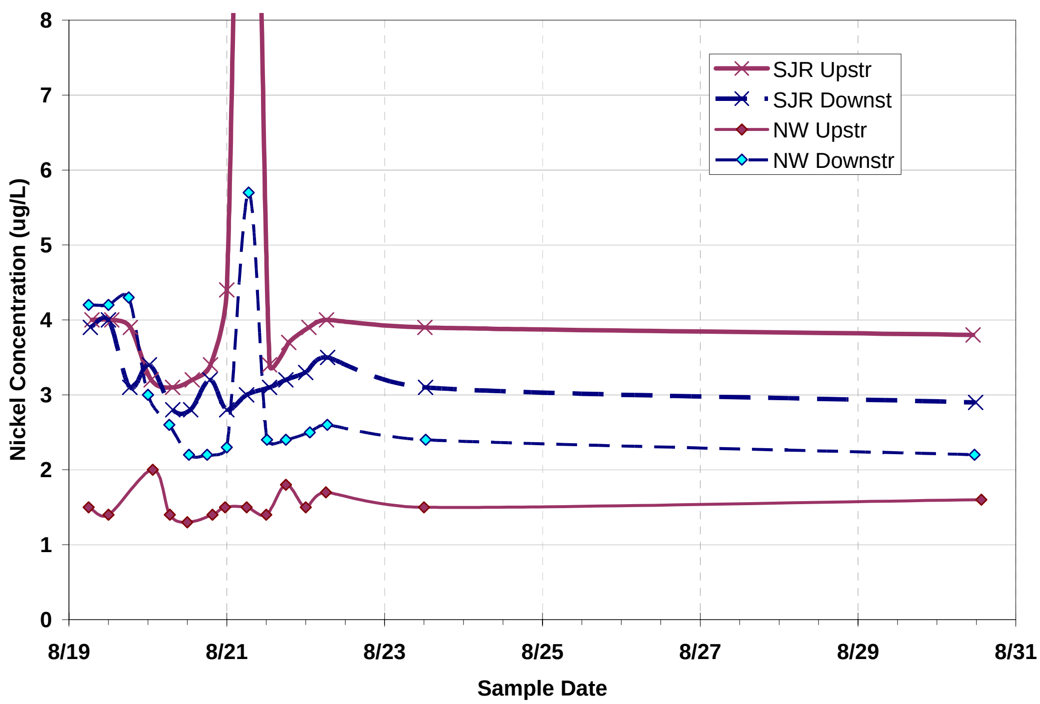

Figure 7. Nickel Concentrations during the Recirculation Pilot Study

Aluminum was the only metal evaluated in the pilot study that was higher in the Wasteway than in the River. However, aluminum was also the only metals parameter that exhibited substantial matrix interference yielding a completeness of 58 percent. None of the metals measured were above action limits. Based solely on the levels measured, there were no apparent adverse effects on the beneficial uses of the River. Individual metal measurements do not take into account potential synergistic or additive effects; therefore toxicity testing was also conducted. Since the toxicity tests showed no adverse effects to the test organisms, this data adds a higher degree of certainty that the Wasteway effluent will not have a deleterious effect on the River.

Organics

The water chemical analysis included 117 organic chemicals that fell into the following four general classes:

Organo Chlorine Pesticides and PCB's

Herbicides and Phenoxy Acids

Organophosphate and Triazine Pesticides

Carbamates

The majority of these parameters were not seen above their associated detection levels. Of the four chemicals that were detected, two were found in multiple samples. The singly detected chemicals include 0.23 µg/L of 2, 4-D found at the River downstream site in the 8/20/04 00:30 hours sample, and 1.7 µg/L of bis (2-ethylhexyl) phthalate, an organic chemical commonly used in plastics, detected at the River upstream site in the 8/19/04 07:00 hours sample. Neither the concentration of 2 ,4-D, nor bis(2-ethylhexyl) phthalate exceeded their respective 70 µg/L and 6 µg/L MCL standard for drinking water set by DHS and EPA.

Two chemicals were found in multiple samples, DCPA and metolachlor. DCPA, also called chlorthal dimethyl, is a preemergent herbicide. It was detected in first flush samples from the downstream Wasteway site at low levels ranging from 0.24 to 0.38 µg/L, but was not detected at the 0.20 µg/L reporting limit 18 hours after the start of the study. There are no established MCLs for DCPA.

Metolachlor, also a preemergent herbicide, was detected in all samples and was highest in samples from the downstream Wasteway site. EPA has an advisory concentration for metolachlor of 44.0 µg /L based on consumption of water and organisms. The highest downstream Wasteway concentration of metolachlor was 0.5 µg/L, which decreased during the initial 18 hour sampling period. As a result of the flush from the Wasteway, the River concentration increased slightly from 0.1 µg/L upstream to 0.2 µg/L downstream. Since the detected levels of metolachlor were an order of magnitude lower than the action limit, the data shows no apparent adverse impact to the River caused by the pilot study.

Total Selenium

The CVRWQCB basin plan water quality objective for selenium is 5.0 µg/L on a four day average and 20.0 µg/L as an instantaneous concentration. These objectives were met at all sampling locations during the study. Figure 8 shows selenium concentrations in the San Joaquin River were reduced by 50% from approximately 4 µg/L to approximately 2 µg/L as a result of the introduced water from the Wasteway.

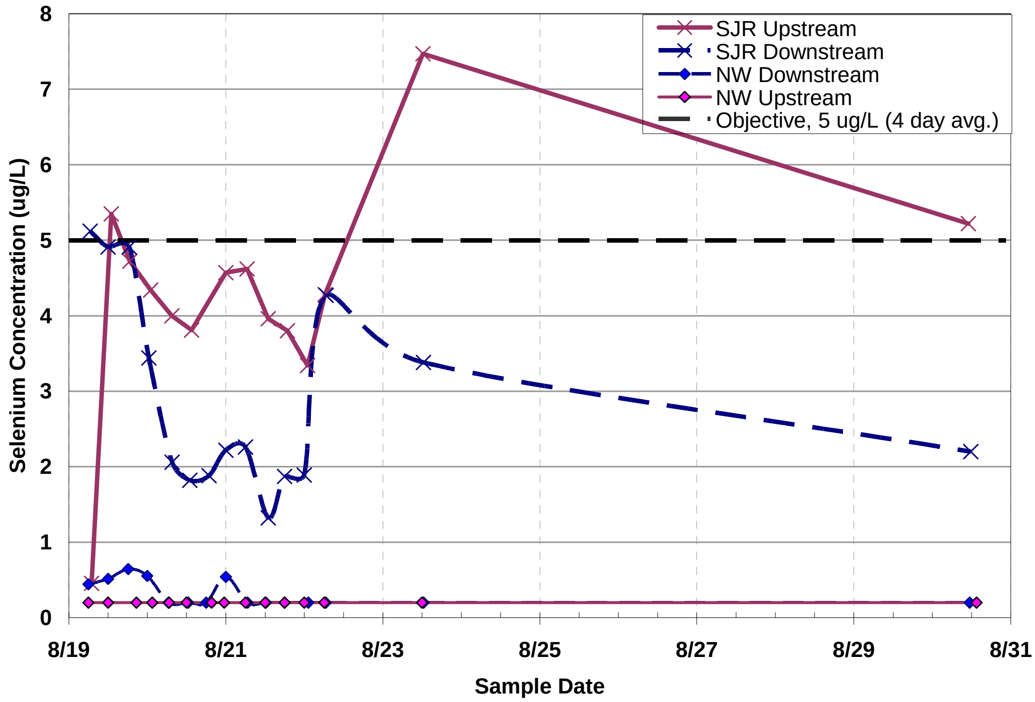

Figure 8. Selenium Concentrations during the Recirculation Pilot Study

TKN, Total Phosphorus and Ammonia as Nitrogen

TKN, total phosphorus, and ammonia concentrations were all higher at the downstream Wasteway site as compared to the upstream site, particularly during the initial 24 hours of the study. The elevated concentrations leaving the Wasteway during the first two days caused an associated concentration increase in the River downstream of the Wasteway. For the remainder of the study after the initial flush, concentrations of TKN and total phosphorus exiting the Wasteway were approximately the same as in the River and had virtually no effect on the River concentrations downstream from the Wasteway. Ammonia concentration exiting the Wasteway was higher on average than in the River, and may be the cause of the slightly higher ammonia average concentration in the River downstream of the Wasteway.

TOC

Total organic carbon (TOC) concentrations exiting the Wasteway fell off rapidly after the initial 18 hours of the study, but remained somewhat elevated over levels of the DMC water entering the Wasteway. Average concentrations of TOC in the River seemed to improve downstream of the Wasteway as a result of recirculated flows, decreasing from 5.9 to 5.1 mg/L.

TSS

Total suspended solids (TSS) are both a significant part of physical and aesthetic degradation of water and are a good indicator of other pollutants, particularly nutrients and metals that are carried on the surfaces of sediment in suspension. Despite this, there is no specific objective for TSS in the CVRWQCB basin plan, merely the statement that "waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses".

Average TSS concentration in the water exiting the Wasteway (174 mg/L) was substantially higher than in the DMC water entering the Wasteway (30 mg/L), particularly during the first 24 hours of the study. The elevated TSS from the Wasteway increased the average concentration in the River from 72 mg/L upstream to 156 mg/L downstream (Figure 9). Although the TSS concentration showed a decreasing trend after the third day of the study, the concentration in both the downstream Wasteway and River sites remained elevated over the upstream sites for the remainder of the study duration.

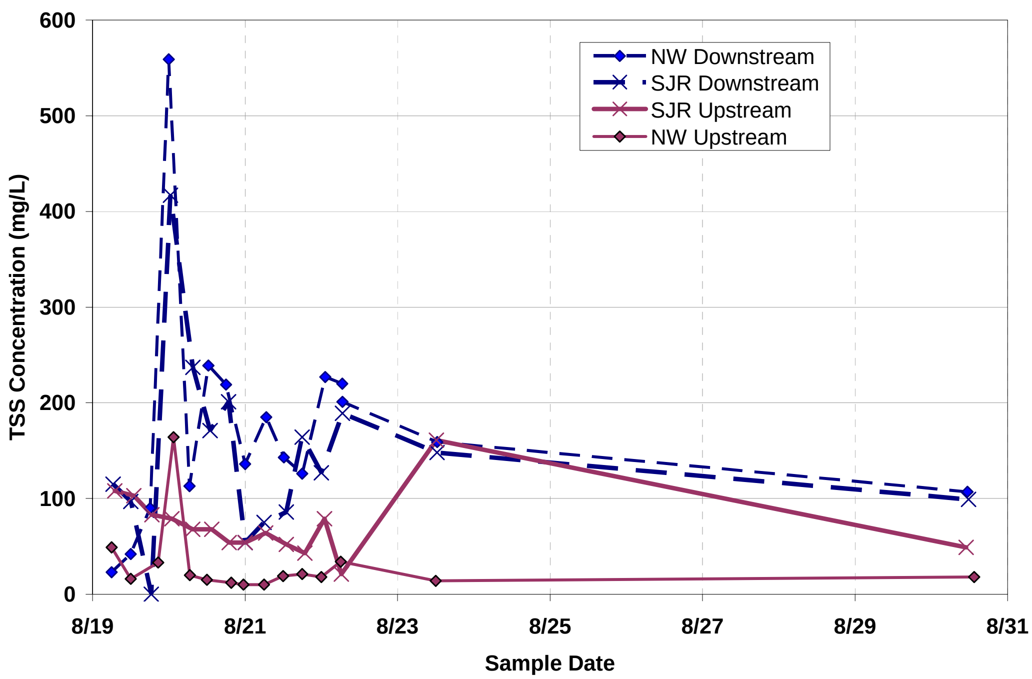

Figure 9. TSS Concentration during the Recirculation Pilot Study

The significant increase of the TSS concentration seen in both the Wasteway and the River can be attributed to the remobilization of fine bottom sediment accumulated in the Wasteway. It is possible that over a longer study period the accumulated sediment would be flushed out of the Wasteway and the TSS concentration at the downstream end of the Wasteway would decrease to the level of the upstream site. If recirculation is determined to be a worthwhile tool for Reclamation to develop, stabilization of the Wasteway channel bottom, a more gradual increase in the flow through the Wasteway, or other methods that reduce sediment mobilization should be considered to reduce TSS impacts to the River.

Turbidity

Turbidity is a measure of light penetration and can be related to TSS concentration. Turbidity in the DMC water entering the Wasteway averaged 15.2 NTU. Recirculated water remobilized fine bottom sediment that had accumulated in the Wasteway, causing the turbidity of the water exiting the Wasteway to peak at 210 NTU in the first 24 hours and average over 100 NTU during the study. The turbid water from the Wasteway increased the turbidity in the River from an average of 49.3 NTU at the upstream site to 89.0 NTU at the downstream site (Figure 10). This increase exceeded the basin plan goal, which states that "where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent" and "where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs." Although the turbidity showed a decreasing trend after the third day of the study, both the downstream Wasteway and River sites remained elevated over the upstream sites for the remainder of the study duration.

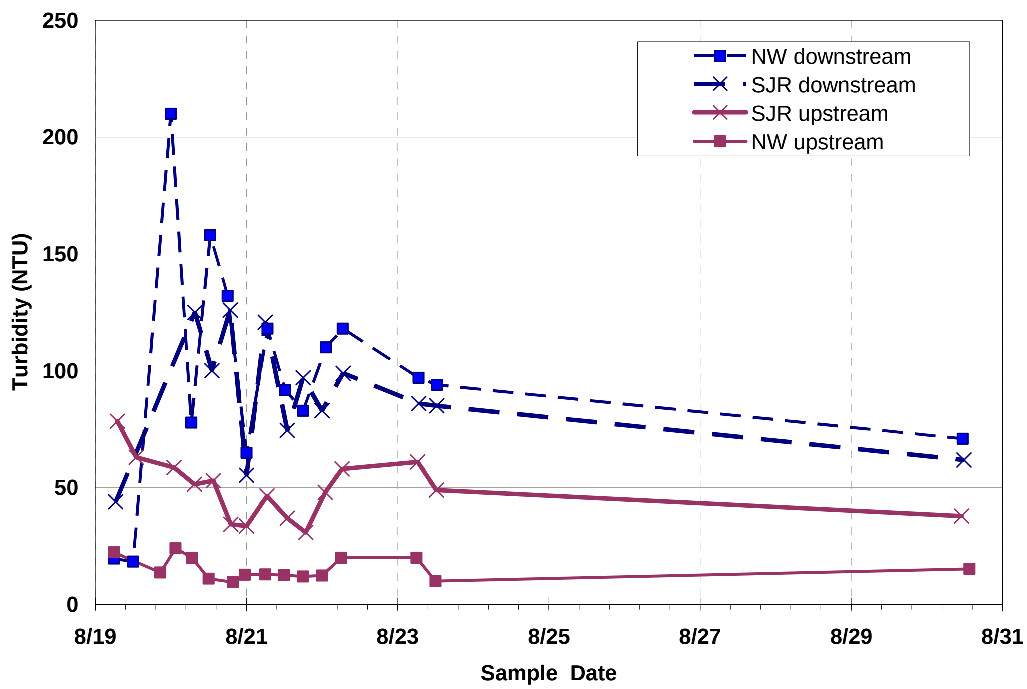

Figure 10. Turbidity Concentration during the Recirculation Pilot Study

During the study Reclamation was in routine communication with the CVRWQCB to apprise them of turbidity readings. When the monitored turbidity readings exceeded the standard, the flow into the Wasteway was reduced from 300 cfs to 250 cfs. Additional monitoring was implemented further downstream to determine the River's ability to assimilate this load. The monitoring at Patterson showed that the River was able to recover given this allowable zone of dilution (average 37.6 NTU from August 20 thru August 23, 2004).

As with TSS, it is unknown from the study if the turbidity level exiting the Wasteway would have decreased to the level of the upstream site given a longer period of time for the sediment to flush out. Methods should be considered that reduce sediment mobilization in the Wasteway, and therefore turbidity impacts to the River, if recirculation is going to be evaluated further.

Dissolved Oxygen

The CVRWQCB basin plan lists 5.0 mg/L as the most stringent objective for dissolved oxygen (DO). DO concentration of the DMC water entering the Wasteway hovered around 8 mg/L. Water exiting the Wasteway during the initial flush dropped below 5 mg/L, and then rose to a concentration around 7 mg/L. Levels in the lower River did not drop below the 5 mg/L water quality goal, but the addition of the recirculated water from the Wasteway decreased the average DO concentration in the River from 8.3 mg/L at the upstream site to 7.7 mg/L at the downstream site.

Water Quality Monitoring Summary

Analysis of the data shows that implementation of the recirculation pilot study impacted the River water quality for the following parameters: aluminum, metolachlor, TKN, total phosphorus, ammonia as nitrogen, TOC, TSS, DO, and turbidity. In assessing the data for the above parameters, a declining trend in concentration over the course of the pilot study was noted with the exception of aluminum, TSS, and turbidity. The initial elevated levels shown for these chemical constituents were the result of the first flush effect caused by the mobilization of accumulated agricultural drainage, channel bottom sediments, and vegetation in the Newman Wasteway.

For the three parameters that were elevated due to the discharge of CVP water, none exceeded the most stringent water quality standards. TSS and turbidity effects attributable to recirculation were expected and could be reduced through design and structural improvements and/or operation of the Wasteway. The elevated aluminum levels may be the result of analytical matrix problems and will be investigated further.

Flow and Salinity Data

In addition to the data collected by the study team in the vicinity of the Newman Wasteway, flow and salinity data from existing gauges along the River were also downloaded from the CDEC website. This data was analyzed to quantify the impact of the study on the River at the Wasteway, as well as determine if the impacts were measurable at downstream monitoring stations.

Analysis of flow data

The flow data plotted in Figure 11 shows an abrupt increase in flow in the River at Newman (NEW) about 12 hours into the study, and about 24 hours at the Patterson (SJP) gauge. Both stations show an abrupt spike in flow which peaked at a little over 600 cfs at both stations (located about 14 miles apart). The 250 cfs flow introduced from the Wasteway was diminished in amplitude to about 200 cfs when the pulse reached the Newman gauging station then increased to the full 250 cfs about 48 hours into the study. The pulse was only 150 cfs when it reached the Patterson gauging station about 12 hours later, then increased to 200 cfs about 72 hours into the study. Since the Fremont Ford and Mud Slough gauges showed stable flows for the first week of the pilot study, the increased flow in the River can be attributed to the discharge from the Newman Wasteway.

Mud Slough (MSG) and San Joaquin River at Fremont Ford (FFB) are the main sources of water upstream of the Wasteway. Fremont Ford diminished from 150 cfs to about 100 cfs after the first week (160 hours) of the pilot study. Newman flows were reduced from 600 cfs to 500 cfs at about the same time – the Patterson gauge showed flow diminishing by the same amount, although starting at about day 4 (100 hours) after onset of the pilot study. The greater flow decrease at Patterson as compared to flow at Fremont Ford can be attributed to the decreased tributary inflow from the Merced River (see Figure 12). The Merced River diminished from 100 cfs to about 50 cfs after the first week (144 hours) of the pilot study.

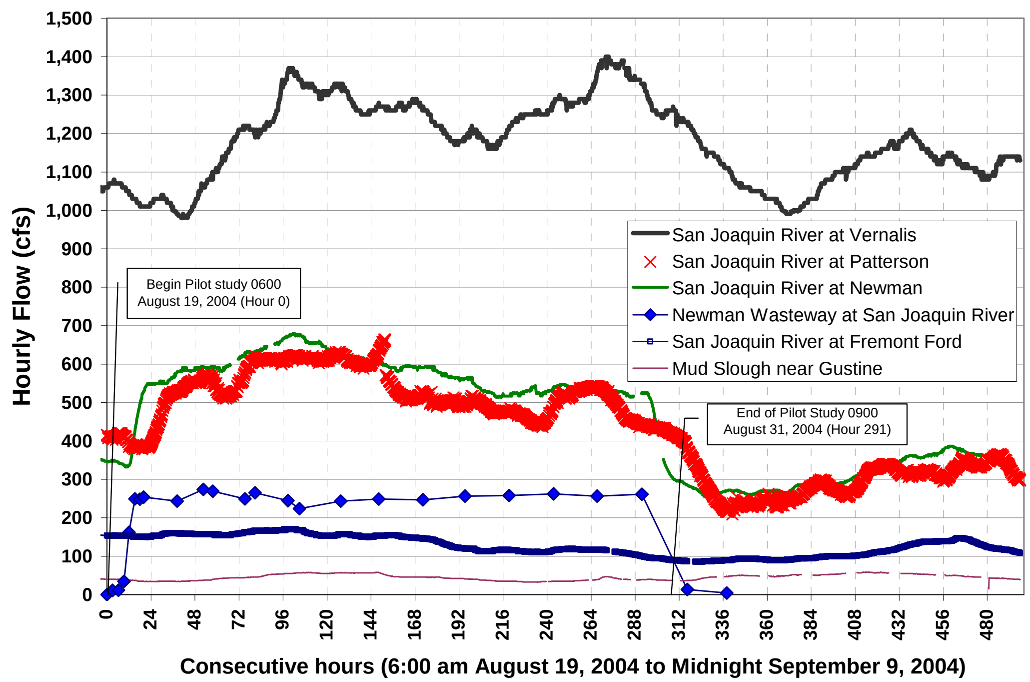

Figure 11. Analysis of San Joaquin River and main tributary flow data.

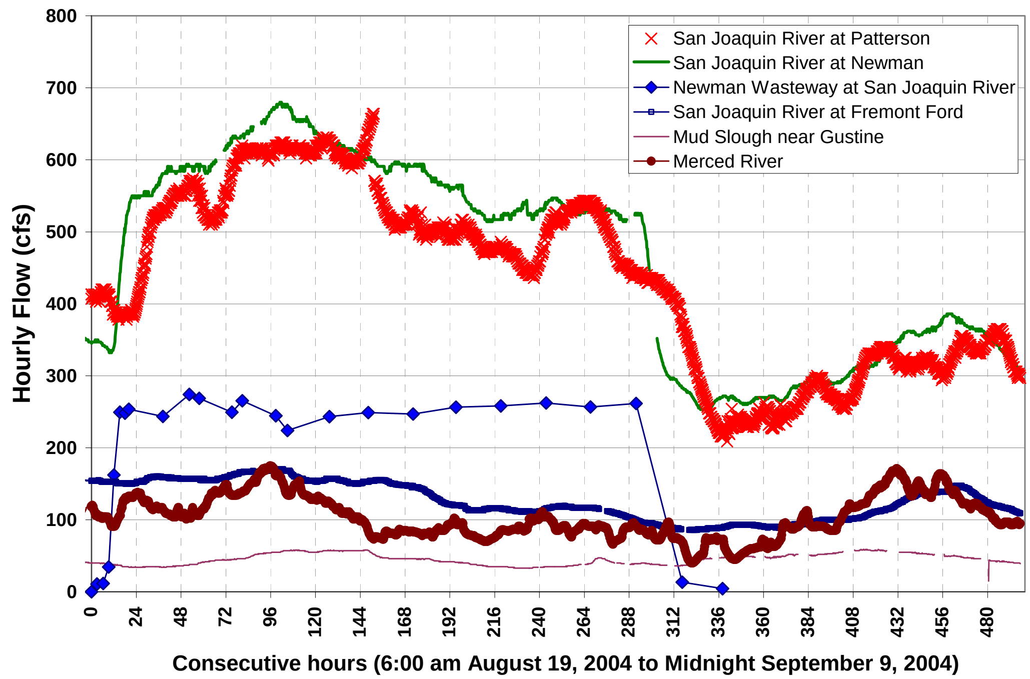

Figure 12. San Joaquin River tributary flow data.

Because there are no major tributaries between the Newman and Patterson gauges, the flow records should be very similar. However, the Patterson gauge data does not document as high of an initial increase from recirculation flow as that recorded at the Newman gauge. That muted response coincided with an increase in diversion by West Stanislaus Irrigation District commencing 20 hours into the pilot study. In contrast, diversion by the Patterson Irrigation District remained quite static at about 125 cfs throughout the pilot study (see Figure 13). Other variations in the Patterson gauge data can be attributed to ungauged surface drain inflows, seepage losses, and late season riparian diversions along the reach between the Newman and Patterson gauges. Because the recirculation pilot study was not designed to monitor all inflows to and diversions from the River, quantification of these flows was not possible.

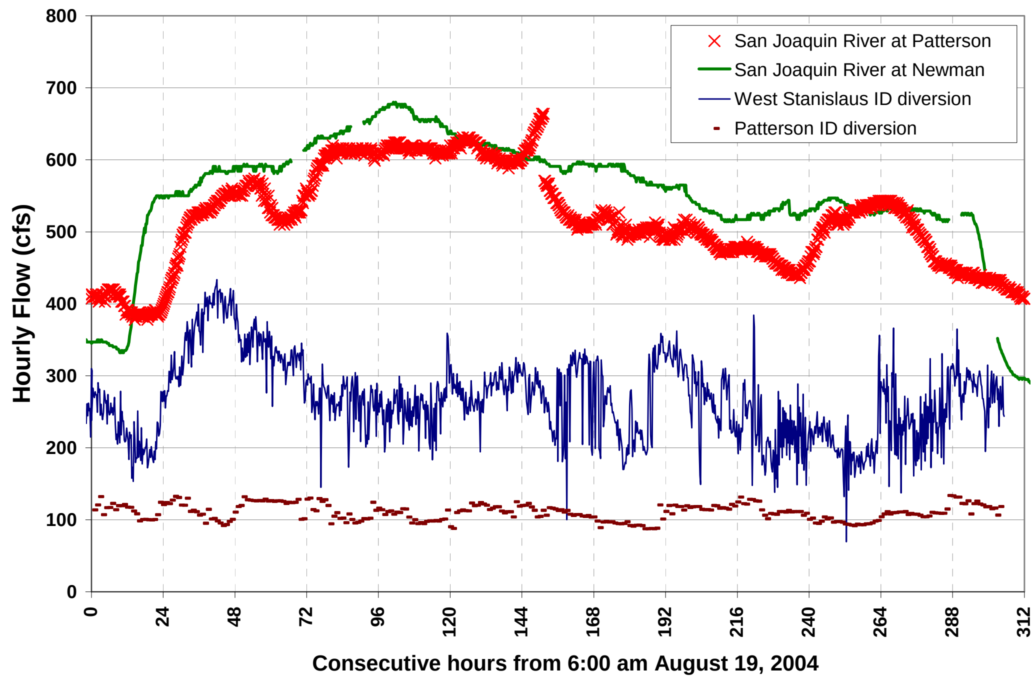

Figure 13. Effect of riparian diversion at Patterson ID and West Stanislaus ID on flow at San Joaquin River at Patterson.

Analysis of electrical conductivity data

D-1641 established a San Joaquin River agricultural salinity objective of 1000 µS/cm between April and August and 700 µS/cm between September and March to be met at Vernalis. Evaluation of the impact of recirculation on salinity, as measured by electrical conductivity (EC), was an objective of the pilot study.

In Figure 14 the displacement of salt in the Wasteway begins about 17:30, eleven and a half hours after the initial release of water into the Wasteway, and continues until about 7:00 the next morning after which time the Wasteway EC takes the characteristic signal of the diverted DMC water.

Interpretation of the EC data is more complex than the flow data on the San Joaquin River. Upon initial observation, the data does not exhibit the inverse relationship between flow and salt concentration expected at the San Joaquin River stations. In the case of the Patterson monitoring site, about 36 hours into the study the EC dropped from approximately 1200 µS/cm to less than 900 µS/cm until the seventh day of the pilot study after which the EC steadily climbed (see Figure 15). The EC increase can be attributed to upstream salinity changes. As shown in Figure 15, the EC concentration upstream of the Wasteway at Fremont Ford was stable near 1150 µS/cm for the first three days of the pilot study, then increased to 1600 µS/cm between day 6 and end of the study (after 290 hours). This 50% EC increase correlated with an approximate 50% reduction in flow during the same period, thus the salt load remained about the same.

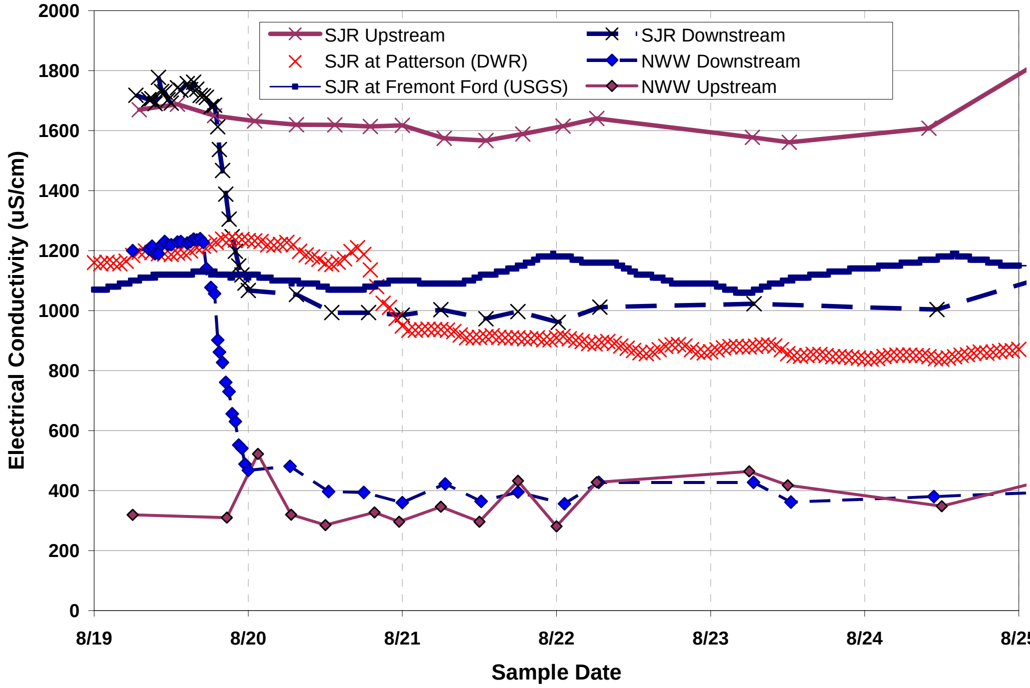

Figure 14. Effect of Recirculation on EC after 6 days (144 hours) at various main stem river sites as well as upstream and downstream sites along the Newman Wasteway

The Vernalis EC data showed a lagged response to the recirculated flow. The reduction in EC from about 700 µS/cm to 600 µS/cm occurred approximately 48 hours after the flow pulse was first evident at the Patterson gauging station. Similar to the trend at Patterson, after the initial drop around hour 72 the EC at Vernalis slowly increased during the 291 hour study period and was about 650 µS/cm at the end of the pilot study.

Initially it was thought that the drop in EC at Vernalis was not as great as might be expected given the reduction at Patterson. After analyzing the EC response with respect to the relative flow contribution from recirculation, the observed drop in Vernalis EC was found to be consistent. The flow at Patterson was only 400 cfs prior to arrival of the 200 cfs recirculation pulse, which provided a 50% increase in flow. The recirculated flow only increased the flow at Vernalis by 20%, from 1000 to 1200 cfs. From such a small increase in the flow at Vernalis one would expect the observed modest reduction in EC.

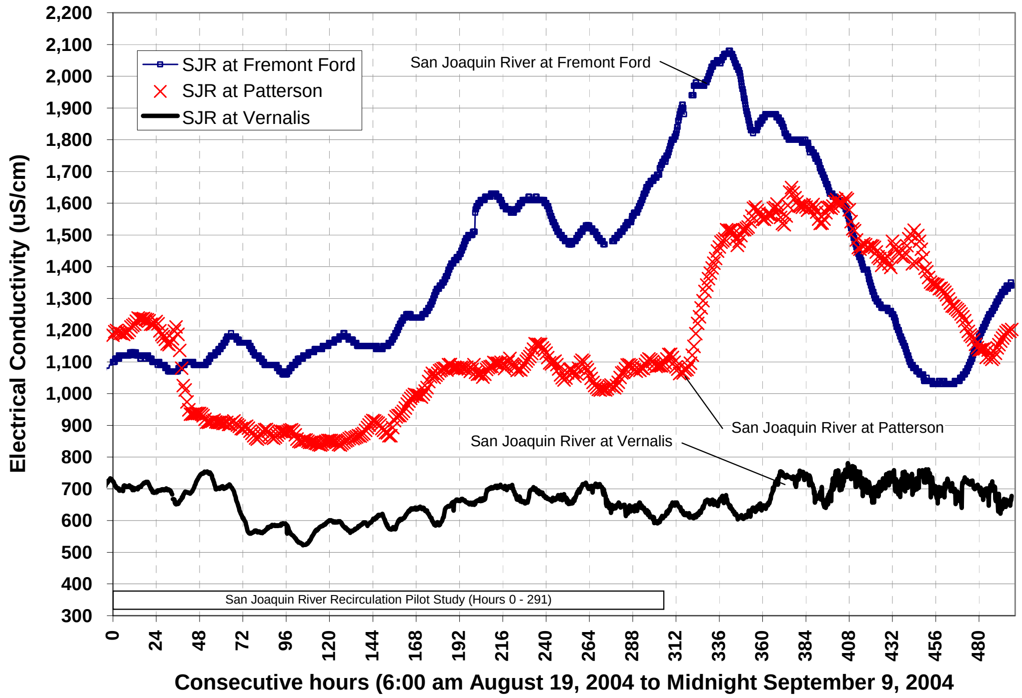

Figure 15. Effect of recirculation on EC after 21 days at various main stem San Joaquin River sites.

Figure 10 shows steady flows in Mud Slough and in the River passing Fremont Ford during the pilot study. These sites represent upstream or baseline conditions in the River and Grasslands Basin. Figure 14 shows an abrupt rise in salinity at Fremont Ford during the study that may have been caused by flushing out the refuges in preparation for the new season. The rise in salinity was diminished by the pilot study flow (reduced 500 uS/cm @ hour 240). This data shows a clear benefit of recirculation.

Findings and Conclusions

Water Quality Assessment

The pilot study showed clearly that recirculated flow through the Newman Wasteway was effective in increasing flow and reducing the EC concentration at Vernalis. The pilot study also demonstrated agency coordination at its best; data collection was well coordinated and a complete water quality characterization of the first flush flow from the Wasteway was obtained. The analysis does suggest, however, that real-time water quality monitoring and management will be essential if recirculation is to realize savings in New Melones water quality releases. A short-term increase in riparian diversion by the West Stanislaus Irrigation District resulted in a much lower response at Vernalis than was expected during the first two days of the pilot study. It was later determined that West Stanislaus Irrigation District had increased diversions for two days and then cutback again to the conditions that existed when the pilot study was initiated. A decision to increase recirculation flows in response to the less than expected Vernalis EC would have resulted in excess dilution and water wastage as West Stanislaus Irrigation District reduced its river diversion. Therefore, real-time flow and EC monitoring data from mainstem River stations, including the major Westside tributaries and the diversions, will be essential for full implementation of any future recirculation program.

Water Supply Assessment

There were no water supply impacts to CVP contractors as a result of the pilot study. It was difficult to accurately measure the losses due to insufficient data and controls during the recirculation operation. There are several irrigation districts which have tailwater flow into the San Joaquin River which are in the process of being calibrated, and monitoring data was not available during the pilot study. In addition, data on the quantities of water diverted from the San Joaquin River by the water districts is limited beyond the data available for West Stanislaus Irrigation District and Patterson Irrigation District. Without a higher level of detail, it is difficult to determine exactly how much of the water released through the Newman Wasteway was lost to the system between the release point and Vernalis. Therefore, monitoring of recirculation water will be an essential component of any future study when, and if, another test of recirculation is performed or a full-scale recirculation program is implemented.

Operational Assessment

Operationally, the implementation of the pilot study was well coordinated. The water quality assessment team was in place to begin testing as soon as the Newman release water reached the San Joaquin River outfall. The main operational challenge initially was sediment mobilization from the Newman Wasteway caused by the turbidity readings in the San Joaquin River that increased beyond the amount allowed by the basin plan. To alleviate this problem, the release to the Wasteway was dropped from 300 cfs to 250 cfs on Sunday, August 22, 2004. An additional challenge encountered was determining how much flow would reach Vernalis. During a portion of the pilot study, the flows at Vernalis were much less than anticipated for a two-day period. For a long-term recirculation program to be implemented, it will be necessary to develop coordination agreements with local water districts so that Reclamation will know when diversions are planned to increase or decrease, and releases to the Wasteway can be adjusted accordingly to provide the desired effect at Vernalis while at the same time utilizing the least possible amount of recirculated releases.

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Bureau of Reclamation, 2005b. Initial Data Assessment, San Joaquin River Recirculation Pilot Study Water Quality Monitoring Program, Sacramento, California, May 19, 2005.

Quinn, Nigel W.T., Berkeley National Laboratory, 2005. Analysis of Results From Real-time Flow Augmentation in the Mainstem San Joaquin River Using Newman Wasteway Recirculation, Sacramento, California, January 18, 2005.

Appendix A

Quality Assurance Plan

8/18/2004 ce

Quality Assurance Plan

San Joaquin River Recirculation Pilot Study
Water Quality Monitoring Program

U.S. Department of Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

<u>**Title and Approval Sheet**</u>

San Joaquin River Recirculation Pilot Study
Proposed Water Quality Monitoring Program

Approvals:

Chet Bowling, Study Manager	Date
Ron Milligan, Study Coordinator	Date
Stuart Angerer, Monitoring Coordinator	Date
Victor Stokmanis, Quality Assurance Officer	Date

U.S. Department of Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

August 3, 2004

Table of Contents

I. Study/Task Organization

This water quality monitoring study will help determine the potential water quality impact to the San Joaquin River (SJR) from the initial flush of water through the Newman Wasteway (NW). This monitoring program is tied to a Pilot Recirculation study where a volume of water from the Delta- Mendota Canal (DMC) is directed to the SJR via the NW. This wasteway flows from west to east with its head gate on the DMC just upstream of Check 10 at milepost 54.38. The terminus of the wasteway is at the SJR 1.24 miles upstream of the Merced River confluence

The wasteway is 8.2 miles long with the upper 1.5 miles concrete lined and the remainder unlined. The capacity of the wasteway is 4300 cfs but on average, there usually is only 50 to 75 cfs of flow from agricultural drainage. Twice a month a pulse flow of 500 cfs for a 5 minute duration is sent down the wasteway to clear sediment loads from the headgates. Additional flows through the wasteway during this study are estimated to be 200-300 cfs.

II. Problem Definition/Background

The study objective is to monitor how water quality is affected as it moves from the DMC through the NW to the SJR. There are questions regarding water quality impacts from possible mobilization of sediments and contaminates as a result of past and current agricultural drainage into the wasteway.

The proposed water quality monitoring program is designed to obtain information on the "first flush" of water from the DMC into the NW. The frequency of monitoring will be more intensive during the first few days of the initial flush and then taper off for the duration of the study.

III. Study/Task Description

Four sample locations will be utilized in this study. DMC water will be tracked and sampled at two sites in the NW, just downstream of the DMC and just upstream of its discharge point into the SJR. Water in the SJR will be sampled upstream of this discharge point (approximately 500 ft) and downstream above the confluence of the Merced River where wasteway water is well mixed with SJR water.

Flow rates will be determined in the wasteway to estimate the travel time from the DMC to the SJR. Flow and salinity of water in the SJR will be derived from US Geological Survey measurements at Mud Slough near Gustine and the SJR at Fremont Ford (Hwy 140).

When water is initially released into the NW, water samples will be collected in the DMC at the NW headgate to measure background water quality before it is affected by possible contaminants in the wasteway.

Flow measurements will be made downstream of the headgate and at the terminus of the NW by San Luis Delta-Mendota Water Authority personnel. It is important to capture the same "block" of water because the source water is in flux due to tidal influences at the Tracy Pumping Facility. Besides flow, water temperature, EC, and turbidity will be used as water quality indicators to determine when the front end of the flushed water has reached the NW terminus.

Table 1. Sample Schedule

Time	Frequency	Number of samples sets
Days 1 – 3	Every six hours at all four sites starting with time 0 as background Minus the 6 composites over the first 18 hours Flow every 2 hours until stable then once per day	42
Day 1	Three composite sample sets collecting every thirty minutes for six hours each at two sites (terminus of NW and downstream SJR)	6
Day 5 or 6	One sample at all four sites	4
Weeks 2, 3, and 4	One sample each week at all four sites	12
		64

Table 2. Sample Schedule Specifics

Time	NW upstream	NW downstream	SJR upstream	SJR downstream
0 hours	Grab: • inorganics • organics	Grab: at 0 hours • inorganics • organics • Ecoli (1,2,3,6 hrs)	Grab: • inorganics • organics	Grab: at 0 hours • inorganics • organics • Ecoli (1,2,3,6 hrs)
6 hours	Grab: inorganics	1st composite every 30 minutes 0 to 6 hours • inorganics • organics	Grab: inorganics	1st composite every 30 minutes 0 to 6 hours • inorganics • organics
12 hours	Grab: inorganics	2rd composite every 30 minutes 6 to 12 hours • inorganics • organics	Grab: inorganics	2rd composite every 30 minutes 6 to 12 hours • inorganics • organics
18 hours	Grab: inorganics	3rd composite every 30 minutes 12 to 18 hours • inorganics • organics • Ecoli	Grab: inorganics	3rd composite every 30 minutes 12 to 18 hours • inorganics • organics • Ecoli
Day 2, 0 hours	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
6 hrs	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
12 hrs	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
18 hrs	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
Day 3, 0 hours	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
6 hrs	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
12 hrs	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
18 hrs	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
Day 5 or 6	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
Day 11	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
Day 18	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics
Day 25	Grab: inorganics	Grab: inorganics	Grab: inorganics	Grab: inorganics

Parameters of Concern

Flow
Temperature
Electrical Conductivity (EC)
Dissolved Oxygen (DO)
Turbidity
Total Suspended Solids (TSS)
Total Organic Carbon (TOC)
Biochemical Oxygen Demand (BOD)
Metals
Hardness
Nutrients
Acute Toxicity
E. Coli
Chlorophyll-a

Organics

- Organochlorine Pesticides
- Organophosphate Pesticides
- Carbamate Pesticides
- Triazine Pesticides
- Phenoxy Acid Pesticides

TABLE 3: BOTTLE TABLE

Parameter	Bottle	Preservative	Filter	Hold Time	Method
BOD Orthophosphate nitrate+ nitrite	500ml HDPE	None	No	48 hour	BOD SM 5210 Orthophos SM 4500P-E N+N EPA 353.2
TSS	250 ml HDPE	None	No	7 days	EPA 160.2
Dissolved Mercury	250ml glass	BrCl	Yes	28 days	EPA 1631
Dissolved Metals	1000ml HDPE	HNO3	Yes	6 months	EPA 200.8
Selenium	125ml HDPE	HNO3	No	6 months	Fluorometric
Boron	500 ml	HNO3	No	6 months	EPA 200.7
TOC	2x 125ml amber glass	H2SO4	No	28 days	SM 5310C
Specific OCL and PCBS	4 x 40 ml VOAs	None or Thiosulfate	No	7 days until extraction, 40 days after extraction	EPA 505
Herbicides and phenoxy acids	2 x 1L amber glass	none	No	7 days until extraction, 40 days after extraction	EPA 515.3
Organophosphate and Triazine pesticides	2 x 1L amber glass	HCL	No	7 days until extraction, 30 days after extraction	EPA 525 plus
Carbamates	2 x 40 ml VOA	MCAA	No	7 days until extraction, 40 days after extraction	EPA 531

Parameter	Bottle	Preservative	Filter	Hold Time	Method
Nutrients (ammonia, TKN, Total P)	500 ml HDPE	H_2SO_4	No	28 days	Ammonia EPA 350.1 TP SM 4500P TKN EPA 351.2
E. Coli	125 ml	none	No	24 hours	SM 18;9221B+E
Chlorophyll A	1 L amber HDPE	none	yes	3 weeks	SM 100200H
Acute Toxicity • *Ceriodaphnia dubia* • *Pimephales promelas*	5 gal Cubitainers	none	No	36 hours	EPA Acute Toxicity EPA/600/ 4-90-027F

Temperature, EC, and DO measurements will be made using a Hydrolab minisonde calibrated at least twice daily (Temperature is factory calibrated). Turbidity will be measured using a Hach 2100 P turbidimeter calibrated or verified at least twice daily.

IV. Data Quality Objectives for Environmental Measurements

The project requires the analytical laboratory to analyze water samples for the parameters identified in Table 4. In addition, the laboratory methods utilized must also meet the reporting limits and acceptance criteria summarized in this table.

Table 5 identifies acceptance criteria for field measurements relative to reporting limits, accuracy, precision, completeness, and sensitivity.

V. Sampling Process Design (Experimental Design)

Inorganic grab samples will be collected every 6 hours at all four sites (NW top, NW terminus, SJR above, SJR below) for the first three days. At time zero, samples will be collected at all four sites for organic compounds and at the lower SJR site for acute toxicity. An acute toxicity sample will also be collected at the 18 hour mark.

During the first 18 hours, two one liter water samples will be collected every thirty minutes at both the NW terminus and the downstream SJR sites. One liter will be composited for inorganic testing, and the other liter composited separately to test for organic compounds. These sub-samples will be composited into a single sample for organics and a single sample for inorganics every six hours at each of the two sites for a total of three events.

If flow, turbidity, and other physical measurements remain elevated at the end of the initial 18 hour period, the intensive, composite sampling protocol will continue until conditions stabilize, indicating the first flush event has subsided.

After the first three days, one sample set will be collected at each of the four sampling locations two or three days later. Following the first week of monitoring, the frequency of sampling further decreases at each of the four sampling locations to once per week for the duration of the re-circulation study (estimated to be three additional weeks).

TABLE 4: DATA QUALITY OBJECTIVES – INORGANIC PARAMETERS

Parameters	Reporting Limit (mg/L)	Accuracy (% Recovery)	Precision (% RPD)	Completeness (%)	Corrective Actions
Nitrate + Nitrite	0.16	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
TKN	0.2	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Ammonia	0.05	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Total Phosphorus	0.05	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Ortho-phosphate	0.03	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Chlorophyll A	0.01 mg/m3	Refer to method	Refer to method	90%	Qualify data or resample
E. Coli	<2MPN per 100ml	Refer to method	Refer to method	90%	Qualify data or resample
TSS	4	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
TOC	0.5	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
BOD	1	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Qualify data or resample
Boron	0.05	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Selenium	0.0004	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Aluminum	0.0058	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Antimony	0.0005	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Arsenic	0.001	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Beryllium	0.005	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Cadmium	0.00025	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch

Chromium	0.0005	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Copper	0.0005	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Lead	0.0005	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Magnesium	1	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Mercury	0.000002	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Nickel	0.005	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Silver	0.0002	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Thallium	0.001	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch
Zinc	0.010	80%-120%	[≥5x RL] = 0%-20%, [< 5x RL] difference within ± RL	90%	Reanalyze sample and if not confirmed, reanalyze the batch

Note: Data Quality Objectives for Organic Compounds are located in Appendix 2.

Table 5: Data Quality Objectives for Field Monitoring

Parameter	Method/range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Completeness
Temperature	Hydrolab Minisonde/ -5 to 50C	Degrees C	NA	0.01ºC	NA	±0.10ºC	NA
Turbidity	Hach 2100P Ratio Nephelometric/0-1000 NTU	NTU	0.01	0.01	± 0.02	±2% of reading or 0.01 NTU	90%
Electrical Conductivity	Hydrolab Minisonde/ 0-100 mS/cm	µS/cm	10	4 digits	± 5%	± 1% of reading or ±0.001 mS/cm	90%
Dissolved Oxygen	Hydrolab Minisonde/ 0-50 mg/L	mg/L	0.1	0.1	± 5%	± 0.2	90%

Physical parameters will be measured on site, at each sampling event (i.e. with every grab sample and composite sub-sample).

E. Coli grab samples will be collected directly from the source water at both the NW terminus and the downstream SJR sites at hours 1, 2, 3, 6 and 18.

The Nitrate + Nitrite and Orthophosphate constituents of the nutrient samples will be collected from the BOD or TSS bottles as they are unpreserved.

Chlorophyll-a samples will be collected at all sites and times (composites not 30 minute intervals) for the first week Chlorophyll-a samples will be collected from the churn splitter into a 1L amber plastic bottle and chilled to freezing immediately. 500 ml of sample water that have been collected to an amber plastic bottle will be filtered through a fiberglass filter. The filter will be folded placed in a plastic bag, inserted into a coin envelope, and frozen immediately.

Water samples for acute toxicity will be collected at the downstream NW and downstream SJR site. Toxicity sampling will be regulated by flow not time. A background toxicity sample will be collected at time 0 and then when the flows are calculated at 50 cfs, 100 to 200 cfs and then at 300 cfs at the downstream NW site. The downstream SJR site will be sampled approximately 30 minutes after each of these pulses. For each sample, a five gallon cubitainer triple rinsed with environmental water will be filled to capacity, leaving no air space.

Flow data, which will be conducted by the San Luis Delta-Mendota Water Authority (SLDMWA), will be collected every two hours during the initial flush, starting from time 0 and continuing until conditions in the NW stabilize. After the first flush event, flow measurements will be taken once per day. Initially, a staff gauge will be located at the terminus of the wasteway (upstream of any anticipated influence from the SJR). This staff gauge will be set to zero at the current elevation of the wasteway discharge and used only as a reference to change and as an indicator to high stable flow. Flow measurements will be determined by the staff gauge on the headworks gates and by the weir structure at the wasteway crossing at milepost 6.88. The outlet works discharge will be verified by flow measurements at the wasteway crossing at milepost 1.14.

VI. Sampling Methods Requirements

1. Each inorganic sample will be collected by a grab method: sample technique where environmental water is collected directly into a churn splitter. The churn splitter must be rinsed with environmental water three times before collecting samples. If this sample is composited over time, the churn splitter will be kept covered and chilled between collection of sub-samples.

2. Each composite organic sample will be collected by a grab method: sample technique where environmental water is collected into a 1L glass container and poured directly into a teflon churn splitter or 20L glass container. The churn splitter and glass container must first be triple rinsed with pesticide grade acetone, followed by three rinses with de-ionized (DI) water, followed by triple rinsing with environmental water before sampling. The composite containers will be kept on ice, dark, and covered between sub-samples, until all representative samples are collected into the container.

3. The duplicate and spike samples are poured from a single volume of water from the churn splitter.

4. Quality Assurance (QA) blank bottles are labeled in the field, but filled by the QA Officer (QAO) with DI water at a Reclamation laboratory. TSS and BOD blanks are filled with DI water by sampling personnel in the field and shipped from field locations.
5. Quality Assurance (QA) duplicate samples are collected and labeled in the field.
6. Quality Assurance (QA) spike samples are labeled in the field, but the QAO will spike these bottles at a Reclamation laboratory.
7. Quality Assurance (QA) reference samples are labeled in the field, but the QAO will fill these bottles with reference material at a Reclamation laboratory. TSS and BOD references will be filled with reference material by the sampling personnel in the field and shipped from field locations.
8. Pre-labeled sample containers that already contain preservatives are not rinsed.
9. A logbook and field sheets are used to document field conditions and sampling information.
10. Samples will be stored in a cooler at 0 to 4^{o}C with either blue or wet ice.
11. All samples must be delivered to the laboratories before the specified hold times, and analyses must begin before hold times expire.
12. Flow measurements will be made using USGS protocol, utilizing 20 points across a transect. The average of these measurements, along with depth at those points, will be used to calculate total discharge.

VII. Sample Handling and Custody Requirements

Samples will be collected in high density polyethylene bottles, except for TOC and organics, which will be collected in amber glass bottles and mercury which is collected in glass. Sample volume and preservation is specified by the laboratory, based on analytical requirements. Following collection, samples are placed in coolers at a temperature of four degrees Celsius. All samples transferred from monitoring personnel to the QAO, laboratory personnel, or a courier will require a chain of custody sheet (COC). The COC will include sample identification numbers for all samples collected during a specific sampling period, the collection time and date, sample type, number of containers, analyses requested, identification of laboratory facility, project manager, point of contact, and signatures of those individuals in possession of the samples. Monitoring personnel will relinquish the samples to the QAO, courier or laboratory by signing, dating and writing the time on the COC when samples are transferred from one party to the next. At this time, the receiving party will also sign, date and write the time on the COC to document when they received the samples. A copy of the COC will be kept on file by the QAO and one with the laboratory.

VIII. Analytical Methods Requirements

Monitoring personnel will measure dissolved oxygen, temperature and electrical conductivity using a portable Hydrolab instrument, and turbidity using a Hach turbidimeter. Laboratories will perform chemical analysis on environmental water samples using analytical methods identified in Table 1.

IX. Quality Control Requirements

To assess laboratory performance on non-organic samples, monitoring and/or QA personnel will incorporate double blind samples (samples that are labeled similarly to that of the environmental samples so the laboratory does not know the sample is a QA check sample, nor do they know the true values of the chemicals they are testing). Spike and/or reference samples, duplicate samples, and blank samples will be added to each sample batch to evaluate analytical accuracy and precision, and to determine whether the laboratory may have contaminated the samples. One spike or reference sample and one set of duplicate samples will be incorporated into every 10 samples or batch, whichever is more frequent. One blank sample will be incorporated into every 20 samples or batch, whichever is more frequent. The QAO will ensure that field personnel properly prepare external QA check samples.

The laboratories will incorporate their own QC check samples to ensure data reliability. For specific rates of QC check sample incorporation, refer to the laboratory QA manuals. Laboratory QC check sample results are reported to the client as QC summary reports and to assess laboratory performance on organic samples, the QAO will rely on these reports, holding time compliance, and other QC information.

X. Instrument Calibration and Frequency

Calibration of the Hydrolab is to be performed according to manufacturer's calibration instructions outlined in the Hydrolab manual. The Hydrolab will be calibrated BEFORE the first physical measurement and checked with standards AFTER the last measurement each day. These techniques are also described in Chapter 4, pages 27-32 of the Environmental Monitoring Section's SOP's. The before and after measurements are recorded on a field calibration sheet and the drift is then calculated. These sheets are kept filed, in a notebook, and archived by MP-157's Environmental Monitoring Section.

Calibration of the Hach 2100P is to be performed ac according to manufacturer's calibration instructions outlined in the Hach 2100P manual. The Hach 2100P will be calibrated BEFORE the first physical measurement and checked with standards AFTER the last measurement each day. The before and after measurements are recorded on a field calibration sheet and the drift is then calculated. These sheets are kept filed, in a notebook, and archived by MP-157's Environmental Monitoring Section.

The laboratory performs instrument calibrations following the procedures and protocols stated in the analytical methods for each parameter.

XI. Assessments and Response Actions

Prior to selecting a laboratory as a participant in this program, the analytical performance was evaluated through the use of performance evaluation samples. After demonstrating acceptable results on these performance samples, a system audit was performed on these laboratories. The system audit consisted of first reviewing the laboratories QA manual and EPA WP/WS performance study results for the past three years. After reviewing these documents, a USBR audit team visited the laboratories to make certain they had everything in place to perform the work.

Data collected for this study will be evaluated by the Monitoring Coordinator who in turn will provide an assessment report. The data will be used to evaluate study impacts, whether changes are needed in the overall monitoring program, and whether data indicates a need for changes in study operations. The primary objective of this monitoring effort is to assess the levels of the parameters of concern and determine if their concentrations exceed the Level of Concern threshold.

XII. Data Review, Validation and Verification Requirements

The QAO and Field Monitoring Team Leader will review and verify all data generated from this study. Reclamation will follow protocol outlined in their QA SOP (revised November 1999) to review and verify data collected for this program. Part of the data validation process may involve re-analysis of external QA check samples. If these samples are not confirmed by reanalysis, a portion or the entire batch of production samples may be reanalyzed.

The laboratory's QC check samples must meet certain levels of acceptability when analyzed with the production samples. These levels of acceptability are established through the use of control charts or set at established limits found in the methods. Part of the data verification process involves checking these laboratory QC check sample results to ensure they are within acceptable ranges. If a laboratory QC check sample fails to demonstrate an acceptable result, the anomaly must be explained with a footnote or included in the case narrative section of the data report. In order to ensure data quality, QA personnel will assess laboratory data packages to determine if all samples were analyzed within their holding times.

XIII. Validation and Verification Methods

When Reclamation incorporates external quality assurance (QA) check samples into a batch of production samples submitted to a laboratory, the laboratory must meet certain standards of acceptance on these QA check samples for the data to be approved as reliable. For this study, the standards of acceptability for the external QA check samples are:

Duplicates: For values $\geq$ 5X Reporting Limit, RPD $\leq$ 20%
For values < 5X Reporting Limit, values may vary $\pm$ 1x Reporting Limit

Spikes: Recovery should be 80%-120%
Limit does not apply when sample value exceeds spike concentration by > 5 times

Reference Materials: Recovery should be 80%-120% of certified value for values $\geq$ 5X Reporting Limit

For values < 5X Reporting Limit, recovery should be $\pm$ 1X Reporting Limit from the certified value

Blanks: Blank concentration should be less than 10% of lowest sample concentration or less than two times the reporting limit.

Reclamation uses the following equations to validate data:

Relative percent difference: A statistic for evaluating the precision of a replicate set. For replicate results X_1 and X_2:

$$RPD=((X_1-X_2)/(X_1+X_2/2))x100$$

Completeness: The amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal operations. It is usually expressed as a percentage:

% completeness =V/n x 100

where: V= number of measurements judged valid

n = total number of measurements

Percent recovery: A measure of accuracy determined from comparison of a reported spike value to its true spike concentration or a reported value to the true concentration:

% Rec. = [(observed spike conc.-sample conc.) / (true spike conc.)]x 100, for a spike

% Rec. = [(reported value/true value)] x 100, for a reference

Accuracy: Accuracy is a measure of the bias inherent in a system or the degree of agreement of a measurement with an accepted reference or true value. It is most frequently expressed as percent recovery.

Precision: A measurement of mutual agreement (or variability) among individual measurements of the same property, usually under prescribed similar conditions. Precision is usually expressed in terms of relative percent difference, but can be expressed in terms of range.

XIV. Reconciliation with DQOs

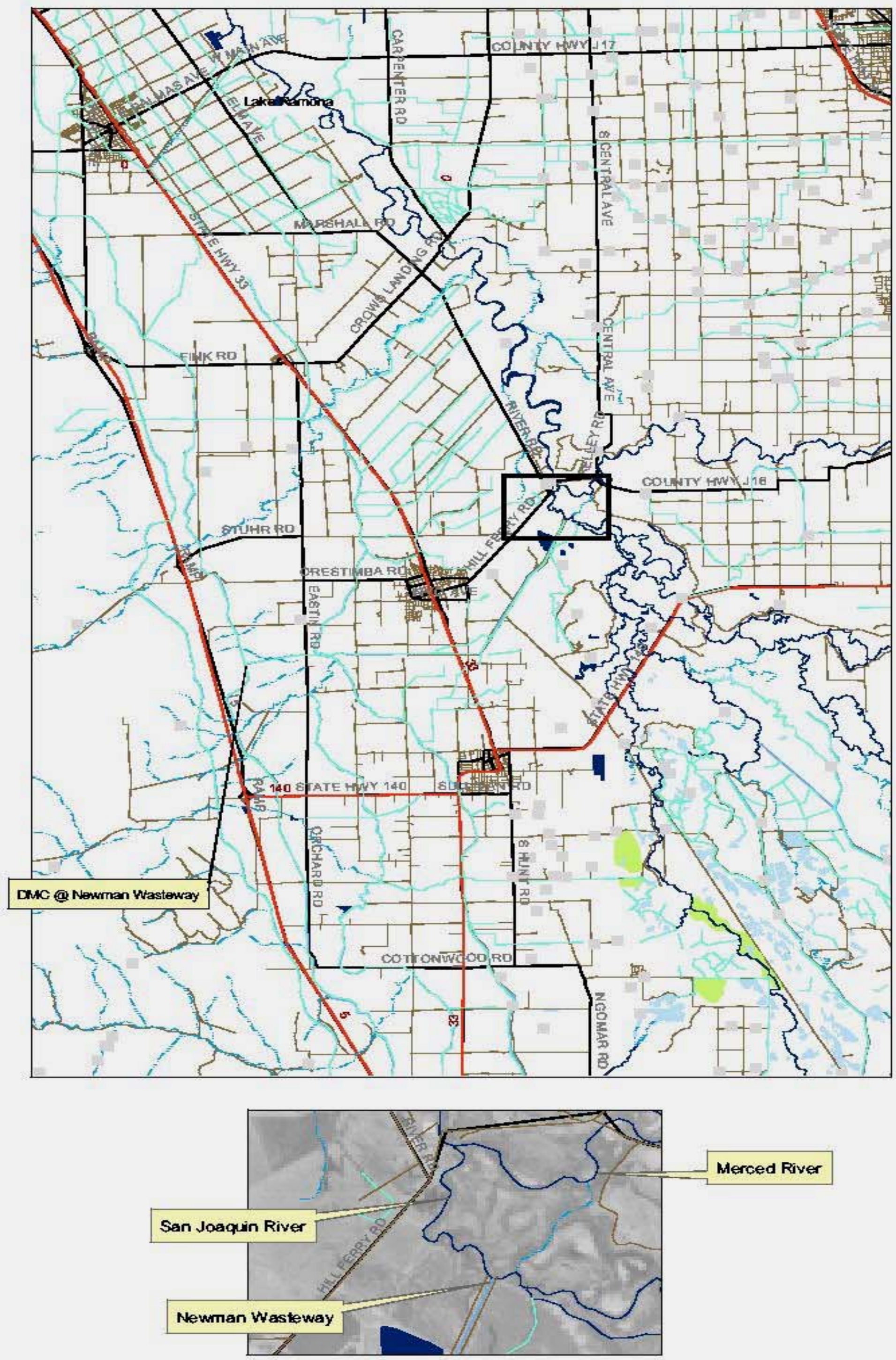
After the sampling event, calculations and determinations for precision, accuracy, contamination, and completeness will be made and corrective actions implemented if needed. If data quality indicators do not meet the study's specifications, data may be discarded and re-sampling may occur. The cause of failure will be evaluated. If the problem is determined to be a sampling error, field personnel will be retrained. If the problem is laboratory related, the laboratory program manager will be contacted and corrective actions implemented. Any limitations on data use will be detailed in both interim and final reports and other documentation as needed.

If DQO failure requires the QAPP to be revised, the QA Officer will perform all revisions in consultation with the Program Leader.

XV. Data Reporting

MP-157's staff will enter field measurements and laboratory data into Microsoft Excel tables. Prior to releasing these tables to the Study Manager, Study Coordinator, and Monitoring Coordinator, all data entered on the spread sheets will be reviewed by a second individual. Reclamation will also generate external QA summary reports to support the validity of the water quality data associated with the San Joaquin River Recirculation Pilot Study.

Appendix 1: Area Map



Appendix 2: Data Quality Objectives – Organic Compounds

Parameters	Reporting Limit (ug/L)	Accuracy (% Recovery)	Precision (% RPD)	Completeness (%)	Corrective Actions
Acifluorfen	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Alachlor	0.05	Refer to method	Refer to method	90%	Qualify data or resample
Aldicarb	0.5	70%-130%	Refer to method	90%	Qualify data or resample
Aldicarb sulfone	0.7	70%-130%	Refer to method	90%	Qualify data or resample
Aldicarb sulfoxide	0.5	70%-130%	Refer to method	90%	Qualify data or resample
Aldrin	0.01	Refer to method	Refer to method	90%	Qualify data or resample
Ametryn	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Atraton	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Atrazine	0.05	70%-130%	Refer to method	90%	Qualify data or resample
Baygon	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Bentazon	0.5	70%-130%	Refer to method	90%	Qualify data or resample
Bromacil	5.0	70%-130%	Refer to method	90%	Qualify data or resample
Butachlor	0.05	70%-130%	Refer to method	90%	Qualify data or resample
Butylate	1.0	70%-130%	Refer to method	90%	Qualify data or resample
Carbofuran	0.9	70%-130%	Refer to method	90%	Qualify data or resample
Carboxin	1.0	70%-130%	Refer to method	90%	Qualify data or resample
Carbaryl	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Chlorpropham	0.7	70%-130%	Refer to method	90%	Qualify data or resample
Chlorpyriphos	0.05	70%-130%	Refer to method	90%	Qualify data or resample
Chlordane	0.1	Refer to method	Refer to method	90%	Qualify data or resample
Cycloate	0.4	70%-130%	Refer to method	90%	Qualify data or resample
2,4-D	0.10	70%-130%	Refer to method	90%	Qualify data or resample
2,4-DB	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Tot DCPA Mono & Diacid Degradate	0.2	70%-130%	Refer to method	90%	Qualify data or resample
4, 4’- DDD	0.10	70%-130%	Refer to method	90%	Qualify data or resample
4, 4’- DDE	0.10	70%-130%	Refer to method	90%	Qualify data or resample
4, 4 – DDT	0.10	70%-130%	Refer to method	90%	Qualify data or resample
Dalapon	1.0	70%-130%	Refer to method	90%	Qualify data or resample
Dichlorvos	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Diazinon	0.1	70%-130%	Refer to method	90%	Qualify data or resample
Dicamba	0.08	70%-130%	Refer to method	90%	Qualify data or resample
Dichloroprop	0.5	70%-130%	Refer to method	90%	Qualify data or resample
Dieldrin	0.01	70%-130%	Refer to method	90%	Qualify data or resample
Dimethoate	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Dinoseb	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Diphenamide	0.4	70%-130%	Refer to method	90%	Qualify data or resample
3,5-Dichloro-Benzoic acid	0.5	70%-130%	Refer to method	90%	Qualify data or resample

Parameters	Reporting Limit (ug/L)	Accuracy (% Recovery)	Precision (% RPD)	Completeness (%)	Corrective Actions
Endrin	0.01	Refer to method	Refer to method	90%	Qualify data or resample
EPTC	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Ethoprop	0.1	70%-130%	Refer to method	90%	Qualify data or resample
Fenamiphos	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Fenarimol	0.4	70%-130%	Refer to method	90%	Qualify data or resample
Fluridone	1.8	70%-130%	Refer to method	90%	Qualify data or resample
Heptachlor	0.01	Refer to method	Refer to method	90%	Qualify data or resample
Heptachlor Epoxide	0.01	Refer to method	Refer to method	90%	Qualify data or resample
Hexazinone	0.3	70%-130%	Refer to method	90%	Qualify data or resample
3-Hydroxycarbofuran	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Lindane	0.01	Refer to method	Refer to method	90%	Qualify data or resample
Malathion	0.1	70%-130%	Refer to method	90%	Qualify data or resample
Methiocarb	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Methomyl	1.0	70%-130%	Refer to method	90%	Qualify data or resample
Methoxychlor	0.05	Refer to method	Refer to method	90%	Qualify data or resample
Methyl paraoxon	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Methyl parathion	0.1	70%-130%	Refer to method	90%	Qualify data or resample
Merphos	0.4	70%-130%	Refer to method	90%	Qualify data or resample
Metribuzin	0.4	70%-130%	Refer to method	90%	Qualify data or resample
Mevinphos	0.3	70%-130%	Refer to method	90%	Qualify data or resample
MGK264	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Molinate	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Metalochlor	1.5	70%-130%	Refer to method	90%	Qualify data or resample
Napropamide	0.5	70%-130%	Refer to method	90%	Qualify data or resample
4-Nitrophenol	1.0	70%-130%	Refer to method	90%	Qualify data or resample
Norflurazon	0.4	70%-130%	Refer to method	90%	Qualify data or resample
Oxamyl	2.0	70%-130%	Refer to method	90%	Qualify data or resample
Pebulate	0.4	70%-130%	Refer to method	90%	Qualify data or resample
PCBs	0.1	Refer to method	Refer to method	90%	Qualify data or resample
Pentachlorophenol	0.04	70%-130%	Refer to method	90%	Qualify data or resample
Picloram	0.1	70%-130%	Refer to method	90%	Qualify data or resample
Prometon	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Simazine	0.05	70%-130%	Refer to method	90%	Qualify data or resample
Simetryn	0.1	70%-130%	Refer to method	90%	Qualify data or resample
Stirofos	0.4	70%-130%	Refer to method	90%	Qualify data or resample
2,4,5-T	0.2	70%-130%	Refer to method	90%	Qualify data or resample
2,4,5-TP	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Tebuthiuron	0.4	70%-130%	Refer to method	90%	Qualify data or resample
Terbacil	3.5	70%-130%	Refer to method	90%	Qualify data or resample

Parameters	Reporting Limit (ug/L)	Accuracy (% Recovery)	Precision (% RPD)	Completeness (%)	Corrective Actions
Terbutryn	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Thiobencarb	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Triadimefon	0.3	70%-130%	Refer to method	90%	Qualify data or resample
Tricyclazole	1.2	70%-130%	Refer to method	90%	Qualify data or resample
Vernolate	0.4	70%-130%	Refer to method	90%	Qualify data or resample
2,4,5-T	0.2	70%-130%	Refer to method	90%	Qualify data or resample
Toxaphene	0.5	Refer to method	Refer to method	90%	Qualify data or resample

RL = Reporting Limit

Appendix B

Initial Data Assessment

RECLAMATION

Managing Water in the West

Initial Data Assessment
San Joaquin River Recirculation Pilot Study
Water Quality Monitoring Program

U.S. Department of Interior

Bureau of Reclamation

Mid-Pacific Region

Sacramento, California

May 19, 2005

Initial Data Assessment
San Joaquin River Recirculation Pilot Study
Water Quality Monitoring Program

prepared by

Environmental Affairs
Environmental Monitoring Branch
John Fields, Branch Manager
Stuart Angerer, Physical Scientist

Table of Contents

Tables

Figures

Introduction

This water quality monitoring study will help determine the potential water quality impact to the San Joaquin River (SJR) from the initial flush of water through the Newman Wasteway (NW). This monitoring program is tied to a Pilot Recirculation Study where a volume of water from the Delta- Mendota Canal (DMC) is directed to the SJR via the NW. The NW flows from west to east with its head gate on the DMC just upstream of Check 10 at milepost 54.38. The terminus of the NW is at the SJR 1.24 miles upstream of the Merced River confluence.

The study objective is to monitor how water quality is affected as it moves from the DMC through the NW to the SJR. There are questions regarding water quality impacts from the possible mobilization of sediments and contaminates resulting from previous and current agricultural drainage into the NW.

Assessment of the data from the SJR Pilot Recirculation Study will focus on data that exceeds numeric values intended to protect beneficial uses set forth in the "Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins" by the Central Valley Regional Water Quality Control Board (CVRWQCB). Water quality standards and criteria that will also be used in this assessment are listed in the CVRWQCB's Compilation of Water Quality Goals, August 2003 edition.

The standards used in this assessment include California Toxics Rule (CTR) criteria for freshwater aquatic life and the United States Environmental Protection Agency's National Ambient Water Quality Criteria (NAWQC) for freshwater aquatic life, the California Department of Health Services (DHS) and the United States Environmental Protection Agency (USEPA) drinking water maximum contaminant levels (MCLs), and the Food and Agriculture Organization of the United Nations Limits (Agricultural Water Quality Limits). The assessment approach used in this pilot study was to employ the most stringent water quality standards.

The SJR Basin Plan identifies beneficial uses for the SJR. These uses include agriculture, municipal, industrial (process water), recreation, and aquatic life. A future potential use is identified for municipal and domestic supply.

Water Quality Assessment

1. Acute Toxicity

Definition**:** The ability of a substance to cause severe biological harm or death soon after a single exposure or dose; also, any poisonous effect resulting from a single short-term exposure to a toxic substance.

Acute toxicity testing has the ability to test whether the chemical interactions in an effluent, receiving water or mixing zone has deleterious effects. Specific toxic concentrations of given inorganic or organic chemicals are known and limits therein are set. Toxicity testing takes into account the synergistic, antagonistic, and additive effects of chemicals in these waters.

The objective of toxicity testing is to test adverse effects of effluents on receiving waters by observing survival of test organisms over a 96 hour period. A 90 percent or better survival rate is the standard most widely accepted as a control pass criteria. A test fails if the survival is less than 90 percent or is significantly different from the control survival (which must be greater than 90 percent).

Only two tests failed under these criteria: In the test using *Ceriodaphnia dubia (C. dubia)* water flea, in 100 percent downstream NW water (collected at the site located on the NW just upstream of the confluence of the SJR on August 19, 2004, at time zero (prior to any flushing in the NW), the results revealed 70 percent survival of the test population (control = 90 percent). In the test using *C. dubia* in 100 percent downstream NW water collected on August 20, 2004, (when effluent was near maximum flow at 250 cubic feet per second [cfs]), the results revealed 80 percent survival (control = 100 percent).

All tests on the receiving waters (SJR downstream of the confluence of the NW) passed with equal to or greater than 90 percent survival. The acute toxicity test showed no adverse toxicity impact to the SJR due to the initial flush of the NW from the pilot study (see Table 10, page 41).

2. Nitrate + Nitrite as N, Orthophosphate as P, and BOD

There are no specific numeric values ascribed to these parameters; however, they are important indicators of algal growth. Algal growth and decay have profound impacts on dissolved oxygen levels that are of concern in the SJR.

Average NO_2+NO_3 concentrations in the SJR downstream of the confluence of the NW were reduced from 1.7 to 1.2 mg/L due to recirculation flow. Average concentration of orthophosphate in the SJR was 0.04 mg/L upstream, with a maximum concentration of 0.07 mg/L, and 0.03 mg/L downstream, with a maximum concentration of 0.3 mg/L. The average concentration of BOD in the SJR was 6.0 mg/L upstream with a maximum concentration of 11.0 mg/L to 4.2 mg/L downstream with a maximum of 12.0 mg/L.

The average orthophosphate and BOD concentrations in the NW effluent, SJR upstream and SJR downstream are essentially the same when the level of uncertainty of the analytical measurement is taken into account, and all concentrations were well below water quality standards. The data collected showed no apparent adverse impact to the SJR from the pilot study (see Table 1, pages 27-28).

3. Total Boron

The CVRWQCB maximum concentration objective of 2,000 µg/L was met in SJR. This objective is for below the mouth of the Merced River to Vernalis, whereas this study sampled above this point. Both the upstream and downstream SJR sites exceeded the agricultural water quality limit of 700 µg/L during the initial 24 hours of the study.

The levels of boron from the DMC and the bottom of the NW were relatively low. The data collected showed no apparent adverse impact to the SJR from the pilot study. Average concentrations of boron at the downstream SJR site were reduced by

40 percent by the NW flows. Introduction of the DMC water through the NW to the SJR improved the downstream concentrations to meet the agricultural limit (see Figure 1, page 15 and Table 2, pages 29-30).

4. Chlorophyll a

Before the pilot study was conducted, field crew documented that the NW contained many pools of stagnant water with decaying algae. The data reflects this observation in showing an increase of 3 to 5 fold between the upstream and downstream NW sites (see Table 3, page 31-32).

The chlorophyll a levels in the NW downstream were significantly lower than levels measured in the SJR upstream. The chlorophyll a levels in the SJR downstream were consistently lower than levels measured upstream as a result of the dilution effect of the NW water on the SJR. The data collected appears to have no apparent adverse impact to the SJR from the pilot study. However, due to an insufficient number of data points as a result of laboratory issues, a definitive conclusion cannot be made on the impact to the SJR.

5. E. Coli

As described in the CVRWQCB Basin Plan…"In waters designated for contact recreation (REC-1), the fecal coliform concentration (based on a minimum of not less than five samples for any 30-day period) shall not exceed a geometric mean of 200/100 ml."

All results from the NW are reported in E. Coli (a fecal coliform) as a Most Probable Number (MPN/100ml). The range of the results was from 20/100 ml to 56/100 ml. Eight E. Coli samples were collected during the first eight hours of the study to characterize the initial flush of water from the NW. Four samples were collected at the downstream NW site and four samples were collected at the downstream SJR site (see Table 4, page 33). The data shows no apparent adverse impact to the SJR from the pilot study.

6. Dissolved Metals

Note: Toxicity of seven metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) is affected by the hardness of the receiving waters. Historic water hardness values of the SJR at Hills Ferry over the August and September period range from 260 to 350 mg/L of calcium carbonate equivalent. Measured hardness in the SJR downstream during the pilot study ranged from 220 to 370 mg/L. For purposes of assessing the toxicity of the metals, the conservative lower value of 220 mg/L was used (see Table 5, page 34-35).

In calculating averages concentrations for each chemical parameter, all non-detect measurements were replaced with the numeric value of the reporting limit (i.e. non-detect of <0.5 = 0.5).

Aluminum

The CVRWQCB Basin Plan has no specific objective for aluminum. The NAWQC criterion to protect freshwater aquatic life is 87 µg/L and is the most stringent standard to protect beneficial uses of the SJR. Concentrations in the NW downstream site averaged 28.2 µg/L with a maximum value of 53.8 µg/L. Since the levels of aluminum discharged from the NW during the pilot study are well below the action limits, the effluent appears to have no adverse impact to beneficial uses of the river. However, due to an insufficient number of data points as a result of laboratory issues, a definitive conclusion cannot be made on the impact to the SJR.

Average concentrations in the SJR went from 8.9 µg/L upstream, with a maximum concentration of 12.4 µg/L, to 18.2 µg/L downstream, with a maximum concentration of 30.4 µg/L. Although the level of aluminum was increased in the river, all concentrations were below water quality standards (see Table 5, page 34-35).

Antimony

The CVRWQCB Basin Plan has no specific objective for antimony. The most stringent objective of 6 µg/L as a primary MCL set by the USEPA and the DHS was used as a limit for possible sources of municipal water in the SJR. Concentrations in the NW downstream site averaged 0.6 µg/L upstream, with a maximum concentration of 0.9 µg/L. Since the levels of antimony discharged from the NW during the pilot study are well below the action limits, the effluent should have no adverse impact to beneficial uses of the river.

Average concentrations in the SJR were 0.5 µg/L upstream and downstream with maximum concentrations of 0.6 µg/L and 0.7 µg/L, upstream and downstream respectively. This data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Arsenic

The CVRWQCB Basin Plan has no specific objective for arsenic. The most stringent objective of 10 µg/L as a primary MCL set by the USEPA was used to protect beneficial uses on the SJR. Concentrations in the NW downstream site averaged 2.7 µg/L with a maximum value of 5.0 µg/L. Since the levels of arsenic discharged from the NW during the pilot study are well below the action limits, the effluent should have no adverse impact to beneficial uses of the river.

Average concentration in the SJR went from 5.4 µg/L upstream, with a maximum concentration of 6.2 µg/L, to 3.6 µg/L downstream, with a maximum concentration of 5.4 µg/L. The data shows a dilution of this metal in the river from the NW effluent. The data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Beryllium

The CVRWQCB Basin Plan has no specific objective for beryllium. The most stringent objective of 4 µg/L as a primary MCL set by the USEPA and the DHS was used as a limit for possible sources of municipal water in the SJR.

The data collected showed no apparent adverse impact to the SJR from the pilot study. Beryllium was not detected at any time at or above the reporting limit of 5 µg/L (see Table 5, page 34-35).

Cadmium

There is no specific Basin Plan objective for cadmium in the SJR. The NAWQC criterion to protect freshwater aquatic life is 0.4 µg/L and is the most stringent standard to protect beneficial uses of the SJR.

Cadmium was not detected at any of the sites at or above the reporting limit of 0.25µg/L. The data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Chromium III

The CVRWQCB Basin Plan has no specific objective for chromium. The NAWQC criterion to protect freshwater aquatic life is 140 µg/L and is the most stringent standard to protect beneficial uses of the SJR. Concentrations in the NW downstream site did not exceed the reporting limit of 0.5 µg/L. Since the levels of chromium discharged from the NW during the pilot study are well below the action limits, the effluent should have no apparent adverse impact to beneficial uses of the river.

Average concentrations in the SJR went from 0.5 µg/L upstream, with a maximum concentration of 0.7 µg/L, to $\leq$ 0.5 µg/L downstream. The average concentrations in the NW effluent, SJR upstream, and SJR downstream are essentially the same when the level of uncertainty of the analytical measurement is taken into account, and all concentrations were well below water quality standards. The data collected showed no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Copper

The CTR and NAWQC criterion to protect freshwater aquatic life is 18 µg/L and is the most stringent standard to protect beneficial uses of the SJR. Concentrations in the NW downstream site averaged 1.3 µg/L with a maximum value of 2.3 µg/L. Since the levels of copper discharged from the NW during the pilot study are below the action limits, the effluent should have no apparent adverse impact to beneficial uses of the river.

Average concentrations in the SJR went from 4.4 µg/L upstream, with a maximum concentration of 5.2 µg/L, to 2.6 µg/L downstream, with a maximum concentration of 3.9 µg/L. Copper concentrations in the SJR were reduced with the introduction of NW water. The data collected shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Lead

The CVRWQCB Basin Plan has no specific objective for lead. The CTR and NAWQC criterion to protect freshwater aquatic life is 5.9 µg/L and is the most stringent standard to protect beneficial uses of the SJR.
Lead was not detected at any of the sites at or above the reporting limit of 0.5 µg/L. The data collected shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Mercury

The CVRWQCB Basin Plan has no specific objective for mercury. The NAWQC criterion to protect freshwater aquatic life is 0.77 µg/L and is the most stringent standard to protect beneficial uses of the SJR. Concentrations in the NW downstream site averaged 0.002 µg/L with a maximum value of 0.004 µg/L. Since the levels of mercury discharged from the NW during the pilot study are more than an order of magnitude below the action limits, the effluent should have no apparent adverse impact to beneficial uses of the river.

Average concentrations in the SJR were 0.002 µg/L upstream, with a maximum concentration of 0.004 µg/L, and 0.002 µg/L downstream, with a maximum concentration of 0.003 µg/L. The data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Nickel

The CVRWQCB Basin Plan has no specific objective for nickel. The CTR and USEPA criterion to protect freshwater aquatic life is 100 µg/L and is the most stringent standard to protect beneficial uses of the SJR. Concentrations in the NW downstream site averaged 3.0 µg/L with a maximum value of 5.7 µg/L. Since the levels of nickel discharged from the NW during the pilot study are well below the action limits, the effluent should have no apparent adverse impact to beneficial uses of the river.

Average concentrations in the SJR were 2.5 µg/L upstream, with a maximum concentration of 4.4 µg/L, and 3.2 µg/L downstream, with a maximum concentration of 4.0 µg/L. The average nickel concentration in the SJR upstream and SJR downstream are essentially the same when the level of uncertainty of the analytical measurement is taken into account, and all concentrations were well below water quality standards. The data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Silver

The CVRWQCB Basin Plan has no specific objective for silver in the SJR. The CTR and NAWQC criterion to protect freshwater aquatic life is 18 µg/L and is the most stringent standard to protect beneficial uses of the SJR.

Silver was not detected at any of the sites at or above the reporting limit of 0.5µg/L. The data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Thallium

The CVRWQCB Basin Plan has no specific objective for thallium. The most stringent objective of 2 µg/L as a primary MCL set by the USEPA and the DHS was used as a limit for possible sources of municipal water in the SJR.

The data collected showed no apparent adverse impact to the SJR from the pilot study. Thallium was not seen at any of the sites at or above the reporting limit of 1.0 µg/L (see Table 5, page 34-35).

Zinc

The CVRWQCB Basin Plan has no specific objective for zinc in the SJR. The CTR and NAWQC criterion to protect freshwater aquatic life is 230 µg/L and is the most stringent standard to protect beneficial uses of the SJR. The NW downstream site had a single detection of zinc over the detection limit of 2.0 µg/L at 2.9 µg/L.

Average concentrations in the SJR were 2.2 µg/L upstream, with a maximum concentration of 3.7 µg/L, and 2.1 µg/L downstream, with a maximum concentration of 2.9 µg/L. The average zinc concentration in the SJR upstream and SJR downstream are essentially the same (when the level of uncertainty of the analytical measurement is taken into account) and all concentrations were well below water quality standards. The data shows no apparent adverse impact to the SJR from the pilot study (see Table 5, page 34-35).

Dissolved Metals Summary

In evaluating the metals in the NW, aluminum was the only metal measured in the NW effluent that was higher than the SJR background concentrations; even the maximum concentration was below action limits.

None of the metals measured were above action limits. Based solely on the levels measured, there were no apparent adverse effects on the beneficial uses of the SJR. Since individual metal measurements do not take into account potential synergistic or additive effects, toxicity testing was also conducted. Since the toxicity tests showed no adverse effects to the test organisms, this data adds a higher degree of certainty that the NW effluent will not have a deleterious effect on the SJR.

In calculating averages concentrations for each chemical parameter, all non-detect measurements were replaced with the numeric value of the reporting limit (i.e. non-detect of <0.5 = 0.5).

7. Organics

EPA Method 505 (see Table 6, page 36)
Organo Chlorine Pesticides and PCB's
EPA Method 515.4 (see Table 7, page 37)
Herbicides and Phenoxy Acids
EPA Method 525 (see Table 8, pages 38-39)
Organophosphate and Triazine Pesticides
EPA Method 531 (see Table 9, page 40)
Carbamates

The majority of these parameters were not detected above their associated reporting limits. Of the samples that were detected, the following narratives explain each.

2,4-D

The CVRWQCB Basin Plan has no specific objective for 2,4-D in the SJR. The most stringent objective of 70 µg/L as a primary MCL set by the USEPA and the DHS was used as a limit for possible sources of municipal water in the SJR. 2,4-D was detected once on the SJR downstream site on August 20, 2004, at 00:30 hours at the concentration of 0.23 µg/L, well below the action limit. The data shows no apparent adverse impact to the SJR from the pilot study.

DCPA

The CVRWQCB Basin Plan has no specific objective for DCPA in the SJR. There are no established MCLs for DCPA. DCPA was found only in the downstream NW site at low levels ranging from <0.20 to 0.38 µg/L (see Table 7). The data shows no apparent adverse impact to the SJR from the pilot study.

bis (2-ethylhexyl) phthalate

The CVRWQCB Basin Plan has no specific objective for phthalate esters. The most stringent objective of 6 µg/L as a primary MCL set by the USEPA was used as a limit for possible sources of municipal water in the SJR. One occurrence of bis (2-ethylhexyl) phthalate (an organic commonly used in plastics) was seen in the SJR upstream site on August 19, 2004, at 07:00 hours at 1.7 µg/L, which was well below the action limit. The data shows no apparent adverse impact to the SJR from the pilot study.

Metolachlor

The CVRWQCB Basin Plan has no specific objective for metolachlor. The data was assessed using the most stringent objective of 44 µg/L, an advisory concentration based on consumption of water and organisms that was established by the USEPA. All samples collected detected metolachlor. The average concentration in the NW downstream site was 0.4 µg/L with a maximum value of 0.5 µg/L. The detected levels of metolachlor were an order of magnitude lower than the action limit.

The upstream SJR concentration was 0.1 µg/L, the downstream average concentration was 0.2 µg/L, with a maximum concentration of 0.2 µg/L. The data shows no apparent adverse impact to the SJR from the pilot study.

Organics Summary

The majority of the organic results were not detected above the method reporting limits. Of the parameters that were detected, the concentrations were many times below the established criteria. Therefore, the pilot study did not adversely impact the SJR for the range of pesticides and organic pollutants measured.

The observed values in the NW downstream site were most likely due to the build-up of chemicals in agricultural drainage water collected in the NW. The baseline value in the NW upstream site measured 0.080 µg/L. During the 18-hour sampling period, metolachlor levels decreased in the NW by approximately half. Thus, this trend was an effect of the first flush.

8. Total Selenium

The CVRWQCB Basin Plan water quality objective for selenium is 5.0 µg/L. The average concentration in the NW downstream site was 0.4 µg/L with a maximum value of 0.6 µg/L.

Average concentration in the SJR was 4.3 µg/L upstream, with a maximum concentration of 7.5 µg/L, and 2.9 µg/L downstream, with a maximum concentration of 5.1 µg/L. Selenium concentrations in the SJR were reduced with the introduction of NW water. The data shows no apparent adverse impact to the SJR from the pilot study.

Note: Both acid soluble and total recoverable results are included in table 11. The primary purpose of collecting samples for total recoverable was to determine the worst-case scenario in assessing selenium. Even though the Basin Plan objective uses dissolved results, both the acid soluble and total recoverable methods are more rigorous tests. Because of interference to the analytical method due to high turbidity, the acid soluble method was chosen as an alternative (see Table 11, pages 42-43 and Figure 2, page 16).

9. TKN, Total Phosphorus and Ammonia as Nitrogen

The CVRWQCB Basin Plan has no specific objective for nutrients. The only established criterion is the NAWQC to protect the most sensitive life stage of freshwater aquatic organisms at 0.56 mg/L for ammonia - and this limit is pH and temperature dependent. The 0.56 mg/L criterion was based on the maximum temperature of 30^{o} C and pH of 8.3. Concentrations of Total Kjehldahl Nitrogen (TKN) in the NW downstream site averaged 1.4 mg/L, with a maximum concentration of 3.8 mg/L. Concentrations of total P averaged 0.4 mg/L, with a maximum concentration 1.0 mg/L. Concentrations of N from ammonia averaged 0.26 mg/L with a maximum concentration 0.96 mg/L. Since the criterion is based on a 30-day average and the average concentration measured in the NW effluent was below the criterion, there should be not apparent adverse effect to the beneficial uses of the SJR.

Average concentrations of TKN in the SJR were 1.3 mg/L upstream, with a maximum concentration of 1.7 mg/L, and 1.4 mg/L downstream, with a maximum concentration of 2.7 mg/L.

Average concentrations of total P in the SJR were 0.34 mg/L upstream, with a maximum concentration of 0.45 mg/L, and 0.39 mg/L downstream, with a maximum concentration of 0.67 mg/L.

Average concentrations of N from ammonia in the SJR were 0.17 mg/L upstream, with a maximum concentration of 0.35 mg/L, and 0.18 mg/L downstream, with a maximum concentration of 0.40 mg/L (see Table 12, pages 44-45).

The maximum concentrations observed for each of the parameters corresponded to the leading edge of the first flush. The data from the upstream and downstream NW indicates the probable source of nutrients in the NW originated from agricultural drainage, including discharges from dairy and poultry facilities observed during the pilot study.

10. TOC

The CVRWQCB Basin Plan has no specific objective for Total Organic Carbon (TOC), and there are no other regulatory standards available at this time. Concentrations of TOC in the NW downstream site averaged 12.3 mg/L, with a maximum concentration of 100 mg/L.

TOC released from the NW peaked during the initial 18 hours of the study at the NW downstream and SJR downstream sites. Average concentrations of TOC in the SJR were 5.9 mg/L upstream, with a maximum concentration of 8.1mg/L, and 111 mg/L downstream, with a maximum concentration of 410 mg/L. Following the first flush, average concentrations of TOC in the SJR were 5.9 mg/L upstream, with a maximum concentration of 8.1 mg/L, and 5.1 mg/L downstream, with a maximum of 6.9 mg/L.

The data collected showed no apparent adverse impact to the SJR from the pilot study (see Table 13, pages 46-47 and Figure 3, page 21) and elevated TOC corresponds to flow data and movement of material during the first flush. Removal of the biomass and/or continued use of the NW should alleviate this problem.

11. TSS

Total Suspended Solids (TSS) are both a significant part of physical and aesthetic degradation of water and are a good indicator of other pollutants, particularly nutrients and metals that are carried on the surfaces of sediment in suspension. There have also been established relationships of TSS with turbidity whereas TSS is a measure of total mass per volume. Turbidity could be said to be a measure of how that total mass effects light penetration.
The Basin Plan states that …“waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.” Average TSS in the NW downstream site was 174 mg/L, with a maximum value of 559.

Average concentrations in the SJR were 72 mg/L upstream, with a maximum concentration of 161 mg/L, and 156 mg/L downstream, with a maximum concentration of 417 mg/L (see Table 14, pages 48-49 and Figure 4, page 22). However, it should be noted that following the first flush there was a declining trend over time.

The increase of TSS and turbidity seen in both the NW and SJR downstream can be attributed to the remobilization of fine bottom sediments accumulated in the NW. Where turbidity has a numeric objective in the CVRWQCB Basin Plan, there is only a narrative objective for TSS (see turbidity under “Physicals” heading on page XX). The data shows that the pilot study increased TSS on the SJR. If recirculation is determined to be a worthwhile tool for Reclamation to develop, stabilization of the channel bottom should reduce TSS levels during future releases.

12. Physicals

EC

The CVRWQCB Basin Plan has no specific objective for conductivity below the Mendota Pool on the SJR. The most stringent objective of 700 µS/cm as an agricultural water quality limit was used. Concentrations in the NW downstream site averaged 547 µS/cm with a maximum value of 1220 µS/cm.

Average concentrations in the SJR were 1603 µS/cm upstream, with a maximum concentration of 2001 µS/cm, and 1053 µS/cm downstream, with a maximum concentration of 1600 µS/cm. Conductivity in the SJR was decreased by the introduction of NW water (Figure 5, page 23 and Table 15, pages 50-51). The data shows no apparent adverse impact to the SJR from the pilot study.

Dissolved Oxygen

The CVRWQCB Basin Plan lists 5.0 mg/L as the most stringent objective for dissolved oxygen (DO). Concentrations in the NW downstream site averaged 6.4 mg/L with a minimum concentration of 2.8 mg/L.

Average concentrations in the SJR were 8.3 mg/L upstream, with a minimum concentration of 4.6 mg/L, and 7.7 mg/L downstream, with a minimum concentration of 6.1 mg/L

The data collected showed a decrease in the DO concentration in the SJR and did not drop below 5.0 mg/L during the pilot study (Figure 6, page 20 and Table X, pages XX-XX).

Turbidity

The Basin Plan states that “…where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent” and “where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.” The SJR upstream averaged 49.3 NTU with a range of 30.8 to 78.4 NTU during the study. The downstream turbidity water quality objective was exceeded throughout the duration of the pilot study (Figure 7, page 25 and Table 15, pages 50-51).

During the study, Reclamation was in routine communication with the CVRWQCB to apprise them of turbidity readings. Additional monitoring, along with a reduction of flow down the NW from 300 to 250 cfs, was implemented further downstream to determine the river's ability to assimilate this load. Turbidity monitoring on the SJR at Patterson showed that the river was able to recover, given this allowable zone of dilution (average 37.6 NTU from August 20 through August 23, 2004).

The data shows that the pilot study significantly impacted turbidity on the SJR. If recirculation is determined to be a worthwhile tool for Reclamation to develop, stabilization of the channel bottom should significantly reduce turbidity impacts to the SJR.

Temperature

The Basin Plan states that…"at no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5º F (2.8º C) above natural receiving water temperature." The temperature in the NW downstream site averaged 24.9 º C with a maximum temperature of 29.3º C.

Average temperatures in the SJR were 25.7º C upstream, with a maximum temperature of 29.2º C, and 24.4 º C downstream, with a maximum temperature of 27.6 º C. Temperature in the SJR was decreased by the introduction of NW water (Figure 8, page 26 and Table 15, pages 50-51). The data shows no apparent adverse impact to the SJR from the pilot study.

Summary

A suite of inorganic, organic, and physical parameters were measured to assess the potential changes in water quality in the NW and impacts to the SJR as a result of recirculating CVP water. Chemical parameters assessed include: (1) heavy metals and trace elements, (2) nutrients, (3) PCBs, and (4) agricultural compounds including organochlorines, organophosphates, triazines, carbamates, and phenoxy acids, bacteriological and biological indicators.

Since individual metal measurements do not take into account potential synergistic or additive effects, acute toxicity testing was also conducted. The data shows that implementation of the recirculation pilot study impacted the river water quality for the following parameters: (1) aluminum, (2) metolachlor, (3) TKN, (4) total phosphorus, (5) ammonia as nitrogen, (6) TOC, (7) TSS, (8) DO, and (9) turbidity.

In assessing the data for the above parameters, a declining trend in concentration over the course of the pilot study was noted with the exception of aluminum, TSS, and turbidity. The initial elevated levels shown for these chemical constituents were the result of the first flush effect caused by the mobilization of accumulated agricultural drainage, channel bottom sediments, and vegetation in the NW.

For the three parameters that were elevated due to the discharge of CVP water, none exceeded the most stringent water quality standards. TSS and turbidity effects attributable to recirculation were expected and could be mitigated through design and structural improvements and/or operation of the NW. The elevated aluminum levels related to this pilot study may be the result of analytical matrix problems and will be investigated further.

Inorganic Constituents Tested

Nitrate + Nitrite
TKN
Ammonia
Total Phosphorus
Ortho-phosphate
Chlorophyll A
E. Coli
TSS
TOC

BOD
Boron
Selenium
Aluminum
Antimony
Arsenic
Beryllium
Cadmium
Chromium

Copper
Lead
Magnesium
Mercury
Nickel
Silver
Thallium
Zinc

Organic Constituents Tested

Acifluorfen	Dichloroprop	Oxamyl
Alachlor	Dieldrin	Pebulate
Aldicarb	Dimethoate	PCBs
Aldicarb sulfone	Dinoseb	Pentachlorophenol
Aldicarb sulfoxide	Diphenamide	Picloram
Aldrin	3,5-Dichloro- Benzoic acid	Prometon
Ametryn	Endrin	Simazine
Atraton	EPTC	Simetryn
Atrazine	Ethoprop	Stirofos
Baygon	Fenamiphos	2,4,5-T
Bentazon	Fenarimol	2,4,5-TP
Bromacil	Fluridone	Tebuthiuron
Butachlor	Heptachlor	Terbacil
Butylate	Heptachlor Epoxide	Terbutryn
Carbofuran	Hexazinone	Thiobencarb
Carboxin	3-Hydroxycarbofuran	Triadimefon
Carbaryl	Lindane	Tricyclazole
Chlorpropham	Malathion	Vernolate
Chlorpyriphos	Methiocarb	2,4,5-T
Chlordane	Methomyl	Toxaphene
Cycloate	Methoxychlor	
2,4-D	Methyl paraoxon	
2,4-DB	Methyl parathion	
Tot DCPA Mono&Diacid Degradate	Merphos	
4, 4'- DDD	Metribuzin	
4, 4'- DDE	Mevinphos	
4, 4 - DDT	MGK264	
Dalapon	Molinate	
Dichlorvos	Metalochlor	
Diazinon	Napropamide	
Dicamba	4-Nitrophenol	
	Norflurazon	

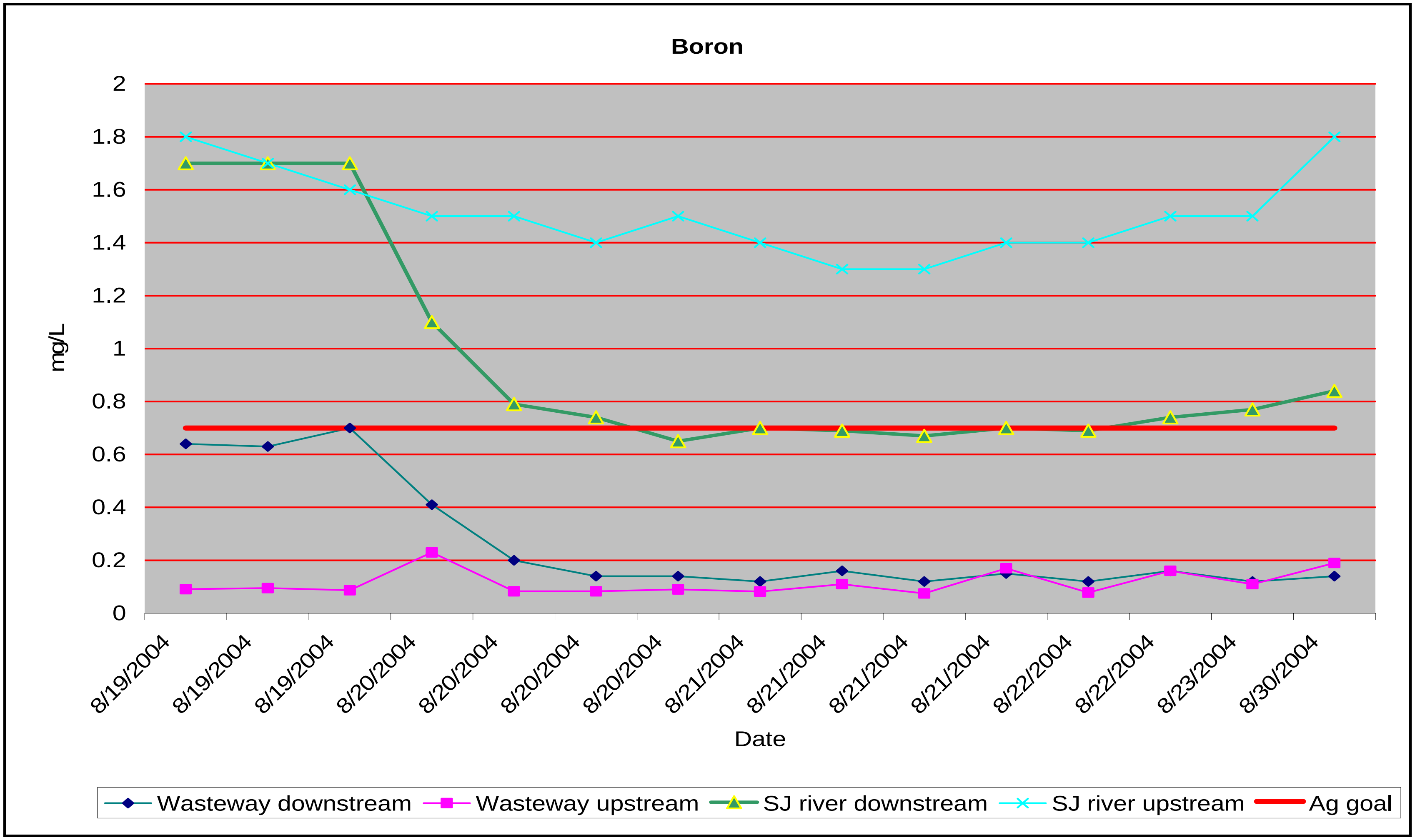


Figure 1. Boron

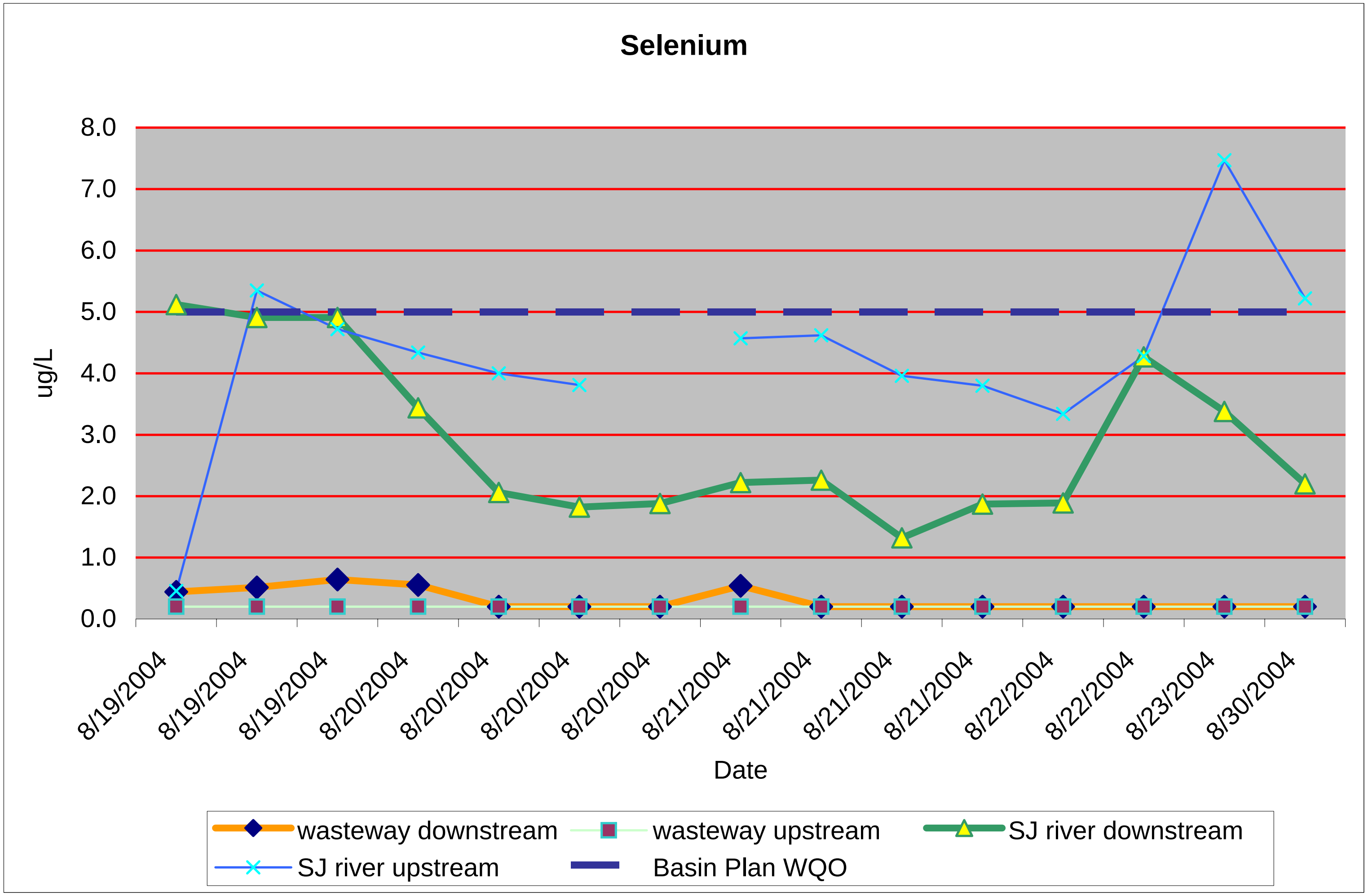
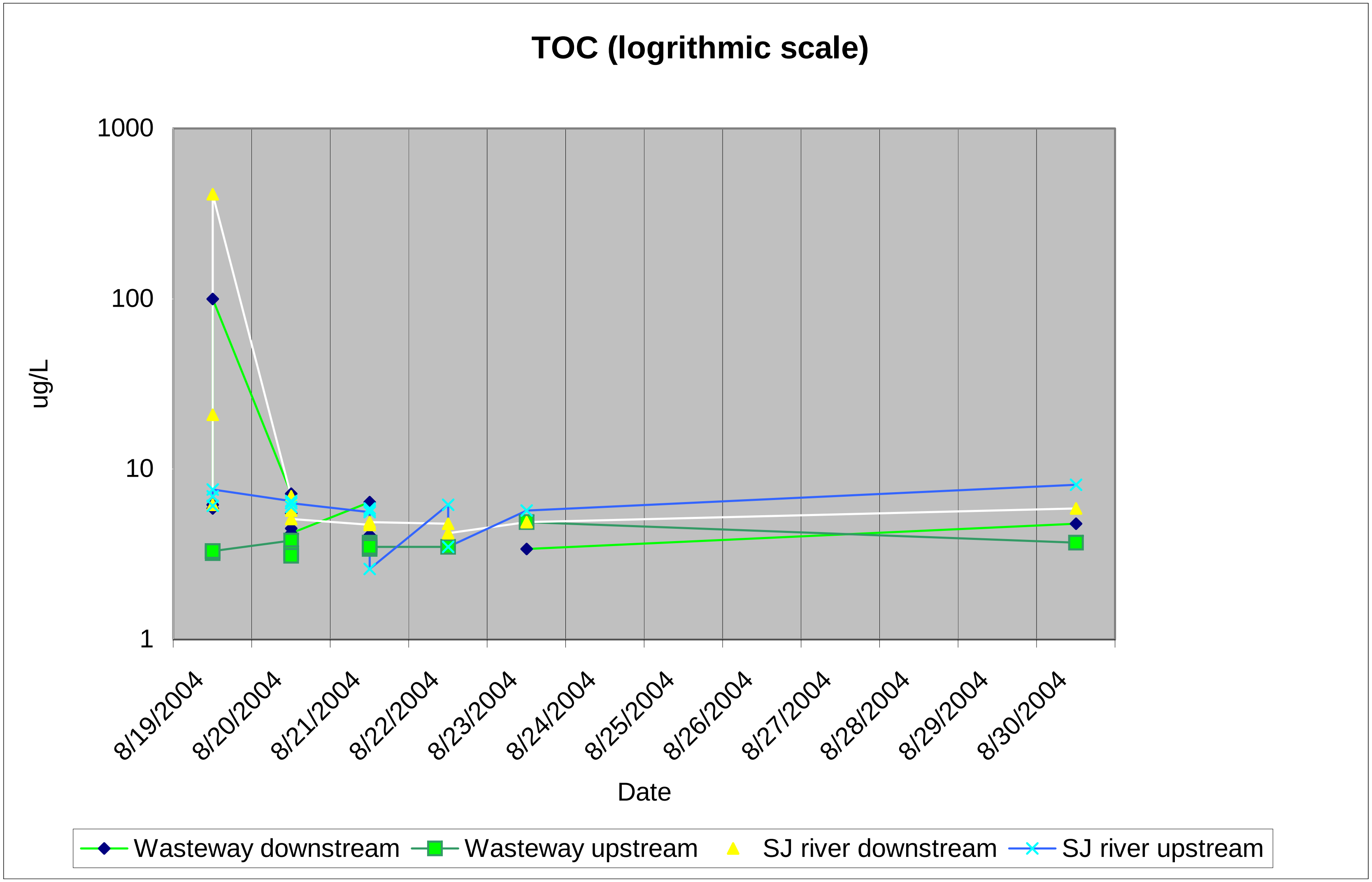


Figure 2. Selenium



TOC (logrithmic scale)
1000
100
10
1
ug/L
8/19/2004
8/20/2004
8/21/2004
8/22/2004
8/23/2004
8/24/2004
8/25/2004
8/26/2004
8/27/2004
8/28/2004
8/29/2004
8/30/2004
Date
Wasteway downstream
Wasteway upstream
SJ river downstream
SJ river upstream

Figure 3. TOC

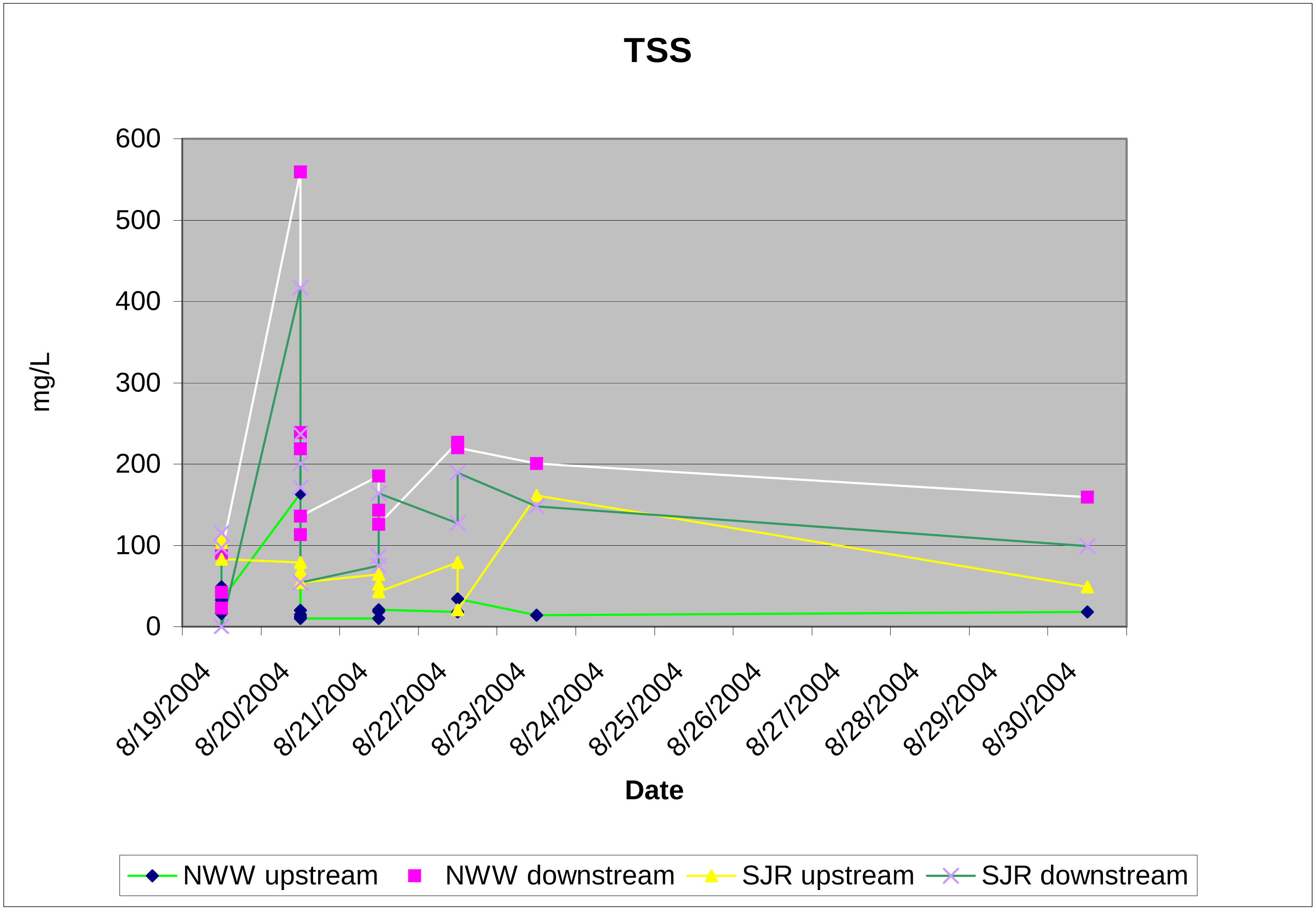

TSS
600
500
400
300
200
100
0
mg/L
8/19/2004
8/20/2004
8/21/2004
8/22/2004
8/23/2004
8/24/2004
8/25/2004
8/26/2004
8/27/2004
8/28/2004
8/29/2004
8/30/2004
Date
NWW upstream
NWW downstream
SJR upstream
SJR downstream

Figure 4. TSS

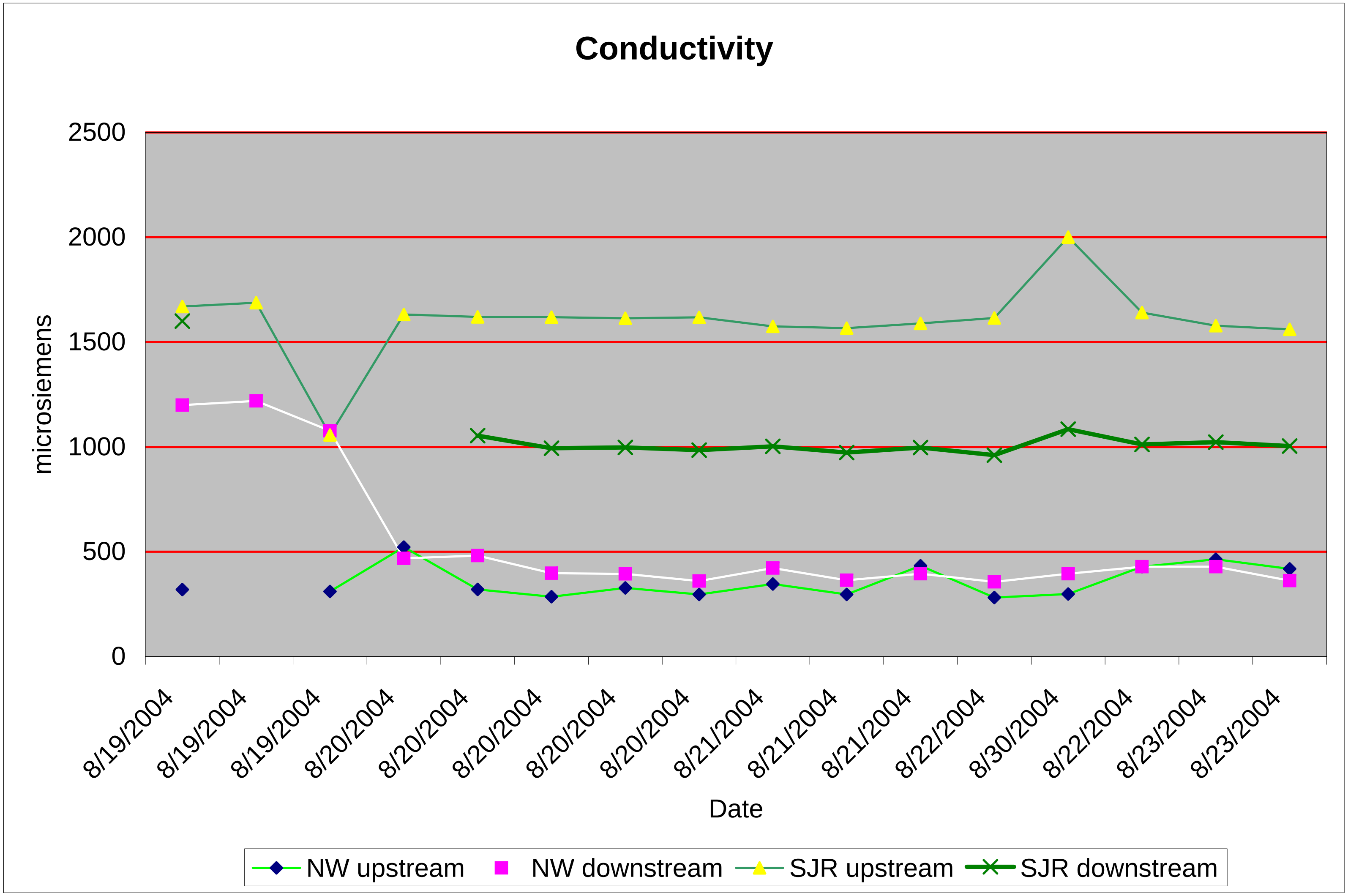


Figure 5. Conductivity

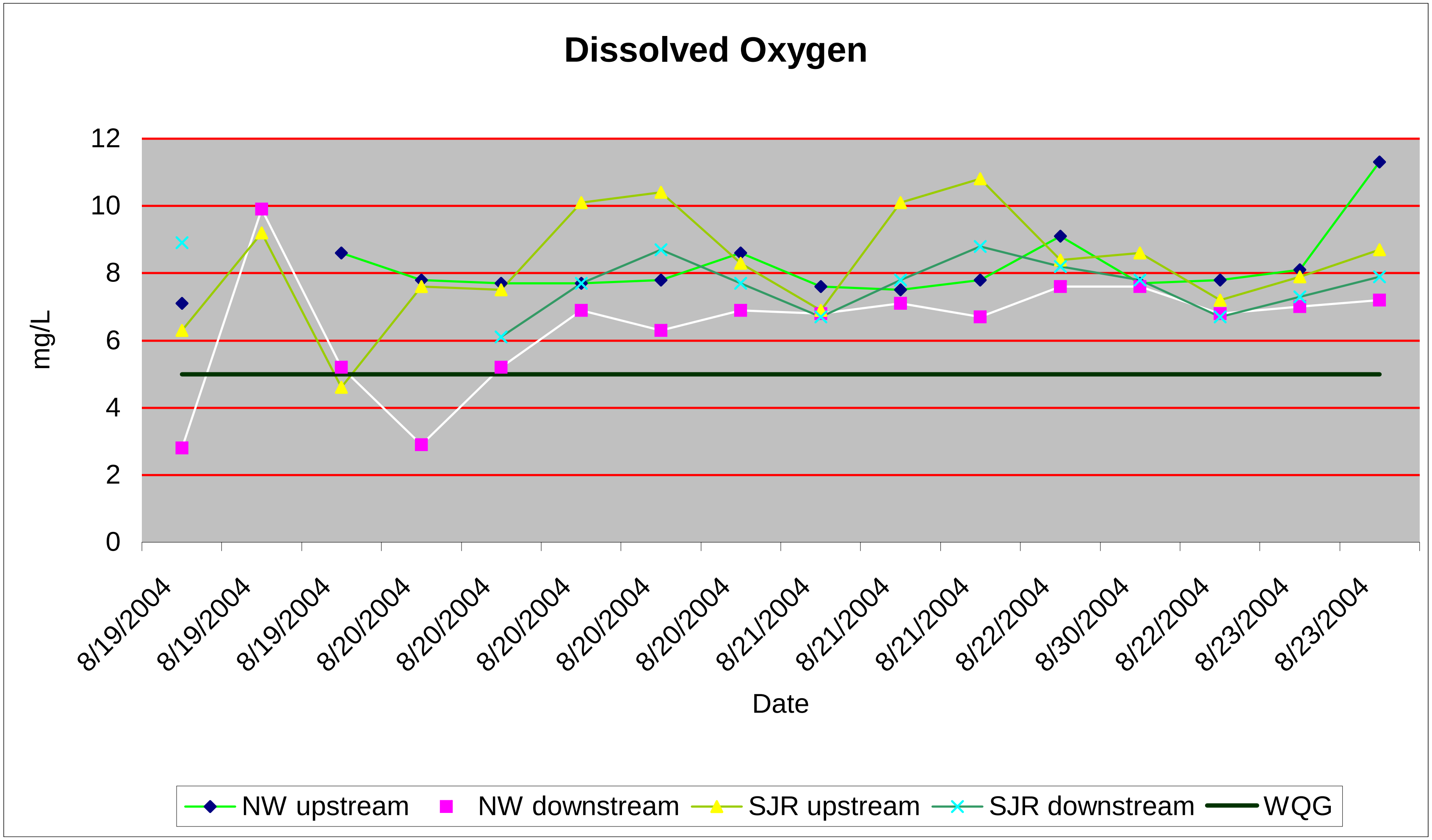


Figure 6. Dissolved Oxygen

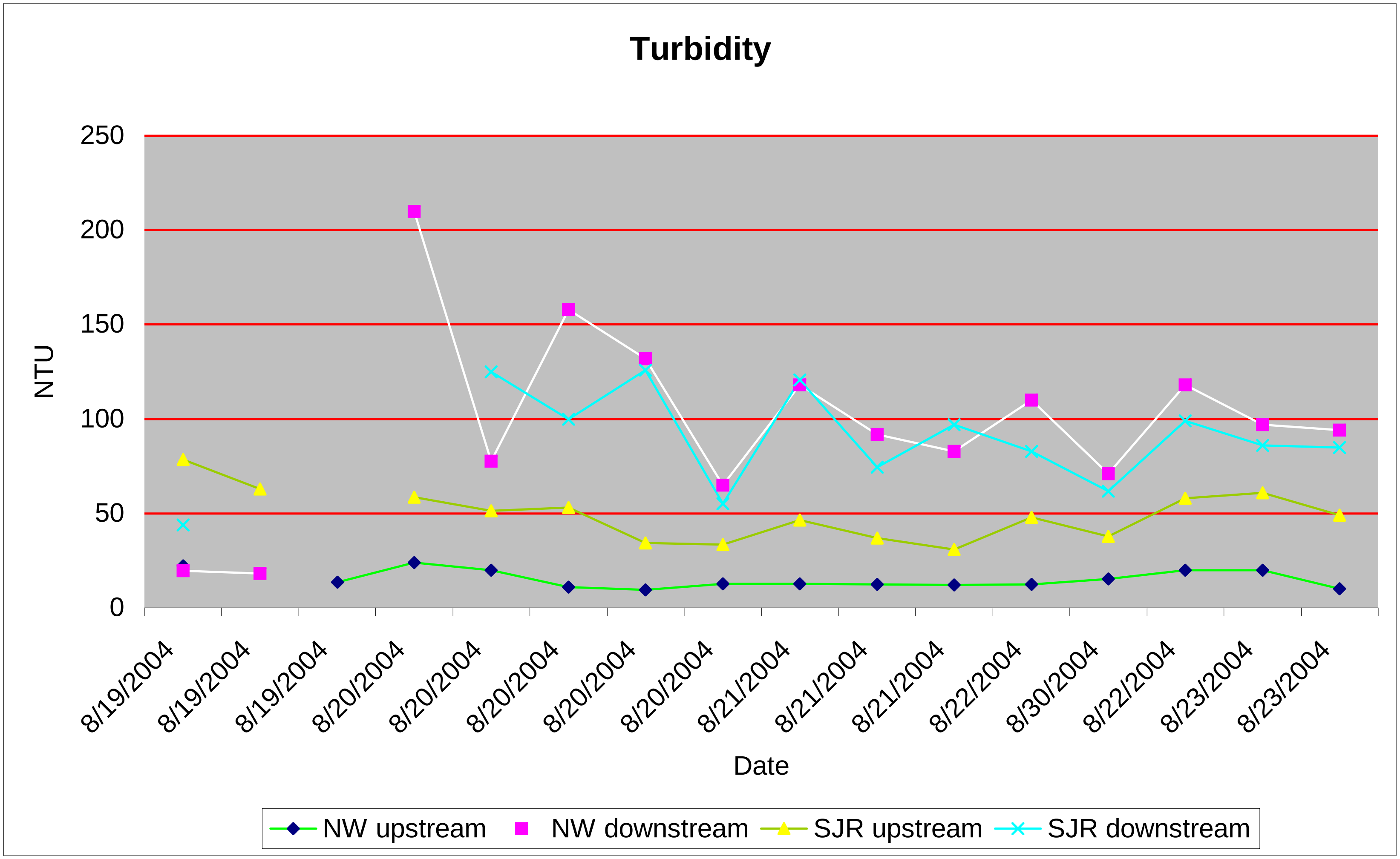


Figure 7. Turbidity

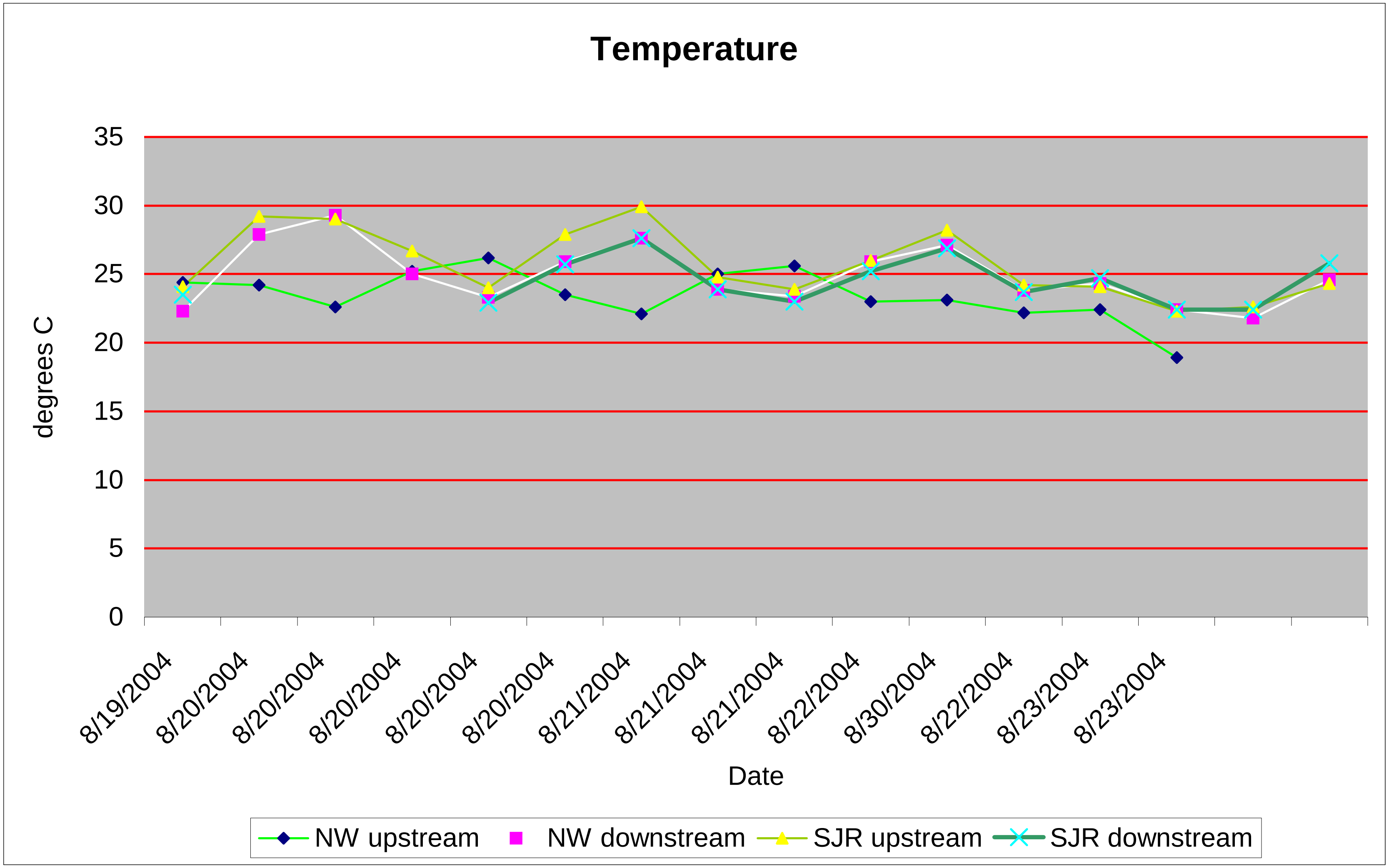


Figure 8. Temperature

Table 1. BOD, Nitrate+Nitrite as N, and Orthophosphate as P

Bureau of Reclamation, San Joaquin River Recirculation Pilot Study BOD, Nitrate+Nitrite as N, and Orthophosphate as P Production Sample Results (mg/L)									
Site Name	Field ID	Date	Time	BOD		Nitrate + Nitrite as N		Orthophosphate as P	
				Result	RL	Result	RL	Result	RL
Newman Waste Way Downstream	NWW002	8/19/2004	06:00	3	3	0.32	0.05	0.33	0.03
	NWW007	8/19/2004	12:00	4	3	0.47	0.05	0.32	0.03
	NWW016	8/19/2004	18:10	6	3	0.62	0.05	0.18	0.03
	NWW020	8/20/2004	00:00	8_{E}	3	0.53	0.05	<0.03	0.03
	NWW023	8/20/2004	06:30	4	3	0.62	0.05	<0.03	0.03
	NWW027	8/20/2004	12:30	<3	3	0.42	0.05	<0.03	0.03
	NWW034	8/20/2004	18:00	<3	3	0.44	0.05	<0.03	0.03
	NWW040	8/21/2004	00:00	<3	3	0.36	0.05	<0.03	0.03
	NWW044	8/21/2004	06:40	<3	3	0.48	0.05	<0.03	0.03
	NWW048	8/21/2004	12:15	<3	3	0.37	0.05	<0.03	0.03
	NWW055	8/21/2004	18:00	<3	3	0.44	0.05	0.04	0.03
	NWW061	8/22/2004	01:15	3	3	0.40	0.05	<0.03	0.03
	NWW102	8/22/2004	06:35	3	3	0.50	0.05	<0.03	0.03
	NWW105	8/23/2004	06:40	3	3	0.52	0.05	0.13_{I}	0.03
	NWW112	8/23/2004	12:30	<3	3	0.43	0.05	0.07_{I}	0.03
	NWW065	8/30/2004	11:25	<3	3	0.54	0.05	<0.03	0.03
Newman Waste Way Upstream	NWW001	8/19/2004	06:00	3	3	0.32	0.05	0.05	0.03
	NWW005	8/19/2004	--	5	3	0.40	0.05	0.07	0.03
	NWW012	8/19/2004	20:40	4	3	0.29	0.05	0.06	0.03
	NWW018	8/20/2004	01:30	5	3	*1.67_{I}	0.05	<0.03	0.03
	NWW022	8/20/2004	06:40	5	3	0.29	0.05	0.06	0.03
	NWW026	8/20/2004	12:00	<3	3	0.31	0.05	0.05	0.03
	NWW033	8/20/2004	19:40	<3	3	0.30	0.05	0.08	0.03
	NWW039	8/20/2004	23:30	6	3	0.29	0.05	0.04	0.03
	NWW043	8/21/2004	06:00	<3	3	0.42	0.05	0.07	0.03
	NWW047	8/21/2004	12:00	<3	3	0.31	0.05	0.05	0.03
	NWW054	8/21/2004	18:00	<3	3	0.59	0.05	0.08	0.03
	NWW060	8/22/2004	00:00	<3	3	0.30	0.05	<0.03	0.03
	NWW100	8/22/2004	06:08	<3	3	0.58	0.05	0.11	0.03
	NWW111	8/23/2004	12:00	<3	3	0.43	0.05	0.08_{I}	0.03
	NWW064	8/30/2004	13:30	<3	3	0.83	0.05	0.08	0.03

Table 1. Continued

Site Name	Field ID	Date	Time	BOD		Nitrate + Nitrite as N		Orthophosphate as P	
				Result	RL	Result	RL	Result	RL
San Joaquin River Downstream	NWW004	8/19/2004	06:30	6	3	1.83	0.05	<0.03	0.03
	NWW008	8/19/2004	12:00	--	--	--	--	--	--
	NWW017	8/19/2004	18:30	12_E	3	1.69	0.05	<0.03	0.03
	NWW021	8/20/2004	00:30	7	3	1.24	0.05	0.03	0.03
	NWW025	8/20/2004	07:35	5	3	1.29	0.05	<0.03	0.03
	NWW029	8/20/2004	13:00	3	3	1.23	0.05	<0.03	0.03
	NWW036	8/20/2004	18:50	4	3	1.10	0.05	<0.03	0.03
	NWW042	8/21/2004	00:00	<3	3	1.04	0.05	<0.03	0.03
	NWW046	8/21/2004	06:00	<3	3	1.12	0.05	0.03	0.03
	NWW050	8/21/2004	13:00	<3	3	1.02	0.05	<0.03	0.03
	NWW057	8/21/2004	18:00	4	3	1.05	0.05	<0.03	0.03
	NWW063	8/22/2004	00:00	5	3	0.91	0.05	<0.03	0.03
	NWW103	8/22/2004	06:40	3	3	0.86	0.05	0.03	0.03
	NWW114	8/23/2004	12:25	5	3	1.09	0.05	0.07_I	0.03
	NWW067	8/30/2004	11:45	3	3	0.79	0.05	<0.03	0.03
San Joaquin River Upstream	NWW003	8/19/2004	07:00	5	3	1.85	0.05	<0.03	0.03
	NWW006	8/19/2004	13:00	8	3	1.81	0.05	<0.03	0.03
	NWW013	8/19/2004	18:40	11	3	1.51	0.05	<0.03	0.03
	NWW019	8/20/2004	01:00	7	3	1.66	0.05	0.04	0.03
	NWW024	8/20/2004	07:30	5	3	1.86	0.05	0.06	0.03
	NWW028	8/20/2004	13:30	4	3	1.91	0.05	<0.03	0.03
	NWW035	8/20/2004	19:00	5	3	1.60	0.05	0.04	0.03
	NWW041	8/21/2004	00:00	3	3	1.66	0.05	0.03	0.03
	NWW045	8/21/2004	06:30	3	3	1.73	0.05	0.07	0.03
	NWW049	8/21/2004	13:00	4	3	1.61	0.05	0.05	0.03
	NWW056	8/21/2004	18:50	5	3	1.59	0.05	0.07	0.03
	NWW062	8/22/2004	01:00	5	3	1.45	0.05	0.03	0.03
	NWW101	8/22/2004	06:20	5	3	1.45	0.05	0.07	0.03
	NWW113	8/23/2004	12:15	5	3	1.55	0.25	0.05_I	0.03
	NWW066	8/30/2004	11:00	4	3	1.20	0.05	<0.03	0.03

*The result was re-analyzed and confirmed
$_E$ = statistical outlier result but result accepted as valid based on environmental conditions
$_I$ = data is not valid (see Quality Assurance Summary)
-- Sample NWW008 was not collected
The time for sample NWW005 was not recorded on the field sheet. According to the sampling design plan, it was to be a grab at 12:00 hrs.

Table 2. Boron

San Joaquin River Recirculation Pilot Study Boron Production Sample Results (mg/L)					
Site Name	Field ID	Date	Time	Boron	Reporting Limit
Newman Wasteway Downstream	NWW002	8/19/2004	06:00	0.64	0.02
	NWW007	8/19/2004	12:00	0.63	0.02
	NWW016	8/19/2004	18:10	0.7	0.02
	NWW020	8/20/2004	00:00	0.41	0.02
	NWW023	8/20/2004	06:30	0.2	0.02
	NWW027	8/20/2004	12:30	0.14	0.02
	NWW034	8/20/2004	18:00	0.14	0.02
	NWW040	8/21/2004	00:00	0.12	0.02
	NWW044	8/21/2004	06:40	0.16	0.02
	NWW048	8/21/2004	12:15	0.12	0.02
	NWW055	8/21/2004	18:00	0.15	0.02
	NWW061	8/22/2004	01:15	0.12	0.02
	NWW102	8/22/2004	06:35	0.16	0.02
	NWW112	8/23/2004	12:30	0.12	0.02
	NWW065	8/30/2004	11:25	0.14	0.02
Newman Wasteway Upstream	NWW001	8/19/2004	06:00	0.091	0.02
	NWW005	8/19/2004	--	0.095	0.02
	NWW012	8/19/2004	20:40	0.087	0.02
	NWW018	8/20/2004	01:30	0.23	0.02
	NWW022	8/20/2004	06:40	0.083	0.02
	NWW026	8/20/2004	12:00	0.083	0.02
	NWW033	8/20/2004	19:40	0.09	0.02
	NWW039	8/20/2004	23:30	0.082	0.02
	NWW043	8/21/2004	06:00	0.11	0.02
	NWW047	8/21/2004	12:00	0.075	0.02
	NWW054	8/21/2004	18:00	0.17	0.02
	NWW060	8/22/2004	00:00	0.078	0.02
	NWW100	8/22/2004	06:08	0.16	0.02
	NWW111	8/23/2004	12:00	0.11	0.02
	NWW064	8/30/2004	13:30	0.19	0.02

Table 2. Continued

Site Name	Field ID	Date	Time	Boron	Reporting Limit
San Joaquin River Downstream	NWW004	8/19/2004	06:30	1.7	0.02
	NWW008	8/19/2004	12:00	1.7	0.02
	NWW017	8/19/2004	18:30	1.7	0.02
	NWW021	8/20/2004	00:30	1.1	0.02
	NWW025	8/20/2004	07:35	0.79	0.02
	NWW029	8/20/2004	13:00	0.74	0.02
	NWW036	8/20/2004	18:50	0.65	0.02
	NWW042	8/21/2004	00:00	0.7	0.02
	NWW046	8/21/2004	06:00	0.69	0.02
	NWW050	8/21/2004	13:00	0.67	0.02
	NWW057	8/21/2004	18:00	0.7	0.02
	NWW063	8/22/2004	00:00	0.69	0.02
	NWW103	8/22/2004	06:40	0.74	0.02
	NWW114	8/23/2004	12:25	0.77	0.02
	NWW067	8/30/2004	11:45	0.84	0.02
San Joaquin River Upstream	NWW003	8/19/2004	07:00	1.8	0.02
	NWW006	8/19/2004	13:00	1.7	0.02
	NWW013	8/19/2004	18:40	1.6	0.02
	NWW019	8/20/2004	01:00	1.5	0.02
	NWW024	8/20/2004	07:30	1.5	0.02
	NWW028	8/20/2004	13:30	1.4	0.02
	NWW035	8/20/2004	19:00	1.5	0.02
	NWW041	8/21/2004	00:00	1.4	0.02
	NWW045	8/21/2004	06:30	1.3	0.02
	NWW049	8/21/2004	13:00	1.3	0.02
	NWW056	8/21/2004	18:50	1.4	0.02
	NWW062	8/22/2004	01:00	1.4	0.02
	NWW101	8/22/2004	06:20	1.5	0.02
	NWW113	8/23/2004	12:15	1.5	0.02
	NWW066	8/30/2004	11:00	1.8	0.02

-- = The time for sample NWW005 was not recorded on the field sheet. But, according to the sampling design plan, it was to be a grab at approximately 1200hrs

Table 3. Chlorophyll A

San Joaquin River Recirculation Pilot Study Chlorophyll A Production Sample Results (ugL)					
Site Name	Field ID	Date	Time	Chlorophyll A	
				Result	RL
Newman Wasteway Downstream	NWW002	8/19/2004	06:00	3.0	2
	NWW007	8/19/2004	12:00	*	-
	NWW016	8/19/2004	18:10	18	2
	NWW020	8/20/2004	00:00	13	2
	NWW023	8/20/2004	06:30	5.8	2
	NWW027	8/20/2004	12:30	17	2
	NWW034	8/20/2004	18:00	13	2
	NWW040	8/21/2004	00:00	21	2
	NWW044	8/21/2004	06:40	11	2
	NWW048	8/21/2004	12:15	N.A.	-
	NWW055	8/21/2004	18:00	N.A.	-
	NWW061	8/22/2004	01:15	N.A.	-
	NWW105	8/23/2004	06:40	N.A.	-
	NWW112	8/23/2004	12:30	N.A.	-
Newman Wasteway Upstream	NWW001	8/19/2004	06:00	3.2	2
	NWW005	8/19/2004	--	3.4	2
	NWW012	8/19/2004	20:40	3.5	2
	NWW018	8/20/2004	01:30	8.8	2
	NWW022	8/20/2004	06:40	*	-
	NWW026	8/20/2004	12:00	*	-
	NWW033	8/20/2004	19:40	2.3	2
	NWW039	8/20/2004	23:30	<2	2
	NWW043	8/21/2004	06:00	<2	2
	NWW047	8/21/2004	12:00	N.A.	-
	NWW054	8/21/2004	18:00	N.A.	-
	NWW060	8/22/2004	00:00	N.A.	-
	NWW104	8/23/2004	06:20	N.A.	-
	NWW111	8/23/2004	12:00	N.A.	-

Table 3. Continued

Site Name	Field ID	Date	Time	Chlorophyll A	
				Result	RL
San Joaquin River Downstream	NWW004	8/19/2004	06:30	65	2
	NWW008	8/19/2004	12:00	96	2
	NWW017	8/19/2004	18:30	98	2
	NWW021	8/20/2004	00:30	48	2
	NWW025	8/20/2004	07:35	23	2
	NWW029	8/20/2004	13:00	44	2
	NWW036	8/20/2004	18:50	45	2
	NWW042	8/21/2004	00:00	30	2
	NWW046	8/21/2004	06:00	N.A.	-
	NWW050	8/21/2004	13:00	N.A.	-
	NWW057	8/21/2004	18:00	N.A.	-
	NWW063	8/22/2004	00:00	N.A.	-
	NWW107	8/23/2004	06:50	N.A.	-
	NWW114	8/23/2004	12:25	N.A.	-
San Joaquin River Upstream	NWW003	8/19/2004	07:00	66	2
	NWW006	8/19/2004	13:00	*	-
	NWW013	8/19/2004	18:40	*	-
	NWW019	8/20/2004	01:00	45	2
	NWW024	8/20/2004	07:30	44	2
	NWW028	8/20/2004	13:30	77	2
	NWW035	8/20/2004	19:00	140	2
	NWW041	8/21/2004	00:00	48	2
	NWW045	8/21/2004	06:30	37	2
	NWW049	8/21/2004	13:00	N.A.	-
	NWW056	8/21/2004	18:50	N.A.	-
	NWW062	8/22/2004	01:00	N.A.	-
	NWW106	8/23/2004	06:30	N.A.	-
	NWW113	8/23/2004	12:15	N.A.	-

N.A = The samples were extracted and analyzed, but computer failure on the UV-Vis Spectrophotometer caused the data to be lost. Due to the nature of the procedure, the samples could not be re-analyzed.
* = Sample was not collected
-- = The time for sample NWW005 was not recorded on the field sheet. But, according to the sampling design plan, it was to be a grab at approximately 1200hrs.

Table 4. E. Coli

San Joaquin River Recirculation Pilot Study E. Coli Production Sample Results (MPN/100mL)					
Site Name	Date	Field ID	Time	Result	R.L.
Newman Wasteway Downstream	8/19/2004	NWW002	06:00	40_T	2.0
		NWW002A	09:00	50	2.0
		NWW002B	10:00	28	2.0
		NWW002C	14:00	20	2.0
San Joaquin River Downstream	8/19/2004	NWW004	07:50	34_T	2.0
		NWW004A	09:30	55	2.0
		NWW004B	10:30	56	2.0
		NWW004C	12:00	34	2.0

$_T$= Sample analyzed outside of the recommended 24 hour hold time
Sample NWW002 was analyzed 2.5 hours past the recommended 24 hour hold time
Sample NWW004 was analyzed 40 minutes past the recommend 24 hour hold time

Table 5. Dissolved Metals

San Joaquin River Recirculation Pilot Study
Dissolved Metals, (ug/L)

Newman Wasteway Downstream

NWW:	002	007	016	020	023	027	034	040	044	048	055	061	102	112	065	
	8/19/04	8/19/04	8/19/04	8/20/04	8/20/04	8/20/04	8/20/04	8/21/04	8/21/04	8/21/04	8/21/04	8/22/04	8/22/04	8/23/04	8/30/04	
Analyte	06:00	12:00	18:10	00:00	06:30	12:30	18:00	00:00	06:40	12:15	18:00	01:15	06:35	12:30	11:25	RL
Aluminum	12.9	5.9	3.7	32.1	33.1	33.2$_I$	35.1	53.8	48.7	59.5$_I$	35.6$_I$	59.4$_I$	42.9$_I$	46.1$_I$	27.4*	4.0
Antimony	0.9	<0.5	0.5	0.6	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.5
Arsenic	4.9	5.0	6.7	2.1	1.9	1.6	1.7	1.8	1.9	2.0	1.9	1.9	1.7	1.9	2.9	0.5
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cadmium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.25
Chromium	<0.5	<0.5	17.3$_I$	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.4$_I$	0.5
Copper	2.1	2.3	1.5	0.6	0.8	0.7	1.2	1.2	16.5$_I$	1.4	1.5	1.6	1.6	1.7	1.6	0.5
Lead	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1$_I$	<0.5	0.5
Mercury (ng/l)	3.7	3.7	<2.0	2.8	<2.0	<2.0	<2.0	3.4	4.1	<2.0	<2.0	2.2	<2.0	<2.0	<2.0	2.0
Nickel	4.2	4.2	4.3	3.0	2.6	2.2	2.2	2.3	5.7	2.4	2.4	2.5	2.6	2.4	2.2	1.0
Silver	< 0.5$_I$	< 0.5$_I$	< 0.5	< 0.5	0.6$_I$	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.2**	0.5
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Zinc	<2.0	2.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1020, 1050^$_I$	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0

Newman Wasteway Upstream

NWW:	001	005	018	022	026	033	039	043	047	054	060	100	111	064	
	8/19/04	8/19/04	8/20/04	8/20/04	8/20/04	8/20/04	8/20/04	8/21/04	8/21/04	8/21/04	8/22/04	8/22/04	8/23/04	8/30/04	
Analyte	06:00	--	01:30	06:40	12:00	19:40	23:30	06:00	12:00	18:00	00:00	06:08	12:00	13:30	RL
Aluminum	47.6	4$_I$	56.7	49.1	54.4	51.9$_I$	46.2	51.5	41$_I$	40.8$_I$	55.7$_I$	45.9$_I$	35.7$_I$	33.9*	4.0
Antimony	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.5
Arsenic	2.5	2.2	2.4	1.9	2.2	2.4	2.3	2.4	2.3	2.6	2.2	2.5	2.3	3.2	0.5
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cadmium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.25
Chromium	<0.5	<0.5	1.1$_I$	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.8$_I$	0.5
Copper	1.8	1.6	1.4	0.9	0.9	1.6	1.5	1.7	1.5	2.1	1.8	2.1	1.8	2.1	0.5
Lead	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Mercury (ng/l)	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	5.0$_I$	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Nickel	1.5	1.4	2.0	1.4	1.3	1.4	1.5	1.5	1.4	1.8	1.5	1.7	1.5	1.6	1.0
Silver	0.5$_I$	< 0.5$_I$	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.1$_I$	< 0.5	< 0.5	< 0.5	0.7$_I$	< 0.5	<0.2**	0.5
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Zinc	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0

Table 5. Continued

San Joaquin River Downstream																
NWW:	004	008	017	021	025	029	036	042	046	050	057	063	103	114	067	
	8/19/04	8/19/04	8/19/04	8/20/04	8/20/04	8/20/04	8/20/04	8/21/04	8/21/04	8/21/04	8/21/04	8/22/04	8/22/04	8/23/04	8/30/04	
Analyte	06:30	12:00	18:30	00:30	07:35	13:00	18:50	00:00	06:00	13:00	18:00	00:00	06:40	12:25	11:45	RL
Aluminum	20.8	7.2	5.4	12.8	28.1	24.0$_I$	30.4	21.4	19.1	24.2$_I$	22.8$_I$	21.4$_I$	15.5$_I$	23.5$_I$	21.0*	4.0
Antimony	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	0.5
Arsenic	5.4	5.4	4.8	3.0	2.6	2.9	3.5	3.1	3.1	3.1	3.3	3.3	3.0	3.4	4.8	0.5
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cadmium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.25
Chromium	<0.5	3.8$_I$	1.7$_I$	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6.7$_I$	0.5
Copper	3.9	3.7	2.5	1.8	1.9	1.5	2.5	2.3	2.4	2.2	2.8	2.9	2.8	2.7	3.0	0.5
Lead	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Mercury (ng/l)	2.7	3.1	4.5$_I$	3.0	<2.0	<2.0	2.1	2.2	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	2.6	2.0
Nickel	3.9	4.0	3.1	3.4	2.8	2.8	3.2	2.8	3.0	3.1	3.2	3.3	3.5	3.1	2.9	1.0
Silver	< 0.5$_I$	< 0.5$_I$	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.6$_I$	< 0.5	< 0.5	<0.2**	0.5
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Zinc	<2.0	<2.0	<2.0	<2.0	2.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0

San Joaquin River Upstream																
NWW:	003	006	013	019	024	028	035	041	045	049	056	062	101	113	066	
	8/19/04	8/19/04	8/19/04	8/20/04	8/20/04	8/20/04	8/20/04	8/21/004	8/21/04	8/21/04	8/21/04	8/22/04	8/22/04	8/23/04	8/30/04	
Analyte	07:00	13:00	18:40	01:30	07:30	13:30	19:00	00:00	06:30	13:00	18:50	01:00	06:20	12:15	11:00	RL
Aluminum	8.7	8.3	12.4	10.9	8.6	6.5$_I$	7.5	5.6	8.0	9.2$_I$	6.7$_I$	8.6$_I$	6.1$_I$	6.0$_I$	1.5*	4.0
Antimony	0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	0.5	0.5
Arsenic	5.4	5.6	6.2	5.3	5.0	5.1	5.6	5.5	5.6	5.3	5.3	5.3	5.1	4.8	7.6$_I$	0.5
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cadmium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.25
Chromium	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9.3$_I$	0.5
Copper	4.3	4.5	4.2	2.9	2.9	2.8	3.9	4.4	15.7$_I$	3.8	4.7	4.7	4.6	4.1	5.2	0.5
Lead	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Mercury (ng/l)	2.7	3.2	3.6	3.3	<2.0	<2.0	2.3	3.2	<2.0	2.0	7.0$_I$	2.5	<2.0	<2.0	2.3	2.0
Nickel	4.0	4.0	3.9	3.2	3.1	3.2	3.4	4.4	15.5$_I$	3.4	3.7	3.9	4.0	3.9	3.8	1.0
Silver	< 0.5$_I$	< 0.5$_I$	< 0.5$_I$	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.2**	0.5
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Zinc	3.1	<2.0	<2.0	<2.0	3.7	<2.0	<2.0	<2.0	56.6$_I$	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0

* RL=0.5 ^ =sample reanalyzed and confirmed (both results shown)

** RL=0.2 $_I$ = data is not valid (see Quality Assurance Summary)

Table 6. Organics EPA Method 505

Bureau of Reclamation San Joaquin River Recirculation Pilot Study Results for EPA Method 505 (ug/L)											
	Newman Wasteway Upstream	Newman Wasteway Downstream				San Joaquin River Upstream	San Joaquin River Downstream				
	NWW001	NWW002	NWW007	NWW016	NWW020	NWW003	NWW004	NWW008	NWW017	NWW021	
	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	
Analyte	06:00	06:00	12:00	18:10	00:00	07:00	06:30	12:00	18:30	00:30	Reporting Limit
Aldrin	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Aroclor 1016	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	0.070
Aroclor 1221	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Aroclor 1232	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Aroclor 1242	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Aroclor 1248	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Aroclor 1254	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Aroclor 1260	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arochlor (Alanex)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.05
Chlordane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Dieldrin	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Endrin	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Heptachlor	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Heptachlor Epoxide	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Lindane	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Methoxychlor	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Total PCBs	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	0.07
Toxaphene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50

Table 7. Organics EPA Method 515.4

Bureau of Reclamation San Joaquin River Recirculation Pilot Study Results for EPA Method 515.4 (ug/L)										
	Newman Wasteway Downstream				San Joaquin River Upstream	San Joaquin River Downstream				
	NWW002	NWW007	NWW016	NWW020	NWW003	NWW004	NWW008	NWW017	NWW021	
	8/19/2004	8/19/2004	8/19/2004	8/20/2004	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	Reporting
Analyte	06:00	12:00	18:10	00:00	07:00	06:30	12:00	18:30	00:30	Limit
2,4,5-T	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
2,4,5-TP	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
2,4-D	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.23	0.10
2,4-DB	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Dichlorprop	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Acifluorfen	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Bentazon	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Dalapon	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
3,5-Dichlorobenzoic Acid	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Tot DCPA Mono & Diacid Degradate	0.38	0.34	0.24	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Dicamba	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	0.080
Dinoseb	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Pentachlorophenol	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.040
Picloram	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10

Table 8. Organics EPA Method 525

Bureau of Reclamation, San Joaquin River Recirculation Pilot Study
Results for EPA Method 525, (ug/L)

Analyte	Newman Wasteway Upstream	Newman Wasteway Downstream				San Joaquin River Upstream	San Joaquin River Downstream				Reporting Limit
	NWW001	NWW002	NWW007	NWW016	NWW020	NWW003	NWW004	NWW008	NWW017	NWW021	
	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	
	06:00	06:00	12:00	18:10	00:00	07:00	06:30	12:00	18:30	00:30	
2,4-Dinitrotoluene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
2,6-Dinitrotoluene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
4,4'-DDD	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
4,4'-DDE	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
4,4'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Acenaphthene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Acenaphthylene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Acetochlor	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Alachlor	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Aldrin	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Anthracene	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Atrazine	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Benz(a)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Benzo(a)pyrene	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020 L	<0.020	<0.020 L	<0.020	0.020
Benzo(b)fluoranthene	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020 L	<0.020	<0.020 L	<0.020	0.020
Benzo(g,h,i)perylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050 L	<0.050	<0.050 L	<0.050	0.050
Benzo(k)fluoranthene	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020 L	<0.020	<0.020 L	<0.020	0.020
Bis(2-ethylhexyl) Phthalate	<0.60	<0.60	<0.60	<0.60	<0.60	1.7	<0.60 L	<0.60	<0.60 L	<0.60	0.60
bis(2-ethylhexyl)adipate	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	<0.60	0.60
Bromacil	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Butachlor	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Butyl Benzyl Phthalate	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Caffeine	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Chlordane-alpha	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Chlordane-gamma	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Chlorneb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Chlorobenzilate	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Chlorothalonil	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Chlorpyrifos	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Chrysene	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020 L	<0.020	<0.020 L	<0.020	0.020
Diazinon	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Dibenz(a,h)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050 L	<0.050	<0.050 L	<0.050	0.050
Dichlorvos	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Dieldrin	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Diethyl Phthalate	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Dimethoate	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Dimethyl Phthalate	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Di-n-butyl Phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0

Analyte	Newman Wasteway Upstream	Newman Wasteway Downstream				San Joaquin River Upstream	San Joaquin River Downstream				Reporting Limit
	NWW001	NWW002	NWW007	NWW016	NWW020	NWW003	NWW004	NWW008	NWW017	NWW021	
	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	
	06:00	06:00	12:00	18:10	00:00	07:00	06:30	12:00	18:30	00:30	
Di-n-octyl Phthalate	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10 L	<0.10	<0.10 L	<0.10	0.10
Endosulfan I	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Endosulfan II	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Endosulfan Sulfate	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Endrin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Endrin Aldehyde	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
EPTC	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Fluoranthene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Fluorene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
HCH-alpha	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
HCH-beta	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
HCH-delta	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Heptachlor	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.040
Heptachlor Epoxide (isomer b)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Hexachlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Hexachlorocyclopentadiene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Indeno(1,2,3-cd)pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050L	<0.050	<0.050 L	<0.050	0.050
Isophorone	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Lindane	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Malathion	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Methoxychlor	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10 L	<0.10	<0.10 L	<0.10	0.10
Metolachlor	0.080	0.47	0.45	0.34	0.25	0.14	0.15	0.15	0.16	0.17	0.050
Metribuzin	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molinate	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Naphthalene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Parathion	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Pentachlorophenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Permethrin (total)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10 L	<0.10	<0.10 L	<0.10	0.10
Phenanthrene	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Prometryn	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Propachlor	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Simazine	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Terbacil	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Thiobencarb	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Trans-Nonachlor	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Trifluralin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10

L =sample results may be biased low

Table 9. Organics EPA Method 531.1

Bureau of Reclamation San Joaquin River Recirculation Pilot Study Results for EPA Method 531.1 (ug/L)											
	Newman Wasteway Upstream	Newman Wasteway Downstream				San Joaquin River Upstream	San Joaquin River Downstream				
	NWW001	NWW002	NWW007	NWW016	NWW020	NWW003	NWW004	NWW008	NWW017	NWW021	
	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	8/19/2004	8/19/2004	8/19/2004	8/19/2004	8/20/2004	
Analyte	06:00	06:00	12:00	18:10	00:00	07:00	06:30	12:00	18:30	00:30	Reporting Limit
3-Hydroxycarbofuran	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Aldicarb	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Aldicarb Sulfone	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70	0.70
Aldicarb Sulfoxide	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Baygon	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Carbaryl	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Carbofuran	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	0.90
Methiocarb	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Methomyl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Oxamyl	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0

Table 10. Acute Toxicity

San Joaquin River Recirculation Study Static Percent Survival Aquatic Acute Definitive Test Results 96-hour Percent Survival						
Site Name	Date	Time	Flow	Dilution (%)	*P. promelas*	*C. dubia*
Newman Wasteway Downstream	8/19/2004	06:00	0 CFS (Background)	6.25	100	90
				12.5	100	100
				25	100	100
				50	100	80
				100	100	70
San Joaquin River Downstream	8/19/2004	06:30		6.25	100	100
				12.5	100	100
				25	100	90
				50	95	90
				100	100	90
Newman Wasteway Downstream	8/19/2004	18:10	Between 100 & 200 CFS	6.25	100	100
				12.5	100	100
				25	100	100
				50	100	100
				100	100	90
San Joaquin River Downstream	8/19/2004	18:30		6.25	100	100
				12.5	100	100
				25	100	100
				50	95	100
				100	100	90
Newman Wasteway Downstream	8/20/2004	00:00	Near 250 CFS @ 22:30	6.25	95	100
				12.5	100	100
				25	100	100
				50	95	90
				100	95	80
San Joaquin River Downstream	8/20/2004	00:30		6.25	100	100
				12.5	100	90
				25	100	100
				50	95	100
				100	100	100

Table 11. Selenium

San Joaquin River Recirculation Pilot Study Selenium Production Sample Results ug/L						
Site Name	Field ID	Date	Time	Selenium		
				Acid Soluble Results	Total Recoverable Results	RL
Newman Wasteway Downstream	NWW002	8/19/2004	06:00	0.6	0.4	0.4
	NWW007	8/19/2004	12:00	0.6	0.5	0.4
	NWW016	8/19/2004	18:10	0.7	0.6	0.4
	NWW020	8/20/2004	00:00	*1.1$_E$	0.6	0.4
	NWW023	8/20/2004	06:30	0.4	<0.4	0.4
	NWW027	8/20/2004	12:30	0.4	<0.4	0.4
	NWW034	8/20/2004	18:00	<0.4	<0.4	0.4
	NWW040	8/21/2004	00:00	<0.4	0.5	0.4
	NWW044	8/21/2004	06:40	<0.4	<0.4	0.4
	NWW048	8/21/2004	12:15	<0.4	<0.4	0.4
	NWW055	8/21/2004	18:00	<0.4	<0.4	0.4
	NWW061	8/22/2004	01:15	0.5	<0.4	0.4
	NWW102	8/22/2004	06:35	0.6	<0.4	0.4
	NWW112	8/23/2004	12:30	0.4	<0.4	0.4
	NWW065	8/30/2004	11:25	Required no filtration	<0.4	0.4
Newman Wasteway Upstream	NWW001	8/19/2004	06:00	<0.4	<0.4	0.4
	NWW005	8/19/2004	--	<0.4	<0.4	0.4
	NWW012	8/19/2004	20:40	<0.4	<0.4	0.4
	NWW018	8/20/2004	01:30	0.4	<0.4	0.4
	NWW022	8/20/2004	06:40	<0.4	<0.4	0.4
	NWW026	8/20/2004	12:00	<0.4	<0.4	0.4
	NWW033	8/20/2004	19:40	<0.4	<0.4	0.4
	NWW039	8/20/2004	23:30	<0.4	<0.4	0.4
	NWW043	8/21/2004	06:00	<0.4	<0.4	0.4
	NWW047	8/21/2004	12:00	<0.4	<0.4	0.4
	NWW054	8/21/2004	18:00	<0.4	<0.4	0.4
	NWW060	8/22/2004	00:00	<0.4	<0.4	0.4
	NWW100	8/22/2004	06:08	<0.4	<0.4	0.4
	NWW111	8/23/2004	12:00	<0.4	<0.4	0.4
	NWW064	8/30/2004	13:30	Required no filtration	<0.4	0.4

* The result was reanalyzed and confirmed.
$_E$ = statistical outlier result but result accepted as valid based on environmental conditions
-- The time for sample NWW005 was not recorded on the field sheet. According to the sampling design plan, it was to be a grab at 12:00 hrs.

Table 11. Continued

Site Name	Field ID	Date	Time	Selenium		
				Acid Soluble Results	Total Recoverable Results	RL
San Joaquin River Downstream	NWW004	8/19/2004	06:30	5.0	5.1	0.4
	NWW008	8/19/2004	12:00	4.9	4.9	0.4
	NWW017	8/19/2004	18:30	4.8	4.9	0.4
	NWW021	8/20/2004	00:30	3.0	3.4	0.4
	NWW025	8/20/2004	07:35	2.1	2.1	0.4
	NWW029	8/20/2004	13:00	1.9	1.8	0.4
	NWW036	8/20/2004	18:50	1.7	1.9	0.4
	NWW042	8/21/2004	00:00	2.0	2.2	0.4
	NWW046	8/21/2004	06:00	1.9	2.3	0.4
	NWW050	8/21/2004	13:00	1.8	1.3	0.4
	NWW057	8/21/2004	18:00	1.9	1.9	0.4
	NWW063	8/22/2004	00:00	1.9	1.9	0.4
	NWW103	8/22/2004	06:40	1.9	4.3	0.4
	NWW114	8/23/2004	12:25	2.2	3.4	0.4
	NWW067	8/30/2004	11:45	Required no filtration	2.2	0.4
San Joaquin River Upstream	NWW003	8/19/2004	07:00	*0.5$_I$	0.5	0.4
	NWW006	8/19/2004	13:00	5.5	5.4	0.4
	NWW013	8/19/2004	18:40	4.6	4.7	0.4
	NWW019	8/20/2004	01:00	4.2	4.3	0.4
	NWW024	8/20/2004	07:30	3.7	4.0	0.4
	NWW028	8/20/2004	13:30	3.7	3.8	0.4
	NWW035	8/20/2004	19:00	NA	NA	0.4
	NWW041	8/21/2004	00:00	4.1	4.6	0.4
	NWW045	8/21/2004	06:30	4.4	4.6	0.4
	NWW049	8/21/2004	13:00	3.8	4.0	0.4
	NWW056	8/21/2004	18:50	3.6	3.8	0.4
	NWW062	8/22/2004	01:00	3.6	3.3	0.4
	NWW101	8/22/2004	06:20	4.0	4.3	0.4
	NWW113	8/23/2004	12:15	3.5	7.5	0.4
	NWW066	8/30/2004	11:00	Required no filtration	5.2	0.4

* The result was reanalyzed and confirmed. $_I$ = data is not valid (see Quality Assurance Summary)
NA - sample NWW035 was not collected.
Acid Soluble samples were acidified in the field and then filtered and digested by the laboratory. Samples NWW001-NWW063, NWW100-NWW103, and NWW111-NWW114 were filtered by the laboratory due to the high amount of sediment, algae, suspended solids, etc. present in the samples. The high turbidity of the samples interfered with the laboratory's ability to produce valid results.
Total Recoverable samples were acidified in the field and digested in the laboratory (no filtration). The total recoverable results for samples NWW001-NWW063, NWW100-NWW103, and NWW111-NWW114 are provided for informational purposes only. In general, the total recoverable results are in good agreement with the acid soluble results. Ninety two percent of the total recoverable results are within either ± RL or 20% RPD of the acid soluble results. The total recoverable results for samples NWW020, NWW050, NWW103, NWW113, and NWW114 are not within either ± RL or 20% RPD of the acid soluble results. These results (which are bolded) should be considered invalid.
Samples NWW064-NWW070 required no filtration. The total recoverable results for samples NWW064-NWW070 are valid.

Table 12. TKN, Total P, and Ammonia

San Joaquin River Recirculation Pilot Study TKN, Total Phosphorus, and Ammonia as N Production Sample Results (mg/L)									
Site Name	Field ID	Date	Time	TKN		Total Phosphorus		Ammonia as N	
				Result	RL	Result	RL	Result	RL
Newman Wasteway Downstream	NWW002	8/19/2004	06:00	0.9	0.2	0.44	0.05	0.48	0.05
	NWW007	8/19/2004	12:00	1.1	0.2	0.44	0.05	0.41	0.05
	NWW016	8/19/2004	18:10	1.6	0.2	0.40	0.05	0.25	0.05
	NWW020	8/20/2004	00:00	3.8_E	0.2	0.99_E	0.05	0.96_E	0.05
	NWW023	8/20/2004	06:30	1.0	0.2	0.23	0.05	0.27	0.05
	NWW027	8/20/2004	12:30	1.4	0.2	0.44	0.05	0.24_I	0.05
	NWW034	8/20/2004	18:00	1.4	0.2	0.38	0.05	0.28	0.05
	NWW040	8/21/2004	00:00	1.2	0.2	0.30	0.05	0.24	0.05
	NWW044	8/21/2004	06:40	1.5	0.2	0.39	0.05	0.25	0.05
	NWW048	8/21/2004	12:15	1.2	0.2	0.27	0.05	0.22	0.05
	NWW055	8/21/2004	18:00	1.1	0.2	0.25	0.05	0.15	0.05
	NWW061	8/22/2004	01:15	1.3	0.2	0.40	0.05	0.19	0.05
	NWW102	8/22/2004	06:35	1.4	0.2	0.46	0.05	0.22	0.05
	NWW112	8/23/2004	12:30	1.0	0.2	0.33	0.05	0.17	0.05
	NWW065	8/30/2004	11:25	0.8	0.2	0.26	0.05	0.19	0.05
Newman Wasteway Upstream	NWW001	8/19/2004	06:00	0.6	0.2	0.18	0.05	0.19	0.05
	NWW005	8/19/2004	not recorded	0.5	0.2	0.12	0.05	0.09	0.05
	NWW012	8/19/2004	20:40	0.6	0.2	0.08	0.05	0.09	0.05
	NWW018	8/20/2004	01:30	1.1_I	0.2	0.24	0.05	0.13	0.05
	NWW022	8/20/2004	06:40	0.4	0.2	0.12	0.05	0.10	0.05
	NWW026	8/20/2004	12:00	0.3	0.2	0.10	0.05	0.05_I	0.05
	NWW033	8/20/2004	19:40	0.3	0.2	0.08	0.05	0.05_I	0.05
	NWW039	8/20/2004	23:30	0.4	0.2	0.08	0.05	0.09	0.05
	NWW043	8/21/2004	06:00	0.4	0.2	0.09	0.05	0.10	0.05
	NWW047	8/21/2004	12:00	0.4	0.2	0.10	0.05	0.07	0.05
	NWW054	8/21/2004	18:00	0.5	0.2	0.12	0.05	0.08	0.05
	NWW060	8/22/2004	00:00	0.4	0.2	0.10	0.05	0.08	0.05
	NWW100	8/22/2004	06:08	0.5	0.2	0.19	0.05	0.10	0.05
	NWW111	8/23/2004	12:00	0.4	0.2	0.12	0.05	0.07	0.05
	NWW064	8/30/2004	13:30	0.5	0.2	0.12	0.05	0.09	0.05

Table 12. Continued

Site Name	Field ID	Date	Time	TKN		Total Phosphorus		Ammonia as N	
				Result	RL	Result	RL	Result	RL
San Joaquin River Downstream	NWW004	8/19/2004	06:30	1.6	0.2	0.48	0.05	0.29	0.05
	NWW008	8/19/2004	12:00	1.6	0.2	0.42	0.05	0.14	0.05
	NWW017	8/19/2004	18:30	1.6	0.2	0.37	0.05	0.12	0.05
	NWW021	8/20/2004	00:30	2.7 E	0.2	0.67	0.10	0.40	0.05
	NWW025	8/20/2004	07:35	1.6	0.2	0.48	0.05	0.26 I	0.05
	NWW029	8/20/2004	13:00	1.4	0.2	0.38	0.05	0.22 I	0.05
	NWW036	8/20/2004	18:50	1.7	0.2	0.41	0.05	0.22	0.05
	NWW042	8/21/2004	00:00	1.1	0.2	0.22	0.05	0.24	0.05
	NWW046	8/21/2004	06:00	1.1	0.2	0.25	0.05	0.15	0.05
	NWW050	8/21/2004	13:00	1.2	0.2	0.30	0.05	0.27	0.05
	NWW057	8/21/2004	18:00	1.1	0.2	0.25	0.05	0.14	0.05
	NWW063	8/22/2004	00:00	1.1	0.2	0.36	0.05	0.15	0.05
	NWW103	8/22/2004	06:40	1.4	0.2	0.44	0.05	0.18	0.05
	NWW114	8/23/2004	12:25	1.2	0.2	0.41	0.05	0.17	0.05
	NWW067	8/30/2004	11:45	1.1	0.2	0.27	0.05	0.12	0.05
San Joaquin River Upstream	NWW003	8/19/2004	07:00	1.6	0.2	0.43	0.05	0.10	0.05
	NWW006	8/19/2004	13:00	1.7	0.2	0.42	0.05	0.34	0.05
	NWW013	8/19/2004	18:40	1.5	0.2	0.34	0.05	0.13	0.05
	NWW019	8/20/2004	01:00	1.2	0.2	0.33	0.05	0.11	0.05
	NWW024	8/20/2004	*	1.2	0.2	0.32	0.05	0.41 I	0.05
	NWW024A	8/20/2004	*	1.1	0.2	0.32	0.05	0.19 I	0.05
	NWW035	8/20/2004	19:00	1.1	0.2	0.38	0.05	0.14	0.05
	NWW041	8/21/2004	00:00	1.2	0.2	0.30	0.05	0.09	0.05
	NWW045	8/21/2004	06:30	1.3	0.2	0.34	0.05	0.08	0.05
	NWW049	8/21/2004	13:00	1.4	0.2	0.28	0.05	0.09	0.05
	NWW056	8/21/2004	18:50	1.1	0.2	0.27	0.05	0.23	0.05
	NWW062	8/22/2004	01:00	1.2	0.2	0.36	0.05	0.21	0.05
	NWW101	8/22/2004	06:20	1.3	0.2	0.45	0.05	0.35	0.05
	NWW113	8/23/2004	12:15	1.2	0.2	0.34	0.05	0.17	0.05
	NWW066	8/30/2004	11:00	1.4	0.2	0.25	0.05	0.11	0.05

*Two samples were labeled NWW024 (0600) and no sample was labled NWW028; unable to determine which one was collected at 06:00 and which was collected at 12:00

E = statistical outlier result but result accepted as valid based on environmental conditions

I = data is not valid (see Quality Assurance Summary)

Table 13. TOC

San Joaquin River Recirculation Pilot Study TOC Production Sample Results (mgL)					
Site Name	Field ID	Date	Time	TOC	
				Result	RL
Newman Wasteway Downstream	NWW002	8/19/2004	06:00	5.9	1.0
	NWW007	8/19/2004	12:00	6.2	1.0
	NWW016	8/19/2004	18:10	*100$_E$	10
	NWW020	8/20/2004	00:00	7.2	2.5
	NWW023	8/20/2004	06:30	4.5	2.5
	NWW027	8/20/2004	12:30	5.5	5.0
	NWW034	8/20/2004	18:00	4.2	2.5
	NWW040	8/21/2004	00:00	6.4	2.5
	NWW044	8/21/2004	06:40	4.1	2.5
	NWW048	8/21/2004	12:15	4.1	2.5
	NWW055	8/21/2004	18:00	4.1	2.5
	NWW061	8/22/2004	01:15	4.0	2.5
	NWW102	8/22/2004	06:35	6.0	2.5
	NWW112	8/23/2004	12:30	3.4	2.5
	NWW065	8/30/2004	11:25	4.8	2.5
Newman Wasteway Upstream	NWW001	8/19/2004	06:00	3.2	1.0
	NWW005	8/19/2004	--	3.3	1.0
	NWW012	8/19/2004	20:40	3.3	1.0
	NWW018	8/20/2004	01:30	3.8	2.5
	NWW022	8/20/2004	06:40	3.2	1.0
	NWW026	8/20/2004	12:00	3.1	1.0
	NWW033	8/20/2004	19:40	3.0	1.0
	NWW039	8/20/2004	23:30	3.7	2.5
	NWW043	8/21/2004	06:00	3.6	1.0
	NWW047	8/21/2004	12:00	3.4	1.0
	NWW054	8/21/2004	18:00	3.5	1.0
	NWW060	8/22/2004	00:00	3.5	2.5
	NWW100	8/22/2004	06:08	4.0	2.5
	NWW111	8/23/2004	12:00	4.9	2.5
	NWW064	8/30/2004	13:30	3.7	1.0

Table 12. Continued

Site Name	Field ID	Date	Time	TOC	
				Result	RL
San Joaquin River Downstream	NWW004	8/19/2004	06:30	6.2	2.5
	NWW008	8/19/2004	12:00	*20.8E	2.5
	NWW017	8/19/2004	18:30	*410E	75
	NWW021	8/20/2004	00:30	6.9	2.5
	NWW025	8/20/2004	07:35	5.0	2.5
	NWW029	8/20/2004	13:00	5.7	5.0
	NWW036	8/20/2004	18:50	5.1	5.0
	NWW042	8/21/2004	00:00	4.7	2.5
	NWW046	8/21/2004	06:00	4.7	2.5
	NWW050	8/21/2004	13:00	4.7	2.5
	NWW057	8/21/2004	18:00	4.9	2.5
	NWW063	8/22/2004	00:00	4.8	2.5
	NWW103	8/22/2004	06:40	4.2	2.5
	NWW114	8/23/2004	12:25	4.9	2.5
	NWW067	8/30/2004	11:45	5.9	2.5
San Joaquin River Upstream	NWW003	8/19/2004	07:00	6.1	2.5
	NWW006	8/19/2004	13:00	6.9	2.5
	NWW013	8/19/2004	18:40	7.6	2.5
	NWW019	8/20/2004	01:00	6.5	2.5
	NWW024	8/20/2004	07:30	6.0	2.5
	NWW028	8/20/2004	13:30	6.3	5.0
	NWW035	8/20/2004	19:00	6.3	2.5
	NWW041	8/21/2004	00:00	5.6	2.5
	NWW045	8/21/2004	06:30	5.7	0.50
	NWW049	8/21/2004	13:00	5.9	2.5
	NWW056	8/21/2004	18:50	2.6	2.5
	NWW062	8/22/2004	01:00	6.2	2.5
	NWW101	8/22/2004	06:20	3.5	2.5
	NWW113	8/23/2004	12:15	5.7	2.5
	NWW066	8/30/2004	11:00	8.1	2.5

* Result was reanalyzed and confirmed
-- The time for sample NWW005 was not recorded on the field sheet. According to the sampling design plan, it was to be a grab at 12:00 hrs
E = statistical outlier result but result accepted as valid based on environmental conditions

Table 14. TSS

Bureau of Reclamation San Joaquin River Recirculation Pilot Study TSS Production Sample Results (mg/L)					
Site Name	Field ID	Date	Time	TSS	
				Result	RL
Newman Waste Way Downstream	NWW002	8/19/2004	06:00	23	6
	NWW007	8/19/2004	12:00	42	6
	NWW016	8/19/2004	18:10	90	6
	NWW020	8/20/2004	00:00	*559$_E$	6
	NWW023	8/20/2004	06:30	113	6
	NWW027	8/20/2004	12:30	239	6
	NWW034	8/20/2004	18:00	219	6
	NWW040	8/21/2004	00:00	136	6
	NWW044	8/21/2004	06:40	185	6
	NWW048	8/21/2004	12:15	143	6
	NWW055	8/21/2004	18:00	126	6
	NWW061	8/22/2004	01:15	227	6
	NWW102	8/22/2004	06:35	220	6
	NWW105	8/23/2004	06:40	201	6
	NWW112	8/23/2004	12:30	159	6
	NWW065	8/30/2004	11:25	107	6
Newman Waste Way Upstream	NWW001	8/19/2004	06:00	49	6
	NWW005	8/19/2004	--	16	6
	NWW012	8/19/2004	20:40	33	6
	NWW018	8/20/2004	01:30	**164$_E$	6
	NWW022	8/20/2004	06:40	20	6
	NWW026	8/20/2004	12:00	15	6
	NWW033	8/20/2004	19:40	12	6
	NWW039	8/20/2004	23:30	10	6
	NWW043	8/21/2004	06:00	10	6
	NWW047	8/21/2004	12:00	19	6
	NWW054	8/21/2004	18:00	21	6
	NWW060	8/22/2004	00:00	18	6
	NWW100	8/22/2004	06:08	34	6
	NWW111	8/23/2004	12:00	14	6
	NWW064	8/30/2004	13:30	18	6

Table 14. Continued

Site Name	Field ID	Date	Time	TSS	
				Result	RL
San Joaquin River Downstream	NWW004	8/19/2004	06:30	115	6
	NWW008	8/19/2004	12:00	97	6
	NWW017	8/19/2004	18:30	NA	6
	NWW021	8/20/2004	00:30	417	6
	NWW025	8/20/2004	07:35	237	6
	NWW029	8/20/2004	13:00	171	6
	NWW036	8/20/2004	18:50	201	6
	NWW042	8/21/2004	00:00	54	6
	NWW046	8/21/2004	06:00	75	6
	NWW050	8/21/2004	13:00	86	6
	NWW057	8/21/2004	18:00	164	6
	NWW063	8/22/2004	00:00	127	6
	NWW103	8/22/2004	06:40	189	6
	NWW114	8/23/2004	12:25	148	6
	NWW067	8/30/2004	11:45	99	6
San Joaquin River Upstream	NWW003	8/19/2004	07:00	108	6
	NWW006	8/19/2004	13:00	103	6
	NWW013	8/19/2004	18:40	83	6
	NWW019	8/20/2004	01:00	79	6
	NWW024	8/20/2004	07:30	68	6
	NWW028	8/20/2004	13:30	68	6
	NWW035	8/20/2004	19:00	54	6
	NWW041	8/21/2004	00:00	54	6
	NWW045	8/21/2004	06:30	64	6
	NWW049	8/21/2004	13:00	52	6
	NWW056	8/21/2004	18:50	43	6
	NWW062	8/22/2004	01:00	79	6
	NWW101	8/22/2004	06:20	21	6
	NWW113	8/23/2004	12:15	161	6
	NWW066	8/30/2004	11:00	49	6

-- The time for sample NWW005 was not recorded on the field sheet. According to the sampling design plan, it was to be a grab at 12:00 hrs

* The sample was reanalyzed and the original result was confirmed

** The sample was reanalyzed, but the original result was not confirmed.

NA - Sample NWW017 was not collected for TSS

$_E$ = statistical outlier result but result accepted as valid based on environmental conditions

Table 15. Physical Parameters

San Joaquin River Recirculation Pilot Study Physical Parameters						
Site Name	**Field ID**	**Date**	**Temp ^{0} C**	**EC mS/cm**	**Turb NTU**	**DO mg/L**
Newman Wasteway Downstream	NWW002	8/19/2004	22.3	1200	19.6	2.8
	NWW007	8/19/2004	27.9	1220	18.3	9.9
	NWW016	8/19/2004	29.3	1077	—	5.2
	NWW020	8/19/2004	25	468	210	2.9
	NWW023	8/20/2004	23.3	481	77.8	5.2
	NWW027	8/20/2004	25.9	397	158	6.9
	NWW034	8/20/2004	27.6	394	132	6.3
	NWW040	8/20/2004	23.9	360	64.9	6.9
	NWW044	8/21/2004	23.4	422	118	6.8
	NWW048	8/21/2004	25.9	364	91.7	7.1
	NWW055	8/21/2004	27.1	395	82.9	6.7
	NWW061	8/22/2004	23.8	356	110	7.6
	NWW065	8/30/2004	24.3	395	70.9	7.6
	NWW102	8/22/2004	22.4	428	118	6.8
	NWW105	8/23/2004	21.8	428	97	7
	NWW112	8/23/2004	24.6	362	94	7.2
Newman Wasteway Upstream	NWW001	8/19/2004	22.5	319	22.3	7.1
	NWW005	8/19/2004	—	—	—	—
	NWW012	8/19/2004	24.4	310	13.6	8.6
	NWW018	8/20/2004	24.2	522	24	7.8
	NWW022	8/20/2004	22.6	320	20	7.7
	NWW026	8/20/2004	25.2	285	11	7.7
	NWW033	8/20/2004	26.2	327	9.5	7.8
	NWW039	8/20/2004	23.5	296	12.7	8.6
	NWW043	8/21/2004	22.1	346	12.8	7.6
	NWW047	8/21/2004	25	296	12.5	7.5
	NWW054	8/21/2004	25.6	433	12	7.8
	NWW060	8/22/2004	23	281	12.4	9.1
	NWW064	8/30/2004	23.1	298	15.2	7.7
	NWW100	8/22/2004	22.2	428	20	7.8
	NWW104	8/23/2004	22.4	464	20	8.1
	NWW111	8/23/2004	18.9	418	10	11.3

Table 15. Continued

Site Name	Field ID	Date	Temp ^{0} C	EC mS/cm	Turb NTU	DO mg/L
San Joaquin River Downstream	NWW004	8/19/2004	23.5	1600	44	8.9
	NWW008	8/19/2004	—	—	—	—
	NWW017	8/19/2004	—	—	—	—
	NWW021	8/20/2004	—	—	—	—
	NWW025	8/20/2004	22.9	1054	125	6.1
	NWW029	8/20/2004	25.7	994	100	7.7
	NWW036	8/20/2004	27.6	998	126	8.7
	NWW042	8/21/2004	23.9	985	55.2	7.7
	NWW046	8/21/2004	23	1003	121	6.7
	NWW050	8/21/2004	25.2	973	74.5	7.8
	NWW057	8/21/2004	26.9	997	97	8.8
	NWW063	8/21/2004	23.7	961	82.9	8.2
	NWW067	8/30/2004	24.7	1085	61.8	7.8
	NWW103	8/22/2004	22.4	1012	99	6.7
	NWW107	8/23/2004	22.4	1023	86	7.3
	NWW114	8/23/2004	25.8	1004	85	7.9
San Joaquin River Upstream	NWW003	8/19/2004	24.1	1670	78.4	6.3
	NWW006	8/19/2004	29.2	1688	63	9.2
	NWW013	8/19/2004	29	1057	—	4.6
	NWW019	8/20/2004	26.7	1632	58.6	7.6
	NWW024	8/20/2004	24	1620	51.4	7.5
	NWW028	8/20/2004	27.9	1619	53	10.1
	NWW035	8/20/2004	29.9	1614	34.3	10.4
	NWW041	8/20/2004	24.8	1618	33.5	8.3
	NWW045	8/21/2004	23.9	1575	46.4	6.9
	NWW049	8/21/2004	26	1567	36.9	10.1
	NWW056	8/21/2004	28.2	1589	30.8	10.8
	NWW062	8/22/2004	24.2	1615	48	8.4
	NWW066	8/30/2004	24.1	2001	37.8	8.6
	NWW101	8/22/2004	22.3	1641	58	7.2
	NWW106	8/23/2004	22.6	1578	61	7.9
	NWW113	8/23/2004	24.3	1561	49	8.7

Appendix C

Quality Assurance Summary Report

RECLAMATION

Managing Water in the West

U. S. Bureau of Reclamation
Mid-Pacific Region
Environmental Monitoring Branch, MP-157

San Joaquin River Recirculation Pilot Study Quality Assurance Summary Report

On August 19 - 23 and 30, 2004 samples were collected in support of the San Joaquin River Recirculation Pilot Study. External Quality Assurance (QA) samples were incorporated with the production samples to assess the ability of the laboratories to produce reliable data. The analytical results were submitted to MP-157's QA section for review and validation of the external QA samples. In addition to evaluating external QA sample results, results for the Quality Control samples incorporated by the laboratory were also reviewed. The QA sample results are discussed below.

Precision

Most parameters had Relative Percent Differences (RPDs) within the QA acceptance limits.

Dissolved Aluminum:

Bracket reanalysis for QA regular/duplicate samples NWW027 - NWW033, NWW047 – NWW063, and NWW0100 - NWW0114 resulted in RPDs that exceeded QA acceptance limits. The sample bracket RPDs ranged from 22% - 55%. A statement from the laboratory director indicated that this variability may have been due to matrix interference because the lab experienced problematic instrument fluctuation for samples below 50 ppb. The variability also may be due to a low level contamination problem that the lab has experienced from time to time. Production results for these samples are suspect because they may show excessive variability from their true values. As a result, data are not valid.

Ammonia as Nitrogen:

Bracket reanalysis for QA regular/duplicate sample within NWW024 - NWW033 resulted in an RPD for the duplicate of 29%. Based on this RPD that exceeded QA acceptance limits, production sample results within the bracket are suspect and may show excessive variability from their true values. As a result, data are not valid.

Orthophosphate as Phosphorus
The difference for the duplicates for samples NWW105 and NWW111 - NWW117 was not acceptable. The duplicate samples (NWW105 and NWW117) were submitted for reanalysis. Upon being reanalyzed, the original result for NWW117 was confirmed. However, there was not enough sample volume left to reanalyze sample NWW105. Consequently, the production sample results associated with these duplicates are suspect and may vary excessively from their true values. As a result, data for NWW105 and NWW111-NWW117 are not valid.

Total Suspended Solids (TSS)
The RPDs for the duplicates for samples NWW001 - NWW025 were not acceptable. The duplicate samples (NWW007 and NWW010, NWW012 and NWW014) were submitted for reanalysis. Upon being reanalyzed, the original results were confirmed. As a result, the original results associated with these samples were accepted as valid. The slightly unacceptable RPDs could be attributed to improper homogenization of the samples.

Accuracy
Most parameters had Percent Recoveries (PRs) within the QA acceptance limits.

Dissolved Arsenic:
Spike analysis of sample NWW070 resulted in a PR of 128%. Reanalysis of this sample confirmed the original result so original data accepted.

Dissolved Copper:
Spike analysis of sample NWW011 resulted in a PR of 78%. Reanalysis of this sample confirmed the original result so original data accepted.

Dissolved Mercury:
Spike analysis of samples NWW011 and NWW070 resulted in PRs of 170% and 125%, respectively. Reanalysis of these samples confirmed the original results so original data accepted.

Dissolved Nickel:
Spike analysis of sample NWW011 resulted in a PR of 78%. Reanalysis of this sample confirmed the original result so original data accepted.

Selenium
The PRs for the spike samples NWW032 and NWW038 were not acceptable. Samples NWW032 and NWW038 were submitted for reanalysis and the original results were confirmed. Therefore, the original results for NWW016 - NWW052 are accepted.

Dissolved Silver:
Reanalysis for the bracket of samples, NWW001 - NWW013, indicated that production sample results are suspect and may be biased low due to spike recovery of only 74%. Reanalysis for the brackets of samples, NWW014 -

NWW026, NWW039 - NWW063 and NWW0100 - NWW0114, resulted in spike recoveries of 171%, 133% and 147%, respectively. This indicates that production results for samples that showed detectable levels of silver, NWW023, NWW043, NWW063 and NWW100, are suspect and may be biased high, 1.6 ug/l being the highest detected value. The 171% spike recovery may be due to sample spiking error since that sample was a blank spike, free of matrix interference. As a result, data for NWW001 – NWW013, NWW023, NWW043, NWW063, and NWW0100 are not valid.

<u>Total Suspended Solids (TSS)</u>
The PRs for the reference samples NWW070 and NWW109 were not acceptable. Samples NWW070 and NWW109 were submitted for reanalysis and the original results were confirmed. The reference manufacturers were contacted to see if any other issues of low recoveries had been reported. The manufacturer of the reference sample for NWW070 indicated that there were no reports of low recoveries for the lot number used, but that the sample may not have been well mixed prior to being poured into the sample bottle. The manufacturer of the reference sample for NWW109 confirmed that they had two previous reports (consisting of a total of 6 samples) of low percent recoveries for the lot number used. The results for sample brackets NWW064 - NWW070, NWW100 - NWW103, and NWW108 - NWW110 are accepted as valid based on acceptable laboratory QC, the laboratory's ability to confirm the original result, the responses from the manufacturers, and acceptable precision and blank sample results of the external QA samples incorporated.

<u>Organics:</u>
Samples NWW004 and NWW017, analyzed by EPA Method 525, may be biased low for the following parameters: chrysene, dibenz(a,h)anthracene, methoxychlor, permethrin A and B, di-n-octylphthalate, indeno(1,2,3,c,d)pyrene, benzo(g,h,i)perylene, benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, bis (2-ethylhexyl) phthalate. This potential bias was indicated through QA assessment of laboratory internal QC results. The laboratory internal QC results showed that one of the internal standards used for these samples had low recoveries, were confirmed by re-extraction, and were possibly due to matrix interference.

<u>Contamination</u>
All QA blank samples were acceptable with respect to contamination for all parameters.

<u>Statistical Outliers</u>
Most parameter results were within three standard deviations of the average for each site.

Dissolved Aluminum
Sample NWW005 had a result greater than three standard deviations from the average for the site. The result could not be explained by environmental conditions, and is therefore invalid.

Ammonia as Nitrogen
Sample NWW020 had a result greater than three standard deviations from the average for the site. The result is valid based on environmental conditions.

Dissolved Arsenic
Sample NWW066 had a result greater than three standard deviations from the average for the site. The result could not be explained by environmental conditions, and is therefore invalid.

Biological Oxygen Demand (BOD)
Samples NWW017 and NWW020 had results greater than three standard deviations from the average for each site. The results are valid based on environmental conditions.

Dissolved Chromium
Samples NWW008, NWW016, NWW017, NWW018, NWW064, NWW065, NWW066 and NWW067 had results greater than three standard deviations from the average for each site. The results could not be explained by environmental conditions, and are therefore invalid.

Dissolved Copper
Samples NWW044 and NWW045 had results greater than three standard deviations from the average for each site. The results could not be explained by environmental conditions, and are therefore invalid.

Dissolved Lead
Sample NWW112 had a result greater than three standard deviations from the average for this site. The result could not be explained by environmental conditions, and is therefore invalid

Dissolved Mercury
Samples NWW017, NWW039 and NWW056 had results greater than three standard deviations from the average for each site. The results could not be explained by environmental conditions, and are therefore invalid.

Dissolved Nickel
Sample NWW045 had a result greater than three standard deviations from the average for the site. The result could not be explained by environmental conditions, and is therefore invalid.

Nitrate + Nitrite as Nitrogen
Sample NWW018 had a result greater than three standard deviations from the average for the site. The result could not be explained by environmental conditions, and is therefore invalid.

Orthophosphate as Phosphorous
Sample NWW114 had a result greater than three standard deviations from the average for the site. The result could not be explained by environmental conditions, and is therefore invalid.

Selenium
Samples NWW003 and NWW020 had results greater than three standard deviations from the average for each site. The samples were reanalyzed and the results were confirmed. The result for NWW003 could not be explained by environmental conditions, and is therefore invalid. The result for NWW020 is valid based on environmental conditions.

Dissolved Silver
Samples NWW043 and NWW063 had results greater than three standard deviations from the average for each site. The results could not be explained by environmental conditions, and are therefore invalid.

Total Kjeldahl Nitrogen(TKN)
Samples NWW018, NWW020, and NWW021 had results greater than three standard deviations from the average for each site. The result for NWW018 could not be explained by environmental conditions, and is therefore invalid. The results for NWW020 and NWW021 are valid based on environmental conditions.

Total Organic Carbon (TOC)
Samples NWW008, NWW016 and NWW017 had results greater than three standard deviations from the average for each site. The samples were reanalyzed and the original results were confirmed. The results are valid based on environmental conditions.

Total Phosphorus
Sample NWW020 had a result greater than three standard deviations from the average for the site. The result is valid based on environmental conditions.

Total Suspended Solids (TSS)
Samples NWW018 and NWW020 had results greater than three standard deviations from the average for each site. Both samples were reanalyzed. The original result for NWW020 was confirmed, but the original result for NWW018 could not be confirmed. The results are valid based on environmental conditions.

Dissolved Zinc
Samples NWW044 and NWW045 had results greater than three standard deviations from the average for each site. Sample NWW044 was re-analyzed

and the original result was confirmed. The results could not be explained by environmental conditions, and are therefore invalid.

Field Calibration
All probe calibration for EC, turbidity, and D.O. showed precision of $\leq$ 10% RPD and accuracy within ± 10% recovery of the true value.

Completeness
Most parameters for this study met the 90% acceptance limit.

Aluminum
Due to unacceptable QA precision results for the brackets NWW027 - NWW033, NWW047-NWW063, and NWW0100 - NWW0114 and an outlier result for NWW005, completeness of only 58% was achieved.

Ammonia as Nitrogen
Due to unacceptable QA precision results for the bracket NWW024 - NWW033, completeness of only 88% was achieved.

Chlorophyll a
Due to a laboratory computer failure, a portion of the data was lost. The samples could not be reanalyzed so a completeness of only 58% was achieved.

Chromium
Due to outlier results for samples NWW008, NWW016, NWW017, NWW018, NWW064, NWW065, NWW066 and NWW067, completeness of only 86% was achieved.

Silver
Due to unacceptable QA accuracy results for the brackets NWW001 – NWW013, NWW023, NWW043, NWW063, and NWW0100 and outlier results for NWW043 and NWW063, completeness of only 78% was achieved.

Holding Times
Most samples were analyzed within the recommended holding times of the parameters.

Ammonia as Nitrogen:
Although reanalysis for sample brackets NWW024 - NWW033, NWW055 - NWW063 and NWW0100 - NWW114 exceeded the holding time, QA spike samples demonstrated acceptable recoveries. Because the spike recoveries were within QA acceptance limits, data is acceptable.

E. Coli
Samples NWW002 and NWW004 were analyzed past the 24 hour recommended holding time. Sample NWW002 was analyzed 2.5 hours past the holding time, and sample NWW004 was analyzed 40 minutes past the holding time.

Organics

Samples analyzed for heptachlor (EPA Method 505) required a second extraction which was not performed within the holding time.

Miscellaneous

For toxicity testing, the acute assay for *C. dubia* was run in the fashion of a chronic assay. A statement from the laboratory director indicated that this testing design is acceptable under EPA methods for assessing survival in seven-day short-term chronic toxicity tests; therefore the results are statistically suitable to conduct an acute assessment.

Table 1. External Quality Assurance BOD Sample Results, mg/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria
NWW007	NWW010	4	4	0	≤ RL
NWW012	NWW014	4	5	1	≤ RL
NWW027	NWW031	<3	<3	0	≤ RL
NWW034	NWW037	<3	4	1	≤ RL
NWW047	NWW052	<3	<3	0	≤ RL
NWW055	NWW058	<3	<3	0	≤ RL
NWW067	NWW069	3	3	0	≤ RL
NWW0100	NWW0110	<3	<3	0	≤ RL
NWW105	NWW117	3	3	0	≤ RL

Accuracy: Reference Sample Results

Reference ID	Reference Result	Reference Certified Value or Range	Recovery	Acceptance Criteria
NWW011	58	37.3-111	--	within certified range
NWW015	65	74.0	88%	80%-120%
NWW032	72	74.0	97%	80%-120%
NWW038	69	74.0	93%	80%-120%
NWW053	80	74.0	108%	80%-120%
NWW059	71	74.0	96%	80%-120%
NWW070	72	74.0	97%	80%-120%
NWW0109	49	45.6	108%	80%-120%
NWW115	48	45.6	105%	80%-120%

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<3	3	< 2 x RL
NWW030	<3	3	< 2 x RL
NWW051	<3	3	< 2 x RL
NWW068	<3	3	< 2 x RL
NWW0108	<3	3	< 2 x RL
NWW116	<3	3	< 2 x RL

Table 2. External Quality Assurance Nitrate + Nitrite as N Sample Results, mg/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria
NWW007	NWW010	0.47	0.47	0.0%	≤ 20%
NWW012	NWW014	0.29	0.30	3.4%	≤ 20%
NWW027	NWW031	0.42	0.43	2.4%	≤ 20%
NWW034	NWW037	0.44	0.45	2.2%	≤ 20%
NWW047	NWW052	0.31	0.33	6.3%	≤ 20%
NWW055	NWW058	0.44	0.45	2.2%	≤ 20%
NWW067	NWW069	0.79	0.80	1.3%	≤ 20%
NWW0100	NWW0110	0.58	0.57	1.7%	≤ 20%
NWW105	NWW117	0.52	0.51	1.9%	≤ 20%

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<0.05	0.05	< 2 x RL
NWW030	<0.05	0.05	< 2 x RL
NWW051	<0.05	0.05	< 2 x RL
NWW068	<0.05	0.05	< 2 x RL
NWW0108	<0.05	0.05	< 2 x RL
NWW116	<0.05	0.05	< 2 x RL

Table 3. External Quality Assurance Orthophosphate as P Sample Results, mg/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria
NWW007	NWW010	0.32	0.34	6.1%	≤ 20%
NWW012	NWW014	0.06	0.06	0.00	≤ RL
NWW027	NWW031	<0.03	<0.03	0.00	≤ RL
NWW034	NWW037	<0.03	<0.03	0.00	≤ RL
NWW047	NWW052	0.05	0.03	0.02	≤ RL
NWW055	NWW058	0.04	<0.03	0.01	≤ RL
NWW067	NWW069	<0.03	<0.03	0.00	≤ RL
NWW0100	NWW0110	0.11	0.11	0.00	≤ RL
NWW105	NWW117	*0.13	*0.06	*0.07	≤ RL

* The difference between the regular and duplicate results did not meet the acceptance criteria of being ≤ RL. Samples NWW105 and NWW 117 were submitted for re-analysis. The original result for NWW117 was confirmed upon re-analysis. There was not enough sample left to re-analyze sample NWW105. The production sample results associated with these duplicates are suspect and may vary excessively from their true values. As a result, the results for sample NWW105 and NWW111-NWW117 are not valid.

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<0.03	0.03	< 2 x RL
NWW030	<0.03	0.03	< 2 x RL
NWW051	<0.03	0.03	< 2 x RL
NWW068	<0.03	0.03	< 2 x RL
NWW0108	<0.03	0.03	< 2 x RL
NWW116	<0.03	0.03	< 2 x RL

Table 4. External Quality Assurance Boron Sample Results, mg/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria
NWW007	NWW010	0.63	0.65	3.1%	≤ 20%
NWW012	NWW014	0.087	0.086	0.001	≤ RL
NWW027	NWW031	0.14	0.16	13.3%	≤ 20%
NWW034	NWW037	0.14	0.14	0.0%	≤ 20%
NWW047	NWW052	0.075	0.076	0.001	≤ RL
NWW055	NWW058	0.15	0.15	0.0%	≤ 20%
NWW067	NWW069	0.84	0.83	1.2%	≤ 20%

Accuracy: Spike Sample Results

Reference ID	Spike Result	Spike Amount	Percent Recovery	Acceptance Criteria
NWW011	0.83	0.21	95%	80%-120%
NWW015	0.30	0.22	97%	80%-120%
NWW032	0.36	0.22	100%	80%-120%
NWW038	0.35	0.22	95%	80%-120%
NWW053	0.52	0.43	103%	80%-120%
NWW059	0.38	0.22	105%	80%-120%
NWW070	1.1	0.26	100%	80%-120%

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<0.020	0.020	< 2 x RL
NWW030	<0.020	0.020	< 2 x RL
NWW051	<0.020	0.020	< 2 x RL
NWW068	<0.020	0.020	< 2 x RL

Table 5. External Quality Assurance Chlorophyll A Sample Results, ug/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria	RL
NWW012	NWW014	3.5	3.9	0.4	≤ RL	2
NWW027	NWW031	17	17	0.0%	≤ 20% RPD	2
NWW047	NWW052	N.A	N.A	--	--	--

N.A = The samples were extracted and analyzed, but computer failure on the UV-Vis Spectrophotometer caused the data to be lost. Due to the nature of the procedure, the samples could not be re-analyzed.

Table 6. External Quality Assurance E. Coli Sample Results, MPN/100ml

Accuracy: Reference Sample Results

Reference ID	Reference Result	Reference Certified Value or Range	Recovery	Acceptance Criteria
NWW011	38	8-350	--	within certified range

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<2.0	2.0	< 2 x RL

Table 7. External Quality Assurance Dissolved Metals Results, Contamination

Parameter	Units	Field ID	Result	Reporting Limit	Acceptance Criteria
Aluminum	ug/l	NWW009	< 4.0	4.0	< 2 x RL
Antimony	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Arsenic	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Beryllium	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Cadmium	ug/l	NWW009	< 0.25	0.25	< 2 x RL
Chromium	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Copper	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Lead	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Mercury	ng/l	NWW009	< 2.0	2.0	< 2 x RL
Nickel	ug/l	NWW009	< 1.0	1.0	< 2 x RL
Silver	ug/l	NWW009	< 0.5	0.5	< 2 x RL
Thallium	ug/l	NWW009	< 1.0	1.0	< 2 x RL
Zinc	ug/l	NWW009	< 2.0	2.0	< 2 x RL
Aluminum	ug/l	NWW030	< 4.0	4.0	< 2 x RL
Antimony	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Arsenic	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Beryllium	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Cadmium	ug/l	NWW030	< 0.25	0.25	< 2 x RL
Chromium	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Copper	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Lead	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Mercury	ng/l	NWW030	< 2.0	2.0	< 2 x RL
Nickel	ug/l	NWW030	< 1.0	1.0	< 2 x RL
Silver	ug/l	NWW030	< 0.5	0.5	< 2 x RL
Thallium	ug/l	NWW030	< 1.0	1.0	< 2 x RL
Zinc	ug/l	NWW030	< 2.0	2.0	< 2 x RL
Aluminum	ug/l	NWW051	< 4.0	4.0	< 2 x RL
Antimony	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Arsenic	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Beryllium	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Cadmium	ug/l	NWW051	< 0.25	0.25	< 2 x RL
Chromium	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Copper	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Lead	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Mercury	ng/l	NWW051	< 2.0	2.0	< 2 x RL
Nickel	ug/l	NWW051	< 1.0	1.0	< 2 x RL
Silver	ug/l	NWW051	< 0.5	0.5	< 2 x RL
Thallium	ug/l	NWW051	< 1.0	1.0	< 2 x RL

Table 7. Continued

Parameter	Units	Field ID	Result	Reporting Limit	Acceptance Criteria
Zinc	ug/l	NWW051	< 2.0	2.0	< 2 x RL
Aluminum	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Antimony	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Arsenic	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Beryllium	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Cadmium	ug/l	NWW068	< 0.25	0.25	< 2 x RL
Chromium	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Copper	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Lead	ug/l	NWW068	< 0.5	0.5	< 2 x RL
Mercury	ng/l	NWW068	< 2.0	2.0	< 2 x RL
Nickel	ug/l	NWW068	< 1.0	1.0	< 2 x RL
Silver	ug/l	NWW068	< 0.2	0.2	< 2 x RL
Thallium	ug/l	NWW068	< 1.0	1.0	< 2 x RL
Zinc	ug/l	NWW068	< 2.0	2.0	< 2 x RL

Table 8. External Quality Assurance Dissolved Metals Results, Accuracy

Parameter	Units	Field ID	Spike Concentration	Spike Result	Regular Result	Percent Recovery	Acceptance Criteria
Aluminum	ug/l	NWW011	2875	2750	5.9	95%	80-120%
Antimony	ug/l	NWW011	23.0	23.6	< 0.5	103%	80-120%
Arsenic	ug/l	NWW011	26.8	33.7	5.0	107%	80-120%
Beryllium	ug/l	NWW011	30.7	26.5	< 0.5	86%	80-120%
Cadmium	ug/l	NWW011	11.5	11.1	< 0.25	97%	80-120%
Chromium	ug/l	NWW011	26.8	25.9	< 0.5	97%	80-120%
Copper	ug/l	NWW011	30.7	26.1 (28.4)**	2.3	**78%**	80-120%
Lead	ug/l	NWW011	23.0	21.9	< 0.5	97%	80-120%
Mercury	ng/l	NWW011	10.0	21.2 (21.3)**	3.7	**170%**	80-120%
Nickel	ug/l	NWW011	383	302 (311)**	4.2	**78%**	80-120%
Silver	ug/l	NWW011	5.4	4.0 *	< 0.5	**74%**	80-120%
Thallium	ug/l	NWW011	15.3	14.4	< 1.0	94%	80-120%
Zinc	ug/l	NWW011	288	269	2.9	93%	80-120%
Aluminum	ug/l	NWW015	2896	3190	---	110%	80-120%
Antimony	ug/l	NWW015	23.2	22.1	---	96%	80-120%
Arsenic	ug/l	NWW015	27.0	27.0	---	100%	80-120%
Beryllium	ug/l	NWW015	30.9	29.1	---	94%	80-120%
Cadmium	ug/l	NWW015	11.6	11.7	---	101%	80-120%
Chromium	ug/l	NWW015	27.0	29.0	---	107%	80-120%
Copper	ug/l	NWW015	30.9	31.8	---	103%	80-120%
Lead	ug/l	NWW015	23.2	24.8	---	107%	80-120%
Mercury	ng/l	NWW015	10.0	8.8	---	88%	80-120%
Nickel	ug/l	NWW015	386	399	---	103%	80-120%
Silver	ug/l	NWW015	5.5	9.4 *	---	**171%**	80-120%
Thallium	ug/l	NWW015	15.4	15.8	---	103%	80-120%
Zinc	ug/l	NWW015	290	288	---	99%	80-120%
Aluminum	ug/l	NWW032	3034	3000	33	99%	80-120%
Antimony	ug/l	NWW032	24.3	23.8	< 0.5	98%	80-120%
Arsenic	ug/l	NWW032	28.3	29.8	1.6	95%	80-120%
Beryllium	ug/l	NWW032	32.4	32.1	< 0.5	99%	80-120%
Cadmium	ug/l	NWW032	12.1	12.0	< 0.25	99%	80-120%
Chromium	ug/l	NWW032	28.3	28.0	< 0.5	99%	80-120%
Copper	ug/l	NWW032	32.4	29.9	0.7	92%	80-120%
Lead	ug/l	NWW032	24.3	24.5	< 0.5	101%	80-120%
Mercury	ng/l	NWW032	10.0	8.0	< 2.0	80%	80-120%
Nickel	ug/l	NWW032	405	363	2.2	90%	80-120%
Silver	ug/l	NWW032	5.7	6.4	< 0.5	112%	80-120%

Table 8. Continued

Parameter	Units	Field ID	Spike Concentration	Spike Result	Regular Result	Percent Recovery	Acceptance Criteria
Thallium	ug/l	NWW032	16.2	15.8	< 1.0	98%	80-120%
Zinc	ug/l	NWW032	303.4	296	< 2.0	98%	80-120%
Antimony	ug/l	NWW038	23.2	22.2	< 0.5	97%	80-120%
Arsenic	ug/l	NWW038	27.0	28.6	1.7	100%	80-120%
Beryllium	ug/l	NWW038	30.9	29.5	< 0.5	95%	80-120%
Cadmium	ug/l	NWW038	11.6	11.3	< 0.25	97%	80-120%
Chromium	ug/l	NWW038	27.0	27.1	< 0.5	100%	80-120%
Copper	ug/l	NWW038	30.9	28.0	1.2	87%	80-120%
Lead	ug/l	NWW038	23.2	23.5	< 0.5	101%	80-120%
Mercury	ng/l	NWW038	10.0	9.6	< 2.0	96%	80-120%
Nickel	ug/l	NWW038	386	333	2.2	86%	80-120%
Silver	ug/l	NWW038	5.5	6.4	< 0.5	116%	80-120%
Thallium	ug/l	NWW038	15.4	15.4	< 1.0	100%	80-120%
Zinc	ug/l	NWW038	289.5	279	< 2.0	97%	80-120%
Aluminum	ug/l	NWW053	2866	2890	41	99%	80-120%
Antimony	ug/l	NWW053	22.9	22.1	< 0.5	97%	80-120%
Arsenic	ug/l	NWW053	26.8	28.4	2.3	97%	80-120%
Beryllium	ug/l	NWW053	30.6	30.5	< 0.5	100%	80-120%
Cadmium	ug/l	NWW053	11.5	11.8	< 0.25	103%	80-120%
Chromium	ug/l	NWW053	26.8	27.0	< 0.5	101%	80-120%
Copper	ug/l	NWW053	30.6	31.7	1.5	99%	80-120%
Lead	ug/l	NWW053	22.9	23.0	< 0.5	100%	80-120%
Mercury	ng/l	NWW053	10.0	9.2	< 2.0	92%	80-120%
Nickel	ug/l	NWW053	382	338	1.4	88%	80-120%
Silver	ug/l	NWW053	5.4	7.2 *	< 0.5	**133%**	80-120%
Thallium	ug/l	NWW053	15.3	15.0	< 1.0	98%	80-120%
Zinc	ug/l	NWW053	287	294	< 2.0	102%	80-120%
Aluminum	ug/l	NWW059	3002	3000	35.6	99%	80-120%
Antimony	ug/l	NWW059	24.0	23.3	< 0.5	97%	80-120%
Arsenic	ug/l	NWW059	28.0	28.5	1.9	95%	80-120%
Beryllium	ug/l	NWW059	32.0	30.4	< 0.5	95%	80-120%
Cadmium	ug/l	NWW059	12.0	12.0	< 0.25	100%	80-120%
Chromium	ug/l	NWW059	28.0	28.4	< 0.5	101%	80-120%
Copper	ug/l	NWW059	32.0	31.4	1.5	93%	80-120%
Lead	ug/l	NWW059	24.0	25.3	< 0.5	105%	80-120%
Mercury	ng/l	NWW059	10.0	9.5	< 2.0	95%	80-120%
Nickel	ug/l	NWW059	400	372	2.4	92%	80-120%
Silver	ug/l	NWW059	5.7	8.4 *	< 0.5	**147%**	80-120%
Thallium	ug/l	NWW059	16.0	15.5	< 1.0	97%	80-120%
Zinc	ug/l	NWW059	300	285	< 2.0	95%	80-120%

Table 8. Continued

Parameter	Units	Field ID	Spike Concentration	Spike Result	Regular Result	Percent Recovery	Acceptance Criteria
Aluminum	ug/l	NWW070	2940	2990	21	101%	80-120%
Antimony	ug/l	NWW070	23.5	27.5	< 0.5	115%	80-120%
Arsenic	ug/l	NWW070	27.4	39.9 (33.3) **	4.8	**128%**	80-120%
Beryllium	ug/l	NWW070	31.4	34.7	< 0.5	111%	80-120%
Cadmium	ug/l	NWW070	11.8	13.3	< 0.25	113%	80-120%
Chromium	ug/l	NWW070	27.4	32.6	6.7	95%	80-120%
Copper	ug/l	NWW070	31.4	32.9	3.0	95%	80-120%
Lead	ug/l	NWW070	23.5	27.1	< 0.5	115%	80-120%
Mercury	ng/l	NWW070	10.0	15.6 (16.0) **	2.6	**125%**	80-120%
Nickel	ug/l	NWW070	392	371	2.9	94%	80-120%
Silver	ug/l	NWW070	5.6	4.9	< 0.2	88%	80-120%
Thallium	ug/l	NWW070	15.7	17.8	< 1.0	113%	80-120%
Zinc	ug/l	NWW070	294	334	< 2.0	114%	80-120%

* = sample bracket reanalyzed, bracket results accepted but data for NWW001-NWW013, NWW023, NWW043, NWW063, and NWW0100 are invalid.
** = sample reanalyzed and confirmed, original result accepted
( ) = reanalysis result
--- = blank spike used for accuracy sample NWW015, no regular results to report

Table 9. External Quality Assurance Dissolved Metals Results, Precision

Parameter	Units	Regular Field ID	Regular Result	Duplicate Field ID	Duplicate Result	Difference	Acceptance Limit
Aluminum	ug/l	NWW007	5.9	NWW010	4.6	1.3	= 4.0
Antimony	ug/l	NWW007	< 0.5	NWW010	< 0.5	0	= 0.5
Arsenic	ug/l	NWW007	5.0	NWW010	4.7	6.2%	= 20%
Beryllium	ug/l	NWW007	< 0.5	NWW010	< 0.5	0	= 0.5
Cadmium	ug/l	NWW007	< 0.25	NWW010	< 0.25	0	= 0.25
Chromium	ug/l	NWW007	< 0.5	NWW010	< 0.5	0	= 0.5
Copper	ug/l	NWW007	2.3	NWW010	2.1	0.2	= 0.5
Lead	ug/l	NWW007	< 0.5	NWW010	< 0.5	0	= 0.5
Mercury	ng/l	NWW007	3.7	NWW010	4.1	0.4	= 2.0
Nickel	ug/l	NWW007	4.2	NWW010	4.1	0.1	= 1.0
Silver	ug/l	NWW007	< 0.5	NWW010	< 0.5	0	= 0.5
Thallium	ug/l	NWW007	< 1.0	NWW010	< 1.0	0	= 1.0
Zinc	ug/l	NWW007	2.9	NWW010	2.8	0.1	= 2.0
Aluminum	ug/l	NWW027	33	NWW014	31	7%	= 20%
Antimony	ug/l	NWW027	< 0.5	NWW014	< 0.5	0	= 0.5
Arsenic	ug/l	NWW027	1.6	NWW014	1.6	0	= 0.5
Beryllium	ug/l	NWW027	< 0.5	NWW014	< 0.5	0	= 0.5
Cadmium	ug/l	NWW027	< 0.25	NWW014	< 0.25	0	= 0.25
Chromium	ug/l	NWW027	< 0.5	NWW014	< 0.5	0	= 0.5
Copper	ug/l	NWW027	0.7	NWW014	0.7	0	= 0.5
Lead	ug/l	NWW027	< 0.5	NWW014	< 0.5	0	= 0.5
Mercury	ng/l	NWW015	8.8	NWW014	8.7	0.1	= 2.0
Nickel	ug/l	NWW027	2.2	NWW014	2.2	0	= 1.0
Silver	ug/l	NWW027	< 0.5	NWW014	< 0.5	0	= 0.5
Thallium	ug/l	NWW027	< 1.0	NWW014	< 1.0	0	= 1.0
Zinc	ug/l	NWW027	< 2.0	NWW014	< 2.0	0	= 2.0
Aluminum	ug/l	NWW027	33 *	NWW031	58 *	**55%**	= 20%
Antimony	ug/l	NWW027	< 0.5	NWW031	< 0.5	0	= 0.5
Arsenic	ug/l	NWW027	1.6	NWW031	1.7	0.1	= 0.5
Beryllium	ug/l	NWW027	< 0.5	NWW031	< 0.5	0	= 0.5
Cadmium	ug/l	NWW027	< 0.25	NWW031	< 0.25	0	= 0.25
Chromium	ug/l	NWW027	< 0.5	NWW031	< 0.5	0	= 0.5
Copper	ug/l	NWW027	0.7	NWW031	0.7	0	= 0.5
Lead	ug/l	NWW027	< 0.5	NWW031	< 0.5	0	= 0.5
Mercury	ng/l	NWW027	< 2.0	NWW031	2.2	0.2	= 2.0
Nickel	ug/l	NWW027	2.2	NWW031	2.5	0.3	= 1.0
Silver	ug/l	NWW027	< 0.5	NWW031	< 0.5	0	= 0.5
Thallium	ug/l	NWW027	< 1.0	NWW031	< 1.0	0	= 1.0
Zinc	ug/l	NWW027	< 2.0	NWW031	< 2.0	0	= 2.0

Table 9. Continued

Parameter	Units	Regular Field ID	Regular Result	Duplicate Field ID	Duplicate Result	Difference	Acceptance Limit
Aluminum	ug/l	NWW034	35.1	NWW037	39.9	13%	= 20%
Antimony	ug/l	NWW034	< 0.5	NWW037	< 0.5	0	= 0.5
Arsenic	ug/l	NWW034	1.7	NWW037	1.8	0.1	= 0.5
Beryllium	ug/l	NWW034	< 0.5	NWW037	< 0.5	0	= 0.5
Cadmium	ug/l	NWW034	< 0.25	NWW037	< 0.25	0	= 0.25
Chromium	ug/l	NWW034	< 0.5	NWW037	< 0.5	0	= 0.5
Copper	ug/l	NWW034	1.2	NWW037	1.3	0.1	= 0.5
Lead	ug/l	NWW034	< 0.5	NWW037	< 0.5	0	= 0.5
Mercury	ng/l	NWW034	< 2.0	NWW037	< 2.0	0	= 2.0
Nickel	ug/l	NWW034	2.2	NWW037	2.2	0	= 1.0
Silver	ug/l	NWW034	< 0.5	NWW037	< 0.5	0	= 0.5
Thallium	ug/l	NWW034	< 1.0	NWW037	< 1.0	0	= 1.0
Zinc	ug/l	NWW034	< 2.0	NWW037	< 2.0	0	= 2.0
Aluminum	ug/l	NWW047	41 *	NWW052	52 *	**22%**	= 20%
Antimony	ug/l	NWW047	< 0.5	NWW052	< 0.5	0	= 0.5
Arsenic	ug/l	NWW047	2.3	NWW052	2.3	0	= 0.5
Beryllium	ug/l	NWW047	< 0.5	NWW052	< 0.5	0	= 0.5
Cadmium	ug/l	NWW047	< 0.25	NWW052	< 0.25	0	= 0.25
Chromium	ug/l	NWW047	< 0.5	NWW052	< 0.5	0	= 0.5
Copper	ug/l	NWW047	1.5	NWW052	1.7	0.2	= 0.5
Lead	ug/l	NWW047	< 0.5	NWW052	< 0.5	0	= 0.5
Mercury	ng/l	NWW047	< 2.0	NWW052	< 2.0	0	= 2.0
Nickel	ug/l	NWW047	1.4	NWW052	1.3	0.1	= 1.0
Silver	ug/l	NWW047	< 0.5	NWW052	< 0.5	0	= 0.5
Thallium	ug/l	NWW047	< 1.0	NWW052	< 1.0	0	= 1.0
Zinc	ug/l	NWW047	< 2.0	NWW052	< 2.0	0	= 2.0
Aluminum	ug/l	NWW055	36 *	NWW058	27*	**26%**	= 20%
Antimony	ug/l	NWW055	< 0.5	NWW058	< 0.5	0	= 0.5
Arsenic	ug/l	NWW055	1.9	NWW058	1.9	0	= 0.5
Beryllium	ug/l	NWW055	< 0.5	NWW058	< 0.5	0	= 0.5
Cadmium	ug/l	NWW055	< 0.25	NWW058	< 0.25	0	= 0.25
Chromium	ug/l	NWW055	< 0.5	NWW058	< 0.5	0	= 0.5
Copper	ug/l	NWW055	1.5	NWW058	1.5	0	= 0.5
Lead	ug/l	NWW055	< 0.5	NWW058	< 0.5	0	= 0.5
Mercury	ng/l	NWW055	< 2.0	NWW058	< 2.0	0	= 2.0
Nickel	ug/l	NWW055	2.4	NWW058	2.5	0.1	= 1.0
Silver	ug/l	NWW055	< 0.5	NWW058	< 0.5	0	= 0.5
Thallium	ug/l	NWW055	< 1.0	NWW058	< 1.0	0	= 1.0
Zinc	ug/l	NWW055	< 2.0	NWW058	< 2.0	0	= 2.0

Table 9. Continued

Parameter	Units	Regular Field ID	Regular Result	Duplicate Field ID	Duplicate Result	Difference	Acceptance Limit
Aluminum	ug/l	NWW067	21.0 (24.6)**	NWW069	16.4 (18.4)**	**25%**	= 20%
Antimony	ug/l	NWW067	< 0.5	NWW069	< 0.5	0	= 0.5
Arsenic	ug/l	NWW067	4.8	NWW069	4.9	2%	= 20%
Beryllium	ug/l	NWW067	< 0.5	NWW069	< 0.5	0	= 0.5
Cadmium	ug/l	NWW067	< 0.25	NWW069	< 0.25	0	= 0.25
Chromium	ug/l	NWW067	6.7	NWW069	6.7	0%	= 20%
Copper	ug/l	NWW067	3.0	NWW069	3.1	3%	= 20%
Lead	ug/l	NWW067	< 0.5	NWW069	< 0.5	0	= 0.5
Mercury	ng/l	NWW067	2.6	NWW069	< 2.0	0.6	= 2.0
Nickel	ug/l	NWW067	2.9	NWW069	2.9	0	= 1.0
Silver	ug/l	NWW067	< 0.2	NWW069	< 0.2	0	= 0.5
Thallium	ug/l	NWW067	< 1.0	NWW069	< 1.0	0	= 1.0
Zinc	ug/l	NWW067	< 2.0	NWW069	< 2.0	0	= 2.0

* = entire sample bracket reanalyzed; bracket results accepted but data for NWW027-NWW033, NWW047-NWW063, and NWW0100-NWW0114 may show excessive variability and are invalid.
** = sample reanalyzed and confirmed, original result accepted
( ) = reanalysis result

Table 10. External Quality Assurance Selenium Sample Results, ug/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria
NWW007	NWW010	0.6	0.6	0.0	≤ RL
NWW012	NWW014	<0.4	<0.4	0.0	≤ RL
NWW027	NWW031	0.4	<0.4	0.0	≤ RL
NWW034	NWW037	<0.4	<0.4	0.0	≤ RL
NWW047	NWW052	<0.4	<0.4	0.0	≤ RL
NWW055	NWW058	<0.4	0.7	0.3	≤ RL
NWW067	NWW069	2.2	2.2	0.0%	≤ 20%

Accuracy: Spike Sample Results

Spike ID	Spike Result	Spike Amount	Percent Recovery	Acceptance Criteria
NWW011	2.6	2.2	91%	80%-120%
NWW015	2.0	2.1	95%	80%-120%
NWW032	*1.7	2.1	*62%	80%-120%
NWW038	*1.7	2.2	*77%	80%-120%
NWW053	2.0	2.2	91%	80%-120%
NWW059	1.9	2.1	90%	80%-120%
NWW070	3.8	2.0	80%	80%-120%

* Reanalysis confirmed the result

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<0.4	0.4	< 2 x RL
NWW030	<0.4	0.4	< 2 x RL
NWW051	<0.4	0.4	< 2 x RL
NWW068	<0.4	0.4	< 2 x RL

Table 11. External Quality Assurance Ammonia as Nitrogen, Total Kjeldahl Nitrogen and Total Phosphorous Results, mg/l

Contamination

Parameter	Field ID	Result	Reporting Limit	Acceptance Criteria
NH_3 as N	NWW009	0.05	0.05	< 2 x RL
TKN	NWW009	< 0.2	0.2	< 2 x RL
Total P	NWW009	< 0.05	0.05	< 2 x RL
NH_3 as N	NWW030	< 0.05	0.05	< 2 x RL
TKN	NWW030	< 0.2	0.2	< 2 x RL
Total P	NWW030	< 0.05	0.05	< 2 x RL
NH_3 as N	NWW051	0.05	0.05	< 2 x RL
TKN	NWW051	< 0.2	0.2	< 2 x RL
Total P	NWW051	< 0.05	0.05	< 2 x RL
NH_3 as N	NWW068	< 0.05	0.05	< 2 x RL
TKN	NWW068	< 0.2	0.2	< 2 x RL
Total P	NWW068	< 0.05	0.05	< 2 x RL

Accuracy

Parameter	Field ID	Spike Concentration	Spike Result	Regular Result	Percent Recovery	Acceptance Criteria
NH_3 as N	NWW011	2.9	3.1	0.41	92%	80-120%
TKN	NWW011	2.9	3.8	1.1	93%	80-120%
Total P	NWW011	3.6	3.8	0.44	92%	80-120%
NH_3 as N	NWW015	3.0	3.0	0.09	95%	80-120%
TKN	NWW015	3.0	3.3	0.6	89%	80-120%
Total P	NWW015	3.7	3.5	0.08	93%	80-120%
NH_3 as N	NWW032	2.8	2.6	0.24	92%	80-120%
TKN	NWW032	2.8	4.1	1.4	95%	80-120%
Total P	NWW032	3.5	3.5	0.44	88%	80-120%
NH_3 as N	NWW038	2.9	3.0	0.28	94%	80-120%
TKN	NWW038	2.9	4.0	1.4	90%	80-120%
Total P	NWW038	3.5	3.5	0.38	90%	80-120%
NH_3 as N	NWW053	3.0	2.8	0.07	97%	80-120%
TKN	NWW053	3.0	3.3	0.4	90%	80-120%
Total P	NWW053	3.7	3.3	0.1	85%	80-120%
NH_3 as N	NWW059	3.0	2.9	0.15	96%	80-120%
TKN	NWW059	3.0	4.0	1.1	97%	80-120%
Total P	NWW059	3.7	3.5	0.25	88%	80-120%
NH_3 as N	NWW070	2.9	2.9	0.12	96%	80-120%
TKN	NWW070	2.9	4.0	1.1	100%	80-120%
Total P	NWW070	3.5	3.4	0.27	89%	80-120%

Table 11. Continued

Precision

Parameter	Regular Field ID	Regular Result	Duplicate Field ID	Duplicate Result	Difference	Acceptance Limit
NH_3 as N	NWW007	0.41	NWW010	0.39	5.0%	= 20% RPD
TKN	NWW007	1.1	NWW010	1.3	17%	= 20% RPD
Total P	NWW007	0.44	NWW010	0.47	0.9%	= 20% RPD
NH_3 as N	NWW012	0.09	NWW014	0.12	0.03	= 0.05
TKN	NWW012	0.6	NWW014	0.5	0.1	= 0.2
Total P	NWW012	0.08	NWW014	0.10	0.02	= 0.05
NH_3 as N	NWW027	0.24 *	NWW031	0.32 *	**29%**	= 20% RPD
TKN	NWW027	1.4	NWW031	1.4	0%	= 20% RPD
Total P	NWW027	0.44	NWW031	0.41	7%	= 20% RPD
NH_3 as N	NWW034	0.28	NWW037	0.26	7%	= 20% RPD
TKN	NWW034	1.4	NWW037	1.3	7%	= 20% RPD
Total P	NWW034	0.38	NWW037	0.35	8%	= 20% RPD
NH_3 as N	NWW047	0.07	NWW052	0.09	0.02	= 0.05
TKN	NWW047	0.4	NWW052	0.4	0	= 0.2
Total P	NWW047	0.10	NWW052	0.09	0.01	= 0.05
NH_3 as N	NWW055	0.15	NWW058	0.19	0.04	= 0.05
TKN	NWW055	1.1	NWW058	1.0	10%	= 20% RPD
Total P	NWW055	0.25	NWW058	0.27	8%	= 20% RPD
NH_3 as N	NWW067	0.12	NWW069	0.14	0.02	= 0.05
TKN	NWW067	1.1	NWW069	1.1	0	= 0.2
Total P	NWW067	0.27	NWW069	0.30	0.02	= 0.05

* = sample bracket NWW024 - NWW033 was reanalyzed and accepted for ammonia as nitrogen; bracket data may show excessive variability from its true value and are invalid.

Table 12. External Quality Assurance TOC Sample Results, mg/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	RL	Acceptance Criteria
NWW007	NWW010	6.2	6.2	0.0%	1.0	≤ 20%
NWW012	NWW014	3.3	3.3	0.0	1.0	≤ RL
NWW027	NWW031	5.5	4.1	1.4	2.5	≤ RL
NWW034	NWW037	4.2	4.0	0.2	2.5	≤ RL
NWW047	NWW052	3.4	3.3	0.1	2.5	≤ RL
NWW055	NWW058	4.1	4.1	0.0	2.5	≤ RL
NWW067	NWW069	5.9	5.5	0.4	2.5	≤ RL

Accuracy: Reference Sample Results

Reference ID	Reference Result	Reference Certified Value or Range	Recovery	Acceptance Criteria
NWW011	28.5	29.1	98%	80%-120%
NWW015	44.0	47.0	94%	80%-120%
NWW032	41.9	47.0	89%	80%-120%
NWW038	45.2	47.0	96%	80%-120%
NWW053	44.1	47.0	94%	80%-120%
NWW059	43.9	47.0	93%	80%-120%
NWW070	34	34.4	99%	80%-120%

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<0.50	0.50	< 2 x RL
NWW030	<0.50	0.50	< 2 x RL
NWW051	<0.50	0.50	< 2 x RL
NWW068	<0.50	0.50	< 2 x RL

Table 13. External Quality Assurance TSS Sample Results, mg/L

Precision: Regular and Duplicate Sample Results

Regular Field ID	Duplicate Field ID	Regular Result	Duplicate Result	Difference	Acceptance Criteria
NWW007	NWW010	*42	*34	* 21%	≤ 20%
NWW012	NWW014	*33	*26	* 24%	≤ 20%
NWW027	NWW031	239	259	8.0%	≤ 20%
NWW034	NWW037	219	224	2.3%	≤ 20%
NWW047	NWW052	19	24	5	≤ RL
NWW055	NWW058	126	122	3.2%	≤ 20%
NWW067	NWW069	99	103	4.0%	≤ 20%
NWW100	NWW0110	34	32	6.1%	≤ 20%
NWW105	NWW117	201	174	14%	≤ 20%

* The result was reanalyzed and confirmed

Accuracy: Reference Sample Results

Reference ID	Reference Result	Reference Certified Value or Range	Recovery	Acceptance Criteria
NWW011	78	82.6	94%	80%-120%
NWW015	70	82.6	85%	80%-120%
NWW032	81	82.6	98%	80%-120%
NWW038	83	82.6	100%	80%-120%
NWW053	82	82.6	99%	80%-120%
NWW059	77	82.6	93%	80%-120%
NWW070	*63	82.6	* 76%	80%-120%
NWW109	*25$_R$	92.8	* 27%	80%-120%
NWW115	96	92.8	103%	80%-120%

* The result was reanalyzed and confirmed

$_R$ = The manufacturer of the reference sample confirmed that other clients had reported low recoveries for the lot number used.

Contamination: Blank Sample Results

Blank ID	Blank Result	Reporting Limit	Acceptance Criteria
NWW009	<6	6	< 2 x RL
NWW030	<6	6	< 2 x RL
NWW051	<6	6	< 2 x RL
NWW068	<6	6	< 2 x RL
NWW0108	<6	6	< 2 x RL
NWW116	<6	6	< 2 x RL

Appendix D

Photographs of Pilot Study

Bottom of the Newman Wasteway

RECLAMATION

SJR upstream of the Newman Wasteway

RECLAMATION

SJR downstream (Hills Ferry)

RECLAMATION

Initial release of 25 cfs of water into the Newman Wasteway

RECLAMATION

Newman Wasteway @ 300 cfs

RECLAMATION

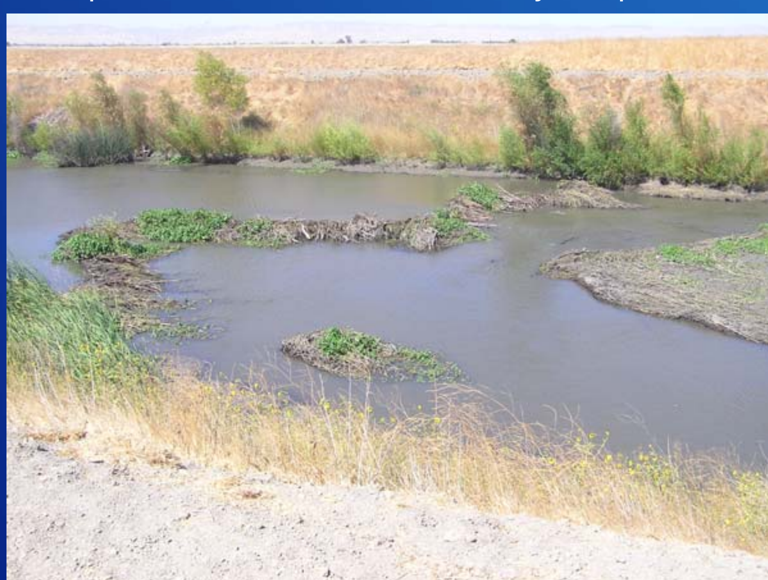
July 21, 2004 - Newman Wasteway Milepost 7.5

RECLAMATION

Aug. 30, 2004 - Newman Wasteway Milepost 7.5

RECLAMATION

Sept. 3, 2004 - Newman Wasteway Milepost 7.5



RECLAMATION

Newman Wasteway at the SJR

August 18, 2004

August 30, 2004

RECLAMATION

SJR at Hills Ferry (downstream of Newman Wasteway)

August 19, 2004

August 30, 2004

RECLAMATION

Testing physical measurements with Hydrolab sonde at 1810 hours.

Processing Samples, 2030 August 19, 2004

Processing samples, 0215 August 21, 2004

Day 1 samples

Appendix E

SWRCB Approval for Use of JPOD

Terry Tamminen
Secretary for Environmental Protection

State Water Resources Control Board

Executive Office
Arthur G. Baggett, Jr., Chair
1001 I Street • Sacramento, California 95814 • 916.341.5615
Mailing Address: P.O. Box 100 • Sacramento, California 95812-0100
FAX: 916.341.5621 • www.swrcb.ca.gov

Arnold Schwarzenegger
Governor

AUG 13 2004

Chester V. Bowling
U.S. Bureau of Reclamation
Central Valley Operations Office
3310 El Camino Ave., Suite 300
Sacramento, CA 95821

Dear Mr. Bowling:

REQUEST FOR PERMISSION TO USE JOINT POINT OF DIVERSION TO FACILITATE A RECIRCULATION PILOT STUDY

This letter responds to your letter dated August 6, 2004 requesting use by the U.S. Bureau of Reclamation (USBR) of the Department of Water Resources' (DWR) Banks Pumping Plant under Joint Points of Diversion (JPOD) to conduct a pilot recirculation project. State Water Resources Control Board (SWRCB) Decision 1641 (D-1641) (Condition 2, page 153) requires USBR to develop a Plan of Action to determine the feasibility and impacts of recirculating water from the Delta Mendota Canal through the Newman Wasteway as a method for meeting and/or augmenting the San Joaquin River water quality objectives. To date, USBR has completed the first stage of a recirculation feasibility study pursuant to an approved Plan of Action. However, additional information concerning the potential impacts to water quality and fisheries is needed to determine the feasibility of recirculation. Pursuant to D-1641 (Condition 1.b.(2) on page 151 and 152 and condition 1c.(3) on page 153), the Executive Director of SWRCB is authorized to grant short term exemptions to the export limits for Stage 1 and Stage 2 JPOD diversions for the purpose of conducting the recirculation study (or for other purposes as the Executive Director deems appropriate), provided that such exemption will not have a significant adverse effect on the environment and will not cause injury to other legal users of water.

Currently, you state that South Delta Water Agency (SDWA) claims to be experiencing critically low water levels that are insufficient to support diversions. You state that SDWA believes that starting a recirculation study immediately could alleviate current water level and water quality problems within SDWA's service area. As a result, you request a short-term exemption from the requirements for JPOD in order to conduct a recirculation pilot study for a period of approximately one month. You indicate that USBR is working with DWR to develop a limited, monitored, recirculation pilot study to both gain information on the potential feasibility of recirculation concepts and to provide water level and water quality benefits in the southern Delta. You state that USBR is coordinating with the Central Valley Regional Water Quality Control Board (CVRWQCB) to develop a water quality monitoring program for any pilot study. The

CVRWQCB has also requested that USBR submit a Report of Waste Discharge with a full project description, including an environmental review, prior to commencing any pilot recirculation project. You state that USBR will be preparing a National Environmental Policy Act (NEPA) document and DWR will be preparing a California Environmental Quality Act (CEQA) document for this activity. SWRCB staff understands that USBR is planning to submit the report of waste discharge in the near future. In addition, SWRCB staff is aware that USBR and DWR have been discussing the pilot study with staff of the federal and State fisheries agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game).

Upon completion of the Report of Waste Discharge and any other requirements of the CVRWQCB and fisheries agencies and concurrence from those agencies that the proposed pilot study is not likely to adversely impact water quality and fish and wildlife, the pilot recirculation project is authorized to commence provided that all water quality objectives included in D-1641 for which USBR and DWR have responsibility are met (with the exception of the export limits that may be flexed in accordance with the conditions included in D-1641). Any pilot recirculation project shall be conducted in accordance with recommendations by the CVRWQCB and the fisheries agencies to ensure that there will be no adverse effects to the environment.

It is unlikely that other legal water users will be impacted by the recirculation pilot project because flows and water levels will be increased as a result of the project and water quality will be monitored in accordance with recommendations by the CVRWQCB. However, upon any allegations of harm by other legal users of water, recirculation shall immediately cease until such time as the situation is resolved to the satisfaction of the party claiming injury or I make a determination that recirculation may commence. Any allegations of harm to other legal users of water shall be forwarded to me immediately.

If you have any questions concerning this matter, you may contact Diane Riddle, Environmental Scientist with the SWRCB's Division of Water Rights, at (916) 341-5297.

Sincerely,

Celeste Cantú
Executive Director

cc: Carl Torgersen, Chief
SWP Operations Control Office
CA Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-001

(cc: Continue on Next Page)

AUG 13 2004

cc: (Continuation page.)

Wayne White, Field Supervisor
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2800 Cottage Way, Suite W-2605
Sacramento, CA 95825

Michael E. Aceituno
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Mr. Alex Hildebrand
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Rancho Cordova, CA 95670-6114

Kenneth D. Landau
Assistant Executive Director
Central Valley Regional Board
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114

Diana F. Jacobs
Deputy Director
CA Department of Fish and Game
1416 Ninth Street, 12th Floor
Sacramento, CA 95814

Appendix F

CVRWQCB Approval of Pilot Study

California Regional Water Quality Control Board

Central Valley Region

Robert Schneider, Chair

Terry Tamminen
Secretary for Environmental Protection

Sacramento Main Office
11020 Sun Center Drive #200, Rancho Cordova, California 95670-6114
Phone (916) 464-3291 • FAX (916) 464-4645
http://www.swrcb.ca.gov/rwqcb5

Arnold Schwarzenegger
Governor

17 August 2004

Daniel G. Nelson, Executive Director
San Luis and Delta-Mendota Water Authority
P.O. Box 2157
Los Banos, CA 93635

PILOT RECIRCULATION PROJECT

Thank you for your Report of Waste Discharge (ROWD) for the Pilot Recirculation Project. The submittal consisted of a 13 August 2004 letter with attachments from Ronald Milligan at the U.S. Bureau of Reclamation to Les Grober of this office as well as a completed Form 200 and addendum received on 17 August 2004. As this is a short-term release of water from the Delta-Mendota Canal to the San Joaquin River via the Newman Wasteway, Waste Discharge Requirements will not be prepared for the project at this time

Staff's initial review of the project found that any potential adverse water quality impacts should be prevented by the operational procedures described in the ROWD. To ensure that any water quality impacts of the pilot project are documented, pursuant to Water Code Section 13267, the San Luis and Delta-Mendota Water Authority (SLDMWA) is required to conduct the monitoring as described in the document titled " San Joaquin River Recirculation Pilot Study Water Quality Monitoring Plan", which was part of the ROWD. If adverse impacts are detected, the SLDMWA is expected to adjust operations to ensure protection of the beneficial uses of the San Joaquin River or cease operation of the project. The water quality objectives in the Board's Water Quality Control Plan should be used to evaluate monitoring results. A final report containing the results of all of the monitoring shall be submitted to the Regional Board no later than four months following the completion of the project.

We look forward to working with you to review the outcome of this project. Please continue to provide status reports to Les Grober at (916) 464-4851 and/or Rudy Schnagl at (916) 464-4701 as the project proceeds.

DENNIS WESTCOT
Environmental Program Manager

Cc: Celeste Cantu, State Water Resources Control Board
Frances Mizuno, San Luis and Delta-Mendota Water Authority, Los Banos
Chester Bowling, U.S. Bureau of Reclamation, Sacramento
Ronald Milligan, U.S. Bureau of Reclamation, Sacramento