Appendix F

Monitoring Plan

Project Monitoring Plan

4-S/SHS Ranch Water Acquisition Project

July 2014

Contents

List of Figures, Tables and Appendices

List of Acronyms and Abbreviations

AF	acre feet of water
AFY	acre feet of water per year
COC	Chain of Custody
CVRWQCB	Central Valley Regional Water Quality Control Board
DPWD	Del Puerto Water District
EC	electrical conductivity
gpm	gallons per minute
GPS	global positioning system
ID	identification
4-S Ranch	4-S Ranch Partners, LLC
4-S/SHS Ranches	4-S Ranch and SHS Ranch acting together
Project	The 4-S Ranch/SHS Ranch DPWD Water Acquisition Project described herein
Plan	Project Monitoring Plan
Properties	The land owned by 4-S Ranch and SHS Ranch in Merced County from which water will be transferred for the Project
QA	Quality Assurance
QC	Quality Control
Reclamation	U. S. Bureau of Reclamation
RL	reporting limit
SHS Ranch	SHS Family Limited Partnership
SJR	San Joaquin River
SJRRP	San Joaquin River Restoration Program
SOP	Standard Operating Procedures

1. INTRODUCTION

The primary goal of the Project is to provide an emergency water supply to Del Puerto Water District (DPWD) on a short-term basis and to develop additional information regarding the characteristics and operations of the aquifer supporting the Properties and their well field. See Figure 1 for the Project Location. Under the Project, the Properties would pump up to 13,000 AFY (up to 11,000 AFY for the 4-S Ranch and up to 2,000 AFY for the SHS Ranch) of groundwater and deliver it via the Eastside Bypass and/or Bear Creek to the SJR where it would be subsequently diverted at the Patterson Irrigation District (PID) river pumping facilities into their distribution system and subsequently delivered into the Delta-Mendota Canal for storage in the San Luis Reservoir and /or delivery to DPWD by the federal Central Valley Project (CVP). Figure 2 shows the Well Field to be utilized for the Project. The proposed Project would be for two years.

Pumping would be on a schedule established by DPWD in coordination with 4-S/SHS Ranches, PID and Reclamation, but also consistent with needs of this Project Monitoring Plan (Plan). Groundwater resources and water quality would be monitored in accordance with this Plan, and pumping would be curtailed, maintained or accelerated on an adaptive management basis. Initial pumping would be set at a specified level that accommodates DPWD water requests and the 4-S/SHS Ranches' water demands subject to available conveyance capacities and other relevant factors affecting the conveyance of water to PID's facilities.

Figure 1 – Project Location

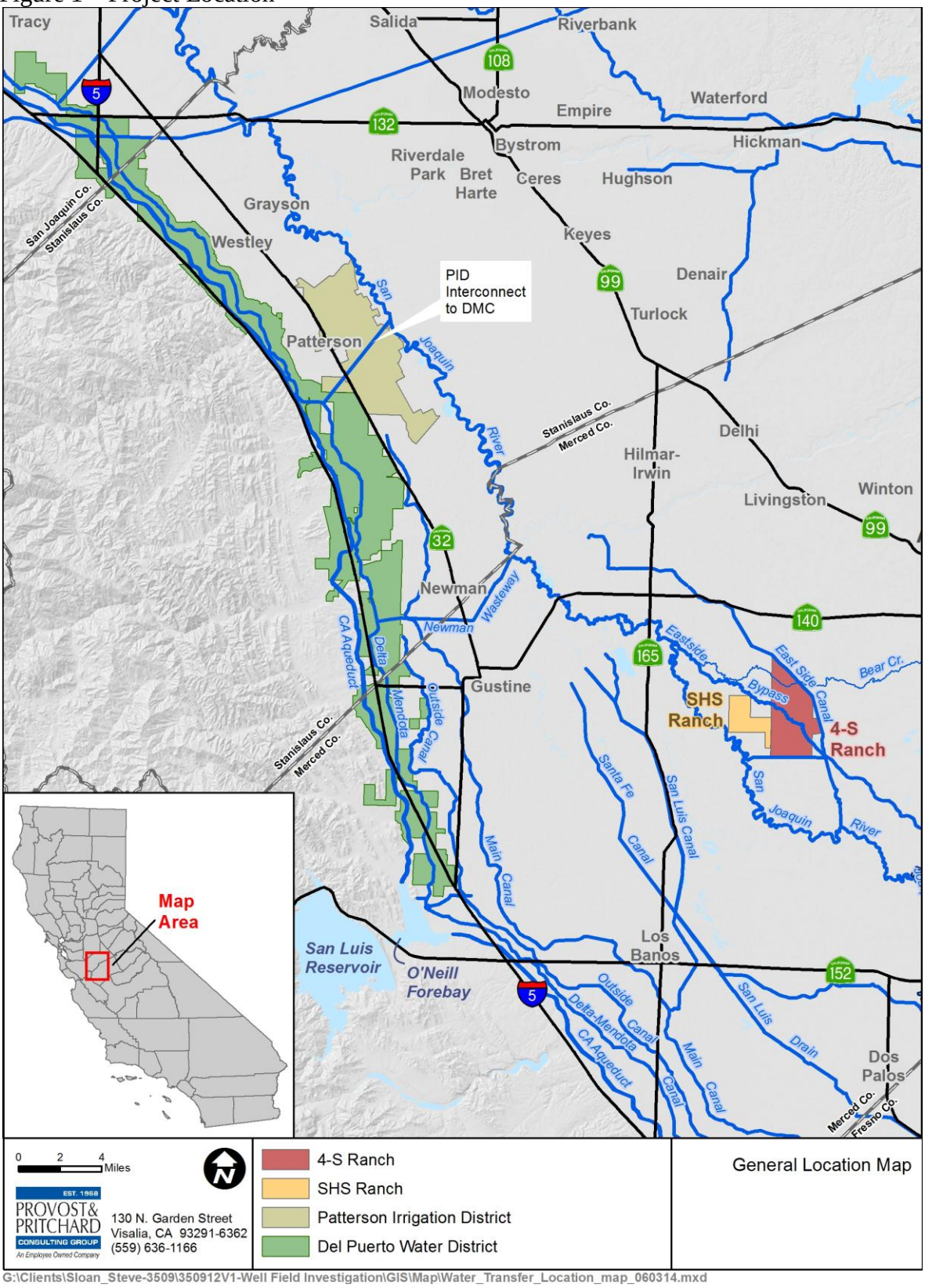
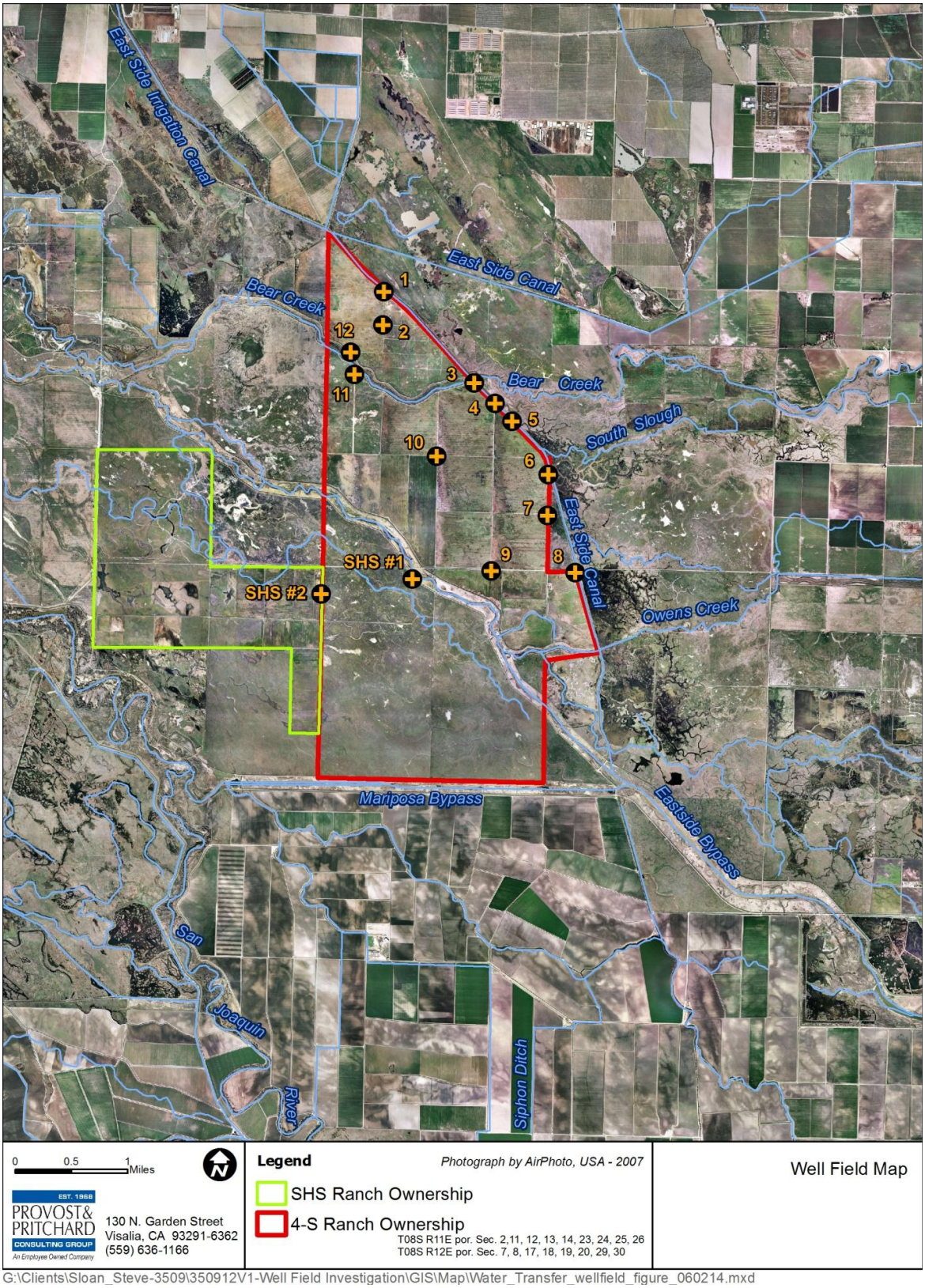


Figure 2 – Well Field Map



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2. PROJECT SETTING

4-S Ranch, a private party, owns land in Merced County that is referred to as the 4-S Ranch. 4-S Ranch also leases and controls an adjacent property owned by the SHS Ranch, a private party, adjacent to the 4-S Ranch. These lands are currently used as rangeland and irrigated pasture and consist of approximately 7,000 acres located east of the San Joaquin River (SJR) and south of Bear Creek.

Groundwater will be delivered into Bear Creek and the Eastside Bypass from 14 wells located on the Properties. According to a memorandum from Provost and Pritchard (August 1, 2012), most of these wells were most likely developed in the 1960s or early 1970s and have capacities ranging from 866 to 2,082 gallons per minute (gpm). The majority of these well discharges are tied together into a subsurface pipeline with a shared discharge point or points into Bear Creek and/or the Eastside Bypass. Discharge points into Bear Creek and/or the Eastside Bypass vary based on the pipeline capacity, with more discharge points needed for higher pumping rates. Existing ditches also are used in the collection and delivery of pumped groundwater into Bear Creek and/or the Eastside Bypass.

2.1 Project Objectives

The objectives of the Project are to:

(1) Provide a temporary supply of supplemental water for DPWD growers to address unprecedented drought conditions,

(2) Develop additional information regarding the characteristics and operations of the aquifer supporting the Properties and the associated well field without creating any significant impacts on the aquifer or on subsidence conditions, and

(3) Assure that the groundwater quality continues to be acceptable for discharge into Bear Creek, the Eastside Bypass and the SJR.

2.2 Project Viability

The key elements of viability for the Properties ability to provide a long-term water supply are the sustainable yield of underlying aquifers and the groundwater quality. Groundwater and surface water quality monitoring will determine if Central Valley Regional Water Quality Control Board (CVRWQCB) water quality objectives are met as outlined in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan, Fourth Edition 1998). This Plan describes the data to be collected during the Project to address the Project Objectives and assess the long-term viability of the Properties to provide a water supply.

3. PROJECT MONITORING PLAN OBJECTIVES

Consistent with the overall Project Objectives, this Plan has the following objectives:

(1) Identify the type of data to be collected during the Project,

(2) Specify the data collection and reporting procedures,

(3) Clarify the responsibilities for data collection and reporting,

(4) Set water quality objectives, and;

(5) Provide procedures for adaptively managing the pumping regime so as to avoid any significant impacts.

The information collected, interpreted, and reported for this Plan will attempt to address the Project Objectives for this Project. The following components will be monitored as part of this Plan:

(1) Hydrogeology– Groundwater supply issues associated with the extraction and discharge of groundwater to Bear Creek and the Eastside Bypass. This Plan describes a suggested course of study, testing and monitoring to evaluate (a) the performance of the groundwater wells (i.e., well efficiency and long-term yield) and (b) the potential effect the wells have on the surrounding area (i.e., radius of influence).

(2) Land Subsidence – Monitor potential land subsidence (if any) due to groundwater extraction. This section summarizes main work items to be addressed by a subsidence monitoring program including: general approach for measuring subsidence, and monitoring groundwater levels in conjunction with measuring land surface elevations.

(3) Water Quality – Potential changes to surface water quality due to the discharge of groundwater. This Plan provides procedures for collecting and analyzing groundwater and Bear Creek and the Eastside Bypass surface water samples for a range of constituents to characterize and monitor water quality during the Project.

4. IMPLEMENTATION RESPONSIBILITIES

The overall implementation of this Plan is the primary responsibility of 4-S/SHS Ranches. The specific responsibilities for implementation of the main components noted previously are as follows:

(1) Hydrogeology – 4-S/SHS Ranches will be responsible for the collection of data as necessary in accordance with the Scope of Work as outlined in Section 5.1 below.

(2) Land Subsidence – 4-S/SHS Ranches has requested and Reclamation has agreed to include the Properties into the established network of subsidence monitoring as outlined in Section 5.2 below. 4-S/SHS Ranches will be responsible for taking groundwater level measurements at wells on the Properties (and neighboring wells to the extent they can be accessed). This data will be used in evaluating any potential effects of groundwater pumping on land subsidence.

(3) Water Quality – 4-S/SHS Ranches will be responsible for the collection, storage, review and transmission of pH, EC, flow, and grab sample water quality data from upstream and downstream discharge locations consistent with this Plan.

4-S/SHS Ranches will take water quality samples in Bear Creek upstream of the discharge points and downstream of the confluence of the Eastside Bypass for monitoring of EC. Should water quality testing from individual wells become necessary (see below), 4-S/SHS Ranches will be responsible for the installation, calibration and maintenance sampling ports on individual wells so that quality samples can be taken from each well.

5. SCOPE OF WORK

The Project Objectives will be accomplished by collecting hydrogeologic, land subsidence, and water quality data on and within the near vicinity of the Properties, as described below. The following concerns need to be addressed in order to evaluate the hydrogeology and potential subsidence during the Project:

(1) Estimate the volume (if any) of induced seepage derived from surface water conveyances on the Properties during pumping. An important concern is whether this volume can be expected to change during consecutive dry years.

(2) What is the sustainability of the aquifer for producing the desired yield without leading to overdraft conditions?

(3) What is the potential impact of the proposed pumping on: a) neighboring well owners; b) hydraulically downgradient surface water features – primarily the SJR, and; c) downstream surface water users?

(4) Will the proposed pumping cause land subsidence in the vicinity of the Properties?

5.1 Hydrogeology

As recommended in Provost and Pritchard's August 1, 2012 memorandum, the following tasks will be completed by 4-S/SHS Ranches over the term of the Project to address hydrogeology and subsidence. A report addressing the following issues will be prepared within a year following completion of Project operations:

Initial Study

Regional Hydrology, Hydrogeology and Groundwater Stratigraphy:

a. Compile and catalog all known sources of existing information that may be of value in understanding the existing groundwater conditions and any impacts related to the potential for various levels of extractions from aquifers available for pumping at the Properties,

b. Describe local water resources and groundwater conditions/characteristics that potentially could affect the availability and the quality of water to be available from the Properties. This should include the development of a conceptual model of the well field and the aquifers that support it,

c. Develop a more detailed description of the stratigraphy of the Properties' aquifers, and

d. Investigate further the history of water levels in the region and the contour of groundwater surface elevations over time.

e. Well Field Yield:

    i. Aquifer Sustainability:

    - Define/estimate aquifer boundaries and likely inflows and outflows (consistent with the conceptual model described above) using existing data.

    - Review existing and nearby well hydrographs and anticipated changes to the aquifers' hydrology to estimate future conditions under various extraction regimes on the Properties including the anticipated restoration flows in the SJR.

    - Prepare an estimate of current and future water balances for the aquifers to be impacted by various pumping regimes and that the aquifers will not be in an overdraft condition.

    - Map other existing users of water from the potentially affected aquifers and to the extent possible (much of this information is privately controlled and thus only available with permission of its owners) provide a history of their pumping and the use of the pumped groundwater.

f. Well Field Production Capacity:

i. Obtain records of past and present well field production capacity to the extent they exist,

ii. Review all existing information from nearby wells and known data (much of this information is privately controlled and thus only available with permission of its owners) describing the aquifer characteristics (both shallow and deep) to estimate potential well field production capacity under maximized yield conditions, and

iii. Suggest potential density of wells to be located on the Properties to for various sustainable yields and for various annual pumping periods.

Pump Tests and Monitoring

Well Field Yield:

a. Validate well field production and future water development potential. Perform well tests with monitoring wells (using existing wells unless insufficient to assure the required data) sufficient to determine/confirm aquifer characteristics such as specific yield, specific capacity and transmissivity of both the unconfined and semi-confined aquifers.

b. Further refine estimates of aquifer sustainability:

i. Monitor water levels in the well field and neighboring areas through the course of the Project,

ii. Refine conceptual model assumptions and results given information generated by the well tests and long-term monitoring, and

iii. Refine estimates of current and future water balance for the aquifer and the conditions under which the aquifers potentially become overdrafted.

Well Field Production Capacity - Refine estimates of maximum extraction capacity needed for the contemplated annual extraction periods and resulting necessary well densities from data obtained from the well tests.

5.2 Land Subsidence

The Properties are located in an area potentially susceptible to land subsidence, particularly in areas where groundwater pumping occurs below the Corcoran clay. The proposed additional pumping at the

Properties would occur in the aquifers above the Corcoran clay, and thus, is not expected to contribute to long-term land subsidence. However, in order to monitor for potential impacts, 4-S/SHS Ranches has requested and Reclamation has agreed to the inclusion of the Properties in Reclamation's land subsidence monitoring program for the SJRRP that establishes baseline land elevation as well as a methodology for collecting, evaluating and reporting subsidence measurements. The SJRRP has conducted GPS-based, land elevation surveys south and east of the Properties every six months in 2011-2013 and expects to continue this survey effort into the future. Monitoring by Reclamation on the Properties for the two years of the Project would assess whether any subsidence that may occur on the Properties can be attributed to either Project pumping or outside influences.

In conjunction with the land elevation measurements, 4-S/SHS Ranches will incorporate within their detailed work plan, a schedule for monitoring groundwater levels both in onsite production and monitoring wells, and to the extent possible, in neighboring wells. By monitoring both groundwater levels and land elevation measurements, these data can be used to assess whether a correlation exists between groundwater level declines and land subsidence, and conversely, whether the land rebounds as aquifer water levels recharge.

5.3 Water Quality

In an effort to characterize the discharge of groundwater into and the relative ambient constituent concentrations present in Bear Creek, grab sampling will occur each month for the first year of pumping. Samples will be collected and analyzed at:

- Upper Bear Creek - Upstream of all groundwater discharge points into Bear Creek including the confluence of the Eastside Bypass;
- Discharge Locations (varies based on discharge amount) - Along Bear Creek and/or the Eastside Bypass at locations that will fairly characterize the water being discharged into Bear Creek, and
- Lower Bear Creek - Downstream of all groundwater discharge into Bear Creek.

After the first year, an analysis will be made as to whether sampling should continue to occur monthly or if quarterly sampling is sufficient to define the water quality conditions of the discharges into Bear Creek at the above locations throughout the balance of the Project's two-year duration.

Should any water quality results exceed acceptable objectives (see below), 4S/SHS Ranches will immediately conduct water quality tests to determine the source of the exceedance using grab sample collection and analysis.

4-S/SHS Ranches will evaluate the water quality monitoring data monthly. Adjustments to the use of the wells and refinement of water quality monitoring sampling plan will be incorporated as necessary. For a complete list of sampling locations and frequency see Table 2.

Constituents, sample locations and frequency were chosen in an effort to insure the CVRWCQB water quality objectives in The Control of Salt and Boron Discharges into the Lower San Joaquin River as amended in the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins are met. The thresholds for the following water quality constituents along with desired laboratory reporting limits are found in Table 1.

Table 1: Water Quality Standards for Acceptance of Groundwater into Bear Creek and the Eastside Bypass

Constituent	Units	Maximum Concentration	Source	Desired Reporting Limit (RL)	Acquired RL**
Arsenic	µg/L	100	(5)	33	0.5
Boron	mg/L	2.0 (Apr 1-Aug 31) 5.8 (Sep 1-Mar 31)	(1)	0.67	0.025
Lead	µg/L	3.2*	(2)	1.1	0.2
Mercury	µg/L	0.77	(3)	0.26	0.2
Molybdenum	mg/L	0.05	(1)	0.017	0.0005
Selenium	µg/L	2	(1)	0.67	0.4
Specific Conductance (EC)	µs/cm	1000	(1)	233	N/A
Chlorpyrifos***	µg/L	0.015 (4 day avg) 0.025 (1 hravg)	(4)	0.005	0.005
Diazinon***	µg/L	0.10 (4 day avg) 0.16 (1 hravg)	(4)	0.033	0.005

* = Values are based on a hardness of 100 mg/L – total concentration. Hardness to be calculated on Calcium and Mg results.
(1) California Regional Water Quality Control Board, Central Valley Region, Fourth Edition of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins III-4.0
(2) California Toxics Rule Criteria to Protect Freshwater Aquatic Life
(3) U.S. Environmental Protection Agency, Natural Recommended Ambient Water Quality Criteria for Freshwater Aquatic Life, Continuous Concentration (4 day average)
(4) California Regional Water Quality Control Board, October 5, 2005. Resolution No. R5-2005-0138. Amending the Water Quality Plan for the Sacramento and San Joaquin River basins for the control of Diazinon and Chlorpyrifos runoff into the San Joaquin River.
(5) Ayers, R.S. and D.W. Westcot, Water Quality for Agriculture, Food and Agriculture Organization of the United Nations – Irrigation and Drainage Paper No. 29, Rev.1, Rome (1985).
** RLs are subject to change due to: dilutions, Method Detection Limit (MDL) studies, or different laboratories analyzing the samples. The acquired RLs should not be greater than the desired RL except for in the case of sample dilutions.

*** Chlorpyrifos and Diazinon will initially be sampled during the baseline sampling event. If these samples are all non-detect these parameters will only be sampled annually by 4-S/SHS RANCH .

6. FIELD DATA AND SAMPLE COLLECTION

6.1 Water Quality

4-S/SHS Ranches will collect water samples for laboratory analysis from Bear Creek and/or the Eastside Bypass as described in Section 5.3. 4-S/SHS Ranches will conduct a baseline sampling event prior to the

first day of pumping. See Table 2 below for a complete list of sample locations and frequencies for the Project.

Table 2: Water Quality Sample Locations and Frequency for Project

Sample Location	Minimum Frequency
Upper Bear Creek at diversion structure	Once before pumping begins, monthly for the first year when pumping is occurring, quarterly for the balance of the Project.
Lower Bear Creek	Once before pumping begins, monthly for the first year when pumping is occurring, quarterly for the balance of the Project.
Discharges into Bear Creek (and/or the Eastside Bypass) from representative locations fairly characterizing the quality of water being discharged into Bear Creek; each point sampled will detail all the contributing wells to that point. All wells contributing to Bear Creek will be accounted for by documenting which discharge point they are contributing to.	Once before pumping begins, monthly for the first year when pumping is occurring, quarterly for the balance of the Project.

Sampling procedures are briefly described below. A detailed description of the sampling procedures, monitoring well purging requirements and a project field log form are included in Appendix B.

- Production Well Sampling– To the extent it may become necessary, water samples from the production wells may be collected at the wellhead. To collect a sample, the pump will be adequately purged to enable the collection of representative formation water (e.g. 3 casing volumes). Once purged, the sample can be collected from the discharge line. Staff will fill the laboratory-supplied sample bottles directly from the discharge. Field water quality parameters (temperature, pH, and EC) will be measured during the sample collection process. Samples will be stored in a cooler containing ice until they are delivered to the analytical laboratory.

- Bear Creek Sampling- Samples can be collected using a sample collection bottle connected to extension pole or similar apparatus to collect a representative sample (i.e. center of channel or deepest highest flow) from Bear Creek. The water will then be transferred to laboratory-supplied sample bottles. Samples will be stored in a cooler containing ice until they are delivered to the

analytical laboratory. Field water quality parameters (temperature, pH, and EC) will be measured during the sample collection process.

- Discharge to Bear Creek - Samples can be collected using a sample collection bottle connected to extension pole or similar apparatus to collect a representative sample from Bear Creek (and/or the Eastside Bypass). At the time and location of sample collection there may be more than one discharge into Bear Creek. If this is the case, a note will be made to indicate which discharge locations were sampled and how many were in operation when the sampling took place and which wells were providing water to each discharge point. The water will then be transferred to laboratory-supplied sample bottles. Samples will be stored in a cooler containing ice until they are delivered to the analytical laboratory. Field water quality parameters will be measured during the sample collection process.

Table 3: Data Quality Objectives for Field Instruments

Parameter	Units	Detection Limit	Sensitivity	Precision	Accuracy
pH	pH units	2.0	0.1 unit	± 0.2 units	± 0.2 unit
EC	µS/cm	10	10 µS/cm	± 10%	± 10%
Temperature	°C	-5 to +50	.01	±0.2 units	± 0.2 units

At each site the sampler will utilize clean collection bottles provided by the laboratory for submittal. Laboratory bottles should not be rinsed. If dedicated intermediate collection bottles will be used, they will be triple rinsed with deionized water before and after each collection event.

Sample bottles utilized for collection and analysis of organic constituents cannot be made of plastic. Intermediate collection devises must be glass or Teflon or direct collections can be in amber glass sample bottles.

Completeness

To adequately assess program objectives at least 90% of valid data from each site needs to be recorded.

Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, a variation in a physical or chemical property at a sampling point, or an environmental condition. This will be achieved by following protocols previously outlined in this section.

6.2 Operational Information

Production well operation, timing and duration will be determined by 4-S/SHS Ranches based on DPWD and the Properties' water orders and well and surface water quality.

During sampling or monitoring events, the status of the production wells and operating equipment will be recorded on the field form. When photographs are taken they will be documented on the field form. Broken, damaged, vandalized and/or otherwise inoperable equipment and appurtenances will be immediately reported to 4-S/SHS Ranches by the person who observed the damage. Field records will also note any maintenance performed on the equipment.

7. DATA COLLECTION AND SAMPLE MANAGEMENT

4-S/SHS Ranches will compile and archive hard copies of the analytical laboratory reports and all documents produced in the field at the time of sample collection (i.e., logbooks, well logs, calibration sheets, etc.). All data collected as part of the Project will be available to DPWD and Reclamation upon request.

Field data will include water level, flow and purging information from the wells.

7.1 Field Data

Field notes and photographs (as applicable) will be maintained by 4-S/SHS Ranches. Well information, field observations and field water quality measurements will be entered onto applicable field forms. Digital images of site photographs collected throughout the project duration will be stored.

7.2 Sample Handling and Custody

The samples will be placed on ice and kept between 2º C and 6º C after collection and until delivery to the lab. The samples will be delivered to the laboratory by the field samplers. Custody of the samples is relinquished to the laboratory on the Chain of Custody (COC). The laboratory receives the samples and stores them in refrigerators (if required). Refrigeration prevents degradation of the samples.

Samples are collected, processed, and shipped to the laboratory in a timely manner to ensure the holding times are not exceeded. The holding times are detailed in Table 4:

Table 4: Required Bottle Sizes, Sample Preservation, and Sample Hold Times

Analyte	Bottle Type	Chemical Preservative	Holding Time
Selenium	125 ml, HDPE	HNO_3, 4°C	6 months
Arsenic, Boron, Lead, and Molybdenum	500 ml, HDPE	HNO_3, pH < 2	6 months
Mercury			28 days
Chlorpyrifos, Diazinon	1000 ml, amber glass x 2	None	7 days to extract and 40 days from extract to analysis

7.3 Analytical Methods

The laboratories follow the protocols for preparation, analysis, and corrective actions stated in the analytical methods and the laboratory Standard Operating Procedures (SOP). Approximate turn-around time for analysis is three weeks. The following analytical methods will be used:

Table 5: Analytical Methods

Analyte	Method
Arsenic, Boron, Lead, and Molybdenum	EPA 200.8
Mercury	EPA 245.1
Selenium	SM 3500 C (fluorometric)
Chlorpyrifos and Diazinon	EPA 8141A

7.4.1 Method Sensitivity

Where practicable, the reporting limit should be at least three times less than the action limit to reliably determine whether a parameter result is above or below the action limit (see Table 1). The analytical methods in Table 4 have reporting limits that can meet this method sensitivity requirement.

7.5 Quality Control

7.5.1 Laboratory Selection

4-S/SHS Ranches will submit samples to a laboratory of their choosing that is acceptable to both Reclamation and Del Puerto. The laboratory must be able to analyze the samples by the methods identified in Table 4 and be able to obtain acceptable reporting limits as identified in Table 1.

7.5.2 Quality Control Acceptance Criteria

The Quality Control (QC) acceptance criteria are specified in the analytical method or the laboratory's SOP. The laboratory's QC results will be compared against these acceptance criteria.

7.5.3 Laboratory Quality Control Samples

The laboratory will incorporate QC samples at the frequency specified in the analytical method and the laboratory SOP. 4-S/SHS Ranches will request the laboratory to use one of the project samples as the matrix spike/matrix spike duplicate so that any matrix interference issues can be assessed.

The results for the QC samples will be assessed based on the acceptance criteria in the analytical method and the laboratory SOP. If any laboratory QC samples do not meet the established acceptance criteria, the laboratory will follow the corrective action protocol detailed in the analytical methods or the laboratory SOP.

4-S/SHS Ranches will request the laboratory to provide a QC report with the analytical results.

7.5.4 Holding Times

The date of the sample extraction and analysis will be compared to the date the sample was collected to ensure the sample was analyzed within the holding time. If the holding times are exceeded, 4-S/SHS Ranches will determine if re-sampling is required. If re-sampling is not required, the data will be qualified as necessary. Applicable hold times are listed in Table 4.

7.6 Instrument Calibration, Inspection, and Maintenance

7.6.1 Field

Field instruments will be calibrated each day before being used in the field; the calibration should be done within 4 hours of sample collection. The calibration will follow the manufacturer's instructions as outlined in the instrument manuals. A post calibration verification check will be performed at the end of each field day to determine instrument drift; the post calibration check should be performed by measuring a standard of known value and comparing the measured result to the acceptance range. Field personnel will record instrument calibrations and post calibration verifications on calibration sheets.

7.6.2 Laboratory

Maintenance procedures are detailed in the manufacturer's specifications, laboratory's Quality Assurance (QA) manual, or laboratory SOPs. Instrument calibration procedures are specified in the analytical method, laboratory's QA manual, or laboratory SOPs.

7.7 Inspection/Acceptance for Supplies and Consumables

Level 1 certified bottles that have been pre-preserved (when necessary) are used for sample collection. Calibration standards used to calibrate field equipment have certified values from the vendor.

7.8 Data Review, Verification, and Validation

4-S/SHS Ranches will validate the analytical data by reviewing the laboratory quality control results. Holding times and completeness will also be assessed.

If all laboratory QC samples meet the acceptance criteria and all samples are analyzed within the holding time, all data will be accepted as valid. Data will be qualified if the laboratory QC sample results are unacceptable, or if the holding times were exceeded. The data assessor will determine the usability of the data.

If the completeness criterion is not met, 4-S/SHS Ranches will determine if re-sampling is required.

7.9 Documentation and Records

7.9.1 Field Logbook

At the time of sample collection, field logbook entries are made. The field logbook documents the site name, the date of sample collection, the start and end time of sample collection, the sample identifications (IDs), the method of sampling, the parameters and matrices (ground water or surface water)collected, and any unusual conditions that might affect the samples. After entering the required information, the field sampler must sign the field logbook entry. Field log books must be bound with numbered pages.

7.9.2 Field Sheet

A field sheet is generated from the entry in the field logbook. Project name, sample IDs, date of sample collection, site name, parameters and matrices collected, and field sampler signatures are recorded on the field sheet.

7.9.3 Instrument Calibration Sheet

The instrument calibration sheet documents the information from an initial calibration, performed prior to instrument use, and information from a verification check, performed after all sampling for that day is completed. Information documented on the instrument calibration sheet should include: project name(s),

date(s), time(s), field sampler's name, instrument type, instrument number, standard value, initial value, adjusted value, and post value.

7.9.4 Chain of Custody

The field sampler generates a COC form. The COC documents legal custody of the samples from the time of collection to the time of delivery to the laboratory. Information provided on the COC can include the project name, project manager, title and signature of sample collector, name of the laboratory performing the analyses, list of samples by sample ID, date and time the samples were collected, sample matrix type, number of containers per sample ID, parameters and analyses requested, point of contact phone number, and the date, time, and signatures of all parties responsible for receiving and relinquishing the samples from the time of collection to the time of delivery to the laboratory.

7.9.5 Analytical Report

The laboratory produces the analytical report which contains laboratory data results. The analytical report documents the analytical results for each parameter analyzed on each sample submitted. The analytical report generally includes the case narrative, analytical results, reporting limits (RLs) for parameters, methods used to analyze the sample, date sample was collected, prepared, and analyzed, and the laboratory's QC results.

8. REPORTING AND ADAPTIVE OPERATIONS

4-S/SHS Ranches will be responsible for reviewing the field and laboratory data in a timely manner. All data collected will also be made available to Del Puerto and Reclamation upon their request but no more often than monthly.

8.1 Water Quality Operations

If the monitoring data indicate that water quality threshold values have been exceeded, required adjustments will be made at least monthly. 4-S/SHS Ranches will:

- Determine the problematic source and curtail flows so that discharges to Bear Creek are within compliance; and/or
- Increase flows from alternative wells so as to have a blended flow that is in compliance.

Water Quality data will be summarized in an annual report as described below.

8.2 Overdraft and Subsidence Operations

4-S/SHS Ranches will also summarize groundwater elevation data in electronic format at least monthly for the entire 2-year Project. It is anticipated Reclamation will collect and manage land subsidence monitoring data following each 6-month survey conducted as part of the SJRRP subsidence monitoring program. Water quality, groundwater elevation and subsidence monitoring data will be evaluated in an annual Project summary report providing evaluations of the various physical and environmental

parameters monitored. Over the course of the first year of operations, 4S/SHS Ranches will install meters on each well to provide additional data on production. As part of the required analysis and reporting, water level depths and the results of the subsidence monitoring will be evaluated with a determination made by a professional registered hydro-geologist as to whether downward changes in water levels, if any, (and thus the potential for subsidence) is conclusively the result of pumping and export of water from the 4-S/Smith Ranches. In the event that such a conclusive determination is made, Pumping will be curtailed as deemed necessary in the opinion of the professional registered hydro-geologist to a level that results in continued pumping and export by the 4-S/SHS Ranch which has less than significant impacts. This analysis and report will be completed prior to the start of the new pumping season.

9. PROGRAM SCHEDULE

The two-year monitoring program will end on January 1st two years following the date the first pumping occurs.

10. REFERENCES

California Regional Water Quality Control Board. 1998. Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin River Basins.

Provost and Pritchard. 2012. Memo to Mr. Steve Sloan regarding Hydrogeologic Conditions Associated with the 4S and SHS Ranches, Merced County, California and Proposed Course of Future Study. Dated July 11, 2012 and revised August 1, 2012.

APPENDIX A

Procedure for Groundwater Level Measurement

Purpose/Application

The objective of these guidelines is to provide general reference information and technical guidance on the measurement of the depth to groundwater in an open borehole, cased borehole, monitoring well, or piezometer.

Method Summary

When measuring groundwater levels, there should be a clearly established reference point of known elevation, which is normally the top of the well casing. The reference point should be scored or permanently marked on the rim of the casing if the casing rim is not even and level. To be useful, the reference point should be tied to a USGS benchmark or a local datum. The field notes recorded should clearly describe the reference used. An arbitrary datum could be used for an isolated group of wells if necessary.

Before measurements are made within the production well casing - water levels should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low-yield conditions, recovery of water levels to equilibrium may take longer. Groundwater levels should be measured and recorded to the nearest 0.1 foot. Water level measuring equipment must be decontaminated prior to and between each use.

The condition of the wells, piezometers, or boreholes should be recorded along with the name of the individual who has measured the groundwater levels. The frequency of such measurements should be pre-established.

Limitations

These guidelines give overall technical guidance only and should be modified as necessary based upon specified requirements of project-specific plans, site conditions, or equipment limitations. Agency protocols, such as those established by the USGS, can also be substituted for these guidelines.

Definitions

- Water table- The surface in an unconfined aquifer where groundwater pressure is equal to atmospheric pressure.
- Potentiometric (or piezometric) surface. An imaginary surface representing the total head of groundwater in an aquifer that is defined as the level to which water would rise in a well

screened at and/or beneath the water bearing zone. The water table is a particular potentiometric surface.

Equipment

- Electronic Water Level Indicator with an accuracy of 0.1 foot or a pressure transducer selected for optimal sensitivity within the appropriate hydrostatic head.
- Record form for groundwater sampling.
- Decontamination materials (deionized water and bleach or equivalent).

An electronic water level indicator consists of a spool of graduated, small-diameter cable and a probe attached to the end. When the probe comes into contact with water, the circuit is closed and a meter, light, and/or buzzer attached to the spool will signal the contact. Nine-volt batteries are typically used for a power source.

Pressure transducers contain miniature strain-gauge sensors that measure changes in electrical resistance and convert these measurements into digital signals within the solid state circuitry of the instrument. These transducers can be deployed autonomously, whereby the data is downloaded from the instrument periodically through a portable interface or continuously in cases where the instrument reports to a data logger and data is downloaded directly or via telemetry from the data logger.

Procedures

The quality assurance procedures for measuring groundwater levels are as follows:

1. Check operation of equipment.
2. Clean all equipment entering the well by washing with an Alconox solution followed by a deionized water rinse.
3. Gain access to well, note well ID, time of day and date in site logbook or an appropriate groundwater level data form.
4. Ensure well is at equilibrium with atmospheric pressure. In wells with air tight plugs, or without vents, the hydraulic head may not be the same as in an open or vented well. Allow sufficient time for the well to equilibrate to atmospheric pressure. Several measurements may be needed to verify if equilibrium has been reached. This is especially important for wells screened in confined aquifers.
5. The probe should be lowered slowly into the well and once the buzzer sounds, slowly raised and lowered until the depth where the meter first creates a sound is determined. At this point,

the depth to water is read directly from the graduated cable at the reference point, and recorded to the nearest 0.1 feet.

6. Pressure transducers that are either deployed autonomously or hard-wired to a data logger will collect hourly hydrostatic head measurements. Data will be downloaded at regular intervals. A barometric probe will be required if the pressure transducer probes are non-vented.

Potential Problems/Troubleshooting

When there is high or low specific conductance, groundwater cascading in the well, or a turbulent water surface in the well, measuring groundwater levels with an electronic sounder may be difficult. Before lowering the probe into the well, the circuitry can be checked by dipping the probe in water and observing the indicator. These issues are not of concern with pressure transducer sensors. However continuous sensors can drift over time and need to be checked against well soundings at least quarterly to ensure data quality. In highly saline environments even stainless steel jacketed sensors can corrode over time. Titanium instrument casings should be chosen where possible in these situations if not cost-prohibitive.

References

Fetter, C.W., 1994, Applied Hydrogeology, Third Edition, Prentice Hall Inc., pp. 691.

United States Environmental Protection Agency (USEPA) 2000, USEPA Environmental Response Team Standard Operating Procedures, Manual Water Level Measurements.

APPENDIX B

Procedure for Groundwater Sampling

Purpose/Application

Sampling of water directly from operating wells may become necessary. This groundwater purging and sampling procedure presents a standard method for collecting groundwater samples from production and monitoring wells that are representative of the formation from which they are being withdrawn.

Equipment

Production well sampling requires the following equipment:

- Water level probe or pressure transducer
- 5-gallon bucket
- Multi-parameter water quality monitoring system
- Record form for groundwater sampling

Pre-Sampling Procedures

The pre-sampling procedures for groundwater purging and sampling are as follows:

1. Position a 5-gallon bucket beneath the well's sampling port.
2. Measure and record the depth to water in the production well, if possible.

Sampling Procedures

Sampling procedures for groundwater purging and sampling are as follows:

1. Purging- If the production well is running prior to sampling then purging is not needed. If upon arrival the well is not running then purging the stagnant water from the well casing is required before sampling. To adequately purge the well the standard protocol is to remove 3 to 4 casing volumes prior to sample collection.

   The volume, in gallons per linear foot, for various well diameters can be calculated as follows:

   v = nr2 (cf)

   Where:
   v = volume in gallons per linear foot

n = pi
r = radius of monitoring well (feet)
cf = conversion factor (7.48 gal/ft3)

TABLE 1
WELL CASING DIAMETER vs. VOLUME
WELL CASING DIAMETER (inches) vs. VOLUME (gals.)/FEET of WATER

CASING	GALLONS/FT
1	0.041
2	0.163
3	0.367
4	0.653
5	1.02
6	1.469
7	1.999
8	2.611
9	3.305
10	4.08
11	4.934
12	5.875

2. Sample Collection- Fill all sample containers directly from the sample port. Allow water to flow from the port, tap gently down the outside of the containers to minimize turbulence during collection. Do not overfill the pre-preserved bottles.

Appendix B-2
Record Form for Groundwater Sampling

GROUNDWATER SAMPLING LOG

PROJECT NAME:	**SITE LOCATION:**	
SAMPLING PERSONNEL:		
DATE:	**START TIME:**	**END TIME:**
WELL NO:	**SAMPLE ID:**	**QA:**

WELL DIAMETER:	**TUBING DIAMETER:**	**TUBING TYPE:**	**CASING TYPE:**	**SAMPLING DEVICE:**

MEASURING POINT: Top of Casing (TOC)	**INITIAL DEPTH TO WATER (ft.):**	**FINAL DEPTH TO WATER (ft.):**	**SAMPLE DEPTH (ft.):**	**FLOW RATE (ml/min):**
ODOR: Y N **SHEEN:** Y N	**OTHER INFORMATION:**			

TIME	pH (units)	TEMP (°C)	EC (µS/cm)	Depth to Water (ft.)	Sample Collected (√)	NOTES/Sample ID
:						
:						
:						
:						
:						
:						
:						
:						

Appendix B-3

Record Form for Water Sampling

Surface Water Collection – Grab Sampling

Summary
This method describes procedures for direct sampling of surface water using the "grab" method.

Equipment
1. Sample collection container of appropriate size and material (based on analytes being tested) (organics/inorganic constituents).
2. Sampling pole or extension pole (optional).
3. Churn with rope (optional)
4. Waders (optional)

Procedure
1. **If no preservative is used:** You can sample directly into your clean, pre-labeled sample bottles. You can also follow the same sampling method as if the sample bottles are pre-preserved.
2. **If bottles are pre-preserved:** collect your sample into a clean "intermediate" sample container (i.e. churn) that has been pre-rinsed three times with environmental water. When pre-rinsing, discard the rinse water away from where you will eventually sample. If more water is collected from the same source, the intermediate container can be reused immediately. If collecting from multiple water sources, the container must be decontaminated, and then pre-rinsed with the new environmental water source as described above.
3. Fill sample bottles one at a time from the intermediate sample container following applicable SOPs
4. If samples require preservative, but bottles were not pre-preserved, add preservative as required following applicable SOPs.

SAMPLING TECHNIQUES
1. **If sampling a stream or other moving water from the bank**, try to collect as close as possible to the predominant downstream current. Reach upstream (or upwind if in still water) as far as possible. Push the container mouth downward until it is about elbow depth below the surface. Avoiding touching the bottom of the water source during sampling. For slow moving water with easily disturbed sediment, collect from the stream bank using an extension pole.
2. **If sampling with an extender pole**, securely attach the (still lidded) sample container to the holder with clamps or bands, remove the lid, then sample by pushing the container mouth downward until it is about elbow depth below the surface. Avoiding touching the bottom of the water source during sampling.
3. **If sampling by wading:** wade out until you are within arm's length of the current. To sample, push the container mouth downward until it is about elbow depth below the surface. Avoiding touching the bottom of the water source during sampling (an extender pole may be used in conjunction with wading). If the water is too deep to wade in, or the current is too strong to safely sample, sample from the water's edge or another safe place (e.g. bridge, boat, pier).
4. **If sampling from a bridge:** visually inspect to find the fast current. Use a rope tied to sample churn splitter to sample water that is below your reach. Sample from the upstream side of the bridge (to avoid contamination from the roadway or from animals living under the bridge).

5. **If sampling from a boat:** collect the sample from near the bow while the boat moves upstream or upwind (to avoid contamination from the boat).
6. **If sampling free-falling water from drains, pipes, faucets or outfalls:** use an intermediate sampling container or place the sample bottle directly in the stream of water being careful not to touch the pipe or bank surface. Fill container with desired about of sample.

Employee Safety
Required
1. Closed toe-shoes
2. Personal flotation device if wading into deep or fast moving water

Recommended
1. Wading boots or hip waders
2. Make sure that you can safely sample without risking drowning; postpone sampling if you can't.
3. Review pertinent emergency procedures, verify locations of emergency equipment and emergency phone number list.