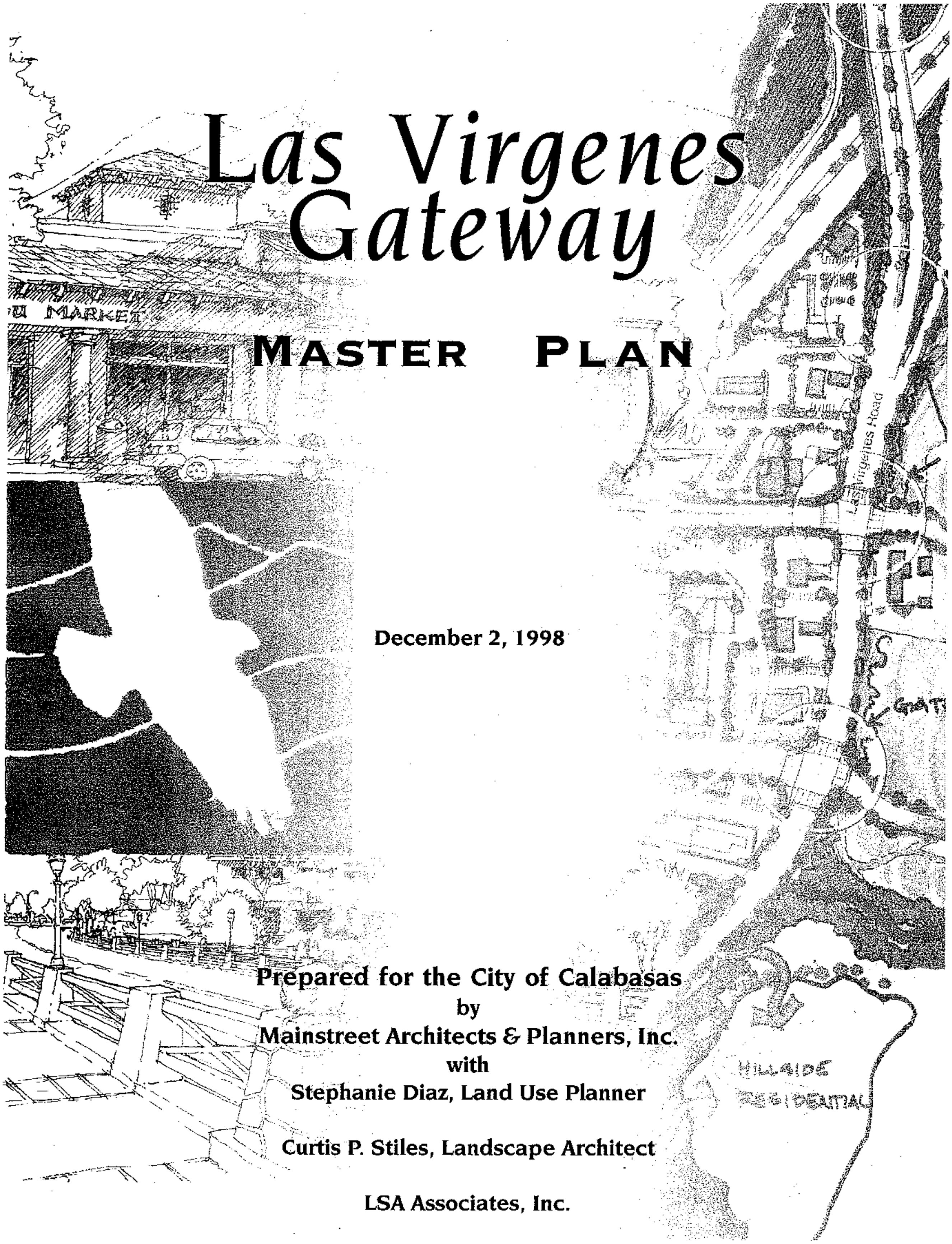

Las Virgenes Gateway

MASTER PLAN

December 2, 1998

Prepared for the City of Calabasas
by
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LSA Associates, Inc.

Las Virgenes Gateway

Master Plan

City of Calabasas
Las Virgenes Gateway Master Plan

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Note of Thanks:

The City of Calabasas and the Project Team would like to thank the many citizens of the City of Calabasas and particularly those residents and business owners in the Las Virgenes area who gave of their time and energy to participate in the workshops and hearings that formed the basis for the development of this Master Plan.

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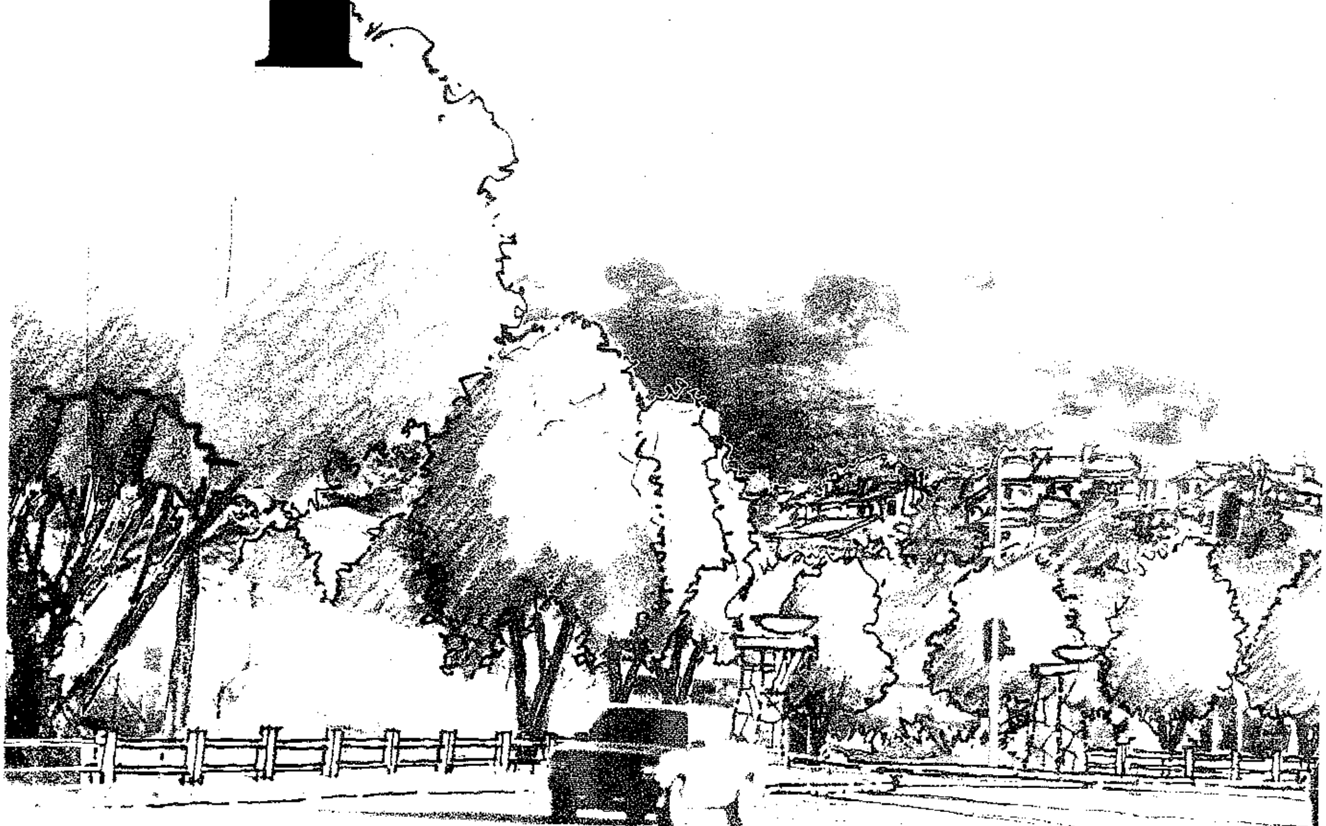


INTRODUCTION

BACKGROUND

The Las Virgenes Road and Ventura Freeway interchange area has historically served as a rest stop and crossroads for travelers. This area is at the western edge of the San Fernando Valley and has been a gateway to the beaches along the Pacific Ocean and the beachfront cities. More recently, this corridor serves the neighborhoods in western Calabasas, as well as a route to Pepperdine University, Malibu Creek State Park and the Santa Monica Mountains.

Visually, the area contains some of the most scenic and diverse topography in the region. Calabasas has always been identified with the beauty of its natural environment: the rolling hills, oak woodlands, canyons, creeks and wildlife. While the rural character and natural beauty are still apparent, the encroachment of urban development has threatened to destroy much of this natural rural character.

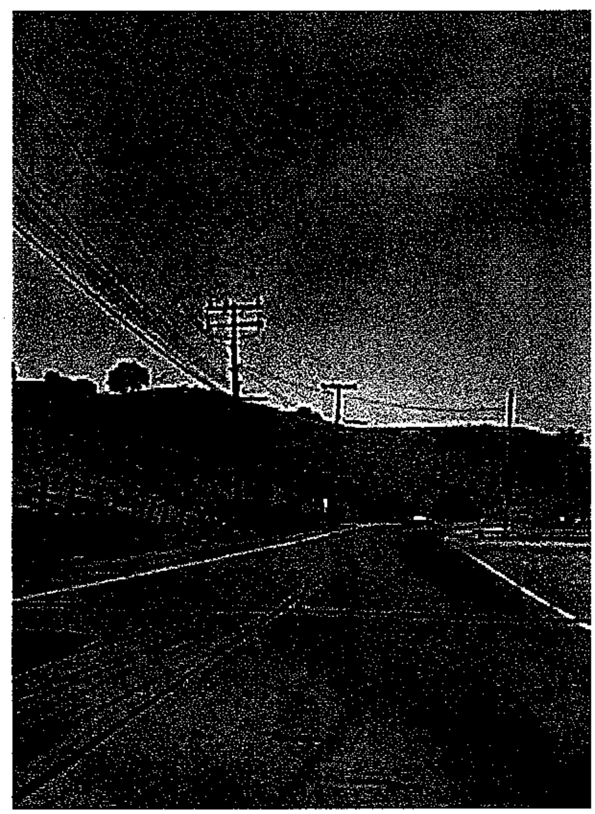
This threat occurs in the Las Virgenes interchange area that has seen a confluence of land uses, businesses and freeway-oriented roadway designs over the years. These uses developed first to serve the traveling public and secondarily the residents who moved into the adjacent neighborhoods. Much of this development occurred prior to the incorporation of the City of Calabasas and therefore, was done without the City's vision for its future. A lack of cohesive standards has led to visual clutter from too many driveways and commercial signs, a lack of landscaping and unaesthetic roadways and sidewalk areas.

This area could be jeopardized by pending development entitlements approved years ago by the County of Los Angeles. Some of this potential development appears to conflict with the General Plan vision for Calabasas as a rural, residential community. Such development could significantly alter the character of the area if allowed to develop independent of an overall vision for the area.

Some land owners in the gateway area recognize the need for planning and renovations to provide a safe and desirable area for residents and visitors. These land owners wish to develop the abandoned commercial sites and to make improvements to out-of-date commercial spaces. A cohesive plan to guide private property development is currently lacking and could provide a blue print for these renovations.

The City has always noted the value and the vulnerability of the Las Virgenes Road corridor. In the General Plan process, Las Virgenes

"Calabasas has always been identified with the beauty of its natural environment: the rolling hills, oak woodlands, canyons, creeks and wildlife. While the rural character and natural beauty are still apparent, the encroachment of urban development has threatened to destroy much of this natural rural character."



Road was identified as a "scenic corridor" and the City developed special regulatory measures to promote protection of its scenic qualities. After completion of the General Plan, the City Council recognized the need for additional planning for the Las Virgenes Road area and initiated the *Las Virgenes Road Corridor Design Plan.* This study was completed in January 1998 and addressed public improvements for roadways and sidewalks. That document identified the necessity for additional planning to address land uses and private property development/design standards. In April 1998, the City Council initiated this planing study to investigate the complex private land use and design issues that are encompassed within the gateway area.

"The General Plan's vision for Calabasas is to maintain its traditional role as a refuge from the congestion of the San Fernando Valley and the metropolitan Los Angles area."

This plan is intended to address the following issues:

- Provide proper urban design standards within the Plan boundary.
- Support neighborhood serving uses.
- Clarify land uses for the eastern hillside area.
- Regulate the mix of auto-oriented and neighborhod serving commercial land uses.
- Coordinate transportation planning in the corridor.
- Formalizing streetscape and public improvements in the Plan area.

PURPOSE OF THE MASTER PLAN

The General Plan's vision for Calabasas is to maintain its traditional role as a refuge from the congestion of the San Fernando Valley and the metropolitan Los Angeles area. Thus, the General Plan's Land Use Plan calls for a primarily low intensity residential community nestled in a natural setting. Urban development should not extend beyond the areas that are now developed or committed to urban uses. Rural residential uses should be located adjacent to the urban uses and should transition to open space uses. A key concept is that the rural, open character of lands be preserved. It is the City's vision that any new development within the rural and open areas fit in with rather than replace the area's natural environment.

For the Las Virgenes Road area, it is the General Plan's intent that the natural hillsides dominate the freeway corridor at the Las Virgenes road interchange. The General Plan calls for development of the northwest quadrant to be limited to the lower portions of the hills so as to preserve oak woodlands and not dominate the views from the freeway. Freeway oriented commercial uses should continue in the southern quadrants of the Las Virgenes freeway interchange, focusing on urban design improvements to reduce visual clutter. New commercial development is called for along the east side of Las Virgenes Road at Agoura Road. A transition from commercial to business park is called for along Agoura Road.

The dominant themes expressed in the City's General Plan are reinforced in the Las Virgenes Gateway Master Plan:

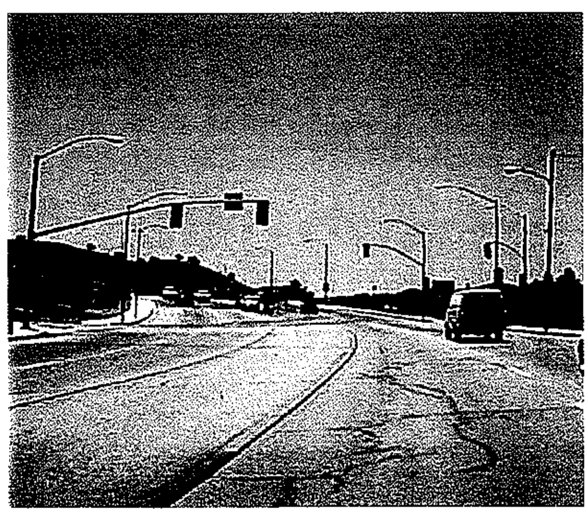
Environmental Responsibility - Preserving the area's remaining natural environment and living within the limits imposed by available resources. The Master Plan sets forth standards for preservation of open space, hillsides and creek areas. Also, traffic and circulation safety issues are addressed.

Local Management and Control - Accepting responsibility for managing Calabasas' affairs and its future in accordance with local values. The Master Plan establishes a vision and a clear set of rules by which development proposals will be reviewed.

Community Image - Protecting Calabasas' distinctive image. The Master Plan addresses the degradation that has occurred along this roadway through a proliferation of commercial signs, nondescript architecture and minimal landscaping. The Plan aims to enhance the natural beauty and improve the built environment along this scenic corridor.

"The Las Virgenes Gateway Master Plan carries out the General Plan vision for this segment of the City while providing more specific land use and development criteria. The Master Plan recommends several General Plan land use designation amendments that are in keeping with the overall vision and the policies of the General Plan."

The Las Virgenes Gateway Master Plan carries out the General Plan vision for this segment of the City while providing more specific land use and development criteria. The Master Plan recommends several General Plan land use designation amendments that are in keeping with the overall vision and the policies of the General Plan. After careful study of the land use issues in the Las Virgenes Road area, refinements to the original General Plan designations were developed, consistent with the vision and intent of the General Plan. In some cases, the Master Plan provides more specificity for new land uses and future development than was outlined in the General Plan.



As noted in the City's General Plan, "Calabasas was founded as a separate community, away from the urbanization and congestion of the Los Angeles metropolitan area." However, the City has inherited some elements of "urbanization and congestion" at its western gateway along the Las Virgenes Road intersection with the Ventura Freeway. The Las Virgenes Gateway Master Plan was formulated to reduce these negative attributes and provide a memorable gateway experience for local residents and visitors.

This Master Plan is intended to inspire and encourage renovation and appropriate new development opportunities. This Plan establishes a foundation upon which renovation and revitalization can occur within the rural context of Calabasas. Concepts are shown for streetscape refurbishment, facade renovations and new development at key sites. The Master Plan enhancement strategies are balanced with development standards and restrictions that will provide land use compatibility and environmental protection.

This document augments the City's General Plan goals and policies and the Development Code standards. In some cases, General Plan and zoning designation changes are recommended by the Master Plan due to changes in development circumstances since the General Plan was adopted. These General Plan Amendments contained in the Master Plan will be concurrently adopted upon adoption of the Master Plan. Development standards presented in this Master Plan may be more restrictive than those required by the Development Code. In all cases, the standards set forth in this document will take precedence over those in the Development Code for properties in the Master Plan area.

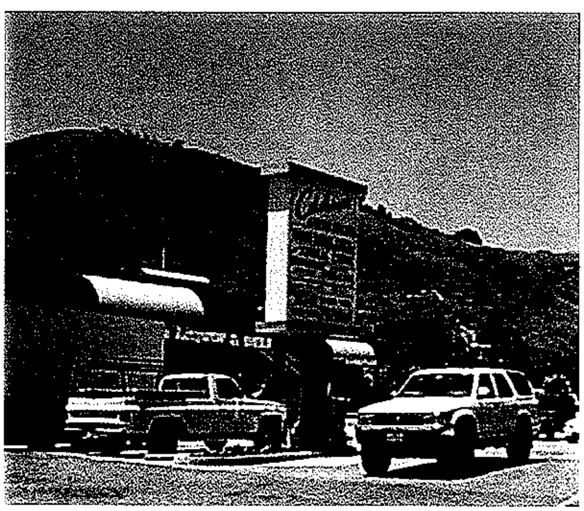
This Plan plays an important role in the future of the Las Virgenes Gateway area by providing the following benefits:

* A community vision for the area using realistic development scenarios;

* A long-range blue print for appropriate change, eliminating uncertainty for decision-makers and property owners;

* A tool for promoting revitalization of the existing commercial properties. The plan can be a marketing tool to attract desired development such as a neighborhood shopping center;

* A tool in obtaining grants for public improvements, streetscape improvements, trail construction and creek restoration; integration of guidelines for public and private property architectural and landscape design.

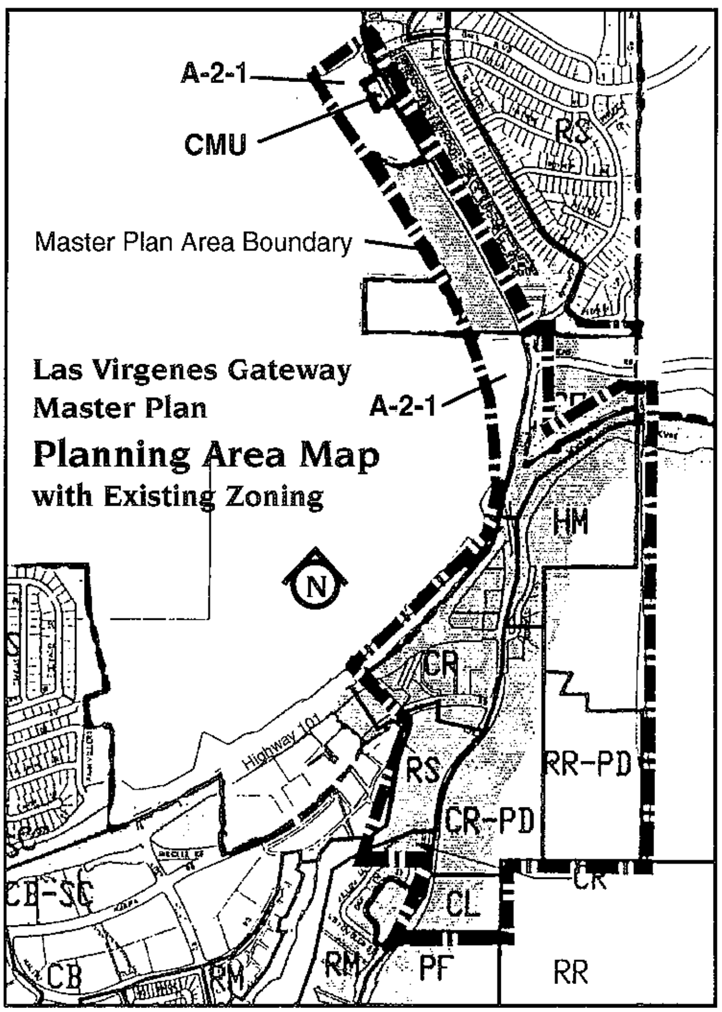


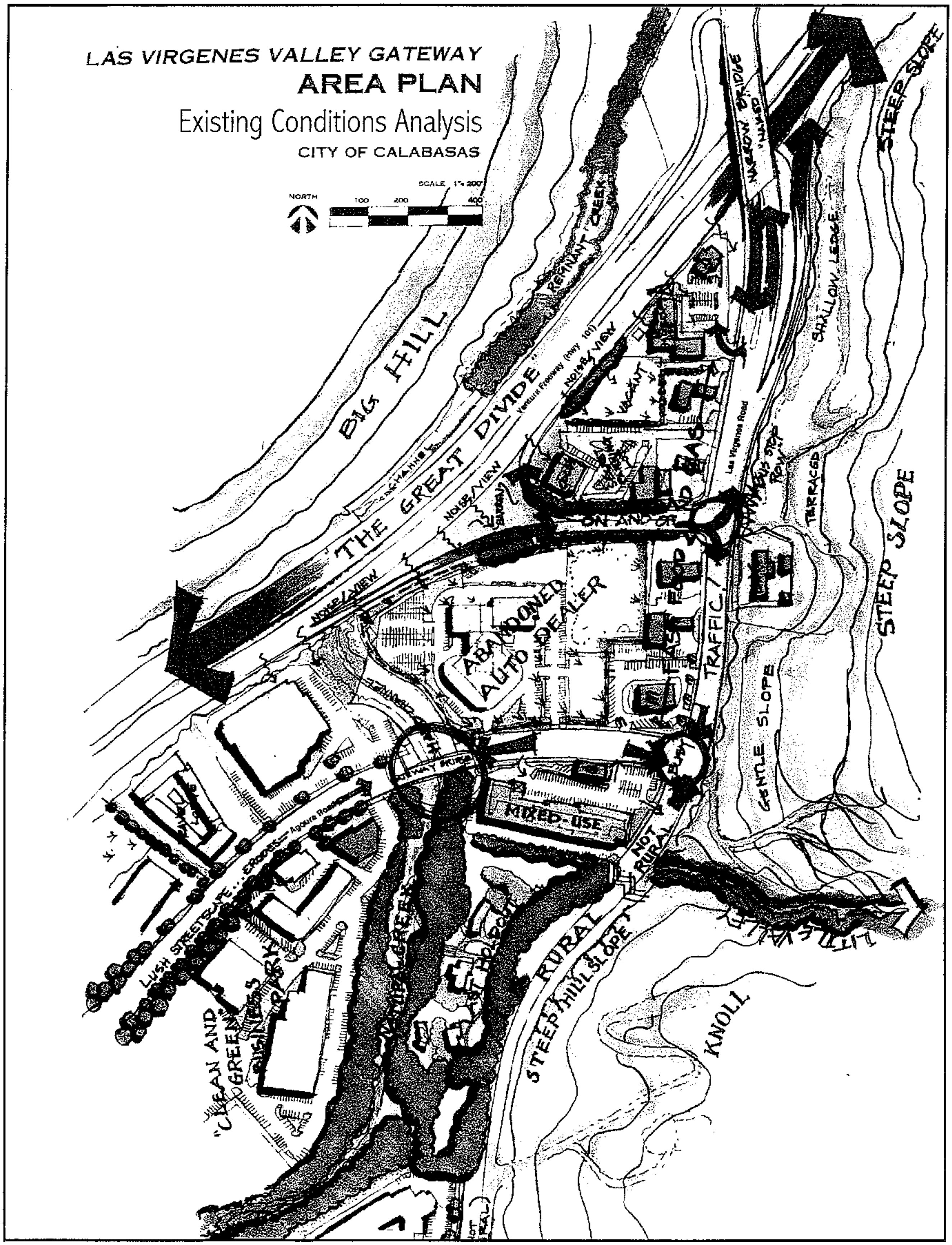
THE PLANNING AREA

The City of Calabasas is located in western Los Angles County, at the edge of the San Fernando Valley. The Ventura Freeway (Highway 101) runs east/west through the middle of the City. Neighboring cities include Agoura Hills, Hidden Hills and Los Angeles. A portion of the City's western boundary abuts the Los Angeles County border and a portion of the northern boundary abuts Ventura County.

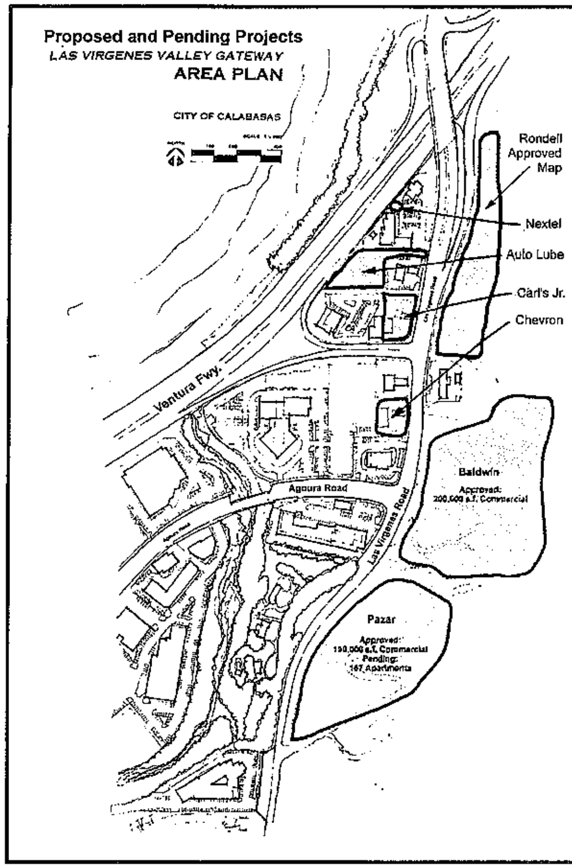
The Las Virgenes Gateway Master Plan encompasses the lands immediately adjacent to the Las Virgenes Road corridor. The area extends along Las Virgenes Road from the Water District Headquarters on the south side to Thousand Oaks Blvd on the north side. The eastern boundary is approximately along the hillside ridge top for the area south of the freeway. To the north of the freeway, the eastern boundary runs along Las Virgenes Road. The west side boundary is at Malibu Creek in the area south of the freeway and the top of the western ridgeline for the lands north of the freeway. Some of the lands north of the freeway are not within the City boundaries. While the City has no decision-making authority for development proposals in either Ventura or Los Angles County, these lands are an integral part of the community and should reflect the quality and character of the City's vision. As the City intends to influence the design and development of these lands, during development review for County projects, the City will recommend that the standards contained in this Plan be adhered to.

The planning area encompasses the Ventura Freeway (Highway 101) on and off ramps and a small commercial area with highway and auto-oriented uses including gas stations, fast food and a sit-down restaurant. A large vacant commercial parcel and several




LAS VIRGENES VALLEY GATEWAY
AREA PLAN
Existing Conditions Analysis
CITY OF CALABASAS
NORTH
100
200
400
BIG HILL
THE GREAT DIVIDE
REMNANT CREEK
CHANNEL
NOISE/VIEW
Ventura Freeway (Hwy 101)
VACANT
ON AND OFF
ABANDONED AUTO DEALER
TRAFFIC
Las Virgenes Road
MIXED-USE
NOT RURAL
RURAL
STEEP HILLSLOPE
KNOLL
LUSH STREETSCAPE
Agoura Road
"CLEAN AND GREEN"
STEEP SLOPE
SHALLOW LEDGE
NARROW BRIDGE
TERRACED
GENTLE SLOPE

vacant gas station sites are located adjacent to the highway oriented businesses. To the east of Las Virgenes Road and the commercial area are undeveloped hillsides that have been the subject of various development proposals over the years. To the north of the freeway, lands are developed with multi-family housing on the east side of Las Virgenes Road. Large tracts of undeveloped hillsides rise above Las Virgenes to the west. A small neighborhood commercial center is located just south of Thousand Oaks Blvd.



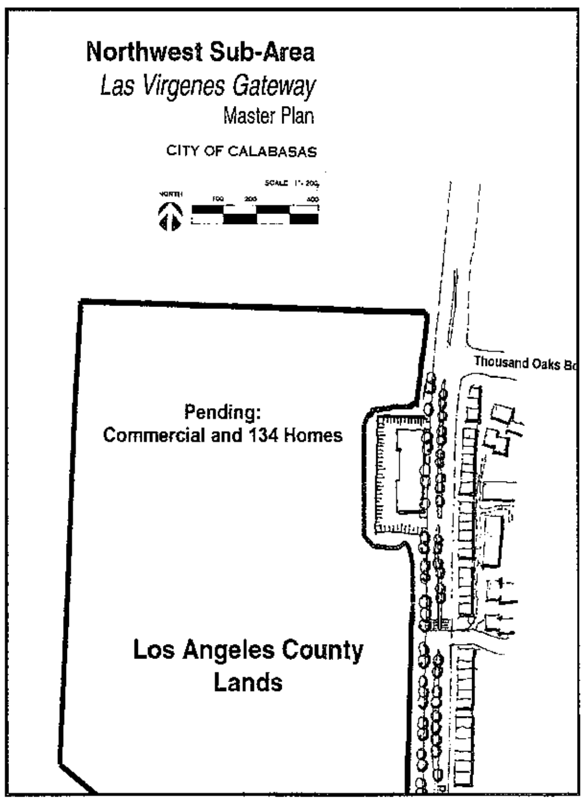
OPPORTUNITIES AND CONSTRAINTS

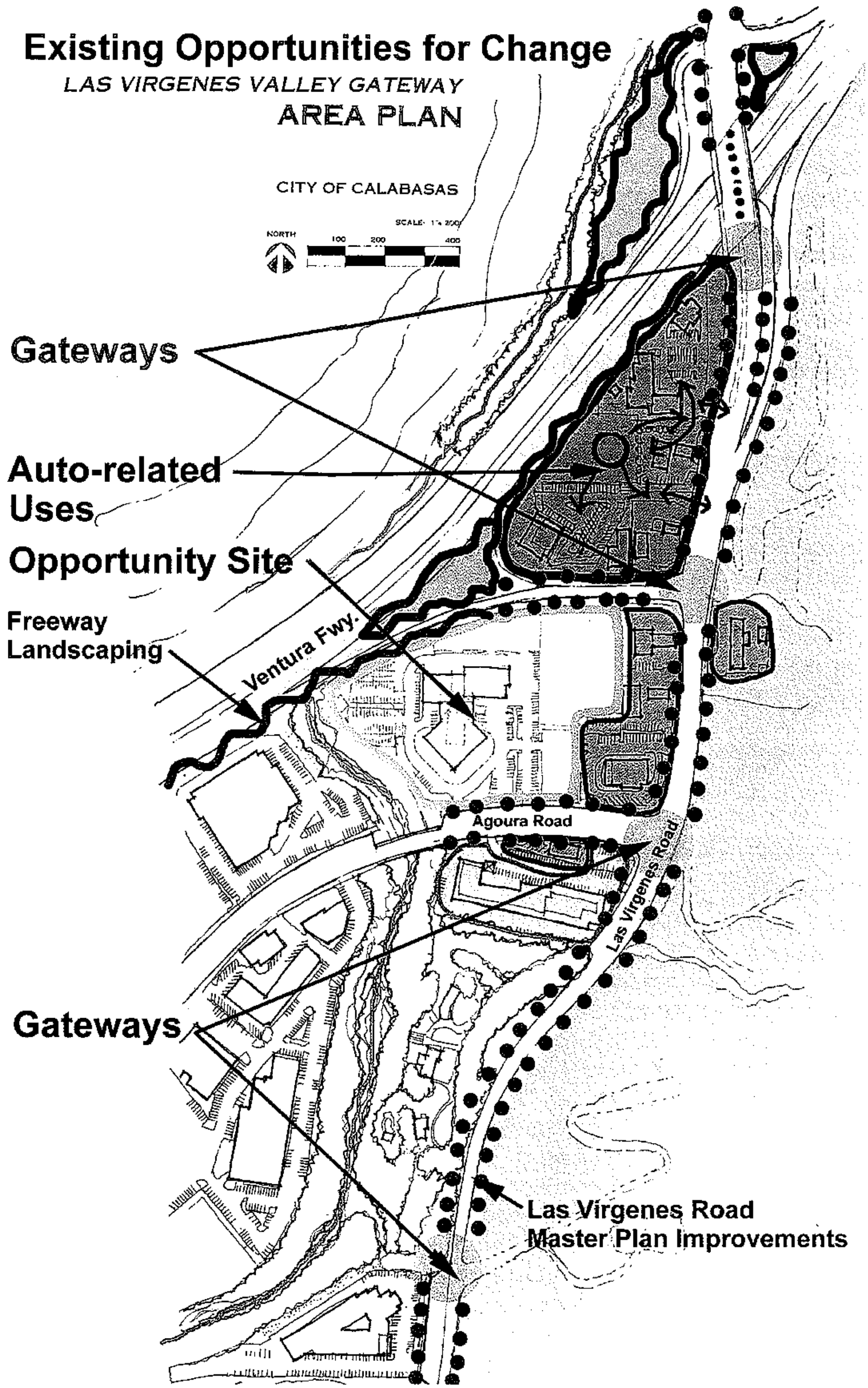
The Las Virgenes corridor has been shaped by both natural and man made forces. Geography has a strong influence on the form of the corridor. High hills rise above the roadway with steep green valleys and prominent ridgelines. This provides a striking backdrop for the man made elements that line the roadway. At the same time, the hillsides present challenges for development including geologic instability, erosion, access and view preservation. The Malibu Creek traverses along the western edge of the study area forming a natural boundary for the Plan. A portion of this creek has been channelized with concrete thereby preventing the development of creekside habitat and recreational amenities.

The opportunities apparent in the Master Plan area include the following attributes:

- Large undeveloped parcels of land.
- Hillsides that provide a majestic and rural backdrop.
- The contrast between the intensity of urban development and the openness and scenic beauty of the surrounding hillsides, canyon and creek areas.
- The Las Virgenes Creek corridor.
- The vacant seven acre auto dealership parcel on Agoura Road.
- The compact development of existing businesses.
- Freeway visibility.
- Land owners that are willing to work together to enhance the area.

The following list of issues represent concerns or constraints expressed at the Community workshops and public hearings, as well as issues identified by the Project Team:



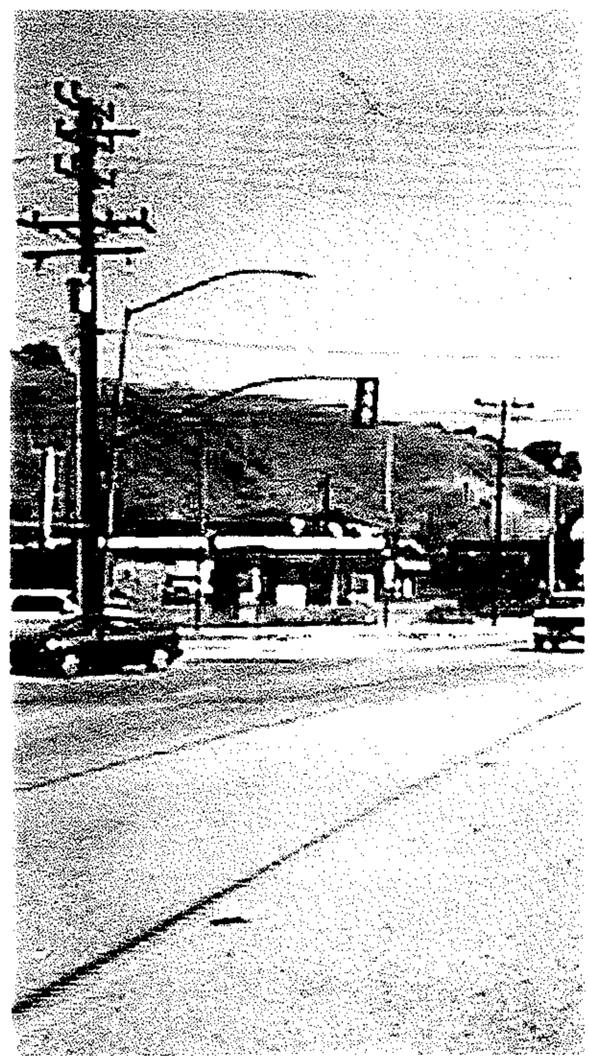

Existing Opportunities for Change
LAS VIRGENES VALLEY GATEWAY
AREA PLAN
CITY OF CALABASAS
NORTH
100
200
400
Gateways
Auto-related
Uses
Opportunity Site
Freeway
Landscaping
Ventura Fwy.
Agoura Road
Las Virgenes Road
Gateways
Las Virgenes Road
Master Plan Improvements

- Visual clutter along Las Virgenes Road between the freeway and Agoura Road.
- Lack of a cohesive design statement for private property.
- Steep, unstable slopes where topography acts as a limitation on various land uses and types of development.
- Vehicle safety issues due to poorly coordinated ingress and egress along Las Virgenes Road between the freeway and Agoura Road.
- Poorly coordinated parking areas for business along Las Virgenes Road.
- Prior entitlements for large commercial developments on the east hillsides.
- Large parcels of land that are under Los Angles County jurisdiction along the west side of Las Virgenes Road, north of the freeway.
- Current applications for development that seem inappropriate or improperly designed for the area.
- Excessive numbers of auto-oriented land uses.

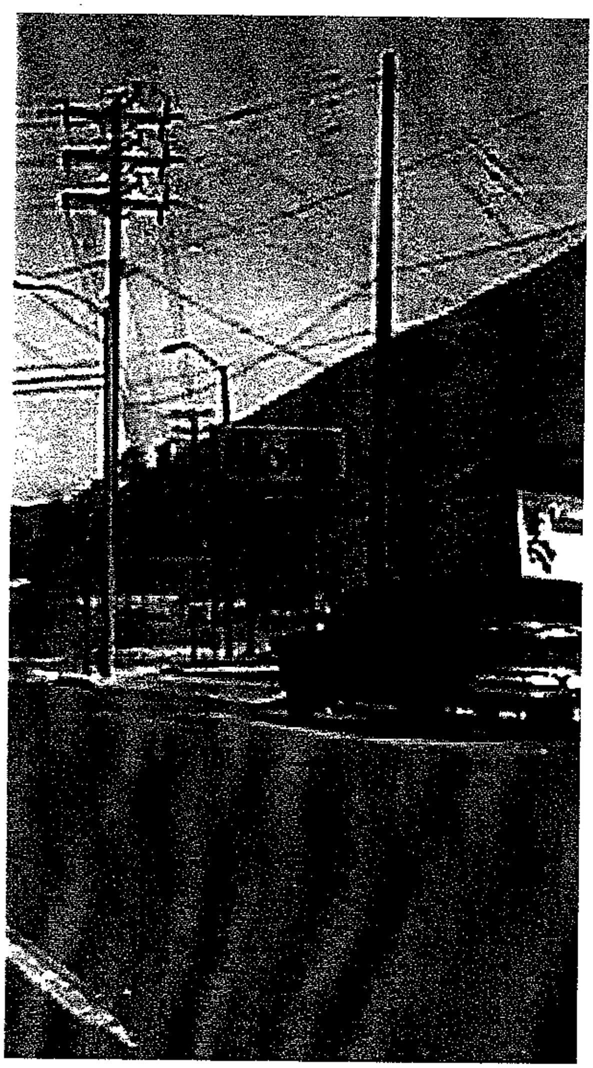
PLANNING ISSUES AND COMMUNITY INPUT

This Master Plan was created from an open public forum using many public outreach opportunities. The Project Team held two public workshops that encouraged community interactions and "brainstorming" sessions for creative solutions. Four public hearing were held by decision makers; two by the Planning Commission and two by the City Council. The results of the preliminary workshops and public hearings are presented in Appendix A. The City also mailed a survey to over 11,000 property owners and residents in the City. Over 630 survey forms were returned and the results were tabulated by City staff. The input received from the surveys was very similar to the comments received at the workshops and hearings. Survey respondents indicated that they frequently used the existing gas stations and fast food restaurants, however, they were not in favor of having more of this auto-oriented commercial development in the Las Virgenes gateway area. Respondents were in favor of adding a grocery store, drug store and upscale restaurant. The majority of survey responses indicated a desire to protect the east

Survey respondents indicated that they frequently used the existing gas stations and fast food restaurants, however, they were not infavor of having more of this auto-oriented commercial development in the Las Virgenes gateway area.



The majority of survey responses indicated a desire to protect the east hillsides from intense development.



hillsides from intense development. The preferred hillside land uses were open space, public park, and grazing. If new development were to occur, there was a preference that it be restricted to one story heights and a design that blends into the hillside environment. A summary of the survey results is presented in Appendix B.

The major land use and design issues raised during the community workshop, public hearings and through mail-in surveys are as follows:

- Auto/highway related uses should be limited to the area adjacent to the freeway.
- A master internal parking/circulation plan is needed for the commercial areas.
- A common architectural theme should be developed that emphasizes rural/rustic styles.
- A common landscaping theme should be developed that is coordinated with the public improvements specified in the Las Virgenes Corridor Plan.
- Fast food uses are okay but should be limited to the area adjacent to the highway and these uses should not involve drive-through service.
- The visual clutter along Las Virgenes Road from the freeway to Agoura Road should be reduced.
- Signage needs to be centralized and consistent with the design theme.
- The views of the hillsides need to be preserved.
- Driveways should be provided to the Land Conservancy open space lands.
- Driveway access should be limited off of Las Virgenes Road.
- Open space should be retained on the hillsides.
- Environmental issues need to be addressed for any development on the hillsides.
- Development on the East Hillsides should be low profile residential uses.
- New development off Agoura Road should orient to the creek.

- The natural creek banks and habitat should be restored.
- Trails are desirable along the creek and to connect the residential areas to the commercial area.
- Local residents need neighborhood serving uses such as a grocery store, library, coffee shop, bookstore and pharmacy. This will reduce the need for residents to travel out of the area to shop.
- Streets and intersections need to be pedestrian friendly.
- Thousand Oaks Blvd should not be extended to the west.
- The County lands along the Las Virgenes corridor should be considered for annexation. Possible uses include low density residential, a public school and recreation fields.
- The Northside neighborhood commercial area should be remain.
- Overhead utility lines should be removed.
- Senior housing is needed in the area, especially a "continuum of care" type complex.
- Telecommunication antennas are needed in the area however they need to be sensitively designed and located.

The Master Plan encompasses the issues raised in the planning process. Existing land use incompatibilities and proposed projects that may require Zoning or General Plan changes are addressed through a revised land use plan for the area. A scheme for coordinated internal circulation and access issues is presented. The Plan also sets forth an appropriate architectural and landscaping theme for private property in this area of the City.

2 The Vision and Theme

THE VISION AND THEME

THE LAS VIRGENES GATEWAY: COMMUNITY AND NATURE IN BALANCE

Narrative Vision Statement

The Las Virgenes Road corridor is a memorable district. Handsome and rustic, its stone monuments welcome residents and visitors to this area as the gateway to western Calabasas, the Santa Monica Mountains and Malibu Creek State Park.

The rural setting is punctuated by lush indigenous landscaping that lines the roadway and center road median. The architecture of new and remodeled buildings reflects the rural character of traditional Southern California. Sidewalks and driveways are lined with rail fences set into stone pillars. There are no overhead utility lines.

Highway-related services and a park n' ride lot adjacent to the freeway are easily accessible to residents and visitors. On the east side of the Las Virgenes corridor, green hills tower over clustered residential development that is tucked into the slope and well screened by abundant landscaping. Below the homes, a compact office complex provides employment opportunities and a Malibu Creek/Santa Monica Mountains visitor center.

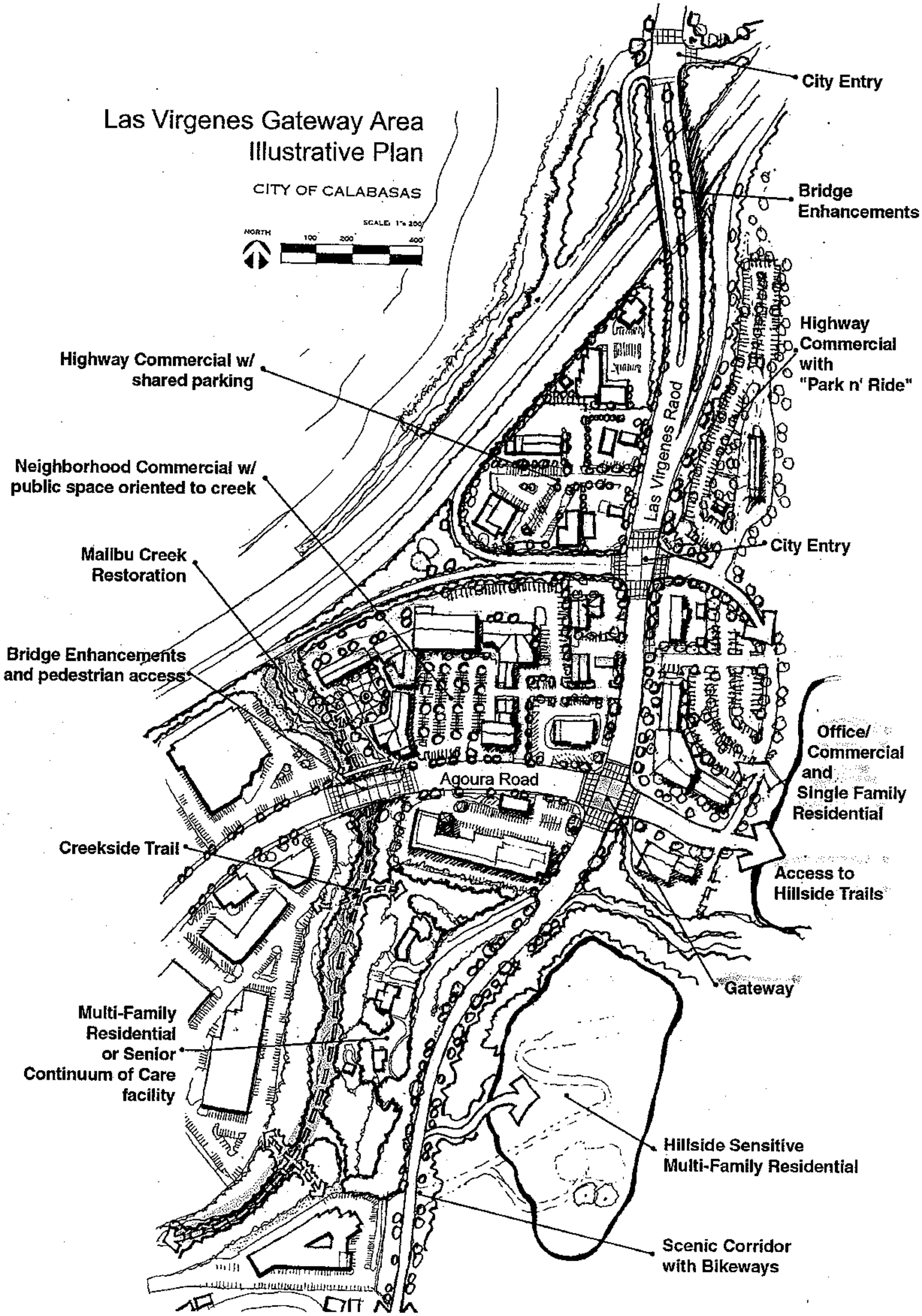
To the west of the corridor, the Agoura Road Village shopping center offers a variety of shops and services that cater to local residents' daily needs as well as a branch library. Patrons of the center arrive by car, foot and bicycle to enjoy the outdoor patios, terraces and creekside paths. The newly reclaimed creek is lush with willows and cattails that provide habitat for a myriad of bird species.

Along the creek, to the south of the neighborhood commercial center, a senior residential complex provides living accommodations including apartments, assisted living and a nursing care facility. A meandering path along the creek provides a connection to adjacent neighborhoods and the commercial center.

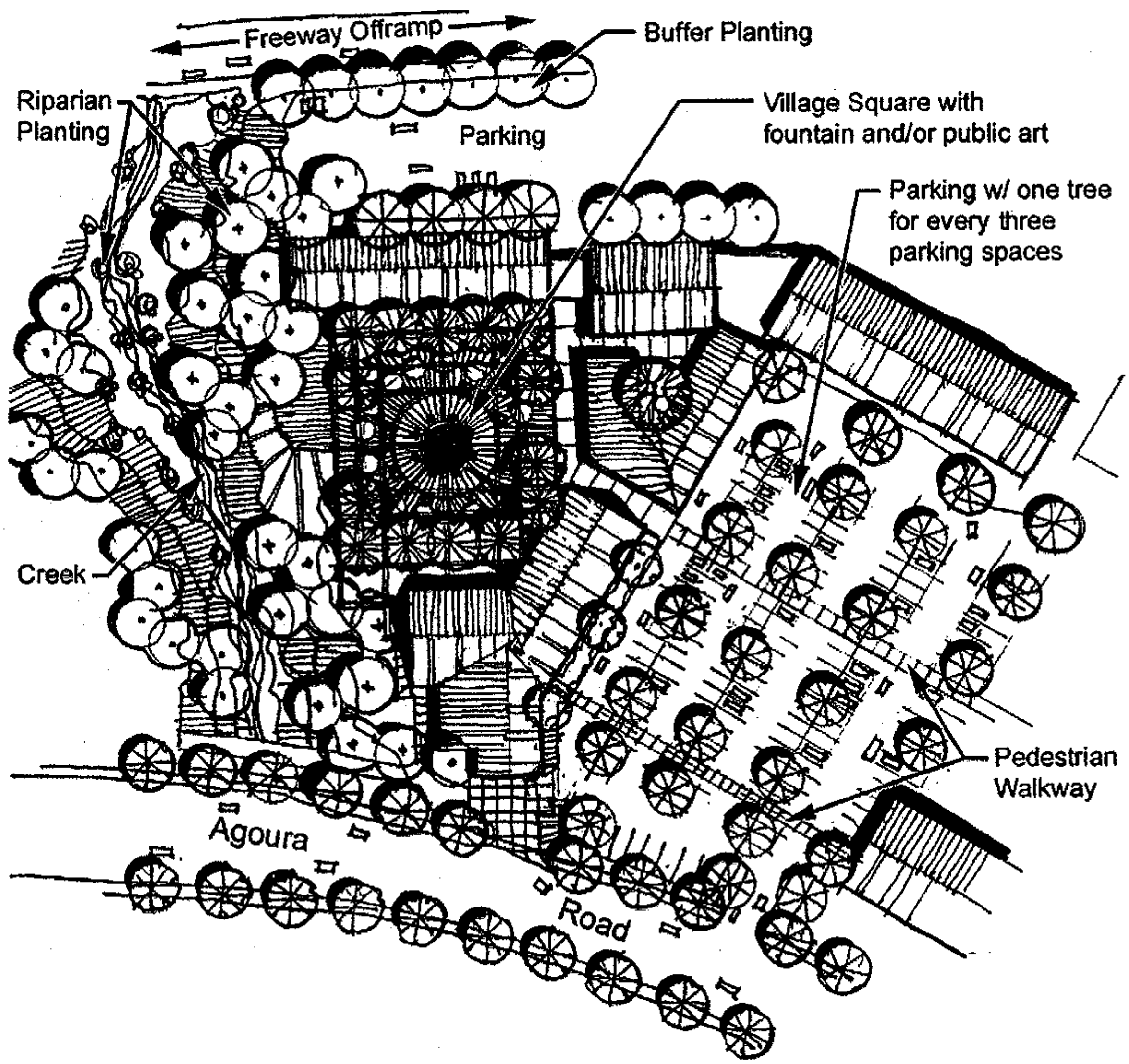
This narrative vignette establishes the guiding vision for the future of the Las Virgenes Gateway Area presented in this Master Plan. This vision includes the following components:

- A small thriving neighborhood commercial center that serves local residents with shops and services that meet everyday needs.

"The rural setting is punctuated by lush indigenous landscaping that lines the roadway and center median. The architecture of new and remodeled buildings reflects the rural character of traditional Southern California. Sidewalks and driveways are lined with rail fences set into stone pillars."


Las Virgenes Gateway Area
Illustrative Plan
CITY OF CALABASAS
NORTH
SCALE: 1"= 200'
100'
200'
400'
City Entry
Bridge Enhancements
Highway Commercial with "Park n' Ride"
Highway Commercial w/ shared parking
Las Virgenes Raod
Neighborhood Commercial w/ public space oriented to creek
City Entry
Malibu Creek Restoration
Bridge Enhancements and pedestrian access
Office/ Commercial and Single Family Residential
Agoura Road
Creekside Trail
Access to Hillside Trails
Gateway
Multi-Family Residential or Senior Continuum of Care facility
Hillside Sensitive Multi-Family Residential
Scenic Corridor with Bikeways

- A highway oriented commercial center that provides auto services and quick food for visitors, as well as local residents.
- A modest yet cohesive streetscape that draws visitors from the highway along the Las Virgenes corridor to Malibu Creek Park and the Santa Monica Mountains.
- Monumentation at Highway 101 is prominently dieplayed to establishes this area as a gateway to western Calabasas as well as the state and national parks.
- Traffic flow and parking is managed to provide safe vehicular



New commercial retail around an open village square are envisioned for the abandoned auto dealership. A reclaimed creek with restored planting will grace the western edge of the development.

movements and access for pedestrians.

- Pedestrian access from the business park to the west is enhanced to draw lunchtime walkers to the neighborhood commercial center.

- A reclaimed creek that collects drainage for the area, provides control of flood waters as well as plant and animal habitat. This natural environment also provides a peaceful respite from urban experience.

- A multi-use trail along the creek corridor connects the southern residential areas to the neighborhood commercial center and encourages local residents to walk or bike to their destinations.

- Low profile residential development is tucked into the east hillsides.

- A small office/commercial center located at the base of the east hillsides along Las Virgenes Road at the Agoura Road intersection.

- A linear park through the area links Malibu Creek State Park to areas north of the freeway.

An illustrative graphic of the Las Virgenes Gateway Master Plan is provided here. This graphic is a conceptual overview of the land use and urban design strategies for the area. The focus of the plan is to recommend appropriate land uses, suggest internal circulation and parking improvements and encourage streetscape improvements. The Plan adoption process will also implement the necessary General Plan Amendments. The illustrative plan shown here is not intended to specify actual projects to be built or actual site plan layouts. It also does not bind the City or property owners to building specific projects. However, the site plan recommendations should be considered in the review and approval of project applications.

3 Master Plan Goals

MASTER PLAN GOALS AND OBJECTIVES

The Master Plan establishes a foundation for appropriate growth within economic and environmental parameters. The Plan seeks to assure that new development and change to existing developments occur in a manner that is compatible with the community's vision.

"The Plan seeks to assure that new development and change to existing developments occur in a manner that is compatible with the community's vision."

This section of the plan sets goals and objectives to guide land use planning efforts, revitalization plans and for the review of new private development proposals. These statements are guidelines for decision making and indicate direction, priorities and the vision for the future.

The Master Plan has four key goals and various objectives that provide the policy framework for the Plan. The Goals are general statements that promote the vision. Objectives provide specific direction for accomplishing the goal. These objectives were defined in the community workshops and have been refined by the City decision makers in their public hearings:

GOAL 1 - ENHANCE THE AESTHETICS OF THE LAS VIRGENES GATEWAY AREA AND PROMOTE THE COMMUNITY'S RURAL CHARACTER.

Objective 1.1 - Provide a unified rural vision and theme for the architecture of private development and for private property landscaping.

Objective 1.2 - Provide design standards for private property to carry out and enforce the community's rural vision and theme.

Objective 1.3 - Integrate the design elements with the Las Virgenes Corridor Plan, the General Plan and the Scenic Corridor Ordinance.

Objective 1.4 - Provide a plan for "gateway" Monumentation.

Objective 1.5 - Provide sign standards consistent with the rural theme to control signage and create an aesthetic gateway.

Objective 1.6 - Provide for the removal of existing non-conforming freeway-oriented pole signs.

Objective 1.7 - Require a component of new development on the former auto dealership property to orient to the creek. Wood decking with seating, a plaza area and pedestrian paths should be included in the development plans.

Goal 2 - Preserve the environmental integrity of natural features and prevent significant environmental impacts.

Objective 2.1 - Provide special development standards to protect and enhance natural features including the hillsides and Malibu Creek.

Objective 2.2 - Integrate development standards of the General Plan, the Development Code and the Scenic Corridor Ordinance into Master Plan standards.

Objective 2.3 - Tailor established development standards for protection of hillside view corridors to meet Las Virgenes Gateway needs.

Objective 2.4 - Provide a plan for safe and efficient vehicle access and parking.

Objective 2.5 - Provide a plan for enhanced pedestrian access.

Objective 2.6 - provide a plan for restoring Malibu Creek to a more natural form.

Goal 3 - Provide a land use plan that maintains a balance of uses, compatible with the existing surrounding neighborhoods.

Objective 3.1 - Address the appropriate land use for parcels with approved or pending projects that have conflicts with the General Plan, Zoning or adjacent land uses.

Objective 3.2 - Establish specialized land uses designations and development standards to address hillside lands.

Objective 3.3 - Establish specialized land uses designations and development standards for a neighborhood serving village center.

Objective 3.4 - Establish specialized land uses designations and development standards to address highway-oriented land uses.

Objective 3.5 - If the neighborhood serving commercial center has not developed within five years of Plan adoption, the City should perform an economic/marketing study for the area. The findings of this study should be considered for determining if modifications to the land use plan and development standards are appropriate.

GOAL 4 - PROVIDE AN IMPLEMENTATION PLAN TO CARRY OUT THE LAND USE PLAN, THE DESIGN STANDARDS AND THE PUBLIC IMPROVEMENTS.

Objective 4.1 - Implement the General Plan Amendments and Zoning changes to carry out the Master Plan.

Objective 4.2 - Develop the Master Plan as a marketing tool to encourage appropriate new development such as a neighborhood serving commercial center.

Objective 4.3 - Develop a creek restoration plan that can be used to secure grants for creek enhancements or other environmental and/or recreational funding opportunities.

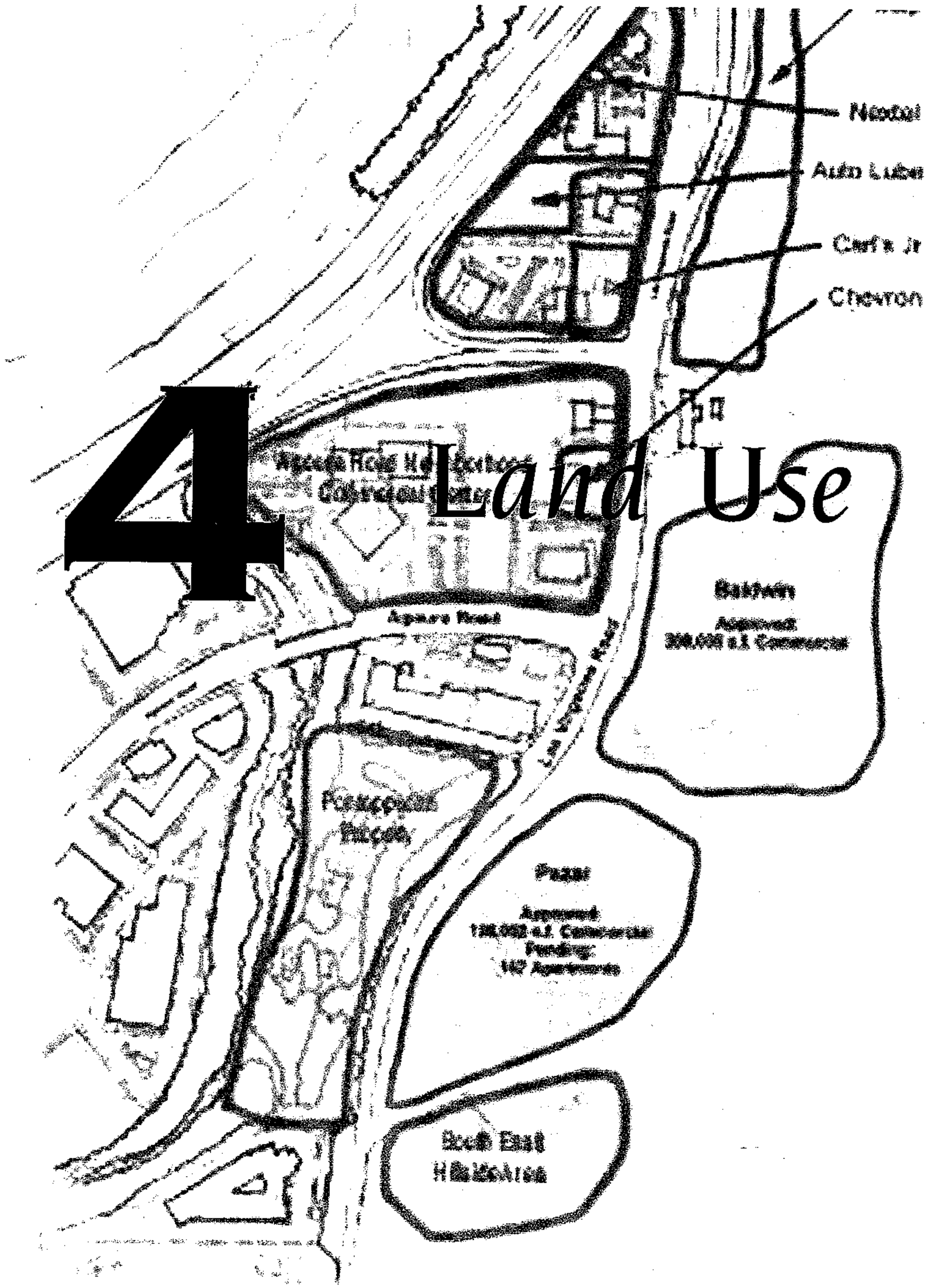
Objective 4.4 - Develop a plan for streetscape improvements consistent with the Las Virgenes Corridor Plan.

Objective 4.5 - Address methods to provide landscaping along freeway edges.

Objective 4.6 - Develop and adopt architectural and landscape design standards for use in the development review process.

Objective 4.7 - Develop and adopt sign standards for use in the development review process

4 Land Use



LAND USE PLAN

The City of Calabasas has a distinctive character derived from the oak studded hillsides, the green open spaces and the small pockets of commercial and residential development. The Las Virgenes corridor that serves as the western gateway to the City should echo this distinctive character. A significant concern in the Las Virgenes Gateway area is the type, intensity, location and character of land uses that will be permitted in the future. The Land Use Plan contained in this Master Plan addresses permitted, non permitted and encouraged land uses within the planning area. The location of each land use is indicated on the Land Use Map exhibit. To implement the Land Use Plan, General Plan and Development Code amendments will be required. These amendments are outlined in Chapter 9.

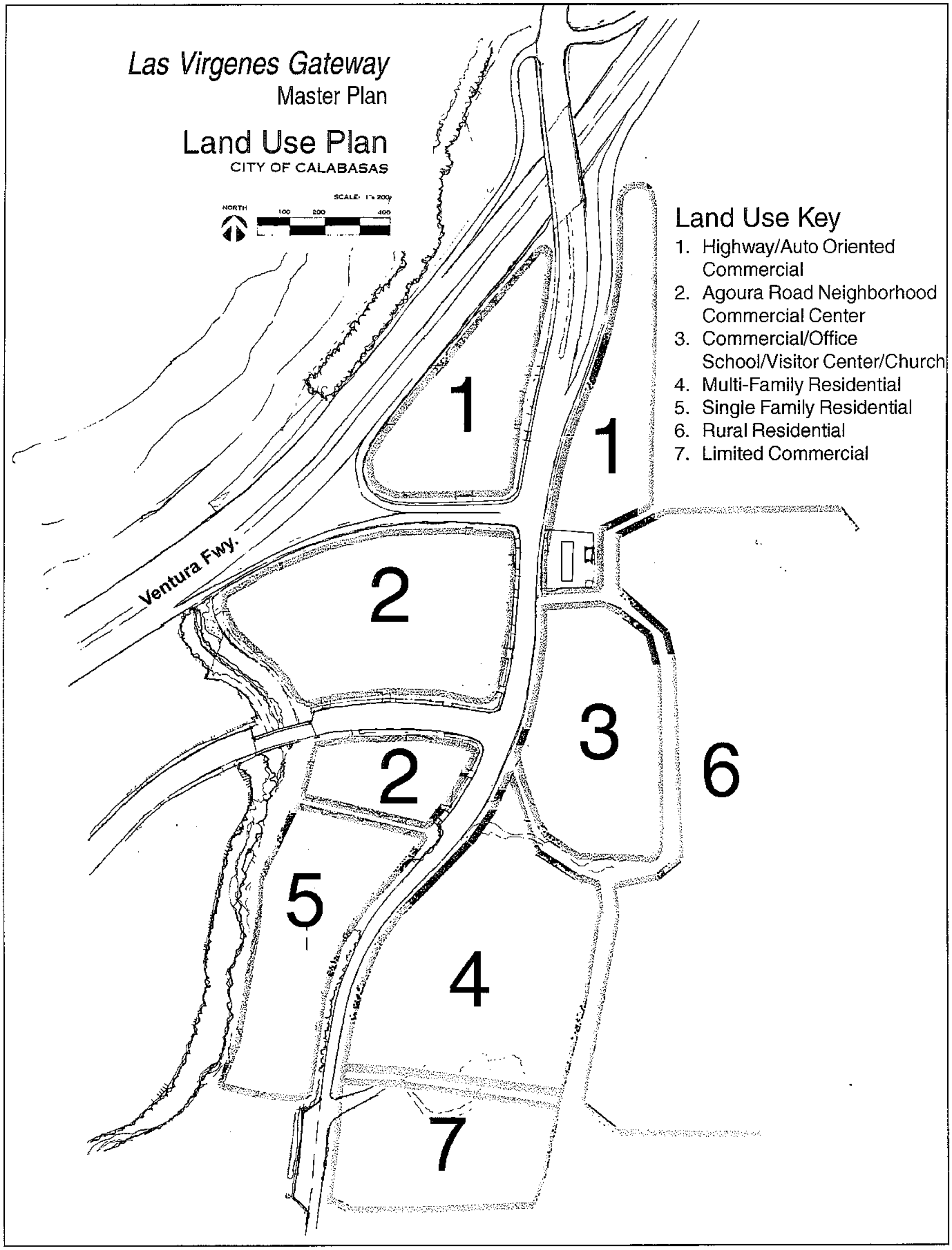
"A significant concern in the Las Virgenes Gateway area is the type, intensity, location and character of land uses that will be permitted in the future. "

It should be noted that several approved but not built developments on the east hillsides predate adoption of the City's General Plan and this Master Plan. The City acknowledges its legal responsibility to recognize valid development agreements and permits. However, the City also recognizes that given current market demands and project status, such development may not occur. In formulating the Master Plan, the City defined land uses and development intensities that reflect a compromise that is consistent with the Master Plan goals. The Plan recommendations are the preferred alternatives for new development in these areas.

EXISTING LAND USE DESIGNATIONS, GENERAL PLAN POLICIES AND DEVELOPMENT STANDARDS

The City has adopted strong measures to promote appropriate development within the City. These measures include General Plan polices, the General Plan Performance Standards, the Scenic Corridor Ordinance and Development Code Standards. All of these measures will continue to provide the criteria upon which new development will be reviewed. The Land Use Plan presented here augments these standards to provide additional guidance for new development. Maximum densities contained in this Plan shall be balanced against topographic and natural site constraints and be subject to the General Plan Consistency Review program. The following list contains excerpts of important existing policies and standards that should be emphasized in the review of new development:

General Plan Policies - The General Plan contains goals and policy statements to guide new development. Relevant policies are as follows:


Las Virgenes Gateway
Master Plan
Land Use Plan
CITY OF CALABASAS
NORTH
Land Use Key
1. Highway/Auto Oriented Commercial
2. Agoura Road Neighborhood Commercial Center
3. Commercial/Office School/Visitor Center/Church
4. Multi-Family Residential
5. Single Family Residential
6. Rural Residential
7. Limited Commercial
Ventura Fwy.
1
1
2
2
3
4
5
6
7

Open Space
Preserve the view of area hillsides and open ridgelines.

Hillside Management
Maintain the visual character of hillsides.

Minimize the alteration of existing land forms and maintain the natural topographic characteristics of hillside areas, allowing only the minimal disruption required to recognize basic property rights.

"Maintain the visual character of the hillsides."

Protect the natural character of hillside areas by means of land sculpting to blend graded slopes and terraces with the natural topography.

Preserve all significant ridgelines and other topographic features such as knolls, rock outcrops, canyons and woodlands.

Avoid mass graded "mega pads" for development. Smaller steps or grade changes shall be used over single large slope banks to the greatest extent feasible.

Biotic Resources
Ensure that new development protects riparian areas, oak woodlands, habitat linkages and other biologically sensitive habitats.

Require that construction be separated from sensitive resources through buffers, setbacks, and protective fencing.

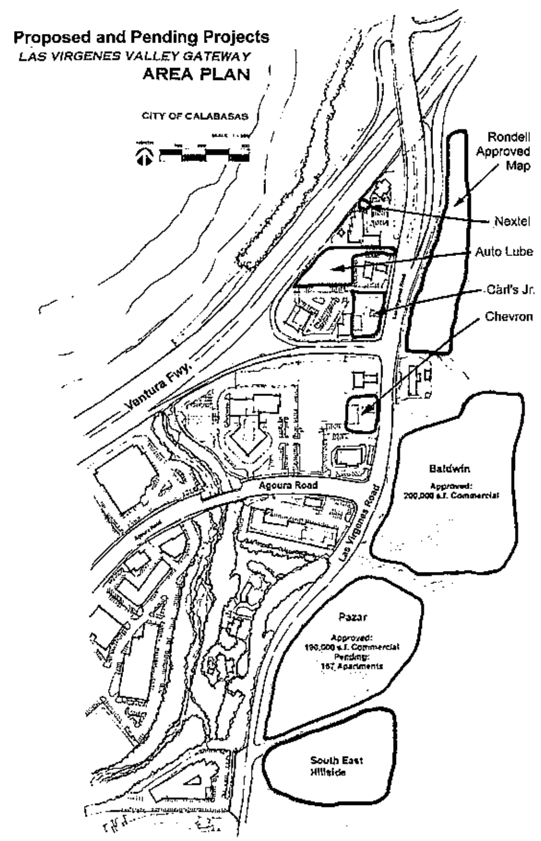
Land Use
Emphasize retention of Calabasas' natural environmental setting, semi-rural character and scenic features as a priority over the expansion of urban areas.

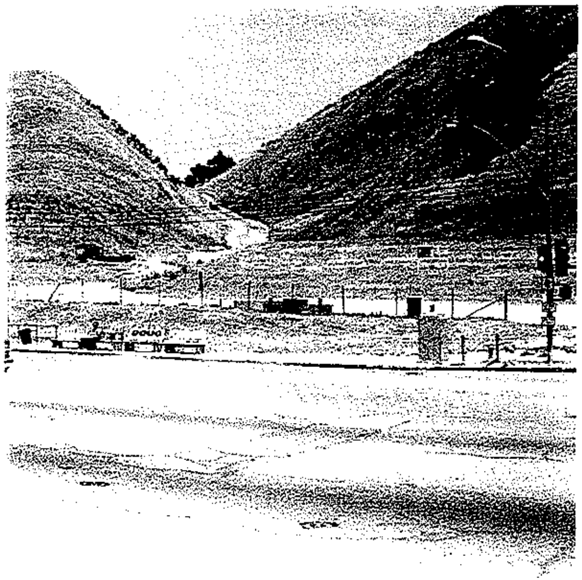
Require that new commercial development be compatible the overall semi-rural and residential character of the community.

Limit approval of new discretionary development to those which can be integrated into the community, providing for protection of existing residential neighborhoods and desirable non-residential land uses, as well as that which represents the rational utilization of presently uncommitted open space.

Community Character
Maintain the total square footage of structures at a size that maintains the area's open space character and is compatible with the surrounding hillsides.

Encourage the clustering of development to preserve significant environmental features.





Limit the intensity of new business/office parks to that which is consistent with Calabasas' special character and its semi-rural image.

Community Image
View new development not as freestanding features, but as potential additions to an integrated community which must conform to community values and make a positive contribution to the community's quality of life.

Municipal Services and Facilities
Place the ultimate responsibility on the sponsor of new development to ensure that the facilities needed to support the project are available at the time that they are needed.

General Plan Consistency Review Program - Performance standards are provided by which General Plan consistency will be judged

LAS VIRGENES GATEWAY MASTER PLAN RECOMMENDED LAND USE CHANGES (11/12/98)

	EXISTING GENERAL PLAN/ZONING DESIGNATIONS	EXISTING BUILD-OUT POTENTIAL	PROPOSED GENERAL PLAN/ZONING DESIGNATIONS	PROPOSED BUILD-OUT POTENTIAL
RONDELL PROPERTY 4.13 Acres	GP: Hillside Mountainous Zoning: Hillside Mountainous	1 Unit	GP: Business-Retail Zoning: Commercial-Retail LV Overlay Zone	40,000 sq ft. highway Commercial and park n' ride or transit center
BALDWIN/VILLAGE PROPERTY **61.4 Acres commercial and 30 Acres residential**	GP: Business-Retail with Urban Hillside Overlay and Rural Residential with Urban Hillside Overlay. Zoning: Commercial-Retail Planned Development and Residential-Rural Planned and Development.	Development Agreement for approximately 200,000 sq ft of retail commercial.	GP: No Designation Change. Zoning: No Change, Commercial use limitations under the LV Overlay Zone	Office/Commercial development up to 50,000 sq. ft., 50,000 sq. ft institutional (church/visitor etc.); Up to 30 single family residences on 30 acres with residential designation, depending on site/environmental constraints
PAZAR PARCEL **12 Acres**	GP: Business-Retail with Urban Hillside Overlay. Zoning: Commercial-Retail Planned Development.	Development Agreement for 190,000 sq ft of commercial development.	GP: Residential- Multiple Family. Zoning: Residential-Multiple Family, Planned Development 12-16 units/acre. LV Overlay Zone	Up to 144 market rate units or 192 affordable and/or senior units depending on site/environmental constraints.
SOUTH EAST PARCELS **19.64 Acres**	GP: Business-Limited Intensity Zoning: Commercial-Limited	171,100 sq. ft of commercial floor area depending upon site/environmental constraints (FAR 0.2 maximum)	Same as existing	Same as existing
PONTOPPIDAN PROPERTY **7.58 Acres** **2-6 du's/ac**	GP: Residential-Single Family Zoning: Residential-Single Family	15 single family residences 15-37 + 25% density bonus for senior or low/moderate income housing	Same as existing	Same as existing
AGOURA ROAD NEIGHBORHOOD CENTER	GP: Business-Retail Zoning: Commercial-Retail	126,240 sq. ft. based on vacant lands of 7.36 acres (FAR 0.2 - 0.4)	GP: Business-Retail Zoning: Commercial-Retail with LV Overlay Zone.	95,180 sq. ft. based on vacant lands of [illegible] acres at FAR 0.3. Uses to be limited to Neighborhood Serving Commercial.
HIGHWAY TRIANGLE	GP: Business-Retail Zoning: Commercial Retail	22,651 sq. ft. based on vacant lands of 1.3 acre (FAR 0.2 - 0.4)	GP: Business-Retail Zoning: Commercial-Retail with LV Overlay Zone	16,980 sq. ft. based on vacant lands of 1.3 acres at FAR 0.3 Uses to be limited to Highway/Auto Oriented Commercial.

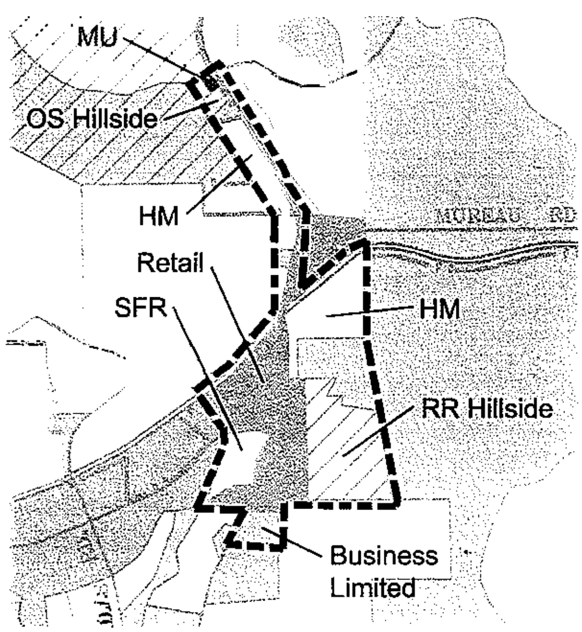
for new development proposals. Relevant standards include Hillside Development, Biotic Resources, Erosion Control, Seismic and Geologic Hazards, Stormwater Management and Flooding, Fire Hazard, Urban Design, and Quality of Life.

Scenic Corridor Ordinance - Las Virgenes Road is a designated scenic corridor. Therefore, all properties located within 500 feet of the road right-of-way and all properties between the right-of-way and the prominent ridge lines are subject to this ordinance. This ordinance specifies the following development guidelines:

- New development shall underground all utilities.
- All roofs shall be surfaced with medium dark colored fire retardant non-glare materials and no obtrusive equipment shall be placed on the roof.
- Colors of fences and walls shall blend with the natural environment.
- Building setbacks from freeways and open spaces between buildings adjacent to the freeway shall be increased to allow landscaping.
- Landscaping and tree planting should visually enhance, soften or conceal as much as possible.
- Lighting shall focus the light directly to the ground to prevent illumination of the night sky and adjacent properties.
- Parking lots shall be screened with earth berms, landscaping and innovative decorative walls.
- Grading shall be kept to an absolute minimum. All grading shall be contour graded, gently sculpted and softened to blend with natural contours, and landscaped with environmentally appropriate trees and shrubs.

Calabasas Land Use and Development Code - This document specifies the allowed land uses within each zone district, as well as the height, setback, floor area ratios, site coverage, parking provisions and required permits. This code also contains development standards for access, circulation, Design, Biotic Resources, Drainage, Fences & Walls, Freeway Corridor Development, Hillside & Ridgeline Development, Screening, and Solar Energy.

Existing General Plan Land Use Designations - The lands with in the Plan boundary currently have a mix of commercial and residential land use designations that were adopted with the City's General

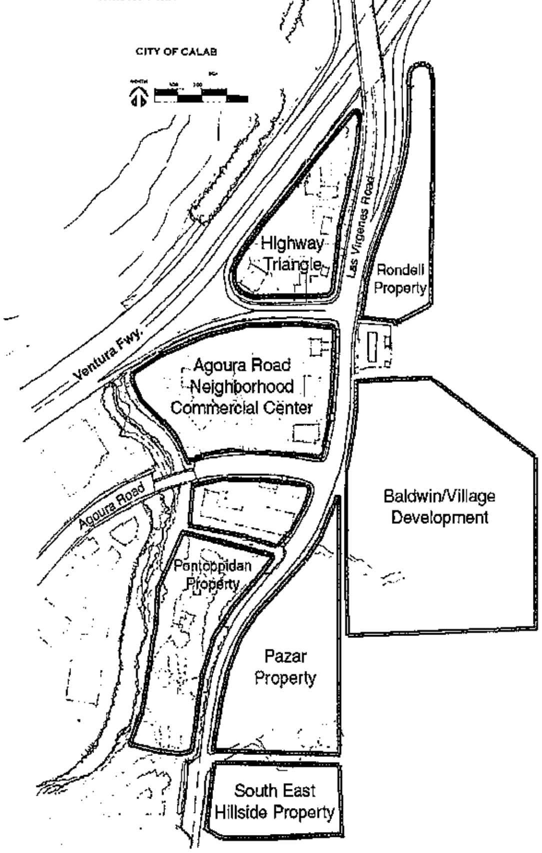


Existing General Plan Designations

Plan in 1995. The specific designations are as follows:

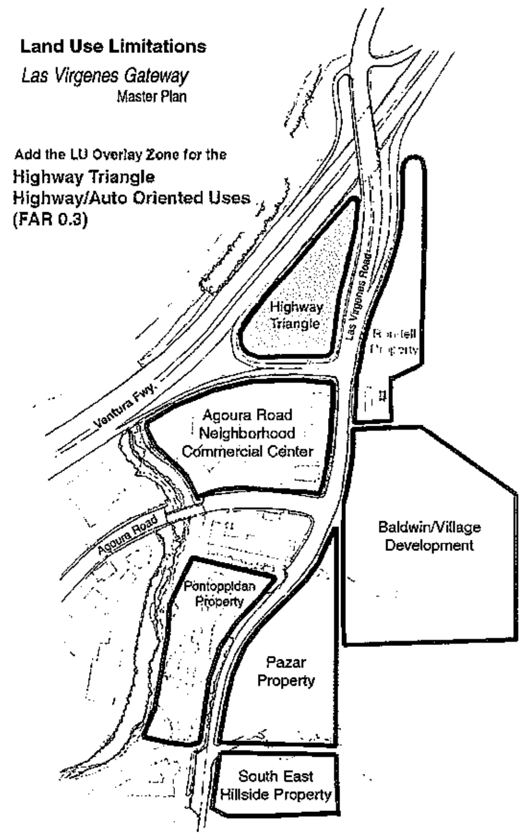
- The Northwest Hillside City lands located north of the freeway and west of Las Virgenes Road are designated Hilside Mountainous. The adjacent County lands that front on Las Virgenes Road are designated for Agricultural use.
- The neighborhood commercial center on the west just south of the Las Virgenes Road/Thousand Oaks Blvd. intersection has a Mixed Use designation.
- The lands north of the freeway at Mureau Road are planned for Busisness Professinal Office uses.
- Immediately south of the freeway, along the east side of Las Virgenes Road, an area referred to as the Rondell Property is designated Hillside Mountainous.
- The lands on the east sdie of Las Virgenes Road at the Agoura Raod intersection, including the Pazar Parcel and a portion of the Baldwin/Village lands have a designation of Business Retail/Urban Hillside. To the east of these lands are additional Baldwin/Village property with a Rural Residential/Urban Hillside designation.
- The southernmost parcels on the east side of Las Virgenes Road, referred to as the South East Hillside Property, are designated for Business Limited Commercial.
- South of the freeway, on the west side of Las Virgenes Road, in an area referred to as the Highway Triangle, the lands are desinged Business Retail.
- The lands along Agoura Road, identified as the Neighborhood Commercial Center in this Plan, are planned for Business Retail land uses.
- The southernmost lands on the west side of Las Virgnes Road, the Pontoppidan property, are designated for Single Family Residential development.

Planning Sub Areas
Las Virgenes Gateway
Master Plan



Land Use Plan Objectives

When carrying out the Land Use Plan, the following objectives shall be pursued for the flisted sub-areas within the Master Plan and adjacent County lands. *All other lands in the Plan area, not discussed below, shall remain under the General Plan and Zoning designations existing at the time the Master Plan is adopted. Except, the Las Virgenes Gateway Overlay Zone shall be applied to all properties in the Plan area.* Future General Plan and Zone change requests can be considered by the City on a case by case basis when appropriate information is provided by the applicant. Such changes should be judged against the overall objectives of this Plan as well as on-site environmental constraints.



The Highway Triangle - This area includes all properties along the west side of Las Virgenes Road from the freeway to the southbound freeway off ramp.

Highway/auto-oriented commercial uses shall be allowed, under the General Plan Business Retail designation and the Commercial, Retail zone designation. All ground floor uses in this area shall be highway/auto-oriented uses such as auto service, gas stations, mini-marts, fast food convenience stores and restaurants. Upper floor uses can be any use allowed under the Commercial, Retail zone designation. Development intensity shall be limited to a Floor/Area Ratio of 0.3.

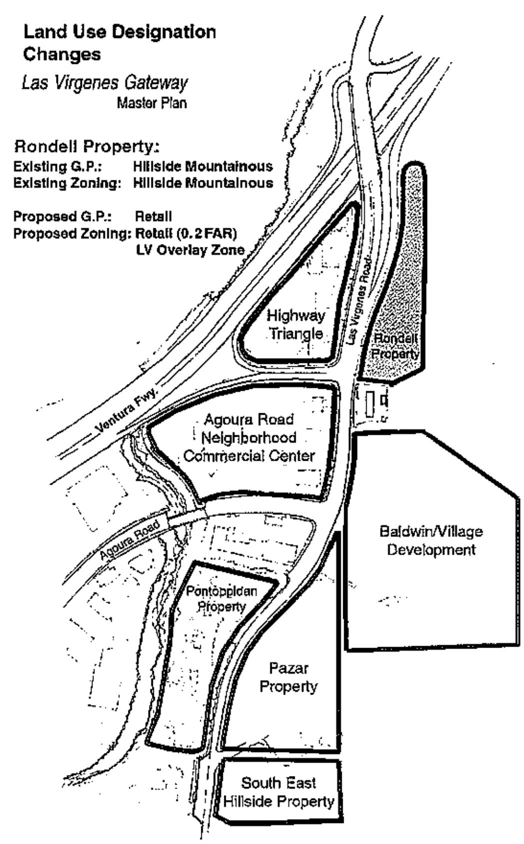
New drive-in or drive-through uses where vehicles que-up with idling engines shall be prohibited, pursuant to the provisions of the City's Development Code.

Reciprocal access and parking plans for internal circulation on contiguous parcels, shall be provided.

Driveways on Las Virgenes Road shall be minimized. Consider shared vehicular access for several parcels.

Telecommunication antennas located in this area shall be of "stealth design," co-located and concealed or integrated into the building.

An entry gateway feature shall be provided at the northeast corner of Las Virgenes Road and the freeway on/offramps (at the Rondell parcel). The northwest corner of this intersection should also receive gateway treatments. This feature shall be consistent with the gateway plan presented in Chapter 9.



The Rondell Property - This 4.1 acre area located on the east side of Las Virgenes Road on the north side of the Mobil gas station is currently designated Urban Hillside but due to Las Virgenes Road frontage and the moderate topography adjacent to the road, could be developed with highway-oriented commercial uses. A General Plan Amendment and Zone change to Business-Retail will be necessary to implement this portion of the Land Use Plan.

Llimited retail/highway/auto-oriented development shall be allowed consistent with the General Plan Business-Retail designation and the Commercial, Retail zone designation. The allowed uses shall include hotel/motel uses. Development intensity shall be limited to a

Floor/Area Ratio of 0.2 or 40,000 square feet, which ever is less. All uses in this area shall be highway/auto-oriented uses such as auto service, gas stations, mini-marts, fast food convenience stores and restaurants.

A park and ride or mini-transit center is a referred use in the public right-of-way. The safety aspects of automobile ingress an egresst shall be examined when such a use is proposed. This park and ride could aslo serve as a trail head for a public trail to the east.

Driveways from Las Virgenes Road shall be minimized. Consider shared vehicular access for several parcels.

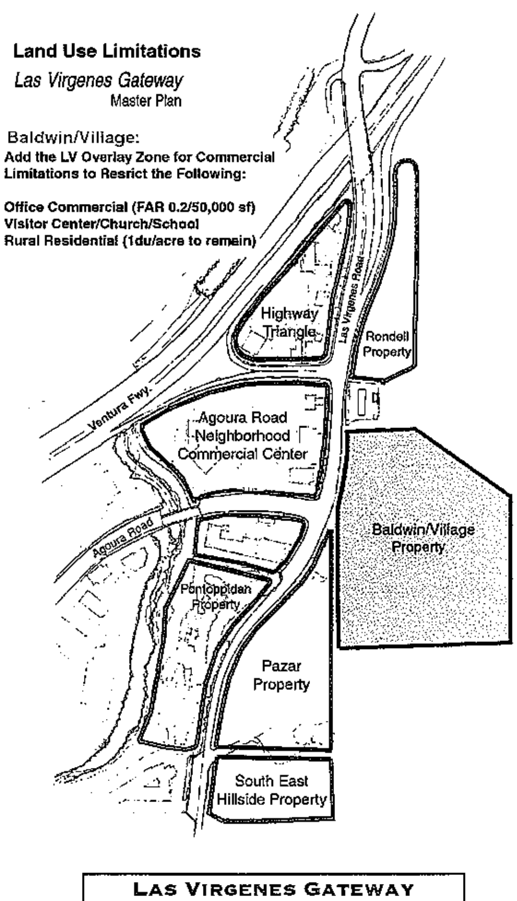
New drive-in or drive-through uses where vehicles que-up with idling engines shall be prohibited, pursuant to the provisions of the City's Development Code.

An entry gateway feature shall be provided at the northeast corner of Las Virgenes Road and the freeway on/offramps This feature shall be consistent with the gateway plan presented in Chapter 9.

The Baldwin/Village Development - This land encompasses 138.37 acres on the east side of Las Virgenes Road starting at the Las Virgenes/Agoura Road intersection and encompassing the hillside area to the east. These lands are currently designated Business-Retail and Rural Residential with an Urban Hillside Overlay. However, an entitlement exists for commercial development as granted by Los Angeles County. A General Plan and Zone amendment may be necessary for this property, if the location of proposed development does not coincide with the existing General Plan and Zone boundary lines. Any such changes should be appropriate for the land forms on the property. If an agreement is reached for an exchange of Conservancy Open Space lands for Rural Residential lands with development constraints, a General Plan and Zoning change shall be processed.

An office/commercial development shall be allowed, located at the east extension of Agoura Road consistent with the General Plan designation of Business Retail and the zone designation of Commercial, Retail. Development intensity shall not exceed a Floor/Area Ratio of 0.2 or 50,000 square feet, which ever is less. In this area, office use shall encompass up to 75% of the building(s) floor area. This lower FAR is proposed to minimize development in this hillside area and provide a transition to residential and open space uses.

A park visitor center and staging area for access to open space/ protected lands is a preferred use and shall be provided in any new commercial development, if feasible.



Lands for a church, child care center and/or one school (limited to approximately 350 students) shall be provided, if feasible.

Clustered detached single family residences at a density of one dwelling unit per acre or senior/affordable housing may be done consistent with the City's Development Code. Residential density shall be calculated on the lands not developed for commercial/public or institutional uses.

Driveway access from Las Virgenes Road shall be minimized. Shared vehicular access for several parcels should be provided.

Gateway feature(s) shall be provided at the corner of Las Virgenes Road and the extension of Agoura Road. This treatment shall include stone monumentation, landscaping and open space consistent with the gateway feature plan in Chapter 9.

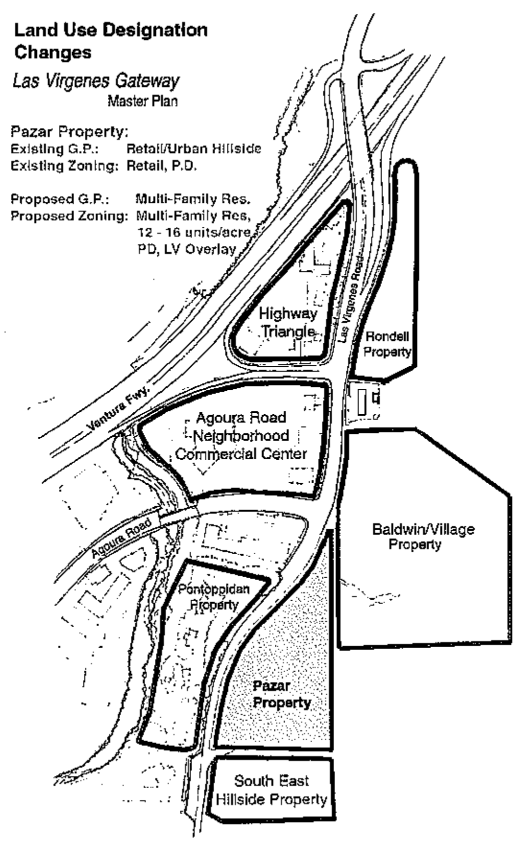
All existing on-site oak trees shall be retained to the greatest extent feasible.

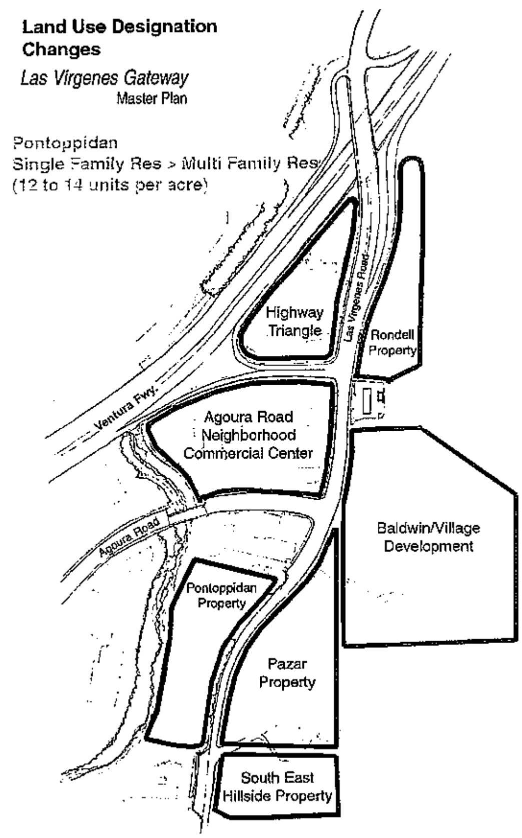
Development shall respect the topography by stepping up and down the slopes. The development shall also blend with the hillside through a variety of massing and the use of muted earthtone colors.
Buildings shall be sited to provide a view corridor through the site to the background hills as seen from the Las Virgenes Road freeway overpass, looking south.

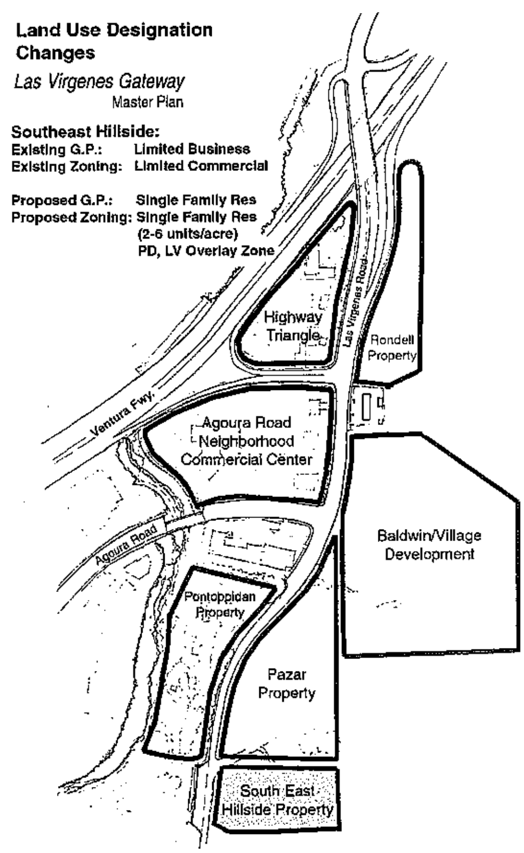
Large retaining walls (over 6 feet in height) shall be avoided. Retaining walls shall be either reinforced earthen wall construction (or similar technology), or faced with stone. Along the Las Virgenes Road frontage, retaining walls shall not be located at the sidewalk level. The slope in this area should be split by a retaining wall located halfway up the slope.

The Pazar Property - This land encompasses 12 acres on the east side of Las Virgenes Road just south of the end of Agoura Road. This land is currently designated Business-Retail with an Urban Hillside Overlay. An entitlement exists on this parcel for commercial development as approved by Los Angeles County. A General Plan Amendment and Zone change to Residential Multiple-Family Planned Development is recommended for this property.

Clustered detached single family or attached multi-family residences shall be allowed at a density of 12 units per acre under the General Plan Residential Multiple-Family designation and the Residential, Multi-Family, Planned Development zone designation. Senior or affordable housing may also be provided for an over all density up to 16 units per acre per the City's Development Code.







Driveway access shall be minimized from Las Virgenes Road. Shared vehicular access for several parcels shall be provided, as feasible.

A gateway feature shall be provided at the corner of Las Virgenes Road and the extension of Agoura Road. This feature shall include stone monumentation, landscaping and open space consistent with the gateway feature plan in this document.

All existing on-site oak trees shall be retained to the greatest extent feasible.

Development shall respect the topography by stepping up and down the slopes. The development shall also blend with the hillside through a variety of massing and the use of muted earthtone colors. Buildings shall be sited to provide a view corridor through the site to the background hills as seen from the Las Virgenes Road freeway overpass, looking south.

Large retaining walls (over 6 feet in height) shall be avoided. Retaining walls shall be either reinforced earthen wall construction (or similar technology), or faced with stone. Along the Las Virgenes Road frontage, retaining walls shall not be located at the sidewalk level. The slope in this area should be split by a retaining wall located halfway up the slope.

The Pontoppidan Property - This property includes 7.58 acres on the west side of Las Virgenes Road south of Agoura Road. This land is currently designated for Single Family Residential uses. At the request of the property owner, no land use amendment is recommneded at this time. When development is proposed for this property, a multi-use trail should be considered along the creek. this trail would connects with the residential neighborhood to the south and the commercial area to the north.

South East Hillside Property - This area includes 19.8 acres between the Pazar Property and the Water District headquarters. This land is currently designated Business-Retail with an Urban Hillside Overlay and zoned Commercial-Limited. No land use designation change is recommended at this time.

Driveway access shall be minimized from Las Virgenes Road. Shared vehicular access for several parcels shall be provided, as feasible.

A secondary gateway feature shall be provided along Las Virgenes Road on these property's frontages. This feature shall include stone monumentation, landscaping and open space consistent with the gateway feature plan in this document.

All existing on-site oak trees shall be retained to the greatest extent feasible.

Development shall respect the topography by stepping up and down the slopes. The development shall also blend with the hillside through a variety of massing and the use of muted earthtone colors. Buildings shall be sited to provide a view corridor through the site to the background hills as seen from the Las Virgenes Road freeway overpass, looking south.

Large retaining walls (over 6 feet in height) shall be avoided. Retaining walls shall be either reinforced earthen wall construction (or similar technology), or faced with stone. Along the Las Virgenes Road frontage, retaining walls shall not be located at the sidewalk level. The slope in this area should be split by a retaining wall located halfway up the slope.

The Agoura Road Neighborhood Commercial Center - This district encompasses the parcels bordering the west side of Las Virgenes Road between the southbound freeway off-ramp and Agoura Road as well as the seven acre vacant auto dealership parcel. (Parcels on both sides of Agoura Road, east of the creek are within this district.)

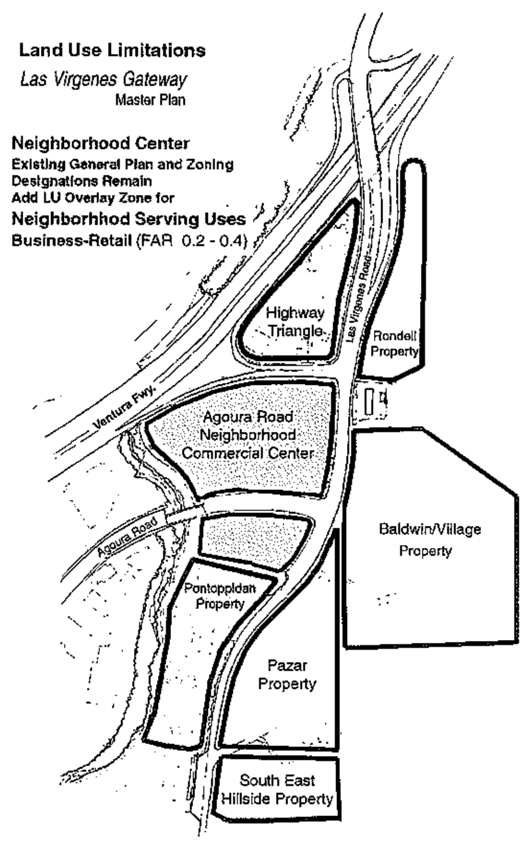
A neighborhood center with a lively environment for eating, shopping and socializing is the preferred land use. A neighborhood commercial center shall be allowed under the General Plan designation of Business-Retail and the Commercial, Retail zone designation. The development intensity shall be limited to a Floor/Area Ratio raange of 0.2 to 0.4. All uses in this area shall be neighborhood serving uses including the following preferred uses: Grocery store, pharmacy, bookstore, coffee shop, ice cream/yogurt shop, library annex, restaurants, deli, medi-center, community center and day care. A limited amount of hotel/motel uses shall also be allowed.

No more than one gas station and two fast food chain or franchise restaurants shall be permitted in this district.

Public and retail/service-oriented uses shall be provided on the ground floor. Upper level uses can be semi-private in nature (e.g. office, professional use).

New drive-in or drive-through uses where vehicles que-up with idling engines shall be prohibited, pursuant to the provisions of the City's Development Code.

Driveways on Las Virgenes Road shall be minimized and wherever feasible joint driveways shall be used to serve several properties.



A portion of new development shall orient to the creek with outdoor patios, plaza area, or creekside park.

Examine the feasibility of providing a library annex in this area.

Telecommunication antennas located in this area shall be of "stealth design," co-located and concealed or integrated into the building.

Development of the former auto dealership property shall include construction, funding and/or dedication of significant public improvements to further the Master Plan (e.g. pedestrian road crossing, creek reclamation, creekside park, library annex.)

A portion of the development on the auto dealership property shall front onto Agoura Road to establish a lively sidewalk environment for pedestrians.

Pedestrian and vehicular access shall be provided between the auto dealership parcel and the adjacent parcels that front on Las Virgenes Road.

A public view corridor shall be maintained into the former auto dealership site from Agoura Road.

A public view corridor shall be maintained to the creek from within the auto dealership property.

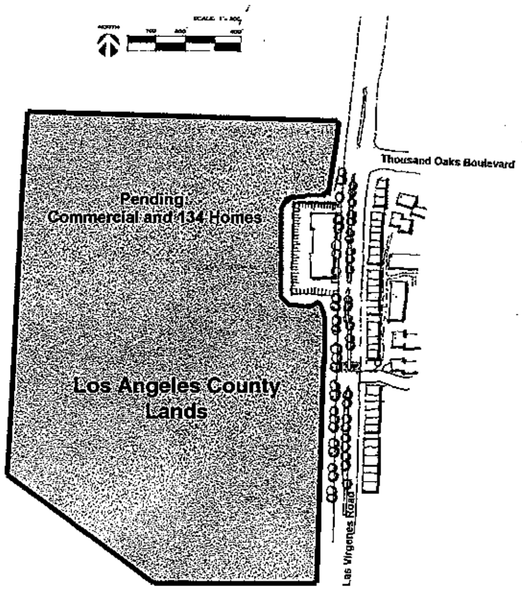
The Northwest Hillsides - This district encompasses a small mixed use parcel in the City and all lands outside the City limits on the west side of Las Virgenes Road, north of the Ventura Freeway. It is recommended that the County lands be annexed to the City.

The Mixed Use parcel shall retain the existing mixed Use designation.

Future development of County lands should provide approximately 10 acres for a school and associated playing fields. Or, at a minimum, 10 acres for only sports playing fields.

On County lands, clustered single family residences should be allowed at a density of 2 - 6 dwelling units per acre or senior housing at a an appropriate density under the General Plan Rural Residential-Single Family designation and the Rural Residential, Planned Development zone district. Residential density shall be calculated on the lands not developed for school/recreational use.

Northwest Sub-Area
Las Virgenes Gateway
Master Plan
CITY OF CALABASAS



LAS VIRGENES GATEWAY OVERLAY ZONE

The important site, neighborhood and environmental objectives listed above require particular attention in project planning and therefore they are addressed in the Master Plan by an Overlay Zone. The *Las Virgenes Gateway Overlay Zone* (LV Overlay Zone) is established to provide guidance for development and new land uses in addition to the standards and regulations of the underlying zoning districts as established in the City's Development Code. Where a conflict arises between the regulations of the underlying zone district and the LV Overlay Zone, the LV Overlay Zone will take precedence. The Overlay Zone provisions are outlined below but must be adopted by Ordinance in order to become effective.

The LV Overlay Zone is intended to apply to all properties in the Master Plan area. The applicability of the LV Overlay Zone to each specific parcel is shown on the maps in Appendix C.

Purpose - It is the purpose of this Overlay Zone to ensure consistency with the Las Virgenes Gateway Master Plan's land use plan, development standards and design standards. It is the intent also to prevent destruction of the natural beauty, open spaces and environment; to create a memorable gateway to the western portion of the City, the Santa Monica Mountains and Malibu Creek State Park; to protect and enhance private investment; and to protect and enhance the public health, safety and welfare.

Application - The LV Overlay Zone applies to all lands covered in the planning area addressed in the Las Virgenes Gateway Master Plan. The LV Overlay Zone shall be applied to the designated properties through a rezoning (an amendment to the Calabasas Zoning Map) and may be combined with a change in the underlying zoning district. All lands with the LV Overlay will also have an underlying base zone district.

Allowed Land Uses - The allowed land uses in the LV Overlay Zone area are as indicated below. The location of each land use/zoning designation is indicated on the Master Plan Land Use Map and specified in the Land Use Plan Objectives.

Permit Requirements - The permit requirements for development within the LV Overlay zone are the same as provided in the underlying zoning district.

Development Standards - All development within the LV Overlay Zone shall comply with the applicable provisions of the City's *Per-*

formance Standards for Hillside Development, Freeway Corridor Design Guidelines and *Urban Design Guidelines* and *Sign* Standards of the *General Plan Consistency Review Program*. All development shall also comply with all applicable provisions of the City's Development Code, the Scenic Corridor Ordinance and the Las Virgenes Gateway Master Plan. Additionally, the following special development standards shall apply:

No development shall be located on the east or west hillside areas along Las Virgenes Road at an elevation that is greater than half the height of the top of the ridgeline or backdrop hillside.

Vehicular access points onto Las Virgenes road shall be minimized. When another access point is available, no access shall be allowed onto Las Virgenes Road.

Vehicular parking areas shall be designed for efficiency and safety and shall incorporate reciprocal access and parking arrangements with adjacent properties, unless found to be infeasible.

A vegetative buffer zone is identified for all portions of Malibu Creek. A setback of 30-feet is required from the top of bank for all structures and paving. Natural surfaced trails and fencing can encroach into this setback. A setback of 50-feet is established for all habitable structures.

Required Findings - Approval of any new development or renovation of existing property shall require that the review authority make all the following findings, in addition to the findings required by Chapter 17.62 (Permit Approval or Disapproval) of the City's Development Code:

1. The proposed project complies with or accommodates the public improvement plan in the Las Virgenes Gateway Master Plan; and

2. The proposed project incorporates design measures to ensure maximum compatibility with the rural vision and theme of the Las Virgenes Gateway Master Plan; and

3. The proposed project incorporates architectural and landscaping elements that enhance the gateway; and

4. The project's vehicular access and parking plan minimizes conflicts and promotes efficient internal circulation and shared use of facilities wherever feasible.

5. "Preferred" land uses as specified in the Land Use Plan Objectives have been incorporated into the project, as feasible.

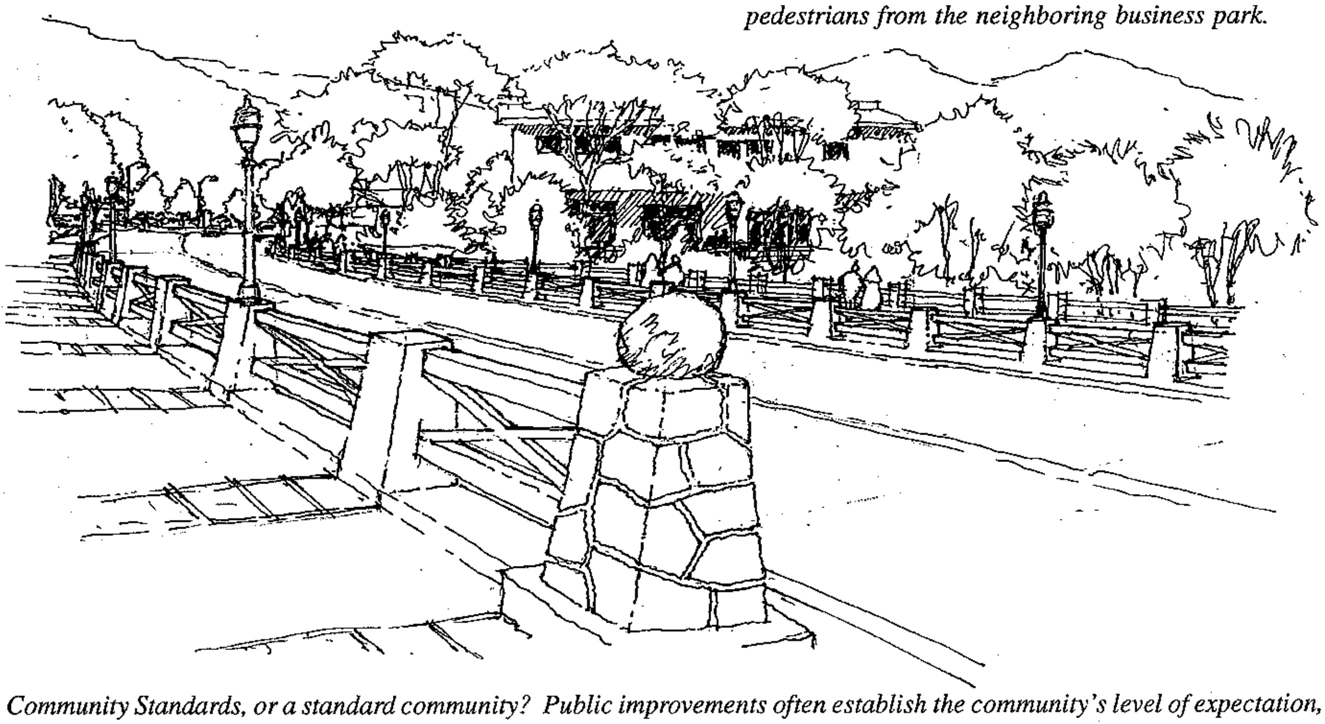
5 Conceptual Images

CONCEPTUAL IMAGES OF MASTER PLAN COMPONENTS

It is possible to build projects, both public and private, which are in harmony with the environment and character of the place of Calabasas. Architecture and site improvements which seek to compliment the natural setting - through the use of materials, colors and forms which are complimentary to the rural setting - can help preserve the character of the place while also providing the residents with needed services.

The illustrations provided in this chapter are not intended to specify actual projects to be built or actual site plan layouts. These vignettes do not bind the City or property owners to building specific projects. However, the conceptual plans should provide inspiration and be considered in the review and approval of project applications.

The Agoura Raod bridge as it crosses Malibu Creek presents offers little enjoyment for potential pedestrians from the neighboring business park.

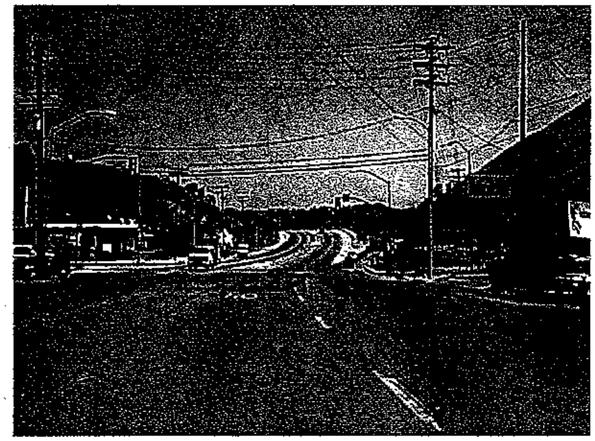


Community Standards, or a standard community? Public improvements often establish the community's level of expectation, and can remind us that we live in a unique and special place.

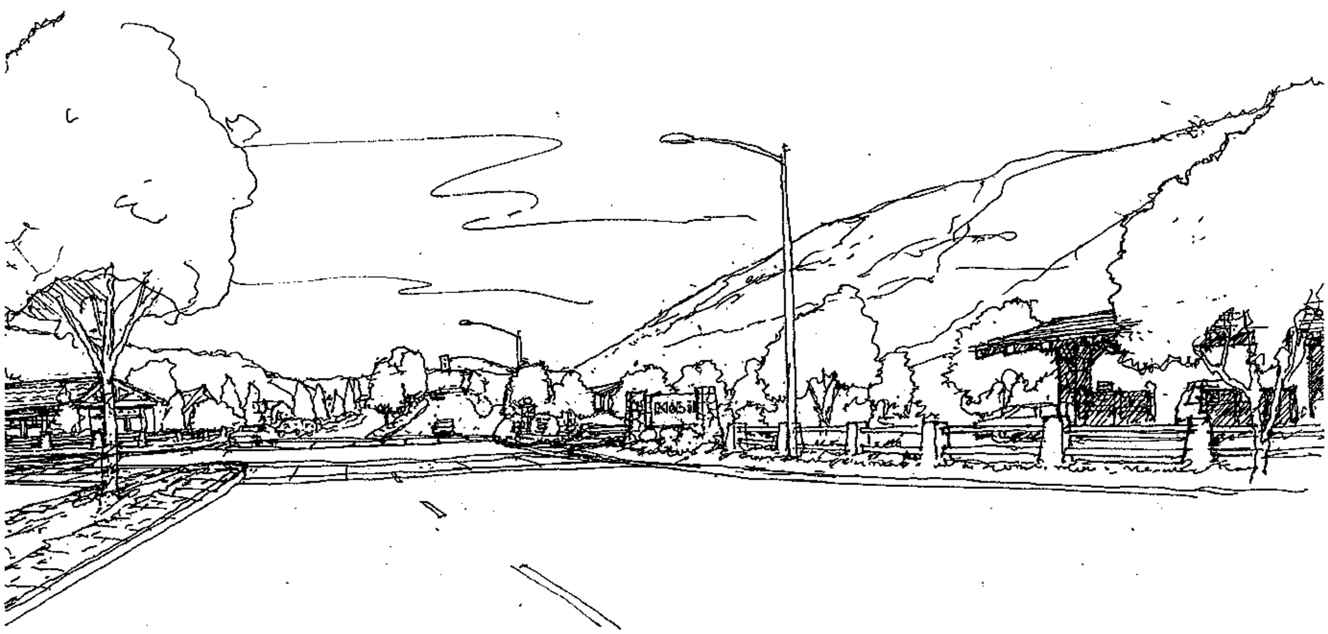
Much of the existing development in the project area was developed without consideration for the area's history and rural context.

"The architecture of new and remodeled buildings reflects the rural character of traditional Southern California." This quote from Chapter Two, "The Vision and Theme," expresses the community's desire to see development which is regional in its origin, respective of the area's history, climate and rural character.

The same project as it might appear if remodeled in conformance with the goals and guidelines of this Master Plan.



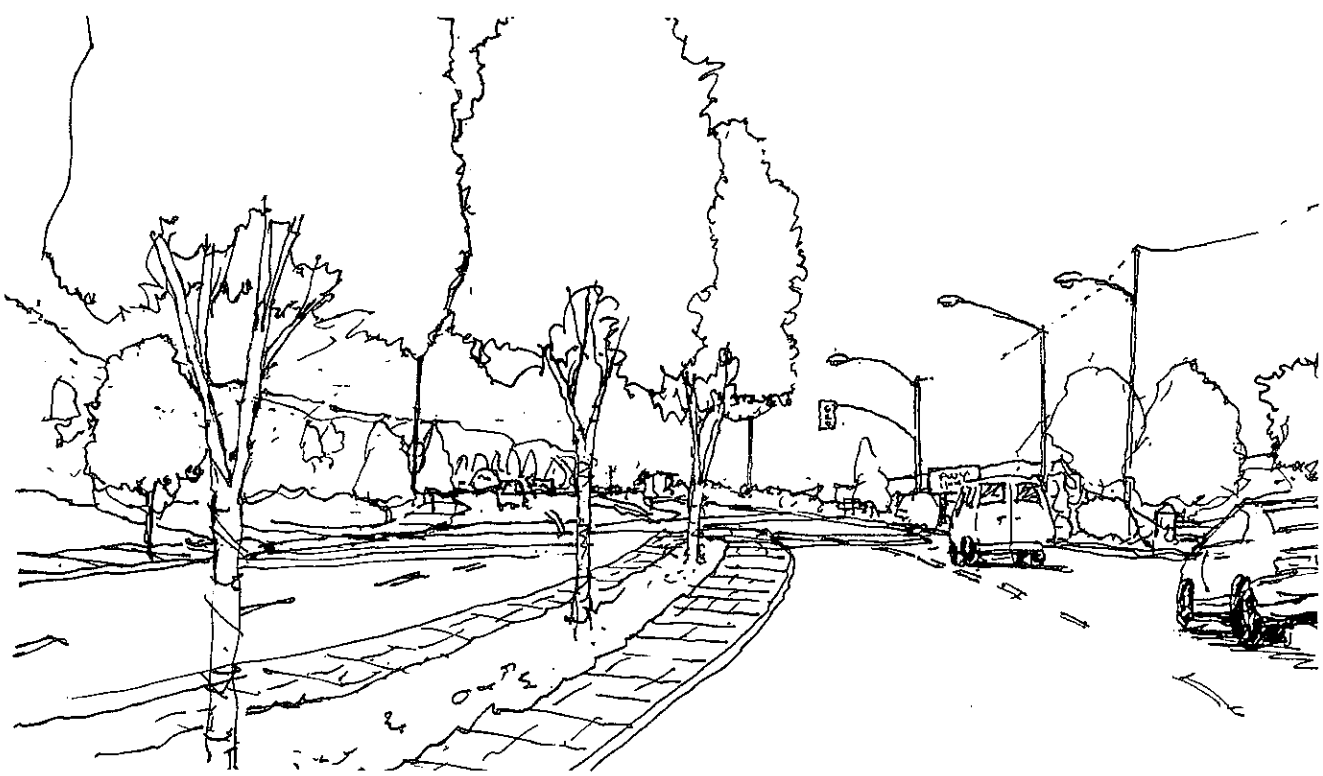
Las Virgenes Road has suffered without a long term vision to guide both private and public changes. (Las Virgenes Road at the 101 Freeway interchange, looking north.)



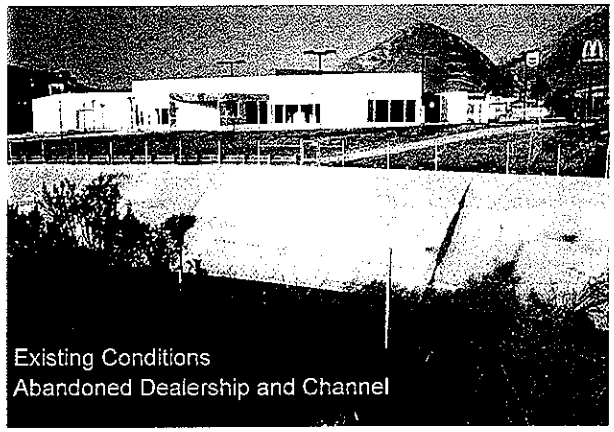
For the Las Virgenes Road area, it is the General Plan's intent that the natural hillsides dominate the freeway corridor at the Las Virgenes road interchange.

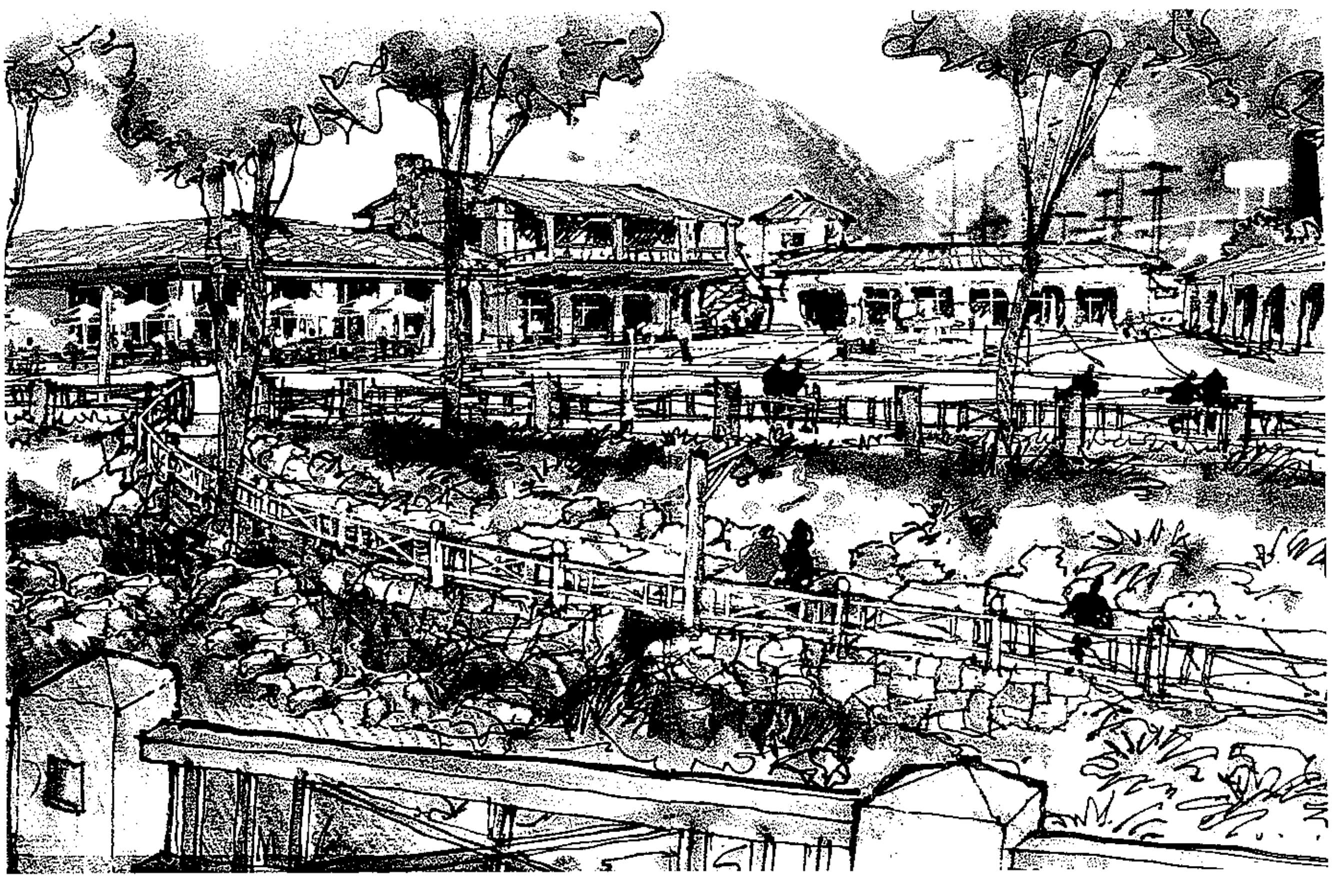
At present, the dominant visual feature at this important entrance to the City is asphalt. (Las Virgenes Road at the 101 Freeway interchange, looking south.)

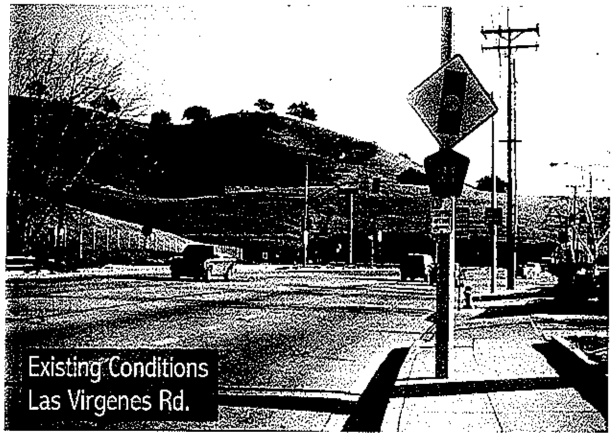
"In the General Plan process, Las Virgenes Road was identified as a "scenic corridor" and the City developed special regulatory measures to promote protection of its scenic qualities."



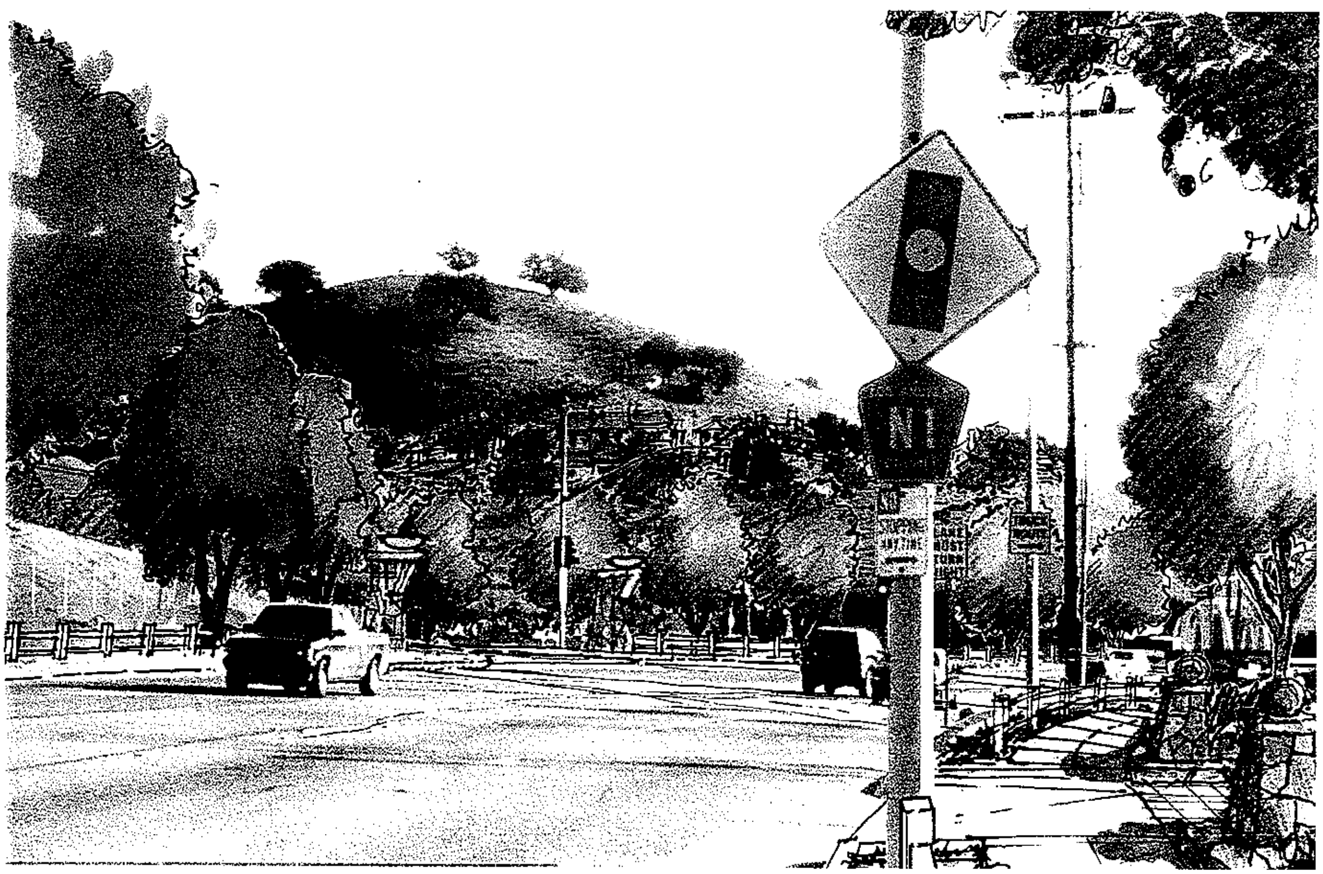
The freeway bridge provides an opportunity to link the north and south areas of the Master Plan in a positive way.

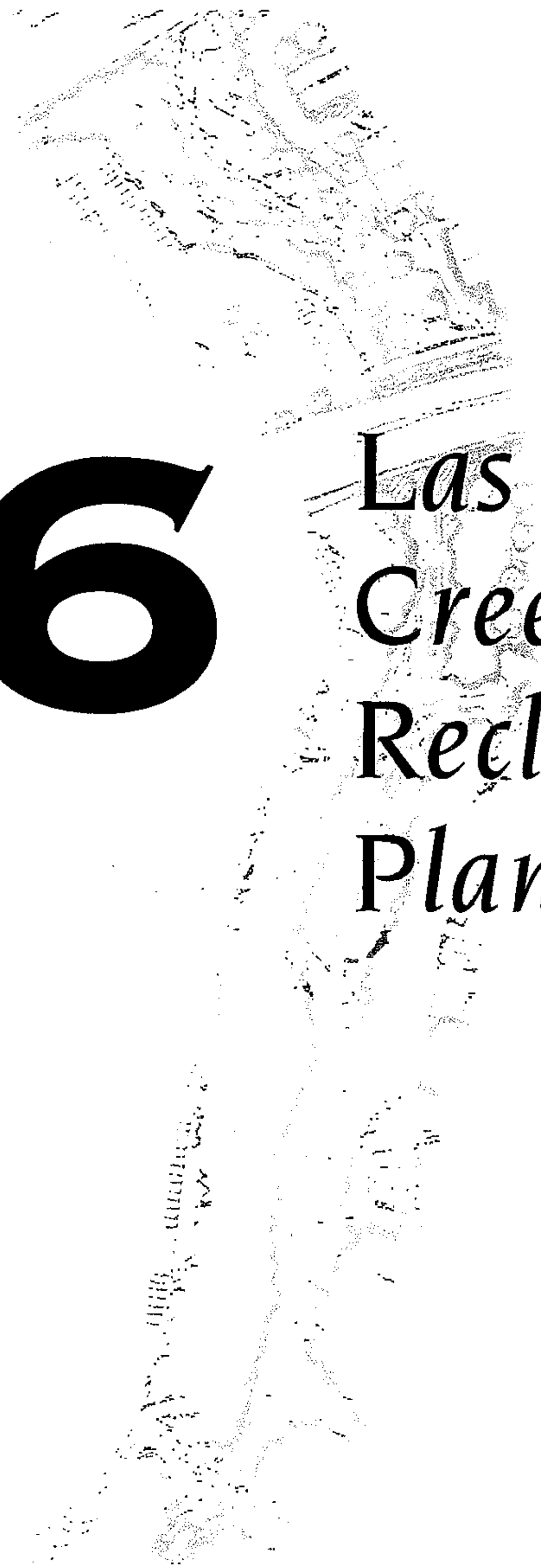

Existing Conditions
Abandoned Dealership and Channel





Existing Conditions
Las Virgenes Rd.





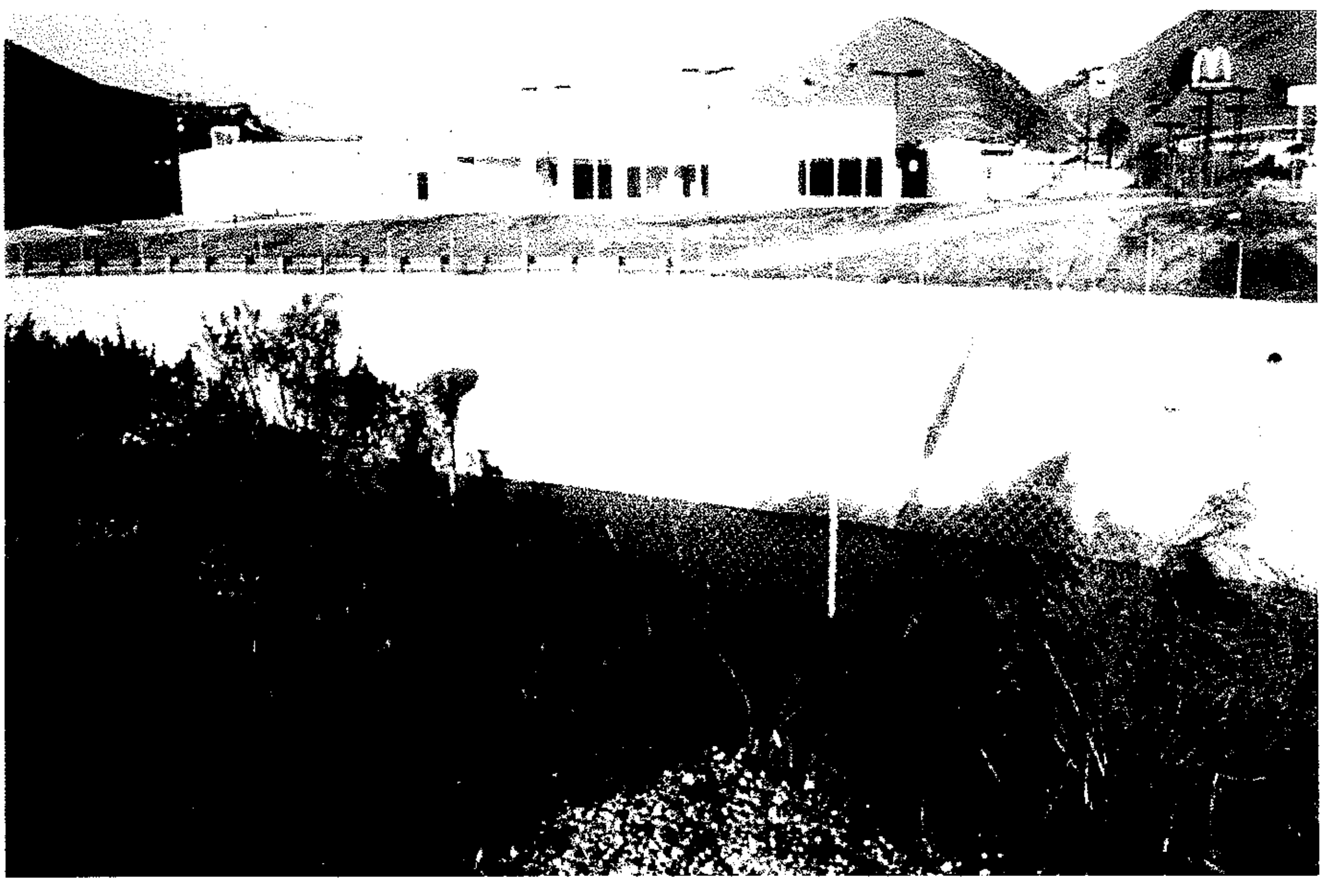
6 Las Virgenes Creek Reclamation Plan

LAS VIRGENES CREEK RECLAMATION PLAN

INTRODUCTION

Las Virgenes Creek runs along the western boundary of the Master Plan area, south of the Ventura Freeway. This creek is a tributary of Malibu Creek and flows from north of Highway 101 southward to join Malibu Creek just outside the Planning Area.

Las Virgenes Creek is an important natural resource in the Master Plan area. The creek segment south of Agoura Road is in a fairly natural state. The creek banks and bottom are natural soil with large stands of willows and sycamores lining the corridor. Unfortunately, the portion of the creek just north of Agoura Road has been lined with concrete for flood control purposes. This creek segment is presently a concrete trapezoidal channel, extending north-to-south, and located between the 101 (Ventura) Freeway and Agoura Road bridge. Construction of the concrete channel years ago removed all habitat and fragmented the riparian system associated with this creek corridor. Currently, no riparian habitat is sustained along this concrete channel.

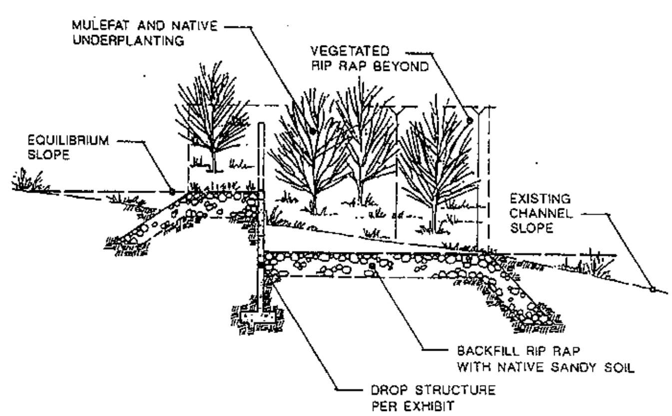


Restoration Plan Objectives

The main objective of the restoration plan is to reestablish a native creekside habitat to enhance the biological environment and the aesthetics of the Master Plan area. This plan will improve the water quality and provide additional riparian habitat. In addition to providing more native habitat in the region, the restoration would re-establish direct connectivity between the two existing riparian communities to the north and south of the concrete segment. Successful restoration would afford better cover for local wildlife and probably promote increased movement of animals up and down the stream course. Restoration would enhance the greenery and views of an area that is essentially devoid of vegetation.

Restoration Plan Components

The potential for restoring the channel, with native riparian plants and establishing a riparian system is excellent. Perennial water flows through this creek segment on an annual basis. This steady supply of water dramatically enhances the successful establishment of riparian plants. The existing slopes are cut back and ideal for restoration. The existing commercial facilities on either side of the subject reach could afford easy access to the channel during construction activities, provided an equitable arrangement can be



Source: Foothill Ranch Resource Management Plan.
County of Orange - Foothill Ranch Company.
Robert Bein • William Frost & Associates • Michael Brandman Associates
Richard Cross • Dike/Runa Jeff Froke • Alden Kelley • Michael E. Macko
Mark A. Roeder • Vail Speck Taylor

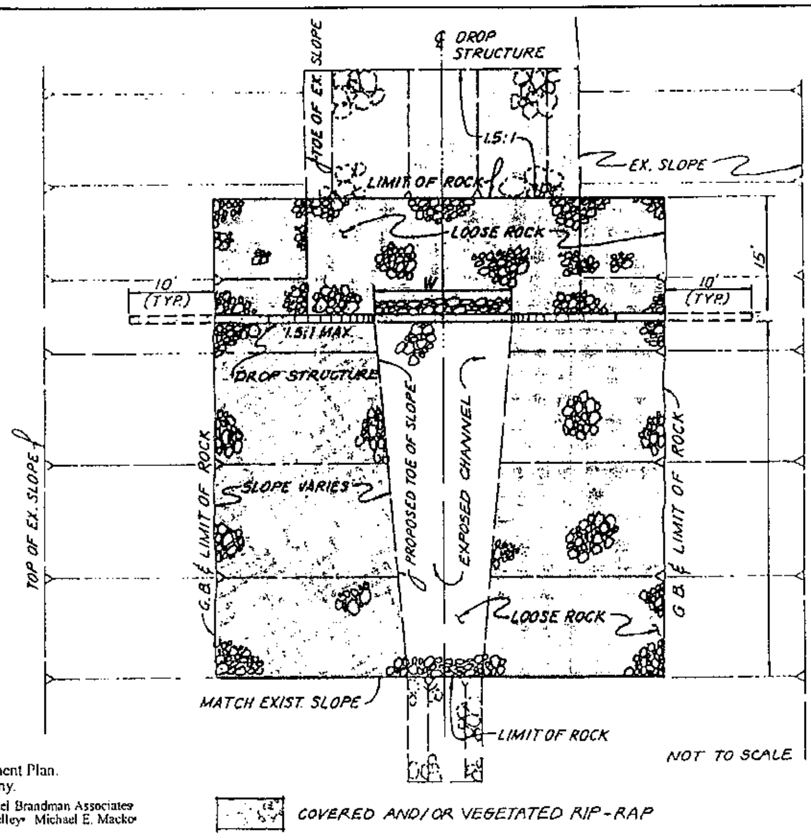
negotiated with the property owner(s). Also, an existing, paved access road/trail, located adjacent and parallel to the east side of the channel, could potentially be used for periodic maintenance activities associated with the restored channel.

Mature willow riparian forests grow immediately upstream and immediately downstream of the concrete segment. This provides an excellent, convenient source of native riparian plant materials (e.g., cuttings) for use in the restoration effort. The availability and use of local plant materials that are adapted to local conditions, increases the likelihood that restoration will be successful, and maintains the genetic integrity of the local ecosystem.

The following recommendations outline a plan for restoration of the Las Virgenes Creek segment between the Ventura Freeway and Agoura Road.

1. First, remove the concrete lining the channel banks and bottom, and over-excavate the banks and bottom of the channel. Establish a slope of 1:1, minimum.

2. Place large riprap along the slopes and channel bottom, and jet soil into the riprap to form a solid foundation for planting native vegetation and to stabilize the streambed and banks. It is important



Source: Foothill Ranch Resource Management Plan.
County of Orange - Foothill Ranch Company.
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not to place any kind of liner beneath the riprap. The presence of a liner would result in weak, shallow rooted trees.

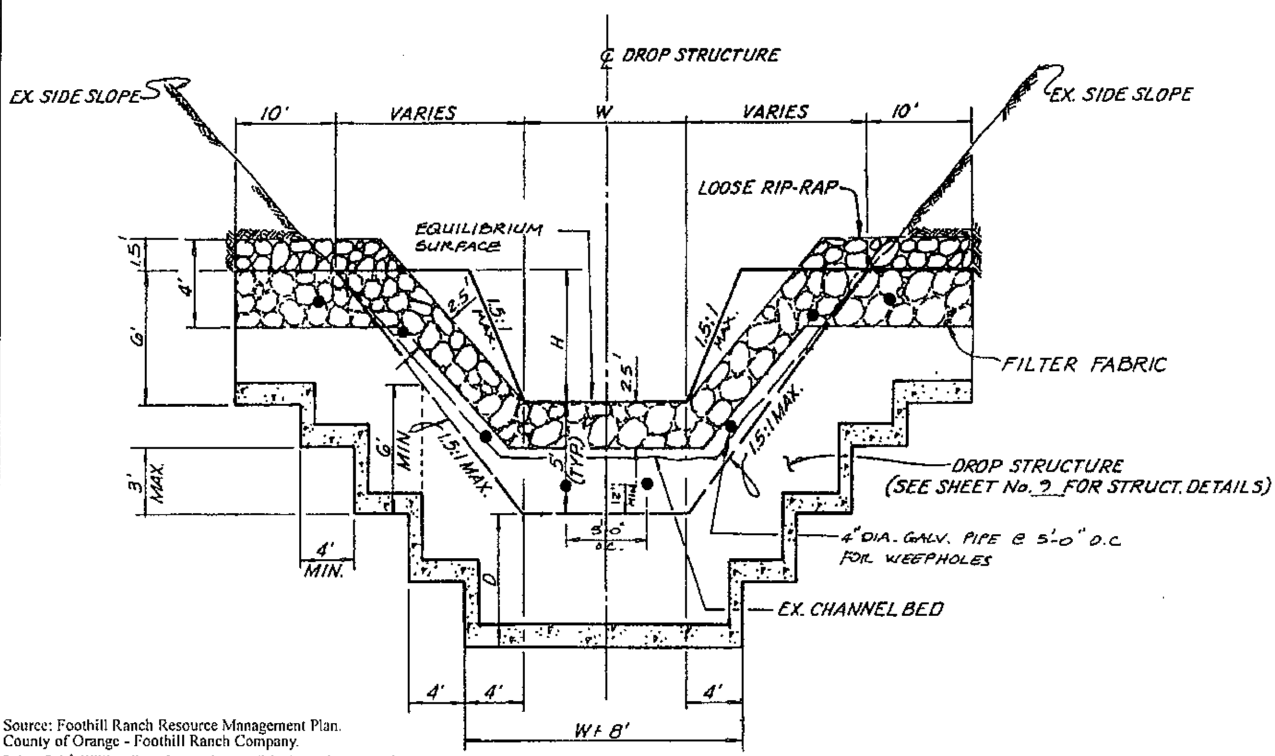
3. Place topsoil over the finished surface prior to planting and seeding. Additional soil may need to be added from time to time, particularly following storm events, until the vegetation is thoroughly established. Allowing some of the riprap to remain exposed will afford the channel a more natural appearance.

4. Provide plantings of native riparian species including the following:

Native riparian trees including sycamore, alder, walnut, cotton woods and willows should be planted to provide shade and enrich the habitat for birds and other wildlife.

The following shrubs, herbaceous plants and vines should also be used in the revegetation program:

Baccharis pillularis consanguinea (coyote bush)
Diplacus/Mimulus (monkey flower)
Rhamnus californica (coffe berry)
Rubus ursinus (blackberry)
Heteromeles arbutifolia (toyon)



Source: Foothill Ranch Resource Management Plan.
County of Orange - Foothill Ranch Company.
Robert Bein · William Frost & Associates · Michael Brandman Associates · Richard Cross · Dike/Runa Jeff Froke · Alden Kelley · Michael E. Macko · Mark A. Roeder · Vail Speck Taylor.

Ribes speciosum (gooseberry)
Sambucus mexicana (elderberry)
Atemesia (mugwort)
Typha spp. (cat tails)
Equisetum (horse tails)

5. Another option is the substitution of the large riprap with interconnected concrete blocks (e.g., Armorflex®). This would result in the establishment of some riparian habitat and would be preferred over the existing condition; however, this approach does have drawbacks and limitations. Armorflex® type materials include a lining of cable-connected, prefabricated concrete blocks with geogrid anchorage for soil reinforcement. The presence of a liner under the concrete blocks could result in weak, shallow rooted trees. Since the liner prevents deep saturation of the soil, it also prevents deep rooting of trees. Shallow rooted trees are more likely to be uprooted and toppled, especially during heavy storm events. Also, the holes in the concrete blocks restrict the diameter growth of developing trees, thus reducing their overall size and weakening them. This approach may be more costly and time-consuming than the buried riprap approach. Several diagrams of creek bottom and bank restoration plans are illustrated on the following pages.

6. Numerous cliff swallows (*Petrochelidon pyrrhonota*) have been observed nesting under the concrete ledge of the Agoura Road bridge. Since these birds are protected under the Migratory Bird Treaty Act, impacts to their nesting must be avoided. All bridge and creek-related construction, such as widening or other improvements, must be carried out when the birds are not present (i.e., September through February).

7. A vegetative buffer zone shall be provided for all portions of Las Virgenes Creek. A setback of 30 feet is required from the top of bank for all non-habitable structures and paving. Natural surfaced trails and fencing can encroach into this setback. A setback of 50-feet is established for all paving and habitable structures.

CONCLUSION

The recommended method of channel restoration has been implemented successfully in Orange County, and the existing conditions of the Las Virgenes Creek channel are optimal for channel restoration. Several photographs of successful creek restorations are included on the following pages.

Permits from various resource/regulatory agencies (e.g., Army Corps of Engineers, California Department of Fish and Game, Fish and Wildlife Service, Regional Water Quality Control Board, Los

Angeles County Flood Control) will be needed to pursue this restoration plan. Support from these agencies can be expected for a number of reasons. A soft bottom channel will greatly improve the hydrogeomorphic functions, including filtration of pollutants, groundwater recharge, and nutrient cycling. Also, the ecological benefits of establishing native riparian habitat are numerous. Flood control concerns can be accommodated by maintaining appropriate flow characteristics and providing maintenance opportunities.

7 Design Guidelines and Standards

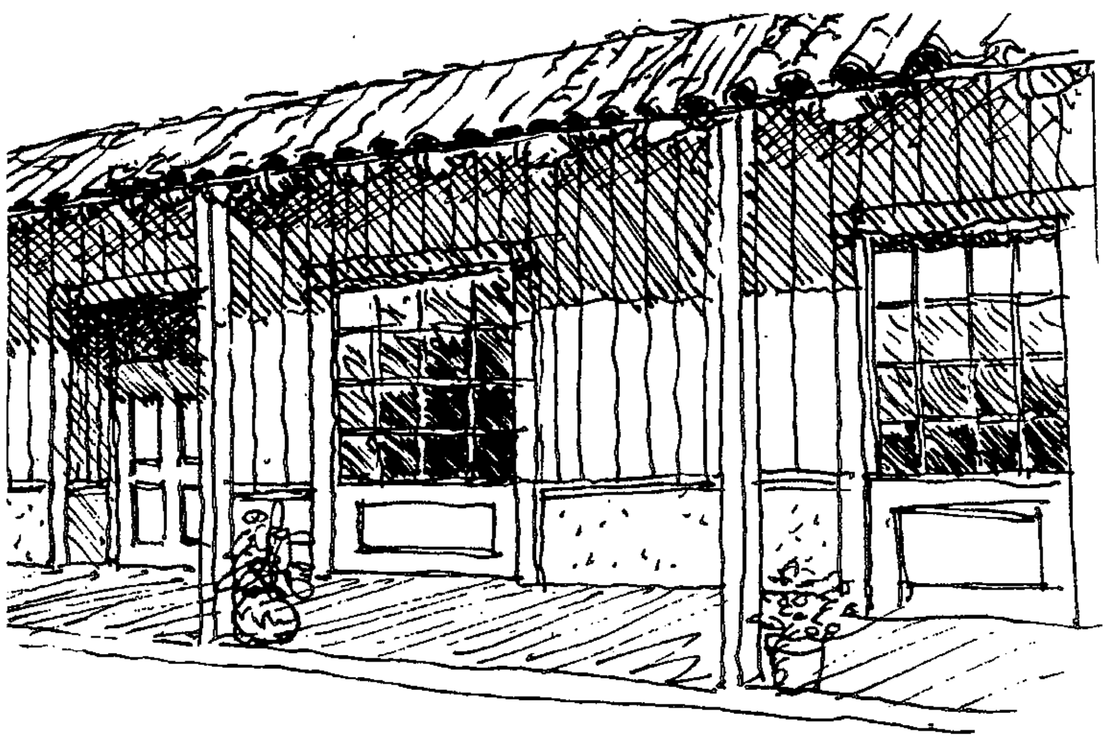
DESIGN GUIDELINES & STANDARDS

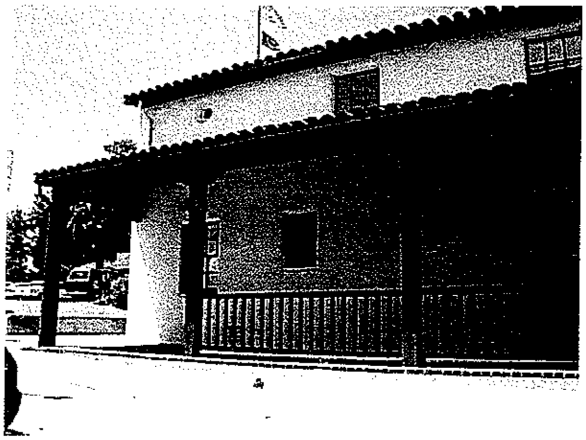
An important function of the Las Virgenes Master Plan is to maintain and enhance Calabasas' character by providing a pleasing visual experience for residents and visitors. Although the improvements in the public right-of-way play an important role in establishing this character, the buildings and site improvements on private property play an equal or greater role in that they create the "backdrop" for the day-to-day use of the place. The following design standards for renovation and new development of private property are aimed at ensuring that the built environment provides an appropriate expression of the community's character and that landscaping is compatible, appropriate and well integrated into all properties. All new development, additions and renovations shall be required to comply with the architectural, landscaping and sign guidelines and standards outlined in this section of the Master Plan.

ARCHITECTURAL GUIDELINES FOR PRIVATE PROPERTY

1. Design Objective

One of the primary goals of this master plan is to reestablish the Las Virgenes Corridor as a rural gateway to the community and sur-

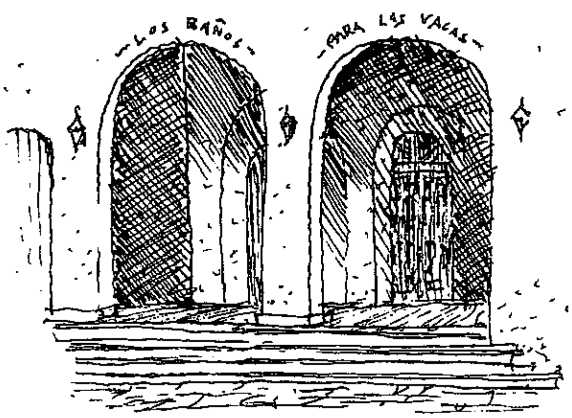




rounding environs. These guidelines are intended to help property owners, developers and architects understand how to implement designs compatible with one of the community's primary objectives of creating a built environment which complements the natural setting.

The design recommendations and requirements provided here are based upon input received from the workshop process, which included residents, business and property owners, as well as developers with an interest in pursuing projects in the planning area.

2. Character, Scale and Building Design



The preferred architectural emphasis which emerged in the community workshops was expressive of a rural theme, rooted in California's history of simple, massive (adobe and timber-based) construction. Although there is latitude for interpretation, the preferred design is decidedly *not Contemporary Mediterranean nor Old Town Western.* Stylistically, the "Monterey" style probably comes closest to reflecting the community's preference, and it is this source that has served as the inspiration for these guidelines. This style is indigenous to the region, as exemplified by the Gillette estate and the Leonis Adobe. This style is also prevalent throughout other regions of California which were colonized by the Spanish Missionaries and settlers in the 18th and 19th centuries, and is quite evident in the San Diego, Santa Barbara and Monterey areas of California.

Design in the Monterey Style

This rural early California architecture is typified by one and two story structures of horizontal mass, with exteriors of wood and plaster. These building often include balconies and exterior stairs and walks. The exterior massing and articulation is usually a result of simple forms brought together informally, often asymmetrically, to create a complex, or grouping, of structures. Landscaping is often integral to the building plan, incorporating courts or half courts, garden walls, trellises, arbors and the like.

Buildings influenced by the Monterey Style often appear to have evolved over time, with different "parts" responding to changing or evolving needs of the inhabitants. The expression of these parts can serve to soften or enliven the otherwise plain and simple massing of the building(s).

People often overlook the subtle differences in California's regional architectural styles of Spanish influence, instead lumping them all together as "Spanish-style" design. True Spanish "high architecture" is the product of a refined and powerful European culture. The buildings of Spain's government and upper class in the 1700's and 1800's were very refined and elegant, and often included ornate iron work, finely hewn stone and decorated tile.

But throughout Mexico and California, there are clear differences in the regional variations of Spanish-influenced architecture, related historically to cultural, climatic and technological constraints which the Spanish and other California Colonials had to deal with as they worked their way up the California coast.

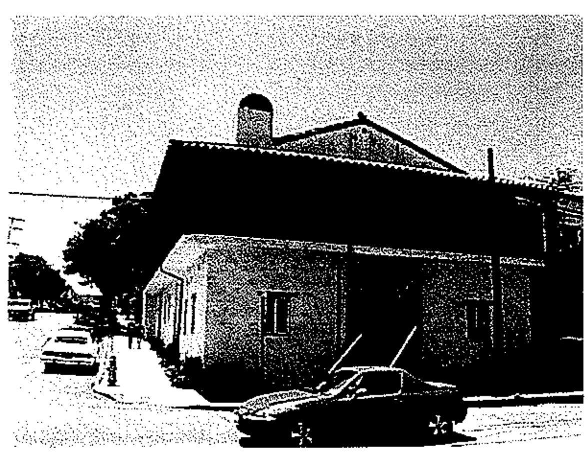
In the Monterey style, the results of these influences are manifest in a somewhat rustic architecture, refined in proportions of wall and openings, but more crude in detail, incorporating heavy timber and coarse wood detailing in lieu of more refined decoration. The result is an architecture which tends to be more relaxed and informal, with deep set windows to keep the hot sun out, and clustered plans to form small courts and protected gardens.

Monterey style architecture often combines wood-framed and woodsided walls (usually at the second floor) with those of heavier adobe and plaster at the ground floor. Roofs were often of wood shake instead of clay tile.

3. Commercial Development

It is the intent of the community that commercial development within the Las Virgenes Gateway Master Plan Area will reflect and compliment the natural, rural and rustic character of the surrounding countryside. Garish, loud, visually busy design which emphasizes commercialism over aesthetics will not be allowed.

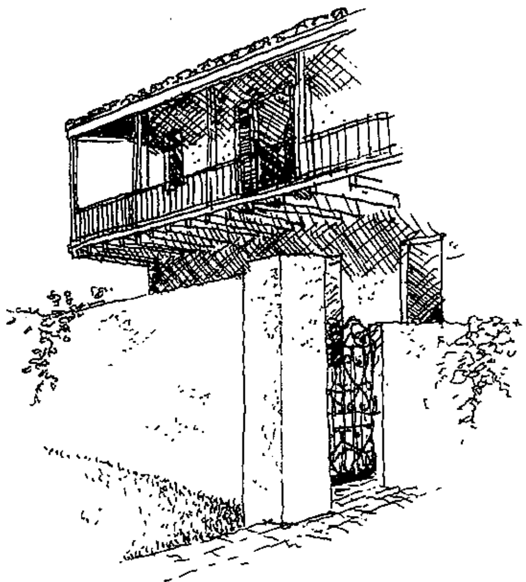
Further, it is the community's intent to establish the area as a "village center," serving first and foremost area residents and employees, and secondly, visitors to the area and region. Corporate design, including colors, logos and architectural icons, which may reflect a particular company's or franchises "national image" will only be supported if such design is also in keeping with the goals and intent of the guidelines presented herein.

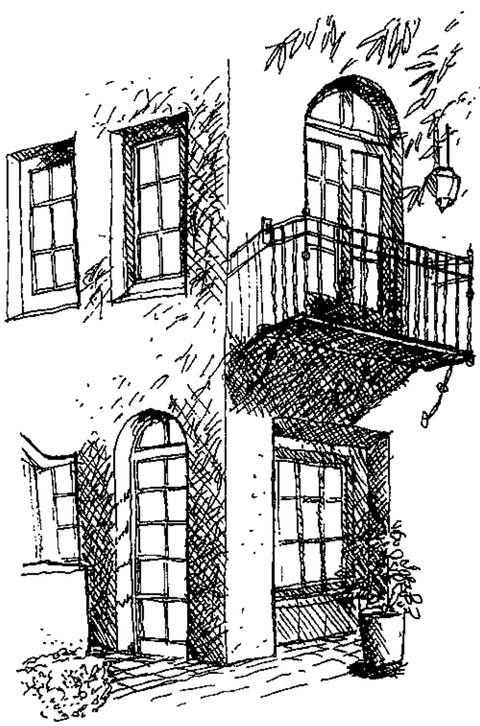


4. Residential Development

It is the community's desire that residential development, especially when located on hillslopes, should be understated - low in profile and designed to step in conformance with natural topography of the site. Architectural character consistent with these guidelines shall be incorporated into projects.

Colors and materials should be muted and sympathetic with the colors and textures of the terrain and foliage of the site and vicinity. Parking areas should be screened and tucked behind buildings where possible. Retaining walls should be minimized, and should be integrated into the building design wherever possible. In addi-





tion, the following guidelines will apply.

5. Design Guidelines

The following criteria will be used to asssess development proposals in the Master Plan area:

A. Site Design

Necessary Elements:

1. Generous setbacks from Agoura Road and Las Virgenes Road;
2. Buildings orient to the street where possible;
3. Parking internalized to the site as part of a court, separated from street and well screened by buildings and landscaping;
4. Edge landscaping to compliment the public improvements;
5. Common vehicular access between adjacent parcels wherever feasible, minimize street curb cuts;
6. Common service access between adjacent parcels wherever feasible;
7. Building Elements combine to create pedestrian spaces (courtyards, paths, etc.) where possible;
8. Pedestrian access from public streets should be pronounced.
9. Projects adjacent to Malibu Creek take special consideration for edge treatment, access to path system and complimentary site design.
10. Shade should be considered a premium amenity, provided by both building and landscape elements.

B. Exterior Building Design

Necessary Elements:

1. Simple building massing; larger buildings result from groupings of smaller mass elements;
2. Building massing tends toward horizontal;
3. Openings for doors and windows tend toward vertical, or groupings of vertical;
4. Roof overhangs are functional for weather and sun protection;
5. Roof massing is simple, roof pitches are low and may vary slightly from mass elements;
6. Openings, especially at entries, are often recessed into wall elements.
7. Clay tile (flat or barrel) roofs are preferred.

C. Architectural Elements

Necessary Elements:

1. Building entries should be readily identifiable, protected by a balcony, arcade, or wall recess;

2. Roofs should range in pitch from 3:12 minimum to 6:12 maximum. Dominant roof pitches should be 3:12 or 4:12 maximum.
3. Balcony elements, either additive (added to exterior) or subtractive (cut out of building mass) can provide interest or emphasis.
4. Windows are generally vertical and sizes may vary. No mirrored glass or glue-on window dividers are allowed in window designs.
5. Support facilities, including utility meters, trash enclosures and mechanical equipment should be accommodated in the building design to "disappear;"
6. Exterior arcades, colonnades and porches provide relief from the simple massing of the buildings.
7. Chimneys and decorative vent stacks can provide relief at the skyline.
8. Exterior stairways can become significant design features, while also announcing the presence of second story tenants.

D. Building Accessories and Details

Necessary Elements:

1. Details, such as decorative lighting, awnings, rails, iron grilles and seat walls, should enliven and compliment the simple forms of the architecture.
2. Decorative Plaster work, in sills, cornices and balconies, add to visual interest;
3. Roof elements, such as rafter tails, rain gutters and down spouts, should be designed to compliment the architecture.
4. Windows and window frames should be substantial, having thickness, color and dimension similar to wood.
5. Mirrored or highly reflective glass should be avoided.
6. Landscape walls, rails and fencing should be designed compatible with the architecture of the building.

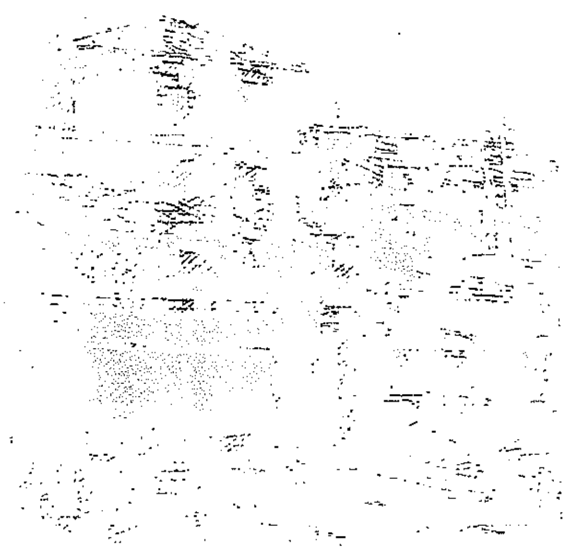
E. Materials

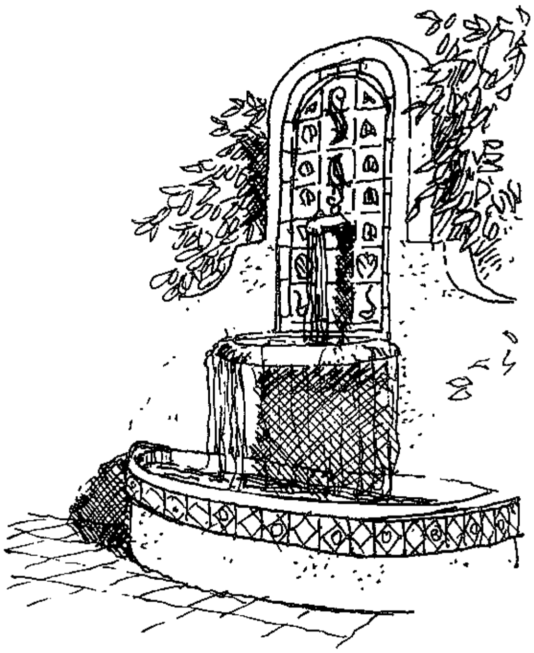
Necessary Elements:

1. Exterior building surface materials should be limited to a maximum of three different types in any design. These should be applied as follows:

walls:

- exterior plaster stucco, hand-finished and light sand or "mission" texture;
- wood siding, shingle, lap or "board and batten", in limited areas;
- stone, brick or block masonry, with appropriate detailing;





roofs:
- clay tile (Spanish, mission);
- concrete tile (shake, slate);

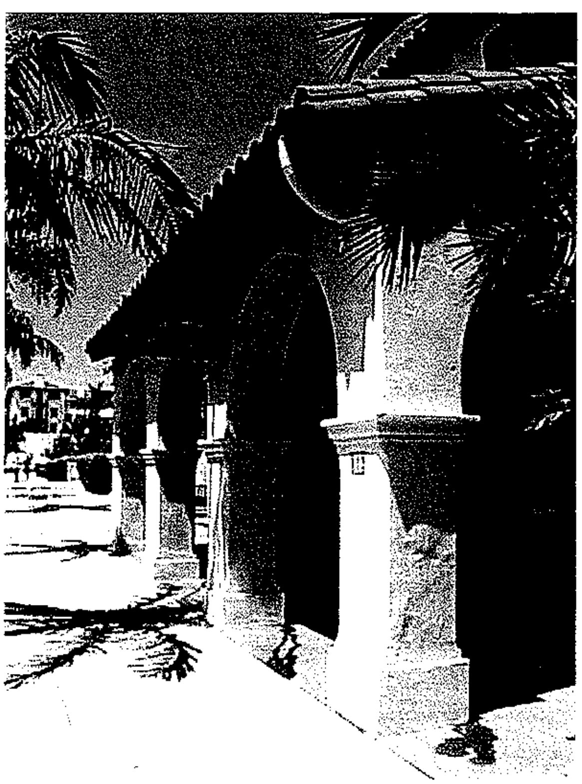
railing:
- wrought iron, painted or blackened;
- wood, turned or shaped, stained or painted;

architectural details:
- sills, cornice and similar details of plaster, stone or precast concrete;
- vent grilles, spires and similar details of wrought iron;
- exposed downspouts, scuppers, flashing and related metal work of copper or galvanized iron.

F. Exterior Colors

The natural setting for the Las Virgenes Master Plan Area is rich and varied in color, but the dominant colors are earthen and muted by the nature of the surroundings. Rock outcroppings boast ochers, rust, burnt siennas and sandy browns. Vegetation is of muted greens, olives, browns and occasional mustard yellows.

These guidelines encourage design which will complement and blend with this natural setting, not contrast with it. The following criteria are in keeping with this intent: should be considered as an integral part of building design.



1. Where possible, materials should present their natural or similar color, appropriately finished and sealed to insure long life and aesthetic durability;

2. Larger surfaces should be of muted colors;

3. The use of more intense color, sparingly and as an enhancement to detail, is acceptable;

G. Additions, Renovations and Remodels

Where the original building is considered to be consistent with these guidelines, design of additions and remodels are to be in keeping with the character and detail of the original structure, especially where an historic or potentially historic building is concerned.

Where the existing building does not reflect the rural quality and design detail depicted in these guidelines, care shall be taken to incorporate the entire building into the redesign effort, such that the end project reflects the quality and character described herein.

H. Architectural Lighting

Lighting should be considered as an integral part of building design. Proper lighting design will have a positive effect on the building and its users, as well as help to promote a safe and enjoyable nighttime pedestrian environment in the plan area. All exterior lighting shall be aesthetic and non-obtrusive.

Types of Lighting

Area Lighting

This is for public and private parking lots, alleyways, parkways and walks. Such lighting should be set in a manner that assures maximum lighting benefit without allowing stray light to intrude into windows of nearby residents or to create glare problems for nearby automobile traffic.

Ornamental Lighting

This is not intended to light large areas or wall surfaces. Ornamental lighting plays an important role in bringing visual life to streets at night. Colors, finishes and design of ornamental lighting should be compatible with the design characteristics of the architecture.

Hidden Source Lighting

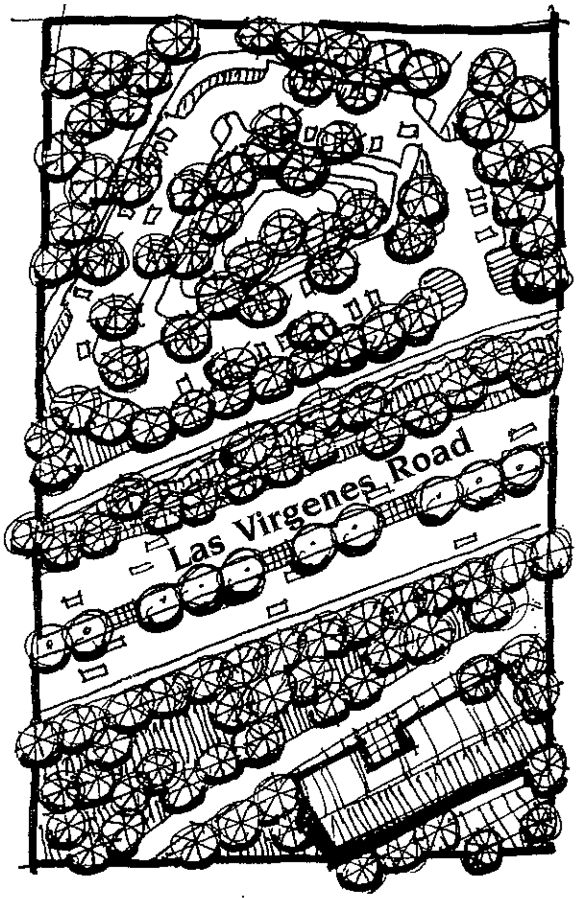
For certain prominent architectural or landscape features, hidden source lighting can be used to create dramatic effects, illuminating towers or other unique architectural or site characteristics. Such lighting can be concealed in soffits, behind ledges or parapets, or even set into landscape areas with the light directed at the desired element to be highlighted.

Lighting Design Integration

It is recommended that a lighting design professional be con sulted as an integral part of the design process for determining types and intensities of lighting to be used. In addition, the following "rules of thumb" should apply:

- Use the minimum brightness necessary for illumination of large areas.

- Use brighter, more intense lighting to highlight architectural features and focal points.



This vignette of Las Virgenes Road and adjacent development illustrates the enhanced proposed streetscape. Note the trees in the parking lots and the landscape buffer to adjacent development.

LANDSCAPE STANDARDS FOR PRIVATE PROPERTY

1. Design Objectives

Landscaping shall preserve and promote the aesthetic character and value of the Las Virgenes Valley in the following ways:

Plantings shall define, unify and enhance streets, gateways, bicycle lanes, and other elements of the public and private realm.

Plantings shall embellish and enhance private yards, edge conditions, circulation areas and parking lots.

Plantings shall provide significant shade on all sidewalks and open parking and sidewalk areas.

Plantings shall screen views of parking, loading and service yards.

Plantings shall frame but not block views of the ridelines as seen from public view corridors.

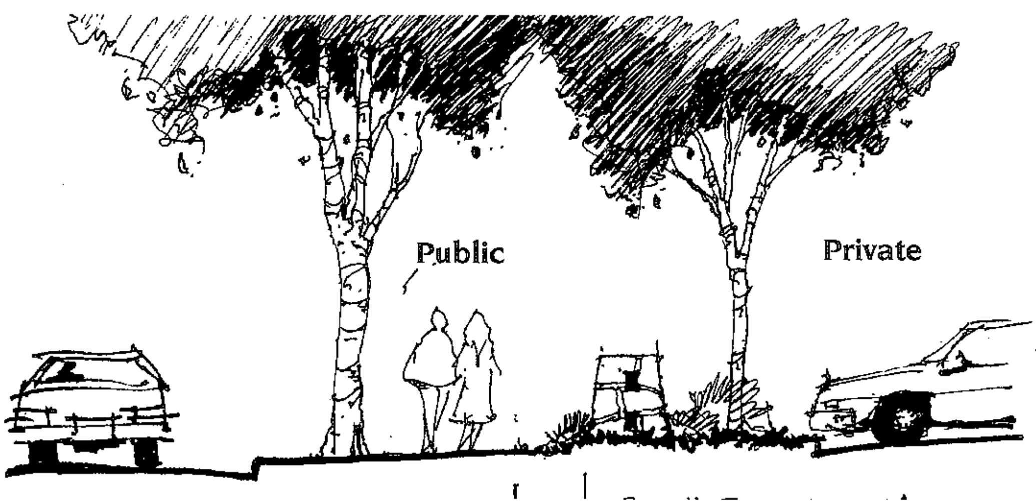
Plantings shall enhance the rural Southern California theme.

2. Planting Design

This section describes the minimum landscape requirements for all improvements on private land within the Master Plan area.

A. Street Frontage

The principal plantings on all street frontages are tree rows, which define the public space. All streetscapes shall be planted

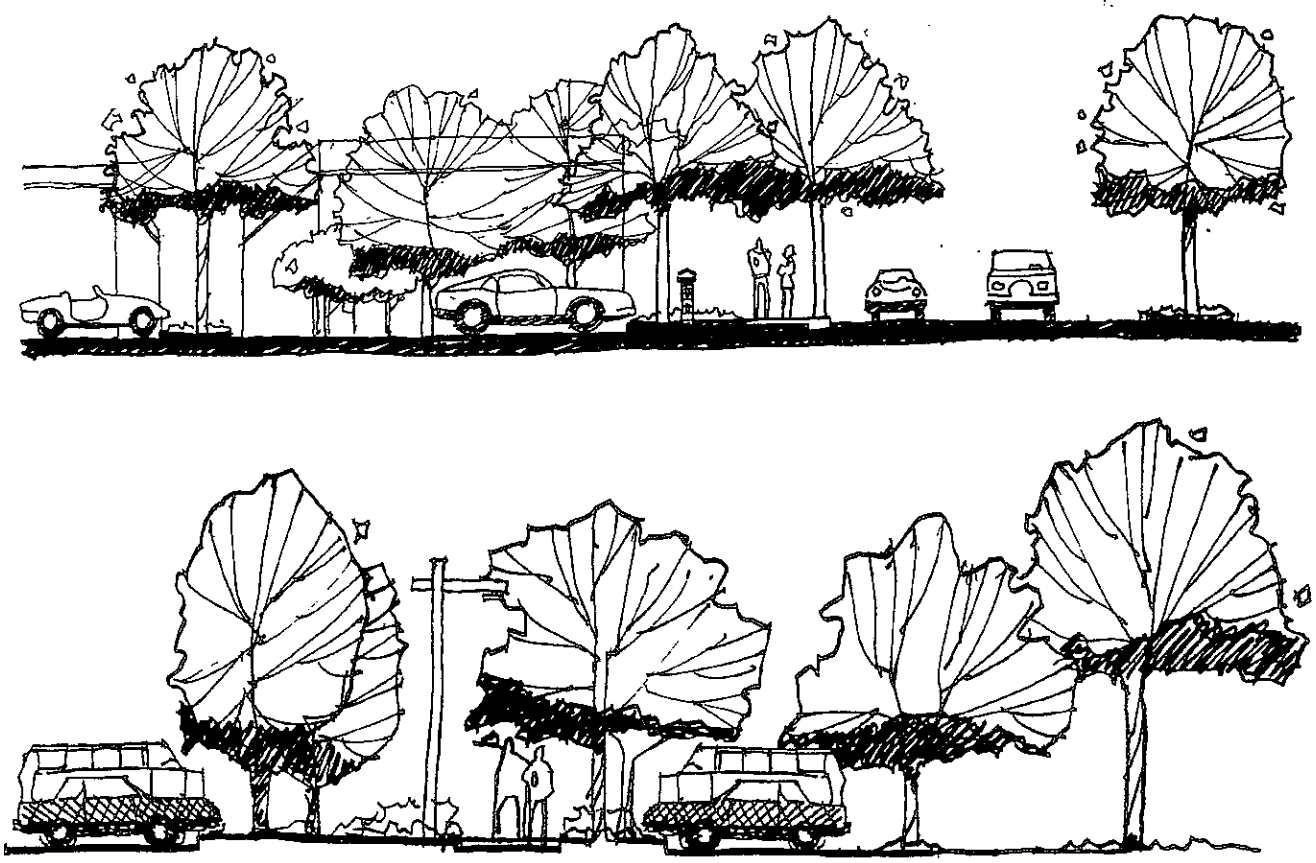


This street section allows for an integrated transition between the public and private realms.

with 36-inch box sized trees as listed in the Public Improvements Chapter of the Master Plan. Consistency in tree species and spacing shall be used to establish a strong street identity. All new and renovation projects shall provide street trees per the Master Plan requirements. These requirements reflect the plans outlined in the *Las Virgenes Road Corridor Plan*:

B. Front Yards (Setback Areas)

Plantings in yard areas fronting on streets shall be appropriate to the scale, orientation, and purpose of the yard. Appropriate plant materials and designs for specific frontage yard types are listed below. Minimum size of tree plantings shall be 24" box, and 33% of the trees shall be at least 36" box size. There shall be a minimum of one tree for every 800 square feet of landscaped area. Ground cover (no turf) and shrubs shall also be planted behind the sidewalk. At facades, low shrubs and/or ground cover shall be planted against the facade. At garden walls and retaining walls, low shrubs and wall vines shall be planted against the wall. Minimum spacing on vines attached to walls shall be 12 feet on center. Shrubs shall be massed and may be configured as maintained hedges. Hardscape shall be



These sections illustrate the condition of a parking lot fronting the street (above) and adjacent parking lots abutting each other (below). Note the minimum 50% shade coverage afforded by fully mature trees.

used to accent entrances and in public plaza or open yard areas.

C. Other Yards

Rear yards and property lines that abut the Ventura Freeway shall be landscaped with trees and shrubs. Appropriate species are listed below. Open yard areas for residential uses may be planted with turf.

D. Parking Lots

Landscaping of parking lots shall consist of 36-inch box sized trees, which shall be provided at a minimum rate of one tree per four parking spaces. Trees shall be the predominant plant material in the parking lots and shall be capable of creating 50% shade upon the total paved surface when mature. Trees shall be round-headed canopy type trees and may be evergreen or deciduous. Trees shall be supplemented with ground covers and shrubs as listed below.

3. Additional Standards

Additionally, the following landscape standards shall apply in the Master Plan area:

- All areas not devoted to paving or building shall be landscaped and permanently maintained.
- All landscaped areas are to be delineated with minimum 6-inch concrete curbs.
- Permanent automatic irrigation facilities shall be provided in all landscaped areas. Moisture sensing devices and water monitoring devices shall be incorporated into the irrigation system in compliance with drought/water conservation standards.
- To minimize water use, the following measures shall be incorporated into project design within the project area, where feasible: Use of drought tolerant plants, extensive use of mulch in landscaped areas, installation of drip irrigation systems where appropriate, and minimization of impervious area.
- All trees planted in turf areas shall receive turf boots to prevent damage from mowers and edgers, etc. Root barriers shall be required where trees are planted within five (5) feet of hardscape.
- Shrubs located at entries, front yards or major intersections shall have a minimum size of five (5) gallons with minor exceptions as approved by the Planning Director.
- Palm trees may be used only in special appropriate instances

as a part of the residential private yard or commercial parking lot landscape design. These trees are generally not reflective of rural Calabasas.

- Drought tolerant plant materials shall be utilized in all landscaping within the project area. Drought tolerant plants shall be defined as plants listed as Moderate, Low, and Very Low in the WUCOLS PROJECT listing of Water Use Classification of Landscape Species as published by the University of California Cooperative Extension. University of California Publications can be obtained from:

  ANR Publications
  University of California
  6701 San Pablo Ave.
  Oakland, California 94608-1239
  (415) 642-2431

4. Appropriate Plant Materials

All plantings shall emphasize natives and avoid invasive species.

Trees:

Platanus acerifolia	London Plane Tree
Pistacia chinensis	Chinese Pistache
Pyrus calleryana"Aristocrat"	Aristocrat Pear
Tipuana tipu	Tipu Tree
Quercus agrifolia	Coast Live Oak
Ulmus parvifolia	Evergreen Elm
Eucalyptus Nicholii	Peppermint Gum
Populus Candidus	Poplar
Olea sp.	Olive

Tall Shrubs for setbacks, yards and parking lots:

These plants reach 3 to 10 feet in height at maturity and shall not be frequently sheared or pruned. The shrubs shall display flower and/or foliage color, and be resistant to prolonged periods of drought. Acceptable species are:

Abelia grandiflora	Glossy Abelia
Escallonia fradesii	Escallonia
Elaeagnus pungens	Silverberry
Nerium oleander	Oleander
Photinia fraseri	Photinia
Plumbago auriculata	Cape Plumbago
Pittosporum tobira "Variegata"	Varegated Tobira
Xylosma congestum	Shiny Xylosma

Low shrubs, groundcovers in yards and parking lots:

These shall reach no more than 3 feet in height at maturity, without requiring frequent shearing and pruning. The shrubs shall display flower and/or foliage color, and be resistant to prolonged periods of drought. Acceptable species are:

Cistus salvifolius	Prostrate Rockrose
Cotoneaster dammeri	Prostrate Cotoneaster
Euonymus fortunei "Colorata"	Purple Euonymous
Lantana montevidensis	Trailing Lantana
Mahonia repens	Prostrate Mahonia
Myoporum parvifolium	Prostrate Myoporum
Pittosporum tobira "Wheelers"	Prostrate Tobira
Trachelospermum jasminoides	Star Jasmine

Hedge plantings, in lieu of a Streetwall:
These hedges can be pruned and sheared into a solid hedgerow of the specified height, without breaks or openings between individual shrubs. Acceptable species are:

Escallonia fradesii	Pink Escallonia
Ligustum texanum	Wax Leaf Privet
Raphiolepis indica	India Hawthorn

Trash Enclosures and Streetwalls at Loading Areas:
These walls shall be planted with self-adhering vines no less than 10 feet on center and a minimum of 5 gallons in size. Acceptable species are:

Ficus pumila repens	Creeping Fig
Parthenocissus tricuspidata	Boston Ivy

SIGN STANDARDS

Signage can contribute positively to the overall-quality of the Master Plan area. Excellent signage serves as a communication tool and an art form. Businesses are encouraged to use signage in a manner that clearly expresses the spirit of their enterprises while enriching the streetscape views.

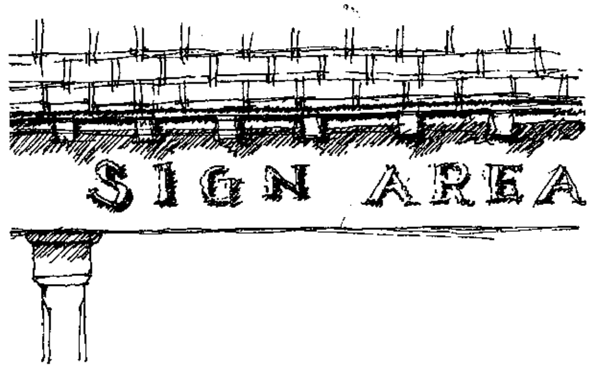
The Master Plan strives to provide sign standards that will reduce visual clutter and provide a cohesive streetscape that reflects a rural/rustic character.

1. Objectives

The following standards are meant to promote viable businesses by providing adequate identification, promoting high quality design and establishing appropriate scale and numbers. These standards are intended to supplement and add clarity to the Development Code requirements. All sign standards not listed in this Chapter are regulated by the City's Development Code. Also, all sign review and permitting shall be as regulated in the City's Development Code.

2. Allowed and Encouraged Signs

The following types of signs are established for the Master Plan area as they are found to be compatible with the rural/rustic theme of the Las Virgenes Gateway Master Plan:



Building design should anticipate signage for tenents as an integral component of the building's aesthetics.

Wall Signs - Flush mounted attached panel or individual letters.

Painted - Applied directly to the building in an appropriate location.

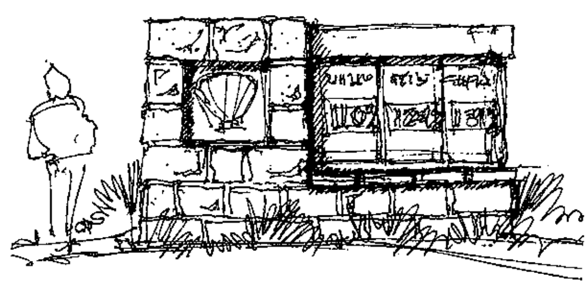
Projecting Signs or Marques - Attached to a building so that no part of the sign extends lower than 7-feet above the adjacent finished grade or 3-feet from the face of the building.

Figurative Signs - Any type of sign that uses a graphic or crafted symbol to advertise the occupant business. Examples are a shoe for a shoe store, a key for a lock smith, a book for a book store.

Awning and Canopy Signs - Lettering to be integrated into the front of the awning.

Applied Window Signs - Applied or painted onto the glass.

Monument Sign - Ground-mounted sign in a landscaped setting.



Signage can express the regional context and announce the quality of the business within.

3. Acceptable Sign Materials

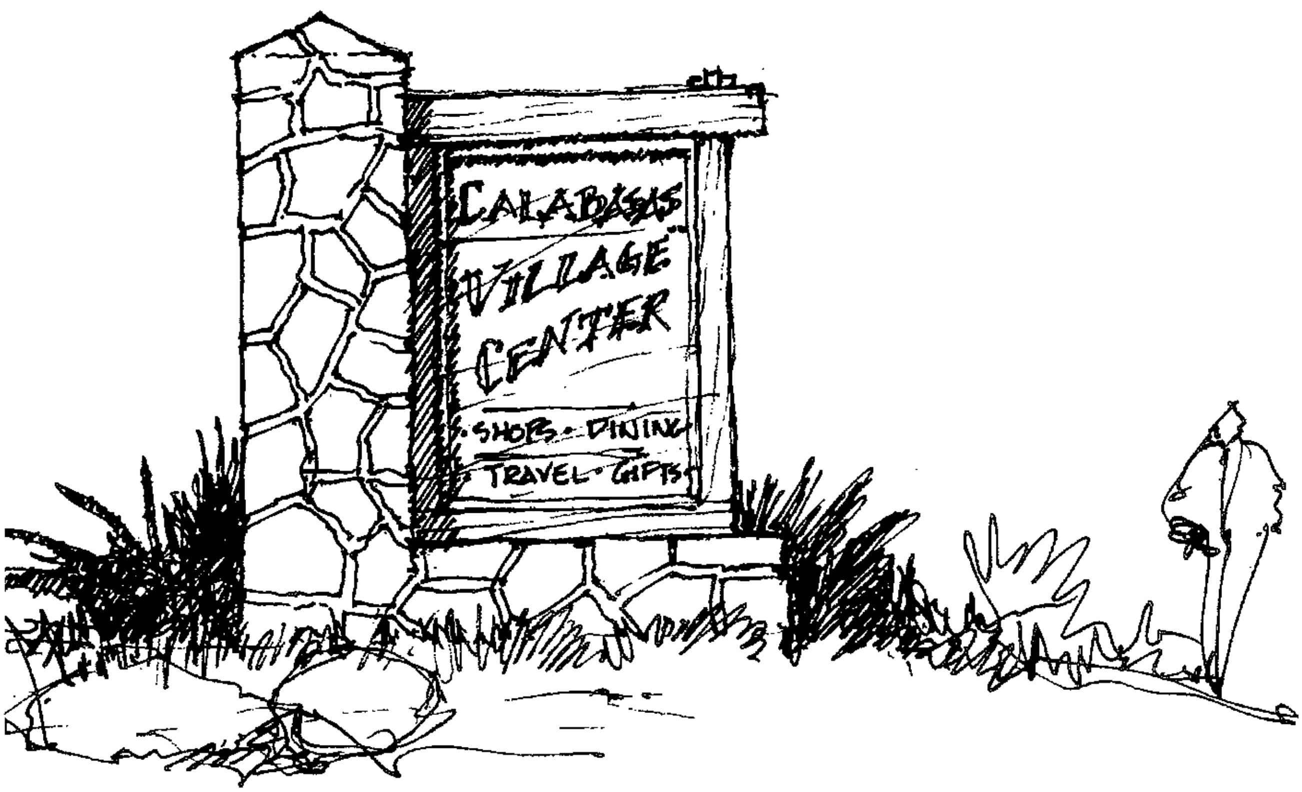
The following materials are encouraged for use in signs to portray the rural/rustic theme of the Las Virgenes Gateway area:

Wood - Carved, sandblasted, etched, painted or stained.

Metal - Formed, etched, cast, engraved, or painted.

High Density Pre-formed Foam - New materials may be appropriate if property designed in a manner consistent with the rural/rustic theme.

Custom Neon Tubing - May be sensitively integrated into allowed signs in the form of graphics or lettering.



*Project signage does not need to identify the name of every store within - a technique that often leaves the sign cluttered and hard to read. Instead, the **types** of businesses and services can be announced succinctly and without clutter.*

Unique Materials and Designs - Creative ideas not addressed but which are compatible with the rural/rustic theme may be considered.

Internally Illuminated - These signs, generally with a plastic face are discouraged but can be used in the Highway Triangle portion of the Master Plan subject to the restrictions in the Development Code and Scenic Highway Ordinance. The businesses in this area cater to visitors and motorists on the highway. These signs improve visibility for passing motorists.

4. Prohibited Signs

The following types of signs are prohibited in the Master Plan area as they add to visual clutter, are out of scale or do not contribute to the rural/rustic theme:

Outdoor Advertising Signs or Billboards
Roof Signs
Rotating, Revolving or Flashing Signs
Pole Signs
Bench Signs
Private signs in the public right-of-way.
Internally illuminated signs except in the Highway Triangle area.

5. Specific Design Standards for Signs

Signs shall be designed to compliment the architectural character of the on-site structure and carry out the rural/rustic theme of the Las Virgenes Master Plan.

- Internally illuminated signs can only be placed in the Highway Triangle area of the Master Plan. These signs shall also contain elements of the rural/rustic theme.

- Monument signs shall be located in a landscaped area.

- Corporate signs and logos shall conform to the rural/rustic theme.

- Commercial centers with two or more tenants, office complexes and other similar facilities shall have a coordinated Sign Program in accordance with the City's Development Code.

- For buildings with one tenant the following signage is allowed:

  - no more than one sign per side of the building that faces a street, sidewalk or parking area. Each sign shall be limited to the square footage specified in the Sign Regulations of the Development Code; *and*

- a single monument sign of no more than 50 square feet and no higher than 6 feet when measured from the base of the monument to the top of the sign.

- For buildings with more than one tenant located in a building:

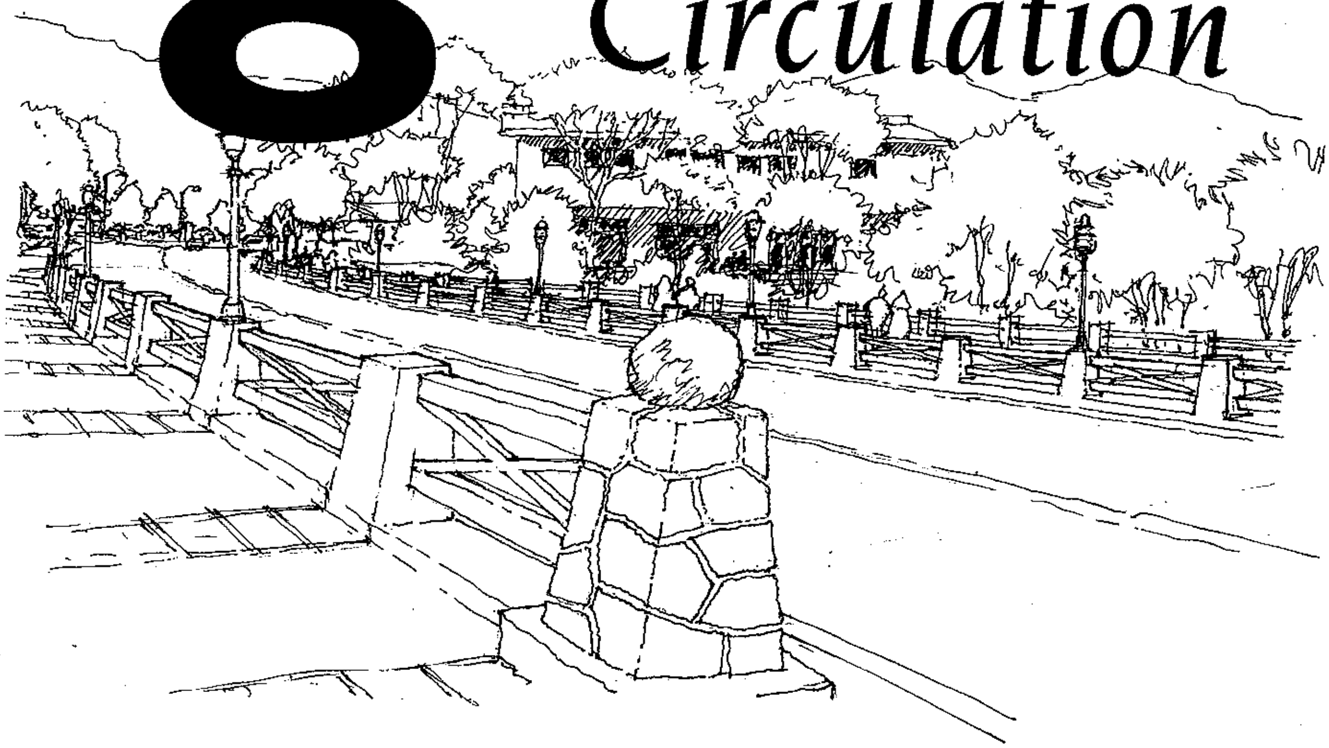
  - each tenant may have one individual building mounted sign for each occupancy frontage, of no more than 0.5 square feet per linear foot of store front, 80 square feet maximum total for all building mounted signs; *and*

  - window signs shall be limited to 25% of the glass area; *and*

  - a single monument sign of no more than 100 square feet and no higher than 8 feet when measured from the base of the monument to the top of the sign. The monument sign may list all businesses in the building.

- All signage shall be consistent with the Scenic Corridor Ordinance.

8 Circulation



CIRCULATION AND PARKING

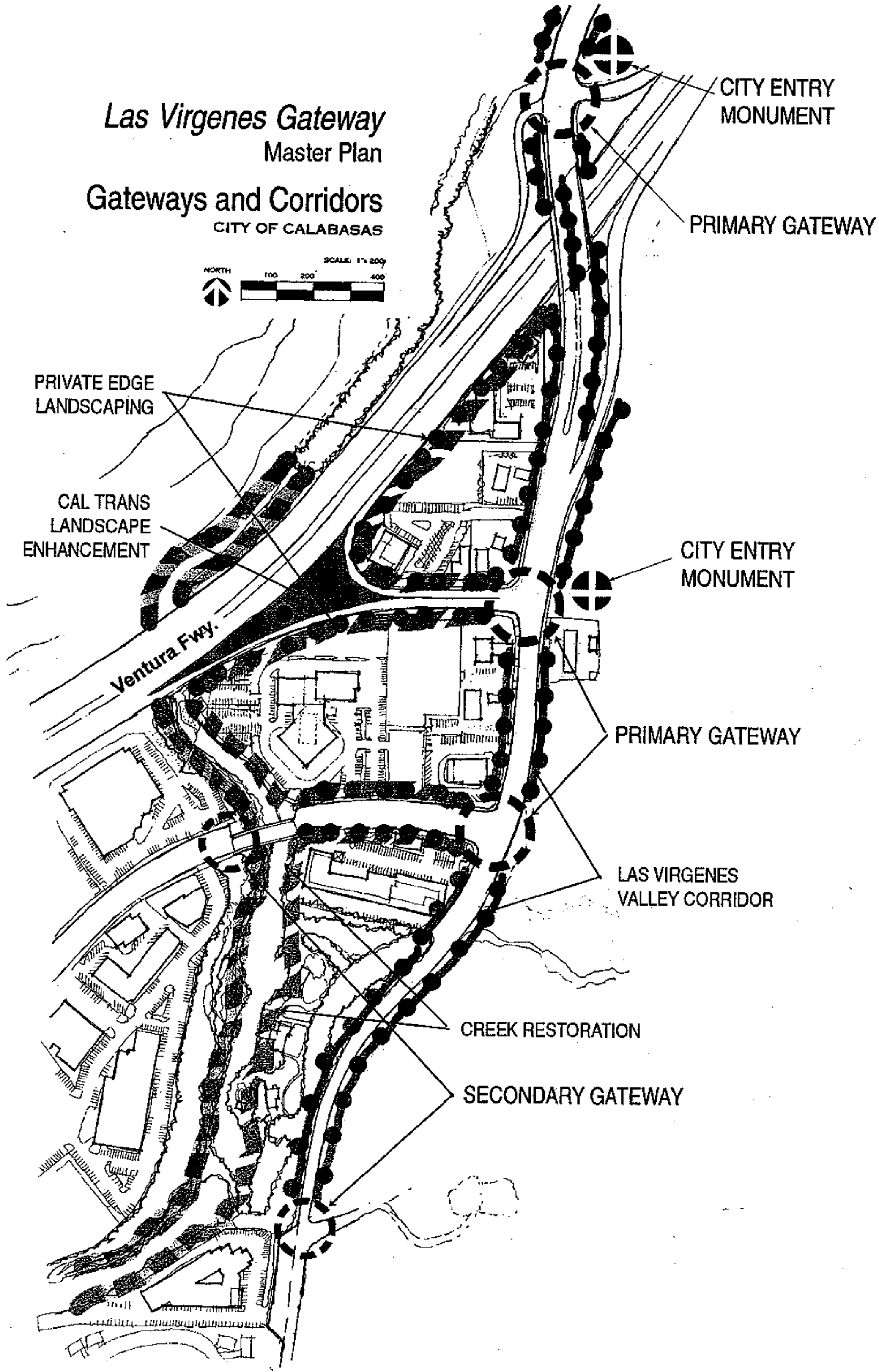
GENERAL CIRCULATION ISSUES

Las Virgenes Road is identified as a Critical Roadway Corridor in the City's General Plan. It is one of several roads that if not properly scaled to the local neighborhood and environmental conditions, could adversely effect Calabasas' quality of life. The segment of Las Virgenes Road immediately south of the Ventura Freeway reflects this concern. This segment is characterized by a very wide paved section, fast moving traffic, conflicting and uncontrolled driveway accesses and unregulated left turns. Las Virgenes Road north of Mureau Road has been identified as an street segment that has a physical capacity greater than is appropriate for its function in the community. This section of Las Virgenes Road serves as a local street for adjacent multi-family residential uses, many of which have driveway access to the street. This road segment is too wide to provide a safe and aesthetic travel corridor for the adjacent residential neighborhood.

The General Plan has an overall policy to promote roadway design that will optimize safe traffic flow within established road configurations by minimizing turning movements, uncontrolled access, on-street parking and promoting safe bicycle and pedestrian movement. To accomplish this policy, the General Plan outlines an Intersection Carrying Capacity Enhancement program for Las Virgenes Road.

The following list summarizes the circulation components of the General Plan that are to be carried out in the Master Plan. In addition to the General Plan circulation components, details for circulation improvement strategies are outlined in the *Las Virgenes Road Corridor Design Plan* prepared in January 1998 by RRM Design Group.

- Consider new signals, signal timing adjustments, re-striping, landscaping, signage, bicycle lanes, and turning movements.
- Reduce the number of driveways and left turn movements along Las Virgenes Road.
- Solutions may include appropriate placement of traffic signals, marked crosswalks, and pedestrian overpasses.
- South of the freeway, improvements for pedestrian and bicycle travel shall be provided south to Mulholland Highway.


Las Virgenes Gateway
Master Plan
Gateways and Corridors
CITY OF CALABASAS
NORTH
SCALE: 1"= 200'
100
200
400
CITY ENTRY MONUMENT
PRIMARY GATEWAY
PRIVATE EDGE LANDSCAPING
CAL TRANS LANDSCAPE ENHANCEMENT
Ventura Fwy.
CITY ENTRY MONUMENT
PRIMARY GATEWAY
LAS VIRGENES VALLEY CORRIDOR
CREEK RESTORATION
SECONDARY GATEWAY

- A right angle intersection should be created at the driveway intersection south of Agoura Road (Pontippidan property).

- The ultimate maximum roadway configuration shall be six through lanes between the Ventura Freeway and Agoura Road and four through lanes between Agoura Road and Lost Hills Road.

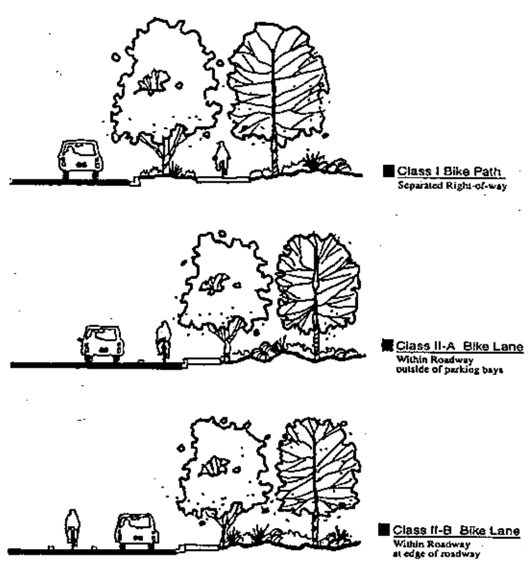
- A bike way is proposed for the length of Las Virgenes Road within the Master Plan area. The bike way plan has been designed in the *Las Virgenes Road Corridor Design Plan* as follows:

  <u>Lost Hills Road to Agoura Road</u> -The bike way shall be a Class II-B on both sides of Las Virgenes Road. The width shall vary from 5 feet to 7 feet to avoid relocation of utility poles, where possible. The bike lane will share a right turn lane at Lost Hills Road intersection.

  <u>Agoura Road to Ventura Freeway</u> - The bike way shall be a Class II-B on both sides of Las Virgenes Road. The width shall be 5 feet. A shared right turn lane will be necessary in the southbound lane at the Agoura Road intersection.

  <u>At the Ventura Freeway Overpass</u> - Class II-B bike lanes, 5 feet wide shall be provided on both sides of the overpass.

  <u>Ventura Freeway to the Ventura County Line</u> - A Class II-A bike lane, 5 feet wide, shall be provided on the east side of Las Virgenes Road. A Class II-B bike lane shall be provided on the west side from the freeway to Mureau Road. A Class I bike path shall be provided on the west side of Las Virgenes Road from Thousand Oaks Blvd. to the County line.



Typical Bikeway Sections

- Enhanced transit opportunities are called for in the General Plan. Transit enhancements have been designed in the *Las Virgenes Road Corridor Design Plan* as follows:

  Each transit stop may have a covered structure, seating and bicycle racks or bicycle lockers.

Transit stops shall be provided along Las Virgenes Road within the Master Plan area on the east side of Las Virgenes Road at the southbound freeway on- and off-ramps, at the northwest corner of the freeway interchange, at the northeast corner of Mureau Road and Las Virgenes Road, at the northeast corner of Parkmor and Las Virgenes Road, and at the northwest and northeast corners of the Las Virgenes Road and Thousand Oaks Blvd. intersection.

Trails for recreation and circulation opportunities are also addressed by the General Plan. The trail plan provides pedestrian and equestrian access to the hillsides and Malibu Creek areas.

MASTER PLAN OBJECTIVES

The following statements reflect the circulation/parking plan objectives of the Las Virgenes Gateway Master Plan:

1. Accommodate a large through-traffic volume as well as local residential, office, commercial and school traffic. Provide for this activity while calming traffic and creating a village center, especially at Agoura Road between the existing mixed use development and the proposed Neighborhood Commercial at the old dealership site.

2. Provide a landscaped median along the entire length of Las Virgenes Road in the Master Plan area.

3. Provide stripping and signalization enhancements as recommended in the *Las Virgenes Road Corridor Design Plan*.

4. Provide a bicycle lane along the length of Las Virgenes Road.

5. Provide enhanced crosswalk paving at all intersections and at the Las Virgenes Creek bridge to enhance pedestrian circulation.

6. Provide access from Las Virgenes Road at Agoura Road to the east side properties. This road should be designed as a local street. A road extension through the east hillsieds shall not occur.

7. Thousand Oaks Blvd. should not be extended to the west, beyond Las Virgenes Road.

8. Improve left-turn and U-turn movements from southbound Las Virgenes Road at the freeway ramps.

9. The main entrance for the neighborhood commercial center shall be on Agoura Road. Secondary or internal access to the commercial center is encouraged to be provided from properties on Las Virgenes Road.

10. Require reciprocal access and parking agreements for adjacent parcels, whenever feasible to reduce the number of drive-

ways and to promote internal circulation.

11. Parking areas shall be designed to promote pedestrian circulation on the site and between adjacent sites and to allow generous landscaping.

12. A hiking and riding trail (the Las Virgenes Trail) shall be provided along Las Virgenes Creek from the Ventura Freeway south to the end of the planning area and beyond. A hiking and riding trail (Calabasas-Cold Creek Trail) shall also be provided from the Agoura Road/Las Virgenes Road intersection eastward to the Conservancy open space lands on the east hillsides. A pedestrian connection shall be provided between these two trails.

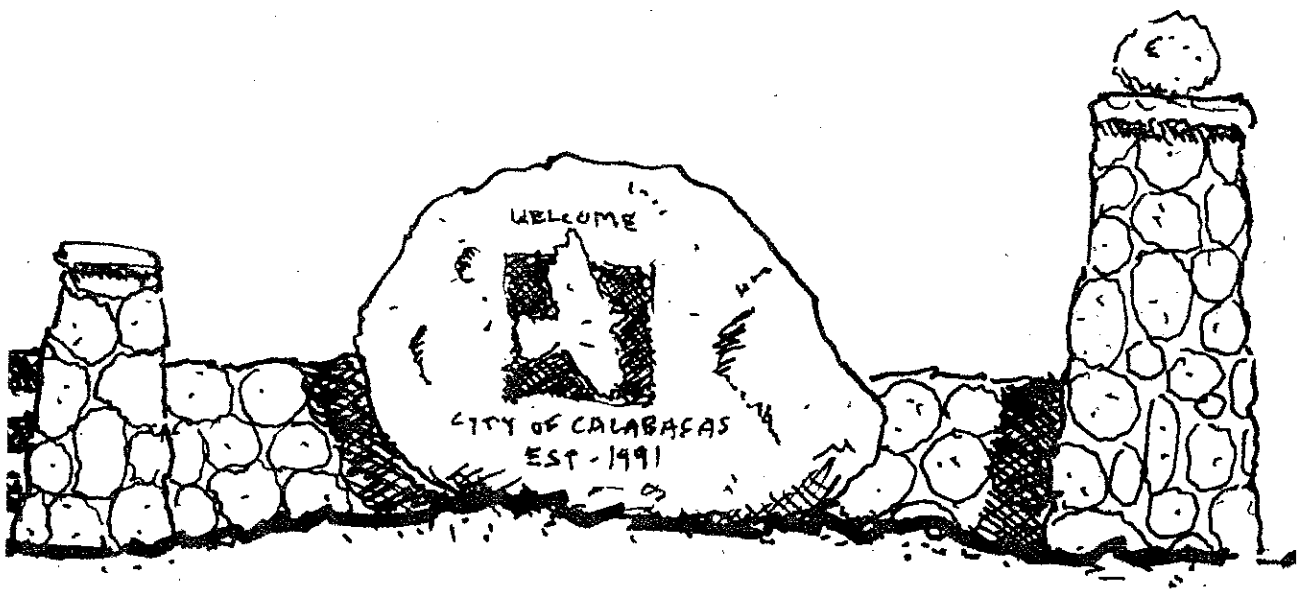
13. Provide a Park and Ride facility on Las Virgenes Road in the vicinity of the Rondell property.

14. Investigate access to the Steeplechase Trail.

15. The City shall pursue undergounding of utility poles and lines.

It is the City's intent to require new developments to mitigate their traffic impacts, either through construction of new roadways or payment of mitigation fees. This system will distribute the costs of the street enhancements discussed above, based on the proportional share of traffic. The Circulation Plan Objectives shall be implemented through the City's Capital Improvment Program.

9 Public Improvements



PUBLIC IMPROVEMENTS

The Las Virgenes Road corridor in the Master Plan area has been traditionally oriented to the highway traveler, very little attention has been given to the street scene as an entry point to western Calabasas. One of the most problematic issues is a lack of cohesiveness. This lack of community is observed in the confusing traffic movements, competing advertising signs, minimal landscaping and disjointed architectural styles.

The Master Plan's goal is to provide public improvements in addition to those outlined in the Circulation and Parking chapter, that will quiet this section of Las Virgenes Road. The objective can be accomplished through landscaping, controlled circulation, unified street furnishings, signage and encouragement of pedestrian and bike travel. The plan is to create a village environment with broad arching street trees, detailed fencing, light posts, banners, colorful landscaping and enhanced pedestrian movement.

The Master Plan's goal is to provide public improvements in addition to those outlined in the Circulation and Parking chapter, that will quiet this section of Las Virgenes Road. The objective can be accomplished through landscaping, controlled circulation, unified street furnishings, signage and encouragement of pedestrian and bike travel.

STREETSCAPES

The *Las Virgenes Road Corridor Design Plan,* prepared in January 1998 by RRM Group, contains an extensive streetscape beatification plan for Las Virgenes Road. The Master Plan incorporates the theme from that plan with refinements to provide a comprehensive gateway streetscape plan.

1. Objectives

The streetscape plan has the following objectives:

1. Promote development of high quality street scenes that reinforce the rural image.

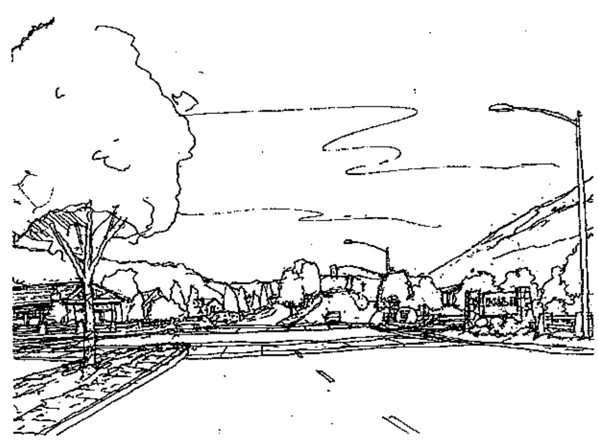
2. Ease tensions between pedestrian and vehicular traffic.

3. Employ landscape treatments to screen negative views and enhance or frame positive views.

4. Identify primary gateways and provide a sense of hierarchy and continuity with secondary gateways.

5. Provide a unified rural theme area along Las Virgenes Road from the Ventura Freeway south to Lost Hills Road and along Agoura Road from its intersection with Las Virgenes Road to the bridge at Calabasas Creek.

6. Place tree plantings to preserve public view corridors from Las



Virgenes Road.

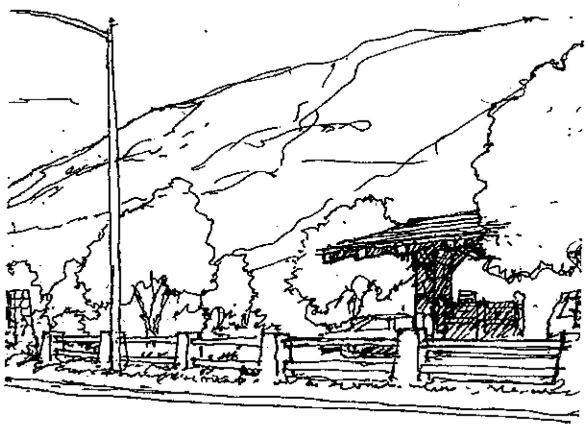
2. Design Elements

The streetscape design elements include the following:

Landscaped medians with river rock centers and textured concrete detail on noses.

Special paving at pedestrian street crossings.

New sidewalk paving with decorative tile or brick/paving treatment.



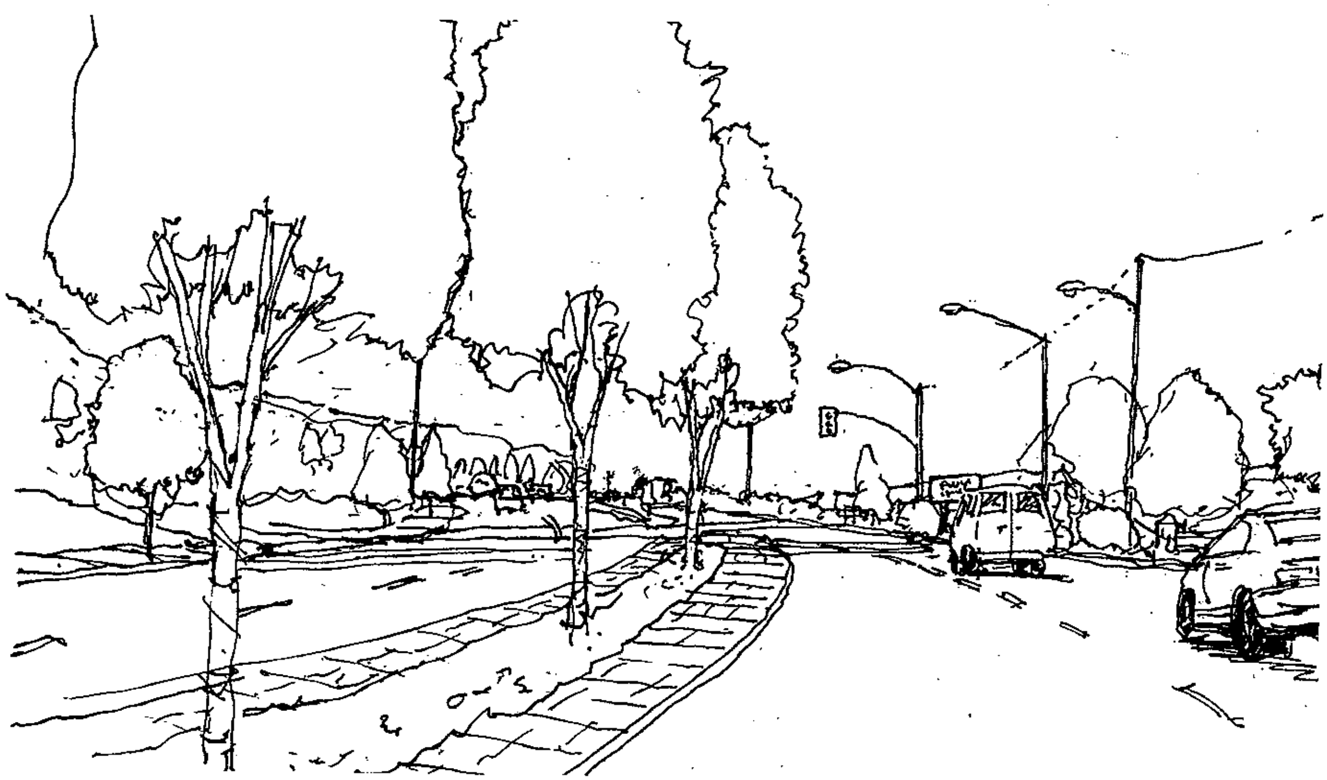
Street trees with tree grates and special pavement surrounds.

Decorative lamp posts with custom banners.

Special fencing at back of sidewalk.

Site furnishings: benches, trash receptacles, planters, bike racks.

Under grounding utility lines.



3. Street Plantings

Las Virgenes Road - The median tree for the segment of Las Virgenes Road from Lost Hills Road to Mureau Road shall be Populus candicans (Balm of Gilead) at a spacing of no less than thirty feet on center. Trees shall be planted in a straight row and centered in the median. Ground cover and paving in the medians shall be predominantly river rock "cultured stone" with pockets of prostrate and accent shrubs planted in drifts and groupings. Prostrate shrubs shall be Lantana, Rockrose, and Cotoneaster. Accent plants shall be Fortnight Lily, Fountain Grass and Compact Flax.

Sidewalks shall be planted with Platanus acerifolia / London Plane Tree at a spacing of no less than forty feet on center. Trees shall be planted in four-foot square tree wells behind the curb face. For the segment of Las Virgenes Road from Mureau Road north to Thousand Oaks Blvd, the median tree shall continue to be the existing London Plane Tree.

For the segment of Las Virgenes Road, north of Mureau Road, sidewalk trees shall be Populus candicans. Medians in this segment shall be developed with river rock and prostrate plantings similar to the southern segment of Las Virgenes Road.

Agoura Road - Sidewalks shall be planted with Schinus molle (California Pepper Tree) at a spacing of no less than forty feet on center in tree wells flanking the street.

Highway 101 Ramps - Planters outside of the Caltrans Right of Way shall be planted with American Sweetgums (Liquidambar styraciflua) no less than 30 feet on center in parkway strips flanking the street. Planting within the Right of Way shall be of species approved Caltrans.

Private Circulation Alleys - Alleys shall be detailed as minor streets, with frequent curb breaks for access to parking and loading. Parkway strips behind the curb are to be planted with trees at 25 to 30 feet on center plus turf or groundcover. The planting strip behind the sidewalk shall be planted with shrubs, with or without ground plantings. Wall vines may be planted on adjacent building walls and streetwalls, and shall be planted on streetwalls over 42 inches in height.

GATEWAYS

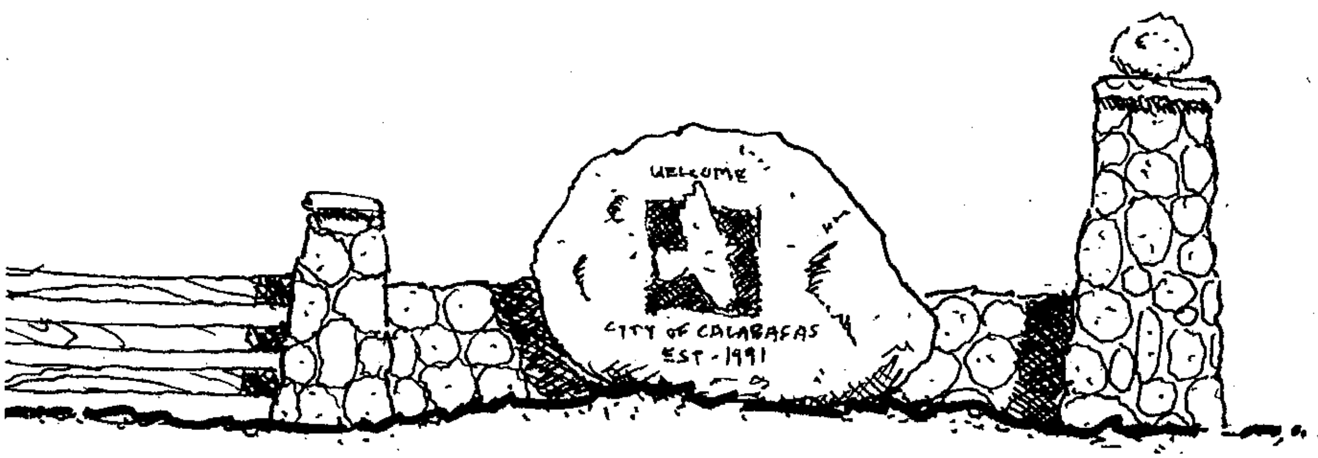
City entries are primary points of arrival, or *gateways*. These entries occur at the Highway 101 southbound and northbound off-ramps at Las Virgenes Road. These entrances to western Calabasas should be distinctive and announce a point of arrival to this rural valley corridor. The design should create a memorable landmark incorporating the City logo and a welcome statement. Monument design and landscape treatments should be bold to relate to vehicular traffic. Paving materials, trees, and rural fencing should be laid out to emphasize this as the western City entry.

These stone monuments should be placed at the northeast corner of the Las Virgenes Road intersection with the northbound freeway off-ramp and at the northeast corner of the Las Virgenes Road intersection with the southbound freeway off-ramp. Placement of these monuments should become a part of the site planning and development review for new or renovated development on these properties.

Secondary gateways occur at various locations where visitors and residents traverse Las Virgenes Road and Agoura Road. These internal gateways occur in locations that link the Las Virgenes corridor with surrounding neighborhoods. These secondary gateways are as follows:

- The intersection of Las Virgenes Road and Agoura Road.
- The Agoura Road Bridge over Malibu Creek.
- The intersection of Las Virgenes Road and Thousand Oaks Boulevard.
- Southerly end of the Master Plan area on Las Virgenes Road.

The secondary gateways should enhance the pedestrian experience and slow down traffic. Pedestrian-scale plantings, detailed paving, special street lights, and benches should be incorporated. These areas should be detailed with rural theme elements that echo the primary gateway but do not compete with it.



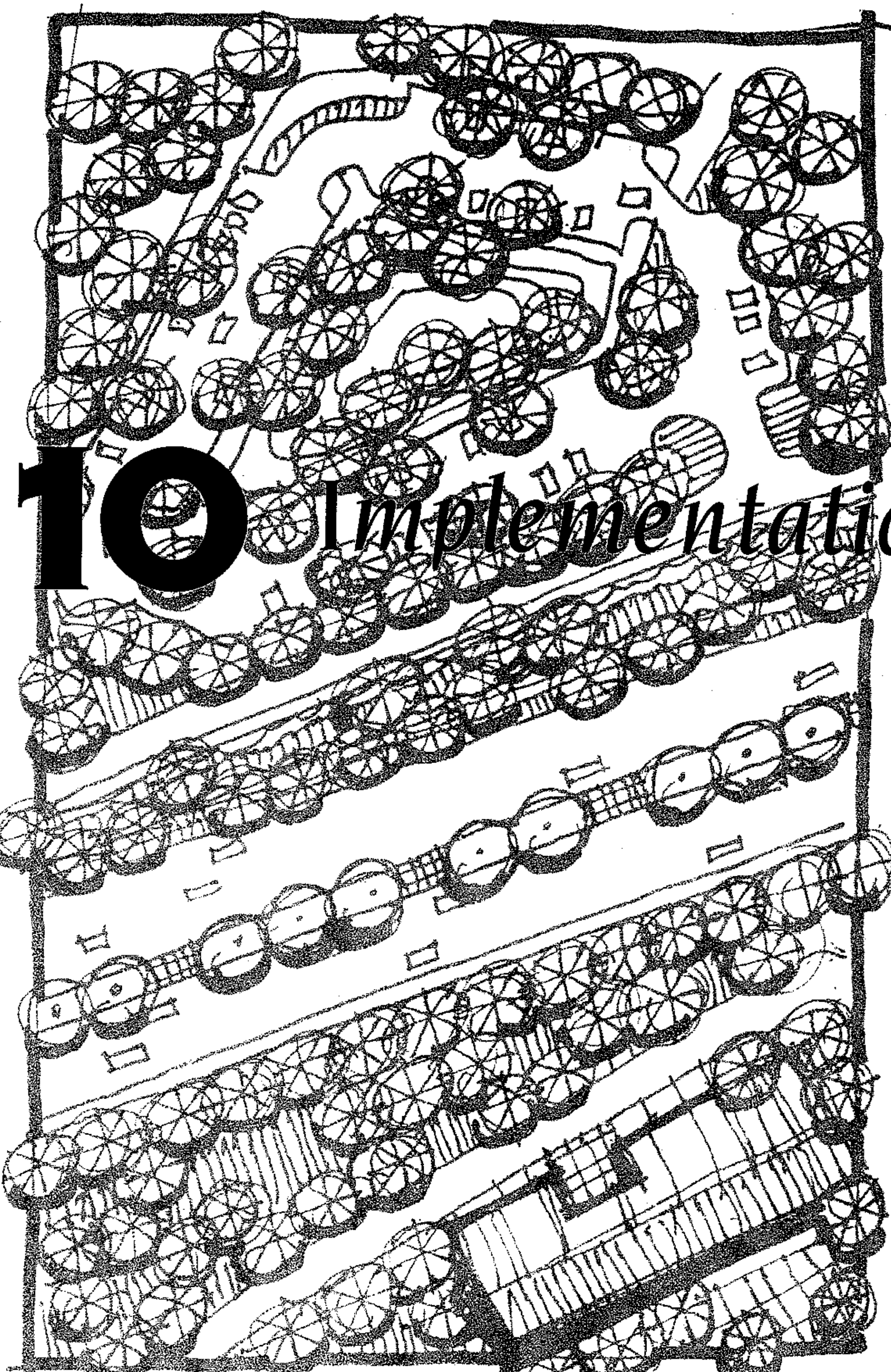
Concepyual study of gateway monumentation at key entry points into the City.

FREEWAY ENHANCEMENTS

Landscape treatments along the Highway 101 freeway and off-ramps can play an integral part in the success of the design treatment. Landscape treatments along these approaches should be simple with a strong sense of greenery contrasting with the appearance of the freeway and off-ramps. This provides a pleasant foreground announcing the gateways. Coordination with Caltrans will be required for this planting.

OVERHEAD UTILITY LINES

All new construction or restoration of existing buildings will be required to place all new utility lines underground. Also, existing utility lines should be placed underground whenever feasible. If existing lines cannot be placed underground, consideration should be given to relocation to an area where they are less visible. The City shall also investigate the feasibility of undergrounding utility lines as part of any streetscape construction project.



10 Implementation

IMPLEMENTATION

MASTER PLAN ADMINISTRATION

The Las Virgenes Gateway Master Plan contains the tools to establish and maintain the vision of a memorable gateway and the rural setting. Goals, objectives and standards are provided to direct renovations and new development. This chapter provides information relative to achieving the Plan. As Plan implementation is dependent on both private and public development, there must be a coordination of efforts. To assure Plan implementation, the following requirements are established:

- The City shall adopt the Las Virgenes Gateway Master Plan and associated General Plan and Zoning amendments so that the Master Plan goals, objectives and standards can be used in the review of development applications. The adoption of this Master Plan also concurrently adopts the associated General Plan Amendments and establishes the Las Virgenes Gateway Overlay Zone.

- The City shall adopt a plan for carrying out public improvements as described in the *Las Virgenes Road Corridor Design Plan* and this Master Plan, including the components listed below. The public improvements shall be coordinated and prioritized through the City's Capital Improvement Program.

  Streetscape Improvements
  Entry Gateway Monumentation
  Intersection/Pedestrian Crossing Decorative Paving
  Roadway Improvements (turn lanes and medians)
  Bridge Widening
  Planted Medians
  Underground Utilities

- The City shall investigate available grants for creek reclamation and trail construction. The City shall apply for those that are determined to be appropriate.

- The City shall establish an incentive program for new development and renovations in the Master Plan area. The incentives can include, lower processing fees, fast-track permit processing, grants and low interest loans.

MASTER PLAN AMENDMENTS

From time to time it may be necessary to amend the Master Plan to respond to specific environmental or economic changes or to accommodate newly identified opportunities. The Plan should be amended by resolution. Whenever feasible, development permits should be considered at the same time as the Plan amendment request.

REGULATORY MEASURES

The City can implement the Master Plan through land use and development controls. To implement the regulatory measures in the Master Plan the following steps must be taken:

1. General Plan Text Amendments - The General Plan Amendments outlined in the Master Plan and in Appendix D will occur at adoption of the Master Plan.

2. General Plan Land Use Map Amendments - The following properties will have General Plan Land Use Designation amendments adopted concurrently with adoption of the Master Plan::

   Rondell (APN 2069-031-014 and 015) Change from Urban Hillside to Business-Retail.

   Pazar (APN 2069-020-025 and 026) Change from Business-Retail to Residential-Multiple Family

   Malibu Commercial Center Parcel (APN 2064-020-008) Change the land use designation from Single Family Residential to Business-Retail to correct an existing General Plan mapping error.

3. Baldwin/Village (APN 2069-078-009 and 011) Land use designation boundaries may need to be changed to implement the Master Plan, however the land use designations should not change.

4. Development Code Amendment - Adopt the Las Virgenes Gateway Overlay Zone.

5. Zone Map Amendments - The following properties shall have Zoning Designation changes:

   Adopt the Las Virgenes Gateway Overlay Zone for all properties in the Plan boundary.

   Rondell (APN 20-031-014 and 015) Change from Hillside/Mountainous to Commercial-Retail.

   Pazar (APN 2069-020-025 and 026) Change from Commercial-Retail to Residential-Multiple Family Planned Development.

6. Baldwin/Village (APN 2069-078-009 and 011) Zone designation boundaries may need to be changed to implement the Master Plan, however the existing zone designations should not change.

7. Architectural and Landscape Design Standards - Adopt the Master Plan Design Standards in Chapter 7 by resolution.

8. Sign Standards - Adopt the Master Plan standards by ordinance.

ANNEXATION

A large portion of the property located along the Las Virgenes corridor north of the Ventura Freeway is not within the City's jurisdiction. These lands are in Los Angles County. This split jurisdiction in the middle of the Master Plan area affects the City's ability to provide land use and design controls consistent with the Master Plan. It is recommended that these lands be considered for annexation to the City. The City should initiate proceedings with the Local Agency Formation Commission. Possible land uses for these properties include low density residential, a public school and recreation fields.

Until such time as these lands are annexed, the City should use the land use and design recommendations in the Master Plan to provide input to the County on any development proposals on these lands.

Las Virgenes Gateway Districts and Permit Requirements

LAND USE	PERMIT REQUIREMENTS BY DISTRICT							
	Highway Triangle	Rondell Property	Baldwin Property	Pazar Property	Pontopiddan Property	Agoura Road	Northwest Hillsides	See Standards/ Procedures in Section
Key to Permit Requirements							*Symbol*	
Permitted use - Zoning Clearance required							*P*	*17.60.080*
Allowed use - Zoning Clearance required for new use in existing structure Site Plan Review required for new construction							*A* *A*	*17.60.080* *17.60.020*
Conditional use - Conditional Use Permit required							*C*	*17.62.050*
Temporary use - Temporary Use Permit required							*TUP*	*17.62.030*
Use not allowed								
LIGHT INDUSTRY, WAREHOUSING								
Printing and publishing			A	A		A		
Recycling - reverse vending machines		P	P	P		P		17.32.150
Recycling - small collection facility		P	P			P		17.32.150
RECREATION, EDUCATION, PUBLIC ASSEMBLY								
Adult entertainment businesses						C		17.32.030
Churches/places of worship			A	A			A	
Community centers			A	A			A	
Health/fitness clubs			C	C		C		
Indoor recreation centers			C	C		C		
Libraries and museums						A		
Night clubs/live entertainment						C		
Outdoor commercial recreation							C	
Schools - elementary and secondary			A	A			A	
Studios for dance, art, music, photography, etc.		A	A	A		A		
Temporary events	TUP	TUP	TUP	TUP	TUP	TUP	TUP	17.62.030
Residential Uses								
Home occupations		P	P	P	P		P	17.32.100
Household pets		P	P	P	P		P	17.32.050
Multi-family housing			C	C				
Residential accessory uses/structures		P	P	P	P		P	17.32.160
Residential care homes, seven or more clients			C	C	C		C	
Residential care homes, six or fewer clients		P	P	P	P		P	
Senior residential projects			C	C	C			17.32.180
Single-family housing		A	A	A	A		A	

LAND USE	PERMIT REQUIREMENTS BY DISTRICT							
	Highway Triangle	Rondell Property	Baldwin Property	Pazar Property	Pontopiddan Property	Agoura Road	Northwest Hillsides	See Standards/ Procedures in Section
Key to Permit Requirements							*Symbol*	
Permitted use - Zoning Clearance required							*P*	*17.60.080*
Allowed use - Zoning Clearance required for new use in existing structure Site Plan Review required for new construction							*A* *A*	*17.60.080* *17.60.020*
Conditional use - Conditional Use Permit required							*C*	*17.62.050*
Temporary use - Temporary Use Permit required							*TUP*	*17.62.030*
Use not allowed								
Retail Trade Uses								
Accessory retail uses	P	P	P	P		P		17.32.020
Alcoholic beverage sales in conjunc-ion with a primary allowable use	C	C	C	C		C		
Art, antiques, collectibles, gifts		A	A	A		A		
Auto, mobile home, and vehicle parts sales	C	C						
Bars and drinking places						C		
Certified farmers' markets			C	C		C		
Convenience stores	C	C				C		
Grocery stores						A		
Outdoor retail sales, temporary	TUP	TUP	TUP	TUP	TUP	TUP	TUP	17.62.030
Plant nurseries		A	A	A		A		
Restaurants, counter service	A	C				A		
Restaurants, table service	A	C	A	A		A		
Retail stores, general merchandise	A	A	A	A		A		
Second hand stores						A		
Shopping centers			C	C		C		
Service Uses								
Automated teller machines (ATMs)	P	A	P	P		P		
Banks and financial services			A	A		A		
Bed and breakfast inns, hotel, motel		C	C	C		C		
Car wash	C							
Cemeteries, columbariums, mortuaries		C						
Child day care centers			A	A	A		A	17.32.070
Kennels and animal boarding		A						
Medical services - clinics and labs			A	A			A	
Medical services - convalescent hospitals and extended care					C			

LAND USE	PERMIT REQUIREMENTS BY DISTRICT							
	Highway Triangle	Rondell Property	Baldwin Property	Pazar Property	Pontopiddan Property	Agoura Road	Northwest Hillsides	See Standards/ Procedures in Section
Key to Permit Requirements							*Symbol*	
Permitted use - Zoning Clearance required							*P*	*17.60.080*
Allowed use - Zoning Clearance required for new use in existing structure Site Plan Review required for new construction							*A* *A*	*17.60.080* *17.60.020*
Conditional use - Conditional Use Permit required							*C*	*17.62.050*
Temporary use - Temporary Use Permit required							*TUP*	*17.62.030*
Use not allowed								
Offices, business						A		
Offices, professional		A	A	A		A		
Offices, property management		A	A	A		A		
Offices, temporary	TUP	TUP	TUP	TUP	TUP	TUP	TUP	17.62.030
Personal services		A	A	A		A		17.32.142
Public safety and utility facilities	A	A	A	A	A	A	A	
Repair and maintenance - consumer products		A	A	A		A		
Repair and maintenance - vehicle, major work	A							
Repair and maintenance - vehicle, minor work	A	C						
Service stations	C	C				C		17.32.200
Storage, accessory	P	P	P	P	P	P	P	
Storage, personal storage facilities (permitted notwithstanding the provisions of the -SC overlay zone)		C						17.32.220
Veterinary clinics & animal hospitals		C	C	C		C		17.32.230
TRANSPORTATION AND COMMUNICATIONS USES								
Antennas, communications facilities	A	A	A	A	A	A	A	17.32.050
Pipelines and utility lines	P	P	P	P	P	P	P	17.02.020 (B)9
Transit stations and terminals	A	A	A	A	A	A	A	

Appendices

Appendix A

Community Workshop and Public Hearing Input

Las Virgenes Valley Planning Area
Summary of Public Work Shop Input
March 14, 1998

On Saturday March 14, 1998 a public work shop was held with citizens, land owners, applicants, several City decision makers, City staff and planning consultants. The group broke up into three small sub groups to discuss the land use and design issues affecting four areas of the Las Virgenes Valley study area: The Highway Triangle, The Agoura Road District, The East Hillsides and the Northside Commercial Center. A map depicting these areas is attached. This summary presents the following information:

1. A chart that summarizes each groups' input on Land Uses. The chart shows the "preferred land uses" mentioned by each work shop participant. After compiling the complete list of preferred land uses, the entire group was asked to pick their top two preferred/priority land uses for each area, by placing blue dots next to the land use lists that were displayed on the walls. Each participant was asked to indicate on the blue dot whether it was placed by a "resident" or a "land owner." Some dots were not labeled and are listed as "other." Although each listed land use had been discussed by a workshop participant, when it came to picking only the top two preferred uses, some land uses received no votes. The top vote getter in each area is shown on the chart in italics.

2. A chart that summarizes the "preferred" architectural style for buildings and structures in the Las Virgenes Study Area. The group was asked to use blue dots to indicate their preferred architectural style on three boards that displayed Mediterranean, Rural and Old Town style architecture. Also, three different styles of "non corporate" gas station architecture were presented. Each participant was asked to indicate on the blue dot whether it was placed by a "resident" or a "land owner." Some dots were not labeled and are listed as "other."

3. An outline that summarizes design issues raised by each group.

I. Summary of Preferred Land Uses and Priority Ranking

Area	Preferred Land Uses	Selected by Residents	Selected by Land Owners	Selected by Others
Highway Triangle				
	Contain all freeway related uses in the triangle.	5	4	1
	Neighborhood serving uses.	7	0	0
	Family restaurant.	4	1	0
	Auto-related uses.	2	0	2
	No fast food.	8	0	0
	Fast food OK.	4	5	1
	Rezoning needed.	2	0	0

Area	Preferred Land Uses	Selected by Residents	Selected by Land Owners	Selected by Others
Agoura Rd. District				
	Neighborhood services uses such as small grocery and pharmacy.	14	2	1
	Civic Center/City Hall	0	0	0
	Office uses.	0	0	0
	Creek/path system.	8	0	0
	Emphasize local uses.	5	1	0
	Auto Dealer.	0	0	0
	Commercial recreational uses.	0	0	0
	Hospital	1	0	0
	No Seven-Eleven	4	0	0
	Mixed use.	2	0	0
East Hillsides				
	Single family detached homes.	5	1	1
	Neighborhood commercial in the middle, near Agoura Rd.	0	0	0
	Residential uses at the south end.	1	0	0
	70-100 room mid-level hotel at Rondell property.	0	6	1
	Upscale restaurant.	3	0	0
	Retain open space.	5	1	0
	Residential use as second choice if land can not be preserved in open space.	1	0	1
	Senior housing.	4	2	1
	Mini storage at Rondell property.	2	0	1
	Retain oaks and other trees.	0	0	0
	Low density residential.	8	2	1
	New public school.	3	1	0
	No commercial.	2	0	0

Area	Preferred Land Uses	Selected by Residents	Selected by Land Owners	Selected by Others
Northside				
	Public school site on county land.	9	4	2
	Keep neighborhood commercial.	3	0	0
	Recreation fields instead of proposed commercial use on County land.	14	1	0
	Low density rural residential on County land.	2	2	0
	Trail access to National Park.	3	0	1

II. Summary of Preferred Architectural Styles

Architectural Styles	Selected by Residents	Selected by Land Owners	Selected by Others
Mediterranean (light stucco, red tile roofs)	10	4	2
Rural (wood, stone, simple barn like forms)	10	1	2
Old Town (western)	0	0	0
Mediterranean Style Gas Station	0	0	2
Rural Style Gas Station	5	2	0
Contemporary Gas Station	1	0	0

III. Summary of Design Issues

Highway Triangle

- Put noise insensitive uses here.
- Need reciprocal access.
- Common landscape theme.
- Need architectural theme.
- Need centralized signage, no pole signs.
- Should be consistent with rural image and scenic corridor.

Agoura Road

- Orient development to the creek.
- This should be the focus of the City's west end.
- Consider the narrow bridge, its good and bad.
- Open up the area at and adjacent to the Malibu Plaza.
- Limit access on Las Virgenes Road.
- Restore the creek.
- Reciprocal access.
- Pedestrian bridge over the creek.
- Creek trails connecting to the homes to the south.

East Hillsides

- Keep low profile at the street level.
- Preserve views of the hills.
- Preserve the views from Agoura Road.
- Too busy for school. Access poor for schools.
- Provide access to conservancy land.
- Use bench area as staging area for conservancy land.
- Development should be hidden.
- Limit access off Las Virgenes for any new uses.

Northside

- Intersection of Las Virgenes and Thousand Oaks Blvd. should be pedestian friendly.
- No east/west road connection to Lost Hills.
- Annex and control the County land in this area.
- Geology issues.
- Hide development.
- Do not extend Thousand Oaks Blvd.

Summary of Planning Commission Workshop
Las Virgenes Valley Gateway Study Area
March 26, 1998

Comments from Citizens:

The Draft Development code must be adopted.

This gateway should rival Old Town.

This area is the gateway to the Santa Monica Mountains. It should inspire the wilderness concept with wildflowers.

The gateways begin at the freeway off ramps.

The area already has 4 fast food restaurants, 5 gas stations, why allow more of the same?

The triangle property could be better used by neighborhood serving uses such as a book store or small pharmacy.

Put a neighborhood serving use by the creek.

This is a large "project." We shouldn't rush through the planning and try to get it done in 45 days. We spent years planning other large projects in the city.

Address power pole blight.

Narrow the scope of the moratorium.

Focus moratorium and planning efforts on the triangle.

The land uses in this area attract transients. The area has become a truck stop. Many large trucks are going through the Lost Hills area.

The neighborhood needs a good shopping center so residents do not have to get on the freeway to shop.

Do a Master Plan so that we all know what to expect. Then we won't be fighting over every single project application.

The east side should be residential, integrated into the hillside.

The plan should be integrated with the Scenic Corridor Ordinance.

We need to look at the economics of a neighborhood market.

Comments from Applicants/Land Owners:

The uses that are currently in the triangle are not going to go way so we should recognize them.

All the land owners in the triangle want to cooperate on a landscape plan.

If circulation and aesthetic issues are addressed, the use isn't so important.

The moratorium is negatively affecting applicants.

Traffic flow at the U-turn on Las Virgenes Road should be addressed.

There is interest in assembling parcels on the east side for a multi-level senior housing project with apartments, assisted living and convalescent care. There is no such facility in the San Fernando Valley or in the Agoura area.

There is a desire to do multi-family residential on the east hillsides.

Continue residential use on the Pontoppidan property.

Creek improvements that don't interfere with the privacy of adjacent residents would be OK.

Comments from Planning Commissioners:

We need to implement a landscaping plan for the entire area.

The new plan should tie into the Corridor Plan by RRM.

Any landscaping should screen and preserve views.

There are major geologic and topographic constraints on the east hillsides. Any development would need to be compatible with the content of the hillside.

Would like to see more single family on the east side, but the topography may prohibit it.

The senior housing concept is interesting.

Our ultimate goal should be to create a master plan for the area.

The plan should address the boundaries that are currently recommended by Staff.

The development standards in the Draft Development Code should be used.

Could we impose the Draft Development Code, in the interim while it is being considered by the City Council?

Extend the moratorium on a limited basis to allow a master plan for landscaping and architectural design to be developed.

Final Planning Commission Action:

Leewong/Brown 4/0: Recommend that the City Council instruct the consultants to take public input and prepare a plan for public review, Planning Commission input and City Council adoption. Adopt the Development Code with the deletion of the grandfather clause as an urgency measure. Address the following ideas in the plan: Freeway/auto oriented uses in the triangle, but not intensified uses; Agoura Road development with mixed retail/small market; Consider recreational uses on the north side; Multi-family and/or senior housing/congregate care on the east side.

Summary of Input
Advisory Committee and Community Workshop
Wednesday April 29, 1998

On Wednesday April 29, 1998 a work shop was held for City advisory committee members. Citizens, land owners, applicants, and residents were also invited. The group broke up into five small sub groups to discuss the land use, development standards and design issues for areas of the Las Virgenes Gateway study area: The Highway Triangle, The Agoura Road/Creek District, and The East Hillsides.

The charts presented below summarize the group's input on land uses, development standards and design issues. Each item listed in the chart represents an important consideration raised by members of the workshop. In some instances, the listed items may conflict such as "Widen the Bridge" and "No Bridge Widening."

After compiling the complete list of important factors, the entire group was asked to pick their top *eight* priority considerations by placing blue dots next to the items as displayed on the walls. The participants could "spend" their eight dots on eight different topics or use several to emphasize their concern for one issue. Each participant was asked to indicate on the blue dot whether it was placed by a"committee member," "resident" or a "business/land owner." Some dots were not labeled and are listed as "other." Although each listed land use had been discussed by a workshop participant, when it came to picking only the priority considerations, some issues no votes. The top vote getters (five or more votes) in each area is shown on the chart in italics.

In analyzing the input, all factors that are listed in the charts should be regarded as important considerations. All items that received at least one vote should be considered a priority. Those issues with the highest number of votes may be considered a directive to be addressed by the planning study.

I. Input on Freeway/Auto Oriented Uses in the Highway Triangle:

	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Low traffic auto uses.	2	1	6	2
Improve architecture, signs and landscaping.		3	4	1
Retail shops that service autos, parts, repair, etc.	3		2	
Park Service Visitor Center	4	3		
Creek may be impacted from auto uses.		2		
Do not restrict to auto oriented uses.				1
Allow restaurants.				1
Clean up traffic access.	1	1		
No new development.				
More parking.				
City to buy vacant land for public parking lot.				

I. Input on Freeway/Auto Oriented Uses in the Highway Triangle:				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Add freeway landscaping.				
Fast food with no drive-thru.				
Gas station, restaurant, car repair.	1			
Mixed freeway and community serving auto service.	1		1	
Gas stations with service bays.	1			
Increase open space.	1			
Skateboard Park	1			
No auto oriented businesses	2			

II. Input on the Agoura Road/Creek District:				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Neighborhood serving, family oriented retail and services.	7	3	2	2
Grocery Store.	2	7	4	2
No Grocery Store.	1			
Maintain integrity of watershed/improve the creek.	7	9		
Multi-use trail system along the creek.	6	7	1	1
Mixed uses - retail and residential.		1	2	
Widen Bridge.	1		2	
Don't widen bridge.		3		
In and Out Burger.				
Small Businesses.				
Starbucks-type coffee shop.			1	
Upscale family restaurant.			1	1
Add pedestrian access at the bridge.	1	1		

II. Input on the Agoura Road/Creek District::				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Connect both sides of Agoura Road for pedestrians.		1		
No more auto oriented uses.	2			
Library		2		
Allow on-street parking on Agoura Road.				
Park Service Visitor Center				
Create park along the creek and design the commercial/restaurants to orient to the creek.	4	2		
Health Club	1			
The creek should be reclaimed to as natural a state as possible, use cobblestones.	1			
No on-street semi-truck parking to be allowed.	1	2		

III. Input on the East Hillsides::				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Residential on the Pazar Parcel.	4		7	
Single family two story maximum.		5		
Open space only.	3			
Respect geologic problems.	2	4		
No custom homes/mansions.		2	1	
Senior housing/affordable housing.	1	1	2	1
Self storage at Rondell parcel.				
Park and Ride on Rondell parcel.	1			
Low rise office uses.			6	
No big box.	1			
Design more important than density.	5	1	6	

III. Input on the East Hillsides::				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
City and School District should work together to get a school site.	2	1	2	1
Trailhead staging area.		3	2	
Community Park.				
School on north side of freeway.	1			
School at church site on East Hillsides.				
Baseball Diamond.	4			
Some recreational uses.				
Non-residential uses at key intersections. Neighborhood serving retail and offices.				
Church			1	
Low profile development tucked into the hillside.	1		2	1
Limit development to half way up the hillside.	2	1		
Require large setbacks.	1	1		
General Plan Development Standards.	1			
No view of parking areas, garage doors and carports.				

IV. Input on Design Issues for the Planning Area::				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Maintain the gateway, make it memorable.	3	3	3	
Architecture and design should be a rural/rustic Mediterranean.	4	5	4	1
Underground utility wires.	3	3	2	1
No pole signs.	1	2	1	

IV. Input on Design Issues for the Planning Area::				
	Selected by Committee Members	Selected by Residents	Selected by Business and Land Owners	Selected by Others
Plant now, build later.	2	4		
Landscape creek with natives - riparian species and sycamores.	2	1		
Enforce repair and maintenance of landscaping.	1			
Provide trees in parking lots.		1		
No tenant menu signs.	1			
Low pedestrian oriented signs.				
Lighting to be attractive and safe.				
No bus bench signs.				
Signage style to relate to architectural style.				
Shaded walkways.				
Patios and courtyards.				
One to two story maximum height.				
Landscape the freeway frontage.	1			
Consistent design standards.		2	1	1
Consistent streetscape and private property landscaping.	1	1		
Not Disney Land.				
"Last of the Old West"	1			1
No palm trees.				
Street names on low wooden signs in the street medians.		1		
No neon signs.		1		
Conservation Easements and Dedication of Open Space.	1			
Landscape Screening	2			

Appendix B

Community Survey Input

CITY of CALABASAS

PLEASE SHARE YOUR THOUGHTS ABOUT THE LAS VIRGENES GATEWAY AREA

The City of Calabasas is conducting a planning study of the Las Virgenes Valley in the area from Thousand Oaks Boulevard to the Water District Headquarters building (south of Agoura Road). This study will lead to the preparation of a Master Plan that will address the allowed land uses, development standards for new structures and architectural design guidelines. The information collected with this survey will be used to expand upon the work done to date on the *Las Virgenes Road Corridor Plan*. We would like to know what you think about the existing land uses and what uses you would like to see in the future. Please take a few minutes to share your thoughts. **Your participation is appreciated!**

Please indicate what type of commercial establishments you **frequently** use in the Las Virgenes Road area with an X and those you **seldom or never use** with an O:

Gas Stations	_____	Pet Clinic	_____
Fast Food	_____	Tanning	_____
Mini-mart	_____	Clothing	_____
Restaurant	_____	Deli	_____
Dry Cleaner	_____	Video	_____
Liquor Store	_____	Other	_____
Postal Annex	_____	____________	

What commercial uses/services would you like to see **added** to the Las Virgenes Road area?

Small Local Market	_____	Large Retail Grocery	_____
Drug Store	_____	Specialty Market	_____
Convenience Store	_____	Restaurant	_____
Other ____________		(type)____________	

____

____

Are there any commercial uses that **should not be** allowed in the Las Virgenes Road area?

____

____

____

The Draft Development Code under consideration by the City prohibits new drive-through uses. Do you support such a prohibition? Yes___ No ___

What land uses would be most **appropriate** on the hillside area east of Las Virgenes Road from the freeway to the Water District Headquarters?

____

____

____

What **development restrictions or requirements** would you like to see placed on new uses for the east hillsides to assure their compatibility with the existing community?

____

____

____

What **architectural theme**, if any, would you prefer on all new and remodeled buildings?

______ Rural (simple wooden structures)
______ Mediterranean (stucco, tile roofs)
______ Old Town (Western)
______ No Standard Style
______ Other ____________________

Please provide any other comments you may have that will help us understand your "vision" for the future of the Las Virgenes Road Gateway area:

Fold Here

The Las Virgenes Gateway Planning Area
Community Questionnaire

Please return the completed form within one week from the date it is received to City Hall at 26135 Mureau Road, Calabasas, Ca 91302, or FAX to (818) 878-4215.

If you have any questions, please call Marilyn Miller, Interim Planning Director at (818) 878-4225.

Thank you for your interest and community involvement!

CITY of CALABASAS

Fold here, tape all three sides. Do not staple.

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CITY OF CALABASAS
26135 MUREAU RD STE 200
CALABASAS CA 91302-9828

Are there any commercial uses that should not be allowed in the Las Virgenes Road area?

NO DEVELOPMENT	84
STORAGE FACILITY	14
MOVIE THEATER	76
FAST FOOD	71
COMMERCIAL	144
INDUSTRIAL	36
MALLS	77
CAR DEALER	19
ADULT VIDEO/BOOK STORE	44
LIQUOR STORE	62
BAR/NIGHT CLUB	50
GUN DEALERS	6
PAWN SHOPS	6
CAR WASHES	6
VIDEO ARCADE	17
LANDFILL	2
POOL HALLS	10
GAS STATION	61
GOLF COURSE	2
AUTO REPAIR SHOP	10
APARTMENTS/CONDOS	10

The Draft Development Code under consideration by the City prohibits new drive-through uses. Do you support such a prohibition?

YES	389
NO	144

What land uses would be most appropriate on the hillside area east of Las Virgenes Road from the freeway to the Water District Headquarters?

OPEN SPACE (NO DEVELOPMENT)	235
PUBLIC PARK	86
LAND FOR SHEEP/COWS TO GRAZE	75
ART CENTER/NATURE BOOK STORE	7
REST STOP	2
COMMERCIAL DEVELOPMENT	42
UPSCALE RESTAURANT	36
UPSCALE GROCERY STORE	53
MOVIE THEATER	7
SMALL SPECIALTY MARKET	9
SCHOOL	9
RESIDENTIAL HOMES	21
WESTLAKE PROMENADE STYLE MALL	67
RETIREMENT HOME	5
UPSCALE HOTEL	1
GOLF COURSE	9

What architectural theme, if any, would your prefer on all new and remodeled buildings?

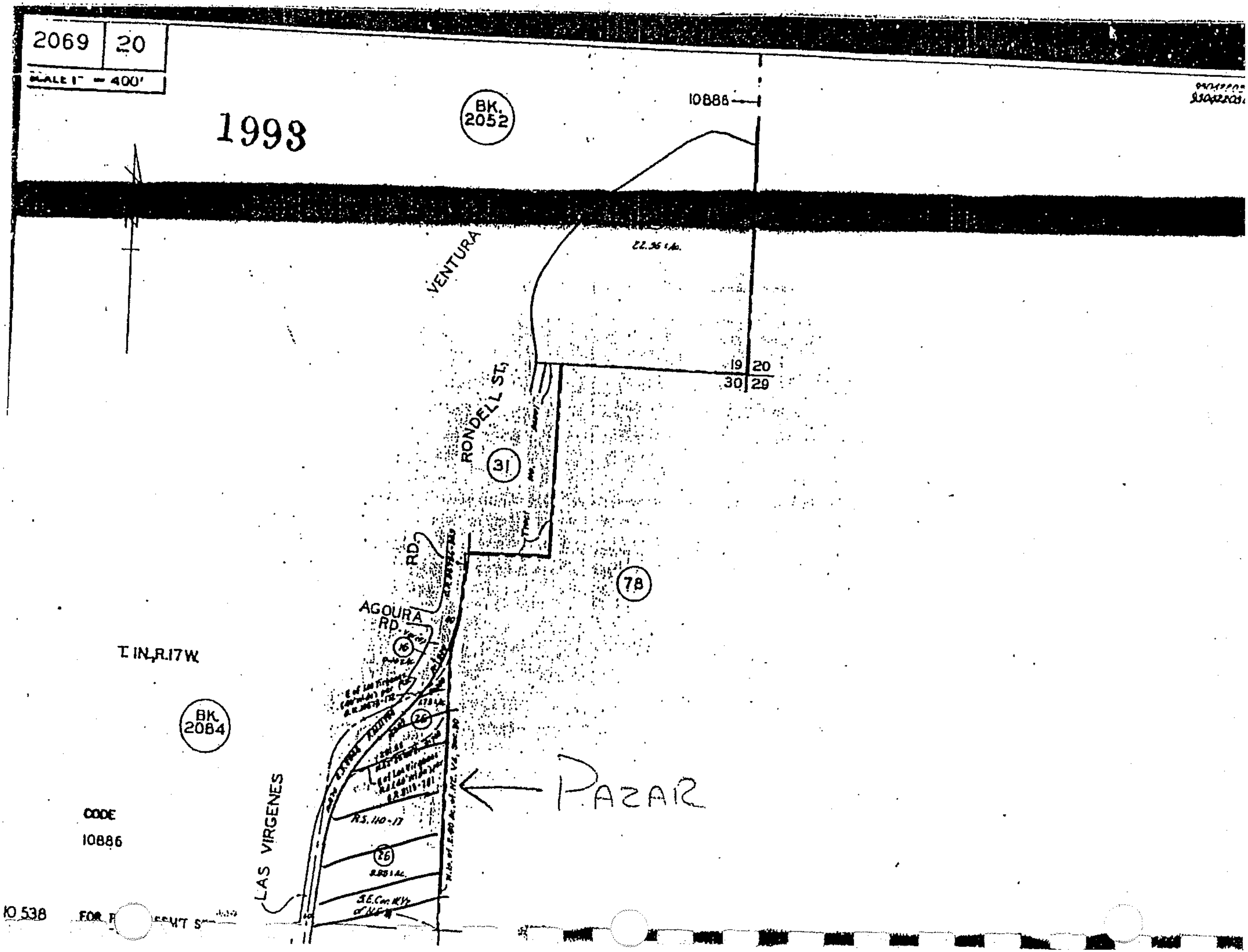
RURAL	147
MEDITERRANEAN	331
OLD TOWN	162
NO STANDARD	35
OTHER:	7

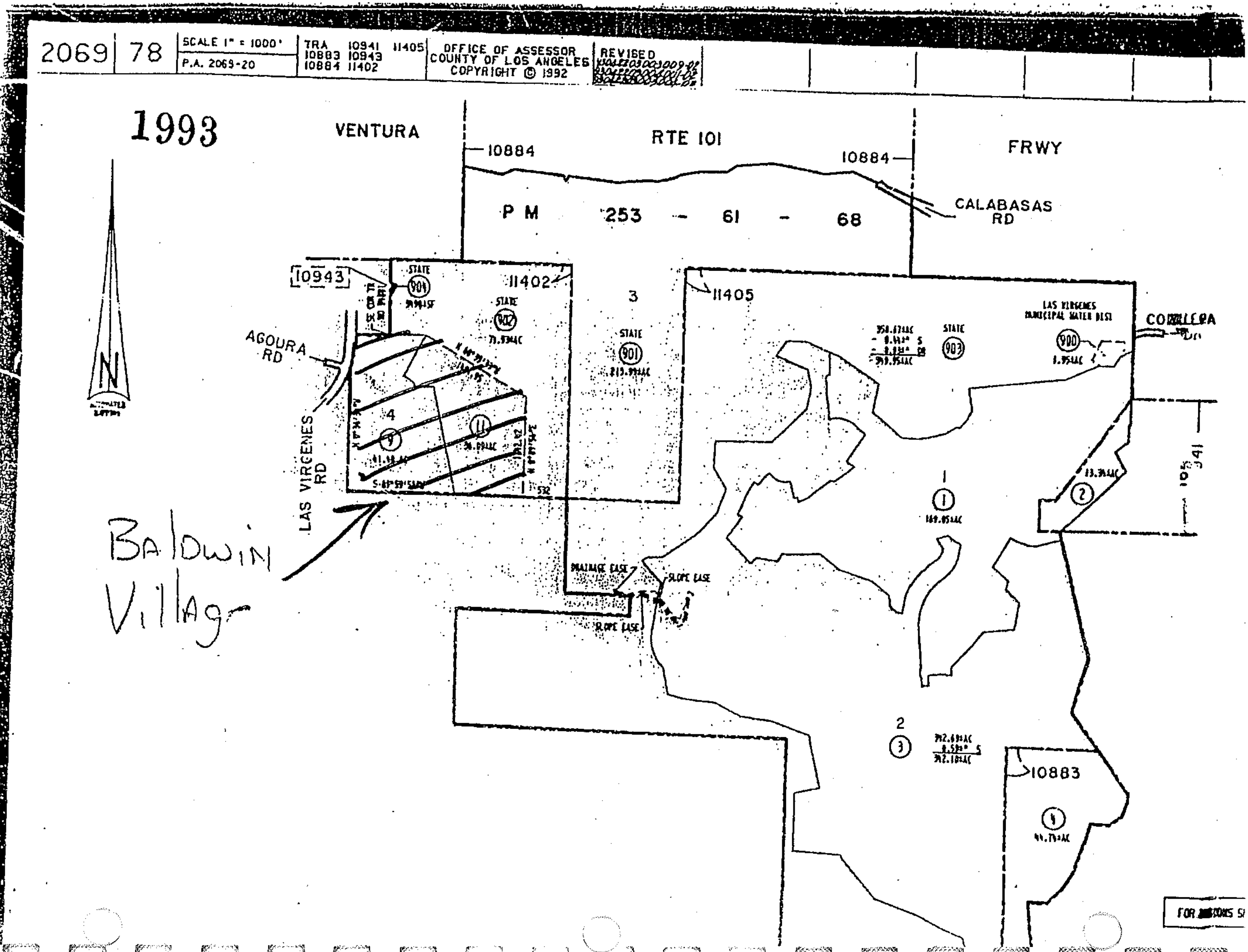
What development restrictions or requirements would you like to see placed on new uses for th east hillsides to assure their compatibility with the existing community?

NO DEVELOPMENT	196
RESTRICT	
STRIP MALLS	5
BLDG. HEIGHT (ONE STORY)	75
BILLBOARDS/SIGNS	16
FAST FOOD	6
COMMERCIAL	63
RESIDENTIAL	26
STORAGE FACILITY	2
HILLSIDE GRADING	27
MOVIE THEATER	6
REQUIRE	
BLDG. TO BLEND IN WITH HILLSIDE/ENVIRONMENT	57
MINIMUM DEVELOPMENT	85
COMMUNITY CENTER	5
CONSISTENT WITH DEVELOP DESIGN	26
QUALITY SHOPS	4
ADEQUATE PARKING	17
TRAFFIC ACCESSABILITY	18
LANDSCAPING	9

Appendix C

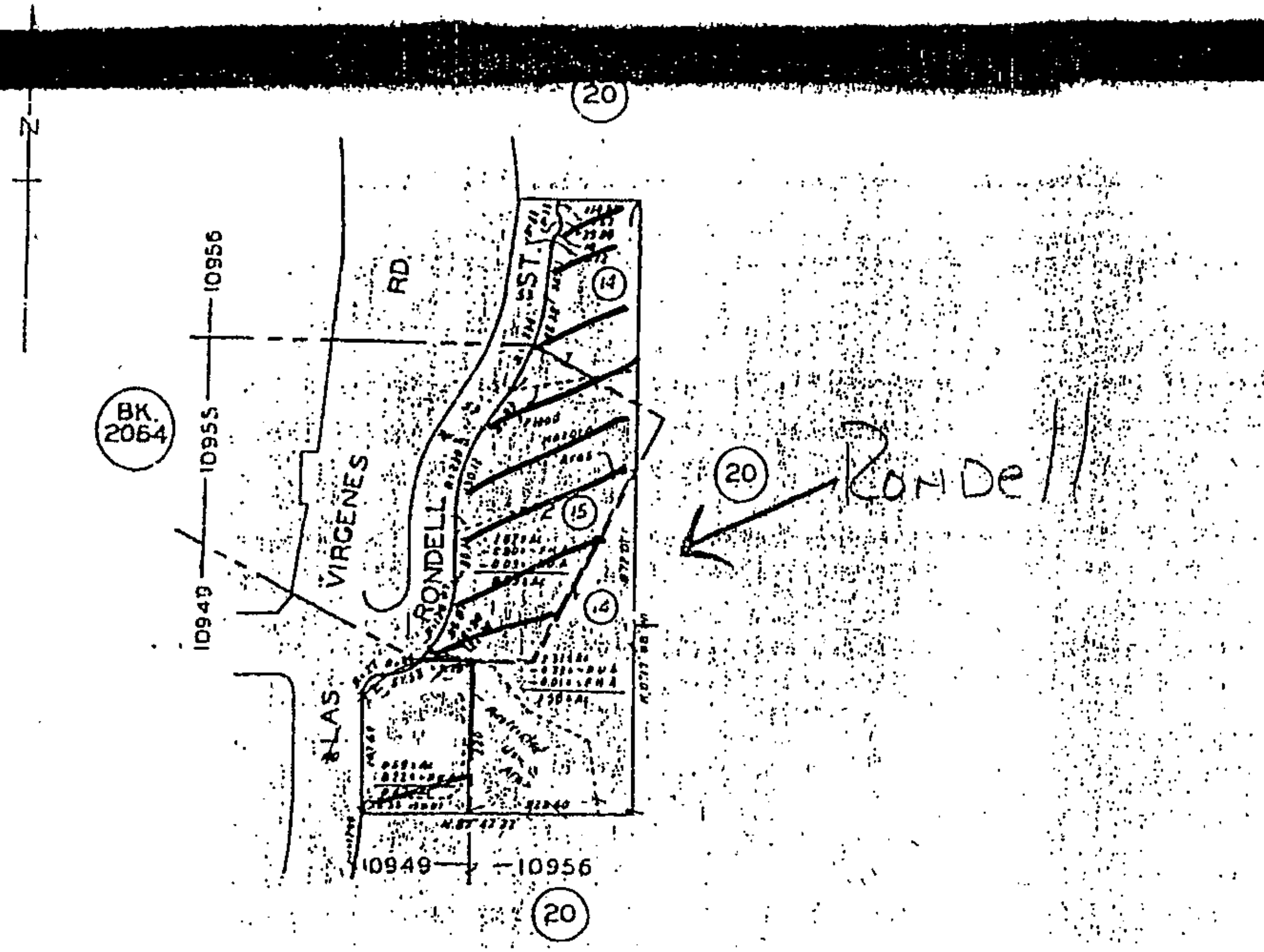
Parcel Maps


2069 20
SCALE 1" = 400'
1998
BK. 2052
10888
VENTURA
22.36 Ac.
19 20
30 29
RONDELL ST.
31
RD.
78
AGOURA RD.
16
26
R.S. 110-17
26
PAZAR
T.1N.,R.17W.
BK. 2084
CODE
10886
LAS VIRGENES
10 538


2069
78
SCALE 1" = 1000'
P.A. 2069-20
TRA 10941 11405
10883 10943
10884 11402
OFFICE OF ASSESSOR
COUNTY OF LOS ANGELES
COPYRIGHT © 1992
REVISED
1993
VENTURA
RTE 101
FRWY
10884
10884
CALABASAS RD
P M 253 - 61 - 68
10943
11402
11405
3
STATE
901
STATE
902
STATE
903
STATE
904
LAS VIRGENES MUNICIPAL WATER DIST
900
AGOURA RD
LAS VIRGENES RD
4
9
11
1
2
3
2
4
10883
DRAINAGE EASE
SLOPE EASE
SLOPE EASE
N
Baldwin Village

2069	31	TRA 10949 10955 10956
ALE 1" = 200'		

1992



TRACT NO. 34801 M. B. 977 - 1 - 2

FOR PREV. ASSM'T SEE:

Appendix D

General Plan Amendment and Development Code Text Changes

LAS VIRGENES GATEWAY PROPOSED GENERAL PLAN AMENDMENT

CHAPTER II, CONSERVATION, ENVIRONMENTAL DESIGN, AND OPEN SPACE

Page II-9

Add a new policy II-9 to read as follows.

> "C.6. Facilitate the restoration of riparian woodlands and corridors within existing concrete-lined channels where such restoration can be feasibly accomplished without increasing erosion or downstream flooding impacts."

CHAPTER III, LAND USE

ge III-4, Paragraph 5

Modify the General Plan Approach description of the Las Virgenes Gateway area to read as follows:

> "Natural hillsides will dominate the Freeway corridor west to the Las Virgenes Road interchange. In this area, office uses will fill in the northeast quadrant of the interchange across from City Hall. Development of the northwest quadrant will be limited to the lower portions of the hillside so as preserve the existing oak woodlands, and not dominate views from the Freeway. Freeway oriented commercial uses will continue in the southern quadrants of the Las Virgenes Freeway interchange, focusing on urban design improvements to reduce the visual clutter created by a proliferation of driveways and signs. Within the triangular area in the southwest quadrant of the freeway interchange, commercial uses will focus on commercial services for freeway travelers and provision of automobile maintenance and repair services. Establishment of a neighborhood-serving commercial center is envisioned to meet the daily shopping needs of local residents. New commercial development will which occurs along the east side of Las Virgenes Road at is to be oriented to local consumers (large scale business offices are not desired), and are to be located at primary intersections, such as Agoura Road. Multi-family residential uses will be located within the hillside areas on the east side of Las Virgenes Road, and be designed in such a manner as to retain views of the natural hillsides. Residential development oriented to seniors will provide a transition between existing commercial development at the southwest corner of Las Virgenes Road and Agoura Road."

ge III-14, Paragraph 5

Modify the General Plan Approach discussion of the Ventura Freeway Corridor to read:

> "*Ventura Freeway Corridor.* For the vast majority of motorists, the view from the Ventura Freeway is the single most important element that will forge their image of Calabasas. The obvious positive aspects of the Freeway corridor viewshed are the views of the scenic terrain, open space, and some of the low-rise office developments and landscaping along the Freeway. Other visual aspects of the built environment, such as large commercial signs, billboards, and some of the bulky, out-of-scale development along the Freeway, combine to create a more negative visual image of the City. The General Plan designates the Ventura Freeway as a scenic corridor. As such, new development is required to protect the scenic resources of the corridor and to ensure compatibility with its surroundings. The problems of older development along the freeway are most notable at the Las Virgenes Road interchange. At this location, and in addition to scenic corridor requirements, a master plan has been developed to ensure landscaping of the southerly freeway right-of-way west of Las Virgenes Road, as well as architectural design that is compatible with the area's rural character."

CHAPTER V, TRANSPORTATION

Page V-2

Add a bullet to the listing of conditions which complicate achievement of transportation goals to read as follows:

- "A proliferation of driveways along commercial corridors, such as Las Virgenes Road, south of the 101 freeway, reduces the roadway's carrying capacity."

Page V-6

Modify the fifth bullet to read as follows:

- improve the carrying capacity of existing roadways through limiting the number of driveways and, where feasible, combining existing driveways along commercial and business park roadways, along with the implementation of transportation systems management concepts;

Page V-21

Modify Table V-6, describing Las Virgenes Road, as shown on the following page.

CHAPTER VIII, GENERAL PLAN IMPLEMENTATION PROGRAMS

Page VIII-8

Add the following to the Follow-Up Studies and Actions Program:

"RESTORATION OF MALIBU CREEK

The City will pursue restoration of riparian woodland habitat within the concrete-lined portion of Malibu Creek north of Agoura Road in concert with development of the abandoned automobile dealership to the east."

Table V-6.
Las Virgenes Road

Location	Roadway and Intersection Carrying Capacity Enhancement Program
General Requirements	Prepare and implement a specific traffic management plan for the segment of Las Virgenes Road between Highway 101 south to Lost Hills Road to facilitate that function and improve traffic safety. This plan shall consider new signals, signal timing adjustments, re-striping, landscaping, signage, bicycle lanes, and improved turning movements in and out of driveways and side streets. Work with the Las Virgenes Unified School District to provide safe vehicular and pedestrian access to district facilities along the roadway. The plan shall also pursue reducing the number of driveways and left turn movements along Las Virgenes Road. Provide noise attenuation as part of any future roadway improvement work along this corridor. Attenuation may include, but is not limited to the use of rubberized asphalt street overlay and incorporating berms and sound walls into landscaping programs. Facilitate consolidation of existing access points and elimination of conflicting left turn movements north of Agoura Road, ~~and~~ minimize the number of access points along the length of Las Virgenes Road, and require the provision of reciprocal access and parking between uses where feasible. Access points for existing and proposed developments along Las Virgenes Road south of the freeway shall be coordinated to mitigate conflicting turning movement problems (both existing and predicted design problems). The range of solutions to be considered include but are not limited to appropriate placement of traffic signals, marked crosswalks, and pedestrian overpasses. South of the Ventura Freeway, improvements for pedestrian and bicycle travel shall be provided south to Mulholland Highway. The improper alignment of the access point along the west side of Las Virgenes Road south of Agoura Road shall be corrected, to achieve a right angle intersection.
Specific Capacity Enhancements	Appropriate widening programs scaled to future buildout shall be required of all discretionary developments contributing traffic to Las Virgenes Road (south of the Ventura Freeway). The ultimate maximum roadway configuration shall be six (6) through lanes between the Ventura Freeway and Agoura Road, and four (4) through lanes between Agoura Road and Lost Hills Road, two (2) northbound and two (2) southbound lanes, with appropriate related intersection design.
Prohibited Actions	In order to protect habitat linkages, as well as in recognition of the location of Malibu Creek to the west of the roadway and steep slopes to the east, widening or provision of more than travel two lanes south of Lost Hills Road is prohibited. In order to protect the existing residential neighborhood north of the Ventura Freeway, creation of additional through lanes north of Mureau Road is prohibited.

Source: Calabasas Traffic and Transportation Commission, 1993; Las Virgenes Gateway Master Plan, 1998.

PAGE II-40

Add a new Section 17.18.050 to read as follows.

17.18.050 - Las Virgenes Gateway (-LV) Overlay Zone

A. **Purpose.** It is the purpose of the -LV overlay district to ensure consistency with the Las Virgenes Gateway Master Plan's Land Use Plan, development standards, and design standards. It is also the intent of this overlay district to prevent the destruction of the area's natural beauty, open spaces, and environment; to create a memorable gateway to the western portion of the City, the Santa Monica Mountains, and Malibu Creek State Park; to protect and enhance private investment; and to protect and enhance the public health, safety, and welfare.

B. **Application.** The -LV Overlay zoning district shall be applied to all lands within the boundaries of the Las Virgenes Gateway Master Plan.

C. **Permitted Land Uses.** Permitted land uses within the -LV Overlay Zone shall be as shown on the table presented on the following page.

D. **Development Standards.** All development within the -LV overlay district shall comply with all applicable provisions of the Las Virgenes Gateway Master Plan. In cases where the Las Virgenes Gateway Master Plan presents standards which differ from those of the Development Code, the Las Virgenes Gateway Master Plan shall apply.

Preliminary Design and Feasibility Analysis for Stream Restoration, Las Virgenes Creek, Calabasas, California

---

Prepared for:

City of Calabasas
Engineering & Survey Services
26135 Mureau Road
Calabasas, California 91302

Prepared by:

Questa Engineering Corporation
1220 Brickyard Cove Road
Suite 206
Pt. Richmond, California 94807
(510) 236-6114

March 2004

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Project No. 230166

March 2004

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INTRODUCTION

This report presents the results of Questa Engineering Corporation's investigation and analysis of the biologic, geomorphic, and hydraulic conditions within the Las Virgenes Creek Channel in the City of Calabasas, California. Questa undertook this study to investigate the existing stream conditions and to develop and evaluate restoration alternatives. A biological database search for any special status wildlife and plant species within the area was conducted. The geomorphic analysis examined the existing fluvial geomorphology and channel geometry parameters to determine appropriate restoration strategies. Hydraulic modeling provided estimated flow depths and velocities through existing and proposed restoration scenarios.

The purpose of these studies was to gain an understanding of Las Virgenes Creek's channel processes and to determine what factors may lead to a successful restoration strategy. The report describes the constraints and realities of urban stream restoration such as existing infrastructure and utility issues. Also, potential fish passage issues are discussed. Incorporating all the baseline information, the report discusses the objectives of the restoration and the potential components of a restoration plan. Finally, this report outlines a preferred restoration strategy by combining individual project components to achieve project objectives. These are starting points for discussing design decisions.

SITE DESCRIPTION

Las Virgenes Creek is in the west-central part of the County of Los Angeles, east of the City of Agoura Hills and west of the City of Calabasas (**Figure 1**). The creek runs north and south between Lost Hills Road on the west and Las Virgenes Road on the east. The U.S. Highway 101 crosses Las Virgenes Creek just west of its junction with Las Virgenes Road. The proposed restoration reach extends approximately 500 feet from U.S. Highway 101 downstream (south) to the Agoura Road Bridge. The proposed restoration reach lies completely within the City of Calabasas, and the area surrounding the creek at the project site is urban, consisting mostly of commercial land use.

The reach consists of three general sections: the upstream natural channel, the middle concrete trapezoidal channel, and the channelized portion below Agoura Road Bridge. The upstream section, a natural bed with rock riprap side slopes, is approximately 40 feet long and extends from the downstream edge of the Highway 101 box culvert to the beginning of the concrete trapezoidal channel. The middle section consists of a concrete trapezoidal channel that is relatively flat, and extends for approximately 370 feet. The section below Agoura Road Bridge is 92 feet long; the upstream half of the section is channelized, and the downstream half consists of grouted rock riprap. Finished concrete bridge piers form the bridge foundations and line this section of the project reach below the Agoura Road Bridge.

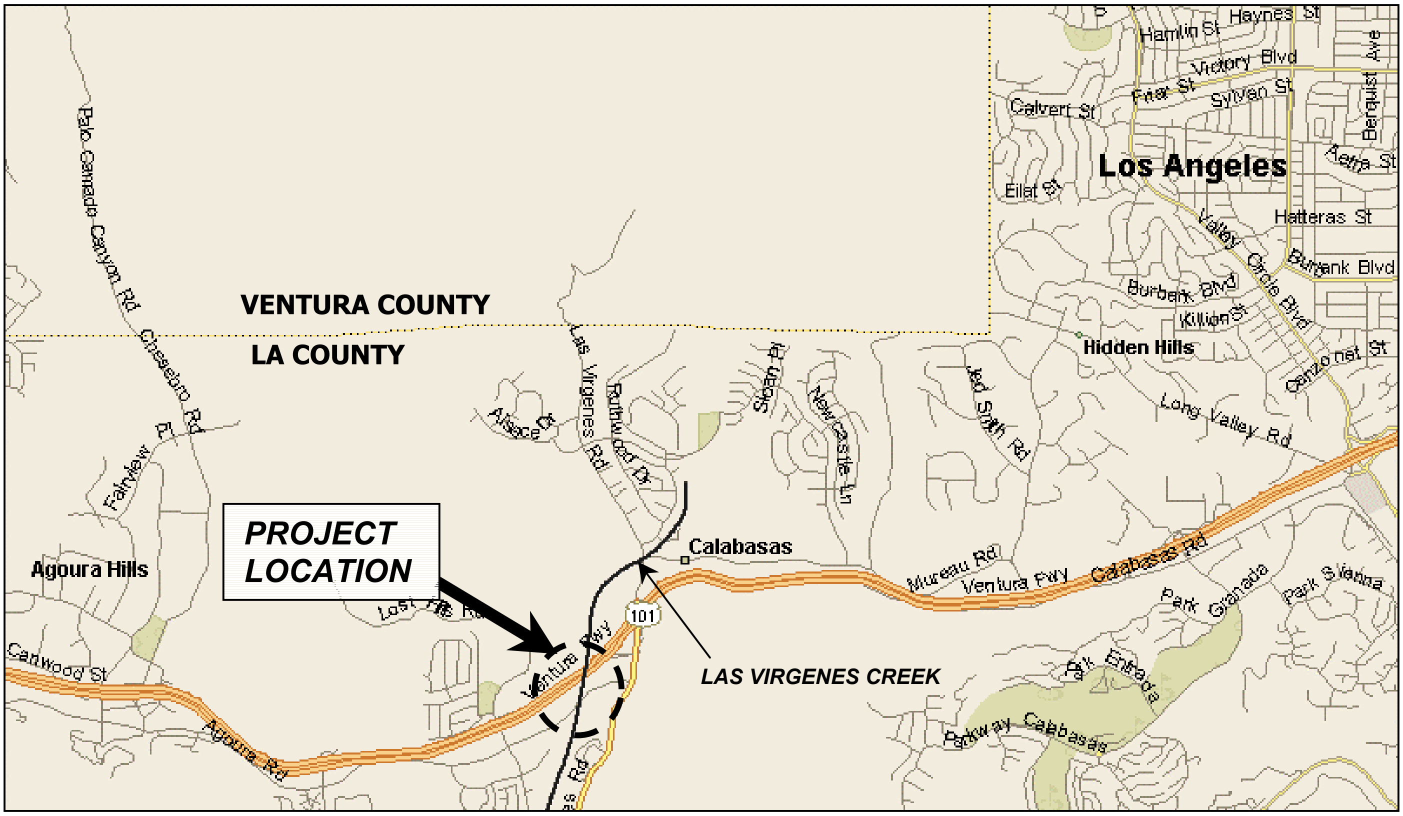


Figure 1. Project Vicinity

GEOMORPHIC ANALYSIS OF EXISTING CONDITIONS

Existing Channel Type

For approximately 460 feet of the 500-ft proposed restoration reach, the channel is a concrete-lined trapezoidal channel. To determine the natural channel geomorphology and geometry, reference reaches above and below the channelized portion were examined. Channel cross-section surveys, longitudinal profiles, and pebble counts in the upstream and downstream reference reaches were conducted to determine existing bankfull discharge and sediment transport regimes.

Upstream of the concrete trapezoidal channel, the 40-ft section below the Highway 101 culvert is characterized by narrow, braided flow channels, wide left and right bank terraces with well-developed vegetation, and rock rip rap side slopes. Perennial flow occurs only through the center and left (looking downstream) box culvert barrels. The third barrel has filled approximately 1.5 ft high with sediment. The confined flows from the center and left barrels have promoted the development of an in-stream sediment bar directly downstream of the culvert. Trees ranging from 2 to 12 inches in diameter have been established on the island, forming a semi-permanent flow diverter in the channel. Vegetation has also established on the terraces, and large, woody debris has also collected on the terrace surfaces. This established channel roughness decreases flow velocities through this section, which accounts for the cobble bar deposition on the terraces. An approximately 2-ft deep pool has formed in the narrow channel directly above the concrete trapezoidal channel.

Downstream of the concrete trapezoidal channel, below the Agoura Road Bridge, the channel widens. The channel is characterized by a single low-flow channel, terraces, and vegetated side slopes. The relatively wider, low-flow channel exhibits few bedforms, with approximately three cobble point bars within 250 feet downstream of Agoura Road Bridge. In-stream vegetation lines the channel bed, and trees (2-20 inches diameter) grow on the terrace, bank slopes, and up to the water's edge. Channel bed material is finer in the downstream reach, consisting mostly of sands and silts, with some cobble material.

Both upstream and downstream reaches can be roughly categorized as stream type "C" according to the Rosgen classification system (Rosgen, 1996). These stream types are alluvial, riffle/pool dominated, moderately entrenched channels with bed slopes less than 2%. They are characterized by moderate to high sinuosities, well developed floodplains, and moderate width to depth ratios.

Existing Channel Gradient

The slope gradients are highly varied through the proposed restoration reach, a function of the channelized portion acting as a grade control structure, maintaining as-built gradients while the natural channel bed above and below adjusted invert elevations since the trapezoidal channel was built. The slope averaged over the entire concrete trapezoidal channel is approximately 2%, though the downstream 200 feet of the trapezoidal channel is flat. The 40-ft section upstream of the trapezoidal channel also had an average slope of 2%, encompassing the 2-ft deep pool just upstream of the trapezoidal channel. Downstream of the Agoura Road Bridge, the channel invert dropped approximately 2 feet at the interface between the grouted riprap below the bridge and the natural channel downstream. The slope downstream of the bridge, averaged over 250 feet, was 0.4%.

Evaluation of Bankfull Discharge

Peak flow with a recurrence interval of 1.5 to 2 years is often considered "bankfull discharge," meaning the flow that is primarily responsible for the delineation or shaping of streambeds and banks. This bankfull discharge is basically the discharge that has a 50 percent chance of being exceeded in any given year. It is important in designing a stable channel to develop a reasonable estimation of the bankfull peak flow. This discharge is important from a design perspective because it generally represents the flow at which bedload becomes mobilized and channel features such as point bars and scour holes are developed and maintained. This discharge is one of the primary starting points of the channel design process.

Bankfull discharge was evaluated and determined using in-stream surveying, consisting of surveying channel cross-sections and identification of physical scour lines to determine bankfull depths. Three bankfull cross-sections were surveyed: one upstream and two downstream of the concrete channel.

Scour lines are used by the U.S. Army Corps of Engineers to determine the Ordinary High Water Mark for use in delineation of Corps jurisdiction over waters of the United States. The Corps definition of OHWM as "that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas," is used here to apply to scour line identification in the field to determine bankfull widths and depths.

Scour lines were readily observable in Las Virgenes Creek, usually due to the presence of a clear line on the bank, terrace shelving, and/or destruction of terrestrial vegetation. Bankfull stations were recorded as part of the cross-section surveys. From the survey data, bankfull depths, widths, and areas were calculated to estimate bankfull geometry.

Hydraulic modeling over a wide range of flows provided estimated water depths and velocities through the existing reach. Bankfull discharge rates were estimated by examining which discharge rates from the HEC-RAS model yielded the field measured bankfull water depths. This technique produced an average bankfull discharge of 200 cfs. Estimates did range from 140 to 250 cfs.

Width/Depth Ratios

The width/depth ratio is defined as the ratio of the bankfull surface width to the mean depth of the bankfull channel. The width/depth ratio is key to understanding the distribution of energy within a channel, and the ability of various discharges occurring within the channel to move sediment.

Width/depth ratios were calculated for four locations within the creek downstream of the concrete trapezoidal channel and two locations upstream. Ratios within the downstream reach averaged 9.2; ratios upstream averaged 12.4. These are low to moderate ratios, and are at the low end of the range of width/depth ratios for stream type "C," according to the Rosgen classification system.

Channel Bed Grain Size Analysis

Bedload Sampling was conducted at two locations, one upstream and one downstream of the concrete trapezoidal channel.

Wolman pebble counts were used to characterize the armor layer. The sampling method for the Wolman pebble count provided a measure of size equivalent to conventional sieving. At 6-inch intervals along a 50-ft tape laid on the bank, samples were taken at randomly generated distances into the channel from the bank. Gravel particles were randomly selected by touching the bed with eyes closed and collecting the first particle encountered by the tip of the index finger. Each particle was categorized into a size class, and cumulative percentages of each size class were calculated. Particle grain analysis produced cumulative percentages of each size class. Median grain sizes (D50) are shown in **Table 1**.

Table 1
Median Grain Sizes

River Station	Median Grain Size (D50) (mm)	Median Grain Size (D50) (inches)
Upstream	2.8	0.11
Downstream	2	0.08

The pebble count results show that bed sediments are dominated by smaller sized material. This indicates that cobble type material is not readily available to the creek system. It is also likely that the amount of channel bank armor and urban development upstream has significantly reduced the quantity and size of material being transported as bedload. Given this data it is likely that small to moderately sized gravel bars could form within the restoration reach after project construction. It is unlikely that excessive sediment deposition or bedload transport would negatively impact the project. However, the lack of sediment supply may impact erosion and scour processes in and around the Agoura Road Bridge.

BIOLOGICAL RECONNAISSANCE

The full results of the biological database review are included in **Appendix A, Biological Reconnaissance**. In summary,

- The three special status wildlife species with recorded occurrences within the project Las Virgenes watershed (California red-legged frog, coastal California gnatcatcher, and the southwestern pond turtle) are all unlikely to occur in the project site due to lack of appropriate habitat conditions, physical barriers to migration within the creek wildlife corridor, or distance from extant populations.

- No special-status plant species are considered likely to occur in the project vicinity.

- The Las Virgenes Creek tributary and Malibu Creek could potentially provide a wildlife corridor between the pristine coastal scrub habitat of the Ahmanson Ranch area in the upper watershed and the Southern Steelhead Stream habitat below Ringe Dam extending to the Malibu Creek Lagoon. The 500-ft proposed project, rehabilitating a channelized section located in Las Virgenes Creek would be a step towards restoring a link of the highly urbanized creek system through Ventura and Los Angeles counties.

HYDROLOGIC AND HYDRAULIC ANALYSIS

Design Hydrology

The Las Virgenes watershed at the project site is approximately 8,000 acres. Previous reports have indicated that the burned and bulked Q50 design flow including Ahmanson Ranch development was approximately 10,083 cfs (DEA, 2003). New updated hydrological evaluation, completed by L.A. County in early March 2004, will exclude the Ahmanson Ranch development to reflect changes in proposed land use. The updated peak flow events excluding Ahmanson Ranch for the 2-, 10-, 25-, and 50-year events are shown in **Table 2**. Under previous restoration studies, these peak flows were substantially reduced because of development. Under L.A. County procedures, all open-space areas are modeled as if they were burned and subsequently a 96-hour storm event occurs. This rainfall following a burn event creates high sediment loads within the flow known as “bulking”. Thus, the “burned and bulked” terminology. These higher flows have implications for restoration project and the hydraulic capacity of the channel is discussed in the following paragraphs.

Table 2
Design Discharges

River Reach	Recurrent Interval (cfs)				
	2	5	10	25	Capitol Flood
Highway 101 to Agoura Rd. Bridge	1,310	3,900	4,670	7,030	14,200

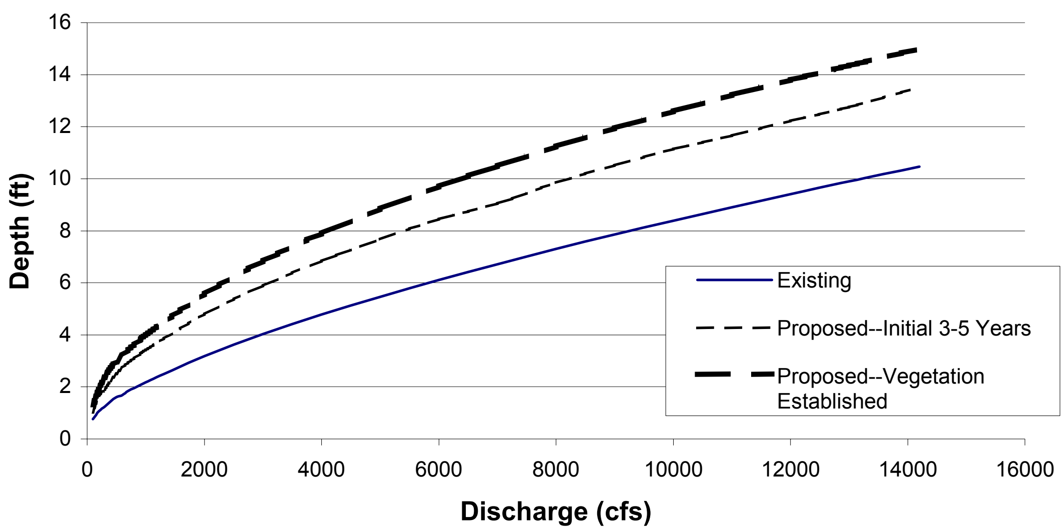
Hydraulic Analysis

The term "hydraulics" is used to describe the way water flows through the channel. Hydraulic analysis is used to determine how high, how fast, and how much force the flowing water is exerting on the channel bed and banks. Any proposed restoration that would modify existing channel geometry, roughness or hydraulic structures would alter the hydraulic properties of the channel. It is essential that any proposed projects not cause or worsen flooding to the surrounding properties. Removing the concrete and restoring the bed would alter several basic aspects of the channel. The slope would be reduced in a series of steps within the channel. The friction resistance of the channel would be increased through re-establishment of vegetation. Frictional resistance would increase incrementally over time as the vegetative planting becomes mature. The increased frictional resistance of the channel would change flooding depths and impact the velocity of water moving through the channel.

Using a range of potential flows from 100 cfs to 14,200 cfs, pending the actual hydrology numbers by LWCPW, a HEC-RAS hydraulic model was developed for the project site. This model was used to determine existing conditions and provide an initial analysis of the impact of restoring the channel to a more natural condition. The model was also used to examine shear forces within the channel to prevent erosion during the restoration process. Three different channel scenarios were modeled: existing conditions, proposed conditions—right after construction, and proposed conditions—with full vegetation established. The hydraulic model outputs for selected flow profiles are attached to this report as **Appendix B.** The results for three key variables are summarized below.

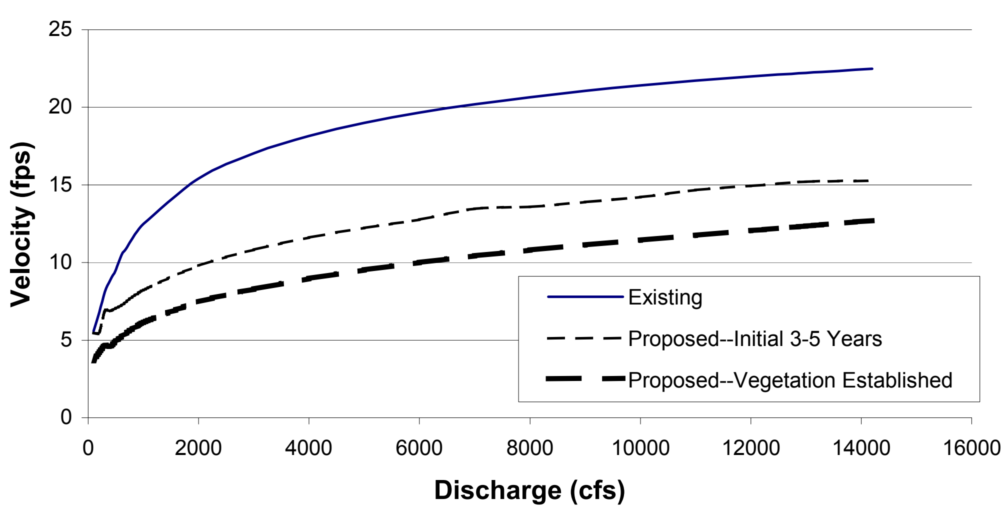
Channel Capacity. The channel as designed is very efficient. The graph below shows a depth vs discharge curve for the channel (**Figure 2**). The channel is approximately 15 feet high from the channel bottom to the top of the bank. The existing conditions hydraulic model predicts a maximum depth of 13.8 feet within the channel at flows of 14,200 cfs, which is the predicted burned and bulked capitol event. Thus, there is approximately 4 feet of extra depth under the 14,200 cfs discharge rate. This equates to extra capacity in the channel that would allow the proposed project to incorporate vegetation planting. Initial modeling indicates that restoring the channel with fully matured vegetation, water surface elevations would rise above the current top of bank elevations in the upper portion of the project reach. This is further discussed in the Constraints section of this report.

Figure 2. Depth vs. Discharge



Channel Velocities. Existing channel velocities within the channel are very high due to the low frictional resistance within the channel and the steep slope. **Figure 3** shows average channel velocity versus discharge for the three different scenarios. These high velocities are an important constraint because the erosion potential of the channel can be linked to the velocity of the water moving through the channel. Once the channel is planted with or colonized by vegetation, velocities will be reduced. The design of the restoration project has to take into account that prior to this vegetation being established the channel will have lower frictional resistance, thus making channel erosion a serious concern during the establishment period.

Figure 3. Velocity vs. Discharge



Channel Shear Forces. Shear force is the force that water exerts across the bed of the creek channel. Knowing the shear force within the channel aids in the design of the extent and type of erosion control features. Depth is a key variable in determining the magnitude of scour force. Our hydraulic analysis shows that shear stresses can be higher after project grow-in because greater vegetative resistance will increase water depths. However, by the time those shear stresses are elevated, mature, well-established vegetation would be able to withstand the high shear stresses predicted (6 to 8 lbs/ft^2). In the case of large, semi-annual floods early in the restoration period, shear stresses on the channel bottom and lower slopes can be expected to be approximately 3 lbs/ft^2. During the initial stages of the restoration prior to vegetation establishing in the bottom of the channel these stresses would be capable of bed and bank erosion.

Groundwater Conditions

Drilling log boring results from the recent Agoura Road Bridge geotechnical analysis indicate that groundwater levels are between elevations 730 and 735 ft, roughly 4 feet below the channel bed elevation under the bridge. Additional borings to be completed during the detailed design phase will provide groundwater elevation levels further upstream near Highway 101.

PROJECT CONSTRAINTS AND DESIGN ISSUES

Utilities

The project reach is in a very urban location with commercial development on either side of the channel. Thus, numerous utilities within the project area either have to be avoided or relocated to accommodate the channel restoration. **Figure 4** shows the existing location of these utilities. On the site are the following:

- Water main
- Sewer Main
- 3” gas line
- Lateral sewer lines at the top of the east bank
- Telephone pole and electrical lines at top of bank

The water lines and gas lines lie approximately 3 feet below the channel bottom invert elevation. These lines will have to be protected and made secure upon removing the concrete bottom of the channel. The most problematic of the utilities is the telephone pole, and the main and lateral sewer lines at the top of the eastern bank. These utilities would have to be relocated if bank slope angles were to be reduced by laying the slope back. Options exist for filling near the base of the slope. These bank slope options are discussed later in the report.

Design Flow Events & Channel Capacity Capitol

L.A. County Public Works supplied information on updated peak flow events for the 2-, 10-, 25-, and capitol flood events--of particular concern is the flow volume of the capitol flood or 14, 200 cfs. The existing channel was designed to be very efficient in conveying this flow through the project reach. The concrete channel is vegetation free, and hence, has low frictional resistance. It can convey high flows in a small area. The restoration will significantly alter the efficiency of the channel to convey flow and will raise flood levels. Initial modeling shows that water surface elevations could raise above existing top of bank elevations on the western and eastern sides. This would cause shallow flooding within the parking areas bordering the channel. There are two basic options to address this issue: either flood protection measures will have to be installed to protect existing developments from flood risk, or the channel will need to be enlarged outside of its current top of bank limits.

Channel Velocities and Erosion Potential

Biotechnical restoration techniques require time for the vegetative structure to develop. Prior to vegetation establishment, the project is vulnerable to the erosive forces of the channel. Significant erosion in the channel could occur if a large magnitude storm event occurs before vegetation establishment. Erosion is a natural occurrence in the California stream systems; however, commercial property and key infrastructure located within the immediate riparian corridor must be protected from any potential erosion damage.

To reduce the risk of erosion during the grow-in period, temporary erosion control measures need to be installed. Utilizing softer approaches such as erosion control mats and biodegradable products reduces erosion but are limited in effectiveness during larger events. Natural, biodegradable coconut fiber (coir) products in block form, as well as planted rock at the toe of bank slopes, would provide erosion protection along the bed and banks of the channel. The risk of erosion before full vegetation establishment needs to be considered and an appropriate erosion control strategy chosen. Several erosion control options are presented later in this report.

Adjacent Parcel Ownership

Property on either side of the channel is privately held. If channel widening or bank top modifications are to be incorporated into the design, additional land and/or easement right-of-ways may need to be secured by the City. Some bank top modification options may also result in the loss of adjacent parking spaces. This loss of parking area may need to be recouped via parking lot modification, which would add cost to the overall project.

Bridge Scour and Fish Passage

Fish passage design considerations could impact channel bed erosion or bed scour under the Agoura Road Bridge. Removing the concrete right below the bridge structure will increase the possibility of bridge scour beneath the structure. If the concrete were removed, an anti-scour strategy (i.e. concrete cut-off walls) to protect the bridge would have to be installed as part of the project. Leaving the concrete channel bottom in place under the bridge would modify and maintain an existing barrier to fish. The barrier would be caused by low water depths and high flow velocities across the broad, flat channel bottom. This 90-ft section of channel would prevent fish migration in all but a small range of flows. Also, the existing grouted riprap bed below the bridge is perched approximately 2 feet above the existing natural channel and may not be passable at lower flows.

Currently, there are no known migratory fish within the project area. The Ringe Dam downstream on Malibu creek prevents fish migration to this area. However, there are potential suitable spawning and rearing areas above the project. There are numerous fish passage barriers upstream of the project. The closest is the long culvert under Highway 101, which is immediately upstream of the project site. High velocities and shallow depth would prevent fish from gaining access to the northern side of Highway 101. A significant question is whether the project should be designed to provide fish passage now or designed to accommodate fish passage at a later date. Certainly, any feature added to the project should be passable by all stages of salmonids, but would the project necessarily need to remove all existing barriers at this time or could fish passage modifications be made at a later date when fish migration issues were truly applicable?

Removing the concrete beneath the Agoura Road Bridge would add to the cost of the project and would entail addressing potentially significant bridge scour issues that may delay implementation of the restoration project.

ALTERNATIVES FOR PROVIDING CHANNEL RESTORATION

Goals and Objectives of Las Virgenes Creek Restoration Efforts

It is important to define the goals of a restoration effort prior to developing a restoration plan alternative. We believe that stable compound channel morphology with significant native riparian vegetation is the desired outcome of the restoration. The creek corridor with this type of channel and riparian area is a positive community amenity and provides an incremental step in the overall restoration of the Las Virgenes Creek watershed and channel. With that goal in mind, restoration strategies can be broken into a series of components that make up the overall restoration plan for the Las Virgenes Creek. These components are follows:

- Gradient Control – Accommodating channel bed slope through grade control structures.
- Bank Slope configuration – How bank slopes and the location of top of bank will relate to the project and to the adjacent facilities.
- Fish Passage - How fish migration and passage will be accommodated within context of the project.
- Erosion Control – What level of erosion protection should be installed to protect against large magnitude flow events.

Gradient Control

The first restoration component involves the slope of the channel. The elevations in the project drop approximately 7 feet in 350 feet. This is a significant change in slope. If the concrete was to be removed and the existing sloped maintained then flow velocities would be high, turbulent flow would dominate and the channel bed would likely undergo significant bed degradation. Typically in high gradient streams either the channel bed is bed rock or elevation is lost through a series of vertical drops with pools and runs in-between the drops. Bedrock is approximately 60 feet below surface and is overlain by sandy, silty material that can be easily transported or eroded.

Alternatively, rock weirs could be constructed to create individual channel gradient segments with lower slopes in the context of the overall project reach. Varying the number of rock weirs and their vertical drop heights allows for numerous options; however, if fish passage is to be accommodated at a later date then these drops should be designed following National Marine Fisheries Service (NMFS) and California Department of Fish and Game (CDFG) guidelines. These guidelines mandate that no vertical drops of greater then 12 to 14 inches occur within the channel bottom. Following these guidelines, 5 vertical drops were proposed (**Figures 5 & 6**). If fish passage is not to be accommodated then two to three gradient control structures could be used.

It is essential that these structures be keyed deeply into the banks of the creek so that flow would not "flank" or go around the structures, making them ineffective as a gradient control.

Reducing the gradient would reduce sediment transport, encourage bar and floodplain development, and increase the chances of developing a stable low flow channel and associated floodplain channel morphology for the creek. The gradient control structures would be a combination of rocked trenches and chutes dropping into a pool and leading to a lower gradient channel.

All rock/stone revetments would be planted with long willow stakes to ensure that vegetation cover would become part of the overall cover of the structure. Additional riparian planting and enhancement would be completed in the bottom of the channel. Deep trenches would be dug into the surrounding gravels and willow/cottonwood poles and/or bundles would be placed in the trenches and backfilled. The trenches would be of sufficient depth so that willow planting could have access to underflow and groundwater resources. Additional riparian planting could be completed but would likely be difficult to maintain prior to the establishment of the willow plantings.

Bank Slope Configuration

The existing concrete bank slopes are currently 1.5(H) to 1(V). At this slope, planting and establishing riparian vegetation will be difficult. For the restoration of the bank slopes to be successful, the angle of the slope should be reduced. Typically, a slope of 2:1 or flatter is recommended for revegetation. Steeper slopes such as 1.75:1 can be revegetated but require greater effort; colonization and growth can be slower, as well. In order to create 2:1 bank slopes there are three potential, basic options (**Figure 7**):

Option B-1. Lay bank slopes back from their existing position to 2:1 slopes (**Figure 8**). This option would seem to be the simplest option; however when other constraints are considered this becomes the most complicated. By creating a 2:1 bank slope, the top of bank would be moved approximately nine feet to the east and west of the existing bank top. On the eastern bank (i.e. Starbucks side) this would encroach into the existing access road. Moving the bank top on the eastern side will also require moving several utility facilities including 90 feet of an 8-inch sewer line, a power pole, and the junction with the 24-inch sewer main. Moving the bank top back on the western side would entail encroaching into the existing commercial building parking lot. Approximately 10 to 20 parking spaces would be lost. It is also likely that the parking area will have to be re-stripped and reconfigured to accommodate proper flow, turning radius etc.

Option B-2. Keep the eastern bank top and move the western bank top (**Figure 9**). Under this option the eastern side of the channel remains the same and the channel is adjusted in a westward direction. The top of the western bank would be set back approximately 18 to 20 feet. This would mean losing 20 or more parking spaces in the adjacent lot. This would extend the channel area outside the current easement lines and would necessitate either purchasing the property or attaining a larger easement.

Option B-3. Retain both bank tops at their current position and construct a retaining wall at the top of bank (**Figure 10**). This option would keep the project within the existing easement right-of-ways and top-of-bank boundaries of the project. Under this scenario, two parallel retaining walls would be constructed near the top of bank on either side of the channel (**Figure 11**). This technique would allow the lower bank slopes to be laid back at a 2:1 slope but still retain existing top of bank boundaries. This option would have a more "engineered" look, but attains slope goals in areas where the majority of the vegetation restoration would take place.

Fish Passage

The fish passage issue has been briefly addressed above. The proposed rock weir gradient control structures would allow fish passage; however, the portion of the concrete channel beneath the bridge needs to be addressed. There are two potential options for ensuring fish passage beneath the bridge:

Option FP-1. Retain the concrete channel bottom beneath the bridge and retrofit it with a baffled fishway (**Figure 12**). Under this option the majority of the existing concrete scour protection would be left under the bridge. A new 15-foot wide channel would be created for approximately 90 feet. This new channel would be fitted with a series of concrete baffles spaced 15 to 20 feet apart. These baffles would increase water depth and reduce velocity facilitating fish passage through a wider range of flow conditions. This fishway would be connected to the restored low flow channel upstream of the bridge.

Option FP-2. Remove the existing concrete channel bottom but retain the concrete side slopes. Anti-scour concrete cutoff walls would be retrofitted at the toe of concrete slopes (**Figure 13**). The channel bed would be returned to the natural ground surface. An additional rock weir gradient control structure would be added beneath the bridge and the channel would be graded to a compound configuration similar to the upper section of the project.

Erosion Control

Effective erosion control within the channel is mandatory. The channel erosion potential would change over time as the vegetation matures. Typically the erosion potential of the channel and banks decreases as the project ages, and mature stable vegetation is established. One key to any restoration project is to reduce erosion during the initial phases of the project construction and establishment. How the project is protected from erosion can vary depending on forces in the channel and the constraints of the site. Erosion control design strives to determine an appropriate level of protection.

Softer "bio-technical" approaches that integrate vegetation, and biodegradable products such fiber blankets, logs, coir blocks etc. can be used quite effectively. These are effective but under certain flow conditions their strength and resistance to erosion is limited. The biodegradable products are used to provide temporary erosion protection and allow for the vegetation to mature and provide the primary erosion control within 3 to 5 years. These types of installations are rated by shear stress and generally can be used for up to 3 lbs/ft^2 shear stresses for short duration. The table below illustrates predicted strengths of some techniques immediately after and within 3-5 years after installation.

TABLE 3
Shear Tolerance of Bank Slope Protection*

Treatment Approach	Directly after Installation		After three to four growing seasons	
	(N/m^2)	(lb/ft^2)	(N/m^2)	(lb/ft^2)
Turf /Grass	10	0.2	100	2.1
Reed Plantings	5	0.1	30	0.6
Reed Rolls, biologs	30	0.6	60	1.3
Live fascine	60	1.3	80	1.7
Willow brush layer	20	0.4	140	2.9
Willow mat	50	1.0	300	6.3
Hard wood plantings	20	0.4	120	2.5
Branch packing, brush mattress	100	2.1	300	6.3
Small rock revetment with live stakes	200	4.2	300	6.3
Boulder sized rip-rap, unplanted	-	-	250	5.2
Concrete wall, cement blocks	-	-	600	12.5
Gabion structures, planted	400	8.4	500	10.4

***H.M. Schiechtl and R.Stern. 1997. Water Bioengineering Techniques for Watercourse Bank and Shoreline Protection. Blackwell Science Ltd.**

Our calculations show that flows greater than 2,300 cfs immediately after project construction would create average shear stress forces that would exceed the design thresholds for all but most stout (i.e. synthetic fibers, rock, wire reinforcement, etc) erosion control fabrics and biotechnical installations.

We anticipate that erosive flow conditions would occur between the 5- and 10-year recurrence interval flow events. The hydraulic model indicates that shear forces in the 2-4 lbs/ft^2 range can be expected during these events. In other words, there could be a 10 percent chance any given year within the first 3 to 5 years that this flow would be met or exceeded. Given the grade control structures, planted rock toe protection, and buried erosion protection measures proposed for the project it is unlikely that significant damage to the utility lines would occur. It is more likely that the low flow channel would be altered and portions of the revegetation planting and irrigation network would have to be replaced. If the capital event (i.e. 50-year, 96 hour storm) were to occur immediately after construction significant structural damage could occur.

Questa has developed three potential erosion control options for the project.

Option EC-1. This option would involve an erosion control installation that would be stable to 1,300 cfs. ***Coir fiber blocks would be installed along the low-flow channel, and coir logs would be anchored at the toe of the bank slopes and planted with willow plantings*** (**Figures 14 & 15**). The floodplain terrace would be covered with an erosion control blanket that would be made of a composite of synthetic netting and biodegradable coir fiber. Typically, the fiber degrades within 2 to 3 years and netting may take up 10+ years to fully disintegrate. Trenches with deeply planted willow stakes would be installed on the benches and used to anchor the blanket to the terrace surface. The bank slope would be hydroseeded with an appropriate woody and grass seed mixture, and a biodegradable erosion control blanket would be installed on top of all exposed slopes. Bank slope planting would be completed by cutting holes within the blanket and installing appropriate tree and shrub species. Existing storm drainage outfalls would be extend to the terrace elevation and retrofitted with appropriate energy dissipation aprons. Anchored log rootwads would be incorporated into the grade control structures to direct flow and dissipate erosive energy. These logs would anchored using large stone counter weights. This option would withstand erosion up to approximately 1,500 cfs or approximately a 2-year protection level.

Option EC-2. This option is similar to the first option, in that coir fiber blocks would be installed along the low-flow channel; however, ***planted rock revetment would be used along the toe of the bank slopes*** (**Figures 16 & 17**)**.** The rock revetment along the toe of the slope would extend approximately 3 vertical feet upward from the toe. This revetment would be planted with willow stakes and irrigated to establish willow cuttings. The theory behind this option is that adjustments in the low flow channel would be expected but the rock toe protection at the base of the bank slope would ensure that those slopes would remain stable, providing increased protection to top of bank facilities and structures. Flows between 2,500 and 3,000 cfs would be confined to the low-flow channel and floodplain terraces. This plan would protect against erosion up to 3,000 cfs or about a 5-year protection level.

Option EC-3. This option incorporates all of the elements of the first and second options, except that ***both the low-flow channel and bank slope toes would be protected with willow staked loose rock revetment*** (**Figures 18 & 19**). Rock revetment would be used to line the low flow channel and provide bank toe protection on the edges of the floodplain. Rock toe protection would extend 5 to 6 vertical feet up the bank slope. This rock would be planted with willow stakes and backfilled with channel bed sediments and topsoil. This option provides greater rock erosion control. This option would be expected to sustain flows up to 5,000 cfs without significant erosion damage. This would generally equate to a 10-year protection level.

PROPOSED RESTORATION PROJECT CONFIGURATION

This section describes the proposed restoration project that combines several options into a configuration that would meet restoration goals (**Figure 20**). Questa has determined that this conceptual plan would be the most feasible, cost effective and secure project given the site constraints discussed above. We view this a starting point; alternative options may be proposed, discussed and potentially adopted as part of the project. The plan was developed under the following assumptions:

- Moving the banks tops from their existing positions would be problematic due to several aspects such as right-of-ways, utility relocation, and loss of existing parking spaces.
- Erosion would be controlled up a 2 to 5 year event immediately after construction; larger events occurring during the establishment period would cause erosion and repairs potentially would be necessary.
- Concrete would not be removed from the base of the channel beneath Agoura Road Bridge to provide fish passage.
- No additional flooding during the capitol flood would occur as a result of the proposed project.

The proposed restoration project configuration would incorporate rock grade control structures and pool (**Figure 21**), bank slope option B-3, fish passage option FP-2, and erosion control option EC-2. A detail of the proposed willow trench and erosion control fabric staking described in the Erosion Control Options section is shown in **Figure 22**.

Flood Control

Flood control aspects of the channel are important. Because the project has increased frictional resistance in the channel, predicted water surface elevations show flooding can occur in the upper portions of the project reach. Specifically, overbank flooding could occur from Station 575 to 700. This would flood the adjacent parking lots. To prevent this flooding, we are proposing the construction of floodwalls. These floodwalls would extend as shown on **Figure 20** and would be constructed to approximately 2 feet above the existing ground surface on the east bank and to approximately 5 feet above the west banktop to ensure a 3-ft freeboard above the capitol flood water surface elevation.

Public Access

Public access along the project site is a priority because the project site is adjacent to a shopping mall and café. Currently, a concrete path extends for the project site length along the top of the eastern bank. Under the proposed project configuration, the existing path would remain in place. A wooden, hexagonal gazebo would be constructed over the creek extending from the existing path (**Figure 23**). The proposed gazebo would be supported by piers and include an outer perimeter observation deck with railings.

Pedestrian ramps to the gazebo would ensure handicapped accessibility following American Disability Act (ADA) guidelines.

Preliminary Planting Plan

Full vegetation establishment within the restored channel will be a key component of the restoration project's success. Planting for the channel would be divided into two different planting zones, bank slope and terrace, to allow site-specific native species selection. Preliminary planting palettes are shown in **Figure 24**. Willow staking of the rock weirs, rock revetment, willow trenches and Bio-D blocks would be installed concurrent with their construction. A temporary irrigation system would need to be installed to ensure adequate irrigation during the vegetation establishment period.

Fish Passage

It is desired to provide complete fish passage through the project reach; however, the expense and potential bed scour issues are significant. For purposes of this report, we have indicated that this aspect of the project is considered optional and could be funded and implemented at a later date. Thus we left this component out of the proposed project.

Cost Estimate

Table 4 shows the estimated costs for the proposed restoration configuration for Las Virgenes Creek. Costs are preliminary and should be considered planning level only. The estimated cost for the proposed restoration configuration is approximately $702,000.

To provide a comparison, costs were also estimated for a minimal flooding/erosion protection configuration and a maximum flooding/erosion protection configuration. The minimal configuration would incorporate bank slope option B-2, and erosion control option EC-1. Also, this configuration does not include fish passage installation under the bridge (existing conditions under the Agoura Road Bridge would be retained) and no gazebo installation. This cost estimate is shown in **Table 5**, and would be approximately $517,000. This estimate does not include costs for the compensation of the loss of 20 parking spaces on the western side of the creek in the commercial parking lot, or the potential costs associated with right-of-way issues resulting from the slope setback.

The maximum protection configuration would incorporate slope setbacks to 2:1 on both banks (B-1), fish passage option 2, planted rock revetment along the toes of both the bank slope and the low flow channel, as well as all the other features from the proposed project configuration. This cost estimate is shown in **Table 6**, and would be approximately $869,000. This estimate also does not include costs for the compensation of the loss of 20 parking spaces on the western side of the creek, or the potential costs associated with right-of-way issues resulting from the slope setback.

Table 4
Proposed Project Configuration Planning Level Cost Estimate

Item No.	Description	Quantity	Unit	Unit Cost	Cost
1	Mobilization	1	Lump Sum	$ 30,000.00	$ 30,000.00
2	Concrete Trapezoidal Channel Demolition & Removal	1,400	Ton	$ 90.00	$ 126,000.00
3	Earthwork (side slopes, terraces, low-flow channel, rock groin, willow trenches)	2,500	C.Y.	$ 10.00	$ 25,000.00
4	Import Fill	500	C.Y.	$ 15.00	$ 7,500.00
5	Floodwalls	1	L.S.	$ 55,000	$ 55,000.00
6	Planted Rock Weirs and Pool	1,500	Ton	$ 100.00	$ 150,000.00
7	Planted Rock Toe Revetment	900	Ton	$ 100.00	$ 90,000.00
8	Planted Coir Bio D Blocks	1,100	L.F.	$ 12.00	$ 13,200.00
9	Rootwads	4	Rootwad	$ 2,000.00	$ 8,000.00
10	Erosion Control Blankets: Terrace	1,300	S.Y.	$ 10.00	$ 13,000.00
11	Erosion Control Blankets: Slopes	800	S.Y.	$ 8.00	$ 6,400.00
12	Hydroseeding	1.00	L.S.	$ 1,200.00	$ 1,200.00
13	Planting	0.75	Acre	$ 30,000.00	$ 22,500.00
14	Willow Trench Staking	1	L.S.	$ 2,000.00	$ 2,000.00
15	Gazebo	1	L.S.	$ 20,000.00	$ 20,000.00
16	Irrigation	1	L.S.	$ 15,000.00	$ 15,000.00
				Subtotal:	**$ 584,800.00**
			Contingency 20%		$ 116,960.00
				Total:	**$ 701,760.00**

Table 5
Minimal Configuration Planning Level Cost Estimate

Item No.	Description	Quantity	Unit	Unit Cost	Cost
1	Mobilization	1	Lump Sum	$ 30,000.00	$ 30,000.00
2	Concrete Trapezoidal Channel Demolition & Removal	1,400	Ton	$ 90.00	$ 126,000.00
3	Earthwork (side slopes, terraces, low-flow channel, rock groin, willow trenches)	2,500	C.Y.	$ 10.00	$ 25,000.00
4	Floodwalls	1	Lump Sum	$ 55,000.00	$ 55,000.00
5	Import Fill	500	C.Y.	$ 15.00	$ 7,500.00
6	Planted Rock Weirs and Pool	1,500	Ton	$ 100.00	$ 150,000.00
7	Planted Coir Biologs	600	L.F.	$ 10.00	$ 6,000.00
8	Planted Coir Bio D Blocks	1,100	L.F.	$ 12.00	$ 13,200.00
9	Rootwads	4	Rootwad	$ 2,000.00	$ 8,000.00
10	Hydroseeding	1.00	L.S.	$ 1,200.00	$ 1,200.00
11	Erosion Control Blankets: Terrace	1,300	S.Y.	$ 10.00	$ 13,000.00
12	Erosion Control Blankets: Slopes	800	S.Y.	$ 8.00	$ 6,400.00
13	Planting	0.75	Acre	$ 30,000.00	$ 22,500.00
14	Willow Trench Staking	1	L.S.	$ 2,000.00	$ 2,000.00
15	Irrigation	1	L.S.	$ 15,000.00	$ 15,000.00
				Subtotal:	**$ 430,800.00**
			Contingency 20%		$ 86,160.00
				Total:	**$ 516,960.00**

Table 6
Maximum Configuration Planning Level Cost Estimate

Item No.	Description	Quantity	Unit	Unit Cost	Cost
1	Mobilization	1	Lump Sum	$ 30,000.00	$ 30,000.00
2	Concrete Trapezoidal Channel Demolition & Removal	1,400	Ton	$ 90.00	$ 126,000.00
3	Floodwalls	1	Lump Sum	$ 55,000.00	$ 55,000.00
4	Earthwork (side slopes, terraces, low-flow channel, rock groin, willow trenches)	3,000	C.Y.	$ 10.00	$ 30,000.00
5	Import Fill	500	C.Y.	$ 15.00	$ 7,500.00
6	Utilities Relocation	250	L.F.	$ 150.00	$ 37,500.00
7	Planted Rock Weirs and Pool	1,500	Ton	$ 100.00	$ 150,000.00
8	Planted Rock Toe Revetment for bank slopes	1,200	Ton	$ 100.00	$ 120,000.00
9	Planted Rock Toe Revetment for low flow channel	800	Ton	$ 100.00	$ 80,000.00
10	Rootwads	4	Rootwad	$ 2,000.00	$ 8,000.00
11	Erosion Control Blankets: Terrace	1,300	S.Y.	$ 10.00	$ 13,000.00
12	Erosion Control Blankets: Slopes	800	S.Y.	$ 8.00	$ 6,400.00
13	Hydroseeding	1.00	L.S.	$ 1,200.00	$ 1,200.00
14	Planting	0.75	Acre	$ 30,000.00	$ 22,500.00
15	Willow Trench Staking	1	L.S.	$ 2,000.00	$ 2,000.00
16	Gazebo	1	L.S.	$ 20,000.00	$ 20,000.00
17	Irrigation	1	L.S.	$ 15,000.00	$ 15,000.00
				Subtotal:	**$ 724,100.00**
			Contingency 20%		$ 144,820.00
				Total:	**$ 868,920.00**

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Appendix A

BIOLOGICAL RECONNAISSANCE

BIOLOGICAL RECONNAISSANCE

Background

This section discusses special-status species that potentially occur in the project area watershed, encompassing approximately 8,000 acres of the Las Virgenes and East Las Virgenes Creeks watershed. The report includes a biological reconnaissance of the project site and a database search for special status species with recorded occurrences within the Calabasas and Malibu Beach USGS 7.5-minute quadrangles. All of the occurrences were located in the upper watershed (i.e. Ahmanson Ranch area) above developed portions of Las Virgenes Creek; thus, though migration through the watershed and use of the Creek as a wildlife corridor is possible, the potential for any of the special status species to occur within the project vicinity is unlikely.

Methods

We conducted a literature search to determine if any sensitive biological resources were known to be present in the project area. The California Natural Diversity Database (CNDDB) was queried for records of special-status species within the Calabasas and Malibu USGS 7.5-minute quadrangle maps. The CNDDB is maintained by the California Department of Fish and Game (CDFG) and provides cross-referenced plants, animals, and plant communities listed by 1) the federal government pursuant to the federal Endangered Species Act, 2) the State of California pursuant to the state Endangered Species Act, 3) the CDFG pursuant to their designation of sensitive and special concern species, and 4) the California Native Plant Society's Code R-E-D program. The CNDDB provides Universal Transverse Mercator (UTM) coordinates and latitude and longitude coordinates for occurrences of listed or sensitive plants, animals and plant communities that correspond to USGS quadrangles.

Results

Special-status Species

Special-status species with a potential to occur in the general project area based on a review of the CNDDB and a species list provided by the U.S. Fish & Wildlife Service are shown in **Tables A1 and A2**. Three special-status wildlife species and two special-status plant species occur within the project Las Virgenes watershed. None of the identified special status species are likely to occur within the proposed restoration reach based on habitat requirements, the distance from extant populations, or physical obstacles to species migration. All federal- or state-listed wildlife and plant species with recorded occurrences within the Calabasas or Malibu Beach USGS quadrangles occurring within the project Las Virgenes watershed are discussed.

Threatened Wildlife Species

California Red-Legged Frog (*Rana aurora draytonii*) is a federally threatened amphibian species. It is a relatively large, brown to reddish brown frog with prominent dorsolateral folds and diffuse moderate-sized dark brown to black spots that sometimes have light centers (Storer 1925). Distribution of red or red- orange pigment is highly variable, but usually restricted to the belly and the undersurfaces of the thighs, legs, and feet.

The historic range of this frog extends through Pacific slope drainages from the vicinity of Redding (Shasta County: Storer 1925) inland and at least to Point Reyes, California (coastally) southward to the Santo Domingo River drainage in Baja California, Mexico. In California, it occurs from Shasta County south to the Mexican border.

The habitat of the California red-legged frog is permanent ponds and streamsides in grasslands, woodlands and forests with emergent vegetation that provides cover. Red-legged frogs require cool water. Deep pools are necessary for many aspects of the frog's life cycle (Hayes and Jennings, 1988).

The CNDDB lists two relatively recent recorded occurrences from the Ahmanson Ranch property, located approximately two miles upstream of the project site. Twenty-one adults and 200 metamorphs were observed during surveys conducted in 1999. Twenty-one adults, 10 juveniles, and 30-60 metamorphs were observed in 2000 (CNDDB, 2003). No occurrences of the California red-legged frog were recorded within the project reach.

Because of physical barriers to corridor migration and lack of suitable habitat within the trapezoidal concrete channel, the California red-legged frog is considered unlikely to occur at the project site.

Coastal California Gnatcatcher (*Polioptila californica californica*) is an obligate, permanent resident of coastal sage scrub habitat below 2500 ft in Southern California. It occurs in low, coastal sage scrub in arid washes, on mesas and slopes.

The coastal California gnatcatcher is a relatively small (4 1/2 –5") bird. It is gray above, paler below. The male has a black crown during the summer that extends below the eyes. The California gnatcatcher has a long black tail, with a little white on the outermost feathers. It is best identified by voice and range.

This subspecies of the California Gnatcatcher that occurs in the United States was placed on the U.S. Endangered Species List in 1993. It is classified as threatened in California. The reduction in numbers can be attributed to development pressures on its coastal scrub habitat in southern California down into Baja California.

Critical habitat was re-proposed by the U.S. Fish & Wildlife Service (USFWS) April 2003 for approximately 495,795 acres of land in portions of Ventura, Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties. Areas proposed as critical habitat are identified in 13 separate units. They include a mixture of Federal, State, local, and privately owned land. Unit 13 includes western Los Angeles and eastern Ventura counties; however, it does not encompass any portion of the project Las Virgenes watershed.

The one record of the coastal California gnatcatcher occurred at the northern edge of the project watershed, approximately 2.5 miles from the project site. One individual was identified by call in 2002 on the west side of the north end of Las Virgenes Road, west of Woodland Hills (CNDDB, 2003). The site was located between land owned by the Santa Monica Mountains Conservancy and the Mont Calabasas development within a patch of coastal sage scrub.

The coastal California gnatcatcher is unlikely to occur at the project site due to lack of coastal scrub habitat and distance from extant populations.

Wildlife Species of Concern

Southwestern Pond Turtle (*Emys (=Clemmys) marmorata pallida*) is a federally listed species of concern. This aquatic turtle is typically found in ponds, marshes, and rivers with aquatic vegetation. The southwestern pond turtle in riverine environments will overwinter in upland areas, while those in permanent ponds generally remain in the pond year-round. Southwestern pond turtles require basking sites and suitable upland habitat for egg laying.

The southwestern pond turtle is a small turtle with a relatively low carapace. The shell may exhibit a pattern of dark spots or lines that radiate from the centers of the scutes, or it may be almost patternless olive brown, dark brown, or grayish. The skin is gray, with some pale yellow on the neck, chin, forelimbs, and tail. The head is plain or reticulated. T turtle is found south of San Francisco Bay. It is identified by its poorly developed inguinal scutes (absent in 60% of individuals), and by the uniform light color of the throat and neck.

The southwestern pond turtle occupies a wide variety of wetland habitats, including rivers and streams (both permanent and intermittent), lakes, ponds, reservoirs, permanent and ephemeral shallow wetlands, abandoned gravel pits, stock ponds, and sewage treatment lagoons (Holland, 1994).

Western pond turtles have been collected from brackish estuarine waters at sea level to over 6,717 feet (2,048 m), but the species is uncommon above 5,015 feet (1,529 m) (Stebbins, 1954; Bury, 1963; Holland, 1994). Optimal habitat seems to be characterized by the presence of adequate emergent basking sites, emergent vegetation, and the presence of suitable refugia in the form of undercut banks, submerged vegetation, mud, rocks and logs (Holland, 1994). The availability of suitable terrestrial shelter sites is necessary to provide protection from predators and thermal extremes. Overwintering and estivation sites are typically located in upland areas, and in southern California may be over 197 feet (60 m) from water (Goodman, 1997a).

Southwestern pond turtles have no recorded occurrences within the Calabasas quadrangle; however, three occurrences within the Malibu Beach quadrangle were suppressed by the CNDDB database to protect specimens from collection. The northern edge of the Malibu Beach quadrangle is approximately 1.25 miles from the project site.

Due to the lack of permanent or nearly permanent water, or basking sites such as partially submerged logs, vegetation mats, or open mud banks at the project site, the southwestern pond turtle is unlikely to occur at the project site.

Threatened and Endangered Plant Species

Two endangered plant special-status species have recorded occurrences within the project watershed (**Table A2**). They are both considered unlikely to occur within the project vicinity due to lack of availability of preferred habitat and distance from extant communities.

Braunton's milk-vetch (*Astragalus brautonii*) is a federally endangered plant that occurs in closed-cone coniferous forests, chaparral, coastal scrub, and valley and foothill grassland habitats. It is often found in recently burned or disturbed areas, or in stiff gravelly clay soils overlying granite or limestone. One record was found in the CNDDB database for an occurrence in 1998 within the Ahmanson Ranch development area near Laskey Mesa in southwestern Ventura County. **The San Fernando Valley spineflower** (*Chorizanthe parryi var. Fernandina*) is a special-status plant species that is a candidate for federal listing and a state endangered species. This variety of spineflower was thought to be extinct, having not been seen since 1929 until it was rediscovered on the Ahmanson Ranch site in 1999. It is generally found in coastal scrub habitat or in sandy soils associated with the Modelo formation. It is found often in sparsely vegetated areas where soils are thin, compacted or bedrock is exposed. The spineflower is also found along the interface between coastal sage scrub habitat and non-native grasslands. The recorded occurrences were located within the Calabasas quadrangle on the Ahmanson Ranch site in areas of open soil habitats concentrated along the outer souther rim of the Laskey mesa, in the southwestern corner of Ventura County. Field surveys found 5,000-10,000 plants in 1999, 23,000 plants estimated later in 1999, over 1.4 million plants estimated in 2000, and 1.8 million plants estimated in 2001.

Special Status Communities

Southern California Steelhead Stream habitat was designated by the CNDDB within the Malibu Beach quadrangle in Malibu Creek from approximately one-half mile upstream of the mouth at the upper lagoon to Ringe Dam, about 3.5 miles upstream. This stream corridor encompasses southern steelhead and pacific lamprey spawning range. Tidewater goby was successfully reintroduced to the lagoon in 1991.

Southern California Steelhead Evolutionarily Significant Unit (ESU) (*Oncorhynchus mykiss irideus*) was federally listed as an endangered species August 1997. Swift et al.

(1993) state that at least a few southern steelhead have been found in virtually every coastal stream in Monterey, San Luis Obispo and Santa Barbara counties north of Point Conception since 1983. The federal listing refers to populations from Santa Maria River south to the southern extent of the range, San Mateo Creek in San Diego County. Southern steelhead evidently once utilized most of the major coastal streams in southern California. Steelhead, named for their steel-blue coloring, are an anadromous species. Steelhead are born and reared in freshwater streams. As juveniles they migrate to estuaries, adjust to saltwater and migrate to the ocean to mature into adults. Juvenile steelhead reside in rivers from 1 to 3 years, requiring water year round to sustain themselves.

The CNDDB shows no recorded occurrences of the Southern Steelhead within the project Las Virgenes watershed. This is due to the fact that the Ringe Dam prevents fish migration upstream of the dam in Malibu Creek, of which Las Virgenes Creek is a tributary. Thus, though the potential for steelhead occurrence within the project reach is unlikely due to the Ringe Dam, consideration of fish passage issues in Las Virgenes Creek is necessary to make accessible the full extent of fish spawning habitat upstream of Ringe Dam, in the event that the dam is either removed or modified to allow fish passage.

Biological Summary

- The three special status wildlife species with recorded occurrences within the project Las Virgenes watershed (California red-legged frog, coastal California gnatcatcher, and the southwestern pond turtle) are all unlikely to occur in the project site due to lack of appropriate habitat conditions, physical barriers to migration within the creek wildlife corridor, or distance from extant populations.

- No special-status plant species are considered likely to occur in the project vicinity.

- The Las Virgenes Creek tributary and Malibu Creek could potentially provide a wildlife corridor between the pristine coastal scrub habitat of the Ahmanson Ranch area in the upper watershed and the Southern Steelhead Stream habitat below Ringe Dam extending to the Malibu Creek Lagoon. The 500-ft proposed project, rehabilitating a channelized section located in Las Virgenes Creek would be a step towards restoring a link of the highly urbanized creek system through Ventura and Los Angeles counties.

Table A1

Recorded occurrences of special status wildlife species within the project watershed within CNDDB Calabasas and Malibu Beach quadrangles. Status of all species is based on the CDFG Threatened and Endangered Animals List for California, September 2003.

Species	Federal Status	State Status	CDFG Status	Potential to Occur at the Project Site
CALIFORNIA RED-LEGGED FROG *Rana aurora draytonii*	Threatened	None	Species of Concern	Unlikely
COASTAL CALIFORNIA GNATCATCHER *Polioptila californica californica*	Threatened	None	Species of Concern	Unlikely
SOUTHWESTERN POND TURTLE *Emys (Clemmys) marmorata pallida*	Species of Concern	None	Species of Concern	Unlikely

Table A2

Recorded occurrences of special status plant species within the CNDDB Calabasas and Malibu Beach quadrangles Status of all species is based on the CDFG Threatened and Endangered Animals List of California, September 2003. California Native Plant Society (CNPS) list designations are based on the Inventory of Rare and Endangered Vascular Plants (2003).

Species	Federal Status	State Status	R-E-D code*	CNPS**	Potential to Occur at the Project Site
BRAUNTON'S MILK VETCH *Astragalus brauntonii*	Endangered	None	3-3-3	1B	Unlikely
SAN FERNANDO VALLEY SPINEFLOWER *Chorizanthe parryi var. fernandina*	Candidate	Endangered	3-3-3	1B	Unlikely

** R-E-D Code. **rarity**, which addresses the extent of the plant; **endangerment**, which embodies the perception of the plant's vulnerability to extinction for any reason; and **distribution**, which focuses on the overall range of the plant. In each case, higher numbers indicate greater concern.*

*** CNPS Plant lists:1A: Plants presumed extinct in California; 1B: Plants rare, threatened or endangered in California and elsewhere; 2: Plants rare, threatened, or endangered in California, but more common elsewhere.*

Appendix B

HYDRAULIC MODEL OUTPUT

HEC-RAS Plan: Existing River: Las Virgenes Cre Reach: LVC

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	763.4	100	100.00	743.20	744.57	4.76	1.37	1.48	20.99	1.01
LVC	763.4	200	200.00	743.20	745.01	5.47	1.81	1.77	36.56	1.01
LVC	763.4	300	300.00	743.20	745.31	6.03	2.11	2.03	49.76	1.02
LVC	763.4	400	400.00	743.20	745.56	6.52	2.36	2.25	61.33	1.02
LVC	763.4	500	500.00	743.20	745.80	6.85	2.60	2.38	72.97	1.00
LVC	763.4	600	600.00	743.20	746.00	7.19	2.80	2.54	83.40	1.00
LVC	763.4	700	700.00	743.20	746.19	7.49	2.99	2.68	93.46	1.00
LVC	763.4	800	800.00	743.20	746.36	7.81	3.16	2.85	102.45	1.01
LVC	763.4	900	900.00	743.20	746.54	8.01	3.34	2.93	112.33	1.00
LVC	763.4	1000	1000.00	743.20	746.68	8.30	3.48	3.09	120.46	1.01
LVC	763.4	2000	2000.00	743.20	747.97	10.05	4.77	4.00	198.98	1.01
LVC	763.4	3000	3000.00	743.20	749.00	11.15	5.80	4.59	269.05	1.01
LVC	763.4	4000	4000.00	743.20	749.90	11.97	6.70	5.04	334.20	1.00
LVC	763.4	5000	5000.00	743.20	750.69	12.63	7.49	5.41	395.94	1.00
LVC	763.4	6000	6000.00	743.20	751.40	13.19	8.20	5.73	454.86	1.00
LVC	763.4	7000	7000.00	743.20	752.06	13.68	8.86	6.02	511.68	1.00
LVC	763.4	8000	8000.00	743.20	752.67	14.12	9.47	6.28	566.74	1.00
LVC	763.4	9000	9000.00	743.20	753.24	14.54	10.04	6.54	619.17	1.00
LVC	763.4	10000	10000.00	743.20	753.78	14.89	10.58	6.76	671.39	1.00
LVC	763.4	11000	11000.00	743.20	754.29	15.22	11.09	6.96	722.54	1.00
LVC	763.4	12000	12000.00	743.20	754.78	15.53	11.58	7.15	772.73	1.00
LVC	763.4	13000	13000.00	743.20	755.25	15.81	12.05	7.32	822.08	1.00
LVC	763.4	14200	14200.00	743.20	755.79	16.13	12.59	7.52	880.26	1.00
LVC	650	100	100.00	742.69	743.24	4.68	0.55	0.14	21.35	1.32
LVC	650	200	200.00	742.69	743.42	6.34	0.73	0.23	31.53	1.49
LVC	650	300	300.00	742.69	743.58	7.43	0.89	0.30	40.39	1.56
LVC	650	400	400.00	742.69	743.71	8.31	1.02	0.35	48.14	1.61
LVC	650	500	500.00	742.69	743.83	9.05	1.14	0.40	55.27	1.65
LVC	650	600	600.00	742.69	743.95	9.65	1.26	0.44	62.17	1.67
LVC	650	700	700.00	742.69	744.06	10.17	1.37	0.48	68.82	1.69
LVC	650	800	800.00	742.69	744.16	10.60	1.47	0.50	75.47	1.69
LVC	650	900	900.00	742.69	744.26	11.04	1.57	0.54	81.49	1.71
LVC	650	1000	1000.00	742.69	744.36	11.41	1.67	0.56	87.63	1.71
LVC	650	2000	2000.00	742.69	745.18	14.05	2.49	0.75	142.37	1.73
LVC	650	3000	3000.00	742.69	745.85	15.70	3.16	0.87	191.04	1.73
LVC	650	4000	4000.00	742.69	746.44	16.93	3.75	0.96	236.24	1.73
LVC	650	5000	5000.00	742.69	746.96	17.91	4.27	1.03	279.23	1.73
LVC	650	6000	6000.00	742.69	747.45	18.71	4.76	1.09	320.64	1.72
LVC	650	7000	7000.00	742.69	747.90	19.43	5.21	1.14	360.32	1.72
LVC	650	8000	8000.00	742.69	748.32	20.05	5.63	1.19	398.92	1.71
LVC	650	9000	9000.00	742.69	748.71	20.62	6.02	1.23	436.57	1.71
LVC	650	10000	10000.00	742.69	749.09	21.12	6.40	1.27	473.41	1.70
LVC	650	11000	11000.00	742.69	749.45	21.59	6.76	1.31	509.55	1.70
LVC	650	12000	12000.00	742.69	749.79	22.02	7.10	1.34	545.05	1.70
LVC	650	13000	13000.00	742.69	750.13	22.40	7.44	1.37	580.37	1.69
LVC	650	14200	14200.00	742.69	750.51	22.85	7.82	1.41	621.47	1.69
LVC	600	100	100.00	739.93	740.17	12.43	0.24	1.32	8.04	5.26
LVC	600	200	200.00	739.93	740.32	13.29	0.39	1.25	15.05	4.24
LVC	600	300	300.00	739.93	740.45	14.02	0.52	1.26	21.40	3.83
LVC	600	400	400.00	739.93	740.56	14.61	0.63	1.27	27.38	3.56
LVC	600	500	500.00	739.93	740.67	15.13	0.74	1.28	33.05	3.37
LVC	600	600	600.00	739.93	740.77	15.58	0.84	1.30	38.51	3.24
LVC	600	700	700.00	739.93	740.87	15.98	0.94	1.31	43.79	3.14
LVC	600	800	800.00	739.93	740.97	16.31	1.04	1.32	49.04	3.04
LVC	600	900	900.00	739.93	741.06	16.65	1.13	1.34	54.05	2.97
LVC	600	1000	1000.00	739.93	741.15	16.95	1.22	1.35	58.99	2.90
LVC	600	2000	2000.00	739.93	741.96	18.99	2.03	1.42	105.29	2.49
LVC	600	3000	3000.00	739.93	742.68	20.27	2.75	1.47	148.02	2.28
LVC	600	4000	4000.00	739.93	743.35	21.17	3.42	1.49	188.96	2.14
LVC	600	5000	5000.00	739.93	743.98	21.85	4.05	1.51	228.80	2.04
LVC	600	6000	6000.00	739.93	744.59	22.39	4.66	1.52	267.93	1.96
LVC	600	7000	7000.00	739.93	745.16	22.85	5.23	1.53	306.30	1.89
LVC	600	8000	8000.00	739.93	745.72	23.23	5.79	1.53	344.38	1.84

HEC-RAS Plan: Existing River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	600	9000	9000.00	739.93	746.25	23.57	6.32	1.54	381.81	1.79
LVC	600	10000	10000.00	739.93	746.77	23.85	6.84	1.54	419.25	1.75
LVC	600	11000	11000.00	739.93	747.28	24.09	7.35	1.54	456.54	1.71
LVC	600	12000	12000.00	739.93	747.78	24.30	7.85	1.54	493.80	1.67
LVC	600	13000	13000.00	739.93	748.27	24.47	8.34	1.53	531.15	1.64
LVC	600	14200	14200.00	739.93	748.84	24.67	8.91	1.53	575.52	1.61
LVC	550	100	100.00	738.78	739.16	7.40	0.38	0.39	13.50	2.39
LVC	550	200	200.00	738.78	739.30	10.00	0.52	0.63	20.00	2.69
LVC	550	300	300.00	738.78	739.42	11.73	0.64	0.81	25.57	2.83
LVC	550	400	400.00	738.78	739.52	13.03	0.75	0.95	30.69	2.90
LVC	550	500	500.00	738.78	739.62	14.05	0.85	1.06	35.58	2.93
LVC	550	600	600.00	738.78	739.72	14.88	0.94	1.14	40.33	2.94
LVC	550	700	700.00	738.78	739.81	15.57	1.03	1.21	44.95	2.94
LVC	550	800	800.00	738.78	739.90	16.16	1.12	1.27	49.51	2.92
LVC	550	900	900.00	738.78	739.98	16.66	1.20	1.32	54.03	2.90
LVC	550	1000	1000.00	738.78	740.07	17.07	1.29	1.35	58.57	2.86
LVC	550	2000	2000.00	738.78	740.86	19.67	2.09	1.52	101.67	2.56
LVC	550	3000	3000.00	738.78	741.58	21.12	2.80	1.59	142.02	2.37
LVC	550	4000	4000.00	738.78	742.24	22.10	3.47	1.62	181.02	2.23
LVC	550	5000	5000.00	738.78	742.87	22.83	4.10	1.65	219.01	2.13
LVC	550	6000	6000.00	738.78	743.47	23.40	4.70	1.66	256.41	2.05
LVC	550	7000	7000.00	738.78	744.05	23.88	5.27	1.67	293.13	1.98
LVC	550	8000	8000.00	738.78	744.60	24.27	5.82	1.68	329.62	1.92
LVC	550	9000	9000.00	738.78	745.14	24.62	6.36	1.68	365.54	1.87
LVC	550	10000	10000.00	738.78	745.66	24.91	6.88	1.68	401.52	1.83
LVC	550	11000	11000.00	738.78	746.16	25.16	7.38	1.68	437.20	1.79
LVC	550	12000	12000.00	738.78	746.66	25.36	7.88	1.68	473.10	1.75
LVC	550	13000	13000.00	738.78	747.14	25.56	8.37	1.68	508.67	1.72
LVC	550	14200	14200.00	738.78	747.71	25.77	8.93	1.67	551.07	1.69
LVC	500	100	100.00	737.00	737.24	9.05	0.24	0.63	11.05	3.28
LVC	500	200	200.00	737.00	737.38	11.29	0.38	0.85	17.71	3.25
LVC	500	300	300.00	737.00	737.50	12.93	0.50	1.02	23.21	3.26
LVC	500	400	400.00	737.00	737.60	14.21	0.60	1.15	28.14	3.27
LVC	500	500	500.00	737.00	737.70	15.25	0.70	1.27	32.79	3.25
LVC	500	600	600.00	737.00	737.79	16.11	0.79	1.36	37.25	3.24
LVC	500	700	700.00	737.00	737.88	16.84	0.88	1.43	41.56	3.21
LVC	500	800	800.00	737.00	737.97	17.48	0.97	1.50	45.78	3.18
LVC	500	900	900.00	737.00	738.05	18.02	1.05	1.55	49.93	3.15
LVC	500	1000	1000.00	737.00	738.13	18.50	1.13	1.59	54.05	3.12
LVC	500	2000	2000.00	737.00	738.91	21.40	1.91	1.81	93.47	2.81
LVC	500	3000	3000.00	737.00	739.62	22.95	2.62	1.89	130.71	2.60
LVC	500	4000	4000.00	737.00	740.27	23.99	3.27	1.93	166.74	2.45
LVC	500	5000	5000.00	737.00	740.90	24.75	3.90	1.95	202.05	2.33
LVC	500	6000	6000.00	737.00	741.49	25.33	4.49	1.96	236.84	2.24
LVC	500	7000	7000.00	737.00	742.06	25.83	5.06	1.97	271.04	2.16
LVC	500	8000	8000.00	737.00	742.61	26.22	5.61	1.97	305.15	2.10
LVC	500	9000	9000.00	737.00	743.13	26.58	6.13	1.98	338.60	2.04
LVC	500	10000	10000.00	737.00	743.65	26.87	6.65	1.98	372.12	1.99
LVC	500	11000	11000.00	737.00	744.15	27.13	7.15	1.97	405.43	1.95
LVC	500	12000	12000.00	737.00	744.64	27.35	7.64	1.97	438.80	1.91
LVC	500	13000	13000.00	737.00	745.11	27.54	8.11	1.96	472.10	1.87
LVC	500	14200	14200.00	737.00	745.67	27.76	8.67	1.96	511.46	1.84
LVC	450	100	100.00	737.00	737.80	2.61	0.80	0.04	38.33	0.52
LVC	450	200	200.00	737.00	738.17	3.54	1.17	0.06	56.44	0.59
LVC	450	300	300.00	737.00	737.73	8.60	0.73	0.40	34.89	1.79
LVC	450	400	400.00	737.00	737.83	10.14	0.83	0.53	39.46	1.99
LVC	450	500	500.00	737.00	737.91	11.43	0.91	0.65	43.76	2.14
LVC	450	600	600.00	737.00	738.00	12.50	1.00	0.76	48.00	2.24
LVC	450	700	700.00	737.00	738.08	13.43	1.08	0.85	52.10	2.32
LVC	450	800	800.00	737.00	738.16	14.26	1.16	0.94	56.11	2.38
LVC	450	900	900.00	737.00	738.24	14.97	1.24	1.01	60.13	2.42
LVC	450	1000	1000.00	737.00	738.32	15.58	1.32	1.08	64.20	2.44

HEC-RAS Plan: Existing River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	450	2000	2000.00	737.00	739.07	19.46	2.07	1.46	102.80	2.46
LVC	450	3000	3000.00	737.00	739.75	21.46	2.75	1.63	139.80	2.37
LVC	450	4000	4000.00	737.00	740.39	22.77	3.39	1.72	175.64	2.28
LVC	450	5000	5000.00	737.00	741.00	23.71	4.00	1.78	210.87	2.20
LVC	450	6000	6000.00	737.00	741.59	24.43	4.59	1.81	245.59	2.14
LVC	450	7000	7000.00	737.00	742.14	25.02	5.14	1.84	279.77	2.08
LVC	450	8000	8000.00	737.00	742.69	25.49	5.69	1.86	313.88	2.02
LVC	450	9000	9000.00	737.00	743.20	25.94	6.20	1.88	347.02	1.98
LVC	450	10000	10000.00	737.00	743.71	26.27	6.71	1.88	380.71	1.94
LVC	450	11000	11000.00	737.00	744.20	26.58	7.20	1.89	413.80	1.90
LVC	450	12000	12000.00	737.00	744.69	26.82	7.69	1.89	447.37	1.86
LVC	450	13000	13000.00	737.00	745.16	27.04	8.16	1.89	480.70	1.83
LVC	450	14200	14200.00	737.00	745.71	27.30	8.71	1.89	520.08	1.80
LVC	400	100	100.00	737.00	737.74	2.87	0.74	0.04	34.82	0.60
LVC	400	200	200.00	737.00	738.08	3.87	1.08	0.07	51.72	0.67
LVC	400	300	300.00	737.00	738.36	4.56	1.36	0.09	65.73	0.70
LVC	400	400	400.00	737.00	738.59	5.17	1.59	0.11	77.36	0.74
LVC	400	500	500.00	737.00	738.82	5.61	1.82	0.13	89.19	0.75
LVC	400	600	600.00	737.00	738.29	9.63	1.29	0.41	62.28	1.52
LVC	400	700	700.00	737.00	738.35	10.71	1.35	0.51	65.36	1.66
LVC	400	800	800.00	737.00	738.42	11.68	1.42	0.59	68.47	1.77
LVC	400	900	900.00	737.00	738.49	12.48	1.49	0.67	72.13	1.84
LVC	400	1000	1000.00	737.00	738.56	13.17	1.56	0.73	75.95	1.90
LVC	400	2000	2000.00	737.00	739.28	17.64	2.28	1.16	113.38	2.13
LVC	400	3000	3000.00	737.00	739.97	19.95	2.97	1.38	150.41	2.13
LVC	400	4000	4000.00	737.00	740.61	21.45	3.61	1.50	186.46	2.09
LVC	400	5000	5000.00	737.00	741.22	22.54	4.22	1.58	221.80	2.05
LVC	400	6000	6000.00	737.00	741.81	23.35	4.81	1.64	256.97	2.00
LVC	400	7000	7000.00	737.00	742.37	24.00	5.37	1.67	291.63	1.96
LVC	400	8000	8000.00	737.00	742.92	24.52	5.92	1.70	326.27	1.91
LVC	400	9000	9000.00	737.00	743.44	25.01	6.44	1.73	359.88	1.88
LVC	400	10000	10000.00	737.00	743.95	25.37	6.95	1.74	394.13	1.85
LVC	400	11000	11000.00	737.00	744.45	25.71	7.45	1.75	427.77	1.82
LVC	400	12000	12000.00	737.00	744.94	25.98	7.94	1.76	461.95	1.78
LVC	400	13000	13000.00	737.00	745.42	26.22	8.42	1.76	495.90	1.76
LVC	400	14200	14200.00	737.00	745.97	26.49	8.97	1.77	536.02	1.73
LVC	350	100	100.00	737.00	737.52	4.04	0.52	0.10	24.76	1.00
LVC	350	200	200.00	737.00	737.81	5.08	0.81	0.13	39.40	1.01
LVC	350	300	300.00	737.00	738.06	5.78	1.06	0.16	51.87	1.01
LVC	350	400	400.00	737.00	738.28	6.33	1.28	0.18	63.15	1.00
LVC	350	500	500.00	737.00	738.49	6.79	1.49	0.20	73.58	1.00
LVC	350	600	600.00	737.00	738.50	8.06	1.50	0.28	74.46	1.19
LVC	350	700	700.00	737.00	738.76	7.98	1.76	0.26	87.69	1.09
LVC	350	800	800.00	737.00	738.74	9.21	1.74	0.35	86.86	1.26
LVC	350	900	900.00	737.00	738.75	10.33	1.75	0.43	87.11	1.42
LVC	350	1000	1000.00	737.00	738.79	11.15	1.79	0.50	89.69	1.51
LVC	350	2000	2000.00	737.00	739.42	16.19	2.42	0.96	123.53	1.90
LVC	350	3000	3000.00	737.00	740.07	18.79	3.07	1.21	159.70	1.97
LVC	350	4000	4000.00	737.00	740.69	20.49	3.69	1.36	195.21	1.98
LVC	350	5000	5000.00	737.00	741.27	21.75	4.27	1.47	229.87	1.97
LVC	350	6000	6000.00	737.00	741.84	22.66	4.84	1.54	264.75	1.94
LVC	350	7000	7000.00	737.00	742.38	23.41	5.38	1.59	299.01	1.91
LVC	350	8000	8000.00	737.00	742.91	24.01	5.91	1.63	333.15	1.88
LVC	350	9000	9000.00	737.00	743.41	24.58	6.41	1.67	366.20	1.85
LVC	350	10000	10000.00	737.00	743.90	25.01	6.90	1.69	399.76	1.83
LVC	350	11000	11000.00	737.00	744.37	25.43	7.37	1.72	432.63	1.81
LVC	350	12000	12000.00	737.00	744.84	25.76	7.84	1.73	465.87	1.78
LVC	350	13000	13000.00	737.00	745.31	26.03	8.31	1.74	499.46	1.76
LVC	350	14200	14200.00	737.00	745.83	26.37	8.83	1.76	538.56	1.73
LVC	320	100	100.00	735.87	736.44	7.87	0.57	5.03	12.71	2.34
LVC	320	200	200.00	735.87	736.68	8.76	0.81	5.57	22.84	2.21
LVC	320	300	300.00	735.87	736.86	9.49	0.99	6.08	31.61	2.14

HEC-RAS Plan: Existing River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	320	400	400.00	735.87	737.01	10.09	1.14	6.57	39.65	2.13
LVC	320	500	500.00	735.87	737.14	10.62	1.27	6.90	47.09	2.07
LVC	320	600	600.00	735.87	737.27	10.99	1.40	7.07	54.57	2.00
LVC	320	700	700.00	735.87	737.38	11.44	1.51	7.38	61.21	1.97
LVC	320	800	800.00	735.87	737.49	11.87	1.62	7.71	67.42	1.95
LVC	320	900	900.00	735.87	737.57	12.42	1.70	8.27	72.45	1.98
LVC	320	1000	1000.00	735.87	737.65	12.96	1.78	8.83	77.16	2.00
LVC	320	2000	2000.00	735.87	738.30	17.21	2.43	13.79	116.24	2.21
LVC	320	3000	3000.00	735.87	738.86	19.80	2.99	16.94	151.49	2.27
LVC	320	4000	4000.00	735.87	739.38	21.59	3.51	19.05	185.23	2.27
LVC	320	5000	5000.00	735.87	739.86	22.94	3.99	20.58	217.93	2.26
LVC	320	6000	6000.00	735.87	740.34	23.96	4.47	21.64	250.37	2.23
LVC	320	7000	7000.00	735.87	740.79	24.81	4.92	22.50	282.11	2.20
LVC	320	8000	8000.00	735.87	741.22	25.52	5.35	23.17	313.52	2.17
LVC	320	9000	9000.00	735.87	741.63	26.16	5.76	23.81	343.97	2.15
LVC	320	10000	10000.00	735.87	742.04	26.70	6.17	24.28	374.58	2.12
LVC	320	11000	11000.00	735.87	742.42	27.20	6.55	25.02	404.43	2.14
LVC	320	12000	12000.00	735.87	742.78	27.64	6.91	25.48	434.19	2.13
LVC	320	13000	13000.00	735.87	743.13	28.01	7.27	25.85	464.14	2.12
LVC	320	14200	14200.00	735.87	743.53	28.47	7.66	26.39	498.74	2.12
LVC	300	100	100.00	734.66	736.18	2.52	1.52	0.38	39.71	0.48
LVC	300	200	200.00	734.66	736.77	2.93	2.10	0.45	68.26	0.45
LVC	300	300	300.00	734.66	737.23	3.20	2.56	0.50	93.90	0.45
LVC	300	400	400.00	734.66	737.62	3.39	2.95	0.54	118.14	0.44
LVC	300	500	500.00	734.66	737.97	3.53	3.31	0.56	141.83	0.43
LVC	300	600	600.00	734.66	738.31	3.64	3.64	0.57	164.71	0.42
LVC	300	700	700.00	734.66	738.61	3.76	3.95	0.59	186.28	0.41
LVC	300	800	800.00	734.66	738.87	3.89	4.21	0.62	205.44	0.41
LVC	300	900	900.00	734.66	739.13	4.01	4.46	0.64	224.33	0.41
LVC	300	1000	1000.00	734.66	739.37	4.12	4.71	0.66	242.59	0.41
LVC	300	2000	2000.00	734.66	741.42	4.85	6.75	0.82	412.61	0.40
LVC	300	3000	3000.00	734.66	742.97	5.31	8.30	0.93	564.55	0.40
LVC	300	4000	4000.00	734.66	744.18	5.73	9.51	1.04	698.13	0.41
LVC	300	5000	5000.00	734.66	745.24	6.08	10.57	1.12	823.03	0.41
LVC	300	6000	6000.00	734.66	746.21	6.37	11.54	1.19	942.09	0.41
LVC	300	7000	7000.00	734.66	747.11	6.63	12.44	1.26	1056.60	0.41
LVC	300	8000	8000.00	734.66	747.95	6.85	13.29	1.32	1167.34	0.41
LVC	300	9000	9000.00	734.66	748.75	7.06	14.08	1.37	1274.45	0.41
LVC	300	10000	10000.00	734.66	749.50	7.25	14.84	1.42	1378.59	0.41
LVC	300	11000	11000.00	734.66	750.23	7.42	15.56	1.47	1481.85	0.41
LVC	300	12000	12000.00	734.66	750.92	7.58	16.26	1.51	1583.39	0.41
LVC	300	13000	13000.00	734.66	751.59	7.72	16.92	1.55	1684.07	0.41
LVC	300	14200	14200.00	734.66	752.34	7.89	17.68	1.60	1800.80	0.41
LVC	290	100	100.00	734.00	736.12	2.46	2.12	0.35	40.65	0.44
LVC	290	200	200.00	734.00	736.71	2.96	2.71	0.46	67.50	0.45
LVC	290	300	300.00	734.00	737.17	3.26	3.17	0.52	91.93	0.45
LVC	290	400	400.00	734.00	737.56	3.50	3.56	0.57	114.32	0.45
LVC	290	500	500.00	734.00	737.91	3.68	3.91	0.60	135.88	0.44
LVC	290	600	600.00	734.00	738.24	3.80	4.24	0.63	157.87	0.44
LVC	290	700	700.00	734.00	738.55	3.89	4.55	0.65	180.04	0.44
LVC	290	800	800.00	734.00	738.82	3.99	4.82	0.66	200.41	0.43
LVC	290	900	900.00	734.00	739.08	4.08	5.08	0.68	220.59	0.43
LVC	290	1000	1000.00	734.00	739.33	4.16	5.33	0.69	240.31	0.43
LVC	290	2000	2000.00	734.00	741.40	4.69	7.40	0.78	426.49	0.40
LVC	290	3000	3000.00	734.00	742.97	5.05	8.97	0.85	593.57	0.39
LVC	290	4000	4000.00	734.00	744.19	5.40	10.19	0.93	740.33	0.39
LVC	290	5000	5000.00	734.00	745.26	5.69	11.26	0.99	879.25	0.39
LVC	290	6000	6000.00	734.00	746.24	5.93	12.24	1.04	1011.71	0.39
LVC	290	7000	7000.00	734.00	747.15	6.14	13.15	1.09	1139.66	0.38
LVC	290	8000	8000.00	734.00	748.00	6.33	14.00	1.13	1263.48	0.38
LVC	290	9000	9000.00	734.00	748.81	6.51	14.81	1.17	1382.71	0.38
LVC	290	10000	10000.00	734.00	749.57	6.68	15.57	1.20	1497.83	0.38
LVC	290	11000	11000.00	734.00	750.30	6.83	16.30	1.24	1610.62	0.37

HEC-RAS Plan: Existing River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	290	12000	12000.00	734.00	750.99	6.98	16.99	1.27	1720.20	0.37
LVC	290	13000	13000.00	734.00	751.66	7.11	17.66	1.30	1827.54	0.37
LVC	290	14200	14200.00	734.00	752.42	7.28	18.42	1.35	1950.72	0.37
LVC	0	100	100.00	733.12	734.96	1.98	1.84	0.21	50.50	0.33
LVC	0	200	200.00	733.12	735.59	2.50	2.47	0.30	80.12	0.34
LVC	0	300	300.00	733.12	736.08	2.86	2.96	0.37	104.73	0.36
LVC	0	400	400.00	733.12	736.50	3.15	3.38	0.43	126.91	0.36
LVC	0	500	500.00	733.12	736.87	3.39	3.75	0.48	147.64	0.37
LVC	0	600	600.00	733.12	737.21	3.59	4.09	0.52	167.09	0.38
LVC	0	700	700.00	733.12	737.52	3.77	4.40	0.56	185.77	0.38
LVC	0	800	800.00	733.12	737.81	3.93	4.69	0.60	203.71	0.38
LVC	0	900	900.00	733.12	738.09	4.07	4.97	0.63	221.04	0.39
LVC	0	1000	1000.00	733.12	738.35	4.21	5.23	0.66	237.74	0.39
LVC	0	2000	2000.00	733.12	740.48	5.07	7.36	0.88	394.31	0.41
LVC	0	3000	3000.00	733.12	742.04	5.64	8.92	1.03	531.64	0.42
LVC	0	4000	4000.00	733.12	743.22	6.20	10.10	1.19	644.87	0.43
LVC	0	5000	5000.00	733.12	744.27	6.67	11.15	1.33	749.56	0.43
LVC	0	6000	6000.00	733.12	745.22	7.07	12.10	1.45	848.28	0.44
LVC	0	7000	7000.00	733.12	746.10	7.43	12.98	1.56	942.06	0.44
LVC	0	8000	8000.00	733.12	746.93	7.75	13.81	1.66	1032.64	0.45
LVC	0	9000	9000.00	733.12	747.71	8.04	14.59	1.75	1120.08	0.45
LVC	0	10000	10000.00	733.12	748.44	8.30	15.32	1.84	1204.43	0.45
LVC	0	11000	11000.00	733.12	749.15	8.54	16.03	1.92	1287.33	0.46
LVC	0	12000	12000.00	733.12	749.82	8.77	16.70	2.00	1367.71	0.46
LVC	0	13000	13000.00	733.12	750.47	8.99	17.34	2.07	1446.62	0.46
LVC	0	14200	14200.00	733.12	751.19	9.24	18.07	2.16	1536.23	0.46

HEC-RAS Plan: PR-B3-rough River: Las Virgenes Cre Reach: LVC

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	763.4	100	100.00	743.20	745.20	2.24	2.00	0.17	44.70	0.39
LVC	763.4	200	200.00	743.20	745.66	3.03	2.46	0.29	66.06	0.46
LVC	763.4	300	300.00	743.20	745.97	3.68	2.77	0.40	81.61	0.52
LVC	763.4	400	400.00	743.20	746.22	4.22	3.02	0.51	94.81	0.56
LVC	763.4	500	500.00	743.20	746.44	4.67	3.24	0.61	107.02	0.59
LVC	763.4	600	600.00	743.20	746.64	5.08	3.44	0.70	118.06	0.62
LVC	763.4	700	700.00	743.20	746.82	5.45	3.62	0.79	128.38	0.65
LVC	763.4	800	800.00	743.20	746.98	5.79	3.78	0.88	138.19	0.67
LVC	763.4	900	900.00	743.20	747.14	6.10	3.94	0.96	147.59	0.68
LVC	763.4	1000	1000.00	743.20	747.29	6.38	4.09	1.03	156.65	0.70
LVC	763.4	2000	2000.00	743.20	748.54	8.45	5.34	1.64	236.78	0.80
LVC	763.4	3000	3000.00	743.20	749.56	9.70	6.36	2.03	309.35	0.83
LVC	763.4	4000	4000.00	743.20	750.49	10.52	7.29	2.29	380.21	0.85
LVC	763.4	5000	5000.00	743.20	751.36	11.09	8.16	2.45	451.01	0.84
LVC	763.4	6000	6000.00	743.20	752.16	11.53	8.96	2.58	520.33	0.84
LVC	763.4	7000	7000.00	743.20	752.90	11.91	9.70	2.68	587.86	0.83
LVC	763.4	8000	8000.00	743.20	753.62	12.19	10.42	2.75	656.23	0.83
LVC	763.4	9000	9000.00	743.20	754.32	12.42	11.12	2.80	724.79	0.82
LVC	763.4	10000	10000.00	743.20	754.97	12.62	11.77	2.84	792.50	0.81
LVC	763.4	11000	11000.00	743.20	755.62	12.77	12.42	2.86	861.31	0.80
LVC	763.4	12000	12000.00	743.20	756.24	12.91	13.04	2.88	929.69	0.79
LVC	763.4	13000	13000.00	743.20	756.85	13.01	13.65	2.89	999.29	0.78
LVC	763.4	14200	14200.00	743.20	757.58	13.09	14.38	2.88	1084.88	0.77
LVC	650	100	100.00	743.06	744.11	4.84	1.05	2.08	20.66	0.90
LVC	650	200	200.00	743.06	744.87	3.19	1.81	0.96	62.64	0.64
LVC	650	300	300.00	743.06	745.12	3.60	2.06	1.11	83.42	0.64
LVC	650	400	400.00	743.06	745.37	3.82	2.31	1.18	104.68	0.61
LVC	650	500	500.00	743.06	745.60	3.99	2.54	1.22	125.39	0.59
LVC	650	600	600.00	743.06	745.83	4.13	2.76	1.25	145.23	0.58
LVC	650	700	700.00	743.06	746.03	4.26	2.97	1.29	164.41	0.56
LVC	650	800	800.00	743.06	746.23	4.37	3.17	1.31	183.18	0.55
LVC	650	900	900.00	743.06	746.42	4.47	3.36	1.34	201.41	0.54
LVC	650	1000	1000.00	743.06	746.61	4.56	3.55	1.37	219.27	0.54
LVC	650	2000	2000.00	743.06	748.16	5.22	5.10	1.56	382.78	0.50
LVC	650	3000	3000.00	743.06	749.44	5.60	6.38	1.66	535.29	0.48
LVC	650	4000	4000.00	743.06	750.58	5.86	7.52	1.72	682.55	0.46
LVC	650	5000	5000.00	743.06	751.60	6.05	8.54	1.76	826.55	0.45
LVC	650	6000	6000.00	743.06	752.54	6.21	9.48	1.79	966.26	0.43
LVC	650	7000	7000.00	743.06	753.40	6.38	10.34	1.82	1096.98	0.42
LVC	650	8000	8000.00	743.06	754.20	6.56	11.14	1.87	1219.16	0.41
LVC	650	9000	9000.00	743.06	754.95	6.75	11.89	1.92	1333.65	0.40
LVC	650	10000	10000.00	743.06	755.65	6.94	12.59	1.99	1440.72	0.40
LVC	650	11000	11000.00	743.06	756.33	7.12	13.27	2.04	1553.09	0.39
LVC	650	12000	12000.00	743.06	757.00	7.24	13.94	2.07	1678.37	0.39
LVC	650	13000	13000.00	743.06	757.65	7.33	14.59	2.09	1805.39	0.38
LVC	650	14200	14200.00	743.06	758.42	7.40	15.36	2.08	1963.35	0.37
LVC	600	100	100.00	741.80	743.22	3.48	1.42	0.97	28.73	0.54
LVC	600	200	200.00	741.80	744.02	3.28	2.22	0.92	61.00	0.57
LVC	600	300	300.00	741.80	744.50	3.34	2.70	0.84	89.86	0.48
LVC	600	400	400.00	741.80	744.72	3.87	2.92	1.09	103.44	0.53
LVC	600	500	500.00	741.80	744.95	4.25	3.15	1.27	117.61	0.55
LVC	600	600	600.00	741.80	745.15	4.59	3.35	1.43	130.79	0.56
LVC	600	700	700.00	741.80	745.35	4.89	3.55	1.58	143.20	0.58
LVC	600	800	800.00	741.80	745.54	5.15	3.74	1.71	155.38	0.59
LVC	600	900	900.00	741.80	745.71	5.40	3.91	1.85	166.69	0.60
LVC	600	1000	1000.00	741.80	745.87	5.63	4.07	1.98	177.60	0.61
LVC	600	2000	2000.00	741.80	747.18	7.46	5.38	3.11	268.12	0.68
LVC	600	3000	3000.00	741.80	748.26	8.61	6.46	3.88	348.47	0.71
LVC	600	4000	4000.00	741.80	749.22	9.44	7.42	4.44	423.91	0.72
LVC	600	5000	5000.00	741.80	750.10	10.08	8.30	4.88	496.04	0.73
LVC	600	6000	6000.00	741.80	750.90	10.63	9.10	5.27	564.64	0.74
LVC	600	7000	7000.00	741.80	751.65	11.10	9.85	5.61	630.79	0.74
LVC	600	8000	8000.00	741.80	752.34	11.51	10.54	5.91	694.98	0.74

HEC-RAS Plan: PR-B3-rough   River: Las Virgenes Cre   Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	600	9000	9000.00	741.80	753.00	11.89	11.20	6.19	756.79	0.75
LVC	600	10000	10000.00	741.80	753.59	12.30	11.79	6.48	813.05	0.74
LVC	600	11000	11000.00	741.80	754.15	12.69	12.35	6.78	866.81	0.74
LVC	600	12000	12000.00	741.80	754.67	13.09	12.87	7.11	916.51	0.75
LVC	600	13000	13000.00	741.80	755.17	13.47	13.37	7.42	965.11	0.75
LVC	600	14200	14200.00	741.80	755.77	13.90	13.97	7.78	1021.93	0.75
LVC	580	100	100.00	741.62	742.52	5.23	0.90	2.50	19.11	1.01
LVC	580	200	200.00	741.62	743.03	6.45	1.41	3.32	31.00	1.01
LVC	580	300	300.00	741.62	743.44	7.30	1.82	3.93	41.11	1.01
LVC	580	400	400.00	741.62	743.97	6.02	2.35	3.01	66.42	1.00
LVC	580	500	500.00	741.62	744.16	6.45	2.54	3.30	77.46	1.00
LVC	580	600	600.00	741.62	744.33	6.83	2.71	3.56	87.87	1.00
LVC	580	700	700.00	741.62	744.49	7.15	2.87	3.78	97.84	1.00
LVC	580	800	800.00	741.62	744.63	7.51	3.01	4.07	106.47	1.01
LVC	580	900	900.00	741.62	744.78	7.78	3.16	4.27	115.63	1.01
LVC	580	1000	1000.00	741.62	744.92	8.03	3.30	4.45	124.46	1.01
LVC	580	2000	2000.00	741.62	746.34	9.11	4.72	4.90	219.46	0.91
LVC	580	3000	3000.00	741.62	747.57	9.73	5.95	5.12	308.37	0.85
LVC	580	4000	4000.00	741.62	748.63	10.25	7.01	5.37	390.13	0.82
LVC	580	5000	5000.00	741.62	749.57	10.72	7.95	5.62	466.62	0.80
LVC	580	6000	6000.00	741.62	750.43	11.10	8.81	5.84	540.37	0.79
LVC	580	7000	7000.00	741.62	751.22	11.45	9.60	6.04	611.11	0.78
LVC	580	8000	8000.00	741.62	751.96	11.77	10.34	6.23	679.70	0.77
LVC	580	9000	9000.00	741.62	752.65	12.07	11.03	6.42	745.56	0.77
LVC	580	10000	10000.00	741.62	753.28	12.39	11.66	6.62	806.94	0.76
LVC	580	11000	11000.00	741.62	753.86	12.75	12.24	6.88	862.91	0.75
LVC	580	12000	12000.00	741.62	754.40	13.11	12.78	7.16	915.19	0.75
LVC	580	13000	13000.00	741.62	754.92	13.47	13.30	7.44	965.25	0.75
LVC	580	14200	14200.00	741.62	755.52	13.88	13.90	7.78	1023.24	0.75
LVC	575	100	100.00	740.78	742.30	2.95	1.52	0.68	33.88	0.44
LVC	575	200	200.00	740.78	743.19	2.90	2.41	0.68	69.02	0.46
LVC	575	300	300.00	740.78	743.60	3.25	2.82	0.78	92.31	0.46
LVC	575	400	400.00	740.78	743.88	3.68	3.10	0.96	108.69	0.48
LVC	575	500	500.00	740.78	744.13	4.03	3.35	1.10	124.12	0.50
LVC	575	600	600.00	740.78	744.37	4.33	3.59	1.24	138.43	0.51
LVC	575	700	700.00	740.78	744.58	4.61	3.80	1.37	151.92	0.52
LVC	575	800	800.00	740.78	744.79	4.86	4.01	1.48	164.76	0.53
LVC	575	900	900.00	740.78	744.98	5.08	4.20	1.59	177.03	0.54
LVC	575	1000	1000.00	740.78	745.16	5.29	4.38	1.70	188.93	0.55
LVC	575	2000	2000.00	740.78	746.64	6.90	5.86	2.59	289.77	0.60
LVC	575	3000	3000.00	740.78	747.84	7.93	7.06	3.20	378.33	0.63
LVC	575	4000	4000.00	740.78	748.87	8.71	8.09	3.69	459.49	0.64
LVC	575	5000	5000.00	740.78	749.80	9.32	9.02	4.08	536.58	0.65
LVC	575	6000	6000.00	740.78	750.65	9.84	9.87	4.43	609.79	0.66
LVC	575	7000	7000.00	740.78	751.43	10.29	10.65	4.73	680.29	0.67
LVC	575	8000	8000.00	740.78	752.16	10.69	11.38	5.00	748.61	0.67
LVC	575	9000	9000.00	740.78	752.85	11.05	12.07	5.25	814.26	0.67
LVC	575	10000	10000.00	740.78	753.48	11.41	12.70	5.49	876.05	0.67
LVC	575	11000	11000.00	740.78	754.06	11.79	13.28	5.76	932.90	0.67
LVC	575	12000	12000.00	740.78	754.60	12.17	13.82	6.04	986.23	0.68
LVC	575	13000	13000.00	740.78	755.12	12.53	14.34	6.32	1037.38	0.68
LVC	575	14200	14200.00	740.78	755.73	12.95	14.95	6.65	1096.71	0.68
LVC	550	100	100.00	740.59	742.08	3.03	1.49	0.72	33.00	0.46
LVC	550	200	200.00	740.59	742.90	3.19	2.31	0.85	62.68	0.53
LVC	550	300	300.00	740.59	743.38	3.33	2.79	0.83	90.03	0.47
LVC	550	400	400.00	740.59	743.63	3.81	3.04	1.04	104.85	0.50
LVC	550	500	500.00	740.59	743.87	4.19	3.28	1.21	119.36	0.52
LVC	550	600	600.00	740.59	744.10	4.52	3.51	1.36	132.86	0.54
LVC	550	700	700.00	740.59	744.30	4.81	3.71	1.50	145.60	0.55
LVC	550	800	800.00	740.59	744.50	5.07	3.91	1.63	157.78	0.56
LVC	550	900	900.00	740.59	744.68	5.31	4.09	1.76	169.42	0.57
LVC	550	1000	1000.00	740.59	744.86	5.53	4.27	1.88	180.76	0.58

HEC-RAS Plan: PR-B3-rough River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	550	2000	2000.00	740.59	746.27	7.25	5.68	2.89	275.70	0.65
LVC	550	3000	3000.00	740.59	747.45	8.30	6.86	3.55	361.32	0.67
LVC	550	4000	4000.00	740.59	748.47	9.08	7.88	4.05	440.40	0.68
LVC	550	5000	5000.00	740.59	749.39	9.70	8.80	4.46	515.43	0.69
LVC	550	6000	6000.00	740.59	750.23	10.22	9.64	4.81	587.04	0.69
LVC	550	7000	7000.00	740.59	751.01	10.67	10.42	5.12	656.05	0.70
LVC	550	8000	8000.00	740.59	751.75	11.06	11.16	5.39	723.50	0.70
LVC	550	9000	9000.00	740.59	752.43	11.41	11.84	5.64	788.57	0.70
LVC	550	10000	10000.00	740.59	753.06	11.76	12.47	5.88	849.99	0.70
LVC	550	11000	11000.00	740.59	753.64	12.14	13.05	6.15	905.97	0.70
LVC	550	12000	12000.00	740.59	754.18	12.53	13.59	6.45	957.79	0.70
LVC	550	13000	13000.00	740.59	754.69	12.91	14.10	6.75	1007.24	0.71
LVC	550	14200	14200.00	740.59	755.28	13.34	14.69	7.11	1064.47	0.71
LVC	525	100	100.00	740.44	741.34	5.22	0.90	2.48	19.17	1.00
LVC	525	200	200.00	740.44	741.84	6.46	1.40	3.33	30.96	1.01
LVC	525	300	300.00	740.44	742.25	7.28	1.81	3.92	41.18	1.01
LVC	525	400	400.00	740.44	742.79	6.16	2.35	3.10	64.97	1.00
LVC	525	500	500.00	740.44	742.98	6.60	2.54	3.40	75.78	1.00
LVC	525	600	600.00	740.44	743.16	6.98	2.72	3.67	85.95	1.00
LVC	525	700	700.00	740.44	743.33	7.32	2.89	3.90	95.69	1.00
LVC	525	800	800.00	740.44	743.49	7.62	3.05	4.12	105.01	1.00
LVC	525	900	900.00	740.44	743.65	7.89	3.21	4.31	114.09	1.00
LVC	525	1000	1000.00	740.44	743.79	8.16	3.35	4.52	122.59	1.00
LVC	525	2000	2000.00	740.44	745.36	9.05	4.92	4.74	220.96	0.87
LVC	525	3000	3000.00	740.44	746.57	9.87	6.13	5.20	303.91	0.84
LVC	525	4000	4000.00	740.44	747.60	10.57	7.16	5.66	378.27	0.83
LVC	525	5000	5000.00	740.44	748.52	11.13	8.08	6.03	449.13	0.82
LVC	525	6000	6000.00	740.44	749.35	11.63	8.91	6.37	515.99	0.82
LVC	525	7000	7000.00	740.44	750.12	12.07	9.68	6.70	579.89	0.82
LVC	525	8000	8000.00	740.44	750.84	12.46	10.40	6.98	642.28	0.81
LVC	525	9000	9000.00	740.44	751.52	12.80	11.08	7.23	703.26	0.81
LVC	525	10000	10000.00	740.44	752.16	13.11	11.72	7.47	762.55	0.81
LVC	525	11000	11000.00	740.44	752.74	13.44	12.30	7.73	818.30	0.81
LVC	525	12000	12000.00	740.44	753.28	13.79	12.84	8.00	870.40	0.81
LVC	525	13000	13000.00	740.44	753.79	14.15	13.35	8.30	919.01	0.81
LVC	525	14200	14200.00	740.44	754.36	14.57	13.92	8.66	974.91	0.81
LVC	520	100	100.00	739.44	741.15	2.60	1.71	0.51	38.52	0.37
LVC	520	200	200.00	739.44	742.00	2.65	2.56	0.54	75.42	0.40
LVC	520	300	300.00	739.44	742.45	2.98	3.01	0.63	100.53	0.39
LVC	520	400	400.00	739.44	742.77	3.39	3.33	0.78	118.11	0.41
LVC	520	500	500.00	739.44	743.04	3.74	3.60	0.92	133.54	0.43
LVC	520	600	600.00	739.44	743.29	4.05	3.85	1.04	148.14	0.45
LVC	520	700	700.00	739.44	743.52	4.33	4.08	1.16	161.79	0.46
LVC	520	800	800.00	739.44	743.74	4.58	4.30	1.27	174.74	0.47
LVC	520	900	900.00	739.44	743.95	4.81	4.51	1.38	187.08	0.48
LVC	520	1000	1000.00	739.44	744.14	5.02	4.70	1.48	199.15	0.49
LVC	520	2000	2000.00	739.44	745.70	6.67	6.26	2.36	299.64	0.56
LVC	520	3000	3000.00	739.44	746.90	7.81	7.46	3.05	384.28	0.60
LVC	520	4000	4000.00	739.44	747.92	8.68	8.48	3.61	460.83	0.62
LVC	520	5000	5000.00	739.44	748.85	9.37	9.41	4.08	533.37	0.64
LVC	520	6000	6000.00	739.44	749.68	9.97	10.24	4.50	601.79	0.66
LVC	520	7000	7000.00	739.44	750.44	10.49	11.00	4.88	667.21	0.67
LVC	520	8000	8000.00	739.44	751.16	10.95	11.72	5.22	730.66	0.68
LVC	520	9000	9000.00	739.44	751.83	11.35	12.39	5.53	792.90	0.69
LVC	520	10000	10000.00	739.44	752.47	11.72	13.03	5.80	853.48	0.69
LVC	520	11000	11000.00	739.44	753.05	12.09	13.61	6.07	909.52	0.69
LVC	520	12000	12000.00	739.44	753.59	12.48	14.15	6.37	961.38	0.70
LVC	520	13000	13000.00	739.44	754.10	12.87	14.66	6.69	1010.10	0.70
LVC	520	14200	14200.00	739.44	754.68	13.32	15.24	7.06	1066.25	0.71
LVC	500	100	100.00	739.36	741.03	2.67	1.67	0.54	37.49	0.38
LVC	500	200	200.00	739.36	741.84	2.80	2.48	0.61	71.51	0.43
LVC	500	300	300.00	739.36	742.33	3.07	2.97	0.67	97.80	0.41

HEC-RAS Plan: PR-B3-rough   River: Las Virgenes Cre   Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	500	400	400.00	739.36	742.63	3.49	3.27	0.83	114.65	0.43
LVC	500	500	500.00	739.36	742.89	3.87	3.53	0.99	129.33	0.45
LVC	500	600	600.00	739.36	743.13	4.19	3.77	1.12	143.36	0.47
LVC	500	700	700.00	739.36	743.35	4.47	3.99	1.25	156.48	0.48
LVC	500	800	800.00	739.36	743.56	4.74	4.20	1.37	168.91	0.50
LVC	500	900	900.00	739.36	743.76	4.98	4.40	1.49	180.70	0.51
LVC	500	1000	1000.00	739.36	743.95	5.20	4.59	1.60	192.28	0.52
LVC	500	2000	2000.00	739.36	745.44	6.95	6.08	2.58	287.78	0.59
LVC	500	3000	3000.00	739.36	746.60	8.15	7.24	3.35	368.28	0.63
LVC	500	4000	4000.00	739.36	747.60	9.04	8.24	3.96	442.55	0.66
LVC	500	5000	5000.00	739.36	748.50	9.76	9.14	4.47	512.38	0.68
LVC	500	6000	6000.00	739.36	749.31	10.36	9.95	4.91	578.90	0.69
LVC	500	7000	7000.00	739.36	750.07	10.89	10.71	5.30	642.71	0.70
LVC	500	8000	8000.00	739.36	750.77	11.35	11.41	5.66	704.59	0.71
LVC	500	9000	9000.00	739.36	751.44	11.77	12.08	5.98	764.86	0.72
LVC	500	10000	10000.00	739.36	752.06	12.14	12.70	6.27	823.64	0.73
LVC	500	11000	11000.00	739.36	752.65	12.50	13.29	6.55	879.87	0.73
LVC	500	12000	12000.00	739.36	753.19	12.88	13.83	6.84	931.87	0.73
LVC	500	13000	13000.00	739.36	753.68	13.26	14.32	7.16	980.09	0.73
LVC	500	14200	14200.00	739.36	754.26	13.71	14.90	7.54	1035.37	0.74
LVC	455	100	100.00	739.21	740.09	5.21	0.88	2.49	19.18	1.01
LVC	455	200	200.00	739.21	740.59	6.44	1.38	3.31	31.04	1.01
LVC	455	300	300.00	739.21	741.00	7.27	1.79	3.91	41.27	1.01
LVC	455	400	400.00	739.21	741.53	6.28	2.32	3.22	63.71	1.02
LVC	455	500	500.00	739.21	741.74	6.65	2.53	3.44	75.20	1.00
LVC	455	600	600.00	739.21	741.92	7.03	2.71	3.70	85.32	1.00
LVC	455	700	700.00	739.21	742.10	7.37	2.89	3.95	94.95	1.00
LVC	455	800	800.00	739.21	742.26	7.68	3.05	4.17	104.13	1.00
LVC	455	900	900.00	739.21	742.41	7.96	3.20	4.37	113.10	1.00
LVC	455	1000	1000.00	739.21	742.56	8.24	3.35	4.60	121.29	1.01
LVC	455	2000	2000.00	739.21	743.97	9.64	4.76	5.44	207.42	0.94
LVC	455	3000	3000.00	739.21	745.21	10.35	6.00	5.77	289.78	0.89
LVC	455	4000	4000.00	739.21	746.25	11.00	7.04	6.16	363.62	0.87
LVC	455	5000	5000.00	739.21	747.18	11.53	7.97	6.50	433.56	0.86
LVC	455	6000	6000.00	739.21	748.02	12.01	8.81	6.83	499.44	0.85
LVC	455	7000	7000.00	739.21	748.79	12.46	9.58	7.16	561.96	0.85
LVC	455	8000	8000.00	739.21	749.50	12.84	10.29	7.44	622.86	0.84
LVC	455	9000	9000.00	739.21	750.17	13.21	10.96	7.72	681.36	0.84
LVC	455	10000	10000.00	739.21	750.79	13.56	11.58	8.01	737.51	0.84
LVC	455	11000	11000.00	739.21	751.37	13.90	12.16	8.30	791.12	0.84
LVC	455	12000	12000.00	739.21	751.91	14.25	12.70	8.61	841.97	0.85
LVC	455	13000	13000.00	739.21	752.41	14.60	13.20	8.91	890.29	0.85
LVC	455	14200	14200.00	739.21	752.96	15.05	13.75	9.31	943.74	0.85
LVC	450	100	100.00	738.21	739.88	2.62	1.67	0.52	38.10	0.38
LVC	450	200	200.00	738.21	740.71	2.72	2.50	0.58	73.65	0.41
LVC	450	300	300.00	738.21	741.19	2.99	2.98	0.64	100.38	0.40
LVC	450	400	400.00	738.21	741.49	3.40	3.28	0.79	117.70	0.42
LVC	450	500	500.00	738.21	741.77	3.74	3.56	0.92	133.72	0.44
LVC	450	600	600.00	738.21	742.01	4.04	3.80	1.04	148.59	0.45
LVC	450	700	700.00	738.21	742.24	4.31	4.03	1.16	162.55	0.47
LVC	450	800	800.00	738.21	742.46	4.55	4.25	1.27	175.85	0.48
LVC	450	900	900.00	738.21	742.66	4.77	4.45	1.37	188.56	0.49
LVC	450	1000	1000.00	738.21	742.86	4.98	4.65	1.46	200.89	0.49
LVC	450	2000	2000.00	738.21	744.45	6.51	6.24	2.25	307.35	0.55
LVC	450	3000	3000.00	738.21	745.69	7.54	7.48	2.84	397.91	0.58
LVC	450	4000	4000.00	738.21	746.74	8.33	8.53	3.33	479.91	0.60
LVC	450	5000	5000.00	738.21	747.68	8.98	9.47	3.74	556.73	0.61
LVC	450	6000	6000.00	738.21	748.53	9.53	10.32	4.10	629.80	0.63
LVC	450	7000	7000.00	738.21	749.31	10.01	11.10	4.42	699.27	0.64
LVC	450	8000	8000.00	738.21	750.05	10.44	11.84	4.71	766.59	0.64
LVC	450	9000	9000.00	738.21	750.73	10.83	12.52	4.99	831.00	0.65
LVC	450	10000	10000.00	738.21	751.36	11.21	13.15	5.25	892.34	0.65
LVC	450	11000	11000.00	738.21	751.95	11.59	13.74	5.52	949.37	0.65

HEC-RAS Plan: PR-B3-rough River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	450	12000	12000.00	738.21	752.49	11.98	14.28	5.81	1001.89	0.66
LVC	450	13000	13000.00	738.21	753.00	12.37	14.79	6.12	1051.07	0.66
LVC	450	14200	14200.00	738.21	753.56	12.84	15.35	6.50	1106.13	0.67
LVC	400	100	100.00	738.04	739.38	3.43	1.34	0.95	29.14	0.54
LVC	400	200	200.00	738.04	739.99	4.57	1.95	1.51	43.72	0.61
LVC	400	300	300.00	738.04	740.68	3.79	2.64	1.10	79.23	0.56
LVC	400	400	400.00	738.04	740.91	4.35	2.87	1.38	91.99	0.60
LVC	400	500	500.00	738.04	741.14	4.76	3.10	1.59	105.13	0.62
LVC	400	600	600.00	738.04	741.36	5.11	3.32	1.78	117.39	0.63
LVC	400	700	700.00	738.04	741.56	5.43	3.52	1.96	128.85	0.64
LVC	400	800	800.00	738.04	741.74	5.72	3.70	2.13	139.89	0.66
LVC	400	900	900.00	738.04	741.92	5.98	3.88	2.28	150.45	0.67
LVC	400	1000	1000.00	738.04	742.10	6.21	4.06	2.41	161.04	0.67
LVC	400	2000	2000.00	738.04	743.52	7.95	5.48	3.52	251.53	0.72
LVC	400	3000	3000.00	738.04	744.65	9.11	6.61	4.33	329.19	0.75
LVC	400	4000	4000.00	738.04	745.63	9.98	7.59	4.96	400.66	0.76
LVC	400	5000	5000.00	738.04	746.51	10.68	8.47	5.48	468.20	0.77
LVC	400	6000	6000.00	738.04	747.32	11.25	9.28	5.91	533.18	0.78
LVC	400	7000	7000.00	738.04	748.05	11.78	10.01	6.33	594.01	0.78
LVC	400	8000	8000.00	738.04	748.75	12.22	10.71	6.67	654.71	0.79
LVC	400	9000	9000.00	738.04	749.40	12.64	11.36	7.00	712.23	0.79
LVC	400	10000	10000.00	738.04	750.00	13.03	11.96	7.33	767.43	0.80
LVC	400	11000	11000.00	738.04	750.56	13.41	12.52	7.66	820.04	0.80
LVC	400	12000	12000.00	738.04	751.06	13.83	13.02	8.03	867.89	0.81
LVC	400	13000	13000.00	738.04	751.54	14.24	13.50	8.40	913.20	0.81
LVC	400	14200	14200.00	738.04	751.98	14.85	13.94	9.03	956.17	0.83
LVC	390	100	100.00	738.00	738.90	5.23	0.90	2.50	19.11	1.00
LVC	390	200	200.00	738.00	739.40	6.45	1.40	3.31	31.01	1.00
LVC	390	300	300.00	738.00	739.82	7.25	1.82	3.88	41.38	1.00
LVC	390	400	400.00	738.00	740.35	6.22	2.35	3.14	64.28	1.00
LVC	390	500	500.00	738.00	740.54	6.67	2.54	3.46	74.91	1.00
LVC	390	600	600.00	738.00	740.73	7.05	2.73	3.72	85.08	1.00
LVC	390	700	700.00	738.00	740.90	7.40	2.90	3.96	94.64	1.00
LVC	390	800	800.00	738.00	741.06	7.70	3.06	4.18	103.86	1.00
LVC	390	900	900.00	738.00	741.22	7.97	3.22	4.38	112.89	1.00
LVC	390	1000	1000.00	738.00	741.36	8.29	3.36	4.65	120.61	1.01
LVC	390	2000	2000.00	738.00	742.63	10.14	4.63	6.08	197.26	1.01
LVC	390	3000	3000.00	738.00	743.66	11.36	5.66	7.08	264.17	1.01
LVC	390	4000	4000.00	738.00	744.59	12.20	6.59	7.75	328.00	1.00
LVC	390	5000	5000.00	738.00	745.39	12.95	7.39	8.41	386.06	1.00
LVC	390	6000	6000.00	738.00	746.12	13.60	8.12	9.00	441.07	1.00
LVC	390	7000	7000.00	738.00	746.79	14.17	8.79	9.51	494.05	1.00
LVC	390	8000	8000.00	738.00	747.41	14.70	9.41	10.03	544.07	1.01
LVC	390	9000	9000.00	738.00	748.03	15.11	10.03	10.38	595.72	1.00
LVC	390	10000	10000.00	738.00	748.63	15.45	10.63	10.69	647.24	1.00
LVC	390	11000	11000.00	738.00	749.20	15.76	11.20	10.97	698.03	1.00
LVC	390	12000	12000.00	738.00	749.74	16.05	11.74	11.23	747.73	1.00
LVC	390	13000	13000.00	738.00	750.24	16.36	12.24	11.52	794.66	1.00
LVC	390	14200	14200.00	738.00	751.03	16.30	13.03	11.17	871.07	0.95
LVC	385	100	100.00	737.00	738.02	4.57	1.02	1.83	21.89	0.83
LVC	385	200	200.00	737.00	738.40	6.46	1.40	3.32	30.97	1.01
LVC	385	300	300.00	737.00	738.81	7.29	1.81	3.93	41.15	1.01
LVC	385	400	400.00	737.00	739.33	6.29	2.33	3.23	63.57	1.02
LVC	385	500	500.00	737.00	739.54	6.67	2.54	3.45	74.95	1.00
LVC	385	600	600.00	737.00	739.73	7.06	2.73	3.72	85.03	1.00
LVC	385	700	700.00	737.00	739.90	7.40	2.90	3.96	94.62	1.00
LVC	385	800	800.00	737.00	740.06	7.71	3.06	4.19	103.76	1.00
LVC	385	900	900.00	737.00	740.22	7.99	3.22	4.39	112.70	1.00
LVC	385	1000	1000.00	737.00	740.36	8.30	3.36	4.65	120.53	1.01
LVC	385	2000	2000.00	737.00	741.63	10.16	4.63	6.11	196.78	1.01
LVC	385	3000	3000.00	737.00	742.98	10.53	5.98	5.97	284.85	0.90
LVC	385	4000	4000.00	737.00	744.09	11.05	7.09	6.20	361.89	0.87

HEC-RAS Plan: PR-B3-rough   River: Las Virgenes Cre   Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	385	5000	5000.00	737.00	745.05	11.55	8.05	6.50	432.78	0.85
LVC	385	6000	6000.00	737.00	745.91	12.01	8.91	6.79	499.73	0.84
LVC	385	7000	7000.00	737.00	746.72	12.40	9.72	7.05	564.73	0.83
LVC	385	8000	8000.00	737.00	747.49	12.72	10.49	7.25	628.88	0.82
LVC	385	9000	9000.00	737.00	748.21	13.01	11.21	7.44	691.58	0.82
LVC	385	10000	10000.00	737.00	748.93	13.23	11.93	7.54	756.14	0.81
LVC	385	11000	11000.00	737.00	749.69	13.32	12.69	7.51	825.63	0.79
LVC	385	12000	12000.00	737.00	750.38	13.46	13.38	7.53	891.56	0.78
LVC	385	13000	13000.00	737.00	751.03	13.64	14.03	7.60	953.40	0.76
LVC	385	14200	14200.00	737.00	751.74	13.90	14.74	7.75	1021.73	0.75
LVC	350	100	100.00	736.00	737.50	2.60	1.50	0.63	38.53	0.51
LVC	350	200	200.00	736.00	737.87	3.51	1.87	1.02	56.93	0.58
LVC	350	300	300.00	736.00	738.14	4.26	2.14	1.40	70.47	0.64
LVC	350	400	400.00	736.00	738.27	5.19	2.27	2.03	77.00	0.75
LVC	350	500	500.00	736.00	738.43	5.86	2.43	2.50	85.38	0.80
LVC	350	600	600.00	736.00	738.63	6.28	2.63	2.78	95.57	0.82
LVC	350	700	700.00	736.00	738.83	6.57	2.83	2.96	106.48	0.82
LVC	350	800	800.00	736.00	739.04	6.82	3.04	3.10	117.30	0.81
LVC	350	900	900.00	736.00	739.24	7.02	3.24	3.20	128.25	0.80
LVC	350	1000	1000.00	736.00	739.45	7.17	3.45	3.26	139.51	0.79
LVC	350	2000	2000.00	736.00	741.27	8.18	5.27	3.65	244.61	0.72
LVC	350	3000	3000.00	736.00	742.70	8.97	6.70	4.07	334.36	0.70
LVC	350	4000	4000.00	736.00	743.78	9.84	7.78	4.67	406.54	0.71
LVC	350	5000	5000.00	736.00	744.71	10.60	8.71	5.24	471.48	0.73
LVC	350	6000	6000.00	736.00	745.56	11.27	9.56	5.71	532.90	0.73
LVC	350	7000	7000.00	736.00	746.33	11.88	10.33	6.14	590.93	0.73
LVC	350	8000	8000.00	736.00	747.06	12.43	11.06	6.54	647.16	0.74
LVC	350	9000	9000.00	736.00	747.75	12.94	11.75	6.90	701.65	0.74
LVC	350	10000	10000.00	736.00	748.40	13.40	12.40	7.24	754.77	0.74
LVC	350	11000	11000.00	736.00	749.03	13.81	13.03	7.54	807.59	0.74
LVC	350	12000	12000.00	736.00	749.64	14.19	13.64	7.82	859.48	0.74
LVC	350	13000	13000.00	736.00	750.23	14.53	14.23	8.06	911.05	0.74
LVC	350	14200	14200.00	736.00	750.89	14.94	14.89	8.37	970.12	0.74
LVC	320	100	100.00	735.87	736.71	4.10	0.84	1.20	24.42	1.01
LVC	320	200	200.00	735.87	737.03	4.87	1.16	1.52	41.06	1.01
LVC	320	300	300.00	735.87	737.26	5.55	1.39	1.80	54.09	1.01
LVC	320	400	400.00	735.87	737.61	5.38	1.74	1.54	74.33	0.85
LVC	320	500	500.00	735.87	737.95	5.25	2.09	1.36	95.25	0.74
LVC	320	600	600.00	735.87	738.28	5.21	2.41	1.27	115.27	0.67
LVC	320	700	700.00	735.87	738.58	5.24	2.71	1.23	133.70	0.63
LVC	320	800	800.00	735.87	738.84	5.33	2.97	1.23	150.17	0.61
LVC	320	900	900.00	735.87	739.09	5.41	3.22	1.23	166.31	0.60
LVC	320	1000	1000.00	735.87	739.33	5.50	3.46	1.24	181.91	0.58
LVC	320	2000	2000.00	735.87	741.33	6.22	5.46	1.37	321.44	0.52
LVC	320	3000	3000.00	735.87	742.84	6.83	6.97	1.55	439.32	0.52
LVC	320	4000	4000.00	735.87	744.01	7.37	8.15	1.75	542.50	0.54
LVC	320	5000	5000.00	735.87	745.05	7.80	9.18	1.89	640.80	0.54
LVC	320	6000	6000.00	735.87	745.99	8.15	10.12	2.00	735.79	0.54
LVC	320	7000	7000.00	735.87	746.88	8.45	11.01	2.10	828.32	0.54
LVC	320	8000	8000.00	735.87	747.70	8.71	11.83	2.18	918.86	0.53
LVC	320	9000	9000.00	735.87	748.49	8.93	12.62	2.25	1007.69	0.53
LVC	320	10000	10000.00	735.87	749.23	9.13	13.36	2.31	1095.06	0.53
LVC	320	11000	11000.00	735.87	749.94	9.31	14.08	2.37	1181.49	0.53
LVC	320	12000	12000.00	735.87	750.63	9.48	14.76	2.41	1265.88	0.52
LVC	320	13000	13000.00	735.87	751.29	9.64	15.42	2.46	1348.68	0.52
LVC	320	14200	14200.00	735.87	752.03	9.84	16.16	2.52	1443.56	0.52
LVC	300	100	100.00	734.66	736.18	2.52	1.52	0.38	39.71	0.48
LVC	300	200	200.00	734.66	736.77	2.93	2.10	0.45	68.31	0.45
LVC	300	300	300.00	734.66	737.23	3.20	2.56	0.50	93.90	0.45
LVC	300	400	400.00	734.66	737.62	3.38	2.96	0.54	118.34	0.44
LVC	300	500	500.00	734.66	737.98	3.52	3.31	0.56	141.91	0.43
LVC	300	600	600.00	734.66	738.31	3.64	3.64	0.57	164.91	0.42

HEC-RAS Plan: PR-B3-rough River: Las Virgenes Cre Reach: LVC (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Max Chl Dpth	Shear Chan	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft/s)	(ft)	(lb/sq ft)	(sq ft)	
LVC	300	700	700.00	734.66	738.61	3.76	3.95	0.59	186.23	0.41
LVC	300	800	800.00	734.66	738.87	3.89	4.21	0.62	205.46	0.41
LVC	300	900	900.00	734.66	739.13	4.01	4.47	0.64	224.39	0.41
LVC	300	1000	1000.00	734.66	739.37	4.12	4.71	0.66	242.80	0.41
LVC	300	2000	2000.00	734.66	741.42	4.85	6.75	0.82	412.61	0.40
LVC	300	3000	3000.00	734.66	742.97	5.31	8.30	0.93	564.53	0.40
LVC	300	4000	4000.00	734.66	744.18	5.73	9.51	1.04	698.11	0.41
LVC	300	5000	5000.00	734.66	745.24	6.08	10.57	1.12	822.98	0.41
LVC	300	6000	6000.00	734.66	746.21	6.37	11.54	1.19	942.08	0.41
LVC	300	7000	7000.00	734.66	747.11	6.63	12.44	1.26	1056.60	0.41
LVC	300	8000	8000.00	734.66	747.95	6.85	13.29	1.32	1167.34	0.41
LVC	300	9000	9000.00	734.66	748.75	7.06	14.08	1.37	1274.45	0.41
LVC	300	10000	10000.00	734.66	749.50	7.25	14.84	1.42	1378.58	0.41
LVC	300	11000	11000.00	734.66	750.23	7.42	15.56	1.47	1481.85	0.41
LVC	300	12000	12000.00	734.66	750.92	7.58	16.26	1.51	1583.41	0.41
LVC	300	13000	13000.00	734.66	751.59	7.72	16.92	1.55	1684.07	0.41
LVC	300	14200	14200.00	734.66	752.34	7.89	17.68	1.60	1800.80	0.41
LVC	290	100	100.00	734.00	736.12	2.46	2.12	0.35	40.65	0.44
LVC	290	200	200.00	734.00	736.71	2.96	2.71	0.45	67.55	0.45
LVC	290	300	300.00	734.00	737.17	3.26	3.17	0.52	91.93	0.45
LVC	290	400	400.00	734.00	737.56	3.49	3.56	0.56	114.52	0.44
LVC	290	500	500.00	734.00	737.91	3.68	3.91	0.60	135.96	0.44
LVC	290	600	600.00	734.00	738.25	3.80	4.25	0.63	158.08	0.44
LVC	290	700	700.00	734.00	738.55	3.89	4.55	0.65	179.98	0.44
LVC	290	800	800.00	734.00	738.82	3.99	4.82	0.66	200.43	0.43
LVC	290	900	900.00	734.00	739.08	4.08	5.08	0.68	220.65	0.43
LVC	290	1000	1000.00	734.00	739.33	4.16	5.33	0.69	240.55	0.43
LVC	290	2000	2000.00	734.00	741.40	4.69	7.40	0.78	426.50	0.40
LVC	290	3000	3000.00	734.00	742.97	5.05	8.97	0.85	593.55	0.39
LVC	290	4000	4000.00	734.00	744.19	5.40	10.19	0.93	740.32	0.39
LVC	290	5000	5000.00	734.00	745.26	5.69	11.26	0.99	879.19	0.39
LVC	290	6000	6000.00	734.00	746.24	5.93	12.24	1.04	1011.70	0.39
LVC	290	7000	7000.00	734.00	747.15	6.14	13.15	1.09	1139.66	0.38
LVC	290	8000	8000.00	734.00	748.00	6.33	14.00	1.13	1263.48	0.38
LVC	290	9000	9000.00	734.00	748.81	6.51	14.81	1.17	1382.71	0.38
LVC	290	10000	10000.00	734.00	749.57	6.68	15.57	1.20	1497.82	0.38
LVC	290	11000	11000.00	734.00	750.30	6.83	16.30	1.24	1610.62	0.37
LVC	290	12000	12000.00	734.00	750.99	6.98	16.99	1.27	1720.21	0.37
LVC	290	13000	13000.00	734.00	751.66	7.11	17.66	1.30	1827.54	0.37
LVC	290	14200	14200.00	734.00	752.42	7.28	18.42	1.35	1950.72	0.37
LVC	0	100	100.00	733.12	734.96	1.98	1.84	0.21	50.50	0.33
LVC	0	200	200.00	733.12	735.59	2.50	2.47	0.30	80.12	0.34
LVC	0	300	300.00	733.12	736.08	2.86	2.96	0.37	104.73	0.36
LVC	0	400	400.00	733.12	736.50	3.15	3.38	0.43	126.91	0.36
LVC	0	500	500.00	733.12	736.87	3.39	3.75	0.48	147.64	0.37
LVC	0	600	600.00	733.12	737.21	3.59	4.09	0.52	167.09	0.38
LVC	0	700	700.00	733.12	737.52	3.77	4.40	0.56	185.77	0.38
LVC	0	800	800.00	733.12	737.81	3.93	4.69	0.60	203.71	0.38
LVC	0	900	900.00	733.12	738.09	4.07	4.97	0.63	221.04	0.39
LVC	0	1000	1000.00	733.12	738.35	4.21	5.23	0.66	237.74	0.39
LVC	0	2000	2000.00	733.12	740.48	5.07	7.36	0.88	394.31	0.41
LVC	0	3000	3000.00	733.12	742.04	5.64	8.92	1.03	531.64	0.42
LVC	0	4000	4000.00	733.12	743.22	6.20	10.10	1.19	644.87	0.43
LVC	0	5000	5000.00	733.12	744.27	6.67	11.15	1.33	749.52	0.43
LVC	0	6000	6000.00	733.12	745.22	7.07	12.10	1.45	848.27	0.44
LVC	0	7000	7000.00	733.12	746.10	7.43	12.98	1.56	942.06	0.44
LVC	0	8000	8000.00	733.12	746.93	7.75	13.81	1.66	1032.64	0.45
LVC	0	9000	9000.00	733.12	747.71	8.04	14.59	1.75	1120.08	0.45
LVC	0	10000	10000.00	733.12	748.44	8.30	15.32	1.84	1204.42	0.45
LVC	0	11000	11000.00	733.12	749.15	8.54	16.03	1.92	1287.33	0.46
LVC	0	12000	12000.00	733.12	749.82	8.77	16.70	2.00	1367.72	0.46
LVC	0	13000	13000.00	733.12	750.47	8.99	17.35	2.07	1446.62	0.46
LVC	0	14200	14200.00	733.12	751.19	9.24	18.07	2.16	1536.23	0.46




September, 2003

Las Virgenes, McCoy, and Dry Canyon Creeks Master Plan for Restoration

Phase I: Comprehensive Final

Prepared For:
City of Calabasas
Department of Public Works
26135 Mureau Road
Calabasas, California 91302-3172

Prepared By:
EDAW, Inc.
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San Diego, California 92101

EDAW

CITY OF CALABASAS
LAS VIRGENES, MCCOY, AND DRY CANYON CREEKS
MASTER PLAN FOR RESTORATION

PHASE I: COMPREHENSIVE STUDY

Prepared for:

City of Calabasas
Public Works Department
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Disclosure:
This project has been funded wholly or in part by the USEPA Assistance Agreement. The contents of this document do not necessarily reflect the views and policies of the USEPA, the State, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. The City of Calabasas contracted with EDAW, Inc. to complete this project for $222,288, which includes $120,320 of State Board funds contracted through Agreement No. 00-164-250-0.

September 2003

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EXECUTIVE SUMMARY

The City of Calabasas (City) has three main creeks that flow through its boundaries: Las Virgenes Creek in the Malibu Creek watershed, and Dry Canyon and McCoy Creeks in the Los Angeles River watershed. These three creeks serve to convey storm water flows to the lower watershed during the wet season. Smaller flows associated with rare summer storm runoff, irrigation runoff, industrial/commercial runoff, and natural seeps and springs, pass through the creeks on the way to Malibu Creek and the Los Angeles River. The results of local water quality monitoring indicate that Las Virgenes Creek has elevated levels of nutrients, selenium, coliform, scum, and trash, while Dry Canyon Creek and McCoy Creek have elevated levels of nutrients, coliform, and trash. It should also be noted that two other creeks, Cold and Stokes Creeks, lie within the City's boundaries. These creeks comprise such a minor portion of the City's watercourses that they were not addressed in this study. Although not specifically addressed, these two creeks may benefit from some of the general recommendations made in this report.

In order to address these water quality concerns, the City applied for, and received a 205(j) grant from the State Water Resources Control Board (SWRCB). The overall objectives of the grant study were to: establish baseline environmental conditions; evaluate historical changes in the watershed; define opportunities and constraints for improving water quality (related both to Total Maximum Daily Loads and aquatic habitat); assess opportunities and constraints to restore creek and riparian habitat; and identify recreational and educational facilities and opportunities.

In order to accomplish the stated objectives, a combination of field evaluation and computer modeling were employed. The field evaluation revealed that all three creeks are exhibiting the signs of an urbanizing watershed; increased flow velocity, down cutting of the creek channel, and increased dry season flow. However there are opportunities for both aquatic and riparian habitat improvement throughout the study area. The computer modeling revealed that there was insufficient water quality monitoring data to run a calibrated Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) model; however, there was sufficient data available to utilize a non-calibrated model. Therefore a non-calibrated BASINS model was used to evaluate the implementation of a series of source control measures and Best Management Practices (BMPs) to reduce the nutrients reaching the creeks.

The modeling results conclude that source control measures were more effective at reducing nitrate loading than removing ammonia and phosphate from runoff within this watershed.

Structural BMPs were more effective at reducing ammonia and phosphate loading than were source control measures.

A survey for native fish habitat for the City's three creeks was also conducted. This survey recommended that arroyo chub be the first species to be re-introduced because it is the most resilient of the seven native species that have the potential to survive in the study area. Other recommendations include educating residents about not introducing unwanted aquarium and bait fish, removing barriers (such as those in the Calabasas Golf and County Club), and conducting further water quality and water quantity studies to determine which sites are suitable for re-introduction of other native fish.

Based on the field evaluation and information provided by the City Planning Department, there are opportunities to improve educational and recreational opportunities within the City. These opportunities include: implementing the Trails Master Plan for the City (currently under consideration), adding watershed specific signage throughout the City, constructing monument/signage at creek sites that are adjacent to and accessible to two local schools, and contacting specific landowners (particularly livestock owners) to inform them of the storm water requirements.

CHAPTER 1.0
INTRODUCTION

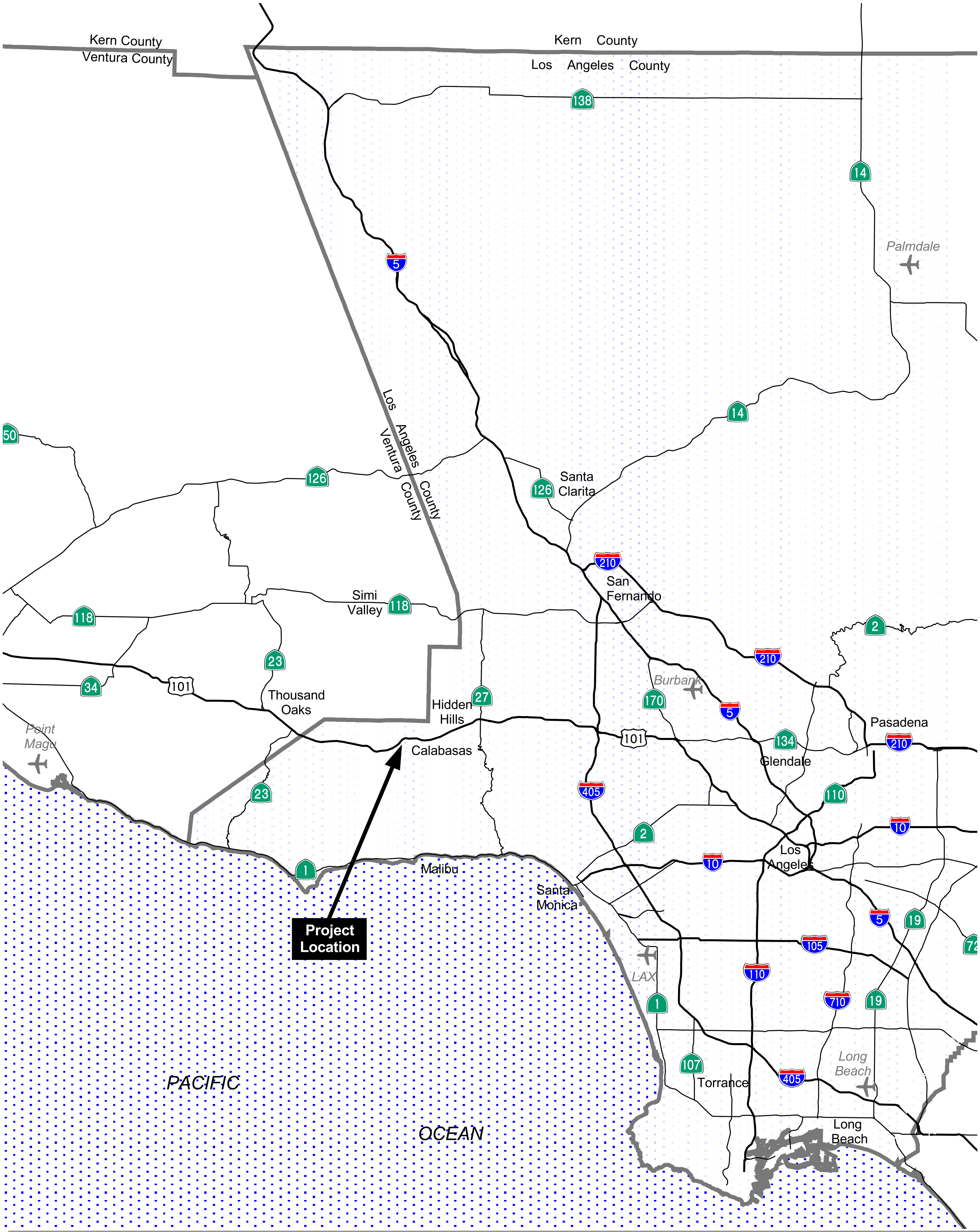
1.1 BACKGROUND

Calabasas (City) has three main creeks that flow through its boundaries: Las Virgenes Creek in the Malibu Creek watershed, and Dry Canyon and McCoy Creeks, in the Los Angeles River watershed (Figure 1.1). Both watersheds, Malibu Creek and Los Angeles River, are areas of regional prime concern. The Malibu Creek watershed is important because of its prominent wildlife corridor and significant planning areas within the Santa Monica Mountains National Recreation Area (SMMNRA). McCoy and Dry Canyon Creeks confluence to form Calabasas Creek, also referred to as Arroyo Calabasas, which is one of the two creeks forming the headwaters of the Los Angeles River. Being situated in the headwaters presents a great challenge and opportunity to protect and enhance the Los Angeles River watershed from its source.

Two corridors for wildlife movement have been identified within the Malibu Creek watershed, and for this reason the watershed provides a key function for habitat linkage to the surrounding natural areas of the Santa Monica Mountains, Simi Hills, Santa Susana Mountains, and beyond. As one of the dual headwaters of the Los Angeles River, McCoy, and Dry Canyon Creeks provide an opportunity for coordination with the Santa Monica Mountains Conservancy's Los Angeles River projects, as well as habitat for wildlife. This study is envisioned to provide a specific, detailed implementation plan with which to direct efforts to protect and enhance these creeks.

The Las Virgenes Creek watershed is approximately 89 percent undeveloped, although the stream has been altered considerably below the Ventura County-Los Angeles County jurisdictional line. Below the county jurisdictional line to Agoura Road, the creek has been straightened, riprapped, relocated, and given other treatments typical of an urbanizing area. This has caused accelerated water flow velocity below the concrete reach.

Previous studies of the Malibu Creek watershed have provided some baseline information for its tributary, Las Virgenes Creek. However, Dry Canyon and McCoy Creeks have gone largely unstudied. Dry Canyon and McCoy Creeks have both been adversely affected by urbanization similar to the effects on Las Virgenes Creek. Large segments of these two creeks flow through gated communities and private properties. Also, the flood control systems take the creeks



Source: Southern California Association of Governments (SCAG) and California Spatial Information Library (CaSIL)

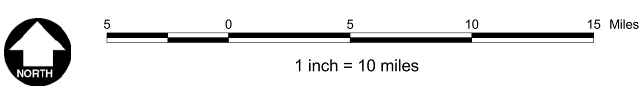


Figure 1-1
Regional Location Map

underground for some stretches. These developments have largely ignored the creek as a resource, and many areas are inaccessible to the public. This inaccessibility is due to several factors: fencing of concrete-lined areas, steep slopes, and ravines created by erosion; lack of resource information; and virtually no trails around the riparian area to accommodate human use. Finding good access points to the creeks, with the least amount of disturbance for outdoor education and increased appreciation of the creek's resource is a major goal of this study.

The three creeks pass through Calabasas serving to convey storm water flows to the lower watershed during the wet season, typically October to April. Smaller flows associated with rare summer storm runoff, irrigation runoff, industrial/commercial runoff and natural seeps and springs pass through the creeks on the way to Malibu Creek and the Los Angeles River. In addition to conveying water from the upper watershed, the three creeks also transport contaminants. The results of local monitoring programs indicate that Las Virgenes Creek has elevated levels of nutrients, selenium, coliform, scum, and trash, while Dry Canyon Creek and McCoy Creek have elevated levels of nutrients, coliform, and trash.

In 1999, the City submitted a 205(j) grant application to the State Water Resources Control Board (SWRCB) to prepare a management plan for Las Virgenes, Dry Canyon and McCoy Creeks, within the City boundaries. The grant was subsequently approved in the fall of 1999. The 205(j) grant program is a federally funded program focusing on water quality planning for local public agencies. Funded projects under the 205(j) program may include broad-based watershed planning or plans aimed at resolving specific water quality concerns. The U.S. Environmental Protection Agency (EPA) grants the funds annually to the SWRCB, which distributes the funds competitively to public agencies and administers the grants. With the increasing water-related regulations applicable to the City, it is desirable to have a master plan document addressing these regulations and ways to achieve compliance.

1.2 GOAL

The overall goal of the project is to create a road map of opportunities for improving the natural environment, with an emphasis on water quality, within the City's boundaries. This project goal coincides with the goals outlined in the Calabasas General Plan. The goal of the Conservation, Environmental Design, and Open Space Element of the General Plan is to:

- Preserve significant environmental features within Calabasas and the City's General Plan study area, and provide for their wise management;

- Define limits on the natural resources needed to support urban and rural life within Calabasas and the City's General Plan study area, and to ensure that those resources are used wisely, and not abused, and
- Maintain an open space system that will conserve natural resources, preserve scenic beauty, promote a healthful atmosphere, provide space for a variety of active and passive recreational activities and protect public safety.

1.3 OBJECTIVES

The overall purpose of the restoration master plan is to describe specific projects that should be implemented throughout the watersheds of the three creeks in a phased approach that will primarily improve water quality as well as enhance habitat, increase recreational facilities, and provide educational opportunities. The following are the overall objectives of the master plan:

- Establish baseline environmental conditions of the existing habitat within the three creeks.
- Evaluate historical land use and vegetation changes within the watersheds.
- Define opportunities and constraints for improving water quality parameters targeting specific Total Maximum Daily Load (TMDL) contaminants for the three creeks.
- Define opportunities and constraints for improving water quality to enhance existing creek habitat for species such as arroyo chub and steelhead trout.
- Define opportunities and constraints to restore creek and riparian habitat.
- Define opportunities and constraints to improve recreational facilities/features within the study area.
- Define opportunities and constraints to provide educational facilities/features within the study area.

1.4 METHODS

1.4.1 Pre-field Survey Evaluation of Existing Data

1.4.1.1 Previous Projects Conducted in the area

Prior to conducting the field survey, previous project reports for work conducted within the study area were reviewed. With Dry Canyon and McCoy Creeks being located at the top of the Los Angeles River watershed, there has been little emphasis placed on studying their features and characteristics. Therefore, very little information was available for these two creeks. As Las Virgenes Creek is located in the Malibu Creek Watershed, slightly more information was available in the way of previous studies. However, much of this information is for Malibu Creek itself, with limited focus on Las Virgenes Creek.

A Protection and Revitalization Plan for Las Virgenes Creek (2001)

One of the previous studies that focused exclusively on Las Virgenes Creek was a graduate study conducted by Bradley Owens, completed in 2001. This study, A Protection and Revitalization Plan for Las Virgenes Creek, was envisioned to be "used by the community as a reference and inspiration for stewardship, and to create plans that include 'big ideas' that positively influence the area for many generations."

With that goal in mind, the study compared quantity and duration of storm water runoff from the predevelopment era to the development within the Las Virgenes Watershed in 1999. As expected, the analysis shows that as development (impervious surfaces) of the watershed increased, the peak flows within the creek also increased. Mr. Owens also identified areas of the creek that were concrete lined and determined that the combination of increased flow with the increase in velocity from the concrete lining would increase erosion downstream of the concrete areas. In addition to the flow studies conducted by Mr. Owens, he also qualitatively identified habitat improvement areas, areas to enhance wildlife corridors, and potential areas to increase public access to Las Virgenes Creek.

The Malibu Creek Watershed: A Framework for Monitoring Enhancement and Action (1998)

The Malibu Creek Watershed: A Framework for Monitoring Enhancement and Action was completed in 1998, by the Graduate Department of Landscape Architecture, California State Polytechnic University, Pomona. The study was prepared for Heal the Bay and the California State Coastal Conservancy. The stated purpose of the project was to design a citizen-monitoring program to evaluate the water quality of the entire Malibu Creek watershed and target areas for future studies, protection restoration, and enhancement.

The report provides an overview of the Malibu Creek watershed and the geologic and hydrologic processes taking place within the watershed. One of the main discussion points of the report is what processes change in an urbanizing watershed and how urbanization can change erosion and sedimentation as well as water quality. In addition, the report provides a lengthy discussion about citizen monitoring and the importance of organizing the data collection.

1.4.1.2 Water Quality Data

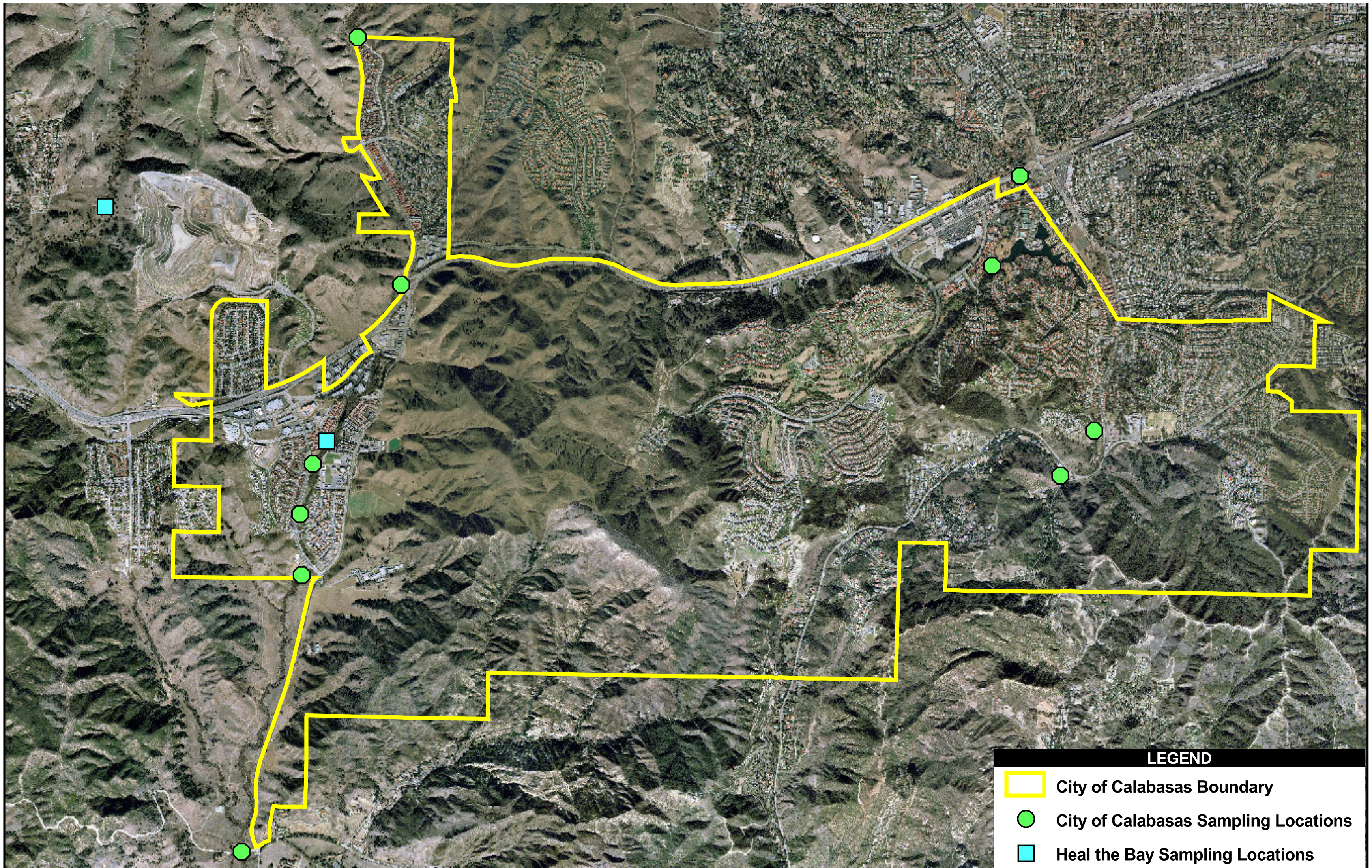
Water quality data are collected by various agencies and organizations within both the Malibu Creek watershed and the Los Angeles River watershed. However, there are limited monitoring stations within Calabasas (Figure 1.2). The two main groups that complete the monitoring within the project area are the City with the Adopt-a-Creek Program and Heal the Bay's Stream Team. The Ventura County Department of Public Works also has one monitoring station on Las Virgenes Creek, near the Los Angeles County-Ventura County jurisdictional line. Water quality data collected for this project are presented in Appendix C, including data on nutrients, dissolved oxygen, temperature, pH, fecal coliform, and other consituents from the three creeks.

City of Calabasas Adopt-a-Creek Program

The Adopt-a-Creek Program uses City staff teamed with volunteers to conduct quarterly monitoring at a total of 10 stations: 6 along Las Virgenes Creek and 2 each for McCoy and Dry Canyon Creeks. At each station a total of 9 parameters are measured in the field and 42 parameters are assessed by laboratory analysis (Table 1.1). The overall results are sent to the Regional Water Quality Control Board – Los Angeles Region (RWQCB-LA) periodically.

Heal the Bay – Stream Team

Heal the Bay sponsors the Stream Team, which is a group of volunteers who conduct water quality monitoring throughout the Malibu Creek watershed. Under the leadership of Heal the Bay staff, these volunteers have also conducted habitat assessments within the watershed. The Stream Team conducts monthly monitoring at three stations along Las Virgenes Creek. At each station, 17 parameters are measured in the field, and 1 parameter is determined by laboratory analysis. In addition to the constituent analysis, the Stream Team also evaluates the Index of Biological Integrity (IBI) for discrete stream segments. The IBI evaluations use benthic macroinvertebrates to determine long-term vitality of the specific stream based on the community of invertebrates identified.



Source: Mountains Restoration Trust, 2002; Calabasas Public Works Department; Heal the Bay

NORTH

1 0 1 Mile

Figure 1.2
Water Quality Sampling Locations

Table 1.1. Overview of the Water Quality Analysis Conducted in the Las Virgenes Creek Watershed

Constituents Sampled	Adopt-a-Creek	Analysis Method	Stream Team	Analysis Method	Ventura County	Analysis Method
Air Temperature	X	Thermometer	X			
Water Temperature	X	LaMotte DO 4000 Meter	X	YSI 55 or 550		
Water Clarity	X	Visual	X	Visual		
Water Color	X	Visual	X	Visual		
Odors	X		X			
Floatables	X	Visual	X	Visual		
Biological Floatables	X	Visual	X	Algae protocol		
Turbidity, NTU			X	LaMotte 2020 Turbidimeter		
pH	X	pH Tester2	X	Cole Parmer pH Testr2	X	na
Flow	X	Global Flow Probe	X	Flowmate II		
Chloride (Cl-), mg/l					X	na
Phosphorus, Dissolved, mg/l					X	na
Phosphorus (P) Total, mg/l	X	EPA 365.2			X	na
Phosphate (P04)			X	Ascorbic acid reduction	X	na
Ammonia Nitrogen (NH3-N), mg/l	X	EPA 350.2	X	LaMotte SMART Colorimeter	X	na
Nitrate Nitrogen (NO3-N), mg/l	X	EPA 353.3 and Cadmium reduction method	X	LaMotte SMART Colorimeter		
Nitrate (mg/l)					X	na
Nitrite Nitrogen (NO4-N), mg/l						
N03+N02+N ppm			X	Cadmium reduction method		
Total Kjeldahl Nitrogen (TKN), mg/l					X	na
Biological Oxygen Demand (BOD), mg/l					X	na
Chemical Oxygen Demand (COD), mg/l					X	na
Total Organic Carbon (TOC), mg/l					X	na
Dissolved Oxygen	X	Winkler Method, La Motte, EPA 4500-G, EPA 360.1	X	YSI Model 55 or 550		
Total Suspended Solids (TSS), mg/l					X	na
Total Dissolved Solids (TDS)	X	TDSTester 20	X		X	na
Conductivity			X (mS)	19830-00 Cole Parmer or YSI 30	X (umhos/cm)	na

Constituents Sampled	Adopt-a-Creek	Analysis Method	Stream Team	Analysis Method	Ventura County	Analysis Method
Total Hardness, mg/l	X	EPA 130.2			X	na
Coliform, Total, mpn/100ml	X	EPA 9221		IDEXX Quanti-tray 2	X	na
Coliform, Fecal, mpn/100ml	X	EPA 9221		IDEXX Quanti-tray 2	X	na
Enterococcus, Fecal, mpn/100ml	X	EPA 9230B	X	IDEXX Quanti-tray 2		
Streptococcus, Fecal, mpn/100ml					X	na
Arsenic, (As), Dissolved, µg/l					X	na
Arsenic, (As), Total, µg/l					X	na
Cadmium (Cd), Dissolved, µg/l					X	na
Cadmium (Cd), Total, µg/l					X	na
Chromium (Cr), Dissolved, µg/l					X	na
Chromium (Cr), Total, µg/l					X	na
Copper (Cu), Dissolved, µg/l	X	EPA 200.8			X	na
Copper (Cu), Total, µg/l	X	EPA 200.8			X	na
Lead (Pb), Dissolved, µg/l					X	na
Lead (Pb), Total, µg/l					X	na
Mercury (Hg), µg/l					X	na
Mercury (Hg), Dissolved, ng/l					X	na
Mercury (Hg), Total, ng/l					X	na
Nickel (Ni), Dissolved, µg/l					X	na
Nickel (Ni), Total, µg/l					X	na
Selenium (Se), Dissolved, µg/l					X	na
Selenium (Se), Total, µg/l	X	EPA 200.8			X	na
Silver (Ag), Dissolved, µg/l					X	na
Silver (Ag), Total, µg/l					X	na
Zinc (Zn), Dissolved, µg/l	X	EPA 200.8			X	na
Zinc (Zn), Total, µg/l	X	EPA 200.8			X	na
Aldrin	X	EPA 508				
Chlordane-alpha	X	EPA 508				
Chlordane-gamma	X	EPA 508				
Clorneb	X	EPA 508				
Chlorthalonil	X	EPA 508				
DCPA	X	EPA 508				
4,4'-DDD	X	EPA 508				
4,4'-DDE	X	EPA 508				

Constituents Sampled	Adopt-a-Creek	Analysis Method	Stream Team	Analysis Method	Ventura County	Analysis Method
4,4'-DDT	X	EPA 508				
Dieldrin	X	EPA 508				
Endosulfan I	X	EPA 508				
Endosulfan sulfate	X	EPA 508				
Endrin	X	EPA 508				
Endosulfan II	X	EPA 508				
Etridiazole	X	EPA 508				
HCH-alpha	X	EPA 508				
HCH-beta	X	EPA 508				
HCH-delta	X	EPA 508				
HCH-gamma	X	EPA 508				
Heptachlor	X	EPA 508				
Heptachlor epoxide	X	EPA 508				
Hexachlorobenzene	X	EPA 508				
Methoxychlor	X	EPA 508				
cis-Permithrin	X	EPA 508				
Propachlor	X	EPA 508				
Trifluralin	X	EPA 508				
Diazinon, µg/l	X	EPA 507				
Chlorpyrifos, µg/l	X	EPA 507				
Macroinvertebrates			X	IBI Method		
Toxicity (TIE)					X	na

mg/l = milligrams per liter
µg = micrograms per liter
NTU = nephelometric turbidity unit
DCPA= dicyclopentenyl acrylate
na = not available

1.4.1.3 Aerial photographs

Aerial photographs were used to identify both existing and historic conditions within the watersheds.

Historic

Historical aerial photographs of the area were reviewed from the collection located at California State University Northridge. The photographs reviewed were from 1960, 1975, and 1989 (see Figures 1.3, 1.4a, 1.4b and 1.5). Figure 1.3, from 1960 (unknown scale), shows primarily the McCoy Creek watershed with Mulholland Highway near the bottom of the photograph. Figure 1.4a, and 1.4b, from 1989 (unknown scale), show the study area. The Las Virgenes Creek watershed is shown in Figure 1.4a, and the McCoy and Dry Canyon Creek watersheds shown in 1-4b. Figure 1.5 from 1975 (unknown scale) show the entire study area with Las Virgenes Creek on the left and McCoy and Dry Canyon Creek shown on the right of the photograph. The evaluation of these photographs was used to determine the land use history of the watersheds (see Section 2.1, Land Use).

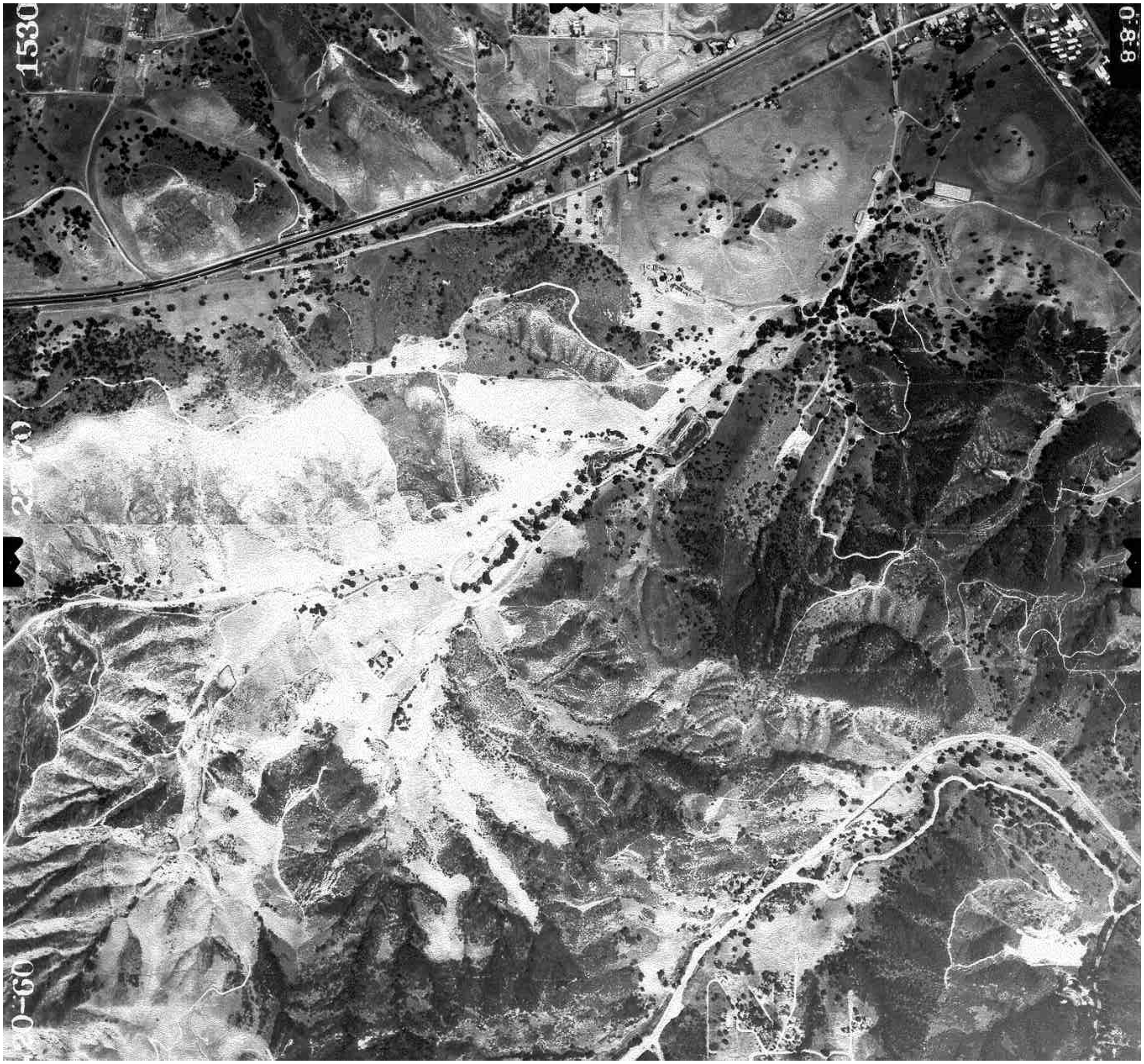
Current

A recent aerial photograph (2002) for the project area was supplied by Mountains Restoration Trust. This photograph was used to evaluate current land use within the study area and for use in developing field and report maps.

1.4.1.4 Cooperating Organizations

The following organizations were contacted and supplied information for this study:

- Las Virgenes Municipal Water District
- Mountains Restoration Trust
- Los Angeles County Department of Public Works – Watershed Division
- Heal the Bay
- Resource Conservation District of the Santa Monica Mountains
- California Department of Parks – Malibu Creek State Park
- Regional Water Quality Control Board, Los Angeles Region



NORTH

Figure 1.3
Historical Aerial Photograph
May 20, 1960

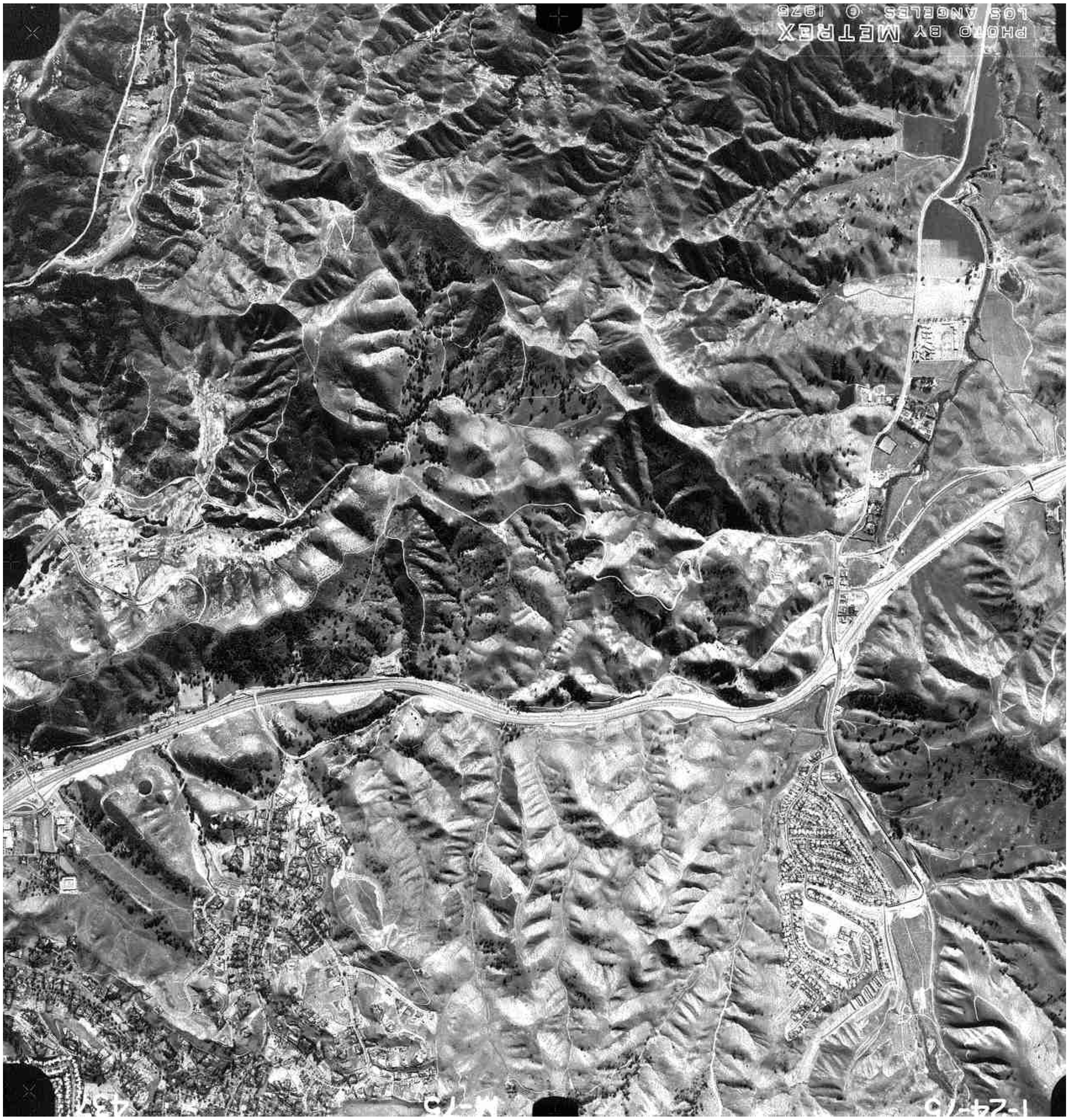


Figure 1.4a
Historical Aerial Photograph
January 24, 1975

NORTH

Figure 1.4b
Historical Aerial Photograph
January 24, 1975

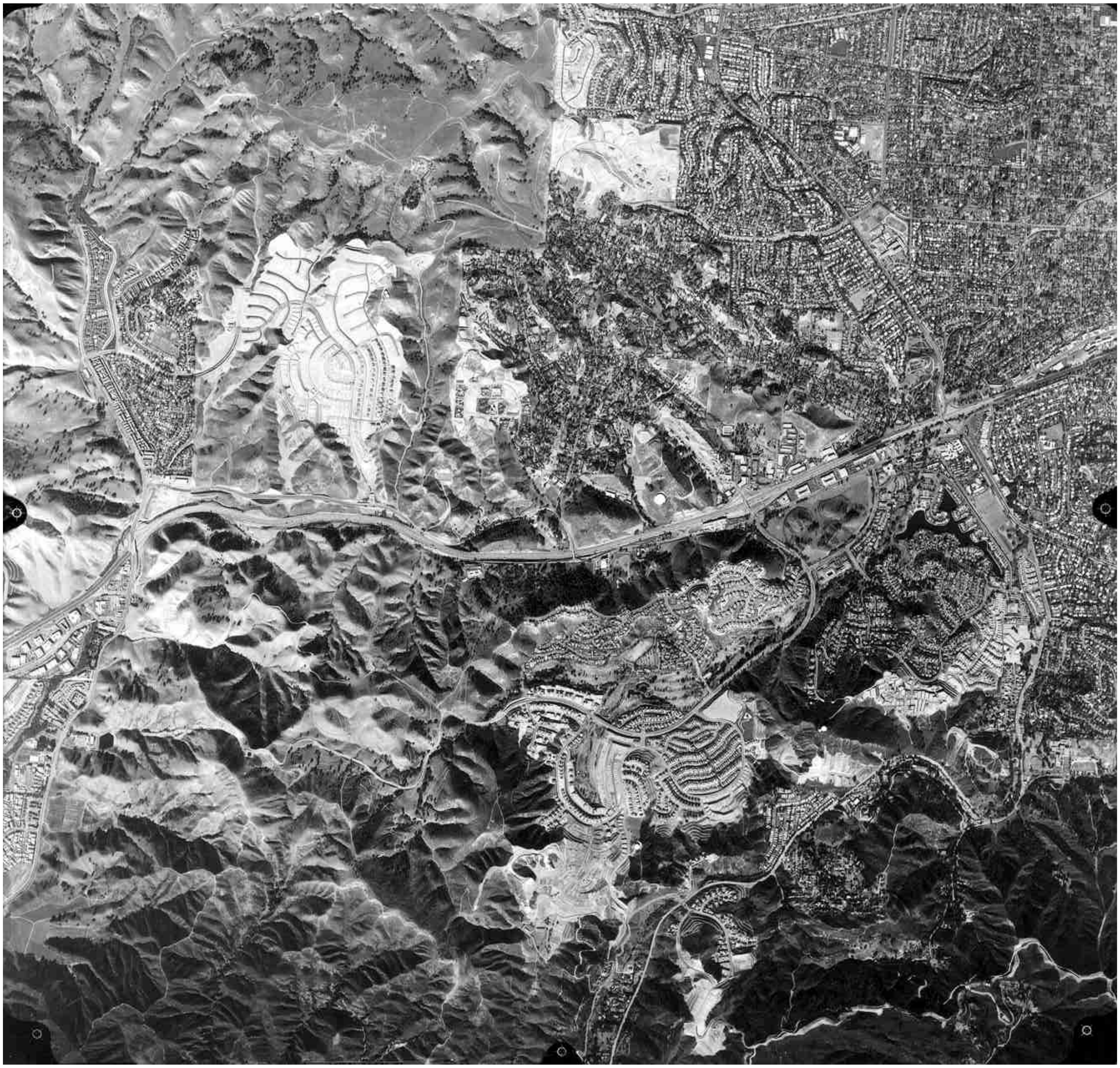


Figure 1.5
Historical Aerial Photograph
December 12, 1989

1.4.2 Field Survey Evaluation

1.4.2.1 Watershed Survey

A driving survey was conducted for each of the three watersheds to evaluate land use practices, storm water program controls, approximate location of storm drain outlets, appropriate potential signage locations, and identification of potential park, education, and recreation facility locations.

1.4.2.2 Stream Walk (Habitat Assessment)

Baseline conditions for Las Virgenes, Dry Canyon, and McCoy Creeks were assessed during field visits performed in January and March 2003. The riparian assessment procedure developed for this project evaluated physical and hydrological properties of stream reaches, presence of plant and animal species, and adjacent vegetation communities and land uses. Each stream was walked from the upper reaches to lower, and unique characteristics were photographed and documented on field maps. This information was then used to identify potential areas for habitat restoration as described in Chapter 4.0.

1.4.3 Modeling

The watershed modeling was completed by Everest International Consultants (Everest) (Appendix A). Everest, as part of the EDAW team, worked collaboratively with the City to develop restoration measures and the model was then used to simulate the corresponding flow and water quality conditions.

The purpose of the watershed modeling study was to develop restoration measures and assess the effectiveness of those measures, at improving water quality within the creeks. The following objectives were developed to achieve this purpose:

- Select appropriate watershed model.
- Acquire information needed to conduct watershed modeling.
- Identify any data gaps related to the scope of work.
- Develop conceptual models of the two watersheds.
- Perform watershed modeling to establish existing/baseline conditions.

- Develop restoration measures aimed at improving water quality.
- Conduct watershed modeling to analyze and evaluate measures.

Scope of Modeling Study

The scope of the watershed modeling study was limited to an analysis of watershed hydrology and nutrients. Existing, available water quality and flow information and data were used for the modeling study as resources were not available to conduct additional data collection for these parameters. The nutrient model simulations were focused on the portion of the creeks that flow through the City's boundaries, along with the corresponding watershed areas. The original intent of the study was to conduct the watershed modeling using a calibrated model. However, an initial review of the available data revealed that the data are insufficient for model calibration; therefore, the scope was modified to allow the use of an uncalibrated watershed model for alternative development and evaluation. The uncalibrated model was used to perform a relative comparison for nutrient reductions between different model simulations.

Approach

The study approach based on the application of a numerical watershed model was developed to meet the study objectives. Potential models were reviewed and a suitable model was selected that met the purpose and objectives of the study. Conceptual models of the three sub-watersheds under existing conditions were developed, and the model was used to establish existing conditions. The results of the existing condition simulations were used to establish baseline values for subsequent comparison with the various restoration measures. The EDAW team worked collaboratively with the City to develop restoration measures, and the model was then used to simulate the corresponding flow and water quality conditions. The results of the model simulations conducted with the restoration measures were compared to the baseline results to determine the effectiveness of the various restoration measures at improving water quality. The results of the various alternatives were also compared against one another to gauge the effectiveness of the restoration measures. This last step provided useful information in the development of the overall restoration alternatives for the creeks.

<u>Watershed Model Selection</u>

The EPA has developed a suite of numerical models and a graphical user interface that can be used to analyze watershed hydrology and water quality. This system, known as the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS), is a multipurpose environmental analysis system designed for the application of watershed approaches to improve water quality. The BASINS system supports the development of TMDLs as required by Section 303(d) of the Clean Water Act. The BASINS suite allows for flexible analysis at varying geographic scales and it includes a compilation of environmental data from various government agencies migrated into a geographic information system (GIS) framework. Environmental data are available for watersheds as defined by hydrologic unit codes (HUCs). BASINS allows for manipulation of watershed characteristics to delineate watershed boundaries and calculate setup parameters for the component simulation models that comprise the BASINS system.

The Hydrological Simulation Program – Fortran (HSPF) model, a component of the BASINS system, was selected for this study for the following three reasons. First, HSPF is a component of BASINS and BASINS is one of the models currently accepted for use by the EPA for loading allocation determination as part of the TMDL program. Second, the model was capable of meeting all the technical requirements of the study purpose, including simulation of watershed hydrology, stream flows, and contaminant loading. The model also allows for relatively easy incorporation of watershed restoration measures such as best management practices (BMPs) (e.g., CDS units), land use changes (e.g., conversion of urban areas to open space), and source control (e.g., reclaimed water use changes). Third, HSPF is currently being used by the RWQCB-LA to establish the TMDL allocations for nutrients and bacteria within the Malibu Creek watershed.

HSPF Model Description

HSPF is a comprehensive watershed modeling package for simulation of watershed hydrology and water quality for both conventional and toxic organic pollutants. It is the only comprehensive model of watershed hydrology and water quality that allows the integrated simulation of land and soil contaminant runoff processes with in-stream hydraulics, water temperature, sediment transport, nutrient, and sediment-chemical interactions (EPA 2001a).

HSPF simulates the movement of water, sediment, and contaminants over the land surface and through the soils of a watershed; computes resultant flows, sediment transport, and contaminant concentrations in the collecting streams; and provides water discharge, sediment discharge, and contaminant loading to the receiving waters. In summary, HSPF simulates all the hydrological processes within the hydrologic cycle.

For a given watershed with known characteristics such as land uses, vegetative cover, and soil conditions, HSPF computes the transport of water, sediment, and contaminants throughout the watershed on a continuous basis under continuous meteorological forcing such as precipitation, temperature changes, and evaporation. HSPF permits complex physical and chemical interactions and transformations of contaminants in the watershed and streams, thereby providing relatively accurate estimates of contaminant loading into the receiving water. The model outputs simulation results in the form of time histories of runoff flow rate, sediment load, and contaminant concentrations at any point of interest within the watershed.

Given the long-term periods of analysis and the comprehensive nature of the processes being simulated, HSPF requires extensive hydrology and water quality data for successful application. Data are needed to characterize the watershed, creek, hydrology, meteorology, and water quality. In addition, for optimal accuracy of the modeled output, the input data should cover the same period of record, or the various data records should be verified to make sure all data are representative of the period being modeled. The data required to conduct watershed modeling using HSPF are listed below.

Watershed Characteristics

- Topography
- Land use
- Soil characteristics
- Water table depth

Creek Characteristics

- Thalweg elevation profiles
- Cross-section geometries for main channel and overflow planes
- Bottom conditions (earth, vegetation type, rock types)
- Creek rating curve for depth versus flow
- Seasonal variation of creek characteristics

Hydrology

- Continuous precipitation records for local area at hourly interval and corresponding creek flow at multiple locations for each creek (Las Virgenes Creek 5 to 10 locations; McCoy and Dry Canyon Creeks 1 to 3 locations per creek)
- Groundwater data, including flow and water table depths

Meteorology

- Evapotranspiration
- Temperature (minimum and maximum) and dew point
- Wind
- Solar radiation
- Cloud cover

Water Quality

- Location, type, and concentration of point sources of contaminants
- Location, type, and concentration of nonpoint sources of contaminants

<u>HSPF Model Calibration Discussion</u>

As with any numerical model, HSPF requires calibration to provide accurate estimates of the various model outputs for a given watershed. Typically, the model will be calibrated by first performing simulations over a given period and then comparing the output to measured values of flow, contaminant loading, and contaminant concentrations. The various model parameters (e.g., initial contaminant storage, atmospheric deposition, and friction) will then be adjusted within accepted limits until the model results match the measured values within an acceptable limit. Therefore, successful calibration requires simultaneous, continuous flow and water quality constituent measurements across the watershed at a level sufficient to resolve the expected variation of these parameters.

The City has been monitoring water quality since 1998 as part of the Adopt-A-Creek Program. The monitoring program consists of instantaneous measurements of various water quality constituents accomplished through direct measurements as well as grab sample collection and subsequent analysis. Instantaneous flow measurements were usually collected; however, no continuous flow measurements were collected as part of the program. Given that no continuous flow or water quality constituent measurements were made within the portion of the three sub-watersheds located within Calabasas, the data were insufficient to conduct a meaningful calibration of the HSPF model for this study. Hence, instead of using a fully calibrated HSPF model, a conceptual model built upon literature values was used for this study. Nevertheless, the conceptual model was verified against analytical methods in flow estimates, as well as comparison with other studies in the regions for pollutant loadings. Details about the conceptual model setup are provided in section 3 of Appendix A.

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CHAPTER 2.0
SITE ASSESSMENT

2.1 LAND USE

This section outlines the changes in land use of the Calabasas area from historic time to the present. Various sources were used to develop this land use perspective, including aerial photographs and City resources.

2.1.1 Historic Land Use

For thousands of years Native Americans occupied the coastal California region. The Chumash is the first known tribe to inhabit the area now known as the City of Calabasas. In addition to the Chumash, the Gabrieleno/Tongva inhabited the area just south of Calabasas and then extended into the Los Angeles basin area. The mild climate and abundant flora and fauna in the area provided ample resources for hunting and gathering. Such resources enabled the Chumash to construct permanent villages, which were connected by established trails. Despite the permanence of their settlements, the Chumash lifestyle had a limited impact on the region (City of Calabasas 1994).

The Chumash had little contact with non-Native Americans until the 18th century, when the Spanish began exploring California. Spaniards such as Gaspar de Portola and Juan de Anza journeyed along the coast via trails established by Native Americans. Shortly after the arrival of such explorers, Spanish missionaries traveled into California to convert Native Americans to Christianity. They established 21 missions on the Californian coastline from San Diego to San Francisco. San Fernando Rey de España and San Gabriel Arcángel are the two closest missions to Calabasas and are both located in Los Angeles County. The missions forever changed the way of life for Native Americans in California. The missionaries introduced livestock, exotic plants, and roads.

El Camino Real, translated as “The Royal Highway,” was the main artery for moving goods and information between the missions. Today Ventura Freeway (Highway 101) runs close to the original alignment of El Camino Real. With the establishment of more missions, travel along El Camino Real intensified. The increased road use, combined with agricultural settlements, escalated impacts on the land (California Missions 2002; Maslach 2000).

While the presence of the missions changed land use patterns and cultural traditions in California, it was the arrival of the Spanish-Mexican ranchers that began to significantly impact the land. At the beginning of the 19^{th} century, the Mexican government granted large ranches in California to Mexican citizens. The new landowners brought intensive land uses to the area. To stake their land claim, the ranchers built permanent structures, planted crops, and introduced large herds of longhorn cattle. Furthermore, they established additional infrastructure to help communication and trade between settlers and missions.

Heavy grazing and clearing of trees for agriculture had a large impact on the native plants and trees. Native grasses could not compete with weeds and exotic plants brought by the Mexicans. Meadows were quickly established in grazing areas where live and valley oak once thrived (Maslach 2000).

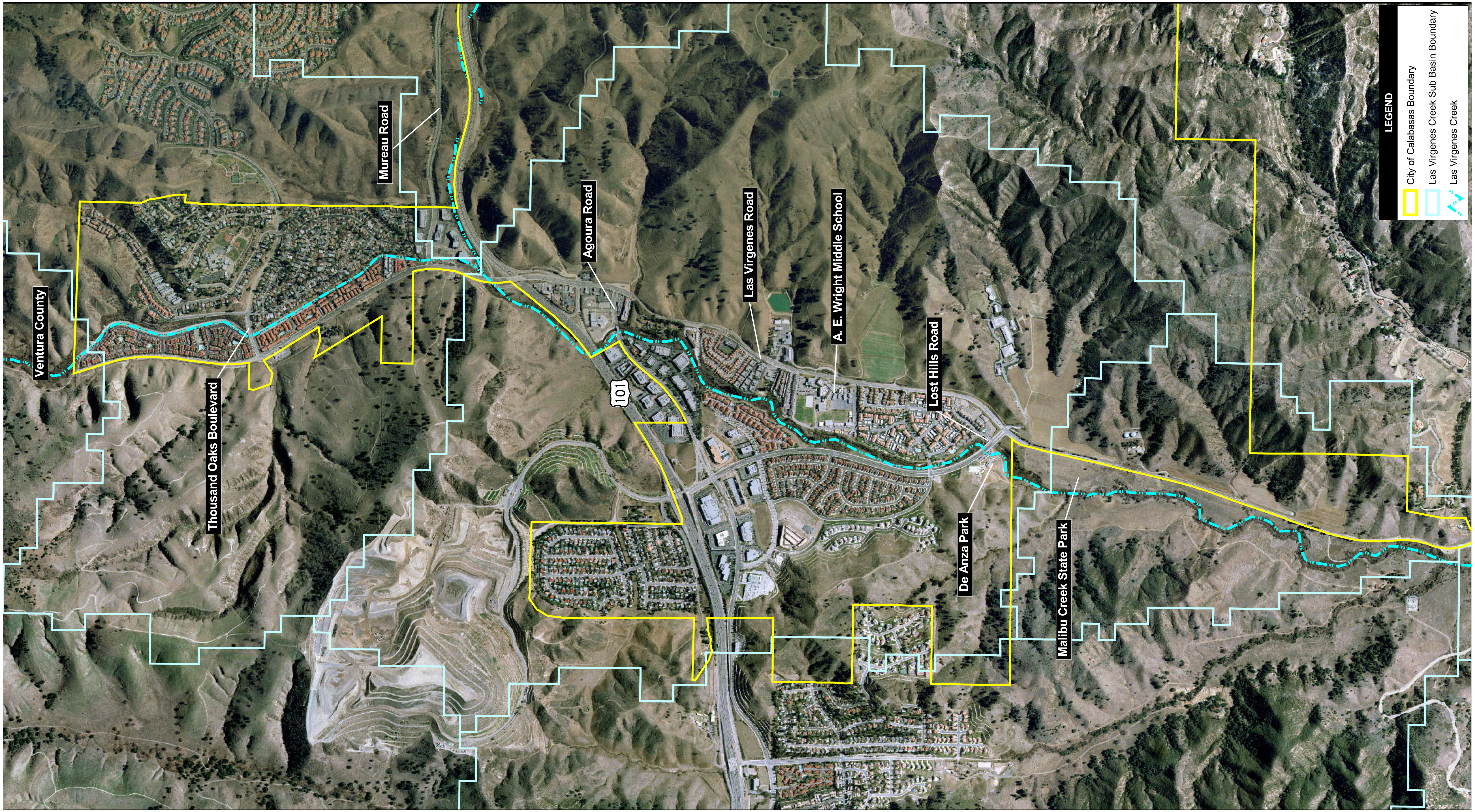
Meanwhile, American homesteaders trying to stake their own claims in California moved into the Calabasas region in the mid-19^{th} century. By the end of the century, Mexican and American ranches were broken into small farms. Soon, however, water ran low due to limited surface and well water in the area. Eventually this water shortage forced the ranchers to leave for more hospitable land.

The beginning of the 20^{th} century brought new land uses to the Calabasas region. The area's proximity to the metropolis of Los Angeles made the mountainous region a desirable spot for recreation, filmmaking, and suburban residential development. The area began to grow substantially after 1958, in conjunction with the formation of the Las Virgenes Municipal Water District (LVMWD).

Las Virgenes Creek

Las Virgenes Creek is part of the Malibu Creek watershed. As shown in Figure 2.1, the creek begins in the undeveloped area of Ventura County and extends south to join Liberty Canyon Creek just north of Mulholland Highway. The area surrounding Las Virgenes Creek developed slowly during the 20^{th} century. Due to the creation of Malibu Creek State Park (MCSP) and SMMNRA, much of the land is preserved in a natural state.

Las Virgenes Creek is an important area within the Malibu Creek watershed due to passing through MCSP and SMMNRA as it flows into Malibu Creek and eventually the Pacific Ocean. The area has long been desirable for filming and recreation and is deemed a significant national resource area protecting the rare Mediterranean ecosystem and our cultural heritage.



Source: Mountains Restoration Trust, 2002

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Scale: 1 : 6,000; 1 inch = 500 feet

Figure 2.1
Watershed Map
Las Virgenes Creek

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In the early 1900s, a group of businessmen acquired land to create Crags Country Club in present-day MCSP. The club employees maintained a farm on the property and added recreational activities. By 1941, the club was closed and 20th Century Fox began to film movies on the land. In 1946, the studio decided to purchase the property. Numerous films and commercials were filmed in the dramatic scenery until the State of California bought the land in 1974. MSCP was established to restore and preserve the natural beauty of the area, opening to the public in 1976. Two years later, SMMNRA was established through combined efforts of public and private entities.

The area adjacent to the intersection of Ventura Freeway and Las Virgenes Road experienced little land use development until the 1940s. In the 1940s, the area south of the freeway was dotted with agriculture. This area continued to experience limited growth until the 1980s. North of Ventura Freeway, land development occurred earlier, with a few houses established in the 1940s. By the 1970s, the area was developed as a residential subdivision and, throughout the 1980s and 1990s, the area experienced heavy development up to the Ventura County jurisdictional line.

Today, Las Virgenes Canyon is a mix of open space and developed land. Most of the development is residential with limited commercial development near the Ventura Freeway. Unlike Dry Canyon or McCoy Creeks, most of Las Virgenes Creek flows in its natural state from the Simi Mountains to Malibu Creek.

Dry Canyon Creek

Dry Canyon Creek is part of the Los Angeles River watershed. As shown in Figure 2.2, Dry Canyon Creek begins in the Calabasas Highlands area, flows parallel to Mulholland Drive, then north along Old Topanga Canyon Road to the confluence with Calabasas Creek. Dry Canyon Creek and its surroundings have been highly impacted by large residential developments since the start of the 20th century although there are numerous patches of open space spotting the canyon. Dry Canyon Creek's tributary along Old Topanga Canyon Road maintains its rural character.

At the turn of the 20th century, most of the land surrounding the northern end of Dry Canyon Creek was agricultural. Harry Warner of Warner Brothers Pictures owned a large parcel on the eastern side of Calabasas. In 1921, he donated a portion of his estate to the newly founded Motion Picture and Television Fund (MPTF).

In the 1920s, the first residential subdivision in Calabasas was built in the mountains just east of Dry Canyon Creek. William Lingenbrick and C. Henry Taylor purchased 140 acres of land to build an artists' colony for the large number of movie directors, writers, sculptors, and architects in the region. In 1931, the development was named "Park Moderne." The area still exists today, located behind Calabasas High School.

Even with the new development, the predominant land uses around Dry Canyon Creek continued to be agriculture and open space until post-World War II. After the war, Edison Company envisioned building a large residential development with the atmosphere of a country club. Calabasas Park was created from their vision. The first section was built near Dry Canyon Creek in the 1960s and included the creation of artificial Lake Calabasas.

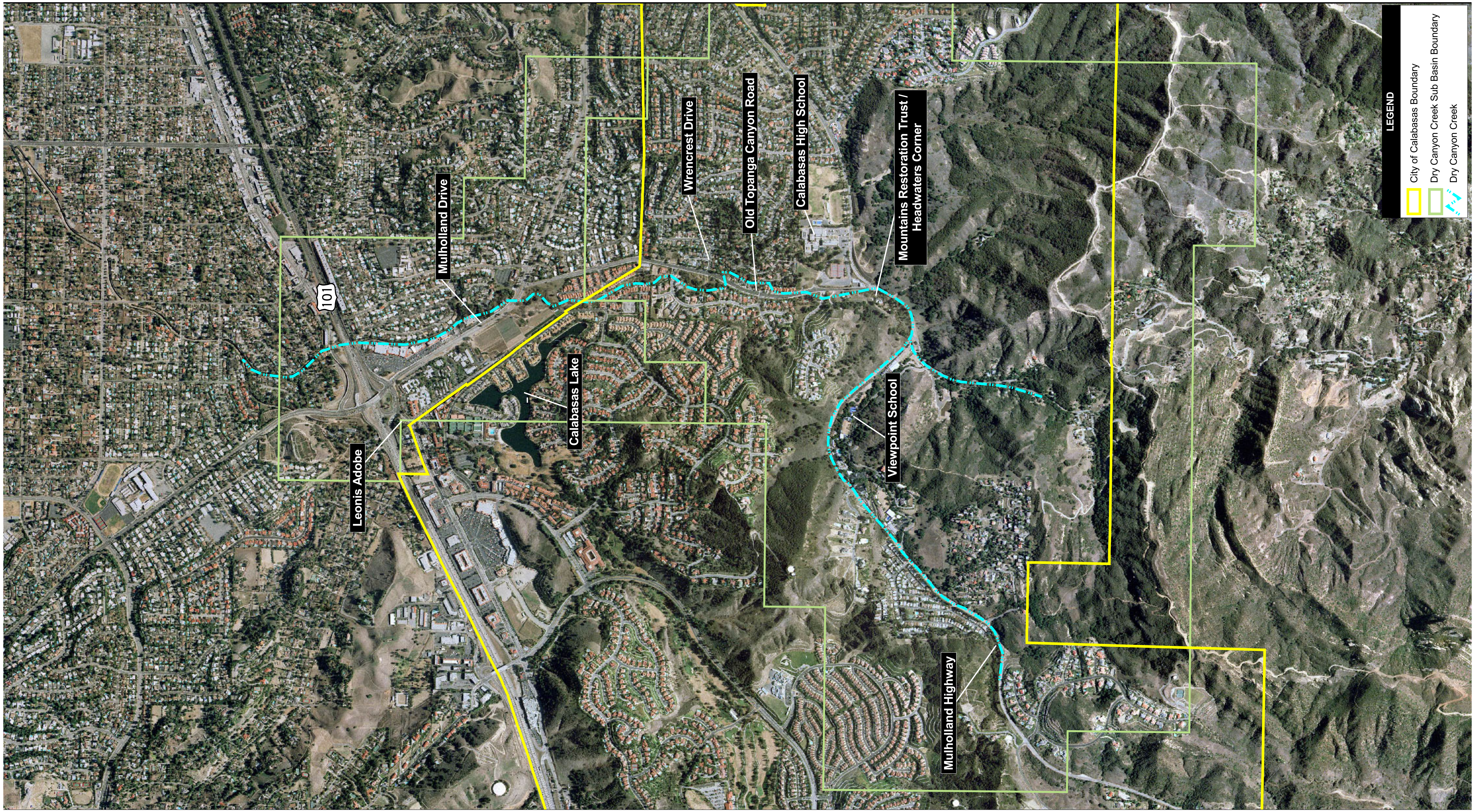
The growth of large housing developments in Calabasas made it necessary to increase the number of roads in the area. New roads for the housing developments were built and, starting in 1955, Ventura Boulevard, which ran close to the original El Camino Real, was upgraded to become the Ventura Freeway (Highway 101).

By the 1970s, agricultural land had mostly disappeared from east Calabasas. Moreover, the eastern region was considered fully built out by the late 1980s. Today Dry Canyon is suburban with a mix of multiple-family and single-family residences in the northern area and rural residential housing in the mountainous southern region. Due to roadway and residential development, most of Dry Canyon Creek runs through private property and in some areas in underground pipes.

McCoy Creek

McCoy Creek is also part of the Los Angeles River watershed. As shown in Figure 2.3, McCoy Creek flows from within the New Millennium housing development, parallel to Parkway Calabasas, continues in a northeast direction, past Calabasas Lake, past Leonis Adobe, and into the Calabasas Creek. McCoy Creek and the adjacent area were greatly impacted by large suburban housing developments after World War II. While most of the natural landscape has been altered, some of the cultural resources were saved from demolition and preserved.

The famous Leonis Adobe is located near the intersection of the Ventura Freeway and Mulholland Drive. The adobe was built in 1844, by an unknown person. Miguel Leonis and his wife Espiritu lived in the house together for 10 years until his death in 1889. Their son Juan



Source: Mountains Restoration Trust, 2002

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Scale: 1 : 6,000; 1 inch = 500 feet

Figure 2.2
Watershed Map
Dry Canyon Creek

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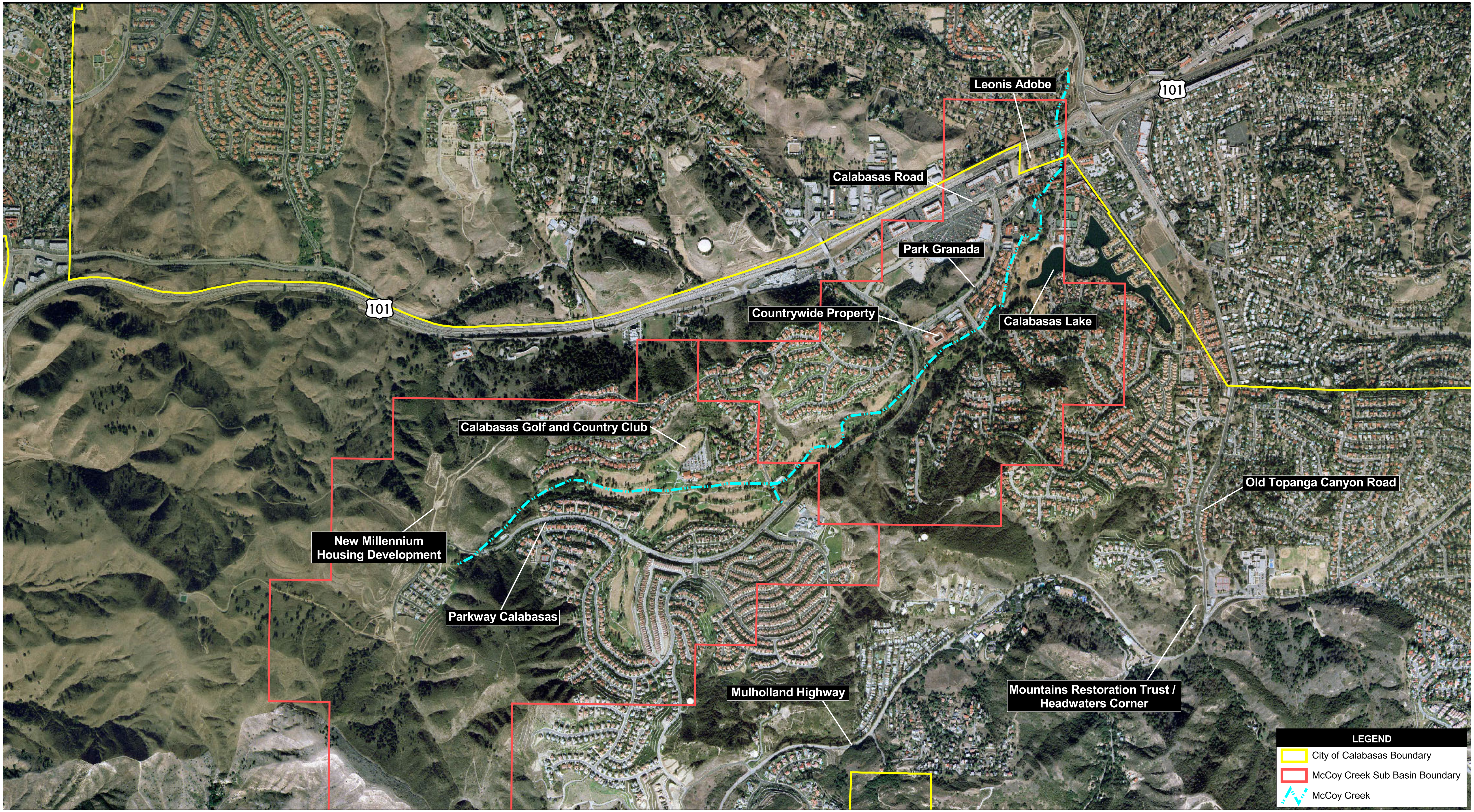

Source: Mountains Restoration Trust, 2002

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Scale: 1 : 6,000; 1 inch = 500 feet

Figure 2.3
Watershed Map
McCoy Creek

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Mendez inherited the ranch and adobe after Espiritu's death in 1906. Over the next 15 years, Mendez sold pieces of the ranch. He sold the last parcel in 1921.

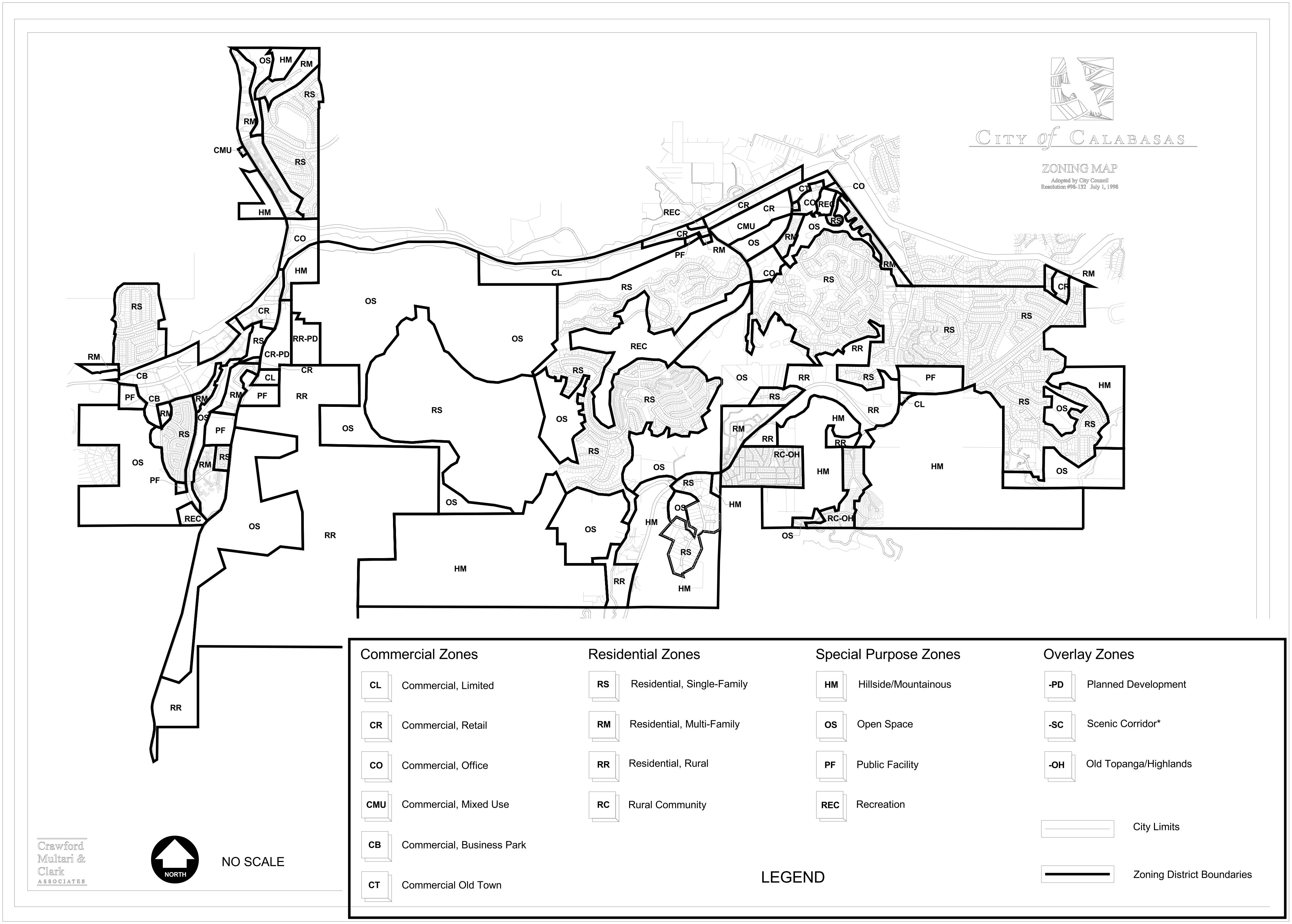
From the 1920s to the end of World War II, McCoy Canyon was characterized by a few mountain homes and open space. With the creation of Calabasas Park in the 1960s, McCoy Canyon was forever changed. As part of its country club residential vision, Edison Company built a Tennis and Swim Club near the Leonis Adobe and continued residential build-out of McCoy Canyon. Near the top of the canyon, the Calabasas Golf and Country Club was built, surrounded by large rural residential houses.

The creation of Calabasas Park increased development pressures in the Canyon. Leonis Adobe was almost demolished in the early 1960s, when Kathy Beachy purchased it in 1963. In 1975, Leonis Adobe was listed on the National Register of Historic Places. Preserving Leonis Adobe was the start of restoring Old Town Calabasas and its history. The Plummer House, once the oldest house in West Hollywood, was moved adjacent to the adobe in 1983. With the adobe saved and the addition and restoration of other historic buildings, the area opened as Old Town Calabasas in 1998 (Leonis 2002; City of Calabasas 1994).

Today, McCoy Canyon is characterized by gated, large, single-family homes and the golf course. Old Town is preserved and the Leonis Adobe and Plummer House are museums. Connecting Old Town to the residential areas of McCoy Canyon is Parkway Calabasas. It is a fully improved four-lane roadway, which follows adjacent to McCoy Creek. During the land development, McCoy Creek was rerouted down the mountains with sections now underground.

2.1.2 Current Land Use

Current land use within the City is outlined within the City's General Plan (Figure 2.4). As stated, the Calabasas General Plan is intended to be a "constitution" for local decision makers. The General Plan addresses immediate, mid-, and long-term issues concerning environmental sensitivity and preservation needs, public services, the economic vitality of the community, and environmental constraints. Land use and policy determinations can thus be made within a comprehensive framework that incorporates public health, safety, and "quality of life" considerations in a manner that recognizes the resource limitations and the fragility of the community's natural environment.



Source: City of Calabasas

Figure 2.4
Current Land Use/ Zoning Map

The Calabasas area has continued to develop from historic times to present. This continued development is represented by a decrease in open space and increase in the urban area within the study area (Table 2.1).

Table 2.1. Land Use Within the Study Area

Watershed	Open Space Area (acres)	Urban Area (acres)	Agricultural Area (acres)
Las Virgenes Creek	10,281	1,325	101
Dry Canyon Creek	2,082	909	0
McCoy Creek	1,339	383	0

Las Virgenes Creek

Narrow stretches of land designated as Open Space (OS) are located along the eastern bank of Las Virgenes Creek near the northern City boundary and along the east side adjacent to Lost Hills Road continuing along both banks southeast toward Agoura Road. Both areas are positioned between various residential uses. In addition, much of the City's land to the east of, but not adjacent to, the southernmost reaches of Las Virgenes Creek is designated for OS use. The purpose of lands with this designation is to protect public health and safety, preserve sensitive environmental resources, or manage resources.

A small area southwest of the intersection of Lost Hills Road and Las Virgenes Road has been designated as Public Facilities (PF). This designation is assigned to land held by public agencies for the primary purpose of providing active and passive recreational opportunities. The land adjacent to Las Virgenes Creek is currently being used or is designated for residential, and commercial uses.

All lands located within 500 feet of Las Virgenes Road are within the viewshed designated by the Scenic Corridor overlay zone. All development and proposed land use within this zoning district require a special land use permit and must include elements that ensure enhancement and beautification of the scenic corridor.

According to City Public Works personnel all housing and commercial areas in the watershed are connected to a sanitary sewer system. The wastewater generated by these uses are pumped to and treated by the Las Virgenes Municipal Water District.

Dry Canyon Creek

Near the northern border of Calabasas, Dry Canyon Creek is flanked on each side primarily by residential uses. As the creek winds northeast along Mulholland Highway, it is bordered by a mix of residential uses and lands designated Hillside-Mountainous (HM). HM lands have a Maximum Land Use Intensity of one dwelling unit per 10 acres, or one dwelling unit per existing lot, whichever is greater. Because of physical constraints and safety issues on certain properties, some parcels cannot be built upon.

East and west of the intersection of Dry Canyon Cold Creek Road and Mulholland Highway, the north bank of the creek is adjacent to land designated as OS. Separated from this area by a small residential use is a second OS designation, which borders the creek for a short distance. The opposite bank of the creek in this area is bordered by HM lands.

All lands located within 500 feet of Mulholland Highway are within the Scenic Corridor overlay zone. Within the viewshed, all development and proposed land use require a special land use permit and must include elements that ensure enhancement and beautification of the scenic corridor.

According to City Public Works personnel there is an unknown number of active septic systems, possibly approximately 50, within the watershed. There is no information currently available as far as location or condition of these systems. All other housing and commercial uses within the watershed are connected to the sanitary sewer system.

McCoy Creek

The area northwest of the golf course along McCoy Creek, designated as open space on the land use and zoning maps, is now undergoing major development based on the review of the aerial photograph. The development in this area is known as New Millennium development.

McCoy Creek is primarily surrounded by commercial and residential land designations. A long segment of the stream flows through lands designated as OS and occupied by a golf course. A small segment of the creek located near the northern City border is adjacent to the OS land designation that includes Lake Calabasas.

According to City Public Works personnel all housing and commercial areas in the watershed are connected to a sanitary sewer system. The wastewater generated by these uses are pumped to and treated by the Las Virgenes Municipal Water District.

2.1.3 Future Land Use

Future land use is difficult to determine at this time and will depend on the actions of the City Council as well as actions taken by adjoining jurisdictions. Land use is governed by the City General Plan; however, this plan can be changed, updated, and amended at different times to allow for changes in future land use. In the Las Virgenes Creek watershed, land use is not only governed by the City, but also by Ventura County, Los Angeles County, and the City of Agoura Hills. In the Dry Canyon and McCoy Creek watersheds, land use is governed by both Calabasas and the City of Los Angeles.

It can be expected that the area in and around Calabasas will continue to develop with the resulting increase in impervious area within the watersheds. This increase in impervious area will increase runoff quantity and velocity unless controls are mandated on all new development with the watersheds. However, all of the contributing municipalities are subject to NPDES Permit regulations and do impose strict urban storm water mitigation requirements on all new developments. NPDES development planning regulations focus on minimizing impervious surfaces, implementing peak flow controls, and providing structural pollution prevention devices for filtration of storm water runoff from urban development.

2.2 BIOLOGY

Biological resources within the study area were compiled based on a site visits, and a review of existing environmental documentation for the region. Information reviewed included the California Natural Diversity Data Base (CNDDB) (CDFG 2003) as well as documents pertaining to Malibu Creek State Park, and the Santa Monica Mountains National Recreation Area. The most through information concerning biology in the study area is from studies conducted within Malibu Creek State Park. There was very little existing information specific to the Los Angeles River Watershed, therefore except where specifically noted the species can be expected to occur throughout the study area.

Plant Communities

Based on vegetation surveys of the area, as well as descriptions provided in R.F. Holland's *Preliminary Descriptions of the Terrestrial Natural Communities of California*, the plant life of the study area can be divided into six different plant communities, i.e., chaparral, oak woodland and valley oak savanna, riparian woodland, grassland, coastal sage scrub, and fresh water wetland. These plant communities are briefly described below. In addition, this section provides information on sensitive plant species that have the potential to occur within the study area.

Chaparral

The chaparral plant community covers much of the undisturbed hillside areas north of the Ventura – Los Angeles County line as well as limited areas within the study area. Chaparral consists of a variety of plants that thrive in poor, dry, sandy, rocky soils. In addition, the plant species associated with chaparral have evolved in a landscape that is subject to periodic fires, and hence have developed adaptations to fire that allow for their continued survival or reestablishment following fire. Heavy chaparral cover provides hillside stabilization thereby minimizing erosion, which in turn minimizes sedimentation loading into the creeks. Chaparral species in the study area include, but are not limited to, ceanothus (*Ceanothus* spp.), chamise (*Adenostema fasciculatum*), currant (*Ribes sp*), fuchsia-flowered gooseberry (*Ribes speciosum*), black sage (*Salvia mellifera*), purple sage (*Salvia leucophylla*), holly-leaf cherry (*Prunus ilicifolia*), holly-leaf redberry (*Rhamnus ilicifolia*), laurel sumac (*Malosma laurina*), mountain mahogany (*Cercocarpus betuloides*), poison oak (*Toxicodendron diversilobum*), scrub oak (*Quercus berberidifolia in Jepson*), sugar bush (*Rhus ovata*), and toyon (*Heteromeles arbutifolia*) (McAuley 1996b).

Oak Woodland and Valley Oak Savanna

The oak woodland plant community is dominated by coast live oaks (*Quercus agrifolia*). In some areas, thick oak woodland, which also includes elderberry (*Sambucus mexicana*), walnut (*Juglans californica*), laurel sumac, and several herbaceous plants, forms a forest environment. A number of small shrubs and animals live within the protective borders of the oak woodland. Oak woodland communities are considered sensitive because of their scarcity, limited range, and high wildlife value. Valley oaks (*Quercus lobata*) once covered large areas of flatlands forming open savannas, but now only a few isolated stands remain. The valley oak is the largest native oak, and grows in fertile soils. The valley oak woodlands just south of the study area in Malibu Creek State Park, define the southernmost extent of this species' range. This range also extends east into the Dry Canyon Creek watershed. However, within the Dry Canyon Creek watershed the valley oak woodland has been disturbed by increased development in the area.

Riparian Woodland

Riparian communities are situated along stream courses and adjacent stream banks. Most riparian species are restricted to areas of a high water table (e.g., drainages), and require moist, bare mineral soils for germination and establishment, much like the conditions following periodic flooding (Holland 1986). The riparian woodland plant community consists of plants located along primarily along Las Virgenes Creek, and at a much smaller scale along Dry Canyon Creek. The trees and plants associated with the riparian habitat include sycamore trees (*Platanus racemosa*), cottonwoods (*Populus* spp.), California bay (*Umbellularia californica*), ash (*Fraxinus* spp.), cattail (*Typha latifolia*, and *T. domingensis*), mule fat (*Baccharis salicifolia*), willows (*Salix* spp.), and a variety of flowering plants.

Grasslands

Grasslands consist of low-growing herbaceous species dominated by annual and perennial grasses and forbs. Grazing and cultivation in the Las Virgenes Creek watershed have left very little native grass. The native grasses (e.g., purple needle-grass, *Nassella pulchra*; California brome, *Bromus carinatus*; and blue wildrye, *Elymus glaucus*) that are present are located in the area south of the City in Malibu Creek State Park. Within the park they occur in small, isolated patches, remnants of the former large expanses of native grasses that once characterized the foothills and flatlands. Today, the dominant grasses in the study area are introduced, nonnative grasses (e.g., various bromes, *Bromus* spp.; wild oats, *Avena* spp.; and ryegrasses, *Lolium* spp.). Open fields contain a mix of grasses and flowering plants (McAuley 1996b). Forbs found in the grassland community within the study area include, but are not limited to, California poppy (*Eschscholzia* spp.), tarweed (*Hemizonia* spp.*Madia* spp.), lupines (*Lupinus* spp.), lilies (variety), clover (*Trifolium* spp.), asters (variety), fennel (*Foeniculum vulgare*), and coyote melon (*Cucurbita* spp.) is also found throughout the area.

Coastal Sage Scrub

Coastal sage scrub is one of the major shrub-dominated (scrub) communities within California. This community occurs on xeric sites (i.e., sites that receive only a small amount of moisture) with shallow soils. Sage scrub species are typically drought deciduous plants with shallow root systems. Both of these adaptations allow for the occurrence of sage scrub species on these xeric sites. Coastal sage scrub, which includes buckwheat (*Eriogonum* spp), sages (*Salvia* spp.), yucca (*Yucca whipplei*), foothill needlegrass (*Nasella lepida*), and cacti (various), is considered a sensitive habitat by CDFG (Holland 1986) because this community's relatively few remaining acres supports an extremely high number of sensitive species. Coastal sage scrub is found throughout the study area with a major community in the upper Dry Canyon Creek watershed.

Freshwater Wetland

Freshwater wetland is a community dominated by perennial, emergent monocots (flowering plants that have one seed leaf), which grow in standing fresh water. This plant community can be found in very isolated areas along Las Virgenes and Dry Canyon Creeks as well as near seeps and springs. There is a large wetland dominated by Yerba Mansa (*Anemopsis californicum*) to the east of Las Virgenes Road by the sheep herders' quarters. Freshwater marsh species common in study area include cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and sedges (*Carex* spp.).

Sensitive Plants

Sensitive plant species are those that are candidates, proposed, or listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or the California Department of Fish and Game (CDFG), and those plants that are considered sensitive species by the California Native Plant Society (CNPS 2001). There are several plant species found within, or in areas adjacent to, Calabasas that are considered to be sensitive. All of these species, and their potential for occurrence within the study area, and within MCSP, are presented in Table 2.2. A total of five sensitive plants occur within the park. Four of these [i.e., Santa Susana tarplant (*Deinandra minthornii)*, marcescent dudleya (*Dudleya cymosa* ssp. *marcescens*), Santa Monica Mountains dudleya (*Dudleya cymosa* ssp. *ovatifolia*), and Lyon's pentachaeta (*Pentachaeta lyonii*)] are associated with chaparral and coastal scrub habitats. The fifth species is round-leaved filaree (*Erodium macrophyllum*), is associated with clay soils within grasslands and woodlands. Known locations for these five species within the study area are noted in Table 2.2.

Table 2.2. Sensitive Plant Species Known From the MCSP and Calabasas Region

Species	Habit and Habitat	Potential for Occurrence*	CNPS	CDFG	USFWS
Braunton's milkvetch *Astragalus brauntonii*	A perennial herb associated with chaparral, coastal scrub, valley and foothill grasslands, closed-cone coniferous forest, and in carbonate soils of recent burned or disturbed areas. Blooms March-July.	Moderate potential to occur within the MCSP. Suitable habitat is present and the occurrence may have been an isolated accidental one resulting from a storm or flood. No known presence.	1B	--	FE

Species	Habit and Habitat	Potential for Occurrence*	CNPS	CDFG	USFWS
Coulter's saltbrush *Atriplex coulteri*	A perennial herb associated with alkaline and clay soils of coastal dunes, coastal bluff scrub, coastal scrub, and valley and foothill grasslands. Blooms March-October.	Low potential to occur within the study area. Only known population in the region is located west of the park on the coastal bluffs of Point Dume.	1B	--	--
Malibu baccharis *Baccharis malibuensis*	A deciduous shrub found in chaparral, coastal scrub, and cismontane woodlands. Blooms in August.	Moderate potential to occur within the study area. Known populations are found along Las Virgenes Road at the base of Stokes Canyon.	1B	--	--
Plummer's mariposa lily *Calochortus plummerae*	A perennial herb found in granitic substrates of chaparral, coastal sage scrub, cismontane woodland, lower montane coniferous forest, and foothill grasslands. Blooms May-July.	Moderate potential to occur on-site. Suitable habitat occurs throughout the study area.	1B	--	FSC
San Fernando Valley spineflower *Chorizanthe parryi* var. *Fernandina*	An annual herb associated with sandy soils of coastal scrub. Blooms April-June.	Low potential to occur within the study area.	1B	SE	FC
Parry's spineflower *Chorizanthe parryi* var. *parryi*	An annual herb associated with sandy or rocky soils of coastal scrub and chaparral. Blooms April-June.	Low potential to occur on-site.	3	--	--
Santa Susana tarplant *Deinandra minthornii*	A deciduous shrub associated with sandstone soils of chaparral and coastal scrub. Blooms July-November.	Present. This shrub is known to occur within study area. A population has been recorded on Calabasas Peak. Most populations are reported from the Santa Susana Mountains.	1B	SR	--
Blochman's dudleya *Dudleya blochmaniae* ssp. *blochmaniae*	A perennial herb found in clay or serpentine soils of coastal bluff scrub, chaparral, coastal scrub, and valley and foothill grasslands. Blooms April-June.	Moderate potential to occur within the study area.	1B	--	--

Species	Habit and Habitat	Potential for Occurrence*	CNPS	CDFG	USFWS
Santa Monica Mountains dudleya *Dudleya cymosa* ssp. *agourensis*	A perennial herb associated with rocky or volcanic soils of chaparral and cismontane woodlands. Blooms May-June.	Low potential to occur within the study area. Suitable habitat occurs within the MCSP, but the closest known population is located in the Santa Monica Mountains Recreation Area, on Cornel Road.	1B	--	FT
Marcescent dudleya *Dudleya cymosa* ssp. *marcescens*	A perennial herb found in volcanic soils of chaparral habitats. Blooms April-June.	Present. This perennial herb is found in three different locations within MCSP.	1B	SR	FT
Santa Monica Mountains dudleya *Dudleya cymosa* ssp. *ovatifolia*	A perennial herb associated with volcanic soils of chaparral and coastal scrub habitats. Blooms March-June.	Present. This inconspicuous herb occurs within MCSP at the Udell Gorge Natural Preserve.	1B	--	FT
Many-stemmed dudleya *Dudleya multicaulis*	A perennial herb found in clay soils of coastal scrub, chaparral, and valley and foothill grasslands. Blooms April-July.	Low potential to occur on-site. Suitable habitat occurs within the MCSP, but the closest known population is located on the south side of Chatsworth Reservoir.	1B	--	--
Round-leaved filaree *Erodium macrophyllum*	An annual herb associated with clay soils of cismontane woodlands and valley and foothill grasslands. Blooms March-May.	Present. This annual herb has been found within MCSP. The exact location of this plant was not recorded, but is noted to occur within oak woodland habitat within the park.	2	--	--
Lyon's pentachaeta *Pentachaeta lyonii*	An annual herb associated with openings in chaparral, coastal scrub, and valley and foothill grasslands. Blooms March-August.	Present. This annual herb is found just south of the study area, approximately 0.5 mile south of Mulholland Hwy.	1B	SE	FE
Sonoran maiden fern *Thelypteris puberula* var. *sonorensis*	A perennial rhizomatous herb associated with meadows, streams and seeps. Fertile January-September.	Low potential to occur on-site.	2	--	--

* Potential for occurrence is based on California Natural Diversity Data Base (CNDDB) 2002 records, and other documents cited herein.

USFWS: FE = Federally Endangered, FT = Federally Threatened, FSC = Federal Species of Concern.

CDFG: SE = State Endangered, ST = State Threatened, CSC = State Species of Concern, SR = State Rare.

CNPS: 1B = Species considered rare, threatened, or endangered in California and elsewhere.
2 = Species considered rare, threatened, or endangered in California, but more common elsewhere.
3 = Species considered but need more information.

Exotic Non-native Plant Species

Exotic plant species are those plants that arrived in an area through human actions. Exotic plants are considered "invasive weeds" when they colonize natural areas and dominate or displace natural communities. Some potential impacts resulting from exotic plant infestation include (1) alteration of ecosystem processes, such as nutrient cycling, erosion, and fire frequency; (2) suppression of native plant recruitment and growth; (3) reduction of wildlife resources, such as food, cover, and nesting habitat; and (4) potential negative visual impacts in areas of heavy infestation.

Exotic plants that are considered invasive weeds often have several characteristics that enable them to compete successfully with native plants by rapidly becoming established and precluding the growth of the native species. Some invasive weeds have more than one method of reproduction. In particular, they can reproduce vegetatively through the sprouting of stem and root segments, as well as sexually through seed production. Often, invasive weeds reach reproductive maturity quickly and produce large amounts of readily dispersed seeds that remain viable for long periods. In addition, invasive weeds tolerate a wide range of habitat conditions and, in many cases, are favored by repeated disturbance.

One particularly invasive plant species that occurs within the study area is the giant reed (*Arundo donax*). The giant reed, a hydrophyte, grows along lakes, streams, drainages, and other wet sites. It can grow quickly and uses large amounts of water. Giant reed reproduces vegetatively through fragmented stem nodes and rhizomes; therefore, floods and other disturbances break up clumps of individuals, which then float downstream where they root and invade other areas. Many of the occurrences of giant reed occur along Dry Canyon Creek and are located on private property.

Additionally, invasive plants can also be introduced through local landscape practices. The main ornamental landscape plants that crowd into native areas are the Virginia creeper (*Parthenocissus* spp.), Periwinkle (*Vinca major*), and Eucalyptus. These invasive plants can be found throughout the study area.

Animal Communities

The diversity of habitat types found within the study area provide habitat for a variety of animals. The natural setting of Malibu Creek State Park and Ventura County are home to a number of sensitive, threatened, and endangered species, as determined by the USFWS and/or the CDFG. The following section provides an overview of general wildlife and associated habitats that occur within and adjacent to the study area.

Aquatic Life

Aquatic life consists of a variety of fish and invertebrates that occur within the waters of the drainages and impoundments throughout the study area. The one native fish currently associated with the Las Virgenes Creek watershed is the arroyo chub (*Gila orcutti*). Historically, two additional native fish were found in Las Virgenes Creek, the southern steelhead (*Oncorhynchus myskiss*) and the Pacific lamprey (*Lampetra tridentate*). The crayfish (*Astacus fluviatilis*), an exotic aquatic invertebrate, is known to inhabit Las Virgenes Creek (Appendix B).

Dry Canyon and McCoy Creek, being located at the top of the watershed, and subject to the potential of dry channels in the summer, do not have any native fish currently associated with them. However, based on the field assessment there is a potential for reintroduction of native fish, but further water quality and quantity studies should be undertaken before attempting to do so (Appendix B).

Of the seven native fish to have potentially inhabited McCoy and Dry Canyon Creeks, the steelhead, lampreys, and stickleback were the first fish to disappear from the Los Angeles River watershed in the 1940s and 1950s. These species apparently were more sensitive to water quality issues than the dace, chub, and sucker, which lasted longer and still occur in a few places in the Los Angeles River watershed. This indicates that the chubs, sucker, and dace would be the easiest to reestablish in the Calabasas streams although there is still the issue of barriers and long segments of concrete channels to consider. Steelhead are known to survive as freshwater populations upstream of barriers to the ocean provided water quality and water quantity are adequate.

Amphibians

The transitional area at the interface between the water in the study area and the riparian and upland habitats supports a variety of amphibians, including the California newt (*Taricha tarosa*), Pacific treefrog (*Pseudacris regilla*), California treefrog (*Pseudacris cadaverina*), and California toad (*Bufo boreas halophilus*). Amphibians are typically associated with mesic areas along streams, or under leaf litter and other objects where moisture is present. Within the study area these conditions are associated with the riparian and oak woodlands, and freshwater wetland habitats that occur primarily along Las Virgenes Creek, and to a lesser extent Dry Canyon Creek.

Reptiles

Several reptile species are known to occur within the study area, including the southwestern pond turtle (*Clemmys marmorata pallida*), San Diego horned lizard (*Phrynosoma coronatum blainvillei*), coastal western whiptail (*Cnemidophorus tigris multiscutatus*), San Bernardino ringneck snake (*Diadophis punctatus modestus*), San Diego mountain kingsnake (*Lampropeltus zonata pulchra*), and coastal rosy boa (*Lichanura trivirgata roseofusca*). The pond turtle prefers permanent streams or ponded areas, typically associated with riparian woodlands and freshwater wetlands within all three creeks. The horned lizard, western whiptail, and ringneck snake are often found in coastal sage scrub and chaparral habitats. The rosy boa also prefers to inhabit sage scrub and chaparral but is strongly associated with streams in proximity to these communities. The kingsnake is often found in riparian and oak woodland settings.

Birds

The broad and diverse vegetation communities, topography, hydrology, and geology combine to provide a variety of habitats for several resident and migratory bird species within the study area. In particular, the riparian woodland, freshwater wetland, and aquatic habitats attract migratory birds by providing valuable resources for nesting, foraging, and protective cover. Bird species typically associated with the riparian and oak woodlands within the study area include Cooper's hawk (*Accipiter cooperi*), black phoebe (*Sayornis nigricans*), phainopepla (*phainopepla nitens*), and Nuttall's woodpecker (*Picoides nuttallii*). The upland coastal sage scrub, chaparral, and grassland habitats within the study area support species such as wrentit (*Chamaea fasciata*), lesser goldfinch (*Carduelis psaltria*), and bushtit (*Psaltriparus minimus*).

Mammals

Development in the study area has destroyed a great deal of natural habitat, limiting animals to pockets of land in which they can survive. These areas are located primarily in Malibu Creek State Park and in Ventura County and provides ideal habitat for many mammals, which flourish in an area untouched by development. Typical large mammals that have potential in the study area include the nonnative red fox (*Vulpes vulpes*), the native gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), bobcat (*Felis rufus*), and mountain lion (*Felis concolor*). These mammals roam the hillsides and feed on rodents, small mammals, berries, amphibians, and reptiles. Large mammals typically use a variety of vegetation communities, including riparian and oak woodlands for cover, grassland and scrub vegetation for forage, and marsh and aquatic communities as sources of water. Small mammals in the study area include Botta's pocket gopher (*Thomomys bottae*), bats (including *Myotis* spp. and *Tadarida* spp.), brush rabbit (*Sylvilagus bachmani*), California ground squirrel (*Spermophilus beecheyi*), raccoon (*Procyon lotor*), mice (including *Peromyscus* spp. and *Reithrodontomys* sp.), woodrats (*Neotoma* spp.), ring tail cat (*Bassariscus astutus*) and others. Small mammals are associated with a wide range of habitats, including the coastal sage scrub, chaparral, grassland, and riparian communities.

Sensitive Animals

Sensitive wildlife are those animal species that are candidates, proposed, or listed as threatened or endangered by the USFWS or CDFG, and those animals that are considered species of concern or are listed as protected or fully protected by the state (CDFG 2003). Additionally, raptors protected under the federal Bald Eagle Protection Act are also considered sensitive species. The USFWS had maintained "Category 2" (C2) and "Category 3" (C3) species candidate lists, which had the similar function as the state lists for species of concern. However, USFWS has since discontinued the recognition of that term and has dropped the C2 and C3 candidate designations in 1995. CDFG has designated all former C2 and C3 species as "federal species of concern." This is a state designation and does not confer any federal protection or status. There are several fish, amphibian, reptile, bird, and mammal species found within, or in areas adjacent to, the study area that are considered to be sensitive, as well as other sensitive species whose distributional range and habitats coincide with the study area. All of these species, and their potential for occurrence within the study area, are presented in Table 2.3.

One sensitive fish species, the arroyo chub, is known to inhabit Las Virgenes Creek. The arroyo chub is considered a species of concern by the CDFG. Historically, the southern steelhead trout, inhabited Las Virgenes Creek, and is listed by the USFWS as endangered, and the CDFG considers both as species of concern. Northern San Diego County represents the present-day southern limit of steelhead distribution in California. The Malibu Creek Watershed steelhead represent an especially important resource, the last of a local race that has survived in the hot, dry climate of Southern California (Appendix B).

Table 2.3. Sensitive Animal Species Known from Malibu Creek State Park or Within the Study Area

Species	Habitat	Potential for Occurrence*	CDFG	USFWS
Fish				
Arroyo chub *Gila orcutti*	Slow-moving streams with mud or sand bottoms.	Known from Las Virgenes Creek	CSC	--
Southern steelhead *Oncorhynchus mykiss irideus*	Stream habitat with riffles on coarse gravel or sand is required for spawning.	Known from Malibu Creek, from Rindge Dam to the ocean but currently blocked from returning to Las Virgenes Creek by Rindge Dam.	CSC	FE
Amphibians				
Arroyo toad *Bufo californicus*	Breeds in shallow, slow-moving intermittent streams on sand or cobble substrate; over-winters in adjacent uplands.	Low potential to occur within the study area along ephemeral or intermittent streams.	CSC	FE
Red-legged frog *Rana aurora draytonii*	Frequents marshes, slow parts of streams, lakes, reservoirs, ponds, and other usually permanent water sources.	Low potential to occur within the study area, in areas of permanent surface water north of the Ventura County line.	CSC	FT
Reptiles				
Southwestern pond turtle *Clemmys marmorata pallida*	Permanent or near permanent bodies of water associated with marsh and riparian vegetation.	Known from several locations along all three creeks	CSC	--
San Diego horned lizard *Phrynosoma coronatum blainvillei*	Frequents a variety of habitats from sage scrub and chaparral to coniferous and broadleaf woodlands; often found on sandy or friable soils with open scrub.	Known from the study area south to Tapia Park.	CSC	--
California horned lizard *Phrynosoma coronatum frontale*	Frequents a variety of habitats from sage scrub and chaparral to coniferous and broadleaf woodlands; often found on sandy or friable soils with open scrub.	High potential to occur within the study area.	CSC	--
Coast patch-nosed snake *Salvadora hexalepis virgultea*	Prefers open coastal sage scrub, chaparral, riparian habitat, grasslands, and agricultural fields with friable or sandy soils.	Moderate potential to occur within study area. Suitable habitat occurs throughout most of the Malibu Creek State Park.	CSC	--
San Diego mountain kingsnake *Lampropeltis zonata pulchra*	Prefers rock outcrops in pine and oak woodlands with moisture present, but can occur in other habitats such as chaparral and wet meadow.	Known from Stunts Ranch and Cold Creek Canyon Preserve. High probability to occur in suitable habitats along all three creeks.	CSC	--

Species	Habitat	Potential for Occurrence*	CDFG	USFWS
Two-striped garter snake *Thamnophis hammondi*	Habitat occurs along streams with rocky beds and permanent freshwater.	High potential to occur within the study area. Known from Malibu Creek State Park.	CSC	--
Birds				
Least bittern *Ixobrychus exilis hesperis*	Fresh and brackish water marshes, usually near open water sources.	Moderate potential to occur in suitable freshwater marsh habitat within the study area.	CSC	--
Cooper's hawk *Accipiter cooperii*	Nests primarily in oak woodlands but occasionally in willows or eucalyptus.	High potential to occur within the woodland and riparian habitats within the study area.	CSC	--
Swainson's hawk *Buteo swainsoni*	Builds relatively fragile nests in shrubs and trees along wetlands and drainages, and in windbreaks in fields and around farmsteads.	Low potential to occur within the study area. Not known to nest in southern California.	CT	--
Golden eagle *Aquila chrysaetos*	Forages in grassy and open scrub habitats; nests primarily on cliffs, with secondary use of large trees.	Known to occur within Malibu Creek State Park.	CSC	BEPA
Southwestern willow flycatcher *Empidonax traillii extimus*	Restricted to wide bands of dense riparian woodlands of willow, cottonwood, oak, and other deciduous shrubs and trees.	Low potential to occur within the study area due lack of wide bands of suitable riparian habitat.	CE	FE
California horned lark *Eremophila alpestris actia*	Resident of grasslands and open habitats such as agricultural fields, beaches, and disturbed areas.	Moderate potential to occur in the grasslands in the study area.	CSC	--
Coastal California gnatcatcher *Polioptila californica californica*	Coastal sage scrub habitats, typically on gentle slopes.	High potential to occur within Malibu Creek State Park in suitable areas of coastal sage scrub habitat. Known to occur in the area east of Las Virgenes Road.	CSC	FT
Loggerhead shrike *Lanius ludovicianus*	A variety of habitats, occurring wherever bushes or trees are scattered on open ground.	High probability to occur within the study area, particularly in areas with open vegetation.	CSC	--
Least Bell's vireo *Vireo bellii pusillus*	Restricted to riparian woodland and scrub, particularly in areas with an understory of dense young willows or mulefat with a canopy of tall willows.	Moderate potential to nest within the riparian woodland habitat along Las Virgenes Creek.	CE	FE
Southern California rufous-crowned sparrow *Aimophila ruficeps canescens*	Prefers grassy or rocky slopes with open scrub, particularly coastal sage scrub.	High probability to occur within the study area throughout the scrub and grassland habitats.	CSC	--

Species	Habitat	Potential for Occurrence*	CDFG	USFWS
Mammals				
San Diego desert woodrat *Neotoma lepida intermedia*	Inhabits a variety of scrub habitats where it constructs large middens, usually consisting of small twigs, cactus pads, and other plant material.	High probability to occur in the study area.	CSC	--

* Potential for occurrence is based on California Natural Diversity Data Base (CNDDB) 2002 records, and other documents cited herein.
USFWS: FE = Federally Endangered, FT = Federally Threatened, BEPA = Bald Eagle Protection Act.
CDFG: CE = State Endangered, CT = State Threatened, CSC = State Species of Concern.

Although no sensitive amphibians are known to occur within the study area, two sensitive amphibian species, the arroyo toad (*Bufo californicus*), and the red-legged frog (*Rana aurora draytonii*) have been documented north of the Ventura County line. The arroyo toad and red-legged frog are federally listed by the USFWS as endangered and is considered a CDFG species of concern.

The southwestern pond turtle, San Diego horned lizard, and San Diego mountain kingsnake are all considered reptile species of concern by the CDFG. The pond turtle is known to occur along all three creeks. The CNDDB also contains a record of the San Diego mountain kingsnake in the Cold Creek Preserve area.

Several of the migrant and resident bird species of the study area are considered sensitive by the federal or state resource agencies. One sensitive species, the golden eagle (*Aquila chrysaetos*), is a CDFG species of concern and is federally protected under the Bald Eagle Protection Act. The coastal California gnatcatcher (*Polioptila californica californica*), listed by the USFWS as threatened, and considered a species of concern by the CDFG, has been documented to the north of Mulholland and east of Las Virgenes Road.

Exotic Non-native Animal Species

The aquatic invertebrate species of biological resource management concern in Las Virgenes are the crayfish and bull frog. Both species have been introduced and prey on native amphibians and fishes. The presence of these species threatens the ecosystem of the Malibu Creek Watershed.

The Virginia opossum (*Didelphis virginiana*) is a nonnative mammal species that was first introduced to northern California in 1910 and has expanded its range down the entire length of the state. This opportunistic feeder competes with native small mammals for food and other resources.

Wildlife Movement Corridors and Habitat Linkages

A wildlife corridor can be defined as a linear landscape feature of sufficient width and buffer to allow animal movement between two patches of comparatively undisturbed habitat, or between a patch of habitat and some vital resources. Regional corridors are defined as those linking two or more large areas of natural open space. Local corridors are defined as those allowing resident animals to access critical resources (food, cover, and water) in a smaller area that might otherwise be isolated by urban development.

Habitat linkages can be defined as large areas of natural open space that provide connectivity to regional biological resources. These linkages are not narrow corridors through which wildlife species must pass to access critical resources. Instead, habitat linkages are wide enough to allow relatively free movement of wildlife species along multiple paths between resources.

Wildlife corridors and habitat linkages are essential in geographically diverse settings, and especially in urban settings, for the sustenance of healthy and genetically diverse animal communities. At a minimum, they promote colonization of habitat and genetic variability by connecting fragments of like habitat, and they help sustain individual species distributed in and among habitat fragments. Habitat fragments, by definition, are separated by otherwise foreign or inhospitable habitats, such as urban/suburban tracts. Isolation of populations can have many harmful effects and may contribute significantly to local species extinction.

A viable wildlife corridor consists of more than a path between habitat areas. To provide food and cover for transient species as well as resident populations of less mobile animals, a wildlife corridor must also include pockets of vegetation.

Malibu Creek State Park currently serves as a functioning wildlife habitat linkage within the Santa Monica Mountains. The natural open space provides biological resources that attract wildlife from throughout the region by providing protective cover, water, and forage for a variety of species, including the mountain lion, mule deer, and coyote. The park provides direct habitat linkages with other areas of open space.

Malibu Creek State Park is the starting point for local wildlife movement corridor functions within the Santa Monica Mountains and is a potential regional corridor. The vegetated drainages outside the study area, including Malibu Creek and Liberty Canyon, are natural corridors which provide local routes for a variety of wildlife species to move between resources in Malibu Creek State Park and open space in Ventura County. The southern steelhead is the one notable species that faces difficulty moving through the Malibu Creek corridor. Currently, the southern steelhead can only travel along Malibu Creek from the ocean to Rindge Dam, at which point it cannot continue farther upstream into the tributaries of Malibu Creek such as Las Virgenes Creek.

The upper Dry Canyon watershed serves as a wildlife corridor and linkage between Topanga State Park and the Cold Creek Preserve extending down to Malibu Creek State Park. The upper Dry Canyon watershed also serves as a critical corridor for the open space areas in and around the subdivisions of Calabasas Park to the protected areas of the SMMNRA.

The City also has plans to restore a critical corridor located on Las Virgenes Creek between the Agoura Road bridge and the 101 Freeway. This site will link the Baldwin open space withthe Malibu Creek State Park, while restoring riparian habitat and improving the aesthetics of this creek section adjacent to a new shopping center.

2.3 HYDROLOGY/HYDRAULICS

2.3.1 Existing Conditions

Baseline conditions for Las Virgenes, McCoy, and Dry Canyon Creeks were assessed during field visits performed in January 2003 and a follow-up visit in March. The riparian assessment procedure developed for this project evaluated physical and hydrological properties of stream reaches, presence of plant and animal species, and adjacent vegetation communities and land uses.

Las Virgenes Creek

Las Virgenes Creek crosses the northern boundary of Calabasas flowing south out of undeveloped, gently rolling hills and through a willow forest (Table 2.4). A short segment of incised dirt channel lined with emergent wetland vegetation transitions to a 20-foot wide trapezoidal concrete channel that is flanked by dense residential uses. From Thousand Oaks Boulevard, south to Parkmor Road, the channel flows through a box culvert. Tributary to this reach is a detention basin that drains runoff from a large development to the west and runs east under Las Virgenes Road to the creek. At Parkmor Road, the culvert goes underground and resurfaces south of the commercial uses northeast of the intersection of Las Virgenes Road and the Ventura Freeway. A tributary that flows west along the north side of the Ventura Freeway joins the creek there.

Table 2.4. Characteristics of Las Virgenes Creek

Reach	Characteristics Physical	Hydrological	Biological
Upstream of City boundary	2:1 bank slope	intermittent	willow forest
City boundary to Parkmor	20 ft concrete trap/box channel	low flow	sparse vegetation (weeds, grasses)
Parkmor to south of Mureau	underground channel	medium flow	None
Eastern tributary north of the 101 Freeway	Concrete channel	medium flow	Willow forest
Las Virgenes Rd to the 101 Freeway	concrete/riprap, gentle slope, braiding	medium flow	willow forest emergent wetlands
101 Freeway to Agoura Rd	50 ft concrete trapezoidal channel	medium flow	willow saplings
Agoura Rd to Las Virgenes Rd	natural bottom, gentle slope, floodplain encroachment	medium flow	willow forest, mulefat scrub, emergent wetlands
Malibu Creek State Park	meandering channel, some incision	medium flow	willow forest, mulefat scrub

The creek passes west under Las Virgenes Road into a stretch of willow forest that extends along the north side of the Ventura Freeway (outside the City's boundaries) approximately 1,500 feet before crossing under the highway to the south. Along this reach, the creek is bordered to the northwest by a small floodplain and disturbed hillside and to the southeast by riprap and concrete stabilizing structures. The natural portion of the channel in this reach is characterized by meanders, riffle/pool complexes, and a gentle slope. In some areas, the banks show signs of instability, and there are bar formations in the channel.

Just south of the Ventura Freeway, Las Virgenes Creek flows through a 50-foot-wide trapezoidal concrete channel for a distance of approximately 300 feet. Sediment deposits on the concrete bottom support some vegetation, including willow saplings. Both sides of the channel are bordered by commercial uses with large asphalt parking lots. The concrete channel ends after passing south under Agoura Road.

South of Agoura Road, Las Virgenes Creek flows approximately 3 miles through dense residential and commercial uses before passing south into MCSP. Throughout this reach, most of the creek maintains a natural soft bottom with small pockets of mulefat scrub, southern willow scrub, and emergent wetlands combined with primarily willow forest vegetation. Pockets of exotic vegetation such as eucalyptus, tamarisk, and vinca exist along the banks.

While much of the channel in this stretch is characterized by a gentle slope and shallow depth, development encroaches on the creek floodplain, and in several locations cement structures have been installed to stabilize banks or channelize the stream for short distances. In addition, storm water outlets drain into the creek periodically throughout this segment. In some places, restriction of flow has led to channel incision or bank instability.

North of the intersection of Lost Hills Road and Las Virgenes Road, the Resource Conservation District of the Santa Monica Mountains (RCD) has completed the Las Virgenes Creek Stream and Habitat Restoration project, a riparian habitat improvement project. The creek passes under Lost Hills Road through a concrete culvert, then flows adjacent to De Anza Park and into MCSP.

As the creek flows through MCSP, it maintains a fairly natural course due to the lack of development within the floodplains. Las Virgenes Road parallels the creek south about 300 feet from the eastern bank. Throughout this reach, the creek is characterized by a meandering channel incised in some locations due to increased flow from the upper watershed.

Dry Canyon Creek

The upper extent of the Dry Canyon Creek watershed is located in the Calabasas Highlands area and is located parallel to Mulholland Highway, just upstream of the Viewpoint School. In this area, the creek channel supports large willows, and surrounding upland vegetation consists of chaparral and coastal sage scrub (Table 2.5). After emerging from the underground culvert and passing south under Mulholland Highway, the creek bends to the southwest adjacent to Viewpoint School, where the bottom and banks have been stabilized with concrete and rock walls.

Table 2.5. Characteristics of Dry Canyon Creek

Reach	Characteristics		
	Physical	Hydrological	Biological
Top of watershed	natural channel	intermittent	oak woodland
Mountains Restoration Trust/Headwaters Corner	concrete bottom, stone wall stabilizing bank	low flow	disturbed oak woodland
Wrencrest Drive to Park Ora	natural channel, walls constraining floodplain	medium flow	southern willow scrub
Park Ora to City boundary	natural bottom with meanders	medium flow	mature trees

Dry Canyon Creek then passes south of the horse stable southwest of the intersection of Mulholland Highway and Old Topanga Canyon Road where areas of the creek bank have been stabilized with a mixture of rocks and concrete. A wooden bridge also crosses the creek at this location.

Before crossing back under Mulholland Highway to the north, the creek is joined by a tributary that flows north along Old Topanga Road. The tributary flows adjacent to the road collecting runoff from storm water culverts and street flows and is constricted in several locations by driveway culverts. The surrounding vegetation community along this segment is primarily oak woodland.

North of the Mulholland Highway/Old Topanga Canyon Road intersection, Dry Canyon Creek flows through Mountains Restoration Trust property, then along the west side of Old Topanga Canyon Road before passing into an underground culvert south of Palm Drive. The creek travels underground for about 0.5 mile before emerging in a residential area near Wrencrest Drive. As the creek continues to the north, the channel is characterized by a gentle slope, natural bottom, and riparian vegetation. The floodplain in this area is constricted by crib walls that stabilize the adjacent terrace for surrounding residential uses.

The crib wall on the western side of the creek ends near the northern boundary of Calabasas and the floodplain expands into a park area containing mature oak trees. A 12-foot-wide cement ramp descends from Park Paloma above to the west into the creek channel.

North of Calabasas, Dry Canyon Creek crosses into Los Angeles City. The natural channel is then contained in a box culvert that continues under the Ventura Freeway. North of the Ventura Freeway, Dry Canyon Creek joins McCoy Creek to form Calabasas Creek.

McCoy Creek

The top of the McCoy Creek watershed is located in the New Millennium housing development, which is located at the end of Parkway Calabasas. The creek emerges from a cement underground culvert under Parkway Calabasas at the east end of the New Millennium property and flows through an area of native vegetation and natural channel until passing into a golf course, which flanks the creek on both sides for the next 0.6 mile (Table 2.6).

Table 2.6. Characteristics of McCoy Creek

Reach	Characteristics Physical	Hydrological	Biological
New Millennium to golf course	gentle slope – emerges from culvert from community	low flow	riparian oak woodland
Golf course	modified channel, floodplain encroachment	moderate flow	turf grass, ornamentals
Park Capri to the Swim and Tennis Center	natural channel with downcutting, some bank stabilization	moderate flow	oak woodland/turf upland vegetation
Swim & Tennis Center to Calabasas Road	north bank stabilized with cement, check structures in channel	moderate flow	some natives planted on banks

Upstream of the golf course, approximately 175 feet of the creek channel, vegetation is primarily natural, then the bank vegetation transitions to turf grass and ornamentals. The segment flowing through the golf course is restricted at several locations by cart path and road crossings, underground culverts, and bank stabilizing structures. Just west of Park Entrada, the creek is joined from the south by a tributary that crosses under Parkway Calabasas from Bay Laurel School. The confluence is lined with concrete.

McCoy Creek passes under Parkway Calabasas through two box culverts and empties onto the private grounds of Countrywide Financial. Within the Countrywide site, the creek is maintained as a natural park with recreational uses available to employees.

The Countrywide Financial property ends at Park Capri where the creek flows under the road and into the park adjacent to Lake Calabasas. In the western portion of the park the creek is bordered to the north by high-density residential uses. Gabions stabilize the north bank along some of this stretch. The southern bank is natural and contains oak woodland vegetation that transitions to turf grass closer to the lake. A concrete lake overflow structure drains into the creek south of the Calabasas Tennis and Swim Center. Downstream of the overflow, concrete has been used to stabilize the east and west banks of the creek.

Near the northern boundary of Calabasas, the creek channel has been stabilized with riprap and check structures before it crosses under Calabasas Road in Old Town Calabasas. On the north side of Calabasas Road, the creek crosses under the Ventura Freeway to join Dry Canyon Creek and form Calabasas Creek.

2.4 WATER QUALITY

2.4.1 Regulatory Setting for Water Quality

The RWQCB-LA adopted the Water Quality Control Plan, Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (The Basin Plan) in 1994 for the purpose of preserving and enhancing water quality and protecting designated beneficial uses of all regional waters. The Basin Plan incorporates all applicable state and Regional Board plans and policies and other pertinent water quality policies and regulations. The Basin Plan also defines beneficial uses of surface waters and identifies the potential, existing, and intermittent beneficial uses of each waterbody within the region. Additionally, the Basin Plan identifies Water Quality Objectives for inland surface waters within the region.

Waterbodies that do not or are not expected to attain the Water Quality Objectives are identified on the 303(d) list of impaired surface waters within the Los Angeles Region. Each pollutant that contributes to the impairment of a beneficial use of the waterbody is listed, and a TMDL for each is developed and implemented.

2.4.1.1 Beneficial Uses

The three major streams within Calabasas, McCoy Creek, Dry Canyon Creek, and Las Virgenes Creek, drain into two different watersheds: Malibu Creek and the Los Angeles River. These waters share a number of existing, intermittent or potential beneficial uses, which include:

- Municipal and Domestic Supply (MUN) – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
- Water Contact Recreation (REC-1) – Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or bathing in natural hot springs.
- Noncontact Water Recreation (REC-2) – Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

- Warm Freshwater Habitat (WARM) – Uses of water that support warm water ecosystems including, but not limited to, preservation of enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
- Wildlife Habitat (WILD) – Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

McCoy Canyon Creek and Dry Canyon Creek also share the following intermittent uses:

- Ground Water Recharge (GWR) – Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Las Virgenes Creek has the following additional existing or potential beneficial uses:

- Cold Freshwater Habitat (COLD) – Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
- Rare, Threatened, or Endangered Species (RARE) – Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.
- Migration of Aquatic Organisms (MIGR) – Uses of water that support habitats necessary for migration, acclimatization between freshwater and saltwater, or other temporary activities by aquatic organisms, such as anadromous fish.
- Spawning, Reproduction, and/or Early Development (SPWN) – Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.
- Wetland Habitat (WET) – Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions that enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

2.4.1.2 Water Quality Objectives

The Basin Plan outlines the water quality objectives that are used in conjunction with beneficial uses to act as water quality standards. When the water quality standards are exceeded then there is the potential for enactment of a TMDL (see Section 2.4.1.3).

Narrative or numerical water quality objectives have been developed for numerous parameters and apply to all inland surface waters in the region.

Ammonia

The neutral, un-ionized ammonia species (NH3) is highly toxic to fish and other aquatic life. The ratio of toxic NH3 to total ammonia (NH4 + NH3) is primarily a function of pH, but it is also affected by temperature and other factors. Additional impacts can also occur as the oxidation of ammonia lowers the dissolved oxygen content of the water, further stressing aquatic organisms. Ammonia also combines with chlorine to form chloramines – persistent toxic compounds that extend the effects of ammonia and chlorine downstream. When ammonia oxidizes, it forms nitrates.

Bacteria, Coliform

Total and fecal coliform bacteria are used to indicate the likelihood of pathogenic bacteria in surface waters. Water quality objectives for total and fecal coliform bacteria vary with the beneficial uses of the water body. In waters designated for water contact recreation (REC-1), the fecal coliform bacteria concentration shall not exceed a log mean of 200/100 milliliters (ml) (based on a minimum of not less that four samples for any 30-day period), nor shall more than 10% of samples collected during any 30-day period exceed 4000/100 ml.

Biological Oxygen Demand (BOD)

The 5-day BOD test indirectly measures the amount of degradable organic material in water by measuring the residual dissolved oxygen after a period of incubation (usually 5 days at 20 degrees Centigrade [ºC]), and is primarily used as an indication of efficiency of wastewater treatment processes. The Basin Plan states that waters shall be free of substances that result in increases in the BOD that adversely affect beneficial uses.

Exotic Vegetation

Exotic (nonnative) vegetation introduced in and around streams is often of little value as habitat for aquatic-dependant biota. Exotic plants can quickly out compete native vegetation and cause other water quality impairments.

Floating Material

Floating materials can be an aesthetic nuisance as well as provide substrate for undesirable bacterial and algal growth and insect vectors. The Basin Plan states that waters shall not contain floating materials, including solids, liquids, foams, and scum in concentrations that cause a nuisance or adversely affect beneficial uses.

Mineral Quality

Mineral quality in natural waters is largely determined by the mineral assemblage of soils and rocks and faults near the land surface. Point and nonpoint source discharges of poor quality can degrade the mineral content of natural waters. High levels of dissolved solids render waters useless for many beneficial uses. For the Malibu Creek Watershed the objectives are total dissolved solids (TDS) 2,000 mg/l, sulfate 500 mg/l, chloride 500 mg/l, and nitrogen 10 mg/l.

Nitrogen (Nitrate, Nitrite)

Excess nitrogen in surface waters can lead to excess aquatic growth and can contribute to elevated levels of NO3 in groundwater. Waters shall not exceed 10 mg/l nitrogen as nitrate-nitrogen plus nitrite-nitrogen (NO3-N + NO2-N), 45 mg/l as nitrate (NO3), 10 mg/l as nitrate-nitrogen (NO3-N) or 1 mg/l as nitrite-nitrogen (NO2-N).

Oil and Grease

Oil and grease are not readily soluble in water and form a film on the water surface. Oily films can coat birds and aquatic organisms, impacting respiration and thermal regulation, and cause death. Oil and grease can also cause nuisance conditions (odors), are aesthetically unpleasant, and can restrict a wide range of beneficial uses.

Dissolved Oxygen (DO)

Adequate DO levels are required to support aquatic life. Depression of DO can lead to anaerobic conditions resulting in odors, or in extreme cases, in fish kills. As a minimum, the mean annual DO concentration of all waters shall be greater than 7 milligrams per liter (mg/l), and no single determination shall be less than 5.0 mg/l, except when natural conditions cause lesser concentrations.

pH

The hydrogen ion activity of water (pH) is measured on a logarithmic scale, ranging from 0 to 14. While a pH of "pure" water at 25ºC is 7.0, the pH of natural waters is usually slightly basic due to the solubility of carbon dioxide from the atmosphere. Minor changes from natural conditions can harm aquatic life.

Solid, Suspended, or Settleable Materials

Surface waters carry various amounts of suspended and settleable materials from both natural and human sources. Suspended sediments limit the passage of sunlight into waters, which in turn inhibits growth of aquatic plants. Excessive deposition of sediments can destroy spawning habitat, blanket benthic organisms, and abrade the gills of larval fish. Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.

Turbidity

Turbidity is an expression of the optical property that causes light to be scattered in water due to particulate matter such as clay, silt, organic matter, and microscopic organisms. Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in natural turbidity attributable to controllable water quality factors shall not exceed an increase of 20% when the natural turbidity is 0 to 50 nephelometric turbidity units (NTUs).

Wetland Objectives

In addition to the regional objectives for inland surface waters (including wetlands), the following objectives apply for the protection of wetlands in the region.

Hydrology

Natural hydrologic conditions necessary to support the physical, chemical, and biological characteristics present in wetlands shall be protected to prevent significant adverse effects on:

- Natural temperature, pH, DO, and other natural physical/chemical conditions;
- Movement of aquatic fauna;
- Survival and reproduction of aquatic flora and fauna; and
- Water levels.

Habitat

Existing habitats and associated populations of wetland fauna and flora shall be maintained by:

- Maintaining substrate characteristics necessary to support flora and fauna that would be present naturally,
- Protecting food supplies for fish and wildlife,
- Protecting reproductive and nursery areas, and
- Protecting wildlife corridors.

2.4.1.3 Storm Water Requirements

Discharge and runoff into inland surface and ocean waters in the Los Angeles Region are controlled by a number of quality standards and implementation plans. These include permitting and waste discharge requirement programs that address point source pollutants as well as storm water and nonpoint source programs that address urban runoff. The City of Calabasas is subject to the urban runoff requirements described in Order No. 01-182, NPDES Permit No. CAS004001 – Waste Discharge Requirements for Municipal Storm Water and Urban Runoff Discharges within the County of Los Angeles, and the Incorporated Cities Therein, Except the City of Long Beach, which was issued by the RWQCB-LA, in 2001. Permittees include the Los Angeles County Flood Control District, the County of Los Angeles, and 84 incorporated cites within the Los Angeles County Flood Control District. The Regional Board finds in the permit that the Permittees' proposed Storm Water Quality Management Plan (SQMP) incorporating the additional and/or revised provisions contained in the Order would meet the minimum requirements of federal regulations.

The objective of the order is to protect the beneficial uses of receiving waters in Los Angeles County. To accomplish this, permittees are required to:

- Ensure that the discharge of non-storm water to the municipal separate storm sewer system (MS4) has been effectively prohibited except in specified allowable instances.
- Ensure that storm water discharges from the MS4 neither cause nor contribute to the exceedance of water quality standards and objectives, nor create conditions of nuisance in the receiving waters.
- Specify BMPs in the SQMP that will be implemented to reduce the discharge of pollutants in storm water to the maximum extent practicable (MEP).
- Coordinate with the Principal Permittee (the Los Angeles County Flood Control District) to implement a Public Information and Participation Program (PIPP).
- Implement programs to minimize storm water pollution impacts from industrial and commercial facilities, development and redevelopment projects, construction sites, and public agencies.
- Eliminate all illicit connections and illicit discharges to the storm drain system.

Total Maximum Daily Loads

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDLs) for these waters.

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings among point and nonpoint pollutant sources. By law, EPA must approve or disapprove lists and TMDLs established by states, territories, and authorized tribes. If a state, territory, or authorized tribe submission is inadequate, EPA must establish the list or the TMDL. EPA issued regulations in 1985 and 1992 that implement section 303(d) of the Clean Water Act - the TMDL provisions.

In February 2003, the RWQCB-LA approved the 2002 Clean Water Act Section 303(d) list of impaired waterbodies, which identifies seven pollutants for Las Virgenes Creek, including high coliform count, nutrients (algae), organic enrichment/low dissolved oxygen, scum/foam-unnatural, sedimentation/siltation selenium, and trash.

The EPA is developing TMDLs in 2003 for coliform count and nutrients in Malibu Creek, which are scheduled to be adopted by the RWQCB-LA within a year. A trash TMDL is expected to be developed for the Malibu Creek watershed by 2004 (Table 2.7).

Table 2.7. TMDLs for Las Virgenes, McCoy, and Dry Canyon Creeks

Creek	303(d) Listing	TMDL Schedule	EPA Priority
Las Virgenes	High coliform count	2003 (draft under review)	High
	Nutrients (algae)	2003	High
	Organic enrichment/low dissolved oxygen	2002 (but not completed yet)	High
	Scum/foam-unnatural	2002 (but not completed yet)	High
	Sedimentation/siltation	No date	Low
	Selenium	2004	High
	Trash	2004	Medium
McCoy	Fecal coliform	Not specified	Low
	Nitrate	Not specified	Low
	Nitrate as nitrogen	Not specified	Low
	Selenium, total	Not specified	Low
Dry Canyon	Fecal coliform	Not specified	Low
	Selenium, total	Not specified	Low

McCoy Creek and Dry Canyon Creek were both identified on the 2002 impaired water body list (303(d) list). Both drainages have been identified as impaired for fecal coliform and total selenium, which can impact warm freshwater and wildlife habitat beneficial uses. In addition, McCoy Creek has been listed as impaired for nitrate, and nitrate as nitrogen, which can impact groundwater recharge beneficial uses.

2.4.1.4 Pollutant Sources

The NPDES Permit No. CAS004001 identifies development and urbanization as causing an increase in pollutant load, volume, and discharge velocity due to two main factors: conversion of pervious ground cover to impervious surfaces such as paved highways, streets, rooftops and parking lots; and creation of new pollution sources as the increased density of human population brings proportionately higher levels of vehicle emissions, vehicle maintenance wastes, pet wastes, trash, and other anthropogenic pollutants.

The Permit cites the seven highest priority industrial and commercial critical source types as identified by the County of Los Angeles: wholesale trade (scrap recycling, auto dismantling), automotive repair/parking, fabricated metal products, motor freight, chemical and allied products, automotive dealers/gas stations, and primary metal products. In addition, automotive service facilities and food service facilities sometimes discharge polluted washwaters to the MS4 and have been identified as a major cause of widespread contamination and water quality problems.

Local Sources of Pollutants

Based on information provided by public agencies, published values from prior studies, and field observations the main source of pollutants in the local watersheds is non-point source related. These sources include; over irrigation of landscaping, erosion of native soils, septic systems, livestock, pet and yard waste and other human related activities (Table 2.8).

Table 2.8. Local Sources of TMDL Pollutants

Pollutant	Pollutant Source
Coliform	Septic system failure Livestock waste Pet waste Decomposition of organic debris Trash
Nutrients	Livestock waste Reclaimed water irrigation Septic system failure Landscape and yard waste Atmospheric deposition
Organic enrichment/low dissolved oxygen	Decomposition of organic debris Trash
Scum/foam-unnatural	Numerous potential sources
Sedimentation/siltation	Erosion of native soil
Selenium	Erosion of native soil
Trash	Human activities

2.4.1.5 Best Management Practices

The Permit requires that the SQMP specify BMPs that will be implemented to reduce the discharge of pollutants in storm water to the maximum extent practicable. For example, Landscape and Recreational Facilities Management requirements include implementation of procedures to encourage retention and planting of native vegetation and to reduce water, fertilizer, and pesticide needs.

The Permit includes provisions that promote customized initiatives, both on a countywide and watershed basis, in developing and implementing cost-effective measures to minimize discharge of pollutants. For example, if a Permittee identifies a need to implement additional or different controls than described in the countywide SQMP, a Permittee may develop and request RWQCB approval for implementation of a Local SQMP that is customized to reflect the conditions in the area under the Permittee's jurisdiction. A Permittee group can also apply to substitute a regional or subregional storm water mitigation program to substitute in part or wholly for the Standard Urban Stormwater Mitigation Plan (SUSMP) requirements set forth in the Development Planning Program of the Permit. The proposed substitute program will be considered for approval by the RWQCB if its implementation will result in equivalent or improved storm water quality, protect stream habitat, promote cooperative problem solving by diverse interests, be fiscally sustainable and include secure funding, and be completed in 5 years including the construction and start-up of treatment facilities.

Existing City Programs

Storm water BMPs are implemented on both public and private land throughout the City of Calabasas. Pursuant to Title 17, Land Use and Development, Chapter 17.56 and Title 8, Health and Safety Chapter 8.28 of the Calabasas Municipal Code relating to the control of pollutants carried by storm water runoff, all new developments are conditioned to include BMPs as applicable per the SUSMP requirements. The Environmental Services Manager in the Public Works Department has the primary responsibility for ensuring that the requirements are implemented. In addition, Chapter 17.26 of the Land Use and Development Code requires a percentage of property to remain pervious depending on the zoning of the property proposed for development. For example, thirty percent of pervious area is required for all new parking lots, with runoff either being directed to those pervious areas or media filtration or like BMP installed to remove oil and grease from storm water flowing over parking lots, with the developer required to submit proof of ongoing maintenance of the media filtration or like device prior to issuance of building permits. These requirements are implemented during the Development Review Committee (DRC) for all development priority projects.

In addition to BMPs implemented on new developments, the City has also implemented structural BMPs in certain priority locations around the City. To date, the City has installed 41 catch basin filter inserts and two in-line gross solids removal units in the municipal storm drain system, with an additional gross solids removal unit to be installed in the near future. Based on the results of this study and subsequent project-specific investigations, the City will continue to seek funding for and implement additional storm water BMPs designed to reduce pollutant loading to the receiving waters to the maximum extent practicable.

CHAPTER 3.0
PLANS AND POLICIES

3.1 CITY OF CALABASAS GENERAL PLAN

The City of Calabasas incorporated in 1991 as a response by local residents to the overly intense development in the region by Los Angeles County. The City's General Plan was adopted in 1995 to define what makes Calabasas a special place, delineate a vision for its future, and formulate programs to achieve that future. The General Plan is reviewed annually and can be amended up to four times per year to ensure that current conditions and social values are reflected.

The three primary watershed drainages that lie within the City's limits are surrounded by a mosaic of residential, recreational, and commercial uses, which developed over time and have been formalized in the General Plan as the City's Land Use Districts. In addition, a parks, recreation, and open space system is envisioned within Calabasas that will provide parks for urban residential neighborhoods, establish a comprehensive trails system, and meet the open space and recreational needs of Calabasas residents.

The preservation of remaining open space lands and the protection of significant environmental features within Calabasas are, according to the General Plan, the highest priorities of the City. This includes protecting significant environmental resources, maintaining public health and safety, managing the production of resources, and providing open space for public recreation. Open space for public recreation includes setting aside public parks and recreational areas as well as maintaining a system of trails that can be used for hiking, equestrian riding, and mountain biking. In addition to preserving existing open space, the General Plan calls for environmental design and site planning that works with nature to minimize the loss of resources, reduce the off-site impacts of development, and restore environmental and landscape quality that may have been compromised by past actions.

With respect to biotic resources, the General plan states, "It is a high priority of the City to protect and, where feasible, facilitate restoration of the biological productivity and quality of vegetative and wildlife habitats throughout the remaining open spaces within the General Plan study area." To accomplish this, the City has undertaken to identify and preserve large self-sustaining habitat management areas through public acquisition of lands and open space easements within significant resource areas. In addition, the City has adopted an oak tree preservation ordinance and has extended similar protection to other stands of significant natural vegetation through the General Plan's Environmental Management and Development Review Programs.

The General Plan also calls for a number of specific policies intended to maintain water quality within natural drainages so that resource-dependent recreation and the biological capacity of riparian areas will not be adversely affected. These measures include protecting natural watershed areas within the General Plan study area, controlling water consumption by existing and new development through an emphasis on drought-tolerant planting techniques, use of water-efficient plumbing and water reclamation, and promoting the reduction of pollutants and sedimentation from existing uses through public education, erosion control, and implementation of workable BMPs.

As called for in the Water Resources Section II E. of the General Plan, the City of Calabasas has maintained full compliance with the NPDES Permit requirements. The City has a dedicated Environmental Services Manager (ESM) and Environmental Services Assistant to oversee the complete implementation of the permit requirements. As outlined in the goals and policies set forth in the General Plan, the City has an overall commitment to the protection and enhancement of their receiving waters that goes beyond minimal Permit compliance.

3.2 DRAFT WATERSHED MANAGEMENT AREA PLAN FOR THE MALIBU CREEK WATERSHED (JANUARY 2001)

Using the Las Virgenes Malibu Conejo Council of Governments as fiduciary agent, the watershed cities (Calabasas, Westlake Village, Agoura Hills, and Malibu) and Los Angeles County pooled funding and resources and hired a consultant to write the Draft Watershed Management Area Plan for the Malibu Creek watershed. Although never formally adopted as a policy document, this study was used as a basis for preparation of the Malibu Creek Watershed Management Area Plan that Los Angeles County submitted to the RWQCB to meet requirements of the 2001 Report of Waste Discharge. At this time, the watershed Cities and L.A. County are working together to develop Plan Blue, an urban runoff reduction plan. Plan Blue incorporates the previously completed Draft Watershed Management Area Plan (WMAP) and focuses on regionally consistent and cost-effective NPDES Permit implementation with a view towards overall watershed stewardship. The action plan developed in Plan Blue will not only be implemented in the Malibu Creek Watershed, but across the entire North Santa Monica Bay area which includes Topanga Canyon and several smaller rural watersheds that drain directly into Santa Monica Bay.

3.3 LOS ANGELES RIVER MASTER PLAN (JUNE 1996)

The Los Angeles River Master Plan (LARMP) creates a vision of the Los Angeles River as a resource. The LARMP goals are to guarantee flood protection to surrounding communities, provide diverse recreational opportunities, enhance river appearance, and create sustainable local economies. Combined, these goals seek to enrich the quality of life adjacent to the Los Angeles River.

3.4 SANTA MONICA MOUNTAINS NORTH AREA PLAN (OCTOBER 2000)

The Santa Monica Mountains North Area Plan (SMMNAP) is an element of the Los Angeles County General Plan. The SMMNAP serves as a planning tool to regulate development within the unincorporated area of the Santa Monica Mountains. The SMMNAP consists of five elements, two of which, the Conservation and Open Space and the Land Use and Housing Elements, affect water quality. The Conservation and Open Space Element prioritizes resource protection over land development. This principle recognizes that irreplaceable resources must be managed to protect biological habitats and corridors, water quality, scenic resources, open space, and recreation. The Land Use and Housing Element aims to protect significant environmental resources and avoid developments that negatively impact environmental resources. Existing communities are expected to maintain their unique character and create distinct boundaries between suburban and rural areas. Furthermore, the plan promotes accessible outdoor recreation.

3.5 LAS VIRGENES GATEWAY MASTER PLAN (DECEMBER 1998)

The City of Calabasas in the Las Virgenes Gateway Master Plan (LVGMP) seeks to establish a balance between the community and nature along the Las Virgenes corridor through specific land use and development plans. The LVGMP goals aim to promote the rural character of Calabasas, increase aesthetics, preserve the natural environment, and prevent significant environmental degradation. This plan may be used as a tool to obtain grants for public improvements, including trail construction and creek restoration.

3.6 LAS VIRGENES CORRIDOR DESIGN PLAN (JANUARY 1998)

The Las Virgenes Corridor Design Plan (LVCDP) is a comprehensive plan that aims to improve Las Virgenes Road from Mulholland Highway to the Ventura County jurisdictional line. The plan recommends methods to beautify the road and better circulation and traffic. Beautification includes planwide landscaping to fit the natural environment, preserve views, and use native and noninvasive drought-tolerant plants. Circulation as well as recreational opportunities will be enhanced by a bikeway system running the length of the corridor.

CHAPTER 4.0
OPPORTUNITIES AND CONSTRAINTS

Numerous opportunities exist for implementation of specific projects related to the overall project objectives. Opportunities were defined as a potential for changing the existing conditions to suit the project objectives of: improving water quality related to TMDLs, improving water quality for native fish, restoring creek and riparian habitat, and improving recreational and educational facilities and features.

In order to effectively evaluate opportunities, constraints must also be identified. Constraints within the study area are conditions that would increase the expense, longevity, or physical difficulty of implementing any identified opportunity within the study area. There are some common constraints that projects would encounter, and those unique to specific locations along each of the creeks.

An important general constraint that would be faced by any restoration project is the California Environmental Quality Act (CEQA) review process. This process could include an Environmental Impact Report (EIR), and permits from regulatory agencies such as the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, California Department of Fish & Game and California Regional Water Quality Control Board. Because of the various requirements of the review process, permits and CEQA documentation can add considerable cost and time to even a small habitat improvement project. A programmatic approach that completed the CEQA and permitting process for many of the restoration projects at once would provide significant savings.

4.1 IMPROVING WATER QUALITY TARGETING THE SPECIFIC TMDLs

4.1.1 <u>Opportunities</u>

As stated previously, the identified TMDLs in the study area include: coliform (bacteria), nutrients, organic enrichment, scum/foam, sedimentation, Selenium and trash. There are numerous options for reducing each of the specific TMDLs through a combination of source control and structural BMPs. In addition to various controls on the contaminants, there should be improvements made in the water quality monitoring program throughout the study area to target TMDL pollutants in a manner that would provide conclusive data on compliance with required water quality standards. With improved monitoring data more appropriate decisions could be made using the most up-to-date data.

An additional option for general water quality improvement is the implementation of a comprehensive storm water management program targeting TMDLs. This program, currently under development by the City, would provide source control measures for residential, commercial, and open space areas within the City. Potential source control options within this plan could include implementing Integrated Pest Management (IPM) practices, which would reduce the quantity of pesticide and herbicide currently applied in the study area by City Public Works contractors.

Coliform

Opportunities for reducing coliform will depend on the type of coliform identified in the study area. Coliform levels can be elevated from the decomposition of organic matter or from the feces of animals or humans. Water quality testing for total and fecal coliform can be used to determine relative levels of coliforms from organic versus feral sources. However, the difference between the two sources of fecal coliform (animal or human) can only be determined by more comprehensive water quality testing, which may include DNA testing.

Typically, organic matter can be controlled through source control options. These can include: increased frequency of street sweeping, proper disposal of lawn cuttings and similar landscape maintenance debris, and public outreach to inform the public of the concern.

If the bacteria are determined to be from feces then a different approach is required. This approach would include a comprehensive survey of all regions within the study area to determine the use of septic systems, the presence of livestock facilities and the condition of the sanitary sewer lines in the area. These three operations make up the primary sources of coliform in the study area.

After determining the locations of active septic systems in relation to local water courses and ground water elevations, it should be determined whether the systems are operating correctly. If any septic systems are determined to not be functioning properly immediate corrective action should be taken. Depending on the quantity and condition of septic uses in the area, it may be beneficial to implement a program to monitor the systems and require reporting on routine inspection and maintenance conducted by the facility owners.

Any existing livestock facilities should also be mapped relative to study area watercourses. Each facility's animal waste management procedures should be reviewed for adequacy and proper functioning. If a need for additional BMPs is identified, corrective action should be taken through partnering with the landowners to improve the runoff pollution prevention controls at their facilities.

Sanitary sewer systems are owned and operated by public entities that are required to implement maintenance programs and spill response procedures pursuant to State and Federal law. EPA has recently developed a comprehensive management framework called Capacity, Management, Operations, and Maintenance (CMOM) to further regulate and assist municipalities in developing more comprehensive sanitary sewer system management programs. These proposed EPA regulations will affect all publicly-owned collection systems and publicly owned treatment works (POTW) systems with collection systems attached. In the study area, the sanitary sewer trunk lines are owned and maintained by the local POTW, Las Virgenes Municipal Water District (LVMWD), and the smaller collection system is owned by the City and maintained through the Los Angeles County Sanitation District. Currently, LVWMD has an informal policy to provide immediate response and containment to overflows on the City's system until the Los Angeles County staff arrives. These partnerships need to be formalized, between the City, the County, and LVMWD to implement the EPA's CMOM programs.

Nutrients

As discussed in Chapter 5 and in Appendix A, there are combinations of source control and structural BMPs that can reduce nutrients (nitrate, ammonia, and phosphate) from entering into the study area waterways. The nutrient levels in receiving waters are dependant on source loadings in the watershed, runoff intensity, and physical, chemical, and biological interactions within the aquatic environment. Therefore decreasing the nutrient source within the watershed lowers the nutrient loading. Several of these sources are also coliform sources (sewage, manure, landscape waste, etc.) and can be addressed as discussed above. Additionally, increases in biological and chemical processes increase the removal of nutrients within the watershed.

The results of the modeling indicate that structural BMPs are more effective in reducing ammonia and phosphate loading than the nitrate loading. The modeling also indicates that nitrate loading is reduced most effectively by source control measure rather than structural BMPs.

Organic Enrichment/Low Dissolved Oxygen

Organic enrichment/low dissolved oxygen can be the result of several different issues occurring within the study area. Among other possibilities, it is certainly related to a combination of organic inputs into the study area creeks, as well as an increase in the water temperature and available sunlight. When there is high organic input into the creek, nutrient levels also increase. When a creek with high organics is subjected to warmer water temperatures and increased sunlight, plant (algae) growth increases. As the algae uses up the available nutrients it starts to die off. As the algae dies and decomposes, oxygen from the water consumed during this process and can reach levels too low to sustain aquatic life.

The opportunities for improving organic enrichment/low dissolved oxygen are interrelated with the nutrient controls and reductions outlined in the previous section. Additional measures that reduce organic enrichment and increase dissolved oxygen include; reducing the amount of concrete, which acts as a heat source, in the stream channel to reduce temperatures, increasing the shade canopy along the creek corridor, and allowing the creek to pass over rocks for turbulence to increase the quantity of dissolved oxygen in the water.

Scum/Foam

There are numerous ways that scum/foam can be created in the study area creeks. Some of the ways it can be created are from natural processes and some unnatural. An example of a natural process would be the growth of plants that produce natural surfactants, while an unnatural process would be the introduction of detergents from illegal dumping or illegal connection of washing facilities into the storm drain system. This TMDL is directed towards the unnatural processes. In addition to detergents, there are a variety of contaminants that when agitated in the creek can create foam. Reduction of scum and foam is accomplished by overall reductions in other non-point source contaminants such as nutrients, coliform, and trash.

Sedimentation/Selenium

Selenium is a naturally occurring element within the soils of the study area. Reducing soil erosion within the study area can reduce sedimentation and selenium within the creeks. Numerous opportunities exist for reducing erosion. The exact locations of these sites are identified in the riparian habitat enhancement section 4.1.3. In addition to the sites within the creek corridor, erosion also occurs along the shoulders of the main roadways within the study area. The road shoulders along Las Virgenes Road and Mulholland Highway are cleared of vegetation to reduce the fire potential. However, once this vegetation is cleared the soil is not held in place and erodes during storm events. If another acceptable fire control option can be identified it should be implemented along the two main highways within the study area. One possible option that could be evaluated for the road shoulders could be a combination of gravel and some type of porous pavement.

Trash

Opportunities for reducing the trash entering the study area creeks include increased street sweeping, increased public outreach to the problem, and coordinated efforts with adjacent jurisdictions, and Caltrans. Caltrans is needed in the coordination so that any trash from the 101 Freeway can be removed before entering the study area. The primary area identified for trash reduction was a dirt turn-out next to the 101 Freeway just east of the westbound off ramp at Las Virgenes Road.

4.1.2 Constraints

Constraints for all water quality parameters within the study area relate to water quality monitoring data. Up to this point there has not been a comprehensive program in place to conduct simultaneous flow measurement and water quality sampling and analysis for the specific TMDL contaminants. Without comprehensive monitoring in place it will be extremely difficult to measure the effectiveness of either source control measures or structural BMPs on the water quality within the study area. Water quality sampling and testing is costly, including a high level of staff commitment, equipment costs, and laboratory fees. Flow monitoring is also costly, and has the added challenge of needing to install structural equipment within waterways. Not only is the equipment expensive, but the process of obtaining all necessary permits to install and operate the flow meters can also be a significant cost as well.

An additional constraint involves mapping of the current storm water conveyance system within the study area. For appropriate structural BMP placement it is imperative to accurately map the storm water drainage area for each specific region. Currently the available AutoCad mapping of the City's storm drain system is in need of updates and should be converted to GIS format so that it can be used in conjunction with local topographic mapping to identify the correct location for the structural BMPs. The majority of the municipal storm drain system is owned and maintained by Los Angeles County Public Works Department, with a few drains still under developer ownership in the process of transfer to the County and some drains owned by the City but maintained by the County through contracted services. Although Los Angeles County is in the process of creating GIS based maps of their storm drain systems, there are proprietary issues that are impeding information sharing between the County and the cities within the County. At this time, the City would be required to purchase the current maps from the County at significant costs.

4.2 IMPROVING WATER QUALITY FOR STEELHEAD TROUT

4.2.1 Opportunities

Currently, steelhead trout (*Oncorhynchus mykiss*) are not found in the study area creeks. As identified in Native Fish Habitat Assessment Report (Appendix B), the steelhead were historically found in Las Virgenes Creek. Opportunities for improving the current water quality for the steelhead coincide with the TMDL improvement opportunities including shading the creek and reducing water temperatures. Reductions of algae blooms are also needed for optimal steelhead habitat. Steelhead require cool, highly oxygenated water for optimum survival rates. Currently, habitat is available within the study area for the steelhead.

The removal of barriers and concrete, as stated in the next section, *Opportunities for Aquatic and Riparian Habitat Enhancement and Restoration*, also facilitate steelhead movement. In addition, this section includes project sites identified for creating riffles, which benefit stealhead by providing one of their food sources, macro-invertebrates, with ideal their habitat. Increasing the survival of their food source may increase chances of steelhead's own survival if re-introduced.

4.2.2 Constraints

As related to the constraints for the TMDL requirements, appropriate water quality data are currently lacking to make a determination on potential steelhead reintroduction. The existing data do not include flow measurements, adequate temperature records, nor dissolved oxygen profiles necessary to make an informed decision on the success of steelhead reintroduction.

In addition to the water quality constraints for the steelhead, there are numerous structural barriers both within and outside the City. These barriers include the Rindge Dam and numerous concrete bridges and culverts on Malibu Creek as well as Las Virgenes Creek (Appendix B). This combination of constraints can also be viewed as a listing of opportunities to improve the water quality and habitat for reintroduction in the future.

4.3 AQUATIC AND RIPARIAN HABITAT ENHANCEMENT AND RESTORATION

4.3.1 Opportunities

Through analysis of the baseline data collected in January and March 2003, a number of opportunities for enhancement and restoration of riparian and aquatic habitat were identified for Las Virgenes, Dry Canyon, and McCoy Creeks (Figures 4.1, 4.2, and 4.3). Table 4.1 summarizes the types of improvements that could be implemented to improve habitat in and around the creeks. Most of the improvements involve the direct creation or restoration of wetland and riparian areas. Some improvements are related to maintaining existing habitat, such as removing sediment, controlling exotic plant species, and stabilizing banks to reduce erosion. Others would involve improving structural aspects of the stream by removing artificial structures such as a concrete bottom, or adding a channel meander.

Table 4.1. Number of Locations for Habitat Improvement Opportunities

Habitat Improvement Opportunity	LVC	DCC	MC
Stabilizing creek banks/channel incision/erosion	8	5	8
Monitoring channel incision/erosion	4	1	3
Pulling back creek banks	11	2	2
Creating/restoring wetland habitat	13	4	3
Creating/restoring riparian habitat	1	1	1
Removing concrete to reestablish soft creek bottom	2	2	
Removing artificial structural stabilization (e.g., crib walls, rip-rap)	4		
Revegetating creek banks/floodplain		4	1
Removing exotic plant species	3	2	1
Removing sediment		1	3
Improving physical creek structure	3	3	3
Adding pools/riffles or creating channel meander		3	

LVC = Las Virgenes Creek
DCC = Dry Canyon Creek
MC = McCoy Creek

Each of the three creeks within the study area presents a unique set of opportunities with respect to habitat improvement based on existing channel modifications, adjacent land uses, and natural conditions.

Las Virgenes Creek

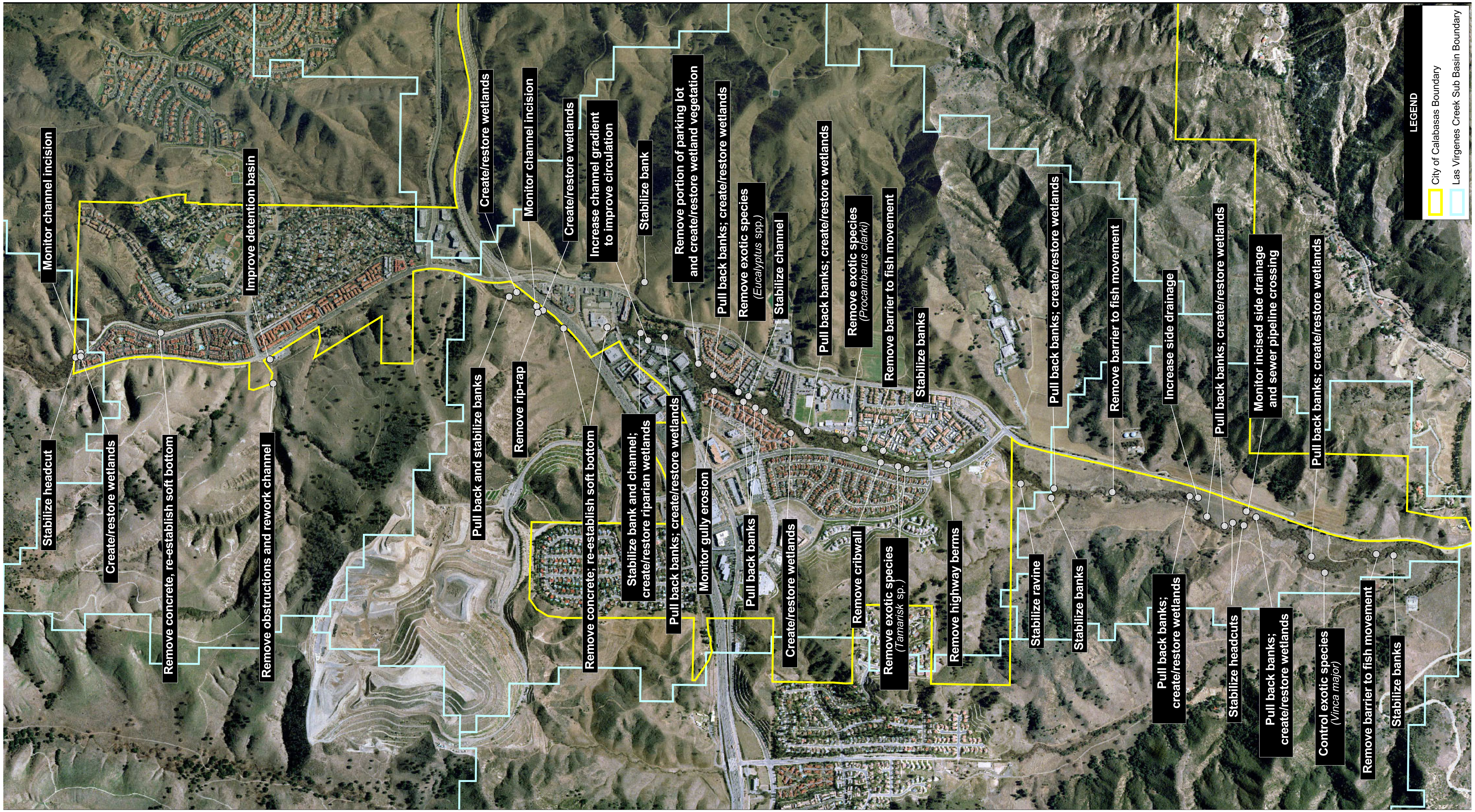
The largest category of habitat improvement opportunities for Las Virgenes Creek, 13 locations, is wetland habitat creation or restoration activities. Twelve sites have been identified where erosion or channel incision could be stabilized or monitored. The remaining opportunity sites would involve removal of artificial stabilization structures, channel maintenance, and improvement of the physical structure of the channel.

Locations that have been identified as possible wetland creation/restoration sites most often include channel alteration (pulling back the creek banks). These sites include the northernmost reach of the creek (near the Ventura County jurisdictional boundary within the City limits), directly north of the existing concrete portion of the Las Virgenes Creek channel (the reach located northwest of the intersection of Las Virgenes Road and the 101 Freeway), three areas south of Agoura Road adjacent to a commercial area, three areas along the reach flanked by residential uses (south to the intersection of Lost Hills Road and Las Virgenes Road), and five locations within Malibu Creek State Park.

Erosion control and monitoring could be implemented at the northernmost reach of the creek upstream of the concrete trapezoidal channel, along the channel as it passes northeast of Las Virgenes Road and the Ventura Freeway, in a number of locations along the reach that is restricted by commercial and residential uses between Agoura Road and the intersection of Lost Hills Road and Las Virgenes Road, and five identified locations within Malibu Creek State Park.

Other opportunities to improve habitat along Las Virgenes Creek include removing a portion of the concrete channel bottom north of Thousand Oaks Boulevard and restoring it to a natural soft creek bottom. The drainage channel and detention basin to the west of Las Virgenes Creek and Thousand Oaks Blvd could be improved by removing obstructions to drainage and reworking the channel and basin. Rip-rap could be removed along the segment of the creek northwest of Las Virgenes Road and the Ventura Freeway and a crib wall along the western bank north of Las Virgenes Road could be eliminated along with highway berms just south of the road. A concrete removal and creek restoration opportunity is also identified along the creek channel between the Ventura Freeway and Agoura Road Bridge, which the City has currently in the planning process.

Exotic species removal would be beneficial in three primary locations, a pocket of eucalyptus located adjacent to residential uses north of A.E. Wright Middle School, tamarisk in the area



Source: Mountains Restoration Trust, 2002

NORTH

500 0 500 1000 Feet

Scale: 1 : 6,000; 1 inch = 500 feet

Figure 4.1
Habitat Improvement Projects
Las Virgenes Creek

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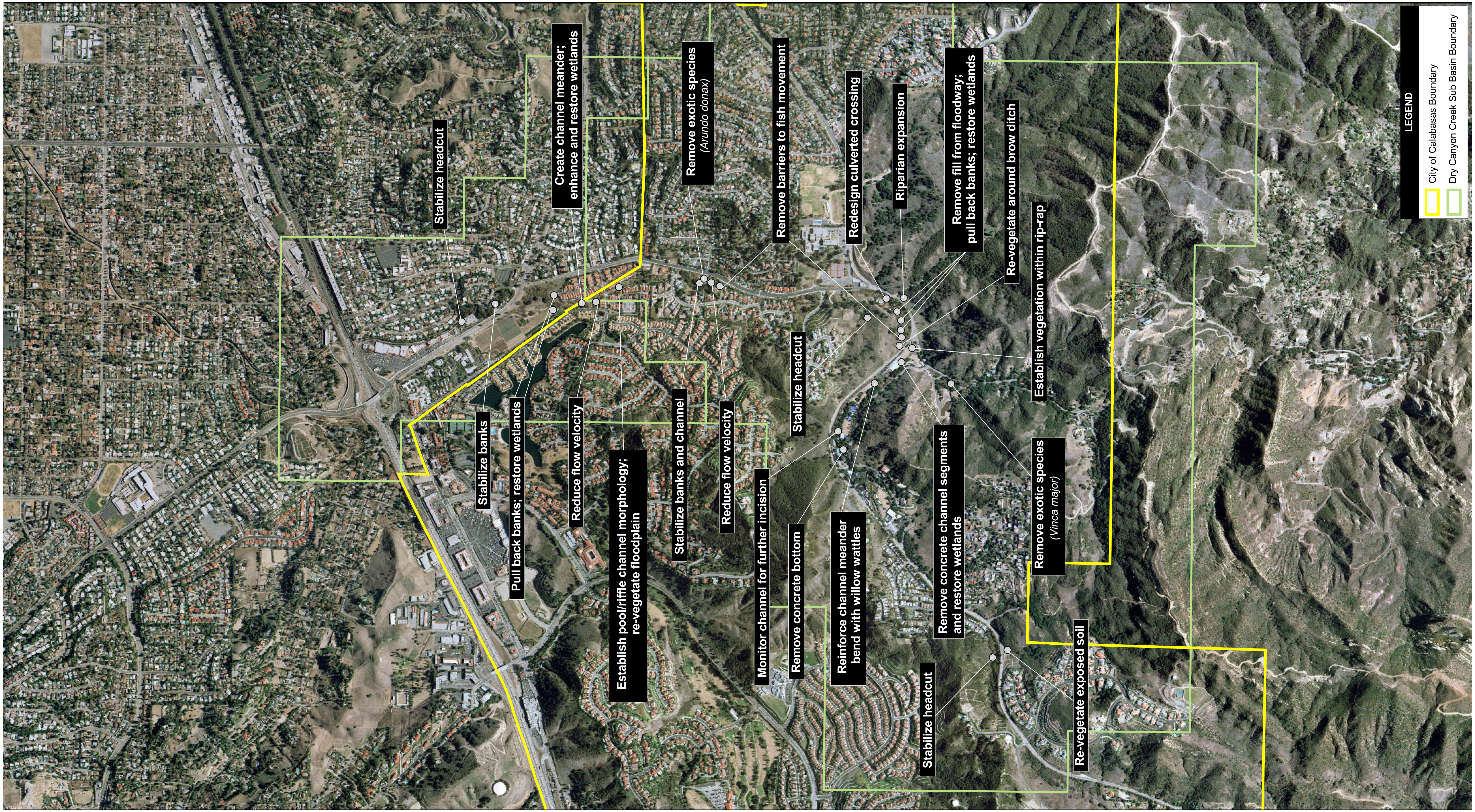

Source: Mountains Restoration Trust, 2002

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Scale: 1 : 6,000; 1 inch = 500 feet

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Figure 4.2
Habitat Improvement Projects
Dry Canyon Creek

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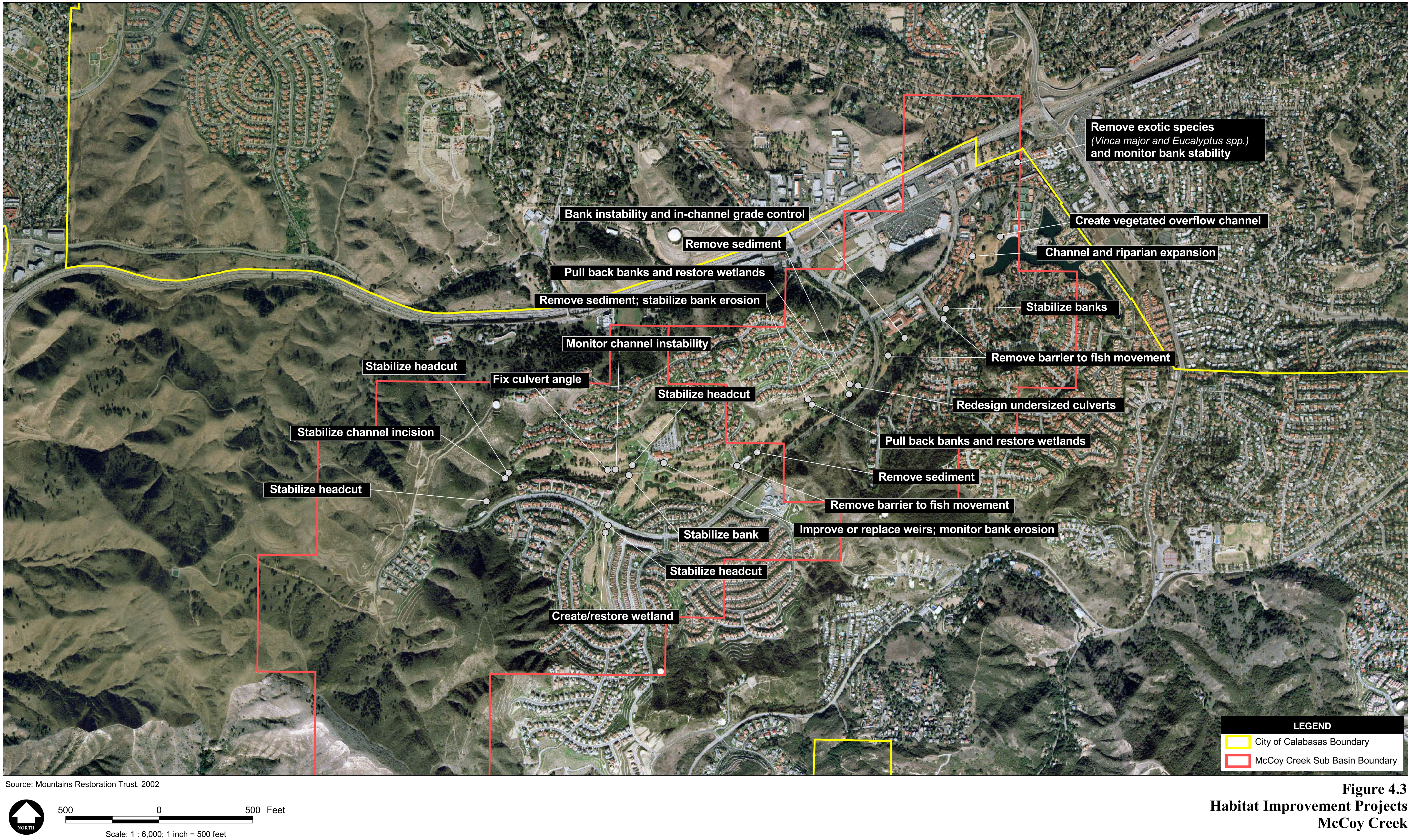

Figure 4.3
Habitat Improvement Projects
McCoy Creek

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north of Las Virgenes Road, and *Vinca major* along the creek in Malibu Creek State Park in the southern portion of the study area.

Dry Canyon Creek

Along Dry Canyon Creek, habitat improvement opportunities primarily relate to erosion control (bank stabilization and revegetation of the floodplain), restoration of wetland and riparian habitat, and physical improvement of channel morphology. Six locations have been identified where stabilization or monitoring of erosion or bank incision are needed. Wetland or riparian habitat restoration would be beneficial in five locations. Revegetation of creek banks or the floodplain, or the removal of exotic species could be implemented in six locations. Physical improvements to the channel structure, such as adding pools and riffles or removing a concrete channel bottom, would be beneficial in nine locations.

Bank stabilization opportunities exist along the upper reaches of Dry Canyon Creek, along Mulholland Highway, along the segment adjacent to the Viewpoint School, and at Wrencrest Drive where the creek emerges from an underground channel.

Creation or restoration of wetland or riparian habitat could be accomplished adjacent to the horse stables west of Old Topanga Canyon Road on Mulholland Highway, on the Mountains Restoration Trust property along the north side of Mulholland Highway east of the intersection with Old Topanga Canyon Road, and adjacent to Park Paloma near the northern boundary of the City.

Revegetation of creek banks or floodplains would be beneficial along the upper reaches of Dry Canyon Creek along Mulholland Highway, around the brow ditch located north of the intersection of Mulholland Highway and Old Topanga Canyon Road, within the rip-rap located at the intersection of Mulholland Highway and Old Topanga Canyon Road, and adjacent to Park Paloma. Exotic plant species removal is needed along the tributary that flows north along Old Topanga Canyon Road (*Vinca major*), where the creek emerges from the underground channel at Wrencrest Drive (*Arundo donax*), and along the Mountain Restoration Trust's property near the intersection of Mulholland Highway and Old Topanga Canyon Road (Virginia Creeper).

Physical improvements of several types could be implemented along Dry Canyon Creek. Concrete channel segments could be removed southwest of the horse stables at Mulholland Highway and Old Topanga Canyon Road. Flow velocity could be reduced near Wrencrest Drive where the creek emerges from an underground channel and adjacent to Park Paloma. The segment near Park Paloma would also be appropriate for establishment of pool/riffle channel morphology, and an upstream reach, near the City boundary, would benefit from an addition of a channel meander.

McCoy Creek

The largest category of opportunities for habitat improvement (11 locations) along McCoy Creek is related to stabilizing the creek banks to prevent or repair erosion and channel incision. Four locations would be appropriate for creating or restoring wetland and riparian habitat, physical channel improvements could be implemented in six locations, and exotic plant removal and revegetation could be performed in two locations.

Stabilization and monitoring of creek bank erosion and incision, as well as the removal of sediment, would be beneficial at a number of locations along McCoy creek. Most of the locations are just upstream of, or within the Calabasas Golf and Country Club, through which the creek flows. Wetland creation or restoration is feasible on the tributary south of Parkway Calabasas, at two locations toward the eastern end of the golf course north of Parkway Calabasas, and riparian expansion could be accomplished along the creek west of Lake Calabasas.

Additional physical improvements to the channel within the Calabasas Golf and Country Club include improvements to culverts and replacement of existing weirs. Bank stabilization and in-channel grade control could also be implemented along the portion of the creek located on Countrywide Financial property.

Exotic plant removal would be beneficial south of Calabasas Road near the northern City boundary, and a vegetated overflow channel for Lake Calabasas could be created near the Calabasas Tennis and Swim Center.

4.3.2 Constraints

Las Virgenes Creek

Because the suitable area for habitat restoration near the northern City boundary on Las Virgenes Creek extends outside the City, activities there may require coordination with the Los Angeles County Department of Public Works. In addition, removal of the concrete bottom along the trapezoidal channel south of the City's northern boundary or widening of the creek banks for restoration purposes cannot impact the flood capacity of the channel. Residential uses in this area encroach on the floodplain along this reach.

Both the drainage and detention basin located south of Thousand Oaks Boulevard west of the creek, and the potential restoration area northwest of the intersection of the Ventura Freeway and Las Virgenes Road, lie outside the City boundary within an unincorporated area of Los Angeles County. Projects in these locations would require coordination with Los Angeles County Department of Public Works. For the restoration area, an additional constraint would be providing access to the project site. No access is available from the Ventura Freeway, and the north bank of the creek quickly rises to a steep incline. Access to the reach would only be possible from Las Virgenes Road. An additional restriction is the close proximity of the Ventura Freeway to the southern bank of the creek at this location.

Removal of concrete and reestablishment of a soft channel bottom in the channel between the Ventura Freeway and Agoura Road would be constrained by the encroachment of commercial businesses on both banks of the creek. The floodplain could not be expanded at this site. Locations of utilities in or near the channel would also affect the planning of structural alterations at this site. The City has recently released a Request for Proposals to contract for the creek restoration design work for this specific site. Grant funding is also secured to complete the construction/restoration phase of the project once the restoration design is approved by the granting agencies.

The area south of Agoura Road where restoration of riparian habitat could be implemented is accessed down a steep embankment, and covered with dense vegetation, both of which would make access to the area problematic. In addition, private property encroaches on the floodplain on each side of the creek along this stretch.

The region of the creek located north of A.E. Wright Middle School and adjacent to residential uses presents opportunities for a number of habitat restoration and improvement projects. The only known constraint for these projects is the boundary of private property along the floodplain.

The reach parallel to Lost Hills Road north of its intersection with Las Virgenes Road has been identified as an opportunity to improve habitat by removing a cribwall and exotic species (tamarisk). Access to this area is down a steep hillside where sensitive resources are present. The equipment needed to complete projects at this location could cause unacceptable damage to existing resources while accessing the area. Depending on the desired scope of work, the exotic species could be removed by hand to minimize the disturbance to sensitive habitat, however the concrete removal would require heavy equipment.

The remaining opportunity locations are located south of the City boundary in Malibu Creek State Park. Projects in this area would require coordination with California State Parks. In some locations along this reach of the creek, it may also be necessary to coordinate with Las Virgenes Municipal Water District to identify the location of sewer lines.

Dry Canyon Creek

Much of the land through which Dry Canyon Creek flows is private property. In addition, all lands located within 500 feet of Mulholland Highway are within the Scenic Corridor overlay zone. Within the viewshed, all development and proposed land use requires a special land use permit and must include elements that ensure enhancement and beautification of the scenic corridor.

Along the creek parallel to Park Paloma, where floodplain revegetation and channel realignment have been identified as opportunities, mature oaks are present on the floodplain. This would necessitate carefully planning of any change in channel morphology to avoid impacts to these sensitive resources.

No known project constraints exist in the area identified as a possible wetland restoration and channel realignment site located between the City boundary and Lake Calabasas.

McCoy Creek

The major constraint on projects proposed for McCoy Creek would be coordination with the owners of the private property, such as the Calabasas Golf and Country Club, through which almost the entire length of the creek flows. An additional constraint exists at the location where the creek emerges from a gated community where a steep hillside would make access difficult. Also, the presence of mature oaks throughout the park adjacent to Lake Calabasas would necessitate careful planning of restoration projects to avoid impacts to this sensitive resource.

4.4 IMPROVE RECREATIONAL FACILITIES WITHIN THE STUDY AREA

4.4.1 Opportunities

Currently the City Planning Department is in the process of completing a Trails Master Plan for the study area. This Plan is being developed in partnership with the Santa Monica Mountains Conservancy with funding provided by the New Millennium development project. The Trails Master Plan will allow for comprehensive planning for a trail system throughout the study area (Figure 4.4). This Plan is currently undergoing internal review and revision and is expected to be available for public input in 2003. Within the Trails Plan there is a proposed trail (Calabasas-Cold Creek Trail) that would provide access to the McCoy Creek riparian area for recreational purposes.

An additional opportunity is to continue to assist Mountains Restoration Trust with open space acquisition particularly in the Headwaters Corner area. This would allow an additional area of access to the riparian area and provide for a valuable passive recreation, as well as educational area.

Other recreational facilities that are currently being planned by the City include two new parks. One at the intersection of Las Virgenes Road and Lost Hills Road, adjacent to De Anza Park, and the second near the intersection of Mulholland Highway and Old Topanga Canyon Road, to be named Wild Walnut Park.

4.4.2 Constraints

Constraints for improving recreational facilities include: purchasing appropriate and available parcels; coordinating between the Planning Department and Public Works Department to determine which Department will lead the effort to identify the appropriate parcels; and determining an adequate funding source for purchase, development and maintenance for any facility.

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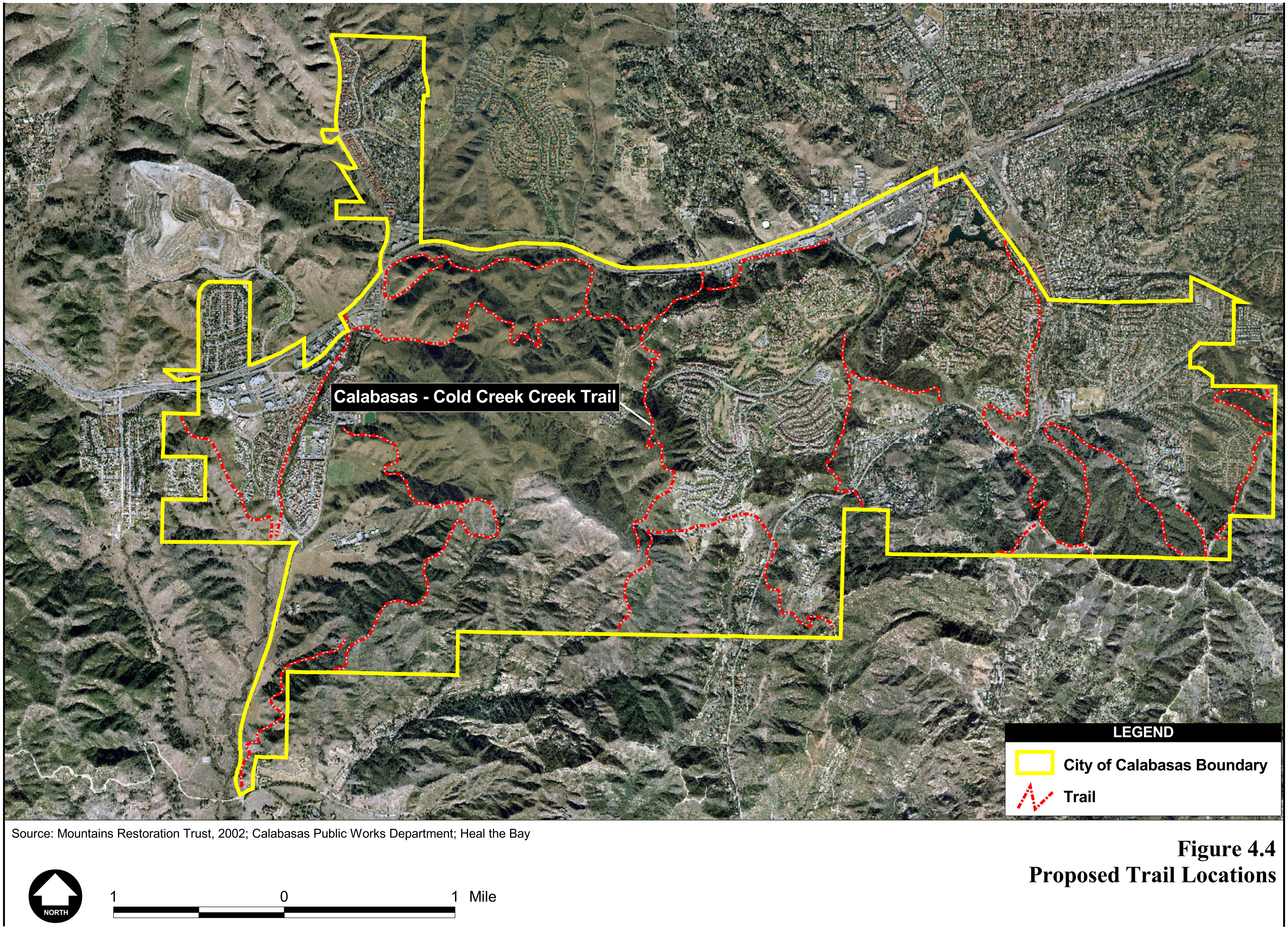

Source: Mountains Restoration Trust, 2002; Calabasas Public Works Department; Heal the Bay

Figure 4.4
Proposed Trail Locations

4.5 IMPROVE EDUCATIONAL OPPORTUNITIES AND FACILITIES WITHIN THE STUDY AREA

4.5.1 Opportunities

Opportunities to improve educational facilities are numerous throughout the study area. These opportunities include:

- Placement of roadside signage to indicate the watershed boundaries so that motorists and pedestrians become more aware of the local geography and where the local creeks drain.
- Assist the Mountains Restoration Trust with the continuing effort to purchase the remainder of Headwater Corners and surrounding parcels on Dry Canyon Creek for continuing watershed education programs.
- Assist the Mountains Restoration Trust with the development of a citizen-monitoring program. Also partner with local groups to develop public participation in creek restoration projects.
- Include storm water pollution prevention and habitat protection signage along the proposed A.E. Wright footbridge crossing of Las Virgenes Creek. For example, the City could post a sign/kiosk explaining how the bridge was designed specifically to allow for fish passage as well as allowing flood flows to pass by unimpeded.
- Incorporation of education facilities into every watershed protection or enhancement project established in the City (i.e., educational placards adjacent to restoration sites).
- Implement educational signs with information about the riparian habitat along Las Virgenes Creek in both De Anza Park and the new park across the creek towards Las Virgenes Canyon Road. These signs can incorporate educational material on native plants, wildlife, and pollution prevention.
- Work with local schools to post pollution prevention messages in classrooms and at various locations on campus. This can include working with art classes to paint a clean water mural on campus or simply by placing pollution prevention posters in classrooms.

4.5.2 Constraints

Educational facility constraints include determining if the City or a local non-profit corporation would be the operator of the facility, identifying funding sources to purchase and develop the materials or a facility, and funding to maintain any new facility. Maintenance would also be required to remove graffiti defacing any signage. Cooperation and commitment from local schools would also be needed.

CHAPTER 5.0
ALTERNATIVES DEVELOPMENT

Water quality can be improved by altering processes that affect nutrient levels in receiving waters. Decreasing the nutrient source within the watershed lowers the nutrient loading. Limiting irrigation or preventing runoff from reaching the receiving water reduces the transport of nutrients. Increases in biological and chemical processes increase removal of nutrients within the watershed also. It is possible to implement several combinations of restoration measures to decrease nutrient levels in receiving waters.

For the purposes of this restoration master plan, three main categories of restoration measures alternatives were developed and analyzed: Creek Restoration Alternative; Watershed Management Alternative 1—Structural BMPs; and Watershed Management Alternative 2—Source Control. Each category was modeled using methods described in Section 1.4. The Creek Restoration Alternative included restoration measures that improved water quality primarily through habitat restoration and creek flow modification. Watershed Management Alternative 1 included restoration measures that improved water quality primarily through trapping nutrients prior to entering the creeks (e.g., sediment trap, CDS units, and treatment wetlands/bioswales). Watershed Management Alternative 2 included restoration measures that improved water quality primarily through reducing nutrient loading at the generation source (e.g., recycled irrigation water use changes). Each of the three alternatives is further described in the sections below.

To provide a baseline for comparison, the nutrient loadings based on historical land use was also modeled. The Historical Land Use scenario and each of three alternatives were modeled for each of the three creeks.

5.1 HISTORICAL LAND USE

The Historical Land Use scenario was developed to represent the baseline nutrient loadings in the absence of human urban land uses, with atmospheric deposition being the only nutrient input to the watershed. Urbanization typically impacts the watershed characteristics and increases nutrient loadings associated with anthropogenic sources. By eliminating urbanization, this scenario establishes the natural baseline and identifies the maximum possible improvement that can be achieved for the watershed.

5.2 CREEK RESTORATION ALTERNATIVE

The Creek Restoration Alternative was developed to represent the effects of restoration opportunities in and along the creeks. The creek restoration opportunities addressed were erosion control, channel modifications, and wetland restoration (Table 5.1).

Table 5.1. Creek Restoration Opportunities

Restoration Opportunities	Stream Modifications
Erosion Control	Stabilize bank and channel
Channel Modifications	Cease vegetation clearing
	Remove concrete and rip-rap
	Stabilize banks with bioengineering techniques
	Remove or improve flow restrictions (e.g., weirs or culverts)
	Pull back banks
	Enhance floodplain
Wetland Restoration	Remove eucalyptus, vinca, tamarisk, and other exotics
	Create and restore riparian wetlands

Specific restoration actions for Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek are identified in Figures 5.1, 5.2, and 5.3. Restoration measures include stabilizing the bank and channel, removing concrete banks, pulling back banks along the creek, removing concrete channels, and reestablishing soft bottom. Improvement of vegetative uptake due to wetland restoration was determined to be relatively localized and insignificant on a watershed scale; therefore, vegetative uptake improvements were not modeled. The nutrient uptake resulting from habitat restoration is insignificant compared to the other nutrient removal alternatives because the steep gradients of the creeks do not allow sufficient time for substantial nutrient uptake and the total area for potential restoration was small.

5.3 WATERSHED MANAGEMENT ALTERNATIVE 1—STRUCTURAL BMPS

Watershed Management Alternative 1 was developed to represent the effects of reducing nutrients from runoff by treating runoff on-site within the watershed using structural BMPs before the runoff reaches the creeks. Four general types of BMPs were identified to be applicable based on land use: detention basins, biofilters, infiltration basins, and pervious concrete. Detention basins capture runoff for treatment through sedimentation. Biofilters utilize

Source: Everest International Consultants, Inc.

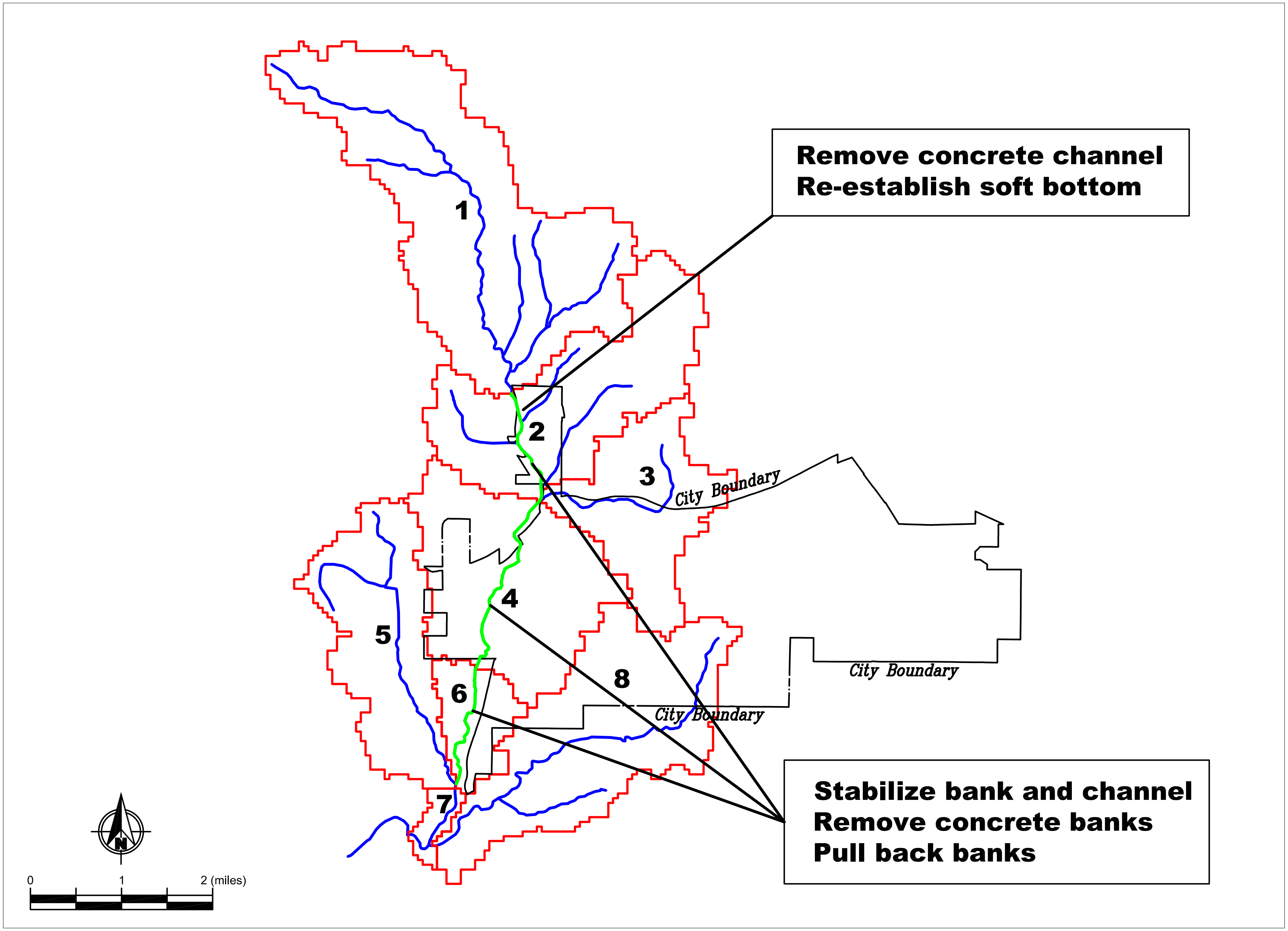

Figure 5.1

Creek Restoration Alternative for Las Virgenes Creek

Source: Everest International Consultants, Inc.

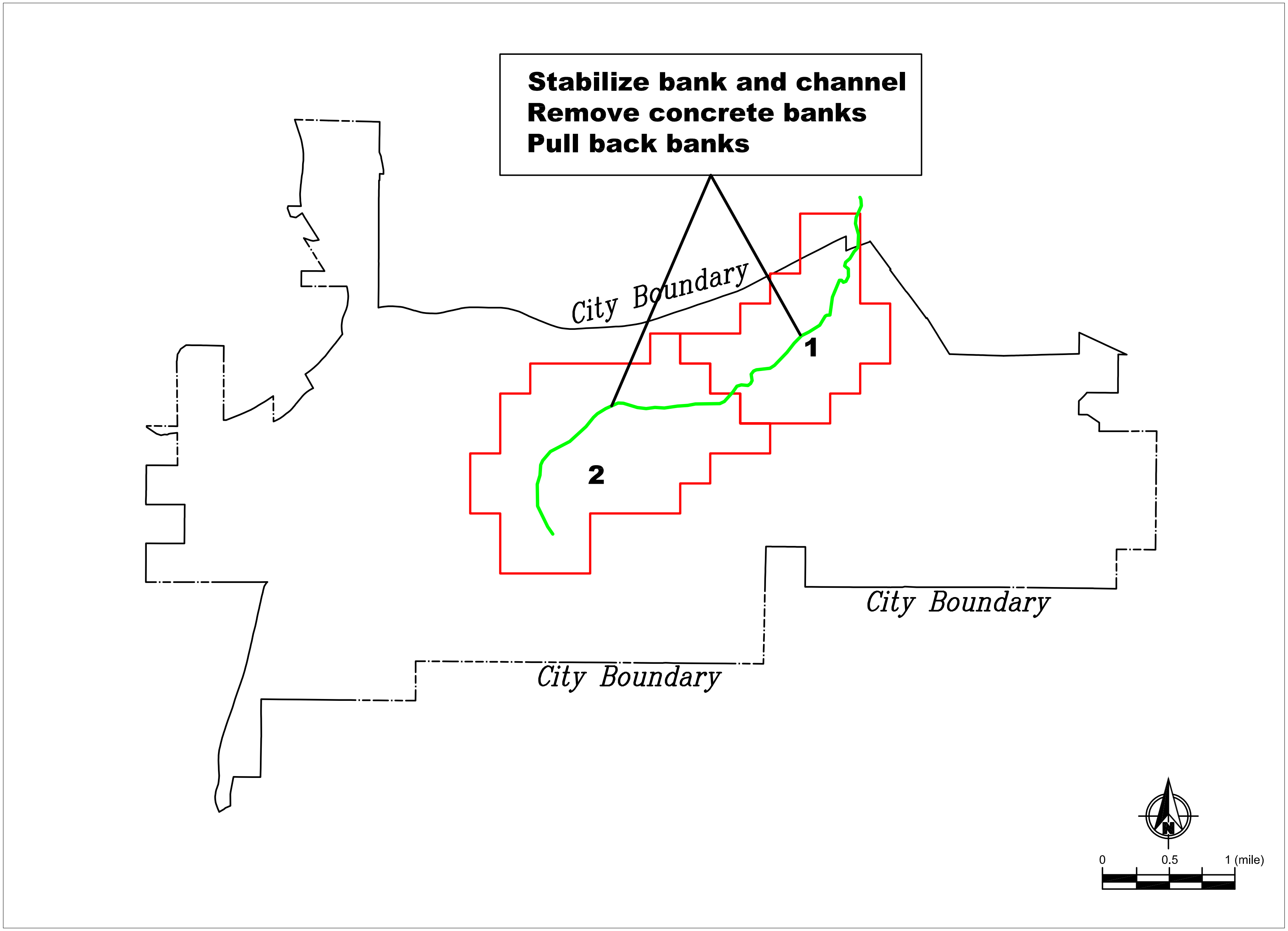

Figure 5.2
Creek Restoration Alternative for McCoy Creek

Source: Everest International Consultants, Inc.

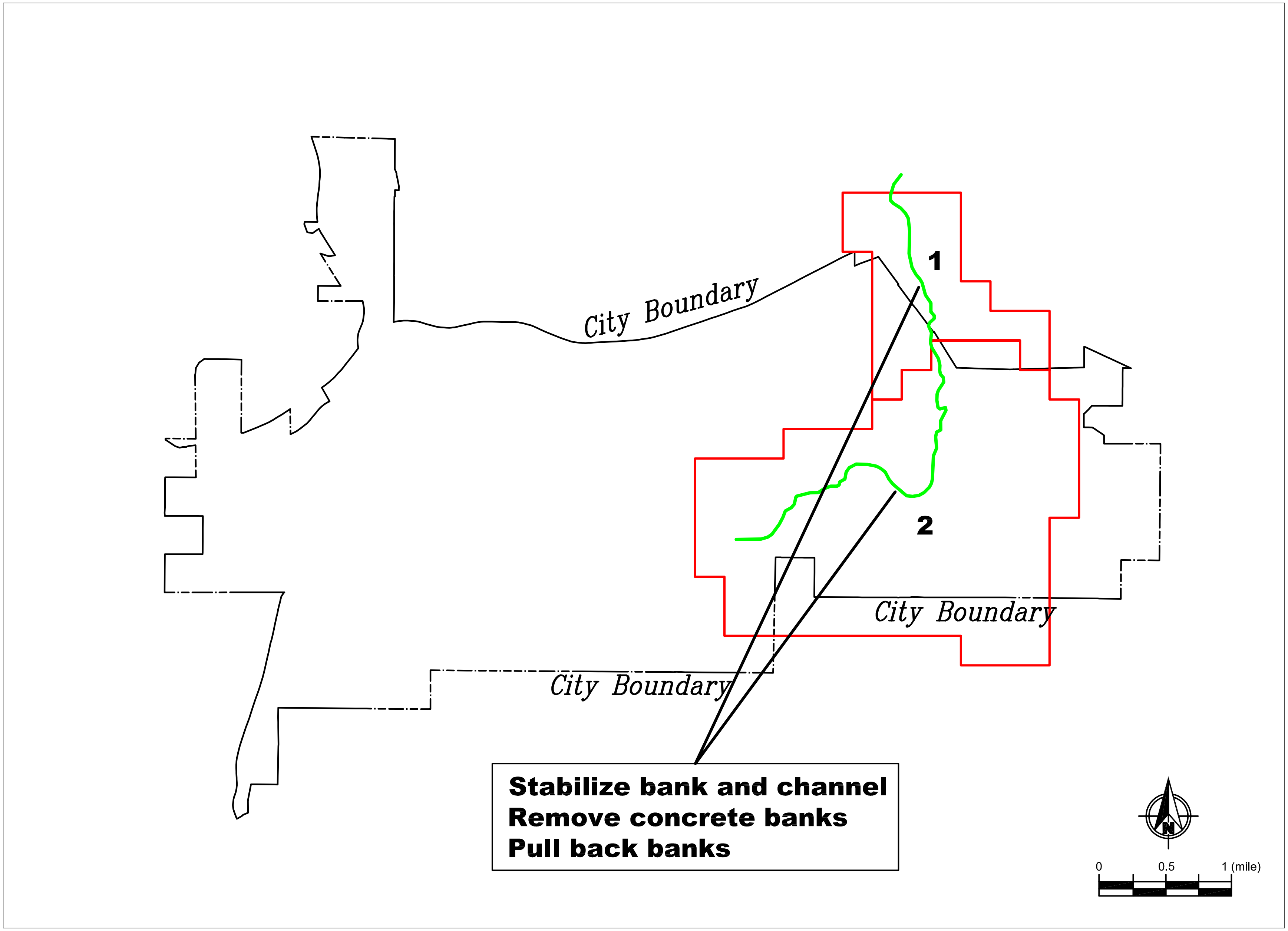

Figure 5.3
Creek Restoration Alternative for Dry Canyon Creek

vegetation to treat runoff and reduce surface runoff. Infiltration basins reduce surface runoff by increasing percolation into the ground and provide removal of contaminants. Similarly, pervious concrete reduces the runoff from impervious urban areas by promoting infiltration and contaminant removal.

The removal efficiencies used in the modeling of Watershed Management Alternative 1 were calculated based on average literature values (Appendix A). To account for the potential range in runoff trapping and poor performance of some structural BMPs, two scenarios were developed to represent Alternative 1. Alternative 1A was based on the assumption that the structural BMPs were successful at treating 50% of the runoff, while Alternative 1B was based on the assumption that the structural BMPs were successful at treating 100% of the runoff.

The use of structural BMPs is limited based on land use. Table 5.2 shows the applicable land uses for each structural BMP. The areas within the subwatersheds of each creek in which BMPs can be implemented are shown in Figures 5.4, 5.5, and 5.6. In some cases, multiple BMPs can be implemented within the same land use. (For example, both detention basins and biofilters can be implemented for agricultural land uses.) For land uses with two applicable BMPs, the efficiency was calculated based on the assumption that the BMPs would be linked in series such that the efficiency of the second BMP was applied to the output of the first BMP.

Table 5.2. Applicable Land Uses for Types of Structural BMPs

Type of BMP	Applicable Land Use
Detention Basins	Agricultural and Husbandry
Biofilters	Agricultural, Husbandry, Residential, and Commercial
Infiltration Basins	Residential and Commercial
Pervious Concrete	Residential

5.4 WATERSHED MANAGEMENT ALTERNATIVE 2—SOURCE CONTROL

Watershed Management Alternative 2 was developed to represent the effects of reducing nutrient loading through reductions in sources. Based on information presented in Section 3.3 of Appendix A, the most significant nutrient sources in the watershed were determined to be atmospheric deposition, septic systems, reclaimed irrigation water use, golf course fertilization, and livestock. It was not considered feasible to reduce atmospheric deposition of nutrients in the watershed modeling analysis (Appendix A) because atmospheric deposition occurs on a regional basis, which is beyond the geographic limits (watershed) of the analysis. Septic systems within

Source: Everest International Consultants, Inc.

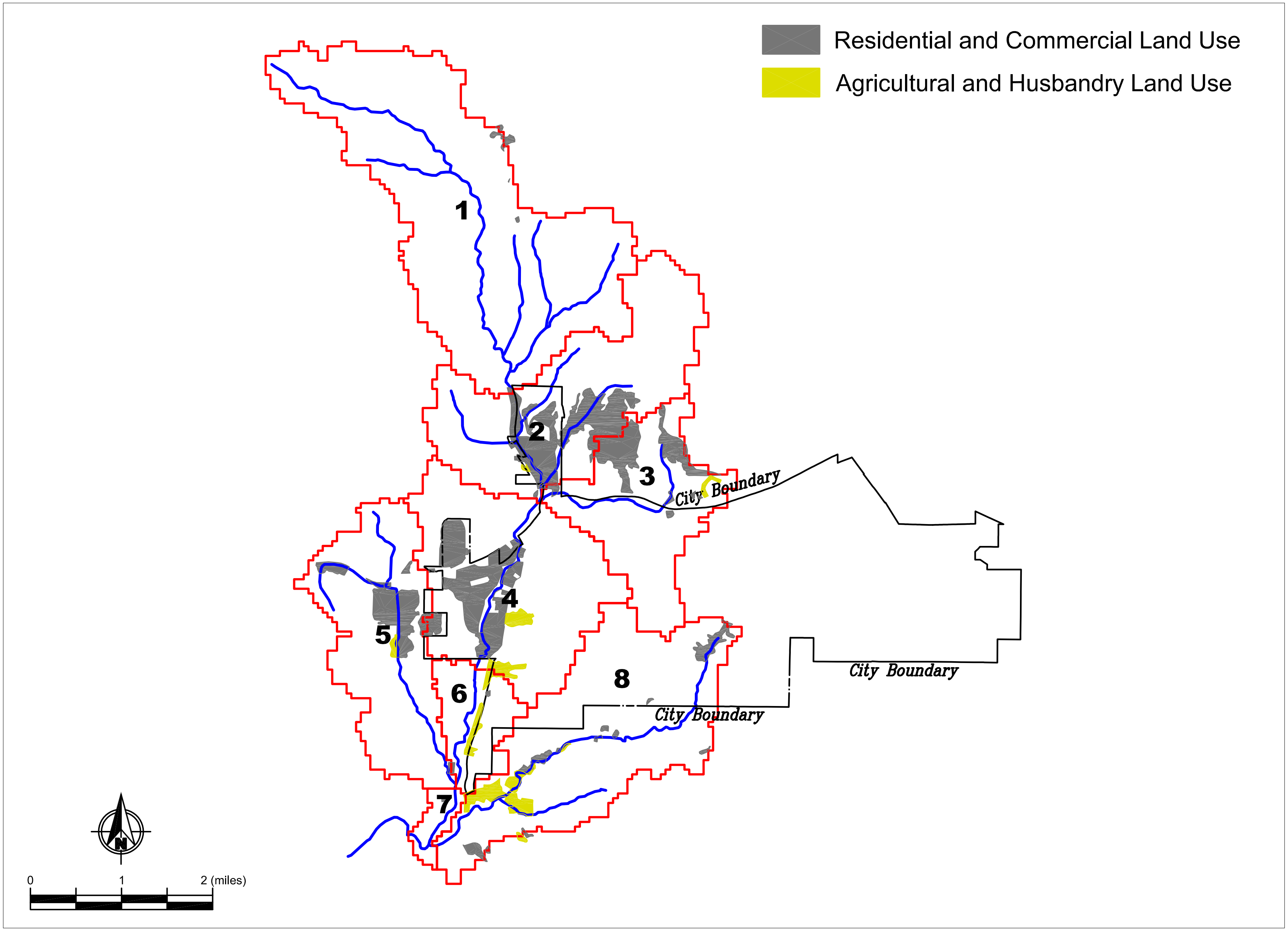

Figure 5.4

Watershed Management Alternative 1 - Structural BMPs for Las Virgenes Creek

Source: Everest International Consultants, Inc.

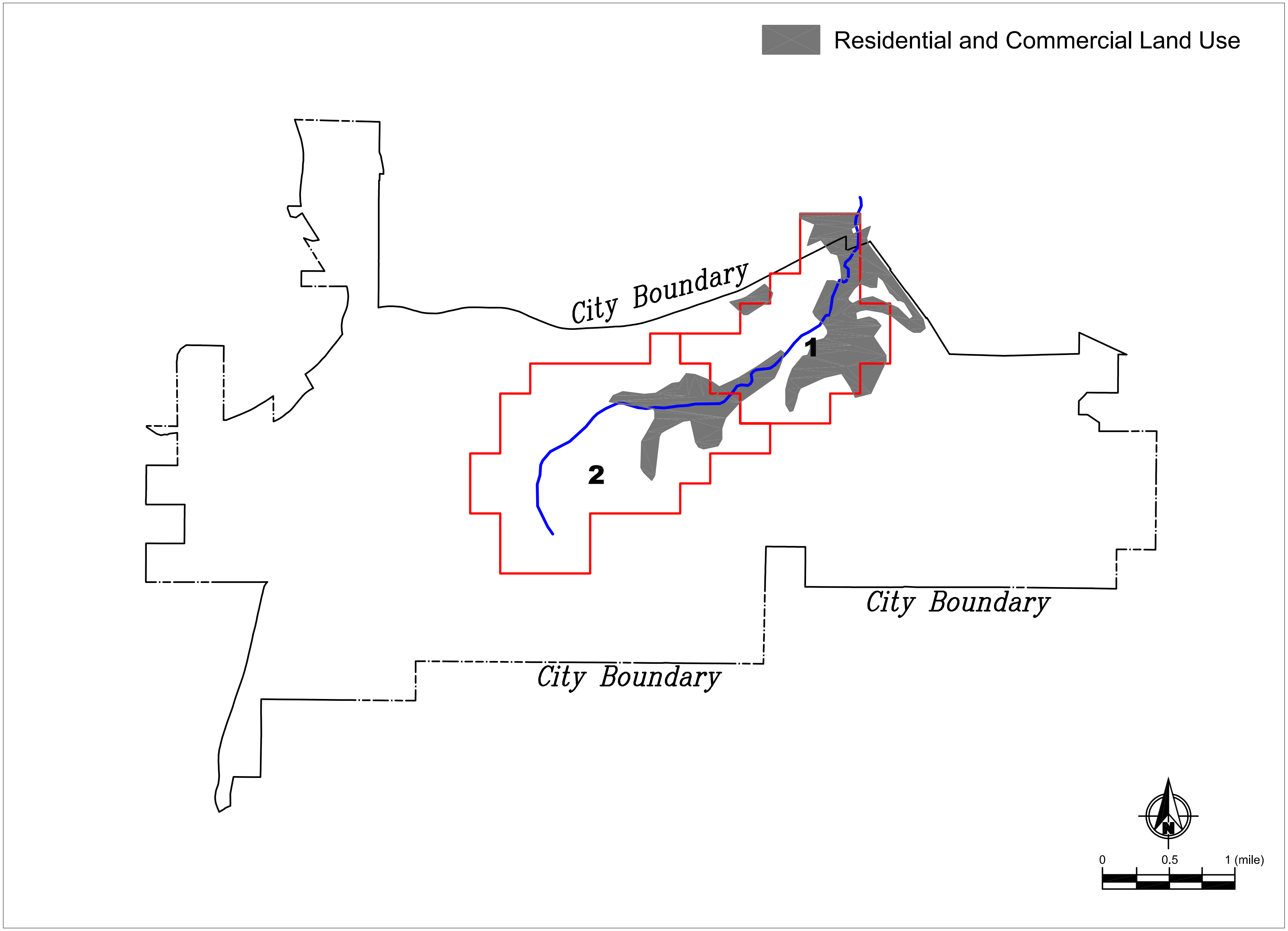

Figure 5.5

Watershed Management Alternative 1 - Structural BMPs for McCoy Creek

Source: Everest International Consultants, Inc.

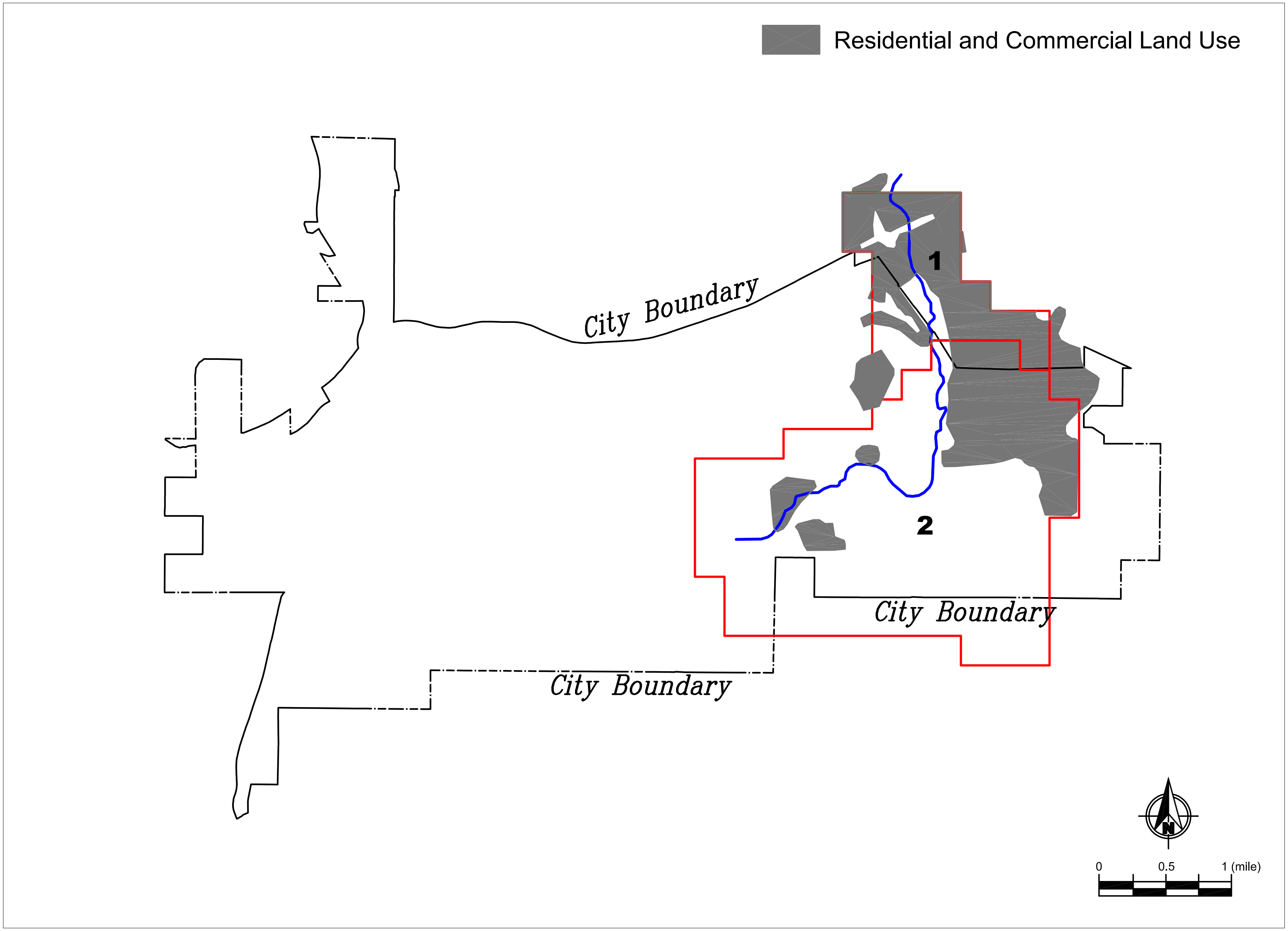

Figure 5.6

Watershed Management Alternative 1 - Structural BMPs for Dry Canyon Creek the Las Virgenes Creek watershed occur downstream of the area of interest (City limits); therefore, changes in septic systems were not addressed in the watershed modeling analysis since those changes would not have any effect on the portion of the creek that flows through the City. The remaining sources of nutrients in the Las Virgenes watershed that were analyzed for control as part of the watershed modeling analysis were reclaimed irrigation water use and livestock. In the McCoy and Dry Canyon Creek watersheds the sources of nutrients that were analyzed for control were golf course irrigation, and reclaimed water irrigation, with some discussion regarding septic systems.

A reduction factor in nutrient loading was applied for each of the controllable sources within each watershed. Figures 5.7, 5.8, and 5.9 show the nutrient source reductions that were applied to the subwatersheds of each creek.

Similar to Watershed Management Alternative 1, two scenarios were developed for the Watershed Management Alternative 2. Alternative 2A was based on the assumption that the source control measures would be effective in achieving a 25% reduction in reclaimed water irrigation and livestock sources. Alternative 2B was based on the assumption that the source control measures would be effective in achieving a 50% reduction in nutrients.

A summary of the watershed model alternatives is given in Table 5.3.

Table 5.3. Summary of Watershed Model Simulations

Alternative	Description
Historical Land Use	No urban land uses and sources; open space only
Creek Restoration Alternative	Implementation of all creek restoration opportunities
Alternative 1A	Structural BMPs – 50% Runoff
Alternative 1B	Structural BMPs – 100% Runoff
Alternative 2A	Source Control Measures – 25% Source Reduction
Alternative 2B	Source Control Measures – 50% Source Reduction

Source: Everest International Consultants, Inc.

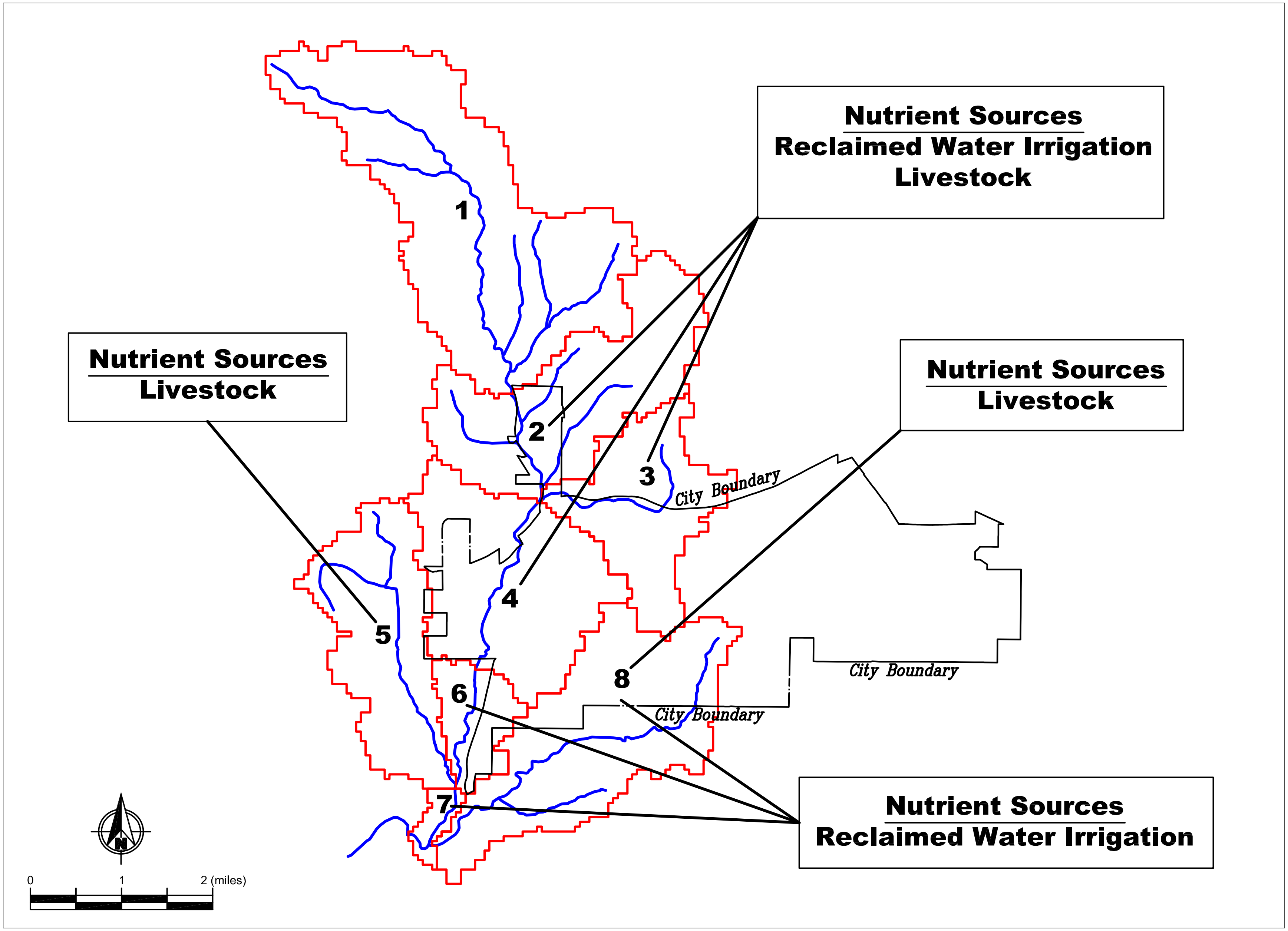

Figure 5.7

Watershed Management Alternative 2 - Source Control Measures for Las Virgenes Creek

Source: Everest International Consultants, Inc.

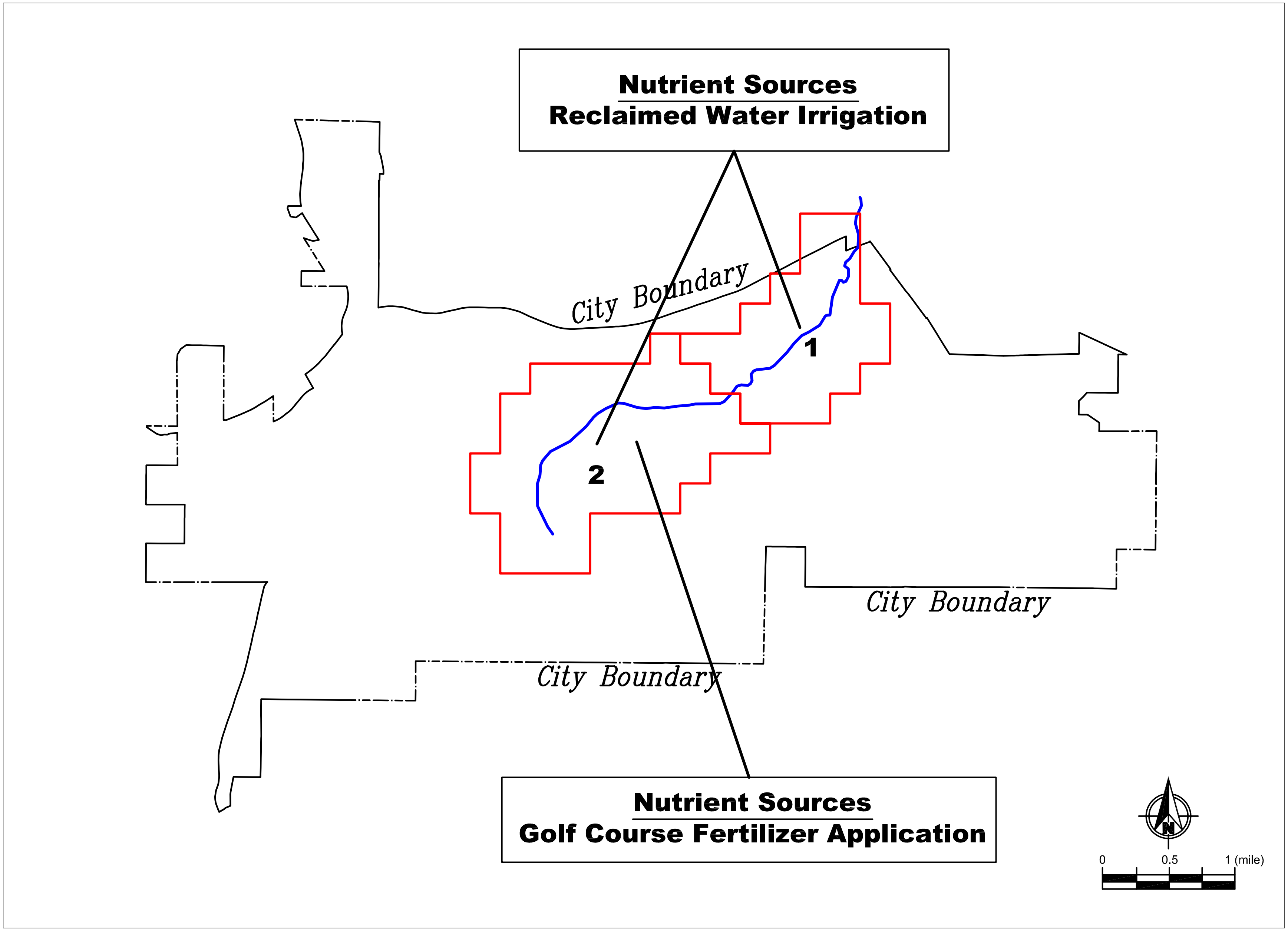

Figure 5.8

Watershed Management Alternative 2 - Source Control Measures for McCoy Creek

Souce: Everest International Consultants, Inc.

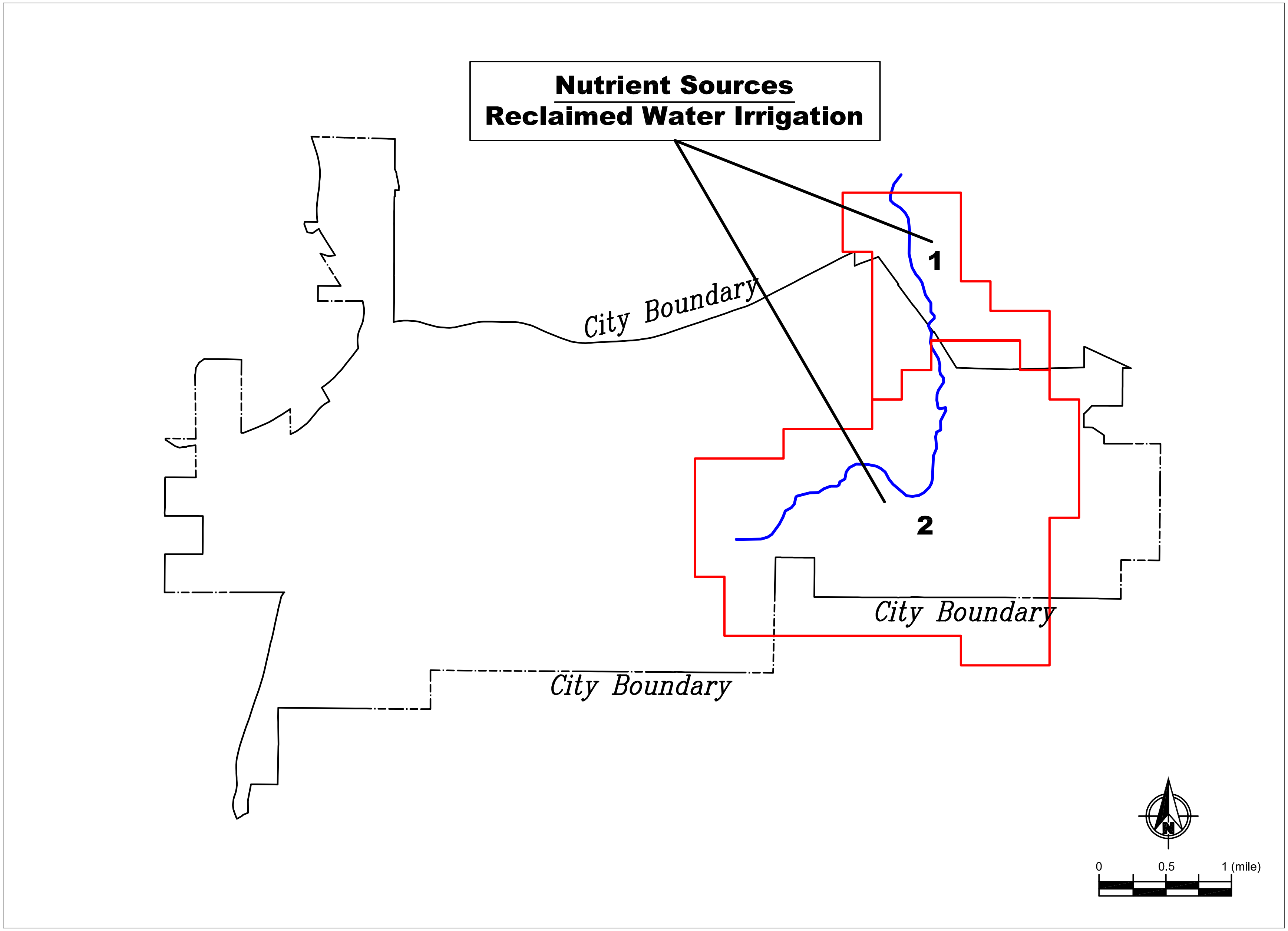

Figure 5.9

Watershed Management Alternative 2 - Source Control Measures for Dry Canyon Creek

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CHAPTER 6.0
ALTERNATIVES EVALUATION

Each alternative was simulated for a 3.75-year time period (October 1996 – June 2000) using the HSPF model. The results from the first year were not used to allow adequate time for the numerical model to reach a dynamic equilibrium. Therefore, nutrients were evaluated based on the average annual load (lbs/yr) over the last 2.75 years of the model results. The model output location for each of the three creeks was established at the downstream City limit (Figures 6.1, 6.2, and 6.3). Thus, the model results reflect the alternative restoration measures upstream of the output location.

The reduction in average annual loading (expressed as a percentage) at each output location was determined for each alternative and then compared to the loading under existing conditions. Table 6.1 presents the results of the model simulations, which are further summarized in the sections below.

6.1 HISTORICAL LAND USE EVALUATION

For the Historical Land Use scenario, all three creeks show notable reductions in loading ranging from 86% to 98% for nitrate, ammonia, and phosphate. The large percentage of potential nutrient loading reduction indicates that the major contribution of nutrients in both watersheds is from human and urban uses. The results also indicate there is a small quantity of nutrient loading attributable to natural sources (e.g., soil erosion and wildlife). Therefore, to achieve a 100% reduction in nutrients may require reductions in loading attributable to natural as well as human sources.

6.2 CREEK RESTORATION ALTERNATIVE

The Creek Restoration Alternative was found to have no detectable impact on nutrient loading for all three creeks. The simulations were based on implementation of all identified creek restoration opportunities within each creek, including bank stabilization, concrete removal, and vegetation clearing. Since the creek restoration opportunities focused primarily on hydrologic and/or habitat changes within the creek channel, neither the nutrient loadings from the watershed nor the water quality processes within the creek were substantially modified through

Source: Everest International Consultants, Inc.

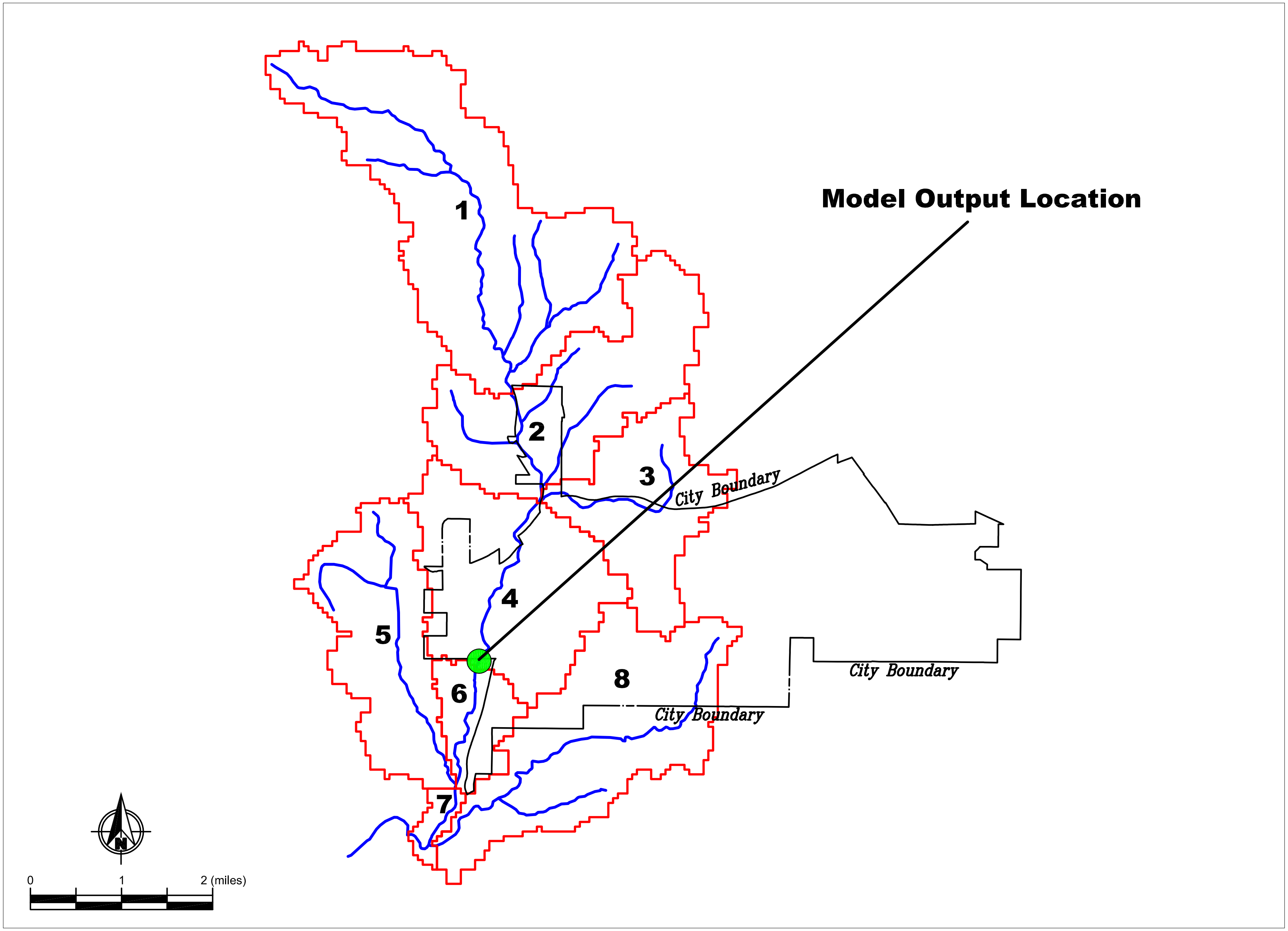

Figure 6.1

Model Output Location for Las Virgenes Creek

Source: Everest International Consultants, Inc.

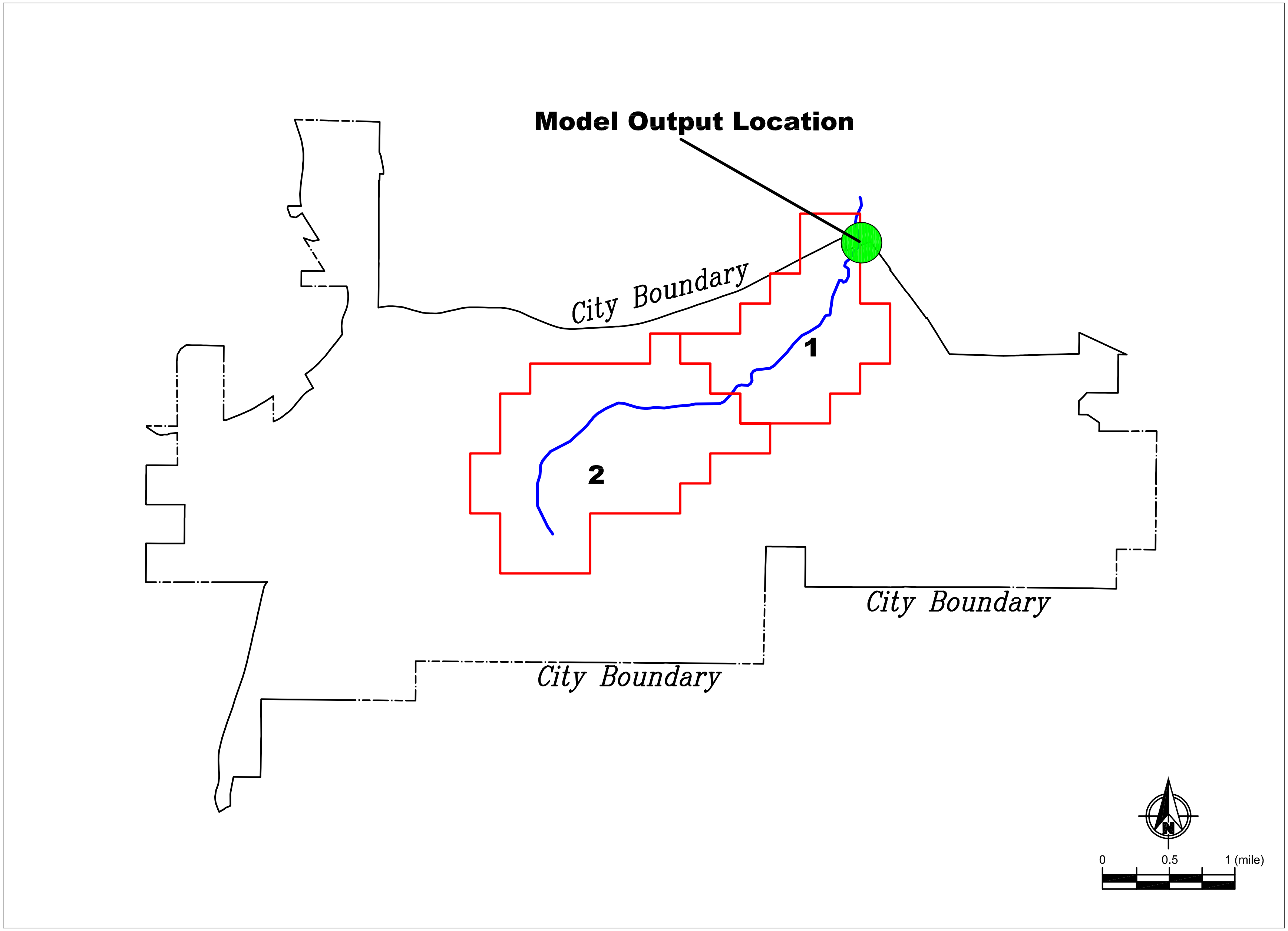

Figure 6.2
Model Output Location for McCoy Creek

Souce: Everest International Consultants, Inc.

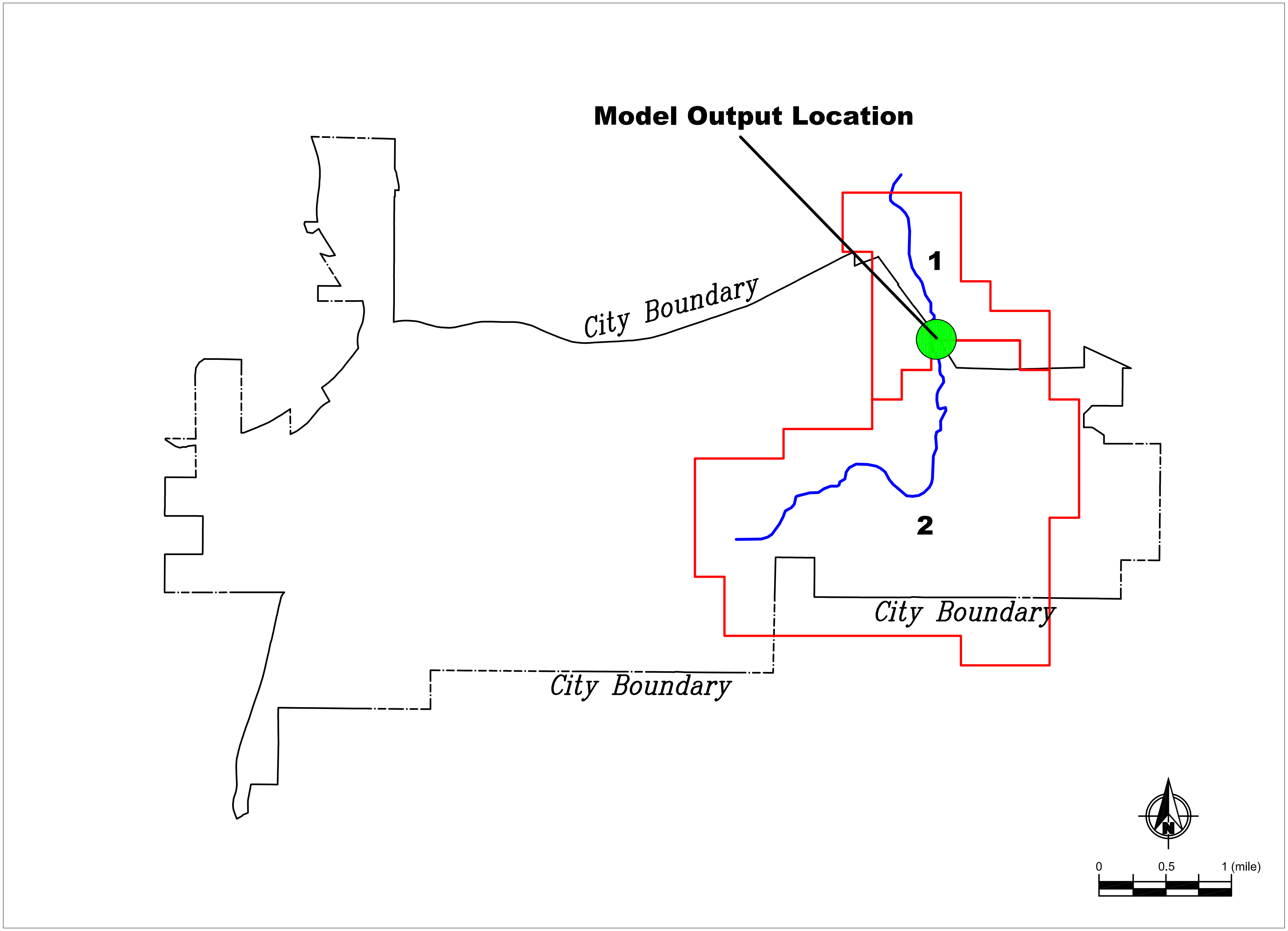

Figure 6.3

Model Output Location for Dry Canyon Creek

Table 6.1. Nutrient Loading Reductions by Alternative

Alternative	Creek	Percent Reduction (%)		
		Nitrate	Ammonia	Phosphate
Historical Land Use	Las Virgenes Creek	91	86	86
	McCoy Creek	98	96	98
	Dry Canyon Creek	98	98	93
Creek Restoration Alternative	Las Virgenes Creek	0	0	0
	McCoy Creek	0	0	0
	Dry Canyon Creek	0	0	0
Alternative 1A	Las Virgenes Creek	4	19	16
	McCoy Creek	2	13	7
	Dry Canyon Creek	5	28	21
Alternative 1B	Las Virgenes Creek	7	39	32
	McCoy Creek	4	26	14
	Dry Canyon Creek	9	55	42
Alternative 2A	Las Virgenes Creek	21	5	4
	McCoy Creek	16	3	8
	Dry Canyon Creek	17	2	2
Alternative 2B	Las Virgenes Creek	41	10	7
	McCoy Creek	33	6	15
	Dry Canyon Creek	35	4	5

implementation of the creek restoration measures. The model results of restoration alternatives for all three creeks indicated that nutrient loading would not be meaningfully affected through implementation of these measures. However, there could be water quality improvements for other pollutants if the identified restoration measures were implemented.

6.3 WATERSHED MANAGEMENT ALTERNATIVE 1—STRUCTURAL BMPS

The results of Watershed Management Alternative 1 modeling indicate that structural BMPs are more effective in reducing ammonia and phosphate loading than nitrate loading. Alternatives 1A and 1B provide a range of reduction based on the amount of runoff treated and the effectiveness of the various BMPs. The quantity of runoff treated with structural BMPs directly impacts the nutrient reduction such that nutrient loading is reduced in proportion to the volume of treated runoff. The percent reductions for Alternative 1B are approximately twice that of Alternative 1A, which corresponds to the treatment of twice as much runoff in Alternative 1B compared to Alternative 1A.

6.4 WATERSHED MANAGEMENT ALTERNATIVE 2—SOURCE CONTROL MEASURES

Watershed Management Alternatives 2A and 2B provided a range in nutrient reductions associated with implementation of a range in nutrient source control measures. Doubling the source control reduction from Alternative 2A (25%) to Alternative 2B (50%) approximately doubled the nutrient loading reduction. The source control measures are the most effective for nitrate reduction and less effective at reducing the loading for ammonia and phosphate.

CHAPTER 7.0
CONCLUSIONS

The following conclusions were developed from the results of this study.

- The City currently implements a variety of storm water pollution prevention and urban runoff regulations pursuant to the Land Development and Health and Safety Codes. The Environmental Services Manager in the Public Works Department is primarily responsible for implementation of these programs with support from the Planning Department and Code Enforcement staff. However, to date these programs do not adequately address/control non-point source pollution from entering the local creeks within the City.
- There is adequate habitat for native fish within the study area. However there is not adequate water quality information to ensure that the reintroduced fish would be able to survive year round.
- The non-native crayfish should be removed from Las Virgenes Creek to improve the survivability of the arroyo chub.
- There are not adequate data on the location and condition of septic systems within the City.
- There are other planning efforts within the City that should be identified at the City planning level. These efforts include: mitigation projects undertaken by private developers; property acquisition by non-profit environmental groups; and trails and parks planning being undertaken by City staff.
- A review of the available, existing data revealed that the water quality data are insufficient to perform a calibration of the model parameters. Continuous flow monitoring and corresponding water quality testing data need to be collected if a calibrated watershed model is to be completed.
- The results of the modeling revealed that human influences account for the majority of nutrient loading to the three creeks. The loading of nutrients (nitrate, ammonia, and phosphate) leaving the City limits under existing conditions with recent human influence was substantially higher than the loading under historical conditions without human influence.

- The results suggest that it is possible to exceed the RWQCB-LA water quality objectives for the study area in the absence of human influence. The overall water quality objectives are described in the Water Quality Control Plan (Basin Plan), and specific pollutants are described in TMDL development documents but have not been incorporated into the Basin Plan yet.
- The results of the sensitivity analysis revealed that increases and decreases in nutrient loading would result in significant changes in the model results.
- Although several habitat improvement opportunities are available throughout the watersheds, implementation of all the restoration measures identified for creek restoration will not result in meaningful reductions in nutrient loading. This is because the creek restoration alternatives will only change the hydraulics/hydrology of the creek and not the nutrient sources or processes. However, in addition to creating/enhancing wildlife habitat, creek restoration projects can be beneficial for controlling other parameters of concern such as dissolved oxygen levels, water temperature, erosion, and sedimentation.
- Implementation of structural BMPs would probably not be effective at reducing nutrient loading associated with nitrates.
- The results of the modeling indicated that implementation of structural BMPs could be effective at reducing nutrient loading attributed to ammonia and phosphate.
- The results of the modeling revealed that source control could be effective at reducing nutrient loading attributed to nitrate.
- There are numerous sources of GIS information for the City and surrounding area. This information is not easily accessible and in many cases stored in disparate coordinate systems, which may cause delays in projects undertaken by the City.
- The City does not have up to date public utilities infrastructure information in electronic format. This limits the ability to use GIS to identify to the areas that are drained by specific storm drains.
- The current available water quality information is inadequate to identify any potential pollutant "hot spots" within the City.
- The results of this study indicate that substantial reductions in nutrient loading (defined as reductions in nitrate, ammonia, and phosphate) will require implementation of a

comprehensive approach involving strategic implementation of structural BMPs and source control measures throughout the watersheds of the three creeks.

- The identified barriers to fish movement are both within and outside the study area. These barriers to movement divide fish populations into smaller segments and make them more vulnerable to small-scale impacts to the creeks.

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CHAPTER 8.0
RECOMMENDATIONS

The following recommendations are provided to improve the effectiveness of existing environmental programs within the City and to improve water quality in the City creeks.

GENERAL RECOMMENDATIONS

- Develop within the City a library of GIS layers and aerial photographs for the area. This data would include relevant environmental data as well as City infrastructure such as storm drains, water and reclaimed water lines, sewer lines, and septic systems. In addition, these data should be maintained with a consistent projection, such as North American Datum (NAD) 83 and could be accessed through the City webpage.
- Work with LVMWD to reduce nutrient levels in reclaimed water if feasible.
- Pursue implementation of automated irrigation control measures to reduce the volume of runoff from areas irrigated with reclaimed water. These control measures would focus on public areas such as median strips, parks and areas with large ornamental landscapes that use reclaimed water.
- Develop a field and/or literature program to verify the applicability of the regional contaminant loading rates to the two watersheds. If the regional rates are found to be not applicable, develop a watershed-specific contaminant loading program.
- Periodically perform a walking survey of the creeks to access the general condition of the creeks, identify new areas of erosion and monitor the areas identified from this project.
- Improve the overall effectiveness of the storm water program to work towards further reducing non-point source contamination. This would include but not limited to; developing alternative weed abatement techniques for City sidewalks and road shoulders, developing irrigation controls to limit runoff, increasing public outreach, as well as monitoring the effectiveness of street and catch basin cleaning to limit trash input into the creeks.
- Install signage at roadways entering the watershed to inform the public of the specific watershed and they are entering. The signs should be designed to raise watershed awareness of the general public and include pollution prevention messages.

- Increase the number of water quality monitoring stations to identify areas of increased contaminant loading.
- Modify the existing water quality monitoring program to provide sufficient data to calibrate the HSPF model.
- Pursue source control measures related to equestrian management and operational practices within the watershed to reduce nutrient loadings.
- Provide public outreach to reduce the fertilizer usage and over-watering in the area. Focus on residents and businesses closest to the creeks first and include outreach to businesses using reclaimed water.
- Coordinate with neighboring jurisdictions to implement structural BMPs at catch basin locations outside of the City boundary but draining into Las Virgenes Creek. These BMPs should focus on sediment control, particularly from the unincorporated areas west of the City boundary.
- Investigate the potential for further installation of commercially available BMPs within the commercial areas of the City.
- Implement structural BMPs throughout the watersheds to reduce nutrient loadings attributed to ammonia and phosphate.
- Conduct modeling of other constituents of concern to develop restoration measures for those constituents.
- Develop integrated alternatives, and simulate the alternatives to determine the effectiveness at improving overall water quality to eliminate single-objective alternatives focused on one or two constituents. This effort should include a cost-effectiveness analysis to optimize multiple objective alternatives.

Las Virgenes Creek

- Continue participation in watershed advocacy groups such as the Malibu Creek Watershed Advisory Council (MCWAC). This will allow for continued data sharing with other organizations located within the watershed.
- Coordinate with Los Angeles County Flood Control District to limit erosion near the City's northern border. This area is also identified for wetland creation and restoration.

- Coordinate with private landowners north of the 101 Freeway, within the City, to install structural BMPs within the large parking areas west of the creek. This can be combined with educational outreach for the residents located within this area on the importance of the storm water program.
- Coordinate with Caltrans and neighboring jurisdictions to limit non-point source pollution from entering the creek. This coordination would emphasize limiting the trash from freeway motorists as well as extensive erosion along the smaller tributaries intersecting Mureau Road.
- Restore a soft bottom creek channel in the area just south of the 101 Freeway by removal of the concrete channel and embankments. This site is located between Agoura Road and the 101 Freeway. The project is currently in the beginning stages of feasibility determination and design.
- Coordinate with the California Department of Fish and Game to develop and implement a program to eliminate crayfish and bull frogs from within the study area. This program would be implemented to improve the existing habitat for the only locally present native fish, the arroyo chub.
- Implement the identified habitat improvement projects discussed in chapter 4. The source control measures and BMPs stated in chapter 5 can also have multiple water quality improvements.

Dry Canyon Creek

- Participate in watershed advocacy groups such as the Los Angeles and San Gabriel River Watershed Council. This will allow for data sharing with other organizations located within the watershed.
- Conduct a survey of septic systems within the City to locate and quantify existing systems within the study area. The survey should include a means of determining the condition of identified septic systems and a mechanism for requiring immediate corrective action for inadequately maintained or failing systems.
- Continue to assist Mountains Restoration Trust with increased public participation activities including public outreach and the development of a citizen-monitoring program.
- Continue coordination with Mountains Restoration Trust to identify and purchase available property within the watershed. These selected acquisitions would include the purchase of the

remainder of Headwaters Corner and adjacent parcels, for consolidation with the existing Mountains Restoration Trust property.

- Implement the identified habitat improvement projects discussed in s chapter 4. The source control measures and BMPs stated in chapter 5 can also have multiple water quality improvements.

McCoy Creek

- Participate in watershed advocacy groups such as the Los Angeles and San Gabriel River Watershed Council. This will allow for data sharing with other organizations located within the watershed.
- Develop a working group of the private property owners within the watershed to share watershed information and coordinate habitat improvement projects. The working group should include, at a minimum, representatives from New Millennium, Calabasas Golf and Country Club, Countrywide Financial, and the Calabasas Tennis and Swim Center.
- Implement the identified habitat improvement projects discussed in chapter 4. The source control measures and BMPs stated in chapter 5 can also have multiple water quality improvements.
- Coordinate the identified habitat improvement projects, in the lower watershed, with the Lake Calabasas Homeowners Association.
- Coordinate with the Lake Calabasas lake managers to identify when the lake overflows into McCoy Creek.
- Provide storm water and water quality educational outreach to the Lake Calabasas Homeowners Association with the potential to expand the outreach to all residents in the future.

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APPENDIX A

WATERSHED MODELING ANALYSIS

Las Virgenes, McCoy, and Dry Canyon Creeks Master Plan for Restoration

Watershed Modeling Appendix

Final Report

Prepared for:
City of Calabasas

Prepared by:
Everest International Consultants, Inc.

EVEREST

August 29, 2003

LAS VIRGENES, MCCOY, AND DRY CANYON CREEKS
MASTER PLAN FOR RESTORATION

WATERSHED MODELING APPENDIX

Final Report

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August 29, 2003

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1. INTRODUCTION

1.1 BACKGROUND

Las Virgenes Creek is located within Los Angeles County and Ventura County of the State of California. McCoy Creek and Dry Canyon Creek are located entirely within Los Angeles County. Las Virgenes Creek is located in the Malibu Creek Watershed, while McCoy Creek and Dry Canyon Creek are situated within the Los Angeles River Watershed. Portions of all three creeks run through the City of Calabasas (City), which is shown in Figure 1.1.

Existing beneficial uses of Las Virgenes Creek identified by the Los Angeles Regional Water Quality Control Board (LARWQCB) in the 1994 Basin Plan include water contact recreation, non-contact water recreation, warm freshwater habitat, wildlife habitat, rare species habitat, and wetland habitat (LARWQCB, 1994). Potential beneficial uses include municipal and domestic supply, cold freshwater habitat, migration of aquatic organisms, and spawning, reproduction and/or early development of fish. Existing beneficial uses of McCoy and Dry Canyon Creeks include groundwater recharge (intermittent), water contact recreation (intermittent), non-contact water recreation (intermittent), warm freshwater habitat (intermittent), and wildlife habitat. Potential beneficial uses of these two creeks include only municipal and domestic supply. All three creeks are listed under Section 303(d) of the Clean Water Act (CWA) for multiple pollutants that impair these beneficial uses. The schedule established by the LARWQCB for development of the nutrient total maximum daily load (TMDL) for all three creeks is December 2003.

The City received a grant from the U.S. Environmental Protection Agency (EPA) under Section 205(j) of the CWA to prepare a master restoration plan (Restoration Plan) for the three creeks as part of an overall watershed approach to improving water quality with a focus on meeting TMDL objectives. In July 2002, EDAW, Inc. (EDAW) was selected by the City to prepare the Restoration Plan. In addition to improving water quality, the Restoration Plan lays out alternatives to increase recreational opportunities, provide educational facilities, and enhance wildlife habitat.

A significant component of the study needed to prepare the Restoration Plan was the use of a numerical watershed model to simulate the flow of water and corresponding transport of contaminants. EDAW retained Everest International Consultants, Inc. (Everest) to perform the watershed modeling component of the study. The watershed modeling study is summarized in this document, which was prepared as an appendix to the Restoration Plan.

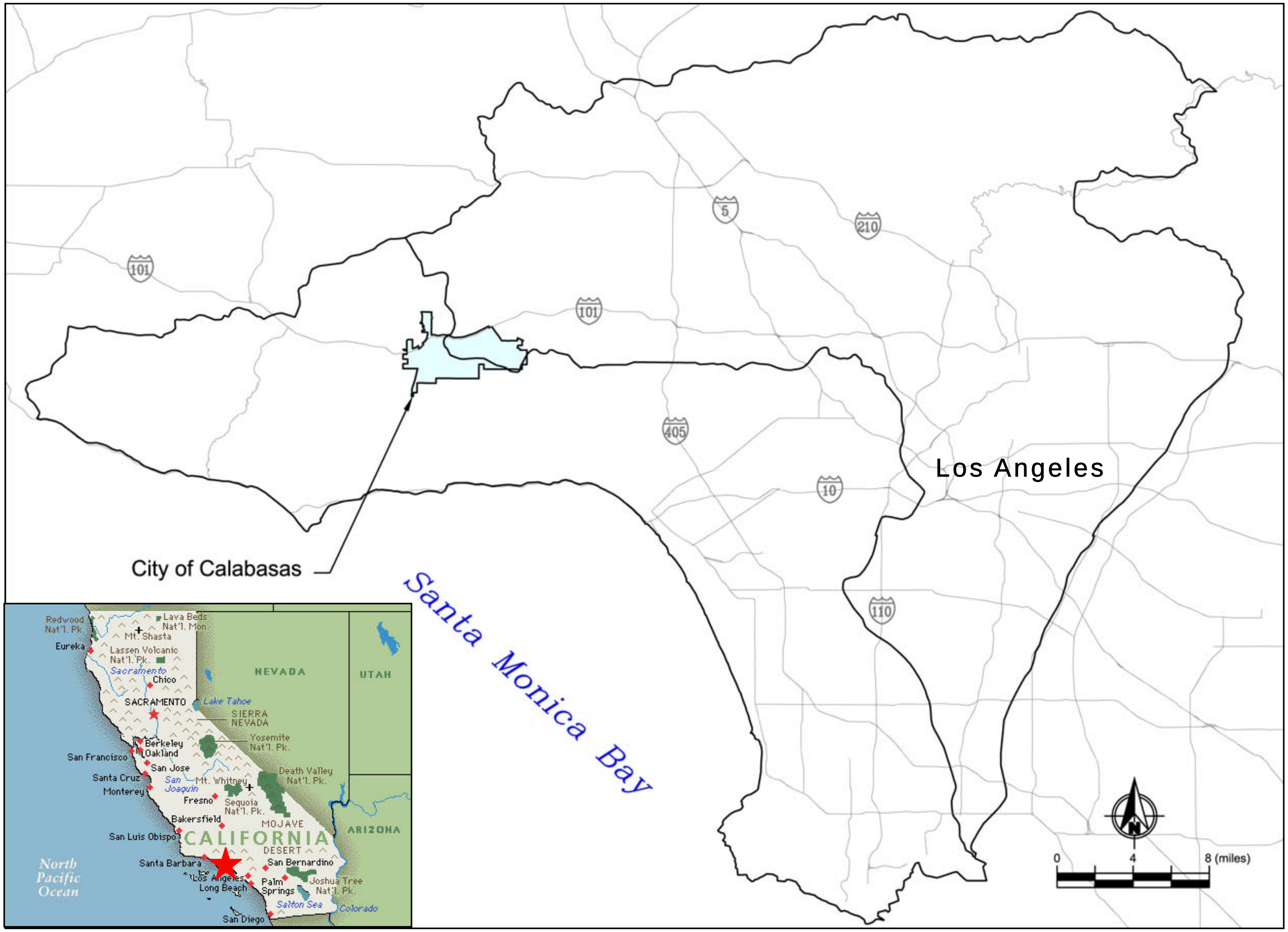


Figure 1.1 Location Map

1.2 PURPOSE AND OBJECTIVES

The purpose of the watershed modeling study was to develop restoration measures and assess the effectiveness of those measures at improving water quality within the creeks. The following objectives were developed to achieve this purpose.

- Select appropriate watershed model.
- Acquire information needed to conduct watershed modeling.
- Identify any data gaps related to the scope of work.
- Develop conceptual models of the two watersheds.
- Perform watershed modeling to establish existing/baseline conditions.
- Develop restoration measures aimed at improving water quality.
- Conduct watershed modeling to analyze and evaluate the restoration measures.

1.3 SCOPE OF STUDY

The scope of the watershed modeling study was limited to an analysis of watershed hydrology and nutrients. Existing, available information and data were used for the modeling study as funding was not available to perform additional field work. The nutrient model simulations were focused on the portion of the creeks that flow through the City boundaries, along with the corresponding watershed areas. The original intent of the study was to conduct the watershed modeling using a calibrated model. However, an initial review of the available data revealed that the data were insufficient for model calibration; therefore, the scope was modified to allow the use of an uncalibrated watershed model for alternative development and evaluation. The implication of this change in scope is discussed in Section 2.3.

2. WATERSHED MODELING APPROACH

A study approach based on the application of a numerical watershed model was developed to meet the study objectives. Potential models were reviewed and a suitable model was selected that met the purpose and objectives of the study. Conceptual models of the two watersheds under existing conditions were developed and the model was used to establish existing conditions. The results of the existing condition simulations were used to establish baseline values for subsequent comparison with the various restoration measures. The EDAW Team worked collaboratively with the City to develop restoration measures and the model was then used to simulate the corresponding flow and water quality conditions. The results of the model simulations conducted with the restoration measures were compared to the baseline results to determine the effectiveness of the various restoration measures at improving water quality. The results of the various alternatives were also compared against one another to gauge the effectiveness of the restoration measures. This last step provided useful information in the development of the overall restoration alternatives for the creeks.

2.1 WATERSHED MODEL SELECTION

The EPA developed a suite of numerical models and a graphical user interface that can be used to analyze watershed hydrology and water quality. This system, known as the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS), is a multipurpose environmental analysis system designed for the application of watershed approaches to improve water quality. The BASINS system supports the development of TMDLs as required by Section 303(d) of the CWA. The BASINS suite allows for flexible analysis at varying geographic scales and it includes a compilation of environmental data from various government agencies migrated into a geographic information system (GIS) framework. Environmental data are available for watersheds as defined by hydrologic unit codes (HUC). BASINS allows for manipulation of watershed characteristics to delineate watershed boundaries and calculate setup parameters for the component simulation models that comprise the BASINS system.

The Hydrological Simulation Program – Fortran (HSPF) model, a component of the BASINS system, was selected for this study for the following three reasons. First, HSPF is a component of BASINS and BASINS is one of the models currently accepted for use by the EPA for loading allocation determination as part of the TMDL program. Second, the model was capable of meeting all the technical requirements of the study purpose including: simulation of watershed hydrology, stream flows, and contaminant loading. The model also allows for relatively easy incorporation of watershed restoration measures such as best management practices (e.g., CDS units), land use changes (e.g., conversion of urban areas to open space), and source control (e.g., reclaimed water use changes). Third, HSPF is currently being used by the LARWQCB to establish the TMDL allocations for nutrients and bacteria within the Malibu Creek Watershed.

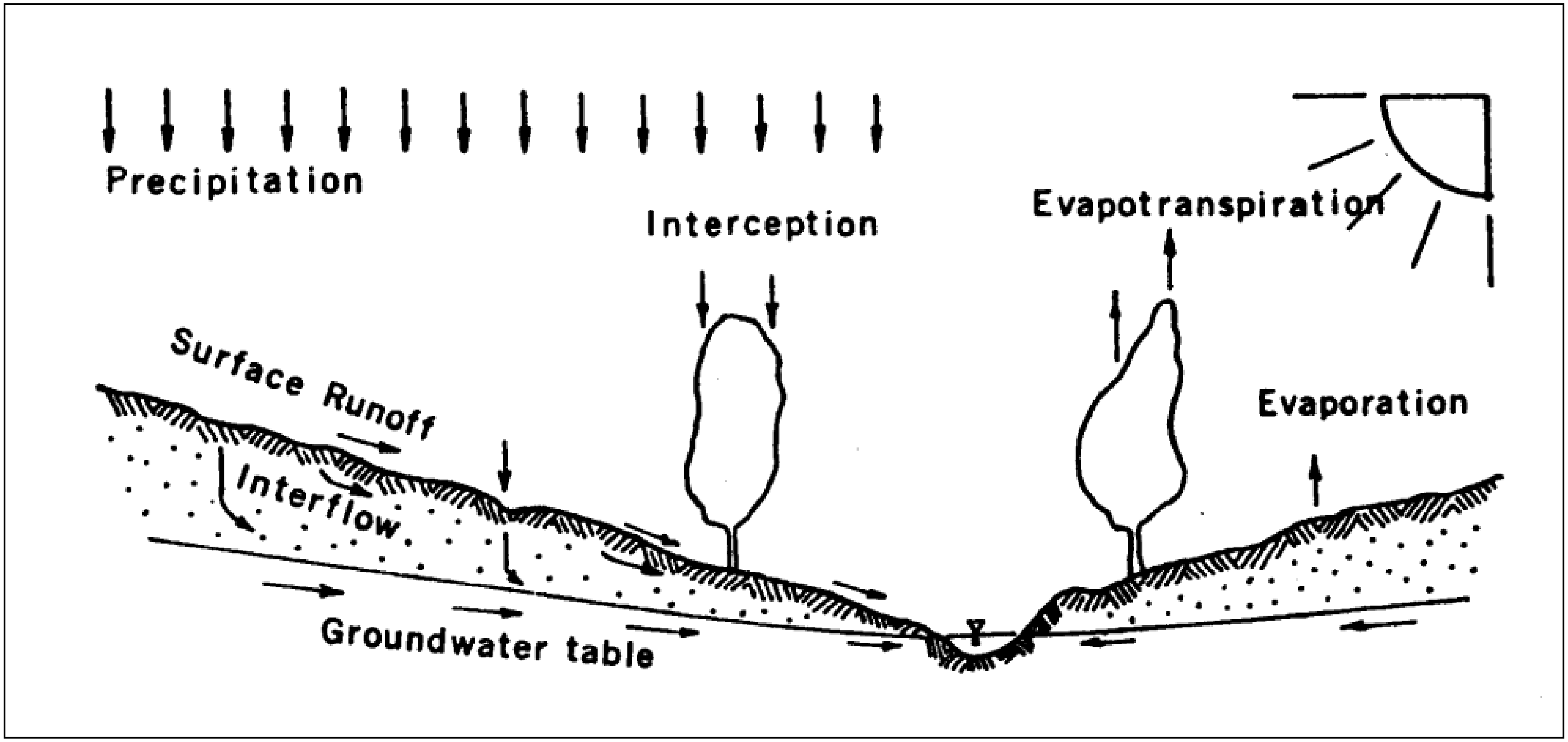
2.2 HSPF Model Description

HSPF is a comprehensive watershed modeling package for simulation of watershed hydrology and water quality for both conventional and toxic organic pollutants. It is the only comprehensive model of watershed hydrology and water quality that allows the integrated simulation of land and soil contaminant runoff processes with in-stream hydraulics, water temperature, sediment transport, nutrient, and sediment-chemical interactions (EPA, 2001a).

HSPF simulates the movement of water, sediment, and contaminants over the land surface and through the soils of a watershed, computes resultant flows, sediment transport, and contaminant concentrations in the collecting streams, and provides water discharge, sediment discharge, and contaminant loading to the receiving waters. In summary, HSPF simulates all the hydrological processes within the hydrologic cycle. Figure 2.1 illustrates graphically the hydrologic components of a typical hydrologic cycle.

For a given watershed with known characteristics (e.g., land uses, vegetative cover, and soil conditions), HSPF computes the transport of water, sediment, and contaminants throughout the watershed on a continuous basis under continuous meteorological forcing such as precipitation, temperature changes, and evaporation. HSPF permits complex physical and chemical interactions and transformations of contaminants in the watershed and streams, thereby providing relatively accurate estimates of contaminant loading into the receiving water. The model outputs simulation results in the form of time histories of runoff flow rate, sediment load, and contaminant concentrations at any point of interest within the watershed.

Given the long-term periods of analysis and the comprehensive nature of the processes being simulated, HSPF requires extensive hydrology and water quality data for successful application. Data are needed to characterize the watershed, creek, hydrology, meteorology, and water quality. In addition, for optimal accuracy of the modeled output, the input data should cover the same period of record or the various data records should be verified to make sure all data are representative of the period being modeled. The data required to conduct watershed modeling using HSPF are listed below.



Reproduced from: EPA, 2001

Figure 2.1 Hydrologic Cycle

<u>Watershed Characteristics</u>

- Topography
- Land use
- Soil characteristics
- Water table depth

<u>Creek Characteristics</u>

- Thalweg elevation profiles
- Cross-section geometries for main channel and overflow planes
- Bottom conditions (earth, vegetation type, rock types)
- Creek rating curve for depth versus flow
- Seasonal variation of creek characteristics

<u>Hydrology</u>

- Continuous precipitation records for local area at hourly interval and corresponding creek flow at multiple locations for each creek (Las Virgenes Creek 5-10 locations; McCoy and Dry Canyon Creek 1-3 locations per creek)
- Groundwater data, including flow and water table depths.

<u>Meteorology</u>

- Evapotranspiration
- Temperature (minimum and maximum) and dew point
- Wind
- Solar radiation
- Cloud cover

<u>Water Quality</u>

- Location, type, and concentration of point sources of contaminants
- Location, type, and concentration of nonpoint sources of contaminants

2.3 HSPF MODEL CALIBRATION DISCUSSION

As with any numerical model, HSPF requires calibration to provide accurate estimates of the various model outputs for a given watershed. Typically, the model will be calibrated by first performing simulations over a given period and then comparing the output to measured values of flow, contaminant loading, and contaminant concentrations. The various model parameters (e.g., initial contaminant storage, atmospheric deposition, and friction) will then be adjusted within accepted limits until the model results match the measured values within an acceptable limit. Therefore, successful calibration requires simultaneous, continuous flow and water quality constituent measurements across the watershed at a level sufficient to resolve the expected variation of these parameters.

The City has been monitoring water quality since 1998 as part of the Adopt-A-Creek Program. The monitoring program consists of instantaneous measurements of various water quality constituents accomplished through direct measurements as well as grab sample collection and subsequent analysis. Instantaneous flow measurements throughout the City were usually collected; however, no continuous flow measurements were collected as part of the program. Given that no simultaneous, continuous measurements of flow and water quality constituents were made the data were insufficient to conduct a meaningful calibration of the HSPF model for this study. Hence, instead of using a fully calibrated HSPF model, a conceptual model built upon literature values was used for this study. Nevertheless, the conceptual model was still useful in providing a relative comparison for the watershed analysis. The conceptual model was verified against analytical methods in flow estimates, as well as comparison with other studies in the region for pollutant loadings. More detailed information regarding the conceptual model setup is provided in the next chapter.

3. CONCEPTUAL WATERSHED MODEL SETUP

The BASINS suite provides a compilation of regional environmental data for the major watersheds of the United States according to HUC. The regional data includes weather, topography, soil type, land use, and point sources of pollutant discharge. In addition, the National Hydrography Dataset (NHD) provides a spatial definition of water bodies within each major watershed of the U.S.

Las Virgenes Creek is located within the Santa Monica Bay Watershed, shown in Figure 3.1, which is designated as HUC-18070104. The Santa Monica Bay Watershed is composed of the Malibu Creek and Ballona Creek Watersheds. A segment of Las Virgenes Creek flows through the western edge of the City of Calabasas, while the upper portion of the Las Virgenes Creek is located within Ventura County. Las Virgenes Creek joins with Malibu Creek just below the downstream boundary of the City. McCoy and Dry Canyon Creeks are part of the Los Angeles River Watershed designated as HUC-18070105. Both creeks originate within the City and join to form Arroyo Calabasas which then flows into the Los Angeles River. Watershed data from the BASINS database, USGS, and NHD were obtained for the watersheds of the three creeks by cross-referencing with the corresponding HUC.

In addition to the data obtained above, meteorological and water quality data were needed to conduct the HSPF modeling. Several available sources were identified to obtain these data and the sources are summarized in Table 3.1. Precipitation data were obtained from the Los Angeles County Department of Public Works (LACDPW) Monte Nido rainfall station (Station No. 435) located just south of Calabasas. Evaporation data was obtained from the closest LACDPW pan evaporation station at Pacoima Dam (Id 33-A). The monthly minimum and maximum temperatures from the National Oceanic and Atmospheric Administration (NOAA) station in Ojai (Station 046399-06) were used to compute the potential evapotranspiration using a computer program based on the Hamon method (EPA, 2001b).

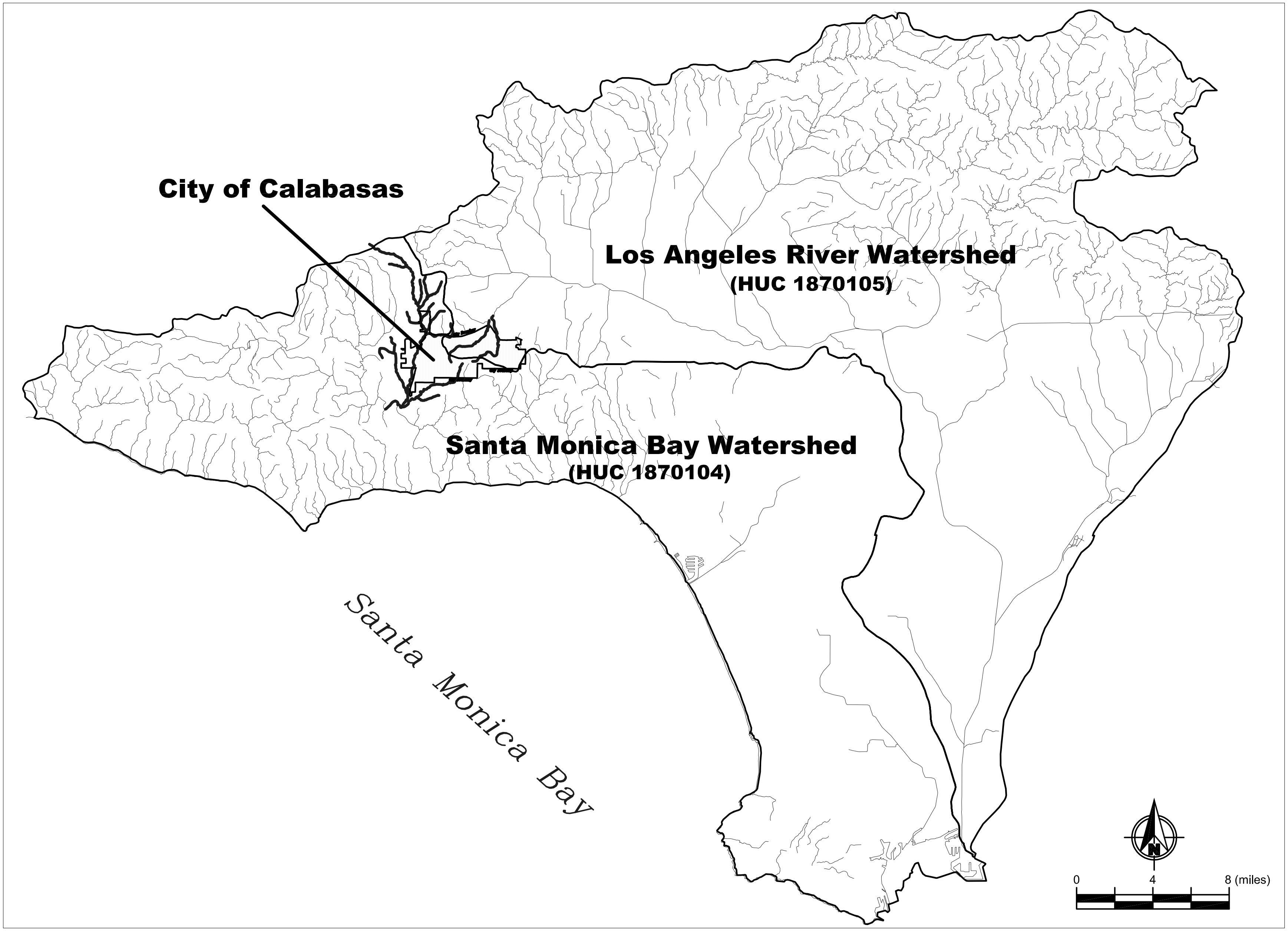


Figure 3.1 Santa Monica Bay and Los Angeles River Watersheds

Table 3.1 Summary of Available Site Specific Data

DATA	LOCATION	RECORD	SOURCE
Precipitation	Monte Nido	10/01/1996 – 9/30/2001	LADPW – Rainfall Station 435
Evaporation	Pacoima Dam	10/01/1996 – 9/30/2001	LADPW – Station Id 33-A
Temperature	Ojai	1/01/1990 – 6/30/2000	NOAA – Station 046399
Land Use	Las Virgenes Creek	1993	SCAG - Malibu Watershed Management Area Plan
Nitrate Ammonia Phosphate	Las Virgenes, McCoy, and Dry Canyon Creeks	Periodically 2001-2002	City of Calabasas
Nitrate Ammonia Phosphate	Las Virgenes Creek	Periodically 1998-2002	Heal the Bay

3.1 WATERSHED SETUP

The watershed boundaries for Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek were delineated based on regional topographic data provided from the BASINS database. The conceptual watershed model for Las Virgenes Creek extends downstream from the upper watershed to the discharge point into Malibu Creek. Figure 3.2 shows the eight subwatersheds used to define the HSPF model area. Las Virgenes Creek flows through the City boundaries in Subwatersheds 2, 3, and 4. The conceptual model extends beyond the area of interest to allow for comparison of the model results with available flow and water quality data at the outlet of Las Virgenes Creek into Malibu Creek (end of Subwatershed 7).

The conceptual watershed model for McCoy Creek is shown in Figure 3.3. McCoy Creek originates within Subwatershed 2 and flows in the northeast direction towards Subwatershed 1.

Dry Canyon Creek flows in a northerly direction from Subwatershed 2 to Subwatershed 1 as shown in Figure 3.4. Dry Canyon Creek exits the city limits at the downstream end of Subwatershed 2.

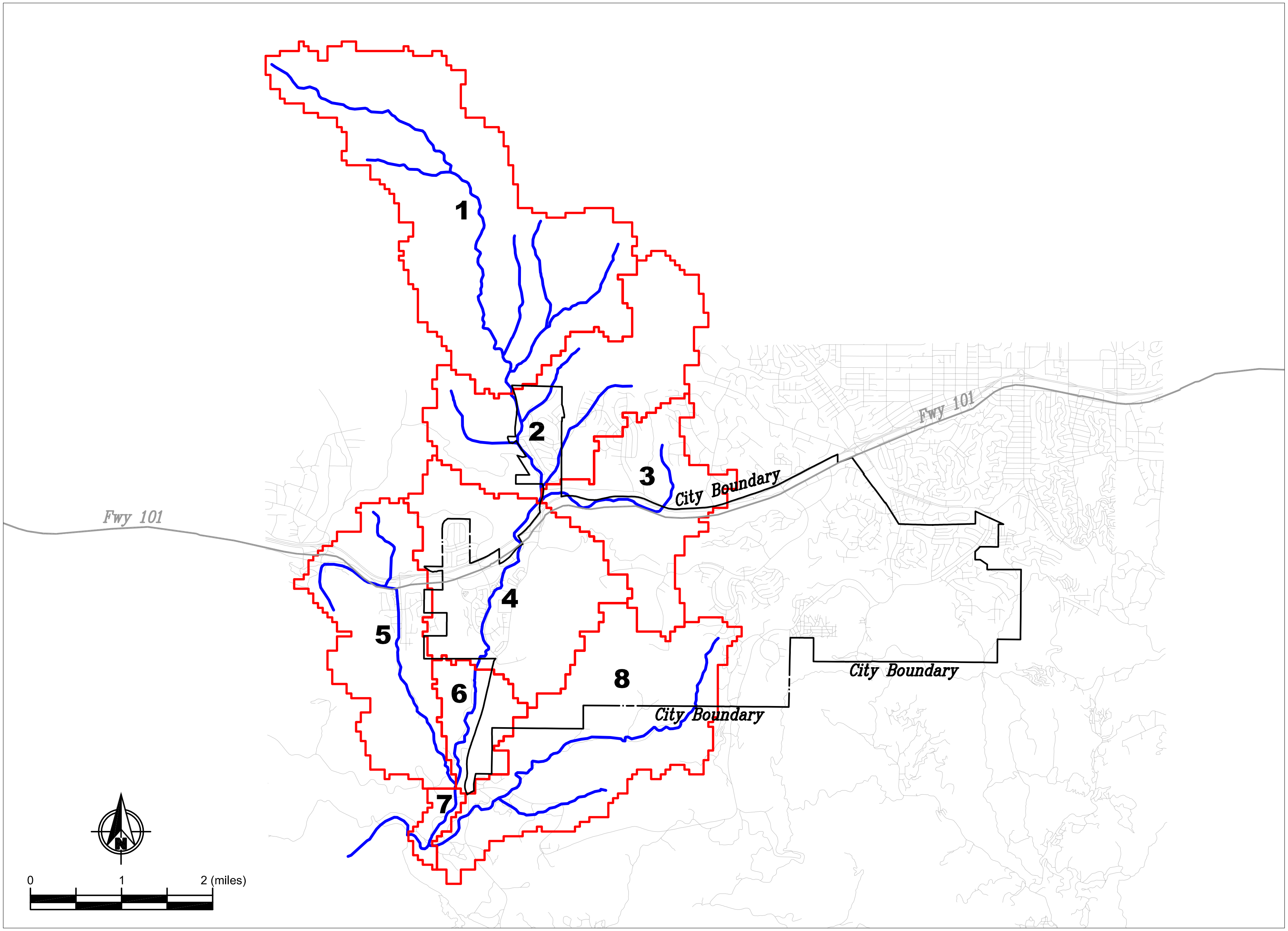


Figure 3.2 Conceptual Model Setup for Las Virgenes Creek

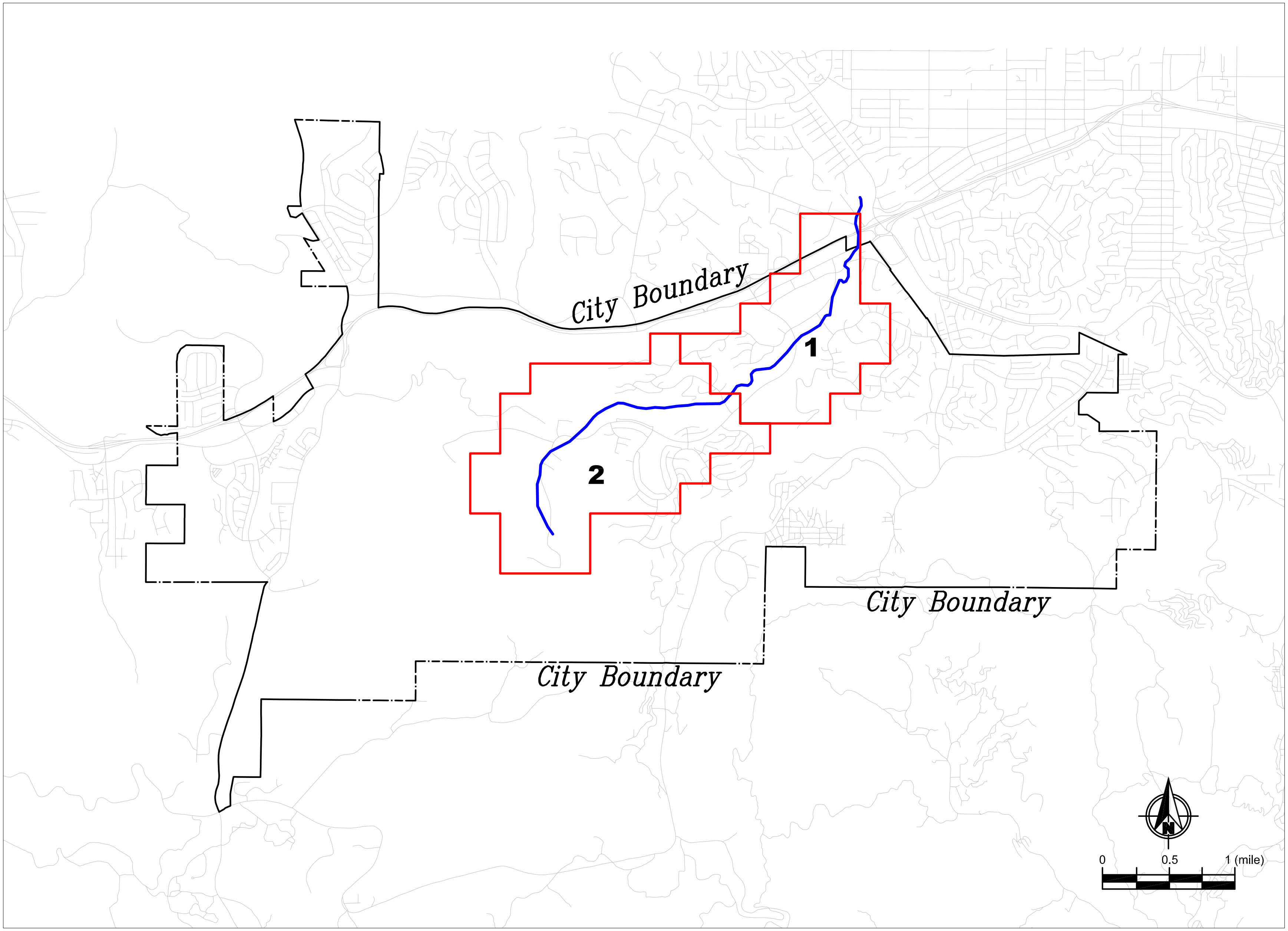


Figure 3.3 Conceptual Model Setup for McCoy Creek

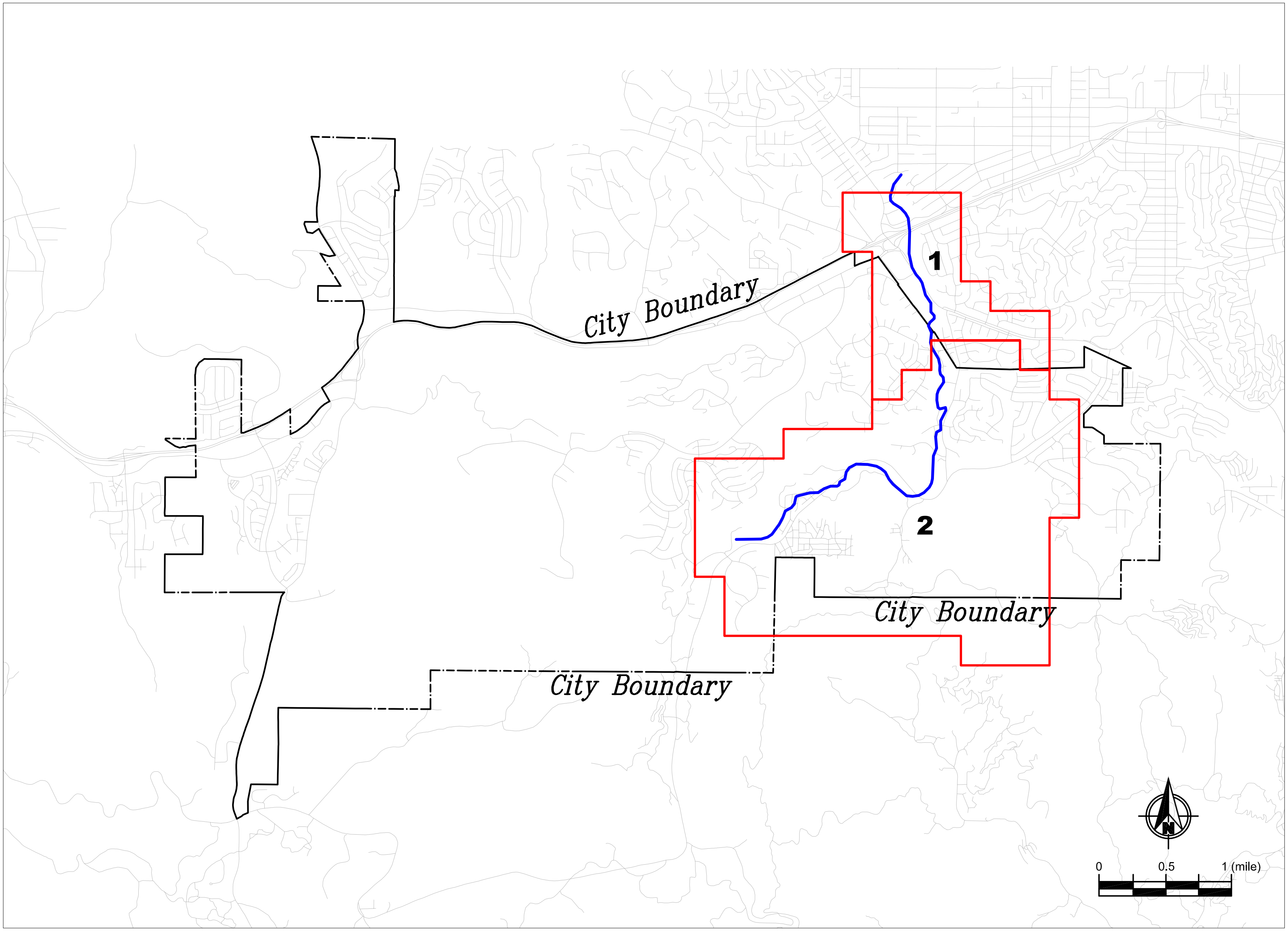


Figure 3.4 Conceptual Model Setup for Dry Canyon Creek

Land uses within the watersheds were obtained from the National Spatial Data Infrastructure and these data were refined with data from the Malibu Watershed Management Area Plan (WMAP) GIS Database. The land uses were grouped into three general categories (open space, urban, and agricultural). Open space included undeveloped area and rangeland. Urban lands comprise all developed areas including residential, commercial, and transportation areas. Agriculture lands are composed of agricultural and animal husbandry areas. Tables 3.2 through 3.4 summarize the areas and land use compositions within individual subwatersheds for Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek, respectively.

Table 3.2 Las Virgenes Creek Subwatersheds

Subwatershed	Area (acre)	Land Use		Description
		Type	Percent of Subwatershed (%)	
1	4396	Open Space Urban	99.8 0.2	Outflow to Calabasas from undeveloped area of Ventura County
2	2465	Open Space Urban	82.0 18.0	Concrete section of Las Virgenes Creek
3	1616	Open Space Urban Agricultural	83.2 16.3 0.5	Tributary
4	2453	Open Space Urban Agricultural	73.4 24.3 2.3	Outflow from Calabasas
5	1940	Open Space Urban Agricultural	87.3 12.3 0.4	Liberty Canyon tributary
6	609	Open Space Urban Agricultural	92.0 2.0 6.0	Open section outside Calabasas
7	171	Open Space Urban Agricultural	99.0 0.5 0.5	Outflow to Malibu Creek
8	2845	Open Space Urban Agricultural	92.0 4.0 4.0	Stokes Creek tributary

Table 3.3 McCoy Creek Subwatersheds

Subwatershed	Area (acre)	Land Use		Description
		Type	Percent of Subwatershed (%)	
1	646	Open Space Urban	59.3 40.7	Outflow from Calabasas to Los Angeles River
2	1076	Open Space Urban	88.9 11.1	Outflow from golf course

Table 3.4 Dry Canyon Creek Subwatersheds

Subwatershed	Area (acre)	Land Use		Description
		Type	Percent of Subwatershed (%)	
1	598	Open Space Urban	16.0 84.0	Outflow to Los Angeles River
2	2393	Open Space Urban	83.0 17.0	Outflow from Calabasas

The Las Virgenes Creek and McCoy Creek watersheds are relatively undeveloped with open space accounting for 88.5% and 77.8% of the watersheds, respectively. It should be noted that the land use distribution for McCoy Creek watershed does not include the New Millennium Project in full build out. The Dry Canyon Creek watershed is substantially urbanized with only 30.4% open space. While open space and agriculture lands were assumed to be entirely pervious, urban lands were considered to have both pervious and impervious areas. The values of percent impervious land for urban land uses assumed for the present study were taken from LACDPW (1994) and the information is summarized in Table 3.5.

Table 3.5 Portion of Impervious Area

URBANIZED DESIGNATION	PERCENT IMPERVIOUS
Single Family	42
High Density	42
Multifamily Residential	70
Transportation	90
Commercial	89

Source: LACDPW, 1994

Soil characteristics within the watersheds were obtained from the State Soil Geographic (STATSGO) Data Base (NRCS, 1995a), which identifies the distribution of hydrologic soil groups based on soil map unit. The percentages of the soil groups identified within the watersheds were used to calculate the weighted averages of infiltration capacity index for the watersheds based on ranges shown in Table 3.6.

Table 3.6 Soil Groups and Infiltration Capacities

SCS HYDROLOGIC SOIL GROUP	INFILTRATION CAPACITY INDEX ESTIMATE		SOIL CHARACTERISTICS	RUNOFF POTENTIAL
	IN/HR	MM/HR		
A	0.4 – 1.0	10.0 – 25.0	Deep sand, deep loess, aggregated silts	Low
B	0.1 – 0.4	2.5 – 10.0	Shallow loess, sandy loam	Moderate
C	0.05 – 0.1	1.25 – 2.5	Clay loams, shallow sandy loam, low in organic content, high in clay	Moderate to High
D	0.01 – 0.05	0.25 – 1.25	Swell significantly when wet, heavy plastic clays, certain saline soils	High

Source: USEPA, 2000

Stream characteristics including cross sections and roughness conditions were estimated from observations made during field visits in February 2003. A representative cross section was assumed for each stream reach within each subwatershed of the three creeks.

3.2 METEOROLOGY

Meteorological conditions in the region that drive the hydrological processes in the watersheds were represented by long-term records of precipitation, temperature, and evaporation from stations maintained by LACDPW and NOAA. Table 3.7 lists the data periods and sources. The monthly minimum and maximum temperatures from the NOAA station were used to produce a record of potential evapotranspiration for the same period using WDMUtil, a meteorological data processor, based on the Hamon method (EPA, 2001b).

Table 3.7 Meteorological Data

DATA	LOCATION	RECORD PERIOD	SOURCE
Precipitation	Monte Nido	10/1/1996-9/30/2001	LADPW Rainfall Station 435
Evaporation	Pacoima Dam	10/1/1996-9/30/2001	LADPW Evaporation Station 33A
Temperature	Ojai	1/1/1990-6/30/2000	NOAA Station 046399

3.3 NUTRIENT SOURCE LOADINGS

Primary nutrient sources within the three watersheds were identified based on information provided by local agencies, published values from prior studies, as well as observations during site visits. Table 3.8 lists the primary nutrient sources.

Table 3.8 Primary Nutrient Sources

WATERSHED	PRIMARY NUTRIENT SOURCES
Las Virgenes Creek	• Atmospheric deposition • Reclaimed water irrigation • Livestock • Septic system
McCoy Creek	• Atmospheric deposition • Reclaimed water irrigation • Golf course fertilization
Dry Canyon Creek[1]	• Atmospheric deposition • Reclaimed water irrigation

[1] At the time modeling was completed there were no data available indicating the presence of septic systems in Dry Canyon Creek; therefore, it was assumed that there were no septic systems in Dry Canyon Creek. After completion of the modeling analysis, information became available indicating the presence of several septic systems within the Dry Canyon Creek watershed but the locations of those septic systems are still unknown.

Graphical representations of the nutrient sources for Las Virgenes, McCoy, and Dry Canyon Creeks are shown in Figures 3.5, 3.6, and 3.7, respectively. The atmospheric deposition rates of nitrate nitrogen (NO_3-N) and ammonia nitrogen (NH_4-N) were estimated from data obtained from the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) Station CA42 in Tanbark Flat, CA to the east of Los Angeles. The nitrogen (N) deposition rates were input as wet deposition (precipitation-associated) and allowed to vary seasonally. The deposition rate of phosphate phosphorous (PO_4), which is not monitored by NADP/NTN, was assumed to be comparable to the nationwide average rate provided by Graham and Duce (1979). The total phosphorous (P) deposition rate (wet and dry) was input to the model as dry (or total) deposition and assumed constant throughout the year. Loadings from atmospheric deposition were applied uniformly to the entire watershed for all three creeks.

The loading rates from reclaimed irrigation water within the watersheds were determined based on effluent flow rates as well as nitrogen (N) and phosphorous (P) concentrations in the effluent from the Tapia Water Reclamation Facility (EPA/RWQCB, 2002). Since irrigation occurs most extensively within the City, the loadings were applied to all subwatersheds with a portion located within the City limits. For each subwatershed affected by irrigation, the total mass loads of nitrogen and phosphorous forms were computed based on the area of Calabasas contained within the subwatershed and divided by the total area of the subwatershed to provide loading rates of nitrogen and phosphorous from irrigation for the subwatershed.

The loading rates from livestock, septic systems, and golf course fertilization were estimated from information provided in EPA/RWQCB (2002). Loadings from these sources were applied to subwatersheds containing animal farming activities, rural residential land use, and golf courses, respectively. For each subwatershed affected by livestock, the total mass loads of nitrogen and phosphorous forms were computed based on the density and types of the animal population in the subwatershed and divided by the total area of the subwatershed to provide loading rates of nitrogen and phosphorous from livestock for the subwatershed. Similarly, for each subwatershed affected by septic systems and golf courses, the total mass loads of N and P phosphorous forms were computed based on the areas of rural residential land use and golf course contained within the subwatershed, respectively, and divided by the total area of the subbasin to provide loading rates of nitrogen and phosphorous from these sources for the subwatershed.

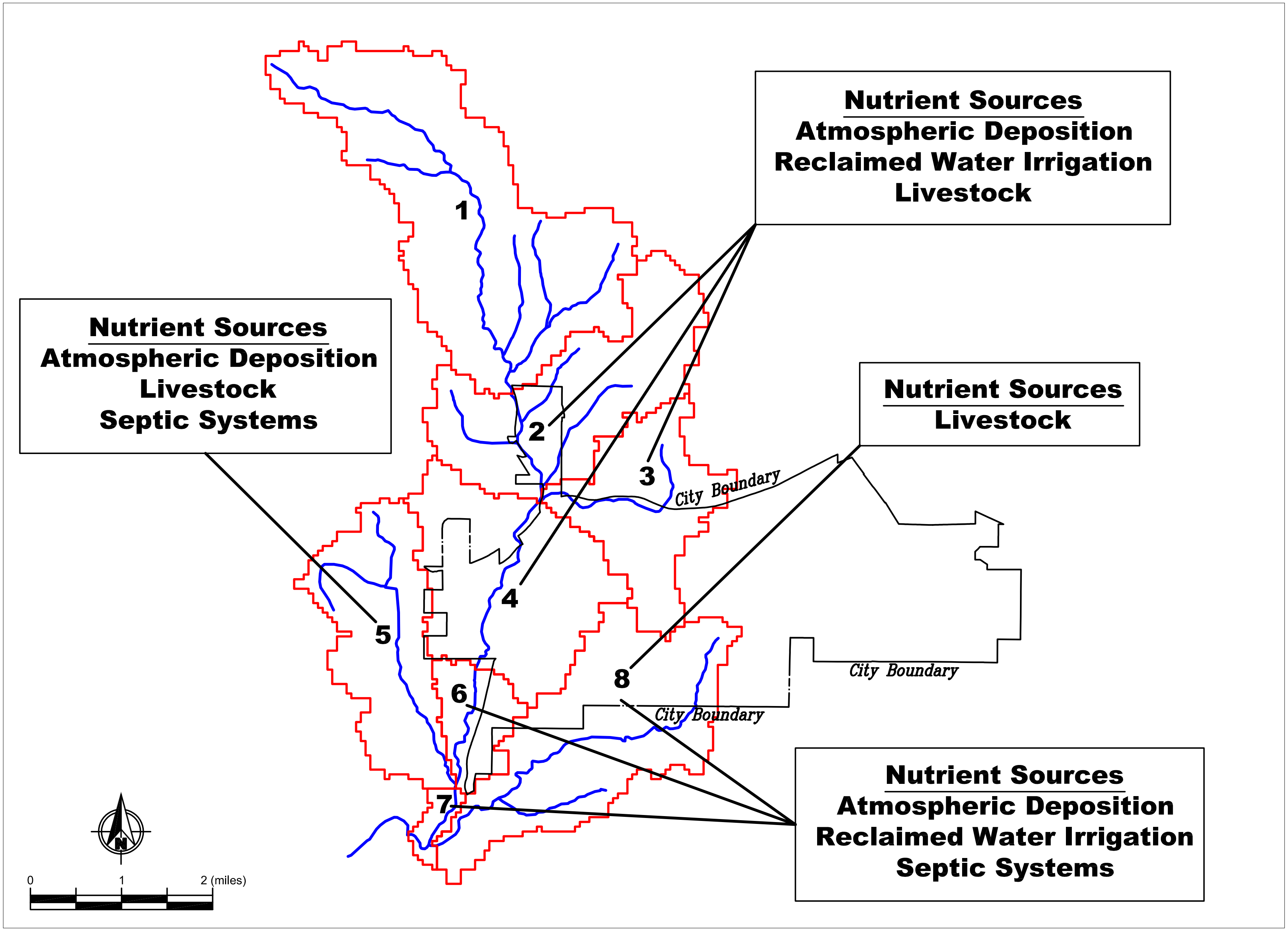


Figure 3.5 Nutrient Sources for Las Virgenes Creek

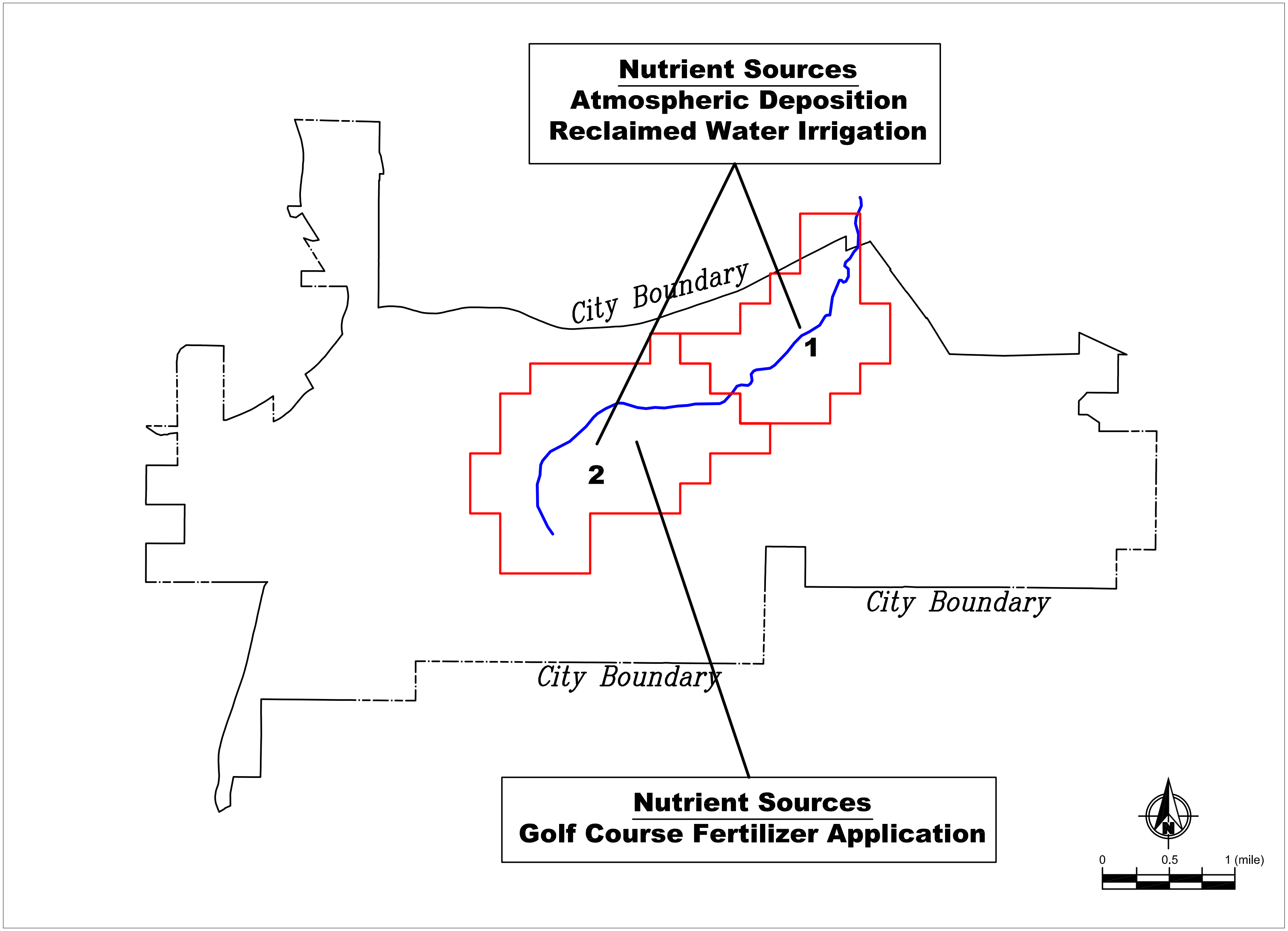


Figure 3.6 Nutrient Sources for McCoy Creek

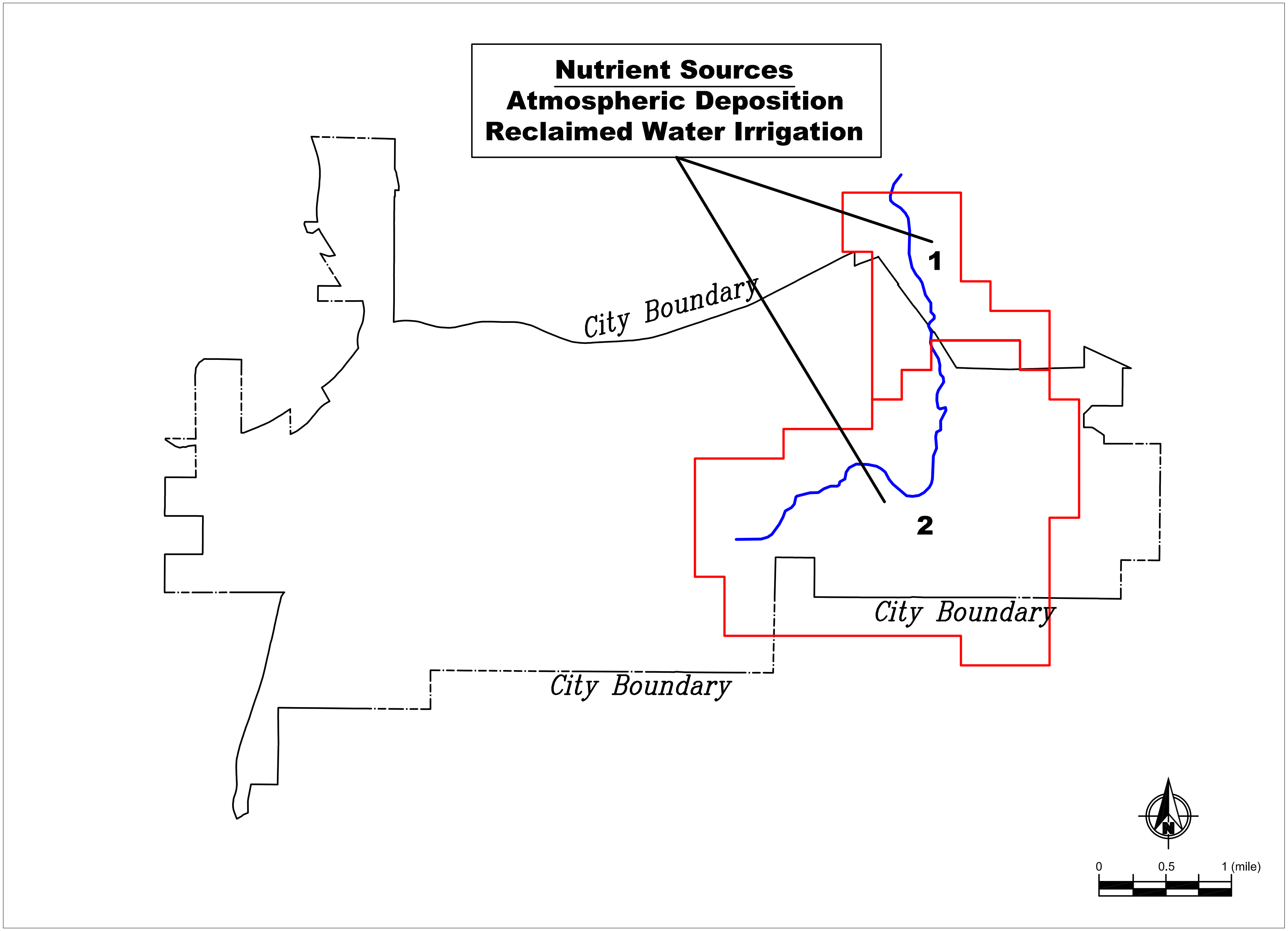


Figure 3.7 Nutrient Sources for Dry Canyon Creek

3.4 CONCEPTUAL MODEL VERIFICATION

Detailed calibration of the HSPF model set up for the three watersheds was not conducted for lack of site-specific water quality data at a level that would permit full calibration of the model. The City has been monitoring water quality since 1998 as part of the "Adopt-A-Creek Program". The monitoring program consists of instantaneous measurements of various water quality constituents accomplished through direct measurements as well as grab sample collection and subsequent analysis. Instantaneous flow measurements were usually collected; however, no continuous flow measurements were collected as part of the program. Given that no simultaneous, continuous measurement of flow and water quality constituents were made, the data were insufficient to conduct a meaningful calibration of the HSPF model.

Instead of full calibration, the model was qualitatively compared against the results of analytical estimates of flows within Las Virgenes Creek and total loadings provided in EPA/RWQCB (2002). Verification was based on loading per acre of watershed with the ranges of nutrient loadings for the Malibu Creek watershed (LACDPW, 2000; Stenstrom et al., 1993; UCLA, 2000; NRCS, 1995b). The nutrient loading trends were also compared to water quality data from the City. The model was found to provide reasonable results given the limited amount of data.

<u>Hydrology</u>

The conceptual watershed model for Las Virgenes Creek was used to check the hydrologic component of the watershed model setup. The conceptual model predicted peak flow rate for existing condition over a 24-hour period are compared with those calculated based on a commonly used analytical method (Rational Method) in Table 3.9. As shown in the table, the conceptual model predicted flow rates at each subwatershed match well with the Rational Method predictions.

Table 3.9 Comparisons of Conceptual Model and Rational Method Flows

SUBWATERSHED	FLOWS (CFS)	
	RATIONAL METHOD	CONCEPTUAL METHOD
1	64	73
2	132	160
3	42	62
4	253	331
5	45	63
6	262	345
7	360	497
8	50	87

Nutrient Loadings

The conceptual model predicted general trends of the nutrient loadings were compared to available monitoring data obtained from the City. An analysis of these data revealed that there is an increase in nutrient concentrations along Las Virgenes Creek moving from upstream to downstream through the City limits. The conceptual watershed models predicted the same general trend of increase in nutrient loadings along the creek through the City. As shown in Table 3.10, the model predicted nutrient loadings compared reasonably well to the values presented in the draft Malibu Creek watershed study (EPA/RWQCB, 2002) report for three separate locations (see Figure 3.8) within the Las Virgenes Creek watershed.

Table 3.10 Average Annual Nutrient Loading Comparisons

LOCATION	NUTRIENT	AVERAGE ANNUAL LOADING (LB/YR)	
		LAS VIRGENES CREEK CONCEPTUAL MODEL	DRAFT MALIBU CREEK WATERSHED STUDY
1	Nitrogen	23,075	19,300
	Phosphorus	8,060	2,075
2	Nitrogen	42,901	43,200
	Phosphorus	16,775	4,340
3	Nitrogen	20,184	14,460
	Phosphorus	3,341	1,640

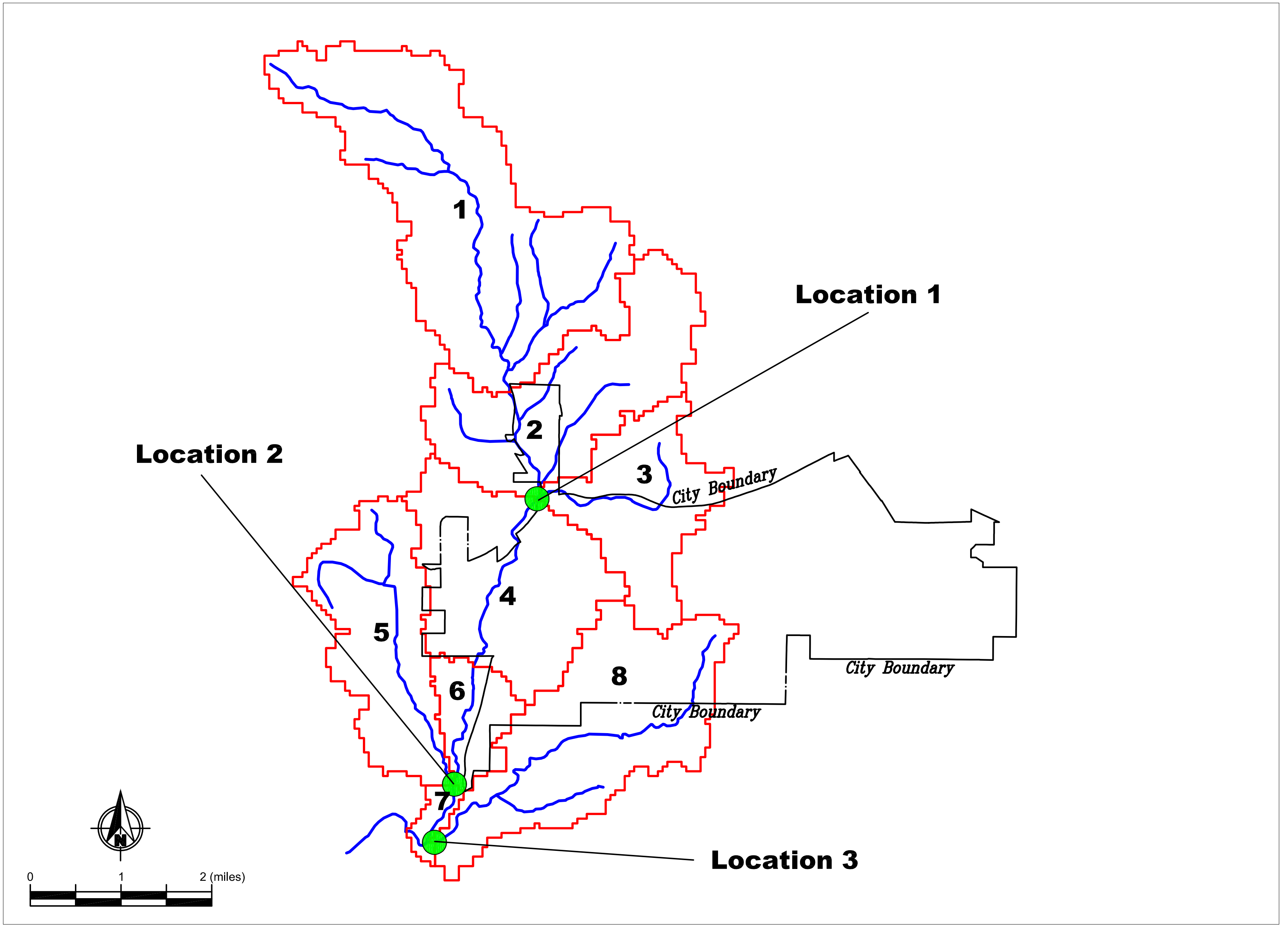


Figure 3.8 Locations for Nutrient Loading Comparison

Loading Sensitivity

Two simulations for each creek were conducted to determine the model sensitivity to the input nutrient loadings. For the sensitivity test, the total loading for each nutrient was increased by 50% and decreased by 50% from the existing condition. The model results were then compared based on percent changes in loading from the existing conditions. Table 3.11 summarizes the percent change for the sensitivity analysis.

Table 3.11 Nutrient Loading Sensitivity Analyses

NUTRIENT	SENSITIVITY CHANGE	PERCENT CHANGE (%)		
		LAS VIRGENES CREEK	MCCOY CREEK	DRY CANYON CREEK
Nitrate	50% Increase	46	33	38
	50% Decrease	46	33	35
Ammonia	50% Increase	23	12	16
	50% Decrease	23	10	9
Phosphate	50% Increase	39	24	38
	50% Decrease	38	24	38

The sensitivity test results show that an increase and a decrease in the input nutrient loadings result in similar percent changes from existing conditions. The nitrate sensitivity change resulted in relatively close changes for Las Virgenes (46%), McCoy Creek (33%), and Dry Canyon Creek (37%).

The results indicate that the absolute nutrient loading is sensitive to the input nutrient loading. The percent change in loading was similar regardless of whether or not the input nutrient loading was increased or decreased. Therefore, the model should only be used to compare relative changes in nutrient loading between alternatives and not to evaluate changes in absolute values. This illustrates the need for model calibration if the model results are to be used on an absolute basis (i.e., actual loading or concentration).

4. ALTERNATIVE DEVELOPMENT

4.1 OBJECTIVE

Nutrient levels in receiving waters are dependent on source loadings in the watershed, transformations on the watershed surface and in the soil environment, runoff intensity, and physical, chemical, and biological interactions within the aquatic environment of the receiving water. Water quality improvement can be achieved by altering these processes. Decreasing the nutrient source within the watershed lowers the nutrient loading. Limiting irrigation or preventing runoff from reaching the receiving water reduces the transport of nutrients. Increases in biological and chemical processes increase removal of nutrients within the watershed also.

Alternative restoration measures were developed to achieve these objectives, thereby reducing nutrient loading to the creeks. The alternative restoration measures were divided into three groups based on the primary mechanism for achieving reductions in nutrient loadings. Alternative restoration measures implemented within the creek (creek restoration) were developed to improve water quality primarily through habitat restoration and creek flow modification. Implementation of structural best management practices (BMPs) within the watershed were analyzed as a class of alternative restoration measures to reduce nutrient loading through methods focused primarily on trapping nutrients prior to entering the creeks (e.g., sedimentation trap, CDS units, and treatment wetlands/bioswales). Finally, source control methods were identified as a class of alternative restoration measures focused primarily on reducing nutrient loading at the generation source (e.g., recycled irrigation water use changes).

4.2 ALTERNATIVE DEVELOPMENT

To facilitate the development of watershed modeling alternatives, improvement goals were established that focused on nutrient reductions and reductions in secondary processes that affect nutrients (e.g., soil erosion). The goals are presented in Table 4.1, along with the corresponding control mechanisms and watershed restoration measures required to achieve each goal.

Table 4.1 Water Quality Improvement Goals, Control Mechanisms, and Watershed Restoration Measures

GOAL	CONTROL MECHANISM	WATERSHED RESTORATION MEASURE
Reduce Fertilizer Runoff	Transport	Structural BMPs
Decrease Husbandry Runoff	Transport	Structural BMPs
Reduce Septic System Failure	Source	Source Control
Modify Reclaimed Water Use	Source	Source Control
Reduce Erosion	Flow	Creek Restoration or Land Use Modification
Increase Vegetative Uptake	Removal	Creek Restoration or Land Use Modification

Since it is possible to implement various combinations of the alternative watershed restoration measures presented above, a clear methodology was needed to cost-effectively analyze the full range of options within a limited number of model simulations. This was done by combining all the restoration measures for each group into one alternative, thereby resulting in three alternatives for model simulation (Creek Restoration, Structural BMPs, and Source Control). To provide a baseline for comparison, a fourth alternative was developed based on the historical land uses that were thought to exist prior to the arrival of European man (i.e., open space/natural). This alternative (Historical Land Use) establishes an upper limit on the amount of improvement that can be achieved through watershed restoration since it reflects a watershed condition absent human influence.

4.3 HISTORICAL LAND USE

The Historical Land Use Alternative was developed to establish nutrient loadings in the absence of human activities. Urbanization impacts the watershed characteristics and increases nutrient loadings associated with anthropogenic sources. By eliminating urbanization, this alternative establishes the maximum possible improvement that can be achieved for the watershed. The alternative was based on the existing watershed without urban land use and with atmospheric deposition being the only nutrient input to the watershed.

4.4 CREEK RESTORATION

The Creek Restoration Alternative was developed to reduce erosion and increase vegetative uptake of nutrients through stream modifications. The alternative addresses all of the creek restoration opportunities, which included erosion control, channel modifications, and wetland restoration actions as identified in Table 4.2. These stream modifications do not impact the nutrient loadings from the watershed that enters the creek, but the modifications were modeled for completeness. In addition, nutrient uptake resulting from habitat restoration is insignificant compared to the other nutrient removal processes because the steep gradients of the creeks do not allow sufficient time for substantial nutrient uptake and the total area of restored habitat was small.

Table 4.2 Creek Restoration Opportunities

RESTORATION OPPORTUNITIES	STREAM MODIFICATIONS
Erosion Control	Stabilize bank and channel
Channel Modifications	Cease vegetation clearing
	Remove concrete and rip-rap
	Stabilize banks with bioengineering techniques
	Remove or improve flow restrictions (e.g. – weirs or culverts)
	Pull back banks
	Enhance floodplain
Wetland Restoration	Remove eucalyptus, vinca, tamarisk, and other exotics
	Create and restore riparian wetlands

Specific restoration actions for Las Virgenes Creek were identified along the main stem defined by the green segment in Figure 4.1. Creek characteristics were modified in Subwatersheds 2, 4, and 6. The concrete channel along the majority of the Subwatershed 2 and along the top of Subwatershed 4 will be removed. Modifications to stabilize the creek bank and channel were identified along the entire segment. Multiple wetland restoration sites were identified in Subwatersheds 2, 4, and 6. Restoration actions were identified for the entire length of McCoy Creek as shown in Figure 4.2. Restoration opportunities for Dry Canyon Creek were also identified along the entire creek. Figure 4.3 indicates the primary restoration actions for Dry Canyon Creek.

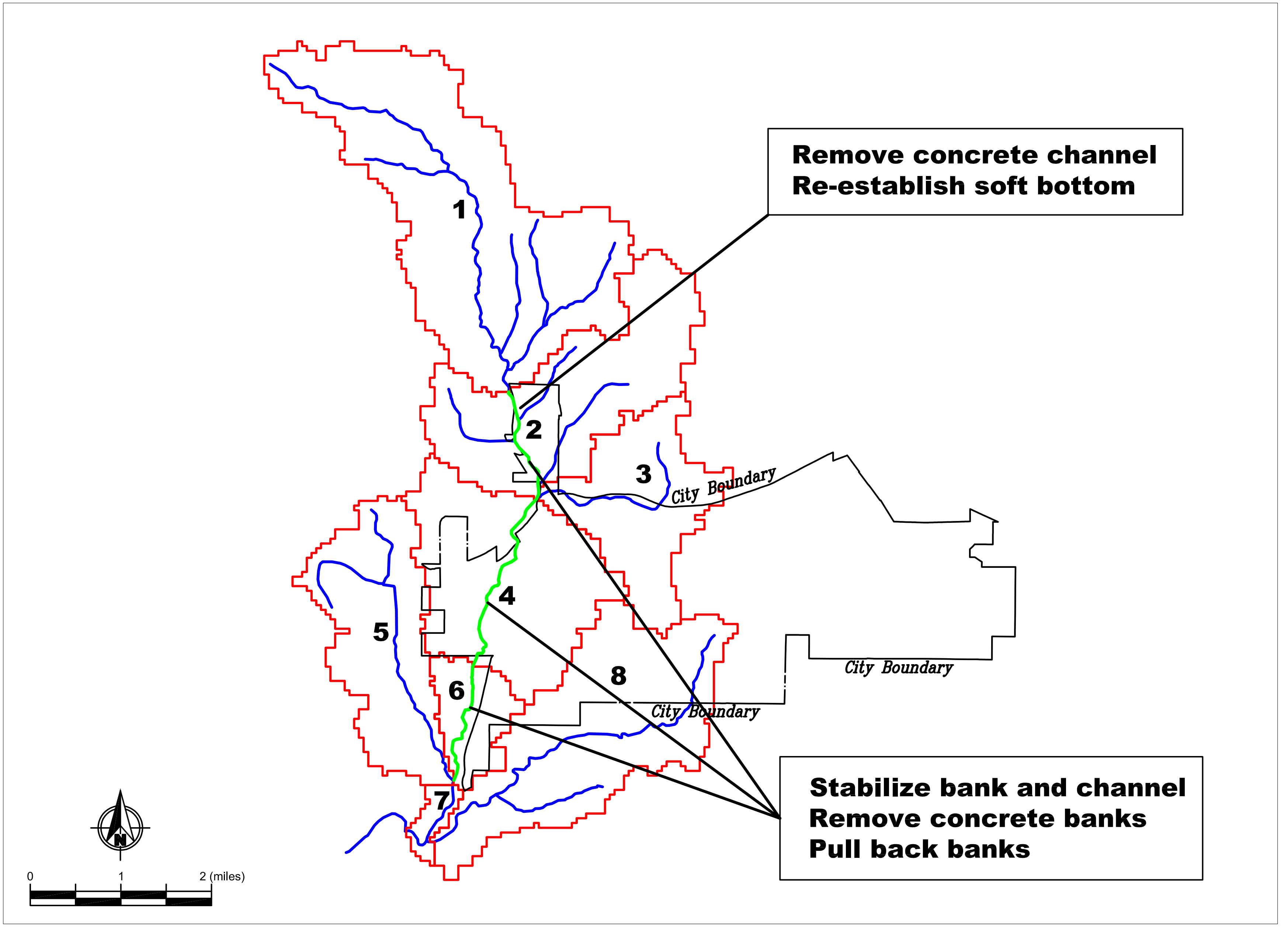


Figure 4.1 Creek Restoration Alternative for Las Virgenes Creek

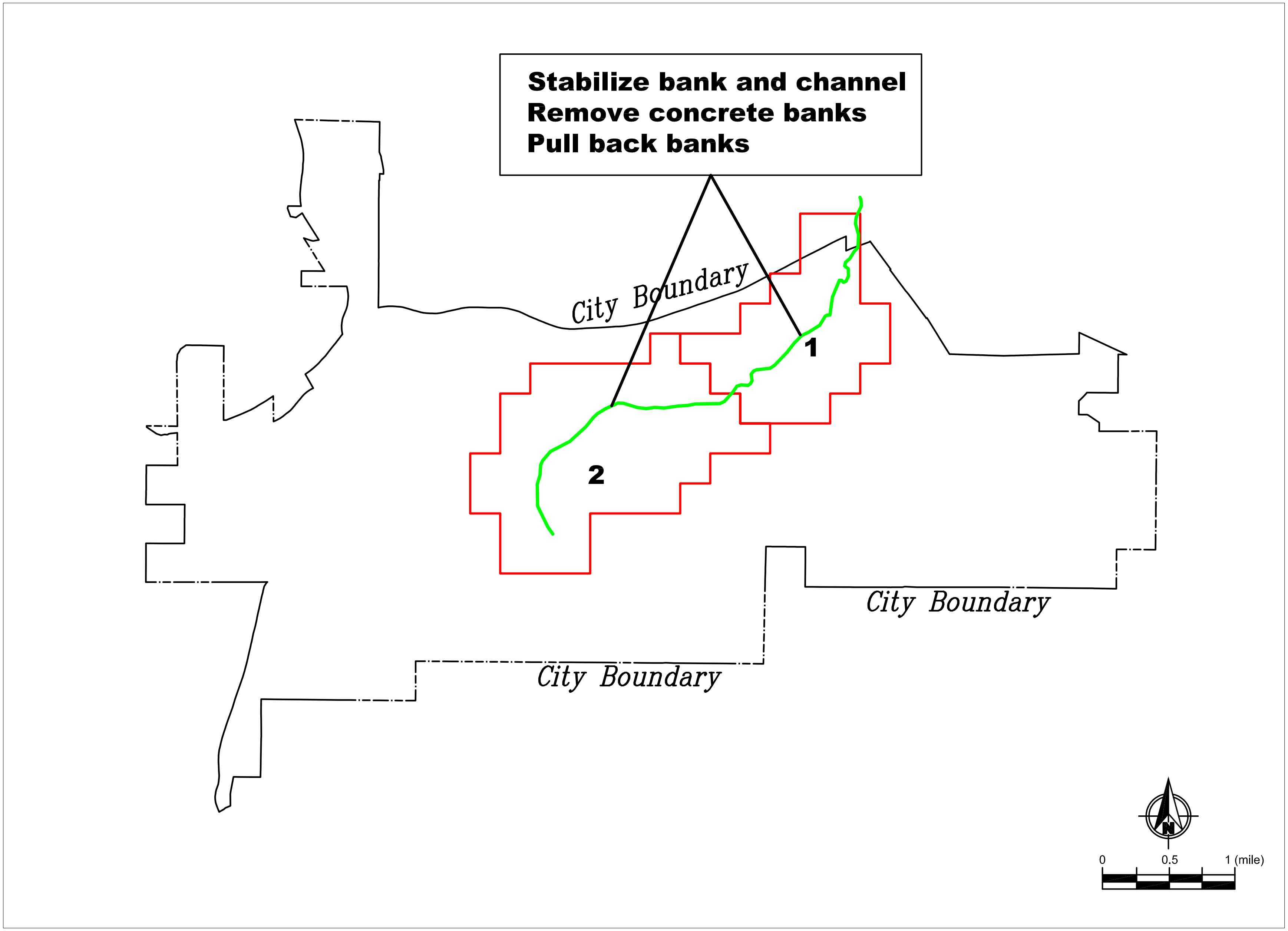


Figure 4.2 Creek Restoration Alternative for McCoy Creek

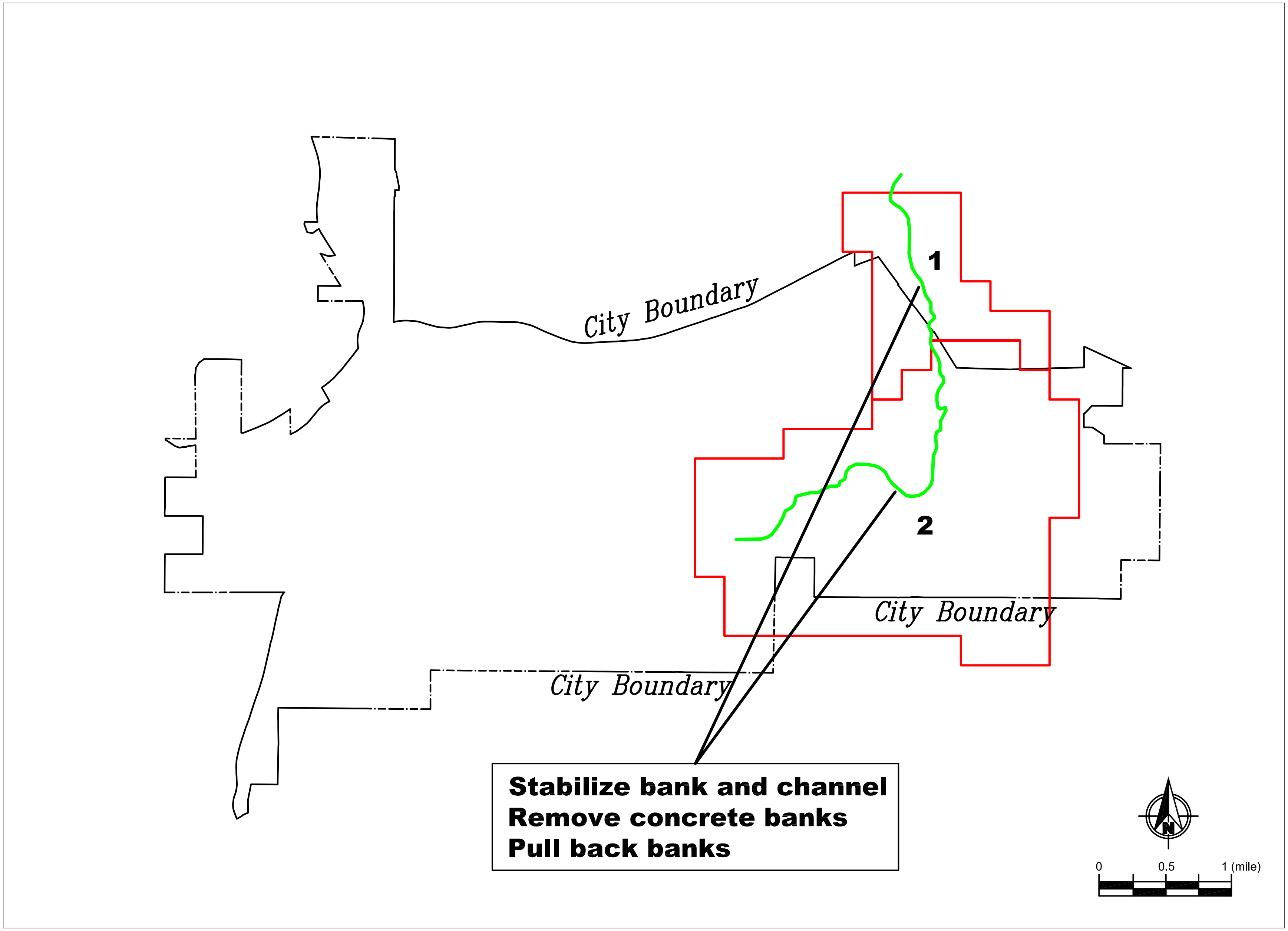


Figure 4.3 Creek Restoration Alternative for Dry Canyon Creek

The Creek Restoration Alternative was simulated by adjusting channel characteristics to reflect stream modifications for erosion control and channel modifications. Improvement of vegetative uptake due to wetland restoration was determined to be relatively localized and insignificant on a watershed scale; therefore, vegetative uptake improvements were not modeled.

4.5 WATERSHED MANAGEMENT ALTERNATIVE 1 – STRUCTURAL BMPS

Watershed Management Alternative 1 was developed to reduce nutrients from runoff by treating runoff on site within the watershed using structural BMPs before it reaches the creeks. Four general types of BMPs were identified to be applicable based on land use: detention basins, biofilters, infiltration basins, and pervious concrete. Detention basins capture runoff for treatment through sedimentation. Biofilters utilize vegetation to treat runoff and reduce surface runoff. Infiltration basins reduce surface runoff by increasing percolation into the ground and provide removal of contaminants. Similarly, pervious concrete reduces the runoff from impervious urban areas by promoting infiltration and contaminant removal.

Table 4.3 shows the typical values of removal efficiency for the BMPs considered for this alternative. The removal efficiencies were calculated based on average literature values (EPA, 1993; SWQTF, 1993; EPA, 1999; EPA, 2002; CASQA, 2003). The nitrogen and phosphorus removal efficiencies were similar for each type of BMP. These values were used to calculate the reduction of the nitrogen and phosphorus species by the BMPs. The nitrogen removal efficiency was assumed to be applicable for both nitrate and ammonia. The phosphorus removal efficiency was assumed to be applicable for phosphate.

Table 4.3 Average Removal Efficiencies of BMPs

TYPE OF BMP	AVERAGE REMOVAL EFFICIENCY (%)		APPLICABLE LAND USE
	NITROGEN	PHOSPHORUS	
Detention Basins	37.5	37.5	Agricultural and Husbandry
Biofilters	51.0	53.0	Agricultural, Husbandry, Residential, and Commercial
Infiltration Basins	70.5	70.5	Residential and Commercial
Pervious Concrete	80.0	60.0	Residential

Source: EPA, 1993; SWQTF, 1993; EPA, 1999; EPA, 2002; CASQA, 2003

The average removal efficiencies presented in Table 4.3 are based on complete treatment of all runoff and successful performance of each structural BMP. To account for the potential range in runoff trapping and poor performance of some structural BMPs, two scenarios were developed to represent Alternative 1. Alternative 1A was based on the assumption that the structural BMPs were successful at treating 50% of the runoff, while Alternative 1B was based on the assumption that the structural BMPs were successful at treating 100% of the runoff.

The use of structural BMPs is limited based on land use. In some cases, multiple BMPs can be implemented within the same land use. For land uses with two applicable BMPs, the efficiency was calculated based on the assumption that the BMPs would be linked in series such that the efficiency of the second BMP was applied to the output of the first BMP. For example, biofilters and infiltration basins were utilized in pervious residential and commercial land use areas. The biofilters can remove 51% of nitrate leaving behind 49% of nitrate assuming the biofilters are 100% effective. Infiltration basins were then linked to the biofilters to remove 70.5% of the nitrate remaining, thereby leaving 29.5% of the nitrate after biofilter treatment. Multiplying the portion remaining after biofilter treatment (49%) by the portion remaining after infiltration basin treatment (29.5%) yields an overall remaining nitrate of 14.5%. Therefore, the sequence of biofilters and infiltration basins has an overall removal efficiency of 85.5% (i.e., 100% - 14.5%).

The overall efficiency of each BMP for each land use within each subwatershed was applied to the nutrient loadings determined from existing conditions. The BMPs applicable to this alternative can be utilized only within the agricultural, residential, and commercial land uses; therefore, the loadings for these three land uses were reduced through application of the BMPs. This process is illustrated in Figure 4.4 as an example flow chart. The flow chart outlines the nitrate loading from the pervious urban area in Las Virgenes Creek Subwatershed 4 under Alternative 1A. The pervious urban area is composed of residential, commercial, and transportation land uses with the transportation land uses accounting for 26.4%. The structural BMPs of biofilters and infiltration basins can be utilized for the residential and commercial land uses; therefore, only 73.6% of the loading can be directed to the structural BMPs. The other 26.4% from the transportation land use enters the creek directly (i.e., no treatment). Based on the assumption of Alternative 1A, 50% of the nitrate loading bypasses the structural BMPs and enters the creek, while the other 50% is captured for treatment by the structural BMPs. Based on the overall removal efficiency discussed above, 85.5% of the treated loading is removed. Thus, 14.5% of the treated nitrate loading enters the creek. This process was applied for each land use in each subwatershed.

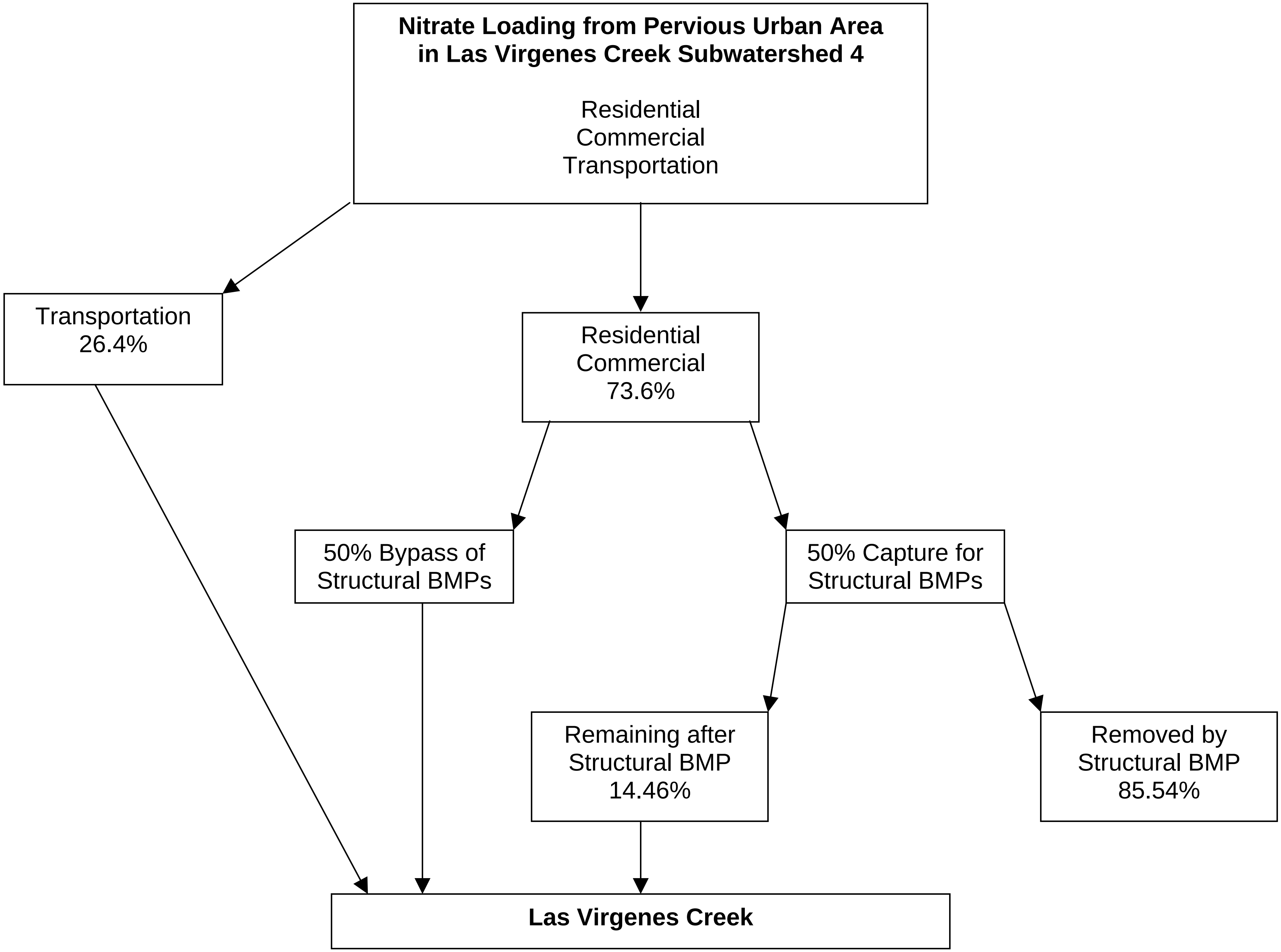


Figure 4.4 Example Flow Chart for Watershed Management Alternative 1A - Structural BMPs

The areas that BMPs can be used within the Las Virgenes Creek watershed are shown in Figure 4.5. The gray areas indicate the residential and commercial land uses and yellow indicates agricultural or husbandry land uses. As shown in the figure, BMPs can only be applied to a limited portion of the entire watershed.

The residential and commercial areas for the McCoy Creek watershed are shown in Figure 4.6. The gray areas indicate the portion of the watershed that BMPs could be implemented.

Figure 4.7 indicates the areas where structural BMPs can be implemented for Dry Canyon Creek. Again, the gray areas indicate the portion of the watershed that BMPs could be implemented.

4.6 WATERSHED MANAGEMENT ALTERNATIVE 2 – SOURCE CONTROL MEASURES

Watershed Management Alternative 2 was developed to reduce nutrient loading through reductions in sources. Based on information presented in Section 3.3, the four most significant nutrient sources in the watershed were determined to be atmospheric deposition, septic systems, reclaimed irrigation water use, golf course fertilization, and livestock. It was not considered feasible to reduce atmospheric deposition of nutrients as part of this study because atmospheric deposition occurs on a regional basis, which is beyond the geographic limits (watershed) of the study. Septic systems within the Las Virgenes Creek watershed occur downstream of the area of interest (City limits); therefore, changes in septic systems were not addressed in the current study since those changes would not have any effect on the portion of the creek that flows through the City. Septic systems within the Dry Canyon Creek watershed were not simulated because there were no available data indicating the presence of septic systems in the Dry Canyon Creek watershed at the time the modeling analysis was conducted. The remaining sources of nutrients that were analyzed for control as part of the study were reclaimed irrigation water use, golf course fertilization, and livestock.

A reduction factor (percent) in nutrient loading was applied for each of the controllable sources within each watershed. Figure 4.8 illustrates the nutrient source reductions that were applied to different subwatersheds of the Las Virgenes Creek watershed. For McCoy Creek watershed, the reclaimed water irrigation and golf course fertilizer source reductions were applied as shown in Figure 4.9. Figure 4.10 shows the only source reduction being considered for Dry Canyon Creek is reclaimed water irrigation.

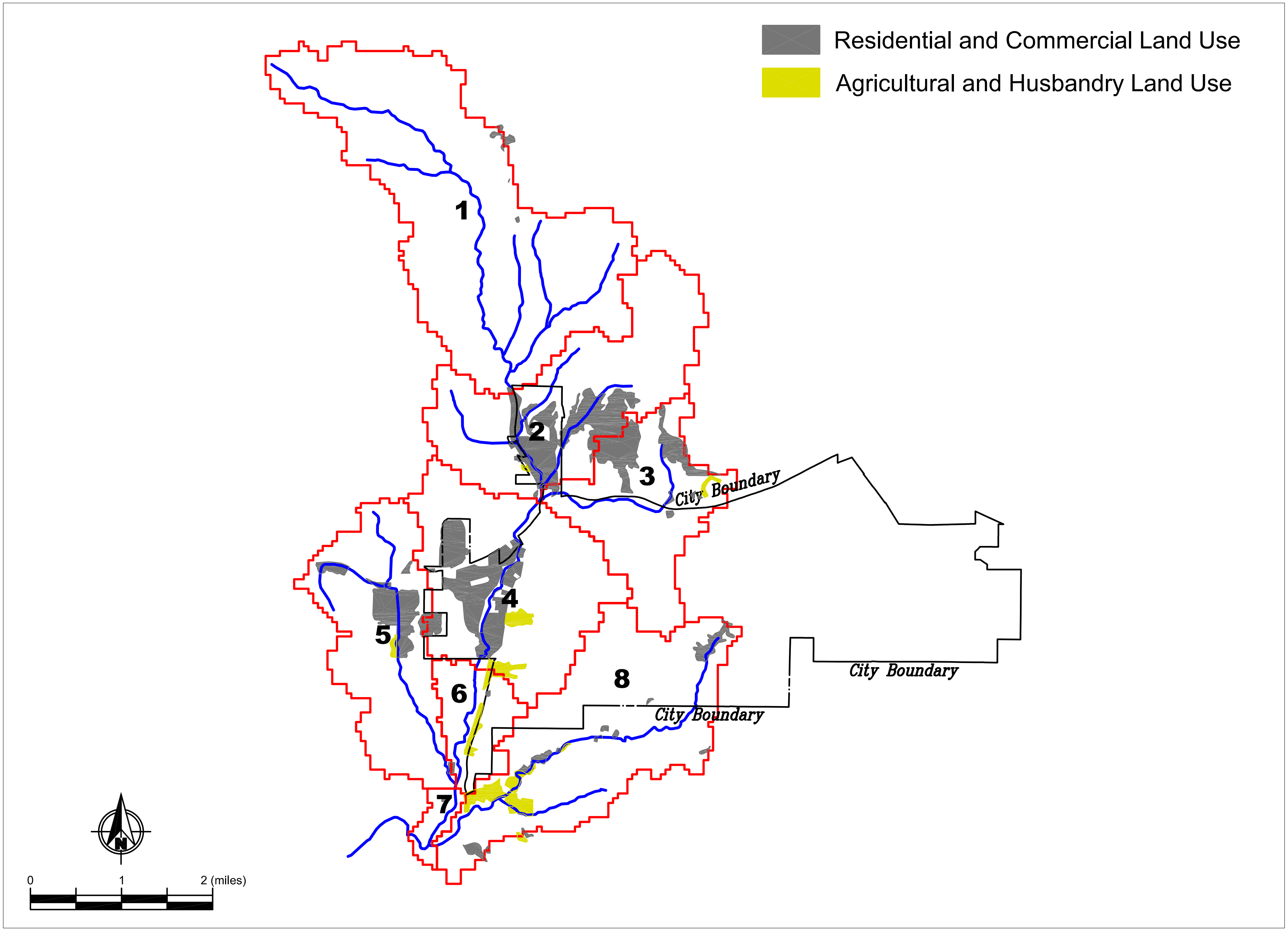


Figure 4.5 Watershed Management Alternative 1 - Structural BMPs for Las Virgenes Creek

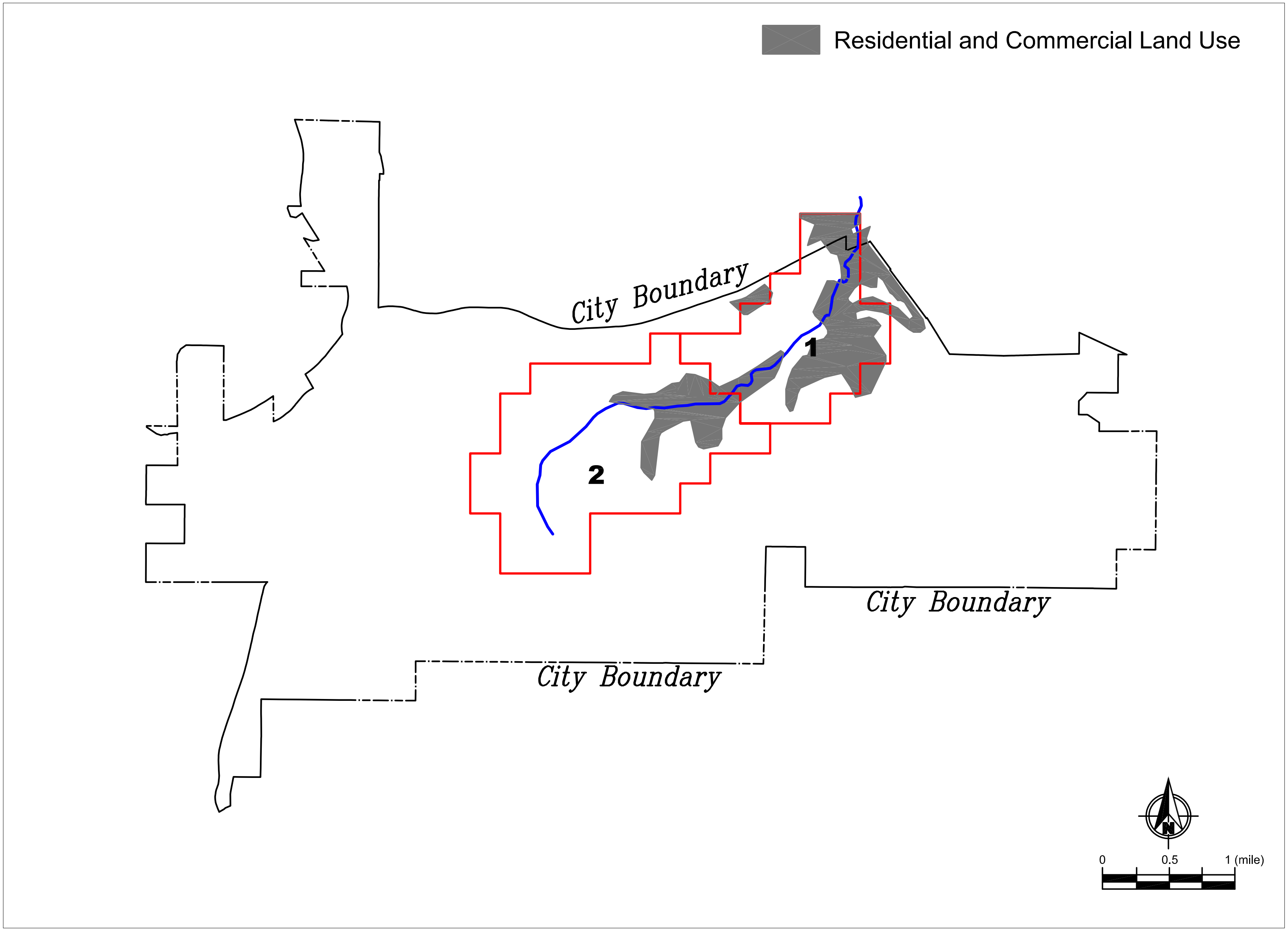


Figure 4.6 Watershed Management Alternative 1 - Structural BMPs for McCoy Creek

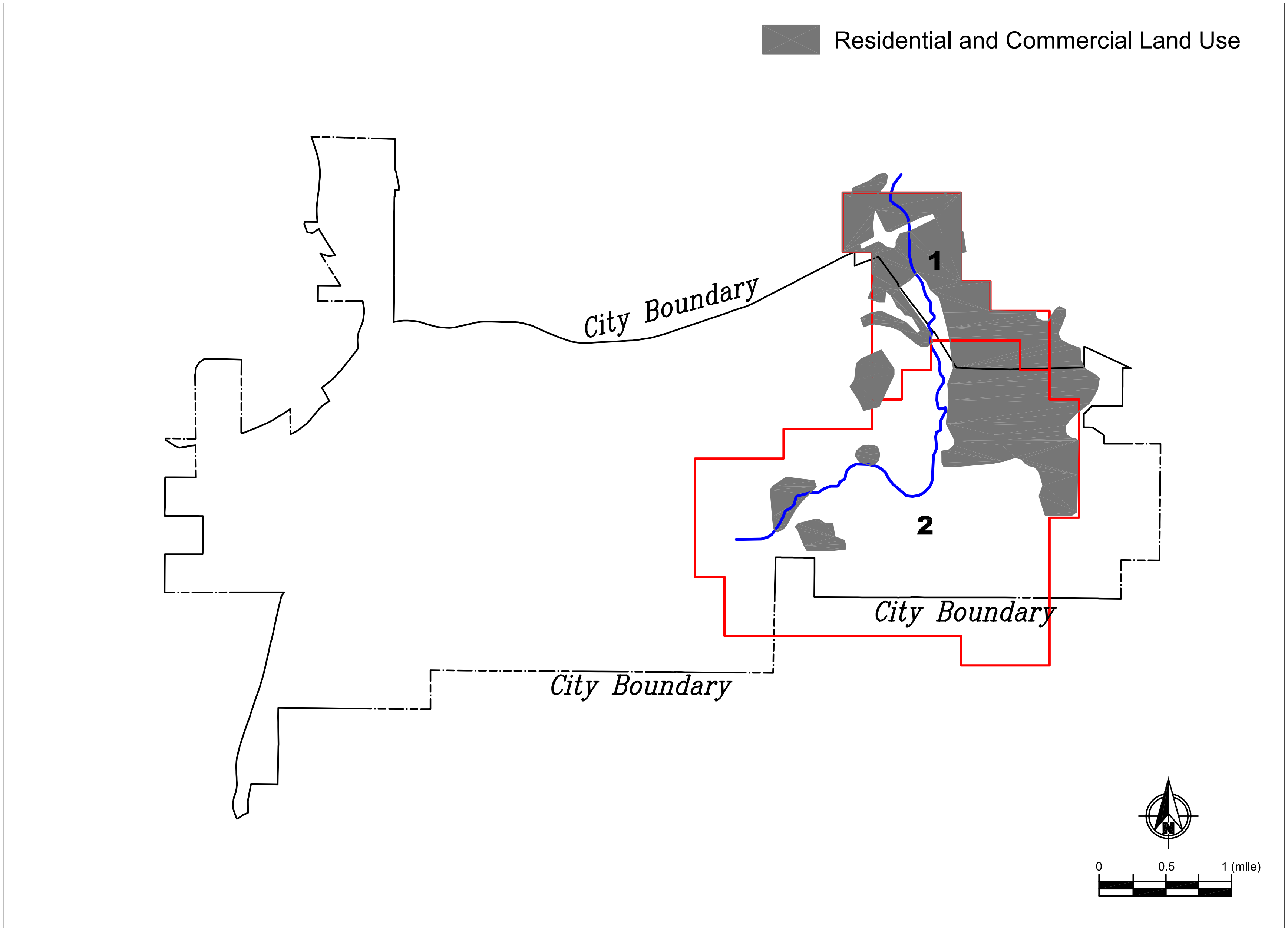


Figure 4.7 Watershed Management Alternative 1 - Structural BMPs for Dry Canyon Creek

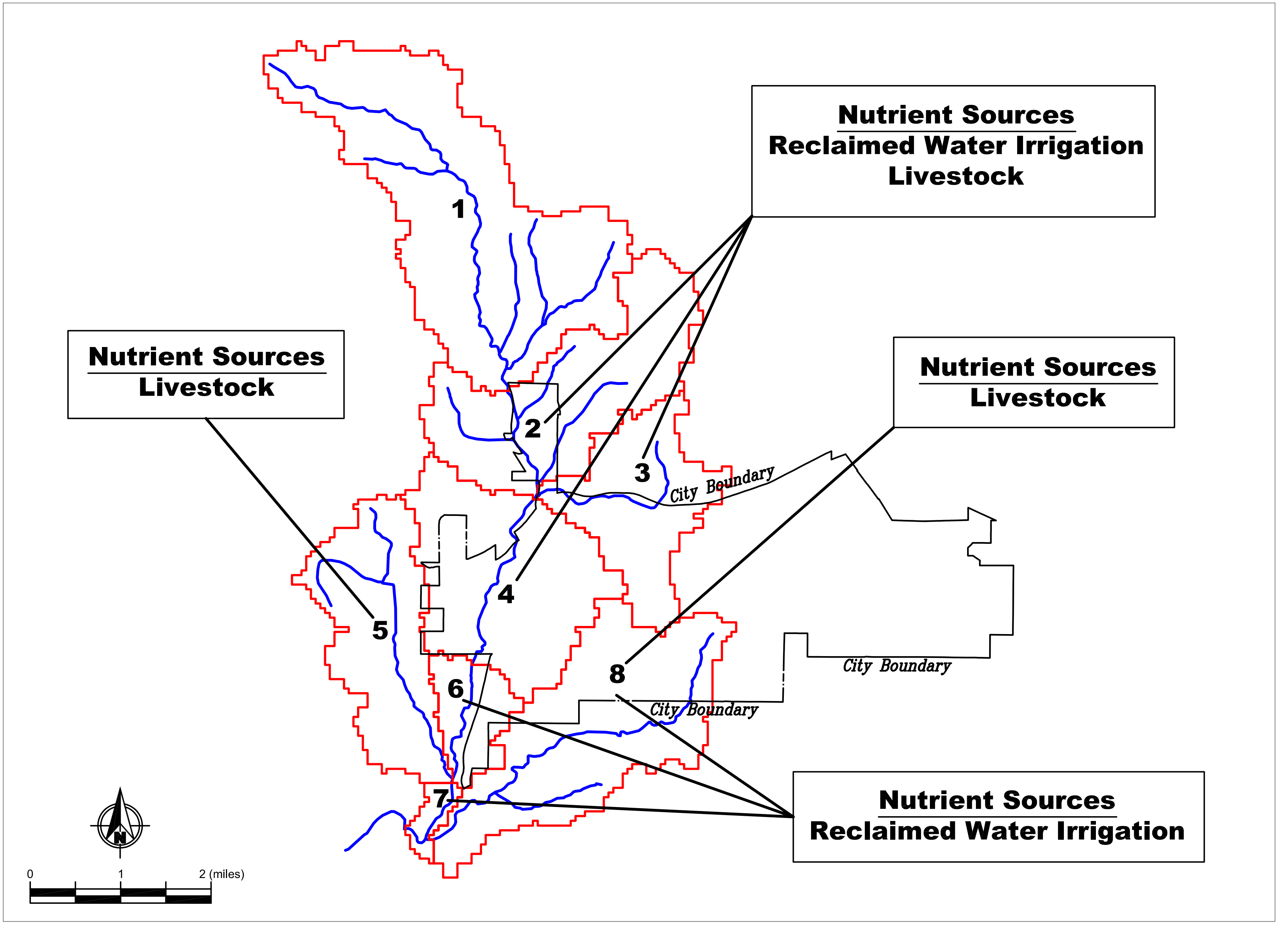


Figure 4.8 Watershed Management Alternative 2 - Source Control Measures for Las Virgenes Creek

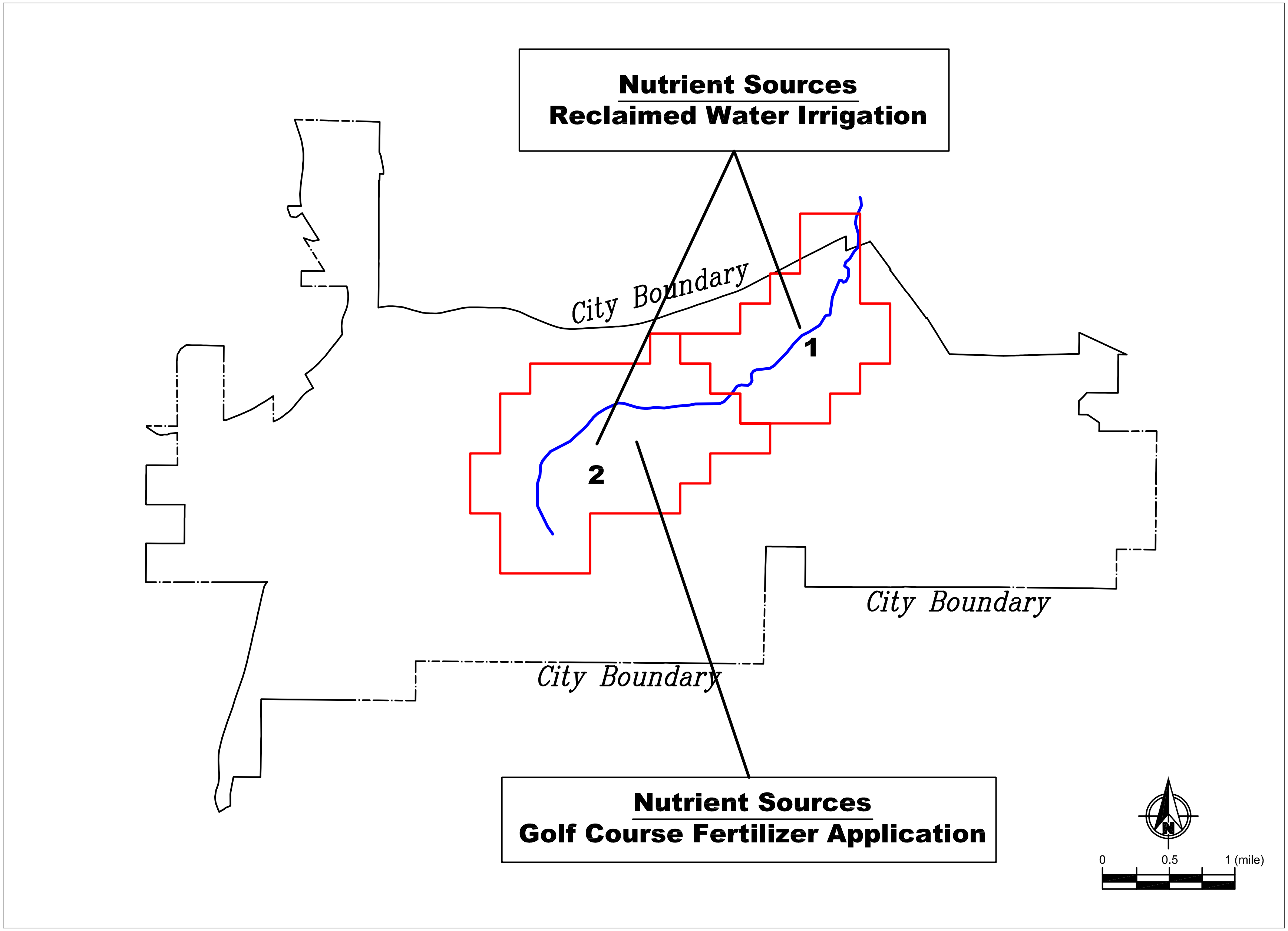


Figure 4.9 Watershed Management Alternative 2 - Source Control Measures for McCoy Creek

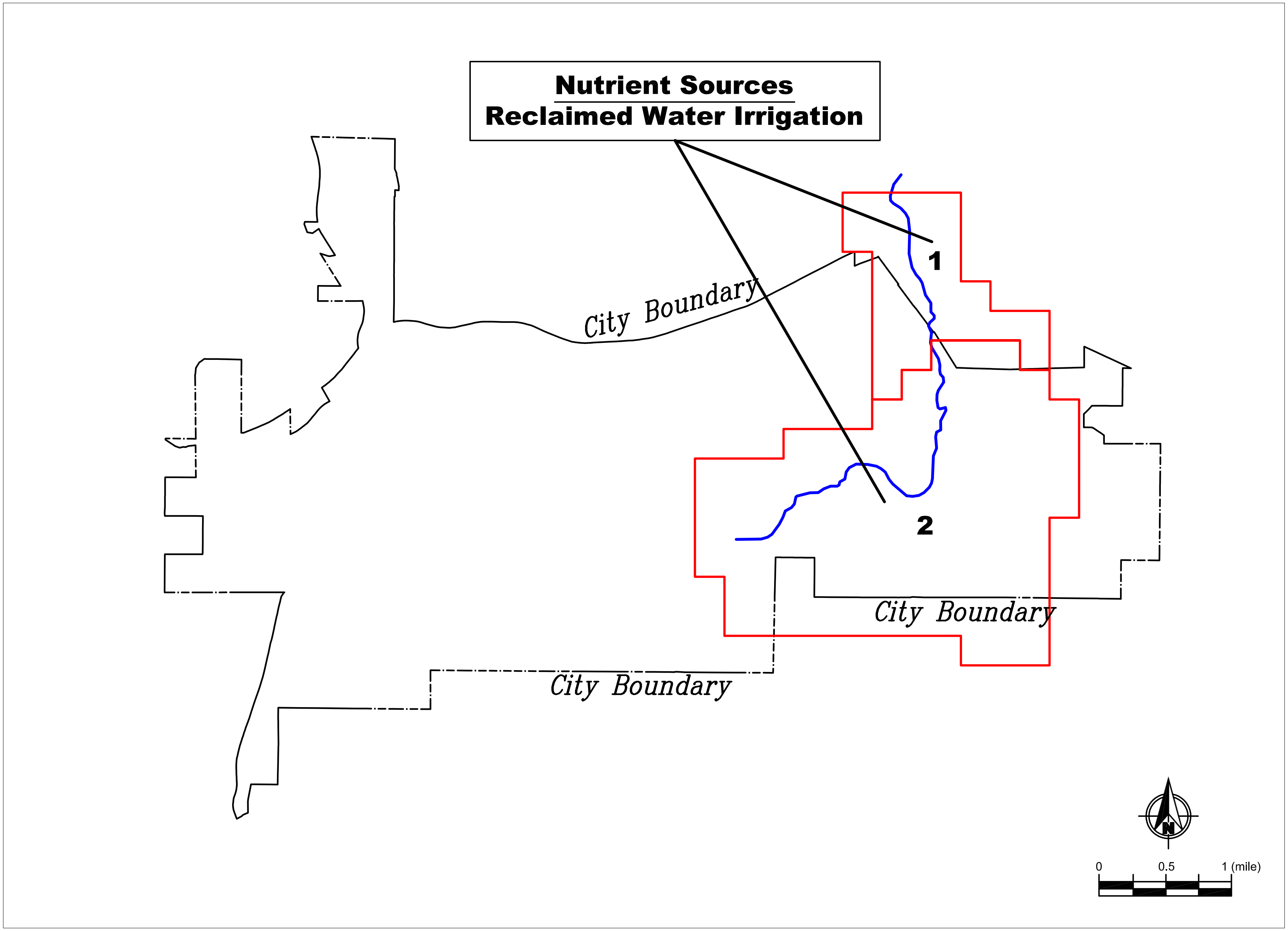


Figure 4.10 Watershed Management Alternative 2 - Source Control Measures for Dry Canyon Creek

Similar to Alternative 1, two scenarios were developed for the Watershed Management Alternative 2. Alternative 2A was based on the assumption that the source control measures would be effective in achieving a 25% reduction in reclaimed water irrigation and livestock sources. Alternative 2B was based on the assumption that the source control measures would be effective in achieving a 50% reduction in nutrients. The nutrient load reduction factor (percent) was applied for nitrate, ammonia, and phosphate.

A summary of the watershed model alternatives is given in Table 4.4.

Table 4.4 Summary of Watershed Model Simulations

ALTERNATIVE	DESCRIPTION
Historical Land Use	No urban land uses and sources; open space only
Creek Restoration	Implementation of all creek restoration opportunities
Alternative 1A	Structural BMPs – 50% Runoff
Alternative 1B	Structural BMPs – 100% Runoff
Alternative 2A	Source Control Measures – 25% Source Reduction
Alternative 2B	Source Control Measures – 50% Source Reduction

5. WATERSHED MODELING RESULTS

As discussed previously in Section 3.2, each alternative was simulated for a 3.75-year time period (October 1996 – June 2000). HSPF produced the nutrient loadings from the watershed over the entire simulation period. The results from the first year were not used to allow adequate time for the numerical model to reach a dynamic equilibrium. Therefore, nutrients were evaluated based on the average annual load (lbs/yr) over the last 2.75 years of the model results.

The nutrient loading under existing conditions was established for each creek at the downstream City limit. Figures 5.1, 5.2, and 5.3 show the three output locations for Las Virgenes, McCoy, and Dry Canyon Creek, respectively. The output location for Las Virgenes Creek is located at the downstream end of Subwatershed 4, thus the results reflect alternative restoration measures located upstream of the output location. Results for McCoy Creek were determined from the entire watershed (downstream end of Subwatershed 1). The City limits for Dry Canyon Creek are located at the downstream end of Subwatershed 2.

The reduction in average annual loading (expressed as a percentage) at each output location presented above was determined for each alternative and then compared to the loading under existing conditions. The results are shown as a percent reduction in loading from existing conditions instead of the absolute loading (lbs/yr) or change in loading (change in lbs/yr). As discussed in Section 3.3, comparison of the actual values of simulated loadings is not meaningful because the model was not calibrated. An uncalibrated model is most appropriately used to compare alternatives against a baseline condition (e.g., existing conditions) or against one another to determine relative effect.

The results of the model simulations for each creek are presented below in Sections 5.1 to 5.3. The results of the model simulations for all three creeks are summarized in Section 5.4.

5.1 LAS VIRGENES CREEK

The nitrate, ammonia, and phosphate reductions for Las Virgenes Creek are summarized in Table 5.1. The percent reduction for each alternative reflects the changes upstream of the output location (i.e., Subwatersheds 1 – 4) as shown in Figure 5.1.

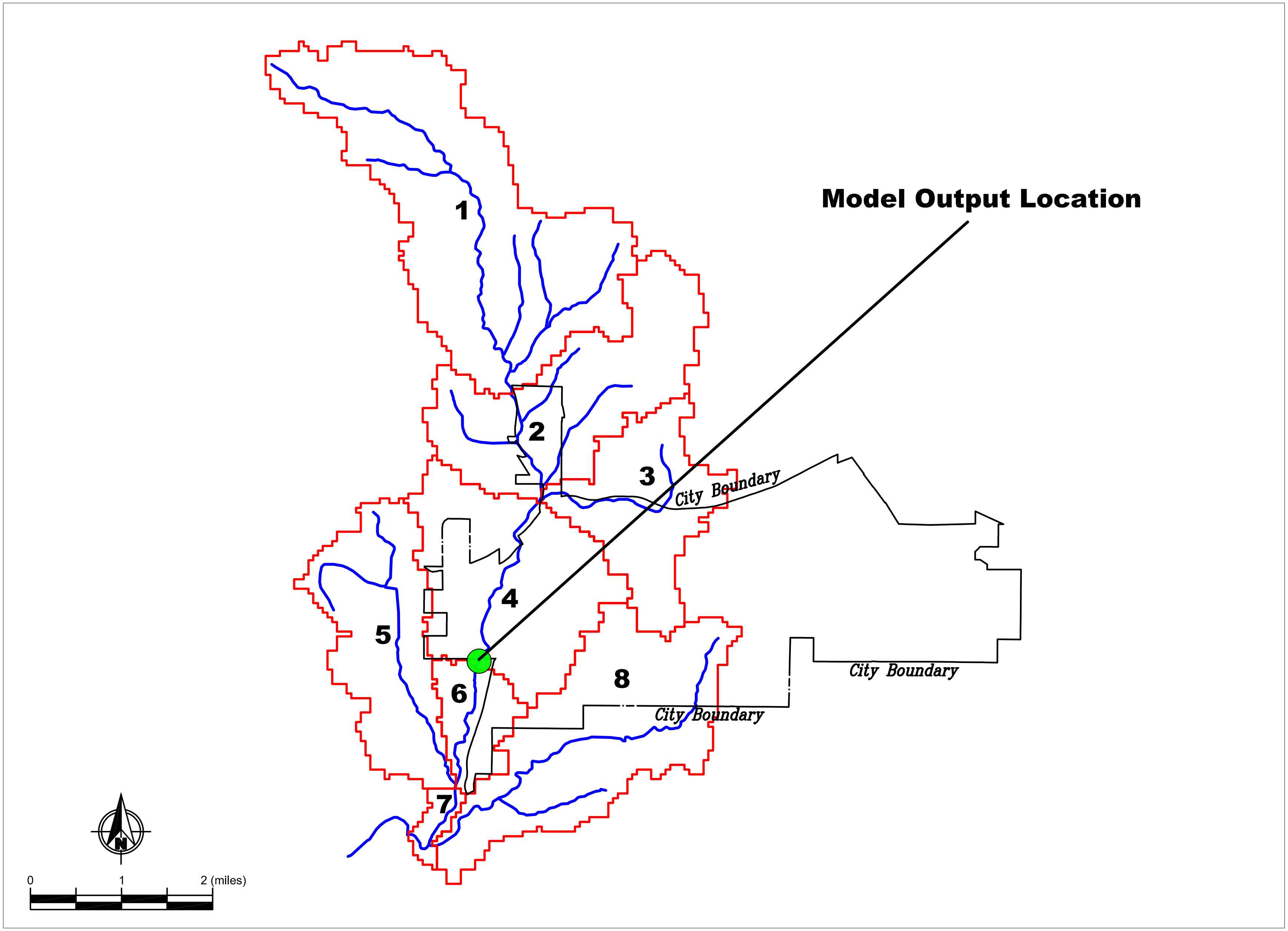


Figure 5.1 Model Output Location for Las Virgenes Creek

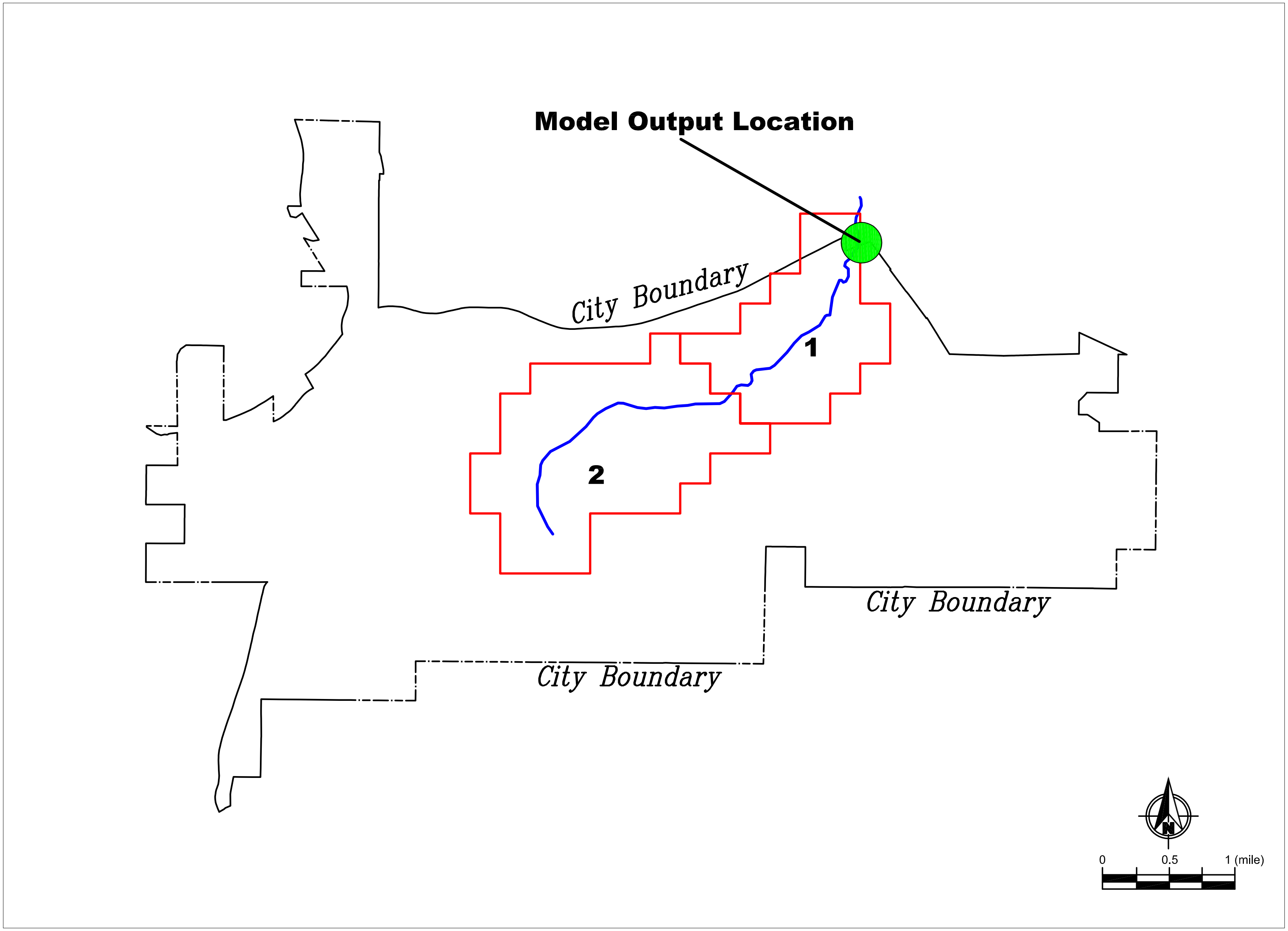


Figure 5.2 Model Output Location for McCoy Creek

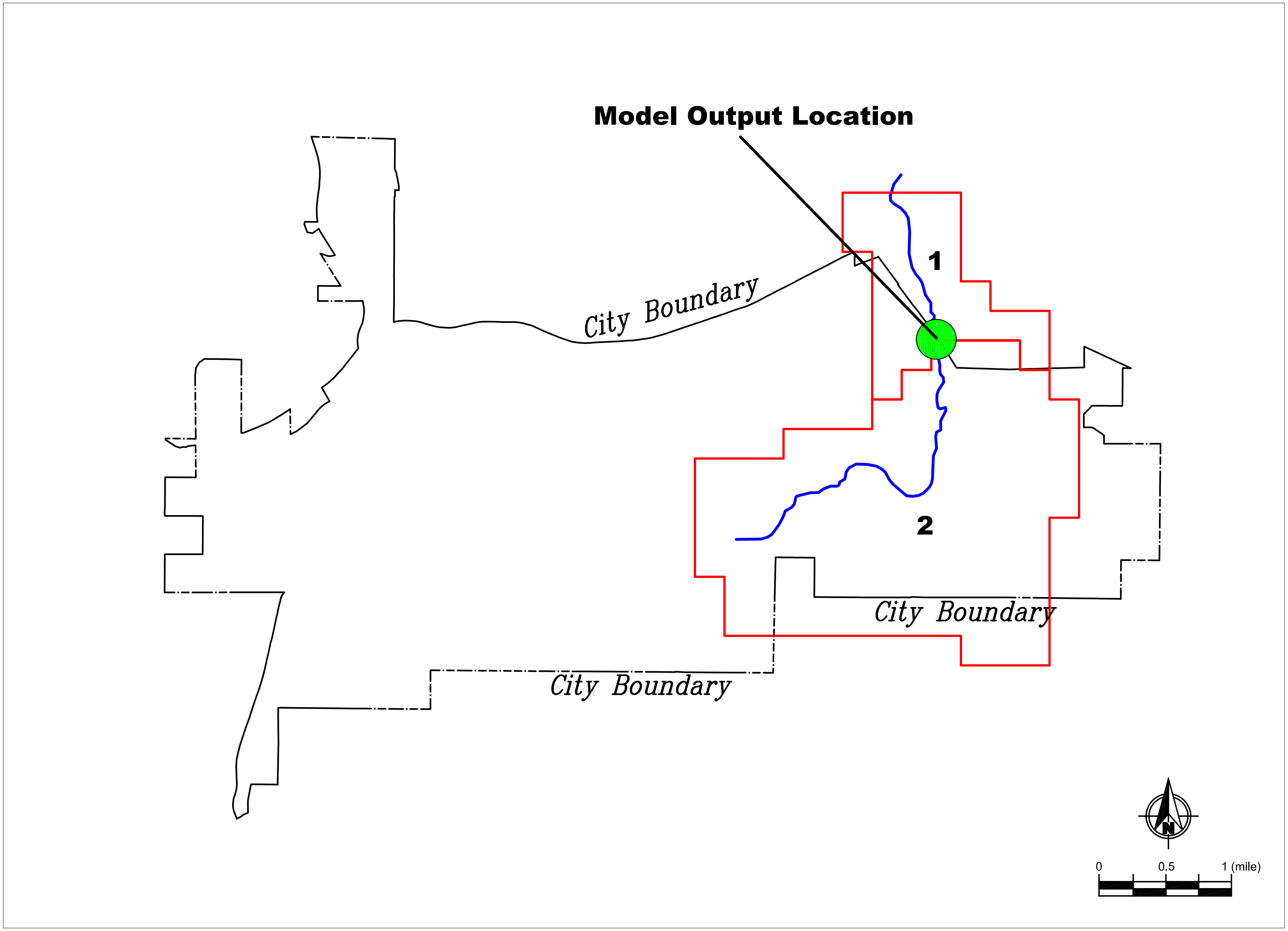


Figure 5.3 Model Output Location for Dry Canyon Creek

Table 5.1 Nutrient Loading Reductions for Las Virgenes Creek

WATERSHED ALTERNATIVE	PERCENT REDUCTION (%)		
	NITRATE	AMMONIA	PHOSPHATE
Historical Land Use	91	86	86
Creek Restoration Alternative	0	0	0
Alternative 1A	4	19	16
Alternative 1B	7	39	32
Alternative 2A	21	5	4
Alternative 2B	41	10	7

The Historical Land Use Alternative shows a significant reduction of 86-91% for nutrients. The potential reduction indicates that the major contribution of nutrients for the watershed is from human sources and urban land uses. The results also indicate that there is a natural nutrient loading attributable to natural source (e.g., soil erosion and wildlife). Therefore, to achieve a 100% reduction in nutrients would require reductions in loading attributable to natural as well as human sources.

The Creek Restoration Alternative was found to have no detectable impact on nutrient loading. This is because the modifications to the hydrological parameters associated with implementation of this alternative do not have any measurable impacts to nutrient loadings of the watershed. Meaningful reductions in nutrient loading within the watershed require restoration measures that focus on the water quality parameters (i.e., structural BMPs and source control).

As shown in the results of Alternative 1A, implementation of structural BMPs results in a 4%, 19%, and 16% loading reduction in nitrate, ammonia, and phosphate, respectively. The corresponding reductions are 7%, 39%, and 32% for Alternative 1B. The results indicate that structural BMPs are more effective in reducing ammonia and phosphate loading than nitrate loading. However, since structural BMPs can only be used in a limited portion of the watershed (see Figure 4.5), the overall nutrient reduction for the watershed is relatively low.

The model results show that implementation of source control measures under Alternative 2A would reduce loading of nitrate, ammonia, and phosphate by 21%, 5%, and 4% respectively. Implementation of Alternative 2B would reduce nitrate loading by 41%, ammonia loading by 10%, and phosphate loading by 7%. As discussed in Section 4.6, the source control measures were only applied to nutrient sources associated with reclaimed water irrigation use and livestock. These results indicate that source control would be more effective in reducing nitrate loading compared to ammonia loading and phosphate loading. Since reclaimed water irrigation use is the dominant source of nitrate, source control measures show a greater impact on nitrate loading compared to implementation of structural BMPs. There is still a relatively substantial contribution of ammonia loading and phosphate loading due to atmospheric deposition that is not addressed under any of the alternatives investigated as part of this study.

5.2 McCoy Creek

Similar to Las Virgenes Creek, the results of McCoy Creek were determined at the downstream City limit (Figure 5.2). The nitrate, ammonia, and phosphate loading reductions of each alternative for McCoy Creek are shown in Table 5.2.

Table 5.2 Nutrient Loading Reductions for McCoy Creek

Watershed Alternative	Percent Reduction (%)		
	Nitrate	Ammonia	Phosphate
Historical Land Use	98	96	98
Creek Restoration Alternative	0	0	0
Alternative 1A	2	13	7
Alternative 1B	4	26	14
Alternative 2A	16	3	8
Alternative 2B	33	6	15

The Historical Land Use shows a 98%, 96%, and 96% reduction in nitrate, ammonia, and phosphate loading compared to existing conditions. The potential reduction indicates a greater contribution of nutrients from human sources and urban land uses compared to Las Virgenes Creek.

As with Las Virgenes Creek, the Creek Restoration Alternative showed no detectable reductions in nutrient loading. As explained previously, the creek modifications were limited to the hydrologic parameters, thus the changes did not affect nutrient loading.

Alternative 1A resulted in a 2% nitrate loading reduction, 13% ammonia loading reduction, and 7% phosphate loading reduction. Implementation of Alternative 1B would yield a reduction in nitrate, ammonia, and phosphate loading of 4%, 26%, and 14%, respectively. The reductions for both alternatives are similar to the simulated reductions for Las Virgenes Creek. Structural BMPs are more effective in reducing ammonia loading and phosphate loading compared to nitrate loading.

The model simulations revealed that implementation of Alternative 2A would result in a reduction in nitrate, ammonia, and phosphate loading of 16%, 3%, and 8%, respectively. Implementation of Alternative 2B approximately doubles the reductions attributed to Alternative 2A resulting in nitrate, ammonia, and phosphate loading reductions of 33%, 6%, and 15%, respectively. Implementation of source control measures would be more effective at reducing nitrate loading compared to ammonia loading and phosphate loading.

5.3 DRY CANYON CREEK

Figure 5.3 shows the location at the downstream end of Subwatershed 2 where the average annual load for Dry Canyon Creek was determined. Table 5.3 summarizes the nitrate, ammonia, and phosphate loading reductions for Dry Canyon Creek.

Table 5.3 Nutrient Loading Reductions for Dry Canyon Creek

WATERSHED ALTERNATIVE	PERCENT REDUCTION (%)		
	NITRATE	AMMONIA	PHOSPHATE
Historical Land Use	98	98	93
Creek Restoration Alternative	0	0	0
Alternative 1A	5	28	21
Alternative 1B	9	55	42
Alternative 2A	17	2	2
Alternative 2B	35	4	5

Similar to McCoy Creek, implementation of the Historical Land Use Alternative indicates high nutrient loading reductions with a 98% reduction in nitrate and ammonia as well as a 93% reduction in phosphate. These results reflect the fact that a significant portion of the

Dry Canyon Creek watershed is urbanized and these urban uses result in substantial impacts to nutrient loading.

Similar to the results for Las Virgenes Creek and McCoy Creek, implementation of the Creek Restoration Alternative will not result in any detectable reduction in nutrient loading for Dry Canyon Creek.

The model simulations indicated that implementation of Alternative 1A would yield a 5%, 28%, and 21% loading reduction in nitrate, ammonia, and phosphate, respectively. Implementation of Watershed Management Alternative 1B would lower nitrate, ammonia, and phosphate loadings by 9%, 55%, and 42%, respectively. The results suggest that implementation of structural BMPs would yield the greatest reductions in ammonia loading, followed by phosphate loading and nitrate loading. However, since additional data made available after completion of the modeling analysis revealed the presence of septic systems in Dry Canyon Creek and septic systems are a source of nutrients, implementation of structural BMPs may not be as effective for ammonia reduction in Dry Canyon Creek if a significant number of septic systems were present in the watershed because structural BMPs do not reduce septic system contributions. This underscores the importance of identifying the number and location of septic systems within the Dry Canyon Creek watershed.

Implementation of Watershed Management Alternative 2A would result in a 7% reduction in nitrate loading and a 2% reduction in loading attributed to ammonia and phosphate. The results indicated that implementation of Alternative 2B would reduce nitrate loading by 35% while reducing ammonia loading and phosphate loading by 4% and 5%, respectively. Implementation of the source control measures were found to have the greatest impact on reducing nitrate loading with less effectiveness at reducing ammonia loading and phosphate loading. Source control measures could be more effective at reducing ammonia if septic systems were determined to be a significant contributor of ammonia.

5.4 SUMMARY OF LOADING REDUCTION BY ALTERNATIVE

The results of the watershed modeling for nutrient loading are presented in Table 5.4 for all three creeks and all simulation alternatives. For the Historical Land Use Alternative, all three creeks show significant reductions in loading ranging from 86% to 98% for all three nutrients. McCoy and Dry Canyon showed the greatest reduction in nutrient loading; hence, greater potential for restoration measures to lower nutrient levels.

As discussed previously, the Creek Restoration Alternative was not expected to reduce nutrient loadings. The simulations were based on implementation of all identified creek restoration opportunities within each creek, including bank stabilization, concrete removal, and vegetation clearing. Since the creek restoration opportunities focused primarily on hydrologic and/or habitat changes within the creek channel, neither the nutrient loadings from the watershed nor the water quality processes within the creek were substantially modified through implementation of the creek restoration measures. The model results of restoration alternatives for all three creek indicated that nutrient loading would not be meaningfully affected through implementation of these measures.

Watershed Management Alternative 1 simulated nutrient loading reductions based on the treatment of runoff using structural BMPs. Alternatives 1A and 1B provide a range of reduction based on the amount of runoff treated and the effectiveness of the various BMPs. The quantity of runoff treated with structural BMPs directly impacts the nutrient reduction such that nutrient loading is reduced in proportion to the volume of treated runoff. The percent reductions for Alternative 1B are approximately twice that of Alternative 1A, which corresponds to the treatment of twice as much runoff in Alternative 1B compared to Alternative 1A. The results for all three creeks show the greatest loading reduction in ammonia and phosphate compared to nitrate.

Alternatives 2A and 2B provided a range in nutrient reductions associated with implementation of a range in nutrient source control measures. Alternative 2A was based on a 25% reduction of the nutrient loading associated with reclaimed water irrigation and livestock sources and Alternative 2B was based on a 50% reduction in nutrient loading. Doubling the source control reduction (25% to 50%) approximately doubled the nutrient loading reduction. For example, the results for Las Virgenes Creek indicated a 21% and 41% reduction in nitrate loading for Alternative 2A and Alternative 2B, respectively. The ammonia loading reduction increased from 5% to 10% with an increase in source control for Alternative 2A and Alternative 2B, respectively. The 4% phosphate loading reduction of Alternative 2A was increased to a 7% phosphate loading reduction under implementation of Alternative 2B. The results for McCoy and Dry Canyon Creek followed the same trend. The source control measures are the most effective for nitrate reduction and less effective at reducing the loading for ammonia and phosphate.

A comparison of Alternative 1 and Alternative 2 revealed that Alternative 2 reduced nitrate loading more than Alternative 1. This indicates that source control measures were more effective at reducing nitrate loading than removing ammonia and phosphate from runoff within this watershed. Structural BMPs were more effective at reducing ammonia loading and phosphate loading than source control measures.

Table 5.4 Nutrient Loading Reductions by Alternative

ALTERNATIVE	CREEK	PERCENT REDUCTION (%)		
		NITRATE	AMMONIA	PHOSPHATE
Historical Land Use	Las Virgenes Creek	91	86	86
	McCoy Creek	98	96	98
	Dry Canyon Creek	98	98	93
Creek Restoration Alternative	Las Virgenes Creek	0	0	0
	McCoy Creek	0	0	0
	Dry Canyon Creek	0	0	0
Alternative 1A	Las Virgenes Creek	4	19	16
	McCoy Creek	2	13	7
	Dry Canyon Creek	5	28	21
Alternative 1B	Las Virgenes Creek	7	39	32
	McCoy Creek	4	26	14
	Dry Canyon Creek	9	55	42
Alternative 2A	Las Virgenes Creek	21	5	4
	McCoy Creek	16	3	8
	Dry Canyon Creek	17	2	2
Alternative 2B	Las Virgenes Creek	41	10	7
	McCoy Creek	33	6	15
	Dry Canyon Creek	35	4	5

6. CONCLUSIONS

Watershed modeling was conducted for Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek, which run through portions of the City of Calabasas. The modeling was useful in developing and assessing restoration measures for the three creeks aimed at improving water quality with a focus on nutrient reduction. Although available data were insufficient for calibrating the watershed model, the data were sufficient to develop and apply an uncalibrated model to the three creeks. The application of this model was used to gain an understanding of the dominant processes related to nutrient loading of the receiving water (i.e., creeks). The following conclusions were developed from the results of this study.

1. A review of the available, existing data revealed that the data were insufficient to perform a calibration of the model parameters. This limits the usefulness of the model because the accuracy of the model output values is unknown. The uncertainty in the model output means that the model results cannot be used to determine the effectiveness of restoration measures relative to absolute metrics such as the LARWQCB water quality standards. However, the uncalibrated model is useful for comparing the effectiveness of alternatives relative to a baseline condition (e.g., existing conditions) and against one another.

2. The results of the modeling revealed that human influences account for the majority of nutrient loading to the three creeks. The loading of nutrients (nitrate, ammonia, and phosphate) leaving the City limits under existing conditions with recent human influence was substantially higher than the loading under historical conditions without human influence. This conclusion supports the development of restoration measures as a means to improve water quality through nutrient reductions since these measures tend to focus on human influences.

3. The results suggest that it is possible to exceed the LARWQCB water quality standards (TMDL) in the absence of human influence. For example, based on the modeling simulations, the concentration of nitrates within the three creeks under historical conditions sometimes exceeded the water quality standard. Since the model was not calibrated it is not possible to draw a definitive conclusion; however, these results, coupled with the results of the sensitivity analysis (see Conclusion 4), reveal the importance of model calibration and input data quality.

4. The results of the sensitivity analysis revealed that increases and decreases in nutrient loading would result in significant changes in the model results. A 50%

change (+/-) in nitrate loading resulted in an average change of approximately 46%, 33%, and 36% in Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek, respectively. A 50% change (+/-) in ammonia loading resulted in an average change of approximately 23%, 11%, and 12% in Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek, respectively. A 50% change (+/-) in phosphate loading resulted in an average change of approximately 38%, 24%, and 38% in Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek, respectively. This level of sensitivity indicates the need to conduct calibration of the model if the results are to be used to provide absolute values of contaminant loadings.

5. Implementation of all the restoration measures identified for creek restoration will not result in meaningful reductions in nutrient loading. This is because the creek restoration alternatives will only change the hydraulics/hydrology of the creek and not the nutrient sources or processes.

6. Implementation of structural Best Management Practices (BMPs) would probably not be effective at reducing nutrient loading associated with nitrates. The results revealed that implementation of all the identified structural BMPs within Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek would only reduce nitrate loading by 4% to 9% compared to existing conditions. This is primarily because the structural BMPs can only be implemented over a relatively small portion of the watershed due to space, land use, or slope limitations; therefore, the overall reduction in nitrate loading attributed to the combined effects of these measures is relatively small.

7. The results of the modeling indicated that implementation of structural BMPs could be effective at reducing nutrient loading attributed to ammonia and phosphate. The results revealed that implementation of all the identified structural BMPs within Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek would reduce ammonia loading by 13% to 55% and phosphate loading by 7% to 42% compared to existing conditions. Structural BMPs may not be as effective for ammonia reduction in Dry Canyon Creek if septic systems were determined to be a significant contributor of ammonia, since structural BMPs do not reduce septic system contributions.

8. The results of the modeling revealed that source control could be effective at reducing nutrient loading attributed to nitrate. The results revealed that implementation of all the identified source control measures within Las Virgenes Creek, McCoy Creek, and Dry Canyon Creek would reduce nitrate loading by 17% to 41% compared to existing conditions. Source control measures could increase the ammonia reduction in Dry Canyon Creek if septic systems were determined to be a significant contributor of ammonia.

9. The results of this study indicate that substantial reductions in nutrient loading defined as reductions in nitrate, ammonia, and phosphate loading will require implementation of a comprehensive approach involving strategic implementation of structural BMPs and source control measures throughout the watersheds of the three creeks.

7. RECOMMENDATIONS

The following recommendations are provided to improve the water quality of the three creeks related to nutrient loading.

1. Pursue implementation of structural BMPs throughout the watersheds of the three creeks to reduce nutrient loadings attributed to ammonia and phosphate.

2. Pursue source control measures related to recycled water use within the watershed to reduce nutrient loadings attributed to nitrate to the three creeks. The following actions should be considered for implementation.

    a. Reduce nutrient levels in reclaimed water.

    b. Conduct a public outreach program to reduce fertilizer use.

    c. Reduce the use of reclaimed water to lower associated runoff; however, this action is probably not feasible since it would probably result in an increase in the use of imported water.

    d. Pursue implementation of irrigation control measures to reduce the volume of runoff from areas irrigated with reclaimed water (e.g., computerized irrigation control devices with moisture sensors).

    e. Conduct research to determine the uptake rate of nutrients associated with different types of grasses for the purpose of developing an integrated program of reclaimed water use for various turf types.

3. Pursue source control measures related to equestrian management and operational practices within the watershed to reduce nutrient loadings to the three creeks.

4. Conduct a survey of septic systems within the watersheds to determine the quantity, location, and condition of septic systems located within the study area to verify the assumptions used in the modeling study presented in this report and/or to update the modeling based on any significant changes in the assumptions.

5. Conduct a monitoring program to provide the data needed to calibrate the HSPF model for the site-specific conditions within the watersheds of the three creeks.

6. Calibrate and verify the HSPF model using data collected from Recommendation 5.

7. Perform updated modeling of the restoration alternatives with the calibrated and verified HSPF model developed under Recommendation 6.

8. Conduct modeling of other constituents of concern (e.g., bacteria) to develop restoration measures for those constituents.

9. Develop a field and/or literature program to verify the applicability of the regional contaminant loading rates to the two watersheds. If the regional rates are found to be not applicable, then develop watershed-specific contaminant loading rates.

10. Overlay results, develop integrated alternatives, and simulate the alternatives to determine the effectiveness at improving overall water quality to eliminate single-objective alternatives focused only on one or two constituents (e.g., trash or bacteria). This effort should include a cost-effectiveness analysis to optimize multiple objective alternatives.

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APPENDIX B

NATIVE FISH HABITAT ASSESSMENT

SURVEY FOR NATIVE FISH HABITAT IN STREAMS OF THE CITY OF CALABASAS WITH SPECIAL REFERENCE TO RESTORATION FOR NATIVE FISHES

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CHAPTER 1.0
INTRODUCTION

The southern California creeks draining the City of Calabasas historically had the potential to hold seven species of freshwater fishes. A few additional fish species that enter freshwater in estuaries near the coast in southern California would not have been expected this far inland. The streams in Calabasas are low gradient, mostly less than 2% slope or gradient. These streams historically could have supported most if not all of the inland freshwater species under pre-settlement, natural conditions. The distribution, biology, and current status of these species have been reviewed by Swift et al. (1993), Swift and Seigel (1993), Stephenson and Calcarone (1999), and Moyle (2002) and personal observations on these local fishes have been added as well.

The fishes possible in these streams can be divided into two groups (Table 1). One group is found in the Malibu Creek drainage that includes Las Virgenes Creek. Only three native species of freshwater fishes are historically known to have occurred in this creek: Pacific lamprey (*Lampetra tridentata*), rainbow trout or steelhead (*Oncorhynchus mykiss*), and arroyo chub (*Gila orcutti*). The second group may be found in the McCoy and Dry Canyon Creek drainages, which drain northwest into the Los Angeles River drainage that originally had the previous three species as well as four additional ones, Pacific brook lamprey (*Lampetra pacifica* spp.), Santa Ana speckled dace (*Rhinichthys osculus* ssp.), Santa Ana sucker (*Catostomus santaanae*), and unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*). The steelhead and Pacific lamprey are anadromous, meaning they reproduce in freshwater, go to sea as juveniles to mature, and return to freshwater streams to spawn. This behavior is similar to the close relatives of steelhead, the Pacific salmons found farther north. Unlike salmon, steelhead do not necessarily die after spawning and may go back to the ocean and return on one or more successive years to spawn again. All the other previously mentioned freshwater fish species are restricted to inland waters and would not have gone to sea. All but one of these species have been locally extirpated in Calabasas and only arroyo chubs still occur in Las Virgenes Creek. However, all the other fish were known historically from farther down in their respective drainages and it has been 50 or more years since some have been taken in the Los Angeles area (Swift and Seigel 1993). The purpose of this study was to survey the streams in Calabasas for these species and their habitat and offer recommendations for restoration towards bringing some or all of the native fishes back to the area.

Table 1
Potential Fish Species Historically Found in the Calabasas Area

Creek	Species of Fish
Las Virgenes Creek	Arroyo chub – *Gila orcutti* Pacific lamprey - *Lampetra tridentata* Steelhead trout - *Oncorhynchus mykiss*
Dry Canyon Creek* McCoy Creek*	Arroyo chub – *Gila orcutti* Pacific brook lamprey – *Lampetra pacifica* spp. Pacific lamprey - *Lampetra tridentate* Santa Ana speckled dace – *Rhinicthys osculus* spp. Santa Ana sucker – *Catostomus santaanae* Steelhead trout - *Oncorhynchus mykiss* Unarmored threespine stickleback – *Gasterosteus aculeatus williamsoni*

* known from the Los Angeles River

CHAPTER 2.0
METHODS

All the creek segments were walked and habitat features were noted with reference to freshwater fishes. The six main creek habitat types noted were bedrock, riffle, run, pool, artificial bottom, and barrier. Artificial habitats included culverts, concrete bottoms under bridges or other channels, and riprap and concrete walls constraining the lateral sides of the floodplain. Riffles are places where shallow, rapidly moving water causes some turbulence in passing, usually over shallow rocks, gravel, or boulders. Some riffles in the local streams are over clay with dense roots that create similar turbulence as found in other riffles. Runs are stretches with similar width and depth such that the water runs through relatively undisturbed; runs usually flow slower than riffles. Runs can have almost any substrate from mud to bedrock. Pools are areas that are particularly deep with shallower entrances and exits. Pools usually form below falls or near resistant features like tree stumps or large boulders where the water flow meets resistance causing it to scour the softer adjacent substrate away.

Substrates or bottom materials in the stream are usually classified by the size of the particles involved. Silt/clay has particles less than 0.05 inches in diameter, sand 0.05 to 0.08 inches in diameter, gravel 0.08 to 2.5 inches, cobble, 2.5 to 5 inches, rock 5.0 to 10 inches, and boulders more than 10 inches. Bedrock is solid immovable rock.

Cover or shelter is rated by the amount of protection or hiding space existing for fish in the water and can consist of aquatic vegetation, logs, brush, boulders, undercut banks, rock ledges, root masses, "bubble curtain" (the dense foam formed by falls), and rapid riffles. Just depth alone provides protection from predators that cannot see into deep pools or are unable to pursue fish in deeper water. To provide cover in the absence of any other places to hide, the depth has to be over about 45 centimeters (cm) (about 18 inches) for average-sized fishes 5 to 10 cm long (2 to 4 inches). Shallower water can suffice for smaller young and juveniles, and deeper water is needed for larger fishes. Turbidity also provides cover when present by blocking the fish from view.

Canopy is the amount of overhead protection from the sun or open sky that is present over the wetted portion of the stream channel. Canopy is usually provided by overhanging trees, streamside herbaceous vegetation, sedges, tules, cattails, or rock ledges. Occasionally bridges, pipeline crossings, and other artificial structures can provide beneficial canopy. While high canopy values can be beneficial by shading and cooling streams, excessive canopy can block all sunlight and reduce plant growth and productivity of the stream. Deciduous trees like willows can be more desirable since they allow sunlight in winter and block the sun less in summer than darker evergreen species like oak, which strongly block the light all year.

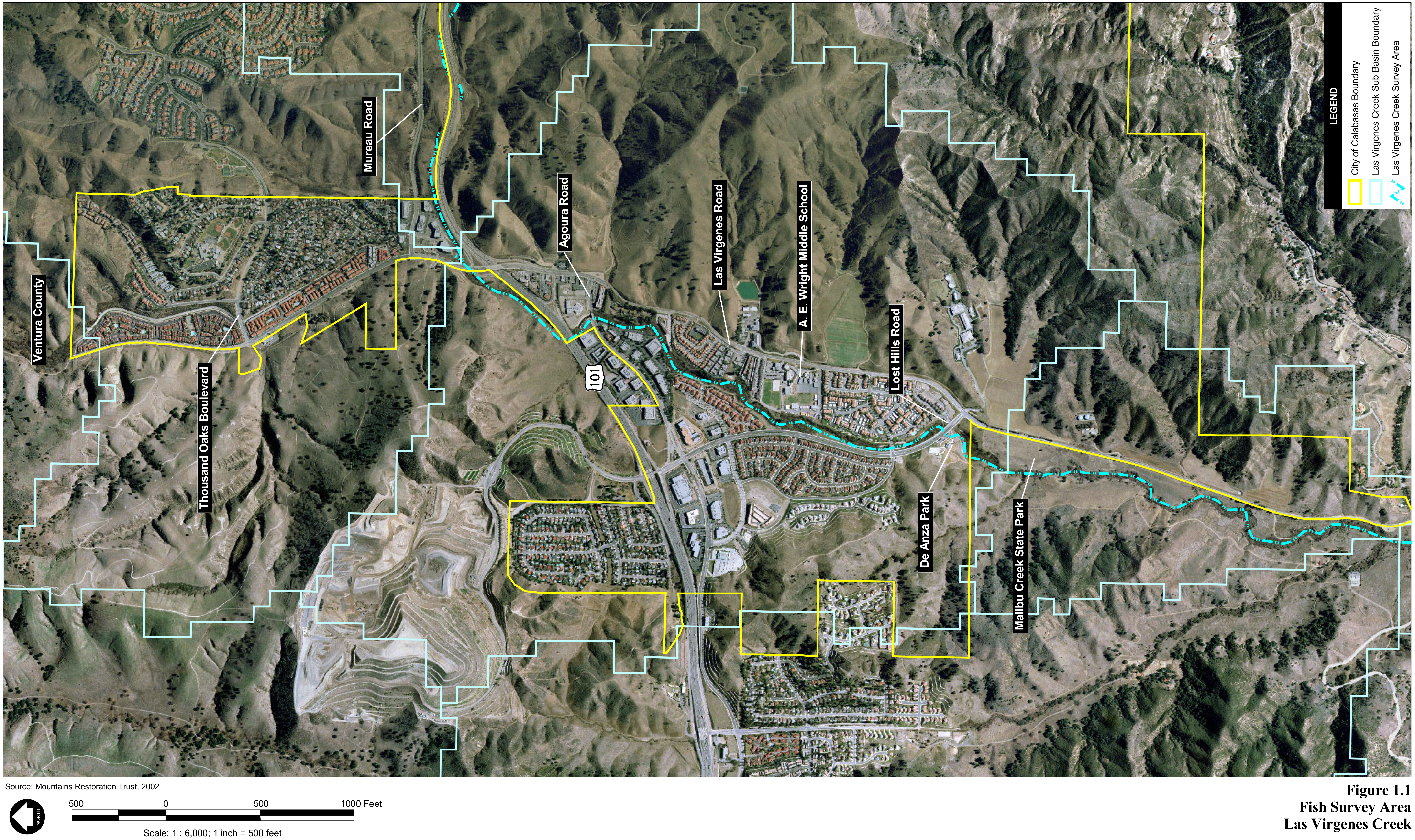
During the survey, temperature was measured and clarity of water was observed, and the conditions of adjacent shores and floodplain were assessed. Flow was estimated in cubic feet per second (cfs).

Observations were made of fishes present and representatives were preserved to verify identification and document existence at the time of the observations. All collections were made under the auspices of a California Department of Fish and Game Scientific Collecting Permit # 801137-03 (expires November 2, 2003). When referring to fishes, YOY means young-of-the-year, fish born in the year of the observations; juveniles refer to immature fish in at least their second season of life; and adult refers to sexually mature individuals. Fish lengths given here are in total length from the anteriormost point, usually the snout, but occasionally the protruding lower jaw, to the tip of the tail. Often fish length in scientific papers is given as standard length, from the tip of the snout to the base of the tail (caudal fin) and is 10% or so less than total length.

The following creeks were examined in the spring of 2003:

- Las Virgenes Creek above the 101 Freeway on 13 February from 09:30 to 10:00 and from Mulholland Drive upstream to the 101 Freeway on 12 March from 06:50 to 15:04 (Figure 1.1);
- upper Dry Canyon Creek and tributaries near junction of Old Topanga and Mulholland down to culvert at the north segment of Old Topanga; 12 March from 16:40 to 17:10, and Dry Canyon Creek from its exit from the culvert opposite the junction of Wrencrest Street and Old Topanga downstream to the cement-lined channel just above the 101 Freeway on 19 April from 12:40 to 14:35 (Figure 1.2); and
- McCoy Creek from about 300 meters above Calabasas Golf Course (100 meters above end of Ariella Drive on Parkway Calabasas) downstream through the golf course and downstream to entrance of Ed Edelman Tennis and Swim Center and crossing of Park Sorrento on 19 April from 08:10 to 12:10 (Figure 1.3).

Virtually all the stream reaches in these sections were walked and examined. Flowing water was present in all streams examined. The length of each creek segment for a particular habitat type was estimated and the summary totals by reach are presented in Table 2. These figures are to be treated as estimates and may vary somewhat from actual measured lengths. However, the relative proportion or percent of each habitat type is close to the estimated values.



Source: Mountains Restoration Trust, 2002

Figure 1.1
Fish Survey Area
Las Virgenes Creek

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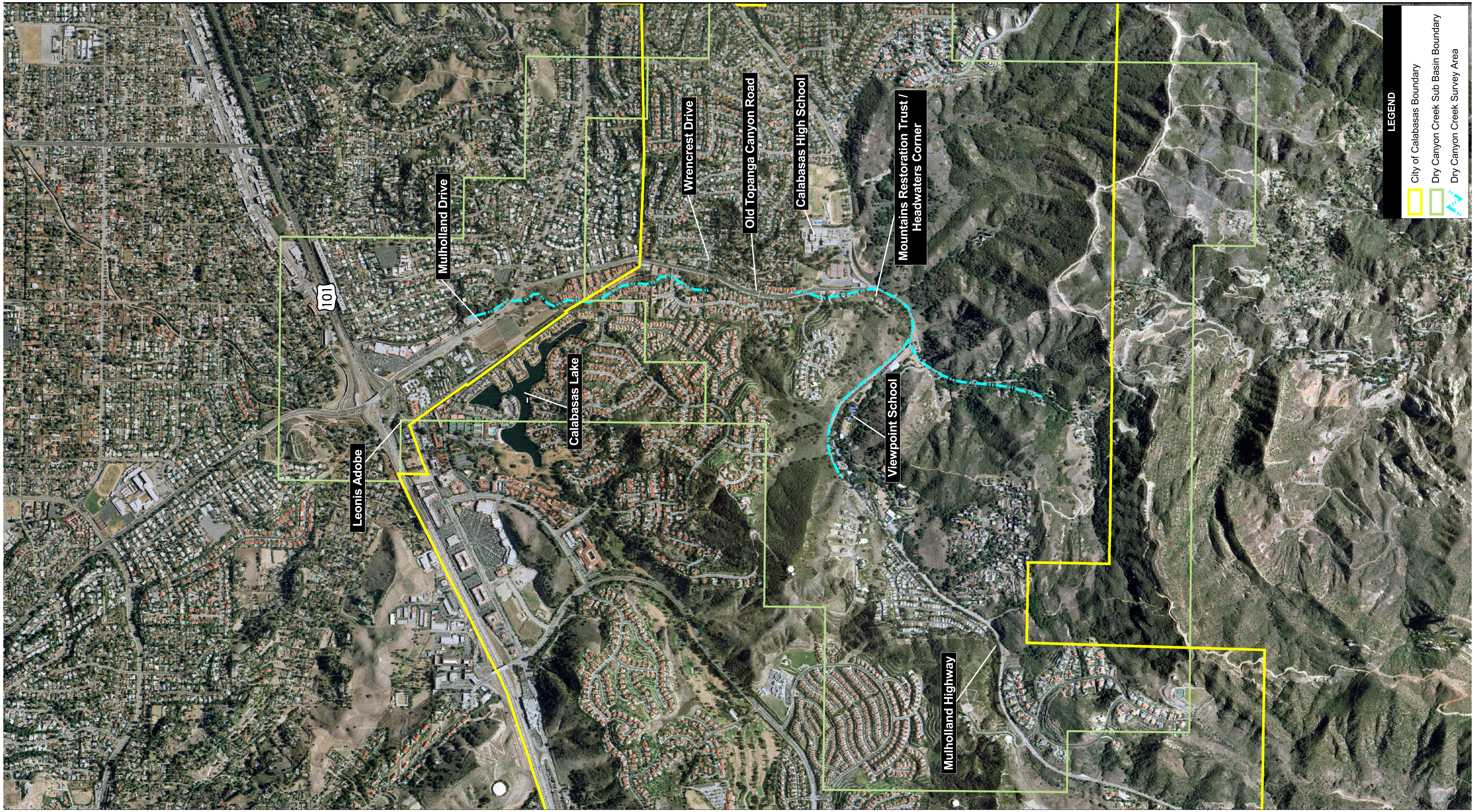

Source: Mountains Restoration Trust, 2002

500 0 500 1000 Feet

Scale: 1 : 6,000; 1 inch = 500 feet

Figure 1.2
Fish Survey Area
Dry Canyon Creek

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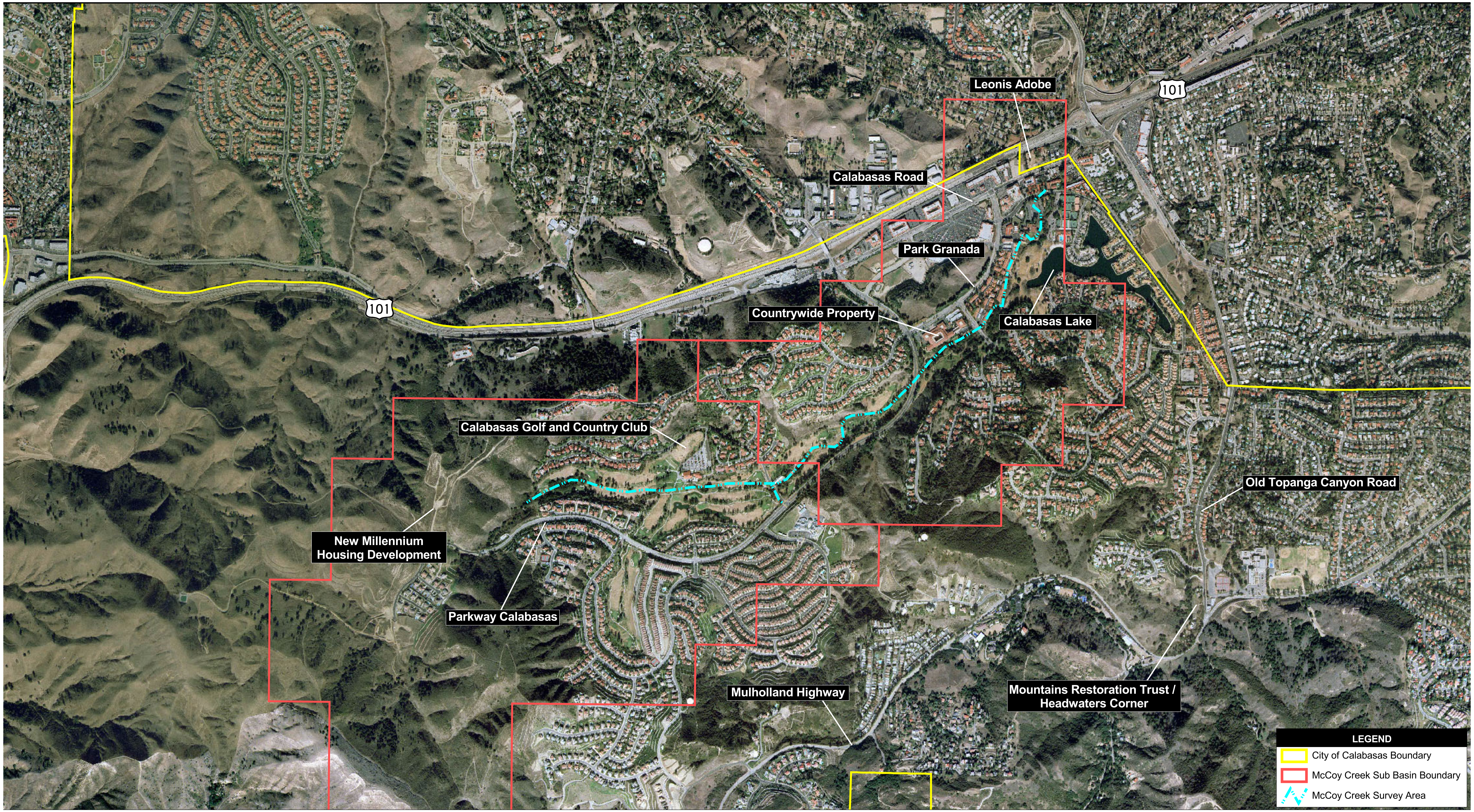

Source: Mountains Restoration Trust, 2002

NORTH

500 0 500 Feet

Scale: 1 : 6,000; 1 inch = 500 feet

Figure 1.3
Fish Survey Area
McCoy Creek

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Table 2
Summary of Habitat Types in Las Virgenes, McCoy, and Dry Canyon Creek Drainages in Calabasas, California, Spring 2003

Creek	Artificial Bottom, meters	Bedrock, meters	Runs, meters	Riffles, meters	Pools, meters	Barrier, meters	TOTAL, meters
Las Virgenes Creek	211 (4.3%)	0	1,221 (25.1%)	1,394.5 (28.7%)	2,009 (41.3%)	27.5 (0.6%)	4,863
Dry Canyon Creek	163 (14.2%)	0	270 (23.5%)	166 (14.3%)	550 (48.0%)	0	1,149
McCoy Creek, downstream	109 (8.3%)	15 (1.1%)	386 (29.2%)	414 (31.4%)	396 (30%)	0	1,320
McCoy Creek, Golf Course	905 (55.2%)	50 (3.0%)	270 (16.5%)	251 (15.3%)	164 (10.0%)	0	1,640
TOTALS	1,388 (15%)	65 (0.7%)	2,147 (24%)	2,225.5 (25%)	3,119 (35%)	27.5 (0.3%)	8,972

Note: Totals do not include small portions of Las Virgenes Creek above the 101 Freeway, or Dry Canyon Creek drainage above Wrencrest Drive and Old Topanga Canyon Road as summarized in the text.

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CHAPTER 3.0
RESULTS

Approximately 8,972 meters (8.9 kilometers) of creek were examined for this study. This included about 4,863 meters of Las Virgenes Creek (plus about an estimated 1,200 meters above the 101 Freeway), 1,149 meters in Dry Canyon Creek, and about 2,960 meters in McCoy Creek (1,640 meters in and above Parkway Calabasas and 1,320 meters downstream of the downstream of Parkway Calabasas). The field survey excluded the shorter sections of Las Virgenes Creek and its tributary immediately above the 101 Freeway. Short segments of upper Dry Canyon Creek were spot-checked in the headwaters area. Flows were present in all the creeks surveyed: approximately 5 to 8 cfs in Las Virgenes Creek, 1 cfs or less in upper Dry Canyon Creek, 2 to 3 cfs in lower Dry Canyon Creek, and 2 to 3 cfs in McCoy Creek.

Las Virgenes Creek

Las Virgenes Creek was the largest continuous stream segment present and was an estimated 4,863 meters. Only 4.3% was artificial, mostly in the upper quarter of the stream segment; 25% was runs, 28.7% was riffles, 41.3% was pools, and 0.6% was barriers of some sort. At least four barriers to fish movement were present. One was a 1-meter-high falls over an eroded clay bank and another was a concrete water diversion structure also 1 meter high. Both of these barriers are between Mulholland Highway and Lost Hills Road bridges. Both had pools below them more than 1.5 meters deep and could be jumped by large steelhead, but not by other smaller fishes. The clay falls had been observed prior to this study on 10 April 2001 and, at that time, the water was only a few cm deep at the base of the falls, making it impassable to all fishes. Apparently high flows have since scoured out a very deep, brushy pool below these clay falls. About 200 meters above Lost Hills Road, a gunnited section of stream ends in a falls again about 1 meter high. Finally a 50 to 60 cm falls exists just downstream of Agoura Hills Road. In addition, very shallow gunnited areas exist under the Lost Hills Road, Meadow Creek Lane, and Agoura Road bridges. These areas are all very shallow and sloped and are probably barriers to fish movement up- and downstream. The canopy was mostly 70% or more except in the gunnite sections above and below the road bridges. Many pools were more than 1 meter deep and cover was good to excellent in many stretches.

Las Virgenes Creek and tributaries above the 101 Freeway occupied about another 500 to 600 meters from its crossing under the 101 Freeway upstream to the crossing of Las Virgenes Canyon Road. This stretch was relatively natural and had lots of gravel, cobble, and sand.

Several pools were deep and fast and a large volume of water was present during the visit. Above Las Virgenes Road, the main creek enters a completely concrete channel, only emerging from a concrete bottom much farther upstream on the Ahmanson Ranch Property at or near the Ventura County line. A tributary from the east lied along the north edge of the 101 Freeway for about another 500 meters and was about 80% natural sand and gravel bottom but included three segments with a concrete slope for substrate. These stretches upstream of the 101 Freeway were not entirely examined and are not included in the totals in Table 2.

Fishes were noted only in Las Virgenes Creek and only arroyo chub were seen. The arroyo chub were first encountered about 800 meters below Lost Hills Road, with crayfish also present, and became more common upstream to Agoura Hills Road. Just below Agoura Hills Road, 10 to 15 YOY chubs were observed indicating reproduction within the previous 2 to 4 weeks. Overall, a few hundred chubs were observed and three or four were preserved for verification. There were no steelhead, or Pacific lamprey, identified during the field visit.

The crayfish seen in the vicinity of the arroyo chub in upper Las Virgenes Creek were the nonnative or exotic red swamp crayfish (*Procambarus clarki*) long known to inhabit the Malibu Creek watershed. The crayfish is known to adversely affect native fish and amphibian species elsewhere in the Santa Monica Mountains.

Dry Canyon Creek

The farthest upstream segments of Dry Canyon Creek examined were above the junction of Old Topanga Canyon Road and Mulholland Highway. These segments are fairly steep and had very little water flowing, less than 0.5 cfs. The tributary upstream along Old Topanga Canyon Road was a series of step pools in bedrock and seemed too small to support fish. The main reach was constrained between Mulholland Highway and development in the canyon. The Mulholland reach was rocky and gravelly and had two pools deeper than 30 cm in a length of about 150 meters of creek examined. Farther downstream at the crossing of Old Topanga Canyon Road, before it goes underground in a concrete culvert, the pools were much larger and deeper, up to 1.2 meters deep. Rock and bedrock predominated in the 200-meter section along the Mountains Restoration Trust's Headwater Corners section. The gradient appeared to be 2% or more in these upstream areas; the substrate was almost completely gravel, cobble, rock, or bedrock; and the canopy was extensive, 80% or more.

The lower section of Dry Canyon Creek from Wrencrest Drive to the 101 Freeway was lower in gradient, estimated at mostly 0.5 to 1.5%. Of this stretch 14% of the creek length was artificial, 23.5% was runs, 14.3% was riffles, and 48% was pools. Many of the pools were deeper than 1 meter and often had boulders, brush, and logs for cover. Good portions of gravel, rock, and sand were present and only small areas of muddy substrate were observed. The canopy was generally 70% or more with both oaks and willows forming the canopy in different sections. The areas with less canopy were from about 100 meters above and below the Park Ora bridge. The floodplain was wide except above the Park Ora bridge for about 200 meters where it is constrained between vertical concrete brick walls about 10 to 15 meters wide. The only barrier to fish movement was a falls about 1 meter high at the downstream end of the Mulholland Drive bridge and falls of gunnite just downstream of the culvert opening at Wrencrest Drive at the upper end of the segment.

The only aquatic vertebrates encountered were small frog larvae (tadpoles) and a turtle in the lower portion of the creek. The tadpoles were hylid frog tadpoles, with possibly some western toad tadpoles, and a few individuals were vouchered in the Hertetology Collection of the Natural History Museum of Los Angeles County. The turtle was not seen well enough to positively identify the species. It was about 10 cm in carapace length and was seen in the large, deep pool just below the creek's emergence from the culvert at the end of Wrencrest Drive. Another disturbance in a pool about 150 meters downstream of Park Ora was almost certainly a turtle or large frog but the animal was not actually seen.

McCoy Creek

The section of McCoy Creek in the Calabasas Golf and Country Club (Golf Course) and above is highly artificial for a little more than half of its length, due to concrete lining or underground culverts (55.2%). The gradient above the Golf Course is about 2% or more. Only the lower portions of the creek are in fairly natural condition: runs 16.5%, riffles 15.3%, and pools 10%. Bedrock makes up the remaining 3%. Several barriers clearly impassable to fishes consist of the following: one pair of falls just above Park Entrada; one barrier 2 meters high just below Parkway Calabasas; and four low barriers, 50 to 80 cm high and lying about 30 meters from each other just upstream of the Golf Course where the stream turns natural again. These barriers look like old water works or debris dams; one barrier is broken down such that it probably does not affect fish movement. The other three barriers are vertical falls 40 to 60 cm high and are impassable to small fish. These falls create deep pools below, which is relatively good habitat for native fish. Only larger fish like steelhead or rainbow trout could jump over these falls. In addition, the road bridges at Parkway Calabasas, Park Capri, and Park Sorrento are floored with concrete and the flow is only a few centimeters deep and not passable by most fishes. The bridge at Park Entrada has a natural soft bottom, which allows for normal channel development in the creek.

Downstream from the Golf Course the fish habitat is much better. Only 8.3% of the creek length in this reach is artificial, consisting of either culverts or cement lining, and 1.1% is bedrock. Riffles make up 31.4%, runs 29.2%, and pools 30% of this stretch. Many of the pools are more than 1 meter deep and often have boulders and logs providing much cover. Almost all of this area has 70% to 100% canopy, which keeps the stream well shaded. The gradient was estimated to be 1% to 1.5% in this section.

The only aquatic vertebrates encountered were small frog larvae (tadpoles). The tadpoles were hylid frog tadpoles, with possibly some western toad tadpoles, and a few individuals were vouchered in the Hertetology Collection of the Natural History Museum of Los Angeles County.

CHAPTER 4.0
SYNOPSIS OF BIOLOGY OF NATIVE SPECIES

The seven native species of freshwater fishes have a variety of habitat requirements and some of these needs are incompletely understood. Steelhead and lamprey require the coolest waters and largest streams since they attain the largest sizes among the locally known species. Santa Ana sucker also requires cooler water, but less consistently cold than steelhead and lampreys. The Santa Ana speckled dace and stickleback are intermediate in temperature requirements between the steelhead and sucker and the arroyo chub, which tolerates the warmest conditions. All of the local native fishes are the southern populations of mostly more northern cool and cold-water species and thus are adapted to the cooler range of aquatic conditions.

Steelhead Trout

Steelhead trout spend most of their juvenile and adult life in the ocean growing and they mature for 1 year or more. They return to local creeks during mid-winter high flows, usually from about 15 December to 15 April at temperatures of 8 to 12 degrees C. (46 to 54 degrees F.) to spawn in tributary streams. Adults can jump barriers up to 2 or more meters high but must have an unobstructed pool directly below the barrier at least one and a half times deeper than the height of the barrier. Of course, larger fish can jump higher barriers. Larger fish can also swim faster and overcome faster water while moving upstream. Usually fish move after peak flows, while water is still high but slower than at the peak. The females excavate a depression in large gravel in the shallow lower ends or tails of larger pools. One or more male steelhead fertilize the eggs as they are laid amongst the gravel and the female covers the eggs with more gravel. Thus a few inches of gravel free of finer sediment like sand or mud with water 50 to 80 cm (4 to 7 inches) deep is required. The water has to stay between about 9 to 12 degrees C. (48 to 54 degrees F.) for a total of 5 to 6 weeks for the young to emerge from the gravel and become free-living young steelhead trout. These juveniles only need shallow water, up to 10 cm (4 inches) deep at first but require deeper water with age. At first in quiet shallow marginal waters, intermediate-sized fishes, up to 10 cm (4 inches) long, tend to be found in riffles, fish 10 to 20 cm (4 to 8 inches) tend to be in runs, and larger fishes prefer deeper pools. Ideal temperatures appear to be about 15 to 18 degrees C. (60 to 66 degrees F.) and temperatures above 20 degrees C. (68 degrees F.) can be stressful or even lethal. Steelhead in freshwater feed largely on invertebrates, mostly insects, that are from the water or carried in from terrestrial sources. Insects are most abundant and numerous in riffles where production is highest for these invertebrates compared to runs and pools. Thus riffles are desirable for high-quality trout habitat as well as for the other native species. The juvenile and adult steelhead can also reside in ponded water like coastal lagoons.

Lamprey

Adult lamprey spend their life in the ocean and, like steelhead, return to the freshwater streams to spawn in the coolest winter and early spring periods. Their spawning habits also require gravelly substrate and cold temperatures in the same range as for steelhead. The young lamprey in freshwater are called ammocoetes or ammocoetes larvae. They are elongate, worm-like, and almost eyeless and live in sandy and muddy substrate in well-oxygenated streams. They are usually buried in the bottom materials with their mouth at the surface feeding on detritus (decaying plant material). They spend a year or so growing to about 10 to 15 cm (4 to 6 inches) long and when the winter rains come they transform into the adult form with the development of large eyes and strong rasping teeth in their conical, jawless mouth. They migrate to the ocean for an adult life of parasitizing other fishes.

Santa Ana Speckled Dace and Arroyo Chub

Dace are often found in riffle and pool environments with lots of rock and cobble and faster flows. Dace reach only about 7.5 cm (3 inches) in length and mostly live only 1 year with some large individuals living for a second year. They spawn in the early spring (late March to early June) and their spawning habits involve crowding into rocky and gravelly riffles and laying eggs among the rocks and gravel. They hatch out in a week or so and the larvae also inhabit the shallowest margins of the stream near faster water. After a week or two the juveniles take up a benthic existence in moving water. Generally dace do not tolerate ponded, standing water but they will live in pools of streams where the flow is fairly slow. Dace, as well as arroyo chub, feed largely on aquatic invertebrates.

Arroyo chub are also stream fish but will inhabit ponds and lakes. They formerly were considered pests in some lakes and reservoirs when they multiplied profusely after being introduced. Chubs grow to about 15 cm (6 inches) in length and can live for 3 to 4 years. Like the steelhead, dace, and Santa Ana sucker, the female chubs average larger in size than the males. Male chub reach between 10 to 12.5 cm (4 to 5 inches) in total length. Chub are known to live for 2 to 4 years. They live in streams but will invade pools and slow-moving water more than dace and Santa Ana suckers. Arroyo chub will spawn in water from approximately 15 to 25 degrees C. (60 to 78 degrees F.) and appear to require flowing water to spawn. The females release the eggs against brush or vegetation trailing in slowly flowing water and the eggs adhere to the vegetation. They take about 5 to 8 days to hatch at a size of 4 to 6 millimeters long (about one-quarter inch). These minute larvae are almost invisible along the shallowest quiet water near the edge of streams. Very small arroyo chub can be found during all of the 9 to 10 warmer months so spawning can take place for much of the year. As they grow they inhabit increasingly deeper water and resemble trout in living and feeding in the water column between the bottom and the surface. The largest individuals are usually hiding under rocks, logs, or other cover and often are not seen without snorkeling or netting. A study in the West Fork of the San Gabriel River found that large chub eat many of the same invertebrates (mostly insects) as the trout in the same stream.

Santa Ana Sucker

Santa Ana sucker attain larger sizes than chub and dace, up to 20 cm (8 inches) in length. Sucker live mostly on the bottom and have strong cartilaginous ridges on their jaws to scrape algae and invertebrates from rocks, logs, and other hard substrate. Sucker live virtually exclusively in flowing water and do not utilize ponds, lakes, and other standing water. They do live in pools in streams. Like the other native species, the size of the fish determines the depth of water inhabited; the smallest fish live in shallow margins and as they grow they inhabit deeper, faster water. Spawning takes place in slow flowing stream water in gravel and sand substrate. The suckers spawn in small groups depositing the adhesive eggs in the gravel. The eggs hatch out in 5 to 10 days and the larvae hatch out at 8 to 10 millimeters (about one-quarter to one-half inch), about twice the size of chub larvae. The larvae and early juveniles, up to about 20 millimeters (three-quarters of an inch) live at the surface and mid-water. Larger fish have the typical turned-down mouth of a sucker and become much more benthic, similar to the adults. Sucker start to spawn earlier than chubs and dace, at 12 to 20 degrees C. (54 to 68 degrees F.) and later than trout, which spawn at cooler temperatures.

Unarmored Threespine Stickleback

Threespine stickleback are small sized, the maximum at about 7.5 cm (3 inches), and mostly live for only 1 year. They are named for the three sharp spines on the back that are elevated to deter predators. The males become brightly colored in the breeding season with red on the sides and undersides of the head and anterior body. The rest of the body is bright green or bluish. The male builds a small mound-like nest of plant debris and excavates a tunnel through it. The female is attracted to the male's display and swims through the tunnel to lay her eggs. The male fertilizes them and guards the nest and eggs until they hatch in a few days. He protects the young for a few more days after which they become independent at about 7 to 10 millimeters (one-quarter to three-eighths inch) in length. The stickleback spawn during most of the warm months, like arroyo chubs. When winters are light and streams are not disrupted, spawning may occur almost year-round. Possibly they cease spawning during the warmest months and resume in the late summer and/or early fall when the water cools. Stickleback have very small mouths and eat very small animal matter, smaller than the other native fishes. Stickleback prefer the slowest of flowing waters near the edges of slow moving portions of streams, often with abundant aquatic vegetation like water cress, veronicas, or cattails and sedges. Thus they are often also in relatively shallow water, less than 30 cm (12 inches) deep, although they may inhabit deeper water if larger predators are absent.

All of these native species prefer cool to cold water and do not do well in waters that are warm all the time, namely over the mid-20 degrees C. or low 80 degrees F. Trout are stressed in water over 70 degrees F. but most of the other species, except perhaps the cold water lampreys, can tolerate water temperatures into the low 80s. Water temperatures in the high 80s or more can be stressful to all the native species. Most of the creeks in Calabasas appear to have good canopy that shades the streams and may keep the water in the streams from warming up too much.

Part of the reason high temperatures are stressful is the lack of dissolved oxygen in the water. The warmer the water is the lower the capacity it has for holding oxygen. So warm water without riffles, falls, or other disturbances to mix in oxygen from the air will be too low in oxygen to support fishes. Oxygen is also produced by plants in the water during photosynthesis in the day time but ceases during the night and oxygen can drop to low levels. Organic and other materials in the water can also oxidize and use up oxygen in the water. Fish kills can occur in streams in the morning if oxygen has been used up over night by pollutants oxidizing the oxygen in the absence of photosynthesis.

Reproduction is restricted from a few weeks to 2 months in the late winter and spring for the steelhead, lamprey, sucker, and dace. The arroyo chub and stickleback can breed over a longer period during the warmer months of the year. In other areas of the southwestern United States, dace have been observed to spawn during high water events several times a year, but this does not occur in southern California. The stickleback is the only native fish in southern California with parental care.

Because of the seasonal and year-to-year variation in water flow, local populations of native fishes can fluctuate widely over the year and between years. Winter storm and flood flows often reduce populations to low numbers. Later in the spring, summer, and fall, numbers will increase greatly. These numbers are greatest during wet years and lowest during dry years when the amount of aquatic habitat to support fishes shrinks. Because of southern California's Mediterranean climate, these fluctuations occur on an annual basis as well as on multi-year cycles of wet years and drought years.

Natural waters in coastal southern California are usually clear or nearly so, becoming turbid only during high winter flows or with local disturbance introducing sediments into the water. Arroyo chub, stickleback, and trout are mostly visual feeders and need clear water to thrive. The suckers, dace, and lamprey are less dependent on clear water but are still found most abundantly in clear streams.

Arroyo chubs, speckled dace, and stickleback are small in size and can tolerate the smallest streams. Trout and suckers attain larger sizes and tend to be restricted to larger streams. Lamprey are specialized for soft substrates where good flow also exists. Dace, trout, and lamprey invade the farthest upstream in local tributaries, into gradients of more than 3%; whereas, sucker do not go as far, remaining in gradients of about 2% or less. Stickleback and chub also remain mostly in lower-gradient streams, usually less than 2%, and these two species inhabit the slower parts of the streams.

The populations of native fishes also provide prey items for several other native species that historically, and perhaps presently, occur in the area. Garter snakes prey on fishes like stickleback, chub, and trout, as well as on tadpoles of tree and redlegged frogs. Some tree frog tadpoles were taken in Dry Canyon and McCoy creeks during the present study. Garter snakes and redlegged frogs certainly occurred historically in the area and might be considered for reintroduction as part of the recovery of these species.

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CHAPTER 5.0
DISCUSSION

The physical habitat of the streams appeared good to excellent in most stretches examined. Based on observed conditions, the amount of flow, kinds of substrate, depth of water, and presence of a variety of habitats are reasonable for the native fishes that occur there now (only arroyo chub in Las Virgenes Creek) or that might be restored to the area (steelhead and lamprey in Las Virgenes Creek and these and all the other species in Dry Canyon and McCoy creeks). However, this conclusion is based on a one-time survey in the spring when flows were relatively good and temperatures were still cool. The lack of any fish in Dry Canyon and McCoy creeks may indicate that the water does not flow year-round, and during the warm summer months water temperatures may increase to unacceptable levels for the fish to survive. It is also possible that the lack of fish in the creeks results from the creeks completely drying out during the summer months. The lack of exotic fishes is also encouraging since they often adversely impact the native species.

The abundance of sand, gravel, and rocks and a good proportion of riffles, runs, and pools with pool depth often 1 meter or more indicate all the habitat requirements of all the fish species discussed here. Good to excellent ratings for cover with rocks, boulders, logs, or brush in many pools and runs indicate adequate protection and hiding places for the native fish species. The canopy is extensive in almost all areas except near bridges and in the Golf Course where much of the stream is artificial. While helping to keep the streams cool, the heavy stands of oak canopy in some areas may be reducing productivity (photosynthesis) of the streams.

Two other observed features (barriers in the study area and those outside of Calabasas) and one unknown feature (water quality) are or may be detrimental to native fish populations. Several barriers to fish movement were noted in the surveys and are described in Section 3.0 of this report. These divide fish populations into smaller segments since interchange of individuals is rendered impossible or only possible in a downstream direction. Thus fish can go over the falls to the area downstream but downstream fish are unable to return. The steelhead and lamprey are migratory and thus would be denied entrance to the areas above barriers. In all the other species the young tend to drift or be washed downstream a few meters to a kilometer or two and as they grow they reinvade upstream areas. With barriers, the fish are unable to return. Even resident fish are divided into smaller reproductive populations that may be more vulnerable to extirpation.

The known barriers in the area were enumerated in Section 3.0 and other barriers are probably present downstream of Calabasas. At least two barriers are known downstream on Las Virgenes Creek. A third barrier on Malibu Creek, Rindge Dam, has prevented steelhead from entering the area since the late 1920s. There are some conservation efforts underway to possibly remove Rindge Dam, including a feasibility study conducted by the US Army Corp of Engineers and California State Parks. If Rindge Dam is removed, Las Virgenes Creek could become accessible to steelhead if the other barriers noted here are also removed or ameliorated. Downstream of Dry Canyon and McCoy creeks, Sepulveda Dam and the vast expanses of concrete-lined channels are barriers to movement of native fishes into and out of the Calabasas area. Even if the habitat is suitable in Calabasas, there is no way for native fish to naturally recolonize the area given the existing conditions downstream. The documented barriers in Dry Canyon and McCoy creeks would make it hard for the fish to survive without being able to exchange individuals. It is desirable to maintain the longest continuous segments of stream possible in order to maintain fish populations.

Water quality and quantity are currently unknown for these three creeks. Data were not available regarding the amount of water present year-round. Even with much lower flows in summer and fall, native fishes have the potential to survive in the many deep pools observed that should hold some water in the dry season. This presumes that excess nutrients, pollutants, or other factors of water quality are not making the water unsuitable for the native fishes. Most of these native fishes are known to live with some degradation of water quality in the Santa Clara and Santa Ana rivers, including tertiary treated wastewater treatment effluent. Thus some altered water quality is not necessarily detrimental and in many cases is providing the necessary water to support populations of native fishes elsewhere. The steelhead, lampreys, and stickleback were the first fish to disappear from the Los Angeles River watershed in the 1940s and 1950s. These species apparently were more sensitive to water quality issues than the dace, chub, and sucker, which lasted longer and still occur in a few places in the Los Angeles River watershed. This indicates that the chubs, sucker, and dace would be the easiest to reestablish in the Calabasas streams; the others would require more restoration, or at least work to identify the factors that have to be corrected. The Riverside-Corona Resource Conservation District has had success in maintaining self-reproducing populations of chub and dace in an outdoor artificial stream and were able to hold suckers in the same stream for most of a year. This means it is possible to bring populations of these fish back to areas where they have been extirpated.

CHAPTER 6.0
RESTOATION NEEDS AND RECOMMENDATIONS

Based on the previous chapters, the five main needs for restoration of native fishes in these streams in Calabasas can be divided into five categories: (1) habitat improvement, (2) barrier removal, (3) reintroduction of native fish species, (4) elimination and management of exotic species, and (5) improved access to the area from downstream sources of native fishes. Water quality and seasonal quantity should also be studied to determine if the quality and amount of water are appropriate for native fishes. Barriers should be removed and more natural substrate used to make these areas passable to native fishes. These barriers are formed by clay banks eroded headward, concrete vertical drops, and/or cement-lined channel bottoms that render them impassable to fishes. Thus, the solutions are different for each type of barrier.

The restoration of the physical conditions of the McCoy Creek is needed in the Golf Course area where the creek is mostly obliterated underground in culverts. The creek in the Golf Course, the main canyon, and the side canyon coming in from the southwest should be returned to surface flow and designed with no obstacles to upstream movement of fishes. A combination of riffles, pools, and runs could be established to provide habitat for native freshwater fishes. This higher-gradient, upper portion of the upper creek would normally have more riffles and pools than runs. Usually runs develop more in lower-gradient areas downstream that meander more. An upstream riffle and pool stretch with relatively high gradient in the Golf Course would be more amenable to the trout, sucker, and dace; whereas, the stickleback and chub would be more prevalent downstream of the Golf Course where gradients are lower and more quiet water runs and pools would be present. However, young of sucker and dace would drift downstream into the lower-gradient area in the spring and after growing bigger would tend to move back upstream into the higher-gradient areas.

The higher-gradient creek section in the Golf Course should be mostly rocks, gravel, and boulders stepped such that fish could freely move up- and downstream. In addition, riparian vegetation should be included to provide shade and keep the stream cool and better oxygenated. The design should prevent nutrients and pollutants from entering the stream and possible groundwater sources should be used to maintain high water quality and to keep water temperatures low. The large pond in the Golf Course should be kept free of exotic aquatic organisms that could adversely affect the native species. Arroyo chub and stickleback could thrive in a pond habitat if the water was appropriate for them. As observed during the survey, the water in this section was very greenish, as if plankton blooms were taking a lot of the oxygen, and no fishes were observed. The barriers to fish movement upstream of the Golf Course should also be removed to maximize the amount of continuous stream available to native fishes.

Once longer, more continuous habitats are available, consideration should be given to introduction of native fishes, recognizing that only steelhead, lamprey, and arroyo chub are native to Las Virgenes Creek and all seven species are native to Dry Canyon and McCoy creek drainages of the Los Angeles River Basin. Steelhead would ultimately require removal of barriers downstream of Calabasas, but good habitat could be seeded with stocks of native steelhead that could be self-sustaining entirely in freshwater until downstream barriers were removed. It is not known whether lampreys would survive in such conditions but steelhead are known to survive as freshwater populations above barriers to the ocean. All the other native fish species could survive in the stream segments in Calabasas based on habitat assessment, however water quality and quantity needs on a year round basis are not currently known. Therefore before any fish species are brought in, studies should be done of the water conditions with particular reference to the amount of water present and the temperature range that occurs in these streams. The conditions appeared good during the survey partly since it was spring and water volumes were high and cool. The high winter flows had scoured out the streams making the habitat look good. These conditions showed that several aspects of the habitat are indeed in good condition; however, permanent populations of fishes depend on suitable features remaining intact year after year.

No exotic fish species were noted in the stream segments, but green sunfish, largemouth bass, and mosquitofish have been recorded in Las Virgenes Creek downstream of Mulholland. These exotic species could be in some of the deeper pools where they could not be detected during this survey. Mosquitofish are placed in many locations by the mosquito abatement districts, although some of these districts are working on finding native replacements, including threespine stickleback. In any case, no exotic fish were seen during the survey and apparently they are rare, absent, or perhaps much reduced by the recent winter rains.

Even though no exotic fish were identified, an exotic invertebrate and an exotic amphibian were identified. The exotic invertebrate identified was the crayfish, which is known to exist in many locations throughout the Malibu Creek watershed. The exotic amphibian identified was the bull frog which is prevalent throughout the study area. These exotics are known to adversely affect the native fishes, as well as amphibians, and need to be controlled or eliminated to successfully support the native fishes. Because of their proximity to large numbers of people, urban watersheds like these streams are known to attract introductions of unwanted aquarium and bait fishes. A simultaneous educational effort should accompany any restoration effort. This can reduce inadvertent introductions of aquatic organisms and build local support for native species restoration.

The crayfish were identified in Las Virgenes Creek above Lost Hills Road. These invertebrates are known to impact native fish in various stream segments of the Malibu Creek watershed. Before efforts are made at native fish reintroduction these exotic invertebrates should be controlled or eliminated. The combination of exotic removal with habitat improvements will greatly improve the native fish reintroduction efforts.

One of the basic tenets of the Endangered Species Act is habitat restoration. Therefore, improving these streams should be looked upon favorably by the agencies that administer this Act. Of the fish species included here, steelhead and unarmored threespine stickleback are federally endangered, the sucker is federally threatened, and the dace and chub are California Species of Special Concern. The freshwater species of lamprey has been extirpated in southern California. The migratory lamprey is now being reviewed for possible consideration for the endangered species list. Thus, considerable coordination with the National Marine Fisheries Service (steelhead), the U.S. Fish and Wildlife Service (stickleback and sucker), and the California Department of Fish and Game (chub, dace, lamprey) will be required. They will most likely require detailed plans for bringing native species back to these stream, including monitoring of fish populations before, during, and after all projects to ensure that the results are assessed scientifically.

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CHAPTER 7.0
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