Item 1.4
QUALITY ASSURANCE PROJECT PLAN

For

CWA 319(h)
Grant Agreement No. 05-194-559-0
San Diego Region
Rainbow Creek Nutrient Reduction TMDL Implementation
Water Quality Monitoring

Prepared by

County of San Diego
Watershed Protection Program
Department of Public Works

Revised June 2008
Finalized February 2007
May 2006

Group A:
Project Management

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Element 1 Title and Approval Sheet

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~~December 15~~June 19, 200~~6~~8
Revision ~~3~~4

The County of San Diego
Watershed Protection Program
Science and Monitoring Group
Department of Public Works

APPROVAL SIGNATURES

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QA Officer	Joanna Wisniewska		
Laboratory QAQC Manager	Pat Iyer		
Laboratory Project Coordinator	Xuan Dang		

STATE BOARD:

Title:	**Name:**	**Signature:**	**Signature Date:***
Grant and Contract Manager	Tony Felix		
Program Analyst	Monica TorresSally Meza		
QA Officer			

*** *This is a contractual document. The signature dates indicate the earliest date when the project can start.*

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Element 3 Distribution List

Table 1 identifies those individuals who will receive one (1) copy of the approved Quality Assurance Project Plan (QAPP) and any additional updates to the QAPP.

Table 1: QAPP Distribution List

Title:	**Name (Affiliation)**	**Tel. No.:**
Environmental Health Specialist Supervisor, Project Manager	Jo Ann Weber (County of San Diego)	(858) 495-5317
Environmental Health Specialist III. Grant Contact	Sheri McPherson (County of San Diego)	(858) 495-5285
Environmental Health Specialist III, QC Officer	Joanna Wisniewska (County of San Diego)	(858) 694-2312
Environmental Health Specialist II, Field Staff	Steven DiDonna (County of San Diego)	(858) 694-2332
Environmental Health Specialist II, Field Staff	Li-Ming He (County of San Diego)	(858) 495-5283
Environmental Health Specialist II, Field Staff	Ken Liddell (County of San Diego)	(858) 495-5293
Laboratory QA/QC Manager	Pat Iyer (Truesdail's Laboratory)	(714) 730-6239
Laboratory Project Coordinator	Xuan Dang (Truesdail's Laboratory)	(714) 730-6239 ext. 265
SWRCB Grant and Contract Manager	Tony Felix (SWRCB)	(858) 636-3134
SWRCB QC Officer	(SWRCB)	

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Element 4 Project/Task Organization

Involved Parties and Project Roles

The Science and Monitoring Group is part of the Watershed Protection Program in the County of San Diego's Department of Public Works. This group will be responsible for the maintenance of field sampling equipment, sample collection, sampling of Rainbow Creek, oversight of field work conducted by the University of California Cooperative Extension Farm and Home Advisors, the management of the consultant service for the tailwater system effectiveness and groundwater well installation and the management of the contract with Truesdail Laboratories, Inc. (Truesdail). See Figure 1 for the organizational chart of the individuals involved in this project.

Jo Ann Weber is Science and Monitoring Group Supervisor and Project Manager. She will be responsible for overall program management and coordination. In addition, she will provide technical advice on the monitoring program, design, data analysis, and reporting.

~~Li-Ming He~~ Steve DiDonna will be responsible for the downloading and labeling of photos from each site visit, the entry of field datasheets, data analysis, and reporting for the Rainbow Creek Water Quality monitoring. As field staff, his responsibilities include calibration and maintenance of field equipment, collection of field and laboratory samples in accordance with all method and quality assurance requirements in this QAPP.

Steven DiDonna will be responsible for the purchasing of sampling equipment and supplies, maintaining the project database, providing GIS support as necessary and downloading and labeling of photos from each site visit, the entry of field datasheets, data analysis, and reporting for the groundwater level monitoring. As field staff, his responsibilities include calibration and maintenance of field equipment, collection of field and laboratory samples in accordance with all method and quality assurance requirements in this QAPP.

Ken Liddell will be responsible for the coordination with Truesdail Laboratories, Inc. for sample pick-up, bottle supplies, invoicing, and all communications regarding the laboratory contract. As field staff, his responsibilities include calibration and maintenance of field equipment, collection of field and laboratory samples in accordance with all method and quality assurance requirements in this QAPP.

Val Mellano is a Farm and Home Advisor with the University of California Cooperative Extension. She will be responsible for the irrigation system optimization project. While assisting in optimizing irrigation systems she may need to collect water samples. She will be responsible for collecting laboratory samples in accordance with all methods and quality assurance requirements in this QAPP.

Gary Bender is a Farm and Home Advisor with the University of California Cooperative Extension. He will be responsible for avocado grove BMP demonstration project. While implementing different irrigation treatments, water samples and flow will be collected.

Gary's responsibilities include calibration and maintenance of field equipment, collection of field and laboratory samples in accordance with all method and quality assurance requirements in this QAPP.

A consultant will be hired to conduct water quality monitoring for the optimization of the tailwater recovery system project. This consultant will be responsible for maintaining any field equipment used and the collection water samples for laboratory analysis samples in accordance with all method and quality assurance requirements in this QAPP.

All field staff are responsible for calibration and maintenance of field equipment, collection of field and laboratory samples in accordance with all method and quality assurance requirements in this QAPP. The QA officer will assign staff to perform routine quality assurance and quality control (QA/QC) of field equipment as well as preparing laboratory control samples.

Truesdail Laboratories, Inc. will be the contract laboratory for all analyses not conducted in the field. Truesdail will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP and their "Quality Assurance and Quality Control Manual for Environmental Sample Analysis" (See Appendix 12). Truesdail will act as a technical resource to the Science and Monitoring Group and the Watershed Protection Program. Xuan Dang will be Truesdail's Project Coordinator. Pay Iyer will be Truesdail's Laboratory QA/QC Manager. All individuals identified above and in Table 2 are responsible parties of the Rainbow Creek Project.

Quality Assurance Officer Role

The QA Officer is responsible for guaranteeing the overall quality of the data produced and reported by the Science and Monitoring Group. Specific duties of the QA Officers include conducting audits of ongoing tests, data packages, and completed reports, conducting audits of the routine quality control documentation of laboratory procedures, communicating potential quality control problems to staff, and assuring that any problems are resolved. The QA Officer is responsible for issuing Quality Assurance Reports to Management, maintaining a current Quality Assurance Manual, and issuing QAPP as required. The QA Officers also ensure that data reported by the Science and Monitoring Group for the County of San Diego has been generated in compliance with the Programs Quality Assurance Manual and the appropriate protocols. The QA Officer will not be involved in the collection of samples or the generations of project data.

Joanna Wisniewska is the Science and Monitoring Group QA Officer. She will be responsible for the quality assurance and quality control procedures found in this QAPP as part of the sampling and field analysis. She will also work with Pay Iyer, the Quality Assurance /Quality Control (QA/QC) Manager for Truesdail and/or Xuan Dang, the Project Coordinator for Truesdail, by communicating all quality assurance and quality control issues in this QAPP.

Joanna Wisniewska will also review and assess all procedures during the life of the contract against QAPP requirements. She will report all findings to Jo Ann Weber, including all requests for corrective action. Ms. Weber, or Ms. Wisniewska under her direction, may stop all actions, including those conducted by Truesdail if there are significant deviations from required practices or if there is evidence of a systematic failure.

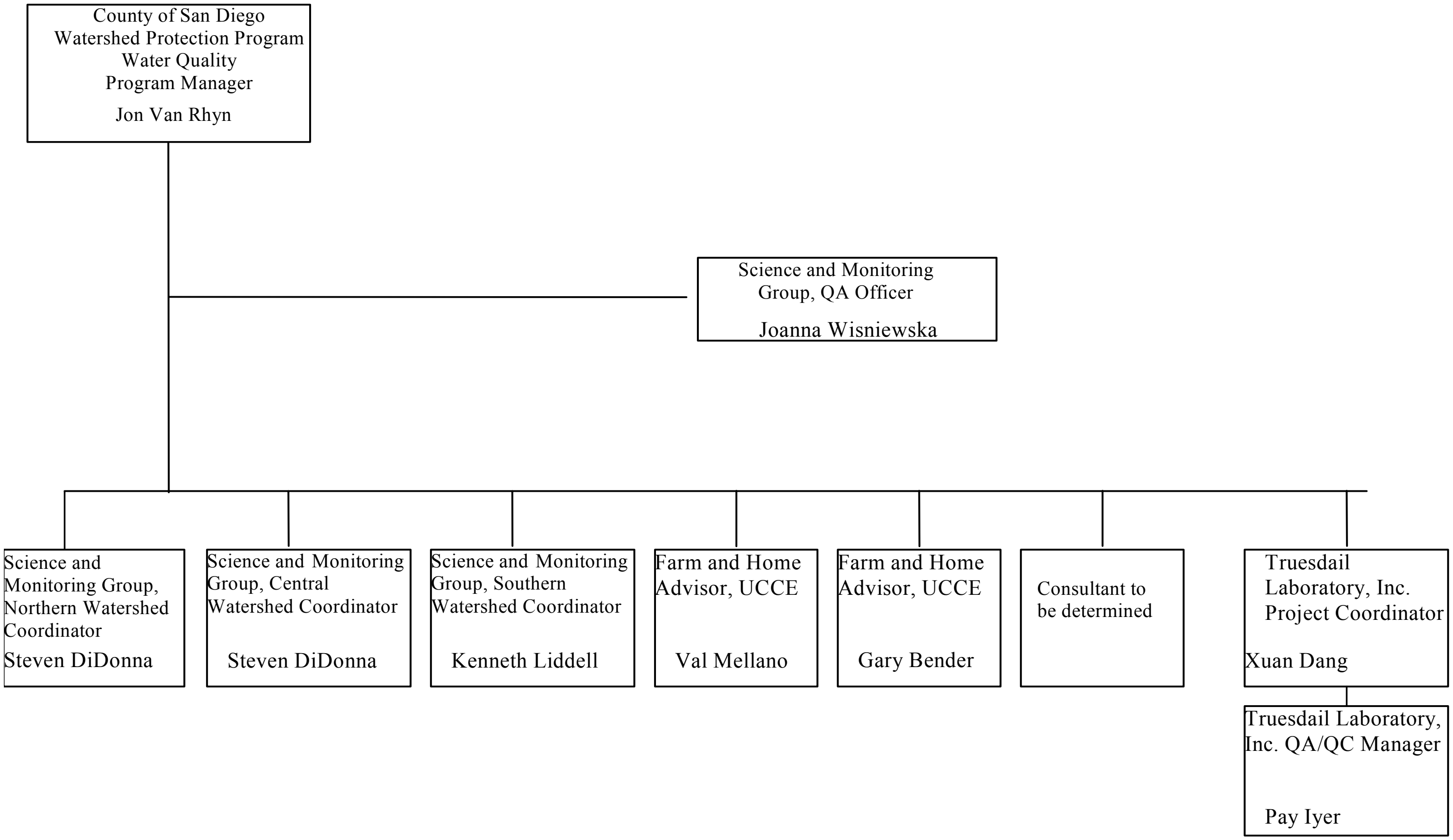
Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by the Science and Monitoring Group Project Manager and/or Quality Assurance Officer. Science and Monitoring Group's Quality Assurance Officer will be responsible for making the changes, submitting drafts for review and preparing a final copy.

Table 2: Personnel Responsibilities

Name	Organizational Affiliation	Title	Contact Information (Telephone Number, fax number, e-mail address)
Jo Ann Weber	County of San Diego, Watershed Protection Program	Project Manager, Supervisor	(858) 495-5317 (858) 495-5263 joann.weber@sdcounty.ca.gov
~~Li-Ming He~~	~~County of San Diego, Watershed Protection Program~~	~~Field Staff~~	~~(858) 495-5283~~ ~~(858) 495-5263~~ ~~liming.he@sdcounty.ca.gov~~
Steven DiDonna	County of San Diego, Watershed Protection Program	Field Staff	(858) 694-2332 (858) 495-5263 steven.didonna@sdcounty.ca.gov
Ken Liddell	County of San Diego, Watershed Protection Program	Field Staff	(858) 495-5293 (858) 495-5263 kenneth.liddell@sdcounty.ca.gov
Valarie Mellano	University of California Cooperative Extension	Farm and Home Advisor	(858) 571- 4204 vjmellano@ucdavis.edu
Gary Bender	University of California Cooperative Extension	Farm and Home Advisor	gsbender@ucdavis.edu
Joanna Wisniewska	County of San Diego, Watershed Protection Program	QA Officer	(858) 694-2312 joanna.wisniewska@sdcounty.ca.gov
Xuan Dang	Truesdail Laboratories, Inc.	Project Coordinator	(714) 730-6239 ext 265 (714) 730-6462 xuan@truesdail.com
Pay Iyer	Truesdail Laboratories, Inc.	Laboratory QA/QC Manager	(714) 730-6239 (714) 730-6462 pat@truesdail.com

Figure 1: Organizational Chart of Individuals Involved in the Project



Element 5 Problem Definition/Background

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Background

The County of San Diego is receiving funds for this project from the State Water Resources Control Board (SWRCB) with funding from the U.S. Environmental Protection Agency under the Federal Nonpoint Source Pollution Control Program (Clean Water Act 319), Agreement Number 05-194-559-0.

This project targets the reduction of identified sources of excessive nitrogen and phosphorus linked to beneficial use impairments in Rainbow Creek (see Figure 2 for location of Rainbow Creek). Implementation of this project will reduce nutrient loads to Rainbow Creek and address the sources identified in the Staff Report for the Total Maximum Daily Loads for Total Nitrogen and Total Phosphorus in the Rainbow Creek Watershed (San Diego Regional Water Quality Control Board, February, 2005). Sources identified in the staff report include commercial nursery operations, residential septic systems, agricultural fields, and orchards.

Grant funding will support the optimization of a nursery tailwater recovery system, the optimization of a nursery irrigation system, an avocado grove BMP demonstration, the installation of a groundwater level warning system for septic systems, extensive targeted public education, the stakeholder development and initial implementation of a Nutrient Reduction Management Plan and BMP effectiveness monitoring to aid in achieving the first phase TMDL target of 20% cumulative reduction. In addition, this project will effectively promote collaboration and coordination among watershed entities.

Decisions and Outcomes

The overall goal of this project is to assist in implementing a combination of structural, nonstructural and pollution prevention measures that will help restore Rainbow Creek's beneficial uses by meeting the first phase goal reductions outlined in the TMDL Staff Report.

Three monitoring programs for the implementation of this grant include photo documentation, water level monitoring of groundwater and water quality monitoring for BMP effectiveness and receiving water quality of Rainbow Creek. Photo documentation will document and monitor the success of the BMP installation for the irrigation optimization and avocado grove BMP demonstration. Water level monitoring of groundwater will be used to alert the Rainbow Valley community of times when the groundwater levels are high and may be impacting septic system performance. Water quality monitoring of tailwater effluent and influent, irrigation runoff and irrigation source waters will document and monitor the effectiveness of the BMP implementation. Water quality monitoring of Rainbow Creek will assist in characterizing baseline conditions, evaluating BMP effectiveness to reduce nutrient loading to creek, and track changes in water quality and the trajectory to attaining the TMDL goals in Rainbow Creek and its tributaries over time with respect to nutrients.

Photo Documentation

The photo documentation monitoring program will document the success of the Avocado BMP demonstration and the optimization of the irrigation system. Photographs will be taken to show the project areas, medium view photos showing examples of irrigation changes, and close views of flow and runoff changes. For the avocado grove BMP demonstration, photographs will also be used to document any changes in the health of the trees.

Groundwater Level Monitoring

The groundwater monitoring program is to monitor water level depths in Rainbow Valley. Ongoing assessments of depth to groundwater will provide Rainbow Valley early warning during periods of excessively high groundwater levels when septic system failures and overflows are more common. The negative effects of high groundwater can be lessened if residents pump their tanks or perform other maintenance when systems are inundated by excessively high groundwater. Groundwater depth information will also be useful for focusing public education efforts to provide the community with information needed to better manage water quality.

Information on groundwater depth and subsequent recommended actions will be disseminated through a variety of means including: a kiosk at Rainbow Valley Community Park, and local newspaper outlets like the Fallbrook Village News, local North County Times, and the Rainbow community newspaper, MRCD website (www.missionrcd.org); and through direct mailings to Rainbow Valley Basin property owners.

Wells identified, in which properties owners have been contacted and asked if they are willing to allow access, will be monitored bi-weekly by County of San Diego staff. A monitoring well will be installed at Rainbow Valley Community Park, owned by the County of San Diego, in the middle of the valley floor (5th Street). The County well will be fitted with a real-time water level pressure sensor and data will be transmitted via radio telemetry to a central location for data processing. A total of six shallow groundwater wells will be monitored.

Depth to groundwater data from the real-time monitoring will be collected and compared to depth data collected from other wells in the valley to establish groundwater depth patterns. If sufficient correlation exists, both temporally and spatially, then the frequency of monitoring the groundwater depth can be modified at other wells, using the real-time data for ongoing data collection. Data collected from groundwater wells will be mapped using GIS tools and provided in a “user friendly” format for informing the public.

Tailwater Recovery System

The optimization of a nursery tailwater recovery system will be conducted by a consultant yet to be determined. A detailed monitoring plan will be submitted, in the form of a BMP effectiveness monitoring plan, as an addendum to this sampling and analysis plan on July 20, 2006. This monitoring plan will describe the activities required to optimize the tailwater recovery system at Hines Nurseries in Rainbow Valley. The optimization of this system will assist in reducing the discharge of nutrients from the nursery into Rainbow Creek.

Irrigation Optimization BMP

Nursery irrigation system optimization will be conducted at a nursery in Rainbow Creek Watershed. The purpose of this project is to review the current practices used at the nursery, and assist the grower in making changes to his management practices that will result in a greater efficiency of water use at the nursery. More efficient water use will minimize runoff problems, and provide the best return for the growers in terms of dollars and effort in managing the nursery. This will serve as a model for other growers in the area, and also those outside the area who are interested in altering their practices to improve the efficiency of their irrigation systems.

Avocado Grove BMP Demonstration

The avocado grove BMP demonstration will compare the current strategy of uniform irrigation emission with a modified strategy to reduce excess water that might contribute to irrigation overflows. Almost all avocado groves in San Diego County are grown on hillsides. Most hillsides in the northern part of the county (where the bulk of the avocados are grown) are composed of decomposed granite (DG) on top of solid granite rock. The DG soils are relatively shallow, often less than 24 inches deep. The solid granite rock is usually fissured which allows excess irrigation water to penetrate into lower strata. However, a significant amount of excess water has been seen to "slide" down the face of the granite rock (below the DG soil) and emerge at the bottom of the hill, creating wet spots and occasionally local flooding. This water may eventually end up in local creeks.

The current strategy in irrigation evaluations is to increase the emission uniformity among the mini-sprinklers so that all mini-sprinklers put out the same amount of water. The goal is to achieve 100% emission uniformity, but this has never been achieved. A "good" irrigation system usually has an 80-85% emission uniformity.

The purpose of this demonstration is to use the lower rows of avocado trees as buffer strips that will use excess water and nitrate before the water flows underground into a local creek. In this project the emission uniformity will be purposefully reduced so that the bottom row of avocado trees will not receive any of the applied water, the second row from the bottom will receive ~33% of applied water, the third row from the bottom will receive ~66% of applied water, and the fourth row from the bottom (and trees above this row) will receive full water during an irrigation. Water flowing below these trees ~~at the bottom row will be sampled for volume of flow,~~ will be collected using lysimeters in each row and analyzed for nitrate N concentration.

Rainbow Creek Water Quality Monitoring

Water quality monitoring of Rainbow Creek will be conducted once a month to characterize pollutant loading and to evaluate the effect of BMP implementation and the reduction of irrigation flow runoff at the avocado grove and commercial nursery as well as in Rainbow Creek. Water Quality sampling of Rainbow Creek will be conducted at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL. In addition, sample locations will be located upstream and downstream of Hines Nursery and, if possible, the nursery identified for the irrigation optimization to determine any effect of this BMP on water quality in Rainbow Creek.

The outcomes of this monitoring program will be to assess the implementation of BMPs and assess current conditions in Rainbow Creek and the impact of BMP implementation on receiving water quality.

Water Quality or Regulatory Criteria

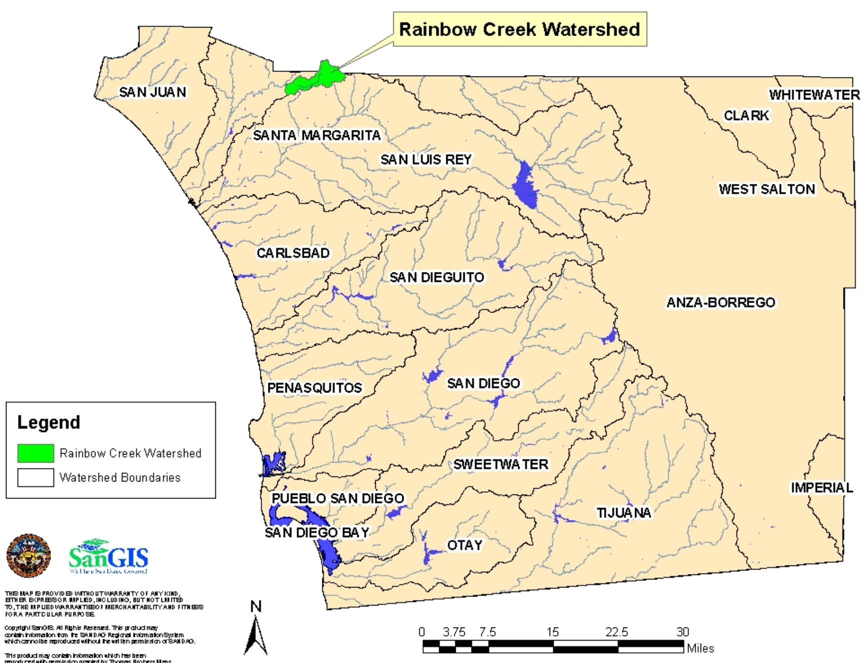
The data quality objective (DQO) for the analytical analyses for the Rainbow Creek monitoring is to obtain, to the maximum extent practicable, reporting limits at or below the applicable and relevant regulatory criteria. To meet this DQO, the analytical quantitation limits are compared to the Water Quality Control Plan (Basin Plan, RWQCB 1994) for the San Diego Region, Title 40 of the Code of Federal Regulations (Part 131; Water Quality Standards) (USEPA 2000a). The purpose of this comparison is to establish that the quantitation limits of the analytical techniques used to measure pollutants are sufficiently low to conclude that a nondetect is below the applicable and relevant criteria. Table 3 lists the constituents that will be monitored as part of the Rainbow Creek Monitoring Project, their associated water quality criteria, and the applicable analytical quantitation limits for this QAPP.

Table 3: Water Quality Criteria for the Rainbow Creek Monitoring Project

Constituent	Water Quality Criteria	Source	Target Reporting Limit
Alkalinity, Total	N/A		5.0 (mg CaCO3/L)
Alkalinity-Bicarbonate	N/A		
Alkalinity-Carbonate	N/A		
Alkalinity-Hydroxide	N/A		
Ammonia-N	0.025 (mg/L (unionized))	Basin Plan (RWQCB 1994)	0.50 (mg/L)
Boron	0.75 (mg/L)	Basin Plan (RWQCB 1994)	0.020 (mg/L)
Calcium, Total	N/A		0.20 (mg/L)
Chloride	250 (mg/L)	Basin Plan (RWQCB 1994)	0.20 (mg/L)
Dissolved Oxygen	5.0 (mg/L)	Basin Plan (RWQCB 1994)	1.0 (mg/L)
Fluoride	1.0 (mg/L)	Basin Plan (RWQCB 1994)	0.1 (mg/L)
Hardness, Total	N/A		2.0 (mg CaCO3/mL)
Iron, Total	0.3 (mg/L)	Basin Plan (RWQCB 1994)	20 (ug/L)
Magnesium, Total	N/A		0.03 (mg/L)
Nitrate-N	1.0 (mg/L)	Basin Plan (RWQCB 1994) and Rainbow Creek TMDL	0.20 (mg/L)
Nitrite-N	1.0 (mg/L)	Basin Plan (RWQCB 1994)	0.005 (mg/L)
Percent Sodium	60%	Basin Plan (RWQCB 1994)	
Ortho-Phosphate-P	0.1 (mg/L)	Basin Plan (RWQCB 1994)	0.02 (mg/L)

Constituent	Water Quality Criteria	Source	Target Reporting Limit
pH	<6.5 or >9.0 (pH units)	Basin Plan (RWQCB 1994), with allowance for elevated pH due to excessive photosynthesis. Elevated pH is especially problematic in combination with high ammonia.	0.1 (pH units)
Residual Chlorine	N/A		0.10 (mg/L)
Specific Conductivity	N/A	N/A	2.0 (umhos/cm)
Sulfate	250 (mg/L)	Basin Plan (RWQCB 1994)	0.5 (mg/L)
Temperature	increase of 5°F above natural water temperature	Basin Plan (RWQCB 1994)	0.2(°C)
Total Dissolved Solids	750 (mg/L)	Basin Plan (RWQCB 1994)	5.0 (mg/L)
Total Kjeldahl Nitrogen	1.0 (mg/L)	Basin Plan (RWQCB 1994)	0.80 (mg/L)
Total Phosphate-P	0.1 (mg/L)	Basin Plan (RWQCB 1994)	0.02 (mg/L)
Turbidity	20 (NTU)	Basin Plan (RWQCB 1994)	1 (NTU)

Figure 2: Location of Rainbow Creek Watershed in San Diego County



Element 6 Project/Task Description

Work Statements and Produced Products

Photo Documentation

Photo points will be established to document the success of the Avocado BMP demonstration and the optimization of the irrigation system. The stations will be established at strategic viewpoints to best ascertain the new irrigation strategies and their success. To maximize the documentation, long view photographs will be taken to show the project area, medium view photos showing examples of irrigation changes, and close views of flow and runoff changes. Photo documentation reports will be created for both the avocado BMP and irrigation optimization projects to display the actual photo point photographs, describe the geographical position of the photo points and offer a brief description of the physical alterations. These reports will be part of the Final Avocado BMP Effectiveness Monitoring Report and Irrigation Optimization BMP Effectiveness Monitoring Report.

Groundwater Level Monitoring

Existing shallow wells identified in Rainbow Valley will be monitored bi-weekly by County of San Diego staff. A monitoring well will be installed at Rainbow Valley Community Park, owned by the County of San Diego, in the middle of the valley floor (5^{th} Street). The County well will be fitted with a real-time water level pressure sensor and data will be transmitted via radio telemetry to a central location for data processing. A total of six shallow groundwater wells will be monitored.

Depth to groundwater data from the real-time monitoring will be collected and compared to depth data collected from other wells in the valley to establish groundwater depth patterns. If sufficient correlation exists, both temporally and spatially, then the frequency of monitoring the groundwater depth can be modified at other wells, using the real-time data for ongoing data collection. Data collected from groundwater wells will be mapped using GIS tools and provided in a "user friendly" format for informing the public.

Water Quality Monitoring

Water quality monitoring will be conducted once a month to characterize pollutant loading and to evaluate the effect of BMP implementation and the reduction of irrigation flow runoff. Sampling will be conducted at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL. In addition, sample locations will be located upstream and downstream of Hines Nursery and the nursery identified for the irrigation optimization to determine any effect of this BMP on water quality in Rainbow Creek.

The outcomes of this monitoring program will be an assessment of the current conditions in Rainbow Creek and the impact of BMP implementation on receiving water quality.

Water quality monitoring for the Avocado BMP project will be conducted weekly when possible during the periods in which irrigation practices are performed. Monitoring will not occur during rain events, periods in which irrigation water is not applied to the grove, or during periods in which the lysimeters do not collect enough water to obtain a representative sample for water quality purposes. Water quality will be compared between the control grove and test grove to establish and baseline and change in water quality.

Constituents to be Monitored and Measurement Techniques

Photo Documentation

The focus of photo documentation is on a qualitative assessment of avocado grove health and irrigation efforts and therefore there are no specific constituents to monitor. Photographs will be taken in accordance with the State Water Resources Control Board (SWRCB) guidelines (SWRCB 2003).

Groundwater Level Monitoring

The focus of the groundwater level monitoring is on a quantitative assessment of the groundwater levels in Rainbow Valley and therefore there are no specific constituents to monitor. Depth to groundwater will be taken following U. S. EPA. 2000. Environmental Response Team, Standard Operating Procedures for Manual Water Level Measurements. All field information will be recorded on the Rainbow Valley Groundwater Level Monitoring Datasheet (Appendix1).

Water Quality Monitoring

Field site visits for water quality monitoring for this QAPP will include field observation, photo documentation, water sample collection for analytical analysis, water flow measurements, and field physicochemical measurements.

Qualitative field observations will be made during each site visit whether or not ponded or flowing water is observed. These observations are intended to provide a general assessment of the site and include variables such as odor, water clarity, the presence of floatable matter, visible deposits/ stains, vegetative density, and biological status. All field information will be recorded on the Rainbow Creek Field Data Sheet (Appendix 2).

Each site will be photographed to provide additional information and documentation of site conditions. In addition to providing important descriptive information, photographs serve as an official record of the site visits, a visual record of the condition of the pipes, structures and the surrounding environment, and can assist other staff in locating sites in subsequent site visits. Flow measurements will be conducted at each site where water is flowing. Estimated flow rates can be used to estimate pollutant mass loading, prioritize storm drains for future investigations, or to identify significant changes in flow that may be indicative of an illegal release upstream. Since a majority of sample locations lack a permanent flow measurement installation, flow is measured using a handheld flow meter. If water flow is too slow or the water is too shallow to measure the velocity using the flow meter the velocity may be estimated by timing the travel of a piece of floating debris (e.g., a leaf). The "apparent" velocity is calculated by dividing the travel distance (feet) by the recorded travel time (second).

Water physicochemical properties will be measured at each site where water is flowing or ponded. The parameters measured will be pH, conductivity, turbidity, dissolved oxygen (DO), and temperature using a Horiba 6-parameter multi-meter. If water is deep enough, the probe will be placed horizontally on the creek bed, facing upstream. If water is shallow, a syringe will be used to collect water to a plastic beaker, and then measure the properties. Due to the sampling process involved, DO measurements in a beaker may be different from *in situ* measurements. All data will be recorded on the Field Data Sheet.

Water samples collected from target sites will be analyzed in the laboratory. Constituents for the Rainbow Creek Monitoring Program include: Nitrite-N, Total Kjeldahl Nitrogen, Ortho-Phosphate-P, and Total Mineral Analysis (Alkalinity-Bicarbonate, Alkalinity-Carbonate, Alkalinity-Hydroxide, Ammonia-N, Boron, Conductivity, Fluoride, Iron, Nitrate-N, Percent Sodium, pH, Sulfate, Total Alkalinity, Total Anions, Total Calcium, Total Cations, Total Dissolved Solids, Total Hardness, Total Magnesium, Total Phosphate-P, Total Potassium, Total Residual Chloride, and Total Sodium). The QC Officer will provide Truesdail with clear instruction on what constituents should be analyzed for a particular sample. The analytical methods used to measure all parameters are presented in Table 4.

Table 4: Constituents to be Monitored and Corresponding Analytical Methods

Field Monitoring		
Constituent	**Analytical Method**	**Notes**
Dissolved Oxygen	Collected in Field	Horiba Multiparameter Water Quality Instrument
pH	Collected in Field	
Specific Conductivity	Collected in Field	
Temperature	Collected in Field	
Turbidity	Collected in Field	
Laboratory Monitoring		
Constituent	**Analytical Method**	**Notes**
Alkalinity, Total	EPA 310.1	Titrimetric method
Alkalinity-Bicarbonate	By Calculation	By Calculation
Alkalinity-Carbonate	By Calculation	By Calculation
Alkalinity-Hydroxide	By Calculation	By Calculation
Ammonia-N	EPA 350.2	Titrimetric method
Boron	EPA 200.7	ICP
Calcium, Total	EPA 200.7 / EPA 6010	ICP
Chloride	EPA 300.0, EPA 325.3	Ion Chromatography
Fluoride	EPA 300.0	Ion Chromatography
Hardness, Total	EPA 130.2 / EPA 200.7, SM 2340 B	Ttitrimetric / by Calculation
Iron, Total	EPA 200.7/ EPA 6010	ICP
Magnesium, Total	EPA 200.7 / EPA 6010	ICP
Nitrate-N	EPA 300.0	Ion Chromatography
Nitrite-N	EPA 354.1	Colorimetric
Percent Sodium	By Calculation	By Calculation
Ortho-Phosphate-P	EPA 365.2	Titrimetric method

pH	EPA 150.1	Electrode
Potassium, Total	EPA 200.7 / EPA 6010	ICP
Residual Chlorine	EPA 330.1, SM 4500 CLD	Titrimetric method
Sodium, Total	EPA 200.7 / EPA 6010	ICP
Specific Conductivity	EPA 120.1, SM 2510	Electrode
Sulfate	EPA 300.0	Ion Chromatography
Total Dissolved Solids	EPA 160.1	By Calculation
Total Phosphate-P	EPA 365.3	Titrimetric method

ICP = Inductively Coupled Plasma

Water samples collected from the lysimeters as part of the Avocado BMP project will be analyzed in the laboratory. The water samples collected from the lysimeters will be analyzed for Nitrate-N. The QC Officer will provide Truesdail Laboratories with clear instruction on what constituents should be analyzed for a particular sample. The analytical methods used to measure all parameters are presented in Table 4.

Project Schedule

Table 5 details the project schedule for Rainbow Creek Monitoring Project, including start and end dates of major task, required deliverables, and their corresponding due date.

Table 5: Project Schedule and Deliverables

Activity	Date		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Sampling and Analysis Plan	March 1, 2006	April 20, 2006	Sampling and Analysis Plan	April 20, 2006
Quality Assurance Project Plan	March 1, 2006	May 20, 2006	QAPP	May 20, 2006
Photo Documentation Monitoring of Avocado Grove	July 1, 2006	June 30, 2008	None	July 1, 2006 through June 30, 2008
Groundwater Level Monitoring of Rainbow Valley	July 1, 2006	June 30, 2008	None	July 1, 2006 through June 30, 2008
Water Quality Monitoring of Rainbow Creek	July 1, 2006	June 30, 2008	None	July 1, 2006 through June 30, 2008
Quarterly Update Reports	July 1, 2006	December 1, 2008	Quarterly Reports	Quarterly
Monitoring of BMP Effectiveness (Nursery Tailwater System, Irrigation Optimization, and Avocado Demonstration)	July 1, 2006	June 30, 2008	None	July 1, 2006 through June 30, 2008
Water Quality Monitoring Analysis and Summary	April 20, 2007	June 30, 2008	Monitoring Analysis and Summary	April 20, 2007, April 20, 2008, September 20, 2008
Results of BMP Effectiveness Monitoring	April 20, 2007	June 30, 2008	Results of BMP Effectiveness Monitoring	April 20, 2007, April 20, 2008, September 20, 2008
Pollutant Load Reduction Report	April 20, 2007	June 30, 2008	Pollutant Load Reduction Report	April 20, 2007, April 20, 2008, December 1, 2008

Geographical Setting

Rainbow Creek is a small tributary to the Santa Margarita River located in northern San Diego County, near the community of Fallbrook (see Figure 2 above). The Rainbow Creek watershed is designated in the Basin Plan as hydrologic unit subareas (HSAs) 902.22 and 902.23, and encompasses 7,085 acres. The watershed is primarily rural, with sixty five percent of the watershed undeveloped. Development within the watershed includes rural residential units (8.7%), agricultural field uses (6.1%), orchards (11.0%), commercial nurseries (4.8%), and a mix of other uses (5%) (MRCD 1999b).

Rainbow Creek headwaters begin in the hilly and sparsely developed area east of Rainbow Valley. The creek traverses the relatively flat Rainbow Valley Basin, located about 1.5 miles west of the headwaters and then enters another sparsely populated area with hilly terrain. Rainbow Creek eventually flows into the Santa Margarita River, approximately eight miles from the headwaters. Rainbow Creek is an intermittent stream and is considered a gaining stream. The geology of Rainbow Valley Basin is much like a bowl, which has a restricted outlet. This condition limits ground water flowing from the basin (Peterson 1989). Ground water surfaces in the creek at the downstream edge of Rainbow Valley, in the vicinity of the Interstate 15 overpass (I-15). Ground water also surfaces in the lower reaches of the creek beginning approximately 1 mile below I-15. Additionally, several tributaries join the creek in the lower reaches of the watershed.

Constraints

Monitoring will not be conducted during any rain event >0.1 inch until the water level returns to within approximately 10% of the pre-rain creek level as verified by using USGS flow station data for Rainbow Creek (http://nwis.waterdata.usgs.gov/nwis/nwisman/?site_no=11044250&agency_cd=USGS). If rain is scattered, rainfall will be checked to determine if any occurred within the Rainbow Creek Watershed. If staff are in the field and the weather turns to rain, staff will discontinue sampling and return to DPW headquarters. If weather conditions are suspect, conditions will be verified prior to departure to sampling locations using the following sources:

- Department of Public Works Flood Control Section at (858) 495-5557 (7:00 am - 4:00 pm weekdays).
- National Weather Service weather forecasts 24-hour recorded message at (619) 289-1212 or http://www.wrh.noaa.gov/sgx/

Water quality monitoring of Rainbow Creek will occur at approximately 30-day intervals for two (2) years unless weather conditions prohibit samples collection. Samples will not be collects if there is no flow (ponded water will not be sampled).

Water quality samples for the avocado grove demonstration site will not be collected during weeks in which rain events occur and irrigation is not conducted or if there is an inadequate amount of water collected in the lysimeters to obtain a representative sample~~if there is no flow (ponded water will not be sampled)~~.

Water quality samples of nursery irrigation runoff will be collected on an as-needed basis as surface water flows are observed.

Element 7 Measurement Quality Objectives and Criteria for Data

Data generated for this project must meet the measurement quality objectives for accuracy, precision, completeness, and recovery (accuracy, precision, and completeness for field testing) as listed in Table 6, Table 7, and Table 8 to be SWAMP compatible. The data must also be representative of the general environment/ conditions being studied. Any previously collected data must meet the aforementioned criteria to be acceptable into the Rainbow Creek Project.

Table 6: Summary of Measurement Quality Objectives.

Measurement or Analyses Type	Applicable Data Quality Objective
Field Testing	
Conductivity Dissolved Oxygen pH Temperature Turbidity	Accuracy, Precision, Completeness
Chemical Laboratory Analysis	
Alkalinity, Total Alkalinity-Bicarbonate Alkalinity-Carbonate Alkalinity-Hydroxide Ammonia-N Boron Calcium, Total Chloride Fluoride Hardness, Total Iron, Total Magnesium, Total Nitrate-N Nitrite-N Percent Sodium Ortho-Phosphate-P pH Potassium, Total Residual Chlorine Sodium, Total Specific Conductivity Sulfate Total Dissolved Solids Total Kjeldahl Nitrogen Total Phosphate-P	Accuracy, Precision, Recovery, Completeness

Table 7: Measurement Quality Objectives for Field Data

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Field Testing	Dissolved Oxygen	± 20%	No SWAMP requirement; will use ± 20%	NA	NA	No SWAMP requirement; will use 90%
Field Testing	pH	± 0.5 units	No SWAMP requirement; will use ± 0.5 units	NA	NA	No SWAMP requirement; will use 90%
Field Testing	Specific Conductivity	± 5%	No SWAMP requirement; will use ± 5%	NA	NA	No SWAMP requirement; will use 90%
Field Testing	Temperature	± 0.5 °C	No SWAMP requirement; will use ± 0.5 °C	NA	NA	No SWAMP requirement; will use 90%
Field Testing	Turbidity	± 30%	No SWAMP requirement; will use ± 30%	NA	NA	No SWAMP requirement; will use 90%

Table 8: Measurement Quality Objectives for Laboratory Data.

Group	Parameter	Accuracy*	Precision*	Recovery*	Completeness*	Laboratory Target Reporting Limits	Project Action Limits
Chemical Laboratory Analysis	Alkalinity, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	1.0 (mg CaCO3/L)	5.0 (mg CaCO3/L)
Chemical Laboratory Analysis	Alkalinity-Bicarbonate	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation

Group	Parameter	Accuracy*	Precision*	Recovery*	Completeness*	Laboratory Target Reporting Limits	Project Action Limits
Chemical Laboratory Analysis	Alkalinity-Carbonate	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Chemical Laboratory Analysis	Alkalinity-Hydroxide	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Chemical Laboratory Analysis	Ammonia-N	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.10 (mg/L)	0.50 (mg/L)
Chemical Laboratory Analysis	Boron	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.020 (mg/L)	0.020 (mg/L)
Chemical Laboratory Analysis	Calcium, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.05 (mg/L)	0.20 (mg/L)
Chemical Laboratory Analysis	Chloride	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.20 (mg/L)	0.20 (mg/L)
Chemical Laboratory Analysis	Fluoride	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.123 (mg/L)	0.2 (mg/L)
Chemical Laboratory Analysis	Hardness, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	1.0 (mg CaCO3/mL)	2.0 (mg CaCO3/mL)

Group	Parameter	Accuracy*	Precision*	Recovery*	Completeness*	Laboratory Target Reporting Limits	Project Action Limits
Chemical Laboratory Analysis	Iron, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	20.0 (ug/L)	20 (ug/L)
Chemical Laboratory Analysis	Magnesium, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.02 (mg/L)	0.03 (mg/L)
Chemical Laboratory Analysis	Nitrate-N	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.01 (mg/L)	0.20 (mg/L)
Chemical Laboratory Analysis	Nitrite-N	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.005 (mg/L)	0.005 (mg/L)
Chemical Laboratory Analysis	Percent Sodium	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Chemical Laboratory Analysis	Ortho-Phosphate-P	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.01 (mg/L)	0.02 (mg/L)
Chemical Laboratory Analysis	pH	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.1 (pH units)	0.1 (pH units)
Chemical Laboratory Analysis	Potassium, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.10 (mg/L)	0.20 (mg/L)

Group	Parameter	Accuracy*	Precision*	Recovery*	Completeness*	Laboratory Target Reporting Limits	Project Action Limits
Chemical Laboratory Analysis	Residual Chlorine	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.10 (mg/L)	0.10 (mg/L)
Chemical Laboratory Analysis	Sodium, Total	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.10 (mg/L)	0.20 (mg/L)
Chemical Laboratory Analysis	Specific Conductivity	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	2.0 (umhos/cm)	2.0 (umhos/cm)
Chemical Laboratory Analysis	Sulfate	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.5 (mg/L)	0.5 (mg/L)
Chemical Laboratory Analysis	Total Dissolved Solids	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	10.0 (mg/L)	25.0 (mg/L)
Chemical Laboratory Analysis	Total Kjeldahl Nitrogen	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.50 (mg/L)	0.80 (mg/L)
Chemical Laboratory Analysis	Total Phosphate-P	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 70% to 130% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum.	Matrix spike 70% - 130% or control limits at ± 3 standard deviations based on actual lab data.	No SWAMP requirement; will use 90%	0.02 (mg/L)	0.02 (mg/L)

* See the attached Truesdail's "Quality Assurance and Quality Control Manual for Environmental Sample Analysis" (laboratory's QA/QC manual) for a discussion on Accuracy, Precision, Recovery, and Completeness in Section 3 – "Environmental Quality Assurance Program", Pages 19 to 27.

All data will be evaluated for their representativeness of the overall ground water levels in the Rainbow Creek area and the quality of headwaters and tailwaters (downstream of the BMPs) of the Rainbow Creek. To obtain an adequate representativeness of groundwater levels 5 **randomly-**distributed shallow wells identified in Rainbow Valley will be monitored bi-weekly. Additionally, a monitoring well with a real-time water level pressure sensor will be installed in the middle of the valley floor. Depth to groundwater data from the real-time monitoring will be collected and compared to depth data collected from the other wells to establish groundwater depth patterns. If sufficient correlation exists, both temporally and spatially, then the frequency of monitoring the groundwater depth can be modified at other wells, using the real-time data for ongoing data collection.

To ensure the proper representativeness of the water quality data, sampling will be conducted monthly at or close to the locations previously monitored by the San Diego Regional Water Quality Control Board (RWQCB) for the development of the TMDL. In order to assess the impact to Rainbow Creek of optimizing the tailwater recovery system at Hines nursery, samples will be collected upstream and downstream of the nursery complex. The upstream and downstream sample locations will be adjusted, if appropriate, to accurately represent the upstream and downstream flow. Sample location RBC01 will represent water quality of the Rainbow Creek headwaters, upstream of Rainbow Valley. All other locations, in Rainbow Creek and its tributaries, will be monitored to assist in characterizing baseline conditions and tracking any changes in water quality and will become the baseline monitoring sites for the Rainbow Creek TMDL.

In order to accurately assess the impact of the new irrigation strategy in the avocado grove, irrigation treatment units will be compared to a control treatment which uses uniform emission irrigation (three replicates each). Water flowing below these trees ~~at the bottom row will be sampled for volume of flow~~will be collected from lysimeters which will be installed in each row of trees and analyzed for nutrients. In addition, sampling may be done at the source of the irrigation water and will include water only and water plus fertilizer materials that are injected with the irrigation water.

Element 8 Special Training Needs/ Certification

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Specialized Training and Certifications

Photo Documentation

There is no specialized training for photo documentation, however all field staff will be knowledgeable of the SWRCB guidelines for photo documentation.

Groundwater Level Monitoring

There is no specialized training for groundwater level monitoring, however all field staff will be knowledgeable of the U. S. EPA. Environmental Response Team, Standard Operating Procedures for Manual Water Level Measurements.

Water Quality Monitoring

Although there are no special training needs required for these monitoring programs, all field personnel will be trained/refresher training in proper field sampling and sample handling techniques prior to each sampling season/year by the QA Officer. All field personnel are trained and have experience in the collection, handling/storage, and chain of custody procedures as they relate to sample collection. Health and Safety training is conducted each month at Watershed Protection Program staff meetings with an annual update of the Illness, Injury Prevention Plan (IIPP) for the Science and Monitoring group.

Analytical Laboratory

Truesdail Laboratories, Inc. is certified by ELAP for the analyses of inorganics, toxic chemical elements, and organics in wastewater (Certificate 1237).

Training and Certification Documentation

All personnel are responsible for complying with all quality assurance/quality control requirements pertaining to their organizational/technical function. Each technical staff member maintains a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, quality assurance/quality control procedures, and records management.

Field Sampling

Field personnel refresher training conducted by the Quality Assurance Officer will be documented and records kept in the County of San Diego Department of Public Work, Human Resources Office and on file at Project Manager's office.

Analytical Laboratory

Truesdail maintains records of its training. Those records can be obtained if needed from Truesdail through the Quality Assurance Manager.

Training Personnel

The Quality Assurance Officer will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and chain of custody procedures.

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Element 9 Documents and Records

The Farm and Home Advisor's will document and track all aspect of the photo documentation of the avocado grove BMP demonstration which includes generating photo datasheets. The Farm and Home Advisor's will also document and track samples collected from the avocado grove lysimeters. These include sample event log, generating field datasheets at each site, and chain of custody forms for all analytical samples collected (also see Table 5 for a list of project reports). Chain of custody forms will accompany water samples to the laboratory for analysis. Truesdail will document and track all aspects of sample receipt and storage, analyses and reporting. Copies of the chains of custody will be included in the final report.

Science and Monitoring Group will document and track all aspects of the groundwater level and water quality sample collection process. These include sample event log, generating field datasheets at each site, and chain of custody forms for all analytical samples collected (also see Table 5 for a list of project reports). Chain of custody forms will accompany water samples to the laboratory for analysis. Truesdail will document and track all aspects of sample receipt and storage, analyses and reporting. Copies of the chains of custody will be included in the final report.

Science and Monitoring Group will maintain the Special Projects database for data collected in this project. Steven DiDonna will manage this database. Data from the field datasheets generated from this project will be entered into the Special Projects database by field staff and checked by the QA Officer. The database and all related electronic files and reports will be backed-up daily through the County of San Diego network service provider.

All records generated by this project will be stored at the Science and Monitoring Group office for a minimum of **10 years**. Truesdail Laboratory records pertinent to this project will be maintained at Truesdail's main office. Copies of all records held by Truesdail will be provided to the Science and Monitoring Group both electronically, in specified format, and by hard copy and stored in the project file. All electronic records will be stored on the County's shared drive system and backed up on a daily basis. The minimum retention time for the electronic records will also be 10 years.

Copies of this QAPP will be distributed electronically to all parties involved with the project (see QAPP distribution list in Table 1). Updates to this QAPP will be distributed in like manner, and all previous versions will be discarded from the project file.

Persons responsible for maintaining records for this project are as follows. ~~Li-Ming He~~Steve DiDonna will maintain the Special Projects sample collection log and the field datasheet forms. The QA Officer will maintain all records associated with the receipt and analysis of samples analyzed by the laboratory, and all records submitted by Truesdail. Ken Liddell will maintain the laboratory chains of custody forms (copies). Steven DiDonna will maintain the Special Projects database. Pat Iyer, Laboratory QA/QC Manager for Truesdail will maintain Truesdail's records. Science and Monitoring Group Project Manager/Supervisor Jo Ann

Weber will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records.

Group B:
Data Generation And Acquisition

Element 10 Sampling Process Design (Experimental Design)

The following information includes excerpts from the Rainbow Creek Surface Water and Groundwater Sampling and Analysis Plans that detail the photo documentation, groundwater level monitoring and water quality sampling activities.

Sample Locations

Photo Documentation

Photo points will be established to document the success of the Avocado BMP demonstration and the optimization of the irrigation system. The stations will be established at strategic viewpoints to best ascertain the new irrigation strategies and their success. To maximize the documentation, long view photographs will be taken to show the project area, medium view photos showing examples of irrigation changes, and close views of flow and runoff changes.

Groundwater Level Monitoring

Wells identified, in which properties owners have been contacted and asked if they are willing to allow access, will be monitored bi-weekly by County of San Diego staff. A monitoring well will be installed at Rainbow Valley Community Park, owned by the County of San Diego, in the middle of the valley floor (5th Street). A total of six shallow groundwater wells will be monitored as summarized in Table 9.

Table 9: Well Locations in Rainbow Valley

Sample Site ID	Location	Latitude	Longitude*	Depth of well
RMW01	5021 2nd St.	33.41667	-117.15400	33'
RMW03	2500 Rainbow Valley Blvd.	33.41902	-117.14040	N/A
RMW05	2029 Rainbow Valley Blvd.	33.41009	-117.14788	N/A
RMW06	2203 Huffstatler St.	33.41252	-117.15151	29'
RMW07	To Be Determined			
RMW08 (installed well)	5th St. and Welty	33.41369	-117.14993	ND

Water Quality Monitoring

Avocado Grove Demonstration Project

In order to assess the impact of the new irrigation strategy, irrigation treatment units will be compared to a control treatment which uses uniform emission irrigation (three replicates each). Water flowing below these trees at the bottom row will be sampled for volume ~~of flow and~~ during collection of water samples form the lysimeters and analyzed for nutrients. In addition, sampling may be done at the source of the irrigation water and will include water only and water plus fertilizer materials that are injected with the irrigation water. An annual leaf analysis will be conducted in the fall and will be analyzed for all plant mineral, nutrients, sodium and chloride (toxic constituents). This data will be used to determine the effect of reducing the water to the lower trees on the slopes. Fruit will be harvested and weighed to determine crop yield.

Irrigation Optimization BMP

In order to determine the changes needed to maximize irrigation practices for improved water use efficiency and reduction of runoff, samples of the irrigation source water will be collected. In addition, grab samples of any runoff leaving the nursery will be collected.

Rainbow Creek

In order to assess the impact to Rainbow Creek of optimizing the tailwater recovery system at Hines nursery, samples will be collected at RBC01 and RBC02. These sample locations represent upstream and downstream of the Hines nursery complex. Sample locations RBC07 and RBC08 are placeholders and will be located, if appropriate, to bracket, upstream and downstream, the nursery identified for the irrigation optimization BMP. Sample location RBC01 represents water quality of the Rainbow Creek headwaters, upstream of Rainbow Valley. All other sample locations, in Rainbow Creek and its tributaries, will be monitored to assist in characterizing baseline conditions and tracking any changes in water quality. These sample locations, identified in Table 10, will become the baseline monitoring for the Rainbow Creek TMDL.

Table 10: Rainbow Creek Sample Locations

Sample Site ID	Location	Thomas Brothers Page	Thomas Brothers Grid	Latitude*	Longitude*
RBC01	Rainbow Creek @ Eastern edge of Hines Nursery	999	A4	33.42042	-117.13571
RBC02	Rainbow Creek @ Huffstatler Road	998	H4	33.41544	-117.15199
RBC04	Rainbow Creek @ Old Highway 395	998	H5	33.41216	-117.16021
RBC07	To Be Determined				
RBC08	To Be Determined				
RBC10	Rainbow Creek @ MWD road crossing	998	E6	33.40696	-117.18344
SMG05	Rainbow Creek @ Willow Glen Road	998	C6	33.40788	-117.20104
RBC06	Rainbow Creek @ Clark Property	998	B5	33.40881	-117.20539
SMG06	Rainbow Creek @ Stage Coach Lane	998	A5	33.41056	-117.21477
HST01	Brow Ditch to Rainbow Creek @ Huffstatler Road	998	H4	33.41526	-117.15204
WGT01	Willow Glen Tributary @ Willow Glen Road	998	C6	33.40784	-117.20309
VMT01	Via Milpas Tributary to Rainbow Creek	998	A5	33.40957	-117.21373
MGT01	Santa Margarita Tributary @ Margarita Glen Road	988	C6	33.40847	-117.19877
RVT02	Chica tributary @ 1st Street	988	J4	33.42126	-117.14983

* NAD83, Decimal degree to the 5th digit

Figure 3: Rainbow Valley Wells Locations

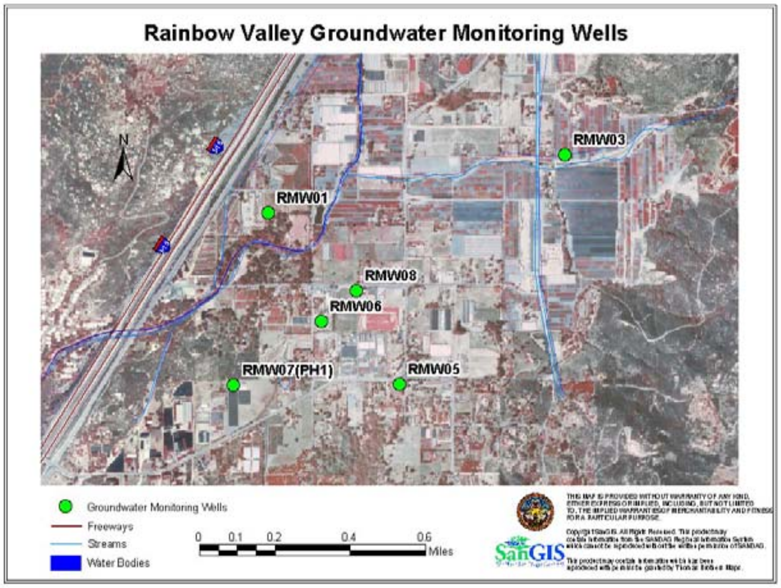
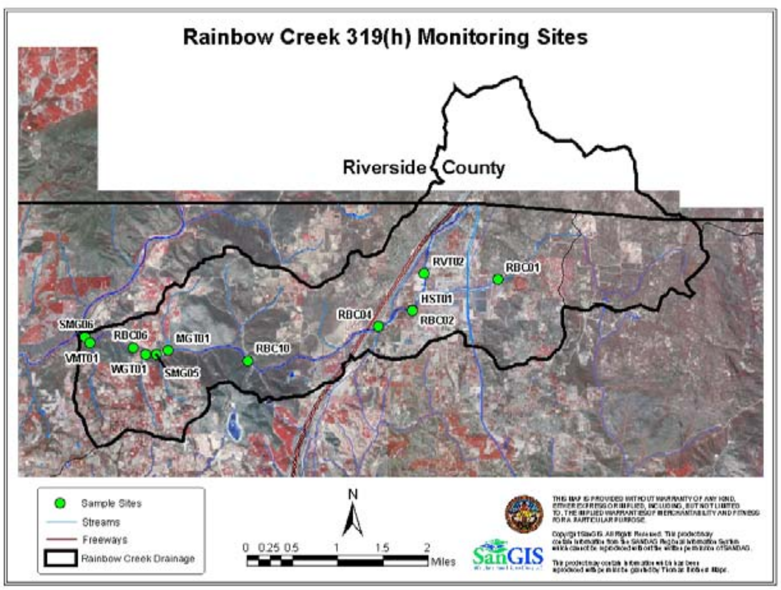


Figure 4: Rainbow Creek Monitoring Project Sites



Sample Frequency

Photo Documentation

A field reconnaissance will be conducted to establish the photo points. One photo documentation survey will be completed prior to the implementation of the irrigation treatments and BMPs. After implementation, photo-monitoring will occur during selected dry and wet weather sampling events over the program duration.

Groundwater Level Monitoring

Groundwater level (depth) monitoring will be conducted biweekly for one year or until sufficient correlation exists. This will amount to 104 samples per year per well or a total of 521 samples. The groundwater level monitoring in the 5 wells will be coordinated both temporally and spatially with the real-time groundwater level monitoring and the sampling frequency at the 5 wells will be optimized accordingly. The real-time groundwater level sensor will be programmed to collect data once a day for the length of the study and any time there is more than 1/10 of a foot change in depth. Data will be instantaneously transmitted via radio telemetry to the County of San Diego Flood Warning System database.

Water Quality Monitoring

Avocado Grove Demonstration Project

Composite sampling will be done approximately weekly during the first year of the project ~~which would amount to 260 samples per sampling site per year~~. A composite sample will be collected from each row of the control and experimental test groves (10 rows total; five control and 5 experimental). It is estimated that up to 260 samples could be collected during the year based on irrigation frequency and the amount of wet weeks that may occur during the study. The time of sample collection relative to the termination of the irrigation cycle will be determined at the on-set of the study to best represent the maximum flow volume. Leaf analysis will be conducted on all trees in the "data row" September 2006 and 2007.

Irrigation Optimization BMP

Grab samples will be collected on a monthly if runoff is observed.

Rainbow Creek

Samples will be collected at a minimum of one time every month for two years. This will constitute a total of 336 sample sets. Samples will be collected at approximately 30-day intervals unless weather conditions prohibit the collection of samples in a safe manner. All identified sample locations have received permission for access.

Monitoring will not be conducted during any rain event >0.1 inch until the water level returns to within approximately 10% of the pre-rain creek level. If rain is scattered, rainfall will be checked to determine if any occurred within the Rainbow Creek Watershed. If staff is in the field and the weather turns to rain, staff will discontinue sampling and return to DPW headquarters. If weather conditions are suspect, conditions will be verified prior to departure to sampling locations using the following sources:

- Department of Public Works Flood Control Section at (858) 495-5557 (7:00 am - 4:00 pm weekdays).
- National Weather Service weather forecasts 24-hour recorded message at (619) 289-1212 or http://www.wrh.noaa.gov/sgx/

One duplicate sample will be collected at a randomly selected site for each sampling event. A field blank will be taken one (1) sample per twenty-four (24) samples (once every other sampling event) and sent to the laboratory for analysis.

If sampling sites become inaccessible due to severe weather conditions, samples will be collected no later than 2 working days after severe weather subsides and site(s) become accessible again. If site(s) become permanently inaccessible, new site(s) that most closely resemble the conditions at the inaccessible site(s) will be selected to be available for sampling no later than 2 working days following the planned sample date. These conditions will include geographic location relative to lost site(s) and the BMPs or, in case of the groundwater wells, to the lost well(s), and topography of Rainbow Valley. Groundwater wells within the Rainbow Valley area are limited; if replacement locations cannot be identified within the high groundwater area of the valley then the number of wells being monitored will need to be reduced.

Element 11 Sampling Methods

Photo Documentation

The field crew will monitor the established photo points after implementation of the avocado grove irrigation treatments and irrigation BMPs in accordance with SWRCB guidelines (SWRCB 2003). The stations will be established by a description of the location, GPS coordinates, and the magnetic compass direction to take the digital photograph. The photographer will try to maintain a level (horizontal) camera view unless the terrain is sloped.

When taking photographs, landscape features that are unlikely to change, such as rock outcrops or structures, will be included as a reference for repeat photos. Long view photos will be taken to show the project area, preferably from an elevated vantage point. Medium views will be included to show examples of irrigation equipment changes, if included in the project. To convey the scale of an image, a stadia rod, person, or other common object will be included. Close views will be useful to show any irrigation overflows. A ruler or similar sized object may be used to show scale.

A dry-erase board, or equivalent, will be included in the photographs marking the location, time and date of the monitoring. A Photo Documentation Field Data Log will be completed for each site (Appendix 3). Observations of the irrigation systems and flows will be documented.

Groundwater Level Monitoring

Groundwater levels in wells RMW01 through RMW07 will be determined manually using a Solinst® Water Level Meter (Model 101). Each well will have a pre-established reference mark for measurement consistency. The weighted water level meter tape will be lowered into the well until the audible alarm is heard. The water level depth will be read relative to the reference mark at each well and recorded on the Groundwater Level Field Datasheet (Appendix 1). Observations of the weather, any surface flows and any observed pumping of other wells in the vicinity will be documented.

The monitoring well installed as part of this project will have a HydroLynx 5050LL-PTD (or equivalent) water level pressure senor installed that will measure water level data and log this information to HydroLynx 50386 data logger (or equivalent). The data logger will be programmed to transmit water level results instantaneously once a day or any time there is more than 1/10 of a foot change in depth. Data will be received and loaded into the County of San Diego Flood Warning System database. Data will be assessed and analyzed using DIAD Client Software.

Water Quality Monitoring

Avocado Grove Demonstration Project

Sampling for nutrient concentrations for the experimental treatment and control will be accomplished by installing soil solution access tubes (suction lysimeters) to collect underground runoff water. These suction lysimeters will be installed below each row of avocado trees to collect subsurface irrigation water for sample analyses. The suction lysimeters will be installed to an approximate depth of 24 inches below grade (the estimated depth of the decomposed granite/granite interface). Approximately five lysimeters will be installed in each row of avocado trees with varying irrigation application rates. Six rows of avocado trees with irrigation application rates of 20%, 40%, 60%, 80%, 100% and no irrigation and a control grove in which irrigation application rate will be 100% for all avocado rows will be used in the study. A total of approximately 60 lysimeters will be installed for the experimental treatment and control groves. Sample collection will be conducted using a vacuum pump and syringe. Samples for each row will be combined and a composite sample will be taken for each treatment and control unit. A grab sample will be taken from each composite.

Prior to installation of all the suction lysimeters a trial study will be performed. A limited number of suction lysimeters will be installed in each row of the control and treatment experimental groves to monitor for nutrient uptake and saturation. This will help confirm of the proposed study is feasible prior to complete application.

All sample locations with water will be monitored for flow if there is any. Field measured results and observations will be recorded on field data sheets (Appendix 2).

~~Sampling for water flow and nutrient concentrations for the experimental treatment and control will be accomplished by setting up stations to collect underground runoff water. These stations will be constructed below the lowest tree on the slope, in the middle row (the data row) of each treatment to minimize any "edge" effect that might occur with the trees that are located on the outside edge of the treatments. A trench will be dug ten feet long on the contour of the hill in the data row; the trench will be 3 ft below the soil surface. The trench will be ten feet down the hill from the lowest tree in the data row. A 4 inch diameter half pipe will be placed in the trench, covered with wire mesh, and packed with pea gravel over the top of the mesh. A drain pipe will be attached to the half pipe, and placed so that gravity will drain the water out of the half pipe into a barrel. Sample collection method may need to be adapted to accommodate field conditions. A composite sample will be taken for each treatment and control unit. A grab sample will be taken from each composite.~~

~~All sample locations with water will be monitored for flow if there is any. Field measured results and observations will be recorded on field data sheets (Appendix 2). Grab samples will be collected in clean sample bottles provided by the lab and analyzed for the possible following constituents: total dissolved solids (TDS), total salinity, ammonia, nitrate, nitrite, total kjeldahl nitrogen (TKN), total phosphorus, and dissolved ortho-phosphate. See Table 11 for analytical methods, sample volume, container type, sample preservation and holding times.~~ The cleaning and decontamination procedures for analytical equipment and glass sample containers are described in section 6.7 of the Truesdail Laboratories' "Quality Assurance and Quality Control Manual for Environmental Sample Analysis" in Appendix 2. The coordination and disposal of laboratory hazardous waste procedures are discussed in section 2.7.6 in Appendix 12. ~~The flow meter will be inspected for debris and rinsed with top~~

~~water by the end of each sampling day. No special decontamination procedures are needed for the flow meter.~~

Irrigation Optimization BMP

Grab samples will be collected in clean sample bottles provided by the lab and analyzed for the following constituents: total alkalinity, bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, ammonia-N, boron, chloride, total calcium, total residual chlorine, specific conductivity, total dissolved solids, total fluoride, iron, total magnesium, nitrate, nitrite, pH, total potassium, total sodium, sulfate, total hardness, total phosphorus-P, ortho-phosphate and total kjeldahl nitrogen (TKN). See Table 11 for analytical methods, sample volume, container type, sample preservation and holding times. The cleaning and decontamination procedures for analytical equipment and glass sample containers are described in section 6.7 of the Truesdail Laboratories' "Quality Assurance and Quality Control Manual for Environmental Sample Analysis" in Appendix 2. The coordination and disposal of laboratory hazardous waste procedures are discussed in section 2.7.6 in Appendix 12.

Rainbow Creek

Water samples will be collected from the most representative portion of the creek. When collecting a water sample from the creek, field personnel will enter the stream just downstream of the designated sampling point. Samples will be collected at the horizontal and vertical center of the stream/creek or at a location that is most representative of the water quality in the creek. Gloves will be worn while analytical sampling. Samples will be collected by pointing the bottle opening upstream lowering the bottle to mid-depth position and allowing the bottle to fill. Field staff will avoid collecting floating debris. In shallow water conditions (less than 6 inches deep), it will suffice to fill the bottle from the surface of the stream rather than sample at mid-depth. A clean syringe may also be used to collect water in very low flow or ponded water situations.

All sample locations with water will be monitored for the in-situ parameters of pH, temperature, conductivity, turbidity and dissolved oxygen. Nitrate test strips will be used at all sample locations were laboratory samples are collected to provide the laboratory an estimate of the nitrate concentration. Field measured results will be recorded on field data sheets (Appendix 2). Test strip results will be recorded on the Laboratory Chain of Custody (Appendix 4). The maintenance and cleaning procedures of the Horiba U-10 Multiporbe Meter are described in the "Instrument Inspection and Maintenance" section of the Horiba Multi-Meter SOP in Appendix 6. The probes will be cleaned with tap water followed by a deionized water rinse. The flow meter will be inspected for debris and rinsed with top water by the end of each sampling day. No special decontamination procedures are needed for the Horiba U-10 Multiprobe Meter or the flow meter. The rinsate will be disposed of in the sanitary sewer.

Grab samples will be collected in clean sample bottles provided by the lab and analyzed for the following constituents: total dissolved solids (TDS), ammonia, nitrate, nitrite, organic nitrogen, total kjeldahl nitrogen (TKN), total phosphorus, and dissolved ortho-phosphate. See Table 11 for analytical methods, sample volume, container type, sample preservation and holding times. The cleaning and decontamination procedures for analytical equipment and glass sample containers are described in section 6.7 of the Truesdail Laboratories' "Quality Assurance and Quality Control Manual for Environmental Sample Analysis" in Appendix 2. The coordination and disposal of laboratory hazardous waste procedures are discussed in section 2.7.6 in Appendix 12.

Table 11: Water Quality Analytical Parameters for Water Quality Monitoring Projects

Analytical Parameter	Analytical Method	Container Type	Sample Volume (mL)	Preservative*	Maximum Holding Time
Dissolved Oxygen	N/A	Analyzed in Field	N/A	N/A	N/A
pH	N/A	Analyzed in Field	N/A	N/A	N/A
Specific Conductivity	N/A	Analyzed in Field	N/A	N/A	N/A
Temperature	N/A	Analyzed in Field	N/A	N/A	N/A
Turbidity	N/A	Analyzed in Field	N/A	N/A	N/A
Alkalinity, Total	EPA 310.1	Plastic	250	None	14 days
Alkalinity-Bicarbonate	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Alkalinity-Carbonate	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Alkalinity-Hydroxide	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Ammonia-N	EPA 350.2	Plastic	250	Acidify to pH<2 with H2SO4	28 days
Boron	EPA 200.7	Plastic	250	Acidify to pH<2 with HNO3	6 months
Calcium, Total	EPA 200.7 / EPA 6010	Plastic	250	HNO3	6 months
Chloride	EPA 300.0, EPA 325.3	Plastic	250	None	28 days
Fluoride	EPA 300.0	Plastic	250	None	28 days
Hardness, Total	EPA 130.2 / EPA 200.7, SM 2340 B	Plastic	250	None	6 months
Iron, Total	EPA 200.7/ EPA 6010	Plastic	250	Acidify to pH<2 with HNO3	6 months
Magnesium, Total	EPA 200.7 / EPA 6010	Plastic	250	HNO3	6 months
Nitrate-N	EPA 300.0	Plastic	250	None	48 hours
Nitrite-N	EPA 354.1	Plastic	250	None	48 hours
Percent Sodium	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Ortho-Phosphate-P	EPA 365.2	Plastic	250	None	48 hours
pH	EPA 150.1	Plastic	250	None	24 hours
Potassium, Total	EPA 200.7 / EPA 6010	Plastic	250	HNO3	6 months
Residual Chlorine	EPA 330.1, SM 4500 CLD	Plastic-Aluminum wrapped	1,000	None	24 hours
Sodium, Total	EPA 200.7 / EPA 6010	Plastic	250	HNO3	6 months

Analytical Parameter	Analytical Method	Container Type	Sample Volume (mL)	Preservative*	Maximum Holding Time
Specific Conductivity	EPA 120.1, SM 2510	Plastic	250	None	28 days
Sulfate	EPA 300.0	Plastic	250	None	28 days
Total Dissolved Solids	EPA 160.1	Plastic	1,000	None	7 days
Total Kjeldahl Nitrogen	EPA 351.3	Plastic	1,000	H2SO4	28 days
Total Phosphate-P	EPA 365.3	Plastic	250	H2SO4	28 days

* All samples will be kept on ice at ≤4°C in a cooler after collection.

Corrective Actions for Field Activities

If monitoring equipment fails, SWAMP personnel will report the problem in the comment section of their field notes and will not record data values for the variables in question. Actions will be taken to replace or repair broken equipment prior to the next field use. No data will be entered into the Special Projects database that were known to be collected with any faulty equipment.

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Element 12 Sample Handling and Custody

Photo Documentation

No special handling or custody procedures are needed. The digital camera is returned to the office and the photographs are downloaded and labeled and placed in their appropriate folders.

Groundwater Level Monitoring

No special handling or custody procedures are needed.

Water Quality Samples

The grab samples collected during monitoring events will be labeled with site location, date, sample time, analysis to be performed, sample preservation (if any) and field sampler's name. All information related to each sample locations will be recorded on a Field Data Sheets (appendix 2). A sample event ID log book will be keeps to record each site visit with a unique sample event ID number. The time, date, site, and event type will be recorded next to the "Sample Event ID" in the log book. Sample bottles will be stored and transported on ice, maintaining ≤ 4 degree Celsius (^{o}C) until processed. Samples will be delivered to and analysis initiated within specific holding times (see Table 11 for specific holding times) by Truesdail. A Chain of Custody (COC) will accompany samples throughout the process.

Chain of Custody Procedures

The principle documents used to identify samples and to document possession will be COC records (Appendix 4) and field data sheets. A chain of custody form will be used to transfer the samples from field collection staff to laboratory staff.

COC procedures will be initiated during sample collection. A COC record will accompany group of samples. Each person who will have custody of the samples will sign the form and ensure the samples are not left unattended unless properly secured. Documentation of sampling handling and custody includes the following:

- Sampler identifier
- Sample collection date and time
- Sample Event ID number
- Any special notations on sample characteristics
- Signature of person(s) collecting the sample
- Date and time the sample was picked up by Truesdail staff
- Constituents to be tested, preservatives, and temperature requirements

Field staff will assure that the chain of custody is kept dry and legible. At the laboratory, check the samples against the chain of custody one last time then sign the form to relinquish the samples. Once the laboratory staff accepts the samples, they will need to date, note time, and sign the COC, and give a copy to the field staff while keeping the original form. This COC copy will be kept in a notebook in the office by the QA Officer.

During sample receipt, the laboratory will verify and document the sample condition and temperature and that the sample labels on the bottle agree with those in the chain of custody form. Any discrepancies will be noted and discussed with the sample delivery personnel or by calling the Program QA Officer. Truesdail will store the samples in accordance with the laboratory's QA/QC manual Section 4.2.2 – "Sample Storage", Page 30. COC records will be included in the final reports prepared by Truesdail and are considered an integral part of the report.

Element 13 Field Measurements and Analytical Methods

Photo Documentation

There are no specified analytical methods for photo documentation. Photo documentation will be used to document the success of the Avocado BMP demonstration and the optimization of the irrigation system in accordance with SWRCB guidelines (SWRCB 2003).

Groundwater Level Monitoring

There are no specified analytical methods for groundwater level monitoring. However, measurement procedures for groundwater levels in the existing shallow wells in Rainbow Valley will follow procedures outlined in U. S. EPA Environmental Response Team, Standard Operating Procedures for Manual Water Level Measurements.

Water Quality Samples

<u>Field Measurements</u>

Water physicochemical properties *in situ* will be measured at each site where water is flowing or ponded. The parameters measured will be pH, conductivity, turbidity, dissolved oxygen (DO), and temperature using a Horiba 6-parameter multi-meter. The following field instruments will be employed for the Rainbow Creek project: Horiba U-10 Multi-parameter Water Quality Instrument and a handheld flow meter (Global Water FP-101 handheld flow meter, Global Water FP201 handheld flow meter. SOPs for each instrument are included in Appendix 5, 6 and 7 which describe calibration, proper use, and what to do if an instrument becomes "fouled". Table 12 details the measurement principal and measurement limits for parameters measured in the field for water quality monitoring.

Table 12: Field Measurements

Constituent	Project Action Limit	Instrument	Measurement Principle	Achievable Field Limits	
				Resolution	Repeatability
Dissolved Oxygen	5.0 (mg/L)	Horiba U-10	Membrane/ galvanic cell	0.01 (mg/L)	± 0.1 (mg/L)
Flow	-----	Global Water FP-101	Propeller / electro-magnetic pickup	0.1 (ft/sec.)	0.1 (ft/sec.)
Flow	-----	Global Water FP201			
pH	<6.5 or >9.0	Horiba U-10	Glass electrode	0.01 (pH units)	0.05 (pH units)
Specific Conductivity	-----	Horiba U-10	Alternating four-electrode	0.001 (mS/cm)	± 1% of full scale
Temperature	-----	Horiba U-10	Thermistor	0.1 (°C)	± 0.3 (°C)
Turbidity	20 (NTU)	Horiba U-10	Scattering/ transmitting light	1 NTU	± 3% of full scale

<u>Analytical Methods</u>

The attached laboratory's QA/QC manual (Appendix 12) discusses operational procedures, Quality assurance, audits, facilities and equipment and other laboratory procedures and policies. The laboratory's QA/QC manual also discusses method performance criteria in Section 5.2.2 – "Performance Audits", Page 45 and in Appendix E – "Quality Control Charts for Environmental Parameters and PE Analysis Results". A list of laboratory instruments and equipment needed for laboratory analysis is included in the attached laboratory's QA/QC manual in Appendix D – "Sample Certification/Accreditations, Pages 82 to 88.

If laboratory quality control limits are exceeded (i.e. process is out-of-control or failure), corrective action(s) shall be taken and documented (see laboratory's QA/QC manual Section 7 – "Corrective Action", Pages 54 to 56 and the laboratory's QA/QC manual, Appendix B, Page 71 for the Corrective Action Form), with regard to:

- Indication/description of the out-of-control situation
- Cause that was discovered
- Action taken to resolve problem
- Was the corrective action acceptable?

Sample will be re-analyzed if possible. If the out-of-control process, failure, or out of calibration conditions affected project data results, notification from the laboratory Project Manager will be sent to the Science and Monitoring Group QA Officer and will be filed in the project binder.

Laboratory sample disposal procedures are outline in the laboratory's QA/QC manual Section 4.2.3 – "Sample Disposal", Page 40. Laboratory analysis turnaround times are specified as "normal", which are standard industry acceptable times depending on parameter analyzed. Expedited sample analysis may be request with a surcharge. Table 12 lists the standard analytical methods for each constituents analyzed by Truesdail. Truesdail will be the sole laboratory to analyze all constituents listed below.

Table 13: Laboratory Analytical Methods

Analyte	Project Action Limit	Project Quantitation Limit	Analytical Methods		Achievable Laboratory Limits	
			Analytical Method	Modified for Method (Y/N)	Method Detection Limits[1]	Laboratory Reporting Limits[2]
Alkalinity, Total	-----	5.0 (mg CaCO3/L)	EPA 310.1	N	1.44 (mg CaCO3/L)	5.0 (mg CaCO3/L)
Alkalinity-Bicarbonate	-----	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Alkalinity-Carbonate	-----	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Alkalinity-Hydroxide	------	By Calculation	By Calculation	By Calculation	By Calculation	By Calculation
Ammonia-N	0.25 (mg/L unionized)	0.50 (mg/L)	EPA 350.2	N	0.11 (mg/L)	0.50 (mg/L)
Boron	0.75 (mg/L)	0.020 (mg/L)	EPA 200.7	N	0.00084 (mg/L)	0.020 (mg/L)
Calcium, Total	-----	0.20 (mg/L)	EPA 200.7 / EPA 6010	N	0.015 (mg/L)	0.20 (mg/L)
Chloride	250 (mg/L)	0.20 (mg/L)	EPA 300.0, EPA 325.3	N	0.044 (mg/L)	0.20 (mg/L)
Fluoride	1.0 (mg/L)	0.2 (mg/L)	EPA 300.0	N	0.018 (mg/L)	0.2 (mg/L)

Analyte	Project Action Limit	Project Quantitation Limit	Analytical Methods		Achievable Laboratory Limits	
			Analytical Method	Modified for Method (Y/N)	Method Detection Limits[1]	Laboratory Reporting Limits[2]
Hardness, Total	-----	2.0 (mg CaCO3/mL)	EPA 130.2 / EPA 200.7, SM 2340 B	N	0.60 (mg CaCO3/mL)	2.0 (mg CaCO3/mL)
Iron, Total	0.3 (mg/L)	20 (ug/L)	EPA 200.7/ EPA 6010	N	0.95 (ug/L)	20.0 (ug/L)
Magnesium, Total	-----	0.03 (mg/L)	EPA 200.7 / EPA 6010	N	0.0079 (mg/L)	0.03 (mg/L)
Nitrate-N	0.20 (mg/L)	0.20 (mg/L)	EPA 300.0	N	0.017 (mg/L)	0.20 (mg/L)
Nitrite-N	1.0 (mg/L)	0.005 (mg/L)	EPA 354.1	N	0.001 (mg/L)	0.005 (mg/L)
Percent Sodium	-----	By Calculation	By Calculation	N	By Calculation	By Calculation
Ortho-Phosphate-P	0.1 (mg/L)	0.02 (mg/L)	EPA 365.2	N	0.004 (mg/L)	0.02 (mg/L)
pH	<6.5 or >9.0	0.1 (pH units)	EPA 150.1	N	0.1 (pH units)	0.1 (pH units)
Potassium, Total	-----	0.20 (mg/L)	EPA 200.7 / EPA 6010	N	0.0021 (mg/L)	0.20 (mg/L)
Residual Chlorine	-----	0.10 (mg/L)	EPA 330.1, SM 4500 CLD	N	0.018 (mg/L)	0.10 (mg/L)
Sodium, Total	-----	0.20 (mg/L)	EPA 200.7 / EPA 6010	N	0.00044 (mg/L)	0.20 (mg/L)
Specific Conductivity	-----	2.0 (umhos/cm)	EPA 120.1, SM 2510	N	0.14 (umhos/cm)	2.0 (umhos/cm)
Sulfate	250 (mg/L)	0.5 (mg/L)	EPA 300.0	N	0.031 (mg/L)	0.5 (mg/L)
Total Dissolved Solids	750 (mg/L)	25.0 (mg/L)	EPA 160.1	N	1.28 (mg/L)	25.0 (mg/L)
Total Kjeldahl Nitrogen	1.0 (mg/L)	0.80 (mg/L)	EPA 351.3	N	0.41 (mg/L)	0.80 (mg/L)
Total Phosphate-P	0.1 (mg/L)	0.02 (mg/L)	EPA 365.3	N	0.004 (mg/L)	0.02 (mg/L)

[1] Method detection limits are subject to change.
[2] Laboratory detection limits are subject to change.

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Element 14 Quality Control

Field Measurements

Photo Documentation

Consistency is the most important component of photo documentation. Photos will be taken from the same position and at the same bearing and vertical angle each survey. Photo stations should be thoroughly documented, including photographs taken of the station.

In the field, copies of previous photos will be referenced to verify position and angle of the photo. The camera should have a level view unless the terrain is sloped. Lighting is important to the quality of the photo, so consideration should be given to the angle of light, cloud cover, background, shadows, and contrasts. It is often important to include a reference item to convey the scale of the image, such as a ruler or stadia rod. A dry-erase board will also be used to identify the specific photo station, date, and time of photograph.

Groundwater Level Monitoring

Groundwater level measurements will be made using Solinst® Water Level Meter (Model 101) according to manufacturer's specifications. Duplicate readings will be made in the field. Proper equipment storage and maintenance procedures will be followed.

Water Quality Samples

Water quality field measurements for pH, conductivity and temperature will be made using a Horiba U-10 multi-meter according to manufacturer's specifications. Calibration will be conducted prior to each sampling event. Duplicate readings will be made in the field. Proper equipment storage and maintenance procedures will be followed.

Chemistry Analyses

Water Quality Samples

Quality control (QC) checks for laboratory will be used to ensure that valid data are collected. Quality assurance and quality control for sampling processes begins with proper collection of the samples in order to minimize the possibility of contamination. All water samples are collected in laboratory provided sample containers.

Field blanks will be collected at a rate of one (1) sample per twenty-four (24) samples (once every other sampling event) collected for laboratory analysis and field testing. Field blanks are check samples that monitor contamination originating from the collection, transport or storage of environmental samples. A field blank is analyte-free water (i.e. deionized water) that is poured into the sample collection device and sub-sampled for chemistry analyses to verify that field cleansing procedures are adequate and sampling handling and transportation does not introduce any analytes of interest. The results from field blanks are reported in the report as part of the Data Quality Control and Quality Assurance discussion; however, they are not used to correct (blank adjust) any of the resultant analytical concentrations on field samples. Field blanks will be collected and analyzed in the laboratory for the following constituents: nitrite-N, nitrate-N, total Kjeldahl nitrogen, ammonia-N, total phosphate-P and orthophosphate-P.

Field duplicates will be collected for each Rainbow Creek sampling event, approximately one (1) sample per twelve (12) samples collected for field and laboratory analyses. Field duplicates are two samples collected at the same time and location using two sampling bottles, and processed and analyzed in an identical manner. Field duplicates will be collected and analyzed in the laboratory for the following constituents: nitrite-N, nitrate-N, total Kjeldahl nitrogen, ammonia-N, total phosphate-P and orthophosphate-P.

The chemistry analysis of samples in the laboratory will be performed under the guidelines of the quality assurance and quality control programs established by Truesdail (see laboratory's QA/QC manual Section 3 – "Environmental Quality Assurance Program", Pages 19 to 27). This includes a blank, laboratory duplicate, laboratory control sample (LCS), laboratory control samples duplicate (LCS Dup), matrix spike, and matrix spike duplicate, per analytical batch of 20 or fewer samples. Duplicate analyses will be prepared by taking two aliquots of sample from the same sample container. The relative percent difference of these two analyses is used to define the precision of the measured result. A matrix spike is a sample prepared by adding a known mass of a target analyte to a specified amount of sample matrix for which an independent estimate of the target analyte concentration is available. Matrix spikes are used to evaluate any bias to the analysis from the sample matrix. A LCS is prepared from a certified standard that is spiked into purified water and analyzed in the same way as with environmental samples. The LCS is used to demonstrate method proficiency irrespective of matrix. The procedures and formulas for calculating precision and accuracy can be found in the laboratory's QA/QC manual in Section 3.4 – "Precision and Accuracy Procedures" on Pages 25 and 26.

If laboratory quality control limits are exceeded (i.e. process is out-of-control or out of calibration conditions), corrective action(s) shall be taken and documented (see laboratory's QA/QC manual Section 7 – "Corrective Action", Pages 54 to 56 and the laboratory's QA/QC manual, Appendix B, Page 71 for the Corrective Action Form), with regard to:

- Indication/description of the out-of-control situation
- Cause that was discovered
- Action taken to resolve problem
- Was the corrective action acceptable?

Sample will be re-analyzed if possible. If the out-of-control process or out of calibration conditions affected project data results, notification from the laboratory Project Manager will be sent to the Science and Monitoring Group QA Officer and will be filed in the project binder.

The data quality indicators for laboratory and field measurements will be calculated as follows:

Precision will be calculated as the relative standard deviation (% RSD):

$$\%RSD = \frac{s}{\overline{X}} \times 100$$

Where s is the standard deviation and $\overline{X}$ is the mean of repeated samples.

Accuracy and recovery will be expressed as percent recovery (% R).

$$\%R = \frac{\text{Measured value}}{\text{Known value}} \times 100$$

The measured value may be the mean of several replicate analyses of a spiked sample/standard.

Completeness will be expressed as percent completeness (%C) for measurement parameters:

$$\%C = V/T \times 100$$

Where V is the number of measurements judged valid and *T* is the planned number of measurements.

Element 15 Instrument/Equipment Testing, Inspection and Maintenance

Field Measurements

<u>Photo Documentation</u>

The survey equipment will be maintained in accordance with the manufacture's specifications. Prior to the survey, the equipment will be checked for proper operation including battery checks and adequate memory space for the digital photos. Equipment will also be inspected upon return for damage.

<u>Groundwater Level Monitoring</u>

The groundwater level equipment will be maintained in accordance with the manufacture's specifications. Prior to the survey, the equipment will be checked for proper operation including battery checks. Equipment will also be inspected upon return for damage. This check will include confirming proper communications between office computer and field water level pressure sensor.

<u>Water Quality Samples</u>

Equipment will be cleaned and inspected upon return from each sample day/event. The Horiba's multi-meter probes will be replaced at the first sign of deviation from standard solution concentrations and noted in the instrument logbook. The Horiba will be checked by field staff for calibration before and after each use which will be documented in the instrument logbook. All field staff will be responsible to ensure that the Horiba has been calibrated properly before each use. Quarterly, a full calibration of the Horiba will be conducted by staff to insure the instrument meets manufacture's specifications and will be documented in the instrument logbook (see Appendix 5, Horiba U-10 Multi-Meter SOP). If calibration results are not within the manufacture's specifications, sensors will be replaces with new parts. Spare parts will be stored in a secure location in the office or will be readily available through the County's vendor. The handheld flow meter will be checked before each measurement to ensure that propeller is free of debris and moves freely (see Appendix 7, Flow Meter SOP). The digital camera will have fresh spare batteries available vehicle (see Appendix 8, Photo Documentation SOP). No other field equipment for this project requires maintenance.

Analytical Laboratory

Truesdail maintains its equipment in accordance with its standard operating procedures (SOPs), which include those specified by the manufacturer and those specified by the method. Truesdail's "laboratory's QA/QC manual" details their equipment and systems testing, inspection, maintenance, and calibration specifications and schedule (see laboratory's QA/QC manual Section 4.4 – "Calibration Procedures and Frequency", Pages 32 to 35). If deficiencies are encountered, the laboratory's QA/QC manual Section 7 – "Corrective Action", Pages 54 to 56 details how their corrective actions are to be conducted.

Element 16 Instrument/Equipment Calibration and Frequency

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All equipment and instruments used by the Science and Monitoring Group are operated and calibrated according to the manufacturer's recommendations as well as by criteria defined in individual SOPs (see Appendix for individual SOPs). Operation and calibration are performed by field staff personnel trained in these procedures. Documentation of all routine and special calibration information is recorded in appropriate logbooks. If a critical measurement is found to be out-of-compliance during analysis, the results of that analysis will not be reported, corrective action will be taken and documented, and the analysis repeated if possible.

Field Equipment

Photo Documentation

The survey equipment does not need calibration for photo documentation.

Groundwater Level Monitoring

The survey equipment does not need calibration for groundwater level measurements.

Water Quality Samples

The Horiba U-10 6-parameter multi-meter used for field *in-situ* measurements will be calibrated prior to use each day using an Autocal calibration procedure. The meter will then be tested using pH 7 and pH10 solutions to verify that the meter is meeting the DQOs. Upon return to the lab from the field (post deployment), the pH 7 and pH 10 solutions will be checked and results recorded. Data will be recorded in a calibration data sheet located in the instrument logbook. If measured results do not meet the DQOs then multi-meter will be recalibrated using the two-point calibrations methods. Calibration frequency for pH, dissolved oxygen, conductivity, and turbidity is approximately every three (3) months (see Appendix 5 for the Horiba daily calibration data sheet and Appendix 6 for the Horiba SOP).

Analytical Laboratory

Truesdail calibrates its instruments at a frequency that ensures validity of the results. Truesdail's calibration procedures follow USEPA guidelines and the recommendations of the instrument manufacturer. Truesdail's "laboratory's QA/QC manual" details their equipment and systems testing, inspection, maintenance, and calibration specifications and schedule. (see laboratory's QA/QC manual Section 4.4 – "Calibration Procedures and Frequency", Pages 32 to 35). If deficiencies are encountered, the laboratory's QA/QC manual Section 7 – "Corrective Action", Pages 54 to 56 details how their corrective actions are to be conducted.

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Element 17 Inspection/Acceptance of Supplies and Consumables

The County of San Diego only purchases supplies and consumables for approved vendors that meet the County of San Diego's Purchasing and Contracting Departments strict guidelines. Critical supplies for this project include sensor parts, calibration standard solutions, buffer solutions, and reagents and will be maintained by Steve DiDonna.

Upon receipt, sensor parts, buffer solutions, standards, and reagents used in the County office laboratory or field will be inspected for leaks, broken seals, or damage. Reagents are replaced before they exceed manufacturer's recommended shelf life. These shelf lives are typically one to two years. However, specific replacement dates can be determined by providing the reagent lot number to the manufacturer. Reagent replacement dates are noted in the reagent log sheet. Field staff will be responsible for keeping the reagent log sheet and ensure that buffer solutions, standards, and reagents used in the laboratory or field will be inspected for leaks or broken seals and replacing if necessary, and also that consumables are replaced before they exceed manufacturer's recommended shelf life. These supplies and consumables are stored on-site in a secure location and are stored in accordance with manufacture's specifications.

All sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation of the sensors on a regular basis.

Truesdail procedure for inspection/acceptance of supplies and consumables is detailed in their "laboratory's QA/QC manual" in Section 6.4 – "Reagents, Solvents and Gases", Pages 49 to 50, Section 9.2 – "Approved Vendors", Page 60, and Section 11 – "Age Control", Page 62.

Element 18 Non-Direct Measurements

Photo Documentation

There will be no non-direct measurements used for the photo documentation portion of the project.

Groundwater Level Monitoring

Non-direct measures will be used to support the selection of well sites and to assist in the development of a monitoring plan for groundwater level in Rainbow Valley. These measures include data collected from County of San Diego Department of Environmental, and data obtained from other agencies. In addition, photo documentation, topographical maps, land use maps, and hydrological maps generated from SANDAG and County of San Diego GIS databases, may be used.

Water Quality Samples

Non-direct measures will be used to support the selection of sampling sites and to assist in the development of a monitoring plan for Rainbow Creek. These measures include data collected from previous years of County of San Diego's Dry Weather Monitoring Program, other special projects, RWQCB SWAMP data, and data obtained from other agencies. In addition, photo documentation, topographical maps, land use maps, and hydrological maps generated from SANDAG and County of San Diego GIS databases, may be used. Any non-direct data used in this project must meet the criteria as stated in Element 7 for measurement quality objectives.

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Element 19 Data Management

Data will be maintained and stored as established in Element 9. All original field data sheets, statistical worksheets, and reports produced will be accumulated into project specific files that are maintained at the Science and Monitoring Groups office. Data files, databases and final report text and tables are maintained on the County of San Diego network in a project specific folder and are backed up daily for storage offsite.

Photo Documentation

Photo files will be named using site and date identifiers.

Groundwater Level Monitoring

Field data sheets will be entered into an Excel spreadsheet developed specifically for the groundwater level project by field staff. Once the field sheets are entered, the data sheets are dated and initialed by field staff. The QA officer will review the field sheets for completeness and accuracy after input. The real-time groundwater level monitoring data will be stored in the County of San Diego Flood Warning System database.

Water Quality Samples

Field data sheets are entered into the Science and Monitoring group's Special Project database by field staff according to the Database Entry SOP (Appendix 11). Once the field sheets are entered, the data sheets are dated and initialed by field staff. The QA officer will review the field sheets for completeness and accuracy after input into the Special Project database.

Following initial data entry the QA officer will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that measurement quality objectives have been met, data analysis can be performed.

Truesdail Laboratory records pertinent to this project will be maintained at Truesdail's main office. Copies of all records held by Truesdail will be provided to the Science and Monitoring Group both electronically, in specified format, and by hard copy and stored in the project file and in a computer folder on the County of San Diego's network. The QA officer will review laboratory electronic data and compare to the hard copy version to confirm that the proper parameters were analyzed and that there are no errors. After performing data checks, and ensuring that measurement quality objectives have been met, data analysis can be performed. All analytical data will be structured as described in the SWAMP Database SOPs for Submitting Laboratory Analytical Data to the SWAMP Database (Appendix 13) and they will be uploaded into the SWAMP database by batch loading using SDTP (see Appendix 13). Microsoft Office Access 2003 will be used for data entry, storage and retrieval. Data will be further processed, summarized and illustrated using Microsoft Office Excel 2003. Data analysis will be performed using Microsoft Office Excel 2003 and SPSS statistical software package.

Group C:
Assessment and Oversight

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Element 20 Assessment and Response Actions

The commitment to using approved equipment and approved methods when obtaining water samples and when producing field measurements and/or laboratory analyses must have periodic verification that sampling and measurement methods are, in fact, being employed as planned. The internal and/or external verification is required to ensure that:

- All elements of the QAPP are correctly implemented as prescribed.
- The quality of data generated by implementation of the QAPP is adequate.
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

Although external assessments including a 3rd party audit may be employed when needed, internal assessments will provide sufficient information about the degree of implementing the QAPP. All assessment reviews will be made by the Science and Monitoring Group QA Officer. Reviews of field activity will be preformed every three months. The assessment information will be reported to the Jo Ann Weber, the Project Manager. Reviews will include, but is not limited to, the examination of equipment, record keeping, sampling procedures, sample handling and transportation, and field documentation (SOPs).

For Truesdail, system and performance audits are thorough and systematic onsite qualitative assessments. The audits will include, but is not limited to, the examination of facilities, equipment, personnel, training, procedures (SOPs), and record keeping for conformance to their QAPP.

Assessments will be accomplished by conducting performance evaluation and technical systems audit on field sampling, field measurement, and laboratory analysis. “Blind” samples will be used for performance evaluation. “Blind” samples are those whose identity is unknown to those operating the measurement system. These can be standards or duplicate samples. Use of these materials will allow for assessment of measurement quality objectives such as precision and accuracy.

The QA Officer has the power to halt all sampling and analytical work conducted by both the Science and Monitoring Group and Truesdail if the deviation(s) noted are considered detrimental to data quality.

Corrective Action Plans

An out-of-control event is defined as any occurrence failing to meet pre-established criteria. A nonconformance is a deficiency in characteristic, documentation, or procedure sufficient to make the quality indeterminate or unacceptable. An out-of-control event is a subcategory of nonconformance.

When either situation is identified, it will be categorized as:

> **Deficiency:** Recognition of a specific requirement (e.g., program, process, or procedure) that has been violated.

Observation: Recognition of an activity or action that might be improved but is not in violation of a specific requirement. Left alone, the activity or action may develop into a deficiency.

Criteria Used for Determination of an Out-of-Control Event

Factors that affect data quality (failure to meet calibration criteria, inadequate recordkeeping, improper storage or preservation of samples) require investigation and corrective action. When a nonconformance is recognized, each individual involved with the analysis in question has an interactive role and responsibility. These are as follows:

- **Technician:** He/She must be able to recognize nonconformances and immediately notify the Laboratory Manager and work with the Quality Assurance Officer to solve the problem. Each technician is responsible for documenting and correcting problems that might affect quality.

- **Laboratory Manager:** He/She must review all analytical and QC data for reasonableness, accuracy, and clerical errors. In an out-of-control event, the Laboratory Manager works with the analyst and Quality Assurance Officer to solve the problem and prevents the reporting of suspect data by stopping work on the analysis in question and insuring that all results that are suspect are repeated, if possible, after the source of the error is determined and remedied. Clients are notified in writing when their samples are affected by an out-of-control event or results of an internal audit. In the event that a QC measure is out-of-control and the data are to be reported, qualifiers are reported together with sample results.

- **Quality Assurance Officer:** In the event that an out-of-control situation occurs that is unnoticed at the bench or supervisory level, the Quality Assurance Officer will notify the Laboratory Manager; help identify and solve the problem where applicable; ensure the work is stopped on the analysis; and verify that no suspect data are reported. The Quality Assurance Officer must review and approve all corrective action reports and submit them to the Laboratory Manager for review.
The Quality Assurance Officer is responsible for reviewing nonconformance report forms, recommending or approving proposed corrective actions, maintaining an up-to-date nonconformance log, and verifying that corrective actions have been completed.

Procedures for Stopping Analysis

Whenever the analytical system is out-of-control, investigation and correction efforts are initiated by all concerned personnel as outlined in Table 15. If the problem is instrumental or specific only to preparation of a sample batch, samples are reprocessed after the instrument is repaired and recalibrated.

Laboratory Corrective Action

If an audit discovers any discrepancy, the Science and Monitoring Group QA Officer will discuss the observed discrepancy with the appropriate person responsible for the activity (see organization chart). The discussion will begin with whether the information collected is accurate, what were the cause(s) leading to the deviation, how the deviation might impact data quality, and what corrective actions might be considered.

Any findings of practice or procedure that do not conform to the written QAPP must be addressed in a timely manner. Any inadequacy will be documented and notified in a response letter to the laboratory Project Manager. The laboratory Project Manager is then responsible for making any corrections needed and to report in writing these corrective actions to the Science and Monitoring Group QA officer. Copies of the documentation are filed in the project binder. Follow-up inspections may be used to confirm that deficiencies have been addressed and corrected.

If an internal laboratory process is out-of-control or other problem, corrective action(s) shall be taken and documented (see laboratory's QA/QC manual Section 7 – "Corrective Action", Pages 54 to 56 and the laboratory's QA/QC manual, Appendix B, Page 71 for the Corrective Action Form), with regard to:

- Indication/description of the out-of-control situation
- Cause that was discovered
- Action taken to resolve problem
- Was the corrective action acceptable?

If the out-of-control process or out of calibration conditions affected project data results, notification from the laboratory Project Manager will be sent to the Science and Monitoring Group QA Officer and will be filed in the project binder.

Field Corrective Action

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. The QA Officer is responsible for verifying that all QC procedures are followed. This requires that the QA Officer assess the correctness of the field methods and the ability to meet QA objectives and make a value judgment regarding the impact a procedure has upon the field objects and subsequent data quality. If a problem occurs that might jeopardize the integrity of the project, cause a QA objective not to be met, or impact data quality, the field staff will immediately notify the QA Officer or the Project Manager. Corrective action measures are then decided upon and implemented. The QA Officer documents the situation, the field objective affected, the corrective action taken, and the results of the action. Copies of the documentation are filed in the project binder.

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Element 21 Reports to Management

Table 13 outlines the schedule of reports due to the Project Manager and SWRCB Grant Manager.

Table 14: Reports to Management

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Surface Water Sampling and Analysis Plan	One Time	April 20, 2006	Sheri McPherson	Jon Van Rhyn, Program Manager County of San Diego And Tony Felix Grant Manager SWRCB
Groundwater Sampling and Analysis Plan	One Time	July 20, 2006	Sheri McPherson	
Quality Assurance Project Plan	One Time	May 20, 2006	Sheri McPherson and Joanna Wisniewska	
Quarterly Update Reports	Quarterly	Varies	Joanna Wisniewska	
Water Quality Monitoring Analysis and Summary	Annually	April 20, 2007 April 20, 2008 September 20, 2008	Li-Ming He	
Groundwater Level Monitoring Summary	Annually	April 20, 2007 April 20, 2008 September 20, 2008	Joanna Wisniewska	
Results of BMP Effectiveness Monitoring	Annually	April 20, 2007 April 20, 2008 September 20, 2008	Joanna Wisniewska	
Pollutant Load Reduction Report	Annually	April 20, 2007 April 20, 2008 September 20, 2008	Joanna Wisniewska	

Group D:
Data Validation and Usability

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Element 22 Data Review, Verification and Validation

Data validation is the process whereby data are filtered and accepted or rejected, based on a set of criteria. It is a systematic procedure of reviewing a body of data against a set of criteria to provide assurance of its validity prior to its intended use. All data are checked for accuracy and completeness. The data validation process consists of data generation, reduction, and review (see Element 7 – "Measurement quality objectives and Criteria for Measurement Data" for required criteria to accept project data as SWAMP compatible and Element 23 - Verification and Validation Methods).

Data reduction, validation, and reporting are on-going processes which involve the technicians, Laboratory Managers, and QA personnel. The Science and Monitoring Group QA Officer will be responsible for the data review, verification, and validation.

Truesdail's internal data reduction and validation is describes in detailed in the laboratory's QA/QC manual Section 4.7 – "Data Reduction and Validation", Pages 40 and 41.

Element 23 Verification and Validation Methods

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Database Generation

After each site visit, the field data sheets are checked for completeness and accuracy by the QA Officer. Field data sheets are placed into the Rainbow Creek binder and are labeled with the sampling date.

The data for all field analyses are entered directly onto data sheets. All data sheets are completed in waterproof ink and initialed by the technician, who is responsible for scanning the sheet to be sure it is complete and accurate.

The technician who generates the data has the prime responsibility for the accuracy and completeness of the data. Each technician reviews the data to ensure that:

- Sample description information is correct and complete
- Analysis information is correct and complete
- Results are correct and complete
- Documentation is complete

Data sheets are entered into the Special Projects database by field staff with oversight of the QA Officer (see Appendix 11 for Database Entry SOP). Once the datasheet is entered, the technician will date and initial the top of the datasheet. The datasheet(s) will then be placed in the appropriate project binder in a logical order.

Error Checking and Verification

On a monthly basis, 10% of the data entries are screened by the QA Officer or designee. If any errors are found they are corrected and noted on original datasheet. If no errors are found, the datasheet is marked with a "√" and initialed. If any errors are found, they are corrected.

Laboratory data validation is performed by the Laboratory Manager and is reviewed by the QA Officer, if an outlier or other question arises with the data, the QA Officer will contact the Laboratory Manager of any discrepancies found. Data validation is accomplished through routine audits of the data collection procedures and by monitoring of QC sample results.

Data validation includes dated and signed entries by the technicians and Laboratory Manager on the benchsheets and notebooks used for all samples; the use of sample tracking and numbering systems to track the progress of samples through the laboratory; and the use of quality control criteria to reject or accept specific data.

The minimum requirements for each analytical run area:

- Matrix spike and duplicate analyses per concentration level and per matrix for every sample batch analyzed (where appropriate).

- Reference materials analyses are compared with "true" values and acceptable ranges. Values outside the acceptable ranges indicate that the sample values are invalid. Following correction of the problem, the reference material should be reanalyzed.

The QA Officer will verify that the parameters listed on the laboratory COC matches electronic data and the hard copy version to confirm that the proper parameters were analyzed and that there are no errors. If the list of parameter from the COC does not match the electronic data and the hard copy versions, the QA Officer will contact Truesdail's Project Manager for information and corrective action. Documentation on corrective actions will be placed in the Rainbow Creek project binder.

Data Reporting

Data tables are created and printed. Tables are reviewed for any errors or irregularities; if any are found it may be necessary to correct and reestablish the databases. Tables are submitted to Project Manager for review. The tables and report are edited by at least two of the following three people; the QA Officer, the Project Manager, and the Laboratory Project Manager. The report returns to the office staff for any corrections, and then the final draft is reviewed once again by the QA Officer. The Project Manager signs the letter of transmittal.

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Element 24 Reconciliation With User Requirements

The QA Officer will review data after each survey to determine if data quality objectives (DQOs) have been met. If data do not meet the project's specifications, the QA Officer will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors. They will suggest corrective action. It is expected that the problem would be able to be corrected by retraining, revision of techniques, or replacement of supplies/equipment. If not, then the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the quality assurance personnel will recommend appropriate modifications. Any revisions would need approval by the Jo Ann Weber, Project Manager.

The data collected by the Science and Monitoring Group will be analyzed using basic scientific and statistical analysis and used by the County of San Diego for water quality assessment. These data will be used to analyze water quality trends over time. The data collected from this project will be SWAMP compatible and assist in determining if target BMPs are effective over time. These objectives will be accomplished by comparing future water quality measurement results to the current established baseline water quality values.

All limitations on data use will be reported to end users in the Quarterly Reports, the Monitoring Analysis and Summary, the Results of BMP Effectiveness Monitoring and the Pollutant Load Reduction Report.

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Appendix 1 –Groundwater Level Field Datasheet

COUNTY OF SAN DIEGO
WATERSHED PROTECTION PROGRAM

DEPARTMENT OF PUBLIC WORKS
9325 HAZARD WAY, SAN DIEGO, CA 92123

Groundwater Level Field Datasheet

Date____________________ **Staff**____________________

Well Site ID	Time	Depth to Groundwater from Reference Point (feet)	Distance from Ground to Reference Point (feet)	Depth to Groundwater from Ground Surface (feet)

Weather:	☐ Sunny	☐ Partly Cloudy	☐ Overcast	☐ Fog
Last Rain:	☐ > 72 hours	☐ < 72 hours		
Amount of Rainfall if <72 hours:	☐ < 0.25”	☐ 0.25” to 0.50”	☐ 0.51” to 1.00”	☐ > 1.00”

Note any surface flows and any observed pumping of other wells in the vicinity.

Comments:____
____
____
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Appendix 2 Field Data Sheet

COUNTY OF SAN DIEGO
WATERSHED PROTECTION PROGRAM

DEPARTMENT OF PUBLIC WORKS
9325 HAZARD WAY, SAN DIEGO, CA 92123

FIELD SAMPLING DATASHEET

New Site? ☐ Yes ☐ No **Project:** Rainbow Creek 319(h) Grant

GENERAL SITE DESCRIPTION

Site ID		**Site Type**	Original	**Sample Event ID**		**Sample Event Type**		Field Screening
Location	Rainbow Creek @					Watershed	**Hydrologic Unit**	902
Date		**Time**		**Latitude**			**Hydrologic Area**	902.2
Field Staff				**Longitude**			**Hydrologic Subarea** (Optional)	902.23

QC Sample	☐ None	☐ Orig-Dup	☐ QC-Dup	☐ Orig-Blank	☐ QC-Blank	☐ Field Standard	
Land Use (Primary) (Check one only)	☐ Residential	☐ Rural Resid.	☐ Comm.	☐ Indust.	☐ Agr.	☐ Parks	☐ Open
Land Use (Secondary) (Optional, >10%)	☐ Residential	☐ Rural Resid.	☐ Comm.	☐ Indust.	☐ Agr.	☐ Parks	☐ Open
Conveyance (Check one only)	☐ Concrete Channel	☐ Natural Creek	☐ Earthen Channel	☐ Manhole	☐ Catch Basin	☐ Outlet	

FLOW OBSERVED ☐Yes ☐ No ☐ Ponded **REFERRAL #** ________ **DISCHARGE AREA** (Optional) ______

GENERAL CONDITION

Weather ☐ Sunny ☐ Partly Cloudy ☐ Overcast ☐ Fog **Last Rain** ☐ > 72 hours ☐ < 72 hours

OBSERVATIONS N/A

Odor	☐ None	☐ Musty	☐ Rotten Eggs	☐ Chemical	☐ Sewage	☐ Other
Color	☐ None	☐ Yellow	☐ Brown (Silty)	☐ White (Milky)	☐ Gray	☐ Other
Clarity	☐ Clear	☐ Slightly Cloudy	☐ Opaque			☐ Other
Floatables	☐ None	☐ Trash	☐ Bubbles/Foam	☐ Sheen	☐ Fecal Matter	☐ Other
Deposits	☐ None	☐ Coarse Particulates	☐ Fine Particulates	☐ Stains	☐ Oily Deposits	☐ Other
Vegetation	☐ None	☐ Limited	☐ Normal	☐ Excessive		☐ Other
Biology	☐ None	☐ Insects	☐ Algae	☐ Snails/Fish	☐ Mussels/Barnacles	☐ Other

FLOW MEASUREMENT N/A

Flowing Creek	**T1**	**T2**	**T3**	**Average**	
Width					ft
Depth					ft
Velocity					ft/sec
Flow Rate					cfs

Evidence of Overland Flow? ☐ Yes ☐ No ☐ Irrigation Runoff ☐ Other ____________

Outlet Diameter ____________ Liters/Second ____________

Leaf Float Distance________ft Time__________sec

FIELD MEASUREMENT N/A

Field Screening Sample Collected? ☐ Yes ☐ No

Is the sample filtered? ☐ Yes ☐ No

Analytical Lab Sample Collected? ☐ Yes ☐ No

Parameter	**Reading**	**Parameter**	**Reading**	**Parameter**		**1st**	**Dil. Times**	**Dil. Reading**	**Final**
pH (Unit)		DO (mg/L)		Phosphate (PO_4)	mg/L				
Cond (mS/cm)		Temp (°C)		Nitrate (NO_3)					
Turb (NTU)		Salinity (%)		Ammonia (NH_3-N)					

COMMENTS: ____

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____

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Completed by________________

COUNTY OF SAN DIEGO
WATERSHED PROTECTION PROGRAM

DEPARTMENT OF PUBLIC WORKS
9325 HAZARD WAY, SAN DIEGO, CA 92123

Land Use Types

1. **Residential**
   Single- and multi-family homes, mobile home parks, etc.
2. **Rural Residential**
   Single family homes located in rural areas with lot sizes of approximately 1 to 10 acres. Rural residential estates may have small orchards, fields or small storage buildings associated with the residential dwelling unit, etc.
3. **Commercial**
   Offices, schools, shopping centers, auto dealerships, government/civic centers, cemeteries, churches, libraries, post offices, fire/police stations, military use, jails, prisons, border patrol holding stations, dormitories, hotels, motels, resorts, and casinos, etc.
4. **Agricultural**
   Orchards, vineyards, nurseries, greenhouses, flower fields, dairies, livestock, poultry, equine ranches, row crops and grains, pasture, fallow, etc.
5. **Industrial**
   Shipbuilding, airframe, aircraft manufacturing, industrial parks, manufacturing uses such as lumber, furniture, paper, rubber, stone, clay, and glass; auto repair services/recycling centers; warehousing, wholesale trade; mining, sand and gravel extraction, salt evaporation; junkyard, dumps/landfills; auto wrecking/dismantling and recycling centers, etc.
6. **Parks**
   Recreation areas and centers, neighborhood parks, wildlife and nature preserves, golf courses, accessible sandy areas along the coast or major water bodies allowing swimming and picnicking, etc.
7. **Open**
   Vacant and undeveloped lands, etc.

Watersheds

HU	Watershed
902	Santa Margarita River
903	San Luis Rey River
904	Carlsbad
905	San Dieguito River
907	San Diego River
909	Sweetwater River
910	Otay River
911	Tijuana River

Action Levels

Field Screening Analyte	Action Level
pH	<6.5 or >9.0
Orthophosphate-P (mg/L)	2.0 (**6.0 PO_4**)
Nitrate-N (mg/L)	10.0 (**44.3 NO_3**)
Ammonia-N (mg/L)	**1.0**
Turbidity (NTU)	BPJ
Temperature (°F or °C)	BPJ
Conductivity (µS/cm)	BPJ

Laboratory Analyte	Action Level
MBAS (mg/L)	1.0
Oil and Grease (mg/L)	15
Diazinon & Chlorpyrifos (µg/L)	0.5
Dissolved Cd, Cu, Pb, Zn (µg/L)	CTR
Total Coliform (MPN/100 mL)	50,000
Fecal Coliform (MPN/100 mL)	20,000
Enterococcus (MPN/100 mL)	10,000

Sample Event Type: Field Screening, Source ID, QC-Duplicate, QC-Blank, QC-Standard, and Confirmation.

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Appendix 3 –Photo Documentation Field Data Log

Project:

Location:

Date:

Photographer:

Team members:

Photo #	Time	Photo Point ID	Photo Pt. Description & Location	Bearing to Subject	Subject Description

General Notes or Comments (weather, cloud cover, time of sunrise and sunset, other pertinent information):

Appendix 4 Laboratory Chain of Custody

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TRUESDAIL LABORATORIES, INC.
14201 FRANKLIN AVENUE - TUSTIN, CA 92780-7008
(714) 730-6239 - FAX (714) 730-6462

CHAIN OF CUSTODY

X TURNAROUND TIME Normal TAT
DATE: ______ PAGE: ____ OF ______

COMPANY COUNTY OF SAN DIEGO
CONTACT Sheri McPherson
PHONE 858-495-5285 FAX 858-495-5263
ADDRESS 9325 Hazard Way
San Diego, CA 92123

PROJECT: Rainbow Creek Monitoring Project

SAMPLER (SIGNATURE) ______________________

SAMPLE I.D.	DATE	TIME	Matrix	Sample Description	TDS by EPA 160.1	TKN by EPA 351.3	Ammonia as N by Dist, EPA 350.2	Nitrite as N by EPA 300.0	Nitrate as N by EPA 300.0	Phosphate as P by EPA 365.3	Orto-Phosphate as P by EPA 365.2							NUMBER OF CONTAINERS	COMMENTS

Chain of Custody Signature Record

1. ______________________ ⇦ *Relinquished By*
Print Name
______________________ ______________________
Signature Company/ Agency Date/ Time

2. ______________________ ⇦ *Received By*
Print Name
______________________ ______________________
Signature Company/ Agency Date/ Time

3. ______________________ ⇦ *Relinquished By*
Print Name
______________________ ______________________
Signature Company/ Agency Date/ Time

4. ______________________ ⇦ *Received By*
Print Name
______________________ ______________________
Signature Company/ Agency Date/ Time

Code	Description	Price
41-TDS	Total Dissolved Solids	12
99-Comb Nutr	Combined Nutrient Analysis: NH3 by EPA 350.2, NO3 by EPA 300.0, NO2 by EPA 300.0, TKN by EPA 351.3, Orgainc Nitrogen (calculation), Total Nitrogen (calculation), PO4 as P by EPA 365.3, o-PO4 by EPA 365.2	120

SAMPLE CONDITIONS:
Cool ☐ Warm ☐
________ °F

CUSTODY SEALS
Yes ☐ No ☐
________ °F

SPECIAL REQUIREMENTS:

Appendix 5 Daily Calibration Log Sheet for Horiba Multi-Meter

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Horiba U-10 Daily Calibration Log Sheet

PRE-FIELD:

CALIBRATED: BY________ DATE_______ TIME_________ METER_____

Calibration		pH*	Cond. (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp. (°C)	Salinity (%)
Auto-Cal Solution	Std. Value	4.00	4.49	0.0	8.52	@ 22	0.23
	Reading						
pH 7 Solution	Std. Value	6.86**					
	Reading						
pH 10 Solution	Std. Value	10.00					
	Reading						

POST-FIELD:

CHECKED: BY_______ DATE_______ TIME________ METER_____

Calibration		pH*	Cond. (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp. (°C)	Salinity (%)
Auto-Cal Solution	Std. Value	4.00	4.49	0.0	8.52	@ 22	0.23
	Reading						
pH 7 Solution	Std. Value	6.86**					
	Reading						
pH 10 Solution	Std. Value	10.00					
	Reading						

*pH readings should fall within +/- 0.5 units; all other parameters should fall within +/- 5% of standard values.
**Horiba pH 7 standard solution

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Appendix 6 Horiba Multi-Meter SOP

Using the Horiba in the Field SOP

Following calibration, place the Horiba securely in its case for transport into the field. Upon arrival at the first sampling site, remove the Horiba from the case and turn it on. Gently place the probe in the water (should be fully submerged). Let the readings stabilize before they are recorded in the appropriate boxes on the field sheet. If the flow rate is <1 ft/sec, move the probe slowly up and down in the water column (being careful not to vigorously agitate the water, disturb bottom sediments or bang the probe into obstacles) in order to maintain flow across the dissolved oxygen (DO) sensor. If the water depth is not sufficient to completely submerge the probe, a bucket may be filled with sample water and the probe submerged in the bucket in order to obtain readings. Be sure and move the probe slowly up and down in the bucket to get an accurate DO reading. Readings for the following water quality parameters should be recorded: pH, temperature, conductivity, turbidity, dissolved oxygen and salinity. Press the **SELECT** key on the Horiba display panel to move from one parameter to the next. Remove the probe from the water and return it to its carrying case when done. Upon return to the lab and following the post-field check (see below), the probe should be rinsed in tap water and kept submerged in a container of tap water on the lab bench until next use.

Daily Calibration Procedures

Instrument Calibration and Frequency

The Horiba U-10 Meter is to be calibrated using the Auto-Calibration procedure described below prior to use in the field each day. Upon return to the lab from the field, the *Horiba* will be checked using pH 7 solution and pH 10 solution and the results recorded. All measurements will be checked against the measurement quality objectives listed in Table 3. If results are out of the DQO range then probe must be calibrated using the manual two-point calibration methods. Manual two-point calibrations for dissolved oxygen, pH, conductivity and turbidity will be conducted quarterly during the months of January, April, July and October (Table 1). Following manual calibration the probe will be checked using the *Horiba* pH 4 (Autocal) solution and probe condition will be noted. All data will be recorded in the calibration data sheet. Auto-Calibration solution values are listed in Table 2 at standard temperature of 22^{o}C. Tables 4 and 5 list concentrations for pH and dissolved oxygen as they vary by temperature.

Table1: Calibration Frequency

Sensor	Auto calibration	Two-point Calibration	Post-Field Check?
pH	Daily	Quarterly	Yes, pH 7 and pH 10
Dissolved oxygen	Daily	Quarterly	No
Conductivity	Daily	Quarterly	No
Turbidity	Daily	Quarterly	No
Temperature	Record Only	Check with Standard Thermometer	Yes

Auto-calibration Procedure:

1. Rinse probe in tap water and dry
2. Using the **MODE** key put in **MAINT** mode then toggle to Set **S.SET**. Using the ↑↓ keys select to ***A*** for (Auto-salinity). Press **ENT** to complete salinity setting.
3. Place probe in beaker 2/3 full of standard *Autocal Horiba* pH 4 (Autocal) solution. Using the **MODE** key put in **MAINT** mode then toggle to **AUTO** sub-mode. Press **ENT** to initiate auto-calibration. Readout will automatically return to **MEAS** mode Calibrate the meter using the pH 4 (*Autocal*) solution.
4. Record readouts for all parameters in the Daily Calibration Logsheet.all data into the logsheet.
5. Remove the probe from the *Horiba* pH 4 solution, rinse in tap water, dry and place in pH 7 solution. Record pH value. Repeat this step with pH 10 solution.
6. Upon return from the field, checked probe using the *Horiba* pH 4 (Autocal) solution and pH 10 solution, record values in the Daily Calibration Logsheet, then rinse probe in tap water and place in a beaker of tap water for short-term storage.

Manual Two-point Calibrations:

pH Calibration:
pH calibration is done using two standard solutions of different pH values, one for the zero calibration, the other for the span calibration. Water Quality objectives for pH in surface waters for the San Diego Region are 6.5 to 9.0, therefore it is recommended to use pH 7 and pH10 solutions.

Zero Calibration:
- Use the pH 7 solution (**Must use pH7 solution**), check temperature of standard.
- Press **MODE**, select **MAINT** mode.
- Press **MODE** again to move the lower cursor to **ZERO**.
- Press **SELECT** to move the upper cursor to **pH**
- Select the appropriate pH value after the readout has stabilized (e.g. enter pH = 6.86 if temp. is 25°C; note that different brands of standard pH solutions may have different pH values at a given temperature; Table 3) using the ↑↓ keys.
  .
- To complete pH zero calibration, press **ENT**. Record this value in the calibration data sheet.

Span Calibration:
- Rinse and dry probe and place in second standard solution (e.g.-pH 10).
- Use the **MODE** key to move the lower cursor to **SPAN**.
- Check the temperature of the standard solution and select the appropriate pH value after the readout has stabilized using the ↑↓ keys.
- To complete pH span calibration, press **ENT**. Record this value in calibration data sheet. Record all data into the logsheet.

Calibrate the meter using the pH 10 solution.
Record all data into the logsheet.
Conductivity Calibration:

The Horiba U-10 automatically selects the proper range to measure conductivity. Therefore, manual calibration must be done for all three ranges used by the probe.

Zero calibration:

— Triple rinse probe in DI or distilled water. Shake off excess water and allow to air dry.
— Press **MODE** and move lower cursor to **ZERO** (done in air).
— Press **SELECT** and move upper cursor to **COND**
— Press the ↑↓ keys to set the readout to zero.
— To complete the zero COND calibration, press **ENT**. Record this value in the calibration data sheet.

Span calibration:

(use Horiba solutions in this order: Range 1, Range 2, Range 3)

— Triple-rinse and immerse probe in 58.7 mS/cm (5.87 S/cm) solution (Range 1).
— Press **MODE** and move lower cursor to **SPAN**
— Use the ↑↓ keys to select 58.7 mS/cm once readout has stabilized.
— Press **ENT** to complete the 58.7 mS/cm conductivity calibration. Record this value in the calibration data sheet.
— Repeat the above procedure using the 6.67 mS/cm (0.667 S/cm) and 0.718 mS/cm (71.8 S/cm) standard solutions (Ranges 2 and 3).

Note: Shelf life of conductivity solutions is six months. Keep solutions tightly capped. Conductivity standards are "one-shot" solutions – do not reuse the standard (from SWAMP guidelines).

Turbidity calibration:

When doing zero calibration it is crucial that you clean the probe thoroughly (insert brush several times in turbidity aperture).

Zero calibration:

— Triple-rinse probe and shake off excess water droplets immerse probe in DI or distilled water.
— Press **MODE** and move the lower cursor to **ZERO**.
— Press **SELECT** and move upper cursor to **TURB**.
— Use the ↑↓ keys to select 0.0 once readout has stabilized.
— Press **ENT** to complete the zero turbidity calibration. Record this value in the calibration data sheet.

Span calibration:

— Triple-rinse and immerse probe in 100 NTU standard solution.
— Press **MODE** and move lower cursor to **SPAN**.
— Use the ↑↓ keys to select 100 NTU once the readout has stabilized.
— Press **ENT** to complete the 100 NTU turbidity calibration. Record this value in the calibration data sheet.

Note: Shelf life of turbidity solutions is six months.

DO calibration:
DO calibration solution for the span calibration must be prepared fresh just prior to use.

Zero calibration:

Make sure that the probe display "S.SET" is set to "A"
Remove the sensor guard.

— Triple-rinse probe in tap water and immerse it in zero DO standard solution (fill the small graduated cylinder to just below the top). *This solution must be opened immediately before use.*
— Press **MODE** and move the lower cursor to **ZERO**.
— Press **SELECT** and move the upper cursor to **DO**.
— Use the ↑↓ keys to select 0.0 once the readout has stabilized.
— Press **ENT** to complete the zero DO calibration.

Span calibration:

— Fill a container with tap water, close lid and bubble air through it with an aquarium pump to saturate it with dissolved oxygen.
— Triple-rinse the probe and immerse it in the container of O_2-saturated water.
— Make sure the probe is set for freshwater by setting the S.SET Sub-Mode to 0.0%. Hit "enter".
— Press **MODE** to move the lower cursor to **SPAN**.
— After the readout has stabilized, slowly move the probe up and down in the water and set the readout value to the appropriate DO value based on the temperature of the water (refer to Table 5: DO saturation at various temperatures).
— Press **ENT** to complete the SPAN calibration for DO. Record in the calibration data sheet.
— Set "S.SET" back to "A"
— Perform post-calibration check using Horiba pH 4 (Autocal), pH 7 and pH 10.

Table 2: Calibration solutions and values at 22^{o} C.

Parameter	pH 4 (Horiba)	pH7 (Horiba)	pH 7 (YSI)	pH 10 (YSI)
pH	4.00	6.86	7.00	10.00
Conductivity (mS/cm)	4.49			
Turbidity (NTU)	0			
DDO (mg/L)	8.52			

Table 3: Measurement Quality Objectives for Accuracy and Precision

Parameter	Value	Lower Limit	Upper Limit
	4.00*	3.50	4.50
	6.86*	6.36	7.36
pH (± 0.5 units)	10.0	9.50	10.50
DO (+/- 5%)	8.52	8.09	8.95
Conductivity	4.49	4.27	4.71
Turbidity	100	95	105

*Standard reference values differ depending on manufacturer.

Table 4: Standard pH values at different temperatures

Temperature (°C)	pH 4 (Horiba)	pH 4 (YSI)	pH 7 (Horiba)	pH 7 (YSI)	pH10 (Horiba)	pH 10 (YSI)
15	4.00	4.00	6.90	7.05		10.12
20	4.00		6.88		10.06	
22	4.00				10.03	
25	4.01		6.86		10.01	

Table 5: Dissolved Oxygen at Various Temperatures

Temperature (°C)	Dissolved Oxygen (mg/L)	+ 5%	- 5%
15	9.76	10.25	9.27
16	9.56	10.04	9.08
17	9.37	9.84	8.90
18	9.18	9.64	8.72
19	9.01	9.46	8.56
20	8.84	9.28	8.40
21	8.68	9.11	8.25
22	8.53	8.96	8.10
23	8.39	8.81	7.97
24	8.25	8.66	7.84
25	8.11	8.52	7.70
26	7.99	8.39	7.59
27	7.87	8.26	7.48
28	7.75	8.14	7.36
29	7.64	8.02	7.26
30	7.53	7.91	7.15

Instrument Inspection and Maintenance

Table 6: Routine Sensor Replacement

Sensor	Replacement Frequency
pH	Once a year
Dissolved oxygen	Twice a year
Reference	Once a year

Routine Maintenance
Normal probe maintenance on a daily basis will include cleaning of turbidity and conductivity sensors.

Temperature Sensor:
Annually check the temperature readout of the probe against another thermometer. If temperature readout is not within 0.2 ^{o}C then replace entire probe.

pH Sensor:
Visually check sensor. If cracked or if not meeting DQOs then replace following the manufactures procedures.

Conductivity Sensor:
Remove Conductivity Sensor guard and carefully use a soft brush to clean off any dust from the sensor unit. Replace guard before taking measurements.

Turbidity Sensor:
Turbidity sensor is a glass tube. Wash out the tube and remove stains carefully, using tap water and a bottle brush. Be careful not to scratch the inside of the glass tube.

Dissolved Oxygen Sensor:
Check sensor to make sure DO membrane has not been broken. If sensor is defective, replace sensor following the manufactures procedures. Dissolved oxygen probe shall routinely be replaced every six months or as necessary to meet DQO.

Reference Sensor:
Reference sensor will be recharged once every two months or more frequently if needed. If reference sensor has a “salt crust”, replace solution using procedure below.

Reference Sensor Recharge:

- Remove the liquid-junction rubber cap from the reference sensor, and pour out the old solution.
- Fill reference sensor completely with new reference solution. Make sure there are no air bubbles.
- Replace the liquid-junction rubber cap.
- Carefully wash off all excess reference solution from the probe.

Horiba U-10 Daily Calibration Log Sheet

PRE-FIELD:

CALIBRATED: BY________ DATE________ TIME_________ METER_____

Calibration		pH*	Cond. (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp. (^oC)	Salinity (%)
Auto-Cal Solution	Std. Value	4.00	4.49	0.0	8.52	@ 22	0.23
	Reading						
pH 7 Solution	Std. Value	6.86**					
	Reading						
pH 10 Solution	Std. Value	10.00					
	Reading						

POST-FIELD:

CHECKED: BY________ DATE________ TIME_________ METER_____

Calibration		pH*	Cond. (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp. (^oC)	Salinity (%)
Auto-Cal Solution	Std. Value	4.00	4.49	0.0	8.52	@ 22	0.23
	Reading						
pH 7 Solution	Std. Value	6.86**					
	Reading						
pH 10 Solution	Std. Value	10.00					
	Reading						

***pH readings should fall within +/- 0.5 units; all other parameters should fall within +/- 5% of standard values.**
****Horiba pH 7 standard solution**

Horiba U-10 Quarterly Calibration Logsheet

CALIBRATED BY________ DATE________ TIME_________ METER_____

Manual Two-Point Calibration Table

Parameter	Range	Manufacturer	Lot No.	Date Opened	Expiration Date*	Std. Value	Temp (°C)	Initial Value	Calib. Value
pH	Zero								
	Span								
Conductivity (mS/cm)	Zero								
	Range 3								
	Range 2								
	Range 1								
Turbidity (NTU)	Zero								
	Span								
Dissolved Oxygen (mg/L)	Zero								
	Span								

Post Calibration Check Using Horiba pH 4 Solution

Calibration	pH	Cond. (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp. (°C)	Salinity (%)
Standard Solution Value	4.00	4.49	0.0	8.52	@ 22	0.23
Reading						
pH 7		N/A	N/A	N/A		N/A
pH 10		N/A	N/A	N/A		N/A

Notes on Probe Condition/Replacement:____
____
____
____
____
____
____
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Appendix 7 Flow Meter SOP

FLOW MEASUREMENT PROCEDURES

A flow measurement should be made during each site visit where flowing water is observed. Flow measurements can be used to estimate pollutant mass loading, prioritize storm drains for future investigations, or to identify significant changes in flow that may be indicative of an illegal release upstream. Since a majority of sample locations lack a permanent flow measurement installation, several field methods may be employed to estimate flow rate. If water is ponded, take width, length, and depth and record velocity as zero (0).

Velocity-area method - The most practical method for measuring the discharge of a stream is the velocity-area method. This method requires the physical measurement of the cross-sectional area and the velocity of the flowing water. Discharge is determined as the product of the area times the velocity.

Discharge (ft^3/sec) = Velocity (ft/sec) x Depth (ft) x Width (ft)

Using the Global Flow Probe, measure the velocity of the water flow (see flow probe instruction in Appendix 6). Use the measurement marks on the probe to measure the stream width and depth. Note: The probe markings are in tenths of a foot, therefore you read directly from the markings and do not need to make any conversions. Record results on the datasheet; the Dry Weather database will calculate the discharge flow.

Fill a bottle method - If conducting an IC/ID investigation on an outfall, staff should record information on the diameter of an outfall for the determination of the discharge flow. The rate can be determined by measuring the length of time it takes to fill a 1-Liter bottle. This method is very helpful for low-flow situations.

Partially filled pipe method - Another method for measuring flow is the partially filled pipe method. This method is helpful when you have a substantial flow coming from an outfall. For this method all measurements must be converted to a common unit before calculation (ft, in, or cm). Measure the water depth and inside pipe diameter and apply the following formula using the partially filled pipe formula chart in Table 1.

- Let D = water depth.
- Let d = *inside* pipe diameter
- Calculate D/d.
- Find the tabulated (Ta) value on the partially filled pipe formula chart below using the D/d value. (i.e. - if D/d = 0.263 then Ta =0.1623).
- Find the area using the formula
  $a = Ta*d^2$.
- Multiply area (a) by the water velocity.
- Convert to desired value.

Table 1: Partially Filled Pipe Formula Chart

Calculating the Area (a) of the Cross Section of a Circular Pipe Flowing Partially Full

D = Depth of water a = area of water in partially filled pipe
d = diameter of the pipe Ta = Tabulated Value Then a = Ta*d2

D/d	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0013	0.0037	0.0069	0.0105	0.0147	0.0192	0.0242	0.0294	0.0350
0.1	0.0409	0.0470	0.0534	0.0600	0.0668	0.0739	0.0817	0.0885	0.0951	0.1039
0.2	0.1118	0.1199	0.1281	0.1365	0.1440	0.1535	0.1623	0.1711	0.1800	0.1890
0.3	0.1982	0.2074	0.2187	0.2280	0.2355	0.2450	0.2540	0.2642	0.2780	0.2836
0.4	0.2934	0.3032	0.3130	0.3220	0.3328	0.3428	0.3527	0.3627	0.3727	0.3827
0.5	0.3980	0.4030	0.4130	0.4230	0.4330	0.4430	0.4520	0.4620	0.4720	0.4820
0.6	0.4920	0.5020	0.5120	0.5210	0.5310	0.5400	0.5500	0.5590	0.5690	0.5780
0.7	0.5870	0.5960	0.6050	0.6140	0.6230	0.6320	0.6400	0.6490	0.6570	0.6660
0.8	0.6740	0.6810	0.6890	0.6970	0.7040	0.7120	0.7190	0.7250	0.7320	0.7360
0.9	0.7450	0.7500	0.7560	0.7610	0.7660	0.7710	0.7750	0.7790	0.7820	0.7840

[Flowing Creek] Record the creeks' water flow characteristics using the hand held stick flow meter (FP-101 or FP-201). Record the waters' "Width", "Depth", and "Velocity" in the appropriate box on the field sheet using the measurement scale on the side of the stick flow meter (note: the scale is shown in tenths of a foot and not in inches). If the water is ponded record "0" (zero) for the "Velocity" and estimate the "Length" of the pond and record in the appropriate box on the field sheet. If the flow is too slow or small to be measured with the stick flow meter, then a "Leaf Float" estimation can be used to determine the velocity. The leaf float method is conducted by floating a small leaf on top of the water and noting the drift, record "Distance" in feet and "Time" in seconds. The final alternate flow measurement technique is accomplished by recording the time need to fill a container with a known volume.

Flow Probe User Instructions (Global Water Model)

1. The FP101 probe handle is a two-piece rod expandable from 3' to 6'. The FP201 probe handle is a three-piece rod expandable from 5' to 15'. To expand the rod for correct placement in flow, loosen the locking nut on the handle, pull out the top piece, and retighten the nut.

2. Make sure the Flow Probe's propeller turns freely by blowing strongly on the prop. Remove any accumulated debris (e.g. - magnetic sediment).

3. Scroll with the bottom button until the "AVGSPEED" for velocity appears on the bottom of the screen. Push the top button for three (3) seconds to reset the display. The display will read in feet/second units.

4. Point the propeller directly into the flow you wish to measure. Face the arrow inside the prop housing **downstream** (arrow points in the direction of flow). Raised bump on outside of housing should be pointed into the flow.

5. For small streams, the probe can be moved slowly and smoothly throughout the flow during average velocity measurement. Move the probe smoothly and evenly back and forth from the edges of the stream and from top to bottom of the flow so that the probe stays at each point in the flow for approximately the same amount of time. Keep moving the probe for 20-40 seconds to obtain an accurate average value that accounts for surging. (Move the probe as if you were spray painting and attempting to get an even coat of paint over the entire surface.).

   The Flow Probe uses true velocity averaging. Reset "AVGSPEED" before starting a new measurement. One reading is taken per second, and a continuous average is displayed. For example, after 10 seconds, 10 readings are totaled and then divided by 10 and this average is displayed. Once the average reading becomes steady, the true average velocity of the stream is obtained. When you pull the probe from the water, this average value is frozen on the display until it is reset. Record this value in the proper cell on the field sheet.

6. Measure/calculate the cross-sectional area of your flow stream in square feet (Note: optional, the database will do this calculation). The average velocity (calculated with the Flow Probe in feet/second) times the cross-sectional area (square feet) equals flow in cubic feet per second (cfs), or Q = V x A. If the propeller gets fouled while measuring flow, clean it until the prop turns freely and start over.

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Appendix 8 Photo Documentation SOP

Introduction:

Photographs provide a qualitative, and potentially semi-quantitative, record of conditions in a watershed or on a water body. Photographs can be used to document general conditions on a reach of a stream during a stream walk, pollution events or other impacts, assess resource conditions over time, or can be used to document temporal progress for restoration efforts or other projects designed to benefit water quality. Photographic technology is available to anyone and it does not require a large degree of training or expensive equipment. Photos can be used in reports, presentations, or uploaded onto a computer website or GIS program. This approach is useful in providing a visual portrait of water resources to those who may never have the opportunity to actually visit a monitoring site.

EQUIPMENT:

Use the same camera to the extent possible for each photo throughout the duration of the project. Either 35 mm color or digital color cameras are recommended, accompanied by a telephoto lens. If you must change cameras during the program, replace the original camera with a similar one comparable in terms of media (digital vs. 35 mm) and other characteristics. A complete equipment list is suggested as follows:

Required:
- Camera and backup camera
- Folder with copies of previous photos (do not carry original photos in the field)
- Topographic and/or road map
- Aerial photos if available
- Compass
- Timepiece
- Extra film or digital disk capacity (whichever is applicable)
- Extra batteries for camera (if applicable)
- Photo-log data sheets or, alternatively, a bound notebook dedicated to the project
- Yellow photo sign form and black marker, or, alternatively, a small black board and chalk

Optional:
- GPS unit
- Stadia rod (for scale on landscape shots)
- Ruler (for scale on close up views of streams and vegetation)
- Steel fence posts for dedicating fixed photo points in the absence of available fixed landmarks

How to Access Aerial Photographs:

Aerial Photos can be obtained from the following federal agencies:

USGS Earth Science Information Center
507 National Center
12201 Sunrise Valley Drive
Reston, VA 22092
800-USA-MAPS

USDA Consolidated Farm Service Agencies
Aerial Photography Field Office
222 West 2300 South
P.O. Box 30010
Salt Lake City, UT 84103-0010
801-524-5856

Cartographic and Architectural Branch
National Archives and Records Administration
8601 Adelphi Road
College park, MD 20740-6001
301-713-7040

Roles and Duties of Team:

The team should be comprised of a minimum of two people, and preferably three people for restoration or other water quality improvement projects, as follows:
1. Primary Photographer
2. Subject, target for centering the photo and providing scale
3. Person responsible for determining geographic position and holding the photo sign forms or blackboard.

One of these people is also responsible for taking field notes to describe and record photos and photo points.

Safety Concerns:

Persons involved in photo monitoring should ALWAYS put safety first. For safety reasons, always have at least two 2 volunteers for the survey. Make sure that the area(s) you are surveying either are accessible to the public or that you have obtained permission from the landowner prior to the survey.

Some safety concerns that may be encountered during the survey include, but are not limited to:

- Inclement weather
- Flood conditions, fast flowing water, or very cold water
- Poisonous plants (e.g.: poison oak)

- Dangerous insects and animals (e.g.: bees, rattlesnakes, range animals such as cattle, etc.)
- Harmful or hazardous trash (e.g.: broken glass, hypodermic needles, human feces)

We recommend that the volunteer coordinator or leader discuss the potential hazards with all volunteers prior to any fieldwork.

General Instructions:

From the inception of any photo documentation project until it is completed, always take each photo from the same position (photo point), and at the same bearing and vertical angle at that photo point. Photo point positions should be thoroughly documented, including photographs taken of the photo point. Refer to copies of previous photos when arriving at the photo point. Try to maintain a level (horizontal) camera view unless the terrain is sloped. (If the photo can not be horizontal due to the slope, then record the angle for that photo.) When photo points are first being selected, consider the type of project (meadow or stream restoration, vegetation management for fire control, ambient or event monitoring as part of a stream walk, etc.) and refer to the guidance listed on *Suggestions for Photo Points by Type of Project*.

When taking photographs, try to include landscape features that are unlikely to change over several years (buildings, other structures, and landscape features such as peaks, rock outcrops, large trees, etc.) so that repeat photos will be easy to position. Lighting is, of course, a key ingredient so give consideration to the angle of light, cloud cover, background, shadows, and contrasts. Close view photographs taken from the north (i.e., facing south) will minimize shadows. Medium and long view photos are best shot with the sun at the photographer's back. Some artistic expression is encouraged as some photos may be used on websites and in slide shows (early morning and late evening shots may be useful for this purpose). Seasonal changes can be used to advantage as foliage, stream flow, cloud cover, and site access fluctuate. It is often important to include a ruler, stadia rod, person, farm animal, or automobile in photos to convey the scale of the image. Of particular concern is the angle from which the photo is taken. Oftentimes an overhead or elevated shot from a bridge, cliff, peak, tree, etc. will be instrumental in conveying the full dimensions of the project. Of most importance overall, however, is being aware of the goal(s) of the project and capturing images that clearly demonstrate progress towards achieving those goal(s). Again, reference to *Suggestions for Photo Points by Type of Project* may be helpful.

If possible, try to include a black board or yellow photo sign in the view, marked at a minimum with the location, subject, time and date of the photograph. A blank photo sign form is included in this document.

Recording Information:

Use a systematic method of recording information about each project, photo point, and photo. The following information should be entered on the photo-log forms (blank form included in this document) or in a dedicated notebook:

- Project or group name, and contract number (if applicable, e.g., for funded restoration projects)

- General location (stream, beach, city, etc.), and short narrative description of project's habitat type, goals, etc.
- Photographer and other team members
- Photo number
- Date
- Time (for each photograph)
- Photo point information, including:
    - Name or other unique identifier (abbreviated name and/or ID number)
    - Narrative description of location including proximity to and direction from notable landscape features like roads, fence lines, creeks, rock outcrops, large trees, buildings, previous photo points, etc. – sufficient for future photographers who have never visited the project to locate the photo point
    - Latitude, longitude, and altitude from map or GPS unit
- Magnetic compass bearing from the photo point to the subject
- Specific information about the subject of the photo
- Optional additional information: a true compass bearing (corrected for declination) from photo point to subject, time of sunrise and sunset (check newspaper or almanac), and cloud cover.

For ambient monitoring, the stream and shore walk form should be attached or referenced in the photo-log.

When monitoring the implementation of restoration, fuel reduction, or Best Management Practices (BMP) projects, include or attach to the photo-log a narrative description of observable progress in achieving the goals of the project. Provide supplementary information along with the photo, such as noticeable changes in habitat, wildlife, and water quality and quantity.

Archive all photos, along with the associated photo-log information, in a protected environment.

The Photo Point: Establishing Position of Photographer:

1. Have available a variety of methods for establishing position: maps, aerial photos, GPS, permanent markers and landmarks, etc. If the primary method fails (e.g., a GPS or lost marker post) then have an alternate method (map, aerial photo, copy of an original photograph of the photo-point, etc).

2. Select an existing structure or landmark (mailbox, telephone pole, benchmark, large rock, etc.), identify its latitude and longitude, and choose (and record for future use) the permanent position of the photographer relative to that landmark. Alternatively, choose the procedure described in *Monitoring California's Annual Rangeland Vegetation* (UC/DANR Leaflet 21486, Dec. 1990). This procedure involves placing a permanently marked steel fence post to establish the position of the photographer.

3. For restoration, fuel reduction, and BMP projects, photograph the photo-points and carry copies of those photographs on subsequent field visits.

Determining the Compass Bearing:

1. Select and record the permanent magnetic bearing of the photo center view. You can also record the true compass bearing (corrected for declination) but do not substitute this for the magnetic bearing. Include a prominent landmark in a set position within the view. If possible, have an assistant stand at a fixed distance from both the photographer and the center of the view, holding a stadia rod if available, within the view of the camera; preferably position the stadia rod on one established, consistent side of the view for each photo (right or left side).
2. Alternatively, use the procedure described in *Monitoring California's Annual Rangeland Vegetation* (UC/DANR Leaflet 21486, Dec. 1990). This procedure involves placing a permanently marked steel fence post to establish the position of the focal point (photo center).
3. When performing ambient or event photo monitoring, and when a compass is not available, then refer to a map and record the approximate bearing as north, south, east or west.

Suggestions for Photo Points by Type of Project:

Ambient or Event Monitoring, Including Photography Associated with Narrative Visual Assessments:

1. When first beginning an ambient monitoring program take representative long and/or medium view photos of stream reaches and segments of shoreline being monitored. Show the positions of these photos on a map, preferably on the stream/shore walk form. Subjects to be photographed include a representative view of the stream or shore condition at the beginning and ending positions of the segment being monitored, storm drain outfalls, confluence of tributaries, structures (e.g., bridges, dams, pipelines, etc.).

2. If possible, take a close view photograph of the substrate (streambed), algae, or submerged aquatic vegetation.

3. Time series: Photographs of these subjects at the same photo points should be repeated annually during the same season or month if possible.

4. Event monitoring refers to any unusual or sporadic conditions encountered during a stream or shore walk, such as trash dumps, turbidity events, oil spills, etc. Photograph and record information on your photo-log and on your Stream and Shore Walk Visual Assessment form. Report pollution events to the Regional Board. Report trash dumps to local authorities.

All Restoration and Fuel Reduction Projects – Time Series:

Take photos immediately before and after construction, planting, or vegetation removal. Long term monitoring should allow for at least annual photography for a minimum of three years after the project, and thereafter at 5 years and ten years.

Meadow Restoration:

1. Aerial view (satellite or airplane photography) if available.

2. In the absence of an aerial view, a landscape, long view showing an overlapping sequence of photos illustrating a long reach of stream and meadow (satellite photos, or hill close by, fly-over, etc.)

3. Long view up or down the longitudinal dimension of the creek showing riparian vegetation growth bounded on each side by grasses, sedges, or whatever that is lower in height

4. Long view of conversion of sage and other upland species back to meadow vegetation

5. Long view and medium view of streambed changes (straightened back to meandering, sediment back to gravel, etc.)

6. Medium and close views of structures, plantings, etc. intended to induce these changes

Stream Restoration/stabilization:

1. Aerial view (satellite or airplane photography) if available.

2. In the absence of an aerial view, a landscape, long-view showing all or representative sections of the project (bluff, bridge, etc.)

3. Long view up or down the stream (from stream level) showing changes in the stream bank, vegetation, etc.

4. Long view and medium view of streambed changes (thalweg, gravel, meanders, etc.)

5. Medium and close views of structures, plantings, etc. intended to induce these changes.

6. Optional: Use a tape set perpendicular across the stream channel at fixed points and include this tape in your photos described in 3 and 4 above. For specific procedures refer to Harrelson, Cheryl C., C.L. Rawlins, and John P. Potyondy, *Stream Channel Reference Sites: An Illustrated Guide to Field Techniques*, United States Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-245.

Vegetation Management for Fire Prevention ("fuel reduction"):

1. Aerial view (satellite or airplane photography) if available.

2. In the absence of an aerial view, a landscape, long view showing all or representative sections of the project (bluff, bridge, etc.)

3. Long view (wide angle if possible) showing the project area or areas. Preferably these long views should be from an elevated vantage point.

4. Medium view photos showing examples of vegetation changes, and plantings if included in the project. It is recommended that a person (preferably holding a stadia rod) be included in the view for scale

5. To the extent possible include medium and long view photos that include adjacent stream channels.

Stream Sediment Load or Erosion Monitoring:

1. Long views from bridge or other elevated position.

2. Medium views of bars and banks, with a person (preferably holding a stadia rod) in view for scale.

3. Close views of streambed with ruler or other common object in the view for scale.

4. Time series: Photograph during the dry season (low flow) once per year or after a significant flood event when streambed is visible. The flood events may be episodic in the south and seasonal in the north.

5. Optional: Use a tape set perpendicular across the stream channel at fixed points and include this tape in your photos described in 1 and 2 above. For specific procedures refer to Harrelson, Cheryl C., C.L. Rawlins, and John P. Potyondy, *Stream Channel Reference Sites: An Illustrated Guide to Field Techniques*, United States Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-245.

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Appendix 9 Sample Collection SOP

Scope and Application:

This protocol describes the techniques used to collect water samples in the field in a way that neither contaminates, loses, or changes the chemical form of the analytes of interest. The samples are collected in the field into previously cleaned and tested (if necessary) sample bottles of a material appropriate to the analysis to be conducted. Pre-cleaned sampling equipment is used for each site, whenever possible and/or when necessary. Appropriate sampling technique and measuring equipment may vary depending on the location, sample type, sampling objective, and weather.

Summary of Method:

Appropriate sample containers and field measurement gear as well as sampling gear are transported to the site where samples are collected according to each sample's protocol. Water velocity, turbidity, temperature, pH, conductivity, dissolved oxygen as well as other field data are measured and recorded using the appropriate equipment, but these field data measurement protocols are provided in Appendix 6. Samples are put on ice and appropriately shipped to the processing laboratories. This procedure has been modified from the "Texas Natural Resources Conservation Commission's Procedure Manual for Surface Water Quality Monitoring", with major input from the "USGS NAWQA protocol for collection of stream water samples", for which due credit is herewith given.

WATER SAMPLE COLLECTION

Water chemistry and bacteriological samples, as requested, are collected at the same location. *Water samples are best collected before any other work is done at the site*. If other work (i.e., sediment sample collection, flow measurement or biological/habitat sample collection or assessment) is done prior to the collection of water samples, it might be difficult to collect representative samples for water chemistry and bacteriology from the disturbed stream. Care must be taken, though, to not disturb sediment collection sites when taking water samples.

For stream samples, the centroid of flow must be accessible for sampling physicochemical parameters, either by bridge, extendable sampling pole, boat or wading. Sampling from the shoreline of any water body is the least acceptable method.

COLLECTION OF WATER SAMPLES FOR ANALYSIS OF CONVENTIONAL CONSTITUENTS

In most streams, near-surface water is representative of the water mass. A water sample for analysis of conventional constituents is collected by the grab method in most cases, immersing the container beneath the water surface to a depth of 0.1 m. Sites accessed by bridge can be sampled with a sample container-suspending device. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge. Care must also be taken to rinse the device between stations. If the centroid of the stream cannot be sampled by wading, sampling devices can be attached to an extendable sampling pole.

Sampling Methods Requirements:

Field personnel will adhere to recommended SWAMP sample collection protocols or approved and documented alternative protocols, in order to insure the collection of representative, uncontaminated (contaminants not introduced by the sample handling procedure itself) water samples for laboratory analyses. If protocols are revised or altered, the deviations from the standard protocols must be documented.

Briefly, the key aspects of quality control associated with sample collection for eventual chemical analyses are as follows: 1) field personnel will be thoroughly trained in the proper use of sample collection gear and will be able to distinguish acceptable versus unacceptable water samples in accordance with pre-established criteria; 2) field personnel will be thoroughly trained to recognize and avoid potential sources of sample contamination (e.g., engine exhaust, winch wires, deck surfaces, ice used for cooling); 3) sample gear and utensils which come in direct contact with the sample will be made of non-contaminating materials (e.g., glass, high-quality stainless steel and/or Teflon™, according to protocol) and will be thoroughly cleaned between sampling stations according to appropriate cleaning protocol; 4) sample containers will be of the recommended type and will be free of contaminants (i.e., pre-cleaned); and 5) conditions for sample collection, preservation and holding times will be followed.

After collection, field-collected samples will be stored at 4˚C until arrival at the contract laboratory.

Collection of Water Samples for Analyzing Bacteria:

Pathogen monitoring in SWAMP will typically include sampling for pathogen indicator organisms (fecal and total coliform bacteria, *E. coli*, and *Enterococcus* bacteria). *Note*: Samplers must wear gloves when collecting any pathogen samples in order to prevent introduced bacterial contamination.

Samples analyzed for bacteria will be collected as near-surface grab samples. Sampling for bacteria will in most cases be performed according to the sampling procedures detailed for Standard Methods 9221B and 9221E (APHA *et al*. 1998). In brief, the sampling procedures are summarized as follows:

- Sample containers should be cleaned and sterilized using procedures described in Standard Methods 9030 and 9040 (APHA *et al.* 1998). In most cases, these containers are provided by the laboratories conducting the analyses. Alternatively, Whirl-pak bags may also be used, per protocol.
- For waters suspected to contain a chlorine residual, sample bottles should contain a small amount of sodium thiosulfate ($Na_2S_2O_3$) sufficient to neutralize bactericidal activity. In most cases, bottles provided by contract laboratories already contain the sodium thiosulfate as a precautionary measure. For water containing high concentrations of copper or zinc, sample bottles should contain sufficient EDTA solution to reduce metal toxicity. *Note*: These conditions are rare in surface waters.

- Sample bottles may be glass or plastic (e.g. polypropylene) with a capacity of at least 100 ml, or again, Whirl-pak bags. After sterilization, sample bottles should be kept closed until they are to be filled.
- When removing caps from sample bottles, be careful to avoid contaminating inner surface of caps or bottles.
- Using aseptic techniques, fill sample bottles (or Whirl-pak bags), leaving sufficient air space to facilitate mixing by shaking. Do not rinse bottles.
- Recap bottles tightly.

If at any time the sampling crew suspects that the sample or sampling container has been contaminated, the sample should be re-collected into a new sample container.

If bacteriological samples are to be used for regulatory compliance purposes, then samples must be kept at 4˚C (dark) and transported to the laboratory so that the analysis begins within 6 hours of collection.

In the field, all samples will be packed in wet ice or frozen ice packs during shipment, so that they will be kept at approximately 4˚C. Samples will be transported in insulated containers. All caps and lids will be checked for tightness prior to placement in the cooler. All samples will be handled, prepared, transported and stored in a manner so as to minimize bulk loss, analyte loss, contamination or biological degradation. Sample containers will be clearly labeled with an indelible marker. Water samples will be kept in Teflon™, glass, or polyethylene bottles and kept cool at a temperature of 4˚C until analyzed. Maximum holding times for specific analyses are listed in the Summary Table at the end of this SOP.

Chain of Custody:

Chain-of-custody procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of analytical results. A complete chain-of-custody form is to accompany the transfer of samples to the analyzing laboratory.

Field Data Logsheet:

Field crews shall be required to keep a field data logsheet for each sampling event. The following items should be recorded on the field data logsheet for each sampling event:

- time of sample collection;
- sample ID numbers, including etched bottle ID numbers for Teflon™ mercury sample containers and unique IDs for any replicate or blank samples;
- the results of any field measurements (temperature, D.O., pH, conductivity, turbidity) and the time that measurements were made;
- qualitative descriptions of relevant water conditions (e.g. color, flow level, clarity) or weather (e.g. wind, rain) at the time of sample collection;
- a description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality.

The field crews shall have custody of samples during field sampling. Chain of custody forms will accompany all samples during shipment to contract laboratories. All water quality samples will be transported to the analytical laboratory directly by the field crew or by overnight courier.

Field Duplicates - Duplicate samples will be collected for all parameters at an annual rate of 1 per sampling event as defined in the Work Plan. The duplicate sample will be collected in the same manner and as close in time as possible to the original sample. This effort is to attempt to examine field homogeneity as well as sample handling, within the limits and constraints of the situation.

The following general information applies to all types of water samples, unless noted otherwise:

Sample Collection Depth	**Sub-Surface Grab Sample** Samples are collected at 0.1m below the water surface. Containers should be opened and re-capped under water in most cases. **Depth-integrated Sample** If a depth-integrated sample is taken, the sample is pumped from discrete intervals within the entire water column. **Surface Grab Sample** Samples are collected at the surface when water depth is <0.1m.
Where to Collect Samples	Water samples are collected from a location in the stream where the stream visually appears to be completely mixed. Ideally this would be at the centroid of the flow (*Centroid* is defined as the midpoint of that portion of the stream width, which contains 50% of the total flow), but depth and flow etc. do not always allow centroid collection. For stream samples, the sampling spot must be accessible for sampling physicochemical parameters, either by bridge, boat or wading. Sampling from the shoreline of any water body (meaning standing on shore and sampling from there) is the least acceptable method, but in some cases is necessary. In reservoirs, lakes, rivers, and coastal bays, samples are collected from boats at designated locations provided by RWQCB's.
Sampling Order if Multiple Media are Requested to be Collected	The order of events at every site has to be carefully planned. For example, if sediment is to be taken, the substrate can not be disturbed by stepping over or on it; water samples can not be taken where disturbed sediment would lead to a higher content of suspended matter in the sample. *For the most part, water samples are best collected before any other work is done at the site*. This information pertains to walk-in sampling.
Sample Container Labels	Label each container with the station ID, sample code, matrix type, analysis type, project ID, and date and time of collection (in most cases, containers will be pre-labeled). After sampling, secure the label by taping around the bottle with clear packaging tape.

Procedural Notes

For most water samples (not for organics, inorganics or bacteria), prior to collecting sample, rinse the container with ambient water, unless protocol for specific analytical procedure dictates otherwise.

If applicable to the sample and analysis type, the sample container should be opened and re-capped under water.

Sample Short-term Storage and Preservation

Properly store and preserve samples as soon as possible. Usually this is done immediately after returning from the collection by placing the containers on bagged, crushed or cube ice in an ice chest. Sufficient ice will be needed to lower the sample temperature to at least 4°C within 45 minutes after time of collection. Sample temperature will be maintained at 4°C until delivered to the laboratory. Care is taken at all times during sample collection, handling and transport to prevent exposure of the sample to direct sunlight. Samples are preserved in the laboratory, if necessary, according to protocol for specific analysis (acidification in most cases). Pre-preserved containers may be supplied by the contract analytical laboratory.

Field Safety Issues

Proper gloves must be worn to prevent contamination of the sample and to protect the sampler from environmental hazards (disposable polyethylene, nitrile, or non-talc latex gloves are recommended, **<u>however, metals and mercury sample containers can only be sampled and handled using polyethylene gloves as the outer layer</u>**). Wear at least one layer of gloves, but two layers help protect against leaks. One layer of shoulder high gloves worn as first (inside) layer is recommended to have the best protection for the sampler. Safety precautions are needed when collecting samples, especially samples that are suspected to contain hazardous substances, bacteria, or viruses.

Sample Handling and Shipping

Due to increased shipping restrictions, samples being sent via a freight carrier require additional packing. Although care is taken in sealing the ice chest, leaks can and do occur. Samples and ice should be placed inside a large plastic bag inside the ice chest for shipping. The bag can be sealed by simply twisting the bag closed (while removing excess air) and taping the tail down. Prior to shipping the drain plug of the ice chests have to be taped shut. Leaking ice chests can cause samples to be returned or arrive at the lab beyond the holding time.

Although glass containers are acceptable for sample collection, bubble wrap must be used when shipping glass.

Chain of Custody Forms (COC)

Every shipment must contain a complete Chain of Custody Form (see Appendix D) that lists all samples taken and the analyses to be performed on these samples.

Make sure you include a COC for every laboratory you ship to, every time you send a shipment.

Include region and trip information as well as any special instructions to the laboratory.

The original COC sheet (not the copies) is included with the shipment (insert into zip lock bag); one copy goes to the sampling coordinator; and the sampling crew keeps one copy.

Samples collected should have the salinity (in ppt), depth of collection, and date/time collected on every COC.

Write a comment on this form, if you want to warn the laboratory personnel about a possibly hazardous sample, or samples, which contain high chlorine or organic levels.

Field QC Samples for Water Analyses

Field duplicates are currently submitted at an annual rate of 5%. Field travel blanks are required for volatile organic compounds at a rate of one per cooler shipped. Field blanks are required for trace metals (including mercury and methyl mercury), DOC, and volatile organic compounds in water at a rate of 5%.

Field Site Data Sheets

Each visited field site requires a completed Field Data Sheet, even if no samples are collected (i.e. at a site which is found to be dry). If water samples are taken, a Water Quality Data Sheet must be filled out as well.

General Pre-Sampling Procedures

Instruments. All instruments must be in proper working condition. Make sure all calibrations are current. Instruments should be calibrated every morning prior to sampling. Conductivity should also be calibrated between stations if there is a significant change in salinity.

Sample Storage Preparations. A sufficient amount of cube ice, blue ice and dry ice as well as enough coolers of the appropriate type and size must be brought into the field, or sources for purchasing these supplies identified in advance.

Sample Container Preparation. After arriving at the sample station, pack all needed sample containers for carriage to the actual collection site, and label them with a pre-printed label containing Station ID, Sample Code, Matrix info, Analysis Type info, Project ID and blank fields for date and time (if not already pre-labeled).

Safety Gear. Pack all necessary safety gear like waders, protective gloves and safety vests.

Walk to the site. For longer hikes to reach a sample collection site, large hiking backpacks are recommended for transport of gear, instruments and containers. Tote bins can be used, if the sampling site can be accessed reasonably close to the vehicle.

GPS. At the sampling site, compare/record reconnaissance GPS reading with current site reading and note differences. GPS coordinates should be in Decimal Degrees i.e. 38.12345 -117.12345.

Summary of Sample Container, Volume, Initial Preservation, and Holding Time Recommendations for Water Samples

Parameters for Analysis in WATER Samples	Recommended Containers (all containers pre-cleaned)	Typical Sample Volume (ml)	Initial Field Preservation	Maximum Holding Time (analysis must start by end of max)
Conventional Constituents in Water				
Alkalinity	Polyethylene bottles (see **NOTE**(1) below)	100 ml	Cool to 4°C, dark	14 days at 4°C, dark
Chloride (Cl), Sulfate (SO_4) and Fluoride (F)	Polyethylene bottles (see **NOTE**(1) below)	300 ml	Cool to 4°C, dark	28 days at 4°C, dark
Ortho-phosphate (OPO_4)	Polyethylene bottles (see **NOTE**(1) below)	150 ml	Cool to 4°C, dark	48 hours at 4°C, dark
Nitrate + Nitrite (00630) ($NO_3 + NO_2$)	Polyethylene bottles (see **NOTE**(1) below)	150 ml	Cool to 4°C, dark	48 hours at 4°C, dark
Total Keldjahl Nitrogen (TKN)	Polyethylene bottles (see **NOTE**(1) below)	600 ml	Cool to 4°C, dark	Recommend: 7 days Maximum: 28 days Either one at 4°C, dark
Total Dissolved Solids (TDS)	Polyethylene bottles (see **NOTE**(1) below)	1000 ml	Cool to 4°C, dark	7 days at 4°C, dark
Ammonia (NH_3)	Polyethylene bottles (see **NOTE**(1) below)	500 ml	Cool to 4°C, dark	48 hours at 4C dark; if acidify, 28 days at

Parameters for Analysis in WATER Samples	**Recommended Containers (all containers pre-cleaned)**	**Typical Sample Volume (ml)**	**Initial Field Preservation**	**Maximum Holding Time (analysis must start by end of max)**
				4°C, dark
Total Phosphorus (TPO_4)	Polyethylene bottles (see **NOTE**[(1)] below)	300 ml	Cool to 4°C, dark	28 days at 4°C, dark
(1)NOTE: The volume of water necessary to collect in order to analyze for the above constituents is typically combined in four 1-liter polyethylene bottles, which also allows enough volume for possible re-analysis and for conducting lab spike duplicates. This is possible since the same laboratory is conducting all of the above analyses; otherwise, individual volumes apply.				
Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC)	40 ml glass vial	40 ml (one vial)	Cool to 4°C, dark	28 days at 4°C, dark
Total Suspended Solids (TSS)	500 ml amber glass jar	1000 ml (two jars)	Cool to 4°C, dark	7 days at 4°C, dark
Suspended Sediment Concentration (SSC)	500 ml amber glass jar	500 ml (one jar)	Cool to 4°C, dark	7 days at 4°C, dark
Chlorophyll *a* Pheophytin *a*	1-L amber polyethylene bottle	1000 ml (one bottle)	Cool to 4°C, dark	Keep at 4°C, dark, but must filter within 48 hours. Filters may be stored frozen up to 30 days.
Non-Routine Compounds in Water Samples				
OIL AND GREASE	1-L glass jar with Teflon lid-liner, rinsed with hexane or methylene chloride	1000 ml (one jar)	Add 2 ml conc. H_2SO_4 to pH <2; cool to 4°C, dark.	28 days at 4°C, dark
PHENOLS	1-L glass jar with	1000 ml	Add 2 ml conc.	28 days at 4°C, dark

Parameters for Analysis in WATER Samples	Recommended Containers (all containers pre-cleaned)	Typical Sample Volume (ml)	Initial Field Preservation	Maximum Holding Time (analysis must start by end of max)
	Teflon lid-liner	(one jar)	H_2SO_4 to pH <2; cool to 4°C, dark.	
CYANIDE	1-L cubitainer	1000 ml (one cubitainer)	Add 2 ml 1:1 NaOH to make pH > 12; Add 0.6 g ascorbic acid if residual Cl present. Cool to 4°C, dark.	14 days at 4°C, dark
BIOCHEMICAL OXYGEN DEMAND (BOD)	4-L cubitainer	4000 ml (one cubitainer)	Cool to 4°C, dark. Add 1g FAS crystals per liter, if residual Cl present.	48 hours at 4°C, dark
CHEMICAL OXYGEN DEMAND (COD)	1-L cubitainer	110 ml (one cubitainer)	Add 2 ml conc. H_2SO_4 to make pH <2. Cool to 4°C, dark.	28 days at 4°C, dark
Trace Metals in Water Samples				
DISSOLVED METALS (except Dissolved Mercury)	60 ml polyethylene bottle, pre-cleaned in lab using HNO_3	60 ml (one bottle) if salinity <3.0 ppt 180 ml (three bottles) if salinity >3.0 ppt	Filter at sample site using 0.45 micron in-line filter, or syringe filter. Cool to 4°C, dark. Acidify in lab, within 48 hrs, using pre-acidified container (ultra-pure HNO_3) for pH<2.	Once sample is filtered and acidified, can store up to 6 months at room temperature
DISSOLVED MERCURY	250 ml glass or Teflon bottle, pre-cleaned in lab using HNO_3	250 ml (one bottle)	Cool to 4°C, dark. Filter in lab within 48 hours, using bench top Hg filtration apparatus.	Once sample is filtered and acidified, can store up to 6 months at room temperature

Parameters for Analysis in WATER Samples	Recommended Containers (all containers pre-cleaned)	Typical Sample Volume (ml)	Initial Field Preservation	Maximum Holding Time (analysis must start by end of max)
			Acidify in lab within 48 hrs, with pre-tested HCL to 0.5%.	
TOTAL METALS (except Total Mercury)	60 ml polyethylene bottle, pre-cleaned in lab using HNO_3	60 ml (one bottle) if salinity <3.0 ppt 180 ml (three bottles) if salinity >3.0 ppt	Cool to 4°C, dark. Acidify in lab within 48 hrs, with pre-acidified container (ultra-pure HNO_3), for pH<2.	Once sample is acidified, can store up to 6 months at room temperature
TOTAL MERCURY	250 ml glass or Teflon bottle, pre-cleaned in lab using HNO_3	250 ml (one bottle)	Cool to 4°C, dark. Acidify in lab within 48 hrs, with pre-tested HCL to 0.5%.	Once sample is acidified, can store up to 6 months at room temperature.
HEXAVALENT CHROMIUM (filtered)	600 ml plastic or glass bottle	600 ml (one bottle)	Cool to 4°C, dark No acid	Keep at 4°C, dark for up to 24 hours; must notify lab in advance.
HARDNESS	200 ml polyethylene or glass bottle	200 ml (one bottle)	Cool to 4°C, dark OR Filter and add 2 ml conc. H_2SO_4 or HNO_3 to pH < 2; Cool to 4°C, dark.	48 hours at 4°C, dark 6 months at 4°C, dark
Synthetic Organic Compounds in Water Samples				
VOLATILE ORGANIC ANALYTES (VOA's) including VOC, MTBE and BTEX	40 ml VOA vials	120 ml (three VOA vials)	All vials are pre-acidified (50% HCl or H_2SO_4) at lab before sampling. Cool to 4°C, dark	14 days at 4°C, dark

Parameters for Analysis in WATER Samples	Recommended Containers (all containers pre-cleaned)	Typical Sample Volume (ml)	Initial Field Preservation	Maximum Holding Time (analysis must start by end of max)
PESTICIDES & HERBICIDES* □Organophosphate Pesticides □Organochlorine Pesticides □Chlorinated Herbicides **SEMI-VOLATILE ORGANICS*** **POLYCHLORINATED* BIPHEYNYL AND AROCHLOR COMPOUNDS** **TPH, PAH, PCP/TCP***	1-L I-Chem 200-series amber glass bottle, with Teflon lid-liner (per each sample type)	1000 ml (one container) ***Each sample type requires 1000 ml in a separate container**	Cool to 4°C, dark If chlorine is present, add 0.1g sodium thiosulfate	Keep at 4°C, dark, up to 7 days. Extraction must be performed within the 7 days; analysis must be conducted within 40 days.
Toxicity Testing Water Samples				
TOXICITY IN WATER	Four 2.25 L amber glass bottles	9000 ml	Cool to 4°C, dark	48 hrs at 4°C, dark
Bacteria and Pathogens in Water Samples				
E. Coli	Factory-sealed, pre-sterilized, disposable Whirl-pak® bags or 125 ml sterile plastic (high density polyethylene or polypropylene) container	100 ml volume sufficient for both E. coli <u>and</u> Enterococcus analyses	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark.	STAT: 6 hours at 4°C, dark if data for regulatory purposes; otherwise, 24 hrs at 4C, dark if non-regulatory purpose.
Enterococcus	Factory-sealed, pre-sterilized, disposable Whirl-pak® bags or 125 ml sterile plastic	100 ml volume sufficient for both E.	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine	STAT: 6 hours at 4°C, dark if data for regulatory purposes; otherwise, 24 hrs at

Parameters for Analysis in WATER Samples	Recommended Containers (all containers pre-cleaned)	Typical Sample Volume (ml)	Initial Field Preservation	Maximum Holding Time (analysis must start by end of max)
	(high density polyethylene or polypropylene) container	coli and Enterococcus analyses	elimination). Cool to 4°C; dark.	4C, dark if non-regulatory purpose.
FECAL COLIFORM	Factory-sealed, pre-sterilized, disposable Whirl-pak® bags or 125 ml sterile plastic (high density polyethylene or polypropylene) container	100 ml volume sufficient for both fecal and total coliform analyses	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark.	STAT: 6 hours at 4°C, dark if data for regulatory purposes; otherwise, 24 hrs at 4C, dark if non-regulatory purpose.
TOTAL COLIFORM	Factory-sealed, pre-sterilized, disposable Whirl-pak® bags or 125 ml sterile plastic (high density polyethylene or polypropylene) container	100 ml volume sufficient for both fecal and total coliform analyses	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark.	STAT: 6 hours at 4°C, dark if data for regulatory purposes; otherwise, 24 hrs at 4C, dark if non-regulatory purpose.

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Appendix 10 Laboratory COC SOP

How to Fill Out a Chain of Custody (COC) Form SOP:

Before leaving for the field, make sure you have at least two copies of the appropriate chain of custody (COC) form for the project for which you will be collecting water samples. Also bring carbon paper if samples are to be picked up in the field by the analytical laboratory courier. To save some time, you may want to fill in the sample I.D. and date columns on the COC prior to departure.

If necessary, please refer to a previously filled out chain of custody for an example of a properly completed COC form. All field staff should sign the form on the signature line below the project name. A separate line on the COC should be filled out for each site sampled as well as for any duplicates. The sample I.D. column should have all the sites where samples were taken listed. The sample date should be entered. The time each sample was taken should be entered using 24-hour clock format (e.g. - 4:00 p.m. should be entered as 1600). Enter “water”, sediment”, etc. as appropriate in the matrix column. The sample description is the event number (event numbers are unique for each sample). An “X” should be placed in the boxes below all parameters that samples were taken for. The total number of bottles filled for each site should be entered (Enter a total at the bottom of the column once all sampling has been completed. This number should match the actual number of bottles collected). Enter date and page numbers in the upper right corner.

All samplers should print and sign their name on the first two lines of the signature record. “County of San Diego” should be entered immediately to the right, along with the time and date of sample transfer.

The analytical laboratory courier should print and sign his/her name on the next two lines of the signature record and enter “T.L.I. (for Truesdail Labs, Inc.)” along with the time and date immediately to the right.

The box marked “cool” should be checked under “sample conditions” (lower right portion of COC form), since the samples should be kept on ice at all times.

Once all the appropriate information and signatures have been entered on the COC and checked, a copy should be made and retained by the sampler(s). The original should be given to the courier along with the samples.

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Appendix 11 Database Entry SOP

Before Starting

1. Organize the field sheets by sample event ID number.
2. Review each field sheet for accuracy and understanding of the chain of events.

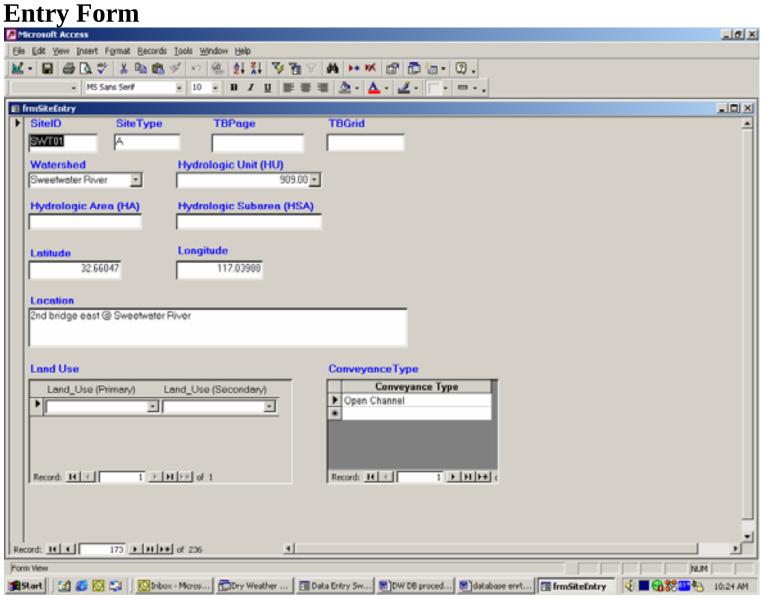
Database Entry Procedures

General Site Description Information

It is important to go through this step for each sample site prior to entering in the data.

1. Open Dry Weather Database; Database will open to Main Switchboard.
2. Click on [Enter Data]
3. Click on [Add a new dry weather monitoring site], a site entry form will appear. Place cursor in the [SiteID] box and press ctrl F (find function) and enter the site ID you are about to enter data for, press [find next]. The database will take you to the first entry for the sample site. Check [SiteType] to see if this is correct, if not, move through the next records until this matches the site location you are interested in. If you cannot find the Site Type you are looking for, go to Step 4. Check that all fields are completed. Update if necessary with Thomas Brothers Page and grid number, Hydrologic unit information, Lat./Long. (please add the negative sign for the Long.), Location, Land Use and Conveyance type (see Form 1 below).

Form 1: Site Entry Form



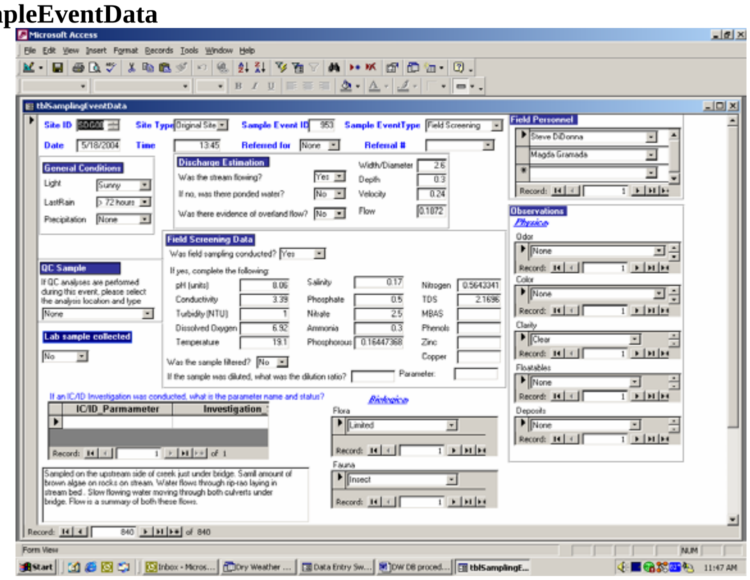
4. To enter a new Site record, press the new record button at the bottom of the entry form. Enter in all the new site information. Press save.
5. Close site entry form after saving, go back to [Data Entry Switchboard]

6. Mark field datasheet when entry is completed (I usually place a checkmark near the Site ID) to assist in record keeping.

Field Screening Data Entry

1. From the [Data Entry Switchboard] click on [Enter Field Screening Data for a Sample Event].
2. Check to make sure that your keyboard has “**Number lock**” on. This will ensure that extra records do not get entered by mistake.
3. Go to the last record entered (see Form 2). Verify [Sample Event ID] number matches the last datasheet entered. If this number is correct go to Step 4, If not correct try to determine what happened. **Do not add a new record until you have figured out what has occurred.**
4. If Site ID information has been entered into and verified for the site entry form, go to a new record in the SampleEventData form. Enter the 3-letter, 2-digit Site ID in the [Site ID] field. Select sample site type from the [Site Type] Field (Original Site, A, B, C, D, .., A 03, B03, .., A 04, B04 as verified when entering site ID information). Enter event type in [Sample Event Type] field.

Form 2: SampleEventData



5. Go to [Field Personnel] field and select staff names from pull-down menu. At this point the database will automatically assign a number for the [Sample Event ID]. Immediately check to make sure this agrees with the Sample Event ID assigned to this sample by filed staff. If you get a message “**cannot create record because information is required in TBL:Location**” then this site needs to be entered into the site entry form, go to Step 10.
6. Continue entering sampling information into the appropriate fields. If the sample site is **Dry** you must enter “**No**” for all three questions under **Discharge Estimation, Was a field sampling conducted?** and **Lab Sample Collected.** Enter **“None”** for **QC Sample.** Enter **Date, Time** and **Referral,** leave remaining fields empty.

7. If multiple entries need to be made for any of the **Observations,** add a new record for that specific observation.
8. If sample event is for an IC/ID, select appropriate parameter from [IC/ID_Parameter] and Select a status for [Investigation_Status].
9. Enter all comments from the bottom of the field datasheet into the **Comments** box at the bottom of the database form.
10. Go back to the [Site ID] field and enter a known site ID, save record, go to back to data switchboard then to [Add a new dry weather monitoring site], and add the information needed for this sample site. Return to [Enter Field Screening Data for a Sample Event], go to the last record, change the [Site ID] to the correct ID. Continue inputting information as in Step 6.
11. If a field has not been completed on a field datasheet, circle, and note (with a post-it) inquire with field staff and correct at the next opportunity.
12. If any changes need to be made to the field datasheet, always put a line through the incorrect entry, correct and initial (I use red ink).
13. When an entry of a sample event is complete, initial and check the top of the field datasheet. Place field datasheet in binder. Save database after each entry.

Database Maintenance Procedures

1. Backup database once a week. Make a copy of the database and save to S:\Watershed Project\Database\msaccess\Dry Weather Database\Backup folder and date with date. **Please delete old copy of backup**.
2. Always use the Exit Button on the menu to close the database; this reduces the likelihood of database malfunctions.
3. On occasion, this database will lock-up if run on a computer that has not been re-booted. It is recommended to re-boot your computer fresh everyday if you are using the database to eliminate any problems.

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Appendix 12 Truesdail's "Quality Assurance and Quality Control Manual for Environmental Sample Analysis"

Previous submitted. No changes.

Appendix 13. SWAMP Database SOPs for Submitting Laboratory Analytical Data to the SWAMP Database

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The typical method for submitting Laboratory Analytical Data to the SWAMP Database is electronically through SDTP. This section document outlines tools and steps involved in submitting these data.

1. Analysis Authorization Forms

Prior to a sampling event, the Analysis Authorization form will be provided to Truesdail Laboratories Inc. in an electronic format and will be used as a more detailed supplement to the Chain of Custody (COC) documentation that travels with the samples from the field to the lab.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**Analysis Authorization**		**Project ID:**	02SW7001		Contact Person:		Marco Sigala										
2	**Fiscal Year:**	02	**Season:**	Fall		Phone:		831-771-4173										
3	**Region:**	7	**Date:**	11/3/2003		email:		msigala@mlml.calstate.edu										
4						Mailing Address:		7544 Sandholdt Rd.										
5								Moss Landing, CA 95039										
6																		
7		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Sediment	Sediment	Sediment	Sediment	Sediment
8		Inorganics	Inorganics	Inorganics	Inorganics	Inorganics	Inorganics	Organics	Organics	Organics	Organics	Organics	Organics	Organics	Organics	Organics	Organics	Metals
9		Nutrients*	Ammonia	TKN	Alkalinity	Hardness	Perchlorate	Conv.**	PCBs	PAHs	TPHs	MTBE-	VOCs	Conv.**	PCBs	PAHs	TPHs	Selenium
10	Station		total					Pesticides				BTEX		Pesticides				
11	000TRV007											x	x					
12	000TRV008											x	x					
13	700FDQ008	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
14	713CRNVBD	x	x	x	x	x	x	x	x	x	x	x	x					
15	715CRDO1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
16	715CPVLG1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
17	715CPVOD2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
18	723ARGRB1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
19	723ARINTL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
20	723NROTWM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
21	723NRBDRY	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
22	728SSGS02	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
23	728SSGS07	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
24	728SSGS08	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
25	728SSDNW2	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
26	719CVSCOT	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
27	**TOTAL**	14	14	14	14	14	10	14	14	14	14	16	16	13	13	13	13	13
28																		
29	*Nutrients: sulfate, chloride, nitrite, nitrate, ortho-phosphate, total phosphate																	
30	**Conv. (Conventional): includes OC pesticides and most conventional OP pesticides																	
31	NOTE: Stations in yellow highlight will have high salinities																	

An Analysis Authorization Form is an Excel workbook with various components.

- There is a worksheet for each of the laboratories to be involved in analyzing the samples.
  - The worksheet shows the Stations for which the samples are being collected and then a chart of which variables should be analyzed in each matrix for each Station.
  - This sheet also lists the general information for a sampling event, such as Fiscal Year, Region, Season and Project ID. This information assists in maintaining the consistency in reporting for all components of the sample in the database.
- Another two worksheets format the general sample information in order to serve as the templates for the lab to enter the analysis results.

2. Chemistry Data

2A. Formatting the Data

Chemistry Results Worksheet

Two worksheets will travel with the data: the first will hold all chemistry or bacteria results, including QA data and will be named Results in its worksheet tab. Each record in this sheet will represent a result from a specific analysis for a particular parameter at a single station or for a single QA sample. This report will also contain all supporting QA sample results. Due to the Analysis Authorization, the following fields will be pre-populated: Station Code, Event Type, Sample Type, Project ID, Season and Agency Code. Additional fields will have the following names and data structure:

I. **LabSampleID**: The Lab Sample ID is a required field intended to provide lab-specific identification for an analyzed sample, with the format and content determined by the lab.

II. **StationCode**: Enter the appropriate Station Code. The format for the StationCode is R##ABC123, where R is one of the 9 state watershed regions, ## is the Hydrologic Unit number, and ABC123 is an alphanumeric description of the Station.

III. **<u>EventType</u>**: The Event Type is used to describe the nature of the sample taken in the field and/or analyzed in a laboratory. It refers to the combination of the matrix and type or combination of types of analyses performed on the sample. For assistance, consult the Event Type Lookup List in the accompanying Chem Analysis Data Template for specific codes.

IV. **<u>Sample Date</u>**: Enter the Sample Date, expressed as dd/mmm/yyyy.

V. **<u>Sample Time</u>**: Enter the Sample Time, expressed as xx:xx.

VI. **<u>Sample Type</u>**: Enter the Sample Type. For assistance, consult the Sample Type Lookup List in the accompanying Chem Analysis Data Template for specific codes. *Please note that **Integrated** samples can be either depth-integrated or integrated from different locations across a body of water, or both.*

VII. **<u>Sample Replicate</u>** should remain 1 unless the entry is a duplicate or split sample.

VIII. **<u>DepthSampleCollection, Depth Units</u>**: Enter the depth at which the sample was collected, expressed in m (meters) or cm (centimeters) in the next two fields. This information should be listed on the Chain of Custody (COC) documentation accompanying the samples from the field.

IX. **<u>ProjectID</u>**: Enter the appropriate Project ID. The ProjectID designates a group of samples related by region and unique projects, fiscal year or Department of Fish and Game task orders, or all of the above. The format is expressed as yySWRxxx, where yy refers to the last two digits of the fiscal year (Fiscal year 00/01 will have 00), SW refers to the SWAMP project, R signifies Region, and xxx is generally arbitrary, but signifies DFG Task Order iteration for DFG contract samples. ***To make it easier to link data from different programs, the "SW" in the project ID for non-SWAMP projects should be replaced with another code. It is suggested that the appropriate State or Regional Board representative is consulted to help formulate the 3rd and 4th digits of the Project IDs. (For instance, Ag Waiver samples would likely have AG in that space and TMDL samples would have TM.)***

X. **<u>SeasonCode</u>**: Enter the appropriate Season at the time of sampling. The SeasonCode records a differentiation between actual seasons (such as Winter, Spring, Summer or Fall) or other discrete periods of time or weather conditions, such as Wet and Dry. These descriptions are provided by, and are often unique to individual Regions. This code will be used to distinguish sampling events where the same station is sampled multiple times throughout the Project or Sample Design.

XI. **<u>Sampling Agency</u>**: Enter the Sampling Agency, which should be listed on the COC documentation accompanying the samples from the field. If in doubt of the exact Agency Code, consult the Agency Lookup List in the accompanying Chem Analysis Data Template.

XII. **<u>Failure Reason</u>**: Enter 'None' for Failure Reason.

XIII. **<u>SampleComments</u>**: The Comments box in this section should be used for any notes or comments specifically related to the sample collection. There will likely be no entry into this data field by the laboratory. *(Not required.)*

XIV. **<u>SampleID</u>**: This Sample ID is an identification created by the organization directing the sampling and is used to track the sample throughout the sampling and analyses processes. This number will likely be on the sample container received from the field crew. If there is no number, leave blank. *(Not required.)*

XV. **<u>PrepCode</u>**: The PrepCode describes any preparation done on the samples prior to analysis. Applicable values can be found in the Preparation Lookup list in the Chem Analysis Data Template for specific codes. If the necessary code does not appear in the lookup list, the SWAMP DMT must be contacted to have it added.

XVI. **<u>PrepDate</u>**: The PrepDate is that on which the preparation is performed and must be formatted as dd/mmm/yyyy. If there is no preparation (None) then the PrepDate should be listed as 01/Jan/1950 (to indicate *none*).

XVII. **<u>DigestExtractCode</u>**: The DigestExtractCode describes any digestion or extraction performed on the sample prior to analysis. Applicable values can be found in the Digestion Lookup list in the Chem Analysis Data Template for specific codes. If the necessary code does not appear in the lookup list, the SWAMP DMT must be contacted to have it added.

XVIII. **DigestExtractDate**: The DigestExtractDate is that on which the digestion or extraction is performed and should be formatted as dd/mmm/yyyy. . If there is no digestion or extraction (None) then the DigestExtractDate should be listed as 01/Jan/1950 (to indicate *none*).

XIX. **LabBatch**: The Lab Batch Code is assigned to and identifies all samples digested or extracted together. In situation where there is no digestion or extraction, then the Lab Batch is all samples within a unique analysis run. The Lab Batch groups all samples with their supporting QA samples and will be used to verify completeness based on the SWAMP QAPP.

XX. **AnalysisDate**: The Analysis Date is the date on which the sample is analyzed on the instrument and should be expressed as dd/mmm/yyyy.

XXI. **LabReplicate**: The Lab Replicate differentiates the first sample analyzed from all subsequent laboratory duplicates. The default is '1' for the first sample and increases by one for each successive replicate.

XXII. **Basis**: Basis indicates whether the sample result is reported as wet weight (use ww) or dry weight (use dw).

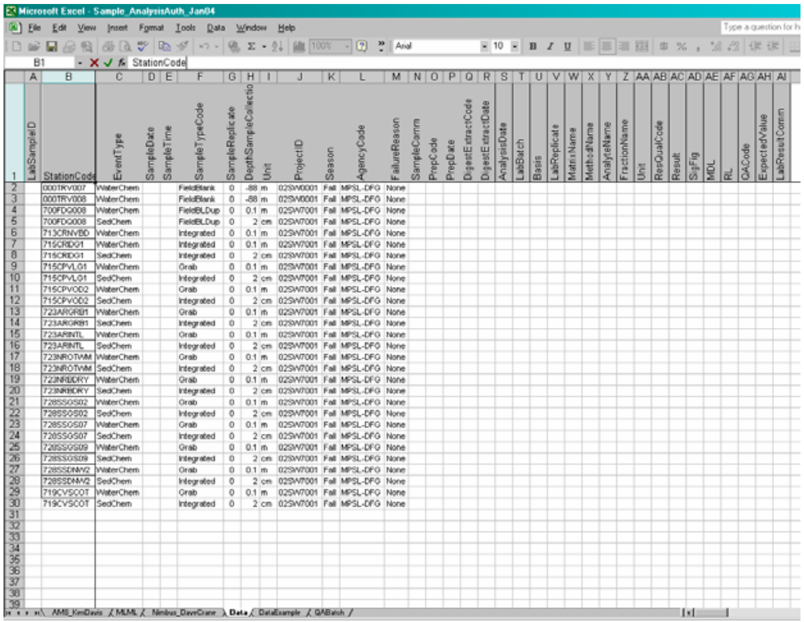
XXIII. **Matrix**: Matrix will be either sediment or the specific form of water in which the sample was collected. For field-generated water samples, the Matrix is **samplewater.** For lab-generated samples, the Matrix should be that which was used in the analysis of the sample. The following should be used for lab-generated water samples:

a. **labwater**: water coming either directly from the tap in the laboratory or bottled water.

b. **blankwater**: Type I or Type II water. It is water that is run through a filtration process in a laboratory, such as DI or MQ.

NOTE: QA for **sediment** samples may actually use "**blankmatrix"** as the Matrix if water is the Matrix used. Blankmatrix is defined in the SWAMP database as "matrix used to identify commercial-/lab-produced medium in tissue and sediment QA samples".

A complete list of matrices can be found in the Chem Analysis Data Template under Matrix.



	LabSampleID	StationCode	EventType	SampleDate	SampleTime	SampleTypeCode	SampleReplicate	DepthSampleCollectio	Unit	ProjectID	Season	AgencyCode	FailureReason
2		000TRV007	WaterChem			FieldBlank	0	-88	m	02SW0001	Fall	MPSL-DFG	None
3		000TRV008	WaterChem			FieldBlank	0	-88	m	02SW0001	Fall	MPSL-DFG	None
4		700FDG008	WaterChem			FieldBLDup	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
5		700FDG008	SedChem			FieldBLDup	0	2	cm	02SW7001	Fall	MPSL-DFG	None
6		713CRNVBD	WaterChem			Integrated	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
7		715CRIDG1	WaterChem			Integrated	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
8		715CRIDG1	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
9		715CPVL01	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
10		715CPVL01	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
11		715CPVOD2	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
12		715CPVOD2	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
13		723ARGRB1	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
14		723ARGRB1	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
15		723ARINTL	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
16		723ARINTL	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
17		723NROTWM	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
18		723NROTWM	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
19		723NRBDRY	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
20		723NRBDRY	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
21		728SSGS02	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
22		728SSGS02	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
23		728SSGS07	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
24		728SSGS07	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
25		728SSGS09	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
26		728SSGS09	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
27		728SSDNW2	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
28		728SSDNW2	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None
29		719CVSCOT	WaterChem			Grab	0	0.1	m	02SW7001	Fall	MPSL-DFG	None
30		719CVSCOT	SedChem			Integrated	0	2	cm	02SW7001	Fall	MPSL-DFG	None

XXIV. **<u>Method</u>**: The Method is the analysis method that is used by the laboratory to analyze the sample. Methods are expressed in the chemistry lab results table with a Method Name such as **EPA 300.0** and must be fully described in the Method Lookup list and in the laboratory records. If a laboratory has modified an EPA standard method, the laboratory agency needs to add "M" to the MethodName. In such situations, the modification should be documented and communicated to the SWAMP DMT for notation in the database. For instance, a lab would report a modified EPA 300.0 as EPA 300.0M accompanied by a description of the modification made. *Any method for the SWAMP Project not in the current SWAMP DB lookup lists must be approved by the SWAMP QA Team prior to being added to the database.*

XXV. **<u>Analyte</u>**: The Analyte is that parameter for which the analysis is conducted and result is reported. The list of analytes to be used may be found in the Analyte Lookup list in the Chem Analysis Data Template. This list includes the acceptable abbreviation or name of the variable used by the database, enabling consistency across reporting. If the necessary Analyte does not appear in the lookup list, the SWAMP DMT must be contacted to have it added.

XXVI. **<u>Fraction</u>**: The Fraction is a more specific descriptor of the Analyte. For instance, metals are often expressed as **Total** or **Dissolved**, each of which would be expressed as the Fraction, distinguishing the appropriate Analyte. Applicable fractions may be found in the Fraction Lookup list in the Chem Analysis Data Template. If there is no need for further description of the analyte, type 'None' in this field. If the necessary Fraction does not appear in the lookup list, the SWAMP DMT must be contacted to have it added.

XXVII. **<u>Unit</u>**: The Unit is that in which the chemistry result is measured or expressed. The Unit Lookup list has the acceptable units listed for the database. Further, each combination of Analyte and Matrix requires that a specific Unit be used in the SWAMP database to ensure comparability across data. This listing can be found in the SWAMP QAPP, online at http://www.swrcb.ca.gov/swamp/qapp.html. Surrogate-Recovery Data will have units of %.

XXVIII. **<u>Result</u>**: The Chemistry Result is expressed as a real number rather than a calculation. The result should be reported with appropriate number of significant figures. (A result of 3.7266945 with a SigFig of 3 should be reported as 3.73.)

XXIX. **<u>ResQualCode</u>**: The Results Qualifier Code qualifies the result for the sample, if necessary. This field may be blank. Applicable codes can be found in Result Qualifier Lookup List in the Chem Analysis Data Template. *(Not required.)* **NOTE**: if the value in this field is NR, then a comment must be entered into Lab Results Comments.

XXX. **<u>SigFig</u>**: The significant figure is required in the Access database because the database does not display trailing zeros. For instance, if the Result is 1.50 the Access database will only show 1.5. If it is important to note the final zero, the significant figure of 3 would communicate to anyone analyzing the data that it is 1.50. Therefore, the SigFig indicates how many figures are significant in reporting the Lab Result and is expressed as a whole number.

XXXI. **<u>MDL</u>**: The MDL is the detection limit associated with the method used to analyze the analyte, or parameter, in the sample.

XXXII. **<u>RL</u>**: The RL is the reporting limit for the sample analyzed, as determined by the laboratory.

XXXIII. **<u>QACode</u>**: The QA Code describes any special conditions or situation occurring during or prior to the analysis to achieve the result. The default code, indicating no special conditions, is X. **NOTE:** If the code is not X, then a comment is required in Lab Results Comments. All codes can be found in QA Code Lookup in the Chem Analysis Data Template.

XXXIV. **<u>ExpectedValue</u>**: The Expected Value is the concentration of the parameter in a reference or matrix spike sample, meaning the original concentration plus the spike amount. For surrogate samples, the expected value should be 100, representing 100%. *(Not required.)*

XXXV. **<u>LabResultComm</u>**: The Lab Result Comments field holds any analysis-related comments. These could be comments needed to clarify any portion of the analysis or which is not accommodated by any other field, such as Percent Recovery or Dilution Factor. The convention for Percent Recovery is PR *xx. (Not required.)*

<u>Special Circumstance Samples: Travel Blank</u>

For those types of analyses that require a Travel Blank to accompany a sampling event, the data is entered into the SWAMP database in the same manner as the samples in the same group. The exceptions are as follows:

<u>SampleDate</u>: should be entered as the date the Travel Blank becomes part of the sample group (ie, leaves the lab for the sampling event). The date the sample returns to the lab should be noted in the Sample Comments field.

<u>DepthSampleCollection</u>: -88m

<u>SampleAgency</u>: agency that created the Travel Blank

<u>Laboratory-generated (QA) samples</u>

There are two types of samples discussed in this section that are generated or modified within the laboratory. The first is a Matrix Spike, which is a modified field sample. For these samples, all fields describing the sample (i.e. Station, Project ID, Agency, Season, Event, Date, and Time) remain the same as the original sample. The only thing to change is the Sample Type, which should be MS. For a list of QA sample types required for each type of chemical analysis, please see the SWAMP Laboratory QA Checklist at the bottom of this section.

All samples generated from within the laboratory, such as LabBlank, LCS, CRM, etc. have specific alternative rules, which are as follows:

<u>LabSampleID</u> = determined by lab (may not be left blank)

<u>StationCode</u> = LABQA

<u>EventType</u> = **WaterChem** or **SedChem**, as appropriate to the sample Matrix

<u>SampleDate</u> = Date sample was analyzed on instrument, expressed as dd/mm/yyyy (same as Digest/Extract Date or Analysis Date when no digestion/extraction is performed)

<u>SampleTime</u> = **0:00**

SampleTypeCode = select from SampleType Lookup List

SampleReplicate = 1 for single samples, incrementing by one for each replicate split within a batch. There are situations within a batch when 2 identical sample types are used for QA reasons and the only way to differentiate between them is to give them each a different Sample Replicate. In such situations, include a Sample Comment to explain the replicates.

DepthSampleCollection = -88

UnitsDepthSampleCollection = m for water or cm for sediment

ProjectID = yySWLAB, where yy refers to last 2 digits of the fiscal year used in the ProjectID for the field-generated samples. When ProjectIDs for related samples span multiple years, use the later year.

AgencyCode = Analyzing agency, as selected from Agency Lookup List

SeasonCode = Not Applicable

FailureReason = **None**

Matrix = For water samples: labwater or blankwater

For sediment samples: blankmatrix (commercially generated product) or sediment (if laboratories are using solvents or water)

Calculating Matrix Spike Percent Recovery

The reported *LabResult* is the number gathered from the instrument and is the net amount recovered from the sample including the spike concentration. For spiked samples, the *ExpectedValue* is the total concentration of the analyte in the native sample plus the spiked concentration. Matrix Spike Percent Recovery will be will be calculated by subtracting the native result from both the MS LabResult and the MS ExpectedValue, then dividing the two by each other and multiplying by 100. To illustrate:

$$\frac{\textbf{MS Lab Result – Native}}{\textbf{MS Expected – Native}} \times 100 \quad \textbf{or} \quad \frac{5-1}{10-1} = \frac{4}{9} \times 100 = 44\%$$

If the sample being used for the matrix spike requires dilution, the reported values for the SampleType MS are the dilution corrected values, not the actual values from the instrument. The dilution factor is reported in the LabResultComments field as “DF=x”.

Non-Project MS and Duplicate Samples:

At times, laboratories use samples not generated through the SWAMP program to satisfy SWAMP batch QA requirements. These samples have different formatting rules, as follows:

StationCode = 000NONPJ

SampleDate = Analysis Date

SampleTime = 0:00

ProjectID = yySWLAB, where yy refers to last 2 digits of the fiscal year used in the *ProjectID* for the field-generated samples, using the later year when *ProjectID*s for related samples span multiple years.

SeasonCode = Not Applicable

DepthSampleCollection =-88

SamplingAgency = LabAgencyCode

QAQualifier = QAX, when the native sample is not included in the batch reported.

LabBatch Worksheet
The second worksheet to travel with the data holds information specific to the laboratory batch in which data is analyzed. This worksheet should be named LabBatch (with no spaces) in its worksheet tab. The fields in this sheet are and should be completed as follows:

LabBatch: There should be one record (and only one record) for each unique Lab Batch ID found in the Results spreadsheet in the field LabBatch.

AgencyCode: This is the Agency Code of the agency or lab performing the analysis. See Agency Lookup in the Chem Analysis Data Template for specific codes.

BatchQualifierCode: This code qualifies the batch as a whole. Applicable codes can be found in the Batch Qualifier lookup list in the Chem Analysis Data Template. Please note that if the qualifier is 'A', meaning Acceptable, the lab is ensuring that all SWAMP QAQC protocols were met for the batch.

LabBatchComm: Use this field for any comments relating to the batch as a whole. *(Not required.)*

2B. Converting the Data

Analysis results in many laboratories are produced in a format that does not easily fit into the format described above. Many labs' instruments provide reports in a vertical rather than horizontal format, for instance. The SWAMP DMT has developed a program to assist in the conversion of data from the analysis instrument-provided format to that required by the SWAMP Database. While this conversion program does not complete all of the work for the lab personnel, it greatly reduces the effort involved. Because each situation is unique, the SWAMP DMT will be contacted to make arrangements.

2C. Checking Data for Quality Assurance

As it is the responsibility of the submitting laboratory to insure the accuracy and completeness of the data, it is necessary to QA the entered data prior to submitting it to the database. This process should include verifying that all data fields are complete, that required QA data is included and properly notated with recoveries, estimated values and RPDs, when applicable, as well as seeing that appropriate replicate values are assigned. Please see below for Laboratory Data Receiving requirements.

2D. Submitting Data to SWAMP Database Management Team

Once the analysis data has been properly formatted and QA'd for accuracy and completeness, it is ready to be submitted to the SWAMP Database. The preferred method for submission varies depending upon the organization's relationship to the Department of Fish and Game contract process.

- Labs with DFG contracts should submit data directly to the Logistics Coordinator who manages the contract data.
- Other labs should submit data to the organization with which they have a contract. Those organizations should then submit the data electronically through email if appropriate, or through the MPSL ftp site. Individual organizations should contact their liaison within the SWAMP DMT to make arrangements for data submission.

This procedure describes the process used by the Moss Landing Marine Laboratory (MLML) Data Management Team (DMT) to receive and begin to process electronic data reports from laboratories and other agencies submitting data for inclusion in the SWAMP Database.

This process will be instituted once each laboratory or other agency working with SWAMP data has been trained on business rules and formats for data submission and have been given access to current lookup lists.

Data reports are submitted through the SWAMP Logistics Coordinator or DMT Liaison. After a basic review for completeness and accuracy, the data is loaded into the temporary side of the SWAMP database. Data reports will be rejected and returned if any of the following is true:

1) The file naming convention is not followed (*see Appendix 1: Laboratory File and Batch Naming Convention*)
2) The report is incomplete, such as missing or incomplete QC or LabBatch tab

3) Incorrect values appear in any fields, such as calculated results or invalid codes
4) More than 3 'typos' appear, such as misspelled names or codes (which makes them impossible to load into the database). In the case where 3 or fewer such instances exist in the report, the DMT representative will correct the error(s) unless otherwise requested by the lab.
5) LabBatch naming conventions are not followed (*see Lab Batch naming convention business rules*).

Data reports that have been returned for resolution should be resubmitted to the DMT within 5 business days for entry into the SWAMP database.

Once the data has been loaded into the database, the SWAMP DMT will verify the data (see *SWAMP SOP Chemistry Data Verification_v1.1*) and prepare for validation and eventual transfer to the permanent and public side of the SWAMP Database.

Process for Addressing Issues Raised During Verification
1) Issues will be compiled as discovered and forwarded to the appropriate lab contact for resolution.
2) Lab needs to provide answer and/or resolution within 5 business days so as not to impede reporting to the appropriate Regional Board and public users.

3. SWAMP Laboratory QA Checklist

The intention of this table is to describe at a high level what QA samples should be included with each batch of data per analysis type. For more detail, such as percent recoveries, RPD and calibration requirements see the SWAMP QAPP (*http://www.swrcb.ca.gov/swamp/qapp.html*).

Generally, laboratories must include with their data reports each QA sample type once per 20 samples or per batch, whichever is more frequent. For instance, if an analytical batch contains 10 samples, there must be ***one*** of each sample type included with the data report. If the batch contains 21 or 38 samples, ***two*** of each type of QA samples must be included. The table below visually describes this idea with each type of QA sample required with the data reports.

Analyte Group	**Matrix**	**Per Samples**	**# MS**	**#MSD**	**# Blanks**	**# CRM,# LCS, or LCM ***	**#Duplicates**
Pathogens	Water	20	n/a	n/a	1	n/a	1
Conventionals**	Water/Sediment	20	1	1	1	1	1
Inorganics	Water/Sediment	20	1	1	1	1	1
Method 8081 Pesticides	Water/Sediment	20	1	1	1	1	n/a
Method 8141 Pesticides	Water/Sediment	20	1	1	1	1	n/a
Method 8082 PCB	Water/Sediment	20	1	1	1	1	n/a
Method 8260 Volatiles	Water/Sediment	20	1	1	1	1	n/a
Method 8270 Semi-Volatiles	Water/Sediment	20	1	1	1	1	n/a
Method 8270 PAH	Water/Sediment	20	1	1	1	1	n/a
Method 8310 PAH	Water/Sediment	20	1	1	1	1	n/a
Metals	Water/Sediment	20	1	1	1	1	1
MeHg	Water/Sediment	20	1	1	1	1	1
Grain Size	Sediment	20	n/a	n/a	n/a	1	1
TOC	Sediment	20	n/a	n/a	1	1 CRM & 1 LCM	1
TDS/TSS/SSC	Water	20	n/a	n/a	1	1	1
Chlorophyll/Pheophtyin	Water	20	n/a	n/a	1	n/a	1

CRM Preferred

*****Conventionals include: Ammonia as N, BOD, Boron, Calcium, Chloride, Chlorophyll a, COD, Fluoride, Iron, Magnesium, Manganese, Ntrate as N, Nitrite as N, Nitrate+Nitrite, OilandGrease, Organic Carbon, OrthoPhosphate as P, Pathogens, Potassium, Silica, Sodium, Sulfate, Suspended Sediment Concentration, Alkalinity as CaCO3, Total Dissolved Solids, Hardness as CaCO3, Total Kjeldahl Nitrogen, Total Phosphate as P, Total Suspended Solid***