San Francisco – Oakland Bay Bridge, East Span

Pier E4-E18 Demolition

Sampling and Analysis Plan

Water Quality Monitoring

Controlled Underwater Blasting of Piers E6 to E18

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San Francisco – Oakland Bay Bridge, East Span

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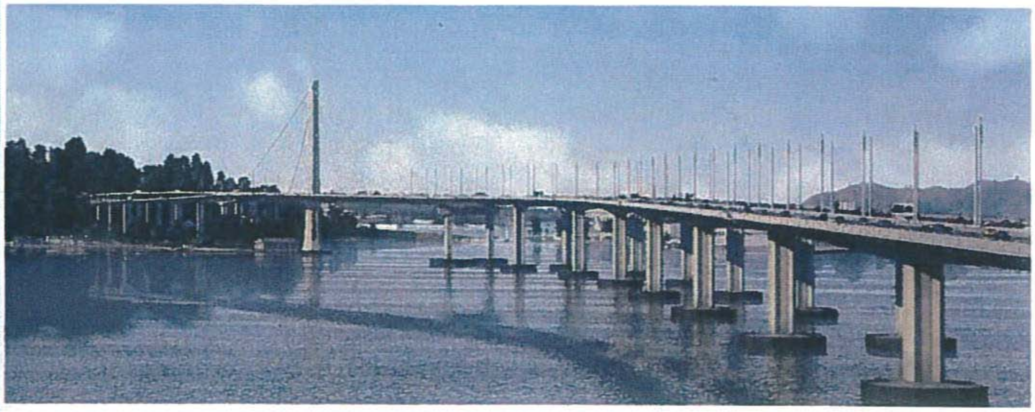

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List of Abbreviations

ADCP	Acoustic Doppler current profiler
Ag	silver
Cd	cadmium
CEDEN	California Environmental Data Exchange Network
Cr	chromium
Cu	copper
DO	dissolved oxygen
EDD	electronic data deliverable
EPA	Environmental Protection Agency
ESA	Environmentally sensitive area
GPS	global positioning system
Ni	nickel
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity units
Pb	lead
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RMP	Regional Monitoring Program
SAP	sampling and analysis plan
SFOBB	San Francisco-Oakland Bay Bridge
SWIC	Surface-water interface core
WQO	water quality objective
Zn	Zinc

Section 1

Scope of Monitoring Activities

This Sampling and Analysis Plan (SAP) describes the approach to monitor bay waters and bay sediments during the controlled underwater blasting of thirteen marine foundations (sequentially numbered Pier E6 through Pier E18) formerly supporting the Old East Span of the San Francisco–Oakland Bay Bridge (SFOBB).

Modeling and assessment of a prior pier implosion, Pier E3, was documented in a Water Quality Study ("Study"; Caltrans 2015). This modeling and assessment suggested that impacts to water quality associated with the controlled implosion of Pier E3 would be temporary and minimal. Subsequent monitoring of the Pier E3 implosion indicated no "significant impacts on water and sediment quality" (Caltrans, 2016). The subsequent implosions of Pier E4 and Pier E5 also had "insignificant impacts . . . on water and sediment quality," as described in a separate, but similar study report (Caltrans, 2017a).

The controlled underwater blasting events planned for Pier E6 through Pier E18 are also anticipated to have insignificant impacts on water and sediment quality and the objective of this SAP is to substantiate and document those impacts. The controlled underwater blasting of these piers, however, will be conducted differently than the implosion of Pier E3, Pier E4, and Pier E5. These first three piers were imploded individually with no less than 2 weeks between implosions. The controlled underwater blasting of Pier E6 through Pier E18 will involve multiple nearly simultaneous blasts.

The controlled underwater blasts, except for Pier E6, will be conducted on groups of 2 or 3 piers nearly simultaneously. These groups will be blasted between September 2017 and November 2017; Pier E6 will be blasted individually during this period. See Section 3-1 for a discussion of the pier blasting schedule. The arrangement of pier blasting, however, is subject to change for reasons of safety, logistics, or weather.

This SAP was developed from Self-Monitoring Plan contained within the SFOBB East Span Seismic Safety Project's ("SFOBB Project") Waste Discharge Requirements, Order No. R2-2002-0011. The procedures in this SAP, meet, and possibly exceed, the specifications provided in the Self-Monitoring Plan.

1.1 Monitoring Goal

The goal of monitoring as described in this SAP is to quantify the following:

- The pH change is the most significant potential water quality impact expected from the controlled implosion. The pH would be increased as a result of explosive by-products and the release of fine-grained Portland Cement Concrete residue from the imploded structure. Based on the models and the actual experience of the Pier E3, Pier E4, and Pier E5 implosions, the area of high pH excursion is expected to be limited to an approximate 100-foot radius around each pier after implosion. The pH increase in is not expected to one standard unit within the impacted area, and the effects would diminish and meet water quality objectives within one to four hour after the implosion, based on experience from previous implosions.
- Turbidity is the next most significant potential water quality impact. Based on the experience from the implosion of Pier E3, Pier E4, and Pier E5, the implosion of the western-most piers (Pier E6 to Pier E10) are not expected to increase turbidity greater than 50 nephelometric turbidity units (NTU) in the vicinity of the piers. Even if the turbidity were to rise this high, turbidity generated by these piers would be expected to return to permit limits within an hour, and return to pre-implosion baseline

conditions within no more than four hours, likely much sooner. The implosion of the eastern piers (Pier E11 to Pier E18) may result in greater increase in turbidity because of the shallower waters in which these piers are located. However, the increase in turbidity is expected to be short in duration, returning to permit limits within an hour, and returning to pre-implosion baseline conditions within no more than four hours. In addition, the blast attenuation system may elevate turbidity during its operation due potential sediment entrainment in the shallower waters.

- Impacts of settled fine concrete residue on benthic habitat quality are also expected to be *de minimis*.

1.2 Sampling Approach

The SAP proposes four approaches to accomplish the monitoring goal:

1. **For Pier E6, Pier E7, and Pier E8, water quality monitoring** using static water column profiling techniques consistent with that prescribed under the pier mechanical dismantling SAP (Caltrans 2017b) used to address in-water work related to the overall demolition activities, excluding the pier blasting activities. In addition, these procedures will be supplemented with use of two fixed buoys positioned within 100 feet of the imploded pier (or as closely as can be safely achieved); one buoy north and one buoy south of the pier (i.e., based on the timing of the blasting, the plume could travel in either direction depending on tidal currents). These actions were deemed appropriate due to the similarity of conditions (in particular, pier size and water depth) of these implosions to previous implosions. The fixed buoys will provide continuous monitoring with multi-parameter sondes and data loggers for measuring turbidity. pH, dissolved oxygen, temperature, and conductivity at mid-depth.
2. **For Piers E9 to Pier E18, plume mapping** using both dynamic and static water column profiling techniques to define the three-dimensional extent of the plume generated, and to track its dissipation until water quality parameters such as pH, turbidity, dissolved oxygen, etc. return to background conditions. This is expected to last for approximately four hours after the implosion. Dynamic plume profiling uses a continuously-recording monitoring device, which is towed across the plume and is raised and lowered in the water column, to define the three-dimensional shape of the plume. Static profiling is done from a stationary vessel, raising and lowering a monitoring device, while trying to maintain position within the center of the plume. Plume mapping would be performed by a specially equipped survey vessel similar to that previously used to monitor the implosion of Pier E3, Pier E4, and Pier E5.

   For each multiple-pier blasting event, the dynamic plume mapping would occur along the expected plume path from the eastern-most pier; this will enable tracking of the plume and define any possible interaction path with ESAs. For each multiple-pier blasting event, static profiling would occur along the expected plume path from the western-most pier; this will define the plume from this western-most pier which is expected to generally parallel the travel path of the eastern-most pier plume. Monitoring the progress of the western-most and eastern-most plume paths creates an enveloped area of all plumes generated by a multiple pier blasting event.

   For example, if Pier E11, Pier E12, and Pier E13 were to be blasted in a simultaneous event, the progress of the plume from Pier E11 (western) would be monitored using static profiling, while the progress of the plume from Pier E13 (eastern) would be monitored using dynamic profiling. Any effects from the Pier E12 plume, if any occurred, would be captured by the monitoring along the Pier E11 plume path or the Pier E12 plume path.
3. **Environmentally Sensitive Area (ESA) monitoring** to confirm that a plume does not impact water quality in the vicinity of eelgrass beds. Continuous monitoring would be performed using buoys

equipped with multi-parameter sondes and data loggers for measuring turbidity. pH, dissolved oxygen, temperature, and conductivity at mid-depth near the ESAs.

4. **Sediment quality assessment** before and after the implosion to measure potential benthic effects and attenuation rates. This would be performed using sediment quality methods developed and implemented by the Regional Monitoring Program (RMP) for Water Quality in San Francisco Bay over the past 20 years. A random stratified sampling design will be implemented to test the spatial variability of sediment chemistry (metals and pH) at the sediment water interface before the controlled implosion. Toxicity at the sediment water interface would only be measured for those post-implosion samples having anomalously high metals concentration.

Each approach is discussed in the following sections.

Section 2

Monitoring Preparation

This section identifies the lead personnel responsible for each task described above. The primary instrumentation and equipment to be used to map and sample the implosion plume water column are illustrated. The analytical laboratories for testing the water grab samples are also introduced.

2.1 Qualified Sampling Personnel

The leads for each task are identified below.

2.1.1 Plume mapping and water quality monitoring

Mr. Rhys McDonald of Brown and Caldwell will lead the plume mapping and water quality monitoring of Pier E6 to Pier E18.

2.1.2 ESA monitoring

Mr. Rhys McDonald of Brown and Caldwell will also lead the configuration, deployment, and data collection and analysis for the ESA monitoring using continuous monitoring sensors.

2.1.3 Sediment quality assessment

Mr. Chris Stransky of Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) will direct the sediment quality assessment task.

2.2 Monitoring Supplies and Field Instruments

The monitoring supplies and field instruments to be used for each task are described below.

2.2.1 Plume mapping

The monitoring team will perform implosion plume mapping from aboard a specially outfitted research vessel using an integrated dynamic water property profiling system developed specifically for three-dimensional subsurface plume tracking and mapping. Dynamic profiling entails repeatedly lowering and raising profiling instrumentation through the water column while the vessel travels across the plume. In contrast, conventional static profiling entails lowering instruments and holding them at discrete depths to record sensor measurements while the survey vessel holds a fixed position. Dynamic profiling can collect high-resolution vertical profiles efficiently over large areas so that the areal extent of a subsurface plume can be defined.

The integrated plume mapping system consists of the following components:

- Research-grade multi-parameter sonde with fast-responding sensors.
- Custom wing to “fly” the sonde up and down through the water column by changing boat speed.
- Bottom depth sounder.
- Surface water property sensors.
- Acoustic Doppler current profiler (ADCP) for measuring water column currents.
- Sub-foot accurate GPS.
- Data acquisition system.

- Multiple computers.
- Multiple daylight readable computer monitors placed strategically aboard the research vessel.

Figure 2-1 shows a photograph of the research vessel used for Pier E3 implosion monitoring, with instrumentation call-outs. A larger, similarly configured vessel was used for the Pier E4 and E5 implosion monitoring and will be used for the monitoring described in this SAP (See Figure 2-2).

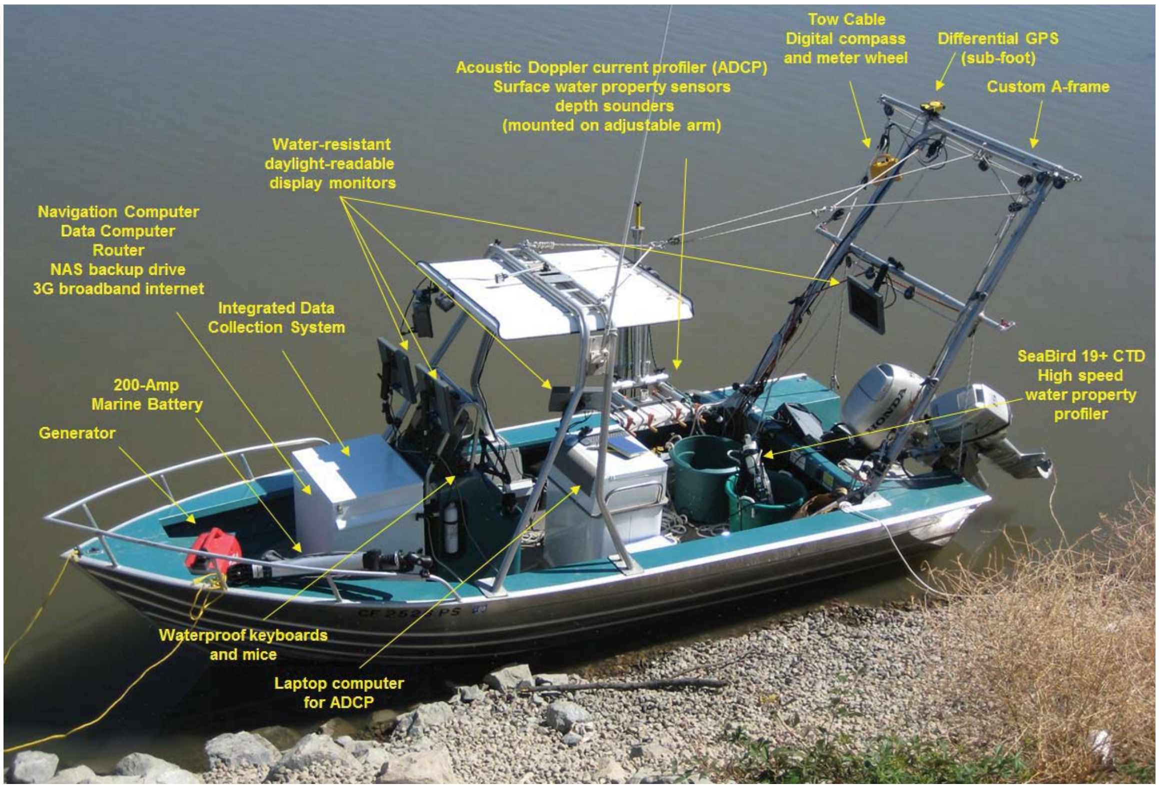

Figure 2-1. Plume mapping survey boat outfitted for dynamic profiling

Figure 2-2. Plume mapping survey boat
used for dynamic profiling for Pier E6 to Pier E18 controlled underwater blasting.

The multiparameter sonde used by the dynamic plume mapping system will be a Sea-Bird SBE 19 plus Profiler CTD equipped with sensors for depth, temperature, pH, turbidity, DO, and conductivity.

During transect profiling, the tow cable length and tow angle are recorded for the purpose of calculating the position coordinates of the sonde in relation to the GPS coordinates of the boat. Profiled parameters are recorded two times a second and displayed aboard the survey vessel on the daylight-readable computer monitors in real time. Strategically placed monitors display real-time navigation information and location data (Figure 2-2d). A remote is used to control data logging at the beginning and end of each transect and profile. The static plume mapping boat will use a similar multiparameter sonde.

Figure 2-2. Examples of (a) side-mounted sensor array; (b) towed multiparameter sonde; (c) shipboard integrated data acquisition system; and (d) daylight-readable computer monitor (showing sonde track in water column).

The monitoring team will use current drogues to help track the movement of the plume and guide the profiling effort. The "window-shade" current drogues, as shown in the photograph on Figure 2-3, consist of a nominal 2 × 2 m flexible plastic sheet attached between a rigid buoyant top PVC pipe and a weighted bottom PVC pipe. The drogues are suspended from a surface float at a target depth determined by the length of the suspension line, and they hang vertically in the water column perpendicular to the direction of the current flow. Attached buoys with GPS sensors and radio transmitters will send drogue position coordinates to the plume mapping vessel.

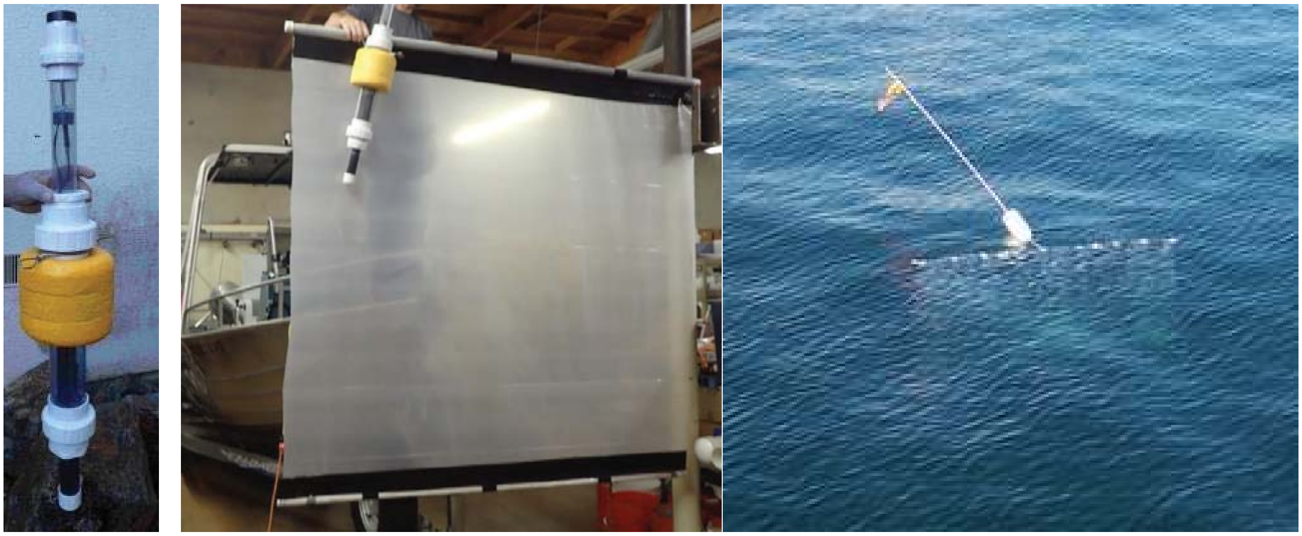

Figure 2-3. Example of current-tracking drogue and GPS buoy

2.2.2 Water quality monitoring

Water quality monitoring at Pier E6 and Pier E7/E8 will be done using the procedures described in the mechanical dismantling SAP (Caltrans 2017b). Each of the two fixed buoys (at the approximate 100-foot boundary) will be fitted with a multi-parameter sonde and data logger for monitoring and recording pH, temperature, dissolved oxygen, conductivity, and turbidity. These sondes will be acquired from Equipco rentals or other appropriate equipment rental vendor.

2.2.3 ESA monitoring

Buoys will be deployed at four locations adjacent to ESA areas as indicated in Section 3.2 (Sampling Locations) below. Each buoy will be fitted with a multi-parameter sonde and data logger for monitoring and recording pH, temperature, dissolved oxygen, conductivity, and turbidity. These sondes will be acquired from Equipco rentals.

2.2.4 Sediment quality assessment

Sediment chemistry (trace metals, pH) and toxicity will be analyzed using methods comparable to the RMP (SFEI, 2012). Surface-water interface core (SWIC) samples will be collected and delivered intact to evaluate developmental toxicity to mussel larvae *Mytilus galloprovincialis*. Collection of intact SWIC samples is key to characterizing potential effects from settling of concrete residue at the sediment water interface, because it avoids “diluting” the effects of settled material on the surface with deeper sediments. In addition to toxicity, one core from each site will be used to evaluate metals concentration and pH in a thin upper layer (approximately 1 cm) of sediment in the intact core.

2.3 Testing Laboratories

Sediment trace metals will be analyzed by Curtis & Tompkins or Brooks Applied Laboratories. Sediment toxicity and pH at the sediment water interface will be analyzed by Pacific EcoRisk.