

Appendix C

Surface Water Quality

**Draft
Annual Technical Report**

SAN JOAQUIN RIVER
RESTORATION PROGRAM

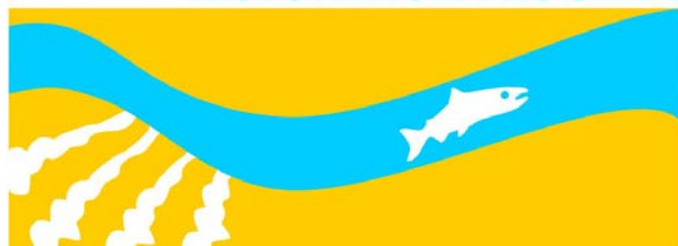


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List of Abbreviations and Acronyms

ABS	acrylonitrile butadiene styrene
CO ₃	carbonate
Ca	calcium
CDEC	California Data Exchange Center
Cl	chloride
DFG	California Department of Fish and Game
DO	dissolved oxygen
DOC	dissolved organic carbon
HCO ₃	bicarbonate
K	potassium
Mg	magnesium
NO ₂	nitrate
NO ₃	nitrite
Na	sodium
NH ₄	ammonium
NIST	National Institute of Standards and Technology
PO ₄	phosphate
QA	quality assurance
QC	quality control
QCO	Quality Control Officer
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Area	San Joaquin River Restoration Area
RM	river mile
RWQCB	Regional Water Quality Control Board
SJRRP	San Joaquin River Restoration Program
TE	trace elements
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TOC	total organic carbon
TP	total phosphate
TSS	total suspended solid
USGS	U.S. Geological Survey
WY	Water Year

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1 **1.0 Monitoring Methodology**

2 The following describes the monitoring methods used during fall Water Year (WY) 2010
3 Interim Flows to collect surface water quality data. Two monitoring programs were
4 conducted: (1) to comply with Paragraph 16(a)(1) of the Settlement, and with the State
5 Water Regional Control Board temporary transfer of water and change, pursuant to water
6 code sections 1725 and 1707, and (2) to evaluate water quality parameters that may affect
7 fish survival. The monitoring methods are presented separately in this document for
8 surface water quality and surface water temperature.

9 **1.1 Surface Water Quality**

10 Water quality monitoring methodology is described below for several sampling
11 techniques used to collect water samples for water quality measurement, including
12 real-time and laboratory analyses of grab and composite samples.

13 The sites of water quality monitoring stations for the San Joaquin River Restoration
14 Program (SJRRP) water quality monitoring plan are summarized in Table C-1.

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**Table C-1.
Water Quality Monitoring Stations, Parameters, and Frequency**

Location	Responsible Agency	Parameters	Frequency	Remarks
Friant Dam (Millerton)	Reclamation (SCCAO)	Physical ¹	Continuous	Multiple parameter sonde*
San Joaquin River below Friant Dam	Reclamation (SCCAO)	Physical ¹	Continuous	Multiple parameter sonde
	Reclamation (MP157)	Short list* ² Baseline ³	Daily composite* Quarterly	Autosampler* Grab sample
San Joaquin River at Gravelly Ford	Reclamation (SCCAO)	Temperature	Continuous	Multiple parameter sonde*
San Joaquin River below bifurcation	Reclamation (SCCAO)	Temperature	Continuous	Multiple parameter sonde*
San Joaquin River near Mendota	Reclamation (SCCAO)	Physical ¹	Continuous	Multiple parameter sonde
	Reclamation (MP157)	Short list* ² Baseline* ³	Daily composite* Quarterly*	Autosampler* Grab sample*
San Joaquin River below Sack Dam	TBD	Physical* ¹	Continuous*	Multiple parameter sonde*
San Joaquin River at top of Reach 4B	TBD	conductivity* Temperature* Dissolved Oxygen* Turbidity*	Continuous*	Recommend using established site at Fremont Ford
San Joaquin River at Fremont Ford Bridge	USGS	Physical ¹	Continuous	Multiple parameter sonde
	Central Valley RWQCB	Selenium Boron Nutrients ⁴ Others ⁵	Weekly	Grasslands Bypass Project Station H
San Joaquin River at Hills Ferry	TBD	Physical* ¹	Continuous*	Multiple parameter sonde
	SLDMWA	Selenium Boron	Weekly	Grasslands Bypass Project Station H
	Reclamation (MP157)	Short list* ² Baseline* ³	Daily composite* Quarterly	Autosampler* Grab sample*
San Joaquin River near Crows Landing	USGS	Physical ¹	Continuous	Grasslands Bypass Project Station N
	Central Valley RWQCB	Selenium Boron Nutrients ⁴ Others ⁵	Daily composite Weekly	Autosampler* Grab sample

3

1 **Table C-1.**
 2 **Water Quality Monitoring Stations, Parameters, and Frequency (contd.)**

Notes:

* New equipment or sampling for the San Joaquin River Restoration Program water quality monitoring plan.

¹ Real-time measurements of electrical conductivity (salinity), temperature, pH, dissolved oxygen, turbidity, and chlorophyll; calibration, as needed.

² Short list of constituents for lab analysis – to be determined (e.g., selenium, boron).

³ Central Valley Project Baseline Water Quality Monitoring Program; full Title 22 organic and inorganic compounds, plus bacterial.

⁴ Parameters included in the nutrient series are nitrate, ammonia, total Kjeldahl nitrogen, total phosphate, and ortho phosphate, required by the Waste Discharge Permit for Grasslands Bypass Project. Nutrient series sampling period increases to every other week during irrigation season (March through August).

⁵ Other constituents include bacteria, trace elements, total organic carbon, and other minerals.

Key:

MP157 = Reclamation Mid-Pacific Region, Environmental Monitoring Branch

Reclamation = U.S. Department of the Interior, Bureau of Reclamation

RWQCB = Regional Water Quality Control Board

SCCAO = Reclamation, South Central California Area Office

SJRRP = San Joaquin River Restoration Program

SLDMWA = San Luis Delta-Mendota Water Authority

TBD = to be determined

USGS = U.S. Geological Survey

3 **1.1.1 Real-Time Water Quality Monitoring Parameters**

4 Continuous measurement of physical conditions, including temperature, electrical
 5 conductivity (salinity), pH, dissolved oxygen (DO), turbidity, and chlorophyll, were
 6 recorded at eight stations using multiple parameter sondes connected to digital
 7 dataloggers. Each parameter was measured every 15 minutes and sent via satellite to the
 8 Internet as preliminary data.

9 Parameters monitored on a real-time basis are described in Table C-2. Methods of
 10 measurement, along with range, resolution, and accuracy of specified sensors, are shown
 11 in Table C-2.

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**Table C-2.
Real-Time Monitoring Physical Parameters**

Parameter	Temperature
Method	Digital thermometer (YSI 6600 sonde)
Range	-5 to +45 °C
Resolution	0.01 °C
Accuracy	± 0.15 °C

Parameter	Salinity – specific conductance
Method	Conductivity meter (YSI 6600 sonde)
Range	0 to 100 mS/cm
Resolution	0.001 to 0.1 mS/cm (range-dependent)
Accuracy	± 0.5%, ±0.1 mS/cm

Parameter	Dissolved oxygen
Method	Digital probe (YSI 6600 sonde)
Range	0 to 50 mg/L
Resolution	0.01 mg/L
Accuracy	0 to 20 mg/L: ± 2% of reading or 0.2% mg/L 20 to 50 mg/L: ± 6% of reading

Parameter	pH
Method	Digital probe (YSI 6600 sonde)
Range	0 to 14 units
Resolution	0.01 unit
Accuracy	± 0.2% unit

Parameter	Turbidity
Method	Turbidity meter (YSI 6600 sonde)
Range	0 to 1,000 NTU
Resolution	0.1 NTU
Accuracy	± 5% of reading or 2 NTU
Depth	200 feet

Parameter	Chlorophyll
Method	Digital sensor (YSI 6600 sonde)
Range	0 to 400 µg/L
Resolution	0.1 µg/L Chl; 0.1% FS
Depth	200 feet

Key:
 °C = degrees Celsius
 µg/L = micrograms per liter
 Chl = chlorophyll
 FS = fluorescence
 mg/L = milligram per liter
 mS/cm = milliSiemens per centimeter
 NTU = nephelometric turbidity unit

3

1 **1.1.2 Laboratory Analysis of Water Quality Parameters**

2 The following sections describe parameter analyzed in the laboratory for water quality, as
3 well as methods used for water quality sampling and chain of custody documentation.

4 ***Parameters***

5 The complete list of parameters measured at various sites along the Restoration Area was
6 determined according to the needs of scientists addressing fish restoration. Parameters
7 included selenium, mercury, boron, nutrients, and other compounds that cannot be
8 measured with field sensors.

9 In accordance with Section 22 of the State Water Resources Control Board (SWRCB)
10 Division of Water Rights Order WR 2009-0058-DWR, the U.S. Department of the
11 Interior, Bureau of Reclamation (Reclamation) collected samples of water and sediment
12 from sites along the river where Interim Flows had passed. Many parameters were
13 measured:

- 14 • Total suspended solids (TSS)
- 15 • Nutrients: total nitrogen (TN), ammonium (NH₄), nitrite (NO₂), nitrate (NO₃), total
16 Kjeldahl nitrogen (TKN), total phosphate (TP), phosphate (PO₄), chlorophyll
- 17 • Total organic carbon (TOC)/dissolved organic carbon (DOC)
- 18 • Bacteria: fecal coliform and E. coli
- 19 • Trace elements (TE)/minerals: cations (calcium (Ca), magnesium (Mg), potassium
20 (K), sodium (Na)); anions (chloride (Cl), carbonate (CO₃), bicarbonate (HCO₃));
21 total TE (copper, chromium, lead, nickel, zinc, arsenic, mercury)
- 22 • Pesticides: water column prerelease scans (carbarnates and organophosphates);
23 postrelease scans (carbarnates, organophosphates, and, depending on sediment
24 results, organochlorines and pyrethroids)
- 25 • Bed sediment: TOC, TE (copper, chromium, lead, nickel, zinc, arsenic, mercury),
26 organochlorine scan, pyrethroid scan, toxicity

27 Samples were collected, preserved, and handled according to Reclamation quality
28 assurance (QA) practices, which included the incorporation of blank, reference, duplicate,
29 and spiked samples to verify laboratory and field measurements. Because of short
30 holding times, bacteria, pesticides and chlorophyll samples were shipped from the field
31 directly to laboratories.

32 ***Sampling Methods***

33 Grab samples were collected using a stainless steel sampling device, which is a cage on a
34 pole that holds the sampling bottle. Grab samples were collected from the stream bank
35 directly into sample bottles or into a churn-splitter. This technique was used for samples
36 collected weekly or less frequently. Depth/width integrated samples were collected where

1 parameters may not have been evenly mixed across the river channel. This method
2 involved collecting samples at regular intervals across the channel.

3 Autosamplers were used to collect time composite samples at three locations. Daily
4 composite samples consisted of up to eight subsamples taken per day and mixed into one
5 sample. Weekly composite samples consisted of seven consecutive daily subsamples
6 mixed into one sample. Reclamation and the Central Valley Regional Water Quality
7 Control Board (RWQCB) currently use Sigma brand autosamplers to collect daily
8 composite samples from the Delta-Mendota Canal, San Luis Drain, and San Joaquin
9 River at Crows Landing.

10 **1.1.3 Quality Control**

11 Quality Control (QC) is the overall system of technical activities that measures the
12 attributes and performance of a process, item, or service against defined standards to
13 verify that stated requirements are met. QA is an integrated system of management
14 activities involving planning, implementation, documentation, assessment, reporting, and
15 quality improvement implemented so that a process, item, or service is of the type and
16 quality needed and expected by the customer.

17 A Quality Assurance Project Plan was written for all SJRRP flow, water quality,
18 groundwater level, and sediment monitoring. QA objectives were used to validate the
19 data for this project. The data were accepted, rejected, or disqualified based on how
20 sample results compared to established acceptance criteria. Precision, accuracy, and
21 contamination criteria were used by the Quality Control Officer (QCO) to validate the
22 data for this project. The criteria were applied to the blind external duplicate/split, blank,
23 reference, or spiked samples submitted with the production samples to the analytical
24 laboratories by the participating agencies to provide an independent assessment of
25 precision, accuracy, and contamination.

26 Samples must be prepared, extracted, and analyzed within the recommended holding time
27 for parameter. Data may be disqualified if a sample was analyzed after the holding time
28 expires (as occurred with a limited number of samples collected during the fall 2009
29 Interim Flows period). Completeness refers to the percentage of project data that must be
30 successfully collected, validated, and reported to proceed with their intended use in
31 making decisions.

32 **1.2 Surface Water Temperature**

33 Data loggers were installed by the California Department of Fish and Game (DFG) at
34 predetermined intervals to best illustrate the temperature regime of the San Joaquin River
35 as defined by the Fish Management Work Group.

36 All data loggers were programmed to record temperatures hourly on a continuous,
37 year-round, basis. As water and air temperature data collection progresses, and modeling
38 commences, the need for additional weather stations, or redeployment of existing
39 stations, may be required.

1 **1.2.1 Methodology**

2 Each data logger was enclosed in a submersible case to prevent damage and anchored
3 with stainless steel cable. Field data were recorded at each logger location. An
4 identification number was assigned to each site logger. All data were downloaded into an
5 HOBO waterproof shuttle and uploaded later into a field computer.

6 Variations in field sampling were addressed through a field check of the instruments with
7 a hand-held thermometer at all thermograph sites after deployment and retrieval. Field
8 auditing (e.g., data QA/QC) was performed at each site visit. Field crews collecting data
9 took a water temperature reading at each sampling station using a thermometer. The
10 thermometer was placed in the stream near the thermograph. The water temperature and
11 time were recorded in a field notebook and used as a cross-reference check for auditing
12 data. Comments were also recorded in the field and were used to help determine the
13 validity of the data (i.e., “thermograph out of the water” or “buried in sand”) and or
14 possibly a malfunctioning thermograph. If the latter was suspected, a second
15 thermograph was placed to cross-reference the data, or the thermograph was retrieved
16 and recalibrated using the same procedure.

17 Temperature loggers deployed in pools required an acrylonitrile butadiene styrene (ABS)
18 pipe housing drilled with ¼-inch holes to allow water to flow through freely. A threaded
19 coupler was used on one end with a galvanized steel plug that functioned as a weight and
20 allowed access to the sensor. The opposite end was closed with an ABS cap. Loggers
21 were spaced on temperature profiling strings to continuously monitor temperature
22 stratification

23 Data loggers recording air temperature were attached to stream side vegetation. Locations
24 for air temperature monitoring were chosen where direct solar radiation was avoided, but
25 where the units were able to record air temperature.

26 Methods for deploying temperature loggers in mining pits are described in Reclamation
27 guidelines (XXXX).

28 Methods for implementation procedures of the Millerton Reservoir temperature
29 monitoring study are described in the Millerton Reservoir Temperature Monitoring
30 Guidelines (Reclamation, XXXX).

31 **1.2.2 Calibration Procedures**

32 HOBO U22 Water Temp Pro v2 data loggers from Onset were used by DFG to collect
33 surface water temperature readings. The thermographs were calibrated using the
34 Calibration and Standardization Procedure adopted and modified from Lewis et al.
35 (2000). This procedure tests each thermograph logger for room air temperature, room
36 temperature water, and cold water temperature against a National Institute of Standards
37 and Technology (NIST) thermometer for precision and accuracy. All thermographs were
38 calibrated before deployment using this procedure unless the manufacturer sent a
39 certification of accuracy for each unit (Onset’s HOBO Temp Pro); however, 10 percent
40 of these certified units were being double-checked for calibration accuracy before
41 deployment.

1 **1.2.3 Quality Control**

2 An important aspect of data collection and reporting is to promote data integrity and
3 validity. The structure of the local DFG database and the characteristics of Microsoft
4 Access usually enforce the integrity of the data. DFG staff used a database equipped with
5 a QA/QC Utility to detect questionable data to help in the validation process. The QA/QC
6 Utility is designed to flag any data points that have a value in excess of a certain
7 tolerance when compared with adjacent points. To minimize the possibility that
8 erroneous data would migrate to other applications, the database will not allow the user to
9 generate any reports or graphs until a QA/QC check is performed and all data points
10 tagged with QA/QC codes are cleared.

11 The QA/QC Utility enables the user to observe which data had been tagged, and provides
12 the user with an editor to clear the data. The data are also graphed and visually inspected.
13 Data that appear to be erroneous are either modified (accepted) or nullified (deleted).
14 These edits are done in a second data column. The original data are always retained for
15 review. Professional judgment is required to determine whether or not to accept (e.g., by
16 interpolating with other points) or to nullify the data. This decision is made on a
17 case-by-case basis by DFG staff in concert with the modeling team who assesses the
18 original and modified data.

19 Once processed, the data can be used for temperature model application purposes and to
20 generate graphs and reports. Updates are exported to the California Data Exchange
21 Center (CDEC) for inclusion in the global database.

1 **2.0 Data**

2 This section presents surface water quality (real-time and grab samples) and temperature
3 data collected during the fall 2009 Interim Flows.

4 Table C-3 describes landmark river mile (RM) locations that were used for consistency
5 purposes. References to RM locations presented in this document and its appendices are
6 offsets from the list presented in Table C-3.
7

1
2**Table C-3.
Features by River Mile**

SJRRP Project River Mile	Type	Description	Distance
267.6	-----	Begin Reach 1 (beginning of Project Area)	0
267.6	Facility	Friant Dam (Millerton) (MIL)	0
267.4	Tributary	Cottonwood Creek Confluence	0.2
266	Gage	San Joaquin River below Friant Dam (SJF)	1.6
260.6	Tributary	Little Dry Creek Confluence	7
255.2	Crossing	California State Highway 41	12.4
255.1	Gage	San Joaquin River at Highway 41 Bridge (H41)	12.5
245.2	Crossing	Atchison Topeka Santa Fe Railroad	22.4
243.1	Crossing	California State Hwy 99	24.5
240.7	Gage	San Joaquin River at Donny Bridge (DNB)	26.9
234.2	Crossing	California State Highway 145	33.4
232.1	Gage	San Joaquin River at Skaggs Bridge (Skaggs)	35.5
229	-----	End Reach 1 – Begin Reach 2	38.6
227.6	Gage	San Joaquin River at Gravelly Ford (GRF)	40
216	Facility	Chowchilla Bypass Bifurcation Structure	51.6
216	Gage	San Joaquin River below bifurcation (SJB)	51.6
211.8	Crossing	San Mateo Road	55.8
204.6	Facility	Mendota Dam	63
204.6	-----	End Reach 2 – Begin Reach 3	63
202.1	Gage	San Joaquin River near Mendota (MEN)	65.5
195.1	Crossing	Avenue 7 1/2 Bridge	72.5
182	-----	End Reach 3 – Begin Reach 4	85.6
182	Facility	Sack Dam	85.6
181.5	Gage	San Joaquin River below Sack Dam	86.1
173.9	Crossing	California State Highway 152	93.7
169	Gage	San Joaquin River at top of Reach 4B (proposed)	98.6
168.4	Facility	Reach 4B Headgates Crossing	99.2
168.2	Gage	San Joaquin River at top of Reach 4B (proposed)	99.4
168	Crossing	Indiana Avenue	99.6
157.2	Crossing	Turner Island Road Bridge	110.4
135.8	-----	End Reach 4 – Begin Reach 5	131.8
132.8	Crossing	California State Highway 165	134.8
125.1	Gage	San Joaquin at Fremont Ford Bridge (FFB)	142.5
125.1	Crossing	California State Highway 140	142.5
118.2	Facility	Temporary Fish Screen	149.4

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**Table C-3.
Features by River Mile (contd.)**

SJRRP Project River Mile	Type	Description	Distance
118.3	Gage	San Joaquin River at Hills Ferry (STC512)	149.3
118.2	Crossing	Hills Ferry Road	149.4
118.2	-----	End Reach 5 (end of Project Area)	149.4

Key:

SJRRP = San Joaquin River Restoration Program

3 2.1 Surface Water Quality

4 Baseline samples of water and sediment were collected from five sites before the arrival
5 of Interim Flows. Routine samples were collected weekly from wetted sites. Postrelease
6 samples of sediment were collected in December 2009 at four sites and the Mendota Pool
7 to assess the movement of sediments by the Interim Flows.

8 Preliminary data indicate that there are few contaminants of concern in Reaches 1 and 2.
9 Despite the adjacent urban areas, few herbicides or pesticides were detected in water or
10 sediments. The slow progress of the Interim Flows to Reach 3 and beyond limited the
11 collection of samples.

12 There are many known sources of contamination in the San Joaquin River below
13 Mendota Dam that are monitored by Reclamation and RWQCB. Preliminary data do not
14 show a measureable improvement in water quality (i.e., reduction of electrical
15 conductivity) due to the arrival of Interim Flows water.

16 Reclamation staff are waiting to receive remaining laboratory results for samples
17 collected from the San Joaquin River below Friant Dam, San Joaquin River at
18 Highway 41, San Joaquin River near Highway 99, San Joaquin River near Gravelly Ford,
19 San Joaquin River below the Chowchilla Bypass Bifurcation Structure, San Joaquin
20 River near Mendota, San Joaquin River near Dos Palos, and San Joaquin River above the
21 Merced River confluence at Hills Ferry.

22 Several other stations are equipped to collect water quality data, but no data were
23 collected from these sites during fall 2009 Interim Flows because the flows did not reach
24 these stations.

25 2.1.1 Friant Dam (Millerton)

26 A full suite of parameters was analyzed for surface water quality samples collected from
27 Millerton Lake (MIL) at Friant Dam before the release of the fall 2009 Interim Flows, as
28 illustrated in Table C-4. During the fall 2009 Interim Flows period, TSS samples were
29 measured periodically at the MIL monitoring station. Field measurements of pH,

San Joaquin River Restoration Program

- 1 electrical conductivity, turbidity, DO, and temperature were collected during the last few
- 2 weeks of the fall 2009 Interim Flows period.

**Table C-4.
Water Quality Results from Friant Dam (Millerton)**

Order WR-2009-0058-DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Total Suspended Solids	N/A	mg/L	1.2	<1.0	1.3 T	X	1.4	1.3	4	6	1.6	2.2
Nutrients	nitrate and nitrite as N	mg/L	<0.050	NA	NA	NA	NA	NA	NA	NA	NA	NA
	ammonia as N	mg/L	<0.50	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total Kjeldahl nitrogen	mg/L	<0.50T	NA	NA	NA	NA	NA	NA	NA	NA	NA
	phosphorous, total as P	mg/L	<0.050T	NA	NA	NA	NA	NA	NA	NA	NA	NA
	chlorophyll A	µg/L	3.5 T	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	N/A	mg/L	2.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Organic Carbon	N/A	mg/L	3.3T	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bacteria	fecal coliform	#/100ml	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total coliform	#/100ml	17	NA	NA	NA	NA	NA	NA	NA	NA	NA
	E. coli	#/100ml	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Cations	calcium	mg/L	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	magnesium	mg/L	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA
	potassium	mg/L	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA
	sodium	mg/L	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Anions	chloride	mg/L	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbonate alkalinity	mg/L	<5.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	bicarbonate alkalinity	mg/L	11T	NA	NA	NA	NA	NA	NA	NA	NA	NA
	alkalinity	mg/L	12T	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table C-4.
Water Quality Results from Friant Dam (Millerton) (contd.)**

Order WR-2009-0058-DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	µg/L	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
	chromium	µg/L	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	lead	µg/L	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	nickel	µg/L	<1.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	zinc	µg/L	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	arsenic	µg/L	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	mercury	µg/L	<2.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbarnates	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	organophosphates	µg/L	ND (29)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Measurements	pH	units	8.0	NA	NA	NA	NA	NA	6.5	7	7	6.5
	electrical conductivity	µS/cm	78	NA	NA	NA	NA	NA	24	43	42	23
	turbidity	NTU	2	NA	NA	NA	NA	NA	3	4	4	3
	dissolved oxygen	mg/L	7.7	NA	NA	NA	NA	NA	5.9	5.8	10.1	
	temperature	°C	23.7	NA	NA	NA	NA	NA	19.8	14.9	16.8	16.2

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = microgram per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

NTU = nephelometric turbidity unit

T = result obtained past the holding time

X = results pending

1 **2.1.2 San Joaquin River Below Friant Dam (Lost Lake)**

2 A full suite of parameters was analyzed for surface water quality samples collected from
3 the San Joaquin River below Friant Dam at Lost Lake (SJF) before and during the fall
4 2009 Interim Flows period (Table C-5). In addition, pore water quality samples were
5 extracted from sediment collected from the San Joaquin River below Friant Dam at SJF
6 before the release of fall 2009 Interim Flows and after the flows were stopped on
7 November 20, 2009, as presented in Table C-6.

**Table C-5.
Water Quality Results from San Joaquin River Below Friant Dam (Lost Lake)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Total Suspended Solids	N/A	mg/L	2.8	<1.0	1.2 T	X	1.2	1.6	2.6	2.6	<1.0	<2.0
Nutrients	nitrate and nitrite as N	mg/L	0.1	0.11	0.11T	NA	0.10T	0.12T	0.1	0.1	0.011	0.14
	ammonia as N	mg/L	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	total Kjeldahl nitrogen	mg/L	<0.50T	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	phosphorous, total as P	mg/L	<0.050T	<0.050	<0.050	NA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorophyll A	µg/L	2.2	<2	X	NA	<2	<2	<2	5.3	<5.0T	<2.0
Total Organic Carbon	N/A	mg/L	2.4	2.3	2.4	NA	2.4	2.3	2.4	2.3	2.1	2.2
Dissolved Organic Carbon	N/A	mg/L	3.0T	2.7T	3.0T	NA	2.4T	2.1T	3.6	3.9	2.3	2.6
Bacteria	fecal coliform	#/100ml	22	13	X	NA	23	80	30	13	X	23
	total coliform	#/100ml	900	110	X	NA	1,600	170	170	500	X	300
	E. coli	#/100ml	14	13	X	NA	13	80	30	13	16T	23
Trace Elements, Cations	calcium	mg/L	3	3	4	NA	3	4	3	3	3	3
	magnesium	mg/L	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
	potassium	mg/L	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
	sodium	mg/L	3	3	3	NA	3	3	3	3	3	3
Trace Elements, Anions	chloride	mg/L	3	3	2.9	NA	2.8	2.9	2.7	2.5	2.5	2.1
	carbonate alkalinity	mg/L	<5.0T	<5.0	<5.0	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	bicarbonate alkalinity	mg/L	14T	14	14	NA	14	14	14	13	13	12
	alkalinity	mg/L	14T	14	14	NA	13	15	13	14	12	13

**Table C-5.
Water Quality Results from San Joaquin River Below Friant Dam (Lost Lake) (contd.)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	µg/L	0.7	0.6	0.6	NA	0.6	0.5	0.5	1.1	0.8	0.7
	chromium	µg/L	<0.5	<0.5	<0.5	NA	<0.5	<0.5	<0.5	1.1	<0.5	<0.5
	lead	µg/L	<0.5	<0.5	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	nickel	µg/L	<1.0	<1.0	<1.0	NA	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	zinc	µg/L	<2.0	2.2	9.1	NA	7.9	4	<2.0	5	4.1	3
	arsenic	µg/L	2.4	2.4	2.3	NA	2	2.3	2.5	3.6	2.7	2.6
	mercury	µg/L	<2.0	<2.0	<2.0	NA	2.5	2.6	<2.0	<2.0	X	<2.0
	selenium	µg/L	<0.4	<0.4	<0.4	NA	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Pesticides	organochlorine scan	µg/L	X	ND (22)	ND (22)	NA	ND (22)	ND (22)	ND (22)	ND (22)	ND (22)	ND (22)
	pyrethroid scan	µg/L	X	ND (6) T	ND (6) T	NA	ND (6)	ND (6)	ND (6)	ND (6)	ND (6)	ND (6)
	carbarnates	µg/L	ND (10)	X	X	NA	ND (10)	ND (10)	X	X	ND (10)	ND (10)
	organophosphates	µg/L	ND (29)	ND (29)	ND (29)	NA	ND (29)	X	ND (29)	X	ND (28)*	ND (29)

**Table C-5.
Water Quality Results from San Joaquin River Below Friant Dam (Lost Lake) (contd.)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Field Measurements	pH	units	7.3	6.6	6.0	NA	6.5	7	7	6.9	6.2	6.5
	electrical conductivity	µS/cm	43	33	40	NA	37	32	36	46	33	41
	turbidity	NTU	2	3	4	NA	3	3	3	3	4	2
	dissolved oxygen	mg/L	10.6	7.6		NA	8.7	10.0	9.2	8.3	8.9	8
	temperature	°C	15.1	11.1	14.5	NA	17.9	14.5	11.7	15.0	13.9	13.7

Note:

* 11/10/2009 Sulfatepp = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = microgram per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = none detected; results below minimum lab detection levels

Not required for Water Rights Order

NTU = nephelometric turbidity unit

T = result obtained past the holding time

X = results pending

**Table C-6.
Pore Water Quality Results from Bed Sediment at San Joaquin River Below Friant Dam (Lost Lake)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples									Post- release	
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	After November 20, 2009	
Total Organic Carbon	NA	mg/L	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Trace Elements	copper	mg/L	17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	chromium	mg/L	23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	lead	mg/L	2.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	nickel	mg/L	18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	zinc	mg/L	31	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	arsenic	mg/L	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	mercury	mg/L	<0.0025	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides	organochlorine scan	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	pyrethroid scan	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Toxicity, acute (<i>Hyalla azteca</i>)	ten day survival	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	ten day dry weight	mg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Extras	grain size analysis	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	percent solids	%	79.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	percent moisture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Key:
 ug/L = microgram per liter
 mg = milligram
 mg/L = milligram per liter
 N/A = not applicable
 X = results pending

1 **2.1.3 San Joaquin River at Highway 41**

2 A full suite of parameters was analyzed for surface water quality samples collected from
3 the San Joaquin River at Highway 41 before the release of fall 2009 Interim Flows (Table
4 C-7).

**Table C-7.
Water Quality Results from San Joaquin River at Highway 41**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples									
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	
Total Suspended Solids	NA	mg/L	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nutrients	nitrate and nitrite as N	mg/L	<0.050	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	ammonia as N	mg/L	<0.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total Kjeldahl nitrogen	mg/L	<0.50T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	phosphorous, total as P	mg/L	<0.050T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	chlorophyll A	µg/L	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	NA	mg/L	2.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Organic Carbon	NA	mg/L	2.8T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bacteria	fecal coliform	#/100ml	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total coliform	#/100ml	90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	E. coli	#/100ml	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Cations	calcium	mg/L	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	magnesium	mg/L	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	potassium	mg/L	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	sodium	mg/L	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Anions	chloride	mg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbonate alkalinity	mg/L	<5.0T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	bicarbonate alkalinity	mg/L	14T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	alkalinity	mg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table C-7.
Water Quality Results from San Joaquin River at Highway 41 (contd.)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	µg/L	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	chromium	µg/L	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	lead	µg/L	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	nickel	µg/L	<1.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	zinc	µg/L	<2.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	arsenic	µg/L	2.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	mercury	µg/L	<2.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	selenium	µg/L	<0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbamates	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	organophosphates	µg/L	ND (29)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Measurements	pH	units	7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	conductivity	µS/cm	51	NA	NA	NA	NA	NA	NA	NA	NA	NA
	turbidity	NTU	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
	dissolved oxygen	mg/L	8.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	temperature	°C	17.1	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: * 11/10/2009 Sulfotepp = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = microgram per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

ND = none detected; results below minimum lab detection levels

NA = not applicable

Not required for Water Rights Order

NTU = nephelometric turbidity unit

T = result obtained past the holding time

X = results pending

1 **2.1.4 San Joaquin River near Highway 99 (Camp Pashayan)**

2 A full suite of parameters was analyzed for surface water quality samples collected from
3 the San Joaquin River near Highway 99 at Camp Pashayan before the release of fall 2009
4 Interim Flows, and also during the fall 2009 Interim Flows period (Table C-8). In
5 addition, pore water quality samples were extracted from sediment collected from the San
6 Joaquin River near Highway 99 at Camp Pashayan before the release of fall 2009 Interim
7 Flows and after the flows were stopped on November 20, 2009, as presented in Table C-
8 9.

**Table C-8.
Water Quality Results from San Joaquin River near Highway 99 (Camp Pashayan)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Total Suspended Solids	NA	mg/L	6.7	<1.0	2.6 T	X	1.5	8.9	2	1.8	1.2	1.4
Nutrients	nitrate and nitrite as N	mg/L	<0.050	X	<0.050T	NA	0.10T	<0.050T	<0.050	<0.050	0.07	0.11
	ammonia as N	mg/L	<0.50	X	<0.50	NA	<0.50	3.5	<0.50	<0.50	<0.50	<0.50
	total Kjeldahl nitrogen	mg/L	<0.50T	X	<0.50	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	phosphorous, total as P	mg/L	0.11T	X	<0.050	NA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	chlorophyll A	µg/L	3.1	<2	X	NA	<2	<2	<2	<2.0	25T	<2.0
Total Organic Carbon	NA	mg/L	2.6	2.5	2.4	NA	3.6	2.4	2.4	2.6	2.4	2.2
Dissolved Organic Carbon	NA	mg/L	3.9T	X	3.2T	NA	3.2T	2.4T	3.5	3.9	3.1	3
Bacteria	fecal coliform	#/100ml	2	50	X	NA	300	23	13	240	X	<2
	total coliform	#/100ml	1600	900	X	NA	>2,400	240	130	900	X	70
	E. coli	#/100ml	2	50	X	NA	170	23	13	240	11T	<2
Trace Elements, Cations	calcium	mg/L	4	4	4	NA	4	4	4	3	3	3
	magnesium	mg/L	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
	potassium	mg/L	<1	<1	<1	NA	1	<1	<1	<1	<1	<1
	sodium	mg/L	4	4	4	NA	3	4	4	3	3	3
Trace Elements, Anions	chloride	mg/L	3.2	3.2	3	NA	3.2	3.3	3	2.9	2.5	2.5
	carbonate alkalinity	mg/L	<5.0T	<5.0	<5.0	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	bicarbonate alkalinity	mg/L	15T	16	15	NA	15	16	16	15	12	14
	alkalinity	mg/L	15T	15	15	NA	15	15	16	15	14	15

**Table C-8.
Water Quality Results from San Joaquin River near Highway 99 (Camp Pashayan) (contd.)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	µg/L	6.6	1	2.1	NA	1	0.8	0.7	0.6	0.7	0.6
	chromium	µg/L	<0.5	0.7	0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	lead	µg/L	<0.5	<0.5	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	nickel	µg/L	<1.0	<1.0	<1.0	NA	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	zinc	µg/L	<2.0	2	3.1	NA	<2.0	2.2	<2.0	<2.0	2.1	<2.0
	arsenic	µg/L	1.9	1.9	1.6	NA	1.8	1.8	1.8	1.9	2.7	2.3
	mercury	µg/L	<2.0	17	<2.0	NA	<2.0	2.2	<2.0	<2.0	<2.0	<2.0
selenium	µg/L	<0.4	<0.4	<0.4	NA	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	
Pesticides	organochlorine scan	µg/L	X	ND (22)	ND (22)	NA	ND (22)	ND (22)	ND (22)	ND (22)	ND (22)	ND (22)
	pyrethroid scan	µg/L	X	ND (6) T	ND (6) T	NA	ND (6)	ND (6)	ND (6)	ND (6)	ND (6)	ND (6)
	carbamates	µg/L	ND (10)	X	X	NA	ND (10)	ND (10)	X	X	ND (10)	ND (10)
	organophosphates	µg/L	ND (29)	ND (29)	ND (29)	NA	ND (29)	ND (29)	ND (29)	ND (29)	ND (28)*	ND (29)

**Table C-8.
Water Quality Results from San Joaquin River near Highway 99 (Camp Pashayan) (contd.)**

Order WR 2009-0058- DWR	Specific Analyses	Units	Baseline	Routine Samples								
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Field Measurements	pH	units	7.0	6.7	6.8	NA	6.4	7.1	6.3	6.5	7.8	7.2
	electrical conductivity	µS/cm	38	35	36	NA	37	35	40	53	44	48
	turbidity	NTU	3	2	3	NA	4	2	2	4	3	2
	dissolved oxygen	mg/L	8.6	NA	8.9	NA	6.3	10.1	7	8.5	9	9.2
	temperature	°C	21.2	16.6	16.2	NA	18.2	16.8	15	13.9	13.5	12

Note:

* 11/10/2009 Sulfotep = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = microgram per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = none detected; results below minimum lab detection levels

NTU = nephelometric turbidity unit

T = result obtained past the holding time

X = results pending

**Table C-9.
Pore Water Quality Results from Bed Sediment in San Joaquin River near Highway 99 (Camp Pashayan)**

Order WR 2009-0058-DWR	Specific Analyses	Units	Baseline	Routine Samples									Post-release	
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	After November 20, 2009	
Total Organic Carbon	NA	mg/L	<850	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Trace Elements	copper	mg/L	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	chromium	mg/L	1.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	lead	mg/L	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	nickel	mg/L	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	zinc	mg/L	7.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	arsenic	mg/L	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	mercury	mg/L	<0.0023	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Acute Toxicity (<i>Hyalla azteca</i>)	10-day survival	%	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	10-day weight	mg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	TIE	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
NA	grain size analysis	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
NA	percent moisture	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Key:
 µg/L = microgram per liter
 mg/L = milligram per liter
 NA = not applicable
 TIE = Toxicity Identification Evaluation
 X = results pending

1 **2.1.5 San Joaquin River at Gravelly Ford**

2 A full suite of parameters was analyzed for surface water quality samples collected from
3 the San Joaquin River at Gravelly Ford before the release of fall 2009 Interim Flows, and
4 also during the fall 2009 Interim Flows period (Table C-10). In addition pore water
5 quality samples were extracted from sediment collected from the San Joaquin River at
6 Gravelly Ford before the release of fall 2009 Interim Flows and after the flows were
7 stopped on November 20, 2009, as presented in Table C-11.

**Table C-10.
Water Quality Results from San Joaquin River at Gravelly Ford**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples								
			10/1/2009	10/7/2009	10/9/2009	10/13/2009	10/16/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Total Suspended Solids	NA	mg/L	21 T	1.8	1.2 T	X	4	5.3	2.4	<1.0	2.8	<1.0
Nutrients	nitrate and nitrite as N	mg/L	NA	<0.050T	<0.050T	NA	0.076T	<0.050T	<0.050	<0.050	0.061	0.062
	ammonia as N	mg/L	NA	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	total Kjeldahl nitrogen	mg/L	NA	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	phosphorus, total as P	mg/L	NA	<0.050	<0.050	NA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorophyll A	µg/L	NA	<2	X	NA	<2	<2	<2	<2.0	<5.0T	<2.0
Total Organic Carbon	NA	mg/L	NA	2.6	2.6	NA	3.4	2.7	2.7	2.4	2.5	2.4
Dissolved Organic Carbon	NA	mg/L	NA	3.3T	2.6T	NA	3.1T	4.4T	2.7	2.5	2.5	3.6
Bacteria	fecal coliform	#/100ml	NA	50	X	NA	50	4	23	30	X	23
	total coliform	#/100ml	NA	900	X	NA	500	300	300	900	X	350
	E. coli	#/100ml	NA	50	X	NA	50	13	23	30	25T	23
Trace Elements, Cations	calcium	mg/L	X	3	3	NA	4	4	4	3	3	3
	magnesium	mg/L	X	<1	<1	NA	<1	<1	<1	<1	<1	<1
	potassium	mg/L	X	<1	<1	NA	1	<1	<1	<1	<1	<1
	sodium	mg/L	X	4	4	NA	3	4	4	3	3	3
Trace Elements, Anions	chloride	mg/L	3.2	3.2	3.1	NA	3.1	3.2	3.2	2.9	2.6	2.7
	carbonate alkalinity	mg/L	<5.0T	<5.0	<5.0	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	bicarbonate alkalinity	mg/L	15T	14	15	NA	16	14	16	15	14	14
	alkalinity	mg/L	15T	14	15	NA	14	15	15	14	14	13

**Table C-10.
Water Quality Results from San Joaquin River at Gravelly Ford (contd.)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples								
			10/1/2009	10/7/2009	10/9/2009	10/13/2009	10/16/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	µg/L	X	0.8	0.6	NA	1.1	1.5	0.7	0.6	0.9	0.7
	chromium	µg/L	X	0.5	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	lead	µg/L	X	0.5	<0.5	NA	<0.5	0.6	<0.5	<0.5	<0.5	<0.5
	nickel	µg/L	X	<1.0	<1.0	NA	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	zinc	µg/L	X	4.4	2.8	NA	2.6	4.7	<2.0	<2.0	2.6	<2.0
	arsenic	µg/L	X	1.2	1.4	NA	1.2	1.6	1.6	1.7	2.4	2.3
	mercury	µg/L	NA	<2.0	<2.0	NA	2.3	<2.0	<2.0	<2.0	<2.0	<2.0
	selenium	µg/L	NA	<0.4	<0.4	NA	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Pesticides	organochlorine scan	µg/L	NA	ND (22)	ND (22)	NA	ND (22)	ND (22)	ND (22)	ND (22)	ND (22)	ND (22)
	pyrethroid scan	µg/L	NA	ND (6) T	ND (6) T	NA	ND (6)	ND (6)	X	ND (6)	ND (6)	ND (6)
	carbarnates	µg/L	NA	X	X	NA	ND (10)	ND (10)	X	X	ND (10)	ND (10)
	organophosphates	µg/L	NA	ND (29)	ND (29)	NA	ND (29)	ND (29)	ND (29)	ND (29)	ND (28)*	ND (29)
Field Measurements	pH	units	NA	6.8	5.9	NA	6.7	7.2	6.4	6.8	6.3	6.8
	conductivity	µS/cm	NA	36	39	NA	41	53	41	39	40	44
	turbidity	NTU	NA	3	3	NA	2	3	4	4	7	3
	dissolved oxygen	mg/L	NA	NA	NA	NA	5.6	NA	6.6	8.9	NA	NA
	temperature	°C	NA	18.6	18.4	NA	19.1	18.1	15.2	15.2	14.9	13.1

Note:

* 11/10/2009 Sulfotepp = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = microgram per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = none detected; results below minimum lab detection levels

NTU = nephelometric turbidity unit

**Table C-11.
Pore Water Quality Results from Bed Sediment at San Joaquin River in Gravelly Ford**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples									Post- release	
			10/1/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	After November 20, 2009	
Total Organic Carbon	NA	mg/L	2400	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Trace Elements	copper	mg/L	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	chromium	mg/L	2.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	lead	mg/L	9.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	nickel	mg/L	1.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	zinc	mg/L	16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	arsenic	mg/L	2.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	mercury	mg/L	<0.0023	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Acute toxicity (<i>Hyalla azteca</i>)	10-day survival	percent	81%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	10-day dry weight	mg	0.08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	TIE	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
NA	grain size analysis	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	percent solids	%	80.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	percent moisture	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X

Key:
ug/L = microgram per liter
mg = milligram
mg/L = milligram per liter

NA = not applicable
TIE = Toxicity Identification Evaluation
X = results pending

- 1 **2.1.6 San Joaquin River Below Chowchilla Bypass Bifurcation Structure**
- 2 A full suite of parameters was analyzed for surface water quality samples collected from
- 3 the San Joaquin River below the Chowchilla Bypass Bifurcation Structure at the end of
- 4 the fall 2009 Interim Flows period (Table C-12).

Table C-12.
Water Quality Results from San Joaquin River Below Chowchilla Bypass Bifurcation Structure

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine									
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	
Total Suspended Solids	NA	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1	1.1
Nutrients	nitrate and nitrite as N	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.056	NA
	ammonia as N	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.50	NA
	total Kjeldahl nitrogen	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.50	NA
	phosphorus, total as P	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.050	NA
	Chlorophyll A	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5.0T	NA
Total Organic Carbon	NA	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6	NA
Dissolved Organic Carbon	NA	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1	NA
Bacteria	fecal coliform	#/100ml	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	NA
	total coliform	#/100ml	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	NA
	E. coli	#/100ml	NA	NA	NA	NA	NA	NA	NA	NA	NA	32T	NA
Trace Elements, Cations	calcium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	NA
	magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	NA
	potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	NA
	sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	NA
Trace Elements, Anions	chloride	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8	NA
	carbonate alkalinity	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5.0	NA
	bicarbonate alkalinity	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	14	NA
	alkalinity	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	15	NA

Table C-12.
Water Quality Results from San Joaquin River Below Chowchilla Bypass Bifurcation Structure (contd.)

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine									
			9/30/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	
Trace Elements, Total	copper	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1	NA
	chromium	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.5	NA
	lead	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.6	NA
	nickel	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	NA
	zinc	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.2	NA
	arsenic	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3	NA
	mercury	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.0	NA
	selenium	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.4	NA
Pesticides	organochlorine scan	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (22)	NA
	pyrethroid scan	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (6)	NA
	carbarnates	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (10)	NA
	organophosphates	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (28)*	NA
Field Measurements	pH	units	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1	6.4
	conductivity	µS/cm	NA	NA	NA	NA	NA	NA	NA	NA	NA	34	29
	turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	2
	dissolved oxygen	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.4	NA
	temperature	°C	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.2	13.5

Note:

* 11/10/2009 Sulfotepp = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = microgram per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = none detected; results below minimum lab detection levels

NTU = nephelometric turbidity unit

T = result obtained past the holding time

X = results pending

1 **2.1.7 San Joaquin River near Mendota (below Mendota Dam)**

2 A full suite of parameters was analyzed for surface water quality samples collected from
3 the San Joaquin River below Mendota Dam before the release of fall 2009 Interim Flows,
4 and once near the end of the fall 2009 Interim Flows period (Table C-13). In addition,
5 pore water quality samples were extracted from sediment collected from the San Joaquin
6 River below Mendota Dam before the release of fall 2009 Interim Flows and after the
7 flows were stopped on November 20, 2009, as presented in Table C-14.

**Table C-13.
Water Quality Results from San Joaquin River near Mendota (below Mendota Dam) (contd.)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline		Routine Samples								
			10/14/2009	10/29/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	mg/L	3.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2
	chromium	µg/L	1.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.6
	lead	µg/L	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.5
	nickel	µg/L	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1
	zinc	µg/L	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7
	arsenic	µg/L	2.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1
	mercury	ng/L	4.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6
	selenium	µg/L	<0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.4
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (22)
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (6)
	carbamates	µg/L	ND (10)	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (10)
	organophosphates	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND (29)
Field Measurements	pH	units	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4
	electrical conductivity	µS/cm	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	401
	turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4
	dissolved oxygen	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	temperature	°C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.8

Note: * 11/10/2009 Sulfatepp = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = None detected; results below minimum lab detection levels

ng/L = nanogram per liter

NTU = Nephelometric turbidity units

T = result obtained past the holding time

X = results pending

**Table C-14.
Pore Water Quality Results From Bed Sediment at San Joaquin River near Mendota (below Mendota Dam)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline		Routine Samples									Post- release	
			10/14/2009	10/29/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009	After November 20, 2009	
Total Organic Carbon	NA	µg/g	NA	<2,600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Trace Elements	copper	µg/g	NA	1.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	chromium	µg/g	NA	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	lead	µg/g	NA	<1.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	nickel	µg/g	NA	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	zinc	µg/g	NA	22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	arsenic	mg/L	NA	<1.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	mercury	µg/L	NA	<0.024	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Pesticides	organochlorine scan	µg/L	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	pyrethroid scan	µg/L	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
Toxicity, Acute (<i>Hyalla azteca</i>)	10-day survival	%	NA	80%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	10-day dry weight	mg	NA	0.07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	TIE	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Extras	grain size analysis	NA	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X
	percent solids	NA	NA	77%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	percent moisture	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Key:
 µg/g = microgram per gram
 µg/L = microgram per liter
 mg/L = milligram per liter

NA = not applicable
 ND = None detected; results below minimum lab detection levels
 TIE = Toxicity Identification Evaluation
 X = results pending

1 **2.1.8 San Joaquin River Below Sack Dam (near Dos Palos)**

2 A full suite of parameters was analyzed for surface water quality samples collected from
3 the San Joaquin River below Sack Dam near Dos Palos before the release of 2009 Interim
4 Flows (Table C-15). One measurement of TSS was collected near the end of the fall 2009
5 Interim Flows period.

**Table C-15.
Water Quality Results from San Joaquin River Below Sack Dam (near Dos Palos)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples								
			10/14/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Total Suspended Solids	NA	mg/L	9.2	NA	NA	NA	NA	NA	NA	NA	NA	7.2
Nutrients	nitrate and nitrite as N	mg/L	0.54	NA	NA	NA	NA	NA	NA	NA	NA	NA
	ammonia as N	mg/L	<0.50	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total Kjeldahl nitrogen	mg/L	0.88	NA	NA	NA	NA	NA	NA	NA	NA	NA
	phosphorous, total as P	mg/L	0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Chlorophyll A	µg/L	6.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	NA	mg/L	2.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Organic Carbon	NA	mg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bacteria	fecal coliform	#/100ml	70	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total coliform	#/100ml	>2,400	NA	NA	NA	NA	NA	NA	NA	NA	NA
	E. coli	#/100ml	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Cations	calcium	mg/L	22	NA	NA	NA	NA	NA	NA	NA	NA	NA
	magnesium	mg/L	14	NA	NA	NA	NA	NA	NA	NA	NA	NA
	potassium	mg/L	3.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
	sodium	mg/L	56	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Anions	chloride	mg/L	99	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbonate alkalinity	mg/L	<5.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	bicarbonate alkalinity	mg/L	84	NA	NA	NA	NA	NA	NA	NA	NA	NA
	alkalinity	mg/L	80	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table C-15.
Water Quality Results from San Joaquin River Below Sack Dam (near Dos Palos) (contd.)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples								
			10/14/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	mg/L	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	chromium	µg/L	0.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
	lead	µg/L	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	nickel	µg/L	2.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
	zinc	µg/L	10	NA	NA	NA	NA	NA	NA	NA	NA	NA
	arsenic	µg/L	1.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
	mercury	ng/L	4.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	selenium	µg/L	<0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbarnates	µg/L	ND (10)	NA	NA	NA	NA	NA	NA	NA	NA	NA
	organophosphates	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Measurements	pH	units	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	electrical conductivity	µS/cm	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	dissolved oxygen	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	temperature	°C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = None detected; results below minimum lab detection levels

ng/L = nanogram per liter

NTU = Nephelometric turbidity units

T = result obtained past the holding time

X = results pending

- 1 **2.1.9 San Joaquin River at Hills Ferry (above Merced River confluence)**
- 2 A full suite of parameters was analyzed for surface water quality samples collected from
- 3 the San Joaquin River at Hills Ferry above the Merced River confluence before the
- 4 release of fall 2009 Interim Flows (Table C-16).

**Table C-16.
Water Quality Results from San Joaquin River at Hills Ferry (Above Merced River Confluence)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples								
			10/29/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Total Suspended Solids	NA	mg/L	21	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nutrients	nitrate and nitrite as N	mg/L	0.54	NA	NA	NA	NA	NA	NA	NA	NA	NA
	ammonia as N	mg/L	<0.50	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total Kjeldahl nitrogen	mg/L	0.88	NA	NA	NA	NA	NA	NA	NA	NA	NA
	phosphorous, total as P	mg/L	0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Chlorophyll A	µg/L	26	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	NA	mg/L	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Organic Carbon	NA	mg/L	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bacteria	fecal coliform	#/100ml	220	NA	NA	NA	NA	NA	NA	NA	NA	NA
	total coliform	#/100ml	>2,400	NA	NA	NA	NA	NA	NA	NA	NA	NA
	E. coli	#/100ml	22	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Cations	calcium	mg/L	68	NA	NA	NA	NA	NA	NA	NA	NA	NA
	magnesium	mg/L	37	NA	NA	NA	NA	NA	NA	NA	NA	NA
	potassium	mg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	sodium	mg/L	170	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trace Elements, Anions	chloride	mg/L	140	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbonate alkalinity	mg/L	<5.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	bicarbonate alkalinity	mg/L	200	NA	NA	NA	NA	NA	NA	NA	NA	NA
	alkalinity	mg/L	200	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table C-16.
Water Quality Results from San Joaquin River at Hills Ferry (Above Merced River Confluence) (contd.)**

Order WR 2009-0058- DWR	Specific Analysis	Units	Baseline	Routine Samples								
			10/29/2009	10/7/2009	10/9/2009	10/13/2009	10/15/2009	10/19/2009	10/27/2009	11/3/2009	11/10/2009	11/17/2009
Trace Elements, Total	copper	mg/L	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
	chromium	µg/L	1.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
	lead	µg/L	56	NA	NA	NA	NA	NA	NA	NA	NA	NA
	nickel	µg/L	16	NA	NA	NA	NA	NA	NA	NA	NA	NA
	zinc	µg/L	640	NA	NA	NA	NA	NA	NA	NA	NA	NA
	arsenic	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	mercury	ng/L	4.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
	selenium	µg/L	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides	organochlorine scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	pyrethroid scan	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	carbamates	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
	organophosphates	µg/L	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Measurements	pH	units	6.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
	electrical conductivity	µS/cm	1,459	NA	NA	NA	NA	NA	NA	NA	NA	NA
	turbidity	NTU	11	NA	NA	NA	NA	NA	NA	NA	NA	NA
	dissolved oxygen	mg/L	5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
	temperature	°C	18.3	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: * 11/10/2009 Sulfotepp = 1.5 ug/L = reporting limit

Key:

#/100 ml = number of counts per 100 milliliters

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

NA = not applicable

ND = None detected; results below minimum lab detection levels

ng/L = nanogram per liter

NTU = Nephelometric turbidity units

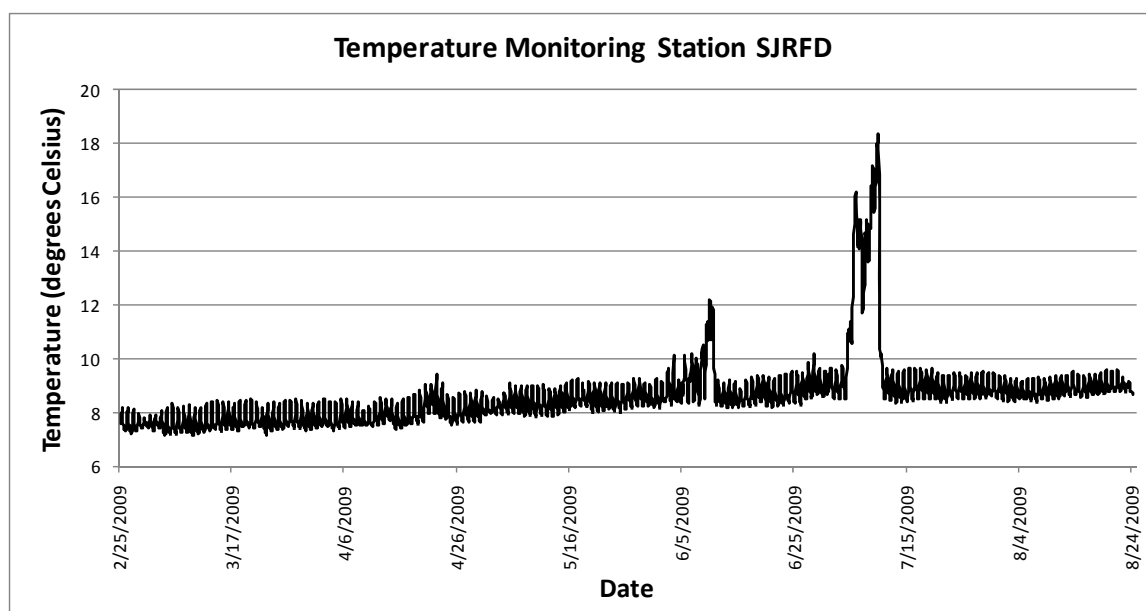
T = result obtained past the holding time

1 2.2 Surface Water Temperature

2 DFG collected surface water temperature data from numerous sites along the San Joaquin
3 River during the fall 2009 Interim Flows period. The following section presents the data
4 collected from the respective monitoring stations.

5 2.2.1 SJRFD

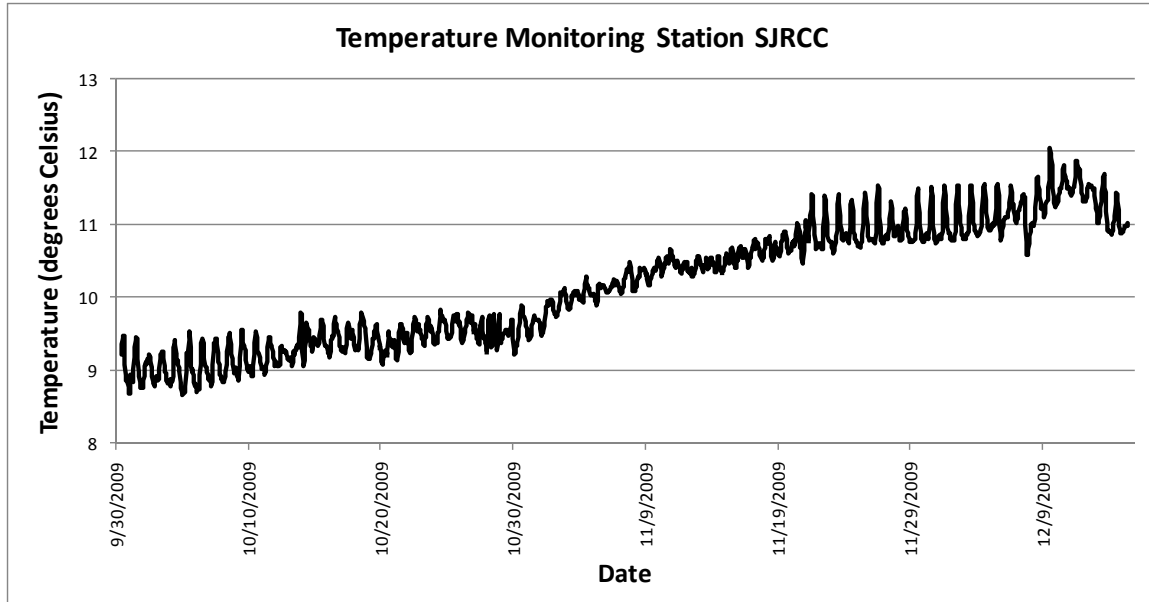
6 The SJRFD monitoring station is located in the trench pool below Friant Dam in
7 Reach 1A at approximately river mile (RM) 267.2. Monitoring data at this site were lost
8 during the fall 2009 Interim Flows period due to vandalism. Figure C-1 illustrates the
9 change in temperature recorded before the fall 2009 Interim Flows period.



10
11 **Figure C-1.**
12 **San Joaquin River Temperature at Monitoring Station SJRFD Before Fall 2009**
13 **Interim Flows**
14

15 2.2.2 SJRCC

16 The SJRCC monitoring station is located at the mouth of Cottonwood Creek below the
17 dam in a trench pool in Reach 1A at approximately RM 267. Figure C-2 illustrates the
18 change in temperature recorded over the fall 2009 Interim Flows period.

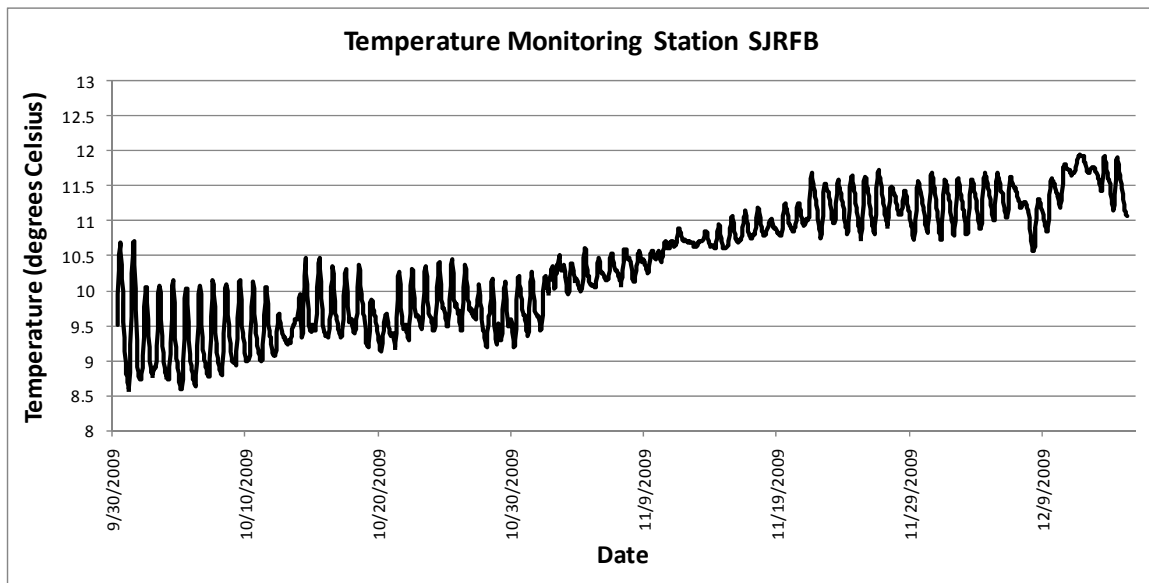


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Figure C-2.
San Joaquin River Temperature at Monitoring Station SJRCC During Fall 2009 Interim Flows

2.2.3 SJRFB

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6 The SJRFB monitoring data is located below the Friant Bridge, just past the dam in
7 Reach 1A at approximately RM 266.6. Figure C-3 illustrates the change in temperature
8 recorded over the fall 2009 Interim Flows period.

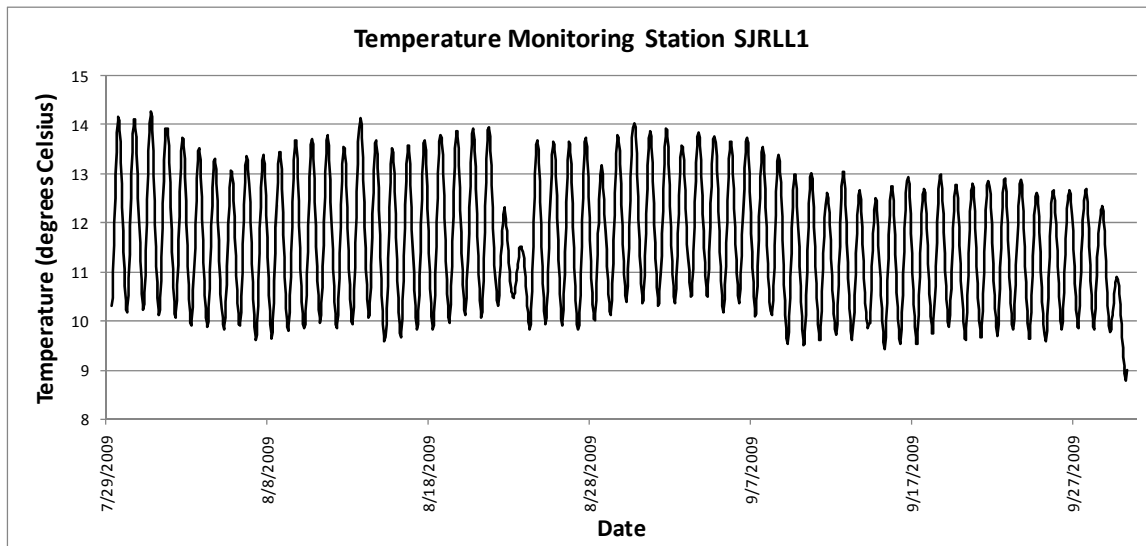


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Figure C-3.
San Joaquin River Temperature at Monitoring Station SJRFB During Fall 2009 Interim Flows

1 **2.2.4 SJRLL1**

2 The SJRLL1 monitoring station is located downstream from Lost Lake Park in Reach 1A
 3 at RM 264.7. Figure C-4 illustrates the change in temperature recorded before the fall
 4 2009 Interim Flows period.



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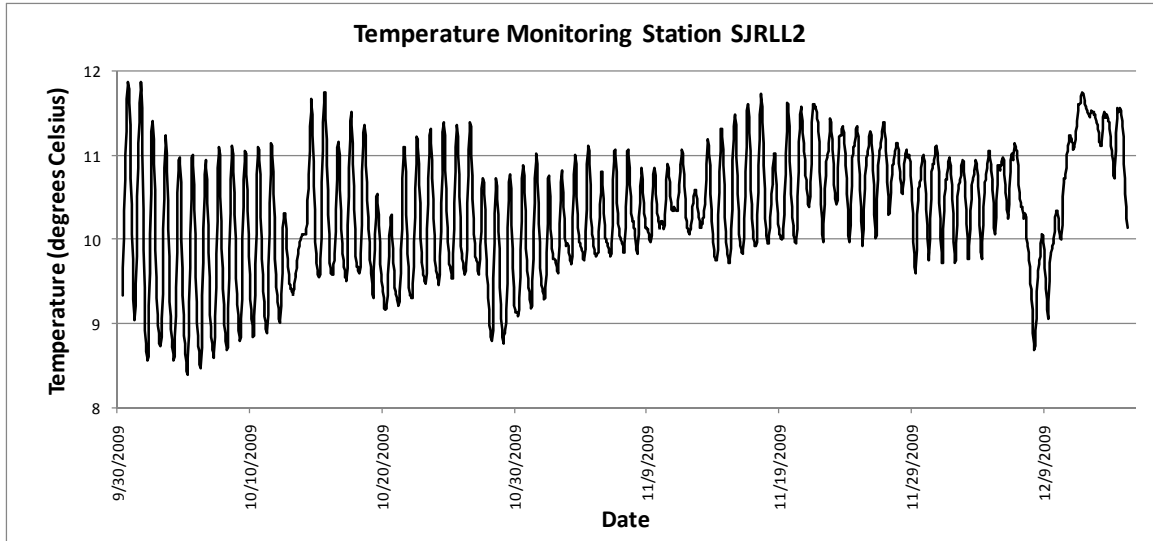
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Figure C-4.
San Joaquin River Temperature at Monitoring Station SJRLL1 Before Fall 2009
Interim Flows

9 **2.2.5 SJRLL2**

10 The SJRLL2 monitoring station is located downstream from Lost Lake Park in Reach 1A
 11 at RM 264.7. Figure C-5 illustrates the change in temperature recorded before and during
 12 the fall 2009 Interim Flows period.

13

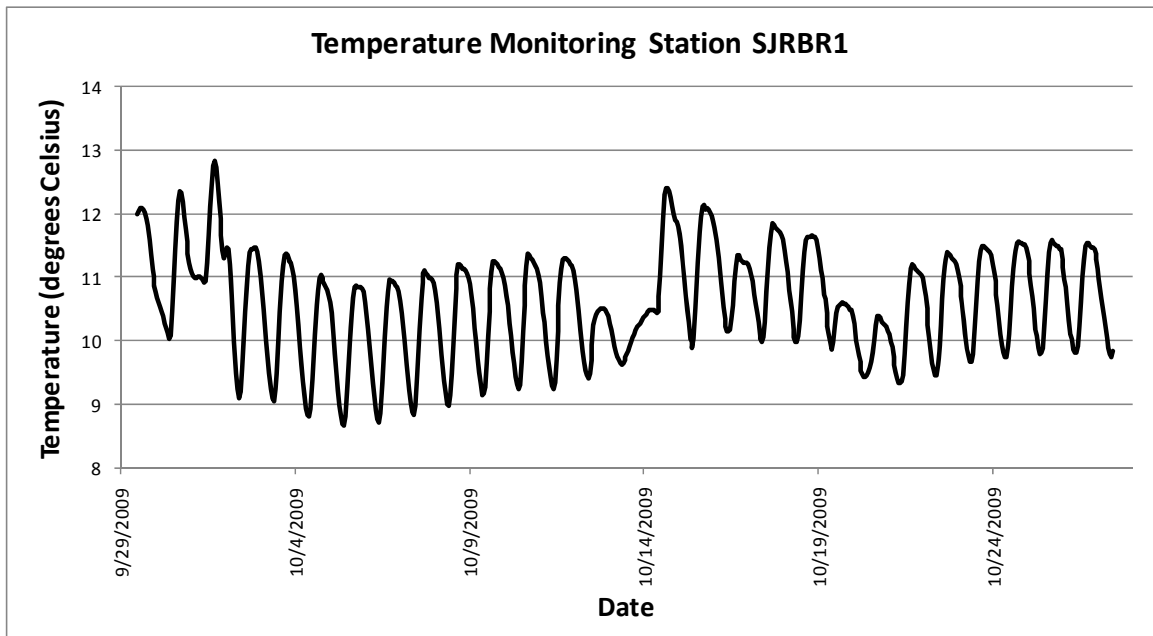


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Figure C-5.
San Joaquin River Temperature at Monitoring Station SJRLL2 Before and During Fall 2009 Interim Flows

5 **2.2.6 SJRBR1**

6 The SJRBR1 monitoring station is located at Holding Pool A upstream from Ball Ranch
7 in Reach 1A at approximately RM 262. Figure C-6 illustrates the change in temperature
8 recorded over the fall 2009 Interim Flows period.

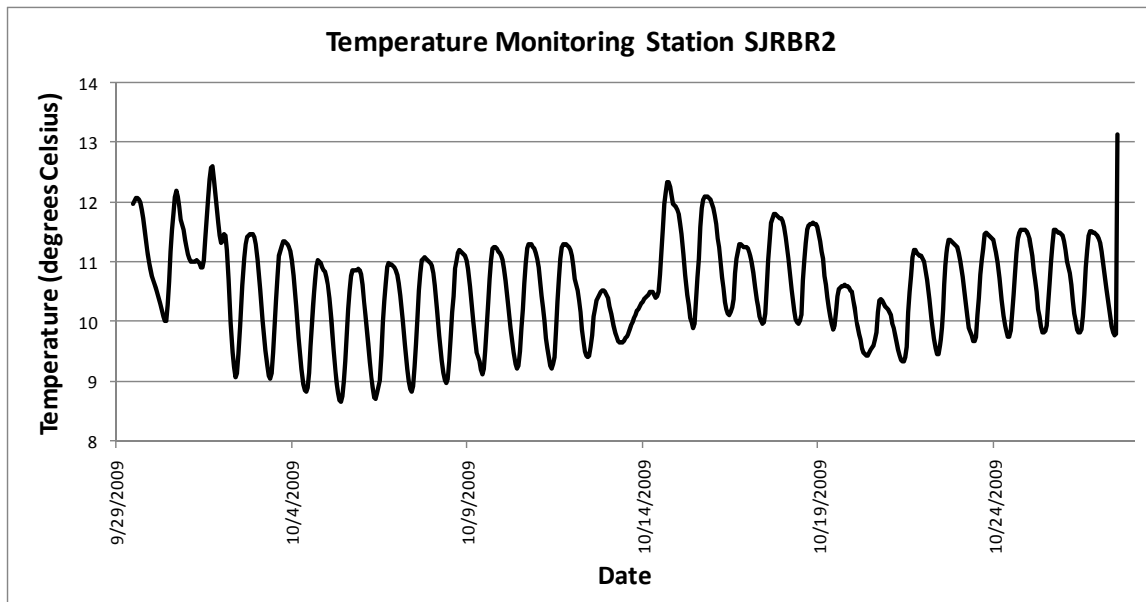


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Figure C-6.
San Joaquin River Temperature at Monitoring Station SJRBR1 During Fall 2009 Interim Flows

1 **2.2.7 SJRBR2**

2 The SJRBR2 monitoring station is located at Holding Pool A upstream from Ball Ranch
3 in Reach 1A at approximately RM 262. Figure C-7 illustrates the change in temperature
4 recorded over the fall 2009 Interim Flows period.

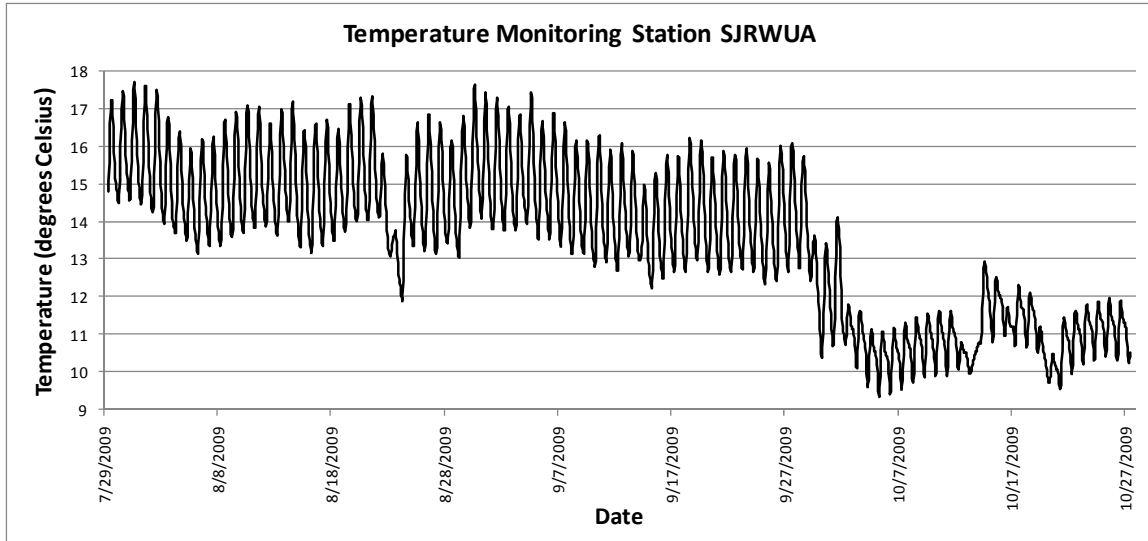


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Figure C-7.
San Joaquin River Temperature at Monitoring Station SJRBR2 During Fall 2009 Interim Flows

9 **2.2.8 SJRWUA**

10 The SJRWUA monitoring station is located in the Willow Unit, with access from a gravel
11 site in Reach 1A at RM 260.9. Figure C-8 illustrates the change in temperature recorded
12 during the fall 2009 Interim Flows period.

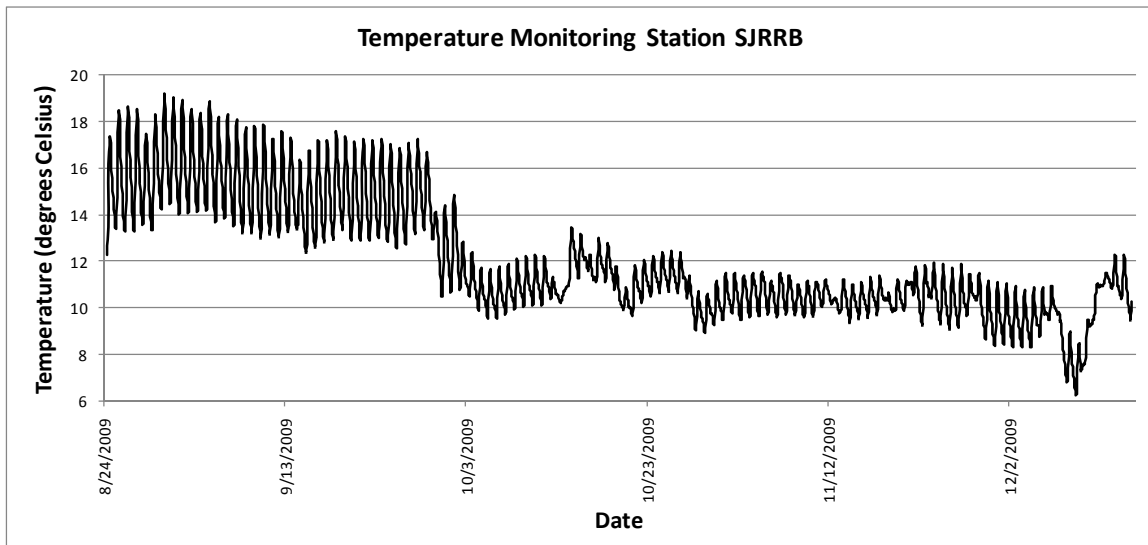


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Figure C-8.
San Joaquin River Temperature at Monitoring Station SJRWUA During Fall 2009 Interim Flows

5 **2.2.9 SJRRB**

6 The SJRRB monitoring station is located in a side channel at Riverbend Golf Club in
7 Reach 1A at RM 259.5. Figure C-9 illustrates the change in temperature recorded before
8 and during the fall 2009 Interim Flows period.

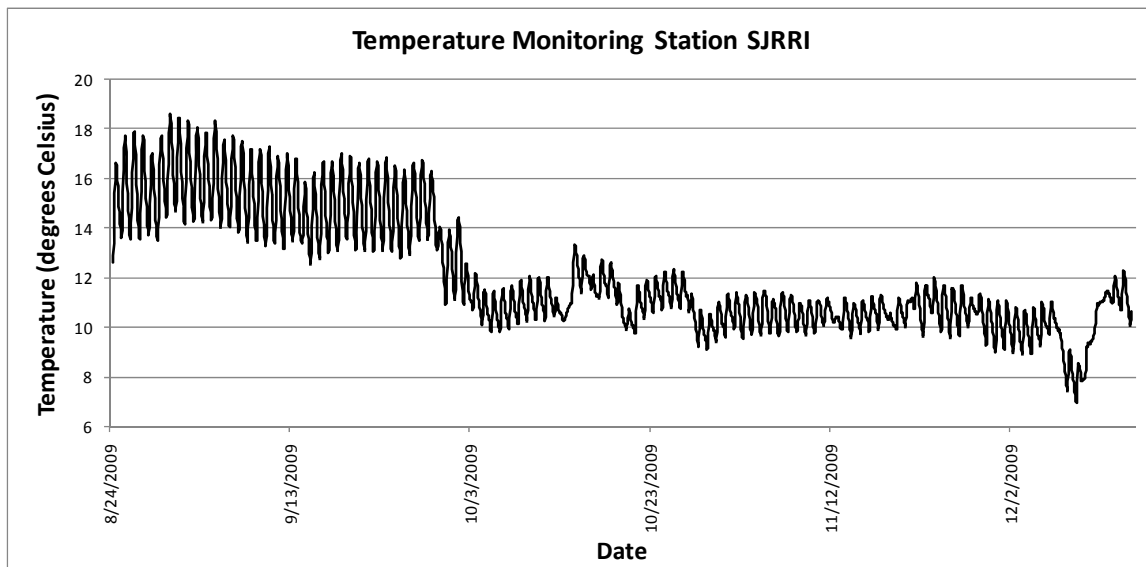


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Figure C-9.
San Joaquin River Temperature at Monitoring Station SJRRB Before and During Fall 2009 Interim Flows

1 **2.2.10 SJRRI**

2 The SJRRI monitoring station is located in at Rank Island with access from Riverbend
3 Golf Club in Reach 1A at RM 259.5. Figure C-10 illustrates the change in temperature
4 recorded before and during the fall 2009 Interim Flows period.

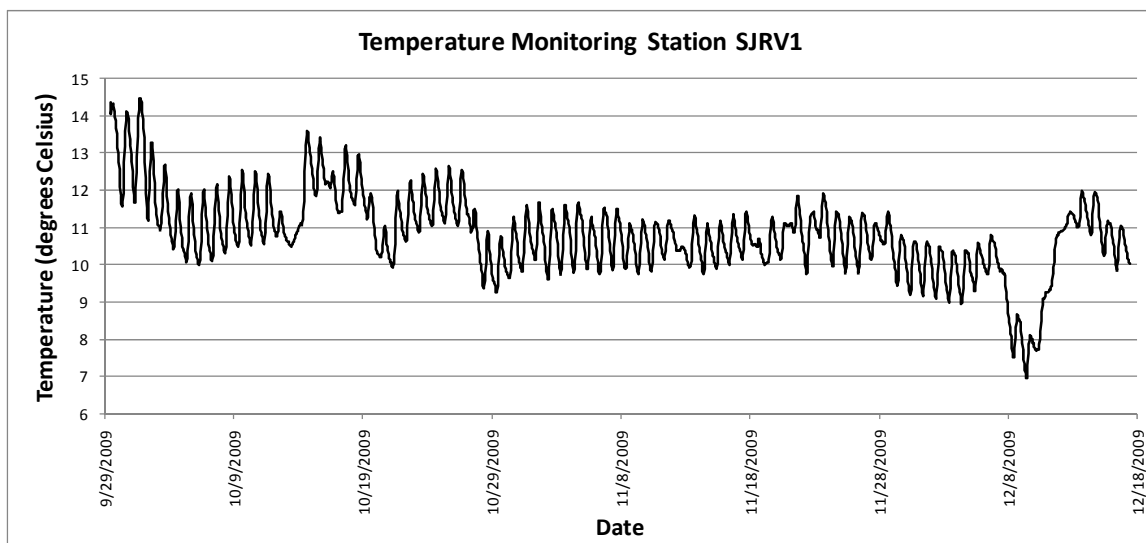


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Figure C-10.
San Joaquin River Temperature at Monitoring Station SJRRI Before and During
Fall 2009 Interim Flows

9 **2.2.11 SJRV1**

10 The SJRV1 monitoring station is located downstream from the Volcan access in Holding
11 Pond B in Reach 1A at RM 258. Figure C-11 illustrates the change in temperature
12 recorded during the fall 2009 Interim Flows period.

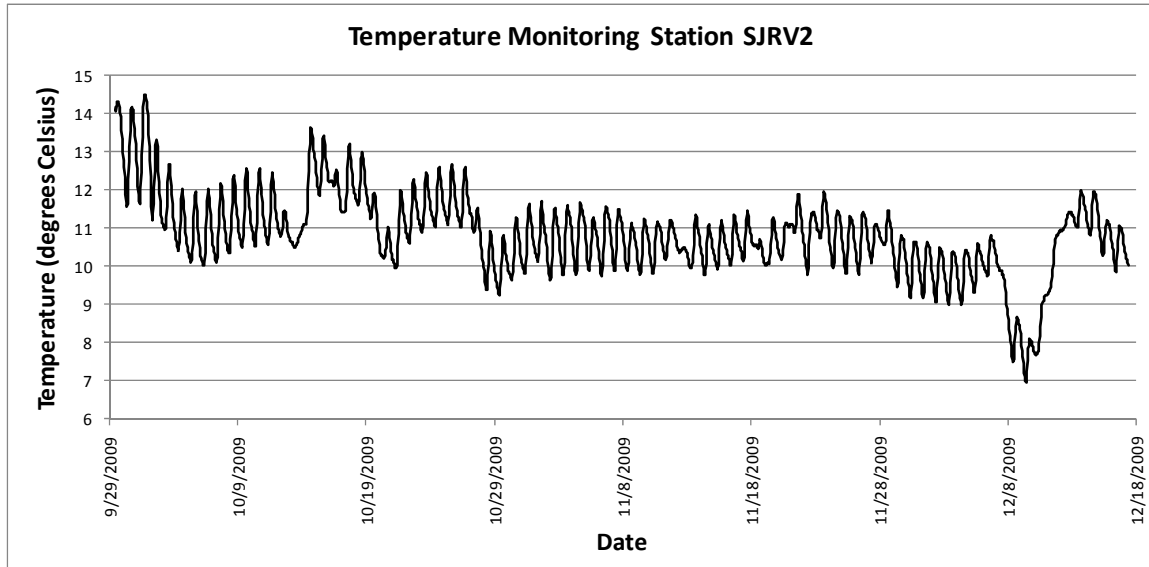


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Figure C-11.
San Joaquin River Temperature at Monitoring Station SJRV1 During Fall 2009
Interim Flows

1 **2.2.12 SJRV2**

2 The SJRV2 monitoring station is located downstream from the Volcan access in Holding
3 Pond B in Reach 1A at RM 258. Figure C-12 illustrates the change in temperature
4 recorded during the fall 2009 Interim Flows period.

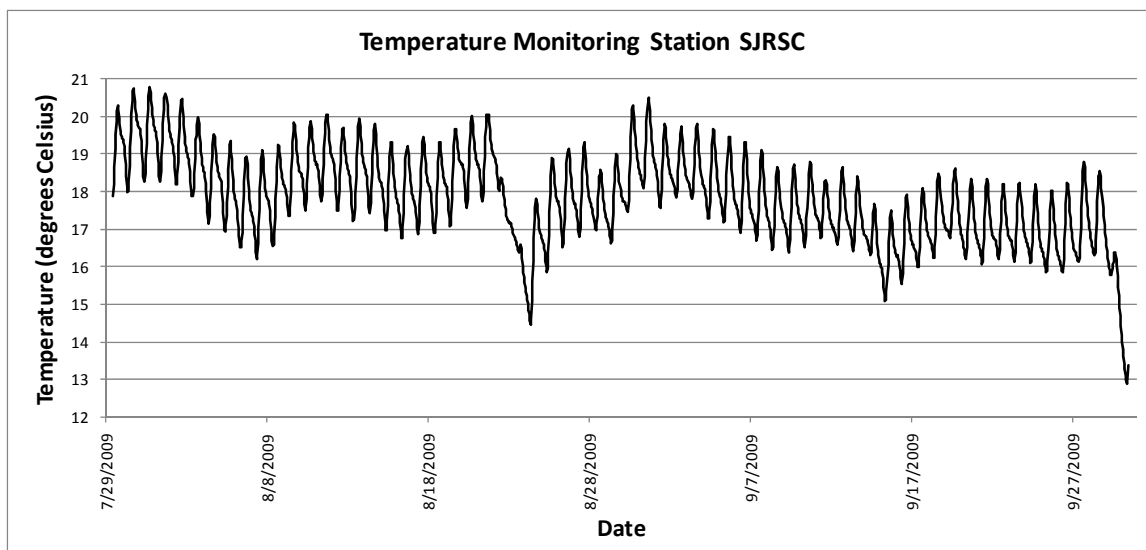


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Figure C-12.
San Joaquin River Temperature at Monitoring Station SJRV2 During Fall 2009 Interim Flows

9 **2.2.13 SJRSC**

10 The SJRSC monitoring station is located at the Sportsman's Club, upstream from a boat
11 launch in Reach 1B at RM 256.4. Monitoring data for this site were lost during the fall
12 2009 Interim Flows period due to vandalism. Figure C-13 illustrates the change in
13 temperature recorded before the fall 2009 Interim Flows period.

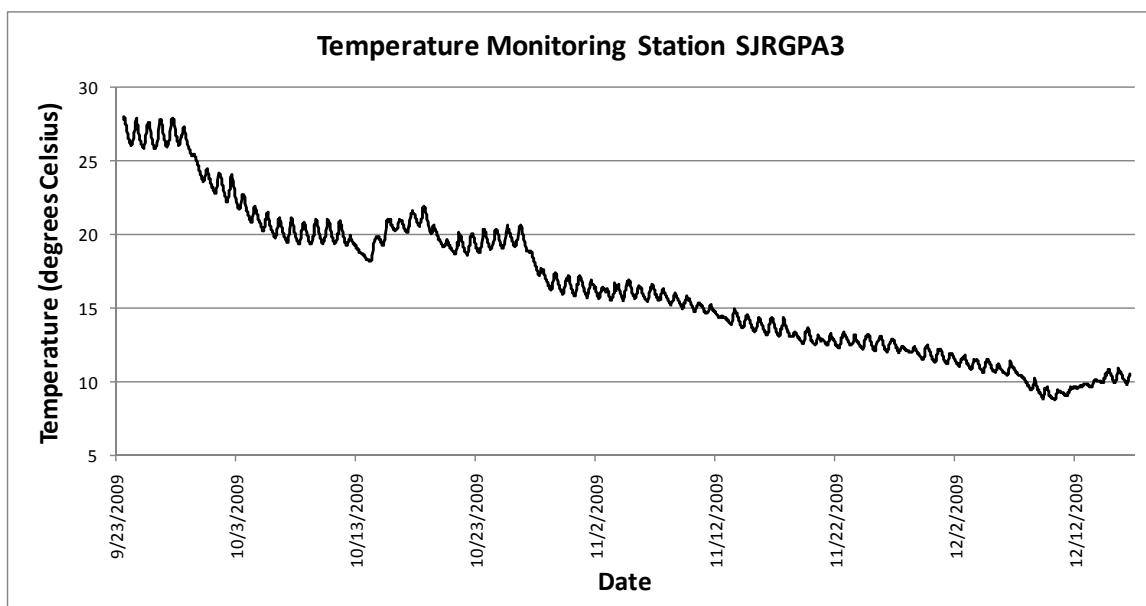


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Figure C-13.
San Joaquin River Temperature at Monitoring Station SJRSC Before Fall 2009 Interim Flows

5 **2.2.14 SJRGPA3**

6 The SJRGPA3 monitoring station is located downstream from the Highway 41 bridge in
7 Gravel Pit A in Reach 1A. Figure C-14 illustrates the change in temperature recorded
8 before and during the fall 2009 Interim Flows period.

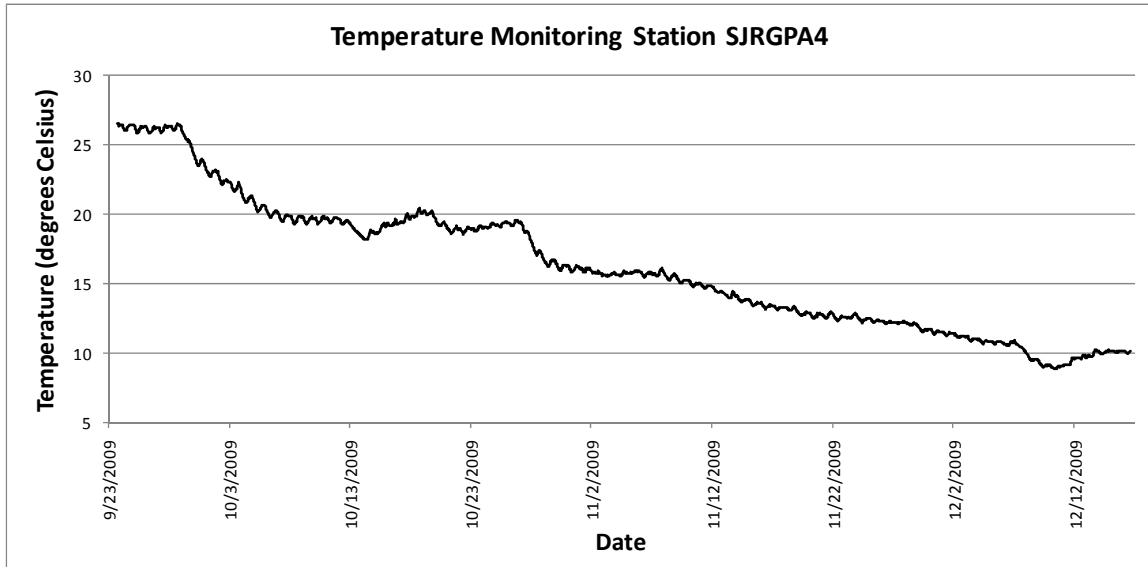


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Figure C-14.
San Joaquin River Temperature at Monitoring Station SJRGPA3 Before and During Fall 2009 Interim Flows

1 **2.2.15 SJRGPA4**

2 The SJRGPA4 monitoring well is located downstream from the Highway 41 bridge in
3 Gravel Pit A in Reach 1A. Figure C-15 illustrates the change in temperature recorded
4 before and during the fall 2009 Interim Flows period.



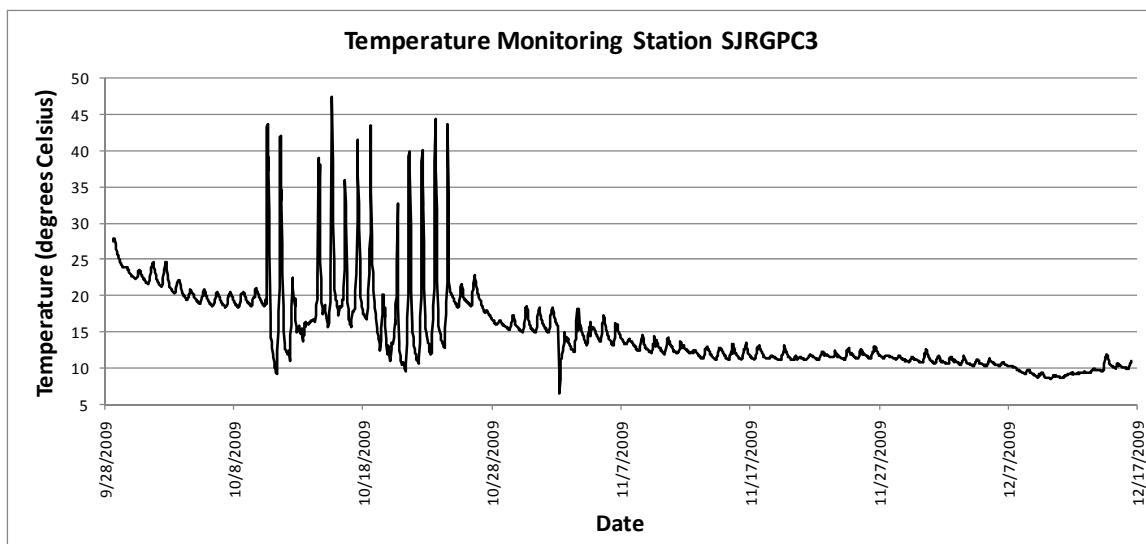
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Figure C-15.
San Joaquin River Temperature at Monitoring Station SJRGPA4 Before and During Fall 2009 Interim Flows

10 **2.2.16 SJRGPC3**

11 The SJRGPC3 monitoring station is located downstream from the Highway 41 bridge in
12 Gravel Pit C in Reach 1A. Figure C-16 illustrates the change in temperature recorded
13 before and during the fall 2009 Interim Flows period.

14



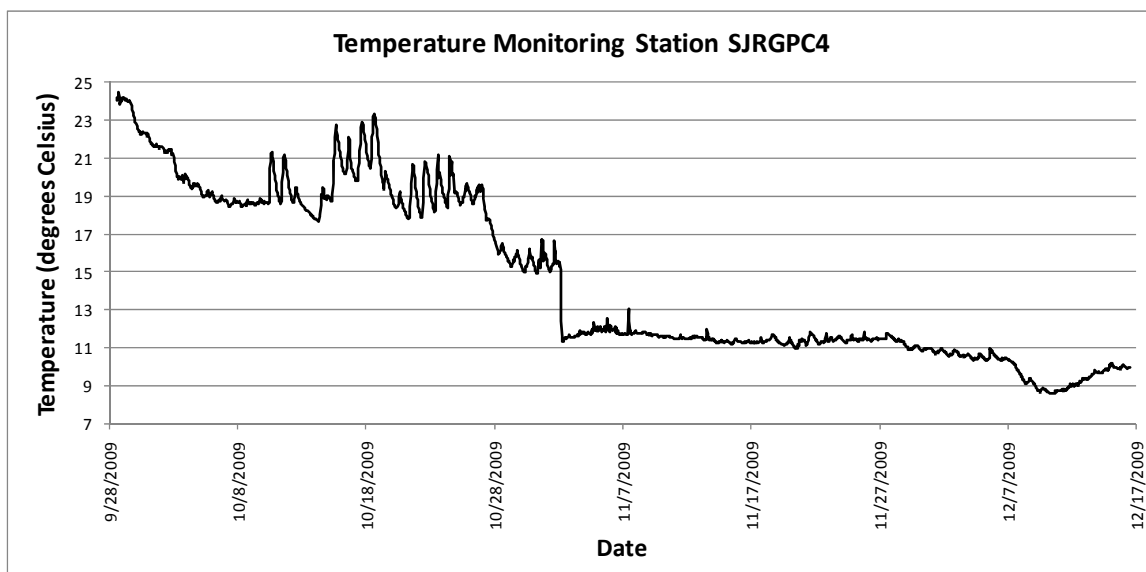
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Figure C-16.

San Joaquin River Temperature at Monitoring Station SJRGPC3 Before and During Fall 2009 Interim Flows

5 **2.2.17 SJRGPC4**

6 The SJRGPC4 monitoring station is located downstream from the Highway 41 bridge in
7 Gravel Pit C in Reach 1A. Figure C-17 illustrates the change in temperature recorded
8 before and during the fall 2009 Interim Flows period.



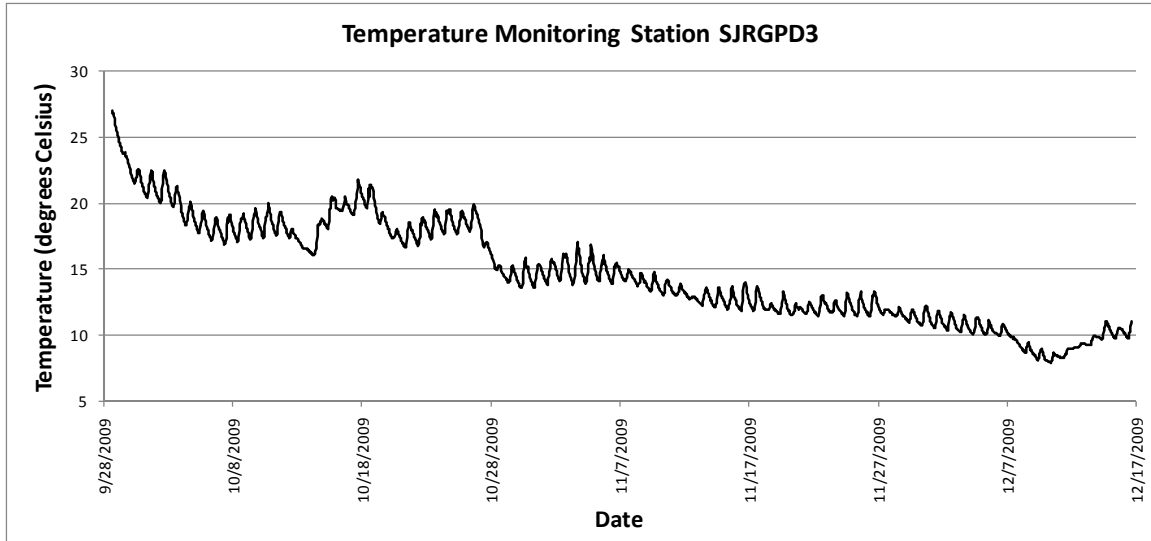
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Figure C-17.

San Joaquin River Temperature at Monitoring Station SJRGPC4 Before and During Fall 2009 Interim Flows

13 **2.2.18 SJRGP3**

14 The SJRGP3 monitoring station is located downstream from the Highway 41 bridge in
15 Gravel Pit D in Reach 1A. Figure C-18 illustrates the change in temperature recorded
16 before and during the fall 2009 Interim Flows period.

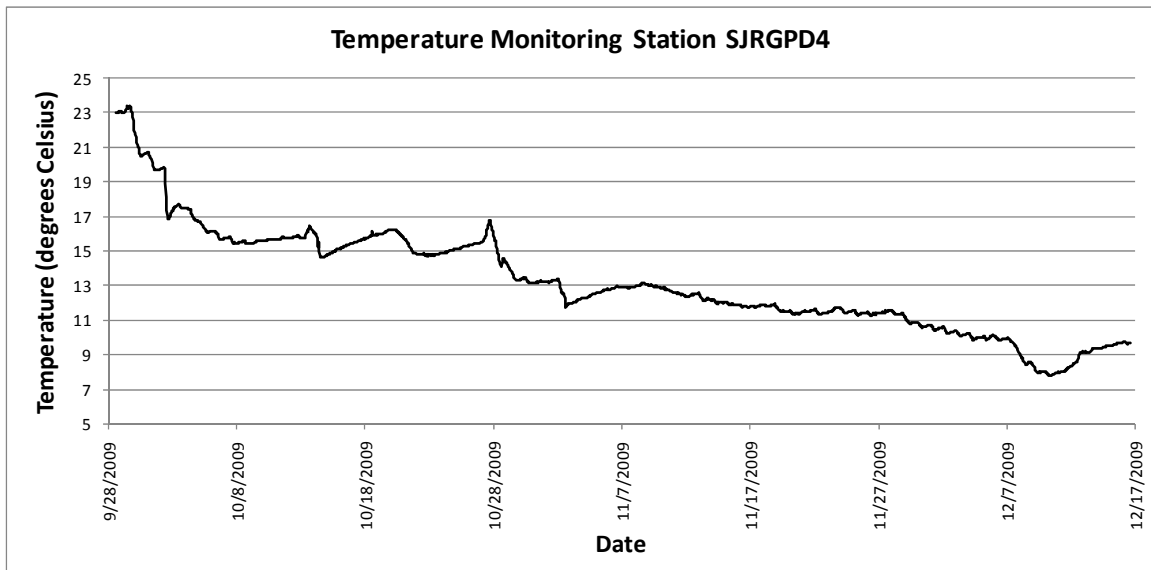


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Figure C-18.
San Joaquin River Temperature at Monitoring Station SJRGP3 Before and During Fall 2009 Interim Flows

2.2.19 SJRGP4

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6 The SJRGP4 monitoring station is located downstream from the Highway 41 bridge in
7 Gravel Pit D in Reach 1A. Figure C-19 illustrates the change in temperature recorded
8 before and during the fall 2009 Interim Flows period.

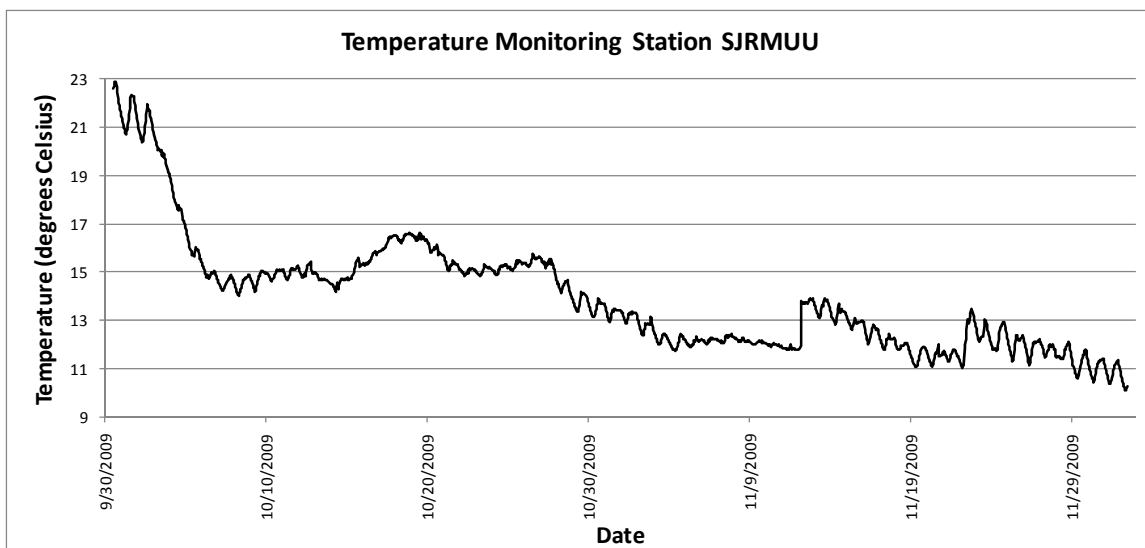


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Figure C-19.
San Joaquin River Temperature at Monitoring Station SJRGP4 Before and During Fall 2009 Interim Flows

2.2.20 SJRMUU

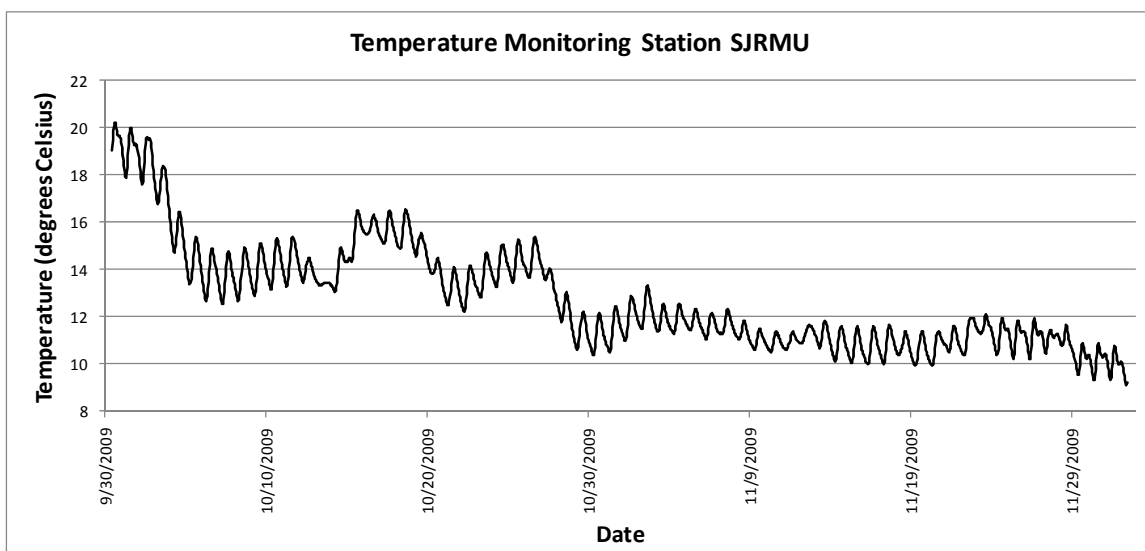
13
14 The SJRMUU monitoring station is located in a gravel pit upstream from the Milburn
15 Unit in Reach 1A. Figure C-20 illustrates the change in temperature recorded before and
16 during the fall 2009 Interim Flows period.



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3 **Figure C-20.**
4 **San Joaquin River Temperature at Monitoring Station SJRMUU Before and During**
5 **Fall 2009 Interim Flows**

6 **2.2.21 SJRMU**

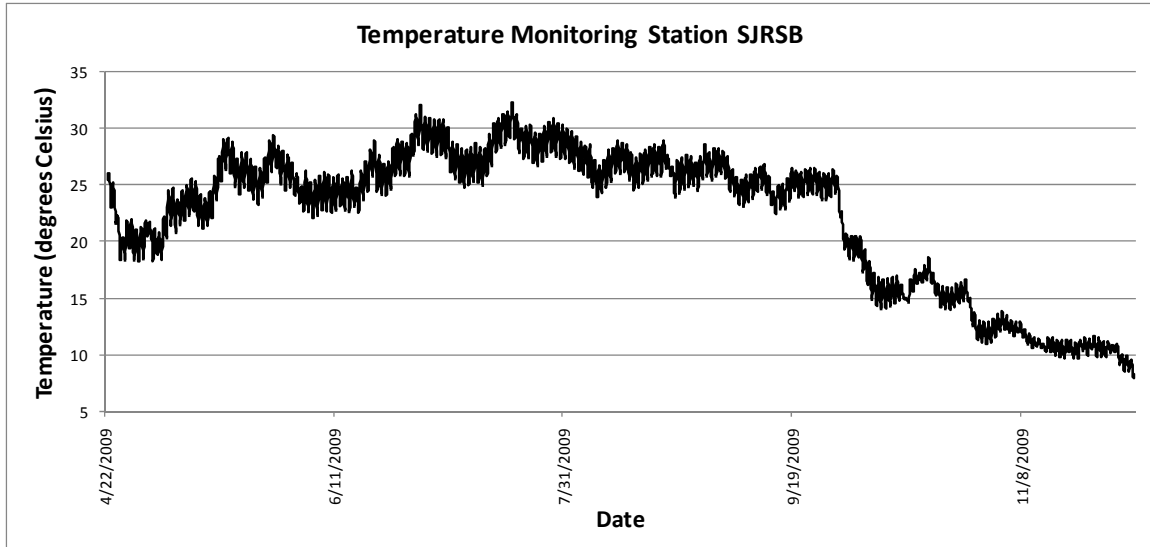
7 The SJRMU monitoring station is located underneath a culvert in the Milburn Unit in
8 Reach 1A at RM 247.5. Figure C-21 illustrates the change in temperature recorded before
and during the fall 2009 Interim Flows period.



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10 **Figure C-21.**
11 **San Joaquin River Temperature at Monitoring Station SJRMU Before and During**
12 **Fall 2009 Interim Flows**

13 **2.2.22 SJRSB**

14 The SJRSB monitoring station is located at Skaggs Bridge upstream from Skaggs Park in
15 Reach 1B at RM 234.5. Figure C-22 illustrates the change in temperature recorded before
16 and during the fall 2009 Interim Flows period.

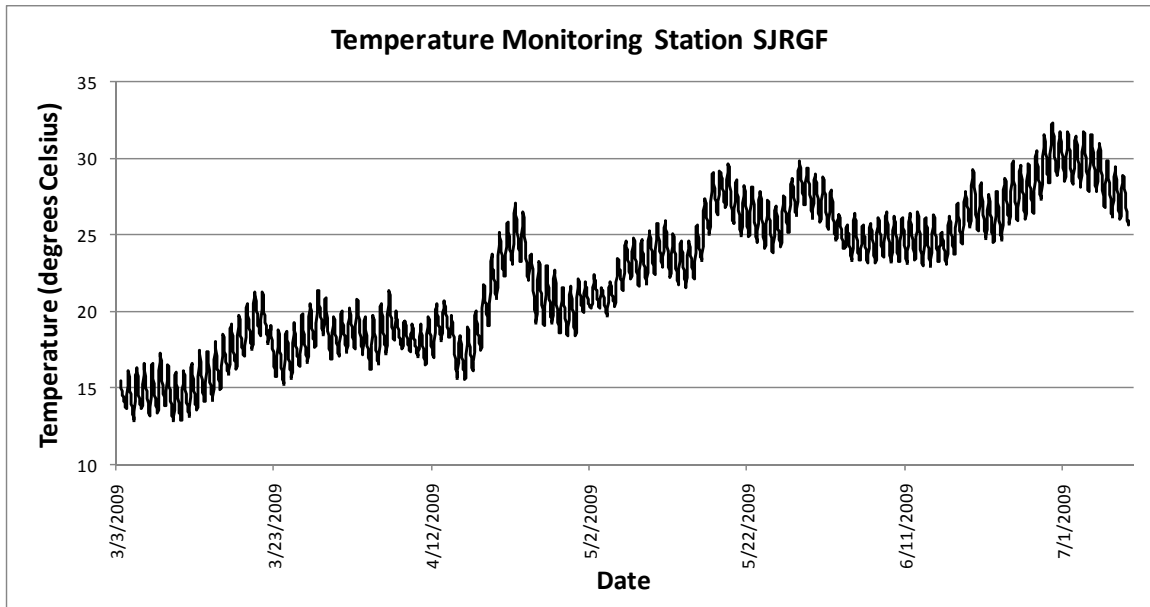


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Figure C-22.
San Joaquin River Temperature at Monitoring Station SJRSB Before and During
Fall 2009 Interim Flows

5 **2.2.23 SJRGF**

6 The SJRGF monitoring station is located 1 mile downstream from Skaggs Park in Reach
7 1B at approximately RM 231.2. Monitoring data from this site were lost during the fall
8 2009 Interim Flows period due to vandalism. Figure C-23 illustrates the change in
9 temperature recorded before the fall 2009 Interim Flows period.

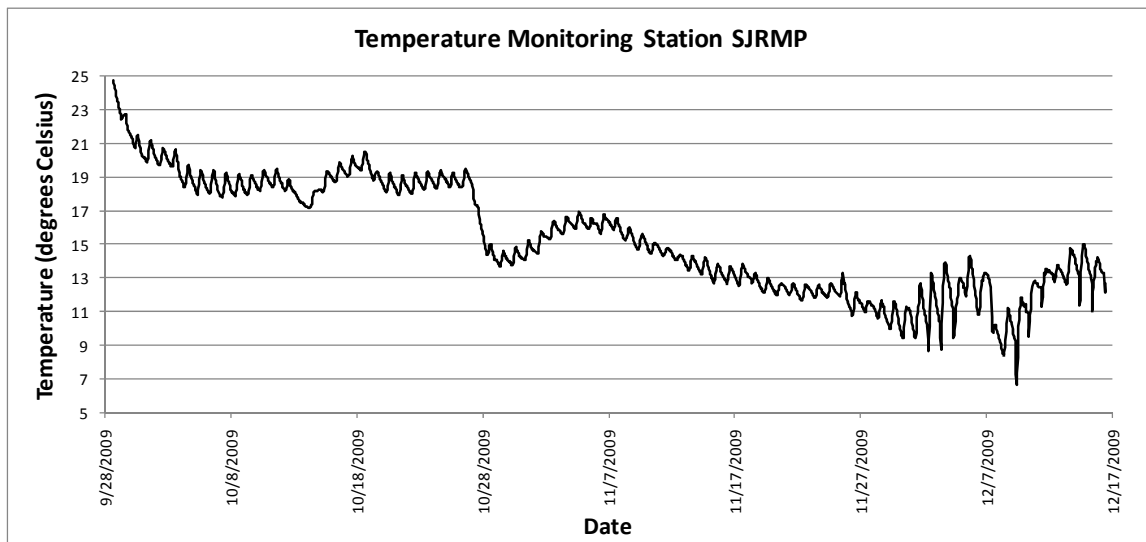


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Figure C-23.
San Joaquin River Temperature at Monitoring Station SJRGF Before Fall 2009
Interim Flows

1 **2.2.24 SJRMP**

2 The SJRMP monitoring station is located downstream from the Mendota Pool in Reach 3
 3 at RM 204.5. Figure C-24 illustrates the change in temperature recorded before and
 4 during the fall 2009 Interim Flows period.



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Figure C-24.

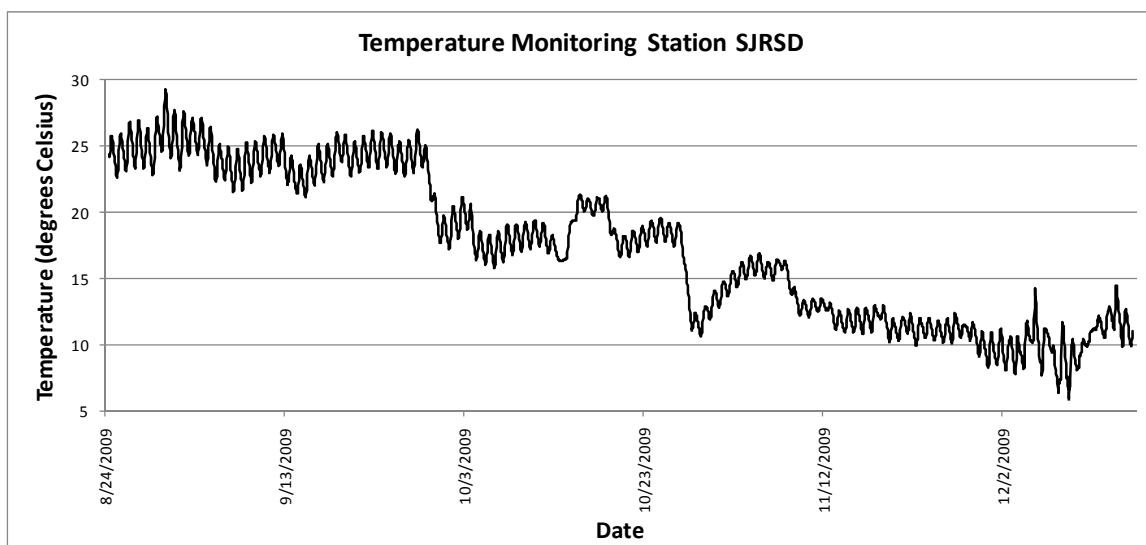
7

**San Joaquin River Temperature at Monitoring Station SJRMP Before and During
 8 Fall 2009 Interim Flows**

8

9 **2.2.25 SJRSD**

10 The SJRSD monitoring station is located downstream from Sack Dam in Reach 4A at
 11 RM 182. Figure C-25 illustrates the change in temperature recorded during the fall 2009
 12 Interim Flows period.



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Figure C-25.

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**San Joaquin River Temperature at Monitoring Station SJRSD During Fall 2009
 16 Interim Flows**

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1 **3.0 References**

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4 29 pp.

5 Lewis, T., D.W. Lamphere, D.R. McCanne, A.S. Webb, J.P. Krieter, and W.D. Conroy.
6 2000. Executive Summary: Regional Assessment of Stream Temperatures Across
7 Northern California and Their Relationship to Various Landscape-Level and
8 Site-Specific Attributes. Forest Science Project. Humboldt State University
9 Foundation, Arcata, California. 14 pp.

10 U.S. Department of the Interior, Bureau of Reclamation (Reclamation). XXXX. Millerton
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