1. Title and Approval Page

San Diego Regional Water Quality Assessment and Outreach Project
QUALITY ASSURANCE PROJECT PLAN

COMPLETED PLAN PREPARED BY:
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And
John Rudolph: Nautilus,
Dr. Rick Gersberg: San Diego State University,
Bryan Bjorndal: Assure Controls, Inc.
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Approvals:

State Project Manager, State Dept of Water Resources: (unnamed Chief, Division of IRWM)

Signature: _____Date: _____

Contract Project Manager, San Diego County Water Authority: Mark Stadler

Signature: _____Date: _____

Local Project Sponsor Manager, San Diego Coastkeeper: Clay Clifton

Signature: _____Date: _____

Local Project Sponsor QA Officer, San Diego Coastkeeper: Travis Pritchard

Signature: _____Date: _____

Contractor QA Officer (Invertebrate bio-assessment), Nautilus Environmental LLC: John Rudolph

Signature: _____Date: _____

Contractor QA Officer (Metal analysis), San Diego State University (SDSU): Dr. Rick Gersberg

Signature: _____Date: _____

Contractor QA Officer (Trash Removal), I Love A Clean San Diego (ILACSD): Morgan Justice-Black

Signature: _____Date: _____

State QA Officer, San Diego Regional Water Quality Control Board (SD RWQCB): Helen Yu

Signature: _____Date: _____

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3. Distribution List

All group leaders and technical advisors will receive copies of this Quality Assurance Project Plan (QAPP), and any approved revisions of this plan. Once approved, this QAPP will be available to any interested party by requesting a copy from the Local Project Sponsor Manager, Clay Clifton. (See address on title page).

Title:	Name (Affiliation):	Tel. No.:	No. of copies:
State Project Manager, State DWR	____(Chief, Division of IRWM)	xxx-xxx-xxxx	1
Contract Project Manager	Mark Stadler (SDCWA)	858-522-6600	ORIGINAL
Local Project Sponsor Manager	Clay Clifton (Coastkeeper)	619-758-7743	1
Local Project Sponsor QA Officer (water chemistry, bacteria, nutrients and toxicity)	Travis Pritchard (Coastkeeper)	619-758-7743	1
Contractor QA Officer (Bio-assessment)	John Rudolph, Nautilus Environmental	858-587-7010	1
Contractor QA Officer (Metal analysis)	Dr. Rick Gersberg, SDSU	619-594-2905	1
Contractor QA Officer (Trash removal)	Morgan Justice-Black, ILACSD	619-291-0103	1
State QA Officer	Helen Yu, SD RWQCB	858-627-3964	1
Technical Advisor	Erick Burres, SWRCB, Citizen Monitoring	213- 576-6788	1
Technical Advisor	Lilian Busse, SD RWQCB	858-467-2971	1
Technical Advisor	Dennis Brown, City of San Diego	619- 668-3249	1
Technical Advisor	Hiram Sarabia, UCSD	858-822-1098	1

4. Project Organization

4.1 Involved Parties and Roles

The Local Project Sponsor, San Diego Coastkeeper (Coastkeeper), is the organization responsible for the implementation of the work plan and project deliverables to the San Diego County Water Authority. As the lead organization, Coastkeeper will organize the training of citizen volunteers, sample collection, field and laboratory analysis of water chemistry, nutrient, and toxicity and microbial samples.

Coastkeeper will coordinate subcontractors to perform the following analyses: macro invertebrate bio-assessment (Nautilus Environmental LLC), dissolved metal analysis (San Diego State University- SDSU), and trash removal (I Love a Clean San Diego- ILACSD). The Coastkeeper Laboratory and the subcontractors will analyze submitted samples in accordance with all state Surface Water Ambient Monitoring Program (SWAMP) methods and quality assurance requirements found in this QAPP. The key personnel are shown in the figure below.

Name	Organizational Affiliation	Title	Contact Information
Clay Clifton	Coastkeeper	Local Project Sponsor Manager/ Watershed Monitoring Program Manager	619-758-7743
Travis Pritchard	Coastkeeper	Laboratory Coordinator / Local Project Sponsor QA Officer	619-758-7743
Dylan Edwards	Coastkeeper	Volunteer Coordinator	619-758-7743
Soumya Chennapragada	Coastkeeper	Data Management Coordinator	619-758-7743
John Rudolph	Nautilus Environmental (Nautilus)	Contractor QA Officer	858-587-7010
Dr. Rick Gersberg	San Diego State University (SDSU)	Contractor QA Officer/ Technical Advisor	619- 594-2905
Morgan Justice-Black	I Love A Clean San Diego (ILACSD)	Contractor QA Officer	619-291-0103
Lilian Busse	San Diego Regional Water Quality Control Board (SD RWQCB)	Technical Advisor	858-467-2971
Erick Burres	State Water Resources Control Board (SWRCB), Citizen Monitoring Coordinator	Technical Advisor	213- 576-6788
Hiram Sarabia	UC San Diego	Technical Advisor	858-822-1098
Dennis Brown	City of San Diego, Public Utilities Dept	Technical Advisor	619-668-3249

Figure 1: Key Personnel

4.2 Quality Assurance Officer Role

Quality assurance and quality control officers are experienced individuals with sufficient knowledge of field, laboratory, and data analysis. They are practiced to detect any errors and suggest corrective actions. The Coastkeeper Water Quality Laboratory Coordinator will serve as Coastkeeper's Quality Assurance Officer. The Coastkeeper QA Officer's role is to establish the quality assurance and quality control procedures found in this QAPP as part of the sampling, field analysis, and in-house analysis procedures. Justin will also work with Quality Assurance Officers for the subcontractors: Dr. Rick Gersberg: SDSU, and John Rudolph: Nautilus by communicating all quality assurance and quality control issues contained in this QAPP to their respective laboratories. There is no laboratory quality assurance required for the trash removal performed by I Love A Clean San Diego.

The State Approval Officer from the SWRCB is independent from the groups that generate the data, conduct the analysis, or process the data.

4.3 Persons responsible for QAPP update and maintenance

Clay Clifton, Local Project Sponsor Manager, is the official responsible for maintaining this QAPP and any subsequent modification.

4.4 Organizational Chart and Responsibilities

The organizational chart for this project is shown below.

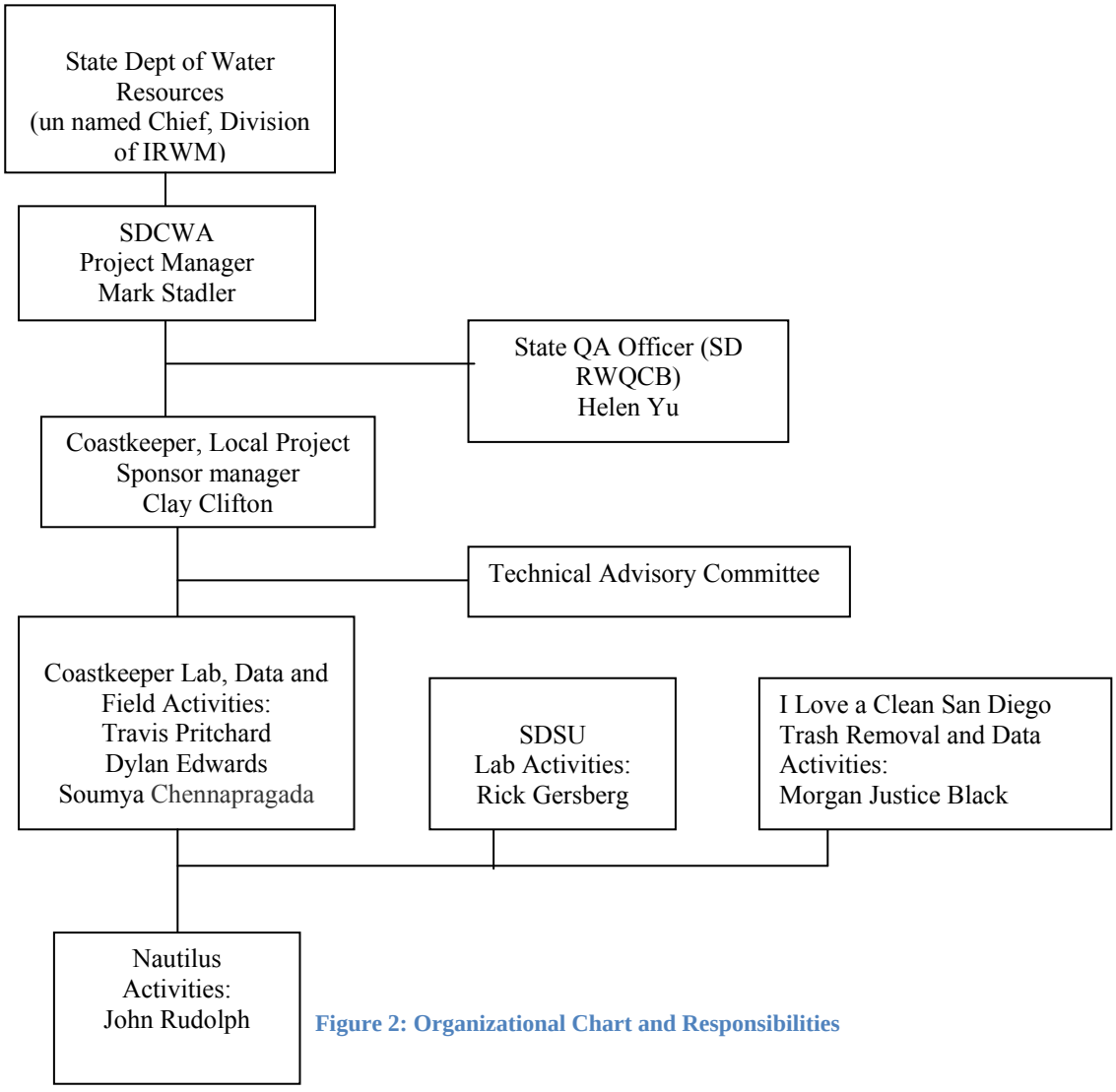


Figure 2: Organizational Chart and Responsibilities

4.5 Mission and personnel of involved parties

4.5.1 San Diego Coastkeeper

The San Diego Coastkeeper is non-for-profit organization that trains and educates community volunteers on monitoring and issues related to chemical, nutrient and microbial water quality in the creeks and rivers in the county's watersheds.

- Dylan Edwards, Volunteer Coordinator, Field Monitors and Team Captains (Volunteers and Staff)
- Soumya Chennapragada, Watershed Program Analyst and Data Management Coordinator
- Travis Pritchard, Water Quality Laboratory Coordinator and Quality Assurance and Quality Control Officer**
- Clay Clifton, Watershed Monitoring Program Manager **

**Note: Within this report the term "Water Monitoring Leader" applies to either the Coastkeeper Watershed Monitoring Program Manager or the Coastkeeper Laboratory Coordinator/ QA Officer. This ensures that the responsibility or duty associated with the "Leader" position is understood and performed by one in the absence of the other.

4.5.2 Nautilus Environmental LLC

Nautilus Environmental is an environmental consulting firm focused on providing high quality environmental toxicology and bio-assessment services. Our team of environmental scientists offers expertise in the fields of environmental toxicology, chemistry, biology, and ecology.

4.5.2.1 Management (Director, Field Coordinator, Laboratory Coordinators)

John Rudolph will be the Nautilus Quality Assurance Officer (QAO). His role is to establish the quality assurance and quality control procedures found in this QAPP as part of the sampling, processing and recordkeeping procedures. The QAO will work with field and laboratory personnel by communicating all quality assurance and quality control issues contained in this QAPP. The QAO will report all findings to the Local Project Sponsor Manager and Quality Assurance Officer, including all requests for corrective action. The QAO may stop all actions if there are significant deviations from required practices, or if there is evidence of a systematic failure.

4.5.2.2 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by the Project Director and Quality Assurance Officer as recommended by the Technical Advisory Council, and with the concurrence of the both Contract Manager and Contract Quality Assurance Officer. The Project Director will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

4.5.2.3 Relationship to State SWAMP Protocols

This document is intended to support the California Surface Water Ambient Monitoring Program (SWAMP) and is therefore subject to modifications as required to remain compliant with the over reaching policies and procedures of the State program.

4.5.3 San Diego State University

The San Diego State University, School of Public Health, Environmental Chemistry Laboratory will perform analyses of dissolved metals on samples delivered by Coastkeeper.

- Dr. Rick Gersberg, Professor and QA Officer,
  School of Public Health
- Kayo Watanabe, Chemist and ICP/ MS operator

4.5.4 I Love A Clean San Diego

I Love A Clean San Diego is a non-profit organization dedicated to improving the quality of life for county residents and the environment by conducting trash removal at inland waterways though-out the county.

4.6 Technical Advisory Committee

The following committee will meet and review deliverables prior to project submittal deadlines:

1. Rick Gersberg, Professor, San Diego State University
2. Hiram Sarabia, University of California, San Diego
3. Dennis Brown, City of San Diego, Public Utilities Dept.
4. Erick Burres, State Water Resources Control Board
5. Lilian Busse, San Diego Regional Water Quality Control Board

5. Problem Definition/Background

5.1 Problem Statement

While recent regulatory programs (i.e., MS 4 Stormwater permit R9-2007-0001) and the Surface Water Ambient Monitoring Program (SWAMP) have increased the monitoring efforts and the availability of surface water quality data in the county's watersheds, there is still insufficient information to adequately assess the status of many of the rivers and streams. Additional ambient water quality data is needed to establish a baseline of water quality conditions in San Diego County watersheds, identify impaired water bodies, and provide focus for non-point source pollution prevention efforts. This data can also be used for Clean Water Act 305(b) assessment purposes, or possibly 303(d) listings.

5.2 San Diego Regional Water Quality Assessment and Outreach Project Goals

5.2.1 Project Goals and Outcomes

The general goals of citizen monitoring are:

- Employ trained volunteers to collect and analyze water and biological samples to produce data that will:
    1. Establish trends in water quality for waters that would otherwise not be monitored,
    2. Develop a body of knowledge about the unique character of San Diego streams with respect to insect and stream ecology.
- Remove gross pollutants from local waterways (trash and litter)

More specifically, this includes efforts that will:

- ***Assess water quality in San Diego County Watersheds using trained volunteers in sample collection:*** San Diego Coastkeeper (Coastkeeper) will conduct citizen monitoring to augment other monitoring efforts (conducted under state programs or permits). This will include:
    - i. Continue existing efforts by San Diego Coastkeeper to educate and engage community members on water quality issues and to monitor water quality in local watersheds
    - ii. Conduct monitoring at regular intervals (12 times a year conditions permitting) at locations that meet the site selection design criteria in the associated monitoring plan (See Element 10 Sampling Process Design)
    - iii. Provide data to fill in the spatial and temporal data gaps (increasing the number of samples in a water body or hydrological unit for better representation). The data may also be useful in increasing the amount of surface water data for a particular constituent in order to help determine an appropriate water quality standard where none currently exists. Coastkeeper and its partners will collect samples for physical, chemical, nutrient, microbial, bio-assessment, dissolved metal, and toxicity analyses. The results from these water quality indicators will compared to water quality standards or thresholds in the San Diego Basin Plan to identify pollution impacted water bodies. Ultimately, the aim is to provide data that complies with all state quality assurance protocols to assist water quality regulators and decision makers.
- ***Share data.*** Data collected through this project will be incorporated into three web-based, publicly-accessible data portals: the water quality page on the San Diego Coastkeeper web site (http://www.sdwatersheds.org/wiki/Main_Page) and the state California Environmental Data Exchange Network (CEDEN). Using these tools, watershed management plans can be developed to address impacts and impairments throughout each of the watersheds of the county.
- ***Present Data Access, Analysis and Interpretation Workshops.*** Through the course of the San Diego Regional Water Quality Assessment and Outreach Project, Coastkeeper and its partners will teach a minimum of 500 members of the community – citizens, decision makers, tribal members, and stakeholders - how to access and interpret publicly available water quality data to identify water quality impacts on a watershed level. Water quality data access, analysis and interpretation workshops will run in parallel with existing monthly water quality training and monitoring events. Regional Data Management Summits will be conducted in the third quarter of each project year to bring key players in the field of data management together to discuss improvements for existing knowledge management, information transfer, transparency of data collected and strategies for data sharing.

- ***Develop Outreach Materials to Inform the Public and address Non-Point Source Pollution.*** Additionally, Coastkeeper will work with community members to develop the San Diego County Watersheds Water Quality 'State of the Watersheds' Report (Watersheds Report) as a tangible product at the end of this project. The Watersheds Report will be a tool to address water quality impacts and impairments on a watershed level. The report will be based on the analysis of collected data that assesses water quality at sampling locations within a particular watershed. The report will also reference previously published data where that information would be useful. Following its publication and distribution, members of the public will be able to refer to the Report to address pollutants of concern and to propose solutions in line with fostering sustainable behavior for watershed protection, management and pollution prevention. The Report will also be disseminated at Coastkeeper events, including World Water Monitoring Day and Coastal Snapshot Day, and through its educational hands-on programs in classrooms throughout the county. Presently, Coastkeeper reaches 40,000 K-12 students annually through the implementation of Project SWELL (Stewardship: Water Education for Lifelong Leadership) curriculum.

- **Linkages with the schedule of other projects and/or integration with other projects:**

  - This project links with a number of other projects that are already operational throughout the county:
    - Tijuana Estuary Research Reserve Project
    - Los Peñasquitos Research Reserve Project
    - Escondido Creek Conservancy Work
    - Friends of Famosa Slough
    - San Elijo Lagoon Conservancy
    - THINK BLUE's Chollas Creek Water Quality Protection & Habitat Enhancement Project
    - San Diego River Conservancy and/or The San Diego River Park Foundation and/or San Diego River Watershed Workgroup
    - Friends of the River (http://www.friendsoftheriver.org)
    - Batiquitos Lagoon Foundation
    - Aqua Hedionda Lagoon Foundation
    - Golden State Flycasters

- **Other local or regional plans in which the project is included:**

  - San Diego River Watershed Management Plan: http://www.projectcleanwater.org/html/ws_san_diego_river_plan.html
  - Project Clean Water: http://www.projectcleanwater.org

5.2.2 Intended Usage of Data

The data can be used by regulators and municipal storm water agencies to better assess water quality in San Diego County watersheds. 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 through CEDEN to supplement their existing data collection efforts. One potential application of the data will be to provide information to the Regional and State Boards for use under Clean Water Act section 305(b) or 303(d) reporting. Data will also be available through posting on the World Wide Web for public use.

5.2.3 Water Quality or Regulatory Criteria

The data in this program is not designed to identify compliance issues. However, it can be used to document poor water quality when results for a particular analyte exceed or violate an associated water quality standard.

6. Project Goals/Task Description

6.1 Work statement and general overview of monitoring performed

River and stream water sample collection will include 12 events a year from 28 to 33 sites per month in nine watersheds in the county to answer the study questions in the Monitoring Plan (see Section 10.5.1). Site selection is based on a non-

judgmental sampling design to represent overall water quality in the watersheds (See Section 10 – Sampling Process Design). Samples will be collected with conditions (weather, safety, and stream flow) permitting. Sampling events will scheduled without respect to rainfall and weather, i.e., sampling events are scheduled before weather forecasts are available. Sampling/ monitoring locations are listed in Table 1 and shown in Appendix 3.

6.2 Water chemistry, nutrients, bacteria, and toxicity

The role of San Diego Coastkeeper in this project is to train and equip citizen volunteers to collect water samples and perform field and laboratory analyses of multiple water quality parameters. The work to be performed is described above in section 6.0.

6.3 Bio-assessment

Employing a non-point source sampling design, Nautilus will perform bio-assessment by collecting benthic macro-invertebrates (BMI's) once annually (in spring) for the duration of the project. Benthic macro-invertebrate monitoring will be performed according to the SWAMP S.O.P. for "Collecting Benthic Macro invertebrate Samples and Associated Physical and Chemical Data for Ambient Bio-assessments in California" 2007.

6.4 Dissolved trace metals

The SDSU School of Public Health, Environmental Chemistry Laboratory will measure dissolved trace metal levels in surface waters. Dissolved metal analyses will include copper, zinc, lead, cadmium, chromium, and nickel. These samples will be collected by Coastkeeper trained volunteers in accordance with sample collection standard operating procedures and transferred to SDSU using chain of custody procedures and paperwork.

6.5 Trash Cleanup

I Love A Clean San Diego will conduct inland cleanup events with volunteers at five watershed locations. Volunteers will remove trash and recyclables and weigh the bags before disposing of them. ILACSD will track the total number of volunteers, number of cleanups, as well as pounds of debris collected for each event. Selected cleanups will involve the usage of the Rapid Trash Assessment Worksheet developed as part of the Surface Water Ambient Monitoring Program.

6.6 Sampling Sites

Table 1 is a list of water quality sampling sites in San Diego County to be monitored as part of this work. A map of sampling sites is located in Appendix 3. Meta data showing the GPS coordinates (decimal degree), jurisdiction, etc. are available from San Diego Coastkeeper.

Table 1: Sampling sites

	Watershed	Water Body	Site ID	Latitude	Longitude	Sampling Frequency
1	San Luis Ray	San Luis Ray River	SLR-010	33.206270	-117.386500	6 times /yr
2	San Luis Ray	San Luis Ray River	SLR-030	33.239767	-117.322433	6 times /yr
3	San Luis Ray	San Luis Ray River	SLR-040	33.261367	-117.235117	6 times /yr
4	San Luis Ray	San Luis Ray River	SLR-050	33.324167	-117.159983	6 times /yr
5	San Luis Ray	Gomez Creek	SLR-070	33.382450	-117.108117	6 times /yr
6	San Luis Ray	Pauma Creek	SLR-080	33.339017	-116.897850	6 times /yr
7	Carlsbad	Buena Vista Creek	BVC-015	33.181417	-117.321417	6 times /yr
8	Carlsbad	Buena Vista Creek	BVC-020	33.177861	-117.341167	6 times /yr
9	Carlsbad	Buena Vista Creek	BVC-035	33.181139	-117.288472	6 times /yr
10	Carlsbad	Encinitas Creek	BTQ-010	33.073194	-117.263917	6 times /yr
11	Carlsbad	San Marcos Creek	BTQ-020	33.088500	-117.244750	6 times /yr
12	Carlsbad	Escondido Creek	EDC-010	33.033889	-117.235556	6 times /yr
13	Carlsbad	Escondido Creek	EDC-020	33.048250	-117.226750	6 times /yr
14	Carlsbad	Escondido Creek	EDC-030	33.071806	-117.164083	6 times /yr
15	Carlsbad	San Elijo Lagoon	SEL-030	33.012833	-117.259861	12 times/yr
16	San Dieguito	San Dieguito River	SGT-028	33.040361	-117.157639	
17	San Dieguito	Lusardi Creek	SGT-025	33.012167	-117.173611	12 times/yr
18	San Dieguito	San Dieguito River	SGT-020	33.003639	-117.199389	12 times/yr
19	Los Peñasquitos	Soledad Creek	LPQ-020	32.929694	-117.241194	12 times/yr
20	Los Peñasquitos	Los Peñasquitos Canyon Creek	LPQ-030	32.906889	-117.230361	12 times/yr
21	Los Peñasquitos	Los Peñasquitos Canyon Creek	LPQ-040	33.904556	-117.222889	12 times/yr
22	Los Peñasquitos	Rose Creek	RSC-010	32.847167	-117.233917	12 times/yr
23	Los Peñasquitos	Rose Creek	RSC-020	32.856139	-117.220861	12 times/yr
24	Los Peñasquitos	Rose Creek	RSC-030	32.860583	-117.209417	12 times/yr
25	Los Peñasquitos	Rose Creek	RSC-040	32.863805	-117.190611	12 times/yr
26	San Diego	San Diego River	SDG-010	32.764333	-117.170083	12 times/yr
27	San Diego	San Diego River	SDG-020	32.838861	-117.045222	12 times/yr
28	Pueblo	Chollas Creek, N. fork	PBL-016	32.712028	-117.120250	6 times /yr
29	Pueblo	Chollas Creek, S. fork	PBL-020	32.727150	-117.069950	12 times/yr
30	Pueblo	Chollas Creek, S. fork	PBL-040	32.691917	-117.112639	12 times/yr
31	Sweetwater	Sweetwater River	SWT-010	32.650500	-117.063528	12 times/yr
32	Sweetwater	Sweetwater River	SWT-020	32.674917	-117.016556	12 times/yr
33	Sweetwater	Sweetwater River	SWT-030	32.733417	-116.940722	12 times/yr
34	Otay	Otay River	OTY-025	32.588750	-116.971444	12 times/yr
35	Otay	Otay River	OTY-020	32.587528	-117.046194	12 times/yr
36	Tijuana	Tijuana River	TJN-040	32.559317	-117.092839	6 times /yr
37	Tijuana	Tijuana River	TJN-050	32.551028	-117.084047	6 times /yr
38	Tijuana	Tijuana River	TJN-060	32.547639	-117.065550	6 times /yr

6.7 Constituents to be monitored and measurement techniques

Table 2 summarizes the sample analyses by method, and type (ambient field analysis or transported for later analysis to Coastkeeper Laboratory or a professional laboratory). The Type column also includes what agency will perform the parameter analysis.

Table 2: Water quality constituents/ parameters to be monitored and measurement techniques

Parameter	Type	Method
Temperature	F (Coastkeeper)	Hach HQ40d electrometric probe
Dissolved Oxygen	F (Coastkeeper)	Hach HQ40d Luminescent Dissolved Oxygen
pH	F (Coastkeeper)	Oakton Double Junction Electrode
Conductivity (fresh water) or Salinity (marine)	F (Coastkeeper)	Hach HQ40d Conductivity probe
Nitrate NO_3- N	L (Coastkeeper)	Hach 8192 and Hach 10206 (TNT 835)
Total Phosphorous PO_4- P	L (Coastkeeper)	Hach 8048 and Hach 10210 (TNT 843)
Ammonia NH_3 - N	L (Coastkeeper)	Hach 10205 (TNT 830)
Total Coliform bacteria	L (Coastkeeper)	IDEXX Colisure or Colilert 18
E. Coli bacteria	L (Coastkeeper)	IDEXX Colisure or Colilert 18
Enterococci bacteria	L (Coastkeeper)	IDEXX Enterolert
Toxicity	L (Coastkeeper)	QwikLite 200 Bio-Sensor System using ASTM E1924
Bio-assessment (Benthic macro-invertebrates)	L and P (Nautilus)	SWAMP Bio-assessment procedures
Bio-assessment (Temperature)	F (Nautilus)	Thermometric
Bio-assessment (Dissolved oxygen)	F (Nautilus)	Colorimetric indigo carmine Vacuum ampoules, Color Comparator
Bio-assessment (Alkalinity)	F (Nautilus)	Titration: Phenolphthalein and Bromocresol Green/Methyl Red
Bio-assessment (pH)	F (Nautilus)	Electrometric
Bio-assessment (Conductivity)	F (Nautilus)	Electrometric
Dissolved Metals (Cadmium, Chromium, Nickel, Lead, Copper, and Zinc)	P (SDSU)	Inductively Coupled Plasma Mass Spectrometer ICP-MS. EPA method 200.8

Codes for Table 2: Type: F: field analysis, L: in-house lab analysis, P: sample only, send to outside professional lab

6.8 Data files to be obtained

Analytic results for these constituents will be entered into an MS 2007 Excel spread sheet or Access database with separate fields for parameter, method, site ID, site name, hydrological unit, analysis, qualifier, result, and laboratory. The data format will be SWAMP compatible. All of the data collected and analyzed for this project will be sent to, or compiled within, and maintained at the San Diego Coastkeeper. This includes Coastkeeper water quality for chemistry, nutrient, bacteria and toxicity, Nautilus bio-assessment including field measurements for water chemistry, SDSU dissolved metals, and ILACSD trash data. Data will be posted on San Diego Coastkeeper's website (http://sdwatersheds.org or http://www.sdcoastkeeper.org/content/waterWatch/monitorData.htm) for sharing with interested parties. Data will also be collated and shared with the State Water Resources Control Board, the San Diego Regional Water Quality Control Board, in a SWAMP compatible format and upon request to other state, federal, and local agencies and organizations. The main database will be maintained at San Diego Coastkeeper offices.

6.9 Project schedule timeline

Figure 3 provides the anticipated initiation and completion dates of the project's major tasks.

Figure 3: Project schedule timeline

Task or Activity	Date (DD/Month/YYYY)		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Start project	31 Dec 2009	31 Dec 2012	None	
Task 1. Project Administration and Quarterly Reports				
1.1 Project administration (prepare project monitoring, quality assurance, and assurance and evaluation plans and subcontract MOUs, etc.)	1 Jan 2010	1 May 2010	MP, QAPP, and PAEP, Subcontractor documentation	1 May 2010
1.2 Submit Quarterly Reports detailing progress on each of the tasks and deliverables met	January 2010	July 2012	Quarterly progress reports	By the 15th day of the month (January, April, July, October) following the quarter
1.3 Attend meetings and TACs for data management, citizen monitoring and TMDL programs in the region.	1 March 2010	Life of project	Lists of meetings Attended in Quarterly progress reports	By the 15th day of the month (January, April, July, October) following the quarter
Task 2. Establish Regional Water Monitoring Training and Resource Center.				
Task or Activity	**Anticipated Date of Initiation**	**Anticipated Date of Completion**	**Deliverable**	**Deliverable Due Date**
2.1 Conduct outreach and education campaign and recruit project participants.	1 January 2010	Life of project	Quarterly Progress Reports with Outreach and Education Materials Outcome Increase public awareness and recruit and train citizens to collect water quality data in accordance to U.S. EPA/SWRCB guidelines to help support the Citizen Monitoring.	By the 15th day of the month following the quarter
2.2 Develop training materials	1 March 2010	1 May 2010	Quarterly progress reports with training materials	By the 15th day of the month following the quarter

Task or Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
2.3 Conduct monthly training workshops at Coastkeeper office/lab.	10 March 2010	6 x year over life of project, ending on 30 March 2012	Quarterly Progress Reports with bi-monthly sign-in sheets Outcome After 2 years, more than 500 trained individuals on watershed management, water quality monitoring, data access, analysis and implementation	By the 15th day of the month following the quarter
2.4 Conduct monthly citizen monitoring events at nine watersheds throughout San Diego County	13 March 2010	12 x year over life of project, ending on 30 May 2012	Quarterly Progress Reports with signed liability forms	By the 15th day of the month following the quarter
2.5 Conduct invertebrate bio-assessment sample collection	May 2010	1 x year over life of project, ending on 30 May 2012	Quarterly progress reports	By the 15th day of the month following the quarter
2.6 Integrate monitoring data into the Coastkeeper on-line database (ArcIMS interactive mapping)	14 March 2010	12 x year over life of project, ending on 30 May 2012	Citizen Monitoring Results posted on Coastkeeper website Outcome Posting of data on the CEDEN web portal so that it is publicly accessible and available to enhance management decisions	By the 15th day of the month following the monitoring event
2.7 Identify and implement measures to evaluate the effectiveness of Coastkeeper citizen training center	September 2010	2 x year over life of project	Measures to evaluate effectiveness of center will be included in the Project Monitoring and Reporting Plan (Submitted under Task 3).	July 2012

Task 3. Develop and Implement Public Outreach and Education Campaign

Task or Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
3.1 Conduct Data Management Summits for water quality professionals and practitioners over the course of the project	3rd QTR each year of project starting October 2010	1 per year in 3rd QTR. Ending after October 2011	Quarterly Progress Reports with Summit agenda/ program & sign-in sheets, minutes from summit / other write up Outcome Collect feedback on how to make these tools even more effective, facilitate progress in regional data management	By the 15th day of the month following the quarter
3.2 Inland water body trash removal events at 5 sites coordinated by ILACSD	June 2010	Once a year ending by June 2012	Quarterly Progress Reports with assessment and analysis of trash data Outcome Engage community members and volunteers to participate in trash removal in watersheds to reduce impacts to surface waters	By the 15th day of the month following the quarter
3.2 Develop and distribute outreach materials at various meetings and events	July 2010	Life of project, ending after May 2012	Quarterly Progress Reports with copy of outreach materials; list of meetings & events attended Outcome Inform the public about water quality in San Diego County and involve interested parties by providing opportunities for involvement. The events will include World Water Monitoring Day and Coastal Snapshot Day.	By the 15th day of the month following the quarter

Task 4: Develop San Diego Region Watersheds Water Quality 'Watersheds Report'

Task or Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
4.1 Conduct 10 workshops to identify pollution trends in the San Diego Watersheds.	May 2010	Bi-monthly until November 2011 (immediately preceding monitoring events)	Quarterly Progress Reports with workshop agendas/minutes & sign-in sheets	By the 15th day of the month following the quarter
4.2 Develop 'Watersheds Report' using the data collected and identify locations with poor water quality, and recommendations for community involvement to improve the health of their local waterways	March 2010	April 2012	*'Watersheds Report'*	April 2012

4.3 Publish, print and distribute 'Watersheds Report' through print newsletters, e-mail alert, on the website and at various meetings, fairs, events and through Coastkeeper's hands-on education programs.	March 2010	July 2012	List of how and when 'Watersheds Report' has been distributed (through the media, by hard copy and electronically) Outcome Information made available about the state of water quality on a watershed basis.	July 2012
Task 5. Final Report				
Task or Activity	**Anticipated Date of Initiation**	**Anticipated Date of Completion**	**Deliverable**	**Deliverable Due Date**
5.1 Submit Final Report detailing progress on each of the tasks and deliverables met	September 2014	31 Dec 2012	Final Report that tracks activities, challenges and progress through the course of the project.	31 Dec 2012

6.10 Geographical setting

This project is located in San Diego County, California. The land area of San Diego County is approximately 4,200 square miles. The sampling sites are located in the county's eleven watersheds, which extend from the Santa Margarita River watershed at the Orange County border in the north to the bi-national Tijuana River watershed in the south. Logistical considerations (spatial extent of locations, travel time to and from lab, and sample holding times) generally limit monitoring efforts by Coastkeeper and its volunteers to eight or nine of the 11 watersheds in the county. Most watersheds contain a brackish water element west of Interstate 5 due to tidal influence. Weather in San Diego County is characterized by a Mediterranean style climate (semi-arid with temperate, wet winters [median annual rainfall of 12"] and dry, warm summers). The county has an approximate population of 3 million, most of which is located within 5 miles of the coast. This equates to more intensive urban land use (commercial, residential) along the coast and more rural and agricultural uses inland. See Appendix 3.

6.11 Constraints

The constraints to this project may include inclement weather conditions, fire, or other issues that may make sample collection unsafe or unfeasible, and volunteer delinquency or unavailability at planned events.

7. Measurement Quality Objectives and Criteria

This section identifies the data quality indicators (DQI) used to verify the quality of the data produced in this project. The DQIs include accuracy, precision, completeness, comparability, sensitivity, and representativeness of field and laboratory measurements. Each DQI has associated measurement quality objectives (MQOs). The MQOs for their respective DQIs meet or exceed those mandated by SWAMP.

At the level of answering the study question or addressing the project need, the water quality parameters to be tested in this project (Table 6.2) will provide a robust data set of standard physical, chemical, and biological indicators that will ensure comparability with existing state data, with a potential application of the data to Section 305(b) reporting purposes.

At the level of the measurements used to support the study question, the MQOs for the water quality parameter test methodologies are summarized in Tables 3, 4, 5, 6, and 7. 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.

7.1 Water chemistry and nutrients

The MQOs for field analyses of water chemistry and nutrient parameters performed by Nautilus are listed in Table 5 and 6. MQOs for field or laboratory analyses of water chemistry and nutrients performed by Coastkeeper are listed in Table 3. Discussions of MQOs for chemistry and nutrients are in sections 7.7, 7.8, 7.9, 7.10, 7.11 and 7.12.

7.2 Bacteria

For laboratory analyses of bacterial parameters by Coastkeeper, the MQOs are listed in Table 4 and sections 7.7, 7.8, 7.9, 7.10, 7.11 and 7.12.

7.3 Toxicity

For laboratory analyses of toxicity by Coastkeeper, the MQOs are listed in Table 4 and sections 7.7, 7.8, 7.9, 7.10, 7.11 and 7.12. Toxicity is determined by measuring the light reduction from the bioluminescent marine dinoflagellates after they have been exposed to possible toxicants. The light emitted is directly related to toxic stress and decreases rapidly (usually within 24 hours). A Control group for all tests performed is used as the 100% or non-effected biological group. All other dosed, tested, and measured samples are compared to this reference group. A calculated estimate indicating the toxicity or biologically harmful effects of the chemical constituents of a water sample is derived.

The test result is expressed as a Biological Indexed Number (scale of 1 to 10) for ease of interpretation and consistent comparisons with successive tests done over time. A high BIN indicates concentrations of the chemical constituents at biologically harmful levels and potentially critically toxic. A low BIN indicates low levels of chemical constituents and not biologically harmful. Toxicity is due to harmful levels of inorganic compounds, organic compounds or heavy metals.

7.4 Bio-assessment

For bio-assessment conducted by Nautilus, the benthic macro-invertebrate (BMI) parameter provides the raw data necessary to calculate any desired metric. MQOs are listed in Table 6 and sections 7.7, 7.8, 7.9, 7.10, 7.11 and 7.12. Definitions and other details can be found in Section 7.4 of EPA's Rapid Bio-assessment Protocols for Use in Streams and Wade-able Rivers: Periphyton, Benthic macro-invertebrates, and Fish. The specific metrics used in calculating the San Diego Region IBI are listed at http://www.waterboards.ca.gov/sandiego/programs/bioassess/2002%20Apendix/San%20Diego%20May%202001%20Metrics.PDF . The BMI bio-assessment will use the SWAMP bio-assessment procedures 2007 developed by Ode (2007).

7.5 Dissolved Metals

For laboratory analyses of dissolved metal parameters by SDSU, the MQOs are listed in Table 7 and sections 7.7, 7.8, 7.9, 7.10, 7.11 and 7.12.

7.6 Trash

Trash amount and type will be recorded on SWAMP compatible Rapid Trash Assessment Worksheets (RTAW) by ILACSD. By using techniques set forward in RTAW, ILACSD will be able to collect accurate data for a defined section of each site within the given watersheds. While cleanups will be supervised by ILACSD staff and interns, the data collection involves volunteers. The RTAW collection data cards were developed for use by volunteers, thus no potential biases exist.

Data collected from the RTAW represents a sample of each site based on current and recent weather patterns and samples are expected to vary. By conducting multiple cleanups of the same location throughout the project period, ILACSD will collect data sets for comparison and trend analysis. MQOs for trash removal data includes the 90% completion, and accuracy by 2nd party verification of amount (mass) and types (quantify) of trash collected to be within 80 – 120% of original.

Table 3: Measurement Quality Objectives for Chemical and Nutrient Parameters by Coastkeeper

Parameter	Target Reporting Limit	Project Action Limits [1]	Precision	Accuracy
Temperature	N/A	--	No SWAMP requirement; will use ± 1 ^{o} C	± 0.3 ^{o} C
Dissolved oxygen	0.2 mg/L	< 5.0 mg/L	No SWAMP requirement; will use ± 0.5 or 10%	± 0.2 mg/l
pH	N/A	< 6.5 or > 8.5	No SWAMP requirement; will use ± 0.2 units	± 0.01 units
Conductivity	2.5 µS/cm	--	No SWAMP requirement; will use ± 10%	±0.5%
Nitrate NO_3- N	0.23 mg/L	*for MUN designated sites* NO_3 > 45mg/L Nitrogen > 10 mg/L *For others* Ratio of N:P = 10:1 or NO_3 – N > 1mg/L *	RPD < 25% (N/A if native concentration of either sample<RL)	80 – 120%
Total Phosphorous PO_4 – P	0.05 mg/L	> 0.1 mg/L	RPD < 25% (N/A if native concentration of either sample<RL)	80 – 120%
Ammonia NH_3 –N	0.015 mg/L	> 0.025 mg/L	RPD < 25% (N/A if native concentration of either sample<RL)	80 – 120%

[1] *Water Quality Control Plan for the San Diego basin ("Basin Plan")*
NA: not applicable.
**does not apply to Hydrologic Unit 908, Pueblo*

Table 4: Measurement Quality Objectives for Bacteria and Toxicity Parameters by Coastkeeper

Parameter	Target Reporting Limit	Project Action Limits	Precision	Accuracy
Total Coliform Bacteria	2 MPN/ 100mL	--	RPD<25% (n/a if native concentration of either sample<RL	Positive control and reference material = 80-120% recovery
E. coli Bacteria	2 MPN/ 100mL	> 406 per 100mL [2]	RPD<25% (n/a if native concentration of either sample<RL	Positive control and reference material = 80-120% recovery
Enterococci Bacteria	1 colony / 100mL	> 108 per 100mL [2]	RPD<25% (n/a if native concentration of either sample<RL	Positive control and reference material = 80-120% recovery
Toxicity testing	BIN value of 0	BIN value of 4 or more [3]	Representativeness : Field duplicates at 5% of samples collected per event with a minimum of 1	Meet all performance criteria in method relative to sample replication

[2] *US EPA criteria for lightly/ moderately used freshwater areas were published in the Federal Register, Vol. 51, No. 45/Friday, March 7, 1986/8012-8016.*

[3] *Rapid Toxicity Assessments with the QwikLite 200 Biosensor System Utilizing ASTM E1924 Test Method, Biological Index Number Explained*

Table 5: Measurement Quality Objectives for Chemical Water Quality Parameters by Nautilus

Parameter	Target Reporting Limit	Project Action Limits [4]	Completeness	Precision	Accuracy
Temperature	N/A	—	90%	± 0.5 ^{o} C	± 0.5 ^{o} C
Dissolved oxygen	0.2 mg/L	< 5.0 mg/L	90%	± 1.0 mg/l	± 1.0 mg/l
pH	N/A	< 6.5 or > 8.5	90%	± 0.5 units	± 0.5 units
Conductivity	2.5 µS/cm	—	90%	± 10%	± 10%
Alkalinity	1.0 mg/L	---	90%	>1	± 1.0% of >100 digits

[4] *Water Quality Control Plan for the San Diego basin ("Basin Plan")*

Table 6: Measurement Quality Objectives for Benthic Macro-Invertebrates Bio-assessment by Nautilus [5]

Parameter	Representativeness	Sensitivity	*Completeness*	*Precision*	*Accuracy*
Sampling	Probabilistic sites are evaluated in order within each panel and management unit. < 1 second nominal Lat/ Long (30 mile radius)	1.0 seconds or 1/10,000th of a degree Lat/ Long	90% successful collection at all sites for probabilistic designs	Record coefficient of variation of biological measures for duplicate samples (no MQO), frequency of 10% or at least one per project each year	N/A
Taxonomic ID's	All sorted organisms are identified	SAFIT Level 2	90% successful analysis of all sorted samples	Random errors ≤ 10% of taxa, 10% frequency (ref lab) • Systemic errors ≤ 10% of common taxa. 10% frequency (external reference lab) • Taxonomic resolution error rate ≤10%.	Taxa count error ≤10%. 10% frequency (external reference lab) • Taxa ID error ≤10%. 10% frequency (external reference lab) • Individual ID error ≤10%. 10% frequency (external reference lab)
Sorting	≥ 3 grids or ≥ 25% of the total sample volume is sorted	N/A	Sorting efficiency ≥95%, 100 % frequency (internal) • Processing efficiency ≥99%, 100% frequency	At least three grids or 25% of the total sample volume must be sorted	Recount accuracy ≥95%. 10% frequency (external reference lab)

[5] *Southern California Regional Watershed Monitoring Program Bio-assessment Quality Assurance Project Plan v1.0. 2009*

Table 7: Measurement Quality Objectives for Dissolved Metals Using Inductively Coupled Plasma Mass Spectrometer

Parameters	Target Reporting Limit	Project Action Limits [6]	Precision	Accuracy
Cadmium (Dissolved)	0.1 µg/L	> 2.0 µg/L	RPD < 25% (N/A if native concentration of either sample < RL). Laboratory sample replicates per 20 samples or analytical batch (whichever is more frequent); Field duplicate 5% of total project sample count	75-125%
Copper (Dissolved)	1.0 µg/L	> 20 - 80 µg/L when Dissolved Organic Carbon is 5mg/L	*Same as above*	*Same as above*
Zinc (Dissolved)	2.0 µg/L	> 120 µg/L	*Same as above*	*Same as above*
Chromium VI(Dissolved)	0.5 µg/L	> 16 µg/L	*Same as above*	*Same as above*
Lead (Dissolved)	0.2 µg/L	> 65 µg/L	*Same as above*	*Same as above*
Nickel (Dissolved)	0.2 µg/L	> 470 µg/L	*Same as above*	*Same as above*

[6] US EPA National Recommended Water Quality Criteria (2005) pursuant to Section 304(a) of the Clean Water Act. (not converted for hardness. Hardness conversion is at http://www.epa.gov/waterscience/criteria/wqctable/index.html#appendxa)

7.7 Accuracy

Accuracy describes how close the measurement is to its true value, and is often used to indicate the degree of precision and bias. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value.

7.7.1 Chemical and Physical Parameters

The accuracy of chemical measurements will be checked by performing tests on standards before the equipment is checked out. 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 should be within the mid-range of the equipment. The Data Quality Form: Accuracy, found in Appendix 1, will be used to record accuracy. Results for tests conducted on chemical and physical parameter standards should be 80 – 120% of the standard's value.

7.7.2 Biological Parameters

Accuracy for bacteria will be determined by analyzing a positive control (Quanti-cult by IDEXX) sample once per reagent lot, or 3 times annually (200 samples per lot; ~50 samples a month including all samples plus field blank, duplicates and positive control). 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. Results for tests conducted on bacterial parameter standards should be 80 – 120% of the standard's value.

7.7.3 Bio-assessment

For benthic macro-invertebrate analysis, accuracy will be determined by having 10% of the samples (annually) re-analyzed and validated to CSBP and SWAMP Bio-assessment Procedures 2007 Level 3 (10% to genus level) by a professional taxonomist.

7.7.4 Dissolved Metals

According to EPA 200.8 method, accuracy will be determined by measuring quality control samples (QCS) in order to verify the calibration standards and acceptable instrument performance. When the QCS is used for determining acceptable on-going instrument performance, analysis of QCS must be within the acceptance limits listed in Table 7.

7.8 Comparability

Comparability is a qualitative expression of the measure of confidence that two or more data sets may contribute to a common analysis. Coastkeeper will use the methods described in the following resource documents to ensure that the project data can be compared to others:

- SWAMP Bio-assessment Procedures 2007
- SWRCB Clean Water Team Compendium for Water Quality Monitoring and Assessment
- U.S. EPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries
- SWAMP Quality Assurance Project Plan template 2008
- Southern California Regional Watershed Monitoring Program. Bio-assessment Quality Assurance Project Plan, (SWAMP) v1.0. 2009
- City of San Diego, Stormwater Pollution Prevention Program, Water Sampling Standard Operating Procedures

7.9 Completeness

Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. There are no statistical criteria that require a certain percentage of data. However, it is expected that 90% of all measurements will be taken as anticipated, unless indicated otherwise in Tables 5 and 6. 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 measurement 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.

7.10 Precision

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 or in the lab).

7.10.1 Chemical and Physical Parameters

Precision for conventional analytes in water 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 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, or at least less than (<) 25% Relative Percent Difference (RPD). The Data Quality Form: Precision, found in Appendix 1, will be used to record precision.

7.10.2 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 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, or at least less than (<) 25% Relative Percent Difference (RPD) for bacterial parameters.

For bio-assessment using BMIs, the duplicate analysis should be within 10% RPD.

7.10.3 Dissolved Metals

Precision measurements will be determined on laboratory replicates. The number of replicates for metals will be two aliquots of the same sample and will be analyzed per 20 samples or per analytical batch whichever is more frequent.

7.11 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.

7.12 Sensitivity (Detection Limits and Target Reporting Limits)

The lowest level at which an instrument or method measurement can be calibrated to produce a result is the detection limit. The Target Reporting Limit or sensitivity is the level at which laboratory can report results with confidence. Method sensitivity is dealt with by the inclusion of the required SWAMP Target Reporting Limits, where such values exist, and by the application of the definition of a Minimum Level as provided by the Inland Surface Water and Enclosed Bays and Estuaries Policy. Target Reporting Limits are noted in Tables 3, 4, 5, 6, and 7.

7.13 Bias

According to the U.S. EPA, bias is "the extent to which a measurement, sampling, or analytic method systematically underestimates or overestimates the true value of an attribute". Bias is controlled using the same QC tools as used for accuracy described in section 7.7 above - the measurement of a sample of known concentration (standard or spiked sample) and comparing the value against the measured value. Results for tests conducted on chemical, physical and bacterial parameter standards should be 80 – 120% of the standard's value. For benthic macro-invertebrate analysis, bias will be determined by having 10% of the samples (annually) re-analyzed and validated to CSBP and SWAMP Bio-assessment Procedures 2007 Level 3 (10% to genus level) by a professional taxonomist.

7.14 Project Action Limits

For Coastkeeper sample results that exceed a project action limit or water quality threshold, Coastkeeper will identify the data in graphs on its public web page with the associated water quality threshold to show the exceeding result. Coastkeeper does not have the capacity at present to conduct follow-up sampling or investigations at all locations that may exceed a project action limit. However, based upon feedback from the San Diego municipal stormwater permit co-permittees monitoring group, Coastkeeper will refer all data with exceedances to the appropriate stormwater agency contact as soon as the data passes QA review and is input into the Coastkeeper database (less than 15 working days from date of sample collection). All other data including bio-assessment, trash and dissolved metals data will be reported annually to the co-permittees in August as the normal results reporting times for these parameters negates the timely reporting of this data.

8. Training Requirements

8.1 San Diego Coastkeeper training requirements

San Diego Coast keeper identifies three types of citizen volunteers with increasing levels of training and commitment.

Watershed Leaders or Captains: Typically 1 year commitment to attend 6 to 12 sampling events and lead teams of new and return volunteers into field for collecting samples. Minimum 1 Lab training event must be attended and 1 re-training. Watershed captains are encouraged to attend all 6 Water Monitoring Meetings.

Lab Fellows: Typically 1 year commitment to attend at least 1 field sampling event and 6 to 12 Lab training events. Lab Fellows typically assist in calibrations, trainings and field audits, in addition to being fluent in all laboratory pertaining to sample intake, analysis and data entry of results. Lab fellows also receive training from the Coastkeeper QA Officer in data entry, the applicable water quality analytic test procedures, as well as the ASTM E1924 Toxicity Assessment procedure.

Citizen Monitors: All citizen monitoring volunteers must participate in two hands-on water quality monitoring training sessions a year conducted by the San Diego Coast keeper. Volunteers are encouraged to commit to three Water Monitoring events in a six month period. The outline below lists the topics that will be covered under this training:

Safety,
Sampling procedures,
Analytical techniques, Data recording, and
Quality assurance and quality control measures.

In addition to completion of the described training course above, the citizen monitoring leaders must participate in semi-annual quality control sessions. These Quality Control Sessions will provide an opportunity for Coastkeeper to check the accuracy and precision of their equipment and techniques. Monitoring equipment from Coastkeeper will be brought to the Quality Control Session. Citizen monitors will conduct duplicate tests on all analyses and meet the measurement 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 prohibited to conduct further monitoring for the analysis of concern until training is completed.

The Coastkeeper Quality Control officer 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. The trainer will discuss and implement corrective action with the volunteers, and the date by which the action will be taken. The Coastkeeper Quality Control Officer 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.

The Coastkeeper Water Monitoring Leader (see section 4.5.1) is responsible for overseeing the water quality training activities and to ensure it covers the required elements. Similarly, the Nautilus Quality Assurance Officer is responsible for overseeing the bio-assessment training activities.

Field-staff training shall be documented and filed at the San Diego Coastkeeper offices. Documentation shall consist of a record of the training date, instructor, whether the specific training was an initial or refresher training, and whether the training was completed satisfactorily by the trainee. Training sessions will be conducted at least 6 times per year. Training will include an approximately 40 minute classroom discussion with Power Point presentation followed by an approximately 1 hour hands-on training with measurement and sampling equipment in a simulated water body.

8.2 Training personnel

The water quality monitoring training (sample collection, field and lab analysis) is provided by the Coastkeeper Water Monitoring Leaders.

Lab fellows that have undergone Coastkeeper training may train additional field samplers. Individual trainees shall be 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. Field audits will be performed four times a year by trained Lab Fellows to provide quality assurance and control of field sampling methods of newly trained citizen volunteers, returning volunteers and Watershed Captains.

8.3 Nautilus training requirements

8.3.1 Specialized training or certifications

To ensure consistent and comparable field techniques, bio-assessment for this project shall include annual classroom macro-invertebrate training and field practice sessions, plus in-situ field assessments. It will focus on sampling methods and field logistics including physical monitoring processes, and participation in the benthic macro-invertebrate sampling (bio-assessment). On site assessments will consist of equipment checks, good sampling practices, record-keeping, and health and safety. Assessments are conducted at the Nautilus Quality Assurance Officer's discretion.

8.3.2 Certifications / Licensing

Nautilus field team leaders will have current and appropriate Scientific Collecting Permit issued by the California department of Fish and Game. This permit requires annual reporting of the samples collected.

8.3.3 Laboratory Taxonomic Analysis Training

It is not envisioned that Nautilus will perform laboratory taxonomic analysis for this project. Nautilus will sub-contract taxonomic analysis to Eco-Analysts or other similar certified professional laboratories. It is strongly recommended that all taxonomists become a member of a taxonomist group for benthic macro invertebrates, such as the Southwest Association of Freshwater Invertebrate Taxonomists (www.SAFIT.org). Although membership is not required, participation in a trade organization for freshwater taxonomists promotes taxonomic education, training, and communication. Membership in organizations like SAFIT offers several benefits to project participants, such as opportunities for continuing education, taxonomic workshops, reviews of current literature, and inter-calibration exercises. Taxonomists are expected to participate in at least one taxonomic workshop focusing on benthic macro invertebrates per year.

8.4 I Love A Clean San Diego training requirements

The ILACSD Quality Assurance Officer will review the RTAW required fields to be completed with ILACSD staff. ILACSD staff are accustomed to completing field data sheets to quantify the amounts of trash collected. ILACSD will provide a brief training to all volunteers involved in collecting the RTAW prior to data collection.

ILACSD staff is responsible for providing volunteers with the necessary training to implement to implement the RTAW for trash removal events. Training will be provided to volunteers on-site directly before the cleanup and trash assessment begins. ILACSD staff will also be on hand to answer any questions during the assessment. Verbal training will be conducted by meeting with volunteers and reviewing how to properly use the data cards. Volunteers will also receive a hand out with more details to refer to during the project.

Training documents will be on-site as each associated cleanup, as well as saved on the ILACSD server. Hard copies will also be provided to staff members as well as to Coastkeeper.

9. Documentation and Records

All field and laboratory results will be recorded at the time of completion, using the field data sheets and lab data sheets, respectively (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. For Coastkeeper and the SDSU Environmental Chemistry Laboratories, field and laboratory data sheets are archived for three years from the time they were collected. See Table 8. 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 all databases will be maintained at the Coastkeeper Laboratory and primarily stored on the main office servers. Data will also be backed up to in house local and external hard-drives in addition to a 3rd party certified off-site data backup server.

The Coastkeeper Laboratory Coordinator / Quality Control officer will be responsible for data entry of field and laboratory results. The Coastkeeper Data Management Coordinator will be responsible for maintaining data records and documents, and data posted to the Coastkeeper web site. Copies of this QAPP document and any revisions or updated versions will be distributed via email to the individuals listed in Section 3 by the Coastkeeper Project Manager.

For bio-assessment data performed by Nautilus, all field results will be recorded at the time of completion, using the SWAMP Stream Habitat Characterization Form in Appendix 2. Data sheets will be reviewed for outliers and omissions by the field team leader before leaving the sample site. Completed data sheets will be stored in a secure area until provided to the project sponsors and /or the Regional Water Quality Control Board. 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 chain-of-custody forms, completed data quality control forms, and maintenance logs will also be kept at the headquarters location. For this project, this location is the San Diego Coast keeper Laboratory. The maintenance log will detail the dates of equipment inspection, battery replacement and calibrations, as well as the dates that reagents and standards are replaced.

Table 8 - Document and record retention and archival information

	Identify Type Needed	*Retention*	*Archival*	*Location*
Sample Collection Records and Field Records	*Field data sheets/ chain of custody*	*3 years for hard copies*	*Data back-up (save) to in house and external hard drives*	*Coastkeeper Laboratory*
Data Records	*Completed laboratory analysis data sheets*	*3 years for hard copies*	*Data back-up (save) to in house and external hard drives*	*Coastkeeper Laboratory, local hard drive and* *3rd party certified off-site data backup server*

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

9.1 Mandatory State reporting for benthic macro-invertebrate sampling

There is a mandatory Report of Specimens Collected or Salvaged due to the California Department of Fish and Game, within 30 days of the expiration of the Scientific Collection Permits.

9.2 Documentation of Trash data

ILACSD will collect all RTAW from volunteers at the end of each cleanup. Each trash item calculation will be confirmed and entered into ILACSD's online database. Original copies of all data cards will be provided to Coastkeeper as well as copy of report generated from ILACSD's online database. Reporting will be as specified in Figure 3: Project Schedule Timeline (by the 15th day of the month following the quarter (January, April, July, October). Coastkeeper will be ultimately responsible for the handling and eventual disposal of original data cards worksheets.

ILACSD will provide hard copies of the RTAW to Coastkeeper who will then provide the information in electronic format for uploading into CEDEN or other SWAMP compatible data portal.

10. Sampling Process Design

10.1 Rationale for Selection of Sampling Sites

The Coastkeeper sampling sites are shown on the map in Appendix 3. These sites are specific to the study question(s) set forth in the monitoring plan (MP) for each project. Coastkeeper may utilize this QAPP for additional projects that will have their own monitoring plans specific to that project's goals. New sampling sites may be selected for other projects based upon the selection criteria as listed in the project's MP. Coastkeeper may also analyze historic data from its own previous monitoring efforts in sampling site selection.

The sampling site selection criteria that are common to all Coastkeeper projects are:

- location has safe access
- Any reference sites are chosen upstream of any potential impact
- permission to cross private property or public land is granted
- location complements or supplements historical data
- location can be accessed from the bank of a water body, or standing in the stream bed directly downstream, using a sampling pole that obtains a sample without collecting surface residue or benthic sediments
- location represents an area that possesses value for fish, wildlife or recreational use
- sample is collected in a location where homogenous mixing of water occurs

Sampling sites may be changed if, based upon a review of data, it is determined that sufficient data has been collected to assess the water quality for that site, or the site is not providing useful data. Coastkeeper will confer with its partner organizations and Technical Advisory Committee to ensure sampling sites meet the project goals as stated in the MP and section 5. Prior to final site selection, permission to access the stream will be 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 Standard operating Procedure.

Sample sites will be reviewed by the Coastkeeper Water Monitoring Leader before sending volunteers out to the site. The monitoring leader will document permission and terms obtained from landowners, and will complete and file a Stream/Shore Walk form for the site, which will include a map and photographs.

10.2 Trash cleanup sites

For trash cleanup sites, ILACSD's will coordinate these events and collection of Rapid Trash Assessment (RTA) data using same approach as the SWAMP Rapid Trash Assessment Method for the San Francisco Bay region. Each area is sampled through the RTAW will be of equal size, as volunteers will measure a 100 foot distance. This is not measured as a straight line, but 100 feet of actual stream length or shore length, using easily identifiable landmarks on each side. The RTA is then carried out along the 100 feet length of the creek bed, both above and below the high water line. If the high water line cannot be determined, volunteers will collect data from the upper boundary of the banks if inferred that debris could end up in the waterway through wind or rain.

I Love A Clean San Diego and San Diego Coastkeeper will focus on five locations (1 clean up event) during the first year and determine how many of these can be repeated during the second year. Data will be collected in ten categories: Plastic, Biohazard, Construction Debris, Metal, Large Items, Toxic, Biodegradable, Glass, Fabric/Cloth, and Miscellaneous.

Sites will be identified by ILACSD and Coastkeeper staff prior to beginning the subcontractor agreement, and certain qualifications will be taken into account when looking at potential sampling locations. Locations must have water flowing through them at least a portion of the year, provide safe access for volunteers, and show some problems with trash.

Sites may become inaccessible during the winter months if creek beds flood or access becomes dangerous. ILACSD will plan data collection events for times during the year when heavy rainfall is not a factor. All sampling sites are city-owned therefore accessibility will not be affected by landowners.

10.3 Bio-assessment Sites

Selection of bio-assessment sites will chosen by the bio-assessment contractor, Nautilus, using best professional judgment. Selected sites will be at the same location or as close as possible to Coastkeeper monitoring locations.

Nautilus will perform standard physical habitat assessment in conjunction with each bio assessment event, utilizing Sampling Process Design provided in the California State Water Board SWAMP Program.
Additional physical habitat assessment data may be collected using the California Streamside Physical Habitat Record Sheet revised 09 / 2003 and attached as appendix 2.1.

10.4 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 Volunteer Coordinator, Sarah Blakeslee, or Coastkeeper Water Monitoring Leader Laboratory 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 the site is located on private property or public land. If access to the site is a problem, the Coastkeeper Water Monitoring Leader will select an alternate site following the site selection criteria identified in Section 10.1 or cancel the collection for that site if a suitable alternate cannot be found.

10.5 Project Activity Schedules

10.5.1 Coastkeeper water chemistry, nutrient, bacterial, and toxicity sampling

Coastkeeper will organize sampling events 12 times/ year, ideally 1 per month. Samples will be collected at each site as conditions (safety, adequate stream flow, etc.) permit. If conditions allow the collection of samples at all locations, the total number of locations sampled will be 28 to 33 per event, depending upon even and odd month rotation for sites listed in Table 1. Events will be planned for the second or third Saturday in each month. Sampling events will be scheduled without with respect to rainfall and weather, i.e., sampling events will be scheduled before weather forecasts are available. Water quality sample collection orientation and training for new volunteers will precede water sampling team deployment on Saturday mornings every other month. On months without training, only volunteers with previous training will participate in sampling events. All sampling teams will return to the Coastkeeper office and laboratory with completed field data sheets for constituents analyzed in the field and samples for laboratory analysis within 4 hours of the first sample collection. All information fields on the field data sheets, including observations, are considered critical.

Safety measures will be discussed with all volunteers. No in stream 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 Standard Operating Procedures for Coastkeeper and Nautilus.

10.5.2 Nautilus bio-assessment sampling

Employing a non-point source sampling design, Nautilus will perform bio-assessment by collecting benthic macro-invertebrates (BMI's), once annually (in the spring). This will result in at least two data assessments at each location over the course of the project.

10.5.3 SDSU dissolved metal sampling

Samples collected by Coastkeeper and its volunteers will be split at the Coastkeeper Laboratory and sent to the SDSU Environmental Chemistry Laboratory for analyses of dissolved metals. If conditions allow the collection of samples at all locations, the total number of locations sampled will be 28 to 33 per event.

10.5.4 Trash clean ups

Trash removal events by I Love A Clean San Diego will focus on five locations (1 clean up event) during the first year and determine how many of these can be repeated during the second year of the project based upon the remaining budget.

10.6 Variability

Sources of variability that may affect data collected for this project include stream water level, temperature, sample collection time, sample collection technique, storage and transfer, and sample analysis. Stream water level and temperature are variables that cannot be controlled and can be identified as seasonal trends in graphs. Sample collection time, sample

collection technique, storage and transfer, and sample analyses are sources of variability that will be minimized by ensuring that participating staff or volunteers are properly trained in the associated Standard Operating Procedures.

11. Sampling Method Requirements

11.1 Physical, chemical, nutrient, and bacterial sampling by Coastkeeper

Water sample collection by Coastkeeper for field and laboratory analysis will follow standard operating procedure for Sample Collection, see Appendix 5. This includes the procedure for field filtering of nutrient samples. In brief, laboratory samples will be collected as single, large (1000 mL) volume grab samples in cleaned HDPE plastic bottles. Samples for field analysis will be collected immediately after the laboratory samples using large (1000 mL) volume grab samples in cleaned HDPE plastic bottles. Sample collection method, sample containers and holding times are shown in Tables 10 and 11.

The following key points for proper sample collection are included in the Coastkeeper S.O.P. for sample collection:

- Do not rinse sterilized collection bottles or bag with sample water prior to sample collection
- Stand downstream from the collection point, and collect samples from mid-stream, 3 - 5 inches below the surface
- Do not disturb stream bed sediment; if necessary to wade into a water body, stand downstream from the collection point
- Allow effects of any disturbance to dissipate before collecting the sample

In those cases where glass bottles are required in Tables 9 or 10, 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. Sterile bottles, whirl-paks, and sample bottles which do contain preservatives/fixing agents (e.g., acids, etc.) are not rinsed with sample water prior to collecting the sample. Also, bottles containing preservatives/fixing agents are never used for sampling; in these cases, a sampling device is used to collect the sample prior to transferring the sample into the bottle with a preservative.

Upon encountering any difficulties with sampling equipment or procedures, the team leader will contact the Coastkeeper Water Monitoring Leader by cell phone to describe the difficulty and ask for advice. The Coastkeeper Water Monitoring Leader will resolve the problem or instruct the team for a corrective action. The sampling team leader is required and will be instructed by the either the Coastkeeper Water Monitoring Leader to document the incident on the field data sheet. If a piece of equipment has failed, upon return of the sampling team, the failed unit will be isolated, inspected, repaired, and recertified. All repairs and certification will be recorded on the equipment log.

Information on seasonal variation of flow rates will be obtained during sample collection by measuring stream depth (average of three measurements per site). See Appendix 5.

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

Table 9 - Sampling Method Requirements for Coastkeeper and SDSU

Parameter	Sample volume	Preferred / Maximum Holding Times
Conventional Parameters in Fresh and Brackish Waters		
Temperature	sample directly from water with probes	N/A. Analyze immediately
Dissolved oxygen	sample directly from water with probes	N/A. Analyze immediately
pH	sample from collection container	N/A. Analyze immediately
conductivity	sample directly from water with probes	N/A. Analyze immediately / refrigerate up to 24 hours
Nutrients in Fresh Waters		
Nitrate	1000mL single grab sample	Refrigerate in dark at 4°C for up to 48 hours.
Phosphate	1000mL single grab sample	Refrigerate in dark at 4°C for up to 48 hours
Laboratory Analysis of Inorganic/ Elemental Parameters in Fresh and Brackish Waters		
Metals (Dissolved)	250 ml polyethylene bottle, pre-cleaned in lab using HCl	Acidified with (1+1) nitric acid to pH<2. Store at room temperature for up to 6 months.
Biological Samples in Fresh Waters and Brackish Waters		
Bacteria	1000mL single grab sample	Refrigerate to 4° C in the dark; start analysis within 6 hours
Toxicity	1000mL single grab sample	Up to 1 week at 4° C

11.2 Cleaning and decontamination by SD Coastkeeper

Water sample collection equipment will be cleaned and decontaminated in the laboratory between monthly monitoring events with a 70% ethanol solution, or a phosphate free alconox, and rinsed with de-ionized water. Water sample collection equipment will be cleaned between sites during monitoring events by rinsing (3x) with de-ionized water. Each toxicity sample will use a clean plastic cartridge containing (6) six 4.0mL cuvettes. These cartridges are reusable and will be returned to Assure Controls by Coastkeeper for cleaning after each test. Cartridges with a BIN of 4 or more will not be reused.

11.3 Bio-assessment sampling by Nautilus

Nautilus will use the SWAMP Bio-assessment Procedures, Ode, P.R. 2007: "Collecting Macro-Invertebrate Samples and Associated Physical and Chemical Data for Ambient Bio-Assessment in California". Bio-assessment SOP 001. This procedure has a systematic method for visual and other sensory observations. Observational data include color, odor, presence of oil or tar, trash, foam, and algae. In addition, the stream habitat quality will be assessed, using the SWAMP Stream Habitat Characterization Form, Appendix 2.1. Observational data include epi-faunal 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. Benthic micro-invertebrates will be collected with a D shaped kick net (0.5 mm mesh) mounted on a pole handle.

Table 10 describes the Nautilus sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

Table 10 - Sampling Method Requirements for Nautilus

Parameter	Sample volume	Preferred / Maximum Holding Times
Conventional Parameters		
Temperature	clear plastic bottle or sample directly	Immediately, sampled in field
Dissolved oxygen	plastic bottle or sample directly	Immediately, sampled in field
pH	plastic bottle or sample directly	Immediately, sampled in field
Alkalinity	plastic bottle or sample directly	Immediately, sampled in field
Conductivity	plastic bottle or sample directly	immediately / refrigerate up to 24 hours
Biological Parameters		
Benthic Macro-invertebrates	wide mouth plastic bottles	fix with ethanol immediately. Store indefinitely

11.4 Cleaning and decontamination by Nautilus

Water sample collection equipment and samplers will be cleaned and decontaminated using the standard operating procedures, see Reference 1 in Appendix 4.

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 2.4) when the sample is collected. Samples that are not analyzed immediately in the field (chemical analyses by Coastkeeper and Nautilus, and nutrient analysis by Nautilus) will be labeled with the sample ID, date and time of collection, sampler's name, and method used to preserve sample (if any). The field data sheets also contain chain of custody information to be completed by the person entering information on this form. Sample holding times are listed in Tables 9 and 10.

12.1.1 Sample handling and storage for Coastkeeper bacteria, toxicity and nutrient samples

Coastkeeper trained volunteers will collect and store samples per standard operating procedures (Appendix 5). This includes the use of gloves while handling samples to prevent cross-contamination. Coastkeeper field crews will collect water samples in sterile whirl packs or glass bottles (for nutrient), and store in closed cooler on ice, and return to the lab within four hours from the time of the first sample collection.

12.1.2 Handling and storage of plankton used in toxicity analyses

The propagation of cultures is done under Standard Operating Procedures for control and consistency (see Appendix 6). These procedures include regular culture maintenance, inspection, and evaluation of cell health, media and water quality assessments, and documentation. Cultures are developed, inspected and approved for shipment. The cultures are indentified throughout their entire life cycle by unique stock numbers. Shipments of *Pyrocystis lunula* for commercial use include optical inspection of the cells and uniform density preparation, completed no more than 12 hour prior to packaging and shipment. A predetermined location (i.e. shelf or cabinet) or a container for controlled Light and Dark exposure (12 hours each) is required. Indirect light of approximately 40 to 60 watts (normal office or reading level light) is sufficient. Do NOT use direct sunlight in the Light-Dark phases. A refractometer (or hydrometer) is needed to measure salinity of the water to be tested. Aquarium grade or laboratory supply grade Sea Salt or Oceanic Salt (not iodized table salt) is required if the water samples

are freshwater or below 30 ppt when measured. The salt will be used as a buffer to raise the mixed solution to 30-33 ppt prior to testing.

12.1.3 Sample handling for bio-assessment samples

Identification information for each sample will be recorded on the field data sheets (see Appendix 2.1) 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 of collection and sampler's name.

12.1.4 Sample handling, storage, preservation and preparation for dissolved metal samples

Coastkeeper trained volunteers will collect and store samples per standard operating procedures (Appendix 5). At the Coastkeeper Laboratory, a volume of the original samples will be transferred into new sample containers that are labeled and stored for transport to the SDSU, Graduate School of Public Health, Environmental Chemistry laboratory, per the SDSU standard operating procedures (Appendix 7).

For the determination of dissolved metals, the sample must be filtered through a 0.45 μm pore diameter membrane filter. This will be done at the SDSU Laboratory at the time of sample receipt from Coastkeeper staff. Use a portion of the sample to rinse the filter flask, discard this portion and collect the required volume of filtrate. Acidify the filtrate with (1+1) nitric acid immediately following filtration to pH < 2. See Table 10 for a summary of this process.

Next, pipet an aliquot ($\geq$ 20 mL) of the filtered, acid preserved sample into a 50 mL polypropylene centrifuge tube. Add an appropriate volume of (1+1) nitric acid to adjust the acid concentration of the aliquot to approximate a 1% (v/v) nitric acid solution (e.g., add 0.4 mL (1+1) HNO3 to a 20 mL aliquot of sample). If the direct addition procedure (Method A, Section 10.3) is being used, add internal standards, cap the tube and mix. The sample is now ready for analysis (Section 1.2). Allowance for sample dilution should be made in the calculations.

For aqueous samples, a field blank should be prepared and analyzed as required by the data user. Use the same container and acid as used in sample collection. . Containers for metals analyses will be 250mL acid-washed plastic bottles.

Samples may be stored until the end of the project.

12.2 Custody Procedures

The water quality monitoring conducted by field testing does not require specific custody procedures since the test 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 natural shelter or volunteer's car. 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 laboratory such as the SDSU School of Public Health, Environmental Chemistry Laboratory, a chain of custody form will be used. This form identifies the water body name, sample ID, date and time of collection, sampler's name, and method used to preserve sample (if any). Similarly, when quality control checks are performed by an outside lab, their samples will be processed under their chain of custody procedures with their labels and documentation procedures. It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. The person named in the Field Data Sheet for the sampling team will be responsible for sample handling and custody.

For benthic macro-invertebrate samples, a chain of custody record will be maintained from the time the bio-assessment sample is collected to its final disposition. The record documents the transferring of samples from one volunteer to another member of the same organization, or from the citizen monitoring group to an outside professional laboratory. Each transfer of custody must be noted and signed. The individual responsible for custody is to maintain direct control (e.g., possession or line of sight) of the sample(s), or must maintain the sample(s) in a secured location, such as in a locked car. The Chain of Custody record shall include (at a minimum) the following:

- Site ID
- Site name/ description
- Sample number
- Sample date and time of collection

- Sampler's name and signature, and
- Preservative used (if any)

It also documents the date(s) and time(s) of transfer(s), and the name and signature of the sample recipient. When a professional lab performs quality control checks, their chain of custody forms and procedures are to be used.

For trash clean up events by ILACSD, standard data cards will be collected from volunteers at the events by ILACSD staff, then turned over to Coastkeeper staff for further analysis within two weeks of clean up events.

13. Analytical Methods Requirements

Table 11 outlines the methods to be used by Coastkeeper laboratory and SDSU laboratory, respectively, any modifications to those methods, and the appropriate reference to a standard method. Analytic target reporting limits are shown in Tables 13 and 14.

For bio-assessment samples collected by the Nautilus, analytic target reporting limits are shown in Tables 5 and 6. For bio-assessment samples collected by the Nautilus, water chemistry is analyzed using protocols outlined in the manual "Measuring the Health of California Streams and Rivers: A methods manual for resource professionals, citizen monitors and natural resources students" (Harrington and Born, 2000). The methods, listed in Table 12, 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 listed in Table 11 or 12 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 11 - Water Quality Parameter Methods by Coastkeeper and SDSU

Parameter	Type	Method	Modifications	Reference
Temperature	F (Coastkeeper)	electrometric	Hach HQ40d	S.M. 2550 / 2550 B.
Dissolved Oxygen	F (Coastkeeper)	Hach HQ40d Luminescent Dissolved Oxygen	Hach HQ40d Luminescent Dissolved Oxygen	ASTM 888-87
pH	F (Coastkeeper)	electrometric	Oakton Double Junction Electrode	Whatman Co. and S.M. 4500-H B.
Conductivity	F (Coastkeeper)	electrometric	Hach 40d Conductivity probe	S.M. 2520 B.
Nitrate- NO_3 - N	L (Coastkeeper)	Dimethylphenol	Hach Method 10206 (TNT835)	no EPA method for dimethylphenol *
Total Phosphorous – PO_4 - P	L (Coastkeeper)	Ascorbic Acid	Hach Method 10210 (TNT 843)	EPA 365.3
Ammonia - NH_3 - N	L (Coastkeeper)	Salicylate	Hach Method 10205 (TNT831)	EPA 350.1
Dissolved Metals (Cadmium, Chromium, Copper, Lead, Zinc, Nickel)	P (SDSU)	Inductively Coupled Plasma Mass Spectrometer (ICP-MS)	None	EPA 200.8
Total Coliform	L (Coastkeeper)	IDEXX Colisure or Colilert 18	dilute sample 1:10	S.M. 9223

E. Coli	L (Coastkeeper)	IDEXX Colisure or Colilert 18	dilute sample 1:10	S.M. 9223
Enterococci	L (Coastkeeper)	IDEXX Enterolert	dilute sample 1:10	S.M. 9223
Toxicity	L (Coastkeeper)	QwikLite 200 Bio-Sensor System		ASTM E1924

*****While this method is not currently US EPA approved or equivalent, research is underway (by HACH) to obtain US EPA approval or equivalency acceptance to S.M. 4500 for Nitrate. Coastkeeper will continue to use the HACH Method 10206 (TNT 835) and make qualified statements about Nitrate data until that time**.**

Table 12 - Water Quality and Bio-assessment Parameter Methods by Nautilus

Parameter	Type	Method	Modifications	Reference
Temperature	F (Nautilus)	Thermometric	Alcohol-filled thermometer marked in 0.5^{O}C increments	2550 B.
Dissolved Oxygen	F (Nautilus)	Colorimetric indigo carmine Vacuum ampoules Color Comparator	None	ASTM D 888-87
pH	F (Nautilus)	Electrometric	Litmus indicator strips, non-bleeding	4500-H B.
Conductivity	F (Nautilus)	Electrometric	None	2520 B.
Alkalinity	F (Nautilus)	Titration: Phenolphthlalein and Bromocresol Green/Methyl Red	None	Hach Titration Method 8203
Benthic macro-invertebrates	L , P (Nautilus)	California Stream Bio-assessment Protocol Level 2 (to Family)	None	Harrington, Jim, CDFG, 2000

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

Codes for Table 13.1 and 13.2:
Type: F: field analysis, L: in-house lab analysis, P: sample only, send to outside professional lab

13.1 Corrective Action

13.1.1 Coastkeeper

Upon encountering any difficulties with analytical instruments, procedures, or analytical methods, the person conducting the analysis will contact the Coastkeeper QA officer or Project Manager. The Coastkeeper QA officer or project manager will resolve the problem or instruct the analyst for a corrective action. The analyst will document all problems, difficulties or deviations from established analytical procedures in the laboratory log book. Analysis for sample or batch of samples that deviated from established procedures will be repeated if enough sample is available. If not enough sample is available to repeat the analysis, the results from these questionable analysis will flagged by the analyst and the QA officer will be informed immediately. If a piece of equipment fails, malfunctions or needs repairs, the unit will be isolated, inspected, repaired, and recertified. All repairs and certification will be recorded on the laboratory equipment log.

13.1.2 Nautilus

For conventional water quality and nutrients, duplicate field samples will be taken once every 20 samples or twice per sampling season, whichever comes first. When replicate sample readings fall outside the precision target value, corrective action will be taken to identify whether it is mechanical, operator or method based error and correct the situation as follows. If the meter fails to read or yields erratic readings, new batteries will be installed. If meter readings are within 20% but fail to

meet pre-determined precision in the field, the same person, a second person, or second team will repeat the measurement or observation at some percentage of the locations and then the results would be compared to pre-determined acceptance requirements. Failure to meet the criteria might result in an additional measurement being required, some of the data being invalidated, or some of the data being flagged as suspect. If the sample reading generates an over the limit reading on the meter, a 1:10 dilution of the sample will be assayed in duplicate, recorded as both the 1:10 value and 1X value and so noted on the field sheet.

If the above steps do not correct the situation, the water quality parameter in question will be assayed by a back-up CHEMets non-digital assay in the field for orthophosphate, nitrate or dissolved oxygen as required, or by pH strip. The meter in question will be subsequently tested in the lab with standards to determine if the meter and reagents are functioning properly. If the meter is functioning properly, this indicates operator error, and more training on the use of the instruments will be performed. If the meter in question is not functioning properly, the kit reagents will be tested on an independent meter using standard solutions as a control. If the independent meter fails to generate the expected values, the reagents will be replaced with new ones. If the independent meter yields the expected value, this indicates that the original meter was yielding faulty readings, and will be sent for analysis and repair.

In the event that water quality values for a particular test fail to meet pre-determined precision in the field on more than two consecutive field events, additional training of field team members will be performed and the test method itself will come under review by the Nautilus technical advisory committee (TAC). Within 2 weeks, the TAC will determine if a new field test and/or modification to the existing method is required, and will direct the Nautilus board of directors to implement the new test and make the necessary changes to the Nautilus QAPP.

13.1.3 SDSU

Upon encountering any difficulties with the analytical method or ICP /MS instrument for metal analyses, the person conducting the analyses will contact the SDSU QA officer. The SDSU QA officer will resolve the problem or instruct the analyst for a corrective action. The analyst will document all problems, difficulties or deviations from established analytical procedures in the laboratory log book. Analysis for sample or batch of samples that deviated from established procedures will be repeated if enough sample is available. If not enough sample is available to repeat the analysis, the results from these questionable analysis will flagged by the analyst and the Project QA officer will be informed immediately. If the ICP/MS instrument malfunctions or needs repairs, the unit will be inspected and repaired, and the instrument then tuned and re-optimized until it is within specifications provided by the manufacturer.

13.2 Results Turnaround Times and Target Reporting Limits

The following laboratory turnaround is expected:

pH, temperature, dissolved oxygen, 1 week
Metal analysis, 4 weeks
Ammonia, Nitrate, and Total Phosphorous, 48 hours.
Microbiological parameters, 24 hours
Habitat assessment, 1 day
BMI level 2 data (Professional Laboratory), up to 12 months

For the BMI data, sample analysis will be completed based on volunteer availability. For professional taxonomists, DFG laboratory schedules will affect turnaround times.

Table 13 – Target reporting limits and method detection limits for analyses by Coastkeeper and SDSU

Parameter	Target Reporting Limit	Detection Limit	Instrument	Range	Resolution
Temperature	N/A	-5°C	Thermometer	0 – 50°C	0.1°C
Dissolved oxygen	0.2 mg/L	0.1 mg/l	Electronic /probe	0.1 – 20.0 mg/L	0.01 mg/L
pH	N/A	2.0 pH units	pH meter	0 – 14.0	0.1
Conductivity	2.5 µS/cm	10 µS/cm	conductivity meter	0.01 µS/cm – 200 mS/cm	0.01 µS/cm
Nitrate (NO_3 -N)	0.23 mg/L	0.23- 13.5 mg/L	Hach DR-3800 Spectrophotometer	320- 1100 nm	0.01 mg/L
Total Phosphorous – PO_4 - P	0.05 mg/L	0.05- 1.50 mg/L	Hach DR-3800 Spectrophotometer	320- 1100 nm	0.01 mg/L
Ammonia (NH_3 - N)	0.015 mg/L	0.015- 2.0 mg/L	Hach DR-3800 Spectrophotometer	320- 1100 nm	0.01 mg/L
Total Coliform Bacteria	2 MPN/ 100mL	1 per 100mL	IDEXX Colisure test or Colilert 18	1:10 dilution = 20 – 24,192 MPN/100mL	
E. coli Bacteria	2 MPN/ 100mL	1 per 100mL	IDEXX Colisure test or Colilert 18	1:10 dilution = 20 – 24,192 MPN/100mL	
Enterococci Bacteria	1 colony / 100mL	1 per 100mL	IDEXX Enterolert test	1:10 dilution = 20 – 24,192 MPN/100mL	0.1 µg/L
Cadmium (Dissolved)	0.1 µg/L	0.03 µg /L	ICP-MS	Up to 500ppm	0.1 µg/L
Copper (Dissolved)	1.0 µg/L	0.02 µg /L	ICP-MS	Up to 500ppm	0.1 µg/L
Zinc (Dissolved)	2.0 µg/L	0.1 µg/L	ICP-MS	Up to 500ppm	0.1 µg/L
Chromium (Dissolved)	0.5 µg/L	0.08 µg/L	ICP-MS	Up to 500ppm	0.1 µg/L
Lead (Dissolved)	0.2 µg/L	0.05 µg/L	ICP-MS	Up to 500ppm	0.1 µg/L
Nickel (Dissolved)	0.2 µg/L	0.06 µg/L	ICP-MS	Up to 500ppm	0.1 µg/L

Table 14 – Target reporting limits and method detection limits for bio-assessment analyses by Nautilus

Parameter	Target Reporting Limit	Detection Limit	Instrument	Range	Resolution / Sensitivity
Temperature	N/A	-5	Thermometer	(-5 to 50)	0.5 ^{o} C
Dissolved oxygen	0.2 mg/L	1.0 mg/l	Vacuum ampoule Indigo carmine	1.0 – 12.0	1.0 (1.0-6.0) 2.0 (6.0-12.0)
pH	N/A	2.0, 4.5	pH meter, Non-bleeding strips (range 4.5-10.0)	2.0 – 10.0	0.1 unit, 0.5 unit
Conductivity	2.5 µS/cm	10 µS/cm	conductivity meter	10 µS/cm - 50M/cm	10 µS/cm
Alkalinity	1.0 mg/L	7.0 mg/L	Hach digital titrator	7.0 -10.0 mg/L	10 mg/L
Physical Habitat	N/A	N/A	Calif. Stream Bio-assessment Protocol	N/A	
Benthic Macro-invertebrates	Family level	Family level	Calif. Stream Bio-assessment Protocol	N/A	
Taxonomic ID's	Family level	Family level	Calif. Stream Bio-assessment Protocol	N/A	

13.3 Disposal

All analyzed samples or spent chemicals will be disposed of according to both federal and state or local regulations as noted in individual Chemical Material Safety Data Sheet section 13. When noted, materials will either be properly pH adjusted for to dilution and dumping to drain connect to sewage treatment plant or held in EPA and D.O.T approved hazardous material storage containers for specific liquid, sharp, or solid waste, and disposed of properly by local partnerships with Department of Toxic Substance Control licensed Waste Generator. Coastkeeper will hold and maintain proper EPA waste generator ID in order for partner to legally obtain and dispose of waste generated by Water Monitoring Laboratory.

San Diego Coastkeeper requires that all partners and sub-contractors such as Nautilus comply with Coastkeeper's internal SOP detailing the handling and disposal of hazardous materials. Specifically Nautilus will keep documentation detailing their use of Cadmium Packages for Nitrate Field Analysis so that Coastkeeper can verify the contents of all waste generated outside of lab supervision are stored, transported, and disposed of in accordance with all applicable state and federal laws.

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. inter-calibration exercises) will be held twice a year to verify the proper working order of equipment, refresh volunteers in monitoring techniques and determine whether the measurement quality objectives are being met. QC samples and information they provide are noted in Table 15.

Table 15 – Quality Control

QC Check	Information Provided
BLANKS	
Bottle blank	Cleanliness
Field blank	Transport, storage, and field handling bias
Reagent blank	Contaminated reagent
Rinsate or equipment blank	Contaminated equipment
Method blank	Response of an entire laboratory analytical system
SPIKES	
QC Check	**Information Provided**
Matrix Spike	Analytical (preparation + analysis) bias
Matrix spike replicate	Analytical bias and precision
Analysis matrix spike	Instrument bias
Surrogate spike	Analytical bias
CALIBRATION CHECK SAMPLES	
Zero check	Calibration drift and memory effect
Span check	Calibration drift and memory effect
Mid-range check	Calibration drift and memory effect
REPLICATES, SPLITS, ETC.	
Field collocated samples	Sampling + measurement precision
Field replicates	Precision of all steps after acquisition
Field splits	Shipping + inter-laboratory precision
Laboratory splits	Inter-laboratory precision
Laboratory replicates	Analytical precision
Analysis replicates	Instrument precision

14.1 Field/Laboratory Blanks for Nutrients, Bacteria, and Toxicity

Field blanks will be analyzed daily when field sampling is conducted. Laboratory blanks will be run per 20 samples or per analytical batch, whichever is more frequent. For spectrophotometers used at the group's facility for nutrient analysis, a laboratory reagent blank will be analyzed and recorded for each day of analysis. For bacterial samples, field blanks will be run daily when field sampling is conducted, and a laboratory blank will be performed for each sampling/analysis event. Blanks do not apply to benthic macro-invertebrate sampling.

14.1.1 Instructions for Field and Lab Blanks and Temperature Blank

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. Temperature Blanks will travel into the field and the temp will be recorded upon its arrival in the lab. Field blanks are recorded on the lab 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 quanti-tray 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.

For pH and conductivity quality control, the lab will use uncolored pH and certified and traceable buffers.

14.1.2 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. (Confirmations will use the Measurement Quality Objectives [MQOs] in Table 3 and Table 5.) 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 be performed during the quarterly field audit by a trained Lab Fellow and will provide additional confidence 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.

14.1.3 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 bacterial 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, (this describes the method we were questioning with the ‘one volume bucket grab) and will be subjected to identical handling and analysis. For bacterial analysis, a minimum 10% of the samples analyzed in duplicate in the lab. The averages of each replicate set represents the data that will be used in assessment of the Precision criteria. This is done in accordance with Standard Methods 9020B.

14.1.4 Split Samples

Split field samples and lab spiked samples (with a known standard) will be analyzed in the blind as part of the (semi-annual) 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, aka positive controls, will be analyzed by the volunteers, and sent to a professional laboratory (except for dissolved oxygen, temperature, conductivity 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 Tables 11 and 12.

For bacteria, split field samples or split positive controls will be analyzed by the citizen monitoring group and an outside professional laboratory annually. In addition, at the quality control session different analysts from the citizen monitoring group(s) will each read a minimum of the three quanti-trays 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.

14.1.5 Corrective Actions for chemical, nutrient, bacteria and toxicity quality control

In the case of a failed quality control for chemical, bacterial or nutrient analyses, the QA Officer will determine cause of problem (e.g., contaminated reagents, equipment), remove sources of contamination, and reanalyze all suspect samples or flag all suspect data.

14.2 Bio-assessment quality control

For benthic macro-invertebrate 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 two square foot PVC frame. A minimum of 10% of the benthic macro-invertebrate samples will be subjected to taxonomic validation by an outside professional taxonomist. Following analysis by Nautilus' sub-contractor, Eco-Analysts, the selected samples will be reconstituted and sent out for professional Level 3 taxonomic analysis. "Reconstituted" means opening the vials containing the 300 identified specimens, pouring the specimens back into the original sample jar, and gently stirring the contents. In addition, once a year Eco-Analysts macro-invertebrate analysts will participate in an inter-calibration exercise in which their sub-sampling/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 sub-sampling 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. The DQIs of accuracy and precision can be determined by the results of these validation and evaluation measures.

14.3 Dissolved metals quality control

Blanks - Three types of blanks are required for this method. A calibration blank is used to establish the analytical calibration curve, the laboratory reagent blank is used to assess possible contamination from the sample preparation procedure and to assess spectral background and the rinse blank is used to flush the instrument between samples in order to reduce memory interferences.

Calibration blank - Consists of 1% (v/v) nitric acid in reagent grade water. If the direct addition procedure (Method A, Section 10.3) is being used, add internal standards.

Laboratory reagent blank (LRB) - Must contain all the reagents in the same volumes as used in processing the samples. The LRB must be carried through the same entire preparation scheme as the samples including digestion, when applicable. If the direct addition procedure (Method A,Section 10.3) is being used, add internal standards to the solution after preparation is complete.

Rinse blank - Consists of 2% (v/v) nitric acid in reagent grade water.

Laboratory fortified blank (LFB) – The laboratory must analyze at least one LFB with each batch of samples. Calculate accuracy as percent recovery using the following equation:
R= (LFB-LRB)/S*100
Where:
R= percent recovery
LFB= laboratory fortified blank
LRB= laboratory reagent blank
S= concentration equivalent of analyte added to fortify the LRB solution

Quality control sample (QCS) – It is used to verify the calibration standards and acceptable instrument performance.

Laboratory duplicates – two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analyses of laboratory duplicate indicate precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

Laboratory fortified sample matrix (LFM) – an aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. For water samples, the added analyte concentration must be the same as that used in the laboratory fortified blank. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations.

R = (Cs-C)/s*100

Where:

R = percent recovery
Cs = fortified sample concentration
C = sample background concentration
s = concentration equivalent of analyte added to fortify the sample

Calibration Standard (CAL) – A solution prepared from the dilution of stock standard solutions. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

Internal standard – pure analytes(s) added to a sample or standard solution in known amount and used to measure the relative responses of other method analytes that are components of the same sample or solution. The internal standard must be an analyte that is not a sample component.

Table 16 - Analytical QC for Dissolved Metals

Matrix: water, nitric acid
Sampling SOP:
Analytical Parameter(s): Dissolved Trace metals (Cd, Cr, Cu, Ni, Pb, Zn)
Analytical Method/SOP Reference: EPA 200.8
Sample locations:

Laboratory QC	Frequency/Number	Acceptance Limits
Calibration blank	Performed each analysis event	
Rinse blank	Between samples, standards	
Quality Control sample (Reference Material)	Routine Accuracy Assessment: per analytical batch	75-125% recovery
Laboratory reagent blank (LRB)	At least one LRB with each batch of 20 or fewer of samples of the same matrix	< MDL for target analyte
Laboratory fortified blank (LFB)	At least one LFB with each batch samples	Recovery falls within 85-115%
Lab. Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD < 25%
Laboratory fortified matrix (LFM)	Add a known amount of analyte to a minimum of one every 20 samples	70-130%
Calibration Standard	Per analytical method or manufacturer's specifications	
Internal Standards	Every sample	The absolute response of any one internal standard must not deviate more than 60-125% of original response in the calibration blank

14.3.1 Corrective action for metal analyses quality control
Quality Control Sample - If deemed appropriate, affected samples and associated quality control may be reanalyzed following instrument recalibration.

Laboratory reagent blank (LRB) - The source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed.

Laboratory fortified blank (LFB) – if the recovery of any analyte falls outside the required control limits of 85-115%, that analyte is judged out of control, and the source of the problem should be identified and resolved before continuing analyses.

Laboratory duplicate – reassessed laboratory procedures, and be reanalyzed.

Laboratory fortified matrix – If recovery of any analyte falls outside the designated range and laboratory performance for that analyte is shown to be in control, the recovery problem encountered with the fortified sample is judged to be matrix related, not system related. The data user should be informed that the result for that analyte in the unfortified sample is suspect due to either the heterogeneous nature of the sample or an uncorrected matrix effect.

Calibration Standard - Affected samples and associated quality control must be reanalyzed following successful instrument recalibration.

Internal Standards - The instrument must be flushed with rinse blank. If, after flushing, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.

14.4 Cautions Regarding Test Procedures

14.4.1 Field Measurements by Nautilus

All field measurements will be made in triplicate. Each result will be recorded along with the average of the three results, the difference between the largest and smallest result, and the percent difference between the largest and smallest result. The percent difference will be calculated as follows.

Percent difference = 100*(largest-smallest)/average

The difference or percent difference, as appropriate, will be compared against the Precision criteria established for field measurements in section 7.

At a time about the middle of the sample run and at the end of the sample run measurement devices for pH and conductivity will be checked against a standard whose source is different than that selected for calibration. Dissolved oxygen will be checked against aerated water whose oxygen content is established by the Winkler method. Triplicate measurements, the average of the results, the difference, and percent difference will be recorded. The difference will be calculated as follows.

Difference = Average-True Value

The percent difference as follows.

Percent difference = 100*(Average-True Value)

The difference or percent difference, as appropriate, will be compared against the Accuracy criteria established for field measurements in section 7.

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.

Tables 17 summarizes the quality control regimen for Coastkeeper field and lab analyses, and SDSU lab analyses. Tables 18 summarizes the quality control regimen for Nautilus field and lab analyses. Measurement quality objectives are listed in Tables 3, 4, 5, 6, and 7.

14.5 Matrix spikes for nutrient samples

Matrix spikes for nutrients will be analyzed per section 4-2 in Standard Methods for the Examination of Water and Wastewater. A minimum of one matrix spike or matrix spike duplicate will be analyzed with each set of 20 or fewer samples, or 5% of the total samples, whichever is greater. The results of the matrix spike duplicates should be within the confidence limits supplied by the manufacturer, or at least less than (<) 25% Relative Percent Difference (RPD).

Table 17 - Summary of Quality Control Requirements for chemical, nutrient, bacterial, toxicity and metal analyses

Parameter	Blank	Duplicate Sample	Positive Control (split sample to lab)	QC session
Conventional water quality parameters				
Temperature	none	For laboratory, per 20 samples or per analytical batch, whichever is more frequent. For field, 5% of total project sample count	none	twice a year
Dissolved oxygen	none	same as above	none	twice a year
pH	none	same as above	none	twice a year
Conductivity	daily	same as above	annual	twice a year
Nutrients (colorimeters or spectrophotometers)				
Nitrate	daily	For laboratory, per 20 samples or per analytical batch, whichever is more frequent. For field, 5% of total project sample count	Annual	twice a year
Phosphate	daily	same as above	Annual	twice a year
Metals (Atomic Absorption)				
Metals (cadmium, copper, zinc, chromium, nickel, and lead)	daily	For laboratory, per 20 samples or per analytical batch, whichever is more frequent.	Annual	twice a year
Biological Parameters				
Total Coliform and *E. coli* bacteria	daily	For laboratory, per 20 samples or per analytical batch, whichever is more frequent. For field, 5% of total project sample count	Twice a year	Twice a year
Enterococci bacteria	daily	same as above	twice a year	twice a year
Toxicity	daily	Field duplicates at 5% of total project sample count	Negative controls with every 5 tests. Positive control once per analysis session	Twice a year

Table 18 - Summary of Quality Control Requirements for Bio-assessment by Nautilus

Parameter	Blank	Duplicate Sample	Split Sample to lab	QC session
Water quality				
Temperature	none	For field, 5% of total project sample count	none	twice a year
Dissolved oxygen	none	Same as above	none	twice a year
pH	none	Same as above	none	twice a year
Conductivity	daily	Same as above	none	twice a year
Alkalinity	none	Same as above	None	twice a year
Biological Parameters				
Benthic Invertebrates	none	None, instead conduct evaluation of sampling area annually	10% per year	once a year

The Coastkeeper QA Officer will inspect all instruments and testing equipment and record maintenance in a log. 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(reagent lot numbers), and any problems noted with instruments, samplers, or reagents.

14.6 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. Digital thermometers are checked to see if they are clean and in good working order.

14.7 Dissolved oxygen

For Coastkeeper, dissolved oxygen meters are cleaned and checked to see that they are in good working order. The black polysterene coating on the Luminesence Dissolved Oxygen sensor is checked monthly. According to manufacturer's specifications, after an initial calibration, additional calibrations are not required for the Hach IntellicalCAL probe. To maintain best performance Hach probes will be calibrated twice annually at QC sessions using the water saturated air technique.

14.8 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 according to manufacturer's guidelines. 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.

14.9 Nutrients and Fecal Indicator Bacteria

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 and consumables are checked for their expiration date and replaced annually according to manufacturer's instructions.

14.10 Toxicity

ASTM E1924 Toxicity Assessment requires the use of live biological test kits as well as the QwikLite 200 Biosensor System (electronic instrument). The instrument does not require calibration as the "negative control" or reference is established with the initial sample to be tested. The instrument should be checked for proper connections and ensure power indicators are showing power is "on".

During the testing process, air is forced into the sample to induce stirring and agitation. Should the turbulence from this process be strong enough to expel liquid from the sample cartridge, a clean, absorbent paper towel should be used to remove this liquid. With the instrument's lid raised, any moisture on the floor of the chamber, or any droplet on the nipple in the roof

of the instrument, should be wiped. In the unlikely event of any droplets reaching the clear "optical window" in the light tight chamber, this area should also be wiped dry.

After testing, the QwikLite 200 BioSensor instrument should be inspected for any water, wiped dry, and the lid left open for a few hours to allow air circulation and completed evaporation of any moisture.

The above inspection and maintenance will ensure accurate light tight seal, air agitation process, and optical measurements.

14.11 Dissolved Metals

Analytical measurement equipment (inductively coupled plasma mass spectrometer (ICP-MS) will be checked for operation in accordance with the manufacturer's specifications before each analysis. This includes vaccum pressure checks, routine replacement of sampling and skimmer cones, peristaltic pump tubings, spray chambers, nebulizers, and plasma torch. All equipment will be inspected before each analysis.

Before each analysis, the instrument will be tuned by running the tuning solution and conducted mass calibration prior to running samples.

If tuning is out of the range set by the instrument manufacturer, the QA Officer will check all parts of the instrument and reassess the quality of tuning solution. Then follow the recommended operating conditions provided by the manufacturer to optimize the instrument until the tuning is within the specifications.

15. Instrument/ Equipment Testing, Inspection and Maintenance

Table 19 - Testing, inspection, maintenance of sampling equipment and analytical instruments

Equipment / Instrument	*Maintenance Activity, Testing Activity or Inspection Activity*	*Responsible Person*	*Frequency*	*SOP Reference*
ICP- MS	*Parts inspection*	*SDSU QA Officer*	*before each set of sample use*	*Manufacturer's specifications*
1 Toxicity cartridge, with 6 new cuvettes for each sample	*Parts inspection*	*Coastkeeper QA Officer*	*before each set of sample use*	*Assure Controls Inc. S.O.P. ASTM E1925*
5Ml or 10mL pipette with new pipette tips for each sample	*Parts inspection*	*Coastkeeper QA Officer*	*before each set of sample use*	*Assure Controls Inc. S.O.P. ASTM E1925*
Coastkeeper field sampling kits with Hach probes, collection containers, gloves, etc.	*Parts and completeness inspection*	*Coastkeeper QA Officer*	*before each sampling event*	*Coastkeeper S.O.P.*
Nautilus field	*Parts and*	*Nautilus QA Officer*	*before each sampling event*	*Nautilus S.O.P.*

sampling kits with Hach probes nutrient field tests, collection containers, gloves, etc.	*completeness inspection*			

The Coastkeeper QA Officer will inspect all instruments and testing equipment and record maintenance in a log. 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(reagent lot numbers), and any problems noted with instruments, samplers, or reagents. The QA Officer will also be responsible for maintaining an inventory of spare parts (batteries, bulbs, etc.) in the laboratory.

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. Digital thermometers are checked to see if they are clean and in good working order.

15.2 Dissolved oxygen

Dissolved Oxygen Meters: For Coastkeeper, dissolved oxygen meters are cleaned and checked to see that they are in good working order. The black polystyrene coating on the Luminesence Dissolved Oxygen sensor is checked monthly. According to manufacturer's specifications, after an initial calibration, additional calibrations are not required for the Hach IntellicalCAL probe. To maintain best performance Hach probes will be calibrated twice annually at QC sessions using the water saturated air technique.

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 according to manufacturer's guidelines. 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 Nutrients and Fecal Indicator Bacteria

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 and consumables are checked for their expiration date and replaced annually according to manufacturer's instructions.

15.5 Toxicity

ASTM E1924 Toxicity Assessment requires the use of live biological test kits as well as the QwikLite 200 Biosensor System (electronic instrument). The instrument does not require calibration as the "negative control" or reference is established with the initial sample to be tested. The instrument should be checked for proper connections and ensure power indicators are showing power is "on".

During the testing process, air is forced into the sample to induce stirring and agitation. Should the turbulence from this process be strong enough to expel liquid from the sample cartridge, a clean, absorbent paper towel should be used to remove this liquid. With the instrument's lid raised, any moisture on the floor of the chamber, or any droplet on the nipple in the roof of the instrument, should be wiped. In the unlikely event of any droplets reaching the clear "optical window" in the light tight chamber, this area should also be wiped dry.

After testing, the QwikLite 200 BioSensor instrument should be inspected for any water, wiped dry, and the lid left open for a few hours to allow air circulation and completed evaporation of any moisture.

The above inspection and maintenance will ensure accurate light tight seal, air agitation process, and optical measurements.

15.6 Dissolved Metals

Analytical measurement equipment (inductively coupled plasma mass spectrometer (ICP-MS)) will be checked for operation in accordance with the manufacturer's specifications before each analysis. This includes vaccum pressure checks, routine replacement of sampling and skimmer cones, peristaltic pump tubings, spray chambers, nebulizers, and plasma torch. All equipment will be inspected before each analysis.

Before each analysis, the instrument will be tuned by running the tuning solution and conducted mass calibration prior to running samples.

If tuning is out of the range set by the instrument manufacturer, then check all parts of the instrument and reassess the quality of tuning solution. Then follow the recommended operating conditions provided by the manufacturer to optimize the instrument until the tuning is within the specifications.

16. Instrument Calibration / Standardization and Frequency

Instruments will be calibrated and reagents checked against standards according to the following schedule by the Coastkeeper QA Officer. Standards will be purchased from a chemical supply company. 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. The frequency of calibration is described in Table 20, 21 and 22.

For equipment, the calibration will be conducted before and after each sampling event. Calibration will be against certified standards and carried out by trained analysts. All calibration will be documented in equipment logbook. For laboratory instruments, means control charts will be maintained for each instrument showing the average, upper and lower warning levels (WL), and upper and lower control levels (CL). Common practice is to use +2s and +3s limits for the WL and CL, respectively. Where "s" represents standard deviations. Results will be entered on the chart each time a laboratory control standard (LCS) is analyzed. The following actions will be taken during the analysis:
If one measurement exceeds a CL, repeat the analysis immediately. If the repeat is within the CL, continue analyses; if it exceeds the CL, discontinue analyses and correct the problem.

Deficiencies will be documented in the calibrations records with the date and instrument ID.

If two out of three successive points exceed a WL, analyze another sample. If the next point is less than WL, continue analyses; if next point exceeds WL, discontinue analyses and correct the problem.
Extensive details on control chart are available in Standard Methods for the Examination of Water and Wastewater, 1999.

Table 20 - Chemical Instrument Calibration and Frequency by Coastkeeper

Conventional Water Quality Parameters		
Equipment Type	**Calibration Frequency**	**Standard or Calibration Instrument Used**
Thermometric (Temperature)	Every 6 months	NIST calibrated or certified thermometer
Dissolved Oxygen meter	During inter-calibration events (twice a year)	At a minimum, water saturated air, according to manufacturer's instructions.
pH	Every day of analysis	pH 7.0 buffer and one other standard (4 or 10)
Conductivity	Every sampling day	Conductivity standard and distilled water
Nutrients (using colorimeters or spectrophotometers**)**		
Equipment type	**Calibration Frequency**	**Standard Used**
Nitrate – Hach DR-3800	During inter-calibration events (twice a year)	Nitrate standard
Phosphate– Hach DR-3800	During inter-calibration events (twice a year)	Phosphate standard
Ammonia (NH_4) – Hach DR-3800	During inter-calibration events (twice a year)	Ammonia Nitrogen standard

QwikLite 200 BioSensor (Toxicity)	ASTM E1924 Toxicity Assessment requires the use of live biological test kits as well as the QwikLite Biosensor System (electronic instrument). The instrument do not require calibration as the "negative control" or reference is established with the initial sample to be tested. At a minimum, one (1) control is to be used for every five (5) samples to be tested. .	

Table 21 - Bio-assessment Chemistry Instrument Calibration and Frequency by Nautilus

Conventional Water Quality Parameters		
Equipment Type	**Calibration Frequency**	**Standard or Calibration Instrument Used**
Thermometric (Temperature)	Every 6 months	NIST calibrated or certified thermometer
Dissolved Oxygen		
pH meter	Every day of analysis	pH 7.0 buffer and one other standard (4 or 10)
Conductivity meter	Every day of analysis	Conductivity standard and distilled/de-ionized water

Table 22 - Metal Analysis Instrument Calibration and Frequency by SDSU

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
ICP-MS	Agilent 7500 ICP-MS ChemStation (G1834B) Operator's manual	Chapter 4 Tuning for sensitivity	Every day of analysis	Kayo Watanabe

17. Inspection / Acceptance Requirements

Upon receipt, buffer solutions, standards, and reagents used in the field kits will be inspected by the Coastkeeper QA Officer 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 be determined by providing the reagent lot number to the manufacturer. Reagent replacement dates are noted in the maintenance log.

17.1 Toxicity Required Supplies, Consumables, and Certificates of Authenticity

Prepared and packaged marine plankton (dinoflagellates in 4.0mL capacity cuvettes) are needed for every water sample to be tested. The six cuvettes are filled with a uniform solution of plankton cells, and provide a sufficient population for the measurement process. In the event of non-uniform or uneven cell distribution into the cuvettes, sufficient measurable light output for inhibition to be measured can still be achieved with 75% of the standard uniform cell solution.

Mixing containers (50mL) are required for every control and water sample prepared for testing. For example, if twenty (20) sites are to be tested, and three (3) controls are to be utilized, then a total of 23 mixing tubes are needed.

The authenticity of biological cell cultures or aquatic research organisms produced by Assure Controls, Inc. will be provided by a certification if required for documentation. The certification provides these facts about the biological cultures for a specific shipment: culture and cell type, preparation and shipping information, intended use, physiological mode of operation, and the measurement process.

18. Data Acquisition Requirements

18.1 Professional Analytical Data

Only certified analytical laboratories laboratories (with approval of State and/or Regional Board staff) will be used for quality assurance checks and analysis of field samples.

18.2 Geographical Information/ Mapping

USGS maps will be used to verify watershed boundaries and river courses. Additional information on distribution of natural resources will be obtained from the National Park Service and the California Dept of Fish & Game'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 meta-data and any information on data limitations. This information will be maintained with the data files.

Coastkeeper will use ARC/GIS data layers in the presentation of monitoring data on its web page. These data layers will be obtained from San Diego Association of Governements (SANDAG), SanGIS and California Spatial Information Library (*CaSIL*). In addition, Coastkeeper creates GIS layers from field data collected by staff.

Coastkeeper will use the following measures to judge whether data are acceptable for their intended uses:

- Coastkeeper checks for annual updates of source data.
- The metadata of the data is thoroughly checked and converted to a standard projection format (North American Datum 1983).
- Additions, deletions and changes to spatial data and its attributes are logged.
- The positional accuracy of data is checked by comparing with results obtained using online mapping tools

19. Data Management

Data will be maintained as established in section 9 of this QAPP, and the Coastkeeper standard operating procedures for Sample Intake and Analysis (Appendix 5). Project data will also be formatted for upload into the SWAMP compatible database.

Project laboratories and contractors will report their results to the Coastkeeper QA Officer. 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 by email for review prior to submission in the quarterly reports to the San Diego County Water Authority.

The Coastkeeper QA Officer 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 comparable with SWAMP database. 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 measurement quality objectives have been met, data analysis will be performed.

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

The following individuals will be responsible for data management: Travis Pritchard and Soumya Chennapragada, Coastkeeper.

1. Travis Pritchard, or current Coastkeeper QA Officer and Laboratory Coordinator, is responsible for completeness of the data and reporting of data.
2. Soumya Chennapragada , or current Coastkeeper Watershed Program Analyst and Data Management Coordinator, will be responsible for entering the field and laboratory data into database.
3. John Rudolph, Nautilus, is responsible for completeness of the bio-assessment data, reporting and entering the data into a database, and sending that data to Coastkeeper.
4. Clay Clifton, or current Coastkeeper Local Project Sponsor Manager, is responsible for reviewing the data, quality assurance and reporting of data to SDCWA.
5. Dr. Richard Gersberg, SDSU, is responsible for completeness of the metal analysis data, reporting and entering the data into a database, and sending that data to Coastkeeper.
6. Morgan Justice-Black, ILACSD, is responsible for completeness of the collected trash data, reporting and entering the data into a database, and sending that data to Coastkeeper.

For toxicity tests, the Coastkeeper QA Officer will store the tests results as a computer file. The file can be transferred to other databases. The data can be manipulated in standard statistical, graphic, or presentation software programs.

For dissolved metal analysis, the data management coordinator for San Diego State University will review the analytical data sheets and enter the data deemed acceptable by the Monitoring Program leader and the technical advisors. Upon entering the data, the data management coordinator will sign and archive the analytical data sheets. Data will be entered into a spreadsheet (MS Excel) or a database (MS Access) in a way that will be compatible with SWAMP database. 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.

20. Assessment and Response Actions

Review of all field and data activities is the responsibility of the Coastkeeper QA Officer, with the assistance of the technical advisory committee. Volunteer teams will be accompanied by a Coastkeeper trained lab fellow, who will act as a field auditor at least 3 times a year. If possible, volunteers in need of performance improvement will be retrained on-site. All volunteers must attend a refresher course offered by Coastkeeper once a year after their initial training. If errors in sampling technique are consistently identified, retraining may be scheduled more frequently.

Within the first three months of the monitoring project, the San Diego Regional Water Quality Control 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.

If an audit discovers any discrepancy, Coastkeeper's QA Officer will discuss the observed discrepancy with the appropriate person responsible for the activity (see organization chart). The discussion will begin with whether the information collected is accurate, what were the cause(s) leading to the deviation, how the deviation might impact data quality, and what corrective actions might be considered.
The Coastkeeper QA Officer has the power to halt all sampling and analytical work by both Coastkeeper and contract Laboratories if the deviation(s) noted are considered detrimental to data quality.

22.1 Toxicity assessment data
ASTM E1924 Toxicity Assessment data is expressed as an Indexed value (scale of 1 to 10) for ease of interpretation and consistent comparisons with successive tests done over time. The "Biological Index Number" (BIN) is a quantified rapid characterization; or screening test result.

The BIN indicates both the presence and severity of biologically harmful substances in a tested sample when compared to the Control. The BIN is a mathematically calculated value indicating the toxic or biologically harmful effects of the chemical constituents of a water sample. A Control group for all testing is used as the 100% or non-effected biological group. All other dosed, tested, and measured samples are compared to this reference group.

As an Index, the formula is
100 - ((Sample Value/Control Value) x 100)/10 = Biological Index Number

A high BIN indicates concentrations of the chemical constituents at biologically harmful levels and potentially critically toxic. A low BIN indicates low levels of chemical constituents and not biologically harmful.

The BIN values are indications of severity, with the general guidance of the following basic categories:

1 to 3 Normal Response (no evidence of harmful levels of toxicants in the sample)
4 to 6 Review Further (some indication of toxicants in the sample)
7 to 10 Effect Detected (toxicants present at biologically harmful levels in the sample)

For each of the categories, it should be understood that "if these concentrations continue to be present" is part of the test result.

Example: "Effect Detected: Toxicants present at biologically harmful levels in the sample, which, if these concentrations continue to be present, are toxic."

These categories are not defined by ASTM requirements or standards. The levels may be modified or interpreted by the user (Coastkeeper) based on other data, site history, etc. The levels may be modified by each test at the discretion of the user (Coastkeeper).

21. Reports

The Coastkeeper QA Officer 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. Clay Clifton, Coastkeeper Project Manager will report the project data in the Quarterly Reports to the SDCWA 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. See Figure 3for Project Schedule timelines.

22. Data Review, Validation and Verification

Data sheets or data files are reviewed quarterly by the Coastkeeper QA Officer 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.

Laboratory validation and verification of the data generated is the responsibility of the laboratory. The laboratory QA Officer will maintain analytical reports in a database format as well as all QA/QC documentation for the laboratory. The procedure for verification and validation of field data is specified in the SWAMP Standard Operating Procedure for Field Data Verification of the SWAMP Database (SWAMP 2004). The Coastkeeper QA Officer or Coastkeeper Local Project Sponsor Manager shall review all data packages received for adherence to guidelines set forth in this QAPP. The Coastkeeper QA Officer will review Chain of Custody (COC) forms to ensure adherence to collection, transport, and receipt requirements. Laboratories will conduct a 100% raw data versus electronic data audit before delivering results to the Local Project Sponsor Manager, and all errors will be corrected.

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 Coastkeeper QA officer 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 we may re-train monitors until their performance is acceptable. It is the responsibility of the Coastkeeper QA Officer or Coastkeeper Project Manager to re-train volunteers until performance is acceptable.

Laboratory validation and verification of the data generated is the responsibility of the Coastkeeper laboratory. The laboratory manager will maintain analytical reports in a database format as well as all QA/QC documentation for the laboratory. The procedure for verification and validation of field data is specified in the SWAMP Standard Operating Procedure for Field Data Verification of the SWAMP Database (SWAMP 2004). The Coastkeeper QA Officer shall review all data packages received for adherence to guidelines set forth in this QAPP. The Project QA officer will review Chain of Custody (COC) forms to ensure adherence to collection, transport, and receipt requirements. Laboratories will conduct a 100% raw data versus electronic data audit before delivering results to the Project Director, and all errors will be corrected.

23.1 Toxicity data

The nature of rapid characterization or toxicity screening test methods (as defined for ASTM E1924 in this instance) is the reliance on other data and management oversight. The easiest way to verify or validate any toxicity test results would be a repeat test of that sample (if kept under storage conditions meeting the requirements of the QAPP).

24. Reconciliation with MQOs

The Coastkeeper QA Officer working with the monitoring leader(s) will review data quarterly to determine if the data quality objectives (MQOs) have been met. If data do not meet the project's specifications, the following actions will be taken. First, the Coastkeeper QA Officer 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. He/ she will suggest corrective action. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the Coastkeeper QA Officer will review the MQOs and determine if the MQOs are feasible. If the specific MQOs are not achievable, they will determine whether the specific MQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to MQOs 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 MQOs are entered into the database. Archived data can also be entered.

Uncertainty of validated data will be evaluated by identifying statistical outliers, cross referencing the data points against all others for that monitoring event, and historic data for the same site, and visual cues when the data is graphed.

Limitations on data will be reported by use of a data field for qualifiers (>, <, N/A, NS, =, etc.) for each result.

List of Appendices

Appendix 1: Quality Control Forms

1.1 Data Quality Form: Accuracy

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 °C								
Dissolved Oxygen (mg/l)								
pH standard units								
Conductivity (umhos/cm)								

Comments:

1.2 Data Quality Form: Completeness

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 °C				
Dissolved Oxygen (mg/l)				
pH standard units				
Conductivity (umhos/cm)				

Comments:

1.3 Data Quality Form: Precision

Data Quality Form: Precision **Quality Control Session**

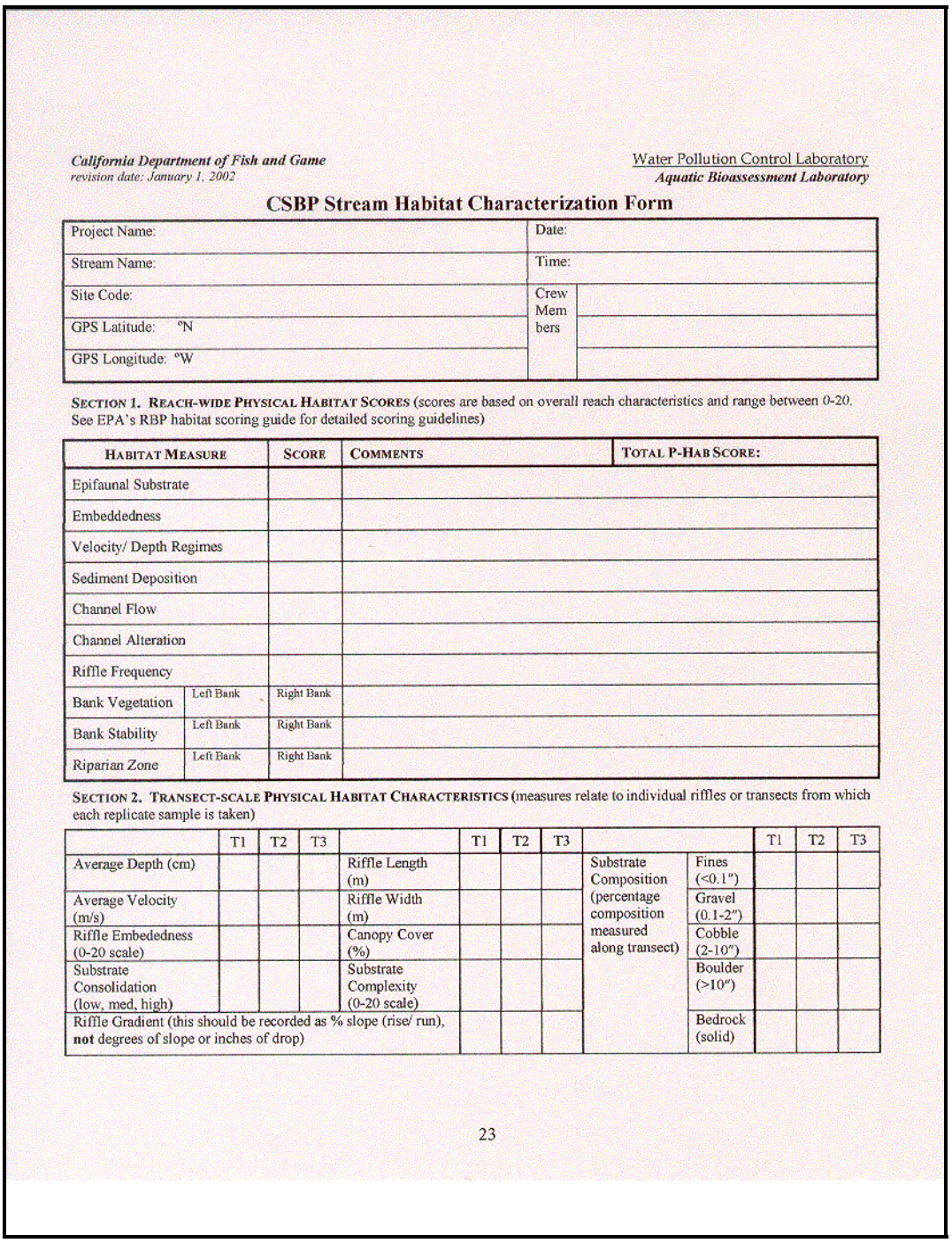
Monitoring Group Name	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

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 °C							
Dissolved Oxygen (mg/l)							
pH standard units							
Conductivity (umhos/cm)							

Comments:

Appendix 2: Data Sheets

2.1 California Stream Bio-assessment Procedure (CSBP) Stream Habitat Characterization Form



California Department of Fish and Game
revision date: January 1, 2002

Water Pollution Control Laboratory
Aquatic Bioassessment Laboratory

CSBP Stream Habitat Characterization Form

Project Name:		Date:	
Stream Name:		Time:	
Site Code:		Crew Members	
GPS Latitude: °N			
GPS Longitude: °W			

SECTION 1. REACH-WIDE PHYSICAL HABITAT SCORES (scores are based on overall reach characteristics and range between 0-20. See EPA's RBP habitat scoring guide for detailed scoring guidelines)

HABITAT MEASURE		SCORE	COMMENTS	TOTAL P-HAB SCORE:
Epifaunal Substrate				
Embeddedness				
Velocity/ Depth Regimes				
Sediment Deposition				
Channel Flow				
Channel Alteration				
Riffle Frequency				
Bank Vegetation	Left Bank	Right Bank		
Bank Stability	Left Bank	Right Bank		
Riparian Zone	Left Bank	Right Bank		

SECTION 2. TRANSECT-SCALE PHYSICAL HABITAT CHARACTERISTICS (measures relate to individual riffles or transects from which each replicate sample is taken)

	T1	T2	T3		T1	T2	T3			T1	T2	T3
Average Depth (cm)				Riffle Length (m)				Substrate Composition (percentage composition measured along transect)	Fines (<0.1")			
Average Velocity (m/s)				Riffle Width (m)					Gravel (0.1-2")			
Riffle Embededness (0-20 scale)				Canopy Cover (%)					Cobble (2-10")			
Substrate Consolidation (low, med, high)				Substrate Complexity (0-20 scale)					Boulder (>10")			
Riffle Gradient (this should be recorded as % slope (rise/ run), **not** degrees of slope or inches of drop)									Bedrock (solid)			

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SECTION 3. CHEMICAL CHARACTERISTICS (one record per site)

CHARACTERISTICS

Specific Conductance (µmhos/cm@25°C)		pH	
Water Temperature (°C)		Salinity (ppt)	
DO (mg/L)		Alkalinity	

SECTION 4. REACH PHYSICAL

Reach Length (m)
Photo Exposures

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2.2 Physical Habitat Scoring Document

Habitat Parameter	Category Category			
	Optimal **Optimal** O	Suboptimal **Suboptimal**	Marginal **Marginal** m	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% (50% for low gradient streams) of substrate favorable for epifaunal colonization and fish cover; most favorable is a mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% (30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% (10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% (10% for low gradient streams) stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2a. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2b. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or submerged vegetation.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3a. Velocity/ Depth Regimes	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3b. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small- deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7a. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7b. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left of right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___**(LB)**	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___**(RB)**	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one- half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.

SCORE ___(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only *minimally*.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

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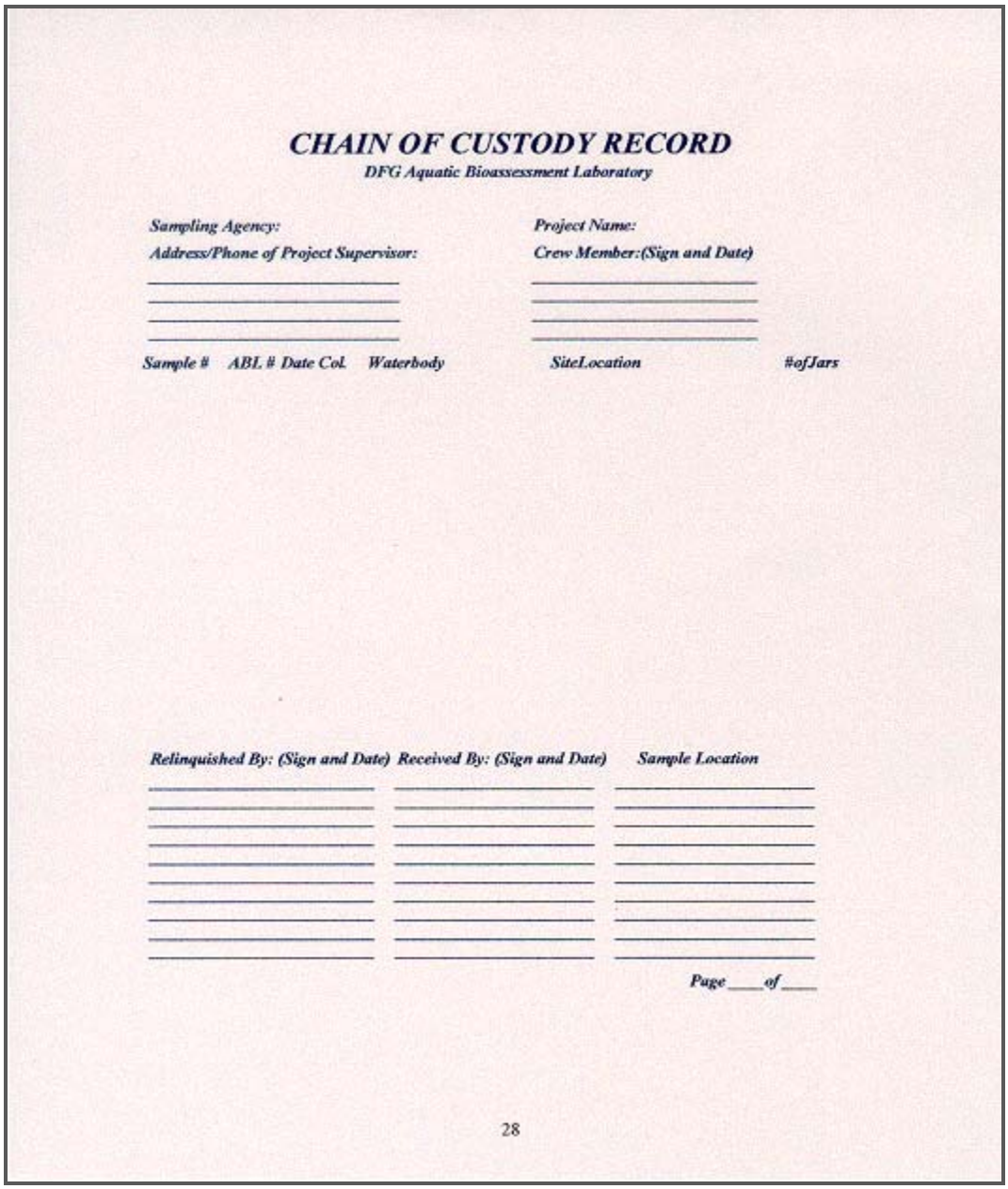
2.3 Chain of Custody Records



CHAIN OF CUSTODY RECORD

DFG Aquatic Bioassessment Laboratory

Sampling Agency: *Project Name:*

Address/Phone of Project Supervisor: *Crew Member:(Sign and Date)*

Sample # *ABL # Date Col.* *Waterbody* *SiteLocation* *#ofJars*

Relinquished By: (Sign and Date) *Received By: (Sign and Date)* *Sample Location*

Page ___ of ___

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2.4 Water Quality Field Data Sheet

Watershed Monitoring Program Field Data and Observations Sheet

SAN DIEGO COASTKEEPER

City of San Diego • County of San Diego • State Water Resources Control Board's Clean Water Team • San Diego Coastkeeper • San Diego County Water Authority • San Diego Sea to Sea Trail Foundation • San Diego State University • San Diego Stream Team • Sister Schools of San Diego • Southwestern College, Physical Sciences Department • Surfrider Foundation • University of California, San Diego Superfund Basic Research Program • County of San Diego Department of Parks and Recreation • Tijuana River National Estuarine Research Reserve • Golden State Flycasters

SAN DIEGO CITIZEN WATERSHED MONITORING CONSORTIUM

Date_____Sample Collection Time _____ | DOC_ID# :

PLEASE USE ONE SHEET FOR EACH SITE / SAMPLING STATION | Datum

If location is dry or not accessible, please complete this sheet and mark that there is no water | (Dark Grey boxes are for Office Use Only)

Watershed:

Station (Site) ID AND Site Name:

VOLUNTEER MONITORS

TEAM LEADER (list full name & phone #):

1) Phone: ( )

2) 3) 4) 5)

INSTRUMENT ID	PARAMETER	RESULT 1	RESULT 2	RESULT 3	UNITS
	pH				pH units
	Air Temperature				°C °F
	Dissolved Oxygen				mg/L
	Water Temperature				°C °F
	Conductivity				uS/cm mS/cm

Was sample collected from center of stream? Yes / No

If 'No', indicate collection point

Other:

Flow Information:

☐ No flow observed ☐ No Water ☐ No Safe Access

Depth at collection point ft _____ in

Depth #2 (within 5 ft of collection point) ft _____ in

Depth #3 (within 5 ft of collection point) ft _____ in

Notes, Observations, and Comments:

(please include any observations such as odor, amount of trash and composition, equipment problems, wildlife encountered, etc.)

Beneficial Uses:

Please select the 'Beneficial Uses' listed for this site in your folder. Note any other use observed, and number of people, if applicable.

☐ REC1 ☐ REC2 ☐ COMM ☐ AQUA ☐ WARM ☐ COLD ☐ SAL ☐ EST ☐ WET ☐ MAR ☐ WILD

Please provide details / comments based on your observations made of Beneficial Uses:

Do not jeopardize your personal saftey to complete this data sheet.

San Diego Citizen Watershed Monitoring Consortium Field Data and Observation Sheet

Weather Conditions:

Has it rained within the last 72 hours?

YES ☐ NO ☐

(Please Circle)

-- SKY--	-- PRECIPITATION--	-- WIND --
no clouds	none	none
partly cloudy	foggy	breezy
heavy clouds	misty	windy
overcast	rain	blustery

Water clarity	Water Color	
Clear	Yellow	Green
Cloudy	White	
	Brown	

FLOATABLES

None ☐ Trash ☐ Bubbles/foam ☐ Sheen ☐

Fecal Matter ☐ Other

DEPOSITS

None ☐ Sediment/Gravel ☐ Fine Particles ☐ Stains ☐

Oily Deposits ☐ Other

VEGETATION

None ☐ Limited ☐ Normal ☐ Excessive ☐

Other

BIOLOGY

None ☐ Insects ☐ Algae ☐ Snails / Fish ☐

Mussels / Barnacles ☐ Other

OBSERVATIONS OF WATER POLLUTION OR ILLEGAL DISCHARGES

Address or intersection of observed pollution or discharge:
(Ex. Park Blvd & Market St. or 9449 Friars Road)

Estimated time frame of discharge

	YES	NO
1. Did you observe evidence of a past discharge (staining, residue, odors)	☐	☐
2. Did you witness someone or a business is in the process of washing, disposing, or dumping something other than water to the street, curb, storm drain, or surface water?	☐	☐

If "Yes" to Question 2, please contact the County Stormwater hotline at 1(888) 846-9800 to report a storm water complaint.

3. If "No" to Question 1 and 2, please use the Notes box to the right to describe what you observed:

4. What was the substance observed in Question 1 or 2?

Automotive fluids☐ Sewage☐ Other chemicals☐ Foam ☐

Herbicides/Pesticides☐ Paint☐ Other _____

5. Did you observe any evidence of sewage? *(Tampon applicators, condoms, grey paper etc)*	☐	☐
6. Did you observe any agency responding or investigating the event?	☐	☐
If 'Yes', what agency? _____		
7. Did you take any pictures? *(Please see disclaimer and contact Coastkeeper staff when returning samples)*	☐	☐

Notes and Observations

8. Did you observe this in a river/creek☐, storm drain outlet/inlet☐, drainage channel☐, alley/street☐, gutter☐ ,other_____

9. Estimate the flow rate of the discharge. (Imagine a hose filling a 5 gallon paint bucket. How much time is required to fill it? I.e., filling ½ of a 5 gallon bucket in a minute is about 2.5 gallons/minute (gpm))

<5gpm ☐, 5 gpm ☐, 10 gpm ☐, >10 gpm ☐ or N/A ☐

10. Is the discharge or pollution coming from a residence ☐ ,business ☐, or unknown ☐

11. Business name or license number or vehicle license plate number : _____

Disclaimer: Please do not put any physical [illegible] or hazardous substances in the [illegible]

Do not jeopardize your personal safety to complete this data sheet.

2.5 Instrument Calibration Forms

Coastkeeper Water Quality Lab – DO meter calibrations
CALIBRATION RECORD - DO METERS (Date)

#	SERIAL #	ID #	ELECTROLYTE EXPIRATION DATE	DATE	By	MEMBRANE QUALITY	NOTES
1	61936433	DO-GSF-001					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No
2	61936437	DO-GSF-002					- initially reading ___ - tip has one crack(8mm) - calibration worked? Yes / No
3	61873108	DOM-GSF-003					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No
4	72402033	DOM-GSF-004					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No
5	72402040	DOM-SDCK-001					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No
6	72345599	DOM-SDCK-002					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No
7	72402037	DOM-SDCK-003					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No
8	72402033	DOM-SDCK-004					- initially reading ___ - excellent condition / no cracks - calibration worked? Yes / No

Coastkeeper Water Quality Lab – pH meter Calibrations

CALIBRATION RECORD - pH METERS ( )

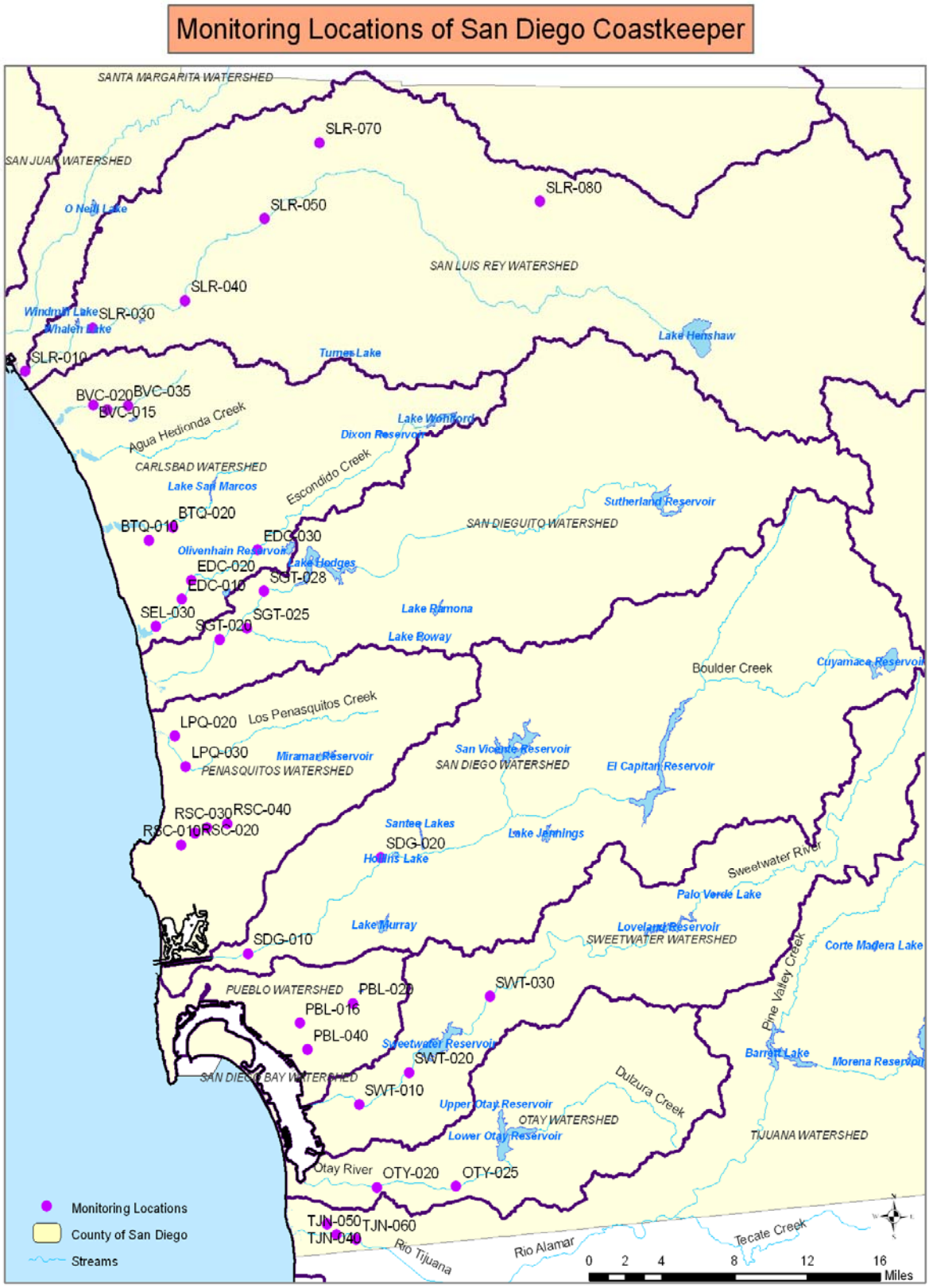
#	SERIAL #	ID #	CURRENT READING (pH)	CALIBRATED FOR	CALIBRATION DATE	By	READING AFTER CALIBRATION (pH)	DRIFT SINCE LAST CALIBRATION	LOT # / NOTES
1	1010433	PHM-GSF-001 (pH Testr 30)		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
2	1189659	PHM-GSF-002 (pH Testr 30)		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
3	1189637	PHM-GSF-003 (pH Testr 30)		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
4	1189678	PHM-GSF-004 (pH Testr 30)		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
5	1010434	PHM-SDSU-0001		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
6	1010429	PHM-SDSU-0006		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
7	1000436	PHM-SDSU-0013		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
8	1000433	PHM- SDSU-0016		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
9	1000535	PHM-SDSU-0018		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:
10	1010431	PHM-SDSU-0019		pH 4: 4.01 pH 7: 7.00 pH 10: 10.01					pH 4: pH 7: pH 10:

Coastkeeper water Quality Lab – ECM Calibrations

CALIBRATION RECORD - CONDUCTIVITY METERS - ( )

#	SERIAL #	ID #	CURRENT READING (µS or S)	CALIBRATED FOR	CALIBRATION DATE	By	READING AFTER CALIBRATION (µS)	Lot # / NOTES
1	121570	ECM-SDCK-001		1,413 µS				Lot #
2	121526	ECM-SDCK-002		1,413 µS				Lot #
3	121555	ECM-SDCK-003		1,413 µS				Lot #
4	121595	ECM-SDCK-004		1,413 µS				Lot #
5	121691	ECM-SDCK-005		1,413 µS				Lot #
6	114257	ECM-GSF-002		1,413 µS				Lot #
7	114194	ECM-GSF-003		1,413 µS				Lot #
8	114249	ECM-GSF-004		1,413 µS				Lot #
9	107135	ECM-SDSU-0001		1,413 µS				Lot #
10	107157	ECM-SDSU-00071		1,413 µS				Lot #

Appendix 3: Map



Appendix 4: References Cited

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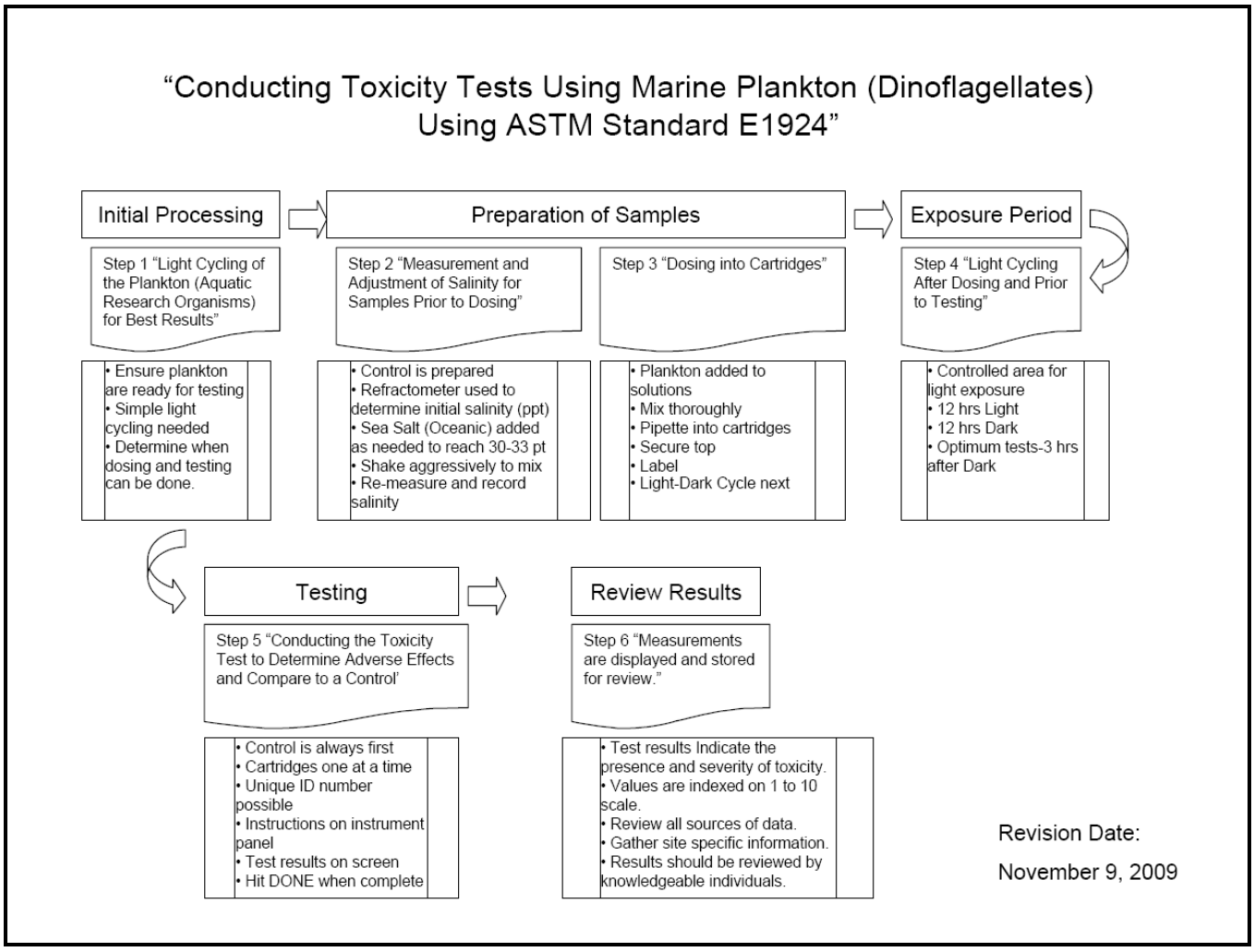
Appendix 5: Coastkeeper Field sample collection S.O.P. (*Separate attachment as pdf file*)

Appendix 6: Assure Controls, Inc. S.O.P ASTEM E1925 for Toxicity testing of plankton



Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) **Following** ASTM Standard E1924"

Description:

This procedure describes the protocol, methods, and endpoint for using sensitive marine plankton (dinoflagellates) as the indicator organism during a live species testing of either freshwater or marine samples. Testing includes a dosing step where a collected water sample(s) (approximately 50ml required) is combined with a prepackaged amount of Dinoflagellates. The mixture is then dispensed into a cartridge and undergoes a predetermined light and dark exposure period, usually 24 hours. Following this, the cartridge will then be inserted into an instrument, which can measure the natural bioluminescent light production of the dinoflagellates. This testing utilizes the bioluminescence, a burst of light resulting from enzymes, produced by the marine organism (Dinoflagellates).

Endpoint:

Toxicity is determined by measuring the light reduction from the bioluminescent marine dinoflagellates after they have been exposed to possible toxicants. The light emitted is directly related to toxic stress and decreases rapidly (usually within 24 hours). A Control group for all tests performed is used as the 100% or non-effected biological group. All other dosed, tested, and measured samples are compared to this reference group. A calculated estimate indicating the toxicity or biologically harmful effects of the chemical constituents of a water sample is derived.

The test result is expressed as an Biological Indexed Number (scale of 1 to 10) for ease of interpretation and consistent comparisons with successive tests done over time. A high BIN indicates concentrations of the chemical constituents at biologically harmful levels and potentially critically toxic. A low BIN indicates low levels of chemical constituents and not biologically harmful.

Toxicity is due to harmful levels of inorganic compounds, organic compounds or heavy metals.

Bacterial contamination of water is NOT detected with this test method.

Proficiency Required:

The person(s) conducting this test should be familiar with general laboratory equipment and procedures. Because this test will detect very small levels of chemicals, cross contamination should be avoided at all times. Clean laboratory procedures should be followed and because toxicity may exist in the sampled water, gloves should be worn during this test.

Documentation of scientific data and terminology is required.

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Required Supplies and Equipment:

a. Water to be tested should be collected and transported to the testing location as soon as possible. Follow water sampling and transportation protocols in the QAPP.

b. Protective eyewear, gloves and lab coat should be worn when handling water samples.

c. Care should be taken with each sample tested by utilizing newly packaged or original supplies to avoid contamination.

d. Prepared and packaged marine plankton (dinoflagellates in 4.0mL capacity cuvettes) are needed for every water sample to be tested.

e. At least one (1) biological control of the marine plankton (dinoflagellates in 4.0mL capacity cuvettes) is required for every 5 samples tested. For example, if ten (10) sites are to be tested, at least two (2) controls are required. If thirty (30) sites are to be tested, then at least six (6) controls, etc. Each control is a prepared and packaged 4.0mL capacity cuvette.

f. A predetermined location (ie. shelf or cabinet) or a container for controlled Light and Dark exposure (12 hours each) is required. Indirect light of approximately 40 to 60 watts (normal office or reading level light) is sufficient. Do NOT use direct sunlight in the Light-Dark phases.

g. A refractometer (or hydrometer) is needed to measure salinity of the water to be tested.

h. Aquarium grade or laboratory supply grade Sea Salt or Oceanic Salt (not iodized table salt) is required if the water samples are freshwater or below 30 ppt when measured. The salt will be used as a buffer to raise the mixed solution to 30-33 ppt prior to testing.

i. A pipetter of 5mL or 10mL volume capacity is required. Clean, new, pipette tips are necessary for each sample.

j. Mixing containers (50mL) are required for every control and water sample prepared for testing. For example, if twenty (20) sites are to be tested, and three (3) controls are to be utilized, then a total of 23 mixing tubes are needed.

k. One new (clean) cartridge containing (6) six new cuvettes and a secured top are required for any water sample tested.

l. QwikLite 200 Biosensor System is the instrument used to measure the light output from all samples to be tested. The instrument has semi-automated software controls for the test and measurement procedure.

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Initial Processing:

Following any Chain of Custody or other documentation required per the established QAPP, the water samples should be processed through this test procedure as soon as possible. Water samples should be kept at 38-40 C if stored.

Follow the established QAPP for labeling or data input requirements.

Data collection sheets or computer data input forms per the established QAPP are required prior to testing.

Sample coordinator obtains sample(s) and places them in storage location under temperature verification.

Appropriately label all samples, mixing containers, cartridges and other materials to ensure immediate identification.

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Preparation of Samples:

Step 1: Light Cycling of the Plankton (Aquatic Research Organisms) for Best Results

Description: The plankton used in the ASTM E1924 test method (dinoflagellates) are photosynthetic and need exposure to moderate light each day to produce their own food and to energize their bioluminescent capability. A daily "12 hour light-12 hour dark" cycle is recommended for best results. After one or two of these light cycles, the sensitive unicellular organisms are ready to be used.

1.) An area or container for controlled Light and Dark exposure (12 hours each) is required. Indirect light of approximately 40 to 60 watts (normal office or reading level light) is sufficient.

2.) Do NOT use direct sunlight in the Light-Dark phases.

3.) A timer is helpful to ensure proper light control. During the Dark phase (lights OFF), the area should be as light tight as possible, simulating night.

4.) After the Dosage of Samples is completed (see Step 3), a predetermined exposure period (normally 24 hours) provides the opportunity for the organisms to react to any contaminants in the water.

5.) For best results, the Testing (see Step 4) should be done approximately 3-5 hours AFTER the 12 hour Dark phase has started.

Example: Lights ON at 8pm for 12 hours, lights OFF at 8am, test of the water samples at 11am or 12 noon.

This schedule can be modified for any desired testing time. Determine the time when testing will be done (i.e.. 2pm), the Dark phase should start 3 hours earlier (i.e. 11am). Therefore the Light cycle is 12 hours as well (i.e. 11pm).

Absolute precision in the 12 hours for light and dark is not critical, it can vary by 1.5 hours and still be optimal.

Test results MUST be conducted in the period 3 to 6 hours after the Dark phase. This period provides the best light production.

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Preparation of Samples:

Step 2: Measurement and Adjustment of Salinity for Samples Prior to Dosing

Description: Freshwater, marine and brackish water samples can be tested with ASTM Standard E1924 using the aquatic research organisms (dinoflagellate plankton). The water sample(s) need to be checked for their salinity levels and adjusted to have a concentration of 30 to 33 ppt salinity.

Note: In ASTM E1924 the use of a Control is required as it is the basis for comparing the results of all other samples. The first samples tobe (Delete) prepared should always be the Control samples, followed by all other collected water samples to be dosed and tested.

1.) Prepare a Control solution: Fill a clean mixing container (50mL) with 22.5mL fresh water (deionzed, not tap water). Using a refractometer (or hydrometer), determine the salinity of the water. If artificial seawater is available, this is preferred. Use 22.5ml volume for all testing. A separate Control is recommended for every five samples that will be tested.

2.) Determine the salinity of the water sample using the refractometer; record the salinity. (Note: test that the refractometer reads zero with a purely freshwater sample to ensure accuracy of salinity readings.)

3.) The 22.5mL sample must be in a range of 30 to 33ppt. Add sea salt in small amounts to raise the salinity as necessary. Shake mixing tube aggressively to mix thoroughly.. Use the refractometer to check salinity with each change.

5.) Complete a final salinity reading of the 22.5mL sample; record final salinity.

6.) Repeat 2-5 above for all other water samples to be tested.

7.) Follow labeling and documentation requirements so that each solution is uniquely and accurately identified.

EPA guidance regarding salinity and toxicity tests: http://www.epa.gov/waterscience/methods/wet/disk1/index.html
See sections 4.4.1, 5.1.1, 6.6.4, 7.2.1, 7.2.3, 7.3.3.
(these are provided at the end of this Standard Operating Procedure for convenience)

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Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Preparation of Samples:

Step 3: Dosing into Cartridges

Description: This step creates a solution that contains the aquatic research organism (dinoflagellates) and the water sample to be tested. The water sample has been checked and adjusted for salinity level in Step 2.

1.) Each sample requires one prepared and plankton package (dinoflagellates in 4.0mL capacity cuvettes). Invert the cuvette several times to get organisms off of the bottom of the cuvette and suspend the cells in the solution. Transfer the entire contents of one prepared and packaged 4.0mL capacity cuvettes) to the mixing tube.

2.) Using a pipetter, take 2-3mL of the solution in the mixing tube containing the sample to be tested and "rinse" the now empty cuvette several times to remove all organisms from the prepared and packaged cuvette. One or two rinsing with 2-3mL of the mixing tube should suffice.

2.) Cap the 50mL mixing tube containing the 22.5mL of the water sample combined with the plankton. Invert 6-8 times to gently mix this solution; do not shake violently as it will affect the plankton.

3.) Obtain appropriately labeled cartridge and remove the secure top (called a "QwikCover").

4.) Pipette 3.25 mL of prepared and mixed 22.5mL solution, from the middle of the 50mL mixing tube, to each of the six cuvettes in the cartridge. Discard the remaining solution in the mixing tube.

5.) Tightly secure the "QwikCover" top, which snaps in place on the six cuvettes in the cartridge and lays completely flat.

6.) Follow labeling and documentation requirements so that each cartridge is uniquely and accurately identified.

7.) Place the dosed cartridges in the location where Light-Dark cycles are maintained. These cartridges will have a predetermined exposure period (normally 24 hours).

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Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Light Cycling After Dosing and Prior to Testing

Step 4: Establish Light-Dark Cycle Based on Exposure Period and Desired Time to Perform Test

Description: As described in Step 1 (Light Cycling of the Plankton for Best Results), proper exposure to another Light-Dark phase, is required to obtain proper bioluminescence from the aquatic research organisms (dinoflagellates). Absolute precision in the 12 hours for light and dark is not critical, it can vary by 1.5 hours and still be optimal. Testing MUST be conducted in the period 3 to 6 hours after the Dark phase. This period provides the best light production.

Equipment: An area or container for controlled Light and Dark exposure (12 hours each) is required. Indirect light of approximately 40 to 60 watts (normal office or reading level light) is sufficient. Do NOT use direct sunlight in the Light-Dark phases. A timer is helpful to ensure proper light control. During the Dark phase (lights OFF), the area should be as light tight as possible, simulating night.

1.) After the Dosing of Samples (see Step 3), a predetermined exposure period (normally 24 hours) provides the opportunity for the organisms to react to any contaminants in the water.

2.) For best results, the Testing (see Step 5) should be done approximately 3-5 hours AFTER the 12 hour Dark phase has started.

Example: Lights ON at 8pm for 12 hours, lights OFF at 8am, test of the water samples at 11am or 12 noon.

This schedule can be modified for any desired testing time of day. Determine the time when testing will be done (i.e.. 2pm), the Dark phase should start 3 hours earlier (i.e. 11am). Therefore the Light cycle is 12 hours as well (i.e. 11pm).

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Testing of Samples

Step 5: Conducting the Toxicity Test to Determine Adverse Effects and Compare to a Control

Description: Toxicity is determined by measuring the light output of the bioluminescent marine dinoflagellates after they have been exposed to possible toxicants in the water samples. The light emitted is directly related to toxic stress and decreases rapidly (usually within 24 hours). A measurement of the light is made with a specialized instrument and the biologically harmful effects of the chemical constituents in the water sample is derived. In this calculation, a Control group for all tests performed is used as the 100% or non-effected biological group. All other dosed, tested, and measured samples are compared to this reference group.

Equipment: QwikLite 200 Biosensor System is the instrument used to measure the light output from all samples to be tested. The instrument has semi-automated software controls for the testing procedure.

1.) Beginning with the Control cartridge, the QwikLite 200 Biosensor instrument is used to measure the light output of the bioluminescent plankton in the prepared solution. The Control MUST be the first cartridge tested, other test results are compared to this Control.

2.) For the testing process, remove the cartridge, ONE at a time, from the controlled light area, Take care to keep the other cartridges in their Dark phase. For example, place a dark cloth over any cartridges that would be exposed to light while waiting to be tested.

3.) Place the Cartridge in the QwikLite 200 instrument, close the lid and follow the on screen controls to begin the testing step. A unique ID number can be input via the display panel for all cartridges. The six cuvettes in the cartridges are automatically stimulated and the light produced via their natural bioluminescence is measured. A status bar indicates progress through this process and a beep sounds when completed. One cartridge takes approximately three (3) minutes to complete the testing process.

Test results are displayed on the instrument panel and will automatically be stored in the electronic memory. If desired, this measurement can be documented manually on a data record sheet.

(steps continued on the next page)

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Testing of Samples

Step 5: Conducting the Toxicity Test to Determine Adverse Effects and Compare to a Control

(steps continued from the prior page)

4.) On the display panel of the QwikLite 200, press NEXT to proceed to another cartridge. Note: Do not press DONE unless you are finished testing all the cartridges you intend to test at this time.

5.) Open the lid of the QwikLite 200 instrument and remove the now tested cartridge. Set this cartridge aside and recycle or dispose of per established or recommended procedures. Use a paper towel to dab any expelled water that may have collected in the basin of the cartridge spindle area.

6.) Repeat the instructions (1, 2, 3, 4 and 5) for the remaining cartridges to be tested.

7.) On the last cartridge of samples to be tested, when the QwikLite 200 instrument indicates (via the status bar and the beep) that the test cycle is complete, the display option labeled DONE should be selected. This will conclude the testing process for the entire series.

Procedure:

"Conducting Toxicity Tests Using Marine Plankton (Dinoflagellates) Using ASTM Standard E1924"

Review Results

Step 6: Measurements of Light Emissions are Displayed on the QwikLite instrument and stored for review

Description: The marine phytoplankton (dinoflagellates) have the ability to produce bioluminescence, a visible blue light, as part of their daily physiological process. Scientific studies and publications have shown that bioluminescence inhibition strongly correlates to reduction of of phototaxis behavior and chlorophyll fluorescence. Inhibition of these functions indicates significant deleterious changes in the physiology of the dinoflagellates. The ASTM E1924 test method is used to detect toxicity in the environment since light reduction is inversely related to the toxicity of the tested sample. The greater the level of toxin the lower the level of light emitted, indicating the plankton are either severely stressed or have died from toxic exposure.

Equipment: QwikLite 200 Biosensor System is the instrument used to measure the light output from all samples to be tested. The instrument has semi-automated software controls for the testing procedure. The results are displayed on an instrument panel, stored in digital memory and available for download via a USB cable to a computer, or a USB flashdrive port.

1.) The test results indicate both the presence and severity of biologically harmful substances in a tested sample when compared to CONTROL.

2.) The percent (%) to Control is provided as a bar graph of all tested samples versus the Control for that group. This calculation is then expressed as an indexed result: or Biological Index Number (BIN). The greater the level of toxin the lower the level of light emitted, indicating the plankton are either severely stressed or have died from toxic exposure.

3.) The result is expressed as an Indexed value (scale of 1 to 10) for ease of interpretation and consistent comparisons with successive tests done over time. A high BIN value indicates concentrations of the chemical constituents at biologically harmful levels and potentially critically toxic. A low BIN value indicates low levels of chemical constituents and not biologically harmful.

4.) In general, low values of 0 to 3 are Normal, values of 4 to 7 should be Reviewed further, retested and other information taken into consideration about the site and sample, values of 8 to 10 indicate a significant biological adverse effect and is likely toxic.

5.) In all cases, test results should be reviewed by a professional with knowledge and experience of toxicity parameters, additional information used in the assessment of the site (such as historical information), retesting and discriminatory laboratory tests may be the next course of action.

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Salinity Adjustment EPA Sections:

EPA guidance regarding salinity and toxicity tests:
http://www.epa.gov/waterscience/methods/wet/disk1/index.html

5.1.1 Effluent toxicity tests may be performed in a fixed or mobile laboratory. Facilities must include equipment for rearing and/or holding organisms. Culturing facilities for test organisms may be desirable in fixed laboratories which perform large numbers of tests. Temperature control can be achieved using circulating water baths, heat exchangers, or environmental chambers. Water used for rearing, holding, acclimating, and testing organisms may be natural seawater or water made up from hypersaline brine derived from natural seawater, or water made up from reagent grade chemicals (GP2) or commercial (FORTY FATHOMS® or HW MARINEMIX®) artificial sea salts when specifically recommended in the method. Air used for aeration must be free of oil and toxic vapors. Oil-free air pumps should be used where possible. Particulates can be removed from the air using BALSTON® Grade BX or equivalent filters, and oil and other organic vapors can be removed using activated carbon filters (BALSTON®, C-1 filter, or equivalent).

6.6.4 The marine organisms can be used at all concentrations of effluent by adjusting the salinity of the effluent to salinities specified for the appropriate species test condition or to the salinity approximating that of the receiving water, by adding sufficient dry ocean salts, such as FORTY FATHOMS®, or equivalent, GP2, or hypersaline brine.

7.2.1 Standard, synthetic, dilution water is prepared with deionized water and reagent grade chemicals (GP2) or commercial sea salts (FORTY FATHOMS®, HW MARINEMIX®) (Table 3). The source water for the deionizer can be ground water or tap water.

7.3.3 The investigator should collect uncontaminated water having a salinity as near as possible to the salinity of the receiving water at the discharge site. Water should be collected at slack high tide, or within one hour after high tide. If there is reason to suspect contamination of the water in an estuary, it is advisable to collect uncontaminated water from an adjacent estuary. At times it may be necessary to collect water at a location closer to the open sea, where the salinity is relatively high. In such cases, deionized water or uncontaminated freshwater is added to the saline water to dilute it to the required test salinity. Where necessary, the salinity of a surface water can be increased by the addition of artificial sea salts, such as FORTY FATHOMS®, HW MARINEMIX®, or equivalent, GP2, a 29 natural seawater of higher salinity, or hypersaline brine. Instructions for the preparation of hypersaline brine by concentrating natural seawater are provided below.

Attachment 1 of 1

Appendix 7: SDSU S.O.P. for metal analysis in water samples

San Diego State University, School of Public Health, Environmental Chemistry Laboratory
Laboratory Standard Operating Procedure for Trace Metal Measurement

Inductively Coupled Plasma Mass Spectrometer (ICP-MS)

Starting the Unit (From Standby Mode)
1. Switch on the computer monitor
2. Turn on the cooler
3. Check the automatic sampler is turned on
4. Turn on the Argon gas. (Outgoing pressure should be about 80 to 100 psi)
5. Turn on reaction gas (Helium – outgoing pressure should be around 40-60 kPa)
6. Check vacuum pressure of the instrument before turn plasma on.
7. Turn the plasma on – allow about 30 minutes (or longer) for complete warm up, and check pressure, exhaust temperature, and power.
8. Check the tubing on the peristaltic pump
9. Check all connections for tubing from the sampler to the nebulizer
10. Place bottles of nitric acid solutions (2%), pure water, and tuning solution in the auto sampler racks.

Daily tuning
1. Load appropriate tune files (for no gas and reaction gas mode) in software.
2. Send the auto sampler to the tuning solution and allow aspirating until the solution reaches nebulizer. Tuning solution for the instrument is containing 10 ppb each of Li, Y, Co, Ce, and Tl in dilute nitric acid, and 0.5% hydrochloric acid to this solution.
3. In each tune mode, monitor values for each mass according to the manufacturer's manual, and adjust parameters in order to get target values, if necessary.
4. Do P/A factor by using the elements of interest at about 50-100 ppb to get in the proper range of the pulse to analog switching point. The P/A factor is the instrument's way of connecting the curve from the pulse mode of detector operation to the analog mode.

Setting up and running a sequence
1. Place calibration standards, blanks, reference samples, and samples in auto sampler rack as well as rinse solutions (nitric acid solution, and pure water).
2. Set up the sequence in software, and run.