2005 NUTRIENT/SEDIMENT REMEDIATION MONITORING PLAN
AGREEMENT NO. 04-204-558-0

INTRODUCTION

The document is intended to satisfy the requirements for a Nutrient/Sediment Removal Monitoring Plan for the Nutrient/Sediment Remediation Project planned for the eastern end of Big Bear Lake. Funding for the Nutrient/Sediment Remediation Project is provided in part by a Proposition 13 grant (Agreement No. 04-204-558-0). Prior to and after project implementation, sampling and analyses efforts will be directed toward lake sediments/dredge material alone. Sampling and analyses during actual dredging activities will include in-situ water quality monitoring and potentially sampling of discharges from dewatered sediments (if Waste Discharge Requirements apply). The monitoring approach was established based on the need to determine if lake sediments contained any hazardous levels of Title 22 metals and select organics.

OBJECTIVES

The primary objectives of this Nutrient/Sediment Removal Monitoring Plan are to ensure the: 1) collection of data that enable a quantitative demonstration of the nutrient and sediment remediation value of the planned dredging activities, and 2) to creation of an initial analytical database and inventory for sediments removed from Big Bear Lake. The analytical data generated will provide measurements of certain chemical and physical properties of the sediment that are important to the identification of sediment removal methods, sediment disposal options and analytical characteristics. Secondary objectives are to establish a program that provides for an impact evaluation of on-going dredging/sediment removal activities through in-situ monitoring and, where necessary, evaluation of the remaining native soils after dredging activities are complete. Constituents proposed for analyses by this Nutrient/Sediment Removal Monitoring Plan consist of those required to demonstrate that lake sediments removed are non-hazardous as well as sediment nutrient characteristics, concentrations, and flux rates. Evaluation of sediment nutrient concentrations will include measurement of forms of phosphorus found in the sediment.

PROJECT APPROACH

The Big Bear Municipal Water District (BBMWD) plans to dredge approximately 220,000 cubic yards of sediments from the eastern end of Big Bear Lake. Due to the recently increased lake level, planned dredging activities under this project will be conducted in the “wet” using dredging equipment designed to work in such conditions. The Big Bear Lake Nutrient/Sediment Remediation Project is a pilot project for large-scale dredging activities in Big Bear Lake.

In November of 1999, the BBMWD investigated the feasibility of re-contouring the east end of Big Bear Lake to improve navigation and recreational uses of the lake in that area. Re-contouring of this area was thought to also provide for long-term control of aquatic plant growth in an area historically heavily dominated by aquatic macrophytes. Removal of sediments by dredging was also a means to remediate both nutrients and sediments for Big Bear Lake.

The Big Bear Lake Nutrient/Sediment Remediation Project area is located along the eastern shore of Big Bear Lake. The remediation area is bounded by Stanfield Cutoff to the east and extends to the west from the lake’s north shore at the existing East Ramp and across the lake to the south shore. The total size of the remediation project area is approximately 65 acres, with the planned excavation footprint encompassing about 15 to 18.5 acres.

DREDGE PROJECT SAMPLING & ANALYSIS PLAN

This Nutrient/Sediment Removal Monitoring Plan includes the following key elements.

- Sample Collection;
- Sampling Equipment and Techniques;
- Sample Preservation and Handling;
- Chain-of-Custody Procedures;
- Analytical Procedures;
- Field and Laboratory Quality Assurance/Quality Control.

The Nutrient/Sediment Removal Monitoring Plan describes the methods that will be used to generate, collect, handle, and analyze samples associated with the planned east end pilot dredge project.

Sampling Objectives

The objective of the sediment sampling effort is to obtain representative samples of the sediments removed by dredging and/or excavation activities. The purpose of sediment sampling and analyses is two fold. The first goal is to demonstrate whether or not the dredge material removed from the project area has hazardous characteristics that might affect dredge material disposal options. Dredged material will be analyzed for metals, chlordane, PCBs and DDT and archived in a sediment database. Questions regarding the presence of absence of hazardous characteristics will be addressed through conduct of specific analytical tests.

Another goal is to quantitatively establish the nutrient and sediment remediation value of the dredging activities. To determine the impact that dredging may have on sediments and nutrients in the water column in Big Bear Lake, nutrient studies/experiments will address two fundamental and inter-related questions. They are:

(i) What are the nutrient characteristics of sediments located within the project area, and what capacity do the sediments in the lake have to assimilate phosphorus? Also, how would the nutrient characteristics and phosphorus assimilation capacity change if the sediments were dredged to the target dredge depth?

(ii) What is the present rate of internal loading of nitrogen and phosphorus from the sediments to the water column and how would this rate change if sediments were dredged to the target dredge depth?

Nutrient questions will be addressed by a series of controlled analytical and laboratory experiments with intact sediment and dissected sediment cores as well as a defined set of physical, chemical, and biological conditions (ambient temperature, ambient oxygen level in the overlying water, coarse-filtered lake water, dark conditions).

Finally, the objective of in-situ monitoring for dredging activities is to evaluate real-time whether or not dredging/excavation activities are having a negative impact on water quality and also to ensure that 401 Certification criteria are being met.

SAMPLING PROCEDURES

Overview of Sampling Procedures and Location

Sediment and water quality sampling efforts will follow the applicable guidelines described below:

Sediment/Dredge Material Sampling

Prior to the actual implementation of dredging activities, the first set of sediment samples from the project area will be collected and analyzed for various constituents. A minimum of seventeen (17) sediment cores will be analyzed for metals, chlordane, PCBs, and DDT in accordance with California Title 22. Total nitrogen and total phosphorus analyses will be performed on these samples as well.

A minimum of fifteen (15) of the seventeen (17) sediment cores will have target sediment core length of 50-cm. Samples submitted for analyses will be homogenized over the entire length of the sediment core[1]. Of these fifteen (15) 50-cm sediment cores, at least two (2) sediment cores will be duplicated cores.
The remaining two (2) sediment cores will be taken from a discrete sediment depth ranging from 50 to 75-cm in depth. Discrete depth sediment core samples submitted for metals, chlordane, PCBs, and DDT analyses will consist of at least a 10 cm discrete depth core sample (e.g., 50 cm to 60 cm sediment depth).

For additional nutrient analyses, five (5) 50-cm long cores, representing three different sampling stations, will be collected for nutrient characterization analyses. Triplicate sediment cores will be collected at one sampling station and only a single sediment core at the remaining two sampling stations. Upon retrieval, each of these five (5) sediment

[1] Sediment core depths of 50 cm are considered representative of potential sediment accretion depths based on preliminary lake sedimentation rates provided by Dr. Matthew Kirby of Cal-State Fullerton.

cores will be sectioned into a minimum of five to six (5 to 6) segments in the following manner: 5-cm (2-inch) segments in the upper 10 cm (4 inches); and 10 cm segments for the remaining next 40 cm (16 inches). Sediment cores will be sectioned in the field prior to transportation to the selected analytical testing laboratory. These analyses will be performed both prior to dredging activities and repeated after dredging activities have been completed.

Next, an additional three sediment cores, from three separate sampling locations, will be collected for nutrient flux analyses. Sediment core length will range target a sediment core length of at least 10-cm. The sediment core samples will be collected and analyzed by Dr. Michael Anderson with the University of California at Riverside in accordance with sampling techniques used in the past.

Sediment sampling equipment may include a gravity coring device, a stainless steel piston coring device and/or a push core device. If vibrocore equipment is required, the vibrocore unit will be mounted on a pontoon boat or barge operated by the BBMWD.

Sediment core sampling locations will be determined by utilizing a grid overlay for applicable sediment quality zones within the project area. The size of individual grid cells must consider the project area. Recommended grid cell sizes could range from 0.25 to 1.0 acre. Sediment sampling locations will be selected based on using the appropriate grid overlay for the project area and amenability to sampling. Sediment cores will be taken from the center of each selected grid cell. GPS coordinates will be recorded for each sampling site.

Although the target recovery length for the majority of sediment core is set at 50 cm, the actual length of each recovered core will be recorded. Due to conditions at the site, complete core recovery is not guaranteed, therefore, the length of each sediment core will be recorded to determined how much of the targeted 50 cm was obtained. As long as sediment recovery for any given core is at least 20 cm, the sediment core will be deemed acceptable for analyses. For longer sediment cores, acceptable recovery length will be determined in the field.

Depending on the analyses planned for the collected sediment core, each individual core will be processed as follows:

Sediment cores collected for metals, chlordane, PCB, and DDT, total nitrogen, and total phosphorus analyses will be shipped to the laboratory after being homogenized over the entire length of the core in the field.

Sediment cores designated for nutrient characteristic analyses will be sectioned in the field using the following approach with respect to sediment core depth:

- 0 to 10 cm (sediment will be sectioned and analyzed in 5.0 cm intervals); and,
- 11 to 50 cm (sediment will be sectioned and analyzed in 10.0 cm intervals).

Sediment cores designated for nutrient flux studies will be maintained intact and shipped to the analytical laboratory in an upright position. The analytical requirements for sediment/dredge material are discussed in greater detail below.

Sediment sampling procedures will be conducted as follows:

<u>Detailed Sampling Procedures –Sediment/ Dredge Material</u>

1. The personnel operating the sediment core equipment must assure that the sediment cores collected are representative of the project area.

2. Blank field log sheets will be used to manually record data in the field. Copies of the completed field log sheets will be provided to the Regional Board. Also manually recorded data will be transcribed into a sediment database the will be maintained by the BBMWD.

3. The exact type of equipment used to collect sediment cores must be recorded.

4. At each sediment core sampling location, latitude and longitude coordinates will be recorded using a field GPS system.

5. Select the core tube type and length (i.e., Lexan or stainless steel). It is recommended that the core tube have an outer diameter of 3-inches and a length of at least 2 feet. Lexan tubing will be used for soft sediments and stainless steel tubing for coarse sediment. Stainless steel tubing will be considered acceptable for samples submitted for metal analyses since this metal is fairly non-reactive.

6. Follow the established Standard Operating Procedures (SOP) for collecting the sediment core based on the type of sediment coring equipment used.

7. Record the length of each sediment core recovered. The length of the cores recovered in Lexan tubing will be determined by direct measurement. The length of cores recovered in stainless steel tubing will be determined indirectly by tapping the core with a metal rod from the top to the bottom. The spot where the pitch of the sound changes corresponds to the approximate top of the recovered core.

8. For each successful core recovery, record the following parameters: 1) date 2) time of recovery, 3) actual sample location coordinates, 4) water depth, 5) core tube material (stainless steel or Lexan), 6) core penetration depth or length, and 7) other relevant observations.

9. If the sediment sample is not processed in the field, store the sediment core vertically in a core tube rack or similar structure on ice. Use a tarp to keep the sediment cores in the dark until they are transported to shore for further processing.

10. Sediment core samples will be processed by one of the three following methods: 1) homogenizing the entire length of the sediment core, 2) taking a composite of discrete core lengths for one boring event, or 3) taking a discrete sample along the length of a core and submitting for analyses.

11. The date, time and sample identification will be recorded on the labels of each sample bottle as the samples are being collected. This information will also be documented in the laboratory logbook along with any significant observations.

12. Samples will then be packed and shipped in the manner described below.

In-Situ Monitoring

An in-situ monitoring program will be conducted when dredging activities are underway. In-situ monitoring will be implemented with the initiation of dredge project. At a minimum, two sampling locations will be established for in-situ monitoring purposes. The location of the in-situ monitoring stations will be established as follows:

- A single monitoring station will be established approximately 100 feet from the most active dredge or dewatering activity area. Monitoring and/or samples collected for turbidity, dissolved oxygen, water temperature, and pH analyses will be collected at a depth of three (3) feet or one (1) meter below the water surface and at three (3) feet or one (1) meter above the bottom of the lake (where possible). Monitoring will be conducted in the area of the most visibly turbid water at the distances and depths specified in the 401 Certification.
- Monitoring for turbidity, dissolved oxygen, pH and temperature will be conducted daily in the lake until a revision in monitoring frequency is approved by the Regional Board.
- A reference or background sampling station will be established in an undisturbed portion of the lake at the same water depth as the station located near the dredging or dewatering activity. Samples from the reference station will be obtained at the same water depths as the other station and on the same day within four hours of the other site being monitored.
- To verify turbidity measurements with field instrumentation, turbidity samples will be collected and sent to a certified laboratory on at least two occasions.
- Field instruments will be maintained and calibrated properly before each use.
- Monitoring results will be submitted to the Regional Board within at least 48 hours of testing by electronic mail.
- Visual observations, during dredge operations, must be performed daily. Visual observations must be recorded in a logbook and include an assessment of turbidity plumes on all sides of the dredge project.

The in-situ monitoring program will be conducted daily during the first month of dredge operations. If turbidity and dissolved oxygen measurements comply with the 401 Certification requirements, the BBMWD will then request a change in the monitoring frequency required. The sampling locations (i.e., GPS coordinates), as well as the depths at which samples are taken, will be recorded on field log sheet established for the project. Copies of the field log sheets and all data recorded as a part of the monitoring program will be submitted to the Regional Board. The analytical requirements are discussed below.

Field QA/QC Program

Reliable analytical measurements of environmental samples require continuous monitoring and evaluation for the analytical processes involved (i.e., quality assurance). To ensure optimum valid data generation, a quality control program must be incorporated into the sample collection and analytical laboratory program. Specific quality control samples, collected and analyzed by the appropriate methods, are introduced into the laboratory as a check on the overall analytical system. These samples are defined below and are summarized in this section. These methods will be described in greater detail in the Quality Assurance Project Plan (QAPP) specific to this Nutrient/Sediment Remediation Project.

QA/QC Duplicates

Duplicate samples are traditionally defined as one of two sample aliquots collected simultaneously or sequentially and placed into separate bottles. Duplicate samples will be collected during the sediment core sampling as described above. The duplicate will be collected immediately after the primary sample containers have been filled. No duplicate samples will be required for in-situ monitoring efforts.

QA/QC Blanks

Standard sampling programs usually incorporate a routine collection and analyses of three types of QC blanks:

- Trip Blanks;

- Field Blanks; and,
- Temperature Blanks.

Since only sediment/dredge material and in-situ monitoring is required for this project, only temperature blank QA/QC samples will be collected for this project effort. Temperature blanks are designed to assess the interior temperature of the cooler during sample shipment. One temperature blank will be included with each sample shipping container. Temperature blanks will be prepared in the laboratory by pouring reagent grade water into a sample container. The temperature blank will be packaged and shipped along with the field samples. Upon arrival at the laboratory, the temperature of the sample will be taken and recorded on the chain-of-custody form or in the laboratory logbook.

Field Documentation

Daily logs will be kept in at the BBMWD documenting the sampling activities for the entire dredge project. These daily logs will be kept in a bound notebook as well as recorded on any of the field log sheets submitted to BBMWD. All entries will be made legibly, in indelible ink, signed, and dated. Information that will be recorded in the field notebooks include:

- Date and time of sample collection (including duplicates);
- Deviations from sampling procedures presented in this Sampling and Analysis Plan; and,
- Any pertinent or unusual observations made regarding the samples (odors, appearance, etc.), or dredging activities;

The daily logs are intended to provide sufficient data and observations to enable participants to reconstruct events that occur during the project and to refresh the memory of field personnel. The daily log entries should be factual, detailed, and objective.

<u>Corrections to Documentation</u>

All original data recorded in the daily logs and on sample identification labels, and chain-of-custody records, are written in waterproof ink. These documents are not to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one person, that individual may make corrections simply by striking out the error with a single line and entering the correct information. The erroneous information should not be obliterated. If possible, any errors discovered on the document should be corrected by the person who made the entry. All corrections must be initialed.

SAMPLE ANALYSES

General Requirements

In accordance with the general monitoring requirements established by the Santa Ana Regional Water Quality Control Board (RWQCB), all laboratory analyses will be performed in accordance with test procedures under California Title 22 and/or 40 CRF 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants". Chemical, bacteriological, and bioassay analyses will be conducted at a laboratory that is certified for such analyses in the California Department of Health Services or USEPA or at any laboratory approved by the Executive Officer of the Regional Board. All applicable sampling and sample preservation will be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). Nutrient concentrations and nutrient flux methods will be performed in accordance with the laboratory SOPs established by the University of Florida and/or the University of California at Riverside.

Dredged Material Sample Analyses

Sediment analyses already performed or planned for the Big Bear Lake Nutrient/Sediment Remediation Project include the following constituents:

- Physical and Geotechnical Properties;
- Title 22 Metals (EPA Method 6010);
- Title 22 Organics[2] (EPA Method 8080);
- Nutrients (Total Nitrogen, Phosphorus Forms); and,
- Nutrient Flux Rate (Ammonia and Soluble Residual Phosphorus);

Physical and Geotechnical Properties

A number of physical and geotechnical properties of the east end sediments designated for removal by the Big Bear Lake Nutrient/Sediment Remediation Project have already been analyzed. The results of these studies are found in the documents listed in the Mitigated Negative Declaration for this project (see Initial Study and Environmental Checklist report).

Metals and Select Organics

Metals and select organic analyses (i.e., DDT, chlordane and PCBs) are now required by the Santa Ana Regional Water Quality Control Board for the removal and land disposal of sediments from Big Bear Lake. According to the Regional Board, if dredged material is to be disposed of on land or landfill, then the dredged sediment material must be tested under California Title 22 to determine whether the material is hazardous or not. In most other states, RCRA regulations apply and the test performed is the Toxicity Characteristic Leachate Procedure (TCLP). In California, the state has selected the Waste Extraction Test (WET).

For sediment/dredged material that will be stored or disposed of on land, initial screening chemical analyses will determine whether or not dredged material is hazardous. A minimum of seventeen (17) sediment core samples will be analyzed for the metals, PCBs, and organic pesticides as presented in the table below. These sediment core results will then be compared to the Total Threshold Limit Concentration (TTLC) values for each constituent analyzed. Dredged sediment material will immediately be considered HAZARDOUS if the result for any given constituent is greater than the corresponding TTLC value given below. For organic pesticide and PCBs, the dredged sediment material will be considered NON-HAZARDOUS if the result for a given sediment core is below the TTLC value. For all metals, if the dredged sediment material result is lower than the TTLC value, BUT greater than 10 times the Soluble Threshold Limit Concentration (STLC) value, the Waste Extraction Test (WET) must be performed to determine the amount of extractable substance in the dredge material and to evaluate whether the extracted sample

[2] Specifically, DDT, Chlordane and PCBs.

result will exceed the STLC value. The original sediment core sample may be used to evaluate STLC concentrations in dredged sediment material.

If an extractable metal result (in mg/L) exceeds the STLC value, then the dredged sediment material is considered HAZARDOUS. If the metal result (in mg/L) is less than the STLC values, it is considered NON-HAZARDOUS.

Parameter	**STLC (mg/L)**	**TTLC (mg/kg)**
Antimony	15.0	500
Arsenic	5	500
Barium	100	10,000
Beryllium	0.75	75
Cadmium	1	100
Chromium IV	5	500
Chromium III	5	2,500
Cobalt	80	8,000
Copper	25	2,500
Lead	5	1,000
Mercury	0.2	20
Molybdenum	350	3,500
Nickel	20.9	51.6
Selenium	1	100
Silver	5	500
Thallium	7	700
Vanadium	24	2,400
Zinc (Zn)	250	5,000
Chlordane	0.25	2.5
DDT, DDE, & DDD	0.1	1.0
PCB	5.0	50.0

Acceptable analytical methods, including Method Detection Limits (MDL) and Practical Quantification Limits (PQL) are given below.

Parameter	**Method**	**MDL (mg/kg)**	**PQL (mg/kg)**
Antimony	EPA 6010 B	0.3	1.0
Arsenic	EPA 6010 B	0.3	1.0
Barium	EPA 6010 B	0.04	0.1
Beryllium	EPA 6010 B	0.02	0.1
Cadmium	EPA 6010 B	0.05	0.2
Chromium IV	EPA 6010 B	0.05	0.6

Chromium III	EPA 6010 B	0.05	0.6
Cobalt	EPA 6010 B	0.06	0.2
Copper	EPA 6010 B	0.08	0.2
Lead	EPA 6010 B	0.2	1.0
Mercury	EPA 6010 B	0.04	0.05
Molybdenum	EPA 6010 B	0.07	0.2
Nickel	EPA 6010 B	0.06	0.2
Selenium	EPA 6010 B	0.2	0.2
Silver	EPA 6010 B	0.05	0.5
Thallium	EPA 6010 B	0.1	0.2
Vanadium	EPA 6010 B	0.1	5.0
Zinc (Zn)	EPA 6010 B	0.5	0.6
DDT	EPA 8080	0.33	1.0
Chlordane	EPA 8080	0.14	1.4
PCBs	EPA 8080	0.65	6.5

Again, sampling for metal and select organic analytical constituents must be conducted prior to the initiation of dredging activities. Ideally, sample collection will be performed about one month prior to the desired start date of dredge activities.

Nutrient Concentrations and Nutrient Flux Analyses

Eutrophication of lakes can be attributed to (i) increased external inputs of nutrients from point and non-point sources and/or (ii) accelerated internal nutrient cycling associated with change in environmental conditions of sediments and water column. For many lakes, eutrophication is often linked to only external sources of nutrients. However, internal nutrient sources can be equally important, especially in lakes or reservoirs with large reserves of organic and inorganic bound nutrients. Previous studies indicate that the majority of nutrient loading to Big Bear Lake originates from internal sources, especially during average and dry precipitation years. Depending on lake water levels, the internal nutrient load in Big Bear Lake can substantially influence water quality.

Analyses of sediment nutrient concentrations and characteristics and sediment nutrient flux rates are critical to quantifying the nutrient remediation achieved by this pilot Nutrient/Sediment Remediation project. Although the east end project area was primarily selected for dredging based on beneficial use designation(s), analyses of these constituents enables a quantitative demonstration of the nutrient remediation benefits achieved by dredging activities. The literature indicates that lake sediments generally function as a net long-term sink for total phosphorus (Reddy, et al., 2002). The forms and amounts of phosphorus in Big Bear Lake are a function of phosphorus input from external sources (e.g., urban activities) and the interchange of phosphorus among the various sediment and water phosphorus components. Sediment and water interchange of phosphorus occurs through both chemical and biochemical reactions. Typically, the direction of net transport of particulate phosphorus is from the overlying water column to the lake sediments, while the direction of net transport of soluble forms of phosphorus (or flux) is from the sediments to the overlying water column.

Examination of total nitrogen as well as the forms of phosphorus in lake sediments will provide a means to determine the potential water quality impacts of partial or complete dredging of accumulated lake sediments. It is anticipated that the results will indicate that dredging will remove lake sediments already enriched with labile pools of nitrogen and phosphorus and reduce the nitrogen and phosphorus flux rates into the overlying water column. This would then decrease in the internal load of nutrients from lake sediments (Reddy, et al., 2002).

Analyses performed on sediment cores will include some or all of the following:

1. Total Kjedahl Nitrogen (TKN);
2. Inorganic form of phosphorus – including,
   - Porewater phosphorus (readily bioavailable);
   - Iron- and aluminum bound phosphorus (slowly available);
   - Calcium-and magnesium bound phosphorus (very slowly available); and,
   - Residual non-reactive phosphorus
3. Organic forms of phosphorus – including,
   - Dissolved organic phosphorus (readily bioavailable);
   - Microbial biomass phosphorus (readily bioavailable);
   - Fulvic acid bound phosphorus (slowly available);
   - Humic acid bound phosphorus (very slowly available); and,
   - Residual organic phosphorus.
4. Total iron, total aluminum, total organic carbon , and loss on ignition (LOI)
5. Oxalate extractable iron and aluminum
6. HCl-extractable calcium and magnesium

Sediment intervals will be analyzed using chemical extraction schemes as described by Olila et al., (1994) and Moore et al., (1998) or similar techniques. Note: Previous analyses of forms of phosphorus in the sediment at Big Bear Lake indicated that the relative proportion of calcium-bound phosphorus increases from west to east.

Sediment nutrient flux studies should also correspond with sediment chemical analyses. Intact sediment cores for nutrient flux studies will be collected from the same general location as the sediment cores processes for chemical analyses. Sediment cores for these efforts will be approximately 10 to 20 cm in length. Ammonia and dissolved reactive phosphorus release from sediment will be calculated based on accumulative release at each water column exchange cycle (Reddy, et al., 2002, or similar approach). Specific field and laboratory methods used for nutrient evaluations are still under development at this time.

<u>In-Situ Monitoring Analyses</u>

In-situ monitoring and/or samples collected will be analyzed for turbidity, dissolved oxygen, water temperature, and pH. The turbidity measurements will be recorded on-site using an YSI multi-parameter probe (or similar water quality instrument), but at least two turbidity samples must also be submitted to a certified laboratory for supporting confirmation of meter results/readings. For dissolved oxygen readings, the determination may be made on-site only using an acceptable and calibrated probe. Other required analyses at in-situ monitoring stations include on-site analyses of pH, and water temperature.

<u>Native Soils Analyses</u>

As described above, analyses of native soils/or lake sediments exposed by dredging activities will be conducted after dredging activities are complete. Analyses of native soils for metals and organics will not be required if the results of initial sediment core sampling efforts indicate that sediment results for metals, chlordane, PCBs and DDT are deemed not hazardous. The results of all sediment analyses will be compared to the National Oceanic & Atmospheric Administration (NOAA) sediment guidelines for freshwater sediments (i.e., the TEL and PEL).

SAMPLE PRESERVATION AND DESIGNATION

Sample Containers, Preservation, and Holding Times

To ensure that sample bottles are uncontaminated, the containers should be thoroughly washed and sterilized by the contracted laboratory. For analyses of dredged sediment material, the laboratory will use only the analytical methods permitted by California Code of Regulations, Title 22 and USEPA procedures as outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods," (SW-846), latest edition. For in-situ monitoring samples, all sampling and sample preservation will be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). Further, all laboratory analyses will be performed in accordance with test procedures under 40 Code of Federal Regulations (CFR) 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants", or alternative methods that have been approved by the Regional Board and/or EPA.

Sample Designation

Sample Identification

Most methods of chemical analysis for environmental samples must be accomplished within a specified holding time. Careful tracking of the analytical status of samples is required to ensure that the holding times are not exceeded.

Sample tracking will be accomplished by assigning each sample a unique number as it is received at the laboratory. This number will be traceable back to the date, time, and sampling location.

Sample Labels

Sample labels are necessary to prevent misidentification of samples. A label will be attached to all sample containers at the time of collection. The labels will be completed in indelible ink to remain legible under wet conditions and will contain the following information:

- Sample Identification Number;
- Initials of Collector; and,
- Date and time of collection.

SAMPLE HANDLING AND SHIPMENT

Sample Custody

An essential component of the sampling program is ensuring that the integrity of individual samples is maintained from the time of collection through analyses to final storage or destruction. Possession of the samples must be traceable identifying all personnel handling the samples (e.g., sampler, transporter, and analyst). To document sample possession, chain-of-custody procedures and records are maintained and followed.

The designated sampling personnel will be responsible for the custody of the samples collected until they have been properly transferred to a courier. The courier will transport samples to the selected analytical laboratory that will then complete the chain-of-custody paper work.

Chain-of-Custody Record

Chain-of-custody (COC) forms will be used to document the identification and the integrity of the samples collected. To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a COC form will be filled out for each sample set and type. Specifically, separate COC will be completed for sediment cores and in-situ water samples collected for analyses. The COC form will contain the following information:

- Sample station identification;
- Signature of the collector;
- Date and time of collection;
- Sample type (sediment vs. water);
- Number of containers;
- Parameters requested for analysis;
- Signature of person(s) involved in the chain of possession; and,
- Pertinent comments and/or remarks.

The individual placed in charge of shipping samples to the laboratory is also responsible for completing the COC form including referencing all applicable QA/QC samples, signing the form, and noting the date and time of shipment. This individual will also inspect the form for completeness and accuracy. Any changes made to the COC form shall be initialed by the person making the change. Copies of chain-of-custody documentation will be kept at the BBMWD Office for a minimum of three years.

Transfer of Custody of Shipment

When the possession of samples is transferred, the individual relinquishing the samples must sign, date, and time the COC document. Samples sealed in a cooler and submitted to a courier are considered secure until receipt at the laboratory. Sealed coolers will be transported by overnight air courier to the laboratory or hand-delivered. The COC form will be transported inside the shipping containers.

Sample Packaging and Shipping

The collected samples are to be delivered to the laboratory for analyses as soon as practicable. Any delay in the receipt of the samples by the laboratory could necessitate a re-sampling and analysis effort.

Sample Packaging

- Each sample will either be sealed with electrical tap around the sample lid or placed in a sealed plastic bag (Ziploc) to prevent leakage.
- Glass sample containers will be wrapped with plastic insulating material to prevent contact with other sample containers and the inner walls of the cooler.
- Ice (double bagged in plastic trash bags) and/or reusable "blue ice" packs will be placed in the cooler with the samples to maintain the samples at 4° C during shipment.
- The COC record will be enclosed in a waterproof plastic bag and taped to the underside of the cooler lid.

- Each cooler prepared for shipment will be securely taped shut with reinforced or other suitable tape (strapping tape).

Shipping Containers

Samples will be packaged in thermally insulated, rigid coolers, with the completed chain-of-custody form placed inside of the shipping container, unless otherwise noted.

Marking and Labeling

When shipping a cooler by commercial carrier, such as Federal Express, all coolers should be shipped “Priority Overnight” and air bills will be completed and attached to the exterior lids of the containers.

Shipping Address

The shipping addresses for two analytical labs previously utilized by BBMWD are provided below. These labs can conduct analyses of sediment or in-situ water quality samples.

E.S. Babcock & Sons Laboratory
Environmental Laboratory Certification #1156
6100 Quail Valley Court
Riverside, California 92502-0704

University of California at Riverside
Environmental and Soil Sciences Department
Riverside, California

University of Florida
Soil and Water Science Department
106 Newell Hall, P.O. Box 110510
Gainesville, Florida 32611
(352) 392-1803 (ext. 317)

Sample Control at the Laboratory

The sample receipt personnel at the laboratory will open the container and perform an initial inspection of the contents to check for evidence of breakage and/or leakage. The container will be inspected for COC documents and any other information or instructions. The sample custodian will verify that all information on the sample bottle labels is correct and in accordance with the COC documents and will sign for receipt. If discrepancies are noted between the COC and the sample labels, the dredge project contact will be notified immediately. All samples will be stored in a refrigerated, secure area. Samples will be removed from storage as needed by the analyst.

QUALITY ASSURANCE OBJECTIVES

The data quality objectives established for the sampling program are based on project requirements and are designed to ensure that the data generated during the project are of known and acceptable quality. This section of the SAP delineates the QA objectives for each of the critical measurements in terms of the data quality indicators: precision, accuracy, completeness, method detection limits, representativeness, and comparability. Actual acceptance criteria for the various QA/QC analyses associated with each method will be determined in the future and will incorporate the recommendation made by the State of California Surface Water Ambient Monitoring Program (SWAMP).

Data Quality Indicators

Precision: Precision objectives for critical project measurements will be based on the relative percent difference (RPD) between duplicates. A minimum of one duplicate will be collected as described above for dredge sediment material and evaluated for precision.

Accuracy: Accuracy for the target analyses will be evaluated by spiking a blank sample with a known amount of target compounds. The percent recovery of the target compounds will be calculated to determine the accuracy of the measurement.

Completeness: Completeness objectives for data capture for this project are expected to approach 90 percent. Completeness is defined as the ratio of the number of complete and valid measurements to the total number of measurements planned.

Reporting Limits: Reporting limit (RL) conventions will be used for sample analyses. Reporting limits may vary based on the laboratory selected to conducted analytical work, the constituent analyzed, and the type of sample collected. The Reporting Limit (RL) is based on an evaluation of the Practical Quantitation Limits (PQLs) for each lab and the expected method performance in routine water and soil matrices. The PQL is the lowest concentration a method can reliably achieve within limits of precision and accuracy and is derived from empirical, matrix-free method performance studies.

Representativeness: A well-defined sampling strategy ensures that the samples collected are representative of the dredge sediment material to be tested during this project.

Comparability: The use of standard, accepted California Code of Regulations or USEPA methods achieves comparability of measurement data. Reporting the data in standard units of measure as specified in the methods, adhering to the method defined calibration procedures, and, when possible, meeting the method detection limit, all contribute to the comparability of the data.

LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Reliable analytical measurements of environmental samples require continuous monitoring and evaluation for the analytical processes involved (i.e., quality assurance). To ensure optimum valid data generation, a scientifically sound and strictly adhered to quality control program will be incorporated into the sample collection and analytical laboratory program (Data Quality Objectives = Level 3). Such a QC program employs a prescribed sequence of routine procedures to control and measure the quality of the data generated. Inherent in this program is the use of scientifically sound sample collection procedures, approved analytical methods, and calibration protocols, as described previously. Additionally, specific quality control samples, collected and analyzed by the appropriate methods, are introduced into the laboratory as a check on the overall analytical system. These samples are defined below and are summarized in this section along with frequency and acceptance criteria.

Laboratory QA/QC

The contracted laboratory for this dredge project will be responsible for implementing the procedures described by the laboratory's QA Plan. This QA/QC program should be consistent with recommended USEPA methodologies and procedures (particularly USEPA SW-846, most recent edition) and as a minimum includes the following components:

- Standards
- Duplicates
- Operator Training
- Laboratory blanks
- Spiked samples
- Instrument Maintenance

The QA/QC program of the laboratory will describe:

- Laboratory Methodologies;
- Personnel Qualifications;
- Analytical Methods; and,
- Holding Times.

To ensure that the lab has an adequate QA/QC program in place, laboratory certification and/or approval by the Executive Officer of the Santa Ana Regional Water Quality Control Board is required.

<u>Matrix Spike/Matrix Spike Duplicate (MS/MSD)</u>

The use of a MS/MSD pair is a means of measuring both precision and accuracy in an analysis. A matrix spike is an aliquot of a sample fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. A second aliquot of the matrix spike, a matrix spike duplicate, is spiked in order to determine the precision of the method.

<u>Laboratory Control Samples</u>

Laboratory control samples (LCS) are blank samples spiked with known amounts of target analytes that are carried through the entire extraction and analysis procedure. Spiking levels are constant over time and are known to the analyst. Since LCS should yield consistent results, anomalous results indicate a laboratory analytical problem, not a matrix problem. In contrast, poor MS/MSD and surrogate results are often inconclusive in differentiating laboratory and matrix problems. In addition, the LCS provide for an indication of accuracy. If conducted, the laboratory will determine the appropriate spiking level to use in the LCS based upon their calibration range and internal standard operating procedures.

Method Blanks

All parameters analyzed in the laboratory require the analysis of a method blank with each batch of samples analyzed, or every 20 samples, whichever is more frequent. A method blank consists of an aliquot of reagent water carried through all preparation and analysis steps, and is designed to document that the analytical equipment and reagents are free of contamination and/or interferences. If method blanks are observed to be above the PQL for a given parameter, the laboratory will notify the dredge project contact.

The selected analytical laboratories will provide specific laboratory methodologies and personnel qualifications upon request.

DATA MANAGEMENT, VALIDATION, AND REPORTING

Data management procedures are established in this SAP to effectively process and archive data such that relevant data descriptions (e.g., sample locations, sample numbers, procedures, methods and analysis) are readily assessable and accurately maintained.

Copies of all analytical results, field log datasheets, and chain-of-custody records will be maintained on file at the BBMWD office. The project contact must also maintain a complete copy of dredge project records. Hard-copies of the data as well as electronic reports of analytical data generated must be supplied to the BBMWD by the selected analytical laboratory.

Data should be reported according to accepted practices of quality assurance and data validation as outlined in USEPA SW-846, most recent edition. The following data should be included:

- Replicate samples;
- QA/QC samples (including calibration samples and spikes);
- Identification of outlier values;
- Reporting limits; and,
- Reporting of results determined to be below detection limits.

Data Validation

The measurement data generated by the analyst are validated in several ways. Strict adherence to the analytical methods, and ensuring that the instrumentation employed was operated in accordance with defined calibration procedures, are critical functions to determining the validity of the generated data.

Within the laboratory, raw data reductions are verified by an independent analyst or a section QC specialist. A 100 percent review of the batch data is a routine procedure regardless of whether problems or errors are discovered during the data review. All QC samples are compared to QA objectives for precision and accuracy; any outliers are immediately flagged. Analytical outlier data area defined as those QC data lying outside of a specific limit for precision or accuracy for the specific method. Upon identification of an outlier, a nonconformance notation must be provided in the analytical report with an explanation of for the reasons for the failure, such as instrumentation problems, calculation problems or difficulties with sample volume, spike volumes or sample matrix. Similarly, any outlier surrogate recoveries (for organic analyses) require investigation. The laboratory must notify the dredge project contact promptly in order to determine whether re-analysis is justified. If re-analysis of the sample (when feasible) indicates sample matrix interferences, a statement to that effect will accompany the original data and the entire batch will be considered acceptable. If the reason for the failure cannot be determined, and re-analysis indicates that the original analysis was in error, the effect on the analytical batch will be evaluated, and all interpretations and corrective actions documented. As necessary, qualifying statements will describe any problems encountered and any restrictions on the use of the data.

Data Reporting

All original laboratory data will be recorded in a permanent manner, and will be readily traceable through all the steps of the data generation, validation, and review. Field measurements will also be reported in an electronic, tabulated summary form.

All raw data associated with this project will be retained by the laboratory for a minimum of three years. Sample remains will be retained by the laboratory for a minimum of 30 days after the final report has been delivered to BBMWD.

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