Codornices Creek Restoration Project

2015 Monitoring Report

Phase 3 Vegetation Monitoring
Phase 1-3 Stream Temperature Monitoring

RWQCB Permit number: 02-01-C0763
USACOE Permit number: 28288-1S
DFG Notification Number: 1600-2006-0169-3

City of Albany / City of Berkeley

Appendices:
Appendix A: *Photopoint Locations*
Appendix B: *2015 Site Images*

REGISTERED LANDSCAPE ARCHITECT
ERIK STROMBERG #5536
EXP. 3/31/2017
STATE OF CALIFORNIA

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Codornices Creek Monitoring 2015

1. Overview

This report presents the 2015 monitoring results for Phase 3 of the Codornices Creek Restoration Project and follows the 2014 Monitoring Report that summarized the previous year's monitoring of Lower Codornices Creek.

To date, three phases of Codornices Creek restoration have been completed. Phase 1 was completed in 2005, Phase 2 in 2006 and Phase 3 in 2010. Vegetation and photo monitoring surveys were completed for Phase 3.

In addition to the scheduled work, the City had four temperature data loggers installed in the creek to monitor stream temperatures within Phase 3 to address ongoing concerns about elevated stream temperatures and lack of vegetated cover along this reach.

2. Vegetation Monitoring Results (Phase 3 Only)

Year 5 / October 2015

2.1. METHODS:

The project monitoring was performed in accordance with the elements of the Monitoring and Mitigation Plan (MMP) prepared by FarWest Restoration Engineering (FRE) dated April 16, 2006. 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. The vegetation monitoring was broken down into four separate tasks. Monitoring for each task was conducted separately using distinct methods:

MMP Task 2.1: Task 2.1 monitors the soil bioengineering components of the project. For year 5, the entire riparian canopy is evaluated for percent cover. This was done using the Line Intercept Transect Along Banks method (Center for Forestry, UC Berkeley, 2005). Both sides of the creek (along bankfull channel) within the project area were measured in a linear fashion for gaps 1-foot or more in riparian cover. Total gaps were compared to total project area reach length (both sides) to quantify a percent of riparian canopy cover.

Table 1: Soil Bioengineering Success Criteria

Year	Criteria

Year 1: 2011	Sprouts
Year 2: 2012	2-feet tall
Year 3: 2013	4-feet tall
Year 4: 2014	6-feet tall
Year 5: 2015	Evaluate entire canopy for percent cover
Year 10: 2020	Evaluate entire canopy for percent cover

MMP Task 2.2: This task evaluates the success of the live staking outside the active channel bank. For year 5, the entire riparian canopy is evaluated for percent cover. See Task 2.1 for method of measurement.

Table 2: Dogwood Stake Success Criteria

Year	Criteria
Year 1: 2011	Survival
Year 2: 2012	Survival
Year 3: 2013	1-foot tall
Year 4: 2014	2-feet tall
Year 5: 2015	Evaluate entire canopy for percent cover
Year 10: 2020	Evaluate entire canopy for percent cover

MMP Task 2.3: Container plants are monitored under this task. The entire site was surveyed and all living plants from the original list of species planted, including additional plants installed by volunteers since the project completion were tallied and compiled on a per species basis. Native species planted or growing as volunteers but not on the original plant list were not tallied. Dead plants were noted but not compiled.

MMP Task 2.4: The final task measures percent cover of native and non-native plants in 10 randomly sampled 3 foot by 3 foot plots using the Daubenmire method as detailed in the USFS Technical Reference: Sampling Vegetation Attributes, 1996.

2.2. RESULTS

2.2.1. MMP Tasks 2.1 and 2.2: Soil Bioengineering and Live Stakes

Soil Bioengineering and live stakes are performing well. Along both banks of the project area, there were 154 linear feet of gaps in riparian cover. Compared to 1,260 linear feet of channel (along both banks), the total measures over 87% riparian cover.

2.2.2. MMP Task 2.3: Container Planting

Table 3: Phase 3 Container Planting Results

		2011 as-built		2012		2013		2014		2015	
Species	**Specified**	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*	#	*% survival from previous period*
Acer macrophyllum	6	6	*100%*	7	*117%*	8	*114%*	7	*88%*	4	*57%*
Acer negundo	3	3	*100%*	3	*100%*	3	*100%*	3	*100%*	2	*67%*
Aesculus californica	18	17	*94%*	16	*94%*	17	*106%*	17	*100%*	13	*76%*
Alnus rhombifolia	40	37	*93%*	37	*100%*	36	*97%*	33	*92%*	24	*73%*
Heteromeles arbutifolia	18	15	*83%*	17	*113%*	20	*118%*	19	*95%*	18	*95%*
Mimulus aurantiacus	15	1	*7%*	3	*300%*	5	*167%*	3	*60%*	0	*0%*
Populus fremontii	20	18	*90%*	19	*106%*	21	*111%*	18	*86%*	20	*111%*
Quercus agrifolia	23	28	*122%*	29	*104%*	29	*100%*	34	*117%*	28	*82%*
Rhamnus californica	14	13	*93%*	22	*169%*	19	*86%*	21	*111%*	18	*86%*
Ribes sanguineum	8	8	*100%*	8	*100%*	9	*113%*	3	*33%*	1	*33%*
Rosa californica	11	8	*73%*	15	*188%*	16	*107%*	14	*88%*	9	*64%*
Sambucus mexicana	11	13	*NA*	14	*108%*	14	*100%*	12	*86%*	7	*58%*
TOTAL # OF INDIV.	**187**	**167**	*89%*	**190**	*114%*	**197**	*104%*	**184**	*93%*	**144**	*78%*

2.2.3. MMP Task 2.4: Percent Cover

The 2014 survey of percent cover indicates a decrease in bare soil. Native plant establishment on the Phase 3 floodplain remains better than the previous two phases.

Fragaria, Bromus carinatus, Hordeum brachyantherum, Baccharis douglasii, and *Equisetum* have successfully established and account for the majority of the native cover on the floodplain. Even with the limited initial container plant palette, ongoing maintenance by the City of Albany and maintenance / follow up planting by volunteer groups has been successful at adding further native cover and limiting the colonization of many of the invasive species typical of urban restoration areas.

Table 4: Percent Cover Results

2015		Species		Species		Species		Species	
		Native		Exotic Forbs		Exotic Grasses		Bare Soil	
Cover Class	Mid-point	Number	Product	Number	Product	Number	Product	Number	Product
1-5%	2.5	0	0	0	0	4	10	3	7.5
5-25%	15	3	45	3	45	3	45	3	45
25-50%	37.5	4	150	6	225	1	37.5	1	37.5
50-75%	62.5	2	125	0	0	0	0	0	0
75-95%	85	1	85	0	0	0	0	0	0
95-100%	97.5	0	0	0	0	0	0	0	0
Total Canopy			405		270		92.5		90
Number of Samples			10		10		10		10
% Canopy Cover			41%		27%		9%		9%
Species Composition			**30%**		**20%**		**7%**		**7%**
Frequency			100%		90%		80%		70%

2.3. DISCUSSION

2.3.1. MMP Task 2.1 and 2.2: Soil Bioengineering and Live Stakes

The riparian canopy as a whole has become quite full. Within one meander at the upstream end of the project, the willow is still struggling to establish. The willows in this area are surviving but continue to grow slowly. Dogwood stakes are establishing well within their planted areas. Additional plantings continue to be installed by volunteers in this area.

2.3.2. MMP Task 2.3: Container Planting

Fewer container plants (78%) were observed in 2015 than in 2014. The 78% does not take into account species that were planted by volunteers or natural colonization. There were specimens of Oregon ash, California Sagebrush, Mugwort, Bee plant, Douglas Iris, Ocean-spray, Coyote Brush, Ceanothus and Ninebark noted during the survey. Of the species planted after the initial project completion, Ninebark and Ceanothus species are doing extremely well. Additionally some species are beginning to self-colonize. One volunteer Fremont poplar was observed on the floodplain at 15-foot height. Overall, the drought conditions and the dense cover of vegetation made locating all of the container plants challenging.

Five alders were noted as dead but the remaining ones are looking healthy with vigorous growth. Overall the container plants are exceeding the 60% survival threshold.

2.3.3. MMP Task 2.4: Percent Cover

The goal for the fifth year of monitoring is to have less than 20% exotic species cover. There is currently 27% cover non-native species detected in the random selected sample plots. Multiple aggressive exotic species are still colonizing within the reach. Acacia seedlings, bristly ox-tongue, fennel, pampas grass, curly dock, bindweed, white clover, rye grass and wild oat are found scattered throughout the site and should continue to be addressed through on-going maintenance. Additional effort should continue with removing these and other invasives.

2.4. General Notes

Overall the vegetation in Phase 3 is performing well. Site soil preparation and compaction mitigation was improved over techniques employed during the prior two phases, and the maintenance and irrigation programs have also been more consistent. Colonization of the site by invasive plant species continues to be an ongoing challenge. City maintenance and the additional planting and maintenance efforts by volunteers has played a significant role in getting native species to colonize this urban site, which in turn decreases invasive plant infestations.

Although the vegetation monitoring indicates that container plantings are meeting the permit requirements, the percent cover of exotic species is slightly over the target of 20%. Additional weed removal is recommended to bring down the percentage of exotic species cover, particularly in the floodplain areas.

2.5. Maintenance Recommendations

2.5.1. Weed: Locate and remove acacia seedlings, bristly ox-tongue, fennel, pampas grass, curly dock, Himalayan blackberry, bindweed, ivy, ripgut brome, wild oat grass and nasturtium.
2.5.2. Mulch: Keep area around container plants/trees clear of weeds; mulch as often as possible around the base of the plants for weed suppression and water retention.
2.5.3. Consider adding trees on bank adjacent to upstream channel meander where willows remain feeble.
2.5.4. Consider adding additional vegetation to inside meander bend across from feeble willows.
2.5.5. Remove Tree Stakes: Check tree stakes and remove if not needed
2.5.6. Remove and dispose of post and rope restoration fencing along multi-use trail.
2.5.7. Weed 6th Street Rain Gardens: Remove Fennel and bristly ox-tongue and other invasive species.
2.5.8. Remove sediment from Rain Garden entry points. This material should be removed from forebay and disposed.
2.5.9. Pick up trash and cigarette butts over entire site.
2.5.10. Prune roses in Rain Garden.
2.5.11. Test irrigation system regularly and fix any issues promptly. Turn off the irrigation for all areas except for the rain gardens and monitor the health of the trees and shrubs. Turn on irrigation if vegetation appears significantly stressed.
2.5.12. Empty trash cans on-site more frequently.
2.5.13. Paint over graffiti on USPS wall along multi-use trail. Remove graffiti from interpretive signage.

3. Stream Temperature Monitoring

Year 5 / April - October 2015

3.1. Methods

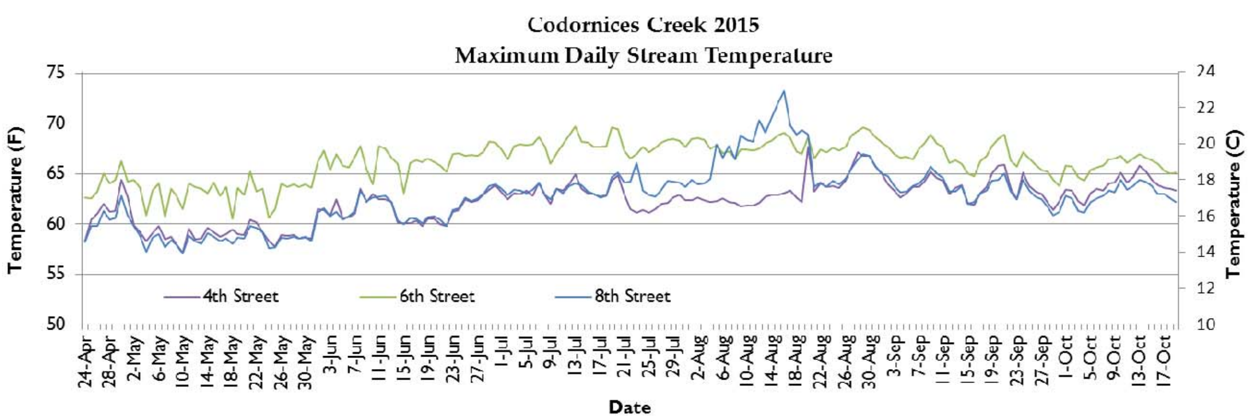
The intent of the stream temperature monitoring is to determine whether summertime stream temperatures within the newly restored reach of Codornices Creek are a concern for steelhead.

Four (4) HOBO U22-001 Temperature Data Loggers set to sample in 15 minute intervals were deployed in Codornices Creek on April 24, 2015 and retrieved on October 19, 2015.

The loggers were positioned along the channel to observe the effects of Phase 3 on stream temperatures. The first logger was installed upstream of the project inside the 8th Street culvert, the next logger was placed within Phase 3 (equivalent to 7th street) and the final two loggers were placed within the 6th street culvert and at 4th street. Phase 3 is bound by 6th and 8th streets. The 8th Street logger provides the baseline and incoming temperatures. The 7th and 6th Street loggers measure temperatures within and just below Phase 3 and the 4th Street logger is situated to capture the attenuation of temperatures downstream.

Unfortunately, the 7th street logger was missing when we went to retrieve the loggers in October. As a result data from this logger was not able to be retrieved or analyzed.

3.2. Results



Looking at the chart above, between July 15 and August 26 the 8th street data logger appears to have recorded ambient air temperature and not water temperature. This is understandable due to the exceedingly low water levels experienced in the creek during the prolonged drought. To best analyze the data, results exclude data within this date range.

Note that the exclusion of these dates did not affect the results for the 4th and 6th street temperature loggers reported in Table 5.

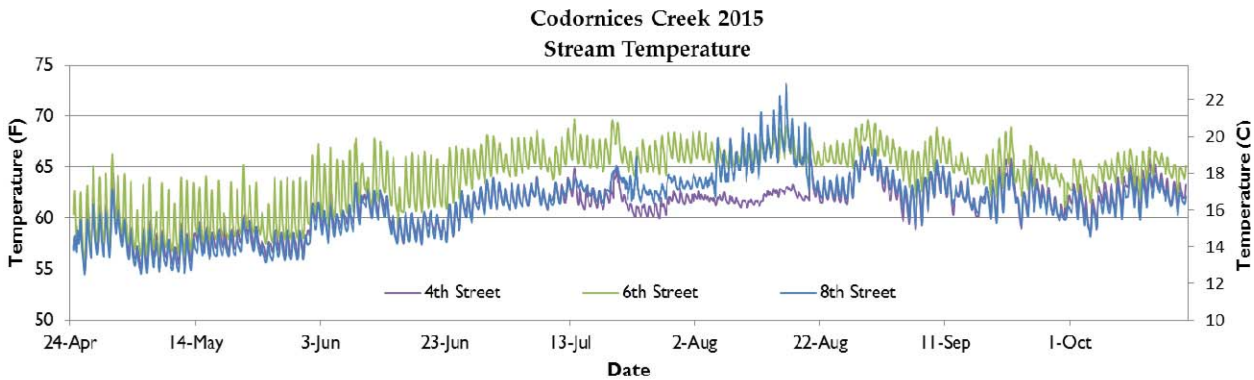


Table 5: Summary of Temperature Monitoring Result

	8th Street	6th Street	4th Street
Average Temperature	61.4 F (16.3 C)	64.1	61.1 F (16.2 C)
Max Temperature	67.0 F (19.4 C)	69.7 F (20.9 C)	67.7 F (19.8 C)
Min Temperature	54.5 F (12.5 C)	55.3 F (12.9 C)	54.8 F (12.6 C)
Max Weekly Average Temperature	64.7 F (18.1 C)	67.4 F (19.6 C)	64.5 F (18.1 C)
Max Weekly Maximum Temperature	65.9 F (18.8 C)	68.8 (20.4 C)	65.9 F (18.8 C)

Similar to years past, the 8th and 4th street stream temperatures are similar and the 6th street temperatures remain elevated in comparison, but remain below recognized critical stress thresholds for steelhead trout.

We looked at the number of hours and percent time that the water temperatures were above certain temperature thresholds. In addition to referenced temperature thresholds noted in the Codornices Creek Biological Opinion and the Mitigated Negative Declaration, we compared the data to recent published data on steelhead thermal preferences. Sloat and Osterback (2013) showed that steelhead had a marked reduction in feeding and agonistic behavior between 75.2 – 77.0 F (24-25 C). Additionally this same study summarizes a series of other studies that attempt to derive the critical thermal maxima (CTM) for steelhead, which can be approximated as 86.0 F (30 C). Both of these thresholds are substantially higher than the 69.7 F (20.9 C) maximum temperature observed during the study period. The maximum temperature for 2015 is 1.3 F lower than 2014 observations.

Draft temperature guidelines developed for the North Coast RWCQB (Carter, 2008) suggest that Maximum Weekly Maximum Temperature (MWMT) values between 14.5 – 21 C will ensure no more than 10% reduction of Maximum growth (Ferguson, 2011). The MWMT values for Codornices Creek range between 18.8 – 20.4 C. The same guidelines suggest

Maximum Weekly Average Temperature (MWAT) temperatures of 17 – 19 C ensure no more than 20% reduction from maximum growth. The MWAT values for Codornices Creek range between 18.1– 19.6 C.

3.3. Discussion

Temperature monitoring indicates that stream temperature is generally below stressful levels for steelhead (*Oncorhynchus mykiss)*. Overtime, stream temperatures are expected to continue to decline as vegetation along Phase 3 matures and further shades the channel.

The greatest impact to stream temperatures in Phase 3 is the relatively high level of insolation compared to the lower two restoration reaches, and the expansive hard pan clay that limits subsurface flow, which is known to reduce the effects of direct sunlight on stream temperatures.

3.4. Maintenance Recommendations

As noted in previous monitoring reports, there is a large portion of channel that has hard pan clay substrate and does not provide suitable habitat and likely contributes to the elevated stream temperatures seen within Phase 3. Addressing this condition can be considered if there is interest to further maximize potential habitat through this reach.

4. Photo Monitoring and Visual Assessment

The photo monitoring captures the change over time of the vegetation since construction. The visual assessments occurred on 2/10, 10/20, 11/2 and involved walking the creek corridor to inspect areas of instability or change within the channel. The site walks and photo monitoring occurred for all three phases of the Lower Codornices Creek restoration project.

Phase 1 is now 12 years old and has recently begun to experience vegetation dynamics more typical of a mature willow riparian environment, most notably with large willows leaning into the channel and obstructing flows in the low flow channel. In multiple locations these willows have collected debris entrained during storms. These small debris jams have begun to create backwaters and low wood step structures. These have in turn, provided additional support for the development of channel evulsions. There are now at least one location with a secondary channel (anabranch) that is activated during flows less than bankfull flow conditions. This evolution is adding complexity to the creek system through this site and is a welcome development. No infrastructure is anticipated to be impacted by these debris jams and anastomosis.

Phase 2 and 3 saw very little change to the stream channel since 2014. No instability or significant erosion or deposition has occurred since the last geomorphic survey occurred in 2014. Another round of geomorphic surveys will occur in 2016.

Figure 1: Secondary channel developing on floodplain

Figure 2: Debris jams developing against leaning mature willow trunks.

5. References

Carter, K. (2008). *Effects of Temperature, Dissolved Oxygen/Total Dissolved Gas, Ammonia, and pH on Salmonids* (p. 53).

Ferguson, L. (2011). *Memorandum to Ann Riley and Brian Wines: Comments on field trip to Codornices Creek Phase 3 Restoration site, July 11, 2011*

Kier Associates (2007) *Final Monitoring Report for the Codornices Creek Watershed Restoration Action Plan, Phase 2* Blue Lake, California

Sloat, M. R., & Osterback, A. K. (2013). *Maximum stream temperature and the occurrence, abundance, and behavior of steelhead trout* Oncorhynchus, *73* (October 2012), 64–73.

Codornices Creek Phase III
Photo Point Locations

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

4/20/2006

8/4/2009

12/14/2012

10/20/2015

Codornices Creek Phase 1

Photo Point #1

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

7/12/2007

8/4/2009

12/14/2012

10/20/2015

Codornices Creek Phase 1

Photo Point #2

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

10/9/2008

8/4/2009

12/14/2012

10/20/2015

Codornices Creek Phase 2

Photo Point #3

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

9/27/2007

7/31/2009

9/25/2013

10/20/2015

Codornices Creek Phase 2

Photo Point #4

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

7/02/2007

7/31/2009

12/14/2012

10/20/2015

Codornices Creek Phase 2
Photo Point #5

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

10/9/2008

12/14/2012

4/18/2014

10/20/2015

Codornices Creek Phase 2

Photo Point #6

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

2/17/2011

2/21/2011

10/22/2012

10/20/2015

Codornices Creek Phase 3

Photo Point #7

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

2/17/2011

3/7/2012

12/14/2012

10/20/2015

Codornices Creek Phase 3

Photo Point #8

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

1/23/2012

3/7/2012

12/14/2012

10/20/2015

Codornices Creek Phase 3

Photo Point #9

Restoration Design Group, LLC
2612B 8th Street
Berkeley, California 94710
T 510.644.2798 F 510.644.2799
RestorationDesignGroup.com

2/17/2011

3/7/2012

12/14/2012

10/20/2015

Codornices Creek Phase 3

Photo Point #10

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