QUALITY ASSURANCE PROJECT PLAN
Montezuma Wetlands Project
Solano County, California

Revision: 1

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Prepared for
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A Montezuma Wetlands Project Technical Review Team Recommendations for Changes to Pre-Breach Water and Sediment Quality Monitoring
B Regional Water Quality Control Board San Francisco Bay Region, Self-Monitoring Program for the Montezuma Wetlands Restoration Project, Order No. R2-2012-0087
1.0 INTRODUCTION

On behalf of Montezuma Wetlands LLC (MWLLC), Acta Environmental (Acta) in collaboration with Lipton Environmental Group (LEG) has prepared this updated Quality Assurance Program Plan (QAPP) for sediment, water and tissue monitoring during the pre-breach period (prior to levee breaching and restoration of tidal action) at the Montezuma Wetlands Project site (“Montezuma” or “the project”). Concentrations of chemicals of concern (COCs) in sediment, water and tissue are monitored in accord with this updated QAPP during the pre-breach stage of each of the four project phases. Results are compared to relevant criteria to assess project performance and inform adaptive management decisions. Adaptive management options and decisions are reviewed with Montezuma’s Technical Review Team (TRT) that is administered by the San Francisco Estuary Institute. This QAPP reflects the recommendations of the TRT and the requirements of the project’s Regional Water Quality Control Board (RWQCB) Waste Discharge Requirements (WDR) and Self Monitoring Plan (SMP) updated November 2012. This QAPP was prepared using guidelines developed by the Surface Water Ambient Monitoring Program (SWRCB 2008, 2013) and the U.S. Environmental Protection Agency (USEPA 2001, 2002). A separate QAPP for post-breach monitoring will be prepared following further TRT coordination during 2013 and 2014. The first tidal breach at Montezuma is not expected to be implemented before 2015.

The QAPP is organized as follows:

Section 1.0 Introduction
Section 2.0 Project Management
Section 3.0 Data Generation and Acquisition
Section 4.0 Assessment and Oversight
Section 5.0 Data Review, Verification and Validation
Section 6.0 References

Appendix A provides the TRT’s recommendations for changes to the pre-breach monitoring program. Appendix B provides the updated Self-Monitoring Plan issued by the RWQCB in November 2012.

2.0 PROJECT MANAGEMENT

This section lists QAPP recipients, outlines background information pertinent to QAPP’s preparation, identifies the project team and management structure, describes the Montezuma Wetlands Project, provides an overview of the pre-breach monitoring program, delineates criteria and monitoring objectives, defines data quality objectives, and describes procedures for documentation and reporting.
2.1 Distribution List

Nedzlene Ferrario, Solano County Department of Environmental Management
Misty Kaltreider, Solano County Department of Environmental Management
Beth Christian, San Francisco Bay Water Quality Control Board
Dominic MacCormack, U.S. Army Corps of Engineers
Bob Batha, San Francisco Bay Conservation and Development Commission
Mary Hays, State Lands Commission
Ryan Olah, U.S. Fish and Wildlife Service
Jim Starr, California Department of Fish and Wildlife
Gary Stern, National Marine Fisheries Service
Josh Collins, San Francisco Estuary Institute

2.2 Background

This QAPP supersedes the sections of the project’s original QAPP (LEG 2003) and Mitigation Monitoring and Reporting Plan (MMRP; LFR 2000) that addressed pre-breach sediment and water quality monitoring. The MMRP was developed in accord with permits from the RWQCB, Solano County and other permitting agencies. The 2003 QAPP was prepared pursuant to conditions of the RWQCB permit. The 2003 QAPP expanded on the MMRP by providing additional information about how sediment and water quality data would be collected, managed and validated.

Minor changes to the pre-breach monitoring program were adopted in 2004 with approval from the RWQCB and based on monitoring data collected in 2003 and 2004 during which time about 500,000 cubic yards (cy) of sediment were placed at the site. Analysis for organics in surface water was eliminated due to a consistent absence of detections. Monitoring of phenols in the makeup water pond and settleable solids in receiving waters was also eliminated.

This QAPP is the outcome of coordination between the project, the TRT and the RWQCB to bring the project’s monitoring program up to date with scientific advances in the decade since the MMRP and the 2003 QAPP were written. Primarily, the pre-breach monitoring program has been changed to incorporate biosentinel monitoring (that assesses COCs in tissue from select animals found at the site) and reduce routine analyses of COCs in water that is not discharged from the site. Biosentinel monitoring is an approach increasingly adopted by regional monitoring programs because it provides a more direct assessment of food-web effects than can be obtained from water sampling. This change in monitoring focus also reflects lessons learned from a decade of project implementation. It was originally anticipated that each of the four project phases would take 2 to 3 years to complete and that sediment placement would be associated with substantial discharge of decant water to receiving waters. In reality, water discharge has been minimal, occurring during only for 4 weeks in spring 2004, and delays in sediment delivery to the site have stretched the pre-breach period in Phase I to over 10 years, during which time it has served as breeding habitat for numerous shorebirds and waterfowl. It is therefore appropriate and protective of beneficial uses to reframe pre-
breach monitoring in a way that best assesses actual conditions and potential risks from COCs in sediment placed at the site.

2.3 Task Description

During the pre-breach stage, the project monitors concentrations of COCs and other relevant parameters (e.g., pH, salinity, groundwater elevations) in the following media and locations (see Section 2.5 for descriptions of these locations):

- Sediment in the sediment placement cells and the makeup water pond (sediment in the rehandling facility will be monitored when that project element is completed and in use)
- Surface water in sediment placement cells, makeup water pond, return water channel, and receiving waters
- Groundwater beneath the project site and in nearby drinking water wells
- Biosentinel species in the sediment placement cells and makeup water pond

COC concentrations are compared to sediment acceptance criteria, discharge limits in the project’s RWQCB permit, onsite groundwater background concentrations and regional ambient tissue concentrations. Application of these criteria is described in Section 2.6 and summarized in Tables 1 and 2.

2.4 Project Team and Management Structure

Current responsibilities for implementation of project monitoring related to sediment and water quality are as follows.

- Doug Lipton, Ph.D., is the technical director responsible for review of the monitoring program, review of monitoring data and reports, and review of decisions about operational changes and implementation of contingency measures.

- Roger Leventhal, P.E., is the chief engineer responsible for management and monitoring of site design, construction, sediment placement operations and sediment placement contractors, management of the tracking system for sediment placement locations, water management including operation and installation of the groundwater extraction system, management of decant water, and periodic discharge of water to Suisun Bay/Sacramento River.

- Rachel Bonnefil is the project ecologist responsible for management of the monitoring program, preparation of the QAPP and monitoring reports, compliance with the MMRP and permits and coordination with the TRT, data manager, field supervisor, field technicians, and laboratories.

- Stan Gollinger is the field supervisor responsible for monitoring of onsite construction and operations including levee and associated facilities construction and
maintenance, sediment offloading and placement operations, field coordination with
construction and engineering contractors, and operation of the site’s supply wells,
pumps, and weirs.

- The field monitoring technicians are responsible for implementation of the sediment
  and water sampling program, maintenance of sampling and operational logs, and
  routine monitoring of site operations. Onsite field management and field technician
duties are performed by AMEC Environment & Infrastructure.

- The San Francisco Estuary Institute (SFEI) is the data manager responsible for
  managing the database of analytical data, coordinating with the laboratories to
  facilitate electronic data transfer, reviewing QA/QC reports from the laboratories, and
  validating data.

- The Technical Review Team (TRT) serves as the technical advisor. The TRT is an
  independent consortium of experts selected and managed by the San Francisco
  Estuary Institute (SFEI) in accord with project permits. The TRT reviews project
  reports, assesses project performance, and makes recommendations on the monitoring
  program, performance criteria, habitat design objectives and approaches, tidal
  hydrology, engineering, and other aspects of project implementation and monitoring.

2.5 Project Description and Current Status

The project site comprises approximately 2,400 acres at the eastern edge of Suisun Marsh
near the town of Collinsville, approximately 17 miles southeast of Fairfield, California
(see Figure 1). The site predominantly supports seasonal wetlands and ruderal grasslands.
Ground elevations at the site have subsided up to 10 feet since its tidal marshlands were
diked and drained for agricultural purposes more than 100 years ago. Restoration of
wetlands at the site will be accomplished by engineered placement of approximately 17
million cubic yards (cy) of agency-approved dredged sediment to raise the subsided site
to elevations appropriate for intertidal marsh. To date, about 4.1 million cy have been
successfully placed into Phase I of the project. Upon completion the project will restore
approximately 1,880 acres of tidal and seasonal wetlands, and approximately 480 acres of
upland buffer zone habitats at the site (see Figure 2).

Sediment placed at Montezuma is dredged from ports, marinas, and navigation channels
in the San Francisco Bay/Delta Estuary and brought by barge to the project site. Since
December 2003, the site has received sediment predominantly from the Port of Oakland’s
50-foot deepening project (“the 50-foot project”), and smaller amounts from maintenance
dredging at the Ports of Oakland and Richmond, the Levin-Richmond Terminal, the
Chevron Refinery Long Wharf in Richmond, the Valero Refinery Crude Dock in Benicia,
Coast Guard Station San Francisco (Yerba Buena Island), the City of San Francisco West
Basin Marina and the Port of San Francisco Piers 32-26.

Water from a constructed pond in the southern portion of the site (the “makeup water
pond”) is mixed with sediment on the barges to form a slurry containing about 15 to 35%
sediment. The makeup water pond is supplied by shallow groundwater wells in the sandy
subsurface soils adjacent to the Sacramento River/Suisun Bay. The project supplements the groundwater system by direct pumping of water from the river/bay through a screened intake during limited times of the year in order to protect listed species of fish. Approval for direct river water pumping between August 1 and December 15 of each year was granted by CDFG in July 2009, by USFWS in November 2010, by NMFS in April 2011. The RWQCB added this water pumping provision to the project’s Waste Discharge Requirements (WDR) that were renewed in November, 2012.

The slurry is pumped to sediment placement cells in the restoration area. Decant water from these cells is drained back to the makeup water pond through an existing network of ditches (the “return water channel”) and recycled for on-site uses to the maximum extent possible. Once the surface of the placed sediment reaches design elevations, the perimeter levees will be breached at certain locations (one breach per phase), allowing the tides to ebb and flow across the site. Depending on the timeframe for phase completion, phases may be subdivided and tides returned in stages to completed portions of the phase as they are completed. Staged breaching plans for Phase I are presented in the Phase I Adaptive Management Restoration Plan (LEG 2007). Placement of dredged sediments at the site, followed by additional natural buildup of sediments from tidal inundation, will raise the subsided land surface to an elevation suitable for the reestablishment of the proposed tidal marsh ecosystem.

Approximately 4.1 million cy of dredged sediment have been placed at the site to date. All of the sediment has been placed into Montezuma’s Phase I sediment cells. Table 3 provides a summary of sediment placement to date. Based on estimated cell capacities and project estimates of sediment quantities received through May 2013, approximately 700,000 cy of sediment capacity remains in the Phase I cells that are already constructed. The capacity estimate may be adjusted once final in-place volumes based on surveys conducted at the dredging sites are available for material received in 2012 and 2013. The remaining unconstructed Phase I cell is planned for 2014 or 2015. Preliminary design calculations for this cell show a potential total sediment capacity of up to 1 million cy, depending on the design alternatives chosen.

Construction in Phase II is not expected to occur before 2015, but one area (Cell 13) in the northwestern part of Phase II is allowed to be constructed in conjunction with Phase I sediment placement activities if necessary to contain overflow sediment or water from Phase I.

The site’s infrastructure and operations are described below in Sections 2.5.1 through 2.5.8.

### 2.5.1 Site Infrastructure

The site infrastructure includes the offloading facility and sediment placement pipeline, sediment placement cells, the makeup water pond and return water channel, water supply wells, groundwater monitoring wells, and a sediment rehandling facility. These components are described in the following sections and shown on Figure 3.
2.5.2 Offloading Facility and Sediment Pipeline

Dredged sediments are transported to the Site in 3,000 to 7,000 cy barges escorted by tugboats. An offloading facility for dredged materials is located immediately offshore at the southern end of the site (Figure 3). The offloading facility consists of the Liberty (an electric offloader specially designed for pumping from dredge barges), two flat-deck mooring barges that help hold the dredge scows in place during offloading operations, and a small dock to access the Liberty. The Liberty draws water from either the makeup water pond or through agency-approved screens in the river/bay during permitted times to slurry the sediment for offloading and placement (see Section 2.1.5).

Sediments used for on-site wetland restoration are pumped by the Liberty through a 24” diameter pipeline to sediment cells within the restoration area of the site. The first 3,000 feet of the sediment pipeline is made of steel and the remaining 11,000 feet is made of high-density polyurethane. At times when sediment offloading is not occurring, the pipeline is used to supply water to the sediment placement cells via a diesel pump.

2.5.3 Sediment Placement Cells

The site will be prepared and filled in four consecutive and hydrologically independent phases (Phases I through IV), each with its own tidal channel system and separated by phase boundary levees. Within each Phase, sediment placement cells are constructed to act as settling basins for dredged sediment brought to the site. The cells are formed by constructing levees (interior cell levees) from onsite soil and/or rehandled sediment. These interior cell levees also form the banks of constructed tidal channels, thus the size and shape of the cells is determined largely by the tidal channel design.

The sediment cells are designed to handle either surface sediment only, or both surface and foundation sediment (these sediment types were originally referred to as “cover” and “noncover” sediment; the sediment designations are described below in Section 2.2). Cells designed to handle both surface and foundation sediment have a second set of levees (foundation separation levees) that form a subcell in the center of the sediment cell. Foundation sediments are placed only within these foundation subcells.

The foundation subcells provide a minimum of 200 lateral feet of separation between foundation sediment and the interior cell levees that define the banks of the constructed channels. At least three vertical feet of surface sediment are placed above these foundation sediments and at least 200 lateral feet of surface sediments are placed between the foundation subcells and the interior cell levees to ensure that the foundation sediments remain isolated from plants and animals. Until the foundation sediments are fully covered with surface sediments, water is added to these foundation subcells to prevent their drying out (thus preventing oxidation) and to limit the exposure of wildlife to foundation sediments.

Phase I, the only project phase constructed to date, is designed to have eight cells ranging in size from 26 to 83 acres; four of these cells (Cells 1, 2, 3/4, 6/7, 11 and 12) are designed for surface and foundation sediment. Cells 8/9 and 10 are surface-only cells.
Figure 3 shows the Phase I cell layout. The approximate acreages of the Phase I cells are shown on Table 4.

Four of the Phase I cells (Cells 3/4, 6/7, 8/9, and 12) each consist of two or three merged cells. The designs for these sediment cells were modified in 2004 in order to create larger cells for improving the settlement of fine-grained sediment (see FRE 2005a).

Cell 11, in accordance with approvals for placement of foundation sediment from the Levin Richmond Terminal (LRTC) in 2006 (see Section 2.3.3 below), was constructed slightly differently from the typical foundation cell design in that the foundation sediment was placed at or below -4 feet National Geodetic Vertical Datum (NGVD) so that it could be covered by at least 7 feet of surface sediment. Typical foundation design holds foundation below -1 foot NGVD so that it is buried under at least 3 feet of surface sediment. Because of the extra depth at which foundation sediment in Cell 11 was buried, foundation separation levees were not required.

### 2.5.4 Decant Water Drainage System

The decant water drainage system is designed to remove excess water drawn (decanted) from dredged sediment slurry placed into the cells after the sediment settles, and to transport this decant water into a makeup water pond for recycling or discharge into the deep waters of the adjacent Suisun Bay/Sacramento River. Decant water from foundation subcells passes through geotextile fabric filters on the levee sidewalls to remove suspended sediments before being decanted into the return water channel and transported into the makeup water pond. Decant water from surface sediment passes over weirs and then into the return water channel. Water from the makeup water pond is used to mix with incoming sediment to create a new batch of slurry for transporting sediment into the restoration or rehandling cells. Water from the makeup pond can also be pumped via a mobile pump into the sediment cells in order to keep certain cells (e.g., those containing foundation sediment) ponded.

### 2.5.5 Makeup Water Pond and Discharge Pipe

The makeup water pond is located adjacent to the offloading facility. It functions as a water storage structure to receive decant water from the cells and groundwater from the supply wells. The water is used by the Liberty for sediment offloading and is pumped to the cells to keep placed sediment inundated prior to tidal breaching. As much decant water as possible from the restoration area is reused onsite; excess water can be periodically discharged from the makeup water pond’s discharge pipe into deep waters of the adjacent Suisun Bay/Sacramento River after testing in accordance with the WDR, although to date only minimal amounts of water have been discharged from the site.

The makeup water pond is divided into two sections of approximately equal size: MP-1 is the easternmost section, where water from the return water channel enters and from which water is supplied to the Liberty offloader, and MP-2 is the westernmost section, where water from the supply wells enters and from which water can be discharged to the
There is a connection between the two sections through a weir that is left open unless separate adjustment of water levels is needed for operational reasons.

Excess water is discharged from MP-2 by gravity flow over a weir that is connected to a 12-inch steel pipe at a depth of approximately 7 feet below mean lower low water. To date, only minimal amounts of water have been discharged from the site. No water has been discharged from the site since April 2004.

Discharge criteria from the RWQCB Waste Discharge Requirements (WDR) and other project water quality criteria are shown on Table 1.

### 2.5.6 Water Supply and Water Management Practices

Fifteen water supply wells supply the makeup water pond with water to facilitate sediment pumping and cell ponding. The location of these wells is shown on Figure 3. Supply wells are typically operated during sediment placement activities. At other times, the wells operate during the dry season to supply water to sediment cells. Limiting factors in supply well operation include lower than expected production rates in the aquifer, power outages, electrical problems, and mandatory well shutdowns for well rehabilitation and pump repair work.

In response to these limitations and to continued water shortages during the dry season, the project requested authorization to supplement the groundwater system by direct pumping of water from the river/bay through screened intakes. Approval for surface water pumping between August 1 and December 15 of each year was granted by CDFG in July 2009, by USFWS in November 2010, by NMFS in April 2011, and by the RWQCB in November 2012.

Surface water can be pumped from the river/bay in two ways: through screened intakes on the hull of the Liberty offloader (bypassing the intake from the makeup water pond that is normally used), and via a levee-mounted pump with a screened intake pipe extending into the river/bay.

The Liberty’s hull intakes were equipped with fish screens when it was in use at the Hamilton Wetland Restoration Project in Marin County. The fish screens achieve an approach velocity of 0.2 ft/sec, as required for protection of Delta smelt. The two fish screens are attached directly to each side of the Liberty hull and are situated about 5 feet below the water surface at all times. Water withdrawn from the river in this manner can be used for sediment offloading or pumped through the sediment pipeline to the cells to maintain ponding.

A 3,000 gpm pump with a screened intake may in future be installed on the perimeter levee in the offloading area. The pump would withdraw water from the river/bay immediately adjacent to the site through a fish screen designed to avoid impacts to Delta smelt. The water would be pumped into the makeup water pond and used for sediment offloading and to maintain ponding in the cells.
Following sediment placement and initial dewatering, effective water management is important to ensure sufficient water supply and limit evaporative concentration of COCs in cell water. Prior to tidal breaching, water from the makeup water pond is pumped to the cells in the dry season to counteract evaporative loss as necessary. Water management practices focus on “banking” as much water as possible in the sediment placement cells during late spring and adding smaller amounts of water more frequently to multiple sediment placement cells in an effort to keep ponding levels as high as possible through the dry season. This approach tends to result in less pronounced fluctuations in water levels in the cells and lower mean salinity by limiting concentration of cell water during the dry season. However, successful water management is often affected by the limitations on supply well operation described above.

2.5.7 Groundwater Monitoring Wells

A network of groundwater monitoring wells is maintained to monitor potential migration of COCs from placed sediment into groundwater. Phase I currently has a total of 11 monitoring wells (Figure 4). In accord with project permits, at least two on-site shallow aquifer wells and one on-site deeper aquifer well will be installed in each phase to monitor potential migration of COCs from placed sediment into groundwater.

Six wells were installed in Phase I during October 2002: three shallow wells (MW-1A through MW-3A) and three deeper monitoring wells (MW-1B through MW-3B). Because of flat groundwater flow gradients in Phase I, the wells were “triangulated” around foundation cells such that wells surround the foundation cells in Phase I. One of the deeper wells (MW-3B) was lost due to levee construction, so a replacement well was drilled late in the third quarter of 2004, along with a new shallow well (MW-4A) and a new deep well (MW-4B) in the vicinity of Cell 3/4.

Five more wells were installed in November 2007 to expand the area characterized by the monitoring wells to include the additional cells constructed and/or filled in 2006 and 2007 (i.e., Cells 6, 7, 8/9, and 11). The new wells consisted of three shallow wells (MW-5A, MW-6A, and MW-7A) and two deeper wells (MW-5B and MW-7B). A deep well was not installed at the MW-6 location because no water-bearing zone was encountered in the target depth interval (30 and 50 feet bgs). The borehole was backfilled with Portland cement. In 2008, the casing of well MW-7B was damaged, possibly due to levee soil movement, and the well could no longer be sampled. In May 2009, MW-7B was destroyed and a deep replacement well, MW-7BR, was installed between MW-7A and MW-7B.

2.5.8 Rehandling Facility

A portion of the sediment brought to the site will be slurried with water from the makeup water pond and placed in the rehandling facility, a group of settling cells in the southeastern portion of the site (Figure 3). The rehandling facility will dewater and rinse salts from sediment to facilitate on-site reuse and off-site sale (e.g., for levee material on site and throughout the Bay/Delta). In accordance with the MMRP and permits, no more than 20% of the volume of sediment brought to the site may be placed at the rehandling
facility while filling of the restoration portion of the site is underway. Construction of the rehandling facility is not complete at this time.

In accordance with the project’s WDR, no decant water from the rehandling facility area will be discharged back into the makeup water pond or river/bay unless an additional permit authorizing such discharge is obtained. No rehandling of sediment has occurred at the site to date and no rehandling is expected to occur before 2014 or 2015.

2.6 Criteria for Sediment, Water and Tissue

Two classifications of sediment, designated “surface” (i.e., suitable for the marsh surface) and “foundation” (i.e., suitable to be buried under surface sediment), are accepted at the site from dredging projects throughout the Bay-Delta region. These designations were originally referred to as “cover” and “noncover” and were derived from interim guidelines established by the RWQCB (RWQCB 1992). The RWQCB circulated a draft revision of sediment guidelines based on ambient conditions in San Francisco Bay fine-grained sediments (RWQCB 2000). These 2000 guidelines serve as the basis for updated criteria for Montezuma in accordance with reauthorized WDR adopted by the RWQCB on November 14, 2012. The updated criteria are shown on Table 2.

Water discharged from the site to receiving waters must meet discharge limits specified in the project’s WDR. The discharge limits are based on the more stringent of the Basin Plan (RWQCB 2011) marine and freshwater acute toxicity-based water quality objectives. The discharge limits are shown on Table 1.

COC concentrations in groundwater from onsite monitoring wells are compared to pre-project groundwater quality, which was assessed via six rounds of sampling between 2001 and 2003. Groundwater samples were collected from four on-site shallow wells (LF-1, LF-2, LF-3, and LF-4) and four off-site drinking wells in December 2001, April 2002, and July 2002. Three shallow/intermediate groundwater monitoring well clusters (MW-1A/B, MW-2A/B, and MW-3A/B, a total of six wells) were installed in Phase I during October 2002 (Figure 4), and samples were collected in November 2002 and March 2003, prior to the start of sediment placement in late December 2003. Maximum levels of COCs detected during pre-project groundwater sampling are shown on Table 1.

COC concentrations in the tissue of biosentinel species are compared with concentrations detected in comparable species collected by regional ambient monitoring programs such as the Regional Monitoring Program (RMP) and the Fish Mercury Project (FMP). The precise concentrations used to represent ambient conditions in a given year will be determined in consultation with the TRT and will depend in part upon which biosentinel species are sampled in that year.

2.7 Monitoring Objectives

The pre-breach monitoring program is designed to answer a set of questions about sediment and water quality at the project site. These questions are summarized below
along with the general criteria for deciding when contingency measures (described in Section 3.1) should be implemented. Questions involving the restored marsh will be addressed in a separate QAPP for post-breach monitoring. Phase I is not expected to be opened to the tides before 2014 or 2015.

**Is incoming sediment meeting acceptance criteria?** Acceptance criteria are presented in project permits and shown in Table 2. Confirmation sampling program is conducted to assess whether incoming sediment meets the criteria. As described in the project’s County permit, confirmation sampling of incoming dredged sediment must demonstrate, to a level of 95% confidence, that COC concentrations do not exceed the project’s surface and foundation criteria. A statistically based sampling program was developed using data from the Port of Oakland’s 50-foot project that supplied the first 3 million cy of sediment to the project site. Similar statistically based sampling programs will be prepared for other major new sources of sediment. Contingency measures will be implemented if the results of confirmation testing indicate that acceptance criteria have been exceeded.

**Are beneficial uses in receiving waters being protected during discharge of water from the makeup water pond?** The relevant beneficial use is water quality in the receiving waters of the Suisun Bay/Sacramento River. The project’s RWQCB permit contains criteria for COCs, conventional parameters and toxicity in water that is discharged from the makeup water pond and in receiving waters (see Table 1). Since discharged water could contain suspended sediment, the project also has sediment quality criteria for the makeup water pond; these criteria are the same as those for surface sediment in the sediment placement cells (Table 2). Contingency measures will be implemented if water quality monitoring during discharge indicates that COC concentrations in the makeup water pond water exceed WDR discharge limits, or if COC concentrations in downcurrent receiving water samples are significantly elevated compared to concentrations in upcurrent samples.

**Are beneficial uses in the sediment placement cells and makeup water pond being protected during the pre-breach period?** The relevant beneficial use is breeding habitat for shorebirds and waterfowl. The project is not responsible for maintaining a vibrant food web in the makeup water pond or in the cells prior to restoration of tidal action. However, the project is responsible for not causing reproductive harm to vertebrate wildlife using the cells and makeup water pond during the breeding season. Therefore, contaminants that bioaccumulate in vertebrates are a concern but contaminants that are toxic to invertebrates but do not bioaccumulate are not a concern for water quality in waters than remain on the Project site. Contingency measures will be implemented if biosentinel monitoring or bioaccumulation modeling show potential adverse effects on breeding wildlife in excess of ambient conditions, or if sediment and/or water sampling conducted in the absence of appropriate biosentinel species detects an exceedance of sediment acceptance criteria or WDR water quality limits (see Tables 1 and 2).

**Are COCs leaching from sediment into groundwater?** Background characteristics of groundwater in a restoration phase are assessed prior to sediment placement; background conditions for Phase I are presented in Table 1. Contingency measures will be
implemented if COC concentrations in groundwater adjacent to sediment placement cells significantly exceed background conditions.

**Is the groundwater extraction system affecting water levels in nearby domestic supply wells?** Background water levels in nearby wells were assessed prior to startup of the project’s extraction well array. Water levels in nearby wells were monitored intensively during the first year of the system’s operation and have been monitored annually since that time. Contingency measures will be implemented if operation of the groundwater extraction system decreases groundwater levels relative to baseline conditions.

**Is the quality of rehandled sediment protective of beneficial uses at end use sites?** The rehandling facility is designed to dewater sediment for onsite use and/or offsite sale for purposes such as levee construction. The relevant beneficial uses are water and sediment quality at onsite and offsite end use locations. The project permits contain criteria for COCs in sediment accepted at the rehandling facility; these are the same as those for surface sediment in the sediment placement cells. The permits also include criteria for salinity in sediment sold offsite for reuse in the Delta. Contingency measures will be implemented if sampling confirms that sediment with COC concentrations exceeding surface criteria have been placed at the rehandling facility or if the EC of rehandled sediment intended for reuse in the Delta exceeds 4 mmhos/cm.

### 2.8 Data Quality Objectives

The purpose of the project’s sediment, water, and tissue monitoring program is to compare contaminant concentrations in those media to the relevant criteria to assess project performance and inform adaptive management decisions. The data quality objective process defines how accurate, precise, complete, comparable, representative, and sensitive the collected data must be to fulfill this purpose. The following sections describe these data quality parameters.

**Accuracy.** Accuracy describes how close a measurement is to the true value of what is being measured. Accuracy is assessed by analyzing a sample of known concentration and comparing the measured value against the known value. Accuracy will be measured by the analytical laboratory using matrix spikes, which are samples prepared using either the batch sample matrix (e.g., sediment) or a blank matrix and adding a predetermined quantity of target chemicals. Following analysis, percent recovery of the “spike” is calculated. Accuracy goals, expressed as spike percent recovery, vary by analytical method and are shown on Table 5.

**Precision.** Precision describes how well repeated measurements agree. Precision will be measured by the analytical laboratory using field duplicates, laboratory replicates, and matrix spike duplicates. Field duplicates measure the combined random error (imprecision) due to sampling and analysis as well as the short-range heterogeneity of the sampled medium between the juxtaposed locations or times. Laboratory replicates and matrix spike duplicates are used to measure the contribution of the analytical process to the overall imprecision of data. Goals for precision, measured as relative percent difference between duplicates, vary by analytical method and are shown on Table 5.
Completeness. Data completeness is evaluated by comparing the number of analyses required by the QAPP with the number of reported analyses, and by assessing the sufficiency of the data reported in fulfilling project objectives. For the former, the target completion rate is 100 percent, while the latter is qualitatively assessed.

Comparability. In order for data to be comparable to both previous and subsequent data, standardized procedures are followed during field sampling activities, laboratory analyses, and data evaluation and interpretation. Whenever procedures change from one sampling round to another or within a sampling round, historical data are evaluated in light of recent data before data compilation and interpretation.

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

- Samples are collected in a location that does not reflect the environment of interest (e.g., receiving water samples are collected upstream from the discharge point)
- Samples are taken under unusual conditions (e.g., if surface-water samples are taken under extremely high rainfall conditions)
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g., if conventional water-quality parameters such as temperature and DO are not taken immediately)

Representativeness is ensured by collecting samples and direct measurements as described in this QAPP, and by using state-certified analytical laboratories.

Sensitivity. Sensitivity is the ability of an analytical instrument to detect concentrations of target chemicals. The reporting limit is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy using a particular analytical method. Analytical methods that can achieve reporting limits at or below the relevant project criteria will be utilized (Table 6).

2.9 Documentation and Records

Sampling activities and locations are consistently documented throughout the monitoring program to ensure accurate data tracking and verify that sampling methods are consistent. Documentation of field activities consist of sample identification, sample labels, chain-of-custody forms, and field activity logs. These documents are completed using indelible ink. Any corrections to the document are made by drawing a line through the error and entering the correct information without obliterating the original entry. Persons correcting the original document initial any changes made.

2.9.1 Sample Identification

All samples are identified and labeled at the time of collection. Sample identification follow a specific format to ensure that all sample numbers are unique. A master sample log is maintained and stored on a file-sharing platform maintained by the field monitoring
technicians and accessible to the project ecologist and data manager. The sample identification format is described below.

All samples have a prefix denoting the sample medium as follows:

- Groundwater – GW
- Sediment – SS
- Surface water – SW
- Animal tissue – AT
- Invertebrate tissue – IT

The prefix is followed by an abbreviation for the area where the samples were collected, as follows:

- Incoming barges — IB
- Influent water – IW
- Makeup water pond – MP
- Off-site supply well – OW
- On-site monitoring wells - MW
- Receiving water – RW
- Rehandling facility cells – RC1, RC2, etc., for Rehandling Facility Cell 1, etc.
- Restoration area sediment cells – P1C1, P1C2, etc., for Phase I Cell 1, Phase I Cell 2, etc.
- Return water channel – RC

The project area abbreviation is followed by a sample location number denoting where within each project area the sample was collected. This is followed by a six-digit date. For example, a sediment sample collected in Phase I Cell 1 on July 12, 2013, would be named SS-P1C1-071203.

Duplicate samples are named as described above, followed by “-0.” For example: P1C1-071203-0.

Split samples sent to an alternate laboratory are named as described above, followed by “-S”

Field blank samples have the prefix “FB,” followed by a unique number corresponding to a six-digit date. For example: FB-071203.
2.9.2 Sample Labels

A sample label is completed for each sample collected and attached to the sample container. The label is made of a waterproof material backed with a water-resistant adhesive. This sample label, to be filled out using waterproof ink, must contain at least the following information: date, time, sampling location, sample identification number, sampler’s name, and the analyses to be conducted.

2.9.3 Chain-of-Custody Forms

Chain-of-custody forms are prepared for groups of samples collected during a given sampling event. A chain-of-custody form is prepared in duplicate or triplicate to accompany every shipment of samples to the respective analytical laboratories. At least one copy accompanies the samples to the laboratory and one copy is retained by the field monitoring technicians. The retained copy is stored in a field binder maintained by field monitoring staff. A scanned copy of the COC and a map of individual sample locations are sent to the project ecologist upon completion of each sampling event. The chain-of-custody form makes provision for documenting sample integrity and the identity of any personnel involved in sample collection and transfer. Other information entered on the chain-of-custody form includes:

- Project name
- Chain-of-custody serial number
- Project location
- Sample identification numbers
- Sampler/recorder’s signature
- Date and time of sample collection
- Sample locations
- Sample types
- Analyses requested
- Inclusive dates of possession
- Name of person receiving the sample
- Laboratory sample number
- Date of sample receipt
- Address of analytical laboratory

2.9.4 Field Activity Logs

A field log is used to record direct measurements of conventional water quality parameters. The field staff are responsible for sending a copy of the field log to the
project ecologist after sampling event, and for maintaining electronic copies of the field logs. Field log entries include the following:

- Field staff’s name
- Date and time of measurements
- Description of measurement locations (e.g., Cell 1)
- Personnel collecting the measurements
- Measurement methods
- Sample type (e.g., surface water)
- Water level relative to staff gauges (where applicable)
- Temperature
- EC
- dissolved oxygen
- pH
- Salinity (ppt)
- Field observations, comments

### 2.9.5 Reporting

The results of pre-breach sediment, water and tissue monitoring are reported to the responsible agencies on an annual basis. Reports are submitted by March 1 of each year by uploading an electronic copy of the report to the Ecoatlas site maintained by SFEI (Ecoatlas.org). An electronic copy is also sent to the RWQCB via email, CD or FTP site.

Report contents include the following elements:

- Project description and current status
- Description of monitoring activities and monitoring results during the reporting period, including tabular and graphical data summaries
- Conclusions and discussion of results in light of monitoring objectives
- Figures showing project elements and sampling locations
- Listing of analytical methods used during the reporting period
- Description of data validation findings
- Description of audits and any corrective actions taken
3.0 DATA GENERATION AND ACQUISITION

This section describes the pre-breach monitoring program, contingency measures to be taken if monitoring results indicate problems, methods for sample collection, sample handling and custody, analytical methods, quality control requirements and procedures for data management.

3.1 Pre-Breach Monitoring Program for Sediment, Water and Tissue

In accordance with the MMRP and permits, monitoring for COCs onsite and at reference sites will occur during each phase of construction and for 10 years after tidal action is restored to each phase. In accordance with TRT recommendations and discussions between 2006 and 2011, monitoring has been revised to include biosentinel species: animals with small home ranges or foraging ranges whose body burdens of certain COCs can be used to represent site-specific potential for biological uptake of contaminants. Tissue samples from biosentinel species will be collected, when and where available, from the vicinity of the sediment cells and makeup water pond. As a result of increased emphasis on tissue analyses for bioaccumulative COCs, sampling of surface water that is not discharged from the site has been reduced. However, water samples are still collected from sediment placement cells, makeup water pond, return water channel, groundwater wells, and receiving waters, primarily to manage water quality onsite and to ensure that any discharge from the site meets WDR criteria. Sediment is collected from sediment cells and COCs analyzed to confirm the quality of sediment that is brought to the site from each dredging project, and will be collected from the rehandling facility when it is completed and in use.

The following sections describe the sampling approach for each element of the monitoring program; performance criteria and contingency measures are also described where relevant. Monitoring objectives are described in Section 2.7. Data quality objectives are described in Section 2.8. Criteria for COCs in sediment, water and tissue are described in Section 2.6. A full list of analytes to be measured is provided in Table 6. Table 7 provides a summary of sampling frequencies and analytes for each monitoring element. Samples will be handled and transported to the laboratory as described in Section 3.3. Analyses will be conducted according to accepted state and federal protocols as described in Section 3.5.

3.1.1 Confirmation of Incoming Dredged Sediment

The confirmation sampling program for incoming sediment was developed based on a statistical analysis of data from the Port of Oakland’s 50-foot deepening project that supplied the first 3 million cy of sediment to the project site. The analysis was conducted to determine the number of sampling events necessary to demonstrate, to a level of 95 percent confidence, that COC concentrations in incoming sediment do not exceed the project’s surface and foundation criteria. At a minimum, samples of incoming dredged
sediments are collected from the cells at a frequency of approximately one sample per 60,000 cy. Sediment samples are collected from each cell being filled. Samples are analyzed for inorganics, PAHs, PCBs, pesticides, grain size, pH, electrical conductivity (EC), TOC, and sulfides. When placing surface sediment over foundation, or when placing surface sediment within one foot of the final design elevation, grain size samples are collected in the sediment cells at a frequency of one sample per 30,000 cy.

PCBs in incoming sediment are analyzed as either Aroclors or congeners, depending on PCB concentrations detected in pre-dredge testing at the source site. Congener analysis is used when receiving sediment from sources whose pre-dredge testing shows levels close to the surface criterion (22.7 µg/kg). Levels substantially below the surface criterion are comparable to ambient levels in the Estuary, in which case there is limited environmental benefit from conducting high-resolution congener analysis as part of confirmation sampling at the site. At levels above the surface criterion, reporting limits for Aroclor analysis are low enough to detect substantial exceedances. Decision criteria for analysis of PCBs were developed in consultation with RWQCB staff and are described below:

- PCBs are analyzed as congeners in surface sediment if pre-dredge testing shows total PCBs above 17 µg/kg (75% of the surface criterion of 22.7 µg/kg) OR if exceedances of the surface criterion are detected using Aroclor analysis and more toxicologically-relevant data is needed to assess risk to receptors
- PCBs are analyzed as Aroclors if pre-dredge testing shows total PCBs below 17 µg/kg
- PCBs are analyzed as Aroclors in foundation sediment

For each sampling event, surface grab samples will be collected from at least four locations within each sediment cell being sampled. Each set of four or more samples is composited by the laboratory for analysis. Sediment samples are submitted to the laboratory(s) for analysis on a 15 to 20 day turnaround time depending on the analyte and the laboratory(s) used.

**Performance Criteria and Contingency Measures**

If confirmation sampling indicates that sediment placed on the site has exceeded the criteria for placement (see Table 2) additional sampling of the affected location(s) will be conducted to establish the nature and extent of the exceedance. Discrete samples will be collected at appropriate depth intervals from at least three locations in each affected cell and analyzed for any COC exceeding its criterion.

If the exceedance is relatively isolated, small in magnitude (within the range of normally expected variability), and not expected to have adverse effects under the conditions of its placement, it may be left in place and additional monitoring (e.g. tissue analysis of biosentinel species) will be conducted.
If the exceedance is large in magnitude, not isolated, and expected to have adverse effects, the sediments of concern will be removed to an approved location. Material will be removed with mechanical grading equipment or a portable dredge capable of working in unconsolidated mud. Sediment placement in affected areas will be discontinued until contingency measures are completed. Additional measures (e.g., liming, capping with fine-grained sediments, increased depth of burial or horizontal isolation from channels, and/or increased long-term monitoring) will be considered by the project and regulatory agencies.

3.1.2 Sediment Cells

As described above in Section 2.5.3, sediment cells are designed to accept either surface sediment only, or both surface and foundation sediment. COC concentrations in the tissue of biosentinel species foraging in the vicinity of sediment cells are monitored to ensure protection of breeding vertebrate wildlife. Biosentinels ideally should be breeding, resident vertebrates with small home ranges and habitat-specific feeding habitats. Water sampling in sediment cells is not required by the project’s WDR but is conducted in both surface-only and foundation sediment cells during active sediment placement to assess whether COCs are approaching levels that, upon recycling into the makeup pond, could exceed discharge requirements. Monitoring approaches vary according to cell type and stage of filling as described below.

Biosentinel Monitoring

When foundation sediment is exposed, biosentinel monitoring is conducted if appropriate species (as determined in discussions with the TRT) are present in or in the vicinity of the cell during the breeding season, for example fish or foraging birds. If appropriate vertebrate species are present, tissue samples (e.g., fish whole body tissue or bird eggs) are collected. If appropriate vertebrate biosentinels are not available, then invertebrates will be considered for use as biosentinels. The frequency of tissue sampling depends on the length of time the foundation sediment is left exposed; permits allow foundation to remain uncovered for up to 6 months except during the waterfowl migratory season when foundation sediment should be covered within 2 months. Tissue samples are analyzed for total mercury, selenium, and the specific COCs that are responsible for the designation of the sediment as foundation. If selected for analysis, PCBs will be quantified as congeners.

Monitoring in completed foundation sediment cells (i.e., those in which foundation sediment is no longer exposed), and surface-only sediment cells, focuses on biosentinel monitoring as well. Appropriate biosentinel species and sampling methods will be identified in consultation with the TRT. Tissue sampling of appropriate biosentinel species is conducted annually during the breeding season. Samples are analyzed for total mercury and selenium. Biosentinel tissue samples are analyzed on a 15 to 20-day turnaround time depending on analyte and laboratory(s) used.

If there are no appropriate biosentinel species (as determined in discussions with the TRT), then methylmercury will be measured once annually in sediment and three times annually in water during the breeding season. Other bioaccumulative COCs in sediment
may be assessed by inputting data from confirmation sediment testing into a bioaccumulation model to estimate whether thresholds for adverse effects on wildlife might be exceeded.

**Water Monitoring**

When sediment placement is occurring, composite surface-water samples are collected every two weeks from each sediment cell receiving sediment. Samples are analyzed for inorganic COCs. Each composite sample comprises four discrete samples from each cell collected near overflow weirs (in surface-only cells) or near geotextile intake points where suspended sediment filtering occurs (in foundation cells). EC, pH, temperature, and dissolved oxygen are measured in the field using a hand-held water quality meter concurrently with sampling for inorganic COCs. Laboratory samples are submitted for analysis on a 15-day turnaround time.

**Performance Criteria and Contingency Measures**

If biosentinel monitoring or bioaccumulation modeling show potential adverse effects on breeding wildlife in excess of ambient conditions, management actions will be determined in consultation with the TRT. One or more of the following actions may be taken:

- Sample fish tissue (if present) to assess whether their body burdens of particular COCs pose a risk to foraging birds
- Increase water levels in the cell to discourage foraging by breeding birds
- Drain and refill the cell to eliminate fish (this would be a temporary solution)
- Drain the cell during the breeding season to discourage foraging by birds (surface-only cells)
- Conduct additional sampling of sediment to determine whether elevated COC concentrations are present. If sediment exceedances are detected, the sediment can be removed and placed in a foundation subcell.

If water monitoring in the cells during sediment placement shows concentrations of COCs that, upon recycling into the makeup pond, could exceed discharge requirements, the input of fresh water from the river and/or the groundwater supply wells will be increased.

### 3.1.3 Makeup Water Pond

**Biosentinel Monitoring**

The makeup water pond is monitored annually during periods of active sediment placement. Monitoring focuses on bioaccumulative contaminants using the biosentinel approach. Small fish (whole body) are likely the most appropriate biosentinel species for
makeup water pond monitoring in any given monitoring year. Biosentinel tissue samples are collected during the breeding season and will be analyzed for methylmercury, selenium, PCB congeners, and pesticides.

The number of analytical samples depends on the amount of tissue available during each collection period. The goal is to collect enough tissue so that at least two analytical samples per biosentinel species can be evaluated annually.

If appropriate biosentinel species cannot be found in the makeup water pond (as determined through discussion with the TRT), sampling of sediment in the makeup water pond will be conducted annually during periods of active sediment placement to ensure that COC concentrations do not exceed surface criteria (Table 2). Surface sediment samples (0 to 1 feet below ground surface [bgs]) will be collected from the makeup water pond. For each sampling event, three samples will be collected near the return water flow pipeline and three samples will be collected near the overflow weir to the discharge pipeline. Each set of three samples will be composited by the laboratory for analysis. Sediment samples will be analyzed for inorganic COCs, PAHs, PCB congeners, pesticides, and pH. Laboratory samples will be submitted to the laboratory(s) for analysis on a 10 to 15-day turnaround time depending on analyte and laboratory(s) used.

**Water Monitoring**

Water quality in the makeup water pond is monitored during discharge of water to receiving waters to ensure that water quality is within discharge limits established by the RWQCB permit (Table 1). Water sampling begins prior to each episode of discharge on a timeframe that ensures that sample results are received before the start of discharge. During discharge, water monitoring is conducted as outlined below. Water sampling may also be conducted at other times as needed to inform onsite water management decisions.

- Inorganic COCs and TSS are sampled daily for the first five days of a discharge episode, then weekly for the remainder of the episode
- Turbidity, dissolved oxygen, EC, pH, temperature, and flow rate are measured daily during discharge
- Acute toxicity (% mortality and % normal development) are tested once within one week prior to discharge, then weekly for the remainder of the discharge episode

Water samples are analyzed for inorganic COCs and TSS in the laboratory. Inorganics are analyzed as dissolved concentrations except for mercury and selenium, which are analyzed as total concentrations. Turbidity, dissolved oxygen, EC, pH, and temperature are measured in the field using a hand-held water quality meter. The flow rate from the discharge weir is estimated using weir-volume calculations. Acute toxicity is evaluated using an ASTM 48- or 96-hour static non-renewal test (ASTM, 2008).
Two composite samples are collected at each water sampling event. One set of two samples is collected from each sub-pond (MP-1 and MP-2). The MP-1 composite comprises one sample collected near the intake from the return water channel and one sample collected from a weir platform on the western side of MP-1. The MP-2 composite comprises one sample collected near the overflow weir for the discharge pipeline and one sample collected near the influent water inflow pipe on the western side of MP-2 (Figure 5). Samples are submitted to the laboratory(s) for analysis on a 5-day turnaround time.

**Performance Criteria and Contingency Measures**

If biosentinel monitoring shows potential adverse effects on breeding wildlife in excess of ambient conditions, if sediment sampling conducted in the absence of appropriate biosentinel species detects an exceedance of surface sediment criteria (see Table 2), or if water quality monitoring during discharge indicates that COC concentrations in the pond exceed WDR discharge limits, one or more of the following contingency measures will be taken as applicable, in consultation with the TRT:

- Halt discharge of water to receiving waters
- Increase settling times in the sediment cells in order to reduce the amount of suspended sediment transported to the makeup water pond
- Increase the efficiency (i.e., filtering capacity) of the geotextile filter fabrics in the foundation cells to enhance removal of suspended sediments
- Decrease the amount of recycled water used in the water supply to reduce the potential concentrating effect of reusing water
- Increase the input of fresh water from the river and/or the groundwater supply wells
- Conduct sediment sampling to delineate the extent of the exceedance. If the exceedance is relatively isolated, small in magnitude (within the range of normally expected variability), and not expected to have adverse effects under the conditions of its placement, it may be left in place. If the exceedance is large in magnitude, not isolated, and expected to have adverse effects, the pond will be closed until the affected sediment can be removed and used as foundation sediment in an available foundation cell. If an exceedance of foundation criteria is confirmed or if no foundation cells are available on site, the sediment will be disposed of at an approved location. Sediment will be removed with a long-reach excavator or a small dredge.

3.1.4 Receiving Waters

Receiving waters of Suisun Bay/Sacramento River are sampled twice during each episode of discharge from the makeup water pond that lasts more than one week (once
within the first week and once within the last week). Receiving waters are sampled once during any discharge episode that lasts less than one week. Additional receiving water sampling events may be conducted depending on the length of the discharge episode and/or changes in the receiving water conditions (e.g. seasonal fluctuations in freshwater outflow) since the last sampling event.

Samples are collected approximately 100 feet upcurrent and 100 feet downcurrent of the discharge point (Figure 5). Samples are collected as close as possible to the discharge depth (-7 feet MLLW).

Samples are analyzed for inorganic COCs and TSS in the laboratory on a 5-day turnaround time. Inorganics are analyzed as dissolved concentrations except for mercury and selenium, which are analyzed as total concentrations. Turbidity, dissolved oxygen, EC, pH, and temperature are measured in the field using a hand-held water quality meter.

**Performance Criteria and Contingency Measures**

If COC concentrations in downcurrent receiving water samples are significantly elevated compared to concentrations in upcurrent samples, one or more of the following contingency measures will be taken as applicable:

- Halt or slow the rate of discharge to receiving waters
- Resample water in the makeup water pond to determine whether water quality exceeds discharge limits
- Resample receiving water at varying distances from the discharge pipe to delineate the extent of the effects of discharge on receiving waters
- Increase settling times in the sediment cells in order to reduce the amount of suspended sediment transported to the makeup water pond
- Increase the efficiency (i.e., filtering capacity) of the geotextile filter fabrics in the foundation cells to enhance removal of suspended sediments
- Decrease the amount of recycled water used in the water supply to reduce the potential concentrating effect of reusing water
- Increase the input of fresh water from the river and/or the groundwater supply wells

### 3.1.5 Influent Water

To measure existing water quality in groundwater that supplies the makeup water pond, water samples are collected at a point after water from all operating extraction wells is combined, and before the water reaches the makeup water pond (Figure 5). Monitoring is
conducted as needed to inform onsite water management decisions. Influent flow rate is measured via an in-line sampling device installed on the supply pipe. Water samples are measured for inorganic COCs and TSS in the laboratory on a 15-day turnaround time. Inorganics are analyzed as dissolved concentrations except for mercury and selenium, which are analyzed as total concentrations. Turbidity, dissolved oxygen, EC, pH, and temperature are measured in the field using a hand-held water quality meter.

### 3.1.6 Return Water Channel

Water sampling in the return water channel is conducted during sediment placement to monitor pH (which can influence contaminant mobility), and TSS (to assess suspended sediment transport to the makeup water pond). Samples are collected every two weeks when water is being decanted from the sediment cells and recycled in the makeup water pond. For each sampling event, one discrete sample is collected within 50 feet of the inflow to the makeup water pond (Figure 5).

Water conductivity in the return water channel is also monitored to assess habitat suitability for western pond turtles. Conductivity monitoring is conducted concurrently with pH and TSS monitoring when water is being decanted from the cells and recycled in the makeup water pond, and monthly at other times. TSS is measured in the laboratory on a 15-day turnaround time. Conductivity and pH are measured using a field instrument.

### 3.1.7 Groundwater Quality

Groundwater wells associated with the MWP (Figure 4) are monitored to detect potential migration of COCs from placed sediment into groundwater, and to verify that operation of the groundwater extraction system is not affecting local groundwater levels.

During sediment placement in each phase, monitoring is conducted twice yearly (once during the wet season and once during the dry season) in shallow and deeper groundwater wells located within that phase. One discrete sample is collected from each well. Samples are analyzed for inorganic COCs (including low-level mercury analysis), pH, conductivity and temperature. Inorganics are analyzed as dissolved concentrations except for mercury and selenium, which are analyzed as total concentrations. Samples are submitted to the laboratory(s) for analysis on a 15 to 20-day turnaround time depending on analyte and laboratory(s) used. Groundwater elevations (in meters below ground surface) are recorded during sampling.

Wells located near Cell 11 (MW-5A/B, MW-6A, and MW-7A/B) were monitored for total DDTs from November 2006 through April 2013 in accordance with the Confirmation Sampling Plan for LRTC Sediment (LEG 2006).

Twice yearly groundwater sampling will continue in each phase until one year after tidal action is restored in that phase. Thereafter, monitoring will be conducted annually for five years, then every two years for another 10 years.
**Performance Criteria and Contingency Measures**

If COC concentrations in groundwater adjacent to sediment placement cells significantly exceed background conditions, additional investigations including fate and transport modeling and installation of additional monitoring wells and offsite perimeter wells will be undertaken to determine the source and extent of contaminants. Depending on the results of these investigations, appropriate correction measures such as ceasing acceptance of foundation sediment or construction of deeper drinking water wells will be undertaken at the discretion of the responsible agencies.

### 3.1.8 Groundwater Levels in Nearby Supply Wells

Groundwater elevations in drinking water wells closest to the project site (Figure 5) are monitored to ensure that operation of the groundwater extraction system is not affecting water levels in the drinking water aquifer. Baseline monitoring of groundwater elevations in the three nearest off-site drinking water wells was conducted continuously for at least one month prior to startup of the groundwater pumping system, then on a monthly basis for one year. Since that time, water level monitoring has been conducted annually. Annual monitoring will continue until the groundwater pumping system is abandoned. Results are presented in the project’s Operations Reports (FRE 2005b, 2005c, 2007).

**Contingency Measures**

If operation of the groundwater extraction system decreases groundwater levels relative to baseline conditions, one or more of the following contingency measures will be implemented:

- Reduce the rate of groundwater pumping
- Increase onsite water storage capacity
- Modify well locations or the groundwater extraction system
- Cease operation of the groundwater supply system and pump surface water using fish screens and seasonal windows in accord with the project’s CDFW Streambed Alteration Agreement and USFWS and NMFS Biological Opinions
- Provide the affected neighbors with alternative water sources

### 3.1.9 Rehandling Facility

Sediment placed in the rehandling facility will be tested to confirm it meets surface criteria (Table 2). Samples will be analyzed for inorganics, PAHs, PCBs, pesticides, grain size, pH, EC, TOC and sulfides on a frequency of at least 1 composite sample per 30,000 cy of sediment placed in the rehandling facility. Samples will be analyzed in the laboratory on a 15-day turnaround time.
Rehandled sediment intended for off-site reuse in the Delta will be analyzed for pH and EC prior to sale to ensure that the sediment will not adversely affect water quality at the reuse sites. The pH must be between 6.0 and 8.5 standard units (SU), and salinity may not exceed 4 mmhos/cm (or other criteria required by the RWQCB) in sediments proposed for use in freshwater areas. Sampling will be conducted after sediment intended for off-site sale has been rinsed (i.e., mixed with brackish groundwater during hydraulic offloading) and dewatered. Samples will be collected at 1-foot depth intervals from three locations within each rehandling facility cell. EC and pH will be measured by a laboratory on a 15-day turnaround time.

**Contingency Measures**

If sampling confirms that sediment with COC concentrations exceeding surface criteria have been placed at the rehandling facility (only surface sediment will be rehandled), sediment samples will be collected from the affected cell(s) to delineate the extent and magnitude of the exceedance. Samples will be collected at 1-foot depth intervals from three locations within each cell, and analyzed for any COCs exceeding the criteria in initial sampling. If an exceedance is confirmed, the affected sediment will be removed and used as foundation sediment in an available foundation cell. If foundation criteria are exceeded or no foundation cell is available onsite, the material will be disposed of at an approved location.

If the EC of rehandled sediment intended for reuse in the Delta exceeds 4 mmhos/cm, the sediment may be rinsed by addition of more water from the makeup water pond until the criterion is met. If the pH of rehandled sediment intended for reuse in the Delta is below 6.0, limestone or other neutralizing agents may be added to buffer pH to neutral conditions.

### 3.2 Sample Collection and Compositing Methods

#### 3.2.1 Tissue Sampling Methods

Appropriate biosentinel species for each area and monitoring year will be determined in discussions with the TRT. Likely biosentinel species monitoring include small fish that may inhabit the makeup water pond and/or sediment cells, and the eggs of black-necked stilts and American avocets nesting onsite near the sediment cells. Appropriate sampling methods and sample sizes for the selected biosentinel will also be determined in consultation with the TRT depending on the biosentinel species available during each sampling year. Likely sample collection methods are outlined below; additional sample collection details specific to the biota being sampled will be developed in consultation with the TRT as more information about biosentinels in the field becomes available.

Depending on target species conditions at the sampling locations, fish will be collected using methods such as beach seines or a small otter trawl deployed from a boat. Collected fish will be sorted by species, rinsed of excess debris, weighed and counted, placed in plastic bags, and stored at 4°C. Fish tissues will be analyzed as whole-body samples.
Shorebird eggs will be collected by surveying the monitoring area for nesting birds, identifying the nesting birds to species by visual observation, and collecting eggs from their nests. One egg will be collected from each nest sampled. Collected eggs will be marked with a pencil to identify collection location and species. Eggs will be placed in plastic bags, stored on ice in the field, and then refrigerated.

If benthic invertebrate tissue sampling is determined to be necessary, sediment will be collected and sequentially screened through fine-mesh stainless steel sieves. Depending on conditions at each sampling location, sediment will be collected using stainless steel trowel, modified-Ponar or Eckman dredge, push core, or handheld stainless-steel auger. Baited traps may also be used to collect larger macroinvertebrates such as crayfish and snails. Collected invertebrates will be rinsed to remove sediment and placed in glass jars using stainless steel spoons or tweezers. The glass jars will contain enough site water to keep the invertebrates from drying out.

Analytical samples will be handled and transported to the laboratory as described in Section 3.3.

3.2.2 Sediment Sampling Methods

Depending on sample depth and the accessibility of sampling locations, sediment samples are collected either directly into the sample container or using a stainless steel dipper or modified Ponar or Eckman dredge. In cases where samples are composited for analysis, each sample is homogenized at the laboratory and half the volume of each sample is used for compositing and analysis. The remaining half of each sample volume is archived at the laboratory for possible analysis should the composite result exceed criteria.

Standard field observations are recorded during sampling including time, air temperature, weather conditions, and sediment color, appearance and odor, presence of visible organic material, roots, etc.

Samples are preserved, handled, and transported to the laboratory as described in Section 3.3.

3.2.3 Surface-Water Sampling Methods

Surface-water samples are collected directly into the analytical sample container if possible. If this method causes excessive suspension of sediment or is not possible, a stainless steel dip sampler is used to collect water; sample containers are then filled from the dipper. Some measurements such as temperature, pH, DO, and EC, are measured in the field with hand-held water quality meters.

The flow rate of influent water into the makeup water pond is monitored using inline sampling equipment installed on the water supply pipeline and linked to an on-site data logging station. Flow rates are reported as average, minimum, and maximum daily rates; times of occurrence for minimum and maximum values are also reported.
Inorganic COCs are analyzed as dissolved concentrations except for mercury and selenium, which are analyzed as total concentrations. Organic COCs are analyzed as dissolved concentrations.

Samples collected for dissolved analysis are filtered in the laboratory using a 0.45-micron filter. Samples to be filtered are sent to the laboratory without nitric acid preservation and with a request to filter with a 0.45-micron membrane filter before preservation and digestion.

Standard field observations are recorded during water sampling, including air temperature, time, weather conditions, and water color, appearance, and odor.

Analytical samples are preserved, handled, and transported to the laboratory as described in Section 3.3.

### 3.2.4 Groundwater Quality Sampling Methods

The primary groundwater sampling method uses a clean Teflon, stainless steel, or new disposable polyethylene bailer lowered into the well using a new length of nylon rope. When a hand bailer is used for well purging, a Teflon or stainless steel bailer is used. Samples are collected from the monitoring wells as soon as a sufficient volume of water has been recovered in the well and no more than two hours after purging. If a well is pumped dry during purging, it is allowed to recover to 80 percent of the original volume (or after a maximum of two hours) before resampling. If and when water levels rise above the ground surface, wells will be fitted with appropriate wellhead fittings to collect water samples (via a sampling port).

Inorganic COCs are analyzed as dissolved concentrations except for mercury and selenium, which are analyzed as total concentrations. Organic COCs are analyzed as dissolved concentrations. Samples for dissolved analysis are sent to the off-site laboratory without nitric acid preservation and with a request for filtering with a 0.45-micron membrane filter before preservation and digestion.

Temperature, pH, DO, and EC of groundwater samples are measured in the field with hand-held water quality meters.

Standard field observations are recorded during water sampling, including air temperature; time; tide height; weather conditions; and water color, appearance, and odor.

Analytical samples are preserved, handled, and transported to the laboratory as described in Section 3.3.

### 3.2.5 Groundwater Level Monitoring Methods

Depth to groundwater in the wells are measured using an electric water-level measurement device with a tape at least a 50 feet long mounted on a hand-cranked reel and equipped with an alarm or signal device that indicates when the probe has
encountered groundwater. The probe at the bottom of the tape is lowered into the well to the point at which the alarm or signal device indicates groundwater. The water level is recorded to the nearest 0.01 foot; the measurement time is noted. Duplicate measurements are taken at each well and are recorded on the fluid-level measurement form. If and when water levels rise above the ground surface, wells will be fitted with appropriate wellhead fittings to measure water pressure. Pressure transducers and data recorders may be used from time to time in place of manual water-level monitoring.

3.3 Sample Handling and Custody

Samples collected in the field are placed in appropriate sample containers and preserved as needed. Sample containers and preservatives vary by analyte and are shown on Table 8.

To maintain the integrity of samples during transit, ice packs are used with all samples collected. The ice packs decrease the potential contamination of samples by melted ice if the cooler shifts during transit. The samples are packed upright in the cooler with at least two times as much ice pack by volume as the total volume of the samples. Chain-of-custody forms are enclosed in a sealed plastic bag and taped to the inside of the cooler lid.

Samples are shipped in such a manner that no more than 24 hours elapses from the time of shipment to the time of receipt by the analytical laboratory. The method of shipment may include hand delivery by the field personnel, laboratory courier, or commercial shipping services (such as UPS or Federal Express). The method of sample shipment is noted on the chain-of-custody form. In any event, the cooler is sealed with heavy-duty packing tape to reduce the possibility of it accidentally opening and to prevent tampering with the samples. Samples are analyzed within recommended holding times for each analytical method. Holding times are shown on Table 8.

3.4 Equipment Decontamination

Thorough cleaning of sampling equipment is necessary to obtain representative samples and reduce the possibility of cross contamination between samples. All non-disposable sampling equipment is cleaned (decontaminated) before and after each use at each sampling location and between sample collection intervals (surface and subsurface) at a given soil or sediment sampling location.

Sampling equipment is cleaned in an area at least 10 feet away from and downwind from sampling locations to avoid cross contamination between sampling points. Soil/sediment and surface-water sampling equipment is decontaminated as follows:

- Before sampling begins, all sample tools are scrubbed in a bucket using a stiff-bristled brush and Liquinox or Alconox solution.
- Sampling equipment is rinsed in tap water, then in distilled water.
- Cleaned equipment is placed on clean plastic sheeting and allowed to air dry.
3.5 Analytical Methods

The following sections describe analytical methods for inorganics, organics, and miscellaneous parameters. This information is also summarized on Table 9.

3.5.1 Inorganic and Organic COCs

Arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver, and zinc are analyzed by inductively coupled plasma mass spectroscopy (ICP-MS; EPA Method 6010B or 6020B).

Mercury is analyzed by cold vapor atomic absorption spectrometry (CVAA) using EPA Method 7471 or 7470A. Mercury may also be analyzed by cold-vapor atomic fluorescence spectrometry (CVAFS; EPA Method 1631) when lower reporting limits are needed.

PCBs are analyzed by gas chromatography/mass spectrometry (GC/MS). PCBs in incoming sediment are quantified either as Aroclors by EPA Method 8082 or as congeners by 8270SIM, depending on concentrations of total PCBs detected in pre-dredge testing as described in Section 3.1.1. PCBs in tissue and makeup water pond sediment are quantified as congeners using EPA Method 8270SIM. Congener analysis by 8270CSIM is performed by Calscience in Garden Grove, California. The DMMO has approved Calscience’s use of its version of method 8270SIM for congener analysis of dredged sediment (USACE 2012).

PAHs are analyzed by gas chromatography/mass spectroscopy (GC/MS) techniques using EPA Method 8270SIM.

Chlorinated pesticides are analyzed by GC and electron capture detector (ECD) using EPA Method 8081.

3.5.2 Miscellaneous Analyses

DO, EC, pH, temperature and turbidity in surface water are measured in the field using a conventional multi-parameter field water quality meter.

EC in monitoring well samples and in sediment is measured in the laboratory using EPA Method 120.1, which measures EC at a temperature of 25 °C using a self-contained conductivity meter.

Groundwater pH is measured in the laboratory using EPA Method 9040B, a procedure in which sample water pH is measured using an electrode. Sediment pH is measured in the laboratory using EPA Method 9045C, a procedure in which the sample is mixed with reagent water and the pH of the resulting aqueous solution is measured with an electrode.
Sediment particle size distribution (i.e., grain size) is measured using sieves for coarse-grained materials and a hydrometer for fine-grained materials. This analysis is conducted according to American Society for Testing and Materials method D422/ for sieve/hydrometer.

Percent moisture in sediment is determined using EPA Method 160.3, a procedure in which samples are weighed before and after oven drying to a constant weight at 104 °C. The percent moisture is used to calculate sediment analytical results on a dry-weight basis.

Sulfide in sediment is analyzed using EPA Method 9034, which determines the amount of sulfide that is released from soils in the presence of aqueous acid by titration.

Sediment TOC is determined by the Walkley-Black method, which uses chromic acid to measure oxidizable organic carbon. In this method, sediment samples are oxidized in a dichromate-sulfuric acid mixture. The organic carbon concentration is determined either by titration of the digest with ferrous ammonium sulfate, or colorimetrically using a spectrophotometer.

TSS in water samples is analyzed by EPA Method 160.2. In this method, a well-mixed sample is filtered through a glass fiber filter and the residue retained on the filter is dried to a constant weight at 103 °C to 105 °C.

A list of all analytes is presented in Table 6.

### 3.6 Quality Assurance/Quality Control Samples

Field and laboratory QC checks are used to evaluate laboratory analytical procedures. The QC checks involve introduction of quality control samples such as blanks, duplicates and spikes into the sample analysis stream in an effort to evaluate the accuracy and precision of the sampling and analysis program. Each laboratory reports actual detection limits obtained during chemical analytes. Each laboratory is required to document the QA/QC procedures as referenced in SW-846, Chapter I, Quality Control.

#### 3.6.1 Laboratory QC Checks

The types of laboratory QC samples that may be analyzed include reagent or method blanks, calibration blanks, laboratory control standards and laboratory control standard duplicates, matrix spikes, and matrix spike duplicates.

Reagent or method blanks are samples prepared from distilled, deionized water that had been treated with all of the reagents and manipulations (i.e., digestions or extractions) to which samples are subjected. Positive results in the reagent or method blank may indicate either contamination of the chemical reagents or glassware and other implements used to store or prepare the sample and resulting solutions.
Calibration blanks are samples prepared from distilled, deionized water that are directly introduced into an instrument without having been treated with the analytical reagents used to analyze samples. Positive results in the calibration blank may indicate contamination of an instrument or the water used in the laboratory.

Matrix spikes and matrix spike duplicates are samples prepared using the batch sample matrix (e.g., site water) and adding a predetermined quantity of a target chemical. Following analysis, percent recovery of the “spikes” and the relative percent difference between the two spikes are calculated.

Control samples are samples of a well-characterized matrix (such as blank water or sand) that are spiked with known amounts of certain target parameters and analyzed to establish method-specific control limits.

Matrix spikes, matrix spike duplicates and control samples are analyzed on at least 5 percent of the samples submitted for analysis. A method blank is performed on either 5 percent of the samples analyzed or every batch of samples analyzed, whichever is more frequent. Calibration blanks are analyzed according to the requirements of each analytical method. Spikes are conducted on the matrix in the case of water samples, but are commonly conducted on the method blank in the case of soil samples. Soil matrix spikes may be analyzed at the laboratory’s discretion.

3.6.2 Field QC Checks

Field QC checks entail field collection of control samples to be introduced to the laboratory as blind samples. Blanks and duplicates are the two sample types used, and these samples are identified in the sample ID according to type as described in Section 2.9.1.

Equipment blanks are collected immediately before collecting field samples by pouring deionized water into the sampler and filling the appropriate sample containers with this water. At least one equipment blank is collected for each piece of sampling equipment per sampling event. Additional equipment blanks may be collected at the sampler’s discretion. The sampler, after consultation with the project ecologist, may instruct the laboratory either to analyze the equipment blanks or to hold them for possible analysis later. Equipment blanks associated with any sample that contains unexplainable concentrations of COCs will be analyzed.

Field duplicate samples for sediment and water are collected and analyzed at a frequency of 1 out of every 20 samples. Additional field duplicates may be collected and submitted to the laboratory with instructions to hold the samples for possible analysis later (if, for example, analytical results for the one duplicate set indicate poor precision).

3.6.3 Field Equipment Maintenance and Calibration

The sampling equipment used depends on field conditions and sampling needs. Sediment sampling equipment may include stainless steel trowels, stainless steel dippers, a
modified Ponar or Eckman dredge, push cores, and/or handheld stainless steel augers. Water sampling equipment may include stainless steel dip samplers; Teflon, stainless steel, or polyethylene bailers; an in-line meter for measuring influent water flow rates; an electric water-level measuring device for groundwater elevation monitoring; and handheld water-quality meters. Tissue sampling equipment may include dipnets and sieves.

Equipment operation is routinely checked to minimize breakdowns in the field. Preventative maintenance and cleaning is performed after each sampling day. Nonfunctional equipment is removed from service and repaired or replaced.

In the course of the project’s monitoring program, field data will be gathered at different times and by different individuals. Calibration of water-quality and flow meters is conducted as specified by the manufacturer. Calibration ensures the proper functioning of field instrumentation and consistency and reproducibility of field measurements.

### 3.6.4 Laboratory Calibration Procedures

Calibration of laboratory instruments is necessary to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established detection limits. Each instrument is calibrated with standard solutions appropriate for the type of instrument and the linear range established for the analytical method. The Standard Operating Procedures (SOP) for analyses for many of the COCs are contained in “Test Methods for Evaluating Solid Waste” (USEPA 1980) and “Methods for Chemical Analyses of Water and Waste” (USEPA 1983). Daily calibration checks and standards for relevant constituents must fall within laboratory control limits.

Laboratory instruments must be calibrated before any analysis (standards, blanks, or samples) using EPA protocols is performed. For EPA Methods 8080, and 8081/8082, calibration will be verified daily (or every 12 hours). A calibration standard must also be injected at intervals of not less than once every 20 samples. For EPA Methods 8270 and 8290, the mass calibration standard will be analyzed daily (or every 12 hours) to demonstrate that the instrument meets the standard mass spectra abundance criteria. Whenever any action is taken that may affect the tuning parameter of the instrument (e.g., source cleaning or other maintenance), calibration must be checked, regardless of the 12-hour time period.

For metals analyses using cold vapor atomic absorption spectroscopy (EPA Method 7471), cold vapor atomic fluorescence spectrometry (EPA Method 1631), and ICP spectroscopy (EPA Method 6010 or 6020), spectrophotometers will be calibrated daily, or at least once per batch of samples.

### 3.7 Data Acquisition Requirements

To accomplish a meaningful evaluation of site conditions, synthesis of some data from outside the project is necessary. Outside data consists primarily of analytical data from source dredging projects. These data are used by project staff and regulatory agencies to determine the suitability of dredged sediment for placement at the project site. The
The project also reviews data from outside sampling efforts such as the RMP, in particular tissue data characterizing background conditions in comparison to project biosentinel data. All sources of data must originate from work plans with quality assurance plans and acceptable quality controls.

### 3.8 Data Entry and Management

Laboratory data entry and management are performed by the data manager with oversight by the project ecologist. The data manager obtains data from the analytical laboratories. All data are transferred electronically. The data manager coordinates with the analytical laboratories to ensure a consistent format for electronic data deliverables (EDDs). Laboratory data are stored electronically in a database maintained by the data manager. Reanalyzed sample results are included in the database using a designator in the sample identification to distinguish reanalyzed results from original results.

Field data entry and management are performed by the field monitoring staff. Field measurements are recorded in a field data log (see Section 2.9.4) and then entered into cumulative data tables that are stored electronically on a file sharing site maintained by the field monitoring technicians.

Data reduction of laboratory and field data is performed by the data manager, project ecologist, and field monitoring staff. The data manager queries the database of laboratory results to produce detailed data tables presenting all sample and QC results for a given monitoring period. COCs that consist of multiple individual analytes (such as PCBs and PAHs) are summarized as total concentrations. Field data for each sampling year are compiled by field monitoring staff from the cumulative data tables. The project ecologist and/or field monitoring staff then reduce the laboratory and field data, summarizing parameters such as number of samples, minimum, maximum and mean concentrations, and number of exceedances of project criteria. Both detailed tables and data summaries are presented in project monitoring reports.
4.0 ASSESSMENT AND OVERSIGHT

This section describes procedures for audits of field and laboratory performance and outlines the decision process for enacting corrective actions.

4.1 Audits and Corrective Action

Field personnel will participate in periodic internal performance and system audits conducted by the project ecologist. Internal audits will also be conducted by the data manager, including evaluation of QC data and validation of all data collected throughout the monitoring program. Internal laboratory performance and system audits will be conducted according to the specifications of the individual analytical laboratories.

4.1.1 Field Personnel Performance Audits

The project ecologist reviews documentation of field activities to ascertain adherence to the sampling protocols described in this QAPP. The project ecologist conducts at least one field inspection during the execution of sampling activities for each new major phase of work (e.g., startup of sediment placement) to ensure field staff are familiar with protocols defined in this QAPP. Thereafter, deviations from field protocols or any procedures that might compromise the quality of data obtained in the field are reported by the field staff to the project ecologist, who determines the appropriate corrective action, in consultation with the technical director if necessary. The results of field audits are summarized in the annual monitoring reports.

4.1.2 System Audits

The project ecologist and technical director perform annual (or as required) system audits to evaluate the following:

- The appropriateness of the sampling for the project area and the monitoring program objectives (see Section 2.7)
- The effect of sampling protocols on data quality and validity
- The significance of sample custody and handling methods for sample integrity
- Sample and data tracking procedures
- The appropriate of the analytical methods
- The sufficiency and appropriateness of quality control checks for ensuring data quality

4.1.3 Laboratory Performance Audits

All contract laboratories must undergo auditing as required by laboratory certifying authorities.
The data manager is responsible for global evaluation of QC data and validation of all data collected throughout the monitoring program to evaluate compliance with data quality objectives described in Section 2.8. The data manager may make recommendations to the project ecologist and technical director regarding corrective action in response to substantial or recurrent deviations from DQOs.

Laboratory data reports and EDDs are reviewed by the project ecologist and/or field monitoring staff. The deliverables are checked against the sample log (see Section 5.1.1) for completeness, and checked for appropriate sample holding times and handling. If questionable data are detected, corrective action may be required. Criteria for determining when corrective action is indicated for chemical analyses are presented in Section 5.1.2. Corrective action in such a case might include reanalysis of samples, analysis of additional blank or duplicate samples if available, rechecking laboratory calculations and checking for laboratory contamination, resampling, modifying the sampling and/or analytical protocol; or other measures. The project ecologist, in consultation with the technical director if necessary, decides what action, if any, will be taken and advises the field monitoring staff as to any additional action that the project should take on the basis of laboratory results, such as resampling or modification of the sampling or analytical protocols.
5.0 DATA REVIEW AND VALIDATION

Data collected during all phases of the project will be checked, validated, and reduced before inclusion in reports. Data validation involves specific procedures for evaluating and/or calculating precision, accuracy, and completeness. This section summarizes the protocol for assessing the validity of the reported chemical data. Also included are diagnostic procedures for identifying possible sources of errors and appropriate corrective actions for data validation.

5.1 Data Validation Procedures

Data are evaluated using quantitative statistical tests, qualitative assessment, and professional judgment. The analytical results are first checked for completeness, including the analytical method sensitivity (reported detection limit). Thereafter, blanks, duplicates, and spikes (quality control samples) are evaluated for contamination, data precision, and data accuracy, respectively.

5.1.1 Completeness and Sensitivity

Data completeness is tracked and checked by the field monitoring staff using a sample log that records all sample identification numbers and analyses requested for a given sample delivery group (SDG). The sample log also records due dates for data delivery and transfer of EDDs to the data manager. The sample log is maintained by the field monitoring staff on a file sharing platform accessible to project staff and the data manager. Laboratory reports are compared to the sample log to verify that results for all requested samples have been received. EDDs are also checked against the sample log for completeness to ensure that all reported data are submitted to the data manager.

Reporting limits are checked against the project’s target quantitation limits. If reporting limits are elevated, the project ecologist and/or field monitoring staff coordinate with the laboratory to investigate causes. The project ecologist, in consultation with the technical director if necessary, makes a decision regarding corrective action. Corrective actions may include reanalysis of existing samples, resampling of the area in question, or analysis with an alternate method or by an alternate laboratory. If target reporting limits cannot be achieved by commonly available laboratory methods for a given medium or analyte, the lab is instructed to report estimated concentrations between the detection limit and the reporting limit.

5.1.2 QA/QC Evaluation

Field and laboratory quality control data are evaluated to assess the representativeness of results for the project area being sampled. The types of quality control samples are described in Section 3.6. Blank samples are used to determine if and where any field samples may have been contaminated and the significance of such contamination. Duplicate samples are used to assess the precision of the analytical procedure as well as the inherent variability within the sampling region. Simple statistical parameters and
qualitative indicators are used in validating data. Quality control samples are comprehensively evaluated for contamination, accuracy, and precision, as discussed below.

**Blanks**

Data from blank samples are evaluated along with associated sample data. The maximum detectable concentration of each COC in any associated blank is used in the evaluation of data.

If the blank contains detectable concentrations of chemicals, the sample results are only considered positive detections if the concentrations exceed five times the maximum amount detected in any blank. The sample result is flagged as “suspect” in the database. No sample results are deleted from the database for blank-related problems.

**Duplicates and Spikes**

Spike results are evaluated for accuracy and expressed as spiked percent recovery for each spike compound. Percent recovery is the difference in concentration between the total concentration in the spike sample and the original concentration in the sample divided by the actual spike concentration added to the sample. Percent recovery is computed on a chemical-by-chemical basis for spiked sample data. Percent recovery must be within the limits shown on Table 5. For surrogate spikes, the laboratory will generate control limits within which percent recovery must fall.

Duplicates are evaluated for data precision, using relative percent difference (RPD) values. RPD is the difference in concentrations between a sample and its duplicate, divided by their average concentration, expressed as a percentage. The RPD must be within the limits shown on Table 5.

**Field Water Quality Measurements**

Field water quality measurements are validated by the project ecologist and/or field monitoring staff by checking procedures used in the field and comparing current measurements with historical project data to check for any noticeable departures from past trends. To allow comparison of data from different sampling episodes, results are reported in the same units. The units for various parameters are identified in Table 6.

5.2 **Reconciliation with User Requirements**

The project ecologist and technical director review data on an annual basis to determine if the monitoring objectives (see Section 2.7) and DQOs (Section 2.8) are being met. If data do not meet the monitoring program’s purposes and needs, corrective action will be taken. First, the project personnel will review the errors and determine if the problem is the monitoring program design, laboratory performance issues, or monitoring methods. The project ecologist and technical director, in consultation with the TRT, will decide
what corrective actions, if any, to implement. The project ecologist will work with the appropriate project staff such as the field monitoring staff, data manager, and/or analytical laboratories to implement the revised monitoring design, sampling methods or analytical procedures.
6.0 REFERENCES


## Table 1
### Water Quality Criteria
#### Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Discharge Limits$^{1,2,3}$ (daily max.)</th>
<th>Receiving Waters$^3$</th>
<th>Groundwater Criteria$^4$</th>
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**Notes:**

2. Criteria are based on the more stringent of the Basin Plan marine and freshwater acute toxicity water quality objectives (1-hr. average for inorganics, 24-hr. average for PAHs)
3. Criteria for inorganic COCs apply to dissolved concentrations unless otherwise noted.
4. Per MMRP, COCs must not be significantly above background as defined by pre-project sampling of on-site monitoring wells and off-site supply wells.
5. Assumes a hardness of 100 mg/L CaCO$_3$
6. This criterion may be met as total chromium
7. These criteria apply to total concentrations
8. See Table 6 for a list of specific analytes
9. Dissolved oxygen criteria are minimum limits. In cases where dissolved oxygen in receiving waters is <7.0 mg/L, dissolved oxygen in discharged water must be at or above dissolved oxygen in receiving waters.
10. Discharge must not promote aquatic growth in receiving waters to an extent that affects beneficial uses.
11. pH must not vary by more than 0.5 unit from ambient conditions.
12. Monthly average must be <50 mg/L
13. Permitted incremental increase over background: 5 units if background turbidity is <50, 10 units if background is 50-100, 10% increase if background is >100.
14. Annual median must not exceed 0.025 mg/L.
**Table 1**

**Water Quality Criteria**

Montezuma Wetlands Project Quality Assurance Project Plan

**Abbreviations:**

- COCs - Chemicals of concern
- DDT - Dichlorodiethyltrichloroethene
- mg/L - Milligrams per liter
- MMRP - Mitigation Monitoring and Reporting Plan
- ND - Not detected
- NTU - Nephelometric turbidity units
- PAHs - Polynuclear aromatic hydrocarbons
- PCBs - Polychlorinated biphenyls
- SU - Standard pH Units
- µg/L - Micrograms per liter

---

**Table 1 - water criteria**
Table 2
Sediment Quality Criteria
Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Permit Criteria¹</th>
<th>Operational Criteria²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Foundation</td>
</tr>
<tr>
<td><strong>Inorganics (mg/kg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>15.3</td>
<td>70</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.33</td>
<td>9.6</td>
</tr>
<tr>
<td>Chromium</td>
<td>112</td>
<td>370</td>
</tr>
<tr>
<td>Copper</td>
<td>68.1</td>
<td>270</td>
</tr>
<tr>
<td>Lead</td>
<td>43.2</td>
<td>218</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.43</td>
<td>1.3³</td>
</tr>
<tr>
<td>Nickel</td>
<td>112</td>
<td>200³</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.64</td>
<td>1.4⁴</td>
</tr>
<tr>
<td>Silver</td>
<td>0.58</td>
<td>3.7</td>
</tr>
<tr>
<td>Zinc</td>
<td>158</td>
<td>410</td>
</tr>
<tr>
<td><strong>Organics (µg/kg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total DDTs</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Total Chlordanes</td>
<td></td>
<td>2.3</td>
</tr>
<tr>
<td>Dieldrin</td>
<td></td>
<td>0.70</td>
</tr>
<tr>
<td>Total PCBs⁴</td>
<td></td>
<td>22.7</td>
</tr>
<tr>
<td>Total PAHs⁵</td>
<td></td>
<td>3,390</td>
</tr>
<tr>
<td><strong>Conventional Parameters (units as noted)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sands in cover sediment over foundation subcells (%)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sands in top 1 foot of marsh (%)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>pH (standard units)</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes:
¹ Criteria from updated RWQCB Waste Discharge Requirements adopted November 14, 2012. Surface and foundation criteria are taken from RWQCB 2000 unless otherwise noted.
² Project-developed sediment criteria from the MMRP (LFR 2000)
³ Foundation criteria for mercury, nickel, selenium and DDTs are taken from noncover criteria for wetland creation (RWQCB 1992)
⁴ Sum of RMP 40 congeners
⁵ Sum of RMP 25 compounds
DDT - Dichlorodiethyltrichloroethene
mg/kg - Milligrams per kilogram
MMRP - Mitigation Monitoring and Reporting Plan
PAHs - Polynuclear aromatic hydrocarbons
PCBs - Polychlorinated biphenyls
RWQCB - Regional Water Quality Control Board
µg/kg - Micrograms per kilogram
Table 3  
Sediment Placement History  
Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>Dates</th>
<th>Volumes (cubic yards)</th>
<th>Destination Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/23/03 - 4/19/04</td>
<td>Total 495,300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surface (Cover) 313,500</td>
<td>Cells 1 and 2</td>
</tr>
<tr>
<td></td>
<td>Foundation (Noncover) 181,800</td>
<td></td>
</tr>
<tr>
<td>12/12/04 - 3/10/05</td>
<td>Total 874,700</td>
<td></td>
</tr>
<tr>
<td>9/26/05 - 11/13/05</td>
<td>Surface (Cover) 802,900</td>
<td>Cells 1, 2, 3/4, 8/9 and 10</td>
</tr>
<tr>
<td></td>
<td>Foundation (Noncover) 71,800</td>
<td>Cells 1 and 3/4</td>
</tr>
<tr>
<td>1/20/06 - 8/3/06</td>
<td>Surface (Cover) 1,500,000</td>
<td>Cells 1, 3/4, 6/7, 8/9 and 10</td>
</tr>
<tr>
<td>11/3/06 - 11/10/06</td>
<td>Total 272,100</td>
<td></td>
</tr>
<tr>
<td>12/8/06 - 12/31/06</td>
<td>Surface (Cover) 248,700</td>
<td>Cell 11</td>
</tr>
<tr>
<td></td>
<td>Foundation (Noncover) 23,400</td>
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<tr>
<td>12/15/11 - 11/30/12</td>
<td>Total 946,000</td>
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</tr>
<tr>
<td></td>
<td>Surface (Cover) 932,000</td>
<td>Cells 1, 2, 3/4, 6/7, 8/9, 10 and 11</td>
</tr>
<tr>
<td></td>
<td>Foundation (Noncover) 14,000</td>
<td>Cell 6/7</td>
</tr>
<tr>
<td>5/18/13 - 5/22/13</td>
<td>Foundation (Noncover) 13,000</td>
<td>Cell 6/7</td>
</tr>
</tbody>
</table>

Notes:  
The project’s original permit criteria for sediment were cover and noncover limits for wetland beneficial reuse (RWQCB 1992). Surface and foundation criteria for wetland beneficial reuse (RWQCB 2000) were adopted in the updated WDR dated November 14, 2012.

1 Approximately 500,000 cy of this material was classified as cover sediment by the DMMO despite levels of mercury and DDT slightly above the project’s cover limits. Additional monitoring and testing was conducted at the site during placement of this material as described in LEG 2004b.

2 Approximately 27,000 of this material was sand that was placed in the cover area of Cell 3/4.

3 Approximately 489,600 cy of this material was sand and approximately 272,300 cy was a mixture of mud and shells. The sand was placed mostly in the northern portion of Cell 8/9 and in Cell 10, with a small amount placed in the southern part of Cell 6/7. Approximately 20,000 cy of the sand was also placed between Cell 1 and the footprint of the Cell 12 levee (not yet constructed) for future levee construction use. The mud/shell mixture was placed mainly in the southern part of Cell 8/9; minor amounts were placed in Cells 1 and 3/4.

4 This material was dredged from the Levin-Richmond Terminal Corporation site and contained levels of DDT above the project’s noncover limit. Per agency approvals, this sediment was placed into the deepest portion of Cell 11 where it could be covered by at least 7 feet of cover material and additional monitoring and testing was conducted as described in LEG 2006b.

5 These volumes are estimates based on project records and may be adjusted once final in-place volumes based on surveys at the dredging sites are received.
<table>
<thead>
<tr>
<th>Cell Number</th>
<th>Approximate Size (acres)</th>
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<tbody>
<tr>
<td>1</td>
<td>31.6</td>
</tr>
<tr>
<td>2</td>
<td>57.9</td>
</tr>
<tr>
<td>3/4</td>
<td>69.4</td>
</tr>
<tr>
<td>6/7</td>
<td>79.8</td>
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<tr>
<td>8/9</td>
<td>82.7</td>
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<tr>
<td>10</td>
<td>26.2</td>
</tr>
<tr>
<td>11</td>
<td>40.4</td>
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<tr>
<td>12</td>
<td>42.6</td>
</tr>
<tr>
<td>Parameter</td>
<td>% Recovery</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Inorganics</strong></td>
<td></td>
</tr>
<tr>
<td>Arsenic, cadmium, chromium, copper, lead, total mercury, nickel, selenium, silver and zinc</td>
<td>75-25</td>
</tr>
<tr>
<td>Methylmercury</td>
<td>70-130</td>
</tr>
<tr>
<td><strong>Organics</strong></td>
<td></td>
</tr>
<tr>
<td>PAHs*</td>
<td>50 - 150</td>
</tr>
<tr>
<td>Organochlorine pesticides and PCBs</td>
<td>50 - 150</td>
</tr>
<tr>
<td><strong>Conventional Parameters</strong></td>
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</tr>
<tr>
<td>Percent moisture</td>
<td>NA</td>
</tr>
<tr>
<td>Total organic carbon</td>
<td>75 - 125</td>
</tr>
<tr>
<td>Sulfides</td>
<td>75 - 125</td>
</tr>
<tr>
<td>pH</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Notes:**

NA  Not applicable
RPD Relative percent difference
PAHs Polynuclear aromatic hydrocarbons
PCBs Polychlorinated biphenyls
### Table 6
Quantitation Limits

Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>Inorganics</th>
<th>Water (µg/L)</th>
<th>Sediment (mg/kg)</th>
<th>Tissue (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RL</td>
<td>MDL</td>
<td>RL</td>
</tr>
<tr>
<td>Arsenic</td>
<td>1</td>
<td>0.39</td>
<td>0.2</td>
</tr>
<tr>
<td>Cadmium</td>
<td>1</td>
<td>0.13</td>
<td>0.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>1</td>
<td>0.40</td>
<td>0.2</td>
</tr>
<tr>
<td>Copper</td>
<td>1</td>
<td>0.14</td>
<td>0.2</td>
</tr>
<tr>
<td>Lead</td>
<td>1</td>
<td>0.09</td>
<td>0.1</td>
</tr>
<tr>
<td>Mercury (EPA 7471)</td>
<td>0.2</td>
<td>0.045</td>
<td>0.04</td>
</tr>
<tr>
<td>Low-level Mercury (EPA 1631)</td>
<td>5.00E-04</td>
<td>1.46E-04</td>
<td>4.00E-04</td>
</tr>
<tr>
<td>Methylmercury (EPA 1630)</td>
<td>5.00E-05</td>
<td>2.58E-05</td>
<td>5.00E-05</td>
</tr>
<tr>
<td>Nickel</td>
<td>1</td>
<td>0.13</td>
<td>0.2</td>
</tr>
<tr>
<td>Selenium</td>
<td>1</td>
<td>0.17</td>
<td>0.2</td>
</tr>
<tr>
<td>Silver</td>
<td>1</td>
<td>0.11</td>
<td>0.1</td>
</tr>
<tr>
<td>Zinc</td>
<td>5</td>
<td>0.48</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Water (µg/L)</th>
<th>Sediment (µg/kg)</th>
<th>Tissue (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RL</td>
<td>MDL</td>
<td>RL</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>0.03</td>
<td>2.0</td>
<td>2.0</td>
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<tr>
<td>1-Methylphenanthrene</td>
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<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>0.03</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>2,3,5-Trimethylnaphthalene</td>
<td>0.11</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>0.02</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>0.02</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>0.02</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Anthracene</td>
<td>0.03</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>Benzo(a)anthracene</td>
<td>0.02</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>0.04</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>0.03</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>0.01</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Benzo(g,h,i)perylene</td>
<td>0.02</td>
<td>0.94</td>
<td>0.94</td>
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<tr>
<td>Benzo(k)fluoranthene</td>
<td>0.02</td>
<td>1.4</td>
<td>1.4</td>
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<tr>
<td>Biphenyl</td>
<td>0.01</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Chrysene</td>
<td>0.02</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Dibenzo(a,h)anthracene</td>
<td>0.03</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dibenzoanthiophene</td>
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<td>1.3</td>
<td>1.3</td>
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<td>Fluoranthene</td>
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<td>0.98</td>
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<td>Fluorene</td>
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<td>1.5</td>
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<td>Indeno(1,2,3-cd)pyrene</td>
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<td>1.1</td>
<td>1.1</td>
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<tr>
<td>Naphthalene</td>
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<td>Perylene</td>
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<td>1.7</td>
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<tr>
<td>Phenanthrene</td>
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<td>1.0</td>
<td>1.0</td>
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<tr>
<td>Pyrene</td>
<td>0.03</td>
<td>0.99</td>
<td>0.99</td>
</tr>
</tbody>
</table>
# Table 6
## Quantitation Limits
### Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>PCBs (8270C SIM)</th>
<th>Water (µg/L)</th>
<th>Sediment (µg/kg)</th>
<th>Tissue (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RL MDL</td>
<td>RL MDL</td>
<td>RL MDL</td>
</tr>
<tr>
<td>PCB 8</td>
<td>4.00E-03 1.30E-03</td>
<td>0.40 0.23</td>
<td>0.40 0.23</td>
</tr>
<tr>
<td>PCB 18</td>
<td>7.00E-04 0.09</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>PCB 28</td>
<td>4.60E-04 0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>PCB 31</td>
<td>9.10E-04 0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>PCB 33</td>
<td>7.50E-04 0.10</td>
<td>0.10</td>
<td>0.10</td>
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<tr>
<td>PCB 44</td>
<td>7.60E-04 0.09</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>PCB 49</td>
<td>8.70E-04 0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>PCB 52</td>
<td>5.40E-04 0.12</td>
<td>0.12</td>
<td>0.12</td>
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<td>PCB 56</td>
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<tr>
<td>PCB 60</td>
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<tr>
<td>PCB 66</td>
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<tr>
<td>PCB 70</td>
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<td>PCB 87</td>
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<td>PCB 97</td>
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<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>PCB 99</td>
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<td>PCB 101</td>
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<tr>
<td>PCB 105</td>
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<tr>
<td>PCB 110</td>
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<tr>
<td>PCB 118</td>
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<tr>
<td>PCB 128</td>
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<td>0.10</td>
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</tr>
<tr>
<td>PCB 132</td>
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<td>0.11</td>
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<tr>
<td>PCB 138</td>
<td>4.00E-03 1.60E-03</td>
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<td>0.40 0.14</td>
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<td>0.11</td>
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</tr>
<tr>
<td>PCB 149</td>
<td>9.30E-04 0.12</td>
<td>0.12</td>
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<tr>
<td>PCB 151</td>
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</tr>
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<td>PCB 153</td>
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<tr>
<td>PCB 158</td>
<td>4.00E-03 1.60E-03</td>
<td>0.40 0.14</td>
<td>0.40 0.14</td>
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<td>6.10E-04 0.10</td>
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<td>0.10</td>
</tr>
<tr>
<td>PCB 174</td>
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<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>PCB 177</td>
<td>6.90E-04 0.06</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>PCB 180</td>
<td>5.90E-04 0.06</td>
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</tr>
<tr>
<td>PCB 183</td>
<td>6.80E-04 0.06</td>
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<tr>
<td>PCB 187</td>
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<tr>
<td>PCB 194</td>
<td>5.70E-04 0.14</td>
<td>0.14</td>
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<tr>
<td>PCB 195</td>
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<tr>
<td>PCB 201</td>
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<tr>
<td>PCB 203</td>
<td>6.20E-04 0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>PCBs (8082)</td>
<td>Water (µg/L)</td>
<td>Sediment (µg/kg)</td>
<td>Tissue (µg/kg)</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>RL</td>
<td>MDL</td>
<td>RL</td>
</tr>
<tr>
<td>Aroclor 1016</td>
<td>0.5</td>
<td>0.2</td>
<td>12</td>
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<tr>
<td>Aroclor 1221</td>
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<td>0.1</td>
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<td>Aroclor 1242</td>
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<td>0.2</td>
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<td>Aroclor 1248</td>
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<td>0.2</td>
<td>12</td>
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<tr>
<td>Aroclor 1254</td>
<td>0.5</td>
<td>0.2</td>
<td>12</td>
</tr>
<tr>
<td>Aroclor 1260</td>
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<td>0.1</td>
<td>12</td>
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<tr>
<td>Aroclor 1262</td>
<td>--</td>
<td>--</td>
<td>12</td>
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<table>
<thead>
<tr>
<th>Pesticides</th>
<th>Water (µg/L)</th>
<th>Sediment (µg/kg)</th>
<th>Tissue (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RL</td>
<td>MDL</td>
<td>RL</td>
</tr>
<tr>
<td>Aldrin</td>
<td>0.05</td>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Alpha-Chlordane</td>
<td>0.01</td>
<td>0.01</td>
<td>0.32</td>
</tr>
<tr>
<td>Gamma-Chlordane</td>
<td>0.01</td>
<td>0.01</td>
<td>0.32</td>
</tr>
<tr>
<td>2,4'-DDD</td>
<td>--</td>
<td>--</td>
<td>0.34</td>
</tr>
<tr>
<td>2,4'-DDE</td>
<td>--</td>
<td>--</td>
<td>0.31</td>
</tr>
<tr>
<td>2,4'-DDT</td>
<td>0.5</td>
<td>0.5</td>
<td>0.32</td>
</tr>
<tr>
<td>4,4'-DDD</td>
<td>0.03</td>
<td>0.03</td>
<td>0.32</td>
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<tr>
<td>4,4'-DDE</td>
<td>0.02</td>
<td>0.02</td>
<td>0.34</td>
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<tr>
<td>4,4'-DDT</td>
<td>0.03</td>
<td>0.03</td>
<td>0.31</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>0.02</td>
<td>0.02</td>
<td>0.33</td>
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<tr>
<td>Endosulfan I</td>
<td>0.05</td>
<td>0.05</td>
<td>0.26</td>
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<tr>
<td>Endosulfan II</td>
<td>0.02</td>
<td>0.02</td>
<td>0.28</td>
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<tr>
<td>Endosulfan sulfate</td>
<td>0.03</td>
<td>0.03</td>
<td>0.34</td>
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<tr>
<td>Endrin</td>
<td>0.03</td>
<td>0.03</td>
<td>0.36</td>
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<tr>
<td>Endrin aldehyde</td>
<td>0.02</td>
<td>0.02</td>
<td>0.24</td>
</tr>
<tr>
<td>alpha-HCH</td>
<td>0.01</td>
<td>0.01</td>
<td>0.32</td>
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<tr>
<td>beta-HCH</td>
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<td>0.01</td>
<td>0.26</td>
</tr>
<tr>
<td>delta-HCH</td>
<td>0.02</td>
<td>0.02</td>
<td>0.26</td>
</tr>
<tr>
<td>gamma-HCH (Lindane)</td>
<td>0.02</td>
<td>0.02</td>
<td>0.35</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>0.01</td>
<td>0.01</td>
<td>0.32</td>
</tr>
<tr>
<td>Heptachlor epoxide</td>
<td>0.01</td>
<td>0.01</td>
<td>0.36</td>
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<tr>
<td>Methoxychlor</td>
<td>0.5</td>
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<td>0.32</td>
</tr>
<tr>
<td>cis-Nonachlor</td>
<td>0.29</td>
<td>0.29</td>
<td>0.29</td>
</tr>
<tr>
<td>trans-Nonachlor</td>
<td>--</td>
<td>--</td>
<td>0.29</td>
</tr>
<tr>
<td>oxychlordane</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
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<tr>
<td>Toxaphene</td>
<td>1.0</td>
<td>1.0</td>
<td>6.30</td>
</tr>
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### Table 6
**Quantitation Limits**

**Montezuma Wetlands Project Quality Assurance Project Plan**

<table>
<thead>
<tr>
<th>Conventional Parameters (units as noted)</th>
<th>Water</th>
<th>Sediment</th>
<th>Tissue</th>
</tr>
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<tbody>
<tr>
<td>RL</td>
<td>MDL</td>
<td>RL</td>
<td>MDL</td>
</tr>
<tr>
<td>EC (µhmhos/cm)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Lipids (%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Particle size (%)</td>
<td>--</td>
<td>--</td>
<td>0.01</td>
</tr>
<tr>
<td>Percent moisture (%)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>pH (SU)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Sulfides (mg/kg)</td>
<td>--</td>
<td>--</td>
<td>1.0</td>
</tr>
<tr>
<td>Total organic carbon (%)</td>
<td>--</td>
<td>--</td>
<td>0.15</td>
</tr>
<tr>
<td>Total suspended solids (mg/L)</td>
<td>1.0</td>
<td>0.95</td>
<td>--</td>
</tr>
</tbody>
</table>

**Notes:**
- DDD - Dichlorodiohenyldichloroethane
- DDE - Dichlorodiphenyltrichloroethylene
- DDT - Dichlorodiphenyltrichloroethane
- EC - Electrical conductivity
- HCH - Hexachlorocyclohexane
- MDL - Method detection limit
- mg/kg - Milligrams per kilogram
- mg/L - Milligrams per liter
- PAHs - Polynuclear aromatic hydrocarbons
- PCBs - Polychlorinated biphenyls
- RL - Reporting limit
- µg/kg - Micrograms per kilogram
- µg/L - Micrograms per liter
<table>
<thead>
<tr>
<th>Monitoring Element</th>
<th>Sample Matrix</th>
<th>Parameters</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cells</td>
<td>Incoming Sediment</td>
<td>Inorganic COCs, PAHs, PCBs, pesticides, grain size, pH, EC, TOC and sulfides.</td>
<td>At least 1 sample per 60,000 cy(^1)</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Inorganic COCs, pH, EC</td>
<td></td>
<td>Every two weeks during active sediment placement</td>
</tr>
<tr>
<td>Surface-Only and Completed Foundation Cells(^2)</td>
<td>Biosentinel Tissue</td>
<td>Mercury, selenium</td>
<td>Annually during the breeding season</td>
</tr>
<tr>
<td></td>
<td>Sediment</td>
<td>Methylmercury</td>
<td>Annually during the breeding season if no appropriate biosentinel species are present</td>
</tr>
<tr>
<td>In-Process Foundation Cells(^3)</td>
<td>Biosentinel Tissue</td>
<td>Mercury, selenium, and whichever COC(s) are responsible for the foundation designation</td>
<td>To be determined in consultation with the TRT depending on the length of time foundation sediment is exposed</td>
</tr>
<tr>
<td></td>
<td>Sediment</td>
<td>Methylmercury</td>
<td>Once annually in sediment and three times annually in water during the breeding season if no appropriate biosentinel species are present</td>
</tr>
<tr>
<td>Monitoring Wells</td>
<td>Groundwater</td>
<td>Inorganic COCs (including low-level mercury analysis), pH, EC, temperature, groundwater elevation</td>
<td>Twice yearly</td>
</tr>
<tr>
<td>Offsite Supply Wells</td>
<td>Groundwater</td>
<td>Groundwater elevations</td>
<td>Annually</td>
</tr>
<tr>
<td>Makeup Water Pond</td>
<td>Biosentinel Tissue</td>
<td>Mercury, selenium, PCBs, pesticides</td>
<td>Annually during periods of active sediment placement</td>
</tr>
<tr>
<td></td>
<td>Sediment</td>
<td>Inorganic COCs, PAHs, PCBs, pesticides, pH</td>
<td>Annually during periods of active sediment placement if no appropriate biosentinel species are present</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Inorganic COCs, TSS, turbidity, DO, EC, pH, temperature, flow rate</td>
<td>Once prior to the start of a discharge episode.(^4) Inorganic COCs and TSS daily for the first 5 days of a discharge episode, then weekly for the remainder of the episode. Turbidity, DO, EC, pH, temperature and flow rate daily during discharge.</td>
<td></td>
</tr>
<tr>
<td>Acute Toxicity</td>
<td>% mortality, % normal development</td>
<td>Once within one week prior to discharge, then weekly for the remainder of the discharge episode.(^4)</td>
<td></td>
</tr>
<tr>
<td>Receiving Waters</td>
<td>Inorganic COCs, TSS, turbidity, DO, EC, pH, temperature</td>
<td>Twice during each discharge episode(^4) (once within the first week and once within the last week). Once if the discharge episode lasts less than one week.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 7
Monitoring Program Summary
Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>Monitoring Element</th>
<th>Sample Matrix</th>
<th>Parameters</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent from Onsite Supply Wells</td>
<td>Groundwater</td>
<td>Inorganic COCs, TSS, turbidity, DO, EC, pH, temperature</td>
<td>As needed to inform onsite water management</td>
</tr>
<tr>
<td>Return Water Channel</td>
<td>Surface Water</td>
<td>pH, TSS, EC</td>
<td>TSS, pH and EC every two weeks during active sediment placement when water is being recycled in the makeup water pond. EC monthly at other times.</td>
</tr>
<tr>
<td>Rehandling Facility</td>
<td>Incoming Sediment</td>
<td>Inorganic COCs, PAHs, PCBs, pesticides, grain size, pH, EC, TOC and sulfides.</td>
<td>At least 1 sample per 30,000 cy</td>
</tr>
<tr>
<td></td>
<td>Rehandled Sediment</td>
<td>EC, pH</td>
<td>Prior to offsite sale of rehandled sediment</td>
</tr>
</tbody>
</table>

**Notes:**
1. Grain size sampling frequency is increased to 1 sample per ~30,000 cy when placing surface sediment over foundation sediment, or when sediment elevations in the cell are within 1 foot of the design elevation.
2. Completed foundation cells are cells where foundation material has been covered by at least 3 feet of surface sediment.
3. In-process foundation cells are cells in which foundation material is not yet covered.
4. A discharge episode is defined as discharge of water from the makeup water pond that does not cease for more than 30 consecutive days. If discharge stops for more than 30 days and starts again, the date of startup will be considered the beginning of a new discharge episode.

COCs - Chemicals of concern  
CY - Cubic yard  
DO - Dissolved oxygen  
EC - Electrical conductivity  
PAHs - Polynuclear aromatic hydrocarbons  
PCBs - Polychlorinated biphenyls  
TOC - Total organic carbon  
TSS - Total suspended solids
| Parameter | Methods | Sample Medium | Sample Container | Preservative | Holding Time
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inorganic Analyses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver and zinc</td>
<td>EPA 6010B/6020/7471</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool, 4°C</td>
<td>1 year frozen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tissue (5g)</td>
<td>Glass or polypropylene jar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Polyethylene bottle</td>
<td>HNO₃</td>
<td>6 mo. after preservation, 48 hrs. if not preserved</td>
</tr>
<tr>
<td>Methylmercury</td>
<td>EPA 1630</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Freeze ≤20°C</td>
<td>1 year frozen</td>
</tr>
<tr>
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<td>Tissue (0.25g)</td>
<td>Glass or polypropylene jar</td>
<td>Cool 4°C</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Glass or fluoropolymer bottle</td>
<td>HCl</td>
<td>6 mo. after preservation, 48 hrs. if not preserved</td>
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<td>Mercury (low-level)</td>
<td>EPA 1631</td>
<td>Water</td>
<td>Glass or fluoropolymer bottle</td>
<td>BrCl or HCl</td>
<td>90 days after preservation, 48 hrs. if not preserved</td>
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<td>Glass jar</td>
<td>Cool 4°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tissue (10g)</td>
<td>Glass or polyethylene jar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Amber glass bottle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tissue (10g)</td>
<td>Glass or polyethylene jar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Amber glass bottle</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tissue (10g)</td>
<td>Glass or polyethylene jar</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Polyethylene or glass bottle</td>
<td></td>
<td></td>
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<td><strong>Organic Analyses</strong></td>
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</tr>
<tr>
<td>PAHs</td>
<td>EPA 8270SIM</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>14 days/40 days</td>
</tr>
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<td></td>
<td>Tissue (10g)</td>
<td>Glass or polyethylene jar</td>
<td></td>
<td>7 days/40 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Amber glass bottle</td>
<td></td>
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</tr>
<tr>
<td>Organochlorine pesticides</td>
<td>EPA 8081</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>14 days/40 days</td>
</tr>
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<td></td>
<td>Tissue (10g)</td>
<td>Glass or polyethylene jar</td>
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<td>7 days/40 days</td>
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<td>Water</td>
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<tr>
<td>PCBs</td>
<td>EPA 8270SIM or 8082</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>14 days/40 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tissue (10g)</td>
<td>Glass or polyethylene jar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Polyethylene or glass bottle</td>
<td></td>
<td></td>
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<td><strong>Miscellaneous Analyses</strong></td>
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<td>EC</td>
<td>EPA 120.1</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>24 hrs.</td>
</tr>
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<td>Water</td>
<td>Polyethylene or glass bottle</td>
<td>Cool 4°C</td>
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<td>Particle size</td>
<td>ASTM D422</td>
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<td>Cool 4°C</td>
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<tr>
<td>Percent moisture</td>
<td>EPA 160.3</td>
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<td>Cool 4°C</td>
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<tr>
<td>pH</td>
<td>EPA 9040B</td>
<td>Water</td>
<td>Glass or polyethylene bottle</td>
<td>Cool 4°C</td>
<td>Immediate</td>
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<td>EPA 9045C</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>Immediate</td>
</tr>
</tbody>
</table>
Table 8
Sample Containers, Holding Times, and Preservative Requirements
Montezuma Wetlands Project Quality Assurance Project Plan

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Methods</th>
<th>Sample Medium</th>
<th>Sample Container</th>
<th>Preservative</th>
<th>Holding Time&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfide</td>
<td>EPA 9034</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
<td>Amber glass bottle</td>
<td>Zn(OAc)&lt;sub&gt;2&lt;/sub&gt;, NaOH</td>
<td></td>
</tr>
<tr>
<td>Total organic carbon</td>
<td>Walkley-Black</td>
<td>Sediment</td>
<td>Glass jar</td>
<td>Cool 4°C</td>
<td>28 days</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>EPA 160.2</td>
<td>Water</td>
<td>Amber glass bottle</td>
<td>Cool 4°C</td>
<td>7 days</td>
</tr>
</tbody>
</table>

Notes:

a  "x" days/"y" days refers to the maximum number of days from sampling to extraction/the maximum number of days from extraction to analysis.
   Sediment and tissue samples can be stored frozen for one year.

b  Value in parentheses is the minimum sample mass required for a single analytical sample

°C  Degrees Celsius
EC  Electrical conductivity
EPA U.S. Environmental Protection Agency
g  Grams
NA  Not applicable
ml  Milliliter
PAHs Polynuclear aromatic hydrocarbons
PCBs Polychlorinated biphenyls
### Table 9 - Analytical Methods

**Montezuma Wetlands Project Quality Assurance Project Plan**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method Number</th>
<th>Reference</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inorganic Analyses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver and zinc</td>
<td>EPA 6010B or 6020</td>
<td>SW-846&lt;sup&gt;a&lt;/sup&gt;</td>
<td>ICP/MS</td>
</tr>
<tr>
<td>Total mercury</td>
<td>EPA 7471 or 1631</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>CVAA or CVAFS</td>
</tr>
<tr>
<td>Methylmercury</td>
<td>EPA 1630</td>
<td>EPA-821-R-01-020&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Organic Analyses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAHs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>EPA 8270SIM</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>GC/MS</td>
</tr>
<tr>
<td>Organochlorine pesticides</td>
<td>EPA 8081</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>PCBs&lt;sup&gt;b&lt;/sup&gt;</td>
<td>EPA 8270C SIM or 8082</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>HRGC/HRMS or GC/MS</td>
</tr>
<tr>
<td><strong>Miscellaneous Analyses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EC</td>
<td>EPA 120.1</td>
<td>EPA 1983&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Potentiometric</td>
</tr>
<tr>
<td>Particle size</td>
<td>ASTM D422</td>
<td>ASTM 2007&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Sieve and hydrometer</td>
</tr>
<tr>
<td>Percent moisture</td>
<td>EPA 160.3</td>
<td>EPA 1983&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Gravimetric</td>
</tr>
<tr>
<td>pH</td>
<td>EPA 9040B (water)</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Electrometric</td>
</tr>
<tr>
<td></td>
<td>EPA 9045C (sediment)</td>
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<td>Sulfides</td>
<td>EPA 9034</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Titrimetric</td>
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<tr>
<td>Total organic carbon</td>
<td>Walkley-Black</td>
<td>SW-846&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Oxidation/Titration</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>EPA 160.2</td>
<td>EPA 1983&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Gravimetric</td>
</tr>
</tbody>
</table>

**Notes:**

- <sup>a</sup> List of RMP 25 compounds
- <sup>b</sup> List of RMP 40 congeners (8270SIM). Sediment PCBs may be analyzed as Aroclors (EPA Method 8082) depending on concentration of total PCBs detected in pre-dredge testing (see Section 3.1.1)

AA  Atomic absorption spectroscopy
CVAA  Cold vapor atomic absorption spectroscopy
CVAFS  Cold vapor atomic fluorescence spectrometry
EC  Electrical conductivity
CG/ECD  Gas chromatography/electron capture detector
GC/MS  Gas chromatography/mass spectrometry
HRGC/HRMS  High resolution gas chromatography/high resolution mass spectrometry
ICP/MS  Inductively coupled plasma/mass spectrometry
PAHs  Polynuclear aromatic hydrocarbons
PCBs  Polychlorinated biphenyls
Site Location Map

MONTEZUMA WETLANDS PROJECT

Source: Brady and Associates (1994)
MONTEZUMA WETLANDS PROJECT

**LANDSCAPE ELEMENTS**
- Black: Created Vernal Pools
- Gray: Undisturbed to Remain
- Purple: Avoided Vernal Pools
- Orange: Sediment Offloading & Rehandling Facility
- Green: Managed Fluvial Hollows
- Red: Created Habitats
- Brown: Seasonally Wet Depressions
- Yellow: Loafing and Nesting Islands
- Blue: Diked Pickleweed Marsh
- Purple: Low Intertidal Marsh
- Pink: Intertidal Point Bars
- Blue: Intertidal Channels
- Gray: High Intertidal Marsh
- Green: Managed Wetlands
- Yellow: Experimental Intertidal Ponds
- Gray: Retention Ponds
- Green: Experimental Intertidal Ponds
- Green: Created Vernal Pools

**EXPLANATION**
- Dashed: Phase Boundary
- Solid: Roadways
- Dashed: Dredged Sediment Placement Cells and Levees
- Solid: Project Boundary
- Plus: NOS/DWR Gauging Station

**PHASE I**
- Levee Breach Phase I
- Extend Public Access Trail on Perimeter Levee to Phase II Breach
- Existing Marsh to Remain Undisturbed

**PHASE II**
- Approximate Wetlands Restoration Boundary
- Levee Breach Phase II
- Existing Marsh to Remain Undisturbed

**PHASE III**
- Created Vernal Pools
- Managed Fluvial Hollows
- Managed Wetlands

**PHASE IV**
- Existing Marsh to Remain Undisturbed

**Figure 2**
Figure 5

LEGEND

Surface Water Sample Location
Offsite Supply Well

APPROXIMATE SAMPLE LOCATIONS
Montezuma Wetlands
APPENDIX A

TECHNICAL REVIEW TEAM RECOMMENDATIONS FOR CHANGES TO PRE-BREACH WATER AND SEDIMENT QUALITY MONITORING
Montezuma Wetland Restoration Project
TRT Recommendations for Changes to Pre-breach Water and Sediment Quality Monitoring

This document provides the final Technical Review Team (TRT) recommendations for changes to the water and sediment quality monitoring of the Montezuma Wetland Restoration Project prior to breaching restoration cells. The content here was developed based on a workshop at the San Francisco Estuary Institute on 14 April 2011.

Phase I of the Montezuma Wetland Restoration Project has remained in an interim, un-breached state for several years longer than expected. This situation has meant that the wetted, non-tidal cells to be restored have become habitat for wildlife in the area, thus providing a Beneficial Use. To protect these wildlife from chemical contaminants related to poor water quality, the Technical Review Team (TRT) proposes that the Beneficial Use be directly monitored. This can be accomplished by sampling appropriate sentinel species that reflect local bioaccumulation of contaminants in the food web of each restoration cell.

Water management has proved to be a significant issue for the Montezuma Project. Obtaining enough water to keep all the cells ponded for many years prior to breaching has been difficult. Therefore, options for allowing each type of cell to dry out seasonally were explored by the TRT.

Guiding Principles

These recommendations are designed around the following guiding principles:

1. Monitoring should focus on clearly stated management or regulatory questions that (a) explicitly focus on the condition of identified beneficial uses or project functions of interest to the managers or regulators; and (b) can be answered by monitoring results that directly inform project management actions or design decisions.

   Answer the question: what is the management or regulatory question that needs to be answered, and how will the answer be used to manage or alter the project?

2. If the beneficial use cannot be monitored directly, then the monitoring can focus on a surrogate. But, in every case the data should pertain as directly as possible to the condition of the beneficial use.
Answer the question: what is the beneficial use that should be protected, and are the monitoring data informing the needed protection?

3. To the extent possible, project data should be comparable from one time to another, from one project to another, and to ambient data.

4. There are two approaches to assessing project condition based on monitoring data. One approach is to compare the project to established limits of acceptable condition such as biological objectives or established toxicity thresholds. This approach measures the effect of the project on the condition of an on-site beneficial use. Another approach is to compare the condition of a beneficial use of a project to the ambient condition of the beneficial use. This approach measures the effect of the project on the condition of a beneficial use across the region that is represented by the ambient data. The preferred approach can differ from one question to another.

5. When there are alternative monitoring methods to adequately answer a management or regulatory question, the least expensive alternative method is preferable.

**Monitoring Approach**

The following approach to water quality monitoring should be applied to each cell type or other habitat area in the Project in a hierarchical fashion, according to the list below.

1. Identify and define the beneficial use to be protected. *The Beneficial Use is breeding habitat for vertebrates, not feeding habitat or wintering habitat. The assumption is that the Montezuma Project is not responsible for maintaining a vibrant food web in the ponds prior to breach. However, the Montezuma Project is responsible for not causing reproductive harm to vertebrate wildlife that use the ponds during the breeding season prior to breach. Therefore contaminants that bioaccumulate in vertebrates are a concern, but those that are toxic to invertebrates but do not bioaccumulate are not a concern for water quality in waters than remain on the Project site.***

2. Identify appropriate biosentinel species to monitor that will indicate the condition of the Beneficial Use. *Biosentinel species should have small, localized home ranges in the particular area to be monitored. They should be commonly found throughout the project, and relatively easily sampled. They should be high enough in the food web to be sensitive indicators of contaminants in the food web, and they should forage in the Project area during the breeding season.***

3. If no appropriate biosentinel species exists in the area, then consider monitoring lower trophic levels in the food web. *Lower trophic levels, such as invertebrates and primary producers, can present difficulties for sampling. These include extensive effort to obtain enough tissue, or to sort tissue into taxonomic*
categories: greater variability of bioaccumulation in space and time, and patchy distributions of species. However, lower trophic level biota can also be a good surrogate for more ideal biosentinels.

4. If no appropriate biosentinel at a lower trophic level exits, then consider monitoring sediment and/or water. Sediment or water measurements do not directly reflect the Beneficial Use defined above, but they may indicate where or when a problem in the food web is likely to occur.

5. Based on the results of initial monitoring using biosentinels, further monitoring to drill down and understand causes may be required in areas where a problem is identified. However, if no problem is identified, then process studies are not warranted, and effort is not expended.

6. Use monitoring results to inform site management (e.g., the spatial and temporal extent of ponding in the cells). For example, if biosentinel monitoring indicates a problem with drying of cover cells, then the cells could be kept wet. If monitoring results do not indicate a problem, then no further action need be taken.

Cover-only Cells

Allowing these cells to dry out seasonally would be acceptable, because drying would not be expected to mobilize significant levels of contaminants in these cells. The seasonally wet playa-like habitat attracts wading birds, such as American Avocets and Black-necked Stilts, that may be good biosentinels. Recent radio telemetry studies by USGS have shown that these species have relatively small home ranges.

Recommendations

1. Allow cells to dry out seasonally.
2. Identify appropriate biosentinels in discussion with TRT.
3. Sample biosentinels in the breeding season (likely stilt or avocet eggs) and analyze tissue for Hg and Se.
4. If there are elevated contaminants in the samples, then work down a decision tree (or bring to TRT for comment) to locate potential stressors.
5. Eliminate water and sediment monitoring for contaminants unless required by step 4 immediately above.

Completed Cover-over-Non-Cover Cells

Allowing these cells to fully dry out seasonally might cause a problem if deep cracks form down into the level of non-cover sediment. The non-cover sediment is present in the middle of the cells. Therefore, these cells could be allowed to dry at the edges seasonally but remain ponded to approximately 6 inches deep in the middle.

---

1 A permit is required from CDFG to sample biota.
(approximately 50% of area ponded) where non-cover sediment is present in the lower layer. American Avocets and Black-necked Stilts may be good biosentinels in this type of playa-like habitat.

**Recommendations**

1. Allow cells to dry out seasonally around the edges but keep them ponded in the middle.
2. Identify appropriate biosentinels in discussion with TRT.
3. Sample biosentinels in the breeding season (likely stilt or avocet eggs) and analyze tissue for Hg and Se.
4. If there are elevated contaminants in the samples, then work down a decision tree (or bring to TRT for comment) to locate potential stressors.
5. Eliminate water and sediment monitoring for contaminants unless required by step 4 immediately above.

**Uncompleted Non-Cover Cells**

In these cells, the non-cover sediment has not yet been capped with cover sediment. These cells need to be kept wet to reduce the chance of contaminant mobilization. Foraging by wildlife should be discouraged in these cells to protect Beneficial Uses.

**Recommendations**

1. Keep these cells ponded to a greater depth to reduce foraging by invertebrate-eating birds.
2. Identify the wildlife that are foraging in these cells during the breeding season, particularly fish and birds. If any are appropriate (localized) biosentinels, then monitor their tissue for all bioaccumulative contaminants (Hg first, then organics if enough material is available). If biosentinels are being monitored, then eliminate water and sediment monitoring for contaminants.
3. If there are no appropriate biosentinels, as determined in discussions with TRT, then monitor MeHg in sediment once during breeding season and MeHg in water 3 times during breeding season. For organic contaminants, input bioaccumulative organic contaminants data (from testing prior to sediment placement) into a bioaccumulation model to estimate whether thresholds for negative effects on wildlife might be exceeded.
4. If a problem is indicated, then the non-cover sediment must be covered with cover sediment within a short time period, as per the current monitoring plan (i.e., in no more than 2 months during the breeding season and no greater than 6 months outside the breeding season).

**Analytical Laboratories**

The quality of laboratory data could be improved in some of the prior monitoring data. However, the extra expense of these improvements is not always warranted by the level
of data quality required to know if contaminant thresholds are being met. Therefore a
two-tiered approach to laboratory analysis is recommended.

Recommendations
1. Continue to send sediment and water to labs used for previous analyses.
2. For biosentinel data, send samples to labs that can provide lower MDLs and
   higher quality data in general.

Barge Sampling

Currently, the Project samples incoming sediment at a frequency of approximately one
sample per 60,000 cubic yards of sediment. The monitoring results do not change the
placement of the sediment at the site, because results are not received until after
offloading of the barge.

Recommendations
1. Discontinue sediment sampling, except when sediment is coming from dredge
   sites with both cover and non-cover sediment. This is a safeguard to ensure that
   the sediment being placed at Montezuma is from the correct location at the dredge
   site.

Dioxin and Radiation Testing

Dioxin and radiation analyses have been very expensive and have provided very little
information in the past.

Recommendations
1. Discontinue all dioxin and radiation testing.

Makeup Water Pond and Return Water Channel Pond

Recommendations
1. Only monitor water samples from makeup water pond when discharging to
   outside the Project. Discharge waters must meet Water Quality Objectives,
   rather than being regulated with dilution credits. Conduct toxicity testing only
   when discharging to slough.
2. Annually monitor both ponds for bioaccumulative contaminants using the
   biosentinel approach outlined above. Small fish (whole body) are likely to be
   appropriate biosentinel. Analyze biosentinel tissue for Hg, Se, and organic
   contaminants.
APPENDIX B

RWQCB SELF–MONITORING PROGRAM FOR THE MONTEZUMA WETLANDS RESTORATION PROJECT, ORDER NO. R2–2012–0087
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

SELF-MONITORING PROGRAM
FOR
MONTEZUMA WETLANDS RESTORATION PROJECT

ORDER No. R2-2012-0087

A. GENERAL

1. Reporting responsibilities of waste dischargers are specified in sections 13225(a), 13267(b), 13383 and 13387(b) of the California Water Code (Water Code) and in the Regional Water Board’s Resolution No. 73-16.

2. The principal purposes of a monitoring program by a waste discharger, also referred to as a self-monitoring program, are: 1) to document compliance with waste discharge requirements and prohibitions established by the Regional Water Board, and 2) to facilitate self-policing by the waste discharger in the prevention and abatement of pollution arising from waste discharge.

B. SAMPLING AND ANALYTICAL METHODS

1. Sample collection, storage, and analyses shall be performed according to 40 CFR 136 or other methods approved and specified by the Executive Officer of the Regional Water Board.

2. Water and soil analyses shall be performed by a laboratory approved for these analyses by the State Department of Public Health.

3. The director of the laboratory whose name appears on the certification, or his/her laboratory supervisor who is directly responsible for the analytical work performed, shall supervise all analytical work including appropriate quality assurance/quality control procedures in his/her laboratory and shall sign all reports of such work submitted to the Regional Water Board.

4. All monitoring instruments and equipment shall be properly calibrated and maintained to ensure accuracy of measurements.

C. DEFINITION OF TERMS

1. A **grab sample** is defined as an individual sample collected in a short period of time not exceeding 15 minutes. It is used primarily in determining compliance with daily maximum limits and instantaneous maximum limits. Grab samples represent only the condition that exists at the time the sample is collected.
2. A **discharge episode** consists of effluent discharge from the make-up water pond that does not cease for more than 30 consecutive days. If discharge stops for more than 30 consecutive days and then starts up again, the date of start-up will be considered the beginning of a new discharge episode for monitoring purposes.

3. **Receiving waters** refers to any water body that actually receives or potentially could receive surface or groundwater that passes over, through, or under dredged sediment during placement, dewatering, and settling/consolidation activities. For the purpose of discharge episode monitoring, the receiving waters are the Sacramento River and Montezuma Slough.

4. **Receiving Waters Standard Observations** refer to:
   a. Evidence of floating and suspended materials generated by project activities, as recorded by visual observations.
   b. Discoloration and turbidity: description of color, source, and size of affected area.
   c. Evidence of odors, presence or absence, characterization, source, and distance of travel from source.

5. **Site Standard Observations** refer to visual inspection of:
   a. Overall condition and integrity of the sediment placement cell containment levees.
   b. Location of placed material, amount of freeboard available, and whether any discharge of dredged sediments outside of the containment levees has occurred.
   c. Overall condition and integrity of the make-up water pond containment levee, effluent discharge weir, and discharge outfall pipeline.
   d. Overall condition and integrity of the dredged material transport pipeline from the intake at the connection point with the Liberty offloader to the point of discharge into a sediment placement cell.
   e. Location and identification of vertebrate wildlife nesting onsite and foraging in partially or fully filled sediment placement cells prior to restoration of tidal action.

**D. SPECIFICATIONS FOR SAMPLING AND ANALYSES**

The Discharger shall perform sampling and analyses according to the schedule in Table 1 in accordance with the most-current Quality Assurance Project Plan (QAPP) accepted by the Executive Officer and the following conditions:

1. **Make-up Water Pond and Phase I-IV Levee Breach Discharges**
   a. If analytical results are received showing any daily limit is exceeded for any inorganic constituent, a confirmation sample shall be taken within 24 hours and the results shall be known within 24 hours of the sampling.
   b. If any instantaneous maximum limit for a constituent is exceeded in the confirmation sample(s), then the preliminary confirmation results shall be reported immediately to the Regional Water Board case manager via email and the discharge shall be restricted to the extent practical, until the cause of the violation can be found and corrected. Within five days of the discharge limit exceedance, the Discharger shall submit a contingency report as described in Section H.
c. For other violations, the Discharger shall implement procedures that are acceptable to the Executive Officer on a case by case basis.

2. Receiving Waters
   a. Receiving water sampling in the Sacramento River shall be conducted on days coincident with discharges from the make-up water pond.
   b. In tidally-influenced receiving waters, samples shall be collected at each station on each sampling day during the period within 1 hour following low slack water. Where sampling at the lower slack water period is not practical, sampling shall be performed during the higher slack water period.
   c. Samples shall be collected at least one foot below the surface and at least one foot above the slough or river bottom.

3. Incoming Sediment Confirmation
   a. Surface grab samples of incoming dredged sediment shall be collected from at least four locations in each placement cell at the same volume-based frequency per dredging project source as is prescribed by the Dredged Material Management Office (DMMO) pre-dredge sediment testing program. Each set of four or more samples corresponding to a specific range of dredged sediment volume in cubic yards may be combined to form one composite sample per cell.
   b. If confirmation sampling shows that sediment placed at the Project site has exceeded numeric acceptance criteria listed in Specification B.2, additional higher resolution sampling shall be immediately conducted to establish the nature and extent of the exceedance. Discrete grab samples shall be collected at one-foot depth intervals from at least three locations in each affected cell and analyzed for each chemical constituent that exceeded an acceptance criterion in the original confirmation sample.
   c. Within five days of receipt of the higher resolution sampling analytical results, the Discharger shall submit a contingency report to the Regional Water Board case manager per Section H.

E. DESCRIPTION OF SAMPLING STATIONS
   1. Incoming Sediment Confirmation
      During each sampling event, the Discharger shall use its discretion to collect grab samples of sediment from at least four locations per placement cell where the sediment slurry has undergone sufficient consolidation to make chemical analysis of the sediment solids practical.

   2. Make-up Water Pond (effluent limits apply during discharges to the Sacramento River)
      
      | Station | Description                  |
      |---------|-----------------------------|
      | MUWP    | The inboard side of the overflow weir for the discharge pipeline |

   3. Phases I-IV on Inboard Side of Levee Breaches
      Sampling locations shall be proposed in the **Levee Breach Water Quality Monitoring and Management Plan**, to be submitted at least 90 days prior to breaching levees in Phase I pursuant to Provision E.5 of this Order.
4. Receiving Waters

<table>
<thead>
<tr>
<th>Station</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW1-down</td>
<td>At a point in the Sacramento River about 100 feet down-current (dependent on tide) from the make-up water pond discharge outfall</td>
</tr>
<tr>
<td>RW1-up</td>
<td>At a point in the Sacramento River about 100 feet up-current (dependent on tide) from the make-up water pond discharge outfall</td>
</tr>
<tr>
<td>RW2-down</td>
<td>At a point in Montezuma Slough about 100 feet down-current (dependent on tide) from the breach in the levee separating the particular Phase of the Project undergoing breaching from Montezuma Slough</td>
</tr>
<tr>
<td>RW2-up</td>
<td>At a point in Montezuma Slough about 100 feet up-current (dependent on tide) from the breach in the levee separating the particular Phase of the Project undergoing breaching from Montezuma Slough</td>
</tr>
</tbody>
</table>

5. Shallow Groundwater Monitoring Wells

<table>
<thead>
<tr>
<th>Stations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWP1</td>
<td>Onsite shallow and intermediate water quality monitoring wells in Phase I.</td>
</tr>
</tbody>
</table>

Well Series Monitoring well locations for future Project phases shall be determined during the detailed design of those phases. At a minimum, the Discharger shall install two wells in the shallowest encountered groundwater zone and one well in the next deeper groundwater zone below a confining silt or clay layer in each Project phase.

6. Pre-Breach Methylmercury Biosentinel Monitoring

Specific sampling locations in the sediment placement cells and the make-up water pond shall be determined based on the species chosen by the Discharger in consultation with the TRT and per future revisions to the QAPP submitted pursuant to Provision E.4 of this Order and accepted by the Executive Officer.

7. Post-Breach Habitat Performance

Sampling and observation locations shall be proposed in the Post-Breach Habitat Performance Monitoring Plan, to be submitted at least 60 days prior to breaching levees in Phase I pursuant to Provision E.6 of this Order.

F. RECORDS TO BE MAINTAINED

Written reports shall be maintained by the Discharger or its laboratory and shall be retained for a minimum of five years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge or when requested by Regional Water Board staff. Such records shall show the following for each sample:

1. Identity of sample and sample station number.
2. Date and time of sampling and the name of the person performing the sampling.
3. Date and time that analyses are started and completed, and name of the personnel performing the analyses.

4. Complete procedure used, including method of preserving the sample, and the identity and volumes of reagents used.

5. Calculation of results.

6. Results of analyses, and detection limits for each analysis.

G. REPORTING REQUIREMENTS

By March 1 of each year, the Discharger shall submit an annual report to the Regional Water Board covering the previous calendar year’s activities. The Discharger shall upload an electronic copy of the report to the California Wetlands Portal website at http://www.california-wetlands.net/tracker/ba/fileset/1062 and provide an electronic copy to Regional Water Board staff via email, CD, or FTP site.

Each annual report shall contain the following:

1. Letter of Transmittal

A letter transmitting the essential points in each report should accompany each report. Such a letter shall include a discussion of any violations of this Order found during the last report period and actions taken or planned for correcting the violations. If the Discharger has previously submitted a detailed time schedule for correcting requirement violations, a reference to the correspondence transmitting such schedule will be satisfactory. If no violations have occurred in the last annual report period, this shall be stated in the letter of transmittal. Monitoring reports and the letter transmitting the monitoring reports shall be signed by the duly authorized representative of the Discharger. The letter shall contain a statement by the official, under penalty of perjury, that to the best of the signer’s knowledge the report is true, complete, and correct.

2. A map or aerial photograph showing observation and monitoring stations.

3. Tabular and graphical summaries of the monitoring data obtained during the previous year.

4. A description of the compliance record and any corrective actions taken or planned that may be needed to bring the Discharger into full compliance with the Order.

5. Laboratory statements of results of analyses specified in Table 1; the director of the laboratory whose name appears on the laboratory certification shall supervise all analytical work in his/her laboratory and shall sign all reports of such work submitted to the Board.

a. The methods of analyses and detection limits must be appropriate for the expected concentrations. Specific methods of analyses must be identified. If methods other than USEPA-approved methods or Standard Methods are used, the exact methodology must be submitted for review and approved by the Executive Officer.

b. In addition to the results of the analyses, laboratory quality assurance/quality control (QA/QC) information must be included in the monitoring report. The laboratory QA/QC information shall include the method, equipment and analytical detection limits; the recovery rates; an explanation for any recovery rate that is less than the recovery acceptance limits specified in the USEPA method procedures or the
laboratory's acceptance limits, if they are more stringent than those in the USEPA method procedures; the results of equipment and method blanks; the results of spiked and surrogate samples; the frequency of quality control analysis; and the name and qualifications of the person(s) performing the analyses.

H. CONTINGENCY REPORTING

Unauthorized Releases: A report to the Regional Water Board case manager shall be made by telephone and email of any accidental discharge of whatever origin immediately after it is discovered. A written report shall be filed with the Board within five days thereafter. This report shall contain the following information:

a. A map showing the location(s) of discharge(s);
b. Approximate flow rate;
c. Nature of effects, i.e., all pertinent observations and analyses; and
d. Corrective measures underway or proposed.

I, Bruce H. Wolfe, Executive Officer, hereby certify that the foregoing Self-Monitoring Program:

1. Has been developed in accordance with the procedure set forth in the Regional Water Board's Resolution No. 73-16 in order to obtain data and document compliance with waste discharge requirements established in this Order.

2. May be reviewed at any time subsequent to the effective date upon written notice from the Executive Officer or request from the discharger, and revisions will be ordered by the Executive Officer.

3. Is effective as of November 14, 2012.

Digitally signed by Bruce H. Wolfe
Date: 2012.11.27
16:05:25 -08'00'

Bruce H. Wolfe
Executive Officer

Attachment:
Table 1 - Schedule for Sampling, Measurements, and Analyses
<table>
<thead>
<tr>
<th>Station</th>
<th>Constituent</th>
<th>Unit</th>
<th>Type of Sample</th>
<th>Frequency of Sampling &amp; Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site &amp; Receiving Water Standard Observations</td>
<td>Varies – see Definitions of Terms, C.4 and C.5</td>
<td>Not Applicable</td>
<td>Visual Inspection</td>
<td>Weekly during sediment placement operations</td>
</tr>
<tr>
<td>Incoming Sediment Confirmation (minimum 4 locations per placement cell TBD at time of sampling)</td>
<td>Inorganics&lt;sup&gt;1&lt;/sup&gt;</td>
<td>mg/kg dry wt. µg/kg dry wt.</td>
<td>Surface grab samples combined into one composite per cell per sampling event</td>
<td>Varies based on volume of sediment delivered from a particular dredging project – minimum number of samples same as in pre-dredge testing program&lt;sup&gt;3&lt;/sup&gt;</td>
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<tr>
<td>MUWP (Make-up Water Pond)</td>
<td>Flow Rate</td>
<td>mgd</td>
<td>Weir volume calculation</td>
<td>Daily during discharge</td>
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<td></td>
<td>TSS</td>
<td>mg/L</td>
<td>Grab</td>
<td>Daily for first five days of discharge episode; weekly for remainder of episode</td>
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<td>Daily during discharge</td>
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</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>µmhos/cm</td>
<td>Field</td>
<td>Daily during discharge</td>
</tr>
<tr>
<td></td>
<td>Inorganics&lt;sup&gt;1&lt;/sup&gt;</td>
<td>µg/L</td>
<td>Grab</td>
<td>Daily for first five days of discharge episode; weekly for remainder of episode</td>
</tr>
<tr>
<td></td>
<td>Acute Toxicity (ASTM 48- or 96-hour static non-renewal)&lt;sup&gt;4&lt;/sup&gt;</td>
<td>% Mortality % Normal Development</td>
<td>Grab – volume varies according to test organism used</td>
<td>Once within one week prior to discharge; weekly for remainder of discharge episode</td>
</tr>
<tr>
<td>RW1-up &amp; RW1-down (Two points in Sacramento River 100 ft up- &amp; down-current of discharge)</td>
<td>Turbidity</td>
<td>NTU</td>
<td>Field</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>mg/L</td>
<td>Grab</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td></td>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
<td>Field</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Std Units</td>
<td>Field</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>°C</td>
<td>Field</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td>Station</td>
<td>Constituent</td>
<td>Unit</td>
<td>Type of Sample</td>
<td>Frequency of Sampling &amp; Analysis</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>----------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>µhos/cm</td>
<td>Field</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td></td>
<td>Inorganics¹</td>
<td>µg/L</td>
<td>Grab</td>
<td>Twice during each discharge episode – once within first week and once within last week. Once if episode lasts less than one week.</td>
</tr>
<tr>
<td>Phase I-IV Levee Breaches (Stations TBD)</td>
<td>Turbidity</td>
<td>NTU</td>
<td>Field</td>
<td>D/W/M¹</td>
</tr>
<tr>
<td></td>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Std Units</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>ºC</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>µhos/cm</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Inorganics¹</td>
<td>µg/L</td>
<td>Grab</td>
<td>D/W/M</td>
</tr>
<tr>
<td>RW2-up &amp; RW2-down (Two points in Montezuma Slough 100 ft up- &amp; down-current of levee breach)</td>
<td>Turbidity</td>
<td>NTU</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Std Units</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>ºC</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>µhos/cm</td>
<td>Field</td>
<td>D/W/M</td>
</tr>
<tr>
<td></td>
<td>Inorganics¹</td>
<td>µg/L</td>
<td>Grab</td>
<td>D/W/M</td>
</tr>
<tr>
<td>MWP1 Well Series (Phase I Groundwater Monitoring Wells)</td>
<td>Groundwater Elevation</td>
<td>meters</td>
<td>Field – measuring tape</td>
<td>Bi-Annual (once during wet season and once during dry season)</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Std Units</td>
<td>Field</td>
<td>Bi-Annual (once during wet season and once during dry season)</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>ºC</td>
<td>Field</td>
<td>Bi-Annual (once during wet season and once during dry season)</td>
</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>µhos/cm</td>
<td>Field</td>
<td>Bi-Annual (once during wet season and once during dry season)</td>
</tr>
<tr>
<td>Station</td>
<td>Constituent</td>
<td>Unit</td>
<td>Type of Sample</td>
<td>Frequency of Sampling &amp; Analysis</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>----------</td>
<td>----------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Inorganics&lt;sup&gt;1&lt;/sup&gt;</td>
<td>µg/L</td>
<td>Grab</td>
<td></td>
<td>Bi-Annual (once during wet season and once during dry season)</td>
</tr>
<tr>
<td>Pre-Breach Biosentinel Monitoring (sediment placement cells &amp; make-up water pond)</td>
<td>Methylmercury&lt;sup&gt;6&lt;/sup&gt;</td>
<td>mg/kg wet weight</td>
<td>Tissue&lt;sup&gt;7&lt;/sup&gt;</td>
<td>Annual – during breeding season for selected biosentinel species</td>
</tr>
<tr>
<td>Post-Breach Habitat Performance</td>
<td>TBD based on Post-Breach Habitat Performance Monitoring Plan, to be submitted at least 60 days prior to breaching levees in Phase I pursuant to Provision E. 6 of this Order. The Self-Monitoring Program shall be revised as ordered by the Executive Officer upon acceptance of this plan. At a minimum, the plan shall describe monitoring protocol for the following biological performance measures: &lt;br&gt; - Vegetation colonization (spatial extent, distribution, and diversity); &lt;br&gt; - Presence of special status wildlife species; &lt;br&gt; - Water quality conventional parameters (e.g., TSS, turbidity, dissolved oxygen, pH, temperature, conductivity); &lt;br&gt; - Methylmercury bioaccumulation in appropriate “biosentinel” (resident or breeding) vertebrate species; and &lt;br&gt; - Physical development of habitat features (e.g., channel morphology, seasonal wetland hydrology).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The plan shall be designed to monitor the performance criteria specified in the original MMRP, as well as any updates to the performance criteria in the MMRP as recommended by the TRT and approved by the appropriate regulatory and resource agencies. In addition, the plan shall include a decision tree linking monitoring data to management actions that the Discharger can implement to improve site conditions if performance criteria are not met.

<sup>1</sup> Arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc – reported as dissolved except for mercury and selenium, which should be analyzed and reported as total concentrations.

<sup>6</sup> PAHs (25 compounds reported by RMP), PCBs (40 congeners reported by RMP), organochlorine pesticides (total Chlordane, total DDT [sum of 6 isomers], Dieldrin)


<sup>8</sup> ASTM E1192-97(2008) Standard Guide for Conducting Acute Toxicity Tests on Aqueous Ambient Samples and Effluents with Fishes, Macroinvertebrates, and Amphibians, or equivalent method if acceptable to the Executive Officer.

<sup>9</sup> Once within 3 days prior to breach; during the first and fifth day following breach; weekly during the first month; monthly thereafter until receiving water limits (Basin Plan water quality objectives for inorganics) met for three consecutive months.

<sup>10</sup> If wildlife are identified foraging in uncovered foundation material placement cells during the breeding season, additional bioaccumulative contaminants may be added to the constituent list as appropriate based on sediment concentrations reported during pre-dredge testing and placement cell confirmation sampling.

<sup>11</sup> Appropriate biosentinel species for each area will be determined in consultation with the TRT. Likely biosentinels for the sediment placement cells include the eggs of non-special status shorebirds such as black-neck stilts and American Avocets nesting near the cells. Small fish (whole body), if present, may be appropriate biosentinels for the make-up water pond.