BIG CANYON WATERSHED
PRELIMINARY SELENIUM SOURCE TRACKING STUDIES
BIG CANYON COUNTRY CLUB AND UPSTREAM TRIBUTARIES
SCOPE OF WORK AND SAMPLING AND ANALYSIS PLAN

Prepared by:

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Coastal Planning Section
Santa Ana Regional Water Quality Control Board

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Introduction and Background

The Big Canyon Creek (or Wash) watershed is a small (less than 2 square miles) watershed that is tributary to Upper Newport Bay (Figure 1). The majority of the watershed (approximately 96%) is highly developed with homes, commercial areas, a golf course (Big Canyon Country Club), cemetery, and other urban features. The 60-acre undeveloped lower portion of Big Canyon (Big Canyon Creek Nature Park) has been identified by the Southern California Wetlands Recovery Project (SCWRP) as an important resource that is in need of restoration. Baseline water quality conditions in the Big Canyon Creek Nature Park (Nature Park) and points upstream were investigated by Weston Solutions, Inc. in 2007 as part of the restoration effort. Selenium measured in water samples collected throughout the Nature Park and just upstream of the park exceeded the California Toxics Rule (CTR) freshwater chronic criterion for selenium of 5 micrograms per liter (µg/L) under both wet and dry conditions. Selenium is a bioaccumulative compound that has been associated with reproductive impairment in fish and birds. Ecological risk screening values for selenium are shown in Table 1.

Table 1. Ecological Risk Screening Levels for Selenium

Media	Ecological Risk Level (mg/kg dw)		
	None	Marginal	Substantive
Freshwater	<2 µg/L	2-5 µg/L	>5 µg/L
Sediment	<2	2-4	>4
Diet (fish & birds)	<3	3-7	>7
Fish Tissue	<4	4-6	>6
Bird Egg Tissue	<6	6-10	>10

(Source: Presser et al., 2004)

The sources of selenium in Big Canyon have been identified. The steep cliffs that rim Big Canyon Creek are formed primarily of the Miocene Monterey Formation. This formation is a known source of selenium in California and is a likely source of selenium in Big Canyon. The changes in the hydrology and habitat in the canyon and areas tributary to Big Canyon Wash as the watershed has developed have likely contributed to the mobilization of selenium.

A baseline monitoring study in the Big Canyon Creek Nature Park was completed by CH2M HILL in June 2008. CH2M HILL staff collected samples of water, sediment, and biota from different areas within the nature park to evaluate selenium concentrations and potential impacts in the food webs in the area. Selenium concentrations measured in water, sediment, algae, and tissues (invertebrates, fish, and frogs) collected from the park all exceeded the ecological risk screening values shown in Table 1. Selenium concentrations in sediment as high as 122 mg/kg dry weight (dw) were found in the lower freshwater marsh ponds in the park. Fish tissue concentrations in the nature park ranged from 58-64 mg Se/kg dw, and algae and dragonfly larvae selenium concentrations exceeded 30 mg/kg dw. Selenium concentrations in sediment and biota were elevated throughout the park, even in the middle and upper sections of the canyon. Selenium concentrations in sediment at those locations, though not as elevated as that seen in the lower freshwater marsh ponds, were still elevated well above screening levels (20-27 mg Se/kg dw; Figure 4) and algae, crayfish, fish (fathead minnow and mosquito fish), and frogs (African clawed frogs) were also extremely high (35-57 mg/kg dw).

Additional sampling in the Nature Park, and on the Big Canyon Country Club (BCCC) golf course located just upstream of the park, were conducted by CH2MHill in May 2009. The purpose of this additional sampling was to further characterize the bioaccumulation of selenium and trace metals in biota in the Nature Park and to trace upstream selenium concentrations and sources. Discussions with the golf course superintendent in 2008 indicated that there were several areas along the east side of the golf course where flows entered the course from the upstream portions of the watershed. These flows pass though the golf course forming creeks and water hazards (ponds) on the course grounds before exiting the course and entering the Nature Park as a single stream flow. Given the high concentrations of selenium in the Nature Park, and the high proportion of selenite (a more bioavailable form of selenium) in the flows entering the Nature Park (as much as 20% of the total selenium), an investigation into the sources of selenium and flows entering the golf course just upstream of the park was considered essential to understanding the potential sources of selenium and selenium cycling and impacts in the Big Canyon watershed.

Samples were collected on May 8, 2009, by CH2MHill staff in the Nature Park and in the drainage areas running through the Big Canyon Country Club golf course to characterize waterborne selenium, selenium speciation, and trace metals throughout this portion of the Big Canyon watershed. Selenium concentrations measured in the biota collected in the Nature Park showed elevated values as compared to those observed in 2008. On the BCCC golf course, water samples were collected from the creeks and lakes and from the area(s) where flows entered the golf course and at the flow outlet where the flows continue into the Nature Park. Total selenium concentrations measured in all of the samples collected on the BCCC golf course exceeded the CTR chronic freshwater criterion for selenium of 5 µg/L. The selenium species (high percentage of selenite and organic selenium) found in the system of lakes and water bodies that form the southern branch of Big Canyon creek as it flows through the golf course have the potential to greatly enhance selenium bioaccumulation rates in resident biota.

The waterborne selenium chemistry results collected from the water bodies on the Big Canyon Country Club golf course provide a clear pattern of selenium loading, transformation, and loss through the golf course portion of the Big Canyon watershed during a period of low flows (CH2MHill, 2009). The conversion of selenium to more bioavailable forms (selenite and organic selenium) increased (probably as a result of biotic uptake and transformation) as flows moved from the eastern end of the golf course where the stream flows first enter the course, to where they exit the golf course at its western end and enter the Nature Park.

Most of the selenium loads in this portion of the watershed were found in the southern branch of Big Canyon Creek, which had both high flows and moderate selenium (41.7 µg/L) concentrations. Selenium in this drainage enters the golf course at approximately 19%

selenite and it is nearly double that in the downstream lakes (37%). This finding necessitates the need to determine (1) where the selenium is ultimately coming from, especially in the southern branch of Big Canyon Creek; (2) if conversions of selenium to selenite and organic selenium are still occurring upstream of the Big Canyon Country Club golf course (possibly in the Harbor View Nature Park); and (3) whether the selenium conversions in the golf course ponds/lakes are resulting in elevated concentrations of selenium in aquatic life and aquatic-dependent wildlife that reside or forage in these areas.

The purpose of this current study is to provide a single point in time snapshot view of selenium concentrations in aquatic life that reside in the BCCC golf course streams and ponds and to gather more information to help delineate upstream sources of selenium and the nature of selenium cycling in the uppermost portion of the Big Canyon watershed.

Project Goals

The goals of this project are to:

1. Assess potential sources of selenium and flows upstream of the Big Canyon Country Club golf course.
2. Determine where and how selenium conversions are occurring upstream of the golf course.
3. Compare selenium concentrations and loads in the main tributaries of Big Canyon creek that enter and exit the BCCC golf course to the concentrations measured in 2009 by CH2MHill.
4. Determine selenium cycling and potential impacts to aquatic life in the golf course ponds and the Harbor View Nature Park.
5. Provide data to help build a conceptual model for selenium for the Big Canyon subwatershed.
6. Determine if preliminary estimates of potential sources of water and selenium (e.g., irrigation, leaking potable water lines) can be made based on general chemical parameters (i.e., use of Piper diagrams or Stiff plots).
7. Provide additional information that can be used in assessing potential selenium source controls and treatment options.
8. Collect data to aid in designing a long-term selenium monitoring and management program for the Big Canyon watershed.
9. Provide additional data that can be used to refine the Newport Bay watershed biodynamic model for the Big Canyon subwatershed.

Sample Locations, Media, and Analytical Parameters

Surface water, groundwater, particulates, sediment, algae, and biota (fish, invertebrates, or frogs) will be collected from the central and upper portions of the Big Canyon watershed to determine potential sources of selenium, selenium cycling, and selenium concentrations in, and potential impacts to, aquatic life. Sample locations and types are shown in Figures 2-4, and sample location descriptions and abbreviations used are shown in Table 2.

<u>Surface Water Samples</u>

As shown in Figure 2, eight (8) areas are targeted for surface water sample collection in the central and upper portions of the Big Canyon watershed: 3 samples will be collected from the BCCC golf course (lakes 3 & 5 and the outflow to the Big Canyon Creek Nature Park);

3 samples will be collected from the south branch of Big Canyon Creek: 1 from the location where the creek enters the golf course, and 2 upstream of the golf course but downstream of Big Canyon Reservoir (in and just upstream of the Harbor View Nature Park); 1 sample will be collected from the middle branch of Big Canyon creek where it enters the golf course; and 1 sample will be collected from the north branch of Big Canyon creek, also where it enters the golf course property (see Figure 2). If water is not present at some of the targeted locations, an alternate location may be selected.

The sample locations have been selected to generate a single-point in time analysis (or snapshot) of selenium in this portion of the watershed and to help further delineate potential sources of selenium. As shown in Tables 3 and 4, all surface water samples will be analyzed for general minerals (calcium, chloride, magnesium, potassium, sodium, sulfate, carbonate, bicarbonate, total hardness, total dissolved solids (TDS)), total suspended Solids (TSS), trace metals (cadmium, copper, lead, nickel, zinc), total organic carbon (TOC), dissolved organic carbon (DOC), total dissolved selenium, and total recoverable selenium. Eight (7) of the surface water samples (4 samples collected from the golf course, 2 samples collected from the south branch of Big Canyon creek, and 1 sample from the north branch of Big Canyon creek – see Figure 2) will also be submitted for analysis of selenium species: selenate, selenite, methylselenitic acid, selenomethionine, and selenocyanite.

Groundwater Samples

Groundwater samples will be collected from three (3) piezometers located up-gradient, cross-gradient, and down-gradient of Big Canyon reservoir to compare groundwater and surface water sample chemistry. The three piezometer locations are shown in Figures 2 and 3. All three groundwater samples will be analyzed for general minerals (calcium, chloride, magnesium, potassium, sodium, sulfate, specific conductance, carbonate, bicarbonate, total hardness, TDS), low detection limit metals (cadmium, copper, lead, nickel, zinc), and total dissolved selenium. One of the samples (from an up-gradient piezometer) will also be submitted for analysis of selenium species: selenate, selenite, methylselenitic acid, selenomethionine, and selenocyanite for comparison to down gradient surface waters.

Particulate Samples

Four (4) areas are targeted for particulate sample collection: three (3) locations on BCCC golf course (lakes 3 and 5 and the outflow to Big Canyon Nature Park) and one location on the south branch of Big Canyon creek in the Harbor View Nature Park (Figure 4). The transformation of dissolved selenium to particulate selenium is the most important step in selenium bioaccumulation in the aquatic food web. Selenium particulate concentrations will be used to calculate partitioning coefficients for selenium at these locations, and for comparison to selenium concentrations in algae and bed sediment, which are often used as surrogates for particulate concentrations. Particulate samples will be filtered and weighed after drying and analyzed for total selenium.

Sediment, Algae, and Tissue Samples

Three (3) locations (Figure 4) are targeted for the collection of sediment, algae, and tissue samples (fish, invertebrates, or frogs). All samples will be analyzed for trace metals and total selenium. Sediment samples will also be analyzed for total organic carbon, and fish tissue samples will also be analyzed for percent lipids. Selenium concentrations in sediment and algae will be compared to particulate concentrations to determine if there is any correlation between the three since selenium concentrations in bed sediment and algae are often used as surrogates for selenium in particulates when calculating partitioning coefficients for selenium. Analysis of selenium concentrations in these different media (water, particulates, sediment, algae, fish tissue/invertebrates) will help to assess how selenium is cycling at these locations and may help to develop preliminary mass balance estimates for selenium in this portion of the watershed.

Field Data Collection

Sample locations will be recorded using a hand-held Global Positioning System (GPS) unit with a resolution of 1 to 5 meters. All sample locations will be photographed.

<u>Field Data Sheets</u>

A field data sheet will be used to record:

- Sample location (description and GPS coordinates)
- Sample identification number/abbreviation
- Sample type (surface water, groundwater, tissue, etc.)
- Date and time sample was collected
- Flow velocity (for streams) or depth sample collected (for ponds/lakes and groundwater monitoring wells/piezometers)
- For sediment:
    - General color using a soil color chart
    - General classification (clay, sandy clay, silt, silty sand, etc.)
    - Odors
    - Any other distinguishing characteristics (gravel, organics, etc.)
- For filamentous algae:
    - Genus, if known
    - Presence/absence of attendant organisms (insects, larvae, attached eggs, etc.)
    - Depth collected and type of attachment (substrate, boulder, bridge abutment, etc.)
    - Overall abundance
- For invertebrates:
    - Genus (species if known)
    - Number/weight (depending on size)
    - Size (crayfish)
    - Environment (benthic, water column)
- For fish/frogs
    - Genus and species (if field identification possible)
    - Life stage (larvae, juvenile, adult)
    - Approximate size (length, head to tail)
    - Number collected

Field data sheets and examples are included in Appendix B.

Water Quality Field Parameters

Dissolved oxygen, electrical conductivity, pH, and temperature should be measured in the field at the time of sample collection (using a field multi-meter) and recorded on the field data sheet. All field multi-meters used should be calibrated according to the manufacturer's instructions before deploying in the field.

Stream Flow Estimates

All eight surface water sampling locations should be measured for flow volumes at the time of surface water quality sample collection. Flow will be estimated by measuring average depth, cross-section width, and velocity (using standard hand-held field velocity meter or other method as appropriate), or by estimation for extremely low flows. All measurements and any cross-section sketches should be recorded in the field log.

Groundwater Elevation Measurements

For the three groundwater piezometers that will be sampled, groundwater elevation measurements should be taken at the same time as the sample is collected using an electronic water level well sounder. Depth to groundwater should be measured before the sample is taken, but after any well purging that may be used to clear the well. If the well has been recently purged, a minimum of three (3) measurements taken at least 5 minutes apart should be made to ensure that the groundwater level has stabilized. All groundwater elevation measurements should be recorded in the field log. In addition, if a well has been purged, this should be noted in the field log, including the number of well volumes purged.

Sample Collection Methods and Analysis

The required Surface Water Ambient Monitoring Program (SWAMP) measurement quality objectives (MQOs) are included in Appendix A for surface water and sediment. Chain-of-Custody forms for each analytical laboratory are included in Appendix C. Standard Operating Procedures (SOPs) for surface water, bed sediment, algae, and tissue are included in Appendix D.

Surface Water Samples

All surface water samples will be collected as grab samples just below the water's surface using standard clean handling techniques and transported on ice to the laboratory for filtration and processing within 24 hours of collection. For most analytical parameters, water samples will be collected in clean, 1 pint, 1 quart, or half gallon plastic bottles depending on the analysis that will be performed on the sample. For analysis of total organic carbon and dissolved organic carbon (TOC and DOC), water samples will have to be pulled using a plastic bottle, cup, or ladle then slowly poured into the 40 milliliter amber bottles (two bottles per analyte are required). The water must be poured so that there are no air bubbles in the sample and the water should just rise in a meniscus above the rim of the amber bottle before capping. The TOC and DOC samples should be clearly labeled and stored together. Bottles for TOC samples are preserved with sulfuric acid (H_2SO_4) and are clearly labeled with yellow stickers. DOC analyses does not require acid for preservation and do not include sulfuric acid.

Samples to be analyzed for selenium, selenium species, or particulates will be shipped by E.S. Babcock & Sons (Babcock) to Applied Speciation and Consulting, LLC (Applied Speciation) analytical laboratories. Babcock will analyze the surface water samples for the water quality parameters listed in Tables 3 and 4, including general minerals, selected trace metals, total organic carbon, dissolved organic carbon, and total suspended sediments. Applied Speciation will analyze surface water samples for total recoverable selenium and total dissolved selenium using a modified version of EPA Method 200.8 that utilizes inductively coupled plasma dynamic reaction cell mass spectrometry methods (ICP-DRC-MS). Applied Speciation will also analyze selected surface water samples for selenium species using ion chromatography inductively coupled plasma mass spectrometry (IC-ICP-MS).

Dissolved oxygen, pH, electrical conductivity (EC), and temperature will be collected at each site at the time of water sampling using a calibrated, field multi-meter. Table 5 includes a list of the analytical parameters and methods, sample containers and preservatives, holding times, and the laboratory performing the analysis on the water samples. The measurement quality objectives for the surface water samples are shown in Appendix A, Table A1, which is from the 2008 SWAMP Quality Assurance Project Plan (QAPrP). The recommended SOP for collecting surface water samples is included in Appendix D. In addition, the minimum method detection limits (MDLs) for selenium and selenium species in water that must be met are included in Table 6.

Groundwater Samples

Groundwater samples will be collected from two (2) of the piezometers located around Big Canyon Reservoir and two (2) drains located on the west side of the reservoir that drain water leaking from beneath the reservoir (Figure 3). A storm drain that issues from the Yacht Street Home Owners Association (HOA) that also likely contains groundwater (Figure 2) will also be sampled, provided that there is sufficient water for sampling. Groundwater samples will be collected using a clean, sanitized bailor (for piezometers), syringe, ladle or bottle (for under drains) before transferring to clean plastic bottles for shipment to the analytical laboratories. Samples will be filtered in the analytical laboratory.

Babcock will analyze the groundwater samples for the water quality parameters listed in Tables 2 and 3, including general minerals and selected dissolved trace metals. Applied Speciation will analyze the groundwater samples for total dissolved selenium. Applied Speciation will also analyze one groundwater sample for selenium species. Groundwater samples will not be analyzed for total or dissolved organic carbon, total suspended solids, or total recoverable selenium. Table 5 includes a list of the analytical parameters, methods, sample containers, preservatives, and holding times for the groundwater samples. Tables A1 and A5 in Appendix A lists the SWAMP QAPrP required measurement quality objectives. The minimum required method detection limit for total dissolved selenium is shown in Table 6. Applied Speciation will provide all QA/QC per SWAMP requirements. A field duplicate and field blank will be included with the samples shipped to Babcock.

Particulate Samples

As shown in Figure 4 and in Table 7a, four (4) locations will be sampled for total particulates. Two liters of water will be collected at each of these locations using standard clean handling techniques and transported on ice to the laboratory for filtration and processing within 24 hours of collection. Water samples will be collected in clean, 2 liter high density polypropylene (HDPE) plastic bottles. Where possible (e.g., golf course ponds) the water samples should be collected from several locations within the targeted area to ensure that the sample is representative of site conditions. Particulate samples should be collected before sediment, algae or tissue samples to avoid stirring up bottom sediments. Samples will be filtered and weighed in the analytical laboratory. Applied Speciation will analyze the samples for total selenium, trace metals, and total suspended solids (Table 7b) and will provide all QA/QC per SWAMP requirements. Holding times and analytical methods for particulates are shown in Table 8.

Sediment Samples

As shown in Table 7a, composite sediment samples will be collected at the three locations shown in Figure 4 after surface water and particulate samples have been collected but before fish and/or invertebrates have been sampled. Samples should be collected from an area in the lake or stream that contains the fine sediments and that has not been disturbed. The upper 2 cm of sediment should be collected as grab samples from 3-5 locations within the area identified as the target sampling location for each water body using a polyethylene scoop. While in the field, each individual sediment sample should be placed into a homogenization jar and thoroughly stirred for at least 5 minutes to completely homogenize the sample. Once all of the samples from the targeted water body have been homogenized, they should be placed into a 125 mL or larger clear glass jar and placed on cube ice at 4°C for transport to the analytical laboratory. Sediment samples will be analyzed for trace metals, including selenium, and percent solids (Table 7b). Analytical results will be reported in dry weight. The sediment samples will be collected and analyzed by the Institute for Integrated Research in Materials, Environments, and Society (IIRMES) located at California State University, Long Beach (CSULB) using SWAMP compatible sampling and analytical protocols and measurement quality objectives (see Table A5 in Appendix A). The recommended SOP for collecting sediment samples is included in Appendix D. Holding times and analytical methods for sediment are shown in Table 8.

Algae and Tissue Samples

Filamentous algae and biota will be collected at the same three locations as the sediment samples (see Table 7a and Figure 4). Fish/invertebrate tissues should be collected before the algae samples to avoid disturbing invertebrates that may be attached to or hiding in the algae. Composite samples of fish (likely mosquitofish and possibly fathead minnows) should be collected using an appropriately sized mesh dip net. The smallest fish in any composite sample should be within 75% of the largest fish in the sample. If sufficient fish cannot be found for tissue analysis, invertebrates (crayfish, corrixids, or insect larvae) or frogs (either adults or tadpoles, but life stages should not be mixed) can be used as surrogates.   Filamentous algae should be collected by hand using clean tongs. Algae and composite tissue samples will be wrapped in foil to keep out light, and then stored in clean, unused one gallon Ziploc bags and shipped on wet ice to the analytical laboratory within 24 hours of collection. Algae and tissue samples will be analyzed for trace metals, including total selenium, and percent solids (Table 7b). Fish tissue samples will also be analyzed for percent lipids. Analytical results will be reported in dry weight. The algae and tissue samples will be collected and analyzed by IIRMES-CSULB using SWAMP-compatible sampling and analytical protocols and measurement quality objectives as shown in Table A5 in Appendix A. Analytical methods and holding times for algae and tissue samples are shown in Table 8 and the recommended SOPs are in Appendix D.

Sample Collection Logistics

Because of restrictions on when sampling can be conducted on the Big Canyon Country Club golf course, the sampling for this project is currently scheduled to take place on Monday, June 21, 2010 at 9:00 AM. The goal is to complete all sampling, including the golf course, upstream locations, and the piezometers at the Big Canyon reservoir, on the same day so we can have a good “snapshot” of selenium cycling at a single point in time for this portion of the watershed. For that reason, at least two and possibly three sampling teams will be needed to ensure that all sampling is completed on time. The water samples will need to be ready for transport back to Riverside by no later than 2:00 PM as some samples will need to be shipped overnight to Applied Speciation and Consulting, LLC for selenium analysis. IIRMES/CSULB will collect and transport the samples back to their laboratory that they will be analyzing (sediment, algae, and tissue samples).

Carla Navarro, Upper Newport Bay Reserve Manager for the California Department of Fish and Game (CDFG), will be observing the tissue sampling to provide the necessary permit coverage required by CDFG for scientific collections. Three locations are targeted for tissue sampling: two of the ponds on the golf course (lakes 3 and 5) and surface water in the creek in the Harbor View Nature Park (if sufficient flows and aquatic life are present) (see Figure 4).

Regional Board staff will be assisting with and/or observing the sample collections. The City of Newport Beach and Orange County Public Works will also be providing staff to assist with or observe the sample collections. Staff from IIRMES/CSULB will conduct the sediment, algae, and tissue sampling in accordance with SWAMP requirements and this Sampling and Analysis Plan. IIRMES/CSULB staff will transport the sediment, algae, and tissue samples back to their laboratory for analysis. Regional Board staff will transport the water and particulate samples to Babcock’s Riverside laboratory. Babcock will then split the water samples and ship the split water samples and the particulate samples overnight to Analytical Speciation in Bothel, WA, for selenium analysis.

The following sampling teams are suggested:

Multi-media sampling team (golf course and Harbor View Nature Park locations):
Terri Reeder, Regional Board
Brandi Outwin, Regional Board
Michelle Clement, Newport Beach
Jian Peng, Orange County
Rich Gossett, IIRMES/CSULB
Jeremy Browning, IIRMES/CSULB
Carla Navarro, CDFG

Groundwater sampling Team (piezometers and reservoir weir samples):
Mark Adelson, Regional Board
Patricia Hannon, Regional Board
John Kappeler, Newport Beach
Stephan Catron, Newport Beach

Big Canyon Creek tributaries surface water sampling team:
Pavlova Vitale, Regional Board
Mike Perez, Regional Board
Aaron Salazar, Regional Board
Bob Stein, Newport Beach
Georghe Simonescu, Orange County

Each sampling team will need to have the following:

- Appropriate chain-of-custody forms
- Appropriate field data sheets
- Clipboard
- Hand-held GPS unit
- Digital camera (with back-up batteries)
- Field multi-meter (e.g., Horiba or YSI; must measure pH, electrical conductivity, dissolved oxygen, and temperature)
- Sample containers appropriate to the media being sampled
- Cooler and ice for sample preservation

The Multimedia sampling team will also need:

- Polyethylene scoop for sediment
- Sediment homogenization jar
- Fine mesh dip nets for fish/invertebrates
- Plastic or metal tongs for algae collection

The Groundwater sampling team will also need:

- A working electronic well sounder
- Disposable bailers for sampling (or bailers that can be sanitized)
- Disposable syringes or small ladle that can be used to sample low flows in drains around reservoir

The Big Canyon Tributaries surface water sampling team will also need:

- Flow velocity meter
- 100 ft measuring tape
- Depth gage
- Float and stopwatch
- Disposable syringes or small ladle that can be used to sample low flows in creek tributaries or springs

Data Verification and Validation

The analytical laboratories' quality assurance officers will be responsible for ensuring that their analyses are in compliance with the MQOs in Appendix A. All analytical reports will be submitted to Regional Board staff in Excel file format. Regional Board staff will archive the data and will be the primary party responsible for data management, analysis, and validation. In addition, the data will also be shared with the City of Newport Beach and will be incorporated into the Nitrogen and Selenium Management Program's database for Big Canyon Wash.

Regional Board staff will also review the data for compliance with the MQOs and to ensure that all samples were analyzed within the required holding times. Regional Board staff will review all COCs and field data sheets to assess whether all samples were collected, correct analyses and QA/QC were performed, and that the sample collection, groundwater and surface water measurements followed the appropriate protocols listed in this Sampling and Analysis Plan or in the SOPs included in Appendix B.

The data collected from this investigation will be combined with that collected from other investigations into selenium concentrations in Big Canyon, including the water, sediment, and tissue sampling conducted by CH2MHill in Big Canyon in 2008 and 2009. This combined information will be used to (1) further define potential sources of selenium and flows in the watershed; (2) determine how selenium is cycling in the upper part of the watershed; (3) provide information on selenium loads, bioaccumulation, and potential adverse impacts to aquatic life and aquatic dependent wildlife in this area; (4) build a conceptual model for selenium in Big Canyon; (5) refine the Newport Bay watershed biodynamic model that is being used to predict the reductions in selenium concentrations that will be needed in Big Canyon to meet the proposed selenium site-specific objectives for fish and bird egg tissue; (6) design a selenium management program and long-term monitoring plan for the Big Canyon subwatershed; and (7) aid in assessing potential selenium source control and treatment options.

Project Contact Information:

Regional Board
Terri Reeder, Coastal Planning Section
Office: 951-782-4995
treeder@waterboards.ca.gov

City of Newport Beach
Robert Stein, Assistant City Engineer
Office: 949-644-3322
rstein@newportbeachca.gov

County of Orange
Jian Peng, Environmental Scientist
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Big Canyon Country Club
Jeff Beardsley, Golf Course Superintendent
Office: 949-644-5404
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jbeardsley@bigcanyoncc.org

E.S. Babcock & Sons, Inc.
Lorenzo Rodriguez, Project Manager
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Applied Speciation and Consulting, LLC
Lydia Greaves, Project Manager
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Lydia@appliedspeciation.com

IIRMES/CSULB
Rich Gossett, Director
Office: 562-985-2469
Mobile: 310-420-4964
rgossett@csulb.edu

Approving Officials Signatures

By signing below you acknowledge that you have read and will implement this Sampling and Analysis Plan including the appropriate SOPs included in Appendix B.

SWRCB Approving Officials

Quality Assurance Officer:
Pavlova Vitale, Santa Ana Regional Water Quality Control Board

Signature________________________________ Date:____________________

Project Manager:
Terri Reeder, Santa Ana Regional Water Quality Control Board

Signature________________________________ Date:____________________

City of Newport Beach Approving Officials

Project Manager:
Robert Stein, Assistant City Engineer

Signature________________________________ Date:____________________

Field Supervisor:
John Kappeler, Division Manager, Code Enforcement

Signature________________________________ Date:____________________

County of Orange Approving Officials

Field Supervisor:
Jian Peng, Environmental Scientist, OC Public Works

Signature________________________________ Date:____________________

IIRMES/CSULB Approving Officials

Field Supervisor:
Rich Gossett, Director, Institute for Integrated Research in Materials, Environments, and Society (IIRMES), California State University, Long Beach (CSULB)

Signature________________________________ Date:____________________

Approving Officials Signatures

By signing below, the analytical laboratories acknowledge that they can and will comply with the measurement quality objectives listed in the tables in Appendix A.

IIRMES/CSULB Approving Officials

Laboratory Quality Assurance Officer:
Alex Long, Institute for Integrated Research in Materials, Environments, and Society (IIRMES), California State University, Long Beach (CSULB)

Signature______________________________ Date:____________________

E.S. Babcock & Sons, Inc.

Laboratory Quality Assurance Officer:
Stacy Fry, Quality Assurance Manager

Signature______________________________ Date:____________________

Applied Speciation and Consulting, LLC Approving Officials

Laboratory Quality Assurance Officer:
Russ Gerads, Vice President

Signature______________________________ Date:____________________

NOTE: Subcontracting laboratories (IIRMES/CSULB and Applied Speciation) **MUST send their invoices for their analyses to E.S. Babcock & Sons, Inc. NOT** the Regional Board. Please send your invoices to:

E.S. Babcock & Sons, Inc.
6100 Quail Valley Court
Riverside, CA 92507

ATTN: Lorenzo Rodriquez

TABLES

Table 2. Sample locations and descriptions shown in Figures 2, 3, and 4

Sample Identification	Water Body Type	Description
BCNP-Outflow	SW	Big Canyon Golf Course Outflow to Big Canyon Creek Nature Park
BCGC-Lake5	SW	Big Canyon Golf Course - Lake 5 (last lake on south branch of creek before flows exit the golf course)
BCGC-Lake3	SW	Big Canyon Golf Course – Lake 3 (lake just north of country club)
BCW-SB-MAIN (Inflow 1)	SW	Big Canyon Wash – South Branch Main Drainage (Inflow 1 to Big Canyon Golf Course)
BCW-SB-HVNP	SW	Big Canyon Wash – Harbor View Nature Park (North Fork of South Branch)
BCW-SB-BCR	SW	Big Canyon Wash – South Branch Drainage from Big Canyon Reservoir
BCW-MB-MAIN (Inflow 2)	SW	Big Canyon Wash – Middle Branch Main Drainage (Inflow 2 to Big Canyon Golf Course)
BCW-NB-MAIN (Inflow 3)	SW	Big Canyon Wash – North Branch (Inflow 3 to Big Canyon Golf Course)
BCW-Yacht-St-HOA	SD	Big Canyon Wash – Yacht Street Home Owners Association storm drain
BCR-PIEZ-I41	GW	Big Canyon Reservoir – Piezometer I-41 (southeast side of reservoir)
BCR-PIEZ-G26	GW	Big Canyon Reservoir – Piezometer G-26 (north end of reservoir)
BCR-West-Underdrain	GW	Big Canyon Reservoir – west underdrain to reservoir
BCR-East-Underdrain	GW	Big Canyon Reservoir – east underdrain to reservoir

SW = surface water
SD = storm drain
GW = groundwater

Table 3. Number of Samples and Water Quality Parameters by Location

SAMPLE LOCATION	NO. OF SAMPLES	Water Quality Parameters*	Low-Detection Limit Metals	Total Dissolved Selenium	Total Recoverable Selenium	Selenium Species
BCNP-Outflow	1	1	1	1	1	1
BCGC-Lake5	1	1	1	1	1	1
BCGC-Lake3	1	1	1	1	1	1
BCW-SB-MAIN (Inflow 1)	1	1	1	1	1	1
BCW-SB-HVNP	1	1	1	1	1	1
BCW-SB-BCR	1	1	1	1	1	1
BCW-MB-MAIN (Inflow 2)	1	1	1	1	1	
BCW-NB-MAIN (Inflow 3)	1	1	1	1	1	1
BCW-Yacht-St-HOA*	1	1	1	1		
BCR-PIEZ-I41*	1	1	1	1		
BCR-PIEZ-G26*	1	1	1	1		
BCR-West-Underdrain*	1	1	1	1		1
BCR-East-Underdrain*	1	1	1	1		
QA/QC Duplicates	2	1	1	1		
Total Samples	**15**	**15**	**15**	**15**	**8**	**8**

* Total Organic Carbon and Total Suspended Solids analyses will not be performed on groundwater samples (BCR-PIEZ samples)

Table 4. Selected Analytical and Field Parameters

Water Quality Analytical Parameters	Water Quality Field Parameters	Low-Detection Limit Metals	Selenium
Calcium	pH	Cadmium	Total Dissolved Selenium
Chloride	Temperature	Copper	Total Recoverable Selenium
Magnesium	Dissolved Oxygen	Lead	**Selenium Species**
Potassium	Electrical Conductivity	Nickel	
Sodium		Zinc	Selenate
Sulfate			Selenite
Magnesium			Methylselenitic acid
Carbonate			Selenomethionine
Bicarbonate			Selenocyanite
Total Dissolved Solids (TDS)			
Total Suspended Solids (TSS)*			
Total Organic Carbon (TOC)*			
Dissolved Organic Carbon (DOC)*			

* Groundwater samples (BCR-PIEZ) will not be analyzed for TOC, DOC, or TSS.

Table 5. Recommended Analytical Methods, Sample Containers, Preservatives, and Holding Times for Water

Analytical Parameter	Analytical Method	Instrumentation/ Method	Sample Container/Size	Preservative	Holding Times	Analytical Laboratory
Calcium	EPA 200.7	ICP	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Chloride	EPA 300.00	IC	1pint plastic bottle	None	28 days	Babcock
Magnesium	EPA 200.7	ICP	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Potassium	EPA 200.7	ICP	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Sodium	EPA 200.7	ICP	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Sulfate	EPA 300.0	IC	½ gal. plastic bottle	≤6º C	28 days	Babcock
Bicarbonate	SM 2320B	Titration	½ gal. plastic bottle	≤6º C	14 days	Babcock
Carbonate	SM 2320B	Titration	½ gal. plastic bottle	≤6º C	14 days	Babcock
Nitrate-N	EPA 300.00	IC	½ gal. plastic bottle	≤6º C, H_2SO_4	28 days	Babcock
Total Hardness	SM 2340B	Calculation	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Total Dissolved Solids	SM 2540C		½ gal. plastic bottle	≤6º C	7 days	Babcock
Total Suspended Solids	SM 2540D		½ gal. plastic bottle	≤6º C	7 days	Babcock
Dissolved Organic Carbon	SM 5310B		2, 40 mL amber glass vial	≤6º, none	28 days	Babcock
Total Organic Carbon	SM 5310B	High Temp. Combustion	2, 40 mL amber glass vial	≤6º C, H_2SO_4	28 days	Babcock
Cadmium	EPA 200.8	ICP-MS	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Copper	EPA 200.8	ICP-MS	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Lead	EPA 200.8	ICP-MS	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Nickel	EPA 200.8	ICP-MS	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Zinc	EPA 200.8	ICP-MS	1pint plastic bottle	HNO_3[8]	6 months	Babcock
Total Dissolved Selenium	Modified EPA 200.8	ICP-DRC-MS*	1 pint or ½ gal. plastic	≤6º C	6 months	Applied Speciation
Total Recoverable Selenium	Modified EPA 200.8	ICP-DRC-MS*	1 pint, 1 qt., or ½ gal. plastic bottle	≤6º C	6 months	Applied Speciation
Selenate†	Modified EPA 6800†	HPLC-ICP-DRC-MS**	1 pint, 1 qt., or ½ gal. plastic bottle	≤6º C	7 days	Applied Speciation
Selenite†	Modified EPA 6800†	HPLC-ICP-DRC-MS**	1 pint, 1 qt., or ½ gal. plastic bottle	≤6º C	7 days	Applied Speciation
Methylselenic acid†	Modified EPA 6800†	HPLC-ICP-DRC-MS**	1 pint, 1 qt., or ½ gal. plastic bottle	≤6º C	7 days	Applied Speciation
Selenomethionine†	Modified EPA 6800†	HPLC-ICP-DRC-MS**	1 pint, 1 qt., or ½ gal. plastic bottle	≤6º C	7 days	Applied Speciation
Selenocyanite†	Modified EPA 6800†	HPLC-ICP-DRC-MS**	1 pint, 1 qt., or ½ gal. plastic bottle	≤6º C	7 days	Applied Speciation

† There is no EPA method for selenium speciation. Laboratory uses a heavily modified version of Method 6800 that does not use isotope dilution.

* ICP-MS w/DRC: Inductively Coupled Plasma Mass Spectrometry with Dynamic Reaction Cell; Dynamic Reaction Cell (DRC) lowers detection limits and eliminates matrix interferences.

** HPLC-ICP-MS w/DRC: High Performance Liquid Chromatography-Inductively Coupled Plasma- Mass Spectrometry with Dynamic Reaction Cell.

Table 6. Recommended Minimum Method Detection Limits for Selenium in Water

Constituent	Method Detection Limit
Total Dissolved Selenium	<0.5 µg/L
Total Recoverable Selenium	<0.5 µg/L
Selenium Species: SeVI SeIV Organic Se Selenomethionine Selenocyanate Methyl selenic acid	 <0.1 µg/L <0.1 µg/L <0.1 µg/L

Table 7a. Sediment, Particulates, Algae, and Tissue Samples

SAMPLE LOCATION	NO. OF SAMPLES	Sediment	Particulates	Algae	Inverte-brate Tissue	Fish Tissue*
BCNP-Outflow	1		X			
BCGC-Lake5	1	X	X	X		X
BCGC-Lake3	1	X	X	X	X	X
BCW-HVNP	1	X	X	X	X?	X?

* Invertebrates or frogs (or tadpoles) will be sampled if there are not sufficient fish available for sampling at that location. One location will have both invertebrates and fish sampled (BCGC-Lake 3).

Table 7b. Analytical Parameters for Sediment, Particulates, Algae, and Tissue

SAMPLE LOCATION	Total No. of Samples	Trace Metals (Cd, Cu, Pb, Ni, Se, Zn)	Total Se only	Total Suspended Solids	Percent Solids	Percent Lipids
Sediment	3	X			X	
Particulates	4	X	X	X		
Algae	3	X			X	
Fish/Invertebrate Tissue	4	X			X	X

Table 8. Recommended Analytical Methods, Sample Containers, Preservatives, and Holding Times for Particulates, Sediment, Algae, and Fish/Invertebrate Samples

Sample Type and Analytical Parameters	Analytical Method	Instrumentation/ Method	MDL	Sample Container/Size	Preservative	Holding Times	Laboratory Performing Analysis
Particulates				HDPE/2 liter	None	7 days	Applied Speciation
Digestion (prep for 200.8)	EPA Method 3050B						
Trace Metals (Cd, Cu, Pb, Ni, Zn)							
Total Selenium	Modified EPA Method 200.8	ICP-DRC-MS					
Total Suspended Solids	EPA Method 160.2	Filter & scale					
Sediment				8 oz glass jar with Teflon Liner	Freeze at -20°C	1 year	IIRMES/CSULB
Trace Metals (Cd, Cu, Pb, Ni, Zn, Se)	EPA Method 6020	ICP-MS	0.025 µg/ dry gram				
Total Organic Carbon	EPA Method 415.1	Elemental Analyzer					
Acid Volatile Sulfides	Plumb, 1981 and TERL	Spectrophotometer	0.05 µg/ dry gram		28 days		
Solids	EPA Method 160.3		0.1% dry weight				
Algae				Al-foil wrapped & placed in 1 gallon Ziploc bag	Freeze at -20°C	6 months	IIRMES/CSULB
Trace Metals (Cd, Cu, Pb, Ni, Zn, Se)	EPA Method 6020	ICP-MS	0.025 µg/ dry gram				
Solids	EPA Method 160.3		0.1% dry weight				
Fish/Invertebrate Tissue				Al-foil wrapped & placed in 1 gallon Ziploc bag	Freeze at -20°C	6 months	IIRMES/CSULB
Trace Metals (Cd, Cu, Pb, Ni, Zn, Se)	EPA Method 6020	ICP-MS	0.025 µg/ dry gram				
Solids	EPA Method 160.3		0.1% dry weight				
Percent Lipids	Gravimetric		0.1% dry weight				

FIGURES

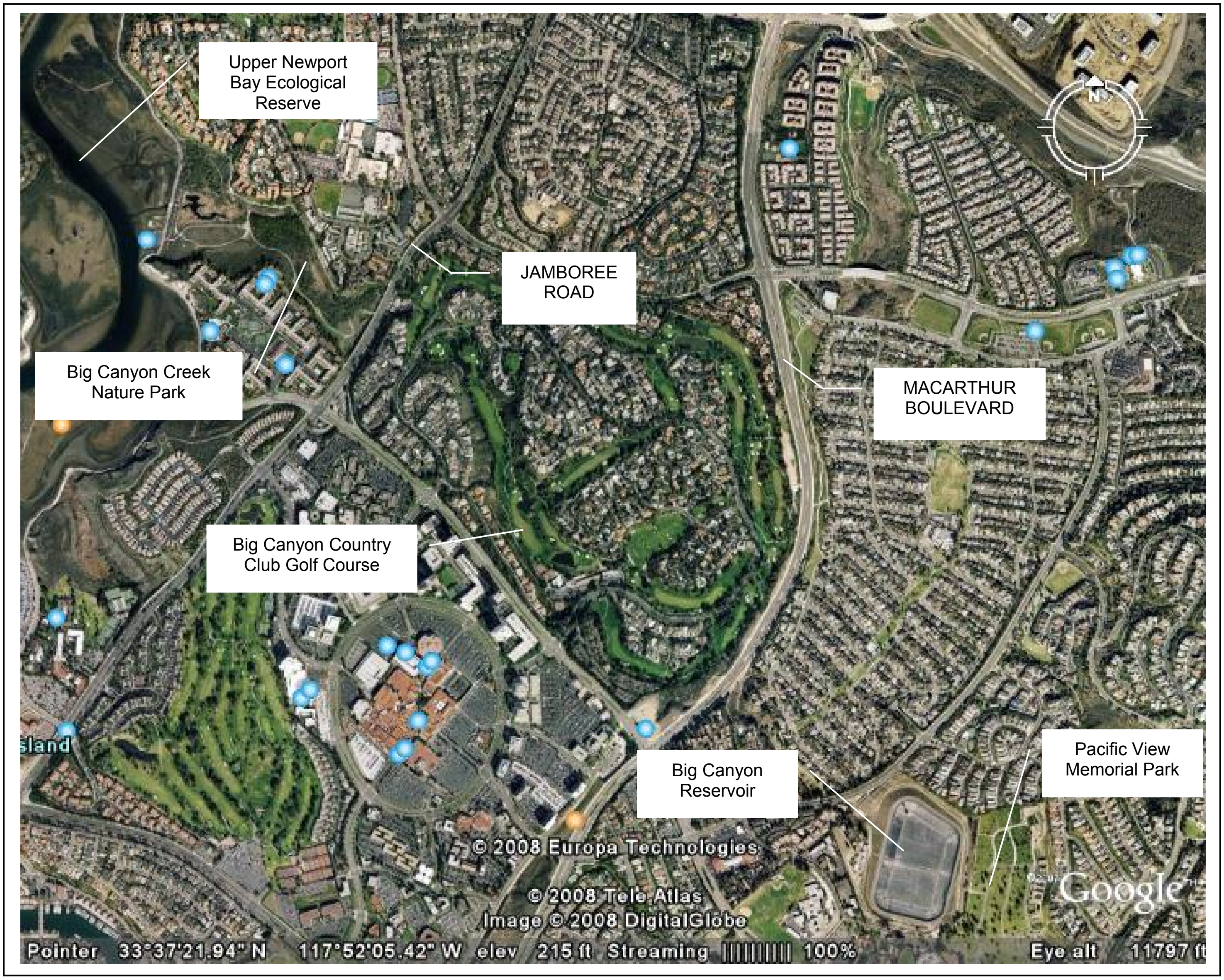

Figure 1. Map showing the location of the Big Canyon watershed and related features.

Figure 2. Proposed Sampling Locations for Big Canyon Creek Tributary Flows

BCW-SB-BCR surface water

BCR-PIEZ-I41 groundwater

● Selenium species ● Total selenium

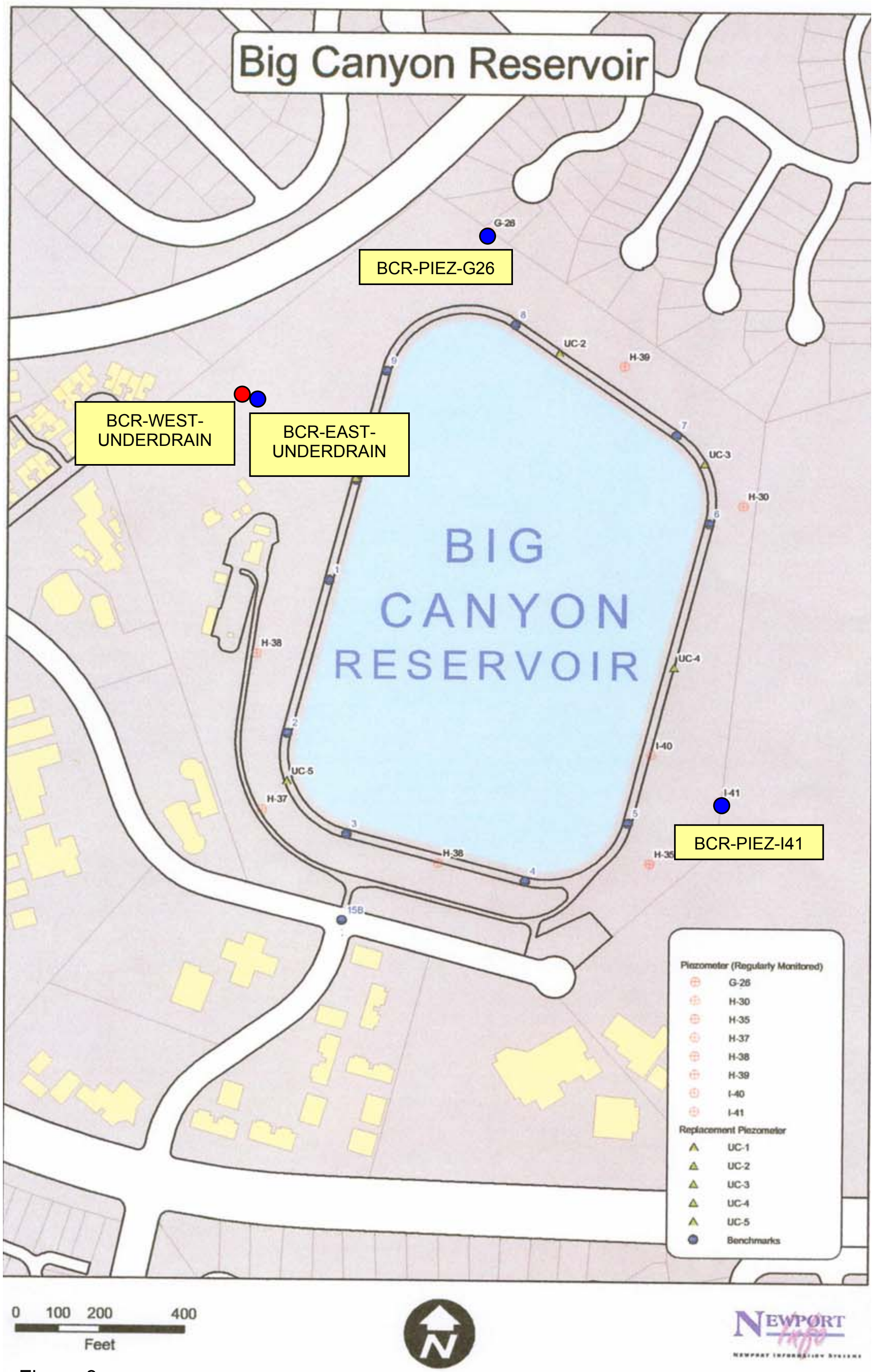

Figure 3

● Groundwater samples that will be submitted for analysis of total dissolved selenium and water quality parameters.

● Groundwater sample that will be submitted for analysis of total dissolved selenium, selenium species, and water quality parameters.

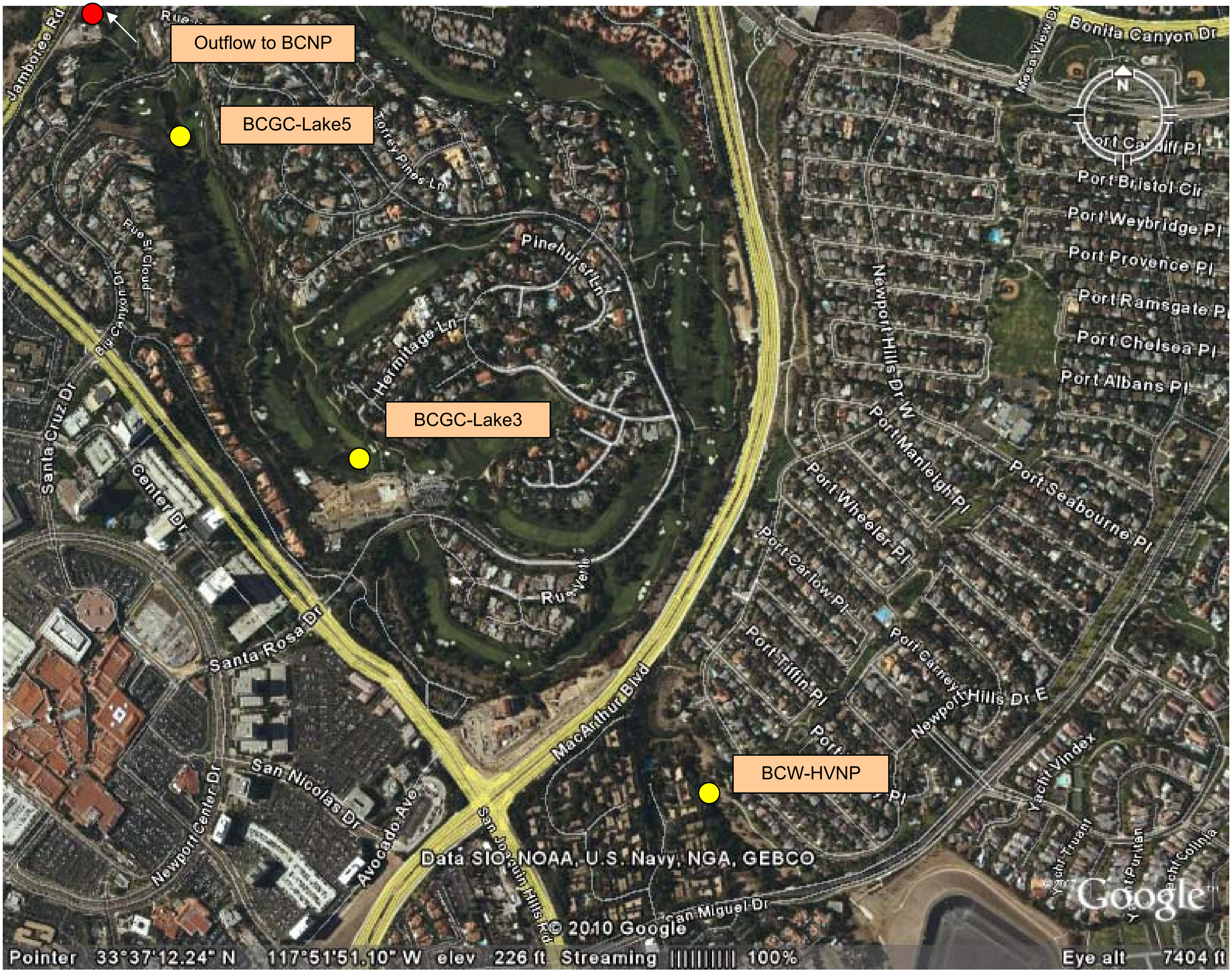

Figure 4. Proposed locations (●) for collection of water, sediment, particulates, algae, and fish/invertebrate tissue. The outflow from the golf course to Big Canyon Nature Park (●) will be sampled and analyzed for water quality parameters including total dissolved selenium, total recoverable selenium, selenium species, and trace metals, and total selenium in particulates.

Appendix A – SWAMP Measurement Quality Objectives

Table A1: Measurement Quality Objectives* - Conventional Analytes in Water

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (chlorophyll: n/a)	80-120% recovery RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (chlorophyll: per method)	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run as method appropriate	Per method
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analyte

*Unless method specifies more stringent requirements

Table A5: Measurement Quality Objectives* – Inorganic Analytes in Water, Sediment, and Tissue

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg); RPD<25%
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run when method appropriate	60-125% recovery
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL), unless otherwise specified by method
Field Blank, Equipment Blank	Per method	Blanks<RL for target analyte

*Unless method specifies more stringent requirements

Appendix B – Field Data Sheets

Notes to Standardize SWAMP Field Data Sheets
(For in the field use)

Key Reminders to identify samples:

1. **Sample Time** is the SAME for all samples (Water, Sediment, & Probe) taken at the sampling event. Use time of FIRST sample; important for COC.
2. **Group;** many diffrent ways to do a group, one suggestion is to create groups which assign trips to assess frequency of field QA

Collection Details

1. **Personnel**: S. Mundell, G Ichikawa (first person listed is crew leader)
2. **Location:** Use "openwater" in bay/estuary/harbor only if no distinguishable channel exists
3. **GRAB vs INTEGRATED**: GRAB samples are when bottles are filled from a single depth; INTEGRATED sample are taken from MULTIPLE depths and combined.
   a. GRAB: use 0.1 for subsurface samples; if too shallow to submerge bottle; depth =0
   b. INTEGRATED: -88 in depth sampled, record depths combined in sample comments
4. **TARGET LAT/LONG**: Refers to the existing station location that the sampling crew is trying to achieve; can be filled out prior to sampling
5. **ACTUAL LAT/ LONG**: is the location of the current sample event.
6. **HYDROMODIFICATION:** Describe existing hydromodifications such as a grade control, drainage pipes, bridge, culvert
7. **HYDROMOD LOC**: if there is an IMMEDIATE (with in range potentially effecting sample) hydromodification; Is the hydromodification upstream/downstream/within area of sample; if there is no hydromodification, NA is appropriate
8. **STREAM WIDTH and DEPTH**: describe in meters at point of sample.

FIELD OBSERVATIONS: (each one of these observations has a comment field in the database so use comment space on data sheet to add information about an observation if necessary)

1. **PICTURES:** use space to record picture numbers given by camera; be sure to rename accordingly back in the office. (StationCode_yyyy_mm_dd_uniquecode)
2. **WADEABILITY**: in general, is waterbody being sampled wadeable to the average person AT the POINT of SAMPLE
3. **DOMINANT SUBSTRATE**: if possible; describe DOMINANT substrate type; use UNK if you cannot see the dominant substrate type
4. **BEAUFORT SCALE**: use scale 0-12; refer to scales listed below.
5. **WIND DIRECTION**: records the direction from which the wind is blowing
6. **OTHER PRESENCE**: VASCULAR refers to terrestrial plants or submerged aquatic vegetation (SAV) and NONVASCULAR refers to plankton, periphyton etc. These definitions apply to vegetation IN the water at the immediate sampling area.
7. **OBSERVED FLOW**: Visual estimates in cubic feet/ second.
8. **WATER COLOR**: This is the color of the water from standing creek side
9. **WATER CLARITY**: this describes the clarity of the water while standing creek side; clear represents water that is clear to the bottom, cloudy may not be clear to bottom but greater than 4” can be seen through the water column.
10. **SedimentComp**: generally described sediments used for chemistry sample

Note: these reminders do not give all details needed to maintain equivalent SWAMP sampling protocols, they are strictly for “infield” use to help insure comparability of field observations.

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ		Entered in d-base (initial/date)	Pg of Pgs
***StationID:** ___ ___ ___ ___ ___ ___ ___ ___ ___	*Date (mm/dd/yyyy): / /	*Group:	*Agency:
***Funding:** ___ ___ ___ ___ ___ ___ ___ ___	ArrivalTime: DepartureTime:	*SampleTime (1st sample):	*Protocol:
***ProjectCode:**	*Personnel: *Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas		*PurposeFailure:

***Location**: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	**Lat (dd.ddddd)**	**Long (ddd.ddddd)**	OCCUPATION METHOD: Walk-in Bridge R/V __________ Other
GPS Device:	**Target:**		**-**	STARTING BANK (facing downstream): LB / RB / NA
Datum: NAD83 / Accuracy (ft / m):	***Actual:**		**-**	Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	None,Sulfides,Sewage,Petroleum,Smoke,Other_______	WADEABILITY: Y / N / Unk	BEAUFORT SCALE (see attachment):
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy	WIND DIRECTION (from):	
OTHERPRESENCE:	Vascular,Nonvascular,OilySheen,Foam,Trash,Other___		
DOMINANTSUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other_____________		
WATERCLARITY:	Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)	PRECIPITATION:	None, Fog, Drizzle, Rain, Snow
WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other_____	PRECIPITATION (last 24 hrs):	Unknown, <1", >1", None
WATERCOLOR:	Colorless, Green, Yellow, Brown	EVIDENCE OF FIRES:	No, <1 year, <5 years
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs		

DISTANCE FROM BANK (m):

STREAM WIDTH (m):

WATER DEPTH (m):

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other LOCATION (to sample): US / DS / WI /

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):

1: (RB / LB / BB / US / DS / ##)

2: (RB / LB / BB / US / DS / ##)

3: (RB / LB / BB / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/ BOTTOM/REP													
SUBSURF/MID/ BOTTOM/REP													
SUBSURF/MID/ BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated

COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other ________________

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS:

Modified 06/27/08

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ		Entered in d-base (initial/date)	Pg of Pgs
***StationID:** ___ ___ ___ ___ ___ ___ ___ ___ ___	*Date (mm/dd/yyyy): / /	*Group:	*Agency:
***Funding:** ___ ___ ___ ___ ___ ___ ___ ___	ArrivalTime: / DepartureTime:	*SampleTime (1st sample):	*Protocol:
***ProjectCode:**	*Personnel:	*Purpose (circle applicable): SedChem SedTox Habitat Benthic	*PurposeFailure:

***Location**: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	**Lat (dd.ddddd)**	**Long (ddd.ddddd)**
GPS Device:	**Target:**		-
	***Actual:**		-
Datum: NAD83 Accuracy (ft / m):	Same as Water/Probe Collection? YES NO		

OCCUPATION METHOD: Walk-in Bridge R/V __________ Other

STARTING BANK (facing downstream): LB / RB / NA

Point of Sample (if Integrated, then -88 in dbase)

DISTANCE FROM BANK (m):	STREAM WIDTH (m):
	WATER DEPTH (m):

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other
LOCATION (to sample): US / DS / WI / NA

Habitat Observations (CollectionMethod = Habitat_generic) **Only complete Sed Observations (bolded) if WQ Observations are already recorded**

WADEABILITY: Y / N / Unk

BEAUFORT SCALE (see attachment):

WIND DIRECTION (from): N W E S

SITE ODOR:	None,Sulfides,Sewage,Petroleum,Smoke,Other_______
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy
OTHERPRESENCE:	Vascular,Nonvascular,OilySheen,Foam,Trash,Other___
DOMINANTSUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other___________________
SEDODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other_____
SEDCOLOR:	Colorless, Green, Yellow, Brown
SEDCOMPOSITION:	Silt/Clay, FineSand, CoarseSand, Gravel, Cobble, Mixed, HardPanClay
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

PRECIPITATION:	None, Fog, Drizzle, Rain, Snow
PRECIPITATION (last 24 hrs):	Unknown, <1", >1", None
EVIDENCE OF FIRES:	No, <1 years, <5 years

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):

1: (RB / LB / BB / US / DS / ##)

2: (RB / LB / BB / US / DS / ##)

3: (RB / LB / BB / US / DS / ##)

Samples Taken (# of containers filled) - Method=Sed_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

COLLECTION DEVICE: Scoop (SS / PC / PE, Core (SS / PC / PE), Grab (Van Veen / Eckman / Petite Ponar)

COLLECTION DEVICE AREA (m2): _____________

Sample Type:	DepthCollec (cm)	Equipment Used	Sediment Only (Y / N)	Grain Size/TOC	Organics	Metals/HgT	Selenium	Toxicity	SWI	Archive Chemistry	Benthic Infauna	Benthic Coll. Area (m^2)	Sieve Size (mm)
Integrated Grab													
Integrated Grab													
Integrated Grab													
Integrated Grab													

COMMENTS:

Modified 06/27/08

Appendix C – Example Chain-of-Custody Forms

E.S.BABCOCK&Sons,Inc.
Environmental Laboratories est 1906

6100 Quail Valley Court Riverside, CA 92507
(951) 653-3351 • FAX (951) 653-1662
www.babcocklabs.com

Chain of Custody & Sample Information Record

Client:	Contact:	Fax No.	Additional Reporting Requests
Phone No.	email:		Include QC Data Package: ☐ Yes ☐ No
Project Name:	Turn Around Time: Routine *72 Hour Rush *48 Hour Rush *24 Hour Rush		FAX Results: ☐ Yes ☐ No Email Results: ☐ Yes ☐ No
Project Location:	*Lab TAT Approval: By:	*Additional Charges Apply	State EDT: ☐ Yes ☐ No (Include Source Number in Notes)

Sampler Information

Name: ______________________

Employer: ______________________

Signature: ______________________

Sample ID	Date	Time	# of Containers & Preservatives: Unpreserved	H_2SO_4	HCl	HNO_3	$Na_2S_2O_3$	NaOH	NaOH/Zn Acetate	NH_4Cl	MCAA		Total # of Containers	Sample Type: Routine	Resample	Special	Analysis Requested									Matrix	Notes

Matrix: DW = Drinking Water, WW = Waste Water, GW = Ground Water, S = Source, SG = Sludge, L = Liquid, M = Miscellaneous

Relinquished By (sign)	Print Name / Company	Date / Time	Received By (sign)	Print Name / Company

(For Lab Use Only) Sample Integrity Upon Receipt/Acceptance Criteria

Sample(s) Submitted on Ice?	Yes	No		Sample meets laboratory acceptance criteria?	Yes	No
Custody Seal(s) Intact?	Yes	No	NA	Permission to continue:	Yes	No
Sample(s) Intact?	Yes	No		Deviation/Notes: ______________________		
Temperature: ________	°C	☐ Cooler Blank		Signature/Date: ______________________		

Lab No. ______________

Logged in By/Date: ______________

Page ________ of ________

Rev. 3/09

Institute for Integrated Research in Materials, Environments, and Society

1250 Bellflower Blvd., Long Beach, CA, 90840, 562-985-2469, www.iirmes.org

CHAIN-OF-CUSTODY

page of

Client Name	
Address	
Project Contact Name	
Email Address	
Phone	
Project Name/Number	
P.O. Number	
Sampled By	

REQUESTED ANALYSES

	Client Sample ID / Description	Sample Date	Sample Time	Sample Matrix	Container Quantity	Container Type															
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

Type of Ice used:	Wet	Blue	None	
Sample Preservative:	Yes	No		
TURNAROUND TIME NEEDED:				

COMMENTS:

Project ID# ________________

RELINQUISHED BY

Signature:	DATE:
Print:	TIME:
Company:	

RECEIVED BY

Signature:	DATE:
Print:	TIME:
Company:	

Appendix C – Example Chain-of-Custody Forms

E.S.BABCOCK & Sons, Inc.
Environmental Laboratories est 1906
6100 Quail Valley Court Riverside, CA 92507
(951) 653-3351 • FAX (951) 653-1662
www.babcocklabs.com

Chain of Custody & Sample Information Record

Client:	Contact:	Fax No.
Phone No.	email:	
Project Name:	Turn Around Time: Routine *72 Hour Rush *48 Hour Rush *24 Hour Rush	
Project Location:	*Lab TAT Approval: By:	*Additional Charges Apply

Additional Reporting Requests

Include QC Data Package: ☐ Yes ☐ No
FAX Results: ☐ Yes ☐ No
Email Results: ☐ Yes ☐ No
State EDT: ☐ Yes ☐ No
(Include Source Number in Notes)

Sampler Information

Name: ______________________

Employer: ______________________

Signature: ______________________

Matrix

DW = Drinking Water
WW = Waste Water
GW = Ground Water
S = Source
SG = Sludge
L = Liquid
M = Miscellaneous

Sample ID	Date	Time	# of Containers & Preservatives: Unpreserved	H_2SO_4	HCl	HNO_3	$Na_2S_2O_3$	NaOH	NaOH/Zn Acetate	NH_4Cl	MCAA		Total # of Containers	Sample Type: Routine	Resample	Special	Analysis Requested									Matrix	Notes

Relinquished By (sign)	Print Name / Company	Date / Time	Received By (sign)	Print Name / Company

(For Lab Use Only) Sample Integrity Upon Receipt/Acceptance Criteria

Sample(s) Submitted on Ice?	Yes	No		Sample meets laboratory acceptance criteria?	Yes	No
Custody Seal(s) Intact?	Yes	No	NA	Permission to continue:	Yes	No
Sample(s) Intact?	Yes	No		Deviation/Notes: ______________________		
Temperature: ________	°C	☐ Cooler Blank		Signature/Date: ______________________		

Lab No. ______________________

Logged in By/Date: ______________________

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Institute for Integrated Research in Materials, Environments, and Society

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CHAIN-OF-CUSTODY

page of

Client Name	
Address	
Project Contact Name	
Email Address	
Phone	
Project Name/Number	
P.O. Number	
Sampled By	

REQUESTED ANALYSES

	Client Sample ID / Description	Sample Date	Sample Time	Sample Matrix	Container																
					Quantity	Type															
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

Type of Ice used:	Wet	Blue	None
Sample Preservative:	Yes	No	
TURNAROUND TIME NEEDED:			

COMMENTS:

Project ID# ________________

RELINQUISHED BY

Signature: DATE:

Print: TIME:

Company:

RECEIVED BY

Signature: DATE:

Print: TIME:

Company: