Monitoring and Maintenance Plan
Codornices Creek Restoration Project

Phase I - UPRR to 5th Street

Berkeley / Albany, California

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Prepared by:

Waterways Restoration Institute
1250 Addison St, Suite 107
Berkeley, CA 94702

FarWest Restoration Engineering
538 Santa Clara Avenue
Alameda, California 94501

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Introduction

This report presents the Monitoring and Maintenance Plan (MMP) for the Codornices Creek Restoration Project (Figure 1). The MMP describes the project goals, monitoring questions, performance criteria and monitoring protocols required to evaluate the success of the restoration project towards achieving project objectives. This monitoring plan has been developed in general accordance with the recent creek monitoring guidelines prepared by UC Berkeley Department of Forestry. In general, the monitoring plan elements are developed around specific questions of interest, such as "are the restored streambanks stable?" The monitoring plan then develops a specific set of monitoring parameters, performance criteria (as quantitative as possible) and field methods to assess the project's success in addressing the monitoring question.

Codornices Creek is a perennial stream that flows from the hills east of San Francisco Bay. The approximately 1.5 square mile watershed extends from the headwaters in the Berkeley Hills and drains ultimately to the San Francisco Bay. Elevations within the basin range from sea level at the outlet near Golden Gate Fields race track to approximately 1,340 feet at the summit of Grizzly Peak (USGS, 1959).

Codornices Creek is one of the most open creeks in this area of San Francisco Bay and represents an important opportunity to restore a viable anadromous fish run along the Bay. Along the lower reaches of the creek between the railroad tracks and San Pablo Avenue, there are plans to implement a significant creek restoration project which began in 2004. This work will involve the removal of culverts at 4th, 5th and 10th and eventually 6th Streets along Lower Codornices Creek below San Pablo Avenue.

The Codornices Creek Restoration Project is a uniquely urban habitat restoration project that is different from many other fish and creek habitat projects and presents a unique set of design challenges. As such, we have developed a new category of specific design questions related to urban restoration projects that we would seek to learn from this project to apply to future projects. Therefore, we have created a new monitoring area, "Additional Monitoring Questions to Inform Future Designs" that details monitoring to answer specific design questions. However, it is not part of the projects goals and objectives to assess project success or failure. It is one of the missions of the Waterways Restoration Institute (WRI) to develop these answers and then disseminate this information to the design community.

The original channel restoration design was prepared by the Waterways Restoration Institute (WRI) using the principles of natural creek design (May 2001) for the University

of California Berkeley and the Cities of Berkeley and Albany, California. The original restoration design was modified during final design and preparation of construction plans and specifications by FarWest Restoration Engineering (FRE) and the Restoration Design Group (RDG) in 2004 and 2005.

The entire project reach extends from upstream of the UPRR tracks to the downstream face of San Pablo Culvert, a distance of 2,740 feet. The project will be constructed in multiple phases depending on the timing of the UC development which provides the additional project right of way.

- Phase I of the project extended from the Union Pacific Railroad Tracks to 5th Street and was constructed in 2004.
- Phase II of the project is from 5th street to 8th street and is currently anticipated for construction in 2006.
- Phase III of the project is from 9th street to San Pablo Avenue and is anticipated to be constructed in 2007 or 2008 depending on the timing of the UC Step III development.

While this plan covers the entire restoration project, the specific details of project monitoring locations (i.e. cross-section locations, photo points etc.) will be presented only for Phase I of the project that has been completed. The monitoring will be expanded as future phases are completed.

Codornices Creek through the project reach is an active creek within a highly urbanized area. The physical features of the natural and improved channel can change periodically and these alterations may be allowed to occur without any maintenance requirements as long as they do not adversely affect the Project's hydraulic performance and hydraulic capacity, or the stability, structural integrity and habitat quality within the Project reach. Hydraulic performance will be assessed through monitoring of physical features, anecdotal reports of high water levels and site visits following storm events. Streambank stability will be assessed using repeated cross section surveys. Establishment of the riparian habitat vegetation will be assessed through visual inspection and mapping of vegetation type and extent.

The MMP uses the concepts of adaptive management to assess the effectiveness of the restoration and make corrections as needed to meet project goals. Adaptive management is by definition the linking of new data to actions and measures in order to achieve the overall project goals.

An annual monitoring report will be produced to include the data, results, recommendations for any remedial actions, and proposed modifications to the project features or monitoring procedures. The annual report will be circulated to the appropriate resource agencies, and made available to the community and other stakeholder members for review. Annual recommendations shall be supported by a record of decision and made available for public review.

Regulatory Requirements

The RWQCB (permit number 2198.09) requires a 5-year Mitigation and Monitoring Plan with annual reports due by December 31 of each year. The US Army Corps of Engineers Permit (#: 28288-1S) requires a Monitoring and Maintenance Plan with annual reports due by December 15 of each year. This report focuses on project monitoring and reporting and does include adaptive management measures to correct deficiencies. A separate vegetation maintenance plan will be prepared and submitted under separate cover. The Vegetation Maintenance Plan will cover specific plant maintenance tasks and steps to increase plant survivability and reduce exotics.

We propose to revise the submittal date of the monitoring reports to correspond with the fiscal year of the Cities of Berkeley and Albany (June 30 to July 1 of each year). This change will facilitate funding and administration of the monitoring program. Therefore, we will submit the annual monitoring report by October 1 of the following year covering the entire previous years monitoring activities.

Note that both the USACE and RWQCB permits require a 5-year monitoring and maintenance plan for project monitoring. The attached plan extends the monitoring period to 10 years and includes additional surveying in Year 8 (cross-sections and profile surveys) and final monitoring in all areas and a final report in Year 10. Note that this additional monitoring is dependent on the availability of project funding and may not be implemented if such funding is not available.

Monitoring Goals and Objectives

The primary ecological goal of the Codornices Creek Restoration Project is to establish more natural creek function and riparian habitat by reestablishing natural creek meanders and planting with native species. Secondary goals include flow and in-channel storage capacity, sustaining or improving water quality within the creek and providing a naturally sustaining, low maintenance project.

To evaluate success in meeting these overall project goals, the MMP will conduct the monitoring in the following five major areas (described in detail in Table 1 attached):

- **Channel Morphology and Stability.** Monitor topographic changes in the channel including sediment deposition and aggradations within the Project Reach and streambank stability; Includes surveying of cross-sections and profile surveys as well as an assessment of channel bank stability.
- **Vegetation Growth.** Monitor existing and proposed vegetation for success of riparian habitat and hydraulic conveyance roughness coefficients; remove invasive plant species and reestablish native riparian vegetation along the creek and floodplain
- **Fish and Biological Habitat**. Monitor the success of ecosystem restoration by documenting habitat indicators, including aquatic and other wildlife populations in the project reach over time.

- **Hydraulic Assessment.** Assess hydraulic capacity of the channel and floodplain by monitoring peak water level elevations.
- **Water Quality.** Assess basic water quality information within the creek (pH, temp and dissolved oxygen) in additional to chromium measurements in creek water due to concerns from nearby chromium pollution sites.

In order to carry out the monitoring program, various physical features that affect performance in the Project reach will be monitored to identify changes. These features include hydrology, channel geometry, vegetation, fish habitat, water quality and bank stability. Not all changes are considered detrimental; considerable reconfiguration of physical features may be allowed as long as they do not adversely affect conveyance, bank stability, structural integrity, or habitat quality. In fact, significant evolution of the physical features is expected to occur following construction.

Monitoring Plan Tables

Table 1 is the summary table for all the proposed project monitoring. As shown, within each major monitoring category (described above), the following elements are described in detail starting with the left hand side column.

Column 1: Monitoring Question: Under each major monitoring area, specific questions of interest are presented. The questions are phrased somewhat broadly to allow for multiple methods of data collection to answer the question of interest.

Column 2: Monitoring Parameters: The specific parameters to be monitored are described in this column. The monitoring parameters should be a measure that can be measured in the field or laboratory to assess the success of the project in achieving its goals and objectives.

Column 3: Performance Criteria: This column presents the specific, usually quantitative, criteria for assessing the success of the performance criteria. Criteria can be a qualitative measure but in general a numerical criterion is preferred whenever possible.

Column 4: Additional Questions to Inform Future Designs: This column is a unique feature of this monitoring plan and is intended to provide information for future design projects. This monitoring will collect information to improve future designs and is not part of the assessment of the project's success or failure.

Column 5&6: Fields Methods 1 and 2: General field methods for collection of data are presented in these columns. The specifics of data collection, i.e. number of sample bottles etc, will be developed separately.

Column 7: Adaptive Management Measures: This column shows any adaptive management measures to be implemented to address significant issues identified through the monitoring program.

Table 2 contains the details of the vegetation monitoring and corrective actions. Table 3 is a summary of monitoring by month for each of the monitoring items.

Project Monitoring

The following sections present the monitoring questions to be answered under each of the major project monitoring categories such as channel morphology, vegetation etc, along with the parameters and performance criteria for each monitoring component. Table 1 contains the specific criteria for each category.

I. Channel Morphology and Bank Stability

This section contains the two monitoring questions related to channel morphology and bank stability, two key parameters of the restoration monitoring program.

Channel Morphology Monitoring Question 1: How is Channel Morphology Changing?

Channel Morphology Monitoring Question 2: Are the Restored Banks Stable?

To answer these questions, the channel and floodplain will be surveyed on an annual basis to determine any changes over time. Changes in morphology are not necessarily problems and in fact are often normal adjustments to site hydraulic conditions.

Monitoring and management of erosion problems is an important component of the adaptive management plan. Erosion of channel banks may not be a problem requiring action, however, erosion of floodbank levees adjacent to critical structures may require immediate attention. The Codornices Creek design has an expanded floodplain area that allows for will allow the creek to meander without resulting in damage to critical structures.

Performance Criteria and Goals

Does the project avoid or correct excessive erosion and/or sedimentation is the primary performance criteria for channel morphology. While there are no specific quantitative performance criteria for these monitoring items, the goal is avoidance of any condition that may lead to increased flooding of adjacent properties or no significant erosion next to critical structures such as bridges, buildings or pathways. This goal will be evaluated by a review of topographic survey data and visual inspection. Erosion and/or sedimentation are natural processes that are not problems unless they harm habitat development or sustainability or an unacceptable risk to property or structures.

Monitoring Parameters and Methods

The monitoring parameter for this analysis shall be annual surveys for the first 5 few years of channel profile and cross-section along with fixed photomonitoring stations to observe changes over time. Topographic cross sections will be established across the project site after construction. An as-built topographic survey shall document post-construction topography. The density of the cross sections should be adequate to represent average conditions across the project. For Phase I, we anticipate from 2 to 3 cross-section locations that should extend from the edges of the flood plain through the channel.

A field survey of the longitudinal profile of the channel will be measured every year for 5 years and then in Year 8 and Year 10. The longitudinal profile will measure streambed thalweg (lowest point in the creek), water surface, bankfull features, and any high water lines. The data will be managed for assessment by the project geomorphologist for an annual review and presentation.

The channel and designated project limit areas will be inspected annually for any problems and areas of excessive erosion. The inspections will be visual, but will also include examination of aerial photos and topographic surveys in order to determine any trends.

Adaptive Management Measures

The topographic cross sections and maps will be compared by a geomorphologist with previous surveys in order to assess changes and make recommendations, if necessary. The key areas of concern are: aggradation of the channel with bedload to a degree that could impair flow capacity or channel stability and aggradation of the overbank flood channels or created flood plain. The project geomorphologist should make recommendations to rectify any problems in consultation with the Project Team and appropriate agencies. No specific adaptive management measures are included in this task.

If surveys or visual inspections indicate that there may be excessive erosion adjacent to critical structures then measures will be implemented accordingly to repair the eroded area. Depending on the extent and severity of the erosion, a registered geotechnical engineer may be retained.

Additional Monitoring Questions for Future Designs

How the creek channel morphology (i.e. width, depth and sinuosity) adjusts to urban stream conditions is important to understand as a foundation to future design efforts. The monitoring conducted under this task will provide information of the generation of updated regional curves for creek design in urban environments.

II. Vegetation Monitoring

The vegetation planting component is a key element of the project as it is anticipated to provide soil and channel stability and habitat value. Vegetation monitoring is broken out by vegetation type, i.e. bioengineering systems, container plants etc. The monitoring program is designed to collect the data necessary to determine if success is being achieved at all stages of plant growth and if adjustments are necessary.

Monitoring Plan Questions

The following are the three questions to be assessed under the vegetation monitoring section:

Vegetation Monitoring Question 1: a) What was the success of the different bioengineering systems? b) What was the survival by species of the various bioengineering system? (species: willow/dogwood/ninebark/cottonwood/other/mixture of more than one species in system)

Vegetation Monitoring Question 2) What was the survival by species of the various container plants and hydroseeded grasslands?

Vegetation Monitoring Question 3) Did the restoration project reduce the abundance of exotic and/or invasive species in the riparian community? Did it substantially avoid a new invasion of invasive specie?.

Performance Criteria and Goals

The performance standard is to achieve a multiple level canopy of diverse riparian species, a floodplain woodland which supports wildlife, and a stream side riparian corridor which functions with the stream channel to provide for shade, bank stability, instream habitat, a food source for aquatic organisms and contributes to in channel sediment sorting.

The specific objectives for vegetative cover are shown in Table 2 and include initial growing estimates as well as the desired ultimate mixture of vegetation canopy. For certain vegetation types, the success criteria are broken out between survivability versus thriving of the species. At years 5 and 10, a comprehensive evaluation of the entire riparian growth canopy will be conducted to make sure the overall desired mixture of species is being achieved.

Monitoring Parameters and Methods

The initial 5-year establishment period will involve intensive efforts to establish native plantings and to have native plantings out-compete undesirable invasive non-natives (i.e.

star thistle, etc.). Table 2 contains the details of the monitoring approach which consists of a combination of plant counts, measurements within sample plots and linear measurements of bioengineered systems.

Prior to construction for phases II and III, vegetation transects will be established to measure pre-project conditions. These will be used to compare future post-project conditions. For phase I, no preconstruction vegetation surveys were conducted. After construction and during the establishment period, the monitoring transects will be established at the same locations as the pre-project locations and will coincide with some of the topographic cross sections (described above).

Adaptive Management Measures

Based upon the monitoring results, the project vegetation specialist may determine that modifications to the original revegetation plans are in order due to different or changing conditions. For example, there may be natural native plant colonization that is different than prescribed by the planting plan or there might be areas subject to frequent scour or too dry to support the intended vegetation cover. The vegetation specialist should propose a modified cover that complies with hydraulic objectives and the goals set by the regulatory agencies.

Additional Monitoring Questions for Future Designs

Maintenance of proper riparian vegetation is a key component of any successful restoration project. In urban environments, there are added difficulties associated with maintaining bioengineering and vegetation plantings such as water quality, disturbances from people and animals, and widespread exotic plant infestations.

Under this category, WRI will seek to evaluate if there is a significant difference in survivability with different planting methods and/or species. Also, are some plants just surviving but not really thriving in the restored channel and floodplain? Also, since irrigation is one of the most costly items on a restoration project, we are also interested in how long the irrigation system lasts and changes to the design that can be made to extend the irrigation system design.

We are also interested in evaluating if erosion control measures have an effect on controlling exotic and invasive species.

III. Aquatic Habitat Conditions

A key component of the restoration project is to achieve significant ecosystem restoration for the project reach and to eventually improve habitat within the restored reaches of the creek. We have focused the biological monitoring on special status fish species since Codornices Creek represents a significant opportunity to establish or perhaps improve an anadromous fish run, especially within the lower reaches of the creek.

The project will perform BMI surveys in the project reach as well as in areas prior to construction in phases II and III. BMI is an important measure of creek health. Continuous temperature monitoring will be conducted in 2006 within the restored reach to assess creek temperatures both before and following restoration activities. This work will be conducted under the Urban Creeks Council (UCC) under their CalFed grant. Note that the UCC will be conducting separate monitoring at various locations within the creek in 2005 and 2006 under separate grants to monitor fisheries and water quality throughout the Codornices Creek watershed. The project team will be working closely with the Urban Creeks Council to integrate and coordinate the two monitoring plan efforts.

Monitoring Plan Questions

There are five monitoring plan questions relative to aquatic and biologic habitat conditions.

Aquatic Habitat Monitoring Question 1: Do pool depths meet minimum fish requirements?

Aquatic Habitat Monitoring Question 2: Does the restoration project increase hiding cover?

Aquatic Habitat Monitoring Question 3: Are creek temperatures acceptable for coldwater fishes (trout/steelhead)?

Aquatic Habitat Monitoring Question 4: Is the creek supporting a macroinvertebrate population?

Aquatic Habitat Monitoring Question 5: Is the creek supporting sensitive species including trout, steelhead or CRLF? What abundance?

Performance Criteria and Goals

The performance criteria and goals to address each monitoring question are detailed in Table 1 and vary by question.

- For pool depths, the goal is residual pool depths greater than 1.5 feet by Year 5.
- For increased hiding cover, the project goal is a shelter rating cover consistent with Central Coast habitat standards by years 5 and again at year 10.
- For creek temperatures, the project goal is a seven day moving average of daily maximum temperatures less then 20 degrees C.
- For macroinvertebrate populations, the goal is to meet CDFG standards for coastal streams by year 5 and year 10.
- Finally, for sensitive fish species abundance, the project goal is multiple age classes of *O. mykiss* present including young of year.

Failure to meet one or more goals may not be a failure of the project but an indication that some kind of adaptive management tool needs to be implemented.

Monitoring Methods

Standard habitat survey methods will be employed by the project fisheries ecologist to assess the various parameters required to assess how the project is meeting its goals and performance objectives. Surveys for aquatic species include diving and electroshock population surveys for fish and sampling of aquatic insects. Other specific monitoring methods are described in Table 1. The Codornices Creek monitoring program will coordinate with the SWAMP program water quality monitoring conducted in association with the Urban Creeks Council.

The California Stream Bioassessment Procedure (CSBP, CDFG 1999) will be used to collect and analyze benthic macroinvertebrates in Codornices Creek. It is anticipated that subsamples will be pooled for site locations and invertebrates will be systematically removed for classification. The Codornices Creek team will work with the Kier Associates who currently uses John Lee of Arcata to provide taxonomic identification and calculation of bioassessment metrics. The bioassessment procedure will generate a number of useful metrics for evaluating water quality and the quality of fish food in Codornices Creek. Taxonomic richness and the EPT index, in particular, will be used to assess conditions at the reaches of Codornices Creek.

Sediment data will be collected in the channel and on the flood plain surfaces using standard pebble count and surface sampling collecting methods. Channel sampling should include pebble counts in the channel in a consistent geomorphic location, sampling of sub-surface layers below the channel bed, and sampling of newly deposited sediments on the banks (i.e. bankfull sediments). The samples should be analyzed for grain sizes and the sample locations mapped. The goal will be to assess if gravel sizes suitable for fish spawning are depositing in the creek section.

Adaptive Management Measures

Specific adaptive management measures will be developed by the project fisheries biologist depending on the specific problem being addressed by the project.

Additional Monitoring Questions for Future Designs

As an aid to future design efforts, we are interested in evaluating how habitat structures are being used in the urban stream and how improvements can be made to improve habitat. Also, given that elevated temperatures may be consistent within urban streams, we will also evaluate the temperature data to evaluate if fish within urban streams are actually adapting to higher temperatures.

IV. Hydraulic Conveyance

Water level elevations of the creek under the restored channel conditions will be monitored under this monitoring area to assess the hydraulic conveyance of the channel. Although the project goal was for creek restoration, a secondary benefit of the project design was some additional channel and floodplain storage capacity that may lower water levels within the creek under high flow conditions.

Monitoring Plan Questions

The single question related to hydraulic conveyance of the creek to be addressed under this monitoring plan is the following:

Hydraulic Conveyance Monitoring Question 1: What are the peak water levels in the creek under high flow conditions?

Performance Criteria and Goals

There are no specific goals associated with this monitoring item.

Monitoring Methods

If sufficient funds can be secured the project will install a flow gauge and water level sensor. Until this time, the project will conduct visual monitoring of high water marks during and immediately after significant storm events. We will also evaluate installation of a high water flow sensing device (crest gauge) to estimate high water marks. There is an operating water gauge further upstream in the watershed and this data can be accessed at the following url:

http://www.balancehydrologics.com/codornices/creek/index.php. Rain gage data can be accessed via a link on the stream gage webpage.

Adaptive Management Measures

A thorough alternative assessment should be undertaken in the unlikely event hydraulic capacity is reduced below the design level and changes are necessary, such as removal of sediment, working with the railroad to clean the downstream culvert, adding vegetation to the floodplain or increasing the height of levees. Any adaptive management measures would have to be coordinated with the adjacent Cities, the railroad, UC Berkeley and any other adjacent properties.

Resource agencies would be consulted and required permits/approvals obtained prior to implementation of any of these measures.

V. Water Quality Monitoring

A key component of the Codornices Creek Restoration Project is to maintain and improve water quality within the restored sections of the creek. Under this monitoring area, basic water quality parameters within the creek will be measured and used to evaluate the health of the creek water. Additional tests for total chromium and chromium +6 will be used to assess if known chromium water contamination from adjacent properties in Berkeley are entering into the creek.

Monitoring Plan Questions

The following water quality monitoring questions will be addressed under this monitoring plan.

Water Quality Monitoring Question 1: Are basic creek water quality parameters within regulatory standards?

Water Quality Monitoring Question 2: Is chromium from toxics at the nearby Berkeley site impacting the creek?

Performance Criteria and Goals

Maintain and improve basic water quality within the restored sections of the creek below regulatory standards. In addition, the creek will be monitored to assess if chromium contamination from the nearby Berkeley site (the skateboard park) is impacting the creek.

Monitoring Methods

Water quality within the creek will be assessed through direct measurement of the pH, dissolved oxygen (DO), dissolved and total suspended solids (TSS). The project will work with the local monitoring groups to integrate collected data into the SWAMP program.

Chromium will be measured by collecting and analyzing water samples for total chromium and chromium +6 to assess if chromium from the adjacent Berkeley site is impacting the creek.

Adaptive Management Measures

Adaptive management techniques will be developed as needed following analysis of water data and causes of water quality issues. It is likely that many water quality issues and concerns are caused by upstream issues that may be difficult to solve within the scope of this restoration project.

Impacts from chromium may require additional remedial actions that are outside the scope of the Codornices Creek restoration project.

Schedule for Monitoring and Reporting

Table 3 shows a yearly breakdown of the project monitoring. The project schedule has been adjusted to June 30 to July 1 of each year. An annual report of the previous years monitoring will be prepared and submitted by October 1 of the following year. This report will contain all data and results from the previous years monitoring.

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