BANK STABILIZATION CONCEPTUAL DESIGN FOR ALHAMBRA CREEK @ BROWN STREET MARTINEZ, CALIFORNIA

PREPARED BY
URBAN CREEKS COUNCIL

STREAM MANAGEMENT PROGRAM FOR PRIVATE LAND-OWNERS

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HISTORY

In 1999, the Urban Creeks Council of California (UCC) developed a pilot program to assist private property owners with stream management decisions on their properties. Through this program, UCC offers alternative low cost, environmentally friendly, suggestions to conventional bank stabilization methods. We perform home visits, respond to telephone inquires, and facilitate community workshops, which discuss stream function & processes and have a hand-on soil bioengineering component. The objectives of the workshops are to give neighbors a common understanding of stream behavior and to encourage coordinated restoration efforts that cross property lines, save money, and benefit longer lengths of creek.

Upon attending a workshop in Martinez, homeowners William Steele of 834 Brown Street and Heidi & Jon Page of 900 Brown Street decided to pursue a joint restoration project. The property owners live directly across from each other on a stretch of Alhambra Creek. UCC reviewed the project site, developed a generalized project plan and timeline, and obtained outside funding to assist the homeowners in meeting design and implementation costs. Unfortunately, both initial and projected timelines were not met due the unique aspects involved in this restoration design. Several factors, including: hazardous site conditions, absence of an adequate base map, and the precarious relationship of vertical stream banks to structures at the top of bank have delayed the process of developing a viable restoration plan.

Staff time and expenses have totaled $6,500 for data collection, watershed analysis, hydrologic study, base map preparation, and conceptual design. The San Francisco Foundation and the EPA Five-Star Challenge Grant both awarded $10,000 to the design and implementation of the project. However, the aforementioned delays have allowed both grant terms to expire before any in-the-ground implementation. UCC has billed the San Francisco Foundation for the work performed with no monies spent from the Five-Star Challenge Grant.

EXISTING CONDITIONS

The reach of Alhambra Creek that concerns this study is about 300 lineal feet starting at the Brown Street bridge-culvert extending upstream. In this area the creek is restricted from its natural functioning by the bridge-culvert, an in-stream flow deflection wall, a failing retaining wall, and general incising of the channel. The proximity of structures to the channel, a driveway and homes, are of concern due to the bank erosion occurring at the site.

On initial viewing, the creek channel seems to support a wide array of appropriate riparian vegetation. There are large mature willow, buckeye, elderberry, and live oaks at the top of the banks. Further examination shows that while these tree species are present, they are all quite old with little new riparian growth occurring on the bank slopes. If these trees die, there is currently no native material poised to take its place to provide stability. In fact, these mature species are shading out possible willow pioneers that could colonize at the toe of the slope and begin to offer roughness to the banks. Instead,

there are large patches of non-native ivy, bamboo, and blackberry threatening to overtake the top of bank on both sides.

Left Bank

The bank slopes are near vertical with little riparian vegetation remaining. The height of the banks ranges from 16-20 feet. Much of the bank shows scour and is devoid of vegetation completely. A homeowner removed much of the hanging non-native ivy cover exposing bare soil banks. At the top of his bank, there are mature Buckeye and Valley Oak, which are native to the watershed. However, there are also patches of ivy and Bamboo that are non-native exotics and may be contributing to the area's instability. Portions of a 10' dilapidated wood & steel deflection wall remain (newly un-obscured from Bamboo). Downstream of the deflection wall is an old two-tier stonewall and then the Brown Street bridge-culvert. There is a driveway, which measures from 5 to 15 feet from top of bank in the area of concern; between the driveway and the bank are a narrow lawn, planter box, Buckeye tree, and a fence.

Right Bank

Throughout this reach, the bank slope height is a near vertical 14-20 feet. Moving up-stream from the bridge-culvert, there is a 21-foot length of natural bank at a very steep slope covered predominately by blackberry. Beyond this begins a 125-foot length of failed or failing retaining wall. This wall is in very poor disrepair. The footings have been exposed and eroded by the incising of the channel. The boards are rotten, cracked, missing, or hanging in various areas. The wall begins approximately 6 feet above the current grade of the stream. At the top of bank is a driveway, hot tub, and the corner of the house which all may be threatened by bank failure.

The bridge culvert at Brown Street impacts both sides of the stream. The bridge is composed of a double box culvert that appears to create an erosive backwater during high flows. The concrete pad that leads into the bridge-culvert is being undermined by the stream. There are several deep scour holes where the channel invert is 2' lower than the pad where it has been broken and eroded. Although we suspect this culvert of exacerbating the erosion problems in the project reach, we do not anticipate any action on the part of the city to correct it in the near future.

DATA COLLECTION

UCC performed several days of field surveying to generate a longitudinal profile and strategic cross-sections of the creek through the project reach. These surveys are conducted to determine the dimensions and geometry needed to establish an "equilibrium" channel, which will neither excessively erode nor deposit sediment within the project reach. We also identified a nearby reference reach, which seemed to represent the most naturalized condition of the stream in the immediate area. The cross-sections are monumented by rebar located on the left bank near the edge of the driveway to 834 Brown Street. The locations of the benchmarks are shown on the base map attached.

We used aerial photographs and orthometric maps supplied by the City of Martinez to measure large-scale stream sinuosity. We also reviewed the 1980 *Alhambra Creek Study*

of Alternatives by the U.S. Army Corps of Engineers and the *Alhambra Creek Watershed Management Plan* prepared by the Alhambra Creek Watershed Planning Group in April 2001. These documents informed our staff of previous and future planning to alleviate flood damages along the creek and also provided flood frequency information mentioned later in this report.

DATA ANALYSIS

A review of the survey data and watershed information was conducted to develop the restoration channel geometry (channel plan, profile, and cross-sectional dimensions. The drainage area for Alhambra Creek at the Brown Street Bridge was calculated to be approximately 16 square miles. Roughly 15% of the watershed is urbanized (*Watershed Management Plan*, 2001). The upper watershed is primarily open space and range-lands used for grazing. The lower watershed is mixed use residential, commercial, and industrial. This lower portion historically floods and has been the focus of flood control engineers for decades. From its mouth through downtown Martinez, Alhambra Creek has recently been widened and reconfigured to hold more storm water and become an aesthetic attraction for residents and visitors.

Survey data for the cross-sections at the project reach and the reference reach were compared to the relationships for channel shapes to drainage area for various hydro-physiographic regions established by Dunne & Leopold (nationally recognized river scientists). The reference reach data showed bankfull dimensions to be: 24' wide, 5' average depth, with a cross-sectional area of 92'. The regional relationship data adjusted for the East Bay showed expected bankfull dimensions to be: 38' wide, 3.2' average depth, with a cross-sectional area of 105'.

A flood frequency curve was developed using the figures provided by the Army Corps of Engineers in the *Alhambra Creek Study of Alternatives*, 1980. The data for this curve was derived from data at a now defunct stream gage station at D Street in Martinez. The flood frequency curve projects bankfull channel discharge near the project area to be approximately 800 cubic feet per second (cfs). This is likely a high end for a 16 square mile watershed.

The profile survey did not provide a clear and consistent pool/riffle sequence. It did call attention to 2 large pools occurring at outside meanders. These pools offer good habitat and summering spots for fish living in the creeks. The profile also identified some scour hole developing by the concrete pad of the Brown Street Bridge culvert. The profile survey did indicate the slope of the creek through the project reach is extremely flat. With a water surface elevation change of .71' over a distance of 200', the stream slope is .0036. This slope is consistent with the extreme sinuosity calculated from the city maps showing a stream length of 320' over a distance of 200'. This translates to a localized channel sinuosity of 1.85. A larger stretch of Alhambra Creek taken off the city map gives a sinuosity of 1.54 through the residential areas of Martinez.

CONCEPTUAL DESIGN

This design is derived from the data analysis and site conditions which are permanent such as Brown St. Bridge, the driveways, and houses located close to the banks. The challenge of the design is to fit the design bankfull channel dimensions into the landscape while providing stability to the banks, re-vegetating the site with appropriate native riparian plantings, and accommodating the features which are permanent at the top of bank.

The design channel dimensions at bankfull should be: 24' wide, 5' average depth, and 100' of cross-sectional area. This design does not call for any changes to the channel's profile or sinuosity. Rather, the design recommends incorporating crib-walls and a soil bioengineering technique called brush layering to stabilize the existing plan view.

Design Options:

Due to the existence of several limiting features at this site (houses and driveways located near the top of bank, severely incised channel, a bridge culvert, and a stone wall), we are unable to recommend the preferred bank grading/stabilization. Therefore, we have used the next best option, a live crib-wall design, to stabilize the creek banks. This was picked because it will provide the necessary integrity to the stream banks without intruding upon the active bankfull channel of Alhambra Creek. At this site we are recommending the use of two crib walls. The crib-walls should be located outside of the active bankfull channel. We have determined the design channel dimensions to be: 24 feet wide, 5 feet deep, with a 100' cross sectional area.

Crib-wall 1 is located on the left bank (looking downstream) on an outside bend starting at the end of the existing stone wall that extends out from the Brown Street bridge. The crib-wall should abut the stone wall so that the upstream edge of the stone wall is not left exposed to water flows that could cause scouring behind the stone wall. The stone wall is not outside the bankfull dimensions of the creek but we are viewing it as unmovable because it is part of the bridge culvert. Therefore, crib wall 1 will begin within the bankfull channel at this end but is to extend to its proper location outside of the bankfull channel, extending upstream 30'. We estimate that it will take 215 logs to construct a wall that is 30 feet long, 10' wide by 18' high. Using 10' logs that are approximately 12" in diameter, this wall should be constructed by following the specifications and drawing enclosed in this report.

The crib wall 2 is located on the right bank at the location of a failing retaining wall. The downstream edge of the wall is to begin at a measure of 50' from the center edge of the bridge culvert following the centerline of the creek upstream. The wall will extend upstream 50' at a width of 10' and height of 20'. We estimate that this wall will take 350 logs that are 10' long by 12" in diameter. Due to the close proximity of a house to the top of bank and the need to begin this wall outside of the active bankfull channel, it will not be possible to construct this wall 10 wide through the entire 50 foot length. As indicated

in our design, where the corner of this house extends closest to the creek the crib-wall "stretchers" will be shortened.

At the upstream and downstream ends of crib-wall 2, we recommend grading the slopes to a near 2:1 slope and installing a live brush layering system into the bank. The plant material extending from this application will slow water velocities at the outside meander on the upstream end. On the downstream end, the greatest benefit of the soil bioengineering technique will be the development of a stabilizing deep root network. Specifications of this system are attached.