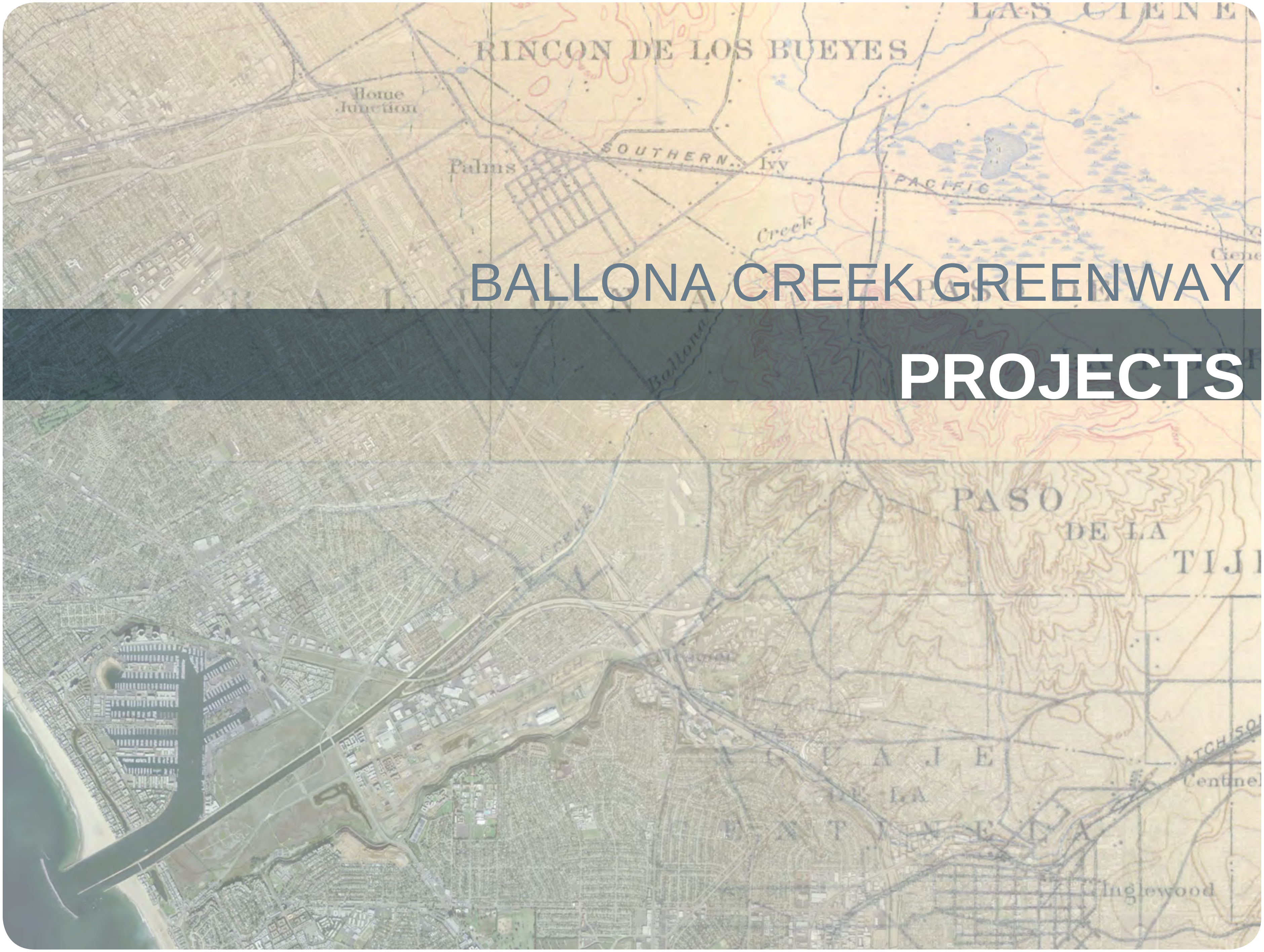
BALLONA CREEK GREENWAY

PROJECTS



Prepared by:

Restoration Design Group, LLC

With assistance from:

alta PLANNING + DESIGN

ecotone studios

Funded by:

bay restoration foundation
STEWARDS OF SANTA MONICA BAY

Coastal Conservancy

Cover: 2009 USGS Aerial Photograph and 1906 USGS Topographic Map

BALLONA CREEK GREENWAY PROJECTS

CONTEXT

Context

*This document details the **Ballona Creek Greenway Projects,** the next phase of planning and design for Ballona Creek following the Ballona Creek Greenway Plan.*

The Watershed

Situated in Los Angeles County, the Ballona Creek watershed drains approximately 130 square miles of highly urbanized terrain from downtown Los Angeles west to the Pacific Ocean at Playa del Rey. Historically a perennial stream, today Ballona Creek is an entirely engineered channel. Half of its length is a buried culvert, the other half is an open concrete channel.

The Ballona Creek Greenway Plan began in 2006 as a project of the Ballona Creek Watershed Task Force. Led by the watershed coordinator, stakeholders walked and made detailed observations along Ballona Creek Channel. The group engaged in design charrettes to envision solutions that created access, habitat, aesthetic and water quality benefits. The Plan summarized these charettes by site and project concepts. Five sites located along four reaches of the creek also demonstrated the application of design concepts including urban forestry, biotreatment, complete streets, green building, and channel naturalization. The Plan was completed in January 2011.

From Greenway Plan to Ballona Creek Greenway Projects

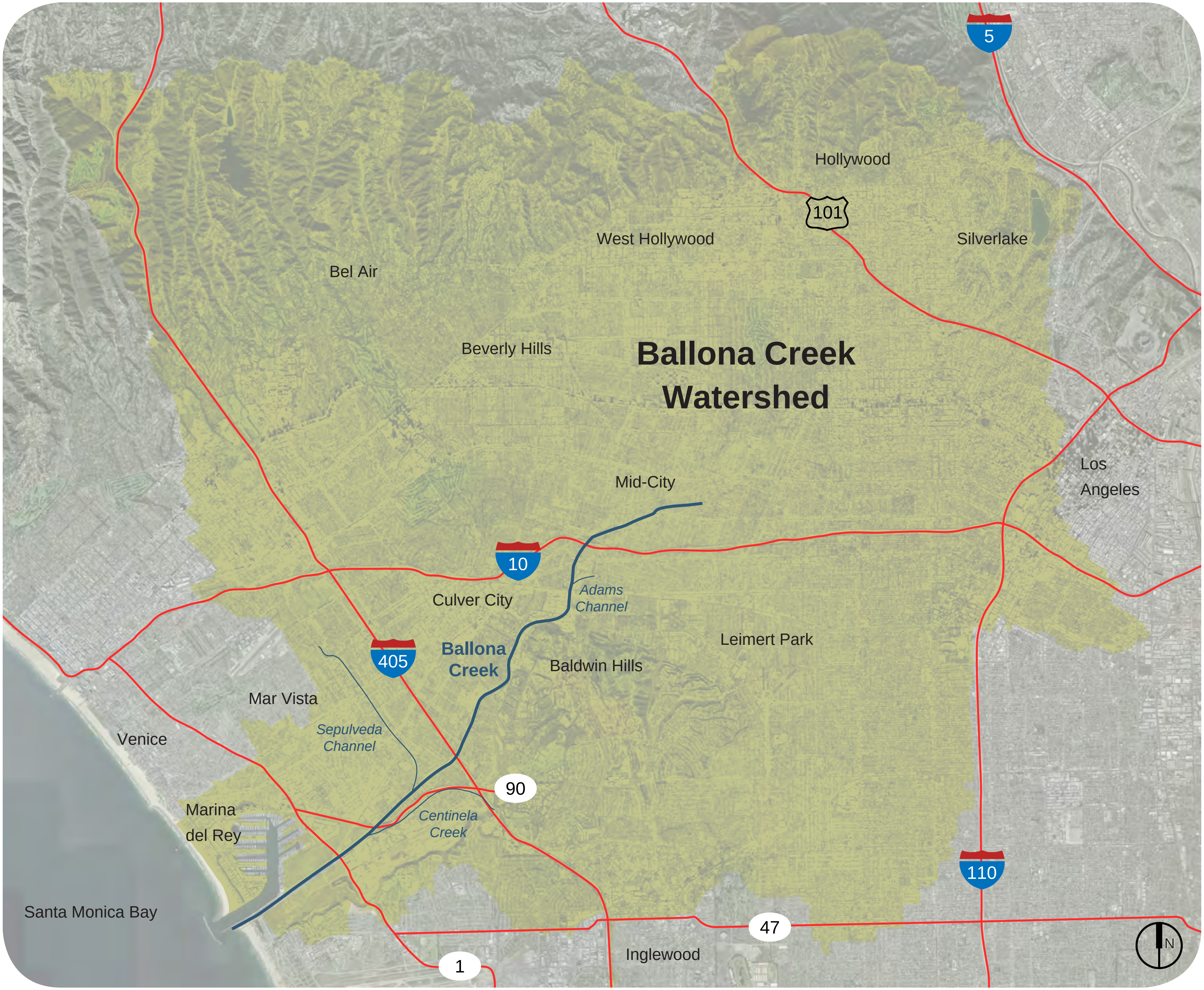
The Greenway Plan provides the basis for the development of implementation projects. Santa Monica Bay Restoration Foundation (SMBRF) selected Restoration Design Group to produce Ballona Creek Greenway Projects, a subsequent phase of the Greenway Plan that develops projects for three sites. ALTA Planning + Design provided bikeway and traffic planning concepts. Joshua Link/Ecotone Studios contributed photorealistic perspective visualizations of the site designs.

The Ballona Creek Greenway Projects site designs include preliminary engineering, planning considerations and cost estimates to enable fundraising and project implementation.

The SMBRF desired projects that span Ballona Creek's communities and present a range of programmatic elements. Sites and objectives are featured on the following page.

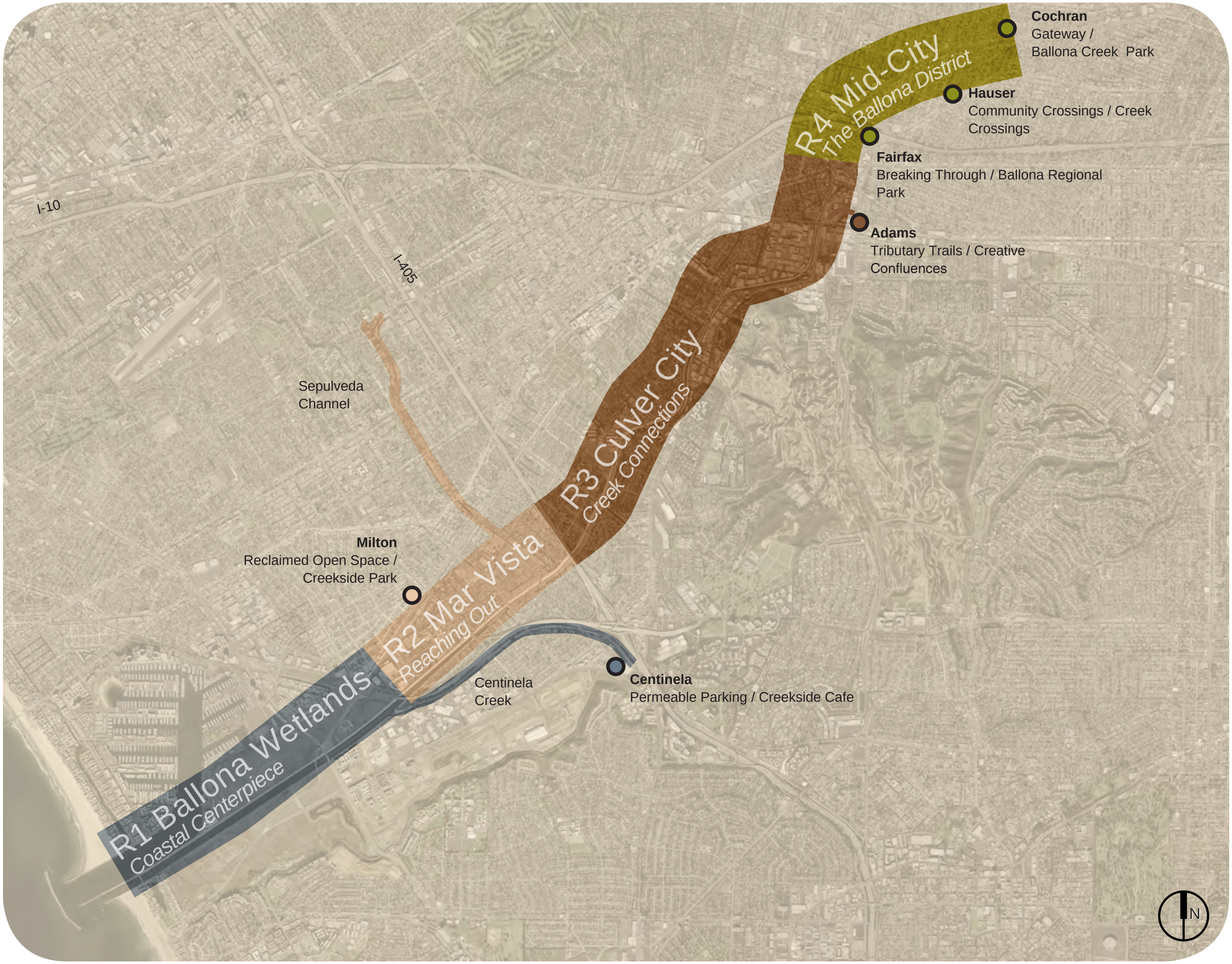
Project Sites

Three sites were selected for project development: the Sepulveda Channel tributary in the Mar Vista reach of Ballona Creek; the Adams Channel tributary in the Culver City reach; and Cochran Avenue in the Mid-City reach. Site designs reflect the unique character of each location.


Ballona Creek Watershed
Hollywood
101
5
West Hollywood
Silverlake
Bel Air
Beverly Hills
Los Angeles
Mid-City
10
Culver City
Adams Channel
Leimert Park
405
Ballona Creek
Baldwin Hills
Mar Vista
Sepulveda Channel
Venice
90
Marina del Rey
Centinela Creek
110
Santa Monica Bay
47
1
Inglewood
N

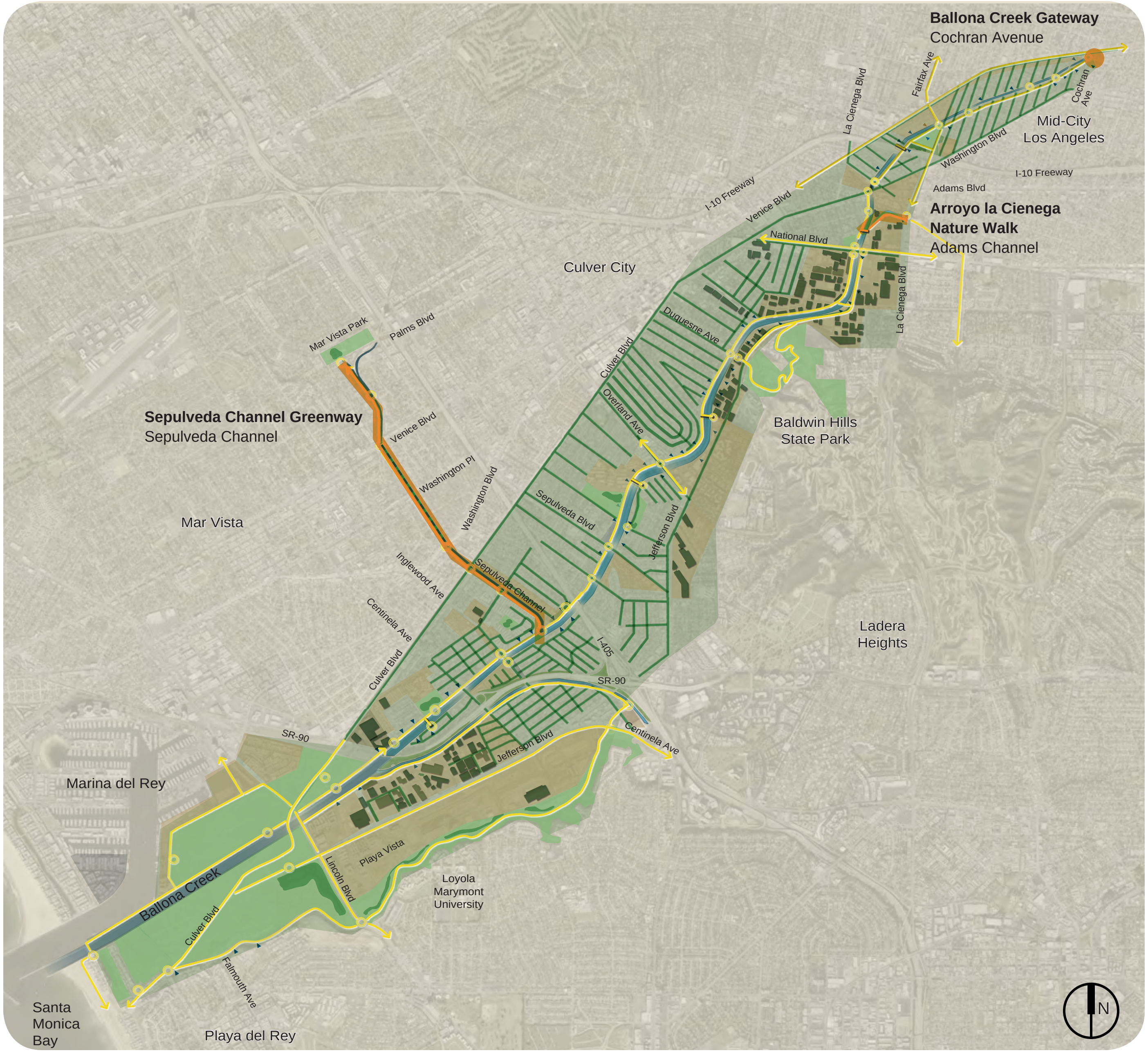
Ballona Creek Greenway Reaches

Ballona Creek Greenway Plan Reaches and Site-specific projects.



Ballona Creek Greenway Plan Projects

Projects sites described in this "Ballona Creek Greenway Projects" document are highlighted in orange on the map below.



Site Objectives

Sepulveda Channel Greenway
Sepulveda Channel

- *Utilize wide rights-of-way for bikeway and pedestrian trails*
- *Increase upland native habitat*
- *Provide safe outdoor gathering space as alternative to an adjacent alley where people and cars come in close contact*

Arroyo la Cienega Nature Walk
Adams Channel

- *Create riparian and wetland habitat while maintaining flood protection*
- *Provide walking trail for wildlife viewing*
- *Increase upland native habitat*

Ballona Creek Gateway
Cochran Avenue

- *Create community park with staging for bicyclists and pedestrians on the future Ballona Creek Bike Path*
- *Improve pedestrian safety*
- *Treat urban runoff and improve water quality of Ballona Creek*
- *Create upland native habitat*

BALLONA CREEK GREENWAY PROJECTS

SEPULVEDA CHANNEL **GREENWAY**

"It is by riding a bicycle that you learn the contours of a country best, since you have to sweat up the hills and coast down them. Thus you remember them as they actually are, while in a motor car only a high hill impresses you, and you have no such accurate remembrance of country you have driven through as you gain by riding a bicycle."

-Ernest Hemingway

Sepulveda Channel Greenway

Trail improvements along the Sepulveda Channel Greenway create safe and pleasing experiences for a variety of trail users.

Located along the Sepulveda Channel in the cities of Los Angeles and Culver City, the proposed Sepulveda Channel Greenway creates over two miles of alternative transportation and recreational facilities, beautifies neighborhoods, and enhances habitat and water quality. The Sepulveda Greenway links Ballona Creek and the Pacific Ocean to bike routes and destinations in West Los Angeles.

The Greenway provides nearly 1.5 miles of Class I Bike Paths and an accompanying pedestrian trail; three-quarters of a mile of the Greenway is a Class III bicycle boulevard with traffic calming, pedestrian enhancements, and stormwater biofiltration elements. A linear park emphasizes passive recreation opportunities and gathering areas. New and improved entry points and crossings improve access, visibility, and public safety for users.

Creating a safe route is essential for the success of the Sepulveda Greenway. The Greenway strives to minimize user conflicts by separating bicycle and pedestrian routes. High visibility crosswalks, user-activated signals, and curb extensions clearly designate crossings. Pavement markings alert motorists to the presence of bicycle lanes.

Preliminary Estimate of Probable Construction Cost

Reach I:	$2.6 to $4.5 million
Reach 2:	$1.3 to $2.8 million
Reach 3:	$2.0 to $3.2 million
Reach 4:	$2.2 to $4.0 million
Total (Range)	**$8.1 to $14.5 million**

"The bicycle is the most civilized convey-ance known to man.."

-Iris Murdoch

Sepulveda Channel Greenway Alignment

Class I and Class III bike facilities decrease travel times and increase safety for bicycle commuters in West Los Angeles.

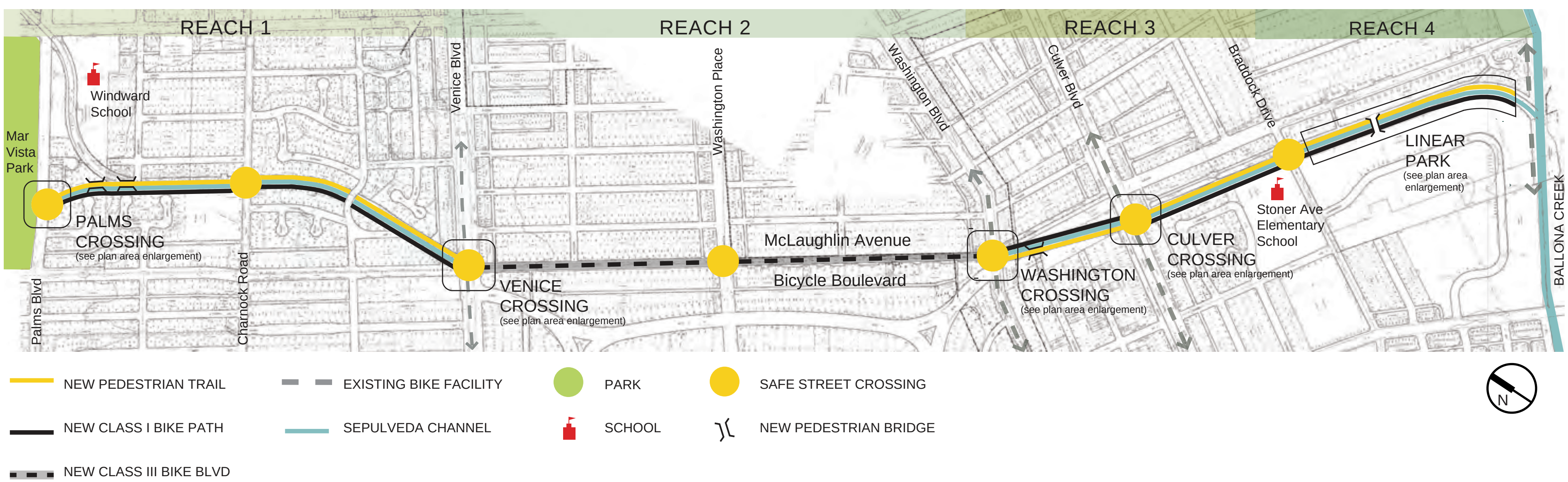
The Sepulveda Channel, a tributary of Ballona Creek, provides wide rights-of-way for landscape and trail improvements. These trails will connect West Los Angeles and Culver City with the Ballona Creek Bike Path and Santa Monica Bay, as well as to other bike facilities on Venice and Culver Boulevards.

The Sepulveda Greenway begins at Mar Vista Park on Palms Boulevard. From here, the Greenway's Class I bike paths and Class III bicycle boulevard follow the Sepulveda Channel and McLaughlin Avenue to reach the Ballona Creek Bike Path.

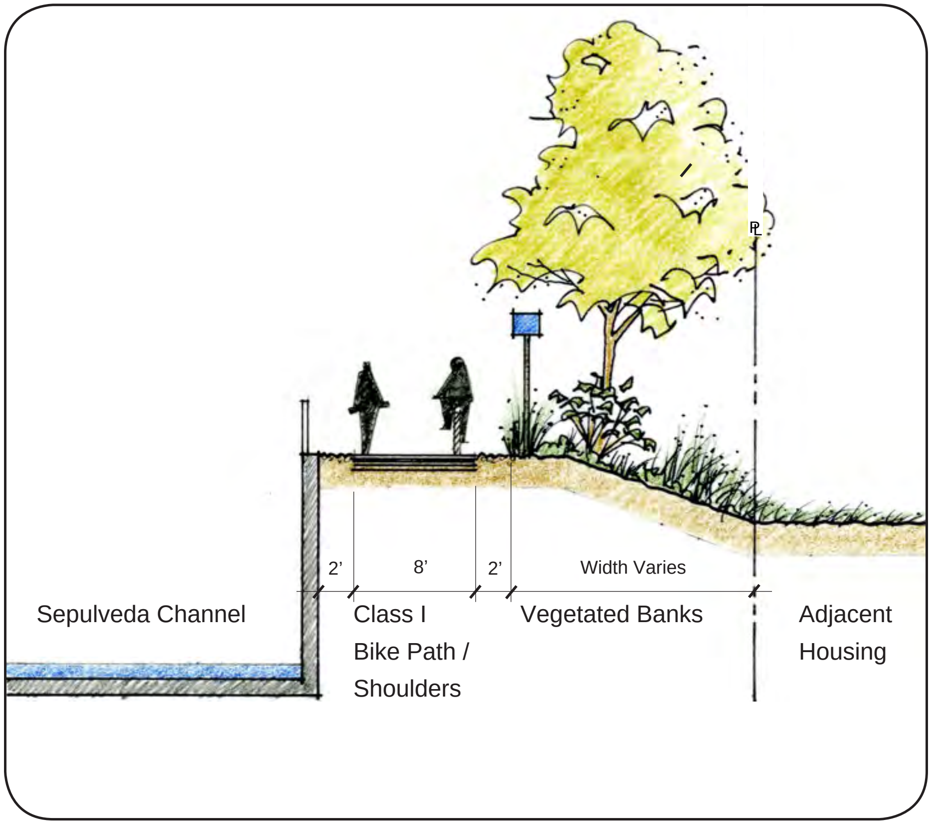
Use of the Sepulveda Channel corridor as a bikeway improves bicycle travel time and enhances bicycle safety. A pedestrian trail parallels the bikeway on the opposite bank of the Sepulveda Channel. Along McLaughlin Avenue, landscape improvements include stormwater treatment rain gardens which double as traffic calming and aesthetic features of the street design. The future success of this Class III bicycle boulevard is supported by the current frequency of bicycle traffic on the street.

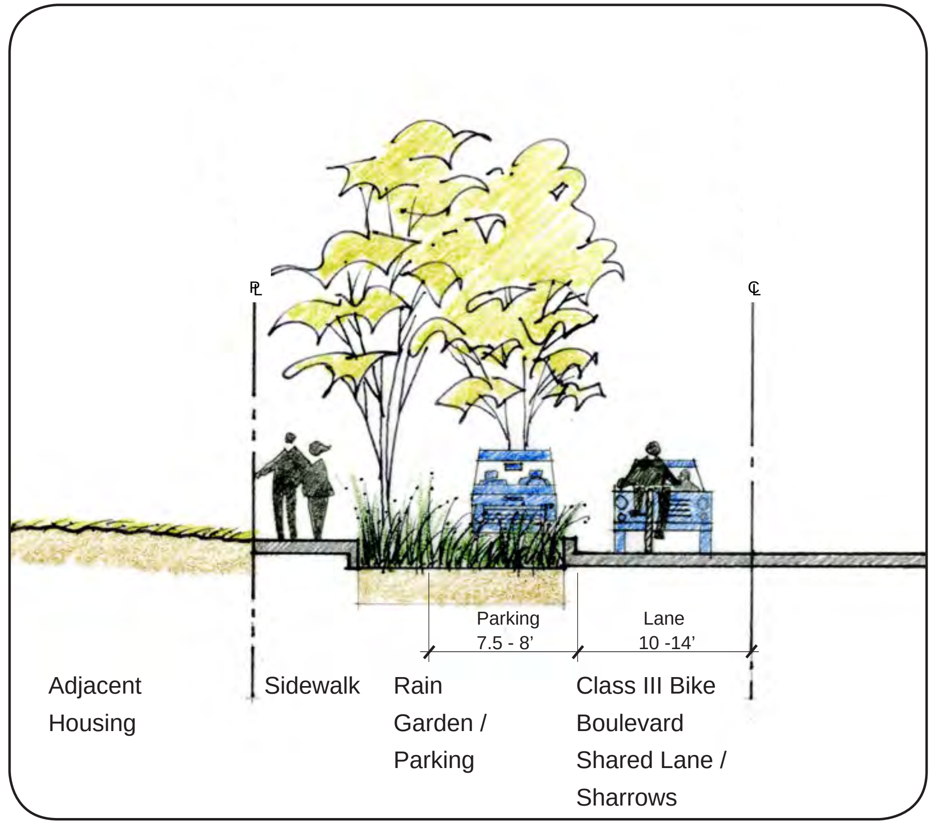
Safe street crossings are key to the success of the Sepulveda Greenway. Street crossings that minimize conflicts between users are provided on the following page. These crossings also lead to rest areas with seating and signage.

Native plantings simulate regional habitat types from coast live oak woodland, coastal sage scrub, and coastal prairie plant communities.



Trail Improvements





Sepulveda Channel Greenway Bike Path

The Sepulveda Greenway Bike Path features standard bikeway details along its Class I reaches. The eight-foot wide paved path has two-foot clear shoulders on each side for safety zones. Safety fencing protects riders from the channel's edge. The bike path is paved in a permeable asphalt or concrete, increasing infiltration, reducing runoff, and improving stormwater quality. Wayfinding signage guides users along the route and identifies special features and information. Native plants provide shade and enhance upland habitat.

McLaughlin Avenue Bicycle Boulevard

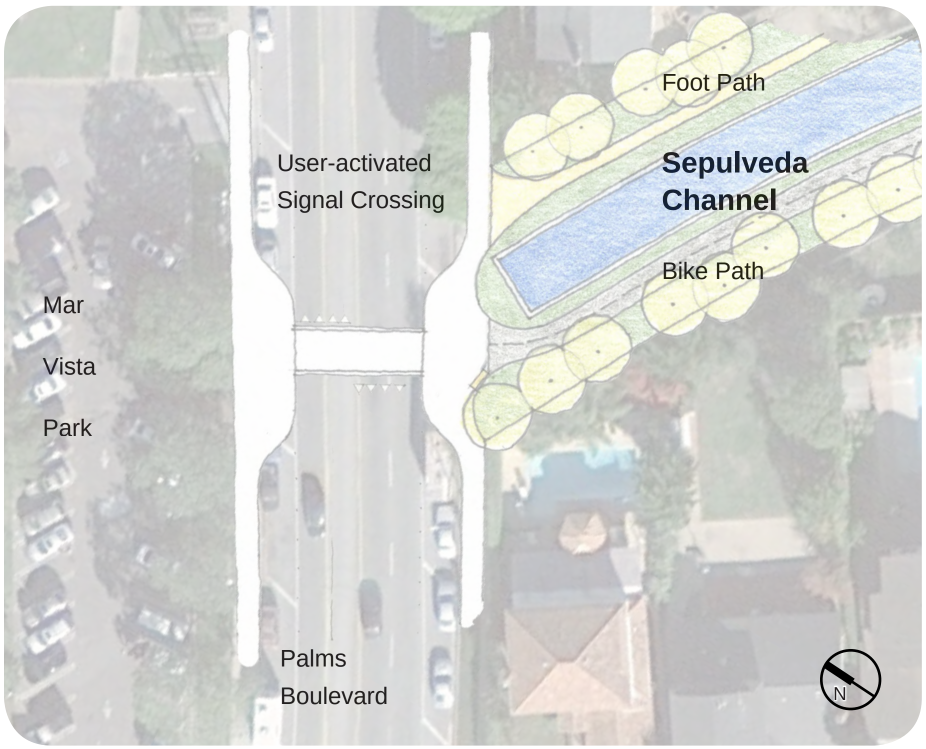
The McLaughlin Avenue Bicycle Boulevard brings the Sepulveda Greenway onto city streets, while maintaining visual and physical connectivity along this culverted reach of Sepulveda Channel. The new bike-friendly street design brings together bicycle and pedestrian safety, traffic calming, street trees, and bioswales to form what is known as Complete Street design. Curb extensions with biotreatment rain gardens alternate with street parking. Trees and native shrubs enhance the boulevard.

Safe Street Crossings

Each intersection along the Sepulveda Channel Greenway provides an opportunity to beautify the streets and improve bicyclist and pedestrian safety.

Palms Boulevard

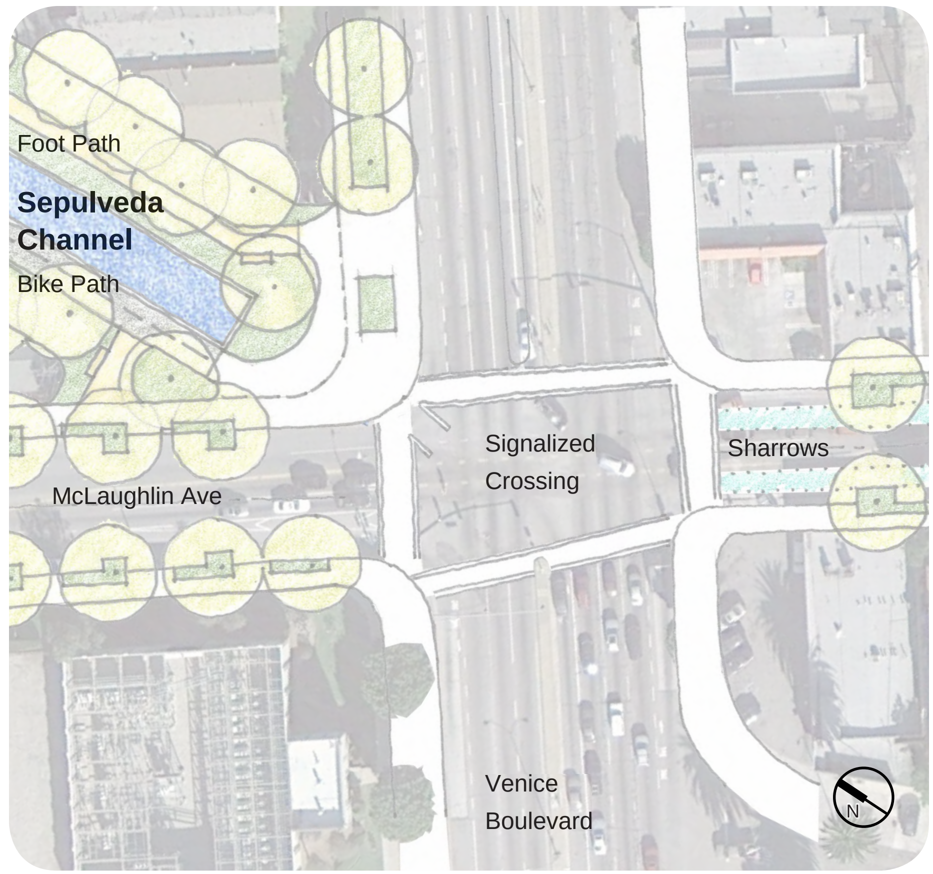
At the northern end of the Sepulveda Channel Greenway at Palms Boulevard, users are greeted with expansive sidewalk/trail entry areas. A user-activated signal illuminates a high visibility crosswalk, connecting Mar Vista Park with the entry to the Greenway. Expanded sidewalks increase pedestrian visibility, shorten crossing distance, and create a staging area for trail users.



Venice Boulevard

At the north side of Venice Boulevard, an expanded sidewalk/plaza area accommodates gathering and seating at the entry to the foot path. Native plantings and wayfinding signs announce the presence of the Sepulveda Channel Greenway.

Crossing Venice Boulevard, users transition from the Class I bike path along the channel to the Class III bicycle boulevard on McLaughlin Avenue. The signalized crossing will have user-activated signals, countdown timers, high visibility crosswalks, and advanced stop bars to create a safe crossing. Posted 'No Turn on Red' signs will minimize bike and pedestrian conflicts with right-turning vehicles. The bicycle boulevard incorporates shared bike/vehicular lanes or sharrows, street trees, and street side plantings.



Washington Boulevard

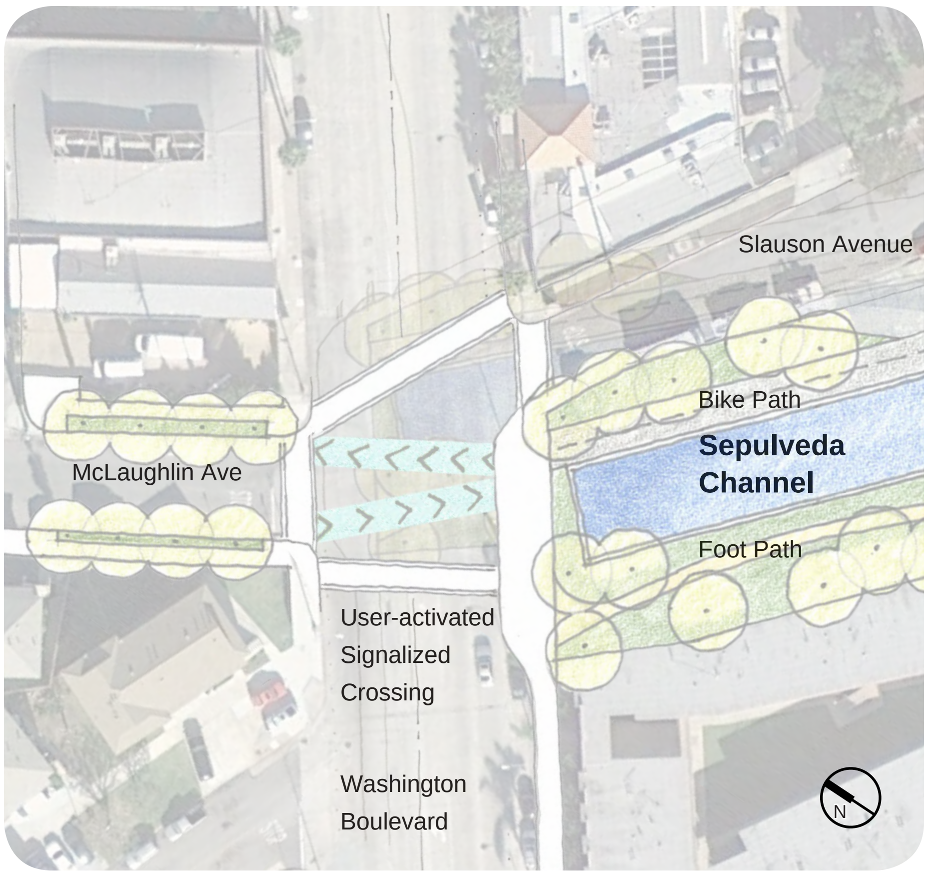
At Washington Boulevard, bicyclists encounter high traffic speeds and blind curves. A safe crossing here is critical to the success of the Greenway. This mid-block crossing is controlled by a user-activated signal to stop all lanes on Washington Boulevard. High visibility crosswalks and sharrow lane striping will separate pedestrian and bicycle users.

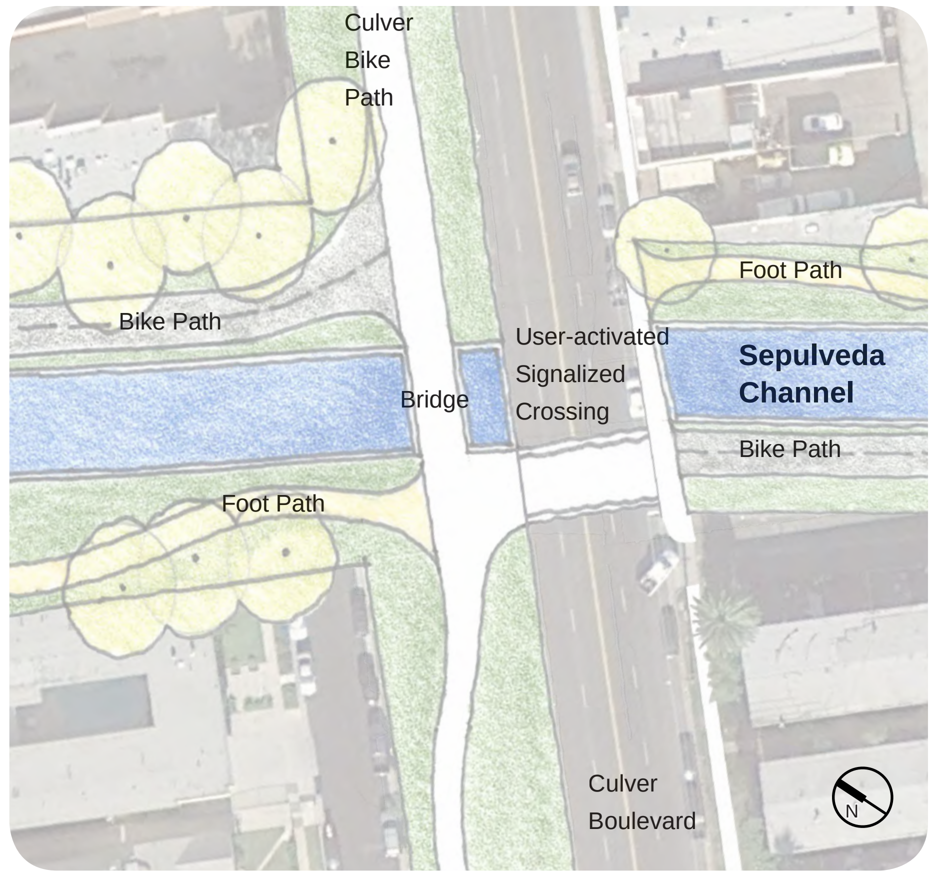
A curb extension on the south side of Washington Boulevard provides additional space for bicyclists to queue and increases pedestrian visibility at the crosswalk. The bike path entry ramps down to the channel right-of-way along its east bank.

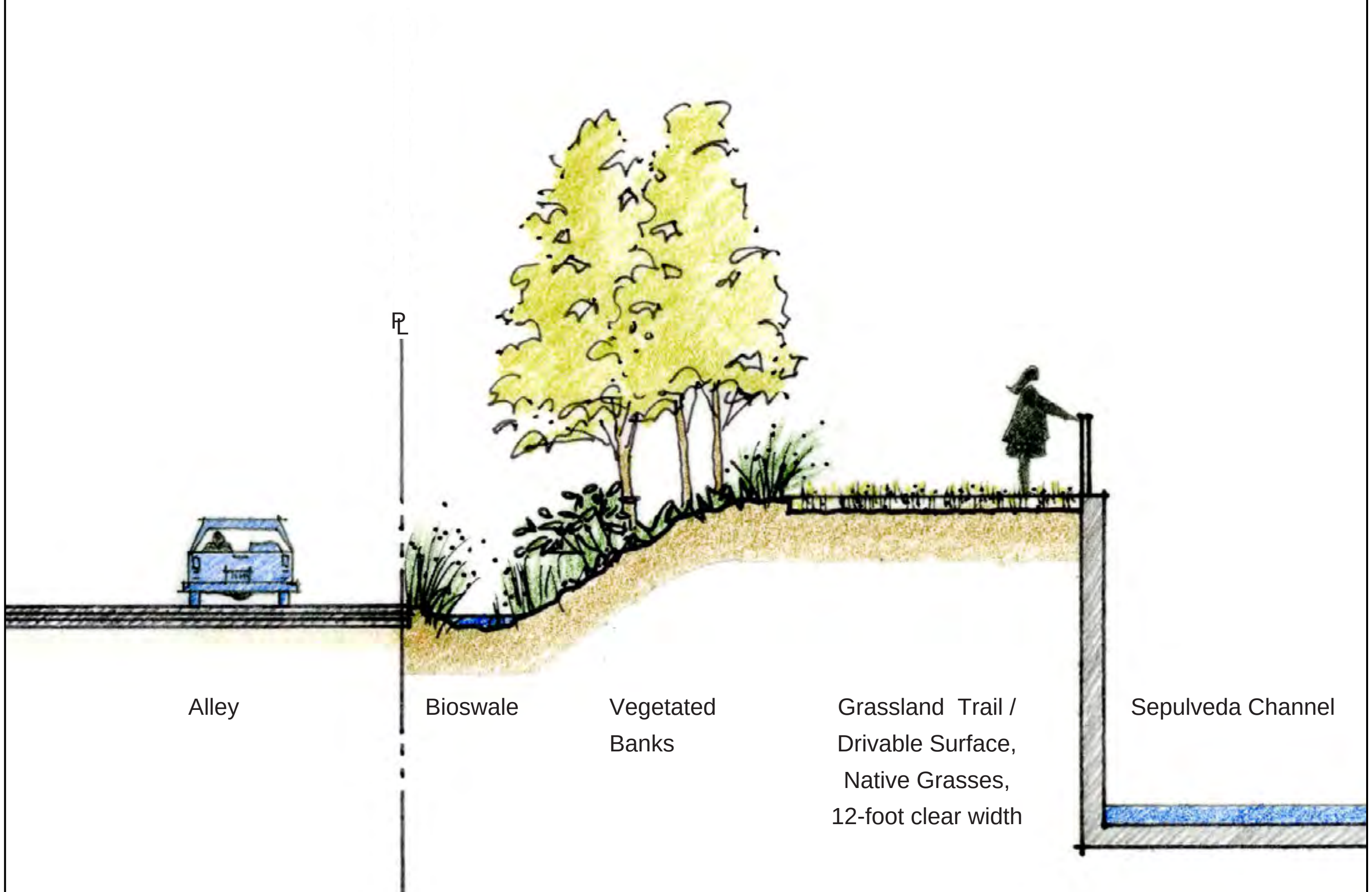
Culver Boulevard

The Sepulveda Channel Greenway crosses Culver Boulevard at an uncontrolled mid-block location. Bike and foot paths criss-cross and change sides of the channel. At this intersection, the Sepulveda Channel Greenway meets the Culver Bike Path. While a user-activated signal will enhance safety at this crossing, a traffic study is recommended to assess feasibily.

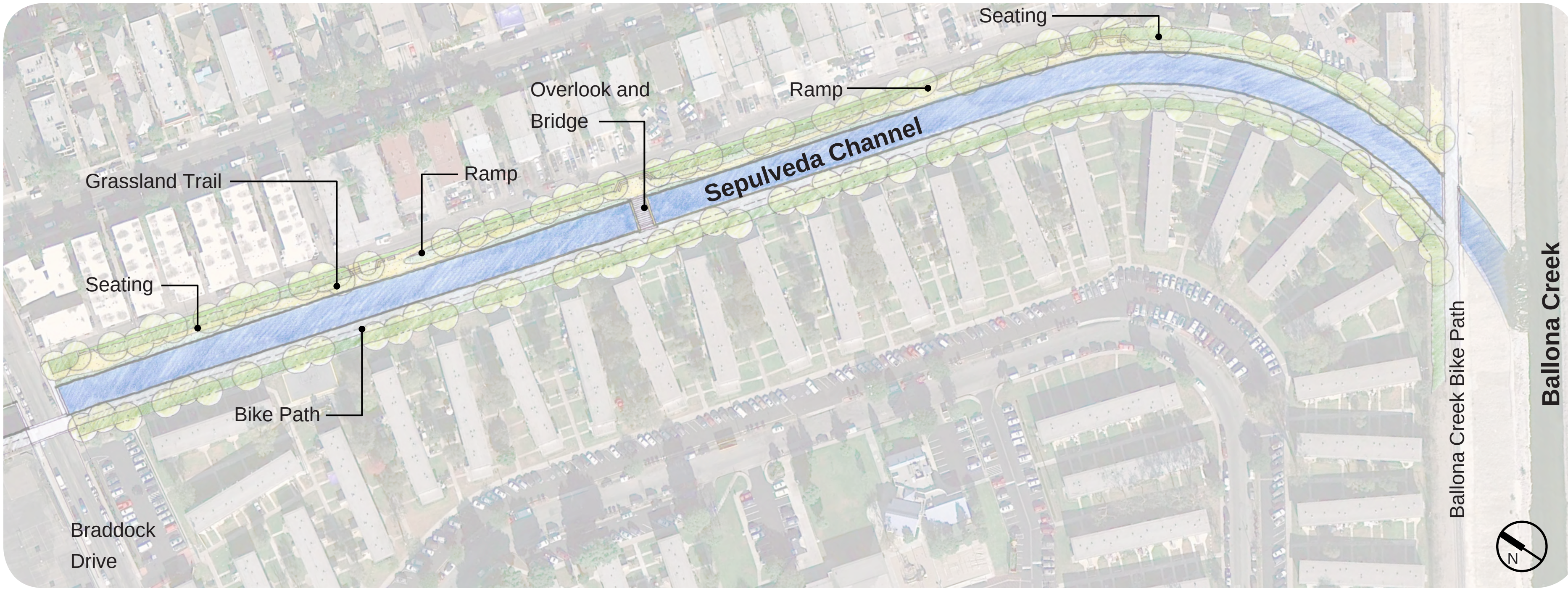
Southbound cyclists and pedestrians on the Greenway arrive at Culver Boulevard and blend with users of the Culver Bike Path and Bridge before crossing south over Culver Boulevard.







Linear Park Section at Grassland Trail and Alley



Linear Park Section at Grassland Trail and Alley

Linear Park

A linear park provides a gathering place for trail users to exercise and socialize with their neighbors.

The linear park consists of a one-third mile trail along Sepulveda Channel's east bank, providing safe exercise and recreational opportunities for residents of the neighboring apartments. Residents are now limited to using the alley paralleling the channel for open space.

Within the park, accessible ramps and adjoining stairs lead visitors from the alley to the channel-side Grassland Trail. Overlooks and gathering areas encourage socializing.

Native plants are utilized throughout the linear park and provide habitat, shade, and recreation. A pedestrian bridge spans the channel, connecting the park with the bike path on the west bank.

Both the park and bike path lead downstream to the Ballona Creek Bike Path. This path connects residents to the nearby Ballona Wetlands and ultimately to Santa Monica Bay.

Coast live oak and western sycamore trees shade the creek and trail. Coastal sage scrub species such as white, black, and Cleveland sages, California sagebrush, and Ceanothus provide color and fragrance. The drivable Grassland Trail, in grasscrete or other planted pavement, meanders through wildflowers and native grasses. The trail accommodates pedestrians and service/ emergency vehicles.

A bioswale follows the alley, capturing and filtering stormwater runoff. Swales periodically cross the alley, directing stormwater to the bioswale and serve as traffic calming features.

BALLONA CREEK GREENWAY PROJECTS

ARROYO LA CIENEGA **NATURE WALK**

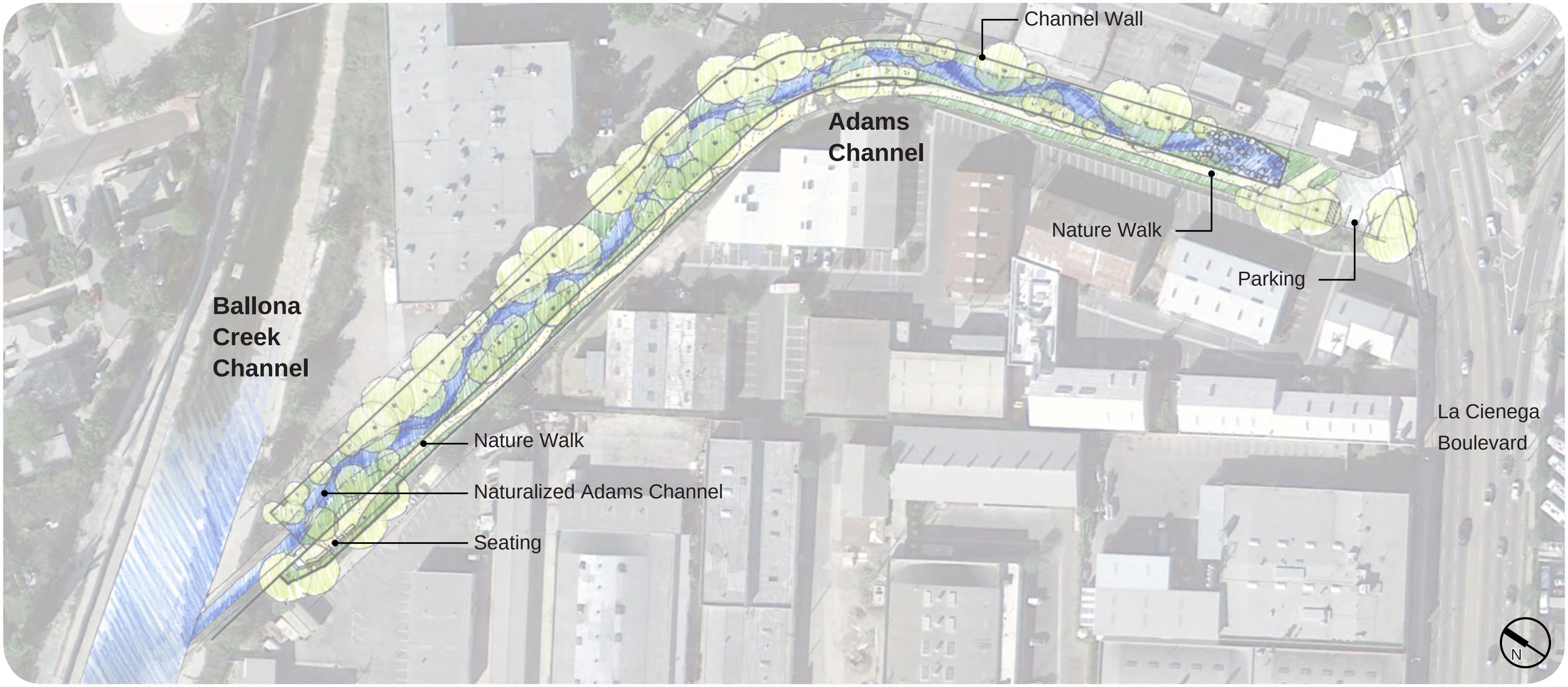
Arroyo la Cienega Nature Walk

Arroyo la Cienega Nature Walk brings back the essence of the old freshwater cienegas (wetlands) that were once located in this district between Mid-City Los Angeles and Culver City. Naturalizing the Adams flood control channel re-creates riparian habitat in the heart of the city while maintaining flood protection.

The Nature Walk provides a local outlet for nature watching and recreation. In the future it may provide a link to adjacent trail routes.

"...the country called the Cienega …at one time it was all a swamp and always had three or four feet of water standing in the low places. The whole valley was marshy, swampy and covered with tullies. Now that the water has been kept out of there to a certain extent and the valley drained, people do not suspect that it is subject to floods."

– Geo. W. Wright, interviewed by James Reagan, in Early Floods in Los Angeles County, 1914.



Arroyo la Cienega Nature Walk

The Arroyo la Cienega Nature Walk brings wildness back to the historical cienegas that once made the Ballona Valley locally famous for its duck hunting and peat bogs.

Located off busy La Cienega Boulevard between the 10 Freeway and the future Exposition Light Rail Line, the Arroyo la Cienega Nature Walk brings wildness back to the historical cienegas that once made the Ballona Valley locally famous for its duck hunting and peat bogs.

Currently, the Adams Channel/Project 53 Line B rapidly conveys flood waters. Transforming the channel into a riparian corridor reestablishes habitat while maintaining the channel's ability to convey flood flows. The restoration involves removing 1,000 linear feet of concrete channel bottom and creating a natural creek bed with a willow-dominated habitat. This naturalized corridor would exceed federal and meet local flood protection standards.

A trail doubling as flood maintenance access runs along the channel and provides opportunities for bird-watching, passive recreation, and creek monitoring. Upland oak woodland, coastal sage scrub, and grassland plants complete the restored setting. Long-term, there is the potential to use this trail as a connector between existing parks and bicycle facilities.

Preliminary Estimate of Probable Construction Cost

Total (Range) **$4.9 to $6.3 million**

Restoration Design

Today, the Arroyo la Cienega is the highly degraded, concrete Adams flood control channel flanked with restricted access signs. It drains a 10.5 square mile watershed originating south of downtown Los Angeles. The channel itself is in the middle of an industrial zone with existing parks and residential areas nearby. The Baldwin Hills State Park, a valuable yet isolated habitat patch, is one mile away. The Exposition Light Rail Line will cross Ballona Creek near this tributary and a station will be one-quarter of a mile away. The channel marks the drainage outlet of the historical cienegas, or freshwater wetlands, that made early residents confident of easily available water in the Ballona Valley. Despite the loss of the wetlands, the channel still flows with seasonal stormwater runoff.

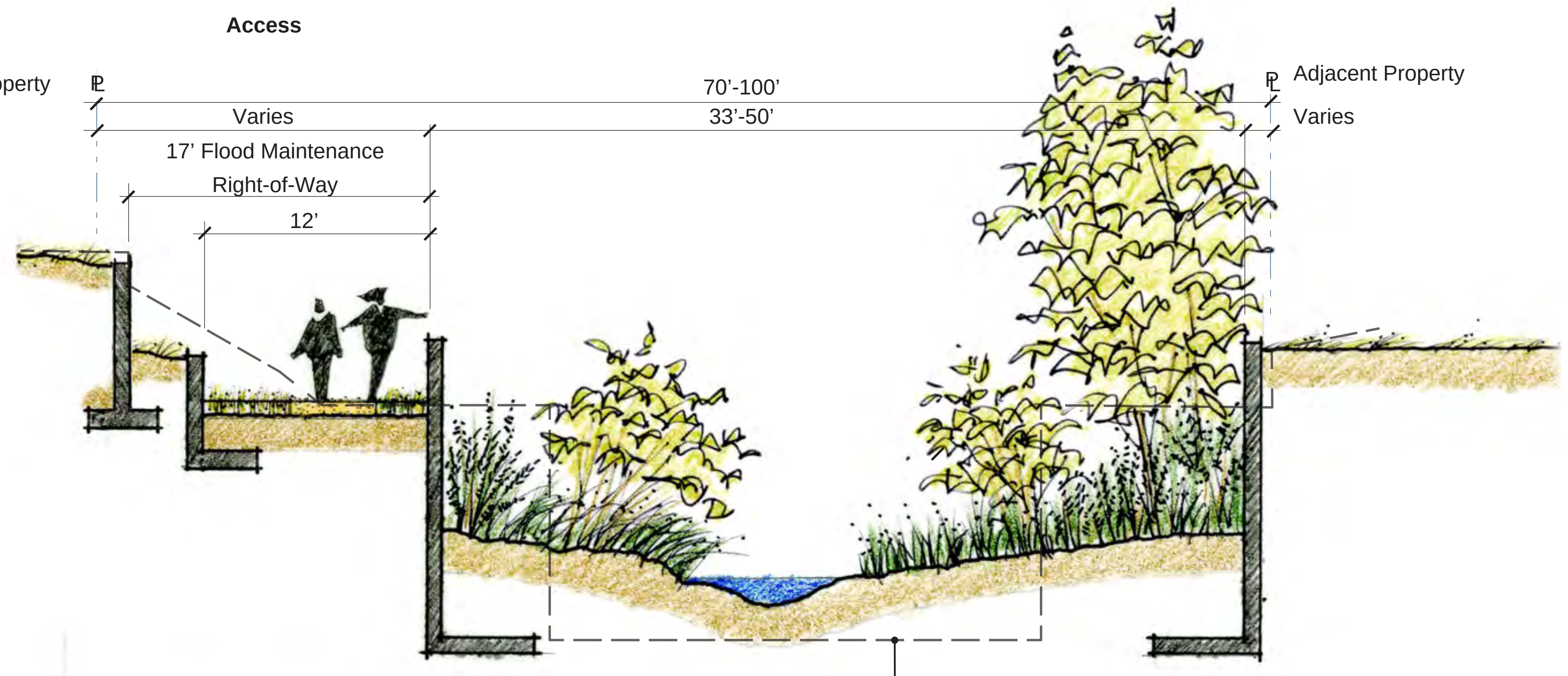
Part of the watershed above Arroyo la Cienega remains a FEMA designated 100-year floodplain. As a linear feature between Westside Park and Syd Kronenthal Park, the Arroyo la Cienega Nature Walk may, in concert with a future extension of the Ballona Creek Bike Path, become a valuable connector of open spaces in a region challenged with fast-movinig traffic and physical barriers such as utility corridors and freeways.

The approach to the Arroyo la Cienega Nature Walk is from La Cienega Boulevard between Washington and Jefferson Boulevards. Turning into the small permeable parking lot, native trees and shrubs welcome visitors to a 1,000-foot long trail. As the walk unfolds, users are treated to a diverse riparian and wetland habitat teeming with waterfowl and songbirds in a part of Los Angeles that has been a stranger to them for at least a century. Herons, egrets, and other waders pick at invertebrates and small amphibians that have recolonized this former wetland. Phoebes and warblers dart among the oak woodland and coastal sage scrub. The occasional mammal may even venture in from the Baldwin Hills State Park to forage.

The nature walk and flood control access are balanced through an innovative approach to planting the accessway. The nature walk has to accommodate maintenance and emergency vehicles and maintain a 12-foot clear width. To accomplish this it will be paved in decomposed granite approximately five feet wide with two outboard 3.5-foot shoulders in a planted pavement system such as grasscrete. The planted shoulders are maintained in low grassy vegetation supporting unrestricted vehicular access.

Other adjacent plantings are managed to sensitively maintain the additional five feet of maneuverability that flood maintenance trucks need for their equipment.

Redesign of the Adams Flood Control Channel provides valuable creek habitat and a place to enjoy it.



Arroyo la Cienega Nature Walk Section

The nature walk provides viewpoints into the riparian corridor of Arroyo la Cienega. At the trail's terminus, pedestrians can rest and observe wildlife before turning back. In the future, this trail could connect to the Ballona Creek Bike Path, eventually crossing over to Syd Kronenthal Park.

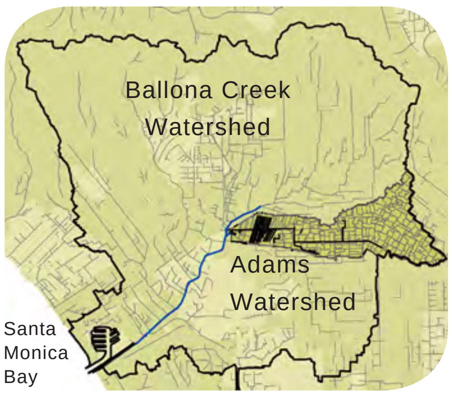
To accommodate flood capacity and a natural creek design, the restored channel width is wider than the existing flood control channel. New vertical walls will meet the design capacity of the existing channel.

In the upper section of the creek, energy dissipaters are installed to reduce water velocities as flows surge from underground culverts. Further down the creek, the water slows and meanders to support willow and emergent wetland plants like cattails and bulrush. These plants help protect the toe of the flood walls through their root systems.

Five hundred feet downstream from the parking lot, the channel widens its floodplain to provide greater depth and diversity of habitat. On the higher slopes of the channel, mulefat colonizes and small stands of willow mature to greater heights.

After two hundred feet, the channel narrows again. A thousand feet from its origin, the creek's waters leave this habitat area and drop down to the concrete bottom of Ballona Creek. It will be another six miles before these waters encounter a natural wetland environment again.

Adams Channel Watershed Storm Drains



Adams Channel Stationing

Channel Design and Hydraulics

Restoring natural stream functions to a flood control channel must not violate flood control standards. In this urban area, consideration of public safety is paramount. While federal and local flood standards differ significantly, naturalization design for the Adams Channel/Arroyo la Cienega seeks to meet both.

Flood analysis considered the effect of three storm events on the water surface of the existing and naturalized channel:

- 1959 Ballona Creek As-Built Storm (2,930 cfs)
- 1968 County of LA Capital Storm (5,700 cfs)
- 2007 ACOE/PWA 50-Year Storm (3,489 cfs)

It should be noted that the upstream area immediately adjacent to the Adams Channel/Arroyo la Cienega is a FEMA-designated flood zone with one to three feet of flooding from the surrounding terrain in a 100-year storm and will also be flooded during a Capital Storm scenario.

The natural channel requires a larger width and depth than a concrete flood control channel to contain the same volume of water. Reestablishing geomorphic features in the channel bottom also increases its durability, as the stream will be more likely to maintain its shape and rebound from disturbances. Creating adequate space within the creek zone for a bankfull channel and a geomorphic floodplain was the minimum criteria for re-establishing riparian habitat at this site. Preliminary channel geometries were determined using the Southern California Regional Curve (Natural Channel Design 2006). Vertical channel walls increase flood capacity and ensure the project can be contained within the available right-of-way.

The Adams Channel/Arroyo la Cienega Channel sits within a 70 to 100-foot wide right-of-way. The width of the proposed project is narrower. Adjacent properties appear to encroach on portions of the Adams Channel right-of-way, and verification of the boundaries is a necessary future task. The naturalized channel would benefit from additional right-of-way should it be made available. This design relocates minor structures found within the indicated right-of-way but avoids relocating significant structures.

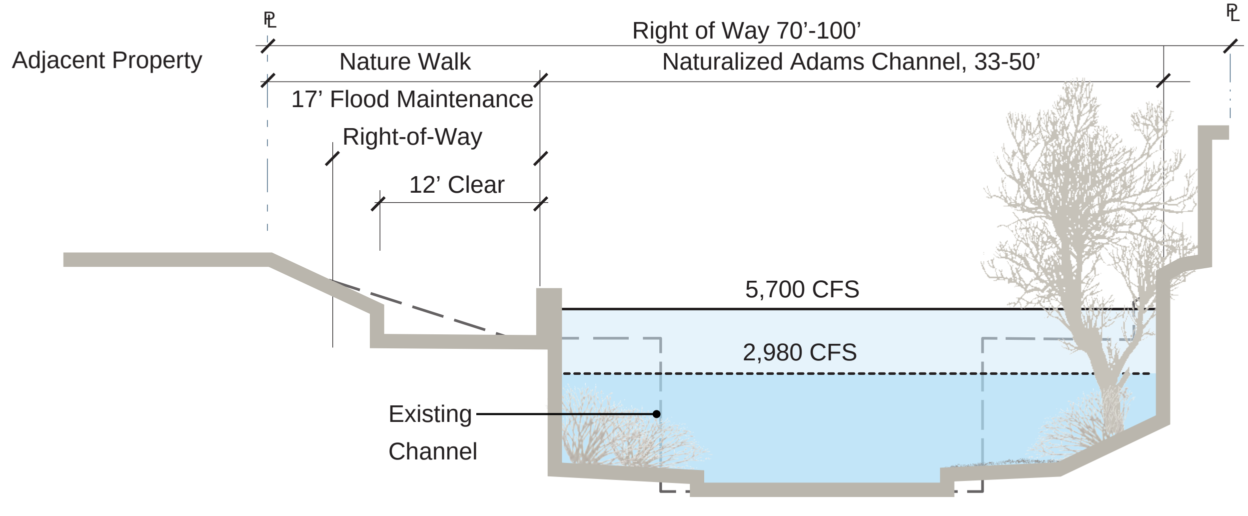
Within these limits, the creek zone is widened from an unvarying 24-foot concrete channel to 33 to 50-foot wide naturalized channel. The trail and accessway is placed on the outer edge of the right-of-way which maximizes the area available for the restoration. This necessitates some retaining walls for the sloped areas at the outer limits of the right-of-way, some of which may have to support adjacent structures and buildings.

Modeling

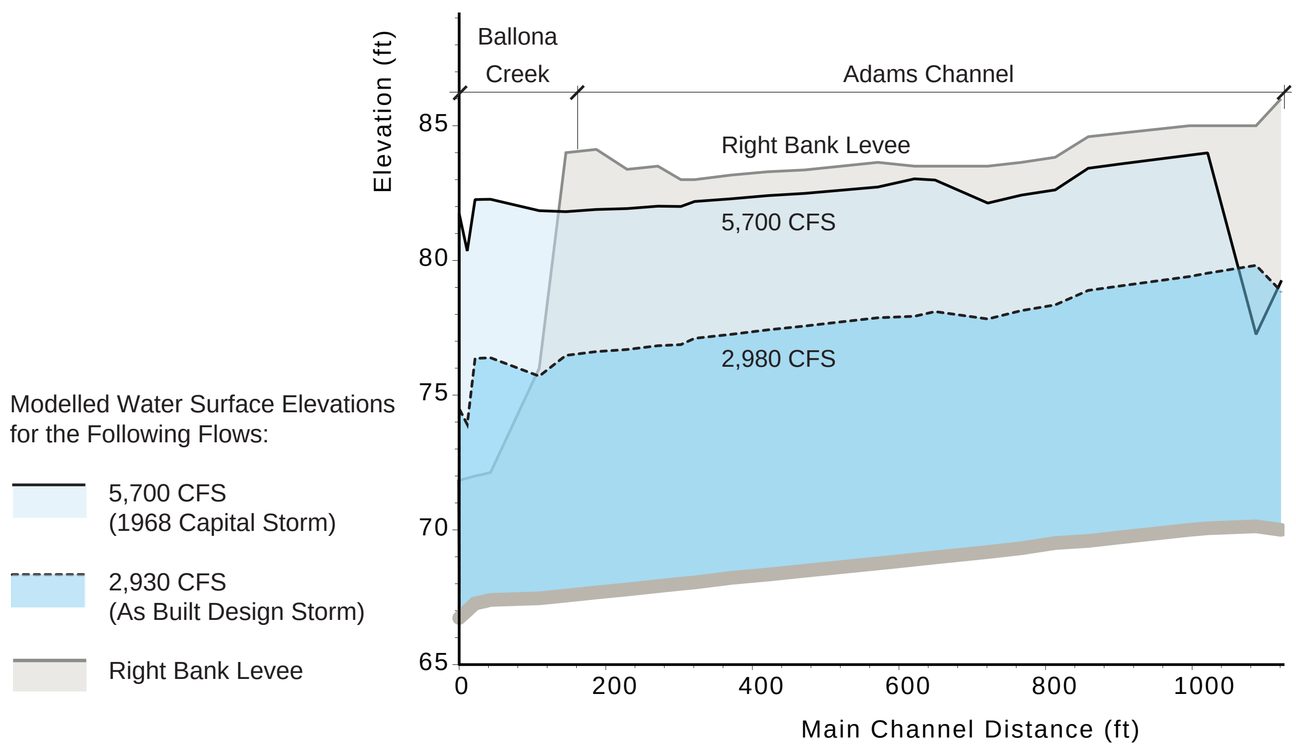
The 1959 Ballona Creek As-Built plans provided data for the Adams Channel designed outflows of 2,930 cfs. The County of Los Angeles provided its Capital Storm flow value last modeled in 1968. The County's estimated runoff value is 5,700 cfs. The 2007 Army Corps of Engineers hydrograph for Ballona Creek was scaled to identify a fifty-year storm flow of 3,489 cfs. These values establish a range of flood control standards applicable to the Adams Channel.

Preliminary flood modeling demonstrated that a naturalized channel could contain 2,930 cfs. In a second round of modeling, the channel design was modified with the addition of 42" flood walls (the height of guardrails). This addition prevented overtopping during the 1968 Capital Storm (5,700 cfs).

This meets local and federal flood control standards. These floodwalls may also detain surface flooding from draining into the Adams Channel. In a 100-year flood, surface drainage may be as important as draining through culverts. Floodwalls that extend above adjacent grades will inhibit this surface drainage. The timing and extent of upstream floodwaters should be included in future studies.



Adams Channel Section at Station 7+00: Proposed Channel Condition



Adams Channel Profile: Proposed Channel Condition

BALLONA CREEK GREENWAY PROJECTS

BALLONA CREEK **GATEWAY**

Ballona Creek Gateway

The Ballona Creek Gateway converts an unused median strip and busy “cut-through” street into a neighborhood park that attracts residents and treats stormwater.

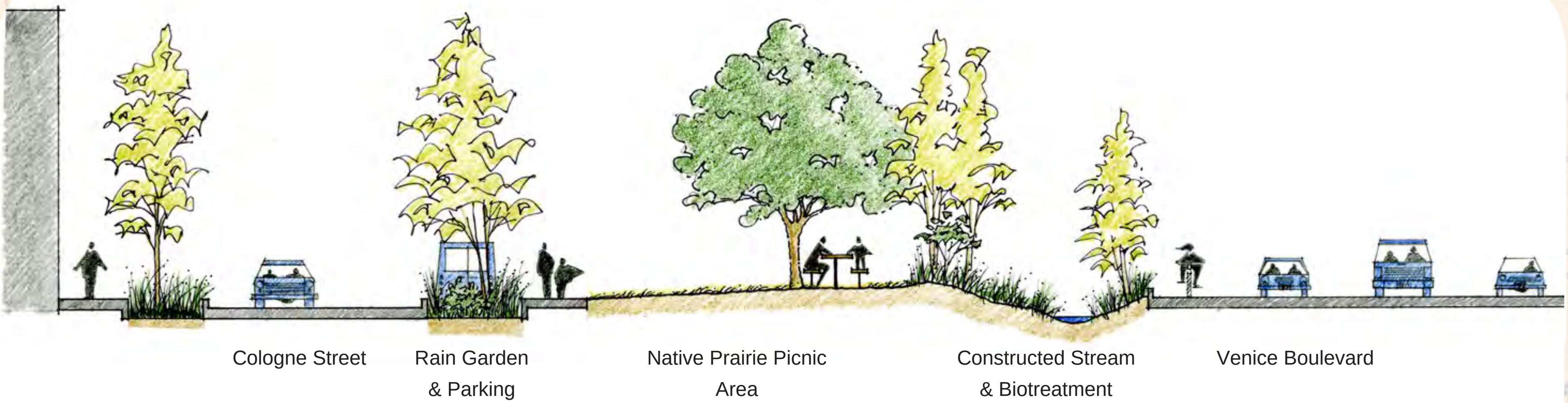
Located in the park-poor Mid-City district of Los Angeles, the Ballona Creek Gateway transforms a fast cut-through street into a pedestrian sanctuary along busy Venice Boulevard. Closing Cochran Avenue between Venice Boulevard and Cologne Street creates over one-half an acre of parkland and an anchor for the future Ballona Creek Bike Path that will run along Ballona Creek and connect to existing bicycle facilities.

The Gateway sits over a culverted reach of Ballona Creek and creates awareness of the creek through its design.

Visitors entering the Ballona Creek Gateway enjoy a shaded plaza with tables for picnics overlooking a constructed stream fed by low flows pumped to the surface of the buried culvert under the Gateway. Over a bridge or playfully hopping stepping stones, visitors cross the stream. The path forks, leading to a native grassland picnic area and Cologne Street to the east. To the west, the path leads to seatwalls, the future Ballona Creek Trail, and the neighborhoods beyond. Parking nestles between rain gardens that treat storm runoff before entering Ballona Creek. Abundant, fragrant native plants provide a sense of wildness, heighten the sense of place, and reduce irrigation water demand.

Preliminary Estimate of Probable Construction Cost

Total (Range) **$0.9 to $1.7 million**

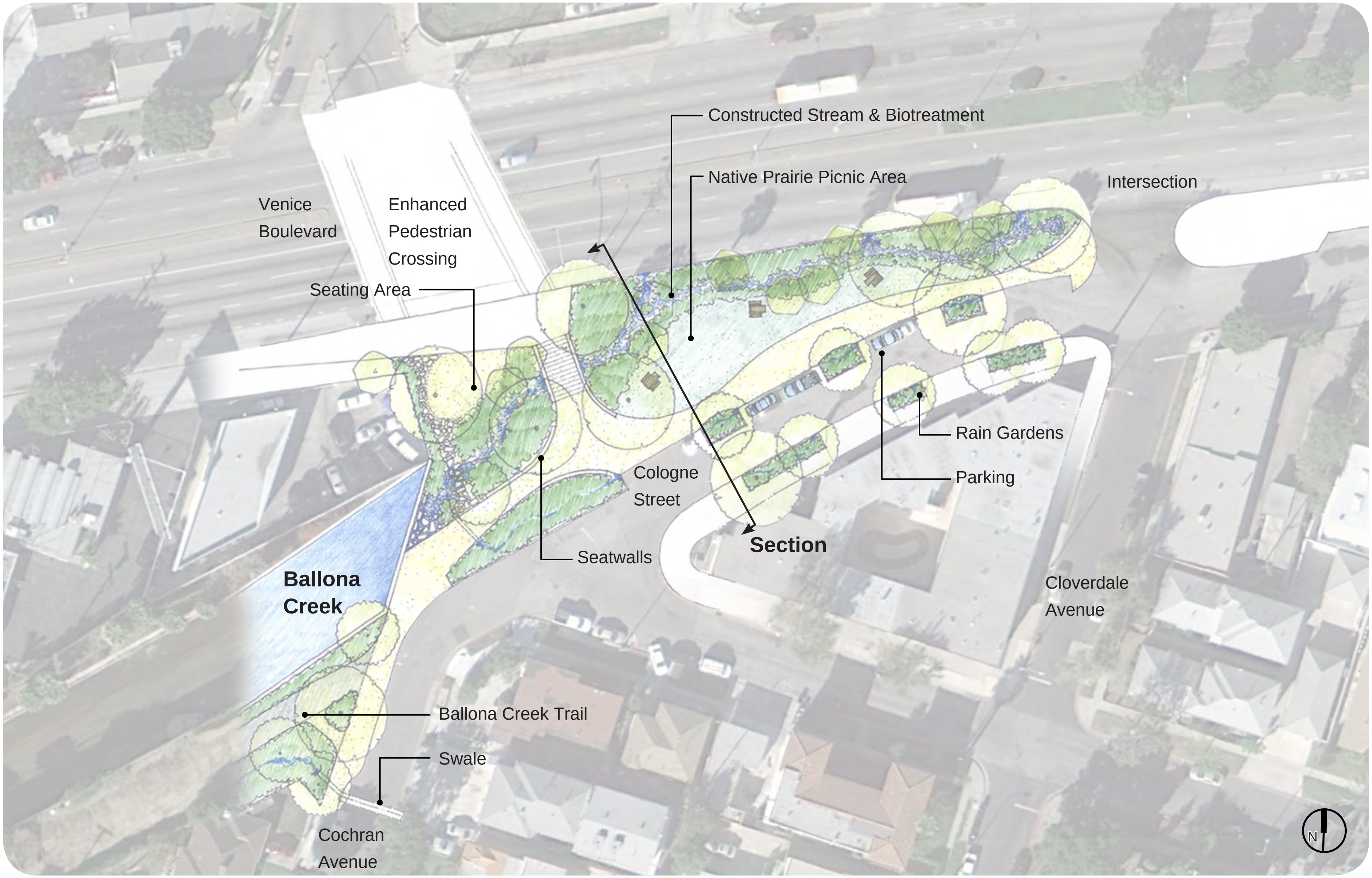


Ballona Creek Gateway Section

“For clerks and students, factory workers and mechanics, the outdoors is freedom... They don’t have to own the outdoors, or get permission, or cut fences, in order to use it. It is public land, partly theirs, and that space is a continuing influence on their minds and senses.”

-Wallace Stegner

Ballona Creek Gateway Plan



The Ballona Creek Gateway will feature a park with a stream, picnic areas, walking paths, site furnishings, native plants, and rain gardens in the Mid-City Ballona District.

The Gateway site today consists of part of Cochran Avenue and a triangular median along Venice Boulevard's south side. Venice Boulevard is a six-lane thoroughfare with bike lanes. Cochran Avenue is a residential street that commuters use as a cut-through from Venice Boulevard to Washington Boulevard. Cochran Avenue is 55-feet wide at Venice Boulevard, narrowing to 27-feet wide after Cologne Street. Cologne Street varies in width from 37 to 48-feet. These wide, busy streets encourage speeding traffic, create pedestrian hazards, and obscure the Ballona Creek Channel.

The triangular median defined by the three streets is an undifferentiated area of lawn and scattered trees that is exposed to Venice Boulevard. This median and one to its east lack sidewalks for 730 feet, forcing pedestrians to cross Venice Boulevard or traverse Cochran Avenue to walk along Cologne Street.

Within one-half mile of the site there are 13,563 residents and no public parks to serve their needs. Apartment buildings, single-family homes, and light industrial uses can all be found within walking distance of the Gateway site.

Stormwater runoff from a 4.25 acre area drains through the site into Ballona Creek. Trash, engine oil, contaminants, fertilizer, and animal waste are carried untreated across pavement directly to storm drains and Ballona Creek. Ballona Creek, a 303(d) listed contaminated waterbody, flows in an enclosed box culvert beneath the median to an open box channel at the west end of the site. While the Gateway site is too constrained to daylight the creek, opportunities do exist to figuratively bring the creek up to street level.

The Ballona Creek Gateway creates over a half an acre of green space that will be a beacon to bicyclists and motorists on busy Venice Boulevard and a respite for area residents. It offers traffic calming by closing Cochran Avenue at Venice Boulevard, and creates a new Cloverdale Avenue intersection at Venice Boulevard. Modest street narrowing and new street trees will enhance the pedestrian environment. Extending the median to Ballona Creek will heighten environmental awareness of the channel.

Approaching the site from Venice Boulevard, bicyclists and pedestrians are directed to a shaded plaza of decomposed granite. From this street side plaza, a bridge spans a naturalized constructed stream offering views through the park. The bridge leads to a second plaza sheltered from Venice

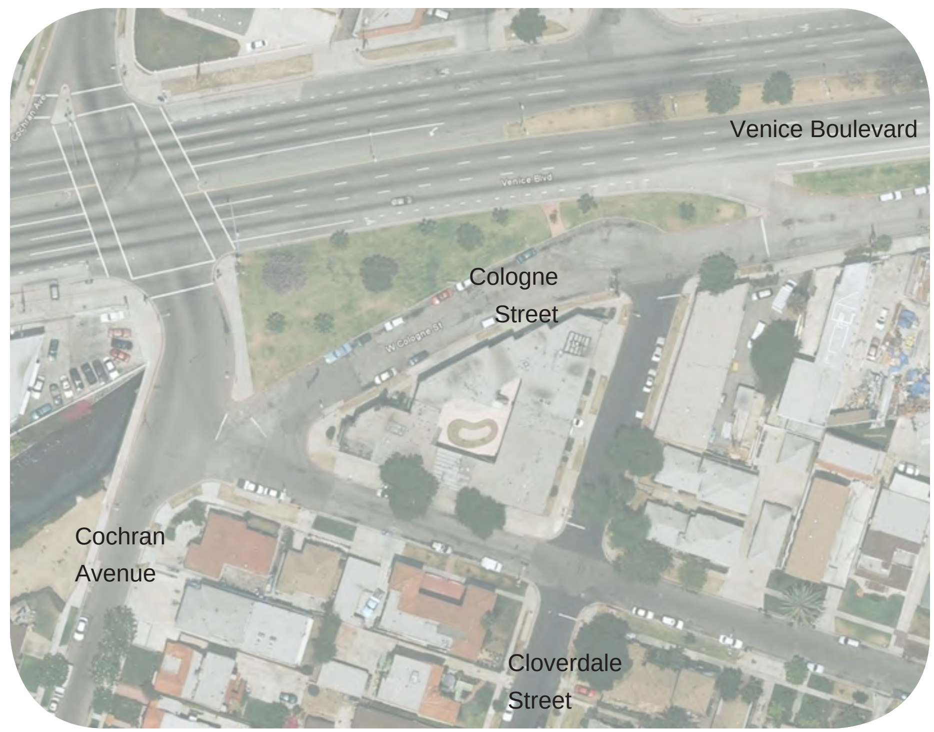
Boulevard with curving seatwalls and native plantings.

A generous sidewalk along Cologne Street leads downstream to the future Ballona Creek Bike Path and upstream on a decomposed granite surface between the streetside rain gardens and the picnic area.

To bring Ballona Creek to the site, the creek's low flows are pumped up from the hidden box culvert to a constructed stream that filters and treats the water. The stream flows through the site and beneath the bridge before cascading back into the Ballona Creek Channel. The constructed stream also captures stormwater from Venice Boulevard and part of Cologne Street.

Along Cologne Street, curb-side rain gardens treat street runoff before it enters Ballona Creek while enhancing the street with plantings and tree canopy. A swale crossing Cochran Avenue where it meets Cologne Street redirects addition street flows to Ballona Creek.

The Gateway plant palette is made up of California natives. The constructed stream and picnic area include native grasses, sedges, and rushes, along with a canopy of willow, sycamore, and oak trees. The rain gardens have a mix of grassland, sage scrub, and oak woodland species selected for their effectiveness in stormwater treatment.



BALLONA CREEK GREENWAY PROJECTS

APPENDIX

Sepulveda Greenway

McLaughlin Avenue Memo / Project Summary

Arroyo la Cienega Nature Walk

HEC-RAS Memorandum / Project Summary

Ballona Creek Gateway

Cochran Avenue Memo / Project Summary

Sepulveda Greenway

McLaughlin Avenue Memo / Project Summary

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Memorandum

To: Jessica Hall, Restoration Design Group
From: Emily Duchon
Send Via: Email

Date: August 25, 2010
Project: Sepulveda Greenway
Project No: 10-021

RE: Memo 1 – McLaughlin Avenue on-street bike facility, intersection improvements, and mid-block crossing recommendations.

Introduction

The Sepulveda Greenway is a proposed Class I multi-use path along the Sepulveda channel from the confluence with Ballona Creek northwest to Palms Boulevard. Between Washington and Venice Boulevards, the Sepulveda channel runs underground along McLaughlin Avenue for approximately three-quarters of a mile where an on-street connection is necessary to connect the Class I segments of the path. This memo provides design solutions for the on-street segment and intersection improvements to accommodate safe transitions to and from the on-street facility.

As substition for Task 3: Feasibility review of the Sepulveda Greenway upstream extension, Alta has evaluated midblock crossings at Braddock Drive and Culver Boulevard. This memo also provides recommendations for these two street crossings.

McLaughlin Avenue On-Street Bicycle Facility

McLaughlin Avenue is the preferred alignment for the on-street segment between Washington and Venice Boulevards. East Boulevard, a low volume neighborhood road south of McLaughlin was not considered a desirable option for two reasons. First, it is not on the direct route and second, the lack of a signalized crossing at Washington Place makes it extremely difficult to cross.

The segment of McLaughlin Avenue in the Ballona Greenway study area is located within City of Los Angeles and Culver City. McLaughlin has been identified as a Bicycle Friendly Street in both the 2010 Draft Los Angeles Bicycle Master Plan and the 2010 Draft Culver City Bicycle and Pedestrian Master Plan. McLaughlin Avenue is a residential street between 35 and 45 feet wide with on-street parking. The posted speed limit is 35 and the average daily traffic (ADT), counted on January 13, 2010 by Los Angeles Department of Transportation (LADOT) at Venice Boulevard was 11,292 cars.

The preferred design treatment for the corridor is a combination of colored bicycle lanes, shared lane markings with colored pavement and sidewalks. Traffic calming such as speed humps and curb bulb-outs should be incorporated to lower traffic speed and volumes. An existing 5' wide sidewalk with a 6'-8' planting zone buffer can accommodate the needs of the greenway's pedestrian users. Improvements to the pedestrian experience could include widening sidewalks and planting additional street trees.

As shown in Figure 1, Section 1 has a 45' curb-to-curb width. The preferred design has 7.5' wide parking, 5' wide colored bike lanes and 10' wide travel lanes. Narrowing the travel lanes (by striping bike lanes) is an effective use of traffic calming. Furthermore, width is available north of Venice Boulevard for future extension of bike lanes north on McLaughlin Avenue.

Along Section 2 where McLaughlin Avenue has a 35' curb-to-curb width a shared lane pavement marking with colored pavement is the preferred design.

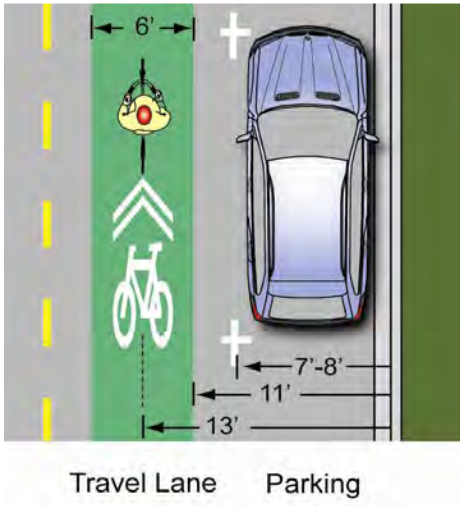
The preferred design for the McLaughlin bicycle boulevard contains non-standard treatments. Section 1 does not meet the City of Los Angeles 11' minimum travel lane design standard. A variance would need to be approved by LA DOT to implement this option. The alternative design is to use the shared lane marking with colored pavement.

The combination of shared lane markings with colored pavement is not currently present in any State or Federal design standards. Cities such as Salt Lake City, Utah and Long Beach, California have used colored pavement in conjunction with shared lane markings to further indicate the appropriate position for bicyclists using the roadway. Increasing the distance from the curb face to the center of the shared lane marking to 13 feet and adding a green stripe provides the following benefits:

- Reduces the probability that bicyclists riding over the marking could be impacted by opening car doors.
- Brings the marking more directly and continuously into the line of sight of drivers.
- Reduces wear on the markings by placing them in a location where they will typically track between car tires.

For further guidance on the use of shared lane markings only, see CAMUTCD.

Shared Lane pavement marking with colored Green Lane on 2nd Street in Long Beach, CA.



Shared lane marking design guideline

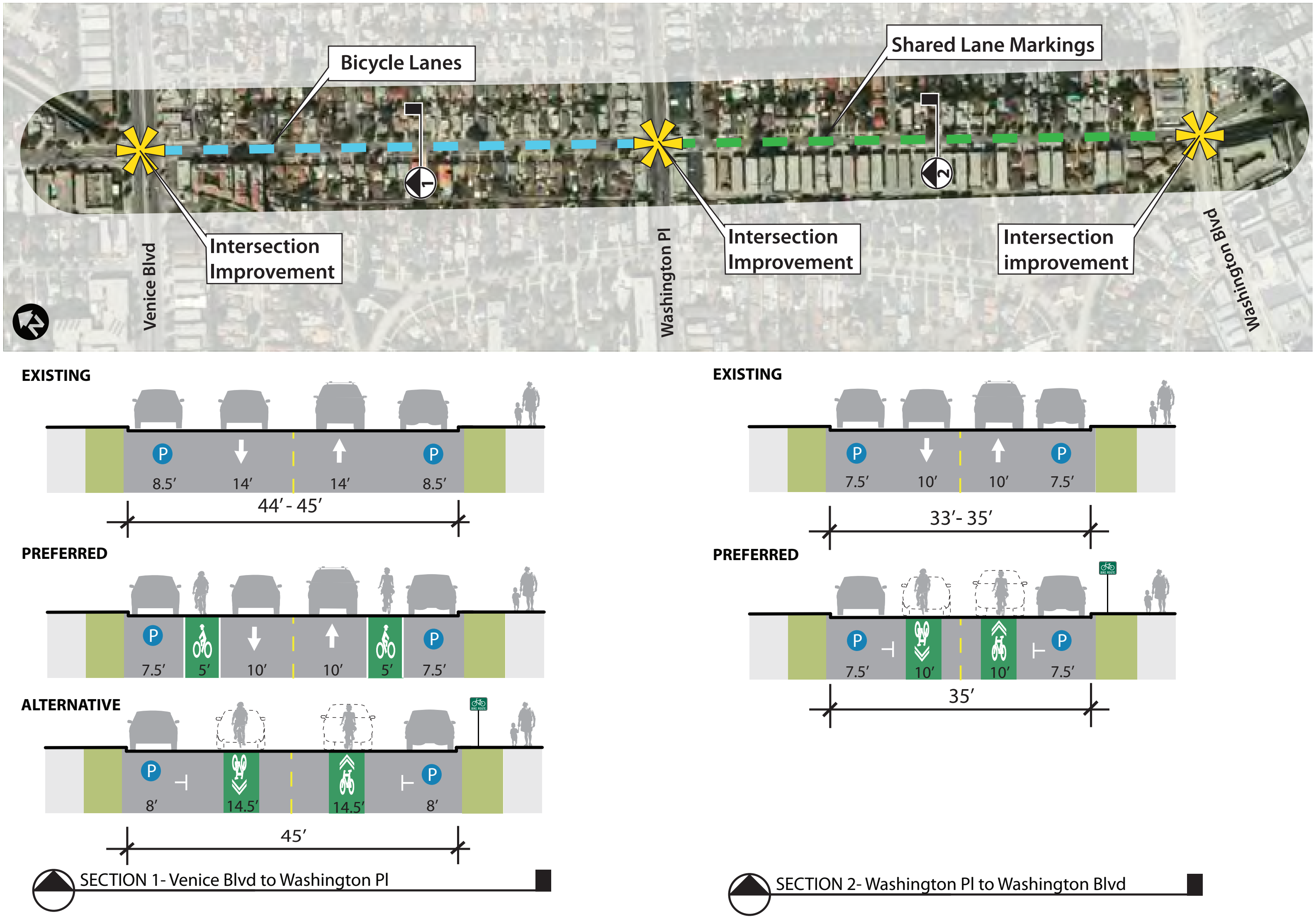


Figure 1- McLaughlin Avenue Bikeway Improvements

Ballona Greenway

Source: Street width data obtained from Google Earth
Author: EMD
Date: 8/25/10

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Intersection Improvements

A safe and direct transition from the Class I multi-use path to and the on-street facility is important to the success of the Ballona Greenway.

Transition at Washington Boulevard

Figure 2 depicts the preferred design to transition to/from the class I path to the McLaughlin Bicycle Boulevard. The path should ramp up to meet Washington Boulevard directly across from McLaughlin. The mid-block crossing controlled by a bicycle and pedestrian activated signal would stop east and west bound traffic on Washington Boulevard. A curb extension provides additional space for bicyclists to cue and increases visibility of pedestrians at the crosswalk. High visibility crosswalks and dashed green lane striping separate pedestrian and bicycle use and help position cyclists into the proper lane placement along the bicycle boulevard.

Dashed green lane striping crossing from on-street bicycle boulevard to multi-use path along the 9th Street Bicycle Boulevard in Berkeley, CA.

An alternative design where the multi-use path would use an existing channel maintenance access to ramp up to McLaughlin Avenue on the south side of Washington Boulevard is not as desirable. Although a sidewalk connection up to Washington Boulevard would be suitable for pedestrians, dropping cyclists onto this mid-block segment of McLaughlin Avenue creates a potentially dangerous and awkward transition that would not be preferred by cyclists.

Transition at Venice Boulevard

Figure 3.1 depicts the preferred design to transition to/from the multi-use path at Venice Boulevard. Greenway users will make a two phase crossing across McLaughlin Avenue and Venice Boulevard. The intersection can be improved by installing bike and pedestrian activated crosswalk signals with count down timers, high visibility crosswalks and advanced stop bars to prevent cars from blocking the crosswalk. No turn on red signs should be posted to minimize conflicts with right turning vehicles.

An alternative option would be to install a bicycle only scramble signal. This type of signal stops all motor vehicle movements at the intersection, creating an exclusive phase for bicyclists and pedestrians to cross the intersection in any direction, including diagonally (Figure 3.2). This intersection treatment is well suited for intersections with high volumes of pedestrian and cyclist crossings from several approaches and/or a high rate of conflict between pedestrians and cyclists and turning motor vehicles. The benefits include eliminating two-stage crossing and reducing unsafe and illegal crossings by cyclists. A traffic study of both cyclist and motorist volumes would need to be completed to assess the need for this type of signal.

Bike scramble signal in Portland, OR.

Figure 2: Transition at Washington Boulevard

Ballona Greenway

Source: Google Earth
Author: EMD
Date: 8/25/10

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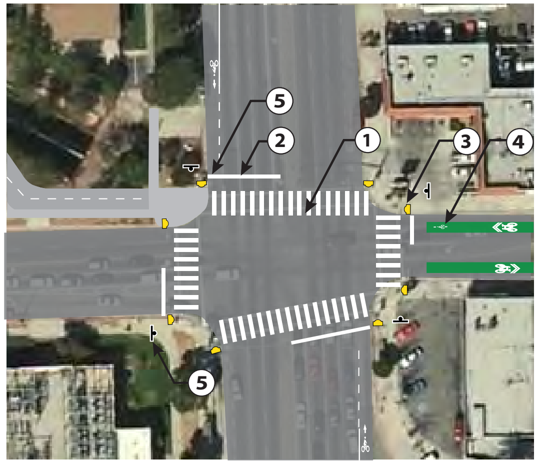
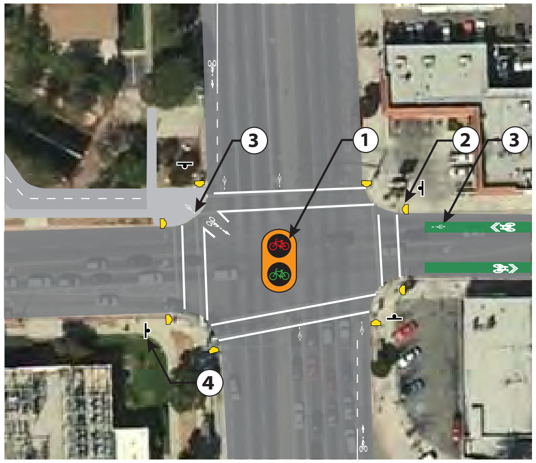
Figure 3.1: Alternative 1



1. High Visibility Crosswalks
2. Advance Stop Bar
3. Pedestrian Activated Pushbutton
4. Bicycle Detector
5. No turn on Red for all Right Turning Traffic

Figure 3.2: Alternative 2



1. Bicycle Only Scramble Signal
2. Pedestrian Activated Pushbutton
3. Bicycle Detector
4. No turn on Red for all Right Turning Traffic

Figure 3: Transition at Venice Boulevard

Ballona Greenway

Source: Google Earth
Author: EMD
Date: 8/25/10

Cost Assumptions

Planning level cost estimates are provided for capital costs and are described in **Table 1**

Table 1: Cost Assumptions

Item	Cost
Bicycle Facility	
Bicycle Path (along flood control channel or rail corridor)	$2,600,000 /mile
Bicycle Lanes (signage, striping, and pavement markings)	$65,000/mile
Bicycle Boulevard (signage, pavement markings, some traffic calming)	$30,000 /mile
Intersection Improvements	
At-Grade Crossing Improvements	$100,000/each
Grade Separated Crossing (Bridge Over Flood Control Channel)	$500,000/each
Pedestrian Actuated Signal	$75,000/each
Curb Extension, Major, with Drainage	$100,000/each
Traffic Calming	
Curb Bulb-Out	$30,000/each
Speedbumps	$4,000/each

Midblock Crossings

Crossing at Braddock Drive

The midblock crossing at Braddock Drive is less than 150 ft southwest of a stop controlled crossing at Slauson Avenue and adjacent to Stoner Avenue Elementary School. Braddock Drive is a residential street and used by local traffic as a cut-though road.

Crosswalks within a designated school zone (500 feet from the school boundary) must be painted yellow, per California Manual on Uniform Traffic Control Devices (CA MUTCD). A yellow high-visibility

Figure 4 – Midblock crossing at Braddock Drive

ladder style crosswalk is recommended at this mid-block location. The use of detectable warnings strips at the curb edges should be used to alert vision-impaired pedestrians that they are entering the roadway. Advanced warning signs should be used in accordance with the CA MUTCD.

An alternative design that could be considered is a raised crosswalk. Raised crosswalks eliminate grade changes and give pedestrians and bicyclists greater prominence as they cross the street. The approaches to the raised crosswalk could be designed to be similar to speed tables which would also serve as traffic calming. This type of facility needs approval from the local fire chief and requires evaluation of the specific location and its impacts to emergency response times.

Crossing at Culver Boulevard

Sepulveda Greenway crosses Culver Boulevard between two signalized intersections. Inglewood Boulevard is approximately 1,400 feet southwest and Berryman Avenue is about 1,000 feet northeast of the crossing. Culver Boulevard is a high volume arterial road. The Culver Bicycle Path is located on the northwest side of Culver Boulevard and intersects the Sepulveda Greenway.

A mid-block crosswalk with a bicycle/pedestrian activated signal is recommended. A traffic study may be required to assess traffic impacts of a mid-block crossing signal. Consideration should be taken when designing the intersection of the Culver Bike path and Sepulveda Greenway. Users of the Sepulveda Greenway will need to cross over the Sepulveda Channel on the Culver Bike path creating a mixing zone of conflicting non-motorized traffic. Design elements to minimize conflicts include 2-way or 4-way stop signs for path users, providing extra width allowing area for maneuvering, and the use of warning signs and pavement markings.

Figure 5 – Midblock crossing at Culver Boulevard

Sepulveda Channel Greenway

Trail improvements along the Sepulveda Channel Greenway create safe and pleasing experiences for a variety of trail users.

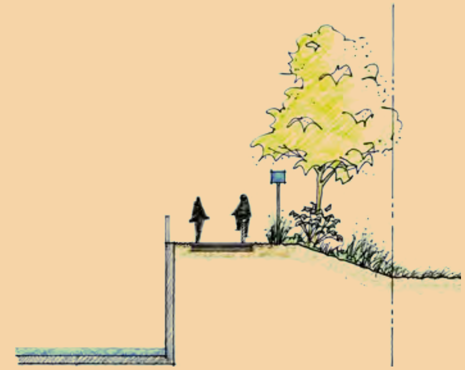
Located along the Sepulveda Channel in the cities of Los Angeles and Culver City, the proposed Sepulveda Channel Greenway creates over two miles of alternative transportation and recreational facilities, beautifies neighborhoods, and enhances habitat and water quality. The Sepulveda Greenway links Ballona Creek and the Pacific Ocean to bike routes and destinations in West Los Angeles.

The Greenway provides nearly 1.5 miles of Class I Bike Paths and an accompanying pedestrian trail; three-quarters of a mile of the Greenway is a Class III bicycle boulevard with traffic calming, pedestrian enhancements, and stormwater biofiltration elements. A linear park emphasizes passive recreation opportunities and gathering areas. New and improved entry points and crossings improve access, visibility, and public safety for users.

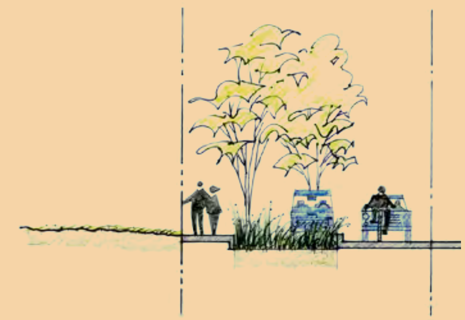
Creating a safe route is essential for the success of the Sepulveda Greenway. The Greenway strives to minimize user conflicts by separating bicycle and pedestrian routes. High visibility crosswalks, user-activated signals, and curb extensions clearly designate crossings. Pavement markings alert motorists to the presence of bicycle lanes.

Preliminary Estimate of Probable Construction Cost

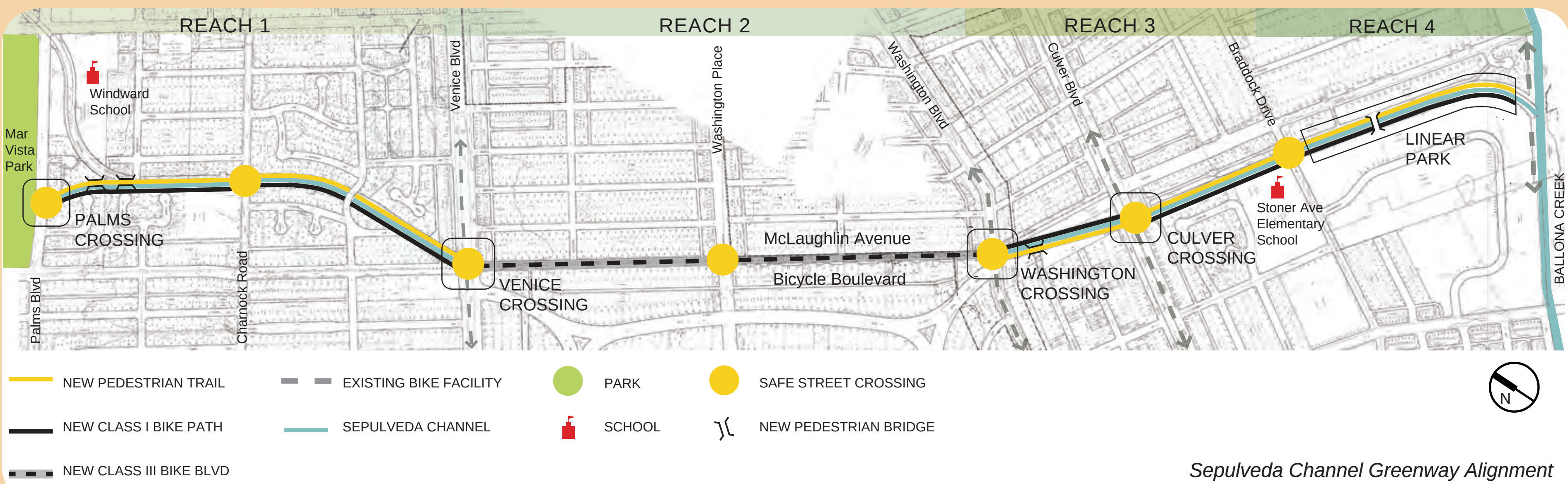
Reach I:	$2.6 to $4.5 million
Reach 2:	$1.3 to $2.8 million
Reach 3:	$2.0 to $3.2 million
Reach 4:	$2.2 to $4.0 million
Total (Range)	**$8.1 to $14.5 million**



Sepulveda Channel Greenway Bike Path



McLaughlin Avenue Bicycle Boulevard



Sepulveda Channel Greenway Alignment

"The bicycle is the most civilized convey-ance known to man.."

-Iris Murdoch

"It is by riding a bicycle that you learn the contours of a country best, since you have to sweat up the hills and coast down them. Thus you remember them as they actually are, while in a motor car only a high hill impresses you, and you have no such accurate remembrance of country you have driven through as you gain by riding a bicycle."

-Ernest Hemingway

Arroyo La Cienega Nature Walk:

HEC-RAS Memorandum / Project Summary

RDG

MEMORANDUM

Date: 11 January 2011

To: Sean Bergquist

Organization: Santa Monica Bay Restoration Foundation

From: Roger Leventhal

Project: Ballona Creek Greenway Projects

RE: Arroyo la Cienega Nature Walk HEC-RAS Memorandum

Dear Sean:

We are pleased to submit this hydraulic study of the proposed Arroyo la Cienega Nature Walk Project, a naturalization of the existing concrete Adams Flood Control Channel. Adams Channel is a tributary to Ballona Creek and the project reach study area is the downstream reach of Adams Channel at the confluence with Ballona Creek. This hydraulic analysis was prepared to provide a preliminary assessment of the impacts to water surface elevations from the proposed naturalization design through the project reach.

Note that our analysis was limited to just the creek restoration project right-of-way and did not include the entire Adams or Ballona floodplains. In order to fully evaluate the potential for flood impacts to development on the floodplain, more detailed hydraulic evaluation would need to be conducted as described in the next steps section of the memo.

Sincerely,

Roger Leventhal, P.E.
Principal Engineer

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ARROYO LA CIENEGA CHANNEL
NATURALIZATION STUDY
HYDRAULIC MODELING TECHNICAL MEMORANDUM

Introduction

This technical memorandum presents the results of both a steady-state and unsteady-state hydraulic modeling study that evaluates changes in flood flow water surface elevations resulting from the naturalization of the Arroyo la Cienega/Adams Channel. The study reach extends 1100′ from the confluence with Ballona Creek and La Cienega Boulevard. The Adams Channel is also known as the Jefferson Avenue Storm Drain and "Project 53 Line B." RDG evaluated impacts to flood protection using several different design storms including the standard Los Angeles County Capital Storm. For this study, naturalization consists of removal of the concrete channel lining and widening of the channel to allow for construction of the geomorphic active channel, floodplain, and revegetation. The details of the naturalization plan are contained within the *Ballona Creek Greenway Projects* document.

Existing Creek Conditions

Prior to channelization, the area known today as the Adams Channel was the approximate location of the outlet of the cienegas, or freshwater spring-fed wetlands, that distinguished Ballona Creek and the lower watershed. In addition to springs, the wetlands were fed by overflows from the Los Angeles River. Constructed levees on the Los Angeles River and groundwater pumping desiccated the cienegas but they remained prone to occasional flooding. Adams Channel, a tributary to Ballona Creek, is a completely urbanized flood control channel. It is an 1100′ concrete-lined and channelized waterway. Adams channel drains into Ballona Creek approximately 0.2 miles downstream of Washington Blvd. An open box concrete channel, it is also known as part of the "Jefferson Avenue Storm Drain" and "Project 53 Line B." The watershed is approximately 10.5 square miles of mostly single family residences and industry. Its drainage area includes highly paved areas south and west of downtown Los Angeles, including acreage east of the 110 freeway (Figure 1).

The Adams Channel drainage is a relatively flat and highly urbanized watershed. Its eastern extent shows subtle variations in terrain; combined with a complicated storm drain network of city and county drains, definitive delineation of the watershed presents challenges. Terrain may be sloped towards one watershed, while storm drains appear to be conveying flows to another. Additionally, storm drains appear to have multiple connections. RDG surmises that these are overflow connections.

Figure 1: Adams Channel project site location map.

A significant area of the Adams watershed upstream of the channel fall within 100- and 500-year flood zones (Figure 2). During storm conditions, these areas under one to three feet of standing water.

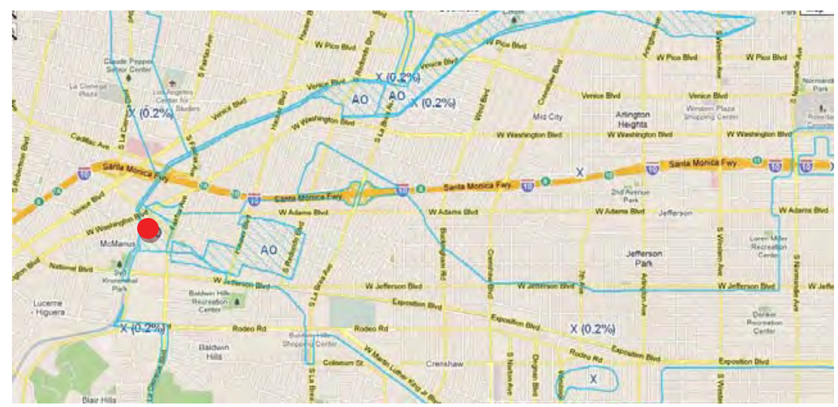


Figure 2: Flood zones. Zone AO indicates 100-year flood zone with one to three feet of flooding, usually sheet flow over sloping terrain. Zone X outlines 500-year flood zone. Project site is highlighted in red. Source: Los Angeles County Department of Public Works.

Main stormdrain lines run down Adams and Jefferson Boulevards, meeting at the channel in a 15′-9″ x 13′-3″ double box culvert.

Through the project reach, the current channel is a 24' wide, 12' deep open box concrete channel. There is a 6" subdrain beneath the invert of the channel. The right of way varies from 70-100' with the appearance of some neighboring encroachments. The right of way needs to be verified with a title report and ALTA survey.

The channel's profile maintains a consistently increasing slope (0.2 to 0.8%) from Sta 1500 to Sta 400 and steepens to 2.6% from Sta 400 to 341, where it meets Ballona Creek's main channel. The channel approaches Ballona Creek at an acute angle. Embankments near the confluence decrease in height, and it is assumed that flows spill over these embankments in high flow conditions. As noted elsewhere, Adams channel is designed to receive backwater flows from Ballona Creek to a height of 74' above sea level.

Proposed "Naturalization" Conditions

RDG has proposed to "naturalize" the creek by removing concrete, widening the floodable area, constructing a more geomorphic active channel and floodplain, and adding native vegetation. New vertical walls would enclose this widened creek corridor. The creek would then be able to provide habitat, public access and aesthetic benefits while maintaining flood protection.

Today, the Adams Channel Watershed is heavily urbanized and the hydrology is altered from its historic condition where the low gradient cienegas slowed and attenuated floods. The historic cienegas no longer function as a backwater to the now leveed and channelized Los Angeles River or Ballona Creek. The Adams Channel serves as a conveyance for a much smaller drainage area in which no riparian or wetland habitat exists. The hydrograph is flashier and velocities are much higher than previous levels. Additionally, the channel itself is confined to a narrow right-of-way surrounded by mostly industrial buildings, some of which appear to have encroaching structures such as walls and parking lots. Groundwater levels are not considered sufficient to support a marsh. Without large flat ground for receiving and detaining stormwater flows, marsh restoration seems unfeasible. However, wetland species that can tolerate the velocity of flows that would be found in a sloping natural bottom channel could be incorporated into a restoration design.

Given these alterations, naturalization concepts were limited to creating wetland or riparian habitat within the Adams Channel right-of-way. RDG qualitatively considered four potential approaches to achieve this:

- *Naturalization of the channel bottom.* At present, areas of the channel right of way are sloped embankments above the access road. This alternative would use a combination of retaining walls and terraces to narrow this change in grade and relocate the access road on the left bank as close to the edge as possible, and eliminate the access road on the right bank. This increases the active channel width, maximizing the floodable area of the channel's cross-section to maintain capacity while allowing some vegetation to colonize. This alternative presents the most self-sustaining habitat. Backwatering of Ballona Creek would reduce capacity in the channel, and new retaining walls would need to be engineered to accommodate the loads of buildings that sit near the property line. Figure 1 shows a conceptual section of the naturalized stream.

- *Naturalization of the channel bottom with a downstream weir.* RDG considered this as an option to increase capacity by preventing the backwater of Ballona Creek into Adams Channel. An unsteady-state model would be needed to verify the timing of flows and the capacity of the channel.

- *Naturalization with a high flow bypass channel.* This option would bypass flood flows around the naturalized channel and reduce overbank flooding. Backwater from Ballona Creek limits the usefulness of any by-pass channels or conveyance pipes. Additionally, although by-pass channels can relieve flooding in the short term, there are often issues associated with unusual sediment deposition patterns that reduce the effectiveness of these by-pass channels over time.

- *Artificial stream along the top of the channel*. Pump low flows from the Adams Channel to create a riparian environment along the access road.

The first alternative, *naturalization of the channel bottom*, was the one deemed most desirable and carried forward for hydraulic analysis under this memorandum.

Peak Flood Flow Rates for Analysis

The Adams Channel is in an ungauged watershed, therefore, the design hydrograph had to be generated from hydrologic modeling. For this project, we used several different available peak flows, both steady-state peak flows and full hydrographs, within the channel for hydraulic analysis.

The three flow scenarios modeled in this project are as follows:

Peak Flow Estimates for Steady-State Analysis

Scenario 1 - Flow Rate from the Ballona Creek As-Built Plans (2,930 cfs peak flow). The Ballona Creek As-Built plan (1959) indicates that the Adams Channel design capacity is 2,930 CFS and includes an assumption of backwatering from Ballona. Neither its design capacity nor its design storm is indicated on the Jefferson Avenue Storm Drain as-builts, although Ballona backwatering is indicated at a water surface elevation of 74′.

Scenario 2 - 1968 County of Los Angeles Capital Storm (5,700 cfs peak flow). A set of 1968 capital storm drain plans were provided by LA County. These plans show that the Capital Storm flow in this part of the Adams Channel was equal to 5,700 cfs. Note that this peak flow rate is substantially higher than the those shown on the 1959 As-Built plans.

Flow Hydrograph for Unsteady-State Flow Analysis

Scenario 3 - Army Corps 2007 Draft Hydrology Study (3,489 cfs peak flow). The Army Corps of Engineers provided a Q50 Hydrograph titled "PWA Hydrograph" for use with this study. RDG scaled this hydrograph by the ratio of watershed drainage areas between Ballona Creek (120 square miles) and Adams Channel (10.5 square miles) to develop an approximate hydrograph for the Adams Channel. The peak flow from this hydrograph is 3,489 cfs.

RDG ran the steady-state and unsteady-state flows through existing and proposed channel conditions (for the naturalization alternative) to compare water surface elevations under peak flood flow. The results of the hydraulic analysis are described below. Table 1 below is a summary of the design hydrology for Adams Channel.

Flow Scenario	Peak Flow (cfs)	Steady-State or Unsteady-State Hydrograph	Design Storm Recurrence Interval	Source/Notes
1	2,930 cfs	Steady state	unknown	Ballona Creek Channel As-Builts, 1959.
2	5,700 cfs	Steady-state	1968 Capital Storm	County of Los Angeles, 1968.[1]
3	3,489 cfs	Unsteady-state	50-year	United States Army Corps of Engineers, 2007. (scaled Ballona hydrograph to size of Adams watershed)

Table 1: Flow Scenarios

[1] LA County is in the process of updating their capital storm flow across Los Angeles including the Adams watershed. Data for the Adams channel is not yet publicly available.

RAS Model Assumptions

The following assumptions were included in the development and computation of the flood modeling:

- All modeled flow rates were provided by others as described above. Determination of additional stormwater inflows from either existing or proposed storm drains adjacent to the creek were not provided and so are not included in the modeling.
- Typical of most flood models, HEC-RAS does not model the effects of sedimentation or debris build-up in the creek channel under storm conditions. Excessive debris or sediment blocking the modeled bridges or culverts may result in backwater flood elevations that exceed the modeled results and increase flooding.

HEC-RAS Model Development

Model Geometry

Existing Model Geometry - Cross sections and slopes for the existing channel condition were developed from a topographic survey conducted in March 2010 and verified using as-builts for the Jefferson Boulevard Stormdrain/Project 53 Line B (1959).

Proposed Model Geometry - The naturalization concept for Adams Channel (Figure 3) widens the riparian corridor by removing the right bank access road and relocating the left bank access road closer to the right-of-way property line. A natural bottom stream includes an active bankfull channel and geomorphic floodplain. Vertical retaining walls with 3-1/2' floodwalls prevent large flows from overtopping the access road. Outside of the floodable area, retaining walls terrace up to the adjacent grades.

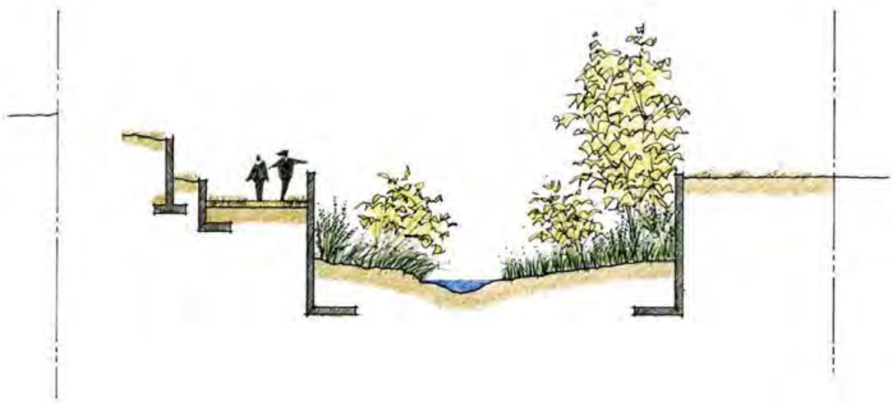


Figure 3: Typical Naturalization Channel Cross-Section (Image: Bob Birkeland, RDG)

Figure 4 shows the location of the hydraulic modeling cross sections used for the HEC-RAS modeling of both the existing and proposed creek without any interpolated cross-sections added for model stability.

Figure 1: HEC-RAS Model Stations

A channel station line was developed that follows along the approximate centerline of the proposed creek alignment as measured from the site survey and as-built plans. As part of the hydraulic modeling work, additional cross-sections were interpolated within the RAS model to improve model stability and these interpolated cross-sections are not shown in Figure 4.

Ineffective Flow Limits

Ineffective flow areas can be set in HEC-RAS to define the boundaries of the active cross sectional conveyance area. Ineffective areas often occur where there are large variations in the cross sectional width between adjacent upstream and downstream sections that result in areas that are not effectively conveying water. This typically occurs upstream and downstream of culverts and bridges. For this model, no ineffective flow limits were set because the model contains no culverts or bridges.

Hydraulic Roughness

Manning's n coefficients were used to define the roughness of the channel and overbank areas. These roughness coefficients relate to channel vegetation and smoothness. Characteristics such as surface roughness, vegetation height and spacing, irregularities in geometry, and flow depths were assessed to estimate existing conditions Manning's n coefficients. Creek roughness coefficients can impact modeling results.

For the proposed Adams Channel vegetated floodplain, we have selected a Manning’s n value of 0.05, which corresponds to a flow condition for a natural channel floodplain of light brush and trees in winter and scattered brush and heavy weeds in summer (French, 1985). The proposed vegetation for the Adams Channel floodplain will be selected to reflect these conditions. Note that these Manning’s n values are under very significant flow depths on the order of several feet which actually make the proposed Manning’s n values more conservative (Fergusen, 2010).

Description	Values Selected for this Model Study
Concrete/gunnite banks	0.013
Active naturalized creek channel	0.03
Vegetated Floodplain	0.05
Pathways	0.02

Table 2: Manning n Values used in Model

For this project, we have modified and sel experience and guidance documents. Note that the model may interpolate intermediate n values in interpolated cross-sections.

Boundary Conditions

In a standard step model such as HEC-RAS the water surface elevation at the downstream model boundary must be specified for a subcritical analysis and an upstream boundary condition is required for a supercritical (steep) flow model run.

Downstream Boundary Condition

The elevation of flows within the larger Ballona Creek will set the downstream boundary condition for the Adams Channel model. However, the timing of the different peak water surface elevations within Ballona Creek and Adams Channel is not known and beyond the scope of this study (understanding the timing of the peak flows would require a single hydrologic model that contains both watersheds). To estimate this backwater elevation, the Ballona Creek existing conditions HEC-RAS flood model for the Ballona Creek Greenway Plan was run for the same flood flow scenarios as the Adams model, and the modeled water surface elevation for Station 821 (the nearest station below where Adams Channel enters Ballona Creek) were used as the backwater elevation for the Adams Channel. For Scenario 1, the modeled backwater elevation agreed well with the backwater elevation given on the 1959 Corps As-Built plans. Table 3 below provides a description of the downstream backwater elevations used in the Adams Channel model.

Flow Scenario	Backwater Elev. from RDG Ballona Creek RAS model at Sta. 821	Comments
Scenario 1: Peak flow from 1959 As-Built plans (steady-state)	74.5	Modeled backwater elevation from RDG Ballona Creek existing conditions model. Note that the backwater elevation from the 1959 As-Built plans was approximately elevation 74 to 74.5 which agreed with the modeled results.
Scenario 2: Peak flow - 1968 LA Capital Storm (steady-state)	81.74	The modeled elevation at Sta 821 from RDG Ballona Creek existing conditions model using the 1968 Capital Storm
Scenario 3: Scaled hydrograph from Ballona Hydrology Report (unsteady-state)	72.15	The modeled elevation at Sta 821 from RDG Ballona Creek existing conditions model using Scenario 3. Note that although the peak flow value for this scenario is between values for Scenarios 1 and 2 (see Table 1), the modeled downstream boundary condition elevation is the lowest for all three scenarios. This is likely the result of the difference between the steady-state modeling of Scenarios 1 and 2 and the unsteady-state modeling of Scenario 3.

Table 3: Downstream Boundary Condition Elevations used in Adams RAS Model

Note that these downstream boundary elevations are based on the Ballona Channel RAS model and their use in the Adams Channel RAS model tend to result in a jump in water surface elevation in the Adams model immediately upstream of the downstream boundary (Figure 5 below). This apparent abrupt "rise" in water surface elevation is likely a result of the RAS model assumptions and not an actual increase in water elevation. As noted above, a more exact determination of downstream boundary conditions would require modeling of both watersheds to determine the magnitude and timing of peak flows. As such, the boundary condition water surface elevations are approximate and are used for assessing water surface elevations in the Adams Channel due to channel modifications.

Upstream Boundary Condition

The upstream boundary condition was set at a normal depth slope of 0.00275 which is the approximate slope of the upstream end of the Adams channel where the two upstream culverts enter the project reach. The slope was used as the upstream boundary condition by assuming that this same slope continues upstream. In reality, the upstream culvert may have hydraulic impacts on the channel due to culvert hydraulics that are not being modeled.

Note on "Glass Wall" Effect on Water Surface Elevations from the HEC-RAS Model

The water surface elevations in the HEC-RAS model extend only to the two ends of the creek channel cross sections. The HEC-RAS model treats the ends of the cross-sections as vertical walls (does not allow water to spill out to the left and right of the sections). In reality, the water that exceeds the top of bank will flow out of the system as described below. Therefore, the water surface elevation shown on the cross sections, tables and figures do not represent actual water surface elevations because of break-out flows onto the floodplain.

Flood Modeling Results

General Overview

The existing creek channel is designed to flow at a relatively low water surface elevation and high velocity by encasing the creek bottom and sides in a smooth concrete lining. By regrading and naturalizing the creek to create a more natural creek channel that provides some habitat as well as aesthetic values, the proposed project does raise water surface elevations above existing conditions but also reduces velocities within the creek and provides some habitat benefits.

Details of the model results are discussed below. Note that some calculated water surface elevations may be higher than reality due to the "Glass Wall" effect described above when the water surface elevation is higher than the elevation at the ends of the cross-section. The calculated water surface elevations through the project site under the existing conditions are shown in Figures 5 through 7; Figures 8, 9, and 11 show the modeled water surface elevations for the naturalized channel under the three flow scenarios.

Existing Conditions Model Run Results

The Adams Channel was modeled through the project reach using the existing channel geometry as developed from the 2010 site survey. The existing channel was modeled for each of the three flow scenarios. Under Scenario 1, the existing channel flows subcritically for almost all of its length and below the top of the existing banks. Under Scenario 2 there is over bank flooding. Under Scenario 3, flows are similar to Scenario 1 and are contained within the channel.

Modeled Water Surface Elevations

Water surface elevations for Scenario 1 are shown below in Figure 5. The water surface elevation ranges from elevation 77 to 79 feet (ignoring the downstream peak which, as discussed, is likely an artifact of the downstream boundary condition being too low).

The results indicate that the channel flows in a subcritical flow condition for the project reach. Note that the lower downstream water surface elevation used as a boundary condition (Table 2) shows a spike and then a large drop in water surface elevation at the lower end of the channel. This is likely a boundary condition effect of the modeling. Depending on the actual timing of the flood peaks in Ballona Creek and Adams Channel, it is possible for Adams Channel to peak either before or after the Ballona flood wave peak and therefore for the Adams channel to flow at a faster velocity and lower elevation.

Velocity Results

The velocity results from the existing channel model range from 12 to 15.4 ft/sec with most values greater than 13 ft/s for the existing conditions as-built flow runs. These elevated values represent relatively high velocities due to the lower friction of the smooth concrete lining of the existing channel.

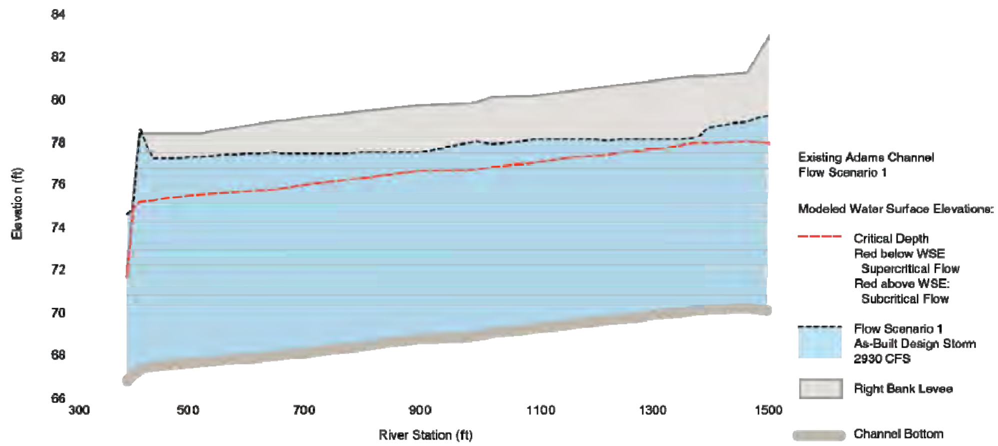


Figure 5: Water Surface Elevations for Existing Conditions Channel with Scenario 1 (USACE Ballona As-Built plan) [Station 3+63 is confluence with Ballona Creek]

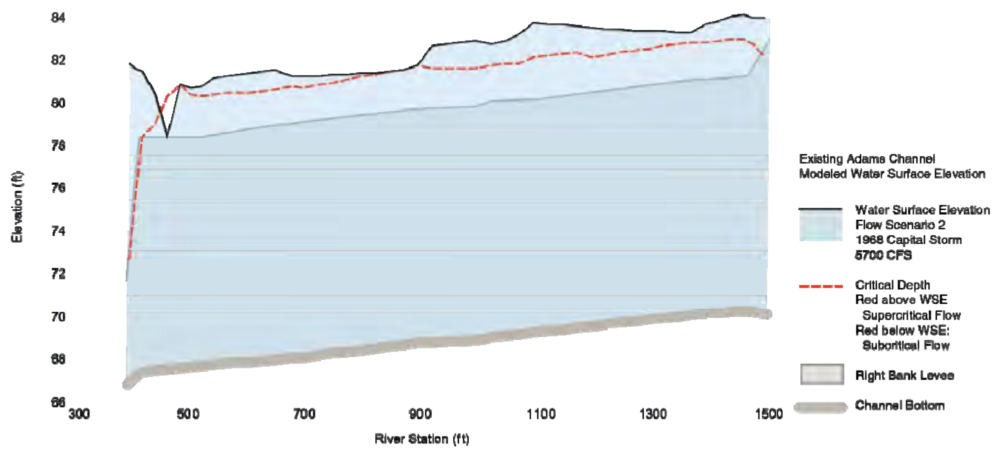


Figure 6: Water Surface Elevations for Existing Channel with Scenario 2 (1968 LA Capital Storm).

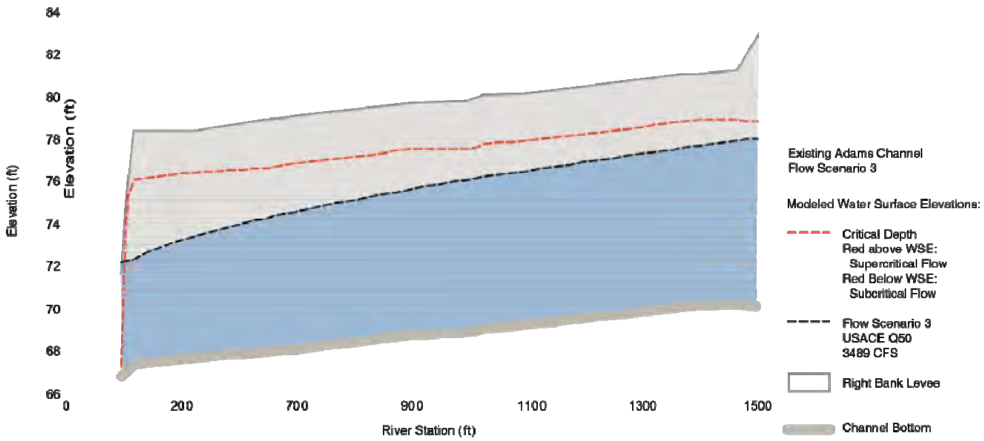


Figure 7: Water Surface Elevations for Existing Channel with Scenario 3 (USACE Q50 Unsteady State run)

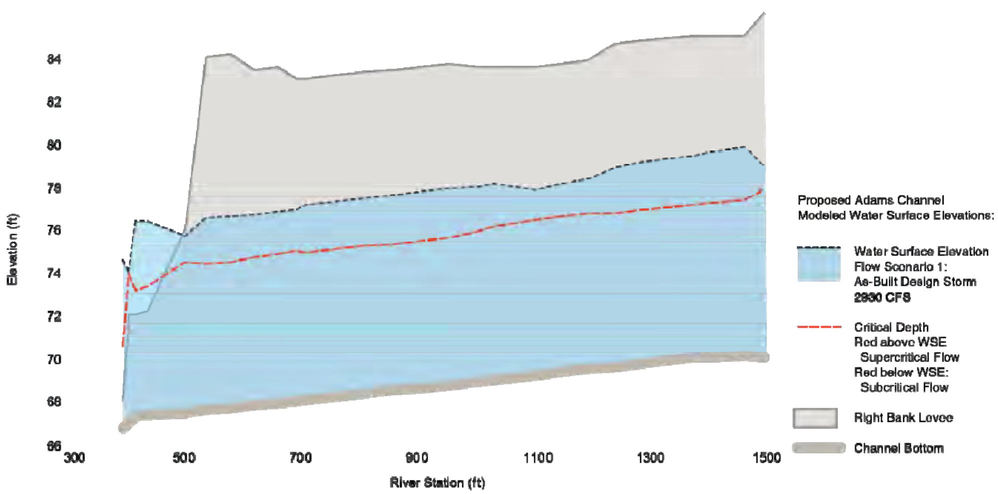


Figure 8: Water Surface Elevations in Adams Channel for Proposed Naturalized Channel and Scenario 1.

Results for Existing Conditions under Scenarios 2 and 3

The results for the other two flow scenarios are similar except that under Scenario 2 (1968 Capital Storm) there is overtopping of the channel banks for the entire length of the channel. This is expected and it is known that there will be significant out of channel flooding during a flow event of this magnitude. Figure 6 below shows the water surface elevations for Scenario 2, which uses a higher downstream boundary condition and results in a hydraulic jump at the downstream end as the flow jumps back up to the elevated boundary condition. This indicates that the modeled downstream boundary condition water surface elevation (developed as described above) may be too high for this model scenario. Velocity values for Scenario 2 range from 15.5 to 18.5 ft/s.

For Scenario 3 (USACE Q50 unsteady-state run) the results show that water surface elevations are contained with the channel (Figure 7) because the flow is running at supercritical flow velocities and depths. An unsteady-state flow analysis is different than a steady-state analysis (Scenarios 1 and 2). It accounts for channel storage which attenuates flows and reduces peak water surface flow elevations. The results also result from the lower downstream boundary condition for this Scenario. When the model is rerun with a higher downstream boundary condition at or above elevation 76, the model starts to run subcritical with lower velocities but with the water surface still contained within the channel. Velocities for Scenario 3 using the lower downstream boundary condition range from 18 to 25 ft/s, reflecting the high velocities from supercritical flow and the low hydraulic friction of the concrete lined channel. Note that the modeled velocity peaks at 29 ft/sec at the downstream boundary which likely reflects a boundary condition effect and not a true result, therefore, it was not included in the range of results.

Proposed Conditions Model Run Results

The naturalized Adams Channel model was run under the three flow scenarios. Under the proposed conditions model, the modeled water surface elevations are higher than the existing conditions model runs in some locations due to the addition of native vegetation and thus higher friction factor values in the channel. This rise is partially off-set by the increase in channel capacity. In general, the naturalized channel successfully contains the Ballona as-built flows (Scenario 1) as well as the flows from Scenarios 2 and 3 without overtopping the levees with the addition of low floodwalls along the naturalized channel. The LA Capital Storm flow results (Scenario 2) produces much higher water surface elevations since the flow is approximately double the Scenario 1 flow rate.

Scenario 1 (Steady-state): 1959 As-Built Flow Results

In general, the results for Scenario 1 successfully contain the flows within the naturalized channel, even without the addition of floodwalls. The results for this model run indicate that a naturalized channel can be constructed within the Adams Channel that meets the intent of maintaining existing levels of flood protection while also providing some habitat, public access and aesthetic values. The modeling shows that the water surface elevation is actually lower under the proposed conditions for the lower part of the channel from Adams Channel Station 8+00 and below (Station 3+63 is the confluence of Adams Channel and Ballona Creek).

Water Surface Elevations

Figure 8 shows the calculated water surface elevations through the project site under the proposed naturalized conditions for Scenario 1. This proposed channel geometry includes 3½' flood walls. The results indicate that the naturalized Ballona channel successfully contains the Scenario 1 flows within the channel banks with freeboard. The water surface in naturalized channels is actually lower than the existing channel condition for the lower 400 feet of the channel study reach.

Velocity Results

The velocity results range from approximately 11 to 13.5 ft/sec in the restored channel disregarding the boundary condition effects. These results are generally acceptable given these values only occur during flood flow conditions and should be acceptable for bioengineering solutions with some toe rock armoring.

Scenario 2 (Steady-state) - 1968 County of Los Angeles Capital Storm Flow Results

Figure 9 shows the water surface elevations for the 1968 LA Capital Storm flow rates under the proposed channel conditions with 3½' floodwalls. This flow is almost twice the Ballona as-built flows and is contained within the channel with minimal freeboard. Without the 3½' floodwalls along the access road, this storm would overtop the channel.

Water Surface Elevations

Figure 9 shows the modeled water surface elevations through the project site under the proposed conditions. The results indicate that the water surface elevations range from elevation 80' to 84'. Without floodwalls there would be overtopping of the channel. The upstream areas are already mapped as a FEMA flood zone AO, and overtopping is expected in the existing channel under the same storm event.

Note that the modeling is showing a hydraulic jump in the upstream end of the model. The upstream culverts were not modeled in the Adams model for this study, and therefore, it is currently unknown if there is sufficient culvert capacity to transmit this large flow and if there would be a hydraulic jump at the culvert outlet as shown (i.e. whether or not the culvert inlet or outlet controlled and large enough to convey this large flowrate). During the next phase of hydraulic analysis, the upstream culverts should be included in the model and analyzed for flow conditions. This jump produces large velocities and flow forces that would require armoring and energy dissipation structures at the outlet if subsequent modeling shows this jump to be real.

Velocity Results

The velocity results range from approximately 9 to 17 ft/sec disregarding the elevated results at the upstream end due to boundary condition effects or a hydraulic jump from the upstream culvert. Given that this flow is for the 1968 LA Capital Storm (50-year storm recurrence interval) and therefore represents a relatively rare event, the velocities are acceptable for a naturalized channel. The higher velocities, over approximately 10 to 12 feet per second, could result in some damage to bioengineered slopes that would require maintenance following large scale storm events. However, recent research has indicated that many riparian plants, notably willow, are very flexible and lay back under high flows to protect banks. The extent of damage to vegetation is unknown and channel revegetation and maintenance may be required under high flood flow conditions but recent studies of the LA River in Elysian Valley and San Jose Creek provide local evidence of how naturalized creeks respond well and quickly following significant flood flow events without excessive erosion. The very high velocities (modeled from 25 to 30 ft/sec) and turbulent flow forces arising from any actual hydraulic jump from the upstream culverts would require some energy dissipation structures consisting of rock or concrete to avoid channel bed and bank erosion.

Scenario 3 (unsteady-state) - Army Corps 2007

The hydrograph for the Adams Channel was developed by scaling the USACE/PWA Ballona Creek hydrograph by the ratio of drainage areas. Figure 10 shows the Adams hydrograph used for this model run. The unsteady-state run accounts for channel storage and can be a more accurate representation of water surface elevations in the channel. Note that the peak flow for this hydrograph is 3,489 cfs: a value between the Flow 1 and 2 scenario peak flows.

Water Surface Elevations

Figure 11 shows water surface elevations for Scenario 3 in the naturalized channel. Although higher than existing conditions, the results of this scenario indicate that the Adams channel can be successfully naturalized and can provide for both habitat and flood protection. The unsteady-state flow simulation is typically a more accurate representation of water surface elevations because the effects of channel storage and attenuation are modeled. Note that the model is sensitive to the selection of the lower downstream boundary condition as described above.

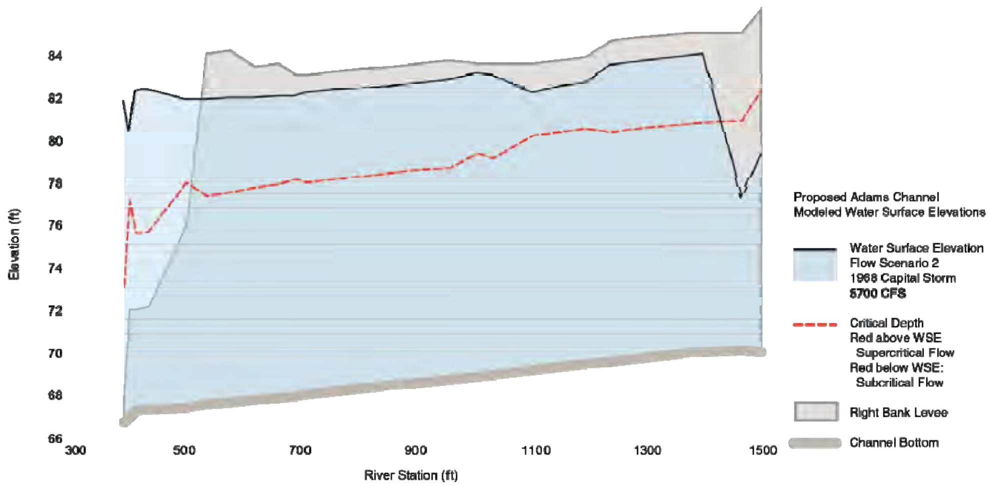


Figure 9: Water Surface Elevations in Adams Channel for Proposed Naturalized Channel and Scenario 2 (1968 Capital Storm).

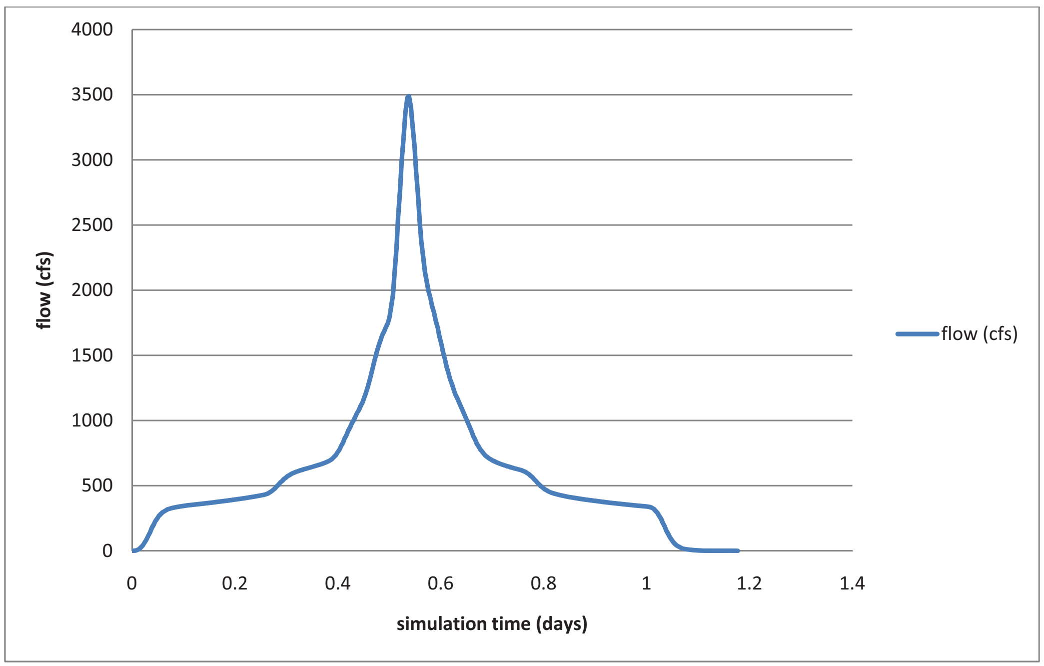


Figure 10: Scaled USACE Hydrograph Used for Unsteady-State Analysis

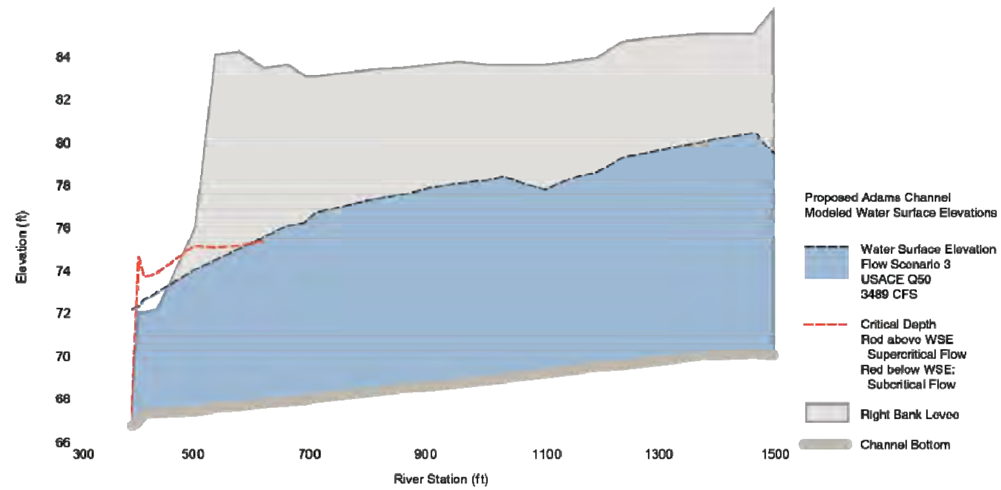


Figure 11: Water Surface Elevations in Adams Channel for Proposed Naturalized Channel and Scenario 3 (USACE Q50 Unsteady State run).

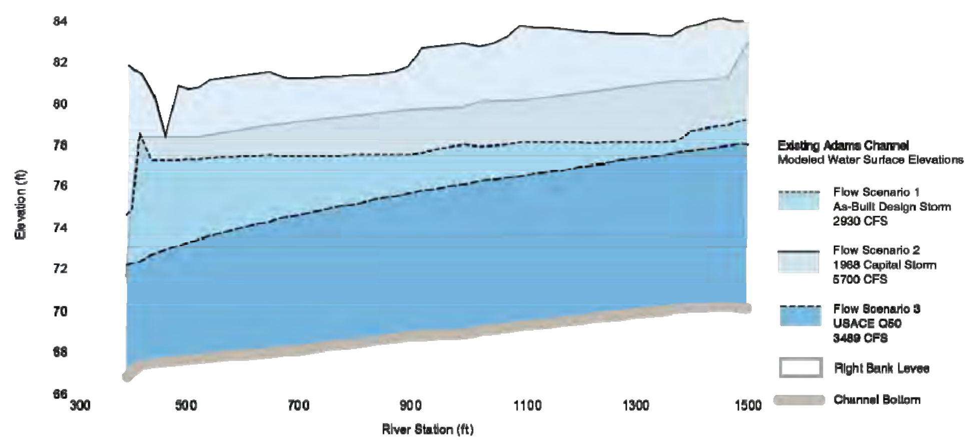


Figure 12: HEC-RAS modeling of the existing channel condition indicates that the existing channel contains the "as-built" flows and the USACE Q50. The 1968 LA Capital Storm exceeds the channel's capacity, however.

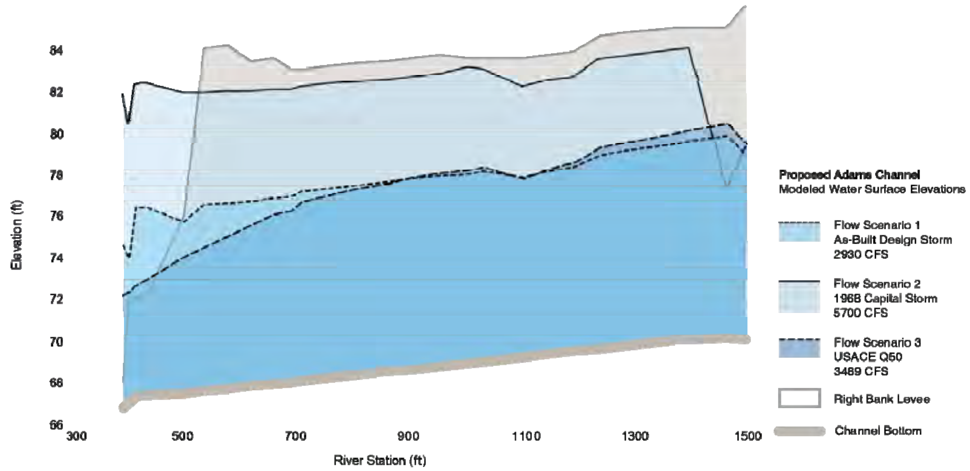


Figure 13: HEC-RAS modeling of the proposed channel shows that the proposed naturalization channel, which includes new 3½' floodwalls above the top of the existing right-of-way's elevation, contains all three flow scenarios.

<u>Velocity Results</u>

The velocity results range from approximately 13 to 24 ft/sec and indicate that some toe rock and channel maintenance may be required following significant flood events. In areas of velocities greater then perhaps 15 ft/sec, additional hardening or armoring of the channel may be required. However, given the backwater effect from Ballona Creek, it is likely that flow velocities do not exceed the lower values for more than very limited areas of the channel, if at all.

Flood Modeling Conclusions

Figures 12 and 13 below show the results for modeled water surface elevations for all three flow scenarios plotted on the same figure for both existing (Figure 12) and proposed (Figure 13) conditions.

Velocities are within the range of values that are acceptable for bioengineering solutions although some hardening of the channel with a rip-rap toe may be required at the base of the channel and at the channel transition to address scour issues.

Recommended Additional Hydraulic Design Work

- Extend the model upstream to include the two culverts discharging into the study reach.
- Analyze the restored creek using the revised LA County Capital Storm flows when made available by LA Public Works.

- Analyze changes to upstream FEMA floodplain that may result from lower velocities at Adams Channel

Recommended Geomorphic/Hydraulic Reference Site Studies

- Perform a study of the effects of flooding on channel roughness, willow regeneration and bank and bed stability along the existing natural bottom reaches of Los Angeles River

Recommended Surveying

- Obtain title report and verify property lines.

References

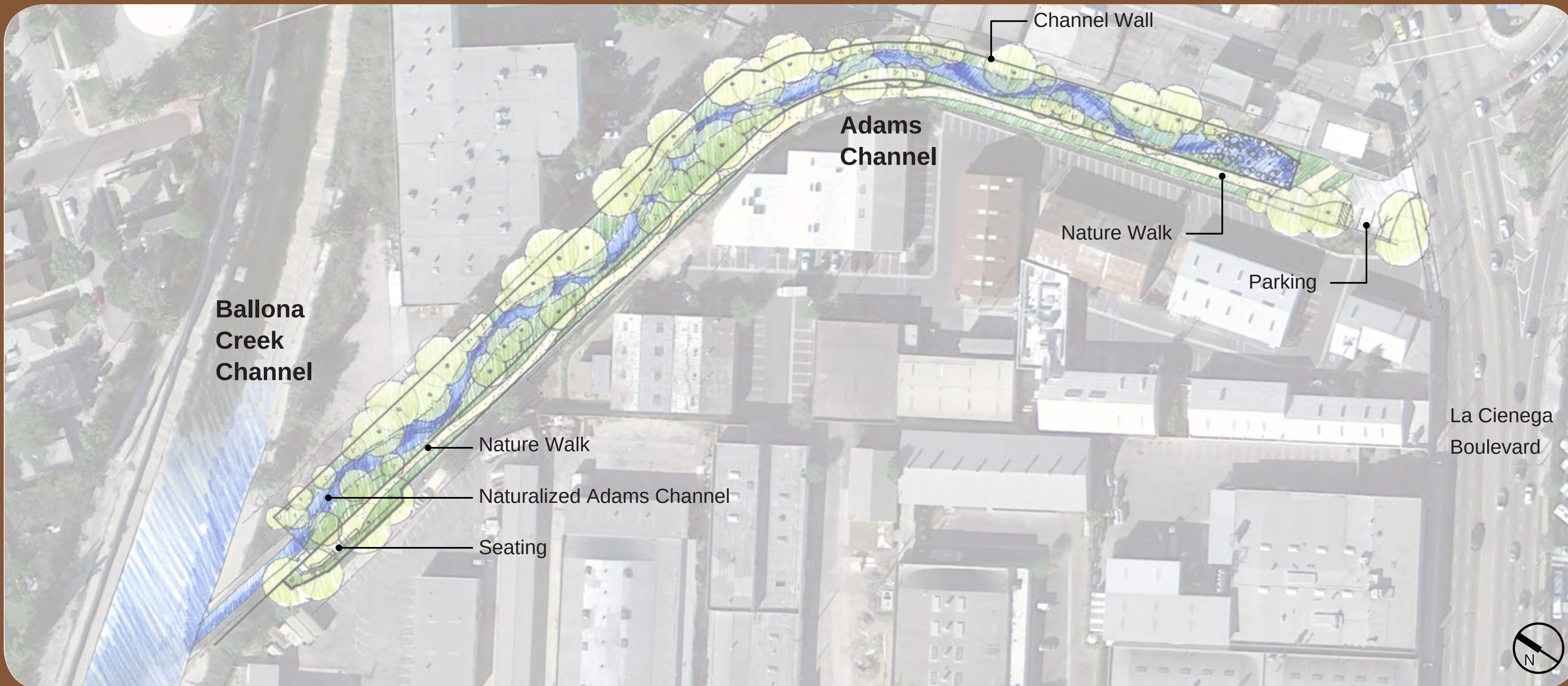
Fergusen, R. “Time to abandon the Manning equation?” Commentary in *Earth Surface Processes and Landforms*. September 2010.

French, R. “Open Channel Hydraulics” 1985

USACE Ballona As-Builts

Email Communication, Army Corps of Engineers, 12/2/2009, 4/28/2010, 5/5/2010

Email Communication, Los Angeles County Department of Public Works, 5/27/2010



Arroyo la Cienega Nature Walk

The Arroyo la Cienega Nature Walk brings wildness back to the historical cienegas that once made the Ballona Valley locally famous for its duck hunting and peat bogs.

Located off busy La Cienega Boulevard between the 10 Freeway and the future Exposition Light Rail Line, the Arroyo la Cienega Nature Walk brings wildness back to the historical cienagas that once made the Ballona Valley locally famous for its duck hunting and peat bogs.

Currently, the Adams Channel/Project 53 Line B rapidly conveys flood waters. Transforming the channel into a riparian corridor reestablishes habitat while maintaining the channel's ability to convey flood flows. The restoration involves removing 1,000 linear feet of concrete channel bottom and creating a natural creek bed with a willow-dominated habitat. This naturalized corridor would exceed federal and meet local flood protection standards.

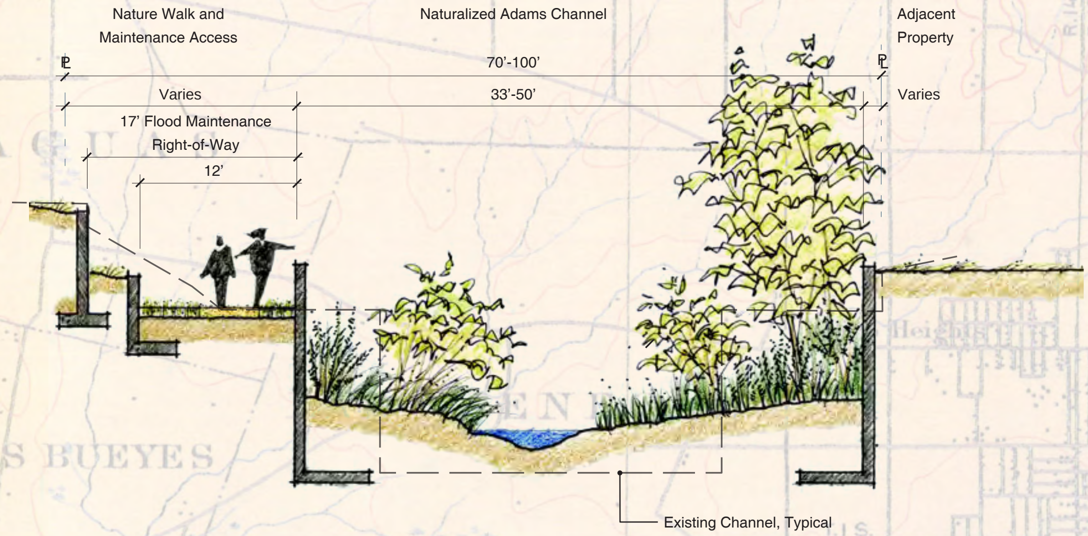
A trail doubling as flood maintenance access runs along the channel and provides opportunities for bird-watching, passive recreation, and creek monitoring. Upland oak woodland, coastal sage scrub, and grassland plants complete the restored setting. Long-term, there is the potential to use this trail as a connector between existing parks and bicycle facilities.

Preliminary Estimate of Probable Construction Cost

Total (Range) **$4.9 to $6.3 million**

Arroyo la Cienega Nature Walk

Arroyo la Cienega Nature Walk brings back the essence of the old freshwater cienagas (wetlands) that were once located in this district between Mid-City Los Angeles and Culver City. Naturalizing the Adams flood control channel re-creates riparian habitat in the heart of the city while maintaining flood protection. The Nature Walk provides a local outlet for nature watching and recreation. In the future it may provide a link to adjacent trail routes.



Arroyo la Cienega Nature Walk Section

"...the country called the Cienega …at one time it was all a swamp and always had three or four feet of water standing in the low places. The whole valley was marshy, swampy and covered with tullies. Now that the water has been kept out of there to a certain extent and the valley drained, people do not suspect that it is subject to floods."

– Geo. W. Wright, interviewed by James Reagan, in Early Floods in Los Angeles County, 1914.

Ballona Creek Gateway

Cochran Avenue Memo / Project Summary

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Memorandum

To: Jessica Hall, Restoration Design Group
From: Emily Duchon
CC: Matt Benjamin
Send Via: Email

Date: March 17, 2010
Project: Ballona Greenway
Project No: 10-021

RE: Evaluation of closing the intersection at Cochran Avenue and the south side of Venice Boulevard

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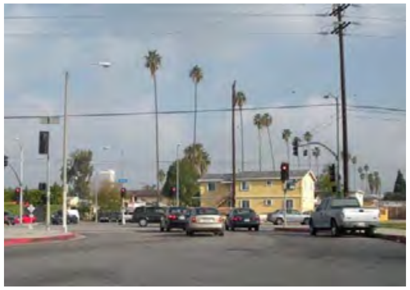
Closing Cochran Avenue between Venice Boulevard and Cologne Street would allow space for a gateway park adjacent to Ballona Creek. The following memo provides an initial evaluation of the existing traffic conditions, potential traffic impacts and benefits of the intersection closure. Additionally, further studies needed to evaluate the actual impacts are identified.

Existing Traffic Conditions:

Cochran Avenue at Venice Boulevard is a four-way signal-controlled intersection. Venice Boulevard is a major east-west arterial road connecting Downtown Los Angeles to the West side. Venice Blvd has three vehicular travel lanes in each direction, bicycle lanes, and a raised median with dedicated left turn lanes at Cochran Ave. Cochran Avenue is a north-south two-lane collector street linking the Mid-Wilshire/Mid-City neighborhoods to Venice and Washington Boulevards and Interstate 10.



Northbound traffic on Cochran Ave at Venice Blvd intersection.

The majority of traffic through the intersection is east/west bound traffic on Venice Blvd. According to the Los Angeles Department of Transportation (LADOT) index of traffic volume counts, the Average Daily Traffic (ADT) on Venice Blvd at La Brea Avenue (0.5 miles east of Cochran Ave) was 25,538 on 1/6/2009 while ADT on Cochran at Venice was 4,016 cars counted on 10/24/2006. ADT on Cochran at Washington Boulevard was 1,891 cars counted on 10/17/2008. Generally, ADT decreases from north (Wilshire Boulevard) to south (Washington Boulevard).

From general observation, the majority of traffic through the intersection on the south side of Venice appears to be cut-through traffic seeking to avoid the light at the Venice/Redondo intersection. The four-way intersection provides a direct cut-through to and from Washington Boulevard via Cochran and Redondo via Pickford Street (see Figure 1). The Cochran /Venice intersection also serves as access to Venice Boulevard for the residents of the neighborhood.

Figure 1. Existing traffic conditions at Cochran Avenue and Venice Boulevard

With the proposed closure, Cochran Avenue would terminate at Cologne Street which parallels Venice Boulevard and transitions into a one way street at Cloverdale Avenue. Access to the residential and commercial properties on Cologne Street is provided by a 3 –way stop sign controlled intersection at Cochran Avenue and Pickford Street and a one-way entrance off of Venice Boulevard. No sidewalks exist along Venice Boulevard between Cochran Avenue and Redondo Boulevard.

Potential Traffic Impacts:

A more detailed traffic study is required to evaluate the potential impacts of closing Cochran Avenue at the south side of Venice Boulevard. The following potential traffic impacts are based on a preliminary field analysis of traffic patterns in the area.

Increased traffic and turning volumes on Venice Boulevard

- Closing Cochran Ave between Venice Blvd and Cologne St will reduce local cut-through traffic on Cochran Ave and Pickford St. and route traffic onto Venice Boulevard increasing turning volumes at the intersection of Venice and Redondo Boulevards.

Increased neighborhood traffic on parallel streets

- Closing Cochran Avenue between Venice and Cologne/Pickford will remove the direct left turn onto Venice and make it more difficult for neighborhood traffic to head west on Venice Blvd. Residents will have to use either Redondo Boulevard to make a left onto Venice, or make a U-Turn from eastbound Venice to westbound Venice at Redondo. Traffic is currently allowed to make a legal U-turn at Venice and Redondo. Removing the left turn from Cochran Ave to Venice may cause increased neighborhood traffic on Cologne and Pickford streets, but this increase is likely to be offset by the decrease in non-local "cut-through" traffic, particularly on Pickford Street.

- Creating a new right-turn opportunity from eastbound Venice Boulevard to southbound Cloverdale Avenue may increase traffic on Cloverdale. Traffic calming measures such as speed humps or curb bulb-outs could be used to discourage cut-through vehicular traffic.

Traffic delays

- Traffic delays at the Venice/ Redondo intersection may need to be addressed if right turn volumes from eastbound Venice to southbound Redondo increase significantly.

Parking removal

- No loss of on-street parking is anticipated

Figure 2. Potential traffic conditions if Cochran Avenue is closed at Venice Boulevard and Cloverdale Avenue is extended north Venice Boulevard.

Potential Benefits:

Creating a gateway park at the entrance of Ballona Creek will bring recreational amenities, ecological enhancements and cultural awareness to the Creek. Closing the intersection to build the park will also provide potential safety benefits for bicyclists, pedestrians and residents.

- Increased open space. Converting the portion of Cochran Avenue and the left turn pocket on Venice Boulevard would add approximately 7,800 square feet of additional open space.
- Reduced cut-through traffic through neighborhood on Cochran Avenue and Pickford Street, especially during commuter hours.

- An opportunity to install sidewalks along the south side of Venice Boulevard from Cochran Avenue to Redondo Boulevard.
- Increase the visibility and safety of pedestrian crossing at Cloverdale Avenue and Venice Boulevard.
- Create a safe off-street staging area for pedestrians and bicyclists to access the proposed Ballona Creek path.

Additional Studies Needed:

A more detailed traffic analysis would typically include current and projected traffic counts (with turning movements) and a "before and after" Level of Service analysis for impacted intersections. This traffic analysis should also evaluate the benefits of reduced "cut-through" traffic on local streets, particularly on Cochran Avenue and Pickford Street.

-END-

Ballona Creek Gateway

The Ballona Creek Gateway converts an unused median strip and busy "cut-through" street into a neighborhood park that attracts residents and treats stormwater.

Located in the park-poor Mid-City district of Los Angeles, the Ballona Creek Gateway transforms a fast cut-through street into a pedestrian sanctuary along busy Venice Boulevard. Closing Cochran Avenue between Venice Boulevard and Cologne Street creates over one-half an acre of parkland and an anchor for the future Ballona Creek Bike Path that will run along Ballona Creek and connect to existing bicycle facilities.

The Gateway sits over a culverted reach of Ballona Creek and creates awareness of the creek through its design.

Visitors entering the Ballona Creek Gateway enjoy a shaded plaza with tables for picnics overlooking a constructed stream fed by low flows pumped to the surface of the buried culvert under the Gateway. Over a bridge or playfully hopping stepping stones, visitors cross the stream. The path forks, leading to a native grassland picnic area and Cologne Street to the east. To the west, the path leads to seatwalls, the future Ballona Creek Trail, and neighborhoods beyond. Parking nestles between rain gardens that treat storm runoff before entering Ballona Creek. Abundant, fragrant native plants provide a sense of wildness, heighten the sense of place, and reduce irrigation water demand.

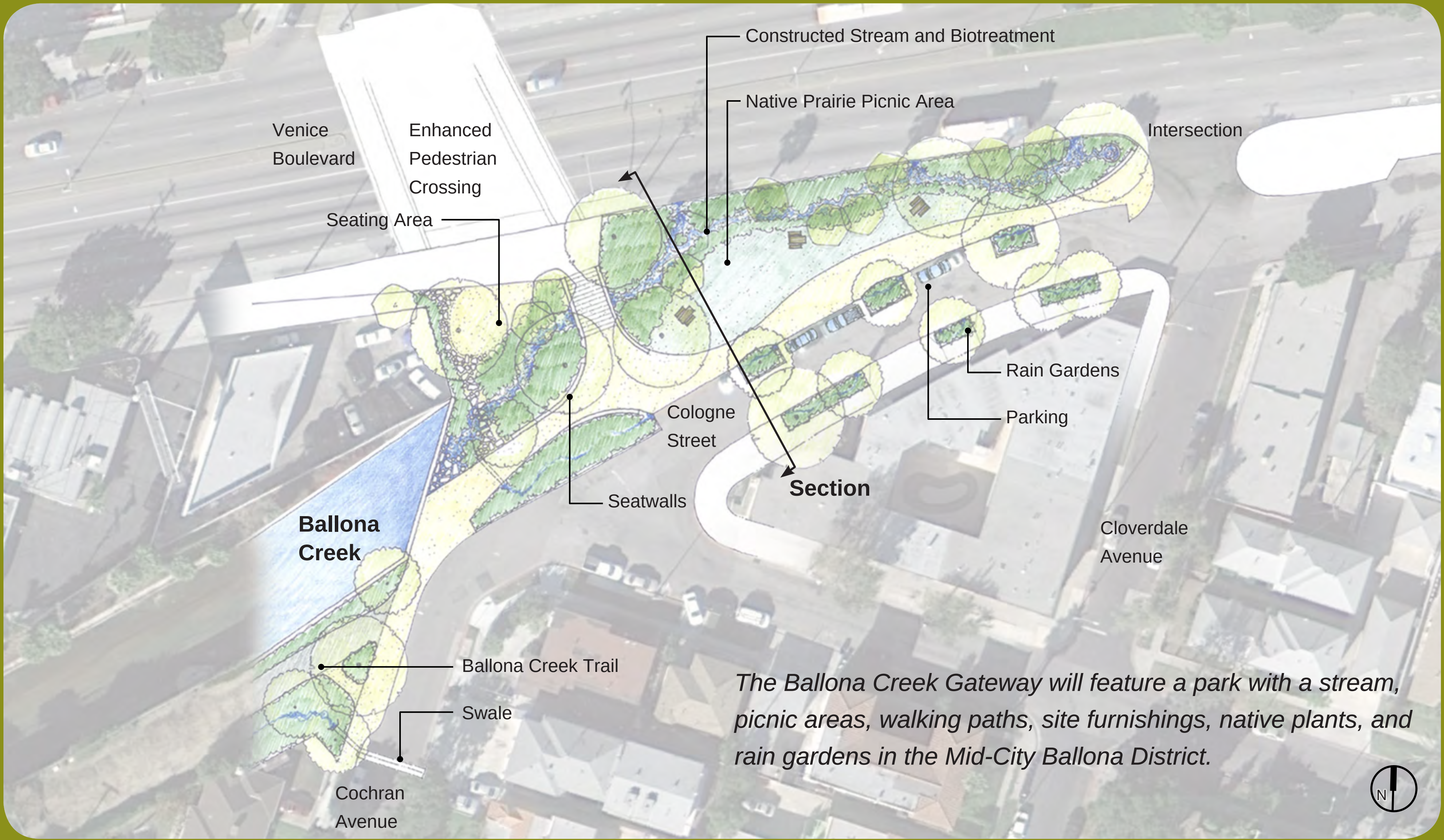
Preliminary Estimate of Probable Construction Cost

Total (Range) **$0.9 to $1.7 million**

"For clerks and students, factory workers and mechanics, the outdoors is freedom... They don't have to own the outdoors, or get permission, or cut fences, in order to use it. It is public land, partly theirs, and that space is a continuing influence on their minds and senses."

-Wallace Stegner

Ballona Creek Gateway Section



The Ballona Creek Gateway will feature a park with a stream, picnic areas, walking paths, site furnishings, native plants, and rain gardens in the Mid-City Ballona District.

Ballona Creek Gateway plan