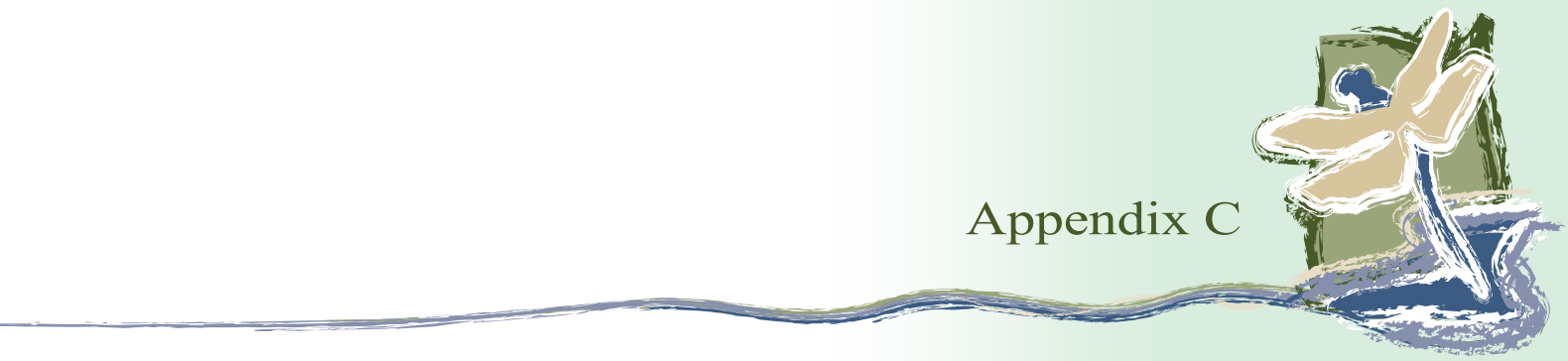
Appendix C



Laguna Creek Watershed Assessment Plan and Available Pre-Project Data

Laguna Creek Watershed Assessment Plan

Purpose

The purpose of the Laguna Creek Watershed Assessment is to gather and evaluate data and information that will be used to: 1) characterize the existing (baseline) conditions of the creek and its resources, 2) provide clues as to the historic form and function of the creek, 3) study the drainage functions and response of the natural creek system under existing and future land use scenarios, and 4) identify stakeholders' values, concerns and preferences. Once the data is gathered, compiled and interpreted, recommendations can be made about future actions to protect, restore and/or enhance the creek resources in years to come.

The assessment work will focus on the main stem of Laguna Creek, although some data will also be collected in Elk Grove Creek.

In July 2005, the Laguna Creek Watershed Grant Oversight Committee assisted the technical consultants to prepare a matrix which outlines the various questions that the watershed assessment is designed to answer, the types of data to be collected, and the methods of data collection (see Table 1). Before the monitoring could begin, a Monitoring Plan was developed and a Quality Assurance Project Plan was prepared, submitted to, and approved by the Regional Water Quality Control Board's Quality Control Officer.

Data Collection

The following types of data will be collected during the watershed assessment using the methods indicated:

- Historic and anecdotal information - collected through interviews and literature/historic aerial review
- Problem areas (e.g., localized flooding, erosion, sedimentation, channel instability, poor water quality or aesthetics) – identified by watershed residents and streamside property owners and project team members
- Maintenance issues and problems – collected through interviews with key maintenance managers working for the local agencies, as well as through observations made by field staff
- Water quality data (physical and some analytical) – collected from representative sections of the creek system in spring and fall 2006
- Flow data - collected from representative sections of the creek system during the fall 2005 – spring 2006 wet season
- Natural resources and bioassessment data - – collected from representative sections of the creek system in spring and fall 2006
- Hydrologic and hydraulic data and modeling results – obtained from Sacramento County and City of Elk Grove

- Hydrogeomorphologic data – collected from representative sections of the creek system in spring 2006

Products of the Watershed Assessment

Opportunities and Constraints Map and Database

The main decision-making tool generated by the Laguna Creek Watershed Assessment will be an "opportunities and constraints" map and associated database. This map will identify and describe sites with reported and observed problems (e.g., erosion, localized flooding, poor water or sediment quality) as well as sites where there exists a potential opportunity to protect, restore, or enhance the creek resources. The map will be used by the technical consultants to guide decisions about recommended actions. The information will also be used as background by the stakeholders considering the recommendations and helping to determine priorities for implementation.

Technical Memorandum with Watershed Assessment Results

The Technical Memorandum will summarize the data collection efforts, methods, limitations, and results. It will include photographs, measurements, cross sections and laboratory data results. It will incorporate the opportunities and constraints information described above. The technical memo will be prepared initially in 2006, after data from the spring 2006 bioassessment monitoring work is available. The memo will then be updated in 2007 to add results of the fall 2006 bioassessment studies. Once the Technical Memorandum is complete, the project team can begin to make decisions about recommended actions for the Watershed Management Plan.

Table 1. Planning Tool for Laguna Creek Watershed Assessment

Question	Topics	How Question Will Be Answered by this Project
What were the historical conditions along Laguna Creek and its tributaries?	*(this list is not all inclusive)* -Oak trees -Hydrology/stream flow conditions -Riparian habitat -Fisheries -Wildlife -Agriculture -Channel conditions	▪ Interviews with G. Waegell, E. Pinkerton [has written books about history of the area], and other long-time watershed residents ▪ Possible K-14 activity: HS students interview members of EG Historical Society. ▪ Review of historical aerial photos dating back to 1937 ▪ Use of computer imagery to compare 1937 creek form to 1950s and present day
What are the known problems and issues along Laguna Creek and its tributaries?	*(this list is not all inclusive)* -Flooding -Aesthetics/water clarity -Algae -Riparian vegetation health/coverage -Erosion/Sedimentation -Recreation/access -Encroachment of creek corridor by development -water quality -channel stability	▪ Input from watershed residents via watershed council meetings, community events and web site ▪ Interviews with maintenance managers/staff from City of Elk Grove, Sac County Dept. of Water Resources Drainage Maintenance, SRCSD (Bufferlands), EGCSD Parks (maintenance manager), Southgate and Cordova Parks Districts ▪ Observations/photos by Consultant Team during Fall 2005 field work ▪ Describe all input in a database and show locations on an "Opportunities/Constraints" Map

Table 1. Planning Tool for Laguna Creek Watershed Assessment

Question	Topics	How Question Will Be Answered by this Project
At what locations are there opportunities for protection/preservation, conservation, restoration, enhancement, and/or stewardship projects?	Same as above.	▪ Input from watershed residents via watershed council meetings, community events and web site ▪ Interviews with maintenance managers/staff (see description above) ▪ Interview staff in local Planning Depts. (Start with Anna Whalen) ▪ Review Groundwater Recharge information from County and decide how best to use it ▪ Observations/photos by Consultant Team during Fall 2005 field work in creek corridor ▪ Use of computer imagery to compare 1937 creek form to 1950s and present day ▪ Observations/photos of upland watershed areas not adjacent to the creeks ▪ Describe all input in a database and show locations on the "Opportunities/Constraints" Map
What data has been collected through summer 2005 in the watershed, and what does the data tell us?	Water Quality (Physical Parameters)	▪ Check with other studies completed in watershed (e.g. County bioassessment work) and determine if physical records were kept. ▪ Obtain/review SRCSD WWTP data for Laguna Creek (Steve Nabozil?)
	Water Quality (Chemical Parmeters)	▪ Obtain/review diazinon data for Elk Grove Creek (RWQCB?) ▪ Obtain/review SRCSD WWTP data for Laguna Creek (Steve Nabozil?)
	Water quantity	▪ Obtain and interpret data from 3 existing flow/precipitation stations (Eagle's Next, Waterman, SRCSD WWTP)
	Bioassessment (benthic macroinvertebrate)	▪ Obtain/review Sac County data for Laguna Creek (collected by Pacific Ecorisk in 4/04) ▪ Obtain/review DPR data for Elk Grove Creek, 2002-04 ▪ Obtain/review Monique Born's data from East Franklin Channel project. (may not be avail)
	Sediment Quality (of creek bed and grain size distr)	▪ Review results of Don Weston's pyrethroid sampling conducted at 3 sites in Camden Passage area – elevated concentrations noted at one location, but no conclusions

Table 1. Planning Tool for Laguna Creek Watershed Assessment

Question	Topics	How Question Will Be Answered by this Project
	Physical Habitat (instream)	▪ Review City of Elk Grove Sensitive Areas Map ▪ Obtain/review EIP survey work (done for Sac County DWR) ▪ Some of this data should be available through bioassessment work completed previously.
	Physical Habitat (riparian zone)	▪ Obtain/review EIP survey work (done for Sac County DWR) ▪ City of Elk Grove study (?)
	Fisheries/Wildlife	▪ Obtain ancedotal/historical info on fish in creek from interviews ▪ Obtain fish kill information/locations/causes from City of Elk Grove ▪ Use the Natural Diversity Database as reference (per Chris Fitzer)
	Hydrology/hydraulics	▪ Review Upper and Lower Laguna Creek Drainage Master Plans by Sac County ▪ Obtain/review data collected by/findings of City of Elk Grove consultants: David Ford Engineers, Harris and Assoicates (2004/05)
	Hydrogeomorphology: Channel Stability and Channel Scour/Deposition	▪ Obtain/review data collected by/findings of William Lettis and Assoc for Sac County (2005)
	Wetlands	▪ Review Upper and Lower Laguna Creek Drainage Master Plans by Sac County ▪ Review HCP information
	Groundwater	▪ Any information available from Water Forum? ▪ Review Groundwater Recharge Map from County Planning – basis for conclusions; accuracy?
	Soils	▪ Review NRCS Soils data for the watershed
What are the existing environmental conditions in Laguna Creek, as measured during the field work for this project?	Water Quality (Physical Parameters)	▪ Collect grab samples along selected reaches in spring/fall 2006 (temperature, pH, turbidity)
	Water Quality (Chemical Parameters)	▪ Collect samples along selected reaches in spring/fall 2006
	Water quantity	▪ Collect flow data from 3 locations along Laguna Creek, Fall 2005 – Spring 2006

Table 1. Planning Tool for Laguna Creek Watershed Assessment

Question	Topics	How Question Will Be Answered by this Project
	Bioassessment (benthic macroinvertebrate)	▪ Conduct BMI sampling along selected reaches in spring/fall 2006 ▪ Obtain and review BMI results by Pacific Ecorisk, spring 2006 (different sites than ours)
	Sediment Quality	▪ No sediment sampling will be conducted.
	Physical Habitat (instream)	▪ During spring/fall 2006 field work, record observations at selected reaches about: composition of substrate, instream cover, water velocity and depth, habitat variability (riffle/glide/pool), and temperature
	Physical Habitat (riparian zone)	▪ During spring/fall 2006 field work, record observations at selected reaches about: type, health and coverage of vegetation
	Fisheries/Wildlife	▪ During spring/fall 2006 field work, record any observations of fish and wildlife and associated nesting areas/take photos if possible
	Hydrology/hydraulics	▪ Conduct modeling under present and projected future land use conditions, to record current creek conditions and projected changes as a result of development.
	Hydrogeomorphology/ Erosion : Channel Stability	▪ During spring 2006 field work, record conditions: upper bank stability, lower bank stability, meander bend stability, bank protection provided by vegetation, and channel cross section geometry
What are the existing (measurable) environmental conditions in Laguna Creek? ***(Continued)***	Hydrogeomorphology/ Erosion : Channel Scour and Deposition	▪ During spring 2006 field work, record conditions: riffle embeddedness, number and structure of pools, deposition indicators, morphology of point bars
	Wetlands	▪ Use field work observations and present day aerials and HCP maps of wetlands/vernal pools to locate areas to be protected.
	Groundwater	▪ Will not be addressed by this project; focus is on surface water.
What are the "reference conditions" for valley creeks?		• Study the DFG definitions and determine how they apply here.

Table 1. Planning Tool for Laguna Creek Watershed Assessment

Question	Topics	How Question Will Be Answered by this Project
What is planned future development, infrastructure and recreation?		• Get information from ULCC base map and database (in progress). • Get projected land use and conservation area information from City of Rancho Cordova, County of Sacramento and City of Elk Grove General Plans. • Obtain conservation information from HCP process. • Conduct interviews with these agencies about future infrastructure plans to support planned new development and growth.
What are the ongoing processes that we would want to get information from, or contribute to?		▪ SACOG – obtain information on planned bike trail ▪ County Dept of Planning (Anna Whalen) – groundwater recharge, HCP, other? ▪ Grantline connector study
What are the stakeholder interests and management objectives?		• Review ULCC documents: mission/vision, etc., stakeholder benefit statements, etc. • Interview others not involved in ULCC: Bufferlands, City of Sac, EGCSD, etc. • Stakeholder preferred future field trips and completed surveys.
What are the constraints?		• Use this opportunity to ask questions and look for these constraints, so that they can be catalogued and used later to identify projects for the Watershed Management Plan.

California Regional Water Quality Control Board
Central Valley Region
Robert Schneider, Chair

Alan C. Lloyd, Ph.D.
Agency Secretary

Arnold Schwarzenegger
Governor

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

15 September 2005

Ms. Kerry Schmitz, Project Manager
Sacramento County Department of Water Resources
827 7th Street Room 301
Sacramento, CA 95814

QUALITY ASSURANCE PROJECT PLAN (QAPP) APPROVAL; SACRAMENTO COUNTY DEPARTMENT OF WATER RESOURCES LAGUNA CREEEK WATERSHED PROJECT; PROP 50 WATERSHED PROGRAM; AGREEMENT NO. 04-177-555-0

Dear Ms. Schmitz:

Enclosed is photocopied version of the signed QAPP with all required signatures for your records. Mr. Bill Ray, the State Water Resources Control Board's Quality Assurance Manager, approved it on 12 September 2005.

Sincerely,

Dan Little, Grant Manager
Lower Sacramento Watershed Unit

Enclosure: QAPP

LAGUNA CREEK WATERSHED MONITORING PROGRAM QUALITY ASSURANCE PROJECT PLAN

Version 1.0

FINAL

OUTLINE PREPARED BY:
First Edition: Gwen Starrett, SWRCB, 1998
Second Edition: Dominic Gregorio, SWRCB, 2001

COMPLETED PLAN PREPARED BY:
Greg Suba
August 25, 2005

Refer correspondance to:
Greg Suba
Laguna Creek Watershed Council
PO Box 580836
Elk Grove, CA 95758-0014
(916) 772-3230
gsuba@surewest.net

Approvals:

Laguna Creek Watershed Program Quality Assurance Officer (Greg Suba)

Signature: Gregory K. Suba Date: 8/29/05

Laguna Creek Watershed Program Manager (Carmel Brown)

Signature: Carmel K. Brown Date: 8/29/05

SWRCB Quality Assurance Officer (Bill Ray)

Signature: Bill Ray Date: 9/12/05

CV-RWQCB Contract Officer (Dan Little)

Signature: Dan Little Date: 8/30/05

2. Table of Contents page

Appendices

3. Distribution List

All group leaders, and technical advisors will receive copies of this Quality Assurance (QA) plan, and any approved revisions of this plan. Once approved, this QA plan will be available to any interested party by requesting a copy from Carmel Brown, Program Manager, CKB Environmental Consulting, Inc., (916) 452-3557, ckbconsulting@comcast.net.

4. Project Organization

The Laguna Creek Watershed Council is a non-profit grass-roots alliance that strives to protect the health of Laguna Creek and its tributary streams by educating residents, promoting active community participation, and fostering partnerships and projects that achieve long-term, balanced solutions with mutual benefits to all stakeholders. Laguna Creek and its tributaries (Elk Grove Creek, Frye Creek, Toad Creek (aka Trib.1), Sheldon Creek, Whitehouse Creek, and other unnamed tributaries) will be monitored as part of this project.

This organization should identify personnel/positions whose responsibility it will be to perform the following functions:

4.1 Monitoring Program Management

Debra Bishop, Senior Restoration Ecologist at EDAW Inc., Gary Palhegyi, Senior Project Engineer, at GeoSyntec Consultants, and Greg Suba, Environmental Education Services (EES) and Coordinator of the Laguna Creek Watershed Council, will be responsible for the management of monitoring leaders during this Calfed grant project.

4.2a Monitoring Leaders: Professional

Chris Fitzer, Aquatic Ecologist at EDAW Inc., and Gary Palhegyi of GeoSyntec Consultants will be responsible for professional field monitoring performed as part of this Calfed grant program. Professional field monitoring will occur twice during the term of this grant to obtain new data for the Watershed Assessment section of our Laguna Creek Watershed Management Plan LCWMP). The first professional field monitoring event will occur in Fall 2005 and the second in Spring 2007.

4.2b Monitoring Leaders: Volunteer Citizens

Greg Suba, Coordinator of the Laguna Creek Watershed Council (LCWC), and Ellen Carlson of the Florin Resource Conservation District (FRCD) will be responsible for recruiting and training volunteer field monitors participating in the K-14 Watershed Education Program, and Laguna Creek Stream Stewards Program. Field and lab work done as part of these volunteer monitoring programs will occur with irregular frequency during the first years of this grant program.

4.3 Data Management

Chris Fitzer and Gary Palhegyi will be responsible for management of data collected by professional field monitors during this Calfed grant program. Mr. Fitzer and Mr. Palhegyi will be responsible for the collating, analyzing, and reporting of field data collected by professional monitors for the Watershed Assessment task of the LCWMP.

Greg Suba, Coordinator of the Laguna Creek Watershed Council will be responsible for management of data collected by volunteer field monitors participating in the K-14 Watershed Education, and Laguna Creek Stream Stewards Programs.

4.4 Quality Assurance Personnel

Greg Suba will be responsible for quality assurance of field monitoring performance, laboratory analyses, and data management by professional and volunteer citizen field monitors during this Calfed grant program. Mr. Suba will be responsible for maintaining the official, approved QAPP, and for overseeing training of watershed monitors.

4.5 Technical Advisors

Ken Allred (MacKay and Somps Civil Engineering (MSCE)) is the Operations Manager of the Sacramento office of MSCE. His 26 years of civil engineering experience includes multiple projects in the Laguna Creek Watershed. Mr Allred provides civil engineering expertise and representation of the land development community to this project. Eva Butler (Riverside Consulting) is a consulting ecologist specializing in projects that meld science, public education, and volunteerism to address habitat conservation needs in the greater Sacramento region. She brings experience gained from work with local government, citizens and non-profit organizations in the areas of land-use planning, development and natural resource management, Stormwater management, water quality monitoring, stream habitat assessment, environmental education, and public outreach. Brian Bledsoe (Professor, Department of Civil Engineering, Colorado State University) provides expertise that will assist in

the design and analysis of hydrologic and geomorphic studies to be performed as part of this program. Together these three comprise the Laguna Creek Watershed Management Plan Technical Advisory Committee.

5. Problem Definition/Background

5.1. Problem Statement

Overall Program Goals

The Laguna Creek Watershed Grant Project has two main goals:

1) Prepare the Laguna Creek Watershed Management Plan (LCWMP) to assess the environmental conditions, identify problems and sources of pollution and recommend prioritized projects to address the problems. Professional field monitors will perform biological and hydrogeomorphological surveys as part of the Watershed Assessment task of the LCWMP.

2) While the LCWMP is being developed, create meaningful, collaborative opportunities for the residents, schools and public agencies to engage in the practice of watershed protection and creek stewardship. These stewardship projects will continue during the implementation of the LCWMP in future years. By engaging watershed residents and youth, both the Laguna Creek Stream Stewards Program and the Laguna Creek K-14 Watershed Education Program will foster a watershed stewardship ethic that is cultivated from one generation to the next. Volunteer citizen monitoring will occur within the context of these two Laguna Creek Watershed programs.

Issues Addressed by this Project

There are four main issues that will be addressed by this Project:

- ***A Need for Data***. The natural resource status of the Laguna Creek Watershed has received little attention to date. There is a critical need to collect environmental data and assess the health of the watershed, and there is an engaged citizenry and local schools that are willing to help with this effort. The watershed presents some unique water quality and urban runoff pollution problems that need to be studied and managed. These include problems with pesticides, sediment (the upper watershed has natural colloidal clays that do not settle out with conventional stormwater quality treatment methods) and nutrients/excessive algae build-up.
- ***Continued Support for A Motivated, Grassroots Watershed Council***. A small amount of seed money was provided in 2002 through a 1999 319h Grant to organize the new Laguna Creek Watershed Council (LCWC), and Sacramento County and the City of Elk Grove contributed funds to keep the group going while alternative longer term funding was sought. The LCWC is remarkably diverse and its members are well educated. Many of the members have relevant professional experience and education in watershed management, water quality studies, land use planning, education and natural resource management. The LCWC is an energetic, broad-based citizen stakeholder group that is busy gathering information about ecosystem health and planned development within their watershed. The members are actively building working relationships with local government agencies and the development community. These efforts are the first step in establishing a common goal for protection and preservation of what natural resources remain in the rapidly urbanizing watershed. A look at models of successful, sustainable watershed management processes in other areas (Portland, Oregon and Maryland) reveals that watershed planning and subsequent development benefit from the contributions of informed, broad-based citizen stakeholder groups. When a planning process is mainly agency-driven, watershed management practices remain contentious and difficult to sustain. However, even organized citizen groups are frequently marginalized by limited volunteer time and technical expertise. Grant funding helps citizens to hire technical experts needed to evaluate and create solution-oriented, engineering plans, and coordinators/facilitators to enable the group to clearly articulate its views and participate more effectively in government processes. This Project will benefit from the grass-roots nature, the qualifications, and readiness of the stakeholders in the Watershed Council.
- ***An Opportunity To Engage the Local Residents and Schools in Meaningful Watershed Projects.*** The Watershed Coordinator has established strong relationships with the schools in the watershed and helped the Elk Grove Unified School District (EGUSD) secure a Service Learning Grant in past years. The local schools (elementary, middle, high school and Cosumnes River College) have been informed about this grant project and are eager to take part in helping us achieve the goals. Several schools have already begun stewardship projects in partnership with the LCWC, and EGUSD teachers, parents, and administrators have been attending Council meetings since the LCWC began in 2002.
- ***A Unique Chance to Minimize Impacts from Future Development***. The LCWC is emerging at a "watershed moment," in a planning process where timing is everything. The upper portion of the watershed will be developed over the next ten years and local government agencies are recognizing the need to try new approaches. Sacramento County is now undertaking pilot-level implementation of new drainage design

techniques that move away from standard trapezoidal ditches towards corridors that integrate riparian and wetland habitats with flood control, water quality treatment and passive recreation.
In addition, the multi-agency Upper Laguna Creek Collaborative (ULCC) is taking an unprecedented step toward coordinated stream-friendly development of the Upper Laguna Creek watershed. Parks and public works agencies' staff and representatives of the LCWC are examining ways to better meld the infrastructure needs of proposed development with the water quality, habitat and recreational needs of the new watershed community. All of the stakeholders share a common goal of achieving sustainable results that will ensure the health and beauty of the area's natural resources for generations to come. The prospects for a successful outcome depend heavily on the continued advocacy role of the LCWC being funded through this grant. The results of this work will surely serve as a model for other growing communities in the Bay-Delta system and elsewhere in California.

To date, there have been no comprehensive efforts to study the watershed as a whole. Individual agencies have embarked on isolated projects, although some of the benefits extend beyond the project boundaries. For various reasons the urbanized watershed of lower Laguna Creek has retained more of its riparian habitat values than any other stream in southern Sacramento County. For instance, in portions of its lower reach, an unprecedented 600 foot wide corridor was preserved by Sacramento County for Giant Garter Snake habitat. In addition, the Sacramento Regional Wastewater Treatment Plant (SRWTP) has invested heavily in enhancement of the riparian and wetland resource values of the terminal reach of Laguna Creek in its "Bufferlands" acreage. Moving upstream, the City of Sacramento created the North Laguna Creek Wildlife Area, complete with wide densely vegetated buffers, pedestrian bridge and interpretive signage. Further upstream on Laguna Creek, the County and the EGCSD worked together to create several nice examples of protected creek habitat. These include the Lower Laguna Bypass (created to preserve valuable wetlands), Camden Lakes, and the Fallbrook neighborhood natural floodplain area. The final example of protected creek habitat is in the Vineyard Springs area, a collaborative effort by the County and Southgate Recreation and Parks District. Opportunities still exist in the upper watershed to maintain and enhance water quality and habitat values, building on these previous investments.

In terms of water quality assessment, the SRWTP has established a long-term water quality database for the terminal reach of lower Laguna Creek. Some water quality data was collected in Elk Grove Creek, due to its presence on the State's 303(d) List for diazinon. Sacramento County's stormwater monitoring data from other local creeks provides evidence of the potential adverse impacts of urban runoff, in the absence of effective water quality treatment.
Several agencies are actively conducting programs which relate to creek awareness and stewardship. The EGCSD trains docents to lead creek tours, implements the Junior Creek Keepers Program for preschoolers, publishes the Laguna Creek Parkways Map/Brochure, and sponsors Elk Grove Creek Week each April in collaboration with the Sacramento Urban Creeks Council. The County and Cities of Sacramento and Elk Grove implement the SPLASH program, which provides creek curricula and other resources to schools in the watershed. The agencies also offer water quality-based classroom presentations, an annual pollution prevention calendar art contest, and provide a stormwater booth and staff for public events held in Elk Grove.

Finally, in Spring 2003, the Elk Grove Unified School District (EGUSD) received grant funds from the CA Department of Education to develop and implement a district-wide Service Learning Program, whose goal is to link required student community service hours to curriculum standards. The EGUSD was encouraged by the Watershed Council to adopt the watershed and its natural resources as the integrating context for student learning in this program.

Desired Outcomes
The Laguna Creek Watershed Council's Vision Statement reads:
The community feels connected to the watershed with its healthy, natural waterways and abundant wildlife and works to protect and enhance this valuable resource for the benefit and enjoyment of present and future generations. Residents, businesses, organizations, landowners and government agencies collaborate to create solutions that balance the need for responsible resource protection and management with continued urban and economic development.
The desired outcomes of this Project are designed to help the residents and other watershed stakeholders achieve their vision:

- Increased awareness by all stakeholders that the creeks and associated riparian corridors are a natural resource to be protected.
- Increased understanding by residents of how their everyday actions can adversely affect the creeks, and how they can modify their behavior to practice pollution prevention.
- A sense of pride and "ownership" of the creek system by residents, schools and community groups.
- Visually enhanced water quality in the creeks due to stewardship activities such as cleanups, planting activities, invasive weed removal and urban runoff pollution prevention efforts.
- Meaningful data regarding environmental conditions (e.g., habitat, water quality) found in the creeks today.

- Increased collaboration between government agencies to plan and implement programs to protect, restore and enhance the watershed.
- Solid partnerships between the schools and the local community for engaging students in meaningful watershed projects that provide environmental benefits, inspire further study and build character.
- Model stewardship, planning and collaboration tools and projects that can be applied in other developing communities throughout California.

5.1.1. Citizen Monitoring Mission and Goals

5.1.1.1. Mission

The Laguna Creek Watershed Council is a grass-roots citizens' alliance that strives to protect the health of Laguna Creek and its tributary streams by educating residents, promoting active community participation, and fostering partnerships and projects that achieve long-term, balanced solutions with mutual benefits to all stakeholders.

The mission of citizen monitoring in the Laguna Creek Watershed is to produce environmental information which is needed to protect our watershed's aquatic resources. Citizen monitoring will also inform and engage the community in effective watershed stewardship.

5.1.1.2. Program Goals

Monitoring Goals

The primary goals of the Laguna Creek Watershed Program are:

1. to identify baseline riparian habitat and in-stream biological, chemical, and physical conditions that will characterize present conditions in the watershed

2. to develop an hydrologic model for upper watershed (headwaters to Bond Rd.) that will provide scientific guidance during development of hydromodification management practices

3. to train volunteer citizen and student monitors to collect and manage stream water quality and habitat survey data for reporting to appropriate agencies and for educational purposes

Professional monitors will perform all work necessary to accomplish our first two Program goals. The successful completion of these goals will result in the Laguna Creek Watershed Assessment portion of the LCWMP document.

Volunteer citizen monitors will perform monitoring work associated with our third Program goal.

This program will gather and supplement as necessary existing agency information by monitoring streams in the Laguna Creek Watershed. The focus of the project is on habitat quality, chemical, physical and biological water quality, and hydrogeomorphological measures that will identify the status of aquatic resources in the Laguna Creek Watershed. The information obtained will be provided to the regulatory agencies. It is the responsibility of the regulatory agencies to ensure that adequate and valid data are collected to meet their regulatory requirements.

5.2. Intended Usage of Data

Data collected by professional monitors will be used by the Laguna Creek Watershed Council to develop the Watershed Assessment section of the LCWMP. The assessment of this data will be useful in providing information for watershed management and pollution prevention. The data will be made available to the public for purposes of watershed education. It will also be made available to the regulatory and resource management agencies to supplement their existing data collection efforts.

The objective of this project is to maintain and improve habitat integrity thoughout the Laguna Creek Watershed through collaboration between public agencies, community groups, and private landowners. The project involves a three-year incremental process to develop the LCWMP and citizen stewardship programs (the LCW Stream Stewards Program and the K-14 Watershed Education Program) aimed at increasing public awareness and understanding of our watershed's natural resources.

Data will be compiled and maintained at the Sacramento County DWR Stormwater Quality Program located in downtown Sacramento at 827 7th Street, Room 301, Sacramento CA, 95814. The information will be shared with the State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, and upon request to other state, federal,

and local agencies and organizations. Data and reports will also be made available to interested parties via the Laguna Creek Watershed Council website.

6. Project/Task Description

6.1. General Overview of Monitoring

Professional field monitoring
Professional field monitors will perform all field work necessary to achieve the objectives of the Watershed Assessment portion of the Laguna Creek Watershed Management Plan. Professional field monitoring will occur twice during the term of this grant to obtain data for the Watershed Assessment section of our Laguna Creek Watershed Management Plan. The first professional field monitoring event will occur in Fall 2005 and the second in Spring 2007.

Professional biological field sampling and surveying will be performed by field biologists from EDAW Consulting. Water samples will be sent to CSL Environmental Chemistry Labs for water quality constituent and bacterial count analysis, and benthic macroinvertebrate samples will be sent to the CA DFG Aquatic Bioassessment Lab for processing and analysis.

Professional hydrogeomorphological field surveying will be performed by hydrologists from GeoSyntec Consultants, in conjunction with EDAW field technicians. Professional field crews will measure stream flow and hydrogeomorphological conditions by employing Channel Stability and Errosional Analysis surveys as part of our Watershed Assessment.

Volunteer citizen monitoring
Groups of volunteer citizen monitors will be recruited and trained through the Laguna Creek K-14 Watershed Education Program, and the Laguna Creek Stream Stewards Program. Field and lab work done as part of these volunteer monitoring programs will occur with irregular frequency during the first years of this grant program, and will focus on establishing a working, sustainable citizen monitoring program infrastructure, verifying adherence to the protocols and measures outlined in this QAPP document, and providing outreach and educational opportunities to watershed residents.

Volunteer monitors will measure physical and biological parameters; however, not all groups will measure all parameters. Table 6.1 identifies the type and frequency of the parameters to be monitored by professional field crews as part of the Watershed Assessment task of the LCWMP, and by volunteer citizen monitors as part of our watershed stewardship and education programs. Table 6.1 also differentiates the type and frequency of monitoring between those to be performed by Professional monitors as part of the Watershed Assessment, and those to be performed by Volunteer Citizen monitors as part of the Laguna Creek K-14 Watershed Education Program and the Laguna Creek Watershed Stewards Program. This QAPP addresses data quality objectives for the following parameters

Temperature
Dissolved Oxygen
pH
Conductivity
Turbidity
Ammonia
Nitrate
Ortho-Phosphate
Chlorine
Phenols
Detergents
Copper
Zinc
Mercury
Total Organic Carbon
Polycyclical Aromatic Hydrocarbons (PAH)
Diazinon
Chlorpyrifos
Pyrethrins
Fecal Coliform Bacteria
Benthic Macroinvertebrates
Physical / Habitat Survey parameters
Bank Stability Survey parameters
Reach / Site scale hydrogeomorphic survey parameters

Table 6.1 Summary of Monitoring Design

Parameter	Professional-level (during Watershed Assessment phase of LCWMP)		Volunteer Citizen-level (K-14 Watershed Education Program, Stream Stewards Program)	
	Type of Monitoring	**Maximum Monitoring Frequency**	**Type of Monitoring**	**Maximum Monitoring Frequency**
Temperature	F	A	F	X
Dissolved Oxygen	F	A	F	X
pH	F	A	F	X
Conductivity	F	A	F	X
Turbidity	F	A	F	X
Ammonia	P	A	F	X
Nitrate	P	A	F	X
Ortho-Phosphate	P	A	F	X
Chlorine	P	A	F	X
Phenols	P	A	P	X
Detergents	P	A	P	X
Copper	P	A	F	X
Zinc	P	A	P	X
Mercury	P	A	P	X
Total Organic Carbon	P	A	P	X
Polycyclical Aromatic Hydrocarbons	P	A	P	X
Diazinon	P	A	P	X
Chlorpyrifos	P	A	P	X
Pyrethrins	P	A	P	X
Fecal coliform	P	A	P	X
Benthic Macroinvertebrates	P	A	P	A
Physical / Habitat Surveys parameters	F	A	F	S
Bank Stability Survey parameters	-	-	F	A
Reach / Site scale Hydrogeomorphic Surveys parameters	F	A	-	-

Codes for Table 6.1: Type: F: field analysis, L: in-house lab analysis, P: sample only, send to outside professional lab; **Frequency**: A: annually M: monthly, S: seasonal, X: irregular

All of the water quality data will be compared to the Regional Water Quality Control Board Basin Plan. For results that are not comparable to the Basin Plan we will review those data with our Technical Advisors.

For stream and urban storm drain environments flow will be determined by using the protocol described in the U.S. EPA Volunteer Stream Monitoring Manual and/or in the California SWRCB Clean Water Team Water Quality Monitoring amd Assessment Compendium. For bioassessment field sampling the Multi-Habitat BMI collection protocol will be used (the EMAP reachwide benthos methodology for BMI collection as modified for low-gradient Central Valley streams by the CA DFG, the CA Department of Pesticide Regulation (DPR), and the CV-RWQCB).

This program has a systematic method for visual and other sensory observations. Stream habitat quality will be assessed, at least once per year, using the California Dept. of Fish and Game Physical Habitat Assessment Form. Observational data include epifaunal substrate/available cover, embeddedness, velocity/depth regimes, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative protection, and riparian vegetative zone width.

Stream Bank Stability Surveys performed by volunteer monitors will use field assessment forms and data spreadsheets developed by Swanson Hydrology & Geomophology (SH&G), Santa Cruz, CA. Professional hydrogeomorphological

assessments will be performed by EDAW field technicians under the direction of Gary Palhegyi of GeoSyntec Consultants, and Reach and Site Level assessments will employ Erosional Assessment Forms developed by GeoSyntec Consultants.

Copies of all the following field data sheets are attached in Appendix 2:
CA DFG Multi-Habitat BMI collection field data sheets
CA DFG Physical / Habitat Assessment form
SH&G's Stream Bank Stability Survey forms
GeoSyntec Consultants' Erosion Assessment form

Section 11 of this plan contains references and instructions for the collection of samples for the following substances: Total Organic Carbon, Metals (Copper, Zinc, and Mercury), PAH's, Chlorpyrifos, Diazinon, and Pyrethrins. It has been determined that there will be no project-specific quality assurance and data quality objectives developed for the data generated in association with these substances. Samples collected for analysis of these constituents will be sent to CSL Environmental Chemistry Laboratories. The project accepts the data generated that is within the analyzing laboratory's internal quality assurance program and the project will not comment on its quality relative to data from the same test generated by other laboratories.

6.2. Project Timetable

Table 6.2 identifies the schedule of major activities associated with this project.

Table 6.2 Project Schedule

Activity	Date
Identify monitoring leaders	9/05 - 3/08
Obtain training for monitoring leaders	9/05, 9/06, 9/07
Recruit monitors	9/05 - 3/08
Obtain and check operation of instruments	9/05 and as necessary
Train monitors	October 2005-2007
Initiate monitoring	10/05
Initiate data entry	11/05
Calibration and quality control sessions	10/05, 10/06, 10/07
Review data with technical advisors	11/05, 6/06, 11/06, 6/07, 11/07

7. Data Quality Objectives

This section identifies how accurate, precise, complete, comparable, sensitive and representative our measurements will be. These data quality objectives were derived by reviewing SWAMP values, the QA plans and performance of other citizen monitoring organizations (e.g. Chesapeake Bay, Texas Watch, Coyote Creek Riparian Station, Southern California Citizen Monitoring Steering Committee, Heal the Bay Malibu StreamTeam), by considering the specifications of the instruments and methods which we will employ, and by considering the utility of the data. For purposes of this QAPP the data quality is considered adequate for the determination of general water quality conditions, with a potential application of the data to Section 305(b) reporting purposes.

Data quality objectives are summarized in Tables 7-1 to 7-5. Whenever possible the methods with the greatest sensitivity and lowest detection limit will be employed as the primary methods. Methods with lesser sensitivity and higher detection limits will be used for field confirmations or as back-up methods in the case that the primary methods are not available or functioning properly for a particular sampling event. Specific DQOs were not given for in-situ continuous monitoring devices. See Section 14 for quality control protocols to be followed when continuous monitoring devices are employed.

Table 7.1. Data Quality Objectives for Conventional Water Quality Parameters

Parameter	Method/range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Complete-ness
Temperature	Thermometer (-5 to 50)	^{o}C	-5	0.5 ^{o}C	$\pm$ 0.5 or 5%	$\pm$ 0.5 ^{o}C	90%
Dissolved oxygen	Electronic meter/probe	mg/l	0.1 mg/l	0.1 mg/l	$\pm$ 0.5 or 10%	$\pm$ 0.5 mg/L	90%

Dissolved oxygen	Micro-Winkler Titration	mg/l	0.2 mg/l	0.2 mg/l	± 0.5 or 10%	± 0.5 mg/L	90%
pH	pH meter	pH units	2.0	0.1 unit	± 0.5 or 5%	± 0.5 units	90%
pH	Non-bleeding strips (range 4.5-10.0)	pH units	4.5	0.5 unit	± 0.5 units	± 0.5 units	90%
Conductivity	conductivity meter	µS/cm	10	10 µS/cm	± 5%	± 5%	90%
Turbidity	Nephelometer	NTUs	0.1	0.1	± 10% or 0.1, whichever is greater	± 10% or 0.1, whichever is greater	90%
Turbidity	Dual Tube Optical	JTUs	5	5 JTUs	± 5 JTUs	NA	90%

NA: not applicable

Table 7.2. Data Quality Objectives for Nutrients Using Colorimeters or Spectrophotometers

Parameter	Method/range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Completeness
Ammonia Nitrogen	Nessler method	mg/l	0.05	0.01	± 20%	± 25%	90%
Nitrate Nitrogen	Cadmium reduction	mg/l	0.05	0.01	± 20%	± 25%	90%
Ortho-Phosphate	Ascorbic acid	mg/l	0.07	0.01	± 20%	± 25%	90%

Table 7.3. Data Quality Objectives for Urban Pollutants Using Field Kits

Parameter	Method/range	Units	Detection Limit	Sensitivity*	Precision	Accuracy	Completeness
Total Residual Chlorine	Colorimetric (0.2 - 3.0)	mg/l	0.2	0.2 (0.2-1.0) 0.5 (1.0-2.0) 1.0 (2.0-3.0)	Laboratory duplicate, Blind Field duplicate, or MS/MSD 25% RPD Laboratory duplicate minimum.	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 80% to 120% of true value	90%
Phenols	Direct Photometric (0.5 - 5.0)	mg/l	0.5	0.5 (0.5-3.0) 1.0 (3.0-5.0)			90%
Detergents	Anionic Surfactants as MBAS (≥0.1)	mg/l	0.1	0.1			90%
Total Copper	Neocuproine (0.25 - 4.0)	mg/l	0.25	0.25 (0-0.5) 0.5 (0.5-2.0) 1.0 (2.0-4.0)	Field replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	Standard Reference Materials (SRM, CRM, PT) 75% to 125%.	90%

* Note: Some test kits vary in sensitivity over the range of detection. The specific range of readings is noted in parentheses.

Table 7.4. Data Quality Objectives for Biological Parameters

Parameter	Method/range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Completeness
Benthic Macro-invertebrates	Calif. Stream Bioassessment Protocol (CSBP) Level II	N/A	Family level	N/A	≤ 5% difference	≤ 5% difference	100%
Fecal Coliform Bacteria	Colilert 18 hour	MPN / 100ml	10	See IDEXX quantitray tables	R_{log} within 3.27*mean R_{log} (reference is section 9020B of 18th, 19th, or 20th editions of *Standard Methods*	Laboratory positive and negative cultures – proper positive or negative response. Bacterial PT sample -–within the stated acceptance criteria.	90%

Table 7.5. Data Quality Objectives for Physical / Habitat and Hydrogeomorphological Parameters

Parameter	Method/range	Accuracy	Completeness
Physical / Habitat survey	CA DFG CSBP form	measurements accurate to within 6 inches	90%
Bank stability survey	Swanson Hydrology Bank Stability Survey	measurements accurate to within 6 inches	90%
Erosion Assessment survey (Reach /site scale hydrogeo-morphic survey	GeoSyntec Erosion Assessment Form	measurements accurate to within 6 inches	90%

7.1. Accuracy

7.1.1. Chemical and Physical Parameters

Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. The accuracy of chemical measurements will be checked by performing tests on standards at the quality control sessions held once a year in the fall. A standard is a known concentration of a certain solution. Standards can be purchased from chemical or scientific supply companies. Standards might also be prepared by a professional partner, e.g. a commercial or research laboratory. The concentration of the standards, known to the volunteer leader, will be unknown to the monitors until after measurements are determined. The concentration of the standards should be within the mid-range of the equipment. The Data Quality Form: Accuracy, found in Appendix 1, will be used to record accuracy.

7.1.2. Biological Parameters

Accuracy for bacteria will be determined by analyzing a positive control sample once annually. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample.

For benthic macroinvertebrate analysis, accuracy will be determined by having 10% of the samples collected as part of this grant project re-analyzed and validated to CSBP Level 2 (genus level) by a professional taxonomist.

7.1.3. Hydrogeomorphological Parameters

Accuracy for hydrogeomorphological surveys will be determined by inspection of field surveyors measurements at the beginning and at mid-point of field surveying events. Survey data measurements will be checked for accuracy to within 6-inches by field monitoring team leaders.

7. 2. Comparability

Comparability is the degree to which data can be compared directly to similar studies. Citizen monitoring groups will use the methods described in the following resource documents to ensure that their data can be compared to others:

- U.S. EPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries,
- SWRCB Clean Water Team Compendium for Water Quality Monitoring and Assessment, and
- California's Department of Fish and Game's (CDFG) California Stream Bioassessment Protocol (CSBP) for Citizen Monitors.
- Heal the Bay's Malibu Creek Stream Team Pilot Project, Shattering the Myths of Volunteer Monitoring
- San Francisco Estuary Institute's Volunteer Monitoring Protocols.

Before modifying these methods, or developing alternative or additional methods, technical advisors will evaluate and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

7. 3. Completeness

Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. Volunteer data will not be used for legal or compliance uses. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we actually collected that were also deemed valid. An invalid measurement would be one that does not meet the sampling methods requirements and the data quality objectives. Completeness results will be checked quarterly. This will allow us to identify and correct problems. The Data Quality Form: Completeness, found in Appendix 1, will be used to record completeness.

7. 4. Precision

7.4.1. Chemical and Physical Parameters

The precision objectives apply to duplicate and split samples taken as part of a QC session or as part of periodic in-field QC checks. Precision describes how well repeated measurements agree. The evaluation of precision described here relates to repeated measurements taken by either different volunteers on the same sample (at quality control sessions) or the same volunteer analyzing replicate samples (in the field). Sampling variability will not be covered in this section. The Data Quality Form: Precision, found in Appendix 1, will be used to record precision.

7.4.2. Biological Parameters

Precision for bacterial parameters will be determined by having the same analyst complete the procedure for laboratory duplicates of the same sample. At a minimum this should be done once per sampling day, or run duplicates on a minimum of

5% of the samples if there are over 20 samples run per day. The results of the duplicates should be within the confidence limits supplied by the manufacturer.

For volunteer citizen benthic macroinvertebrate analysis, precision will be determined by having the technical advisor annually perform an evaluation on the citizen analysts as discussed in Section 14.2 of this QAPP.

7.4.3. Hydrogeomorphological Parameters

Precision for hydrogeomorphological parameters will be determined by having field survey teams begin field survey events by measuring a stream channel profile at a previously measured site and comparing results.

7. 5. Representativeness

Representativeness describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a stream reach that does not describe the area of interest (e.g. a headwaters sample should not be taken downstream of a point source),
- Samples are taken in an unusual habitat type (e.g. a stagnant backwater instead of in the flowing portion of the creek),
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with Section 10, 11 and 12, by following the established methods, and by obtaining approval of this document.

7. 6. Method Detection Limit and Sensitivity

The Method Detection Limit is the lowest possible concentration the instrument or equipment can detect. This is important to record because we can never determine that a pollutant was not present, only that we could not detect it. Sensitivity is the ability of the instrument to detect one concentration from the next. Detection Limits and Sensitivities are noted in Tables 7.1. - 7.5.

Copies of the following forms are attached in Appendix 1:
Data Quality form: Accuracy (used for equipment calibration sessions)
Data Quality form: Completeness

8. Training Requirements

All citizen monitoring leaders must participate in a hands-on training sessions on water quality monitoring conducted by the Clean Water Team of the State Water resources Control Board.

For macroinvertebrate bioassessment citizen monitoring leaders must also participate in a three day training course provided by the California Department of Fish and Game, the Sustainable Lands Stewardship Institute, the American Fisheries Society, or the State Water Resources Control Board.

Trained citizen monitoring leaders may then train their rank-and-file volunteers. Individual trainees are evaluated by their performance of analytical and sampling techniques, by comparing their results to known values, and to results obtained by trainers and other trainees.

Greg Suba is the citizen monitoring leader for the K-14 Watershed Education, and citizen Stream Stewards Programs. Mr. Suba has successfully completed the hands-on training sessions on water quality monitoring conducted by the Clean Water Team of the State Water resources Control Board.

Mr. Suba has also participated in three separate three day training courses for macroinvertebrate bioassessment provided by the California Department of Fish and Game in conjunction with the Sustainable Lands Stewardship Institute, and has conducted an annual 7-day Stream Monitoring Training workshop in the South Fork American River watershed since 2000.

In addition to completion of the above described training course, the citizen monitoring leaders must participate in an annual Calibration and Quality Control Session. These Quality Control Sessions will be supervised by Quality Control Trainers and will provide an opportunity for citizen monitors to check the accuracy and precision of their equipment and techniques. Quality Control Trainers are defined as water quality professionals from the U.S. Environmental Protection Agency, the State Water Resources Control Board, and the Regional Water Quality Control Boards, and / or professional consulting hydrologists. Additional qualified trainers may be recruited and designated by the above agencies from experienced citizen

monitoring organizations, universities and colleges, commercial analytical laboratories, and other federal, state, and local agencies.

The monitor will bring his/her equipment to the Quality Control Session. The monitor will conduct duplicate tests on all analyses and meet the data quality objectives described in Section 7. If a monitor does not meet the objectives, the trainers will re-train and re-test the monitor. If there is insufficient time at the QC session to re-train and re-test monitors, the monitor will be scheduled for an additional training session. The monitor will be encouraged to discontinue monitoring for the analysis of concern until training is completed.

The Quality Control Trainers will examine kits for completeness of components: date, condition, and supply of reagents, and whether the equipment is in good repair. The Trainers will check data quality by testing equipment against blind standards. The trainers will also ensure that monitors are reading instruments and recording results correctly. Sampling and safety techniques will also be evaluated. Trainers will also review visual, habitat, and bank stability survey forms and techniques with volunteers. The trainer will discuss corrective action with the volunteers, and the date by which the action will be taken. The citizen monitoring leader is responsible for reporting back that the corrective action has been taken. Certificates of completion will be provided once all corrective action has been completed.

9. Documentation and Records

All field results will be recorded at the time of completion, using the field data sheets (see Appendix 2). Data sheets will be reviewed for outliers and omissions before leaving the sample site. Data sheets will be signed after review by the citizen monitoring leader. Data sheets will be stored in hard copy form at the location specified in Section 5.2. Field data sheets are archived for three years from the time they were collected. If data entry is ever performed at another location, duplicate data sheets will be used, with the originals remaining at the headquarters site. Hard copies of all data as well as computer back-up disks are maintained at headquarters.

All voucher collections, completed data quality control forms and maintenance logs will also be kept at the headquarters location specified in Section 5.2. The mainenance log details the dates of equipment inspection, battery replacement and calibrations, as well as the dates reagents and standards are replaced.

10. Sampling Process Design

10.1. Rationale for Selection of Sampling Sites

Sampling sites are detailed in the Laguna Creek Watershed Monitoring Plan. The following criteria were evaluated when choosing sampling locations:

- access is safe,
- permission to cross private property is granted,
- sample can be taken in main stream current or where homogeneous mixing of water occurs,
- sample is representative of the part of the water body of interest,
- location complements or supplements historical data,

Any reference sites are chosen upstream of any potential impact. A site chosen to reflect the impact of a particular discharge, tributary or land use is located downstream of the impact where the impact is completely integrated with the water, but upstream of any secondary discharge or disturbance.

Prior to final site selection, permission to access the stream was obtained from all property owners. If access to the site becomes a problem, the citizen monitoring leader will select a new site. Safety issues are included in the both the U.S. EPA Volunteer Stream Monitoring Manual and the California SWRCB Clean Water Team Water Quality Monitoring and Assessment Compendium **.**

Sample sites will be reviewed by the leader before sending volunteers out to the site. The monitoring leader will document permission and terms obtained from landowners.

10.2. Sample Design Logistics

Volunteers are instructed to work in teams of at least two people. If a scheduled team cannot conduct the sampling together, the team captain is instructed to contact the citizen monitoring leader so that arrangements can be made for a substitute trained volunteer.

Prior to final site selection, permission to access the stream is obtained from all property owners. If access to the site is a problem, the citizen monitoring leader will select a new site following the site selection criteria identified in Section 10.1.

Safety measures will be discussed with all volunteers. No instream sampling will be conducted if there are small creek flood warnings or advisories. It is the responsibility of the citizen monitoring organization to ensure the safety of their volunteer monitors. Safety issues are included in the both the U.S. EPA Volunteer Stream Monitoring Manual and the California SWRCB Clean Water Team Water Quality Monitoring and Assessment Compendium **.**

11. Sampling Method Requirements

The U.S. EPA Volunteer Stream Monitoring Manual describes the appropriate sampling procedure for collecting samples for water chemistry. Water sampling apparatus may include Van Dorn Samplers, Niskin Bottles, Kemmerer Tubes, LaMotte Oxygen Samplers, DH 48 Sediment Samplers, extension pole type sampling devices, and hand held plastic containers. Benthic invertebrates will be collected with a D shaped kick net (0.5 mm mesh) mounted on a pole. In those cases where glass bottles are required in Table 11.1, plastic samplers are allowed as long as the hold time in the sampling device is minimal before transfer to the glass sample bottle. Sampling devices and sample bottles (that are not pre-sterilized and do not contain preservatives/fixing agents) will be rinsed three times with sample water prior to collecting each sample. For sterile bottles, whirl-paks, and sample bottles which do contain preservatives/fixing agents (e.g., acids, etc.) never rinse with sample water prior to collecting the sample. Also, never use a sample bottle containing preservatives/fixing agents for sampling; in these cases always use a sampling device to collect the sample prior to transferring the sample into the bottle.

Whenever possible, the collector will sample from a bridge so that the water body is not disturbed from wading. All samples are taken approximately in mid-stream, at least one inch below the surface. If it is necessary to wade into the water, the sample collector stands downstream of the sample, taking a sample upstream. If the collector disturbs sediment when wading, the collector will wait until the effect of disturbance is no longer present before taking the sample.

The following table describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

Table 11.1 Sampling Method Requirements

Parameter	Sample Bottle	Preferred / Maximum Holding Times
Conventional Parameters		
Temperature	clear plastic bottle or sample directly	immediately
Dissolved oxygen	plastic bottle or sample directly	immediately / for wet chemistry fix per protocol instructions, continue analysis within 8 hr.
pH	plastic bottle or sample directly	immediately
conductivity	plastic bottle or sample directly	immediately / refrigerate up to 24 hours
turbidity	plastic bottle	immediately / store in dark for up to 24 hr.
Nutrients		
Ammonia N	plastic bottle	immediately / up to 8 hours if the sample is acidified with sulfuric acid to less than 3.0 pH
Nitrate N	plastic bottle	immediately / refrigerate in dark for up to 48 hours.
Ortho-Phosphate	plastic bottle	immediately / refrigerate in dark for up to 8 hours
Urban Pollutants – Field Measurements		
Total Residual Chlorine	glass bottle	immediately
Phenols	glass bottle	immediately
Detergents	glass bottle	immediately
Total Copper	plastic bottle	immediately
Laboratory Analysis of Chemical Parameters		
Total Organic Carbon	acid and d.i. water rinsed glass sampling bottle, teflon liner in lid	refrigerate to 4 degrees C, send to lab immediately

Mercury	acid and d.i. water rinsed plastic sampling bottle	fix with Ultrapure (or comparable) nitric acid, send to lab immediately
PAH's	Solvent rinsed and dried glass sampling bottle, teflon liner in lid	refrigerate to 4 degrees C, send to lab immediately
Chlorpyrifos Diazinon Pyrethrins	Solvent rinsed and dried glass sampling bottle, teflon liner in lid	refrigerate to 4 degrees C, send to lab immediately
Biological Samples		
Fecal Coliform Bacteria	sterile plastic sampling bottle or whirl-pak	Refrigerate to 4 degrees C in the dark; deliverd to the lab within 4 hours, start analysis within 6 hours
Benthic macroinvertebrates	wide mouth plastic bottles	Fixed with ethanol immediately

12. Sample Handling and Custody Procedures

12.1. Sample Handling

Identification information for each sample will be recorded on the field data sheets (see Appendix 2) when the sample is collected. Samples that are not processed immediately in the field will be labeled with the waterbody name, sample location, sample number, date and time of collection, and sampler's name.

12.2. Custody Procedures

The conventional water quality monitoring tests do not require specific custody procedures since they will, in most cases, be conducted immediately by the same person who performs the sampling. In certain circumstances (such as driving rain or extreme cold), samples will be taken to a nearby residence for analysis. Samples requiring chemical preservation will be fixed prior to transport.

When samples are transferred from one volunteer to another member of the same organization for analysis, or from the citizen monitoring group to an outside professional laboratory, then a Chain of Custody form should be used. This form identifies the waterbody name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. In cases where the sample remains in the custody of the monitoring organization, then the field data sheet may be allowed to double as the chain of custody form. It is recommended that when a sample leaves the custody of the monitoring group, then the Chain of Custody form used be the one provided by the outside professional laboratory. Similarly, when quality control checks are performed by a professional lab, their samples will be processed under their chain of custody procedures with their labels and documentation procedures. For benthic macroinvertebrate samples, the **California Department of Fish and Game Aquatic Bioassessment Laboratory Chain of Custody** form will be used.

12.3. Disposal

All analyzed samples or spent chemicals (except for waste from the nitrate/cadmium reduction test and the Nessler ammonia test) including used reagents, buffers or standards will be collected in a plastic bottle clearly marked "Waste" or "Poison". This waste material will be disposed of according to appropriate state and local regulations. This will usually mean disposal into a drain connected to a sewage treatment plant.

Liquid waste from the cadmium reduction nitrate test will be kept separate and disposed of at a facility that is permitted to handle, transport, or dispose Cd waste. Liquid waste from the Nessler ammonia test (which contains mercury) will likewise be kept separate and disposed of at a facility that is permitted to handle, transport, or dispose Hg waste. Waste from the zinc reduction nitrate test and the salicylate ammonia test can be held in the regular waste container and disposed of as described in the previous paragraph.

Whenever possible, if waste includes reagents from the detergent test, these wastes will be poured down a drain underneath a flume hood.

13. Analytical Methods Requirements

Water chemistry is monitored using protocols outlined in the U.S. EPA Volunteer Stream Monitoring Manual and the California SWRCB Clean Water Team Water Quality Monitoring and Assessment Compendium**.** The methods were chosen based on the following criteria:

- capability of volunteers to use methods,
- provide data of known quality,
- ease of use,
- methods can be compared to professional methods in *Standard Methods*.

If modifications of methods are needed, comparability will be determined by side-by-side comparisons with a US EPA or APHA Standard Method on no less than 50 samples. If the results meet the same precision and accuracy requirements as the approved method, the new method will be accepted.

Table 13.1 outlines the methods to be used, any modifications to those methods, and the appropriate reference to a standard method.

Table 13.1 Analytical Methods for Water Quality Parameters

Parameter	Method	Modification	Reference (a)
Temperature	Thermometric	Alcohol-filled thermometer marked in 0.5^{o}C increments	2550 B.
Dissolved Oxygen	Winkler Method, Azide Modification	Prepackaged reagents, 20 ml sample size	4500-O C.
Dissolved Oxygen	Membrane Electrode	none	4500-O G.
pH	Electrometric	none	4500-H B.
pH	Litmus indicator strips	Non-bleeding	Whatman Co.
Conductivity	Electrometric	none	2520 B.
Turbidity	Dual tube optical comparisons	none	None
Turbidity	Nephelometric	none	
Ammonia N	Nessler or Phenate/Salicylate	prepackaged reagents, colorimeter or spectrophotometer	4500 – NH3 C 18th edition only (1992)
Nitrate N	Cadmium Reduction or Zinc Reduction	prepackaged reagents, colorimeter or spectrophotometer	4500 – NO_3^- E.
Ortho-Phosphate	Ascorbic acid	prepackaged reagents, colorimeter or spectrophotometer	4500 – P E.
Total Residual Chlorine	DPD Colorimetric	none	4500 - Cl G.
Phenols	Direct Photometric	Color Comparator	5530 D.
Total Copper	Neocuproine	prepackaged reagents, colorimeter	3500 -Cu D.
Detergents	Anionic Surfactants as MBAS	none	5540 C.
Fecal Coliform Bacteria	Colilert 18 hour	none	9221
Benthic Macroinvertebrates	Multi-Habitat field collection protocol	Level 2 (to family level)	Harrington, Jim, CDFG, 2005

(a) All of the above methods, with the exception of dissolved oxygen via indigo carmine, pH via non-bleeding indicator strips, turbidity via dual tube (JTUs), and benthic macroinvertebrates are described in Standard Methods for the Examination of Water and Wastewater 20th Edition. American Public Health Association et al, 1998.

14. Quality Control Requirements

Quality control samples will be taken to ensure valid data are collected. Depending on the parameter, quality control samples will consist of blanks, replicate samples, and split samples. In addition, quality control sessions (a.k.a. intercalibration

exercises) will be held annually to verify the proper working order of equipment, refresh volunteers in monitoring techniques and determine whether the data quality objectives are being met.

14.1. Cautions Regarding Test Procedures

14.1.1. Winkler Method for Dissolved Oxygen

The Winkler method is not appropriate for highly alkaline waters.

Other citizen monitoring groups have noted problems with short shelf-life of the sodium thiosulfate reagent. Field measurements should be evaluated immediately to determine whether they are reasonable.
The validity of the dissolved oxygen test will also be assured by taking these steps:

- Care is taken not to aerate water samples during collection,
- Water is added gently to the dissolved oxygen bottle,
- No air bubbles are present in the sample,
- The titration sample will be measured carefully with a graduated cylinder,
- The sample is swirled thoroughly after each drop of titrant,

If the endpoint is overrun, another 20 ml. of the sample will be titrated.

14.1.2. Nutrients

The nitrate test measures nitrite as well as nitrate. Therefore the results for the nitrate test are actually mg/l Nitrite + Nitrate Nitrogen. When mixing nitrate reagents take care not to agitate aggressively. The LaMotte phosphate reagents have been shown to degrade well within their listed shelf life once opened.

14.1.3. Urban Pollutants

The tests for detergent, chlorine and phenol should not be conducted on saline waters. Suspended matter and algae may give false positive results for detergent. The low sensitivity of the copper test may preclude detecting copper as most falls out of solution forming copper carbonate.

14.2. Blanks, Replicates, Split Samples, and Standardization

Field/Laboratory Blanks: For all conventional water quality analyses, except temperature, dissolved oxygen and pH, field blanks will be analyzed once daily. For nutrients using comparators, a field blank will be analyzed every sampling trip. Color can sometimes appear in these nutrient blanks, suggesting that the real samples may be overestimating the true nutrient concentration. When colorimeters or spectrophotometers are used at the group's facility for nutrient analysis, a laboratory reagent blank will be analyzed and recorded for each day of analysis. For urban pollutants field blanks will be run daily. For bacterial analysis performed at a group's facility, a laboratory blank will be performed for each sampling/analysis event. Blanks do not apply to benthic macroinvertebrate sampling. (see Table 14.1)

Instructions for Field and Lab Blanks: Distilled water is taken into the field or used in the laboratory and handled just like a sample. It will be poured into the sample container and then analyzed. When reagents are used in a test method, then the reagents are added to the distilled water and these types of blanks are referred to as reagent blanks. Field blanks are recorded on the field data sheet. For nutrients measured with comparators, results from the field reagent blanks should be "not detected". If nutrients are detected, corrective action will be taken to eliminate the problem. For nutrients measured with colorimeters, the lab reagent blanks should be less than 0.05 ppm and the specific value should be recorded and subtracted from the field sample result. For bacterial analysis, the reagents are added to distilled water (in the same manner as for a field sample) and that blank is then sealed in a quantitray and incubated along with the field samples. The blank should be below detection limits (i.e., no positive wells) at the end of the incubation period.

Field Confirmations: When a second method for measuring temperature, dissolved oxygen, and pH is available in the field, then the monitors are encouraged to perform both measurements on a split sample at least once daily. Examples of this sort of redundant measurement would be:

- for temperature, the use of an electronic thermometer (such as those that are built into dissolved oxygen meters) and an armored thermometer;
- for dissolved oxygen, the use of an oxygen meter and an indigo carmine colorimetric kit;
- for pH, a meter and a non-bleeding indicator strip.

This will serve to provide backup capability if the more sensitive electronic meters fail, and will provide additional confidence as to the quality of the data. The results of both measurements will be recorded along with the procedure used on

the field data sheet. If both results are comparable then the result produced using the method of greater sensitivity will be the one entered in the final data set by the data manager in consultation with the monitoring leader. If the two results are inconsistent, then the monitoring leader will note on the data sheet which of the results will be entered on the final data set by the data manager.

Replicate Samples: Replicate samples are two or more samples collected at the same time and place. When there are only two replicates then these are referred to as duplicates. For conventional water quality, nutrients, and urban pollutant analyses duplicate field samples will be taken once every 20 samples, or quarterly whichever comes first. Duplicate samples will be collected as soon as possible after the initial sample has been collected, and will be subjected to identical handling and analysis. For bacterial analysis lab duplicates will be run at least once per sampling day, and when there are more than 20 samples run per day then there will be a minimum 5% of the samples analyzed in duplicate. For benthic macroinvertebrate sampling, instead of duplicate sampling, each sampler will be evaluated annually by measuring the area sampled upstream of the net. The area should be one square foot and should be verified by using a one square foot pvc frame.

Split Samples: Once a Year, split spiked samples (standards) will be analyzed as part of the Quality Control Session. The split standard is one sample, containing a known concentration of an analyte, that is divided equally into two or more sample containers. Split standards will be analyzed by the volunteers, and sent to a professional laboratory (except for dissolved oxygen, temperature, and pH), before the maximum sample handling time is exceeded. Volunteers will analyze the split standard normally and will perform at least three analyses on that same sample. From these results accuracy and precision will be determined. The professional laboratory will analyze the sample using the method referenced in Table 13.1

For turbidity using the dual tube (JTU) method, split field samples will be analyzed as part of the Quality Control Session. The laboratory receiving the split sample will analyze it using the nephelometric method, even though these results are not strictly comparable to the visual JTU comparators. The results of turbidity using the two methods will be plotted to determine if there is a linear correlation. If this correlation is significant, then it will be used to estimate and compare results of the turbidity tubes with nephlometric results. The Technical Advisory Committee for all groups will use the product-moment correlation coefficient (r) to determine the adequacy of the correlation.

For bacteria, split field samples or split positive controls will be analyzed by the citizen monitoring group and an outside professional laboratory once annually. In addition, at the quality control session different analysts from the citizen monitoring group(s) will each read a minimum of the three quantitrays and compare their results. These results should be within $\pm$ one well for concentrations of less than 1000 MPN/100 ml, and within $\pm$ two wells for concentrations of greater than 1000 MPN/100ml.

A minimum 10% of the benthic macroinvertebrate samples will be subjected to validation by an outside professional taxonomist. Following analysis by the citizen group the selected samples will be reconstituted and sent out for professional level 2 taxonomic analyses. Reconstituted means opening the vials containing the 100 identified specimens, pouring the specimens back into the original sample jar, and gently stirring the contents. In addition, once a year citizen macroinvertebrate analysts will participate in an intercalibration exercise in which their subsampling/sorting and taxonomic skills will be evaluated. A minimum of two teams of analysts will each inspect each other's processed grids immediately following completion of the subsampling procedure. There should be no more than 10% missed organisms. A technical advisor should then evaluate each of the citizen analysts by testing their identification to order and family level on at least 20 specimens, including at least one representative from each of the major orders and families as determined by the technical advisor for that watershed. Accuracy and precision can be determined by the results of these validation and evaluation measures.

Standardization of Instruments and Procedures: At the Quality Assurance Sessions the temperature measurements will be standardized by comparing our thermometers to a NIST-certified or calibrated thermometer in ice water and ambient temperature water. All meters (pH, conductivity, oxygen) will be evaluated at the Quality Assurance Session using standards provided with the assistance of a professional laboratory and/or the technical advisors. For oxygen meters the standard will be distilled water saturated with oxygen. The Winkler kits for dissolved oxygen will be checked by standardizing the sodium thiosulfate solution in the test kit, and/or by comparing the entire kit to a saturated oxygen standard. Instructions for checking the sodium thiosulfate are included in the test kit. (Additional reagents and glassware must be purchased separately however.) If the result is unsatisfactory, as indicated in the instructions, the sodium thiosulfate and/or other reagent will be discarded and replaced with new reagents.

Continuous Monitoring Devices: Should continuous monitoring devices be used for any parameters then such devices must be calibrated and deployed according to the manufacturer's specifications and field confirmation will be performed using replicate sampling (for laboratory analysis) or standardized instruments. For example, there is the possibility of using in-situ continuous monitoring devices for flow or temperature measurements. Confirmations using a flow meter or a standardized

field thermometer will be perfomed at the time of deploying and retrieving the device. This will serve to determine the accuracy of the continuous monitoring device.

Table 14.1 summarizes the quality control regimen.

Table 14.1 Summary of Quality Control Requirements

Parameter	Blank	Duplicate Sample	Split Sample to lab	QC session
Water quality				
Temperature	none	5% or a minimum of once a year	none	once a year
Dissolved oxygen	none	5% or a minimum of once a year	none	once a year
pH	none	5% or a minimum of once a year	none	once a year
conductivity	daily	5% or a minimum of once a year	once a year	once a year
turbidity	daily	5% or a minimum of once a year	once a year	once a year
Nutrients (comparators)				
Ammonia	daily	5% or a minimum of once a year	once a year	once a year
Nitrate	daily	5% or a minimum of once a year	once a year	once a year
Ortho-Phosphate	daily	5% or a minimum of once a year	once a year	once a year
Nutrients (colorimeters or spectrophotometers)				
Ammonia	daily	5% or a minimum of once a year	once a year	once a year
Nitrate	daily	5% or a minimum of once a year	once a year	once a year
Ortho-Phosphate	daily	5% or a minimum of once a year	once a year	once a year
Urban Pollutants				
Total Residual Chlorine	daily	5% or a minimum of once a year	once a year	once a year
Phenols	daily	5% or a minimum of once a year	once a year	once a year
Total Copper	daily	5% or a minimum of once a year	once a year	once a year
Detergents	daily	5% or a minimum of once a year	once a year	once a year
Biological Parameters				
Total Coliform Bacteria	daily	5% or a minimum of once per day	once a year	once a year
Benthic Invertebrates	none	None, instead conduct evaluation of sampling area annually	10% per grant program	once a year
Field Survey Parameters				
Physical / Habitat Survey	none	none, instead conduct evaluation of volunteer performance annually	none	once a year
Bank Stability Survey	none	none, instead conduct evaluation of volunteer performance annually	none	once a year

15. Instrument/Equipment Testing, Inspection and Maintenance

A maintenance log is kept by the monitoring group leader. This log details the dates of instrument and sampling gear inspection, calibrations performed in the laboratory, battery replacement, the dates reagents and standards are replaced, and any problems noted with instruments, samplers, or reagents.

15.1. Temperature

Before each use, thermometers are checked for breaks in the column. If a break is observed, the alcohol thermometer will be placed in nearly boiling water so that the alcohol expands into the expansion chamber, and the alcohol forms a continuous column. verify accuracy by comparing with a calibrated or certified thermometer.

15.2. Dissolved oxygen

Dissolved Oxygen Winkler Titration: Before each use, bottles, droppers, and color comparators are checked to see if they are clean and in good working order. Reagents are replaced annually according to manufacturer's recommendation.

Dissolved Oxygen Meters: Membranes and solutions should be replaced according to manufacturer's specifications, but no less frequently than quarterly. Membranes should be checked for bubbles after replacement. Before each use, D.O. meters are checked to see if they are clean and in good working order.

15.3. Conductivity and pH

Before each use, conductivity and pH meters are checked to see if they are clean and in good working order. Conductivity and pH meters are calibrated before each use. Conductivity standards and pH buffers are replaced at least annually. Conductivity standards are stored with the cap firmly in place and in a dry place kept away from extreme heat. Do not re-use pH or conductivity standards.

15.4. Turbidity

Dual Tube Turbidity (JTU's): Before each use, turbidity tubes are checked to ensure that they are clean. The turbidity standard will be replaced annually.

Nephelometers: Meters and tubes should be checked for cleanliness and proper operation. The tubes should not be smudged or scratched.

15.5. Nutrients and Urban Pollutants

Before each use, test kits are checked to ensure that droppers, sample containers, and color comparators are clean and in working condition. Colorimeter tubes should be checked to make sure they are clean and are not scratched. Reagents are replaced annually according to manufacturer's instructions.

16. Instrument Calibration / Standardization and Frequency

Instruments will be calibrated and reagents checked against standards accordingly to the following schedule. Standards will be purchased from a chemical supply company or prepared by (or with the assistance of) a professional laboratory. Calibration records will be kept in the maintenance log at the headquarters location (described in Section 5.2.) where it can be easily accessed before and after equipment use. Calibrations that are performed by monitors in the field are recorded on the field data sheets, also archived at the headquarters. The frequency of calibration is described in Table 16.1.

Table 16.1 Instrument Calibration and Frequency

Conventional Water Quality Parameters		
Equipment Type	**Calibration Frequency**	**Standard or Calibration Instrument Used**
Temperature	Every 6 months	NIST calibrated or certified thermometer
Dissolved Oxygen (Winkler)	Every 6 months	Check sodium thiosulfate and/or against a saturated oxygen standard every 6 months.
Dissolved Oxygen meter	Every sampling day	At a minimum, water saturated air, according to manufacturer's instructions.
pH	Every sampling day	pH 7.0 buffer and one other standard (4 or 10)
conductivity	Every sampling day	Conductivity standard and distilled water
Turbidity meter (nephelometer)	Every sampling day	For clear ambient conditions use an 1.0 NTU standard, for turbid conditions use an 10.0 NTU standard
Dual TubeTurbidity	Every sampling day	Distilled water

Nutrients (using colorimeters)		
Equipment type	**Checked against Standard**	**Standard Used**
Ammonia	Every day of analysis	ammonia standard
Nitrate	Every day of analysis	nitrate standard
Ortho-Phosphate	Every day of analysis	ortho-phosphate standard

Urban Pollutants		
Equipment type	**Checked against Standard**	**Standard Used**
Total Residual Chlorine	every 6 months or when reagents replaced	sodium hypochlorite
Phenols	every 6 months or when reagents replaced	phenol standard
Total Copper	every 6 months or when reagents replaced	copper standard
Detergents	every 6 months or when reagents replaced	MBAS surfactant standard

17. Inspection/Acceptance Requirements

Upon receipt, buffer solutions, standards, and reagents used in the field kits will be inspected by the citizen monitoring leader for leaks or broken seals, and to compare the age of each reagent to the manufacturer's recommended shelf-life. All other sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation.

Before usage, thermometers are inspected for breaks. Breaks can be eliminated by heating (see Section 15.1). If not, they will be returned to the manufacturer.

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 determined by providing the reagent lot number to the manufacturer. Reagent replacement dates are noted in the maintenance log.

18. Data Acquisition Requirements

18.1. Professional Analytical Data

Only certified analytical laboratories or academic laboratories (with approval of State and/or Regional Board staff) will be used for quality assurance checks and analysis of field samples. The Technical advisory Committee (TAC) or technical advisors will review these laboratories' data as well as the volunteers. They may also review the lab's own quality control data to ensure data validity.

18.2. Geographical Information/ Mapping

USGS maps and aerial photographs will be used to verify watershed boundaries and stream courses. Additional information on distribution of natural resources will be obtained from the National Park Service and the CDFG's Biodiversity database. Land use information will be obtained from local planning offices. When information is requested, the agency will be asked to provide appropriate megadata and any information on data limitations. This information will be maintained with the data files.

19. Data Management

Field data sheets are checked and signed in the field by the citizen monitoring leader. The citizen monitoring leader will identify any results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate. Such data will be marked as unacceptable by the monitoring leader and will not be entered into the electronic data base.

Independent laboratories will report their results to the citizen monitoring leader. The leader will verify sample identification information, review the chain-of-custody forms, and identify the data appropriately in the database. These data are also reviewed by the technical advisors quarterly as available.

The data management coordinator will review the field sheets and enter the data deemed acceptable by the citizen monitoring leader and the technical advisors. Upon entering the data the data management coordinator will sign and archive the field data sheets. Data will be entered into a spreadsheet (MS Excel) or a database (MS Access) in a way that will be compatible with the SWRCB's SWAMP database guidelines. Following initial data entry the data coordinator will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed.

Raw data will be provided to the State WQCB and Regional WQCB in electronic form at least once every two years so that it can be included in the 305(b) report. Appropriate quality assurance information may be provided upon request.

20. Assessment and Response Actions

Review of all field and data activities is the responsibility of the citizen monitoring leader, with the assistance of the technical advisory committee. Volunteers will be accompanied by the citizen monitoring leader, or a technical advisor on at least one of their first 5 sampling trips. If possible, volunteers in need of performance improvement will be retrained on-site. All volunteers must attend a refresher course offered by the citizen monitoring group. If errors in sampling technique are consistently identified, retraining may be scheduled more frequently.

Within the first three months of the monitoring project, the State Water Board or Regional Board staff, or its designee, will evaluate field and laboratory performance and provide a report to the citizen monitoring group. All field and laboratory activities, and records may be reviewed by State and EPA quality assurance officers as requested.

21. Reports

The technical advisors will review draft reports to ensure the accuracy of data analysis and data interpretation. Raw data will be made available to data users per their request. The Laguna Creek Watershed Council will report their data to stakeholders after quality assurance has been reviewed and approved by their technical advisors. Every effort will be made to submit data and/or a report to the State and/or Regional Board staff in a fashion timely for their data uses, e.g. 305(b) reports.

22. Data Review, Validation and Verification

Data sheets or data files are reviewed quarterly by the technical advisors to determine if the data meet the Quality Assurance Project Plan objectives. They will identify outliers, spurious results or omissions to the citizen monitoring leader. They will also evaluate compliance with the data quality objectives. They will suggest corrective action that will be implemented by the citizen monitoring leader. Problems with data quality and corrective action will be reported in final reports.

23. Validation and Verification Methods

As part of standard field protocols, any sample readings out of the expected range will be reported to the citizen monitoring leader. A second sample will be taken as soon as possible to verify the condition. If the data is invalid, then the data will be noted (flagged) on the data sheet. The citizen monitoring leader will take further actions to trace the sources of error, and to correct those problems. If the error is a result of improper monitoring procedures, then the citizen monitoring leader may re-train monitors until their performance is acceptable.

24. Reconciliation with DQOs

The Technical Advisory Committee working with the monitoring leader(s) will review data annually to determine if the data quality objectives (DQOs) have been met. A quorum of 1/2+1of the technical advisory committee will be required for committee decisions. If a quorum is not met at the meeting, work will still proceed. The work product (e.g., review and comments on data or reports) will then be sent out to the whole technical advisory committee for approval with a 30-day review period.

If data do not meet the project's specifications, the following actions will be taken. First, the technical advisors working with the monitoring leader(s) will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. They will suggest corrective action. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the technical advisors and the TAC will review the DQOs and determine if the DQOs are feasible. If the specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to DQOs will be appended to this QA plan with the revision date and the reason for modification. The appended QAPP will be sent to the quality assurance panel that approved and signed this plan. When the appended QAPP is approved, the citizen monitoring leader will work with the data coordinator to ensure that all data meeting the new DQOs are entered into the database. Archived data can also be entered.

APPENDIX 1. Data Quality Forms

Data Quality Form: Accuracy — Quality Control Session

Monitoring Group Name	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter/ units	Sensitivity	Accuracy Objective	Standard Conc.	Analytical Result	Estimated Bias	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{o}C								
Dissolved Oxygen (mg/l)								
pH standard units								
Conductivity (umhos/cm)								

Comments:

Data Quality Form: Completeness

Quality Control Session

Monitoring Group Name			Type of Session (field or lab)	
Your Name			Quality Assurance Leader	
Date				
Parameter	**Collection Period**	**No. of Samples Anticipated**	**No. Valid Samples Collected and Analyzed**	**Percent Complete**
Temperature ^{o}C				
Dissolved Oxygen (mg/l)				
pH standard units				
Conductivity (umhos/cm)				

Comments:

Data Quality Form: Precision — Quality Control Session

Monitoring Group Name	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter/ units	Mean (x)	Standard Deviation (s.d.)	s.d./x	Precision Objective	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{o}C							
Dissolved Oxygen mg/l							
pH standard units							
Conductivity (umhos/cm)							

Comments:

Laguna Creek Watershed
Monitoring Program
Work Plan
Years 1&2

revised
July 2006
(original draft July 2005)

Submitted by:
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95758-0014

In collaboration with:
EDAW
GeoSyntec Consultants

Laguna Creek Watershed Monitoring Program Year One

1. Introduction

The intent of this plan is to outline the monitoring responsibilities required in the Laguna Creek Watershed Protection Program Grant, as funded under Calfed. This document is a work plan for Year One of the Laguna Creek Watershed Monitoring Program.

The Laguna Creek Watershed Council is a non-profit grass-roots alliance that strives to protect the health of Laguna Creek and its tributary streams by educating residents, promoting active community participation, and fostering partnerships and projects that achieve long-term, balanced solutions with mutual benefits to all stakeholders.

There are four main issues that will be addressed by this Program:

- ***A Need for Data***. The natural resource status of the Laguna Creek Watershed has received little attention to date. There is a critical need to collect environmental data and assess the health of the watershed, and there is an engaged citizenry and local schools that are willing to help with this effort. The watershed presents some unique water quality and urban runoff pollution problems that need to be studied and managed. These include problems with pesticides, sediment (the upper watershed has natural colloidal clays that do not settle out with conventional stormwater quality treatment methods) and nutrients/excessive algae build-up.
- ***Continued Support for A Motivated, Grassroots Watershed Council***. A small amount of seed money was provided in 2002 through a 1999 319h Grant to organize the new Laguna Creek Watershed Council (LCWC), and Sacramento County and the City of Elk Grove contributed funds to keep the group going while alternative longer term funding was sought. The LCWC is remarkably diverse and its members are well educated. Many of the members have relevant professional experience and education in watershed management, water quality studies, land use planning, education and natural resource management. The LCWC is an energetic, broad-based citizen stakeholder group that is busy gathering information about ecosystem health and planned development within their watershed. The members are actively building working relationships with local government agencies and the development community. These efforts are the first step in establishing a common goal for protection and preservation of what natural resources remain in the rapidly urbanizing watershed.

A look at models of successful, sustainable watershed management processes in other areas (Portland, Oregon and Maryland) reveals that watershed planning and subsequent development benefit from the contributions of informed, broad-based citizen stakeholder groups. When a planning process is mainly agency-driven, watershed management practices remain contentious and difficult to sustain. However, even organized citizen groups are frequently marginalized by limited volunteer time and technical expertise. Grant funding helps citizens to hire technical experts needed to evaluate and create solution-oriented, engineering plans, and coordinators/facilitators to enable the group to clearly articulate its views and participate more effectively in government processes. This Project will benefit from the grass-roots nature, the qualifications, and readiness of the stakeholders in the Watershed Council.

- ***An Opportunity To Engage the Local Residents and Schools in Meaningful Watershed Projects.*** The Watershed Coordinator has established strong relationships with the schools in the watershed and helped the Elk Grove Unified School District (EGUSD) secure a Service Learning Grant in past years. The local schools (elementary, middle, high school and Cosumnes River College) have been informed about this grant project and are eager to take part in helping us achieve the goals. Several schools have already begun stewardship projects in partnership with the LCWC, and EGUSD teachers, parents, and administrators have been attending Council meetings since the LCWC began in 2002.
- ***A Unique Chance to Minimize Impacts from Future Development***. The LCWC is emerging at a "watershed moment," in a planning process where timing is everything. The upper portion of the watershed will be developed over the next ten years and local government agencies are recognizing the need to try new approaches. Sacramento County is now undertaking pilot-level implementation of new drainage design techniques that move away from standard trapezoidal ditches towards corridors that integrate riparian and wetland habitats with flood control, water quality treatment and passive recreation.

  In addition, the multi-agency Upper Laguna Creek Collaborative (ULCC) is taking an unprecedented step toward coordinated stream-friendly development of the Upper Laguna Creek watershed. Parks and public works agencies' staff and representatives of the LCWC are examining ways to better meld the infrastructure needs of proposed development with the water quality, habitat and recreational needs of the new watershed community. All of the stakeholders share a common goal of achieving sustainable results that will ensure the health and beauty of the area's natural resources for generations to come. The prospects for a successful outcome depend heavily on the continued advocacy role of the LCWC being funded through this grant. The results of this work will surely serve as a model for other growing communities in the Bay-Delta system and elsewhere in California.

To date, there have been no comprehensive efforts to study the watershed as a whole. Individual agencies have embarked on isolated projects, although some of the benefits

extend beyond the project boundaries. For various reasons the urbanized watershed of lower Laguna Creek has retained more of its riparian habitat values than any other stream in southern Sacramento County. For instance, in portions of its lower reach, an unprecedented 600 foot wide corridor was preserved by Sacramento County for Giant Garter Snake habitat. In addition, the Sacramento Regional Wastewater Treatment Plant (SRWTP) has invested heavily in enhancement of the riparian and wetland resource values of the terminal reach of Laguna Creek in its "Bufferlands" acreage. Moving upstream, the City of Sacramento created the North Laguna Creek Wildlife Area, complete with wide densely vegetated buffers, pedestrian bridge and interpretive signage. Further upstream on Laguna Creek, the County and the EGCSD worked together to create several nice examples of protected creek habitat. These include the Lower Laguna Bypass (created to preserve valuable wetlands), Camden Lakes, and the Fallbrook neighborhood natural floodplain area. The final example of protected creek habitat is in the Vineyard Springs area, a collaborative effort by the County and Southgate Recreation and Parks District. Opportunities still exist in the upper watershed to maintain and enhance water quality and habitat values, building on these previous investments.

In terms of water quality assessment, the SRWTP has established a long-term water quality database for the terminal reach of lower Laguna Creek. Some water quality data was collected in Elk Grove Creek, due to its presence on the State's 303(d) List for diazinon. Sacramento County's stormwater monitoring data from other local creeks provides evidence of the potential adverse impacts of urban runoff, in the absence of effective water quality treatment.

Several agencies are actively conducting programs which relate to creek awareness and stewardship. The EGCSD trains docents to lead creek tours, implements the Junior Creek Keepers Program for preschoolers, publishes the Laguna Creek Parkways Map/Brochure, and sponsors Elk Grove Creek Week each April in collaboration with the Sacramento Urban Creeks Council. The County and Cities of Sacramento and Elk Grove implement the SPLASH program, which provides creek curricula and other resources to schools in the watershed. The agencies also offer water quality-based classroom presentations, an annual pollution prevention calendar art contest, and provide a stormwater booth and staff for public events held in Elk Grove.

Finally, in Spring 2003, the Elk Grove Unified School District (EGUSD) received grant funds from the CA Department of Education to develop and implement a district-wide Service Learning Program, whose goal is to link required student community service hours to curriculum standards. The EGUSD was encouraged by the Watershed Council to adopt the watershed and its natural resources as the integrating context for student learning in this program.

The Laguna Creek Watershed Council's Vision Statement reads:
The community feels connected to the watershed with its healthy, natural waterways and abundant wildlife and works to protect and enhance this valuable resource for the benefit and enjoyment of present and future generations. Residents, businesses, organizations, landowners and government agencies collaborate to create solutions that balance the

need for responsible resource protection and management with continued urban and economic development.

The desired outcomes of this Project are designed to help the residents and other watershed stakeholders achieve their vision:

- Increased awareness by all stakeholders that the creeks and associated riparian corridors are a natural resource to be protected.
- Increased understanding by residents of how their everyday actions can adversely affect the creeks, and how they can modify their behavior to practice pollution prevention.
- A sense of pride and "ownership" of the creek system by residents, schools and community groups.
- Visually enhanced water quality in the creeks due to stewardship activities such as cleanups, planting activities, invasive weed removal and urban runoff pollution prevention efforts.
- Meaningful data regarding environmental conditions (e.g., habitat, water quality) found in the creeks today.
- Increased collaboration between government agencies to plan and implement programs to protect, restore and enhance the watershed.
- Solid partnerships between the schools and the local community for engaging students in meaningful watershed projects that provide environmental benefits, inspire further study and build character.
- Model stewardship, planning and collaboration tools and projects that can be applied in other developing communities throughout California.

2. Organizational Structure

A team of experienced environmental professionals and water resource engineers will direct and conduct the technical work necessary to assess water quality, habitat and drainage conditions and develop solutions which balance the needs of water quality improvement, habitat protection, channel stability and drainage/flood control, recreation and open space conservation. Field assessments and office research will be conducted to assess existing watershed water quality, habitat, drainage and other conditions. Problems and opportunities will be identified and mapped and presented to the Watershed Management Plan Technical Advisory Committee (WMP TAC) for feedback. Then projects will be identified to address the problems and take advantage of opportunities (e.g., land availability). For each recommended project, the project team will outline in a fact sheet a project description, stakeholders, order of magnitude budget estimates and projected benefits. They will then use weighted evaluation criteria to rank the projects in terms of priority. Ranking results will be presented to the WMP TAC, and then to the broader community in an open house to get feedback before proceeding with development of the final WMP document. The challenge will be in selecting and prioritizing actions that have the greatest chance of success, but there are several successful implementation models in the San Francisco Bay Area and Pacific Northwest

that can guide the effort. The strategy is to facilitate collaboration between agencies, citizens, developers and landowners, and involve youth, in order to foster a sustainable stewardship culture within the watershed. This, in turn, will increase the capability of sustaining the water quality benefits derived from the activities.

A. Grant Program and Project Managers

The Program and Project Managers of the Laguna Creek Watershed (LCW) Grant Program directly involved with the Laguna Creek Watershed Monitoring Program are listed in Table 1 below.

Table 1. Grant Program and Project Managers

Task	Managers
Watershed Management Plan, Consultant Team Manager	Carmel Brown, Principal, CKB Consulting Inc.
Watershed Assessments (Professional level)	Debra Bishop, EDAW Chris Fitzer, EDAW Ron Unger, EDAW Gary Palhegyi, GeoSyntec Consultants
K-14 Stewardship Project Citizen Stream Stewards Project	Greg Suba, Environmental Education Services Chris Fitzer, EDAW Ellen Carlson, Florin RCD

B. Grant Program Advisors

The Grant Oversight Committee will receive reports from Program and Project Managers and meet quarterly to ensure the successful progression and completion of grant tasks. The members of the Grant Oversight Committee are listed in Table 2 below.

Table 2. Grant Oversight Committee

Laguna Creek Watershed Council Grant Oversight Committee
Janet Parris, County of Sacramento Department of Water Resources Stormwater Quality Program
Barbara Washburn, California Office of Environmental Health Hazard Assessment, local landowner
Maynard Flohaug, Public Works Department, City of Elk Grove
Nancy Myers, watershed resident and landowner
Alta Tura, President, Sacramento Urban Creeks Council

The Watershed Management Plan Technical Advisory Committee (WMP TAC) will advise Project and Program managers on matters associated with the development of the Watershed Management Plan, and review all products associated with the Watershed Management Plan. The members of the WMP TAC are listed in Table 3 below.

Table 3. Watershed Management Plan Technical Advisory Committee (TAC)

Watershed Management Plan Technical Advisory Committee
Ken Allred, Civil Engineer, Operations Manager - MacKay and Somps Civil Engineering

Eva Butler, Aquatic Ecologist, Principal, Riverside Consulting
Brian Bledsoe, Assistant Professor of Civil Engineering, Colorado State University Department of Civil Engineering

3. Goals

The primary goals of the Laguna Creek Watershed Monitoring Program (LCWMP) for Year 1 are:

1. to identify baseline riparian habitat and in-stream biological, chemical, and physical conditions that will characterize present conditions in the watershed

2. to develop an hydrologic model for upper watershed (headwaters to Bond Rd.) that will provide scientific guidance during development of stormwater quality management practices

3. to train volunteer citizen and student monitors to collect and manage stream water quality and habitat survey data for reporting to appropriate agencies and for educational purposes

This program will gather and supplement as necessary existing agency information by monitoring streams in the Laguna Creek Watershed. The focus of the project is on habitat quality, chemical, physical and biological water quality, and hydrogeomorphological measures that will identify the status of aquatic resources in the Laguna Creek Watershed.

4. Objectives

<u>Professional monitoring efforts</u>
The objective of professional monitoring work related to the Laguna Creek Watershed Management Plan are to:

1.identify available data that can be used to establish baseline biological, chemical, physical, habitat, and hydrogeomorphological conditions in the watershed

2. collect new data to supplement any pre-existing data to be used to establish baseline watershed conditions.

<u>Citizen monitoring program</u>

The first objective related to the K-14 Watershed Education Project and the citizen Stream Stewards Project tasks will be to identify and map creek reaches in the developed portion of the watershed. Outreach will then be conducted with local neighborhoods, agencies and schools to designate groups to "adopt" each reach. The goal will be to establish one new "Adopt a Creek" group every 2-3 months, so as not to overwhelm the coordination effort, with an ultimate goal of having 50% of the creeks in developed areas "adopted" by the end of the project term. Several actions will be taken to educate and inform citizens along the way: A "Caring for Your Creek" guide will be developed, following the model of similar guides produced in Santa Cruz and Marin Counties. A

series of "expert" lecture workshops will be presented on various topics throughout the project term, such as:

- Invasive and Native Plants - Identification and effects of invasive non-native plants on the natural riparian ecosystem within the watershed, benefits and types of native plants acceptable in the watershed, and training in weed removal techniques (include materials produced by the UC Davis Water Wise Program (Master Gardeners)..
- Stream Monitoring - Urban runoff / water quality issues in local creeks, common pollutants and their sources, pollution effect on stream ecosystem, and methods of monitoring.

5. Outreach

Through outreach meetings, mailings, newspapers, visits to school sites and the LCWC website (www.lagunacreek.org) the LCW Monitoring Program will recruit a list of volunteers for the next year, and for subsequent grant years. Each volunteer understands that they are responsible for sampling at their assigned site on the assigned monitoring dates. The timetable for citizen monitoring development, recruitment and field work is presented in Table 4 below.

Table 4. K-14 and Citizen Monitoring Project Schedule

Activity	Date
Identify monitoring leaders	9/05 - 3/08
Obtain training for monitoring leaders	9/05, 9/06, 9/07
Recruit monitors	9/05 - 3/08
Obtain and check operation of instruments	9/05 and as necessary
Train monitors	October 2005-2007
Initiate monitoring	10/05
Initiate data entry	11/05
Calibration and quality control sessions	10/05, 10/06, 10/07
Review data with technical advisors	11/05, 6/06, 11/06, 6/07, 11/07

6. Monitoring Program Description

A. Narrative

The Laguna Creek Watershed is almost 50 square miles of land draining to Laguna, Whitehouse and Elk Grove (303d-listed for diazinon) Creeks in a rapidly urbanizing area of south Sacramento County (see Figure 1, Map). Laguna Creek carries water to Morrison Creek (303d-listed for diazinon), which in turn discharges to the Sacramento River, except during the winter, when flows are also directed to the Stone Lakes National Wildlife Refuge. About half of the watershed (the lower portion) is located in the City of Elk Grove, while the upper portion is located in unincorporated Sacramento County. Small portions are located in the Cities of Sacramento and Rancho Cordova. Parks and trail systems (including creekside trails) in the watershed are managed by the Elk Grove

Community Services District, Parks and Recreation Department (EGCSD), Southgate Recreation and Parks District (Southgate) and the County of Sacramento Parks Department. Open space is managed by private landowners and several different entities.

The Laguna Creek Watershed is home to a diverse population of over 100,000 residents, and just over one-third of the watershed is owned and/or managed by farmers and ranchers. The area is experiencing unprecedented growth in residential and commercial land uses; this growth is expected to continue for another 10-20 years. In the lower portion of the watershed, which is largely developed with some infill occurring, there is a need to assess conditions in the creeks and involve the community in stewardship, enhancement and restoration activities. In the upper portion of the watershed, there is a great need to get out ahead of the development curve and preserve and protect open space and riparian buffers along undeveloped portions of the creek corridors. Additionally, assessments conducted as part of the South County Habitat Conservation Plan (HCP) process show that there are approximately 380 acres of vernal pools still existing in the upper watershed that will require protection or mitigation as development progresses.

The mission of citizen monitoring in the Laguna Creek Watershed is to produce environmental information which is needed to protect our watershed's aquatic resources. Citizen monitoring will also inform and engage the community in effective watershed stewardship.

The Laguna Creek Watershed Grant Project has three main goals:

1) Conduct a watershed assessment to evaluate the environmental conditions, identify problems and sources, and recommend prioritized projects to address the problems.
2) Prepare a watershed management plan that is practical and achievable, recommending a prioritized list of projects to be implemented by the stakeholders over the next ten years or so.
3) While the watershed assessment is being conducted and management plan developed, create meaningful, collaborative opportunities for the residents, schools and public agencies to engage in the practice of watershed protection and creek stewardship. These stewardship projects will continue during the implementation of the watershed management plan in future years. By engaging watershed residents and youth, this Program will foster a watershed stewardship ethic that is cultivated from one generation to the next.

Water quality monitoring, BMI bioassessment, habitat surveys, and hydrogeomorphic analysis of the watershed associated with the development of the Watershed Management Plan will be performed by professional field biologists, ecologists, engineers and geomorphologists. Protocols, equipment, field data sheets, and quality assurance measures associated with professional monitoring projects are discussed in the *Laguna Creek Watershed Monitoring Program Quality Assurance Project Plan* (LCWMP QAPP).

Environmental professionals (Greg Suba, Chris Fitzer) will oversee the design and implementation of a citizen monitoring and stewardship program that features both standardized stewardship projects from reach to reach (i.e., visual surveys, water quality monitoring) and reach-specific projects that may including stream habitat visual surveys, volunteer stream bioassessment, tree planting, watershed tours, nature walks, workshops, special events, and lectures. Field monitoring methods will adhere to the Monitoring Plan and LCWMP QAPP and projects will build on successful programs implemented by the Sacramento Urban Creeks Council and the Elk Grove Community Services District, such as the Elk Grove Creek Week Clean Up (April each year)

B. Criteria for Site Selection

The following criteria will be used to establish monitoring locations for Year 1 of the LCW Monitoring Program. Criterion for initial selection of sites included the following:

1.) Is there an existing flow gauging station?
2.) Has there historically been land use activities (agriculture, mining, recreational, etc.) that may have affected water quality or the physical integrity of the creek?
3.) Is the site included in the designated critical habitat for listed species?
4.) Are there site access constraints?
5.) Are there sampling access constraints?
6.) Is there a potential water quality impairment?
7.) Is there previous water quality data that could be used?
8.) Is the site part of an existing watershed restoration program?
9.) Has the state identified the waterbody as an impaired watershed under the Clean Water Act?

All sites chosen for water quality sampling will fit at least 4 of the criteria for monitoring described above.

C. Sites

Once established, Year 1 sampling sites of the LCW Monitoring Program will be listed and described in subsequent revisions of this work plan.

Table 5. Sampling Sites and Parameters for the LCW Monitoring Program: Year 1

Site #	Level of Effort (Professional or Citizen monitoring)	Monitoring Parameter
LC1	Professional	BMI Bioassessment Vegetation Survey
LC2	Professional	BMI Bioassessment Vegetation Survey

LC3	Professional	BMI Bioassessment Vegetation Survey
EGC1	Professional	BMI Bioassessment Vegetation Survey

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D. Narrative Description for Sites

Site	Description
LC1	Laguna Creek mainstem in the upper watershed with intermittent flows, between Blodgett Reservoir and Sunrise Ave. within a reach that follows the original stream alignment (as per 1937 aerial photographs).
LC2	Laguna Creek mainstem in the upper watershed immediately upstream of Excelsior Rd. along the stream reach within the Were conservation easement area (held by Sacramento Valley Conservancy.
LC3	Laguna Creek mainstem in the lower Watershed immediately downstream of the West Stockton Rd. and HW 99 bridges - along the "Laguna Falls" bypass weir.
EGC1	Elk Grove Creek immediately downstream of the Emerald Vista Rd. bridge.

E. Sampling Frequency

Table 6. Summary of Year 1 Sampling Frequency

Parameter	**Professional**		**Volunteer Citizen**	
	Type of Monitoring	**Maximum Monitoring Frequency**	**Type of Monitoring**	**Maximum Monitoring Frequency**
Temperature	F	S	S	X
Dissolved Oxygen	F	S	S	X
pH	F	S	S	X
Conductivity	F	S	S	X
Alkalinity	F	S	S	X
Benthic Macroinvertebrates	P	S	-	-
Physical / Habitat Survey parameters	F	S	F	S
Vegetation Survey	F	S	-	-
Bank Stability Survey parameters	-	-	F	A
Reach / Site scale Hydrogeomorphic Survey parameters	F	A	-	-

Codes for Table 6: Type: F: field analysis, L: in-house lab analysis, P: sample only, send to outside professional lab; **Frequency**: A: annually M: monthly, S: seasonal, X: irregular

7. Sampling Dates

Year 1 professional sampling, performed as part of the Watershed Management Plan development, will begin in late August, early September, 2005. Citizen monitoring will begin in October, 2005 and occur as projects are developed. Below are known sampling events and descriptions for Year 1:

Level of Monitoring Effort	Parameters	Location	Date
Professional	BMI Bioassessment / Vegetation Survey	LC1	May / June 2006 September / October 2006
Professional	BMI Bioassessment / Vegetation Survey	LC2	May / June 2006 September / October 2006
Professional	BMI Bioassessment / Vegetation Survey	LC3	May / June 2006 September / October 2006
Professional	BMI Bioassessment / Vegetation Survey	EGC1	May / June 2006 September / October 2006
Professional	Channel Stability study (Hydrogeomorphological surveys)	15 stream channel profiles between Grant Line Rd. and Bond Rd.	May / June 2006
Citizen	DO / Temp / pH / Conductivity / Turbidity	Elk Grove Creek east of Waterman Rd.	October 2005 (World WQ Monitoring Day)
Citizen	DO / Temp / pH / Conductivity / Turbidity	Elk Grove Creek west of Waterman Rd.	October 2005 (World WQ Monitoring Day)

8. Field Procedures

Each Volunteer Monitor will be given a field procedures manual that includes the U.S Environmental Protection Agency (USEPA) and State Water Resources Control Board (SWRCB) monitoring protocols for each parameter. Each manual will contain:

Site location, including map
Site number
Schedule of sampling dates
Specific parameters to be measured for that site.
List of equipment necessary for each parameter for that site
EPA and SWRCB approved protocols for sample collection

Appropriate survey forms
Appropriate Data collection Sheets
Instructions for sample handling, labeling and transport
Field Safety checklist

9. Monitoring Methods

Water quality and benthic macroinvertebrate samples, and stream habitat and hydrogeomorphological surveys will be collected by both professional field scientists and volunteer citizen monitors. The former will collect samples and information to be used in the development of the Laguna Creek Watershed Management Plan, and the latter group will collect samples as part of both the K-14 Watershed Education Program and the citizen Stream Stewards Program. All samples will be taken and analyzed in accordance with the *Laguna Creek Watershed Monitoring Program Quality Assurance Project Plan* (LCWMP QAPP) as approved by the SWRCB, USEPA, and the LCWC WMP TAC. Specific methodologies are listed in Table 7 below.

Parameter	Method	Location	Comments
Temperature	Thermometer (-5 to 50° C)	Field	Thermometer will be calibrated before every use.
Dissolved Oxygen	Meter	Field	Meters will be calibrated before every use.
pH	Meter	Field	Meters will be calibrated before every use.
Conductivity (Dissolved solids/salts)	Meter	Field	Meters will be calibrated before every use.
Alkalinity	Colorimeter	Field	Meters will be calibrated before every use.
Benthic Macroinvertebrates	CA DFG 11-transect Multi-Habitat method	Lab	Will be analyzed by independent professional laboratory
Physical / Habitat Surveys parameters	CA DFG 11-transect Multi-Habitat method	Field	Will be performed by professional and trained volunteer citizen monitors
Bank Stability Survey parameters	Swanson Hydrology protocol	Field	Will be performed by trained volunteer citizen monitors

Reach / Site scale Hydrogeomorphic Surveys parameters	GeoSyntec Consultants Erosion assessment	Field	Will be performed by professional monitors

10. Quality Assurance Policy and Protocols

The U.S. Environmental Protection Agency, State Water Resources Control Board, River Watch Network, and RiverKeeper programs nationwide all recommend the formation of a Quality Assurance Project Plan (QAPP) for volunteer monitoring programs. In fact, U.S. Environmental Protection Agency-funded and State Water Resources Control Board-funded monitoring programs must have an approved QAPP before sample collection begins. A QAPP, *The Laguna Creek Watershed Monitoring Program Quality Assurance Project Plan* (LCWMP QAPP), has been developed for the Laguna Creek Watershed Monitoring Program which outlines the procedures for Volunteer Monitors to collect and transport data. Copies of the LCWMP QAPP are available for download from the LCWC website at www.lagunacreek.org.

11. Sample Analyses

The table below lists the types of field samples collected as part of the LCWC Calfed grant program that will require analysis by an outside laboratory, and the laboratories that will be used to perform the analyses. The LCWC data manager will notify Calfed in the event the LCWC elects to use a different analytical laboratory than those listed below.

Type of Sample	Laboratory performing analysis
BMIs	CA DFG Aquatic Bioassessment Lab
Erosion Assessments / Channel Stability surveys	Geosyntec Consultants

12. Data Management

Water quality data will be stored in a database that supports sorting and the use of the data in various types of models. This may be in MicroSoft Excel or MicroSoft Access files, which can support a variety of sorting and query types. This storage device will allow the development and updating of the information management system for the the Laguna Creek Watershed on a long-term basis.
The database management program and accompanying website will be created in Year 1 and will be based on the specific needs of the LCW Monitoring Program and the LCWC. Data files will be saved as .pdf files and made available for download via the LCWC website, www.lagunacreek.org.

13. Reporting

Data collected and analyzed as part of the LCWMP will be reported to Calfed as part of the Final Report, and will be presented to the general public via the Exploring our

Watershed / Science link on our website www.lagunacreek.org. Results of data collection and analysis will be reported as updates and as a Focus Topic agenda item at future LCWC general meetings.

Laguna Creek Watershed-related Existing Data and Reports

The following is a list of documents and reports relevant to the development of the biological and hydrogeomorphic assessments of Laguna Creek and its tributary streams.

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Lower Laguna Creek Drainage Master Plan: Final Report*	Zentner & Zentner and Gill Water Resouces Engineering for Sacramento County, Water Resources Division, Department of District Engineering	May 1996	Lower Watershed	Hydrologic and Hydraulic and Stormwater Quality Features Analyses of Laguna Creek from Bond / Waterman Rds. downstream to the City of Sacramento boundary; also Whitehouse Creek	Hardcopy
City of Elk Grove DRAFT Flood Control and Storm Drainage Master Plan Report*	West Yost Associates, in association with David Ford Consulting Engineers for the City of Elk Grove	November 2006	Lower Watershed	Hydrologic and Hydraulic and Stormwater Quality Features Analyses of all streams within the City of Elk Grove	Hardcopy

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Maintenance Map for City of Elk Grove	Maynard Flohaug at the City of Elk Grove	Fiscal Year 2004-2005	Lower Watershed	locations and types of maintenance practices performed on streams and channels within the City of Elk Grove during 2004-2005	Hardcopy. Using a GIS parcel basemap of Elk Grove, Maynard Flohaug marked layers by hand on this map
Lower Laguna Creek Drainage Master Plan Post-Construction Monitoring: First Year (2000) Report*	Zentner and Zentner for Sacramento County, Water Resources Division, Department of District Engineering	November 2000	Bypass Area of Lower Watershed	Vegetation and wildlife survey data from within the Laguna Creek Bypass area, from HW 99 downstream to Center Parkway	Hardcopy
Lower Laguna Creek Drainage Master Plan Post-Construction Monitoring: Fourth Year (2003) Report*	Zentner and Zentner for Sacramento County, Water Resources Division, Department of District Engineering	August 14, 2003	Bypass Area of Lower Watershed	Vegetation and wildlife survey data from within the Laguna Creek Bypass area, from HW 99 downstream to Center Parkway	Hardcopy

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Lower Laguna Creek Drainage Master Plan Post-Construction Monitoring: Fifth Year and Final (2004) Report*	Zentner and Zentner for Sacramento County, Water Resources Division, Department of District Engineering	March 2005	Bypass Area of Lower Watershed	Vegetation and wildlife survey data from within the Laguna Creek Bypass area, from HW 99 downstream to Center Parkway	Hardcopy
City of Elk Grove Routine Channel Maintenance Program: Habitat and Special-Status Species Assessment*	North State Resources, Inc. for the City of Elk Grove Planning Department	March 18, 2005	City of Elk Grove	CNDDB reports and maps for species occurring within the City of Elk Grove boundaries. For each species, report presents regulatory status, habitat requirements, and potential for occurrence.	Hardcopy

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Upper Laguna Creek Drainage Master Plan: Status Report*	Sacramento County Water Resources Division, Drainage Master Plan Section	August, 1997	Upper Watershed - following Laguna Creek and Tributary One (Toad Creek) from Florin Rd. downstream to Bond / Waterman Rds.	Hydrologic and Hydraulic Analyses and Habitat Type maps for Laguna Creek from Florin Rd. to intersection of Bond / Waterman Rds.	Hardcopy
Upper Laguna Creek Drainage Master Plan: Status Report*	Sacramento County Water Resources Division, Drainage Master Plan Section	September, 1997	Upper Watershed - following Laguna Creek and Tributary One (Toad Creek) from Florin Rd. downstream to Bond / Waterman Rds.	Hydrologic and Hydraulic Analyses and Habitat Type maps for Laguna Creek from Florin Rd. to intersection of Bond / Waterman Rds.	Hardcopy. Updated / revised version of above report; with addendum report (April 1, 1998) analyzing alternative basin locations and channel configurations
Preliminary Determination: Upper Laguna Creek Drainage Master Plan Regional Detention Basin Alternatives Wetland Delineation*	EIP Associates for Sacramento County Water Resources Division	October 1998	Upper Watershed - locations of proposed detention basins along Laguna Creek and Tributary One in upper watershed	wetlands delineation data; vegetation and soils surveys	Hardcopy
Upper Laguna Creek Drainage Master Plan Biological Resources Background Report*	EIP Associates for Sacramento County Water Resources Division	February 1998	Upper Watershed - following Laguna Creek and Tributary One (Toad Creek) from Florin Rd. downstream to Bond / Waterman Rds.	potentially occurring special status species in Upper Laguna Creek watershed	Hardcopy

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Vineyard Springs Comprehensive Plan: Final*	the Spink Corporation for Sacramento County Water Resources Division	June 22, 1999	Upper Watershed - Vineyard Springs planning area bounded by Gerber, Excelsior, Calvine, and Bradshaw Rds.	Comprehensive plan for development of Vinyard Springs area	Hardcopy. Contains stream profiles for Laguna Creek and Tributary 1 at bridge crossings from Excelsior Rd. to Sheldon Rd.
Upper Laguna Creek Hydro-Geomorphic Stability Analysis: Draft Report*	William Lettis & Associates for Sacramento County Department of Water Resources	September 2005	Upper Watershed - Geomorphic data collected from upstream of Excelsior Rd. to intersection of Bond / Waterman Rds.	Hydrologic, Hydraulic, and Geomorphic data and analyses for Upper Laguna Creek, especially from Excelsior Rd. to Bond / Waterman Rds.	Hardcopy
Laguna Creek Watershed Management Plan: Hydrogeomorphic Model and Water Quality Study*	GeoSyntec Consultants for the Laguna Creek Watershed Council	April 2007	Upper Watershed - from the uppermost reaches of Laguna Creek to the intersection of Bond / Waterman Rds.	Hydrologic, Hydraulic, and Geomorphic data and analyses for Upper Laguna Creek, especially from Excelsior Rd. to Bond / Waterman Rds. including modeling of future conditions of watershed	Hardcopy and CD-ROM

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
A Technical Study of Hydrology, Geomorphology and Water Quality in the Laguna Creek Watershed: Draft	GeoSyntec Consultants for the Laguna Creek Watershed Council	June 2007	Lower Watershed - from the uppermost reaches of Laguna Creek to the intersection of Bond / Waterman Rds.	Review of existing water quality data from Sacramento Stormwater Quality Partnership and SRCSD (without BMI data) in Lower Laguna Creek, Lower Morrison Creek and Elk Grove Creek	Hardcopy and CD-ROM (Chapter 3 of original GeoSyntec report to LCWC)
Geologic Log of Drill Hole: Test hole drill logs	Teichert, Inc.	July, 1995	Carli property along Florin Rd. between Eagles Nest Rd. and Triangle Rock aggregate mine	boring data for 17 drill holes	Hardcopy
Geologic Log of Drill Hole: Test hole drill logs from pre-construction surveys for the Folsom South Canal	United States Bureau of Reclamation	1970	along length of Folsom South Canal	boring data for drill holes	Hardcopy
Laguna Creek Open Space Maintenance Guidelines: Fallbrook Reach	WRC - Environmental	February 1992	Lower Watershed - Fallbrook Reach (Waterman Rd. to Elk Grove-Florin Rd.)	Vegetation and Trail Maintenance guidelines; maintenance and irrigation maps	Hardcopy

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Sacramento Prairie Vernal Pool Preserve Area Management Plan: Kassis, Sylva, Were and Laguna Parcels*	Carol W. Witham for Sacramento Valley Conservancy	December 9, 2005	Sylva parcel is upstream of the Shehadeh property along Fyre and Laguna Creeks; Laguna Parcel is the site of LC2 Bioassessment site, just upstream of Excelsior Rd.	Land management plans for these four parcels.	Hardcopy
"Mull" Property Rare Plant Survey Report: DRAFT	Ramona Robinson for Waegell Villages development group	August 15, 2006	site of proposed Waegell Villages development	vegetation survey data (observed plant lists); potentially occurring species of concern plant lists	Hardcopy
Water Quality Monitoring data from SRCSD Bufferlands	SRCSD	2002	Laguna Creek between Franklin Rd. and wastewater treatment plant	data for various constituents	MS Excel files
Sacramento Stormwater Quality Partnership BMI monitoring data	Pacific EcoRisk for Sacramento Stormwater Quality Partnership	2004-2006	for sites in Laguna Creek, Morrison Creek, Arcade Creek, and Willow Creek	BMI taxa lists, metric calculations, physical / habitat data	MS Excel files
Laguna Creek Watershed Council BMI monitoring data	EDAW for LCWC	June and December 2006	for 3 sites in Laguna Creek and 1 site in Elk Grove Creek	BMI taxa lists, metric calculations, physical / habitat data, and upland bank vegetation survey data	MS Excel files

List of Environmental Studies Relevant to the Laguna Creek Watershed					
Title	**Prepared by**	**Date of Document**	**Location in watershed**	**Content**	**Notes**
Technical Memorandum: Biological Assessment Findings*	EDAW for LCWC	November 30, 2006	4 sites from east of Sunrise Rd. to west of HW 99 on Laguna Creek (3 sites) and Elk Grove Creek (1 site)	BMI data and upland bank vegetation surveys for first (Spring 2006) sampling period	Hardcopy and CD-ROM
Pyrethroid Insecticides and Sediment Toxicity in Urban Creeks from California and Tennessee	Amweg et al. in Environmental Science and Technology (**40**, 2006, 1700-1706)	2006	Lower Watershed - 2 sampling locations at Camden Lake, 1 site in NLWA upstream of Franklin Rd.	study of pyrethroid concentrations in stream sediments in streams	.pdf

The upper watershed is defined from east of Waterman Road.
The lower watershed is defined as west of Waterman Road.
* = Indicates a figure utilizing GIS data is included.
Source: Data compiled by Greg Suba, August 2007

Summary of Biological Resources Data:

- SRCSD water quality data for Laguna and Morrison Creeks (5 sites, wet and dry weather)
- SACSW water quality data for Elk Grove Creek (at Laguna Blvd., wet and dry weather)
- Amweg paper on pyrethroids in stream sediments / water (2 sites at Camden, 1 site in NLWA)
- CA DPR water quality data for 2 sites on Elk Grove Creek

- BMI data for 2 sites on Elk Grove Creek by CA DPR
- BMI data for 3 sites on Laguna Creek for 2 years by SACSW (Pacific EcoRisk)
- BMI data for 3 sites on Laguna Creek, 1 site on Elk Grove Creek for 2 seasons by LCWC

- physical / habitat data for 8, 150m reaches associated with SACSW and LCWC BMI data
- upland bank vegetation surveys associated with 4, 150m reaches of LCWC BMI data
- sensitive-species habitat assessment / distribution within City of Elk Grove (City of EG Planning document)
- sensitive-species habitat assessment / distribution in upper watershed from SSHCP planning group
- plant surveys on selected parcels and open space conservation areas in upper watershed (SVC document)
- riparian corridor habitat types delineation for upper watershed by Sacramento County for ULCDMP