El Camino Real Master Planning Study

City of Palo Alto

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Executive Summary

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The *El Camino Real Master Planning Study* is ground breaking in many of its aspects, particularly as it applies concepts of Context Sensitive Design (CSD) and multi-modal transportation planning to a California State Highway (Highway 82) consisting of 6-lanes carrying high levels of traffic during peak travel times. Setting out to make a street like El Camino Real multi-modal is a unique proposition, especially since the City of Palo Alto does not intend to take over ownership of the roadway from Caltrans. In the past, this drastic step was the only option available to communities that wanted to achieve the flexibility in design necessary to construct pedestrian-, bicycle-, and transit-friendly design elements that are needed to make major streets a true community asset. The City of Palo Alto's long-time intent to achieve such goals and objectives without taking over ownership of the street significantly gained momentum when the City was able to secure a grant from the newly created Caltrans Office for Community Planning (OCP), which helped fund the preparation of the *El Camino Real Master Planning Study*. The OCP's and Caltrans' goal in funding this study was to learn from this process, and to better understand what Caltrans can do to better achieve context-sensitive design for the many miles of urban arterial state highways that exist throughout the State of California. The City selected a consultant team led by an urban design firm, Community Design + Architecture (CD+A), with a transportation and planning firm, Fehr and Peers Associates (FPA) taking a major role in the master planning effort.[1] The multidisciplinary nature of the consultant team was fundamental to the successful design and analysis that has resulted in the *El Camino Real Master Planning Study*

The following is a summary of the planning and design development process as well as the proposed corridor design concepts and improvements created as part of this study.

1. Introduction

Successive generations of Palo Alto citizens, community leaders, city planners and transportation engineers have wrestled with the various safety, aesthetic, and operational issues presented by El Camino Real as it passes through the center of town. In the 1960's, El Camino Real was widened, and in some cases re-aligned, into its present state as an auto-oriented major arterial street. When the new Caltrans Office for Community Planning instituted a Demonstration Grant Program available to communities with planning projects that would address more "context-sensitive design" for in-town highways, Palo Alto saw an opportunity to address a wide range of long-standing issues involving El Camino Real. The resulting Master Planning Study will be used to apply for federal, state, and other funding sources for incremental implementation of the project, allowing the city to be proactive in taking advantage of construction funding as it becomes available.

Why Change El Camino?

A planning process typically begins with a definition of the problem or issue that triggers the need for intervention, so Why Change El Camino? The answer to this question is that presently no one particular user group – including drivers – is satisfied with how El Camino in Palo Alto accommodates their needs. A look at the experiences of different users of the street and an analysis of roadway design elements reveals a strong imbalance in how the finite resource of right-of-way width is allocated between different users of the street.

While vehicular traffic occupies approximately 83% of the available public right-of-way, the **Pedestrian Experience** is largely characterized by long crossing distances and narrow sidewalks (8 feet), that are not conducive to pedestrian travel along the street, nor supportive of a positive environment for typical pedestrian activities such shopping and strolling. Many of the crossings are perceived to be unsafe for school children, the elderly, or in some cases active adults.

The **Bicycle Experience** is characterized by traveling with high volume – and at times speeding– traffic, and a minimum accommodation within the 20 to 21 foot wide outside lane, shared with traveling and parked cars.

Transit Experience is defined by poor bus stop conditions for waiting and boarding passengers; and minimal pedestrian access afforded by narrow sidewalks and long crossing distances.

The **Merchants' Experience** is defined by the negative aesthetics of El Camino and narrow sidewalk widths that reduce pedestrian access and do not allow business related activities, such as a sidewalk café.

The **Neighborhood Residents' Experience** is characterized by the perception of El Camino as a barrier between neighborhoods and other parts of town in general and for school children in particular. Traffic and other conditions on El Camino also contribute to a sense of perceived poor community character and concerns about cut-through traffic.

Even the **Driver Experience** on El Camino is dissatisfying as inconsistent vehicle speeds result in abrupt stops and starts, which on one hand can contribute to accidents at key intersections and, on the other, create a feeling of frustration for drivers, as they perceive high levels of congestion throughout the Corridor. In reality what they are experiencing is inefficient progression down the Corridor as a result of drivers rushing at high speeds between major intersections and then coming to abrupt and at times prolonged stops at the major intersections.

Although it is a goal of the Master Plan to support El Camino's role as a regional north/south arterial on the Peninsula, it has to be concluded that by today's standards of increased attention to and acceptance of Context Sensitive Design concepts (see below), the current conditions present an imbalance between the accommodation of vehicular traffic and that of all other modes of transportation and other functions of the street.

Palo Alto's Comprehensive Plan includes policies that recognize the short-comings of El Camino Real. However for many years the community has felt that effective changes to the street were beyond their reach given the high levels of traffic and the perceived inflexibility of Caltrans' design standards.

This has changed vis-a-vis the arrival of federally sponsored concepts like Context Sensitive Design (CSD) and flexibility in Highway Design: "Both flexible design and Context Sensitive Design call for less rigid application of design standards to highway projects. Flexible design involves utilizing the flexibility inherent in the current design process and in current national guidelines and state standards. CSD implies tailoring designs to adjacent land uses with sensitivity to community values." [2] The translation of these concepts into federal and Caltrans initiatives, such as the inception of the *CalTrans Office of Community Planning* have given rise to the opportunity for a future redesign of El Camino Real, that will transformation the street into one that benefits adjacent neighborhoods and meets the needs of pedestrians, bicyclists, public transit users, drivers, neighborhood residents, and business owners alike.

2. Planning Process and Community Participation

The critical component in the public participation process for this project was the Community Advisory Committee (CAC). Its members were recruited by the City and proved to be highly committed to a consensus process focused on achieving a successful new future for the street. They were also a very knowledgeable resource for information on existing local conditions. The group represented a broad base of interests in the community, including: the bicycling community, tree advocates, neighborhood associations of the different neighborhoods that adjoin El Camino, business owners, Stanford University (the largest land owner on the Corridor), and others.

The work of the Advisory Group was complemented by two widely advertised Public Workshops and individual meetings with particular stakeholders such as Neighborhood Associations, the "Trees for El Camino" and "Canopy" groups, the "Safe Routes to Schools" group, and Palo Alto High School. Both workshops were well attended and generated critical feedback needed to inform the issues assessment, and the goal setting and design concepts stages of the project.

The technical aspects of the planning process were aided by a Technical Advisory Committee (TAC), that included representatives from City Departments and outside agencies, including Caltrans, VTA, and Stanford University. This group was provided information with respect to the technical aspects of the El Camino redesign and was critical to assessing the feasibility of a given design proposal. In light of the importance of Caltrans' as the agency in control of the right-of-way and its operational aspects, several focused meetings were held with Caltrans representatives separate from the TAC. These meetings involve key decision-makers from the operations and design divisions of both District 4 and Caltrans Headquarters in Sacramento. This cooperative process was key to the successful development of the Master Plan's recommendations for improving El Camino Real.

3. Setting Goals and Objectives

The Design Plan process was built on a strong foundation of goals established in Palo Alto's Comprehensive Plan, which identifies El Camino Real as a Corridor vital to its adjoining neighborhoods but also as deficient in its current configuration to achieve goals supporting walking, biking and transit uses. It was a critical step to complement the goals of the Comprehensive Plan with goals rooted in neighborhood support for changes of the street, and stakeholder interest in the realization of multi-modal goals for El Camino. The Advisory Group, with input from the public workshops, worked to broaden these base goals to a set of goals and objectives that were used as a 'touchstone' throughout the master planning effort.

These are the key goals:

> The overall goals of the future design are to change the character of El Camino Real from a highway designed primarily for motor vehicle mobility to:

- A fully multi-modal urban thoroughfare that maintains mobility and improves safety for transit, trucks, and autos, while improving safety and convenience for pedestrians and bicyclists;
- A center of community activity rather than a barrier between activities on either side of the street; and,
- An aesthetically attractive corridor that projects a positive image of Palo Alto.

Additional goals include:

- Improve quality of life along El Camino Real while protecting its adjacent neighborhoods and districts;
- Create economic benefits for both businesses and property owners along El Camino Real and for the City of Palo Alto; and,
- Make positive change soon with full development occurring incrementally over time.

The importance of having a broad base of community support, including active support from local elected officials, also became clear in discussions with Caltrans. The agency was clearly more inclined to consider flexibility in their interpretation of applicable standards if the desired changes had been based on a broad-based and informed decision-making process.

CD+A and FPA worked with the Advisory Group and the Technical Group to develop an evaluation matrix that defined specific strategies for achieving the project goals and objectives and then listed a variety of performance and design criteria that could be used to evaluate the success of proposed design alternatives.

Caltrans Project Goals

What set the stage for the success of this planning effort is the maturation of a set of goals and policies at Caltrans that relate to the need for transportation projects to be imbedded in a community planning process and a recognition of the need for a context-sensitive design approach for State Highways that also serve as community "main streets."

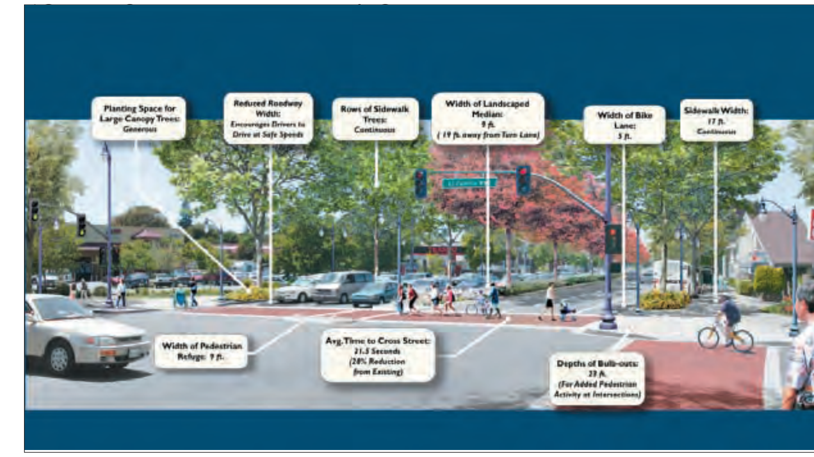
> Following is the Caltrans' Director's introduction to ***Main Streets: Flexibility in Design and Operations Booklet***, published in the July 2002:
>
> *"Caltrans remains committed to the notion that people live, work and play in the communities through which our facilities pass. It is our duty, by recognizing the needs of both non-motorized and motorized modes of transportation, to assure that living space is good space in which to live. We are committed to full cooperation with the citizens and elected officials of those communities to find transportation solutions that meet both our duty to protect the lives and mobility of travelers, as well as making main streets a good place to be."*

4. Assessing Existing and Projected Future Conditions

The assessment of the existing context along El Camino Real included a comprehensive review of physical and transportation conditions. In addition, the assessment considered projected future conditions as represented by public policies and sound transportation growth projections.

Urban Form and Landscape Character

The existing conditions assessment established a clear link between travel speed, roadway function, and ultimately transportation design solutions on one hand and existing and planned future urban form and landscape character of land uses along the Corridor on the other hand. A key finding of the Land Use and Urban Design Assessment was the fact that the El Camino Corridor is not uniform from beginning to end but rather consists of two distinct segments:



'Urban' Segment - between Stanford Avenue and Adobe Creek

This segment includes the most urban portions of El Camino Real in Palo Alto. In general the area is characterized by commercial buildings fronting directly onto the street. Parcels in this segment tend to be smaller than along the 'Stanford Frontage' segment. The landscape character of the 'Urban' Segment is variable, but mostly characterized by street tree planting in medians and along sidewalks.

Nodes of Concentrated Activity

In addition, some 'nodes' along El Camino were identified as standing out for their more intense pedestrian and bicycle activity and present or planned concentration of commercial/retail activity. These include:

- University Avenue/Palm Drive/Caltrain Stop;
- Embarcadero Road/Town and Country/Palo Alto High School;
- California Avenue Area; and,
- the El Camino Way Triangle Area.

The segmenting of the Corridor by function and urban context allowed for different approaches to achieve similar goals at different locations along the Corridor, while the visual and physical transitions of the roadway design from one segment to the next and the horizontal roadway shifts associated with such transitions can contribute to traffic speed management.

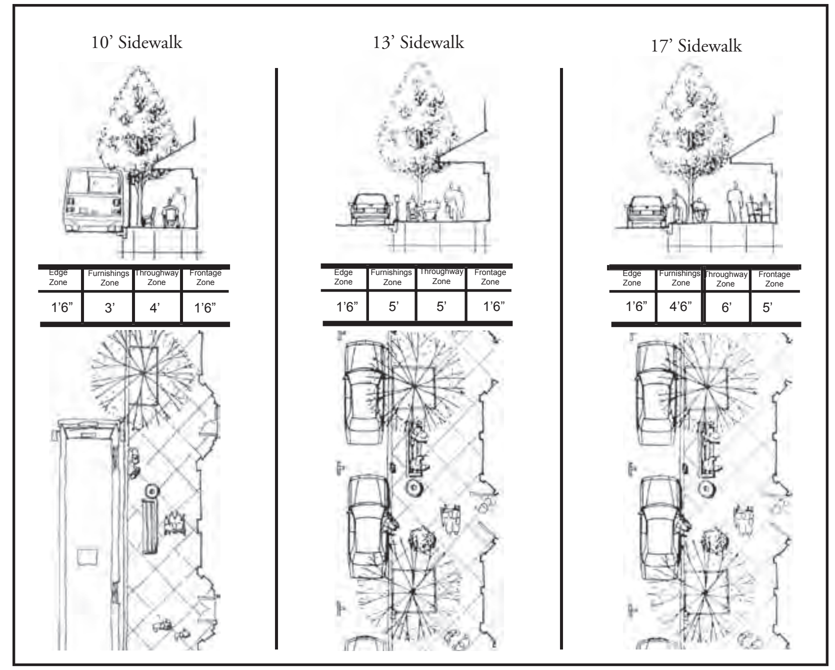
Trees in Sidewalks and Medians

An important portion of the existing conditions assessment was a study of the condition of existing street trees along the Corridor. Landscaping can be a key element in the definition of urban form and character of street. Many highly valued, grand boulevards are typified by their street trees with buildings providing a backdrop and detailed human character. While this is the hope for the redesign of El Camino Real, the existing conditions along the street do not fulfill their potential. Investigations indicate that while a significant number of trees have been planted along the Corridor in major portions of the ‘Urban’ segment of the Corridor sidewalk trees have been stunted in their growth. This stunting has occurred because of the soils conditions in which the trees are planted. The Master Plan includes a set of recommendations for improving this situation for many existing trees, and how to avoid the situation in future planting.

The Public Right-of-Way Dimensions

A key finding of the corridor-wide analysis of cross sectional dimensions of the roadway is the relative consistency of the dimensions of key elements throughout the corridor such as sidewalks, parking lanes, travel lanes, turn lanes, and medians. This occurs regardless of differences in local land use conditions and roadway utilization. A case in point is the presence of the right shoulder. Throughout the Corridor this 8-foot-wide space is sometimes used as a parking lane but it persists where parking is not allowed or necessary. This occurs because of the Caltrans requirement for a ‘break down lane.’ This is a pertinent example for how the application of highway design standards to urban arterials leads to a design that does not reflect roadway function or context.

Other key findings of the urban design analysis include the absence of unifying design elements such as street furnishings and the lack of lighting scaled to the needs of pedestrians with regard to fixture height and fixture spacing.



Transportation Assessment

To support the development of the design alternatives, the Consultant Team collected a variety of transportation data including accident history, travel speeds, and corridor signalization. This data proved instrumental in developing alternatives.

Existing Conditions

Safety and Accidents: While the overall accident rate along El Camino Real is average for similar facilities throughout the state, analysis of accident data revealed locations where the accident rate exceeded the expected level. Analysis indicated that several locations had high percentages of rear-end accidents with speeding cited as a cause. Therefore, it can be inferred that excessive travel speeds are contributing to accidents in these locations. While data indicates that pedestrian and bicycle accidents are not unusually high for this type of highway, it is clear from public input that there are concerns and a perception that El Camino Real is not a safe place to ride a bicycle along or to cross as a bicyclist or pedestrian.

Travel Time Study: Travel time along El Camino Real was studied in comparison with parallel routes. Travel time was an important evaluation criteria for the future condition of the Corridor, because if a relatively high quality of travel time can be maintained on El Camino, drivers will be less likely to divert to parallel routes and otherwise ‘cut-through’ adjacent neighborhoods. The travel time studies also indicate that speeding is an issue in the Corridor with traffic exceeding the speed limit in some segments of the Corridor even during the rush hour.

Corridor Signalization: The timing of traffic signals along El Camino has a great effect on the quality of the driving experience and the ability of pedestrians to safely cross the street. Initial analysis indicated that signal timing along the Corridor was not well coordinated, a factor which contributed to the ‘peaks and valleys’ in vehicle speeds evidenced in the travel time studies conducted as part of the Corridor assessment. Also, analysis showed that pedestrian signals did not provide enough crossing time to satisfy Caltrans or Palo Alto standards at several intersections. Since this initial analysis, improvements were made to the signal coordination along El Camino Real in 2005, with a further updated scheduled to occur some time in 2007.

Pedestrian and Bicycle Conditions: As mentioned earlier, sidewalks along the Corridor are too narrow for comfortable pedestrian use of the street. Also, the frequency of pedestrian crossings is inconveniently long in much of the Corridor, and as mentioned above signal timing often does not allow the desired amount of time for pedestrians to cross the street. The speed of traffic and the lack of a marked bicycle lane, particularly where cars are parked along the street makes many bicyclists uncomfortable with riding along the street. The street is used by a substantial number of bicyclists, particularly by people commuting to work (which was observed many times during the study).

Transit Conditions: Several bus routes run along or cross El Camino Real. The most comprehensive transit service is provided by VTA, which operates two bus lines along the corridor. These lines are Line 22, and Rapid bus Line 522. Busses of Line 22 run at 9-11 minute on the weekday peak periods and 15 minute intervals on the weekends. Headways for the other periods range from 20 to 60 minutes. Within Palo Alto, Line 22 has about 5000 daily passenger. In July of 2005, VTA implemented Rapid bus 522, a precursor to BRT in the El Camino Real Corridor. Rapid 522 replaced Limited-Stop Line 300, which previously served the El Camino Real Corridor, and supplemented Line 22 providing faster, more frequent, and more direct service between Eastridge and the Palo Alto Transit Center.

Future Conditions and Programs

Traffic Growth Rates: Sound prediction of traffic growth is important for effective evaluation of future traffic conditions resulting from different roadway design options. Over the period from 1992 to 2002, El Camino Real experienced and average traffic growth (combining accelerated growth periods with more static or stable periods) of between 1 and 1.5 percent per year. Extending this trend over the next twenty years, the projected growth in Corridor traffic is expected to be nearly 25%.

For comparison purposes, this growth rate was compared to the future growth rate shown in Palo Alto's Comprehensive Plan. The growth rate shown in the Comprehensive Plan for various intersections along El Camino average 1 to 1.5 percent. Therefore, this historical growth rate is consistent with the growth rate shown in the Comprehensive Plan.

Planned Transit Improvements: VTA is currently developing study and design efforts that will lead to implementation of a Line 22 Bus Rapid Transit (BRT) program in this corridor. VTA's vision for the BRT corridor is to increase capacity, reduce travel time and improve customer facilities and information services. Future improvements could include real time passenger information, station construction, dedicated bus lanes and more signal priority.

5. Creating Corridor Concept Design Alternatives

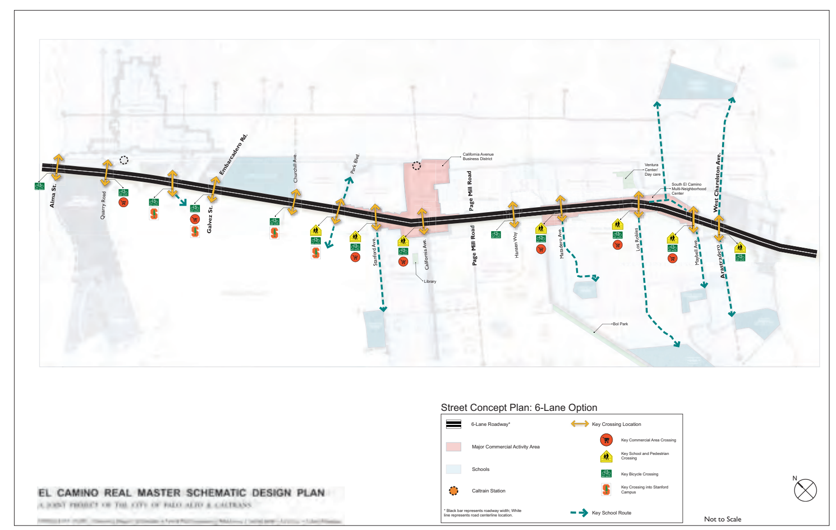
Context-sensitive design requires a different approach to the creation of alternative design solutions. The solutions must be more comprehensive and take into account their interrelated impacts on all modes of transportation and the quality of the physical context.

Summary of Design Approach and Alternatives Evaluations

Using the community's goals for El Camino Real as a guide and the analysis of existing conditions to highlight deficiencies in the Corridor, the Consultant Team created a range of options for the future design of El Camino Real. These design concepts were reviewed and refined with the advisory groups. At the same time work began with Caltrans to identify where a flexible interpretation of standards, or exceptions from standards, would be warranted to achieve the design concepts. The process with Caltrans involved identifying the individual design elements that required a variation from existing interpretations of Caltrans guidelines and standards (e.g.; lane width, shoulder width, curb extensions, etc.).

The approach to establishing a design concept applicable to the entire Corridor consisted of the following key steps:

- Identification of desired improvements and design elements based on the evaluation of existing deficiencies , functional requirements (such as continued use as a truck route and major transit corridor), and projected 20-year growth in Corridor traffic, and on preliminary community goals;
- Preparation of a broad range of alternative, illustrative corridor concepts and cross section designs;
- Evaluation of design alternatives based on feasibility relative to right-of-way constraints and Caltrans standards, effectiveness in handling traffic and multi-modal travel demand, as well as performance relative to evolving community goals and selected trade-offs;
- Selection of two alternative corridor design concepts and associated cross section and intersection designs that reflect two approaches to balancing corridor operations and community goals;
- Comparative transportation and urban design analysis of selected alternatives;
- Refinement of alternative corridor design concept(s) and associated cross section and intersection designs.



The following design elements were identified by the community as desirable for El Camino Real:

- 2 or 3 travel lanes for each direction as needed;
- left-turn lanes where needed and appropriate;
- sufficient traffic capacity to accommodate growth related to the Comprehensive Plan without reducing El Camino's travel efficiency (travel time) relative to parallel streets;
- adequate accommodation of transit vehicles (VTA and other busses) and truck traffic where these are designated to occur;
- safe bicycle accommodation throughout the Corridor either in form of a bike lane or in wider travel lane;
- on-street parking where needed for businesses and other uses along the street;
- wider sidewalks for pedestrian and business activity;
- corner curb extensions (bulb-outs) and other design features to create safer crosswalks throughout the Corridor;
- longer "WALK" times on traffic signals to meet City of Palo Alto crossing-time standards
- median refuges for slower paced pedestrians and bicyclists, and to provide for the planting of large trees;
- raised medians, lined by trees including the narrower medians along turn lanes; and,
- large canopy trees, that shade the roadway, beautify the street and provide additional environmental benefits.

Two Key Conclusions

The assessment of the corridor concepts resulted in two key conclusions regarding future traffic operations in the Corridor, and these shaped the final recommendations of the Design Plan:

Capacity must be maintained at major intersections for queuing and storage. This storage requirement averaged approximately 600 feet on either side of the four major intersections within the Corridor: Alma / Sand Hill Road, Embarcadero, Page Mill Road, and Charleston / Arastadero.

Signal timing and coordination adjustments can be used to meter traffic flow along El Camino distributing delays more evenly, reducing stopping-and-starting, and **controlling queue lengths and delays at the most critical intersections while allowing for reduction in the number of lanes at other key locations where there is excess road capacity**.

Street Cross Section Designs

(For cross section Diagrams see chapter 5.3)

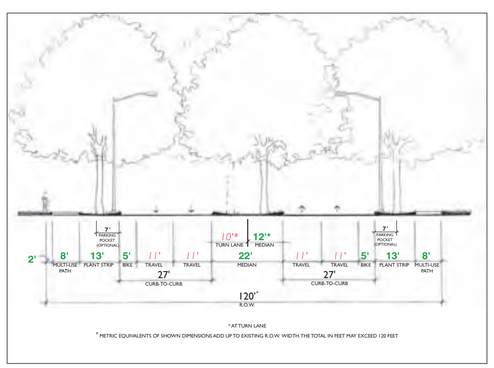
The constraints imposed by the finite width of available right-of-way became apparent when the optimum dimensions for all community-desired design elements were summed in an "Ideal Cross Section" and then compared to the actual width of the existing El Camino right-of-way. The example of the "Ideal Cross Section" emphasized the need for trade-offs and compromises relative to desired optimum championed by proponents of a given mode of transportation or particular design element.

Based on Caltrans' willingness to explore and exercise flexibility in the application of highway design standards, Caltrans, the Consultant Team, City staff and the Advisory Group worked through an iterative process of reviewing street cross section designs that favored different functions of the roadway and working to the consensus street cross sections illustrated here:

'Urban' 6-Lane: This cross section is the typical 6-lane configuration for the 'Urban' portion of the Corridor. This cross section is characterized by many design elements being accommodated at the minimum end of their range, such as the 10-foot wide sidewalks.

'Stanford' 6-Lane: This is the typical 6-lane cross section for the 'Stanford' area. The cross section reflects the character of the adjacent uses and landscape. Trees are accommodated in planting strips and planted in a more informal arrangement.

'Urban' 4-Lane: Defining feature of this cross section is the 17-foot wide sidewalk, 19-foot wide medians and the short crossing distances afforded by the reduction to two lanes in each direction. The wide sidewalks can accommodate a variety of sidewalk uses such as sidewalk cafés, transit facilities and public art.



'Stanford' 4-Lane: This cross section is primarily defined by its generous landscape character, created by a 22-foot wide median and the 13-foot wide planting strips.

5-Lane Cross Sections: In certain locations because of differing traffic demands in a north or south direction, a 5-Lane cross section is necessary. A 5-Lane cross section can be implemented in two ways. By putting one half of a 4-Lane section and a 6-Lane section together, which results in uneven sidewalk treatments, or by redistributing the non-roadway portions of the street section to the median and equal sidewalk areas on both sides of the street.

Recommended Corridor Concepts

The Master Planning Study recommends three overall Corridor Concepts that apply the street cross sections to different segments of the Corridor (see Chapter 5.3 for Concept Plans). The Corridor Concepts and cross sections underwent an iterative and increasingly detailed process of development and refinement with input from the Advisory Group, the TAC, Caltrans, and the public. Throughout this process, FPA subjected preliminary versions of concept plans to traffic flow Level of Service tests in the CORSIM model, a step that strongly informed the development of the final design options.

Six-Lane Throughout Option

The 6-Lane Throughout Option is the most conservative approach to the redefinition of El Camino Real. In this option, the current number of travel lanes of El Camino, three travel lanes in each direction, is fully maintained. However, the redesigned cross sections for this option do provide an increased sidewalk width (10 feet), the introduction of 5-foot bicycle lanes, and a basic set of crosswalk improvements, such as 8-foot wide median refuges and curb extensions to reduce the pedestrian crossing distance. This approach limits the extent to which some of the multi-modal and other goals can be accommodated. Many of the desired design elements are included at the minimum of their dimensional ranges.

Six/Four-Lane Hybrid Configurations A and B

These options are based on detailed analysis using the CORSIM simulation tool. The options were developed through a process of repeated refinement with respect to length and location of segments with a reduced number of lanes. At the beginning of the process, lane reductions were made to the areas that would benefit most from a reduction in number of travel lanes. Included were street segments where commercial and pedestrian activities are strong today or are expected to increase in the future based on city policies and zoning, and where a higher number of school-route crossings occur. Several of the preliminary options therefore attempted to stretch out the use of 4-lane cross sections throughout these segments. However, the CORSIM analysis quickly demonstrated that there were limits to how long 4-lane segments could be extended and where they could occur.

In testing the options and balancing community-supported context sensitive concepts with traffic performance, the Consultant Team and city transportation staff developed two variations of the 6/4-Lane Hybrid Option (Configuration A and B), which primarily differ in the length of their proposed 4-Lane and particularly their 5-lane segments. The relative traffic performance of these alternative concepts was tested using the CORSIM tool.

6/4-Lane Hybrid Option-Configuration A: The following are the key intersection crossings for pedestrians, bicyclists and school children that would benefit from the reduction by one or two lanes: Stanford Avenue (4 lanes), California Avenue (5 lanes), Los Robles (4 lanes) and Maybell Avenue (5 lanes).

6/4-Lane Hybrid Option-Configuration B: The chief difference between Configuration A and B is the increased number of intersection crossings for pedestrians, bicyclists and school children that would benefit from the reductions by one or two lanes, and the increased length of widened sidewalk.

Transition between 4 and 6 lane Segments: Lane additions and lane drops would each occur twice in each direction of travel under Hybrid Configuration A and under Hybrid Configuration B. Lane drops need to be carefully designed to ensure that cars merge safely into the adjacent lane. This condition was discussed extensively with Caltrans to ensure a safe design concept.

Design Characteristics of Typical Crosswalk Improvements

A number of prototypical crosswalk improvements are recommended for use throughout the Corridor. Key intersection improvements for six, five, or four-lane roadways are:

- 6-foot corner bulb-outs (curb extensions) to shorten crossing distances;
- Ladder-type striping of pedestrian crossings for added visibility (at unsignalized, marked crosswalks);
- Special paving material such as (colored) concrete brick pavers for crosswalks with higher pedestrian crossing volumes; and,
- 8-foot pedestrian refuge protected by the median and an 8-foot by 4-foot wide concrete curb on the opposite side.

Comparative Analysis Between Four Lane and Six Lane Improvements

Travel times will increase over the next 17 years regardless of change to the street. However, relatively small differences exist between the three corridor concept alternatives for a redesign of El Camino. Compared with the future baseline ("Future without any Improvements"), the increases in travel time for the entire length of the Corridor are only about 3% to 4% for Option A, and 3% to 11% for Option B. All proposed alternatives improve the multi-modal experience of the Corridor, with the 6/4-Lane Hybrid options producing relatively higher benefits for pedestrians, bicyclists, and transit users.

Using the CORSIM Model to Refine the Configurations: A major reason why reducing the number of lanes in selected segments along El Camino Real does not significantly increase the travel time is the preservation of capacity at the major intersections. All of the proposed alternatives retain the necessary turn lanes and length of lanes carrying traffic into the intersection (i.e.; 'queuing distance') at the four major intersections (Alma/Sand Hill Road, Embarcadero Road, Page Mill Road, and West Charleston/Avashadero). Lane reductions to the 4 or 5-lane cross sections only occur at minor side streets where the traffic model shows that good intersection performance (LOS C or better) and excess capacity will be maintained.

Street Tree Concept Plan and Recommendations for Successful Tree Planting

Large canopy street trees are a prominent feature along many grand boulevards throughout the world, and they can also be a very cost effective tool and bring a short-term significant change to the character of the El Camino Corridor, and over time make for a dramatic transformation of a streetscape. Large canopy trees also provide a variety of environmental benefits including improving air quality, shading pavements, and reducing peak storm water flows.

The approach to the tree concept plan acknowledges and builds on the significant difference between the 'Stanford' segment which has an almost rural appearance, dominated by deep building setbacks and generous landscaping, while the 'Urban' segment is characterized by buildings that come up to the property line and the more urban landscape character of street trees in sidewalks and median.

For the **'Stanford' area**, the landscape treatment reflects the 'looseness' of the adjacent existing landscaping. The proposed tree species of Valley and Cork Oak blend in with existing oak trees on both sides of the street. New trees should be planted with offsets from the centerline of side planting strips or the median, and 'on-center' distances should vary to give the trees a clustered appearance more reminiscent of an Oak-Woodland landscape character. For the medians a combined use of London Plane trees and Valley Oaks is recommended. While the predominant London Plane trees lend continuity to the visual appearance of the overall Corridor, where this species is the dominant street tree, the occasional occurrence of clusters of Valley Oaks will provide a visual and horticultural 'bridge' across El Camino and connect the landscaped areas on either side of the street.

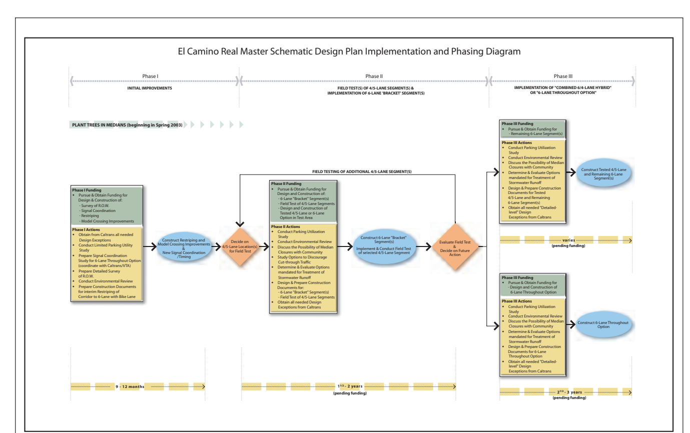
Planting strips and the center median in this area should both be landscaped with native shrubs and ground cover to match the oak woodland character of the selected trees and adjacent portions of the Stanford University campus. Since the initial writing of this report, first planting efforts that follow the recommendations of this Plan have gotten underway for the medians between Embarcadero Road and Stanford Avenue. Additional planting work in medians north of this area is expected to move forward in the Summer of 2007.

Throughout the **'Urban' area** the street tree concept plan proposes the use of London Plane trees in sidewalks and medians. However, this approach is modified and varied by the intention to emphasize the importance of two areas of intense commercial and pedestrian activity. The plan recommends that either Red Maples or American Elms be planted in the medians between Leland and Grant Avenues and between Curtner Avenue and West Charleston Road. Either species would provide a strong color in the fall while they are otherwise very compatible with the London Plane trees of the sidewalks.

Tree Planting Practices: The Master Plan includes recommendations for both the planting of new trees and remedial improvements that can be made for existing trees soil conditions to improve tree growth. Approaches vary depending upon specific soils conditions, but in general, to achieve large canopy trees, sidewalk trees should be planted in wells with a minimum dimension of 4 feet by 6 feet with a 3 foot depth back filled with soils and provided with other treatments to ensure proper drainage.

6. *Implementation and Phasing*

The first step toward the transformation of El Camino Real into a street that better serves the goals expressed by Palo Alto is the preparation of this *Master Planning Study*. This step will be followed by Caltrans and the City signing a Memorandum of Understanding (MOU) about key design elements of the future street and how to proceed with the implementation of improvements to El Camino Real.



The completion of the Master Planning Study and the signing of the MOU will allow the implementation to move forward as funds become available. As demonstrated by the comparative analysis of the benefits associated between six and four-lane improvements, the effectiveness of the future El Camino Real in meeting the community's goals and objectives is increased where 4/5-Lane improvements are implemented. The transportation analysis has shown that traffic is predicted to function well while pedestrians, bicyclists and transit modes will reap benefits in accessibility and safety.

Implementation and phasing recommendations follow a clear 'decision tree' that provides a flexible path for incrementally building-out the Master Planning Study. It allows the first steps to be taken very soon and does not include lane reductions in the initial improvements. The basic steps are:

Phase 1: Initial Improvements – Re-time the signals in the Corridor and re-stripe the roadway to approximate the recommended 6 Lane redesign, including narrower lanes and addition of bicycle lanes. This will allow near-term benefits for transportation in the Corridor. Also, tree planting can continue to move forward in many of the medians along the street.*

Phase 2: Field Test – Select a segment or segments of 4/5 Lane improvements and "field test" them as temporary improvements. Construct permanent adjacent segments of 6 Lane improvements and evaluate the effectiveness of the 4/5 Lane field tests.

Phase 3 and beyond: Further Field Testing or Incremental Build-Out of Corridor-wide Improvements – Make decision either to do more field testing, begin building final improvements of one of the 4/5 Lane Hybrid Options, or abandon the concept of the 4/5 Lane sections and begin building the 6 Lane Option.

At any point during the process a decision could be made to move forward with Corridor-wide 6 Lane improvements.

Additional Studies

As the implementation of the Design Plan moves forward several additional studies will need to be undertaken:

A. Design-level Exceptions

Caltrans requires 'Design Exceptions' for all roadway design elements that deviate from standard dimensions or characteristics (or ranges) as described in the Highway Design Manual. Two levels of design

*Some median tree planting has already been completed (See Section X) exceptions can be granted at the planning or detail design level, with the latter being the more common of the two. Planning-level design exceptions will be granted as part of the MOU process.

All key design elements included in the Master Planning Study that need a design exception have been discussed and coordinated with Caltrans as part of this project. However, the level of planning, design, and analysis undertaken in the study did not allow for every one of these elements to be taken through the design exceptions process. It is therefore recommended that the City of Palo Alto continue working with Caltrans on all needed design exceptions that can be granted at the planning-level. A draft *'Design Exceptions Matrix'* is included in the Final Master Planning Study appendix, which lists all key design elements and indicates whether a planning or detail design-level exception is needed.

Item	Subject	Existing Condition/Standard	City's Desired Condition	Caltrans' Criteria for Design Exception and Comments	*Prepare Fact Sheet Justifying Generally Corridor-Wide (G), for a Class of Locations (C), for a Specific Location (L)*	*Design Speed Related*	*Excep-tion Priority*	*Action Items*
A	Design speed vs. posted speed	Straight alignment allows actual speed to be 40 to 50 mph or 5 to 10 mph over posted speed limit of 35 to 40 mph.	Incorporate design elements that will reduce *actual and posted* speed to 30 to 35 mph	Does not require a Fact Sheet Exception. Safety and operations are top priorities. Posted speed is determined by a standardized speed zone survey. May not always apply principle that design speed may exceed the posted limit by 5-10 MPH. There is a set range of design speeds that apply to every type of state highway, such as arterial streets bordered by extensive development. Must consider stopping, decision and corner sight distance. Need to analyze speed reduction elements and devices individually and collectively. Need consistency of speeds on the corridors as they relate to adjacent cities on El Camino Real. Caltrans agrees with City's initiative to consider geometric features to reduce speed, such as changing the current straight alignment to one that is more curved or varied. May consider on-site and other studies to validate traffic calming (speed reduction) elements. *[Urban Arterial Streets should be designed for 50 to 70 kph (30 to 45 mph), Caltrans desires signing the corridor for 35 mph (55kph); portions where the City desires 30 mph (50kph) may be signed for 30 mph and then a speed zone survey would be required to determine if the speed limit can be enforced with radar]*	*Reduce design speed to 35 mph, with features that strongly enforce this travel at speeds below 35.(G) [Possibly to 30 mph design in the two 4-lane "urban" segments(L)] Justify based on accident history, and incompatability of 40 to 50 mph measured speeds with ped/bike safety and multi-modal Main street function.*		*NA*	*Verify posted speed in adjacent communities.*
B	Number of Lanes	Caltrans has expressed a desire to maintain six through lanes.	Alternatives are being considered to reduce the number of through lanes to two in each direction to accommodate median, sidewalk widening and/or bike lanes to serve multimodal and aesthetic goals of the project. Proposals to reduce lanes would consider local and regional requirements for accommodating increased traffic volumes in the future and preserving El Camino Real's role as an arterial in the regional transportation system. Propose eliminating free right turn "slips" through the corridor.	Not mandatory Design Standard. Exception requires approval by the Caltrans District Director and HQ reviewer. Lane reduction is a function of the effects on operations based on a 20-year projection of demand; *and cannot reduce LOS (LOS D min. unless existing exceeds LOS D) or quality/safety of operational characteristics.* San Mateo County and Santa Clara County Congestion Management Agencies (CMAs) must support the decision for lane reduction. The elimination of right turn slips or pork chop islands will be evaluated individually with respect to the effect on traffic operations and pedestrian safety.	*This is not a design standards exception, it is an operations review and approval process (L).*	*No*	*NA*	*City to get letters of support from San Mateo and Santa Clara County CMAs, and from adjacent cities (Menlo Park, Los Altos, and Mountain View)*

A snapshot of the *Design Exceptions Matrix*

B. Environmental Review

Environmental review will be a required step for the implementation of each phase of the El Camino improvements project. City staff and/or the designer of the street improvements would prepare an environmental checklist and depending upon the outcome of this either prepare a negative declaration of no significant environmental impact, a mitigated negative declaration or move forward to prepare an environmental impact report (EIR per CEQA standards), and if federal funds are used an environmental impact statement (EIS per NEPA standards).

C. Parking Utilization Studies

One area requiring further analysis is on-street parking along portions of El Camino. Field visits have indicated that on-street parking is heavily utilized in certain areas, such as the commercial areas adjacent to California Avenue, and not highly utilized in others. It is therefore recommended that parking utilization surveys be conducted for segments of the street as they enter the detailed design process.

A focused parking study will also provide opportunities for discussions with property owners and businesses that are adjacent to the areas being studied, as well as meetings with residents of the neighborhoods adjacent to El Camino Real.

D. Neighborhood Traffic Studies

Another additional study would be an analysis of any possible location-specific traffic diversion into adjacent neighborhoods that might result from changes on El Camino Real. These focused neighborhood traffic studies could be conducted as detailed designs are prepared for segments or concurrently with field-testing that would occur on El Camino Real.

7. Cost Estimates

The level-of-magnitude cost estimates created for the proposed design alternatives indicate that no significant cost difference exists between the three key corridor concept options: 6-Lane Throughout Option, and the 6/4-Lane Hybrid Options–Configuration A and B. The following table shows that highest (Hybrid Option-B) and lowest estimated cost (6-Lane Throughout Option) differ by only about $1 million.

It is also important to note that Initial Improvements can be made at a relatively low cost, approximately $1.5 million. Such initial improvements would allow for the Corridor to be prepared for the field testing of potential 4/5-Lane segments, and include the following:

- Initial survey and aerial;
- Signal Coordination Study and Implementation of Signal Re-timing;
- Limited Parking Utilization Study;
- Design and construction drawings for re-striping and model crosswalk improvements at one intersection;
- Construction of model crosswalk improvements at one intersection; and
- Re-striping of the entire Corridor and scraping off the old markings from the roadway surface (resulting in a cost at the lower end of the range given above); <u>or</u>
- Re-striping of the entire Corridor and covering of old markings by applying a thin layer of asphalt across the entire roadway surface (resulting in a cost at the higher end of the range given above).

Alternative Options: 6-Lane Throughout or 6/4-Lane Hybrid Options

All figures include a 30% contingency on capital cost items (excluding any "soft" costs such as design and engineering). Using this relatively high contingency is justified by the built up nature of this urban corridor, where potential complicating factors can result during detailed design and final Caltrans review, and where currently unknown conditions including, r.o.w. encroachments, or conditions can complicate the engineering and construction stages. It should also be noted that the overall cost figures for the alternative options include a significant amount for the construction of a completely new lighting system (roadway and pedestrian) throughout the Corridor.

All presently anticipated "soft" cost items, such as surveying, a signal timing study and its implementation, a parking utilization study, and design and engineering were accounted for after the 30% contingency was applied to the subtotal of all capital improvement costs.

	OVERALL COST FOR ALTERNATIVE OPTIONS		
	6-Lane Throughout Option (w/o Segment North of University Avenue)	6/4-Lane Hybrid Option Configuration A (w/o Segment North of University Avenue)	6/4-Lane Hybrid Option Configuration B (w/o Segment North of University Avenue)
Total of Capital Cost Items	$ 29,950,000	$ 30,350,000	$ 30,800,000
Total of "Soft" Costs Items	$ 2,350,000	$ 2,500,000	$ 2,450,000
Subtotal	***$ 32,300,000***	***$ 32,850,000***	***$ 33,250,000***
30% Contingency on Capital Cost Items	$ 8,985,000	$ 9,105,000	$ 9,240,000
Rounded Total	**$ 41,300,000**	**$ 42,000,000**	**$ 42,500,000**

Each of the estimates includes the following key items:

- Additional Survey of Detail Features;
- 2nd Signal Timing Study and Implementation of Re-timing;
- Parking Utilization Study;
- Design and Construction Drawings for fully improved Option;
- Utility Add-on for the relocation of some existing utilities between Maybell and Adobe Creek.
- Construction of fully improved 6-Lane Throughout or 6/4-Lane Hybrid Option, with replacement of lighting system (roadway and pedestrian).

1 Introduction

A. Description of Project Area

The project area addressed by proposals in this Design Plan encompasses the entire length of El Camino Real's public right-of-way between the Palo Alto city limit lines at San Franciscquito Creek in the north and Adobe Creek in the south.

B. Project Background

Successive generations of Palo Alto citizens, community leaders, city planners, and transportation engineers have wrestled with the various safety, aesthetic, and operational issues presented by El Camino Real, a state highway passing through the center of town. Most recently in 1999, local citizens organized to improve the street by planting shade trees along the sidewalks and in the medians of the street. The City Council supported this effort by passing a Resolution making the planting of shade trees on El Camino Real a city priority and by allocating funds for renovation of the medians and for establishing a nonprofit organization, Trees For El Camino, to spearhead the tree planting project. This effort was undertaken in collaboration with Palo Alto's neighbors to the north, Menlo Park and Redwood City, who had similar plans underway to plant shade trees on El Camino Real in their cities.

However, the median tree planting efforts of all three cities were slowed when Caltrans requirements for such landscape projects were reviewed and it was found that trees could only be planted in medians of 12 or more feet. This Caltrans requirement for clearances between large median trees and the curb face of the raised median would effectively prohibit planting of large trees in many of the medians, especially along the many left turn lanes that are a common occurrence in all three communities.

About this time, the new Office of Community Planning was created at Caltrans to foster collaboration between Caltrans and local communities to assure that highway design was sensitive to the communities" goals and interests. When this new Caltrans office instituted a Demonstration Grant Program available to communities with planning projects that would address more "context sensitive design" for in-town highways, Palo Alto saw this as an opportunity to address a wide range of long-standing issues involving El Camino Real. This included the objective of lining the street with shade trees. The City applied for and was awarded a grant in the first funding cycle of the Demonstration Grant Program, in July, 2001, to develop a feasibility study and Master Planning Study for the public right-of-way of El Camino Real in Palo Alto. The project got underway in January, 2002.

This project provides the City with an opportunity to address existing safety, operational and aesthetic concerns that the community and particularly neighborhood residents have long had with El Camino Real. The Design Plan addresses these issues while recognizing future traffic needs. The Master Planning Study will be used to apply for federal, state and other funding sources for incremental implementation of the project, allowing the city to be proactive in taking advantage of construction funding as it becomes available. The Design Plan will also be used to guide the tree planting effort and other landscape improvements in El Camino Real medians and sidewalks, and to guide any design of minor improvements on El Camino Real and on cross streets where they intersect with El Camino.

C. Why Change El Camino Real?

In 1998, Palo Alto's "Comprehensive Plan" described El Camino Real in Palo Alto as the City's "most recalcitrant community design problem" and included several policies and programs to address these urban design and transportation issues *(also see Chapter 4: Summary of Existing Conditions Assessment*). And as recent as the year 2000, City Planning and Transportation Staff realized that narrow interpretation of highway design standards by Caltrans would not allow for a reduction in roadway width and the amount of landscaping desired along El Camino, when Palo Alto and Stanford engaged in a major redesign of El Camino along the frontage of the Stanford Shopping Center and the intersections of Sand Hill and Quarry Roads. This experience underscored how difficult the task was to affect real change to a street that was widely seen as not serving the full range of the community's transportation and quality of life goals.

Figure 1.1: El Camino Real today: A street for cars and not for people.

Among the key policies and programs addressing conditions on El Camino contained in the Palo Alto Comprehensive Plan are the following *(also see Chapter 4.1.5 –A)*:

- Balance traffic circulation needs with the goal of creating walkable neighborhoods that are designed and oriented towards pedestrians. A few, like El Camino Real, serve only to move traffic and have a negative effect on community design.
- Study ways to make South El Camino Real more pedestrian-friendly, including redesigning the street to provide wider sidewalks, safe pedestrian crossings at key intersections, street trees, and streetscape improvements.
- Improve pedestrian connections across El Camino Real.

As indicated in the previous chapter, changes are occurring in the way that transportation engineers and planners understand the function of arterial streets in communities. There is an increased realization that arterials can serve transportation functions for automobiles while also serving bicyclists, transit riders, and pedestrians, as well as making a positive impact on the quality of life in the community. The advent of "Context Sensitive Design" (CSD) and "Flexible Design" *(see below)* at the federal and state levels, gives hope that effective change can be brought to El Camino through a cooperative consensus-building process within the community and between Palo Alto and Caltrans.

But what exactly are the conditions that have led to the policies of the Comprehensive Plan and to citizens' dissatisfaction with El Camino Real? In other words: *Why change El Camino Real?*

Summary of Shortcomings

The following highlights El Camino's present shortcomings from the perspective of different people who use the street.

Figure 1.2: Pedestrian accommodation at medians is minimal.

The Pedestrian Experience is characterized by narrow (8-feet) sidewalks which are not conducive to pedestrian travel along the street, nor do narrow sidewalks support a positive environment for typical pedestrian activities such as shopping and strolling.

Figure 1.3: Negative pedestrian environment.

Figure 1.4: Sidewalks are narrow.

It is also characterized by long crossing distances, often with substandard signal-protected "WALK" times and minimal protection at the median. All of these factors contribute to the safety concerns of pedestrians and the sense of separation between the two sides of the street. Broad, sweeping traffic turns at several locations place pedestrian crossings in the path of high-speed traffic. Finally, school district boundaries and routes to school require crossing El Camino at a number of locations.

These conditions discourage pedestrian activity along the street and contribute to the sense that land uses along El Camino do not serve adjacent neighborhoods.

Figure 1.5: Crosswalk distances are long.

The Bicycle Experience is characterized by travel with high volume traffic and at times speeding traffic with minimum accommodations within the 20 to 21 foot-wide outside lane, which also accommodates parking and a 12-foot travel lane. Long crossing distances and minimal protection at the median contribute to safety concerns for bicyclists.

Figure 1.6: Bicycle accommodation is minimal...

Figure 1.7: ...which causes some cyclists to divert to the sidewalk.

Poor traffic lane and signal sharing combinations result in confusion for cyclists and motorists who attempt conflicting through-maneuvers and turns at the same intersection.

These conditions discourage bicycle use along and across El Camino. But all one needs to do is spend some time on El Camino to see that some segments of the community, including those who cannot afford to own a car, use their bicycles to get to work everyday. Many parents of school children in Palo Alto would like to encourage their children to bicycle to school, but they feel crossing El Camino is unsafe. Also, students from Stanford uses bicycles as a primary mode of transportation and must cross El Camino to get to downtown and other parts of Palo Alto.

The Driver Experience is characterized by a roadway design that encourages speeding; inconsistent vehicle speeds, that result in abrupt stops and starts; numerous of accidents at key intersections; and traffic capacity and signal coordination that are perceived as insufficient.

This creates a feeling of frustration for drivers. They believe they are experiencing a high level of congestion, which is accentuated by inefficient progression. As a result, drivers speed ahead only to be stopped a few intersections down the road.

Figure 1.8: Traffic speeds up between traffic lights and comes to a halt at key intersections.

The Transit Experience is characterized by poor bus stop conditions for waiting and boarding passengers. Minimal pedestrian access is afforded by narrow sidewalks and long crossing distances. Still, VTA's Route #22 is one of the most highly utilized bus routes in Santa Clara County, with bus service along El Camino providing a valuable transportation option for many Palo Alto residents and workers.

Figure 1.9: Access to transit and conditions at bus stops require improvements.

The Merchants' Experience is characterized by the negative aesthetics of El Camino, and narrow sidewalks that reduce pedestrian access and don't allow for a sidewalk café or other business-related activities.

Figure 1.10: Narrow sidewalks and poor aesthetics negatively impact the business environment.

The Neighborhood Residents' Experience is characterized by their perception of El Camino as a barrier, in particular to school children. Poor community character is afforded by El Camino and the dominance of traffic functions within the streetscape. There is also concern about cut-through traffic when traffic flow on El Camino is poor.

The combination of all of these factors and characteristics creates a high level of frustration with El Camino. But people may feel that its function as a major arterial street does not allow for positive change for anything but traffic.

Figure 1.11: Cut-through traffic from El Camino is a concern for some neighborhoods.

Figure 1.12: El Camino and its traffic are perceived as a barrier between adjacent neighborhoods.

As was discussed, recent federal and state initiatives, as well as the establishment of the Caltrans Office for Community Planning *(see next paragraph and Section 3.2)*, have brought a successful redesign of El Camino Real within reach; a redesign that can address most of the concerns expressed by the community and evidenced in the 'experiences' described above.

D. Context Sensitive Design and Flexible Design

The previous paragraphs have made reference to Context Sensitive Design (CSD) and Flexible Design as two key concepts that have given rise to hopes that urban arterials, such as El Camino Real, can be turned into streets that are designed and operated to benefit adjacent neighborhoods as well as fulfilling the community's goals for creating supportive environments for pedestrians, bicyclists, and public transit; enhancing neighborhood character; and contributing to economic vitality.

The following is a concise definition of the two concepts as stated in the report "Flexible Design of New Jersey's Main Streets," by Reid Ewing and Michael King: "Both Flexible Design and Context Sensitive Design call for less rigid application of design standards to highway projects. Flexible Design involves utilizing the flexibility inherent in the current design process and in current national guidelines and state standards. CSD implies tailoring designs to adjacent land uses with sensitivity to community values." As previously discussed, in the past few years, federal initiatives have made it possible and encouraged the approach of flexibility in highway design. This is evidenced by the publication of "Flexibility in Highway Design", by the FHWA in 1997. This ground-breaking document describes how a flexible interpretation of highway design standards can lead to context sensitive design solutions, which are presented in the report in case study format. As a result, many states have stepped to the forefront using an ever broadening application of a flexible approach to highway design, in which due consideration is given to environmental, scenic, aesthetic, historic, community, and preservation impacts.

The California Department of Transportation has responded to the federal initiative by establishing the Office for Community Planning in the year 2000, "…to address a statewide need for community-sensitive approaches to transportation decision-making." Most recently Caltrans' director issued a Director's Policy, which emphasizes the importance of context sensitive design and outlines the responsibilities for implementation at each level of Caltrans' hierarchy.

2 Summary of Planning & Public Process

2.1 Overview of Planning Process

The planning process for the El Camino project was set up to include input from the general public and interests organized around a particular subject, technical expertise from different city departments, and input from Caltrans as the final approval agency for the actual construction of proposed improvements. The following is an overview of the key steps that were taken by the City and the Consultant Team in moving the project through the planning process:

1. Assembling of an Advisory Group of stakeholders that included a broad range of interests surrounding issues involved with the redesign of a major street like El Camino;
2. Assembling of a Technical Advisory Committee (TAC) to give input on the many technical aspects of the redesign;
3. Preparation of detailed analysis of the existing and projected traffic and transportation conditions as well as analysis of key land use and physical conditions within the right-of-way;
4. Consultants, City staff, Advisory Group and the public engaged in an interactive and iterative process to develop goals and objectives for the redesign of El Camino. As goals were shifting or being negotiated between members of the public, different conceptual design alternatives and their details were developed to help illustrate and explore feasibility issues or trade-offs associated with sets of differently weighted goals and objectives;
5. Consultants, City staff, and the Technical and Advisory Groups developed two more detailed alternative corridor concept plans and associated typical street cross sections;
6. Consultants performed a detailed transportation analysis of alternative corridor concept plans and comparative evaluation of benefits for proposed typical cross sections and plan details and reviewed these with the Technical Advisory Group;
7. City Staff and Consultants undertook discussion and negotiations with Caltrans about the feasibility of proposed design elements with a focus towards achieving a memorandum of understanding between the City and Caltrans; and,
8. Preparation of implementation strategies for both conceptual design alternatives that allow for final implementation decisions to be made after field tests confirm the feasibility of key design concepts.

2.2 Public Process

In light of the vested interest of all Palo Alto residents in a potential redesign of El Camino Real and the particular importance of the street for adjacent neighborhoods, city planning staff intended to give the project a strong public involvement component from the very beginning. Critical to this end was the inception of a broad-based Advisory Group, which was complemented by other means of public involvement. The following are the key components that allowed the public to become actively involved in the process and afforded timely information updates for interested parties and individuals:

- a broad-based Advisory Group that held its meetings in public;
- two Public Workshops;
- a project web page on the City's internet web page;
- presentations at small group meetings by city planning staff (e.g.; neighborhood groups and the chamber of commerce);
- a series of meetings with specific interest groups including Trees for El Camino, Canopy, and Safe Routes to Schools; and,
- a series of Public Hearings, including working and formal sessions by City Council and the Planning and Transportation Commission.

A. Advisory Group and Technical Advisory Committee (TAC)

El Camino Real Advisory Group

The City convened a broad based Advisory Group, representing key interests along the Corridor and beyond, including the bicycling community, tree advocates, neighborhood associations from the different neighborhoods that adjoin El Camino, business owners, Stanford University, City Boards and Commissions, and others *(please see the Acknowledgements page for a detailed list of all Advisory Group Members).*

This group held a total of 7 public meetings and was instrumental in formulating project goals, providing intimate knowledge about existing conditions and concerns, and evaluating and shaping the design alternatives for the redesign of El Camino.

El Camino Real TAC

In addition to the Advisory Group, the City assembled a group of people including city and outside agencies to act as technical advisors to the project. This group was intended to help inform both the technical aspects of the redesign and the assessment of the design's feasibility. The TAC included representatives from Caltrans, Palo Alto's Public Works and Parks Departments, City Arborists, the Valley Transportation Authority (VTA), and others *(please see the Acknowledgements page for a detailed list of all TAC Members).*

Three months into the process, a workshop was held with Advisory Group and TAC members as well as several Caltrans representatives. Aim of this workshop was to receive broad based input from attendees about the existing conditions assessment and to allow for a roundtable discussion of potential and perceived issues involved with the current design of the street as well as some preliminary design concepts for the intended redesign of the street.

B. Public Workshops

Two widely announced public workshops were held to inform the broader public about the project, to solicit input about concerns, ideas and suggestions with regard to existing conditions and the proposed designs for El Camino. Both workshops were well attended and generated feedback needed to inform the issues assessment, goal setting and design concepts stages of the project.

Figure 2.1: The El Camino Real Project generated lively discussion at two public workshops.

C. Interest Group Meetings

In addition to the Advisory Group meetings and public workshops, several meetings were held which focused on interests, suggestions and concerns of particular stakeholders. Such meetings included neighborhood associations; Palo Alto High School; and advocacy groups such as Trees for El Camino, Canopy, and Safe Routes to Schools. The City's project manager conducted several meetings with neighborhood associations to inform citizens about content and the progress of the project. This effort established additional outreach to those not able to attend public meetings and allowed for in-depth discussions about concerns particular to the location of the respective neighborhoods along El Camino.

Figure 2.2: The interests and expertise of many groups and parties went into the process for the El Camino Project.

2.3 Coordination with Caltrans

The California Department of Transportation (Caltrans) is not only a cosponsor of the El Camino project, but also the owner and operator of State Highway 82. Caltrans is also the approval agency for any proposed changes to the design and operation of El Camino Real and its right-of-way. From the beginning of the project it was, therefore, critical to involve Caltrans representatives from both the operations and design divisions of the agency. Although Caltrans representatives were included in the project TAC group, it quickly became clear that more intense discussion, coordination, and negotiation with the agency was necessary if a redesign of El Camino was to be achieved that would fully address the goals set by the community.

Therefore, Caltrans and the City decided to conduct focused meetings separate from the TAC and to involve key decision-makers from the operations and design divisions of both Caltrans District 4 and Caltrans Headquarters in Sacramento. City staff, the Consultant Team, and Caltrans representatives conducted a total of six meetings to discuss issues of roadway design, design standards, and the Caltrans' approval processes for projects such as the redesign of a major arterial like El Camino.

A. Goal Setting and Negotiations Process

At the beginning of the more focused negotiation and coordination process, Caltrans requested that the community clearly state the goals it wanted the redesign of El Camino Real to achieve. This was followed by establishing linkages between such community goals and individual, or sets of, roadway design elements included in the conceptual design alternatives.

Based on this approach, a matrix was developed *(please see the Appendix for a copy of the matrix)* that reflected:

- all key design elements included in proposed design alternatives;
- the existing condition or characteristic (i.e. a dimension) of a given design element;
- the City's desired condition or characteristic of a given design element contained in a proposed design alternative; and
- existing Caltrans standards for the respective condition or characteristic of the design element in question, as well as a discussion of the specific approvals process for the requested change.

Over time, as the community considered the different schematic design alternatives, the content of the "Desired by City" column would change, sometimes eliminating a conflict between Caltrans standards and the "desired" condition, sometimes adding a new element to the negotiation and discussion process.

B. Design Exceptions Process and Memorandum of Understanding (MOU)

In its approval process for road projects, Caltrans breaks down a given street design into individual design elements, such as travel lanes, turn lanes, lane transitions, medians, shoulders, parking, bicycle lanes, sidewalks, etc. Using the design standards of the "Highway Design Manual," Caltrans determines whether a design element contained in a proposed design conforms to the standard or requires a design exception. For instance, a design exception is required if a design proposes travel lanes that are narrower than the Caltrans standard for the respective facility type. The facility type is typically determined based on speed, volume, and other highway characteristics.

If a design exception is required, the typical Caltrans process requires the preparation of construction drawings for the roadway. For Caltrans review the applicant would also complete a 'Fact Sheet', that includes a description of the project, existing conditions, future conditions, any non-standard design elements, and the justification for design exceptions. It also contains information on the cost required to meet the design standards, traffic data, and an analysis of the accident history. Finally, Caltrans representatives, which include the Caltrans project manager, the District Design Manager, and Caltrans Headquarters representatives, must approve the design exception.

For this project, the typical exceptions process could not be followed because no construction drawings or detailed design plans were prepared. The preparation of such detailed designs would have been cost-prohibitive given the extent of the proposed improvements and the interdependencies of many of the potential design exceptions. In other words, if one or several design exceptions are not granted, the basis of the detailed designs would change and all of the work would need to be redone. Instead, the Consultant Team, City staff, and Caltrans discussed and negotiated design elements and any needed design exception through the 'Exceptions Matrix' described above. At the end of the process the design elements were distinguished in three different categories requiring:

- no design exception;
- planning-level exception; and,
- full detail design-level exception.

The use of planning-level exceptions allows several key design elements to be approved prior to the preparation of detailed design documents. This reduces the risk that the investment in the detailed design will be wasted by later rejection of a proposed design exception.

As part of the planning process, the City and Caltrans will draft and sign a Memorandum of Understanding (MOU) about the intended redesign of El Camino in Palo Alto. This document will be legally non-binding, but it will clearly spell out the City's and Caltrans' mutual understanding of both the intentions of the project and the design solutions agreed upon between the two parties.

C. Large Trees in Medians

In a process that has run parallel with Palo Alto's redesign effort for El Camino, the cities of Menlo Park, Redwood City, and Palo Alto expressed strong community interest in improving El Camino Real by planting large canopy trees in the medians. All three cities requested permission from Caltrans to allow large trees in medians narrower than the standard 12 feet. This issue was of critical importance to the redesign and tree planting efforts on El Camino because of the frequent occurrence of left-turn lanes paralleled by narrower medians. If the planting of trees in medians narrower than 12 feet remained prohibited, it would create a visual discontinuity along much of the street in spite of replanting efforts where medians were 12 feet or greater.

A compromise was negotiated by State Assemblyman (now State Senator) Joe Simitian with the Director of Caltrans. According to this compromise, the three cities were given approval for their tree planting projects as part of a pilot project.

Figure 2.3: Narrow median on El Camino today.

Figure 2.4: Tree-lines narrow median in Downtown Oakland.

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3 Project Goals & Objectives

3.1 Community Project Goals and Objectives

The Goals and Objectives for the El Camino Project stated below are the result of several rounds of review and discussion among members of the Advisory Committee. Refinements were also made following the two Community Workshops on June 1st, 2002 and September 30th, 2002, and the Council Study Session on July 15th, 2002.

Project Goals

The following "Primary Goals" are an adaptation of the "overall goal of this project" as stated in Palo Alto's request for proposal and grant application to Caltrans. The "Other Goals" resulted from input received at the Community Workshops and through the Advisory Group.

Primary Goals

The overall goals of the future design are to change the character of El Camino Real from a highway designed primarily for motor vehicle mobility to:

- A fully multi-modal urban thoroughfare that maintains mobility and improves safety for transit, trucks, and autos, while improving safety and convenience for pedestrians and bicyclists;
- A center of community activity rather than a barrier between activities on either side of the street; and,
- An aesthetically attractive corridor that projects a positive image of Palo Alto.

Other Goals for the Future of El Camino Real

- Improve quality of life along El Camino Real while protecting its adjacent neighborhoods and districts;
- create economic benefits for both businesses and property owners along El Camino Real and for the City of Palo Alto; and,
- make positive changes soon with full development occurring incrementally over time.

Project Objectives

The following paragraphs define the objectives of the project and the ultimate redesign of El Camino Real.

Objective: Provide Equity and Balance for All Modes

Re-design El Camino Real to reduce potential conflicts between, and balance the needs of, all modes of transportation: local and sub-regional auto, transit, and truck traffic; bicyclists of varied skill levels; and all pedestrians (including seniors, school children, and the disabled).

Objective: Improve Safety for All Modes

Improve El Camino Real to be a safer place for all pedestrians (including seniors, school children, and the disabled), bicyclists, transit riders, buses, autos, and trucks.

Objective: Design the Street to Encourage Motorized Traffic to Drive at Safe Speeds and not Exceed the Speed Limit

Redesign El Camino Real to encourage traffic to drive at safe speeds that do not exceed the speed limit and to allow aesthetic and multi-modal improvements to El Camino Real.

This objective will be balanced with the need for traffic and transit to move efficiently along the length of the Corridor.

Figure 3.1: Drivers' awareness of others rises with lower speeds. (source: ?)

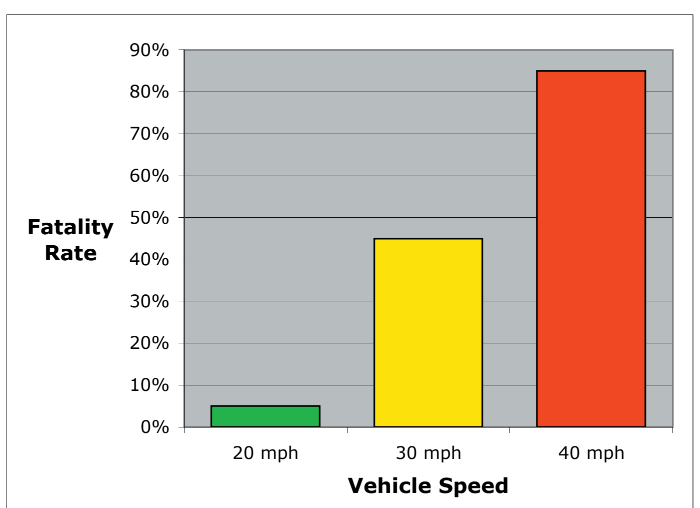

Figure 3.2: Pedestrian fatality rates significantly rise with vehicle speeds exceeding 30 mph. (source: *Killing Speed and Saving Lives*, UK Dept. of Transportation, London, England. 1987.)

Objective: Improve the Ability to Cross the Street

Make El Camino Real safer and more convenient for pedestrians and bicyclists to cross by improving intersections and possibly adding one mid-block crossing at Stanford Campus.

Objective: Create a Street and Streetscape that Complement Community Character

Redesign El Camino Real with a character and function that is more directly related to the existing and desired future character and function of the community along it.

Objective: Minimize Direct and Indirect Impacts on Quality of Life and the Environment

Minimize direct and indirect impacts on quality of life along the street and in adjacent neighborhoods and districts through the design, construction, and function of the new El Camino Real. Design the roadway and associated improvements so as to avoid the diversion of traffic into adjacent residential neighborhoods. In addition, reduce impacts on the environment, particularly relating to water and air quality and the solar "heat island" effects associated with large areas of unshaded pavement in urban settings.

Objective: Improve Landscape Quality and Quantity

Increase the amount of land area within the r.o.w. for landscaping, and the number, health, and size of trees and other landscaping along the edges of the street and in the median, to achieve a shaded, tree-lined streetscape.

Objective: Improve Aesthetic Quality of Street Design

Improve the quality and condition of streetscape elements (lighting, benches, bus stops, etc.) and the paving of the roadway and sidewalks. Public art and new landscaping must also contribute to this objective.

Objective: Create Cost Effective Improvements

The improvements to El Camino Real will be of the highest quality feasible. Consider and compare both cost to benefit and initial cost to life-time cost.

Objective: Define Some Immediate Improvements

Identify a set of improvements that can be implemented as soon as possible to incrementally build towards the ultimate vision for the future of El Camino Real, particularly in regards to planting trees and making other landscape improvements in the near term.

3.2 Caltrans Project Goals

A. Office for Community Planning

The El Camino project was financed to a large extent by a grant from the Demonstration Grant Program of the Office for Community Planning (OCP), a division of Caltrans established in the year 2000. OCP was "…established to address a statewide need for community-sensitive approaches to transportation decision-making." The following is the Office of Community Planning's Value Statement: "To promote and participate in community based planning that integrates land use, transportation and community values." Some of the broader goals of the OCP include:

- Affect and change existing Caltrans processes and functions to reflect relevant community values.
- Develop partnerships to enhance community based transportation planning approaches at local, regional and state levels.
- Develop technical and program expertise in community based transportation planning and public participation techniques.
- Enhance Caltrans leadership role in planning by integrating community based transportation planning approaches in the department's planning processes.
- Provide incentives that further support community-based transportation planning at all levels.
- Allow the development of transportation projects that enjoy public support and are easier to develop and deliver because of consistency with community values…"

In light of this statement, the community project goals outlined in the previous chapter stand as a good example for the expression of community values and the desire of communities to provide input at the local level that will impact the design of a key element within the neighborhood environment. In the past, this level of contribution and opportunity for participation has been beyond the reach of local communities. The objectives of the OCP, as stated above, and the desire of people to influence and partake in the design of urban highway facilities, therefore, point in the same direction. However, as witnessed by this project, "affecting change in existing Caltrans processes" is a step that goes well beyond that of establishing the OCP and requires the involvement of all Caltrans divisions *(also see Chapter 9: Lessons Learned)*.

B. Director's Policy

In November of 2001, Jeff Morales, Director of the California Department of Transportation, published Director's Policy #22, entitled "Context Sensitive Design Solutions" *(for full policy document, see Appendix)*, applicable to "All employees and others involved in the planning, development, construction maintenance, and operation of State transportation and support facilities." In summary, the policy emphasizes the importance of solutions that use "innovative and inclusive approaches that integrate and balance community aesthetic, historic, and environmental values with transportation safety, maintenance, and performance goals." It also outlines for all Caltrans employees their share of responsibility in employing the concept of Context Sensitive Design to their work in designing, constructing, maintaining, and operating the State transportation system.

The Director's Policy is directly applicable to El Camino based on the street's particular shortcomings as a main street, its location at the heart of several neighborhoods, and the fact that the community has expressed clear goals for improvement of the street. The project can, therefore, serve as an excellent example for the implementation of Context Sensitive Design, as well as the need for its application at all levels of responsibility within the Caltrans organization.

C. Shared Multi-modal Goals

Making El Camino a street that serves not only vehicular traffic but also accommodates the needs of transit users, pedestrians and bicyclists, is an expressed goal of the Palo Alto's Comprehensive Plan and was emphasized within the goal setting process for this project. In addition, Caltrans has begun to formulate and publicly express goals for its transportation facilities that include multi-modal goals. Following are a few examples of such goals.

In March of 2001, Caltrans issued the Deputy Directive: "Accommodating Non-Motorized Travel." The Directive states: "The Department fully considers the needs of non-motorized travelers (including pedestrians, bicyclists, and persons with disabilities) in all programming, planning, maintenance, construction, operations and project development activities and products. This includes incorporation of the best available standards in all of the Departments practices. The Department adopts the best practice concepts in the US DOT Policy Statement on Integrating Bicycling and Walking into Transportation Infrastructure."

In addition, Caltrans recently completed the "2025 California Transportation Plan", which sets broad goals for the transportation system in the State of California. Each general goal includes several strategies for implementation, several of which are consistent with goals and objectives generated for this project.

The following are key applicable goals and strategies from the "2025 California Transportation Plan" :

Goal 1 - Enhance Public Safety and Security

Consider the safety needs of bicyclists and pedestrians, and ensure educational programs include components focusing on bicyclists and pedestrian safety.

Goal 3 - Improve Mobility and Accessibility

Improve connectivity among all modes to help mobility and accessibility, and improve balanced use of the system, and

Integrate bicycle and walking facilities into transportation, design, and circulation plans.

The document also contains several policies that are particularly applicable to this study:

Policy 3 - Develop, manage, and operate an efficient, interconnected, and inter-modal transportation system. People, goods, services, and information must travel by the most efficient means possible to foster economic prosperity. Different modes of travel should interconnect seamlessly to allow convenient and efficient movement between modes.

Policy 5 - Enhance system capacity and provide viable transportation choices. Some key strategies for accommodating increased demand are developing new facilities and expanding existing ones, promoting alternative fuel vehicles, and improving operational characteristics and system management practices.

Finally, to quote the Caltrans' Director's introduction to the July 2002 and January 2005, "Main Streets: Flexibility in Design and Operations" booklet: "Caltrans remains committed to the notion that people live, work and play in the communities through which our facilities pass. It is our duty, by recognizing the needs of both non-motorized and motorized modes of transportation, to assure that living space is good space in which to live. We are committed to full cooperation with the citizens and elected officials of those communities to find transportation solutions that meet both our duty to protect the lives and mobility of travelers, as well as making main streets a good place to be."*

* In the 2005 edition, the last sentence was changed to, "... as well as making main streets an integral part of the community."

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4 Summary of Existing Conditions Assessment

The following is a summary of key contents of the Existing Conditions Assessment Report, submitted on August 12, 2003. This report was compiled for the El Camino Real project and is available as a supplement to this Master Planning Study document.

4.1 Land Use, Urban Design and Right-of-Way Characteristics

4.1.1 Existing Land Use Context

Figure 4.1 shows the context of existing land uses along El Camino Real. It illustrates that the northern third of the corridor is dominated by large-scale, individual land uses, such as Palo Alto Medical Foundation, 'Town & Country' Shopping Center, and Palo Alto High School on the east side of the street and Stanford Shopping Center and Stanford University on the west side. South of Churchill Avenue and south of the Stanford Campus a land use pattern unfolds that is largely characterized by a continuous commercial frontage along El Camino with residential neighborhoods backing directly onto the commercial properties.

Roughly at the half way mark of the corridor through Palo Alto, this pattern is interrupted by three major land use areas. To the east of El Camino the California Avenue business/retail area, which serves as a retail center for the surrounding neighborhoods and business areas, as well as a core of activity adjacent to the California Avenue Caltrain Station; and a mixed-use area (between Grant and Fernando Avenues), that consists of a mix of commercial and residential uses. The Comprehensive Plan refers to the combination of these two areas as the 'Cal-Ventura Area.' To the west of El Camino the Stanford Research Park provides a major regional employment area. The Stanford Research Park generates much of the activity in the area in terms of commute and service traffic, transit ridership on the VTA bus lines and Caltrain, and pedestrian activity at lunch crossing El Camino Real to the California Avenue business/retail area.

Between Los Robles and Maybell Avenues, uses on the west side of the street are all residential, and two larger residential projects have been built in the past few years. The lack of commercial frontage on this side of the road makes this area a notable exceptions from the otherwise continuous commercial frontage of El Camino Real south of the Stanford campus.

Similar to the land use pattern at the northern end, but to a lesser extent, the southern end of the corridor is characterized by larger scale uses, such as the Rickey's Hyatt, the Elks Club, and the Hyatt Cabana Hotel. In addition, a noticeable concentration of car sales and service businesses was found in this area. Several of the larger properties are also likely to change their function or development pattern in the future as the sites are redeveloped.

The Context Map *(Figure 4.1)* also illustrates the spatial relationship between neighborhoods, school sites and open spaces along the corridor providing an indication of 'desire lines' for crossing and moving along El Camino Real.

4.1.2 Corridor Segments and Nodes

A. Corridor Segments

From traveling the length of El Camino Real through Palo Alto and from analysis of existing land use, street and access patterns, building scale, landscaping and street frontage along the street it is clear that the corridor consists of two distinct segments. The following segments, sub-segments and activity nodes have been identified *(see Figure 4.2)*

"Stanford Frontage" Segment - between Northern City Limit and Stanford Avenue

This area is dominated by large-scale properties, such as the Stanford Shopping Center, the Palo Alto Medical Foundation, the Town & Country Shopping Center, the Stanford Campus, and the Palo Alto High School. Building footprints on these properties are respectively large and most structures are set back from the street *(Figure 4.3)*.

The segment is also characterized by large scale landscaping along most of its edges, including Palo Alto Park across from the Stanford Shopping Center, the Arboretum area on the Stanford campus, with its substantial stands of mature trees, and the athletic fields on the Stanford Campus. If viewed in combination with the tree-planted edge along Palo Alto

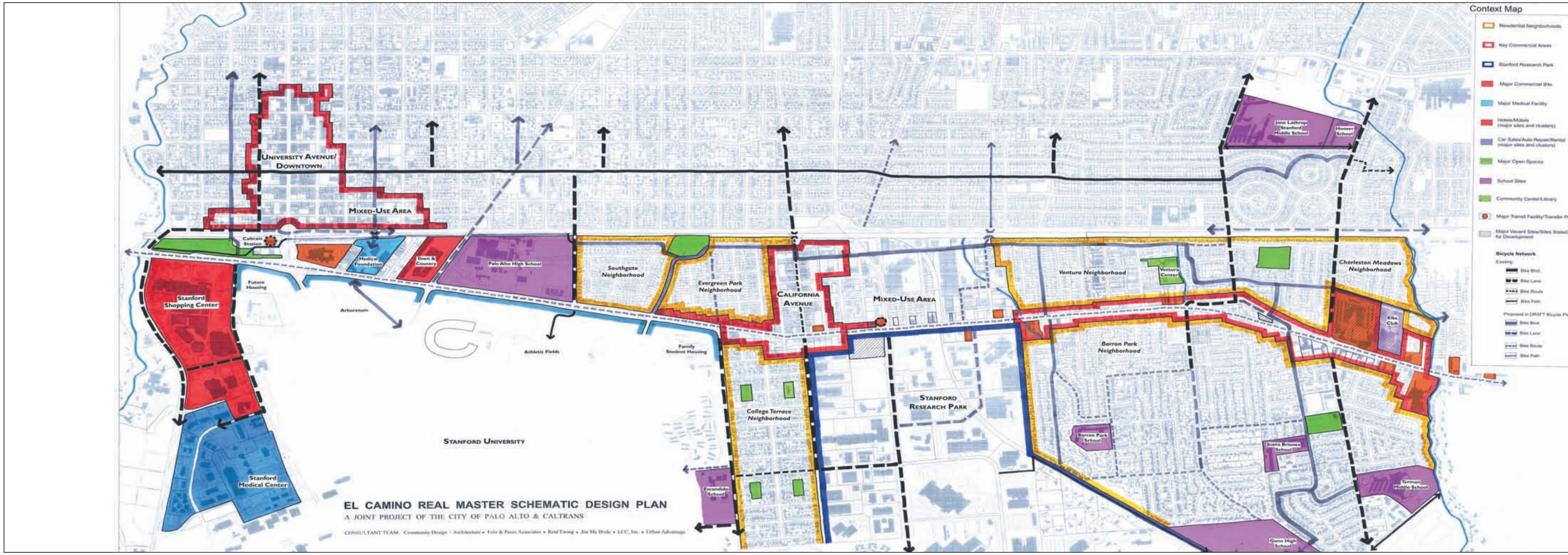

Figure 4.1: Context

Figure 4.2: Illustration of Segments, Sub-segments and Activity Nodes

High School and other properties on the east side of the street, this area has an almost rural character. Stanford plans to maintain a substantial landscaped edge in the area north of Stanford Avenue even as they develop the area to the west potentially for student or family housing.

Figure 4.3: 'Stanford' Segment of El Camino Real.

'Urban' Segment - between Stanford Avenue and Adobe Creek

This segment includes the most urban portions of El Camino Real in Palo Alto, particularly around California Avenue. In general the area is characterized by commercial buildings fronting directly onto the street with parking located behind or to the side of buildings. Parcels in this segment tend to be smaller than in the 'Stanford Frontage' segment. The landscape character of the 'Urban' Segment is variable, but the City has made a concerted effort in much of the area to plant where possible in the medians and plant trees along the sidewalks. Specific issues affecting the health and quality of the landscaping are discussed in *Section 4.1.4*, below. However, along its length the 'Urban' Segment breaks down into the following notable 'sub-segments':

Figure 4.4: El Camino at California Avenue.

'Urban' Segment - between Stanford and Grant Avenues

This sub-segment exemplifies the character of the overall 'Urban' segment. A variety of retail and commercial uses front along the street *(Figure 4.4)*. On-street parking tends to be utilized most frequently in this area and there is also a relatively high level of pedestrian activity, particularly during weekday lunchtimes when employees in the area and from Stanford Research Park come to the areas many restaurants, including those along California Avenue to the east of El Camino Real.

'Urban' Segment - between Grant Avenue and Portage Avenue/Hansen Way

The east side of the street tends to have a character that is similar to the previous sub-segment, with one and two story buildings fronting directly onto the street. The west side of the street is dominated by the recently completed community soccer fields north of Page Mill Road, Stanford Research Park, parking lots and landscape buffers where buildings are setback substantial *(Figure 4.5)*.

Figure 4.5: El camino south of Page Mill Road (looking north).

'Urban' Segment - between Portage Avenue/Hansen Way and Ventura Avenue

The area has similarities to the 'Urban' Segment between Stanford and Grant Avenues, but in general there are more exposed off-street parking areas, so the activity on the sidewalk is reduced and the street appears to be wider in many locations. The frequency of intersections is also lower which reduces the potential for people to more safely cross the street at intersections. While jaywalking was not reported to be a specific concern in this area the distance between crosswalks could result in an issue with jaywalking in the future.

'Urban' Segment - between Ventura Avenue and Southern City Limit

The uses and building fabric in this area differs from all the previous ones in that uses tend to be more auto-oriented *(Figure 4.6)*. More infrequent intersections encourage traffic to travel at higher speeds. Several new and future planned uses, supported by Comprehensive Plan policies will continue to change the character of this area making it more pedestrian-oriented over time. The landscape character of the median becomes more noticeable in this area as it is more continuous with fewer left turn pockets.

Figure 4.6: El Camino north of Arastradero (looking south).

B. Nodes

The following areas stand out for their particular pedestrian, bicycle, and more concentrated commercial/retail activity, and were therefore identified as current or future nodes *(Figure 4.2)*. These characteristics inform to the details of the streetscape design in these areas:

- University Avenue/Palm Drive/Caltrain Stop;
- Embarcadero Road/Town and Country/Palo Alto High School;
- California Avenue Area; and,
- the future El Camino Way Triangle Area.

Street design considerations include the width of sidewalks in these areas and the character and frequency of crossings. There is also the potential for new development to positively contribute to the character of the street through on-site parking relocation, reconfiguration of curb cuts, and setback/easements to widen the area for sidewalks.

In addition, it was pointed out by several Advisory Committee members that many pedestrian crossings occur along the street segment south of Stanford Business Park. The area's activity level is not as focused as in the California Avenue area, but is nonetheless noteworthy. The area between Los Robles and Maybell Avenues (the El Camino Way Triangle) carries particular importance. This is supported by the fact that this area is specifically addressed in Palo Alto's Comprehensive Plan, which calls out the potential for and the desired character of development in this area. In addition, El Camino Real is frequently crossed by school children at Maybell and Los Robles. This contributes to the general activity level in the area, which should be viewed as an emerging node.

4.1.3 The Public Right-of-Way

A. Street and Access Pattern

The frequency and intervals of streets intersecting with El Camino Real largely determines the level of access that residents of adjacent neighborhoods and employees in the Corridor are afforded to uses along both sides of the street. In addition, the accessibility of opposite sides of the street is dependent on whether and how frequently crosswalks are provided to allow for pedestrian movements from one side of the street to the other *(see Figure 4.7)*. For a pedestrian-supportive area, the distance between intersecting streets should generally not be longer than 600 feet and ideally be between 300 to 400 feet. Such block lengths allow for convenient access from residential neighborhoods, are appropriate for pedestrian walking speeds, and support the kind of visual and architectural diversity that cannot be achieved on blocks that are oversized ('superblocks') that are occupied by a single use or large-scale building.

As mentioned earlier, between the northern city limit and Park Boulevard access to El Camino is largely determined by large-scale uses located along this part of the Corridor. Here, block lengths on the east side of the street range between 700 and 2,200 feet, while those on the west side measure between 900 and 3,400 feet. The long block lengths on the west side are mostly a result of the small number of streets that access into Stanford Campus. In many portions of this segment the spacing of pedestrian crossings is even wider as not all 'T-intersections' have pedestrian crossings *(see Figures 4.7 and 4.8)*.

Between Park Boulevard and Ventura Avenue a largely regular street pattern unfolds with blocks of approximately 300 feet in length. This pattern continues south with the exception of some larger blocks at the Palo Alto Business Park and around Page Mill Road. The street pattern of the neighborhoods east of El Camino Real is mostly based on a regular grid and thus affords good access to uses along El Camino Real.

South of California Avenue, a large number of T-intersections occur where a side street intersects El Camino Real without continuing on the opposite side of the street. This is the dominant intersection type in this part of the corridor. Many of these intersections are currently unsignalized and/or do not provide marked pedestrian crosswalks.

Blocks south of Ventura Avenue measure up to 1,500 feet long. In this area streets in adjacent neighborhoods are not based on a regular street grid, creating a less direct access between streets within the neighborhoods and to uses along El Camino Real. The street patterns of the Ventura mixed-use area, and to an even greater extent the ones of the Stanford Research Park, offer only very limited routes for travel parallel to El Camino Real. As a result, residential neighborhoods in the south of the corridor are somewhat separated from those in the north. El Camino Real is the only effective access route between these residential neighborhoods and between neighborhoods and businesses along the corridor.

B. Typical Cross Sections

Urban 6-Lane - Park Avenue (east side) to Southern City Limit

The 120-foot r.o.w. cross section illustrated in Figures 4.9 represents the typical section in the urban portion of the corridor. However, two key exceptions exist with the Page Mill and Arastradero Road intersections, where the right-of-way has been widened to 130 feet to allow for the accommodation of an additional left turn lane in each direction.

Stanford 6-Lane

The 120-foot r.o.w. cross section illustrated in Figure 4.11 represents the typical section along most of the Stanford University Campus. It is characterized by the lack of a paved sidewalk on the west side and the substantial landscaped setbacks on the east side.

Figure 4.7: Signalized and Unsignalized Crossings and their spacing along the corridor

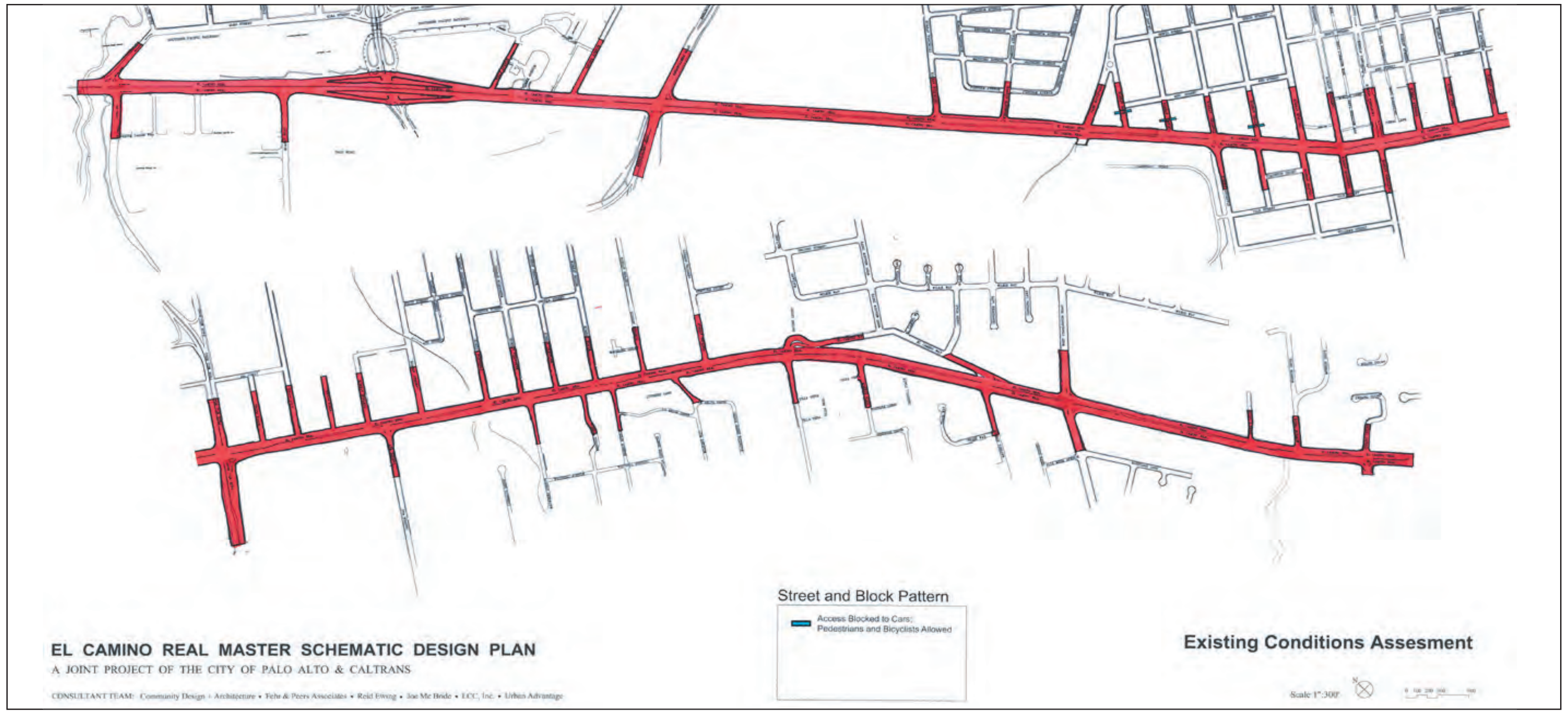

Figure 4.8: Street and Block Pattern. Note the frequency of T-intersections throughout the corridor

C. Location-specific Cross Sections

Northern City Limit to University Avenue Underpass

This area has recently been reconstructed. From the city limit with Menlo Park to the University Underpass, the right of way has varying widths exceeding 120 feet in some locations and widening substantially toward the University Avenue underpass to accommodate north and southbound access ramps leading to Palm Avenue and University Avenue. The median in this area varies from 20 feet wide at the turn lanes at the Stanford Shopping Center to just 2 feet wide south of Quarry Road Figure 4.10.

Figure 4.10: El Camino at Stanford Shopping Center (looking south)

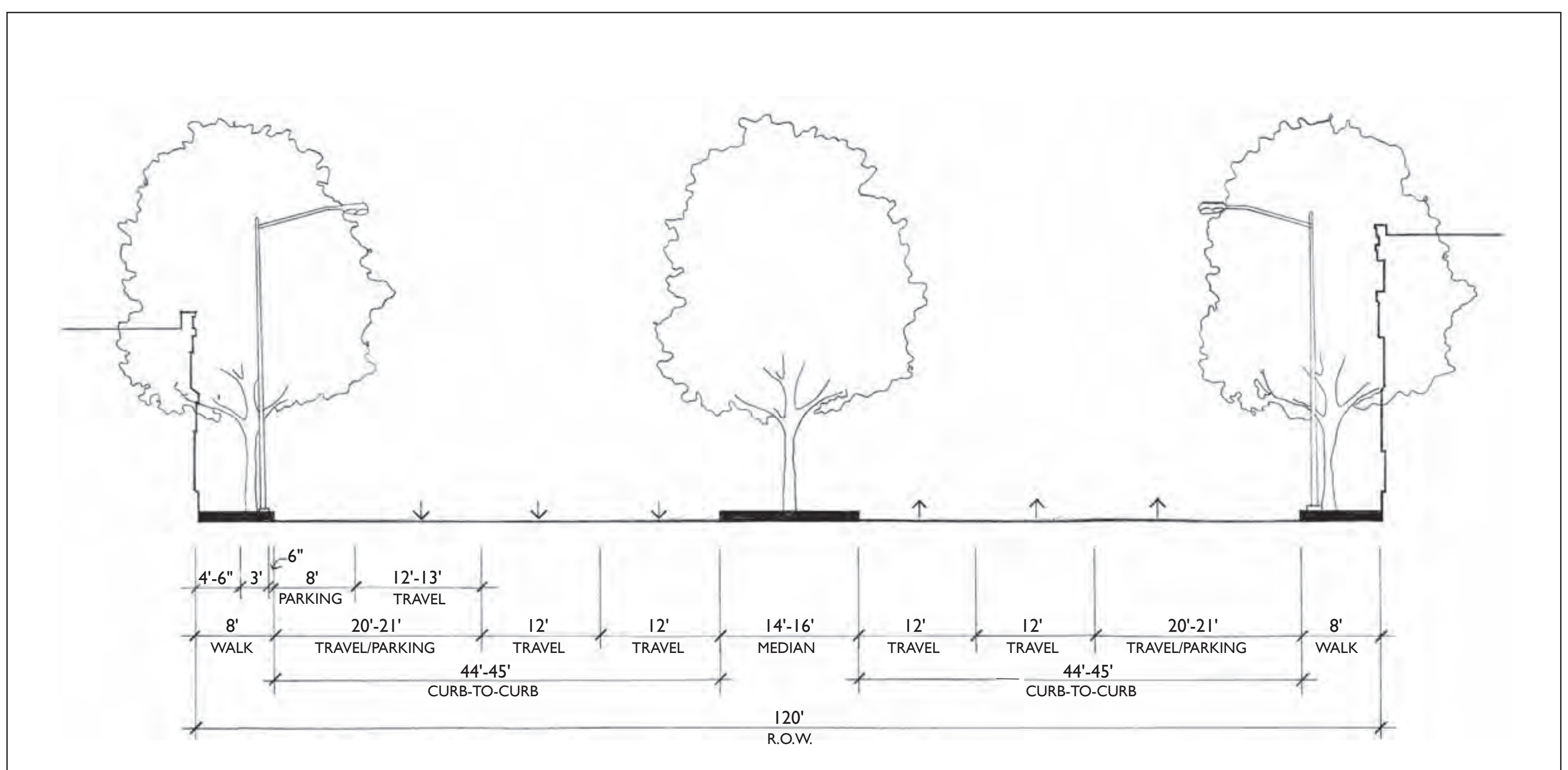

Figure 4.9: Typical existing 120-foot R.O.W. cross section

University Avenue Underpass

The portion of the roadway that continues under University Avenue has an overall width of 82 feet curb to curb. The median in this area narrows from just under 11 feet just north of the down slope to 5 feet, 8 inches at its low point and then widens again to 6 feet, 11 inches. South and north of the underpass, four ramped access roads lead from El Camino Real to University Avenue/Palm Drive above. Where the access ramps connect to University Avenue traffic movements are coordinated by traffic signals. However pedestrian and bicycle movements at the two intersections are handled differently. While the westerly intersection of access ramps and University Avenue provides bicyclists and pedestrians with a crosswalk across University Avenue, the easterly intersection does not include a pedestrian crosswalk, and Pedestrians have to divert toward the Caltrain Station. Bicyclists can cross University Avenue by going straight through the intersection in the vehicle lane. It should be noted that the City of Palo Alto is pursuing funding for the implementation of its plans for the Palo Alto Intermodal Transit Center (PAITC). This project proposes a major upgrade, reorganization and rebuilding of the entire area around

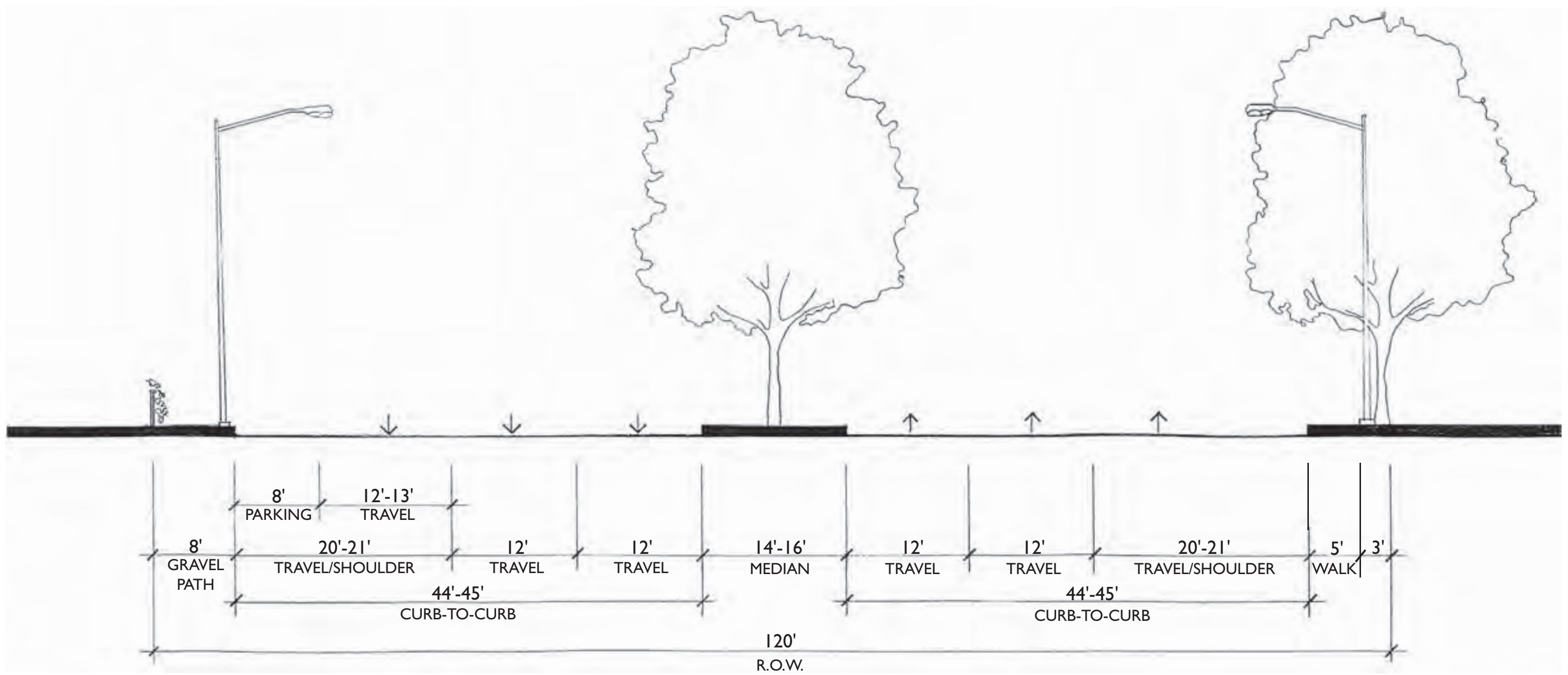

Figure 4.11: Typical Cross Section along the 'Stanford' Segment (looking north).

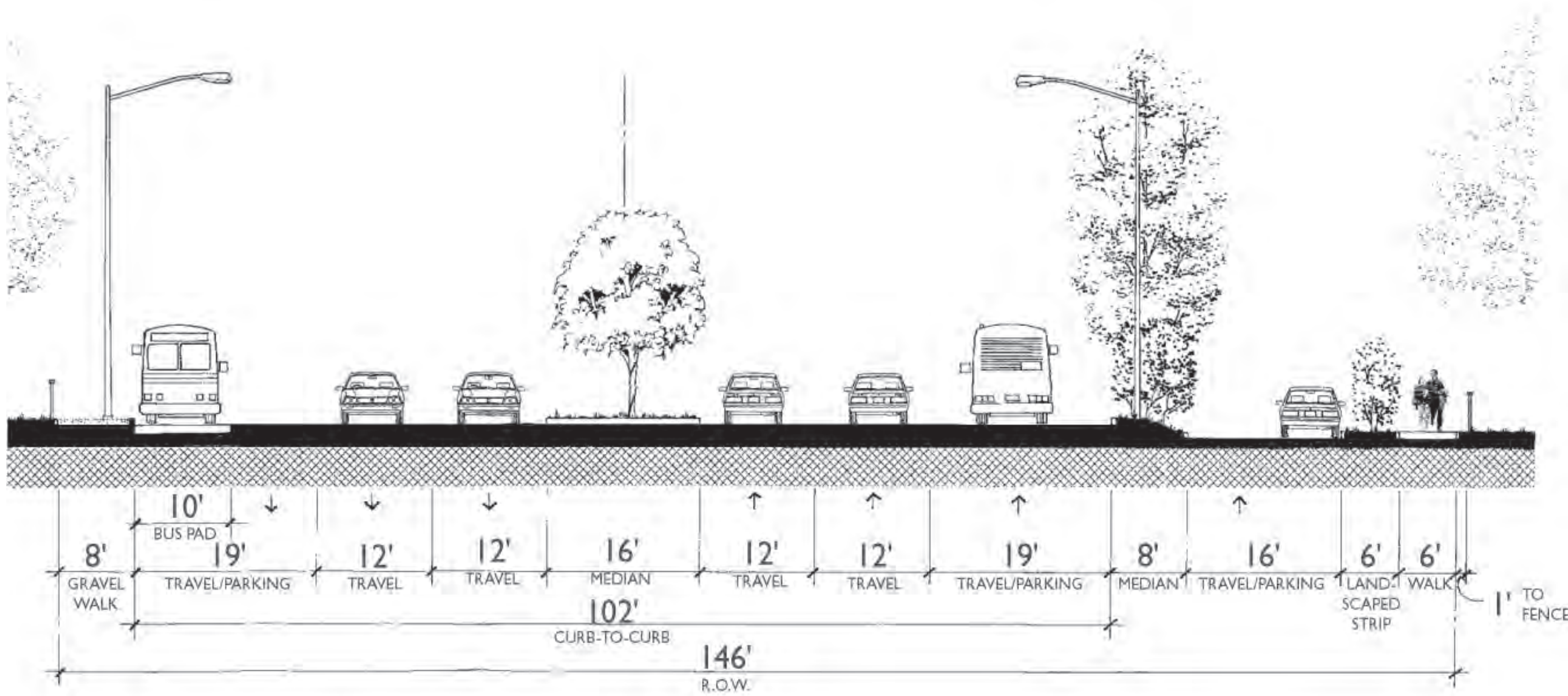

Figure 4.12: El Camino at the Southgate Neighborhood (looking north).

the Caltrain Station and would bring major changes to the existing circulation system. In light of the existing plans for the area, no detailed consideration was given to the interface between the access ramps on El Camino and University Avenue *(Figure 4.13)*. However, the lack of sufficient bicycle and pedestrian accessibility described above should be considered and resolved within the future implementation of both the El Camino improvements and the PAITC planning effort.

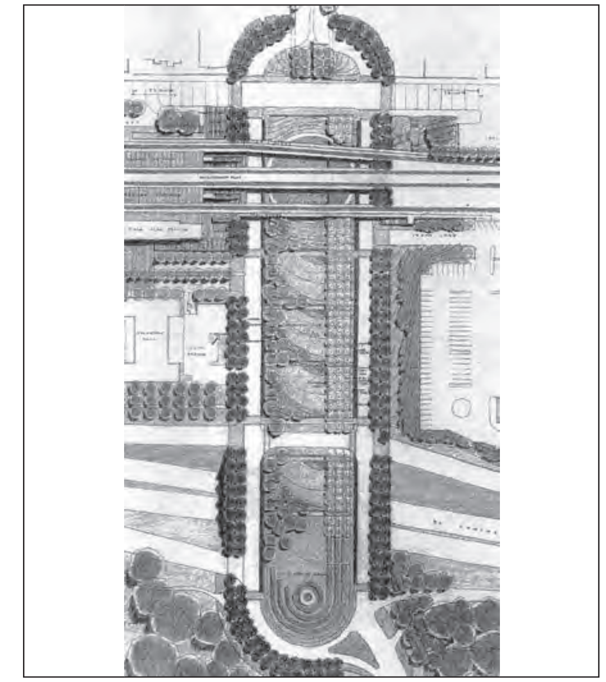

Figure 4.13: Preferred Scheme for the palo Alto Intermodal Transit Center.

Embarcadero to Churchill Avenue (Transition)

This segment represents a transition zone between the typical 'Stanford' cross-section described above *(Figure 4.11)* and the special cross-section along the Southgate Neighborhood described below *(Figure 4.12)*. Here, along the Palo Alto High School frontage the right-of-way on the east side of the street widens from 120 to 146 feet, with most of the additional right-of-way east of the eastern sidewalk being occupied by a landscape buffer between the high school grounds and El Camino Real.

Churchill Avenue to Park Boulevard

This street segment is set apart from the rest of the corridor because of its inclusion of a frontage road along El Camino Real that gives access to homes in the Southgate neighborhood *(see Figure 4.12 and 4.14)*. This is the only location where a residential neighborhood directly abuts the El Camino Real right-of-way. Here, the right-of-way has a total width of 146 feet.

Figure 4.14: El Camino and Frontage Road at Miramonte Avenue.

Park Boulevard to Park Avenue (Transition)

This short segment represents the southern transition zone from the Southgate Neighborhood, where the right-of-way transitions from a 146-foot width back to the typical section of 120 feet.

D. Gateways

The El Camino corridor stretches between Palo Alto's northern and southern city limit and therefore includes two entry/exit points with adjacent communities (Menlo Park in the north and Mountain View / Los Altos in the south). This condition presents an opportunity for marking these transition points with specific streetscape designs and public art.

The northern limit line between Menlo Park and Palo Alto coincides with San Francisquito Creek. El Camino passes over the creek via a concrete bridge of modest design with narrow, somewhat dilapidated sidewalks *(Figure 4.15)*. For travelers on the street headed south, the Stanford Shopping Center on the west side of the street is the most noticeable and widely known landmark for having arrived in Palo Alto.

The southern city limit west of El Camino Real is located where Adobe Creek passes under the street *(see Figure 4.16)*. In 2003, the City and the Santa Clara Valley Water District implemented a major upgrade to the design of this gateway as part of a bridge renovation project. The improvements will include sidewalk extensions with viewing areas located above the creek on either side of the bridge, special paving, pedestrian street lighting and public art. With slight modifications, the new improvements could be made compatible with future conditions based on the designs proposed in this document (such as widened sidewalks or a different type of pedestrian streetlight).

Figure 4.15: El camino at San Francisquito Creek (looking south).

Figure 4.16: El Camino Adobe Creek (looking north).

E. Lighting and Street Furnishings

Lighting

Street lighting is needed for proper illumination of vehicular traffic areas and sidewalks. As with most urban highways the existing light fixtures ('cobra-head fixtures) on El Camino Real are optimized for lighting the roadway, while no special consideration is given to the specific needs of pedestrians and businesses along the street for a better walking and shopping environment. The light source of the existing fixtures is located about 30 feet above ground, at the end of a light standard that arches out over the roadway by approximately 10 feet. The light posts are spaced at an average distance of 130 feet along the street. El Camino currently lacks any pedestrian-scaled lighting, which is characterized by a spacing of light standards between 30 to 50 feet on center and a light source height between 12 and 15 feet.

Street Furnishings

General

Furnishings provided in conjunction with active pedestrian-friendly public streets commonly include trash and recycling receptacles, benches, and bicycle racks, and depending on the character and function of the street additional information panels or kiosks, banners, and news racks. With exception of many individual and some modular news racks, no pedestrian-oriented furnishings are currently provided along the El Camino Real Corridor.

At Transit Facilities

Public amenities typically located at bus stops of the Valley Transportation Authority (VTA) 22 Line and 300 Line include one bench and one trash receptacle per stop *(Figure 4.17)*. In addition, shelters with advertising panels are located at several of the bus stops and a special information display is located at the Page Mill stop, where bus lines operating on Page Mill and El Camino Real intersect. While the transit related furnishings provide some pedestrian amenity to the street, these should not be seen as a substitute for a coordinated set of public street furnishings.

VTA is currently advancing plans for the operation of Bus Rapid Transit service on El Camino Real. The stops for this service coincide with those currently served by the 300 Line (West Charleston/Arastradero, Page Mill, and California Avenue). Although no final designs for these stops have been prepared at this point, it is VTA's long-term goal to install a set of 'branded' bus stop improvements at all three BRT stops, including custom design shelters, light fixtures, and information displays.

Figure 4.17: Example of poorly furnished Bus Stop.

Bicycle Parking

Bicycle facilities such as bicycle loops or other devices for bicycle parking do currently not exist within the public right-of-way.

F. Major Utility Alignments

Most underground utilities in the project area are concentrated near the existing curbs or under the sidewalks. The most significant effect that existing underground utilities will have is on the location of tree wells and light standard foundations. Otherwise the effect on the project appears to be minimal.

Storm Drainage

There are existing storm drainage facilities for most of the entire length of the project. Drainage mains which run along the length of the road, longitudinal drainage, for the most part are on the west side of the existing roadway. Relocating longitudinal drainage facilities would be very expensive but transverse facilities could be relocated at a moderate cost. It would be best to respect the location of longitudinal drainage by avoiding the location of trees and light standards above the drain lines. Low landscaping, sidewalk paving, curbs and roadway paving may occupy space above storm drainage facilities without adverse effect. Obviously, any curb relocation, roadway narrowing or widening would require modification and addition of storm drain inlets and manholes. The anticipated costs for such modifications would not be large.

Sanitary Sewers

Sanitary sewers, like storm drainage facilities are gravity systems, and as such, are more difficult to relocate, although less so than typical storm drain relocations. The pipe sizes are typically smaller than storm drains. There are longitudinal sanitary sewers in El Camino Real. For the most part longitudinal sewers are located near the existing curbs, either in the sidewalk areas or in the existing parking lane. However, there are a few blocks between Stanford Avenue and Cambridge Avenue where the sanitary sewer runs under the median in the center of the street, and several blocks north of Cambridge where the longitudinal sewer is in the #1 (left) lane north or south bound. While most of these mains would be deep enough to accommodate trees and lamp foundations above, placing trees or lamp foundations over sanitary sewers is considered poor practice from a sewer operations and maintenance point of view and should be avoided.

Water

There are longitudinal water lines throughout most of the project area. In the Stanford campus area waterlines are generally on the northeast side of the roadway in the rightmost (northbound) traffic lane while heavy storm drainage facilities occupy the opposite side of the street. Most of the remainder to the project has longitudinal water lines on both sides of El Camino Real.

Gas and Electric

Longitudinal electric conduits for street lighting exist throughout the project area. Underground electric power distribution and gas lines are located in the sidewalk areas on most of the commercial frontages. There are numerous large electrical boxes in sidewalk locations that are relatively difficult to relocate horizontally but less difficult to adjust to vertical grade. The gas mains are generally located 30 inches below the surface. Locations of future trees and new lamp foundations should avoid these facilities or alternatively the relocation of gas mains could be considered.

Communications

While the consultants were unable to view system maps from the telephone and cable companies, evidence of major underground telephone facilities were observed in the rightmost northbound traffic lane in the northerly half of the project area. It is assumed that there are lesser telephone and CATV facilities in most of the sidewalk areas or that these share joint trenches with electric and gas facilities.

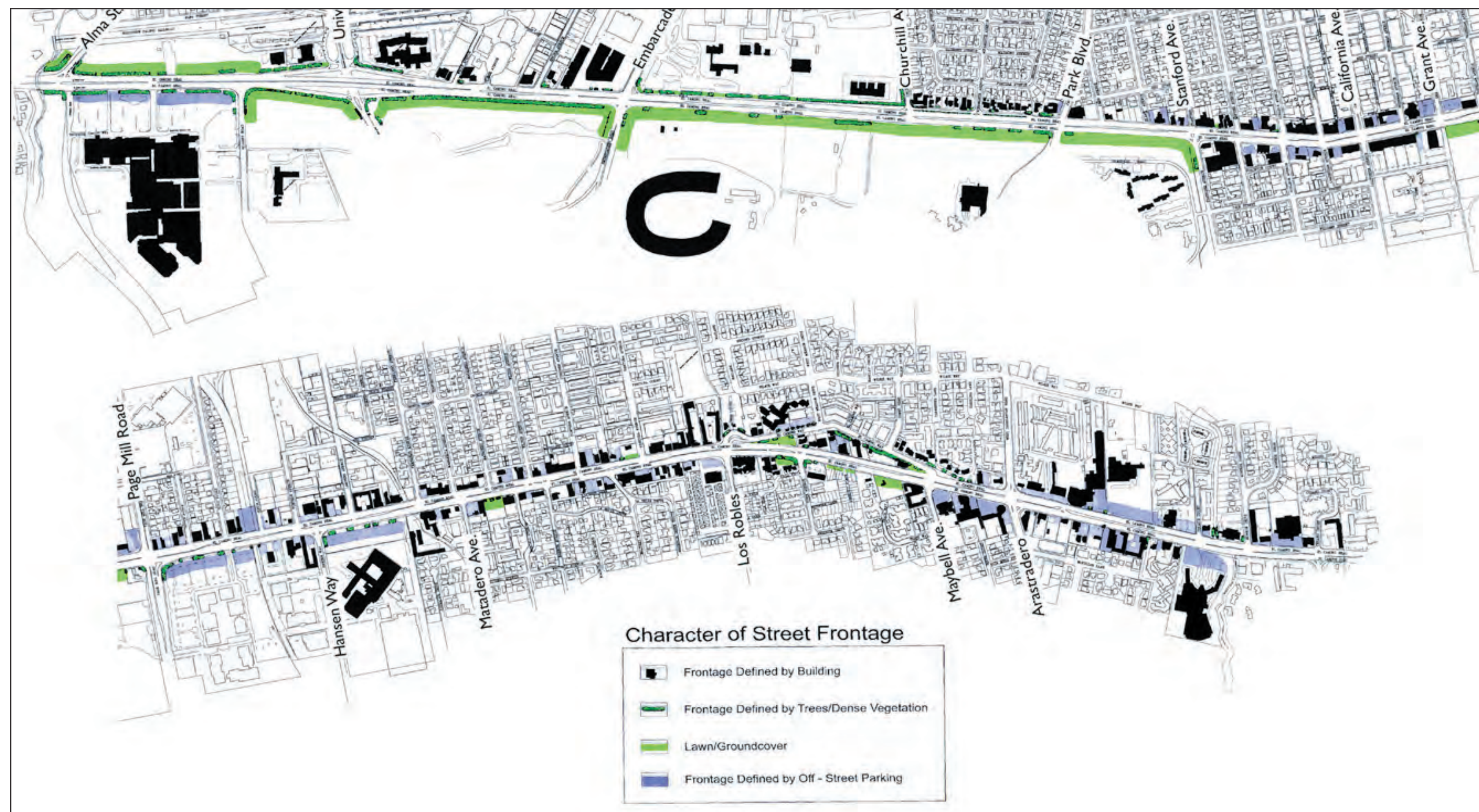

Figure 4.18: Character of Street Frontage along the El Camino Corridor

4.1.4 Trees and Landscape Character of El Camino

A. Landscape as an Element of Urban Form

A distinct difference in landscape character exists between the segments of the corridor north and south of Stanford Avenue *(see Figure 4.18)*. The first has an almost rural character created by generous building setbacks and mature landscaping on private properties along the street. The latter has a more urban character created by the buildings that come up to the sidewalk and the dominance of sidewalk trees as the defining landscape element.

Landscaping is often a key element in the definition of urban form and character of street. Many highly valued, grand boulevards are typified by their street trees with buildings providing a backdrop and detailed human character. The quality and character of landscaping can also be a cost effective way to make a short-term significant change to the character of a corridor. This is the hope of the suggested redesign of El Camino Real.

In the Stanford portion of the corridor trees and other landscape elements generally are made up of species that complement the oak woodland character of the area, and generally create a strong linkage between the character of the street and the adjacent areas. Some 'exotic' species, such as eucalyptus, ginkgo, and bottle brush and were are also planted along this area. These are typically not planted to highlight significant locations, such as intersections or gateways into neighborhoods. Landscaping is planted informally in this segment with varying setbacks from the street in keeping with its rural character *(Figure 4.19)*.

Figure 4.19: Landscaping along 'Stanford' Segment (looking north).

The landscaping in the urban portions of the corridor is characterized by relatively consistent rows of trees planted in sidewalks and somewhat varied tree planting occurring in medians where these are about 14 feet wide *(Figure 4.20)*. The visual consistency of the landscaping in medians is significantly reduced by the frequent occurrence of turn pockets at the many T-intersections and access points to adjacent uses. These turn pockets are paralleled by 4-foot wide medians, which do not contain any landscaping and therefor cause the occurrence of large gaps between the wider landscaped medians *(Figure 4.21)*. The potential of the trees in sidewalk locations to form a strong landscape edge along the street is greatly reduced by the poor performance of many of the trees planted over the years (also see paragraphs below). However, in some locations where the landscaping on private properties is more dominant, like at the Palo Alto Square development, this landscaping and the sidewalk trees combine to form a noticeable 'green' edge *(see Figure 4.18)*.

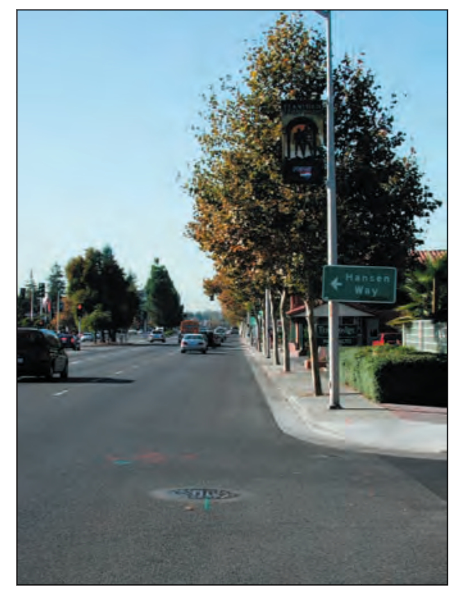

Figure 4.20: Consistent row of London Plane trees along a portion of the 'Urban' segment of El Camino.

Figure 4.21: Frequent turn lanes interrupt the tree-planted medians.

B. Trees in Sidewalks and Medians

Tree Species and Tree Condition

Because of the significance of trees for the transformation of El Camino Real, a tree survey was conducted determining the location of each tree on the public right-of-way along El Camino Real in Palo Alto *(see Figure 4.22)*. The survey distinguished between trees in sidewalks and trees in medians. Twenty-three tree species were encountered along El Camino Real. While 17 species occurred in sidewalk locations, London plane trees accounted for 75% of the 502 street trees found in the survey. The next most common other species was ginkgo that made up only 5% of the street tree population. Fifteen tree species occurred in the median strips *(see Table 1)*. The most common of these was ginkgo with 50% of the population. A few very large trees of heritage status occurred in or adjacent (within 15 feet) of the public right of way. Coast live oak was the most common species of these heritage trees.

Species	Scientific Names	Sidewalk	Median
Acacia	*Acacia melanoxylon*	•	
American Elm	*Ulmus americana*	•	
Bottle Brush	*Callistemon lanceolatus*		•
Canary Island Pine	*Pinus canariensis*		•
Cherry*	*Prunus sp.*		•
Chinese Tree of Heaven	*Ailanthus glandulosa*	•	
Coast Live Oak	*Quercus agrifolia*	•	•
Crepe Myrtle	*Lagerstroemia indica*	•	
Deodora Cedar	*Cedrus deodara*	•	•
Eucalyptus	*Eucalyptus sp.*	•	•
Ginkgo	*Ginkgo biloba*	•	•
Glossy Privet	*Ligustrum lucidum*	•	•
Incense Cedar	*Calocedrus decurrens*		•
Italian Stone Pine	*Pinus pinea*		•
London Plane	*Platanus acerifolia*	•	•
Ornamental Pear*	*Pyrus sp.*	•	•
Pin Oak	*Quercus palustris*	•	•
Red Oak	*Quercus ruba*	•	
Redwood	*Sequoia sempervirens*	•	
Scarlet Oak	*Quercus coccinea*	•	
Sweetgum	*Liquidambar*	•	•
Valley Oak	*Quercus lobata*		•
Water Gum	*Nyssa sylvatica*	•	

* not leafed out at time of survey, identification incomplete

Table 1: Tree Species occurring along El Camino Real

Sidewalk and median trees ranged in size from 1 to 35 inches in diameter and from 4 to 74 feet in height. The size of the trees is a function of their age and growing condition. Many of the trees along El Camino Real appear to be restricted in growth due to limited water supplies *(Figures 4.23 and 4.24)*. There is considerable variation in crown radius of the trees along El Camino Real due to variation in age and pruning practices. It was noted that crown radii tended to be greater on the south sides of the trees. This difference is related to prevailing northwest winds that tend to suppress growth on the northern and western sides of the tree crowns.

The overall condition of the trees along El Camino Real is good. Only 17.7% of the street trees were rated as being in fair condition and only 5.2% in poor condition. Many of the sidewalk trees (especially ginkgo and pin oak) were ranked as being in poor condition because of the crude way that they had been pruned. The condition of median trees varied with species. Ginkgo, Canary Island pine, and London plane trees growing in the median had relatively small percentages (less than 10%) of trees, which were rated as being in fair or poor condition. In contrast, 20 to 40% of the Italian stone pine and ornamental pear trees growing in the medians were ranked as in fair condition.

Figure 4.22: Approximate locations of trees in Medians and Sidewalks. Note the extent of unplanted medians.

Figure 4.23: London Plane Trees grow large under good conditions.

Figure 4.24: London Plane Trees remain small under adverse conditions.

Sidewalk Damage

Twenty-two percent of the trees had caused damage to the sidewalks *(Figure 4.25)*. This damage was usually associated with trees over 6 inches in diameter that were growing in tree basins less than 3 feet wide *(Figure 4.26)*. Analysis of the sidewalk damage data collected along El Camino Real suggests that tree basins need to be at least 4 by 6 feet to accommodate large London plane trees.

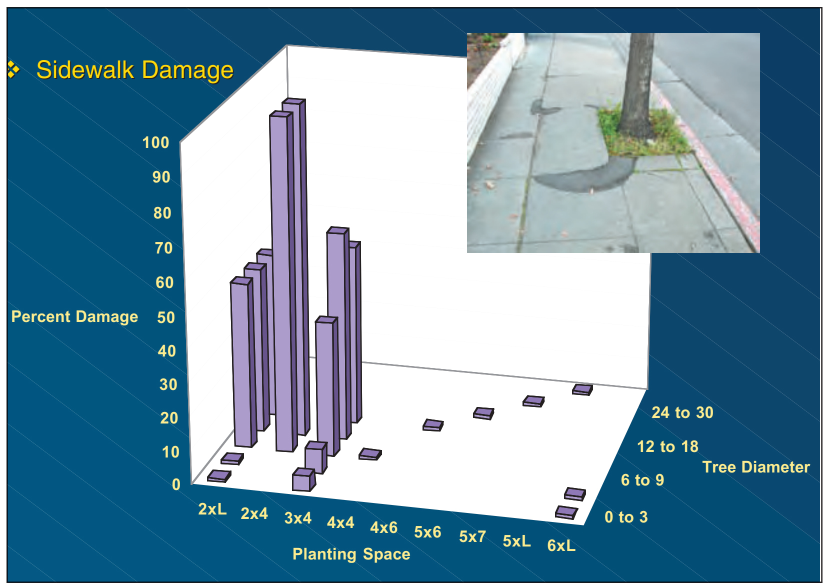

Figure 4.25: Sidewalk damage caused by poor accommodation of tree roots.

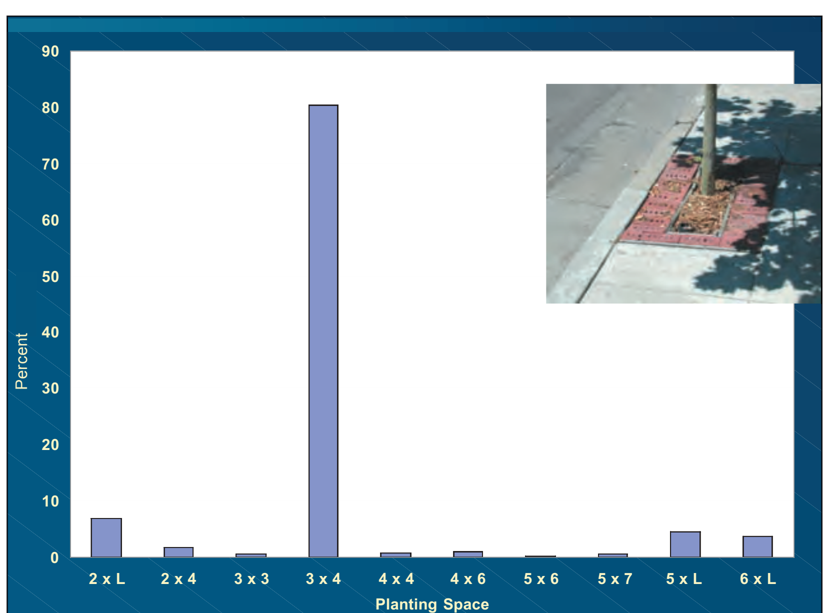

Figure 4.26: Most trees on El Camino are accommodated in tree wells sized 3x4 feet.

Climate

The definitive characteristics of the Palo Alto climate are the relatively mild winter temperatures, dry summers, and prevailing northwest winds. The average January temperature in Palo Alto is 48° F, while the lowest minimum temperature recorded was 22° F. Average summer precipitation for June, July, and August amounts to only 0.2 inches. These conditions put Palo Alto in Plant Climate Zone 15, which is not too restrictive in terms of trees which can be grown. The summer drought does, however, require summer irrigation to maintain a number of tree species not common to Mediterranean climates. The major influence of the prevailing northwest wind has been to cause excessive lean in some trees planted along El Camino Real and to produce lopsided tree crowns having southern radii exceeding their northern radii. The prevailing wind, which can exceed 10 mph in velocity in any season of the year, has and must continue to be addressed with an aggressive tree-staking program for newly planted trees.

Soils

Ten soil types occur along El Camino Real. Four of these soils (Clear Lake clay, Dublin clay loam (adobe), Pleasanton clay loam, and San Ysidro clay loam) have subsoils which interfere with water infiltration and in some cases with root penetration *(Figure 4.28)*. These soils can be expected to have perched water tables during the rainy season. Trees planted in fill soil over these soils can also be expected to develop root platforms at the interface between the fill soil and the native soil.

Many London plane trees planted along El Camino Real in 1984-85 have exhibited slow rates of growth *(Figure 4.24)*. This slow growth raises a concern over the feasibility of planting addition London plane trees and the potential of the existing trees to form canopies over the street. Exposure of the roots of three trees growing along El Camino Real, conducted as part of a field study supplemental to this report, indicates root growth has been restricted by the characteristics of the native soils and the small volume of fill soil used in the planting of these trees. Some of the native soils along El Camino Real have high clay contents in their subsoils that restrict downward infiltration of water and in some cases restrict root penetration. The prime example of this type of soil is the San Ysidro clay loam. The very low rate of infiltration of this soil often results in a perched water table that restricts root growth to the gravel layer above the fill soil. In contrast, trees planted on Zamora gravelly clay loam and have initially developed a root system in the fill soil and, with time, sent roots down into the native soil. Neither of the investigated trees have shown growth rates comparable to several trees planted at the same time on better soils or at sites where lawn irrigation provides them with more water during the growing season.

General Conclusions

The general conclusions that can be drawn from the conducted analysis are (1) future tree planting must consider the differences in the soils along El Camino real as they affect tree growth and remediate soils as needed, and (2) remedial action needs to be taken in the case of existing trees to improve soil condition for tree growth. However, the existing conditions along El Camino Real are suitable for a number of tree species, which can be used as median and/or sidewalk trees *(see Chapter 5.4)*.

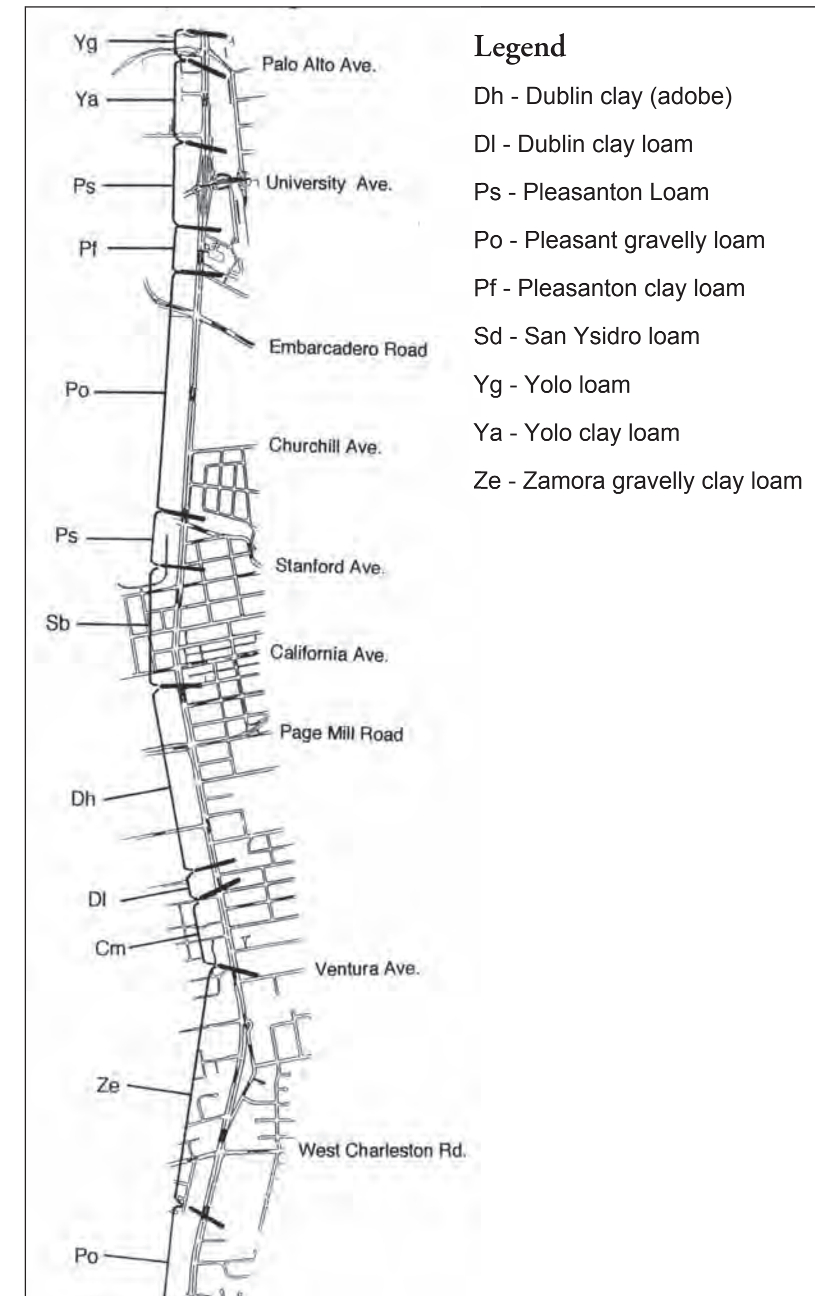

Figure 4.28: Distribution of Soil Types

4.1.5 Relevant Plan Documents and Plans for Future Development

A. Palo Alto Comprehensive Plan

Palo Alto's Comprehensive Plan recognizes complexities of El Camino Real's land use and transportation function and context, and addresses the street and uses along it in several policies. Following is a list of the key policies and associated programs that either address the intended character for land uses along the corridor or El Camino's streetscape directly:

- POLICY B-25: Encourage the development of pedestrian-oriented neighborhood retail and office centers along the El Camino corridor.
- POLICY L-31: Cal-Ventura offers exceptional opportunities for new transit-oriented development... New housing in this area could provide the momentum for new pedestrian amenities.
- POLICY L-32: Maintain Town and Country Village as an attractive community-serving retail center. Future development at this site should preserve its existing amenities, pedestrian scale, and architectural character. The street edge should be strengthened with wider sidewalks, street trees, and a low hedge to screen the pavement and parked cars.
- PROGRAM L-32: Improve pedestrian connections across El Camino Real.
- PROGRAM L-33: Study ways to make South El Camino Real more pedestrian-friendly, including redesigning the street to provide wider sidewalks, safe pedestrian crossings at key intersections, street trees, and streetscape improvements…two-story structures with retail-oriented street frontage and rear parking should be encouraged. Second, redesign of the public right-of-way should be encouraged to make it more suitable for pedestrians without reducing the number of travel lanes. These improvements should be focused at retail nodes and along segments of the street where they can benefit from existing positive design features, such as street trees.
- POLICY L-34: Encourage improvement of pedestrian and auto circulation and landscaping improvements, including maintenance of existing oak trees and planting additional oak trees.
- PROGRAM L-34: Provide better connections across El Camino Real to bring the Ventura and Barron Park neighborhoods together and to improve linkages to local schools and parks.
- POLICY L-35: Establish the South El Camino Real area as a well-designed, compact, vital, Multi-neighborhood Center with diverse uses, a mix of one-, two-, and three-story buildings, and a network of pedestrian-oriented streets and ways.
- POLICY L-67: Balance traffic circulation needs with the goal of creating walkable neighborhoods that are designed and oriented towards pedestrians. A few, like El Camino Real, serve only to move traffic and have a negative effect on community design.
- PROGRAM L-71: Recognize Sand Hill Road, University Avenue, Embarcadero Road, Page Mill Road,…Arastradero Road (west of Foothill Expressway),…as scenic routes.
- POLICY L-71: Strengthen the identity of important community gateways, including…Embarcadero Road at El Camino Real.
- PROGRAM L-72: Develop a strategy to enhance gateway sites with special landscaping, art, public spaces, and/or public buildings.

The plan also recognizes the opportunities for distinctive gateways on El Camino Real that highlight the connection between the City and its natural setting at the bridges across San Francisquito and Adobe Creeks.

B. Design Guidelines for Private Properties

The City of Palo Alto contracted an urban design consultant to develop urban design guidelines for private development along the El Camino Real Corridor. In June of 2002, the Architectural Review Board recommended the Draft Design Guidelines for interim use. Although the guidelines will have an overall long-term impact on the quality of development along the Corridor, there is one aspect that is of particular interest as it relates to the potential future allocation of space within the public right-of-way. The draft guidelines suggest that future development along El Camino Real set back from the street by a minimum of 4 feet, creating an easement to increase the width of the existing 8-foot public sidewalks, effectively creating an 12-foot wide sidewalk for the length of frontage of the proposed development.

C. Plans for Future Development along El Camino

At the time of the writing of this report, there were only few known plans for development of private properties along El Camino Real. The Planning Department expected the following two larger sites to redevelop in the near future:

- Rickey's Hyatt at the southeast of the El Camino and West Charleston Road intersection: This property is likely to include a new hotel and conference facilities as well as a housing component of undetermined size;
- The Elks Club just south of the above site: A senior housing development built along the site's El Camino frontage in the club's parking lot was discussed as a possible development on this site.

In addition, it was expected that the triangular area between El Camino Real and El Camino Way would continue to transform into an active mixed-use area. No plans were known for the largest vacant site along the corridor, a vacant former Mayfield school site, located just northwest of the Page Mill intersection.

D. Stanford University

Through conversations with Stanford University Planning staff, the following key aspects long-range planning for the Stanford Campus were found to have a bearing on future changes within the El Camino Real public right-of-way:

- Stanford University Planning views existing on-street parking areas along the Stanford Campus frontage as non-essential to activities occurring on campus. In fact, planning staff explored in the past how a wider sidewalk and street trees along the campus could be accommodated if the area currently occupied by on-street parking (or an 8 foot shoulder) were used for this purpose.
- In the long-term, Stanford is interested in creating a new bicycle connection through the eastern portion of campus (the Arboretum) to the traffic signal on El Camino Real at the Palo Alto Medical Foundation. Here the bicycle path would connect to the one continuing eastward and through a new underpass under the Caltrain r.o.w. designated in the City's Draft Bicycle Plan.
- Stanford University has long-term plans for changing the character of the landscaping in the Arboretum area. Currently mature eucalyptus trees dominate much of the area, with oak trees interspersed throughout. It is the University's intention to phase out the eucalyptus trees in many areas and replace failing specimen with oaks and other species, turning the area into an oak-woodland and other habitat environment.
- New housing is proposed in two locations on campus land along El Camino Real. In the south, the existing student housing and proposed child care center may expand toward El Camino Real. It is not expected that such an expansion will front directly onto the street, but that buildings will remain separated from the street

edge by a significant landscape buffer. In the north, future faculty, post-doctoral or visitor housing has been proposed just south of the Quarry Road intersection. This development will be principally located on a clearing within an existing stand of trees in this area. These trees may largely separate housing and El Camino Real or the buildings may be built up to the street at this corner.

4.2 Transportation Characteristics and Issues

To support the development of the design alternatives, the Consultant Team collected a variety of transportation data including accident history, travel speeds, and corridor signalization. Caltrans requires this data prior to approval of proposed improvements and design exceptions. This data also proved instrumental in developing alternatives. For instance, the data from the travel speed study was one impetus for the recommendation of signal re-timing and coordination. Please note that the complete existing conditions analysis is provided in the appendix of this document.

4.2.1 Accident Study

A. Vehicular Accidents

Two sources of accident were obtained for the El Camino Real Corridor. The first source of the accident data was the accident reports compiled by the City of Palo Alto Police Department. The second source was the Caltrans TASAS accident database. Each of these sources were analyzed to determine if unsafe conditions existing on the corridor. This analysis considered the following factors:

- Number of accidents by location and severity level;
- Involvement of pedestrians or bicyclists
- Corridor accident rate vs. statewide average;
- Intersection accident rate vs. statewide average;
- Accident type; and
- Accident cause.

A review of the overall accident data indicated that the overall roadway accident rate was near the statewide average for a comparable facility. However, a review of the accident occurrence at intersections throughout the corridor indicated that the following intersections had accident rates substantially above the statewide average.

- El Camino Real / Charleston / Arastradero;
- El Camino Real / Churchill Avenue;
- El Camino Real / Quarry;
- Sand Hill / Alma Street

(for location of these intersections see Figure 4.28)

During the study period, the intersections at El Camino Real / Quarry and El Camino Real / Sand Hill / Alma were under construction involving major modification/relocation of the intersecting streets, driveways and traffic signals. The higher-than-average accident rate at the location is probably attributable to those temporary conditions. A review of the data indicated a single fatality along the Corridor, which occurred at the Page Mill intersection. *(See Figures 4.29 and 4.30)*

Two of the intersections which had higher than average rates of accident occurrence also exceeded the corridor-wide average for rear end collisions and speeding accidents. These intersections are listed below:

- El Camino Real / Maybell Avenue
- El Camino Real / Curtner Avenue;
- El Camino Real / Page Mill Expressway
- El Camino Real / Churchill Avenue; and
- El Camino Real / Sand Hill / Alma Street.

Therefore, it can be concluded that speeding is a cause of accidents at various locations throughout the corridor. These locations also coincide with several areas of the corridor with the largest spacing between traffic signals, and the greatest travel speeds, as shown in the following sections of this report.

In conclusion, the overall accident rate along El Camino Real in Palo Alto is consistent with the statewide average for similar facilities. However, an in-depth analysis of the accident data revealed locations along the corridor where the accident rate exceeded the expected level. It also indicated that many of these locations had high percentages of rear-end accidents with speeding cited as a cause. Therefore, it can be inferred from the accident data that excessive travel speeds are contributing to accidents at several locations.

Figure 4.27: Location of Major Intersections

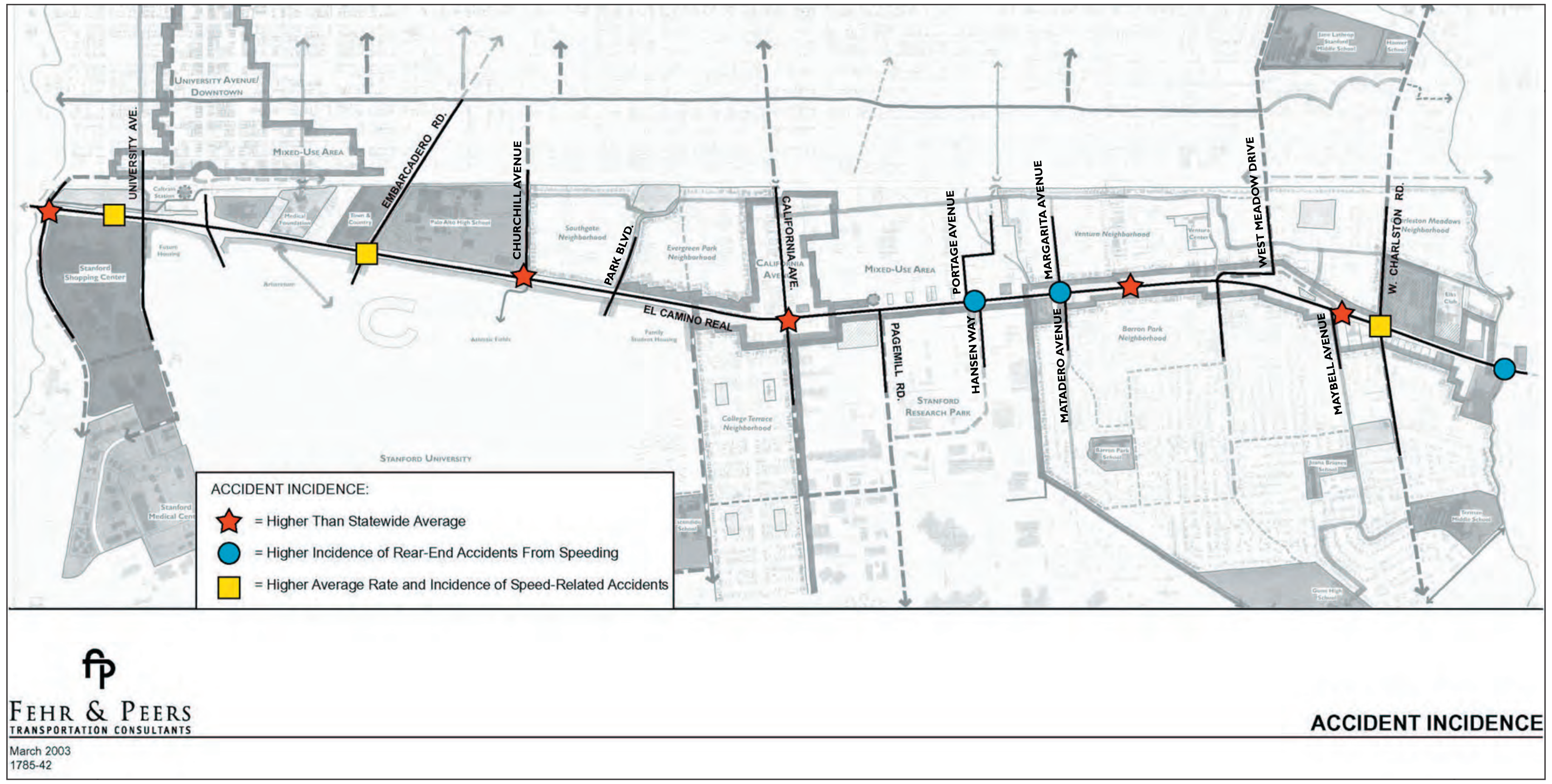

Figure 4.28: Accident Incidence for the El Camino Real Corridor

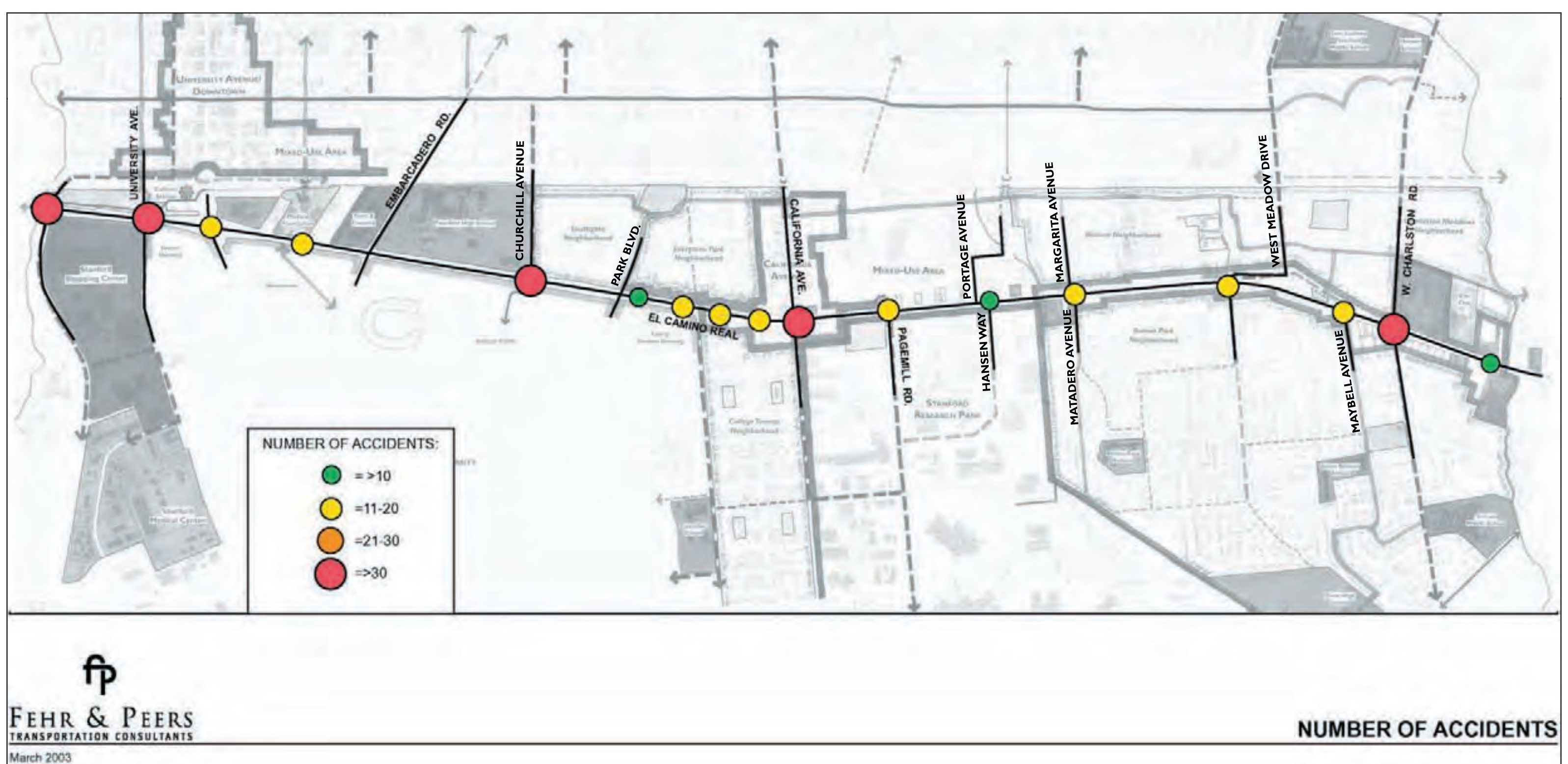

Figure 4.29: Number of Accidents throughout the El Camino Corridor

B. Bicycle and Pedestrian Accidents

The accident data also indicated the number of bicycle and pedestrian accidents in the corridor at each intersection location. There were 21 bicycle and nine pedestrian accidents in the three years covered by the analysis. Intersections with more than one bicycle or pedestrian accident included Arastadero Road, Curtner Avenue, Page Mill Road, Cambridge Avenue, University Avenue, Quarry, Alma/Sand Hill Road. There were no bicycle or pedestrian fatalities.

4.2.2 Travel Time Study

Data using global positioning (GPS) data collectors was gathered related to relative travel speeds and travel times for El Camino Real and other parallel roadways *(Figure 4.31)*.

- Middlefield
- Alma Street
- Cowper-Waverly

Figure 4.30: Global Positioning Equipment was used for the assessment of travel times.

These roadways were selected based on consultations with City of Palo Alto Staff. Travel times were collected for each of these routes during peak travel periods in May 2002. Approximately 80 travel time runs were performed on all four roadways.

Based on the collected travel times, travel speeds were computed for each of the routes. Presentation in terms of travel speeds simplifies comparisons among the alternate corridors given the differences in length for each of the routes. These travel speed comparisons indicate that Alma Street has the highest travel speed (20% to 62% faster than El Camino), which is reasonable given its lack of traffic signals and cross-streets. El Camino Real speeds are similar to speeds along Middlefield and Cowper-Waverly (generally within 1% to 17% depending on the time of day).

Average Total Travel Speed Comparison (Includes impacts of congestion and traffic signal delay)				
	AM		PM	
	Southbound	Northbound	Southbound	Northbound
Middlefield	17.61 mph		17.68 mph	17.33 mph
Alma Street	24.35 mph	26.02 mph	21.48 mph	27.24 mph
Cowper-Waverly Corridor	16.67 mph	16.44 mph	18.03 mph	18.15 mph
El Camino Real	19.44 mph	19.20 mph	17.83 mph	16.80 mph

Note: This is the average travel speed over the entire study area, which stretched from the South Palo Alto City Limit to the North Palo Alto City Limit on El Camino Real. This speed includes the impacts of congestion and delays due to traffic signals.

Source: Fehr & Peers Associates June 2002

Table 4.2: Comparison of Average Total Travel Speeds on Alternate Routes

This data was analyzed further to determine travel speed variations along the El Camino Real Corridor. The analysis considered the average number of stops, the average free flow travel speed, and the maximum speed. The overall travel speed was highest during the morning period and lowest during the PM period thereby indicating that the level of congestion was highest in the afternoon period. One example graphic is provided as Figure 4.32.

Speed profile graphs were prepared to illustrate the variations in travel speed along short segments of El Camino over the length of an entire trip. As shown in Figure 4.33, the speed profile is quite uneven with numerous high-speed peaks and numerous low-speed valleys during the peak periods. These peaks and valleys indicate that the drivers are racing from location to location and slowing down and stopping when forced by the traffic signals along the corridor.

This analysis concluded that the corridor has two separate speed related issues that required improvement. The first issue is the speeding of drivers in between signalized intersections. Vehicles regularly exceeded 40 miles per hour in the roadway between Embarcadero Road and California Avenue. The second issue is the frequent stopping required by the traffic signals at intersections. From these two issues, the Consultant team concluded that it would be appropriate to improve the signal coordination in the corridor to reduce the overall travel speed while reducing the number of abrupt stops and also reducing travel time.

4.2.3 Corridor Signalization

There are nineteen traffic signals along the El Camino Real Corridor in the City of Palo Alto. These signals are maintained by Caltrans with input from the City of Palo Alto.

The traffic signal timings have been set by Caltrans. The total cycle length varies from 60 seconds to 156 seconds. At each intersection, a majority of the green time is allocated to El Camino Real with the side street allotted a lesser amount of green time. The amount of green time for the side street varies by intersection. Each of the traffic signals also includes pedestrian phases to facilitate crossing for walkers and bicyclists when the pedestrian push button is used. The amount of time allocated for pedestrians ranges from 25 to 37 seconds.

Signal coordination allows individual signals to operate as a group. When signals are coordinated correctly, drivers who drive a steady speed are able to drive through multiple intersections without stopping. Since the initial writing of this Plan, a signal timing coordination was carried out in 2005 and will be updated in 2007. This effort is funded by through a grant from the Regional Signal Timing Program, administered by the Metropolitan Transportation Commission (MTC).

In the Menlo Park Traffic Adaptive Signal Coordination has been used to improve signal coordination along El Camino Real, and Quarry Road and Sandhill Road in Palo Alto are tied into that same system.

Prior to the improvements listed above, drivers did not drive at a consistent speed through the El Camino Real Corridor. Rather drivers driving faster than the speed limit in the segments between traffic signals in one part of the, endured constant starts and stops in other segments of the Corridor.

The location of signalized intersections are shown in Figure 4.7 on page 4.4.

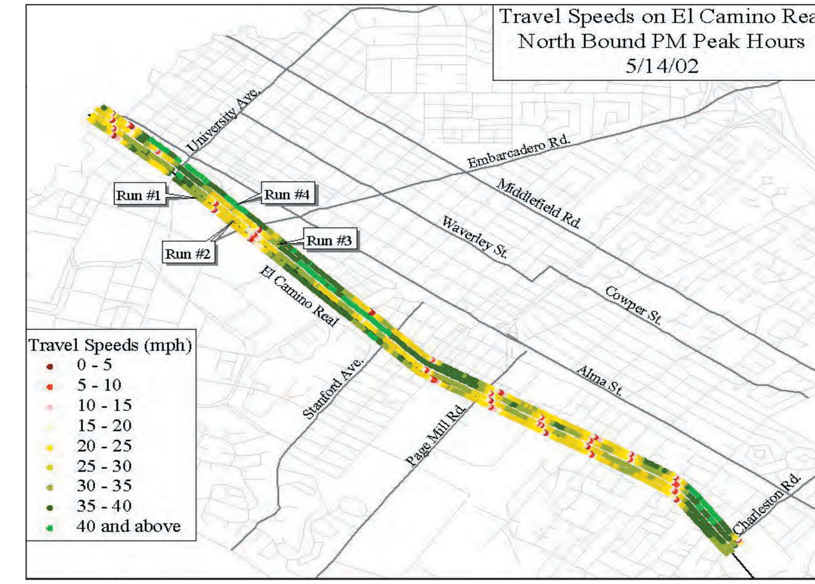

Figure 4.31: Results of one run conducted for the Travel Time Study.

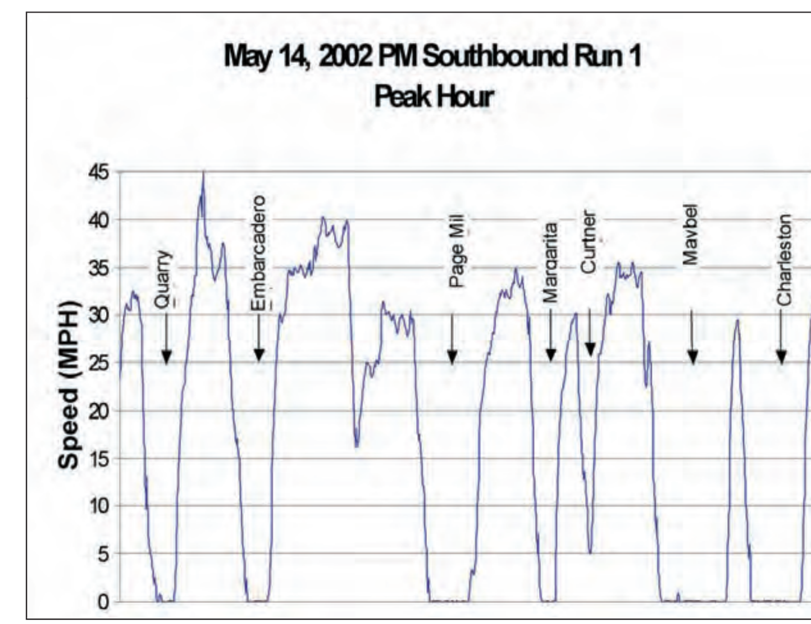

Figure 4.32: Progression in "Fits and Starts" for travel on the El Camino Corridor.

4.2.4 Pedestrian and Bicycle Facilities

A. Public Sidewalks

Sidewalk Width

A public sidewalk is located along the majority of the corridor. This sidewalk is generally 8 feet wide *(Figure 4.34)*. Locations, which do not provide sidewalks, include the Stanford University frontage between University and Stanford Avenues (southern side of the roadway) and

Figure 4.33: 8-foot Sidewalks constrict pedestrian circulation and access.

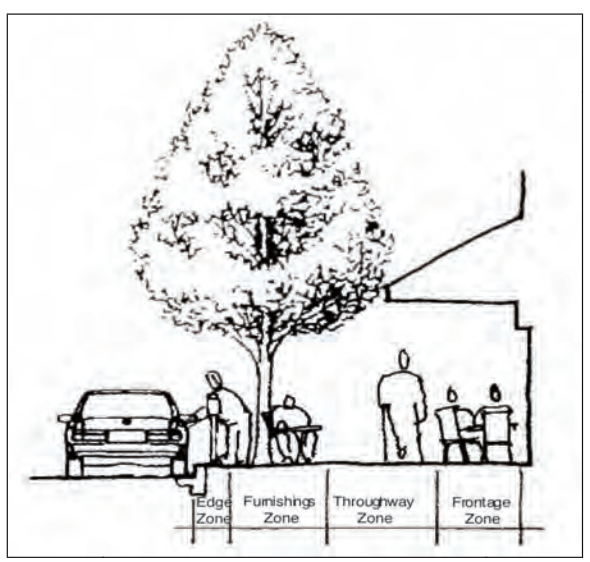

Figure 4.34: Desirable Sidewalk Zones.

the portion of El Camino between the northern and southern ramp approaches at the University Avenue overpass. Where pedestrian circulation is provided to varying degrees along the ramps, rather than under University Avenue. On the west side of the street, the southbound off ramp has a new asphalt path along the ramp while the southbound on ramp has a dirt path not a paved sidewalk. On the east side, the northbound off ramp has a concrete sidewalk running along it. Pedestrian access is not provided through the signalized intersection with University Avenue which forces pedestrians who are trying to walk along El Camino Real to jaywalk or go far out of their way. The southbound on ramp does not include pedestrian accommodation.

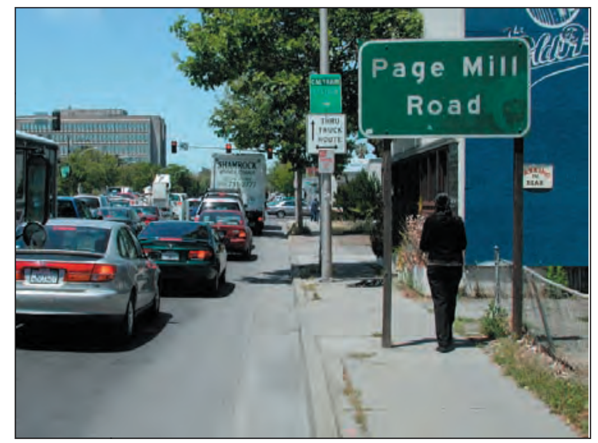

Figure 4.35: Poor Sidewalk environment north of page Mill Road (looking south).

Figure 4.36: Example of landscaping and signal equipment further constricting an already narrow sidewalk.

In order to support a higher level of pedestrian activity, the desired width for a sidewalk along El Camino Real is somewhere between 13 and 16 feet *(see Figure 4.35)*. This breaks down into several functional 'zones.' For example, a 13-foot wide sidewalk would have an *Edge Zone* of 1-foot – 6 inches to allow for the 6 inch curb, parking meters, and door swings; a 5-foot *Furnishing Zone* for street trees, lamp posts, planters, benches, trash can, bicycle racks, etc.; a 5-foot *Throughway Zone* for pedestrian movement and the desired minimum clear width for ADA access; and a 1-foot – 6 inch *Frontage Zone* which allows for building door swings, and provides an area for people to slow down and window shop.

Narrow sidewalks (8 feet), traffic noise and the proximity of automobiles, trucks and busses to sidewalks all negatively impact the pedestrian and business environment along El Camino Real *(Figure 4.36)*. The existing 8-foot wide sidewalk provides for a 6 inch curb area, a 2.5-foot combined *Edge* and *Furnishing Zone*, a 5 foot *Throughway Zone*, with no *Frontage Zone* (please refer to the *Trees in Sidewalks and Medians section* above for a description of impacts on trees that result from a tree well limited to the size of a 2.5- foot wide *Furnishing Zone*).

Encroachments

In several locations, it was observed that landscaping or buildings on properties adjoining the sidewalk encroach into the public right-of-way *(Figure 4.37)*. This typically results in the reduction of effective sidewalk width by the margin of encroachment. The City will need to address this situation when final designs for improvements are drawn up, as any future street section will make use of the entire width of the limited public right-of-way. It should be noted that several of the many signal and metering boxes (each with an approximate footprint of 1.5 to 2 feet by 2 to 3 feet) are located within the 8-foot sidewalks thus severely limiting the space available for passing pedestrians, particularly the disabled.

Curb Ramps

Curb ramps on El Camino Real are consistently provided at all marked or signalized pedestrian crossings, with the exception of the Stanford Avenue intersection where no curb ramp is provided at the northerly end of the unpaved westerly sidewalk. At intersections without crossings across El Camino Real, curb ramps are installed for the crossing of the intersecting street. All curb ramps are single ramps located at the center of the curb return, thus serving two crosswalks at once *(Figure 4.38)*. However, this diagonal arrangement has been criticized by many disabled advocates and designers as it directs the ramp user's path of travel toward the center of the intersection and requires additional maneuvering to redirect i.e. a wheelchair toward the desired of the two crosswalks. While some ramps are not compliant with the existing ADA or Title 24, new draft federal ADA guidelines currently being developed will set a new preference and standard in which two ramps are provided *(Figure 4.39)*, one each per direction of travel (across the major street and across the intersecting street). The design of the ramps will also be modified, and future improvements will need to comply with these requirements.

Figure 4.37: Example of diagonal curb ramp.

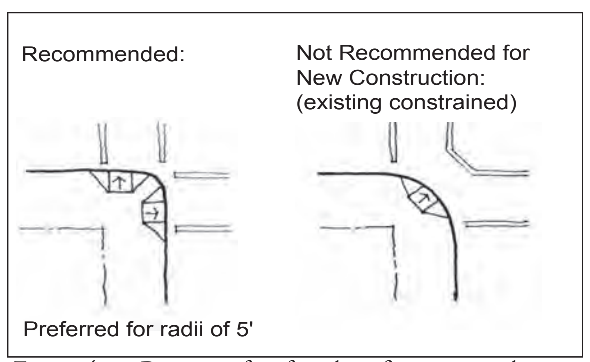

Figure 4.38: Diagram of preferred configuration with two directional ramps..

B. Bicycle Accommodation

There are no existing bicycle lanes on El Camino Real. For most sections of the corridor, the outside lane is 21 feet wide that incorporates vehicular travel, parking, and cyclists. Even though the current bicycle accommodation is minimal and no exclusive bicycle lane exists, many bicyclists have been observed traveling down El Camino Real and crossing the street at various intersections throughout the corridor. *(See Figure 4.40)*

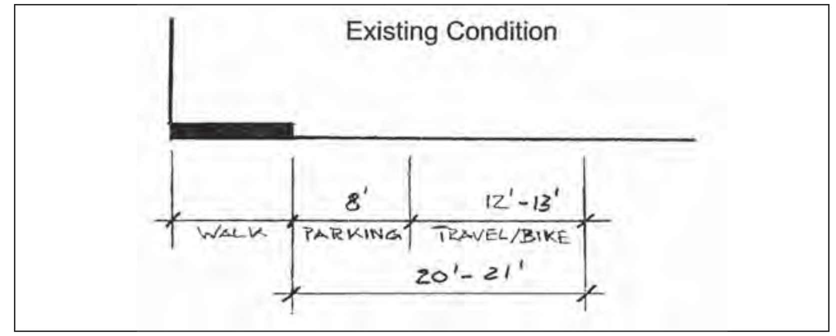

Figure 4.39: Existing Bicycle Accommodation on El Camino

C. Crosswalks and Pedestrian Crossing Times

Crosswalks at Signalized and Unsignalized Intersections

The existing pedestrian crossing distance of El Camino is 104 feet from curb to curb in most locations. Crossing distance and the frequency of crossings are key criteria in judging the safety and convenience of access for pedestrians (and bicyclists alike) along the corridor. Crosswalks and pedestrian signal equipment (push buttons) are found at each of the signalized intersections *(Figure 4.41)*. There are marked crosswalks at several of the unsignalized intersections particularly in the southern half of the corridor *(see Figure 4.7 on page 4.4)*.

Figure 4.40: Crosswalks on El Camino have an average length of 104 feet. The distance increases where crosswalks are not perpendicular to the roadway.

Between the northern city limit and Stanford Avenue all crossings are signalized, they are, however, spaced as far apart as 2,400 feet (the distance between signal at Embarcadero and Churchill Avenue). This condition is undesirable from a pedestrian circulation point of view as it can encourage jaywalking. The maximum distances between marked crosswalks should not exceed 600 feet whenever possible. In the segment just north of Quarry Road, pedestrians have been observed to jaywalk across El Camino Real from one bus stop to another, rather than walk about 200 feet further south to cross at the Quarry Road intersection. Similarly high school students were seen crossing El Camino Real between Embarcadero and Churchill where no crosswalk is provided to reach the bus stop located on the west side of El Camino Real, half way between the two intersecting streets *(Figure 4.42)*.

Figure 4.41: Sign warning against jay walking in an area along Palo Alto High School where signalized crossings are too far apart.

Signalized crossings are more closely spaced in the California Avenue area, where average distances between signals are about 350 feet, thus supporting more pedestrian-friendly conditions in this area.

The area between Hansen Way and Los Robles is characterized by the presence of a number of marked, unsignalized crosswalks, complemented by crossings located at signalized intersections. Several of the unsignalized crosswalks are located within the area between Ventura and Maybell Avenues where one of two bends of El Camino occurs in Palo Alto *(Figure 4.43)*. This raises potential safety concerns as drivers' sight lines are somewhat shortened as they approach these crossings and pedestrian also have a difficult time seeing approaching vehicles at some intersections. In addition, many of the crosswalks in this area are located at T-intersections, which provide a reduced 'set of clues' to the drivers traveling on the side of the corridor that is not intersected by the side street.

South of Los Robles, the spacing between crossings increases again and reaches up to 1,500 feet. Crossings in this area are provided only at signalized intersections.

There is a clear correlation between the presence of crosswalks and the scale of adjacent uses, as is evident in the northern and southern segments of the corridor. Overall, 67 % of all (43) intersections throughout the El Camino Real Corridor are T-intersections. Here drivers traveling on the side of the corridor that is not intersected by a side street are provided with less visual 'clues' about the presence of pedestrians in crosswalks at these intersections.

Figure 4.42: Not all crosswalks near the roadway - bend are signalized like the one at Los Robles.

Pedestrian Crossing Times

An analysis of the signalized intersections was conducted to determine whether sufficient crossing time is provided. Sufficient crossing time ensures that pedestrians who push a walk button are provided with enough time to cross the roadway. Currently, Caltrans bases the walk time on an assumed 4–feet-per-second pedestrian walking speed. Caltrans provides 3 seconds of solid "WALK" symbol on the crossing signal, before the signal begins flashing "DON'T WALK." As a comparison, the City of Palo Alto provides, wherever possible, longer crossing times, allowing a slower walking speed of 3.5 feet per second, and providing 7 seconds of solid "WALK." In general, the distance required to cross all six lanes of El Camino Real is 104 feet and medians- although equipped with push buttons- do not provide sufficient space for pedestrians to feel safe *(Figure 4.44)*.

Based on this data, it can be concluded that sufficient pedestrian crossing times are not provided at many of the intersections along the corridor *(Figure 4.45)*. Intersections such as Hansen and Portage provide only a little more than half of the Palo Alto preferred pedestrian crossing time, and intersections such as Serra, Stanford, and California provide only about 70% of the desired time based on City of Palo Alto criteria. By Caltrans criteria, three of the intersections do not provide sufficient pedestrian crossing time.

Figure 4.43: Medians like the one here at Page Mill Road do not provide a safe place for waiting pedestrians.

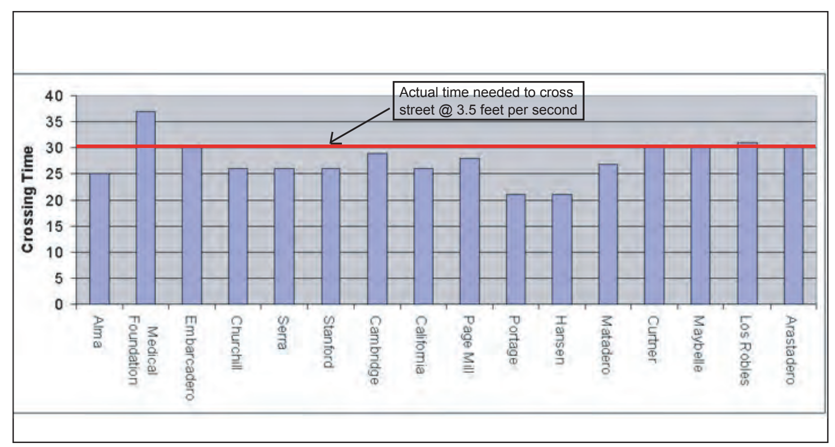

Figure 4.44: At ten crosswalks currently provided crossing times do not meet Palo Alto standards.

D. Bicycle and Pedestrian Traffic

Bicycle and pedestrian counts were taken at five intersections in the corridor, identified as among the highest-activity locations:

- El Camino Real / Serra Street;
- El Camino Real / Stanford Avenue;
- El Camino Real / California Avenue;
- El Camino Real / Arastradero Road; and
- El Camino Real / Page Mill Road.

Like the traffic counts, these bicycle and pedestrian counts were taken in April 2002 during the morning and evening peak periods (7-9 AM and 4-6 PM). These counts indicated that the overall level of bicycle and pedestrian activity was limited. However, informal counts conducted by the City indicate that 200 to 300 bicyclists travel along the street on a daily basis, and during field visits, the Consultants encountered many bicyclists riding on sidewalks to avoid the adverse bicycling conditions on the roadway *(Figure 4.46)*. The highest bicycle and pedestrian volumes occurred at the intersection of El Camino Real and California Avenue. At this location, there are nearly 100 bicyclists and 200 pedestrians using this intersection during the morning peak hour (7-9 AM) and the evening peak hour (4-6 PM). There was some bicycle and pedestrian traffic at both the Page Mill and Charleston/ Arastradero intersections with El Camino Real. Minimal bicycle and pedestrian activity was found at the remaining two intersections.

Figure 4.45: Some cyclists ride on sidewalks to feel safer.

E. Draft Bicycle Plan

The Draft Bicycle Plan proposes to establish El Camino Real as a bicycle route. Such a designation does not necessarily include the striping of a bicycle lane but acknowledges the importance of bicycling on this street and creates the basis for discussions between the City of Palo Alto and Caltrans about traffic signal-related improvements for bicycling purposes. The Draft Bicycle Plan also lays out the long-term vision for a bicycle facilities network. New bicycle paths, routes, lanes, and boulevards would complement already existing facilities in the El Camino Corridor area (*see the 'Context Map' Figure 4.1 in Chapter 4.1.1*). It is noteworthy to point out that locations in which several of the envisioned new and some of the existing network components cross El Camino Real correlate with crossings identified as important routes used by school children (and their parents) on their way to and from school (see Routes Between Neighborhoods and Schools in Chapter 3). Bicycle system's crossings include:

- Stanford Avenue (new Bike Route on east side, existing bike lane on west side);
- Matadero Avenue (new Bike Boulevard on east and west sides);
- El Camino Way/Los Robles Avenue (existing bike lane on east and west sides);
- El Camino Way/Maybell Avenue (new bicycle boulevard on east and west sides);
- West Charleston/Arastradero (existing bike lane on east and west sides).

F. School Routes

The following schools are located in proximity to the El Camino Real Corridor *(see the 'Context Map' Figure 4.1 in Chapter 4.1.1)*.

- East of the Corridor: *Palo Alto High School,* and *Jane Lathrop Stanford School;*
- West of the Corridor: *Escondido School, Barron Park School, Gunn High School, Juana Briones School,* and *Terman Middle School.*

From conversations with Palo Alto's 'Safe Routes to School' interest group it is clear that many students cross El Camino Real on foot or on bicycles in order to get to school. This is particularly important for Gunn High School, which serves all of Palo Alto and not just adjacent neighborhoods.

The following intersections have been identified as particularly important for student movements (on bicycle or on foot) across El Camino Real (from north to south):

- Stanford Avenue,
- Matadero Avenue (west),
- El Camino Way/Maybell Avenue, and
- West Charleston/Arastradero.

In addition, a mid-block location at Palo Alto High School between Embarcadero and Churchill Avenues requires attention in light of the fact that here students have frequently been observed crossing the street in absence of a marked crosswalk. Most crossings are related to the presence of a VTA bus stop and an entrance to Stanford's sports facilities located opposite from the high school.

4.2.5 Public Transit: Operations, Ridership and Future Bus Rapid Transit

A. Existing Transit

The El Camino Real corridor has extensive transit service from a variety of operators including VTA, SamTrans, and the Stanford Marguerite Shuttle.

The most comprehensive transit service is provided by VTA, which operates two bus lines along the corridor. These lines are Line 22, and Rapid bus Line 522. These lines extend through Palo Alto to San Jose. For Line 22, service begins at 5:30 AM and terminates at 2 AM on throughout the week. Buses run at 9-11 minute on the weekday peak periods and 15 minute intervals on the weekends. Headways for the other periods range from 20 to 60 minutes. Within Palo Alto, Line 22 has about 2,500 daily passenger boardings in northbound direction and an equal number of boardings for the southbound route. These total boardings represent approximately 20 percent of the total boardings for the entire line. The major boarding locations of this line through the corridor include the Palo Alto Transit Center on University Avenue near El Camino Real (1,400 total boardings) and the El Camino Real / California Avenue area (400 total boardings). The Palo Alto Transit Center has the second highest boardings of all stops.

Much of the transit on El Camino Real accesses the Palo Alto Transit Center and the Caltrain Station located on University Avenue. This station serves 3,000 passengers per day with over 700 buses stopping at this station per day from all the different transit companies (VTA, SamTrans, Marguerite).

In July 2005, VTA implemented Rapid bus 522, a precursor to BRT in the El Camino Real Corridor. Rapid 522 replaced Limited-Stop Line 300, which previously served the El Camino Real Corridor, and supplemented Line 22 providing faster, more frequent, and more direct service between Eastridge and the Palo Alto Transit Center. The service combines state-of-the-art technology and service enhancements. In comparison to the Line 300 and Line 22 schedules, travel times were reduced up to 25 percent. Bus Signal Priority, limited stops, frequent service, headway-based schedules, queue jump lanes and a new service image are key elements of the implementation.

Project features of the Rapid bus service that were implemented in July 2005 include:

Bus Signal Priority (BSP) – Provides an advantage for buses when traveling through intersections, by extending green traffic signals or reducing the red phase of traffic signals when a bus is approaching. The BSP system of 55 intersections along El Camino Real from Palo Alto to Race Street in San Jose was developed and installed by the California Department of Transportation (Caltrans) in collaboration with VTA. BSP will be installed at 30 additional intersections in San Jose in 2007.

Limited Stops – Stops (30 in each direction) are spaced approximately one-half to one-mile apart compared to stops spaced approximately a quarter-mile apart for local bus service.

Frequent Service (Weekdays and Saturdays) – Frequent service linking VTA's Eastridge, Santa Clara and Palo Alto Transit Centers and bus and light rail lines to businesses and residential areas. Initial service will operate every 15 minutes between 5 a.m. and 9 p.m. on weekdays and 6 a.m. and 8 p.m. on Saturdays. Line 522 will not operate on Sundays.

Headway-Based Schedules – Buses will serve each bus stop approximately every 15 minutes. However, unlike all other VTA Bus lines, Line 522 buses will travel as fast as traffic and signals allow, meaning buses will not sit idle at bus stops when ahead of published time-schedules.

Figure 4.46: Articulated busses like the one shown will provide faster bus service on El Camino.

Queue-Jump Lanes – Allow buses to bypass traffic at congested intersections, by making use of an exclusive right-turn lane and a "receiving" lane across the intersection. Initial queue-jump lanes are located at the Page Mill Road and Arastradero intersections in Palo Alto.

Fully Accessible – Line 522 service will be fully accessible in accordance with the Americans with Disabilities Act (ADA). The service will use a combination of low floor 40 foot and articulated coaches.

"Rapid" Branding – The new Line 522 service will be known as Rapid service. Marketing and outreach efforts will be implemented to promote the faster trip this service provides. Vehicle wraps, bus stop signage, time guides and other material will all present the new image and enhance the service delivery.

B. Future Transit

VTA is currently developing study and design efforts that will lead to implementation of a Bus Rapid Transit (BRT) program. Rapid bus Line 522 is VTA's first Rapid service and is the precursor to full BRT implementation in this corridor. VTA's vision for the Line 22 BRT Corridor is to increase capacity, reduce travel time and improve customer facilities and information services. Future improvements could include real time passenger information, station construction, dedicated bus lanes and more signal priority.

VTA stated that the agency currently neither has mid nor long-range plans for the introduction of light rail service, particularly a center-running system, on the El Camino Corridor.

4.2.6 On-Street Parking

On-street parking is a major asset for businesses along the street where off-street parking is insufficient or hard to reach. However, where on-street parking is consistently underutilized it unnecessarily adds paved surface to the streetscape. In addition, underutilized on-street parking areas present an opportunity for wider sidewalks or a better accommodation of bicyclists and landscaping.

On-street parking along El Camino Real is accommodated in the 8-foot wide portion of the 20 to 21-foot lane next to the sidewalk (the remaining 12 to 13 feet serve as travel lane and bicycle accommodation). The full width of this 20 to 21 foot wide lane is maintained even in segments of the corridor where on-street parking is not permitted. The continuous presence of this roadway element is explained by Caltrans highway design standards that require a 'shoulder' for the potential accommodation of disabled vehicles. In urban areas Caltrans accepts parking or a bicycle lane as uses within the shoulder. However, the described condition contributes to the visual perception of the roadway as overly wide, and may also be a contributing factor for speeding in these segments of the corridor (also see Travel Time Analysis above).

Between the northern city limit and Park Avenue, on-street parking is disallowed on both sides of the street, with exception of three longer segments along the Stanford Campus *(Figure 4.48)*. Actual usage of these three stretches of parking appeared intermittent and it was observed that many of the cars parked here were offered for sale, as evidenced by the many 'For Sale' signs. During evenings and on some weekends, these parking areas are more heavily used, predominantly by people accessing the recreational facilities within the Stanford Campus. The latter was particularly emphasized by residents of the Southgate neighborhood, who expressed concern about the possible removal of these parking areas and the potential for parking seekers to enter their neighborhood. However, it was pointed out by representatives of Stanford Campus that parking facilities on campus close to the recreational fields are open to the public in the evening when some of the informal, non-campus use of the fields takes place. During events at Stanford Stadium that draw large or capacity crowds, parking is typically prohibited along all of the campus frontage on El Camino including the zones where parking is allowed.
As the potential elimination of existing parking is a subject important to adjacent neighborhoods, it is recommended that a parking utilization study be conducted for this area, whose results would inform whether parking pockets or zones should be included in the final designs for this segment of El Camino.

South of Park Avenue on-street parking is generally allowed with only few exceptions. Although no parking utilization study was conducted for this project, observations throughout the corridor indicated that the utilization of available on-street parking varies widely, with heavier use concentrated in the California Avenue commercial area. As for the 'Stanford' frontage segment of El Camino, a parking utilization study should be conducted to determine which areas might be able to function without on-street parking in the future and therefore present an additional opportunity for future sidewalk widening.

Figure 4.47: On-street parking is allowed only in parts of the corridor.

5 Corridor Concept Plan & Recommended Improvements

5.1 Summary of Design Approach and Alternatives Evaluations

The Consultant Team, City staff, and the community (represented through the Advisory Committee and workshop participants, and attendants of neighborhood association meetings and public hearings) engaged in an incremental and iterative goal setting and design process. In the first part of the process, after a set of preliminary goals had been established, the Consultant Team prepared illustrations of a broad range of design alternatives for community review, intended to explore the feasibility of a broad range of potential futures for El Camino, such as the accommodation of future light rail in the Corridor. This approach also helped inform the process of potential conflicts among some of the goals, (such as the amount of right-of-way that should be made available for trees, pedestrians and bicycles), and possible means for resolving those conflicts. The approach to establishing a design concept applicable to the entire Corridor consisted of the following key steps:

- Identification of desired improvements based on the evaluation of existing deficiencies (as described in Chapter 4.2 – Transportation Issues), functional requirements (such as continued use as a truck route and major transit corridor), projected 20-year growth in Corridor usage, and on preliminary community goals;
- Preparation of a broad range of alternative, illustrative corridor concepts and cross section design alternatives;
- Evaluation of design alternatives based on feasibility relative to right-of-way constraints and Caltrans standards, effectiveness in handling traffic and multi-modal travel demand, as well as performance relative to the evolving community goals and selected tradeoffs;
- Identification of desired improvements based on final community goals (described in Chapter 3 – Project Goals and Objectives);
- Selection of two alternative corridor design concept(s) and associated cross section and intersection designs that reflect two approaches to balancing corridor operations and community goals;
- Comparative transportation and urban design analysis of selected alternatives;
- Refinement of alternative corridor design concept(s) and associated cross section and intersection designs.

Following the refinement of the alternatives, the Consultant Team worked with City Staff and the community to prepare an implementation strategy for moving the project forwards towards construction. These recommendations are described in *Chapter 7 – Implementation and Phasing*.

5.2 Design Parameters

5.2.1 The Physical Design Elements that Make the Street

A. Desired Design Elements

Through discussions with the Advisory Committee and during the first public workshop the following design elements were identified as desirable for El Camino Real:

- 2 or 3 travel lanes for each direction;
- left-turn lanes where needed and appropriate;
- sufficient traffic capacity to accommodate growth anticipated in the Comprehensive Plan without reducing El Camino's travel efficiency (travel time) relative to parallel streets
- adequate accommodation of transit vehicles (VTA and other busses) and truck traffic where these are designated to occur;
- safe bicycle accommodation throughout the Corridor either in form of a bike lane or in wider travel lane;
- on-street parking where needed for businesses along the street;
- wider sidewalks for pedestrian and business activity;
- corner curb extensions (bulb-outs) and other design features to create safer crosswalks throughout the Corridor;

- longer "WALK" times on traffic signals to meet City of Palo Alto crossing-time standards
- median refuges for slower paced pedestrians and bicyclists;
- raised medians, with trees including the narrower medians along turn lanes;
- large canopy trees, that shade the roadway, beautify the street and provide additional environmental benefits.

B. Design Standards and "Ideal Cross Section"

In a next step, each of the desired design elements was assigned a dimension based on recommendations in federal and state standards and documents describing best management practices for bicycle and pedestrian traffic, such as Caltrans' "Highway Design Manual", the AASHTO 'Green Book', the AASHTO "Guide for Development of Bicycle Facilities", other appropriate sources, and the knowledge and experience of the Consultant Team (e.g.; best practices for the planting of a healthy street trees). After assigning cross sectional dimensions to the desired design elements, they were illustrated as "Ideal Cross Section" (*see Figure 5.1*). When combined, the desired design elements add up to a total of 146 feet, 26 feet more than the available average El Camino r.o.w. of 120' (average). In light of the established existing uses along El Camino, it is unlikely that additional r.o.w. width anywhere near 26 feet can be made available consistently throughout the Corridor. Also, the use of standard elements, such as 12 foot wide lanes does not meet other goals of the project, such as encouraging motorists to drive at safe speeds and not to exceed the speed limit and reducing crossing distances for pedestrians. Therefore, it was concluded that it is not feasible to satisfy accommodation of all desired design elements to the fullest extent recommended in the above referenced standards. As a result either a lesser number of desired design elements can be accommodated or the accommodation of some of the design elements is only possible if the recommended optimum dimensions are reduced.

In other words, the "Ideal Cross Section" emphasized the need for tradeoffs and compromises relative to desired optimum championed by proponent of a given mode of transportation or particular design element. Through a facilitated process that included the illustration and exploration of different design approaches the Consultant Team and City staff supported the Advisory Committee and larger community in identifying agreeable tradeoffs and compromises. To ensure that such compromises were not contradicted by the reality of the Caltrans approval process and dimensional minimums or by City of Palo Alto standards, the Consultants and staff engaged in a continues exchange of information and discussions with these agencies (through the TAC and individual meetings with Caltrans). It should be noted that the possibility of engaging in a process of finding compromises with regard to highway design elements is a relatively novel approach and directly related to the concepts of 'Flexibility in Highway Design' and 'Context Sensitive Design', discussed in Chapter 1 of this document.

C. Achieving a Balanced Street Cross Section of Consensus Design Elements

Typically design standards are written to satisfy, and exceed by a certain margin, safety, traffic operations (vehicle size, turning radii, etc.) and other requirements. But the standards may vary depending on the given context or local conditions. The existing conditions along El Camino are a good example of how the negative impacts on the quality community and commercial environments can result from a strict application of design standards. However, the concepts of Flexible Highway Design and Context Sensitive Design recognize the opportunities for existing and negotiable (design exceptions process) flexibility already available within application and interpretation of existing design standards. The Highway Design Manual and other design standards often give ranges for dimensions of design elements. However, this flexibility cannot be fully and effected without addressing an array of potential liability and safety concerns with the approval agency (Caltrans). The quality of the community environment and community desires have not traditionally provided a basis for considering an exception to the design standards.

Based on Caltrans' willingness to engage in a discussion of process to consider the possibilities for flexibility in the application of the highway design standards to El Camino Real, Caltrans, the Consultant Team, City staff and the Advisory Committee developed the following set of design elements (and their dimensions) for the use in developing the roadway design options used in the Corridor Concept Designs that are discussed later in this Chapter. Different approaches are used in some portions of the Corridor in reaction to the particular community context and transportation function of the Corridor's segments.

A Note on the Caltrans Exception Process

Caltrans often grants 'exceptions' to their highway design standards. This allows flexibility to meet the needs of specific roadway sections. Typically, exceptions are granted where constraints, such as a limited right-of-way would not allow the width of the standards to be achieved economically. Detailed designs and a technical report are prepared as well as the exceptions 'fact sheet,' which describes the need for the exception and through the citation of examples or studies shows that the exception does not create undue safety or operations concerns.

What is important to note is that a relatively detailed level of design is required, more than could be achieved through the limited budget of this *Master Planning Study* for El Camino Real. Yet some of the design exceptions that are required for the designs proposed here are necessary in order to achieve basic goals of the project. For example, without an exception to the standard 12-foot lane width, wider sidewalks and the bicycle lane would not be possible. A break through was achieved in this study in that Caltrans agreed to consider "planning-level" exceptions that do not require a high level of site specific design. "Planning-level" exceptions allow a community to seek Caltrans approval for exceptions to design standards prior to undertaking more costly detailed design and engineering studies.

Throughout the discussion of the design elements, below, this terminology will be used: "planning-level" exceptions can be considered at a master planning level without site specific detailed designs, and "detail-level" exceptions follow the more standard exceptions process with engineering drawings and detailed studies having been prepared before the exception is granted.

Lanes and Shoulders

Travel Lanes

Existing travel lanes on El Camino are 12 feet wide, which is the general standard for highway lanes. However, in discussion with Caltrans it became clear that the agency would be willing to consider 11 foot wide travel lanes as a planning-level design exception, based on past approval of such lanes on other highway facilities (*see Figure 5.2*). When approached about the possibility of using travel lanes as narrow as 10.5 feet, Caltrans representatives indicated that this width is more of a concern. While lanes this narrow, or narrower, may exist on some State Highways such as Van Ness Avenue (Highway 101) in San Francisco a very limited right-of-way and other factors have led to that condition. An exception for 10.5-foot lanes would require a detail-level exception with thorough research and justification to prove that travel lanes of this width indeed operate at an adequate level of safety. To avoid a lengthy effort to prove the safety of 10.5 foot travel lanes, the Consultant Team, City staff and the Advisory Committee concluded to use 11 foot travel lanes for the further development of alternative designs. Future detailed design of the most constrained portions of the Corridor, such as the Page Mill intersection, may include narrower lanes and a detail-level exception process.

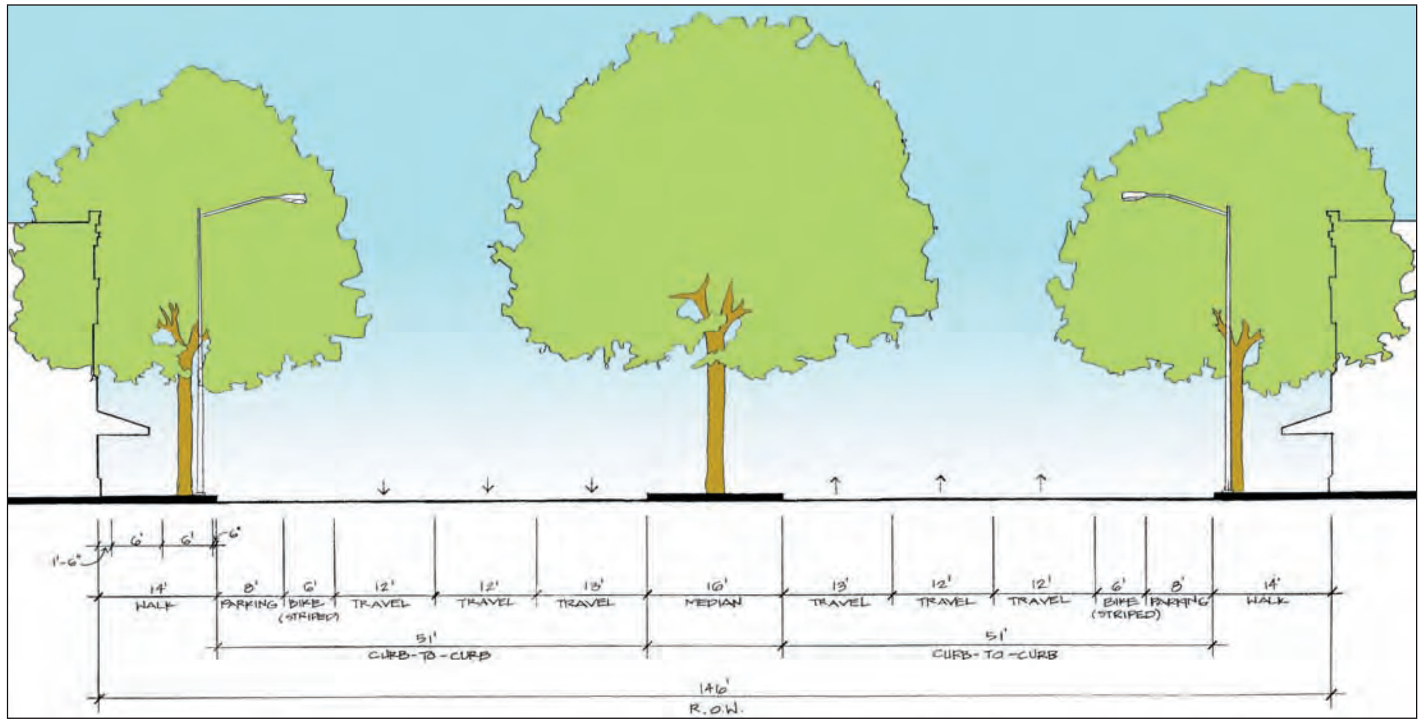

Figure 5.1: "Ideal" Cross-section

Figure 5.2: San Pablo (lanes are 11 feet)

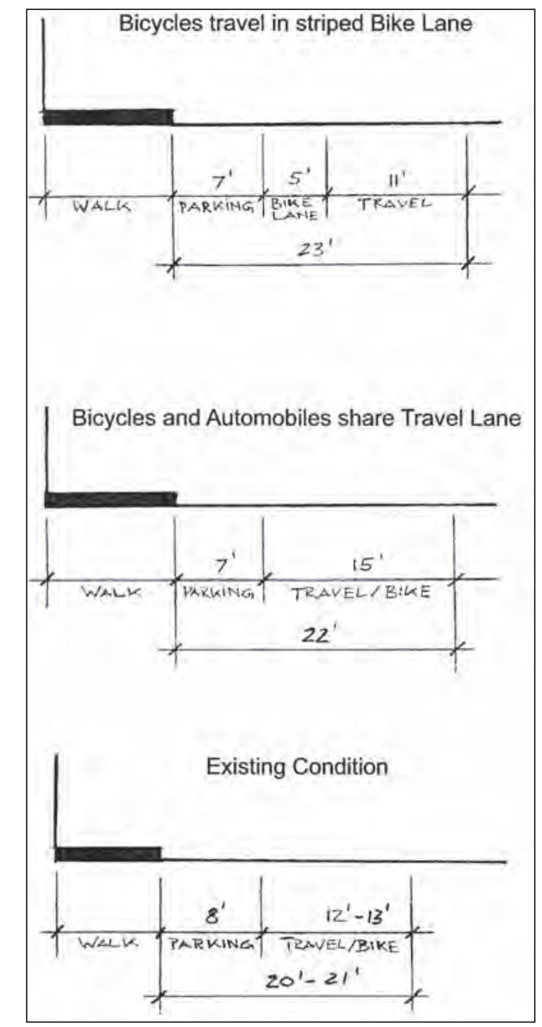

Figure 5.3: Comparison of Existing Conditions and Alternative Bicycle Accommodations

Left-Turn Lanes

Existing left-turn lanes on El Camino are typically 12 feet wide, with the exception of those at Page Mill Road and West Charleston/ Arastradero, where right-of-way constraints have caused the use of 10 foot wide turn lanes. Because of this and other precedents of 10-foot left-turn lanes, it was decided to use this dimension for the El Camino cross-section designs. Ten-foot left-turn lanes do require a Caltrans design exception, and would likely be a detail-level exception. This issue would be addressed in the design process through consideration of turning-maneuver requirements for trucks and buses on a case-by-case basis.

Right and Left Roadway Shoulders

Caltrans highway design standards typically require the presence of an 8-foot wide shoulder to the right of the outside lane (next to the sidewalk). Caltrans accepts the presence of uses such as parking and bike lanes within the shoulder space. The visual appearance of El Camino as overly wide, and the paved roadway expanse is largely related to this requirement as it stipulates that even in areas where parking is not allowed today, such as along much of the Stanford campus frontage and the frontage along Palo Alto High School, an 8-foot wide area is provided to accommodate potentially 'disabled vehicles'.

Caltrans has indicated that detail-level exceptions are conceivable that would allow the reduction of required shoulder width to 5 feet in those portions of the Corridor where only a bicycle lane, but no parking, is provided. This is based on the assumption that for the relatively short time while that a disabled vehicle would be present in this multi-lane roadway in a very urban context, bicycles and vehicles in the outside travel lane would be able to safely negotiate around the disabled car.

In the past, Caltrans has also required a left shoulder, next to the raised median. However, Caltrans representatives indicated that impending changes to the Highway Design Manual will define the left shoulder as a desired but not required roadway feature.

Bicycle Lanes

Exclusive bicycle lanes would represent an improvement over the existing conditions. Currently, bicyclists must share a 20-21 foot outside lane with moving traffic and parked cars. As illustrated in Figure 5.3 an exclusive bicycle lane is easily accommodated within the existing right-of-way. Adding a shared lane of dimensions described as desirable in the AASHTO "Guide for Development of Bicycle Facilities" for both vehicles and bicycles would require 22 feet of pavement. The introduction of an exclusive bike lane, on the other hand, would require only 23 feet of pavement, adding 2 or 3 feet to the existing 20 to 21 feet.

In some limited cases the bicycle lane will be less than 5 feet in width, in which case it will be 4.5 feet wide for lengths not much longer than 80 feet. Also, depending upon the resolution of detailed design considerations at the Page Mill intersection, the bicycle lane may be 4 or 4.5 feet wide on the west side of the street. These conditions will require a detailed-design exception from Caltrans. It should be noted that AASHTO's "Guide for the Development of Bicycle Facilities" assigns a minimum dimension of 11 feet to the combined accommodation of parking and bicycle lanes on curbed streets. As on-street parking stalls will be striped as 7 feet wide (see below), this minimum will be exceeded by at least one half foot.

The one section of El Camino that would not be able to accommodate exclusive bicycle lanes is the portion of El Camino Real that passes underneath the University Avenue Overpass. Here, bicycle lanes should be accommodated on the access ramps to University Avenue and be connected with bicycle lanes beyond the overpass (*see Chapter 5.3.5-C.*)

Parking Space Width

Although the Highway Design Manual does not give a specific number for the width of parking spaces along highways, this is typically assumed to be 8 feet, the width identical to the required right shoulder along highway facilities. Caltrans representatives have indicated that a design exception can be obtained to create 7-foot wide parking spaces as desired for this project. Such 7-foot wide parking spaces are common throughout urban areas, and therefore, do not represent a design element that has the potential to confuse drivers attempting to park their cars. All parking stalls should be striped with "T"-marks on the pavement. This will aid drivers in adhering to the allocated width of the space and help avoid encroachment of parked vehicles into the adjacent bicycle lane.

It is recommended that parallel on-street parking spaces on El Camino be striped at 22 feet length each, to make more efficient use of the available space and to correlate parking spaces and trees in sidewalks. The latter is intended to avoid conflicts between car door swings and tree trunks.

Medians with Large Trees

The planting of large canopy trees in the medians along El Camino was a community goal established even before the beginning of this Study. Current Caltrans standards allow the planting of trees in raised medians at a distance of six feet between edge of median curb and the face of the tree trunk. This condition is met by all existing standard medians, whose width ranges generally between 14 and 16 feet. Medians along left-turn lanes on El Camino are typically 4 feet wide and therefore can

Figure 5.4: San Pablo Avenue in Berkeley has a center tree lined median

not be planted with large canopy trees. It is the frequent occurrence of this type of median throughout the southern half of the Corridor that does not allow the creation of a consistent, tree-lined median.

For this reason the Cities of Palo Alto, Menlo Park, and Redwood City as well as several tree interest groups have requested that Caltrans allow exceptions to the current Caltrans design standard. Caltrans responded to the cities' interest by commissioning safety of median trees with narrow clearances on urban conventional highways. The subject of the study is of critical importance to the redesign and tree planting efforts on El Camino as medians narrower than 12 feet occur frequently particularly in the southern half of the corridor. If the planting of trees in medians of less than 12 feet remained non-permissible, the consequence would be visual discontinuity of the reduced benefit from the positive environmental effects of trees.

Although Caltrans, the three Cities, and the City's consultant, Reid Ewing, differ in their interpretations of the results provided by the study a compromise was negotiated by Assemblyman Joe Simitian and Caltrans director Jeff Morales, which provides the three cities with approval for their tree planting projects as part of a pilot project.

Standard Medians (where no left-turn lanes are present)

The standard medians for the proposed redesign varies between 16 and 22 feet in the 'Stanford' sections and between 11 and 19 feet in the 'Urban' segments, depending on the number of travel lanes that need to be accommodated (four, five, or six). Only the 11-foot wide median conflicts with Caltrans' current interpretation of the standard for tree clearances, and therefore would be part of the pilot program.

Figure 5.5: Example of a narrow, tree-lined median in Downtown Oakland

Narrow Medians at Turn Pockets

The proposed increase in width of the turn lane medians is informed by the strong desire by the community for safer pedestrian and bicycle crossings. It is accepted best practice to provide refuges for pedestrians and bicyclists who cannot cross the roadway within the length of one signal cycle, that range between a minimum of 6 feet to a desirable 8 feet or wider. There was agreement that the 8 foot width should be the standard for the redesign of crosswalks and medians, with the 6 foot refuge to be used where this is demanded by an extremely constrained right-of-way condition such as at Page Mill Road or at the West Charleston/Arastradero. The second reason for the selection of 8 foot narrow medians as the standard is the desire to plant large canopy trees in such medians in order to provide a visually continuous, tree-lined median and to maximize the other benefits from trees in urban environments. Examples of trees in narrower medians do exist on California State Highways and the Metro Regional Services regional roadway design manual "Making Livable Streets"[1] has several urban roadway design concepts, for contexts similar to El Camino Real in Palo Alto, which include 8 foot wide medians with large canopy trees. Large canopy trees in the 6- or 8-foot medians would be part of the Caltrans pilot project.

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[1] *Creating Livable Streets: Street Design Guidelines for 2040*; Metro Regional Services, Portland, Oregon; Second Edition, June, 2002; prepared by Fehr & Peers Associates and Calthorpe Associates.

Sidewalks for Pedestrians and Healthy Trees

The existing 8-foot wide sidewalks on El Camino are unacceptable by today's standards for multi-modal and pedestrian-friendly environments. Wider sidewalks are the basis for achieving improved access to transit, neighborhoods, and businesses. The different design alternatives proposed during the alternatives stage of the Study provided a range of different sidewalk widths from a minimum of 10 feet to 17 feet depending on the number of required travel lanes.

Sidewalks are typically thought of as one uniform space, but similar to the entire street right-of-way, sidewalks serve different functions and there are guidelines that recommend widths to service these different functions.[2] There are four zones that exist within the width of a sidewalk:

- The **Edge Zone** is the interface between the roadway and the sidewalk. It should range from 0.5 to 1.5 feet in width to provide for the curb and a clear area for the door swing of parked cars.
- The **Furnishing Zone** is the area that accommodates landscaping, parking meters, street furniture and combines with the edge zone to provide room for transit stops. The dimension of this zone varies depending upon the presence of parking and the speed of adjacent traffic. For a street like El Camino, in the future, with a posted speed of 30 to 35 mph where parking exists this zone should be at least 4.5 feet wide and without parking it should be 7 feet wide.
- The **Throughway Zone** is where pedestrians move along the street. For disabled access it is desired that this zone be a minimum of 5 feet wide, and in areas with more pedestrian activity it should be widened. For example four people walking next to each other should have at least an 8 foot wide zone.
- The **Frontage Zone** is the part of the sidewalk next to the property line of adjacent development. In locations where buildings come up to the street this zone should be at least 1.5 feet wide to allow some separation between walking pedestrians and the building and for window shopping. Where outdoor seating is desired this area should be at least 4 feet wide.

[2] *Planning and Designing for Pedestrians: Model Guidelines for the San Diego Region*; SANDAG – San Diego's Regional Planning Agency, June, 2002; prepared by Community Design + Architecture and W-Trans. [Note: In October 2003, CD+A completed work on a similar set of pedestrian guidelines for the Santa Clara Valley Transportation Authority (VTA), the *Pedestrian Technical Guidelines*

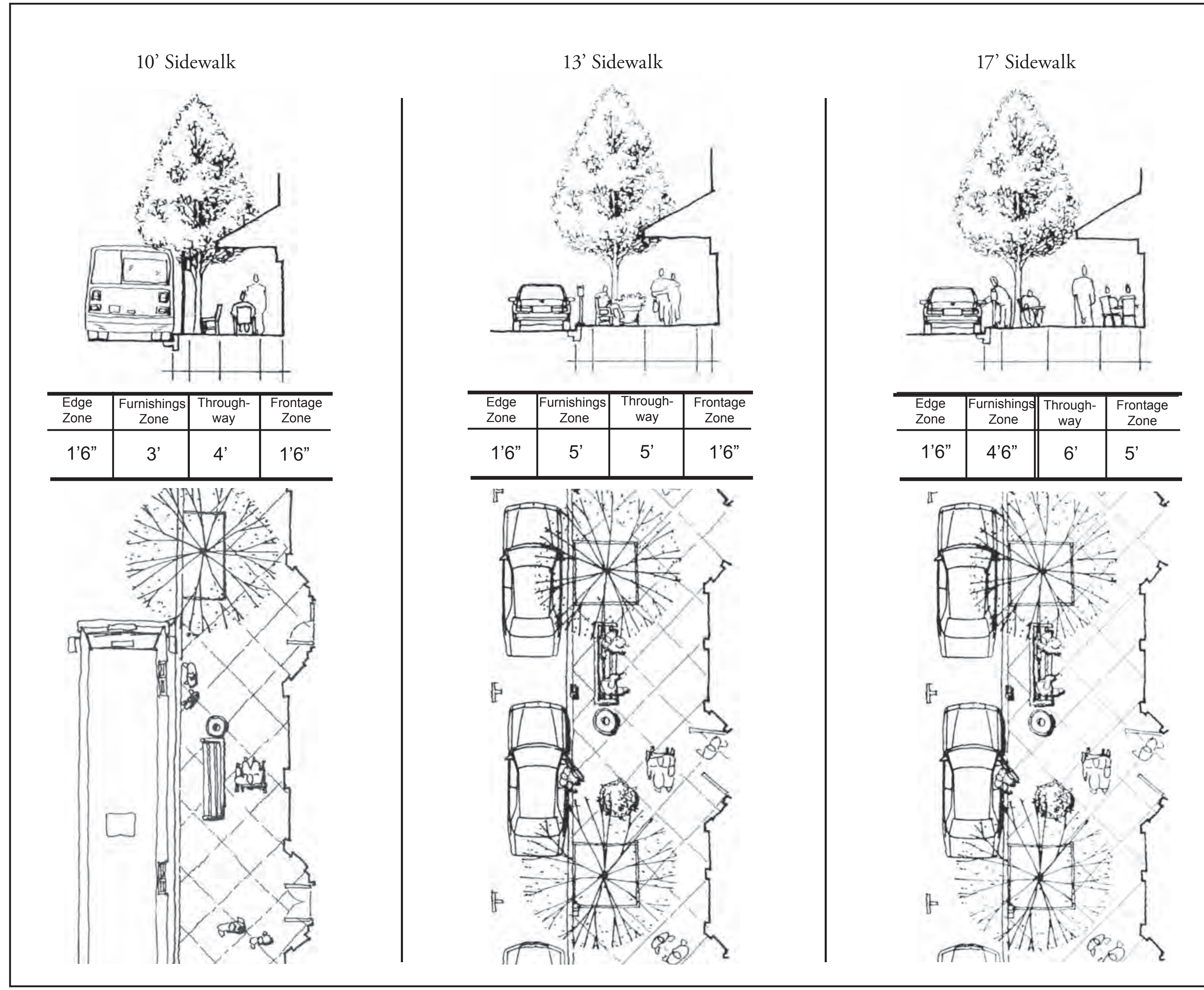


Figure 5.6: Different sidewalk widths support a different range of functions and activities. This is illustrated above for the typical sidewalk widths of 10, 13 and 17 feet proposed for El Camino Real.

Figure 5.6 illustrates how the dimensions for each of the sidewalk zones can be put together to serve a range of activities expected along the Corridor's sidewalks. It is clear that a 10-foot wide sidewalk should be considered as the absolute minimum for pedestrian access to shops, services and transit, and the overall experience of a pedestrian traveling along the street. A 13 foot width is a more desirable minimum, but it may not be available for much of the Corridor given the existing 120 foot right-of-way and the other demands on the street. However, the City of Palo Alto is currently updating its zoning ordinance, which provides for revised setback requirements along El Camino Real. If new development provided an easement of at least two to five additional feet to the sidewalk this – over time – will create the desired (minimum) 10 to 13-foot wide sidewalks in locations where new pedestrian-oriented development occurs.

Where the number of travel lanes can be reduced, sidewalk widths can be widened to 17 feet and will support increased pedestrian activity and outdoor seating for restaurants in areas such as the California Avenue segment.

In the parts of the Corridor where commercial uses do not front the street, such as the Stanford area and where residential uses come up to the street, the sidewalk area can be distributed between a 6 to 8 foot sidewalk and additional landscaping.

It should be emphasized that if large canopy trees are to succeed on El Camino these will have to be provided with adequate soil volumes for their root system to unfold and with sufficient open surface area as is necessary for oxygen to reach the roots (Trees absorb oxygen necessary for photo synthesis through their roots; *also see Chapter 5.4.2*). The above diagrams indicate minimum and desired dimensions for the Furnishing Zone in this regard. It is evident that the existing 8-foot sidewalk cannot accommodate the space needed to fulfill the important goal of growing canopy trees along the street. A 10-foot wide sidewalk begins to provide enough soil volume for the trees to grow close to the desired crown diameter of 40 feet if tree wells are 4 feet wide by 6 feet long. A 13-foot wide sidewalk allows for a 6 foot by 6 foot tree well which will better serve the health of a large tree. Wider sidewalks in some locations and the use of continuous landscape areas in the Stanford portion of the Corridor will all provide sufficient soil volumes for canopy trees to grow to near the respective species full crown diameters.

Curb Extensions/Corner Bulb-outs

Curb Extensions (a.k.a. bulb-outs) are extensions of the sidewalk into the parking lane. They are typically installed at street corners or in mid-block locations where crosswalks reach across the street. Curb extensions shorten the pedestrian crossing distance, visually narrowing

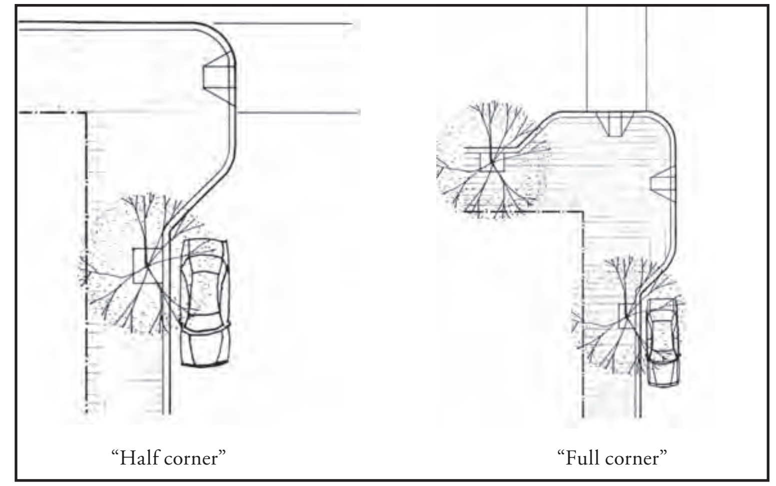


Figure 5.7: Curb extensions or bulb-outs can extend into El Camino, the side street or both.

the paved roadway and separate parking from travel lanes. Bulb-outs can be designed to either extend into the side street, the arterial (El Camino), or both (*see Figure 5.7*). It is proposed to use 6-foot wide curb extensions at all intersection along El Camino where this is feasible. In addition they should be used at the end of crosswalks at T-intersection locations opposite from the side street. The final determination of where curb extensions on El Camino and its side streets are feasible will be made during the later detailed design of specific improvements. Considerations involved in this determination include:

- Need to accommodate right turn movements out of parking lane on El Camino;
- Need to accommodate truck turning movements;
- Available pavement width for bicycles;
- Side-street width, and need to accommodate right or left-turn lanes on side street.

In most cases curb extensions would not eliminate existing parking on El Camino. There may, however, be particular cases where a longer curb extension is desirable, such as bus stop locations, and therefore eliminate a few parking spaces.

In locations where no parking is allowed either the street section should be modified to take advantage of this additional street width, or curb extensions should be used to add this area to the sidewalk width.

The proposed 6-foot curb extensions will likely not be subject to Caltrans' design exception process. While the current Highway Design Manual does not provide for curb extensions, Caltrans staff informed

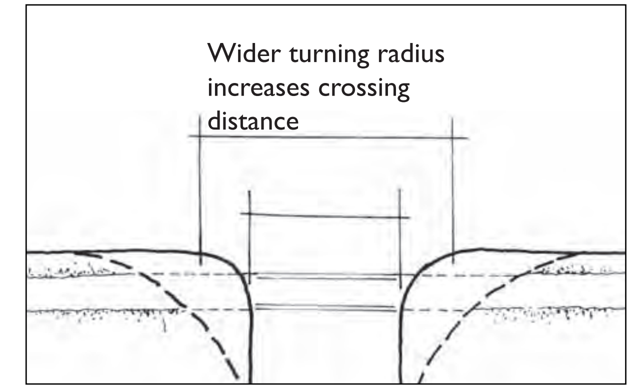


Figure 5.8: Vehicular turning radii affect pedestrian crossing-distance

the Consultant Team that they expect the update to the Manual to allow for the curb extensions being proposed in the Plan. The City of Palo Alto requires that a one-foot distance be maintained between the bicycle lanes and the face of a curb extension. This condition is satisfied by the proposed design.

Curb Radii

The radius of curbs at street intersections are important for vehicles, as well as pedestrians and bicyclists. Existing curb radii at intersections along El Camino vary widely. Many of the residential side streets (such as Leland or Sheridan Avenues) have curb radii between 8 and 12 feet. Other residential side streets, such as Margarita and Wilton Avenues, have curb radii around 18 feet. However, all major intersections have large curb radii, ranging between 45 and 125 feet (like at West Charleston). This has been standard practice over the past 40 years in order to facilitate traffic movement. While the turning movements of trucks, buses, etc. need to be taken into account they need not be universally applied along the whole length of El Camino, as the 30 foot and larger radii that result can encourage cars to take turns too quickly. Large radii can also greatly increase pedestrian crossing distances at intersections (*see Figure 5.8*). The goal for curbs along El Camino Real should be 15 to 20 feet where feasible.

As with curb extensions, decisions about curb radii will be made during the final design of the improvements. Applicable truck turning requirements will have to be taken into account in locations where truck routes intersect with El Camino. In addition, the presence of curb extensions on El Camino or the side street will inform the dimension of a given turn radius, as will the need for right turn movements out of the parking lane, at corners with no curb extensions. Caltrans will review the curb radii as part of their approvals process for detailed and final designs for future improvements.

Speed Management Elements

Design standards for many of the elements that are in a street are linked with the 'design speed' for the street. Elements that are most affected include: lane widths, lateral shifts in lanes as you move along the street, and sight distance clearances that affect tree planting near intersections. Therefore, there is a direct relationship between the goal of changing the general character of the El Camino Real into a multi-modal street and the design speed that is used to design elements of the street. Whatever the posted speed along a stretch of road may be, this speed limit will only be observed if drivers "sense" that a lower speed is appropriate for safe driving. Presently, El Camino is designed to speeds much higher than the posted speeds along the street (35/40 mph). This is evidenced by the large number of cars that drive above the speed limit throughout much of the Corridor. In the northern part of the Corridor this condition occurs even during peak traffic flows. For this reason, it is important to incorporate into the redesign of El Camino design features that will manage traffic speeds and reinforce lower speed limits on the street. On El Camino, the desirable visual and physical narrowing of the street will occur through the use of narrower travel lanes, the introduction of a bicycle lane, curb extensions and the use of large canopy street trees. These aspects of a narrowing of the street will be enhanced by occasional horizontal shifts in the roadway alignment of El Camino. Today the street is entirely straight with the exception of the road bend at Los Robles/Maybell and at Cambridge Avenue. This condition has contributed to the frequent occurrence of speeding on the street.

Particular standards apply to horizontal roadway shifts, these are addressed in the following two paragraphs. Those applicable to the other speed management features have been described elsewhere in this chapter.

Lane Transition Formula

A reduction in number of lanes (as proposed by the 6/4-Lane Hybrid Option described in this study) requires a roadway taper by the width of one travel lane, in the case of El Camino 11 feet. Between the beginning and the end of the taper vehicles have to merge from the tapering lane into the continuing lane to their left. As per Caltrans standards, the formula used for calculation of the necessary taper length (figure 5.9) should be 2/3 * WV (W=width of transition and V=design speed). For instance: at a design speed of 35 mph, the transition length for reducing the roadway width by 11 feet will be 255 feet. This formula highlights the need for lowering the design speed for El Camino, as any design speed higher than 35 mph would result in longer transitions. Such smooth transitions would not reduce travel speeds and would not help achieve a more pedestrian and bicycle-friendly environment. It should be emphasized that this Caltrans standard is based on conservative engineering standards and would make the operation of a lane reduction zone built to these specifications very safe. Examples of lane 'drops' were brought up in the community meetings by members of the public to express their concerns about the safety of lane transitions. These examples do not follow the standard cited above. For example, in Menlo Park the north bound lanes of El Camino Real reduce from three to two at the intersection with Ravenswood Avenue by 'dropping' a lane from one side of the intersection to another. This can 'trap' a car in a forced right turn lane and not allow the car to safely continue to move north along El Camino Real. This type of configuration is not being proposed in the Master Plan.

Horizontal Alignment Formula

Lane reductions are addressed with conservative standards because they involve merging maneuvers. This is not the case where a lane is added or where lanes just shift horizontal alignment within the roadway. Caltrans representatives have indicated that less conservative engineering formulas can be applied to non-merge lane realignments . It is therefore proposed to use WV2 / 150 as the formula to calculate the length needed for horizontal lane shifts, such as needed to shift lanes away from the center median to accommodate a left turn lane (*see Chapter 5.3.3-A. Urban 6-Lane at turn Lane*). For example: a horizontal shift by 8 feet would occur over a distance of 48 feet at 30 mph, but would require an increase to 65 feet at 35 mph - a 35% increase in distance for a 15% increase in speed.

The occurrence of this type of lane shift in locations throughout the Corridor will contribute to a driving environment that is less conducive to speeding and therefore help to even out travel speeds throughout the corridor, particularly if combined the visual and physical narrowing of the roadway described above. This will improve auto safety as an accident between two vehicles driving at the proposed speed limits is less sever than an accident between two speeding vehicles; and similarly it will make El Camino safer for pedestrians and bicyclists.

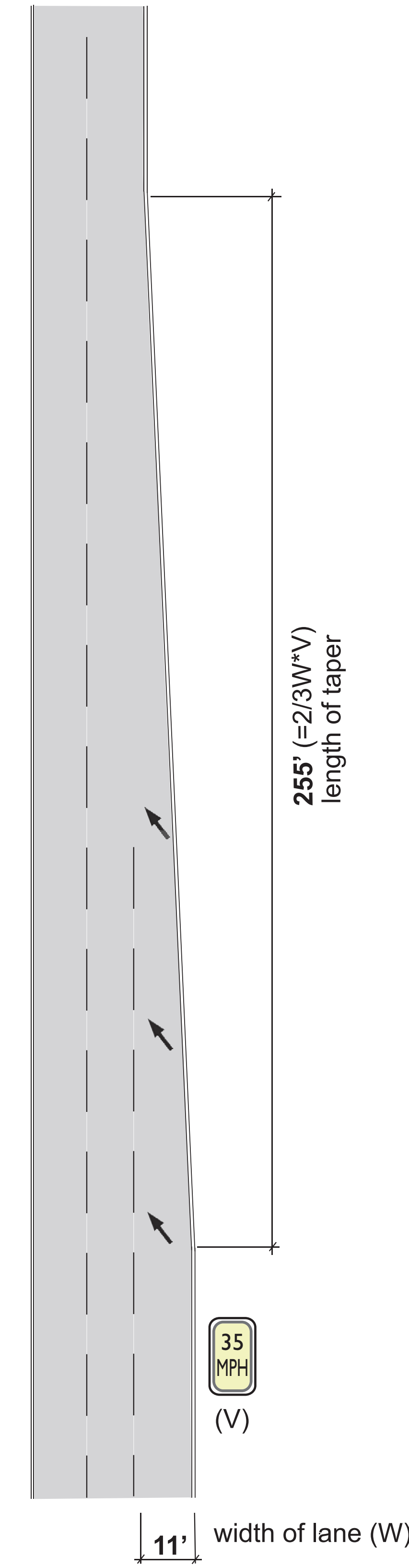


Figure 5.9: The formula 2/3W*V is used by Caltrans to determine the distance necessary safely taper a lane.

5.2.2 Transportation System Elements and General Recommendations for their Improvement

A. Travel Time Analysis and Evaluation of Schematic Corridor Options

Fehr & Peers Associates (FPA) prepared an extensive transportation analysis related to the future conditions under a variety of schematic corridor options and build-out scenarios. For study purposes, the options examined included the possible reduction of the number of lanes from six to four throughout the entire Corridor. This analysis included:

- Development of "CORSIM" traffic flow simulation model for the Corridor and validation with respect to measured traffic volumes, speeds and congestion along El Camino;
- Preparation of 20-year traffic forecasts consistent with historic traffic trends and growth anticipated in the Palo Alto Comprehensive Plan;
- Simulation and evaluation of future segment and intersection operations along the Corridor; and,
- Development of future speed and travel- time estimates for the Corridor for alternative design concepts

Based on this traffic analysis, the Consultant Team developed concepts that met the urban design concerns while retaining corridor operations.

Over the period from 1992 to 2002, El Camino Real experienced an average traffic growth (combining accelerated growth periods with more static or stable periods) of between 1 and 1.5 percent per year. Extending this trend over the next twenty years, the projected growth in Corridor traffic is expected to be nearly 25%. The historic and future corridor growth is shown in Figure 5.10. For comparison purposes, this growth rate was compared to the future growth rate shown in Palo Alto's Comprehensive Plan. The growth rate shown in the Comprehensive Plan for various intersections along El Camino average 1 to 1.5 percent. Therefore, this historical growth rate is consistent with the growth rate shown in the Comprehensive Plan.

To analyze the intersection operation and travel times, FPA built a CORSIM model to replicate existing morning and evening peak hour traffic conditions in the Corridor and analyze the effects of projected traffic growth on future operations. CORSIM is a tool developed by

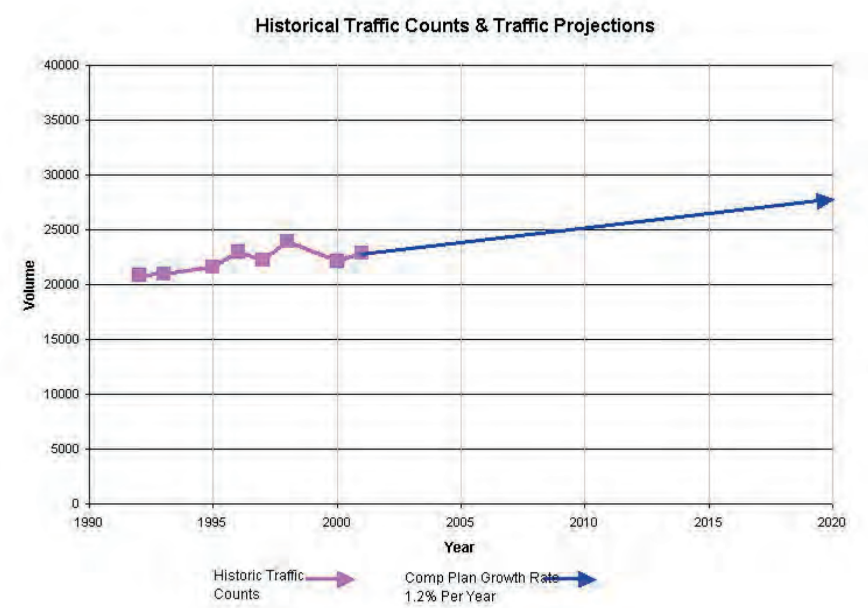


Figure 5.10: Historic traffic counts and traffic projections

Federal Highways Administration for microscopic traffic simulation of individual surface streets and integrated networks such as the El Camino Real Corridor. CORSIM simulates traffic and traffic control systems using commonly accepted vehicle and driver behavior models, accounting for the following effects:

- Platooning (groups of cars)
- Signal coordination (traffic signals working as a single unit)
- Spillback (queuing from one intersection affecting another)

The CORSIM network included the entire project study area from north of the Alma / Sand Hill Road intersection to City boundary south of the Arastadero / West Charleston Road intersection. An example of the CORSIM network is shown below for the El Camino Real / Page Mill Road intersection.

FPA analyzed each intersection in the Corridor based on the CORSIM results by determining the future level of service (LOS). This future condition accounts for the project growth in the corridor over the next 20 years. LOS is a method of measuring the operation of an intersection based on delay experienced by a driver. LOS A indicates little or no delay while LOS F indicates significant delay. LOS A through D is the generally considered acceptable LOS for El Camino Real according to the City of Palo Alto. According to the CORSIM model, if the entire corridor were reduced to four lanes, two of the study area intersections would operate at worse levels than LOS D. These intersections were

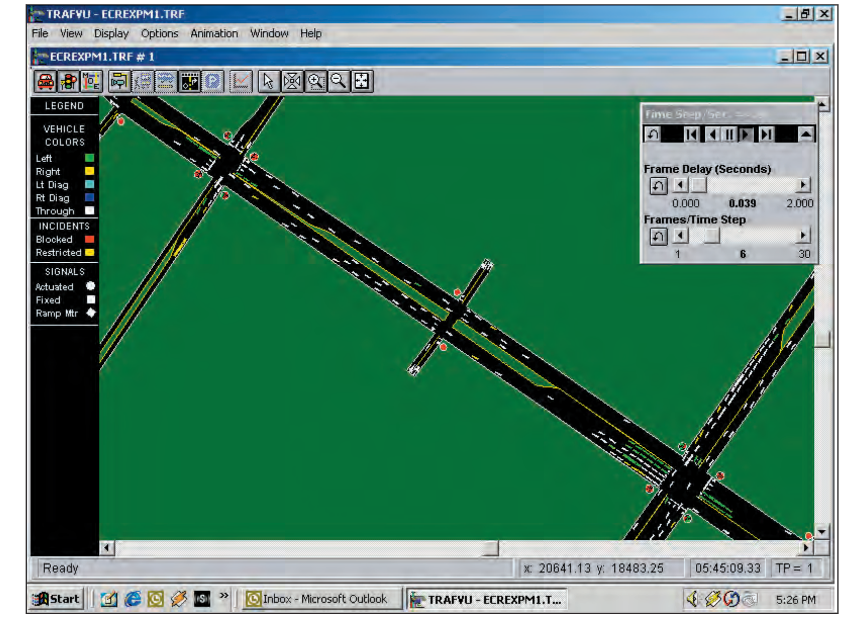


Figure 5.11: Sample "screen shot" of CORSIM model

the Page Mill Road (LOS E) and the Embarcadero Road (LOS F). Other intersections which would experience congestion include Alma Road / Sand Hill Road and Arastadero Road / Charleston Road. Even with a reduction to four lanes throughout the corridor, the remaining intersections would operate at LOS C or better.

The LOS analysis was supplemented by an analysis of Corridor travel times. As stated previously, the existing conditions CORSIM model replicated the existing travel times that were based on numerous peak period travel time runs for El Camino. The existing travel time analysis is discussed in further detail in Chapter 4. The existing time required to traverse the Corridor in a car is approximately 12 minutes (northbound and southbound) during the evening peak hour. With the additional growth in traffic that would occur over the next twenty years, the travel time would increase by 15 to 20 percent prior to any changes to the design or signal operations along El Camino Real.

Based on the LOS and the travel time analysis, FPA reached two conclusions:

- Capacity must be maintained at major intersections for queuing and storage. This storage requirement averaged approximately 600 feet at all of the major intersections. This storage is needed intermittently during the peak morning and evening periods as delays occur at the intersections. The four major intersections are Alma / Sand Hill Road, Embarcadero, Page Mill Road, and Charleston / Arastadero ; and

- Changes can be made at other intersections given that this would not significantly impede travel through the Corridor. Changes made at these intersections, along with signal timing and coordination adjustments, could be used to meter traffic flow along El Camino distributing delays more evenly, reducing stopping-and-starting, and controlling queue lengths and delays at the most critical intersections.

Based on these conclusions, several potential alternatives were excluded. The first alternative excluded would be a uniform lane reduction from six lanes to four lanes throughout the entire Corridor. This reduction would reduce capacity at the major intersections and therefore would not be acceptable. The second potential alternative that was excluded would be options with Light Rail in the El Camino right-of-way. Potential Light Rail alternatives would require a dedicated right-of-way that would entail the removal of turn lanes at major intersections. Removing turn lanes at intersections such as Page Mill Road and West Charleston/Arastradero would reduce capacity to an unacceptable level, and the alternative of grade-separating the turn movements and the light rail is cost prohibitive. Therefore, light rail alternatives were excluded from further consideration.

Other transit improvements such as regular bus and BRT do not require a dedicated right-of-way and are easily accommodated within any potential alternatives; these alternatives are discussed below.

B. Signal Timing & Coordination

Caltrans' ongoing signal update and interconnection program is attempting to establish a corridor-wide improvement to the signal timing and coordination along El Camino Real in Palo Alto. Following are Fehr & Peers' recommendations for addressing signal timing and coordination in the Corridor. These recommendations are reflective of conditions encountered during the analysis of existing conditions in 2001.

It is recommended to conduct a comprehensive signal re-timing and coordination study for the El Camino Real Corridor. This analysis will serve the following purposes:

- Revise pedestrian phases to ensure that walkers and bicyclists have sufficient time to cross El Camino Real;
- Revise signal timings for each movement to account for recent changes in traffic volumes and traffic patterns;
- Better coordinate signals to facilitate movement of traffic throughout the Corridor and improve traffic operations.

According to the analysis of existing signal timings, ten of the existing intersections do not provide sufficient time for a pedestrian to cross El Camino by City of Palo Alto Standards. These standards assume a walking speed of 3.5 feet per second for a pedestrian with a 7 second "Walk" interval. For this reason it is recommended to analyze how the signal re-timing can increase the amount of "Walk" time that is provided to pedestrians to El Camino Real.

Simultaneously, the signal timings at each of the intersections would be studied and modified to obtain optimal intersection performance. This comprehensive review is warranted for a variety of reasons

First, many of the existing signal timings are at least several years old. Given the changes in traffic conditions that have occurred over the past several years as traffic volumes have ebbed and flowed, a comprehensive analysis is certainly warranted. Secondly, there is a history of piecemeal signal timing changes in the corridor, such as the addition of an exclusive southbound right turn lane at Page Mill Road led to a re-timing of the intersection. However, the adjacent intersections, such as California Avenue, that would be effected by this improvement were not re-timed.

Fehr & Peers also recommends that the signal coordination study suggested above involve Menlo Park, VTA, and Caltrans. Menlo Park has recently installed an adaptive signal coordination system along El Camino Real in Menlo Park. VTA is planning on modifying the existing traffic signals to facilitate more efficient movement of buses and BRT by introducing the capability of signal pre-emption. Caltrans participation is required given that the signals are under its jurisdiction.

C. Frequency of Pedestrian Crossings

Parts of the El Camino Corridor are characterized by long distances between signalized and/or marked crosswalks (see Chapter 4: *Summary of Existing Conditions Assessment*). Based on the goal to transform El Camino into a multi-modal street with a safe pedestrian environment it is therefore recommended to add pedestrian crossings in some locations.

First, signalized intersections should typically provide two crosswalks across El Camino. It is therefore recommended to explore the installation of additional crosswalks at the following intersections:

- Churchill Avenue (north side);
- Curtner Avenue; and,
- Dinah's Court.

The additional crosswalks should be installed as part of the overall corridor improvements and according to the typical crosswalk design suggested in this document. This should also occur at the new Ventura Avenue signal location that has already been approved by Caltrans. Additional signal locations, particularly in the area between Hansen Way and Los Robles should be considered if this is warranted by increases in future pedestrian volumes.

Second, all marked crosswalks at unsignalized locations should be maintained and be upgraded to include the following features:

- The width of crosswalks should be a minimum of 12 feet.
- Special crosswalk markings like those in Figure 5.12 should be used in order to increase the visibility of the crosswalk on uncontrolled approaches to unsignalized intersections. Markings should be of 70% color contrast from the adjoining walking surface to meet ADA standards.
- Directional curb ramps compliant with ADA standards.

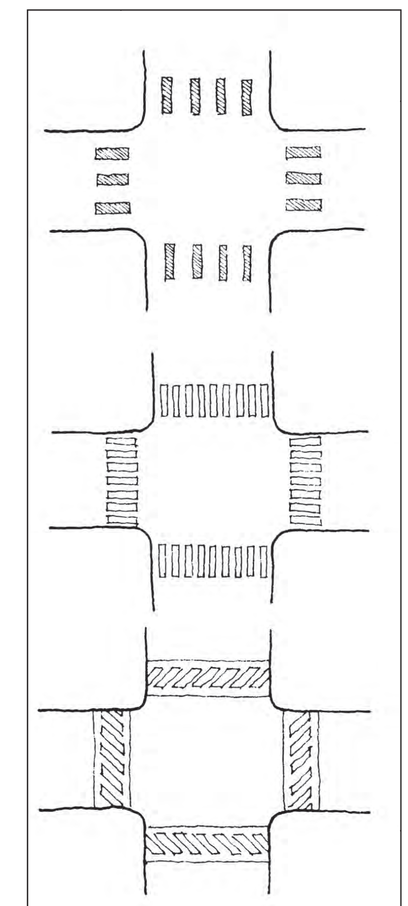


Figure 5.12: Possible crosswalk markings for unsignalized, marked crosswalks

It is recommended that crosswalks at signalized intersections with high existing or future pedestrian volumes, such as the one at California Avenue, be emphasized by use of a special pavement treatment. Such treatment could include the use of concrete instead of asphalt or colored concrete pavers. For a full description and discussion of proposed crosswalk designs at signalized intersections see Chapter 5.3.4.

In addition, strong consideration should be given to working with Caltrans on getting approval for a signalized mid-block crosswalk between Churchill Avenue and Embarcadero Road (*see Section 5.3.4-B.*).

D. Reduction of Speed Limit and Speed Management

Until new/modified design features are implemented to reinforce lower travel speeds, FPA recommends that existing posted speed limits on El Camino Real be maintained. However, the initial signal re-timing effort should explore the possibility of setting the signal coordination speed at 5 mph below the posted speed throughout the corridor. In conjunction with this signal re-timing the City could consider installing progression speed signs ("Signals Timed for 35 MPH") throughout the Corridor to inform motorists of the change and the advantage of traveling the speed limit.

Speed limit signs should be changed only when the full set of geometric design changes are in place to physically manage traffic speeds on a segment of El Camino (either with temporary or permanent measures). Design features that would manage traffic speeds and reinforce lower speed limits on El Camino Real would include travel-lane horizontal alignment changes, visual narrowing of the travel way through adding bicycle lanes, reducing lane widths, additional landscaping, more frequent and more pronounced pedestrian crossing treatments, and other physical changes engineered to produce a tangible reduction in speeds on El Camino. Posting of lower speed limits is appropriate and needed to "inform" drivers about the proper safe speed for a redesigned roadway, that includes the above design features.

To further reinforce the new design speed, FPA recommends that the signal coordination be modified at the same time to promote a "progression speed" of 30 to 35 mph. Signal coordination can reinforce established design speeds and posted speeds, although under the conditions prevailing in the El Camino corridor (relatively large spacing between signals, multi-phase signal operations) coordination alone cannot unilaterally control speeds. FPA recommends that the signal coordination be set at 30 mph in the 'Urban' segments of the Corridor and 35 mph in the 'Stanford' segments to complement the design speed and posted speed changes, and to achieve the congestion reducing benefits of uniform compact traffic flow as predicted in this study. Signs could be posted stating the progression speed (e.g. "Signals Timed for 30 MPH"). Vehicles that traveled at the progression speed would gain the most benefit from the signal coordination and would incur fewer stops than a driver who exceeded that speed.

Following the construction of improvements, posted speed limits should initially be set either equal to the new design speed (35 mph) or five miles per hour lower (30 mph) as described above. After a few months during which drivers can adjust to the new conditions on the street and adjust to the new posted speed limits, an official speed survey should be conducted to verify driver response to the changes in design speed, posted speed, and progression speed. After review of the results of the speed study, the City could finalize its decisions on whether to use radar to enforce speeds of either 30 or 35 mph.

Any increase in travel time between intersections resulting from the reduction design speed and coordination speed would be offset by improvements in individual intersection operation and corridor-wide signal coordination. These improvements should "even out" the speed of vehicles in the Corridor, reducing speeding between intersections and reducing the number of abrupt stops at traffic signals. As a result, drivers should find the experience of driving on El Camino less frustrating.

E. Bicycle Traffic

The City of Palo Alto Bicycle Plan adopted in 2003 identifies El Camino Real as a bicycle route. This recognizes its importance as one of the few continuous north-south bicycle connections through Palo Alto. In light of the frequency at which bicyclist have been encountered on the street (and on its sidewalks) and out of safety considerations, the Consultant Team recommends going beyond the suggestions of the bicycle plan and create exclusive bicycle lanes throughout the Corridor. In addition, the striped bicycle lane will help to visually narrow the street and encourage slower, safer vehicle driving.

F. Transit

The proposed Corridor design alternatives are intended to support and promote transit use throughout the Corridor. Much of this support and promotion occurs through improving the pedestrian environment, which in turn should encourage transit use.

Figure 5.13: The proposed bulb-outs would increase the amount of space available for bus stop improvements and passenger boarding.

One of the major corridor improvements that will promote transit use, is the proposed widening of sidewalks. The existing 8-foot sidewalks provide only the ADA minimum for clear zones required at bus door locations within bus stops. Wider sidewalks and the introduction of curb extensions will create larger station waiting areas and allow for future station upgrades when this portion of the intended BRT service is implemented. Wider sidewalks will also make it safer and more comfortable to walk to and from transit stations that are located on or near El Camino Real *(see Figure 5.13)*.

The results from the ongoing signal re-timing and coordination efforts will also improve transit operations in the Corridor . In addition, VTA has installed initial queue-jump lanes at the Page Mill Road and Arastradero intersections. A bus signal priority system comprising 55 intersections along El Camino (including those in Palo Alto) was developed and installed by the California Department of Transportation (Caltrans) in collaboration with VTA. As part of transit signal priority, slight changes are made to the signal timing and operations when transit vehicles are present. The effect of these changes is a reduced delay and travel time for transit vehicles with little or no increase in travel time for automobiles.

5.3 Corridor Concept Design Options

The corridor concept plans and cross section described in the following sections are the result of a series of preliminary concept plans and slight variations in cross sections discussed and in many cases debated by the Advisory Committee, the TAC and the general public; and at key points the concepts were reviewed with Caltrans. Concept plans and cross sections underwent an iterative and increasingly detailed process of development and refinement. Throughout this process, Fehr and Peers Associates subjected preliminary versions of concept plans to traffic flow Level of Service tests in the CORSIM model, a step that strongly informed the development of the final design options.

The corridor concept drawings presented in this section illustrate the extent of 4-, 5-, and 6-Lane segments proposed with each option. They also show approximately where lane drops and additions would occur as well as locations of important crossings along the Corridor.

Three general notes on how to read the cross section drawings on the following pages:

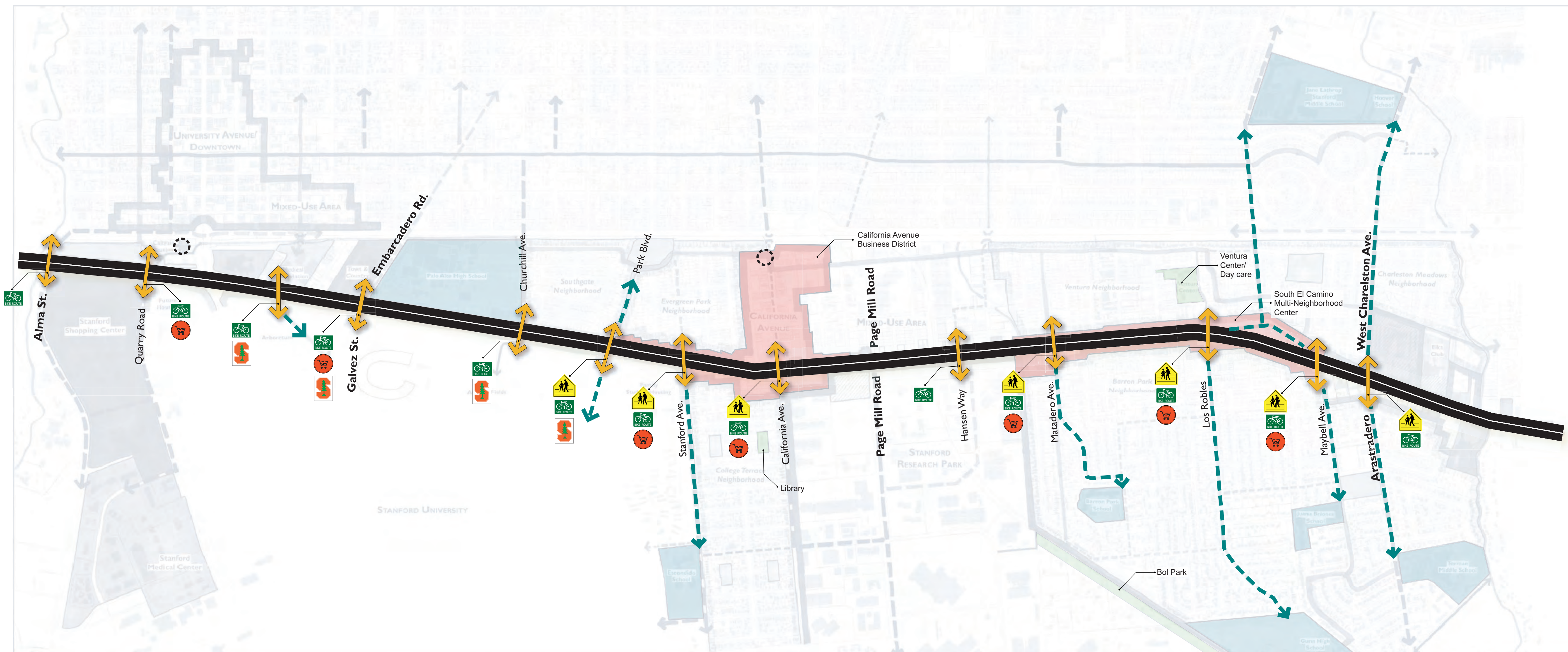
- Caltrans standards define all roadway design elements using the metric system. However, to allow for a more intuitive understanding of the proposed cross sections, the metric dimensions were translated back into dimensions of feet and inches. This was done by using the same methods of rounding as used by Caltrans. This typically results in sum totals of feet per cross section slightly exceeding the total right-of-way width of 120 feet. However, the metric equivalents add up to the actual metric total of right-of-way width.

- Dimensions shown in '*italics*' represent reductions in width of the design element as compared to the existing condition. Dimensions in '**bold**' indicate design elements whose width was increased in comparison to the existing conditions. 'No change' is expressed by regular type. Dimensions of turn lanes and narrow medians at intersections are indicated above the dimensions for the standard median at mid-block.

- The cross sections described below are differentiated by using '**Stanford**' and '**Urban**' as designations for their area of applicability within the Corridor. 'Stanford' is defined as the area between the northern city limit and Stanford Avenue. 'Urban' is defined as the area between Stanford Avenue and the southern city limit.

5.3.1 Six-Lane Throughout Option

The 6-Lane Throughout Option (*Figure 5.14*) represents the most conservative approach to the redefinition of El Camino Real in Palo Alto. In this option, the current configuration of El Camino with three travel lanes in each direction is fully maintained. However, the redesigned cross sections for this option do provide an increased sidewalk width (10 feet), the introduction of a 5-foot bicycle lane, and a basic set of crosswalk improvements, such as 8-foot wide median refuges and curb extensions to reduce the crossing distance. This approach limits the extent to which some of the multi-modal and other goals can be accommodated. Many of the desired design elements are included at the minimum of their dimensional ranges.



Street Concept Plan: 6-Lane Option

- 6-Lane Roadway*
- Major Commercial Activity Area
- Schools
- Caltrain Station
- Key Crossing Location
- Key Commercial Area Crossing
- Key School and Pedestrian Crossing
- Key Bicycle Crossing
- Key Crossing into Stanford Campus
- Key School Route

* Black bar represents roadway width; White line represents road centerline location.

N

Not to Scale

EL CAMINO REAL MASTER SCHEMATIC DESIGN PLAN

A JOINT PROJECT OF THE CITY OF PALO ALTO & CALTRANS

CONSULTANT TEAM: Community Design + Architecture • Fehr & Peers Associates • Reid Ewing • Joe Mc Bride • LCC, Inc. • Urban Advantage

Figure 5.14: Corridor Concept Plan: 6-lane Throughout Option

A. Typical Sections

‘Stanford’ 6-Lane

Figure 5.15 illustrates the typical 6-lane cross section for the ‘Stanford’ area. The cross section reflects the character of the adjacent uses and landscape. Trees are accommodated in planting strips and planted in a more informal arrangement (*also see Chapter 5.4*). Within the 16-foot median trees should be planted in a staggered and clustered arrangement rather than in straight rows (except for trees in narrow medians). Sidewalks of 6-foot width provide adequate pedestrian access. A 2-foot planting area along the frontage of Stanford Campus provides space for the existing roses planted in front of the fence to be maintained.

‘Urban’ 6-Lane

Figure 5.16 illustrates the typical 6-lane cross section for the ‘Urban’ portion of the Corridor. This cross section is characterized by many design elements being accommodated at the minimum end of their range. The 10-foot sidewalks provide minimum accommodations for trees (4 feet), the ‘Through Zone’ (4 feet) and ‘shy’ distance from adjacent buildings (1.5 feet), and the standard medians are 11 feet wide which are less than the current Caltrans standard of 12 feet, but are allowed by the special pilot program that has been established by the Director of Caltrans. Accommodation of needed parking at turn-lane locations requires specific design solutions (*see Chapter 5.3.3-A.*).

Please reference Figures A and B for the existing cross-sections in these areas.

In locations where urban uses front onto only one side of the street, like between Park Avenue and Stanford Avenue, one side of the street should be configured as described in the ‘Urban’ 6-Lane cross section, the other side as per ‘Stanford’ 6-Lane.

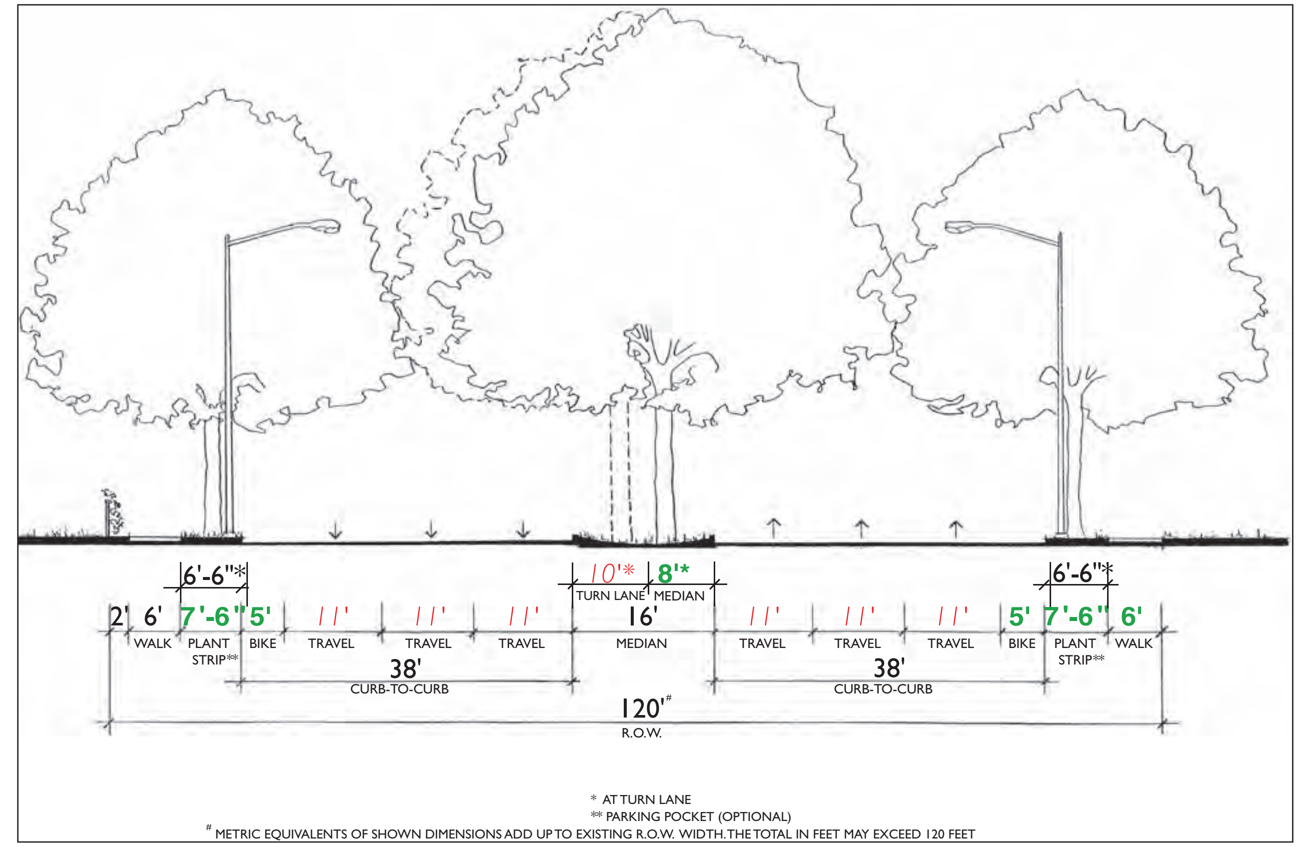


Figure 5.15: Typical ‘Stanford’ 6-lane cross-section

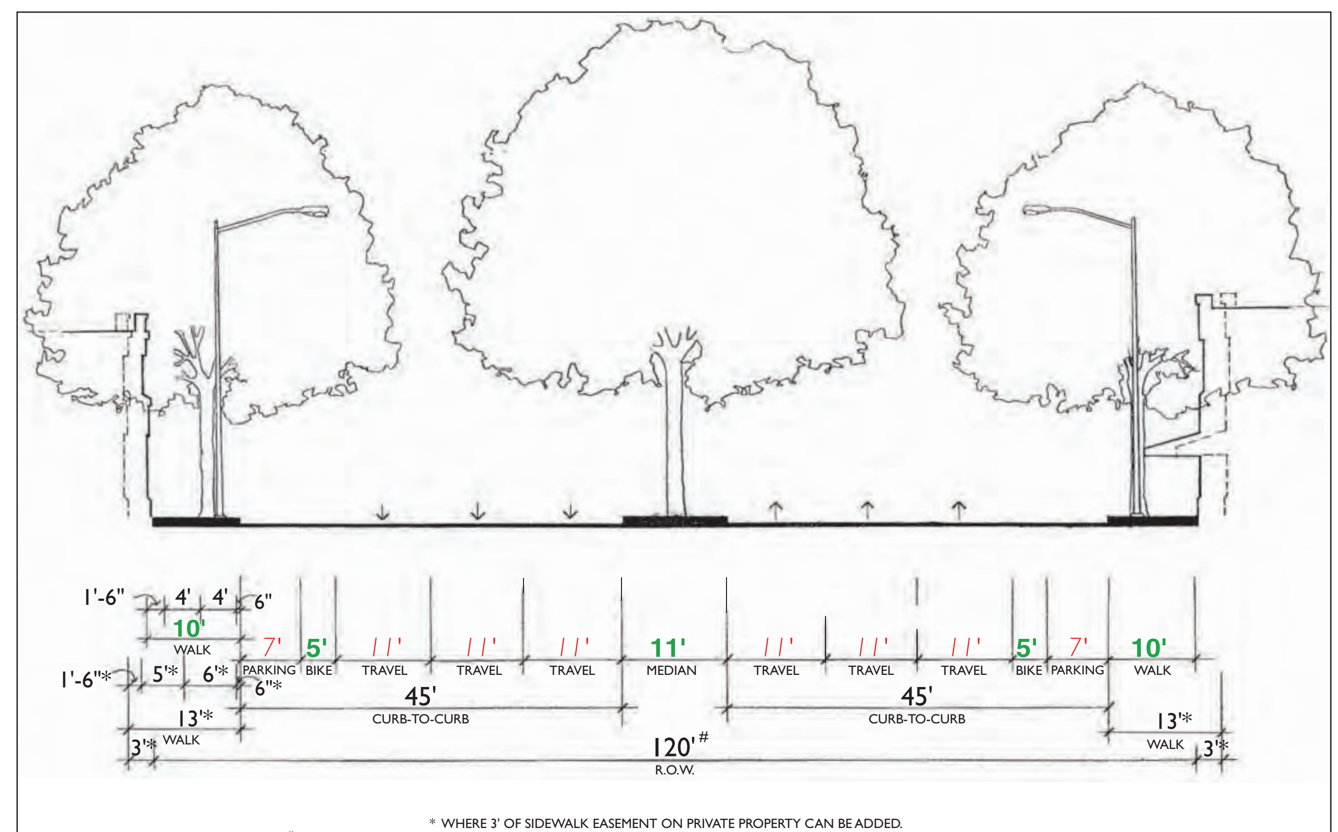


Figure 5.16: Typical ‘Urban’ 6-lane cross-section

Figure 5.17: Corridor Concept Plan: 6/4-lane Hybrid Option - Configuration A

Street Concept Plan: 6/4-Lane Hybrid Option, Configuration B

- 3 Lanes per Direction of Travel
- 2-Lanes per Direction of Travel
- Lane Drop: 3 to 2 Lanes
- Lane Add: 2 to 3 Lanes
- Major Commercial Activity Area
- Schools
- Key Crossing Location
- Key Commercial Area Crossing
- Key School and Pedestrian Crossing
- Key Bicycle Crossing
- Key Crossing into Stanford Campus
- Key School Route
- Caltrain Station

* Black bar represents roadway width; White line represents road centerline location.

N

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Figure 5.18: Corridor Concept Plan: 6/4-lane Hybrid Option - Configuration B

5.3.2 Six/Four-Lane Hybrid Option – Configurations A and B

The 6/4-Lane Hybrid Options (*see Figures 5.17 and 5.18 on previous two pages*) are based on detailed corridor analysis using the CORSIM simulation tool; and through a process of repeated refinement with respect to length and location of segments with a reduced number of lanes. At the beginning of the process, the Consultant Team identified those areas that would benefit most from a reduction in number of travel lanes. Included were street segments between Embarcadero and Grant Avenues and between Acacia Avenue and West Charleston Road, where commercial and pedestrian activities are strong today or are expected to increase in the future based on city policies and zoning, and where a higher number of school-route crossings occur. Several of the preliminary options therefore attempted to stretch out the use of 4-lane cross sections throughout these segments. However, the CORSIM analysis quickly demonstrated that there were limits to how long 4-lane segments could be extended and where they could occur.

The CORSIM analysis of future traffic volumes (*discussed in Chapter 5.2.2-A.*) indicated that no reduction in lanes would be feasible at the following intersections and within the first 400 to 600 feet of roadway north and south of each respective intersection:

- Alma/Sand Hill Road,
- Embarcadero Road,
- Page Mill Road,
- West Charleston/Arastradero.

Although Embarcadero, West Charleston, and California Avenue and Grant Avenue represent important pedestrian and school-route crossings included in the original list of desirable 4-Lane segments, the analysis showed that 4-lane cross sections at these intersections would be detrimental to traffic operation of the overall corridor. In response to the above findings, the Consultant Team developed the concept of a 5-lane cross section that could be used in locations where a sufficient difference between morning and evening traffic peaks was found to allow an asymmetrical roadway layout. This represented an important step in the process of refinement of the design concepts as it reflected the realities of future corridor operation, while retaining some improvements that come from a reduction of number of lanes. With respect to the above listed intersection it represented an opportunity to bring at least some pedestrian improvements to the California Avenue intersection with its high pedestrian crossing volumes.

In providing options that covered the range of community-supported emphasis on context sensitivity versus traffic performance, the Consultant Team and city transportation staff developed two variations of the 6/4-Lane Hybrid Option (Configuration A and B), which primarily differ in the length of their proposed 4-Lane and particularly their 5-lane segments. The relative traffic performance of these alternative concepts was tested using the CORSIM tool.

A. 6/4-Lane Hybrid Option - Configuration A

Figure 5.17 illustrates the extent of 6-, 5-, and 4-lane segments for Configuration A of the 6/4-Lane Hybrid Option. Key intersection crossings for pedestrians, bicyclists and school children that would benefit from reductions by one or two lanes are: Stanford Avenue (4 lanes), California Avenue (5 lanes), Los Robles (4 lanes) and Maybell Avenue (5 lanes).

B. 6/4-Lane Hybrid Option- Configuration B

Figure 5.18 illustrates the extent of 6-, 5-, and 4-lane segments for this configuration of the 6/4-Lane Hybrid Option. The key difference is the increased number of key intersection crossings for pedestrians, bicyclists and school children that would benefit from the reductions by one or two lanes, these include: Churchill Avenue (5 lanes), Stanford Avenue (4 lanes), California Avenue (5 lanes), Matadero Avenue (4 lanes), Los Robles (4 lanes) and Maybell Avenue (5 lanes). In addition, the 4-lane segment south of Matadero Avenue would afford a series of intersections with shortened crosswalk distances in this area of increasing business activity.

C. Typical Cross Sections

The typical cross sections for the 'Stanford' 6-Lane segments and the 'Urban' 6-Lane segments have already been described in the 6-Lane Throughout option (*see Figures 5.15 and 5.16*). The following Figures and descriptions are of the 4- and 5-lane sections for both configurations of the 6/4-Lane Hybrid Option.

'Stanford' 4-Lane

This cross section (*Figure 5.19*) is primarily defined by its generous landscape character, created by a 22-foot wide median and the 13-foot wide planting strips. If needed, parking could be accommodated in parking pockets between tree locations (See Fig. 5.24 and Fig. 5.26.) Multi-use paths allow for use not only by pedestrians but also by individual bicyclist who do not feel comfortable riding in the bicycle lanes provided on the street.

'Urban' 4-Lane

Defining feature of this cross section (*Figure 5.21*) is the 17-foot wide sidewalk and the short crossing distances afforded by the reduction to two lanes in each direction. The wide sidewalks can accommodate a variety of sidewalk uses such as sidewalk cafés, transit facilities and public art. The sidewalk width also affords an almost optimal amount of space for street trees. The 'Urban' 4-Lane cross section also provides 19-foot wide medians, where trees could be panted in two staggered rows. This median width allows for left-turn lane, median refuge and parking to occur simultaneously and without spatial conflicts.

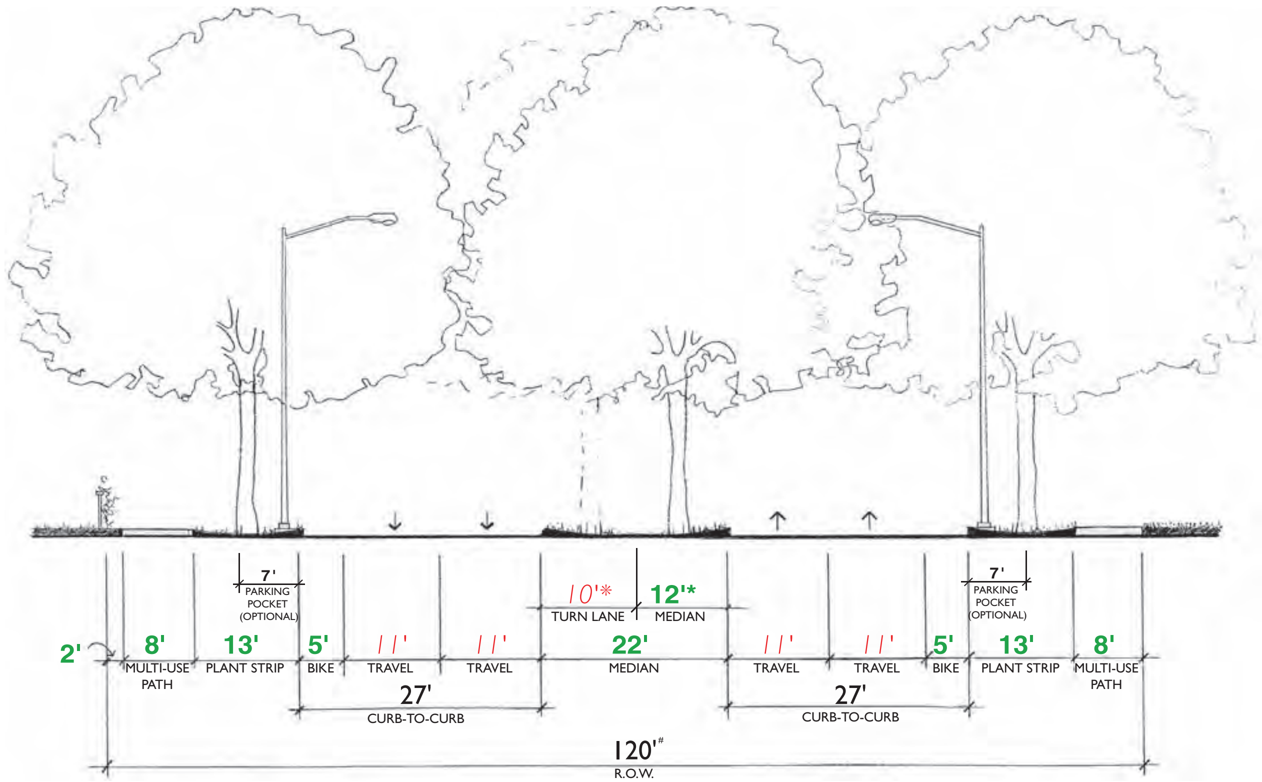
5-Lane Cross Sections

The 'Urban' 5-Lane cross section can be implemented in two ways:

1. As a simple combination of one half 'Urban' 4-lane and one half 'Urban 6-Lane with one sidewalk being 17 feet and the second 10 feet wide and a 14-foot wide median, or
2. Through a redistribution of the "gain" in right-of-way (from the reduction of the typical cross section) to both sidewalks and the median, resulting in sidewalk widths of 13.5 feet and an 18-foot median.

The second approach would have the advantage that it does not require the elimination or reduction of existing on-street parking along left-turn lanes.

Figure 5.23 Illustrates the appearance of the California Avenue intersection in a 5-Lane configuration according to the first approach listed above.



* AT TURN LANE

\# METRIC EQUIVALENTS OF SHOWN DIMENSIONS ADD UP TO EXISTING R.O.W. WIDTH. THE TOTAL IN FEET MAY EXCEED 120 FEET

Figure 5.19: Typical proposed 'Stanford' 4-Lane Cross-sections

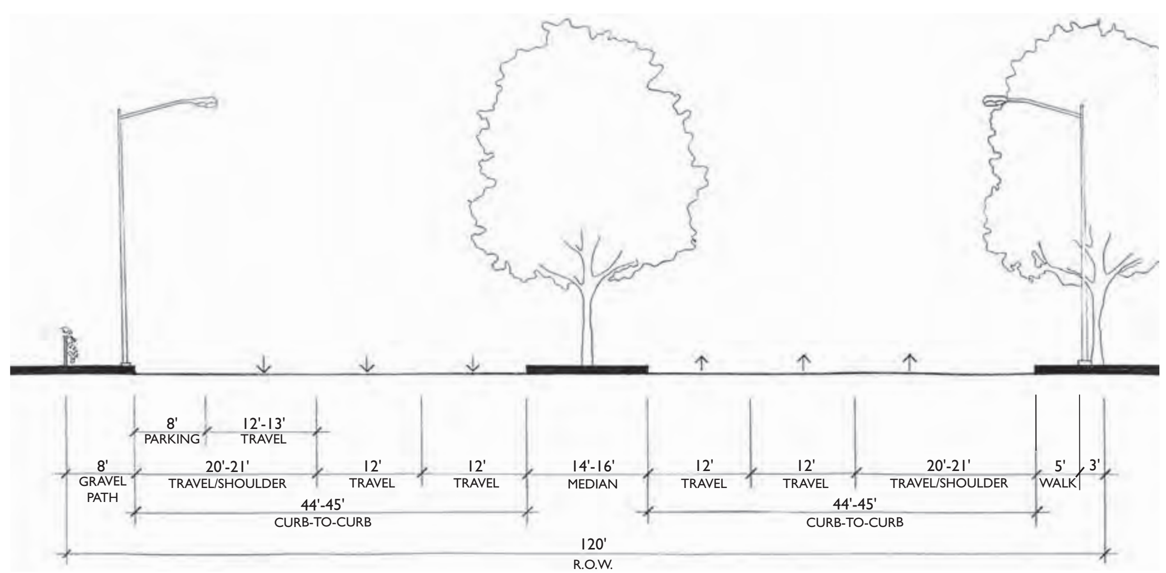
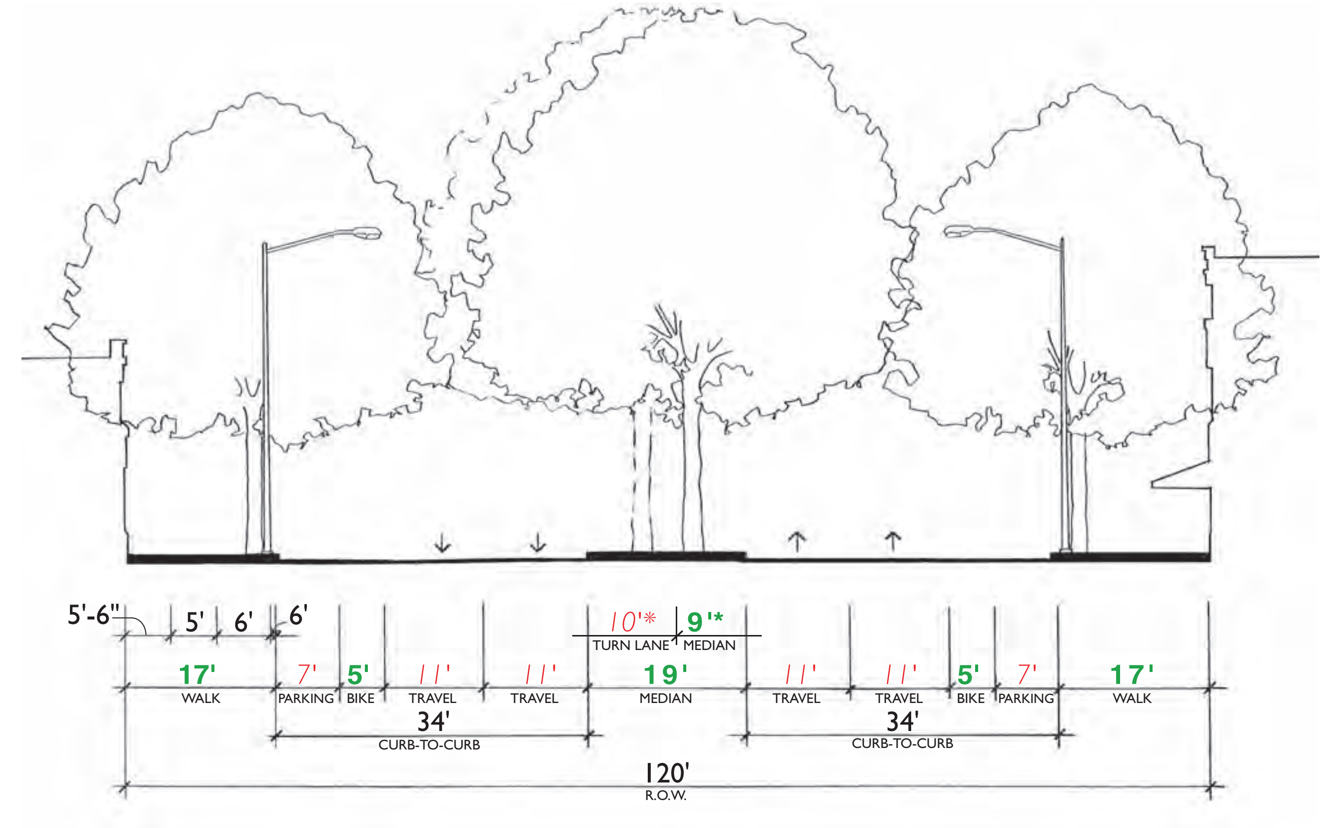


Figure 5.20: Typical existing 'Stanford' 6-Lane Cross-sections



* AT TURN LANE

Figure 5.21: Typical proposed 'Urban' 4-Lane Cross-section

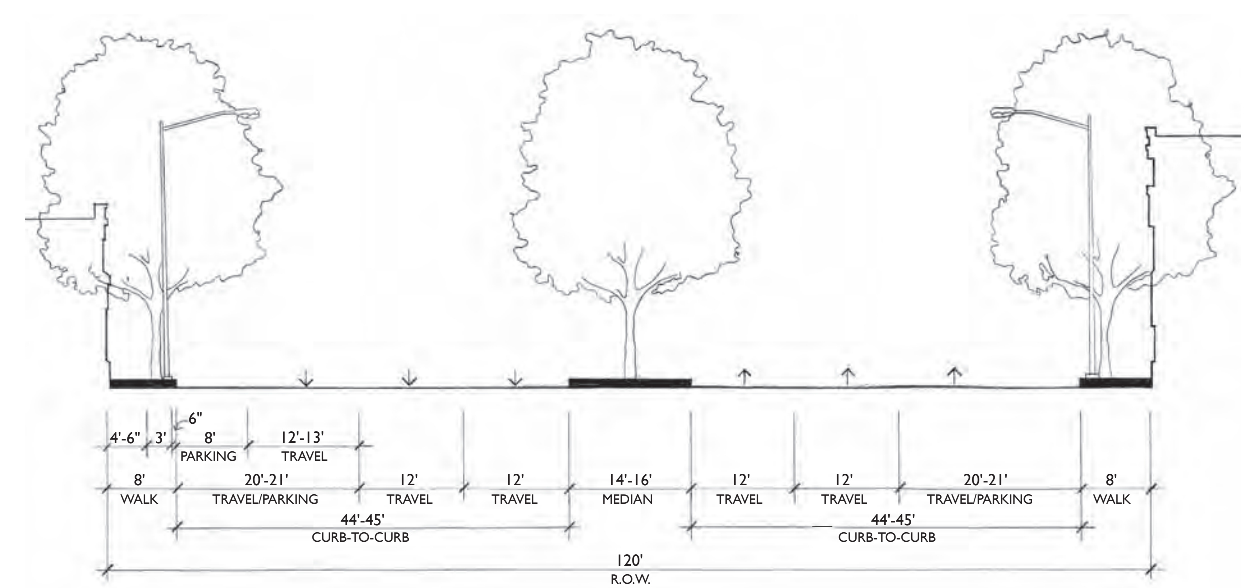


Figure 5.22: Typical existing 'Urban' 6-Lane cross-section

Figure 5.23: Before and after photo simulation of the California Avenue intersection (as proposed in the 6/4-lane hybrid option)

Figure 5.24: Example of a lane reduction from 3 to 2 lanes in northbound direction occurring between Cambridge and College Avenues

The 'Stanford' 5-Lane sections can be treated similarly.

B. Transition between 4 and 6-Lane Segments

As illustrated in the Corridor Concept Plans, lane additions and lane drops would each occur twice for each direction of travel under Hybrid Configuration A and under Hybrid Configuration B. Lane drops need to be carefully designed to ensure that cars merge safely into the adjacent lane. This condition was discussed extensively with Caltrans, which agreed to the use of the formula $WV^2/150$ for the calculation of the length of tapering roadway needed to allow safe merging at speeds under 35mph which would result in a length of about 90 feet of street length to 'drop' an 11 foot wide lane.

Figure 5.24 illustrates the conceptual design of a lane transition (lane drop) north of California Avenue (between Cambridge and College Avenues).

Lane drops would occur in the following locations (*also see Figures 5.17 and 5.18-just a reference*):

Configuration A:

- In southbound direction: north of Stanford Avenue and north of Los Robles Avenue;
- In northbound direction: just north of Maybell Avenue and between Cambridge and College Avenues.

Configuration B:

- In southbound direction: north of Churchill Avenue and just north of Matadero Avenue;
- In northbound direction: just north of Maybell Avenue and between Cambridge and College Avenues.

Lane additions would occur in the following locations:

Configuration A:

- In southbound direction: just south of California Avenue and south of Maybell Avenue;
- In northbound direction: north of Los Robles Avenue and north of Park Avenue.

Configuration B:

- In southbound direction: just south of California Avenue and south of Maybell Avenue;
- In northbound direction: just north of Acacia Avenue and north of Park Avenue.

C. Rapid Bus Service and Stops

The combined Line 22 and Rapid 522 corridor is the most heavily used in VTA's bus system. It currently carries 22-23,000 riders per day, or about 20% of VTA's total bus ridership. Since Rapid 522 was implemented in July 2005, ridership in this corridor has increased over 18%. Rapid 522 now averages about 6,000 passengers per weekday.

In the long-term, VTA plans to improve bus stops with "Rapid" service to include features and furnishings that are consistent with operational needs and provide a distinct identity for the special service bus line

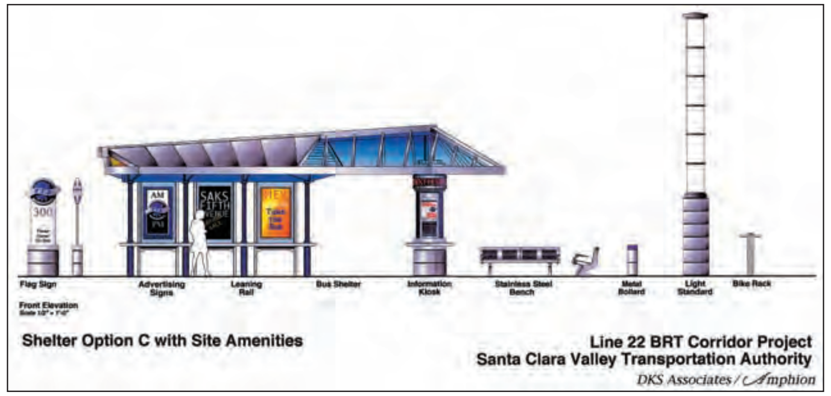
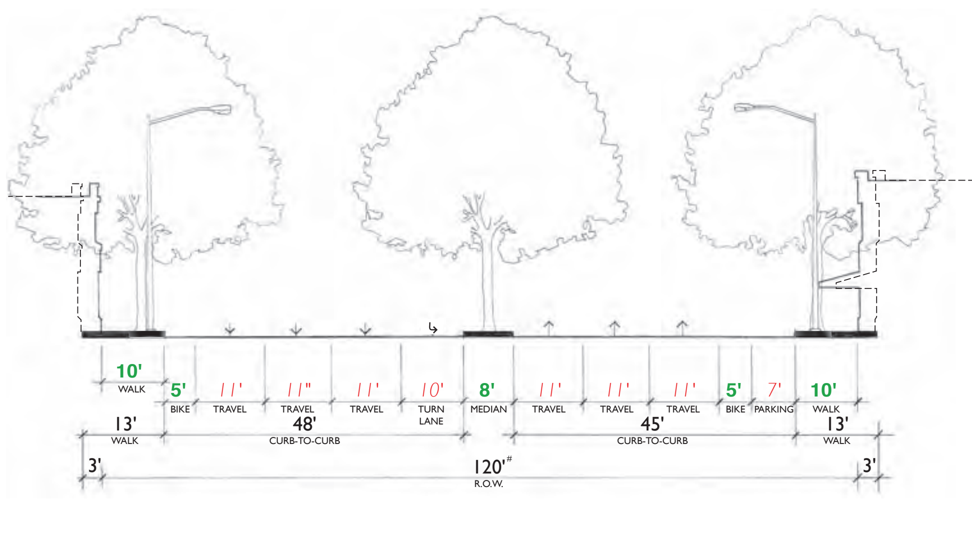
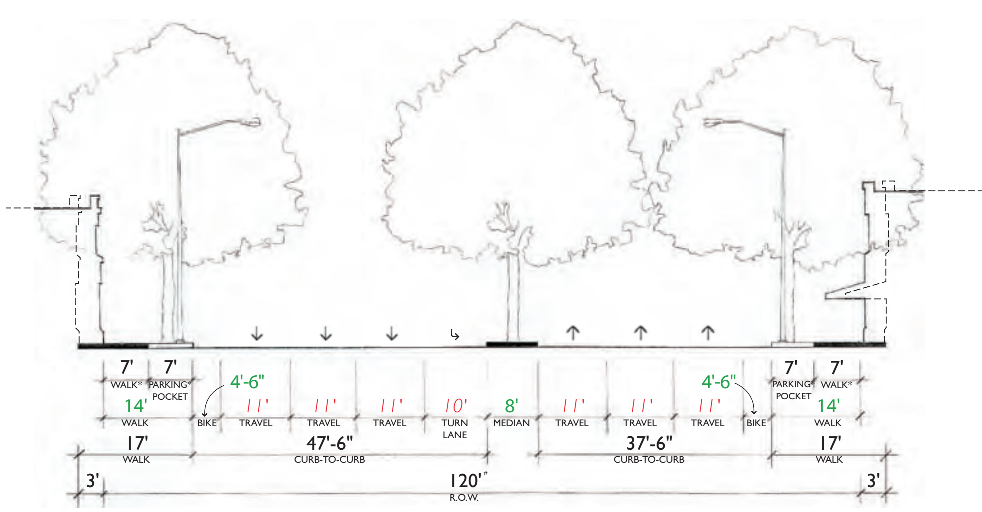


Figure 5.25: Conceptual illustration of VTA BRT amenities (November, 2001 - DKS Associates/Amphion)



* METRIC EQUIVALENTS OF SHOWN DIMENSIONS ADD UP TO EXISTING R.O.W. WIDTH. THE TOTAL IN FEET MAY EXCEED 120 FEET

Figure 5.26: Typical proposed 'Urban' 6-Lane at left-turn lane w/ parking on ***one*** side



* AT OPTIONAL PARKING POCKET
* METRIC EQUIVALENTS OF SHOWN DIMENSIONS ADD UP TO EXISTING R.O.W. WIDTH. THE TOTAL IN FEET MAY EXCEED 120 FEET

Figure 5.27: Typical proposed 'Urban' 6-Lane at left-turn lane w/ optional parking pockets

(Rapid and eventually Bus Rapid Transit service). These improvements will include curb extensions (bulb-outs) which allow for more efficient boarding while the bus remains in the outermost traffic lane, bus shelters, information kiosks, special lighting, benches and trash receptacles. At two (West Charleston/Arastradero and Page Mill Road) of the three proposed locations for Rapid stops in the Palo Alto portion of the Corridor, the addition of curb-extensions does not pose an issue. In the case of the California Avenue stop however, stopping the bus at a bulb-out proved to be difficult within the 5- or 4-lane cross sections considered for this location. The conflict was resolved by moving the northbound bus stop to just south of College Avenue, a solution that VTA agreed to consider. This allowed California Avenue to be designed as 5-lane intersection in both configurations of the Hybrid Option described above. Figure 5.25 illustrates initial design concepts that illustrate the extent and type of improvements considered by VTA.

5.3.3 Section Variations addressing Specific Issues

A variety of special conditions exist along the Corridor that require design variations. This section describes the major variations that have been studied during this project. As the Master Plan moves forward to design of construction projects, other special variations will likely need to be designed. These can be informed by the tradeoffs that are considered below.

A. Urban 6-Lane at Turn Lane

At intersections with left turn lanes, the 11-foot wide median of the typical 'Urban' 6-lane cross section is not able to accommodate the width of a 10-foot turn lane and the 8-foot pedestrian refuge. This makes it necessary for the travel lanes and the bike lane to shift into the parking lane before a turn lane is added to the cross section, resulting in the loss of parking spaces along the street. This is not a concern where on-street parking does not exist today or does not need to be maintained in the future. However, where parking does need to be maintained parallel to turn lanes the 6-lane configuration reaches its most constrained condition. Different design solutions are available to address the issues involved:

- Parking is eliminated on one side of the street, resulting in a cross section where all dimensions of the standard 'Urban' 6-Lane section can be maintained except for one parking lane. (*see Figure 5.26*)

- On both sides of the street, parking is accommodated in parking pockets of two to three car lengths at a time. This will reduce the available sidewalk width next to the parking pocket to 7 feet. In addition, the width of the bike lane will have to be reduced from 5 to 4.5 feet for approximately the length of the turn lane (see *Figure 5.27*)

Figure 5.29 illustrates the existing conditions at left-turn lanes.

Figure 5.28: Examples of parking pockets along Park Boulevard in Palo Alto

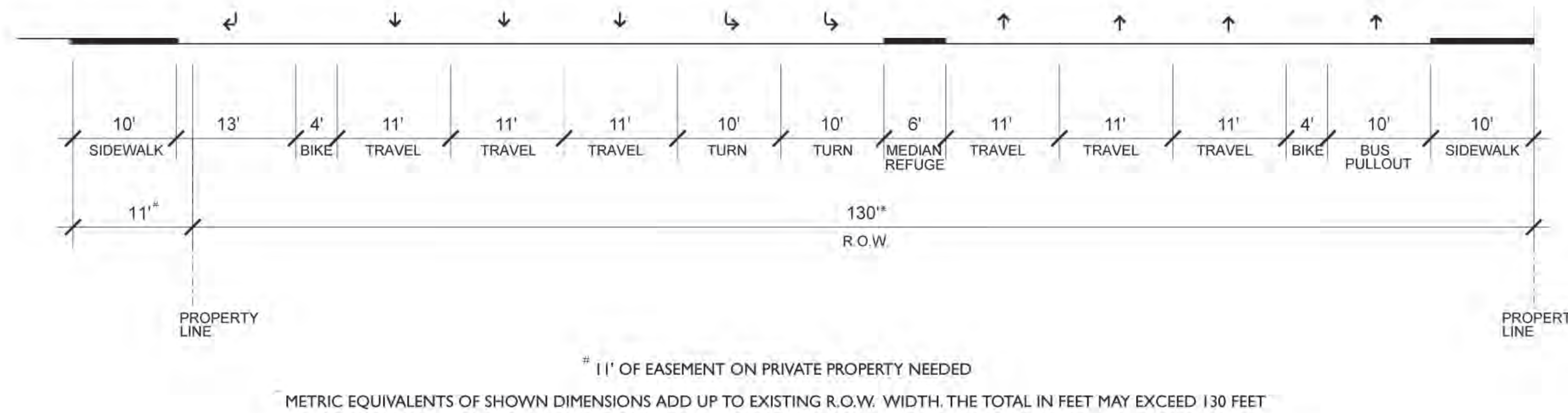


Figure 5.30: Additional right-of-way of 11 feet is required on the north side of Page Mill Road even when minimal dimensions are used for all design elements.

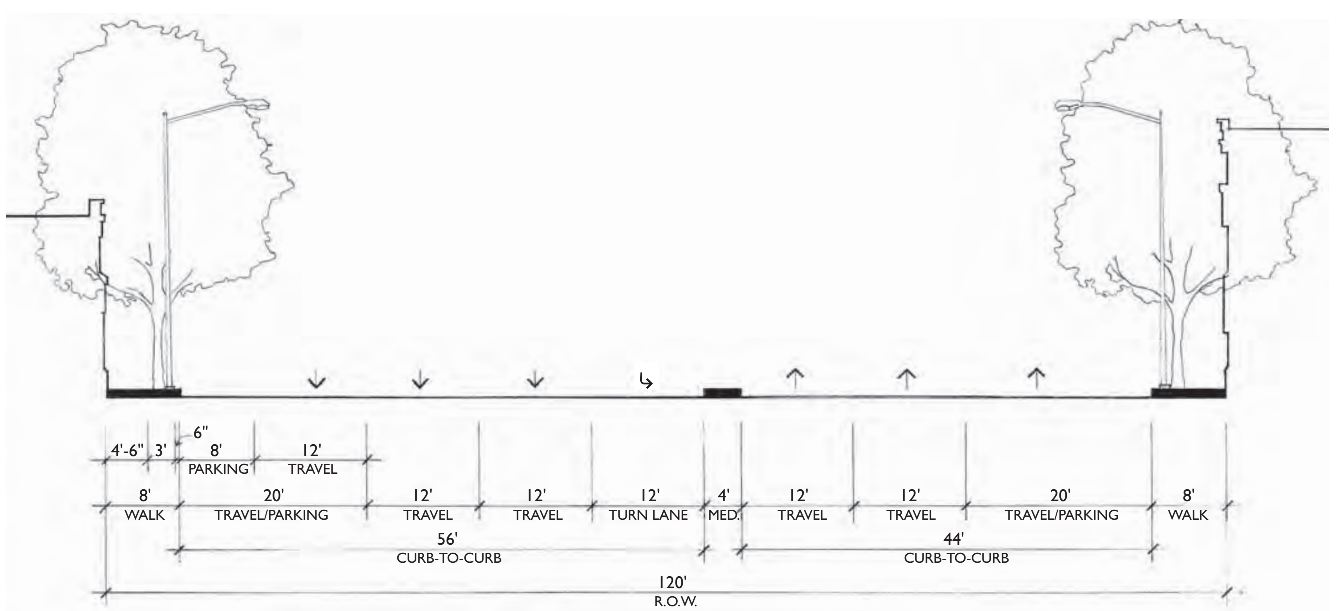


Figure 5.29: Typical existing cross-section of 'Urban' 6-lane at left-turn lane.

Currently on-street parking on both sides of the street located alongside turn lanes exist in 18% of the total curb length of Corridor. Therefor the occurrence of this condition is rather limited, and may be further reduced through exploration of possible on-street parking elimination in such locations. However, any such possible reductions in on-street parking can only be made on the basis of a parking utilization study.

Because of the significant reduction of sidewalk space at the parking pockets, it is recommended that this design be used only where future parking utilization studies conclude that no other alternative exists. Figure 5.26 shows an example of an existing parking pockets on Park Boulevard in Palo Alto .

Where parking can be eliminated on both sides of the street this will result in 14-foot wide sidewalks for the length of the turn lane.

B. Page Mill Road and Arastradero/West Charleston Road Intersections

The southern side of the Arastradero/West Charleston intersection and the northern side of the Page Mill Road intersection are two locations within the Corridor that require a reduction of some of the standard dimensions of the 'Urban' 6-lane cross section. In both locations the right-of-way has previously been widened to a total of 130 feet to allow for the accommodation of two left-turn lanes. Indeed, at Page Mill Road even the most minimal improvements such as 4-foot bike lanes and an urgently needed 6-foot pedestrian refuge would require the acquisition of additional right-of-way in that location, or the sidewalk width will drop to an unacceptable 4.5 feet on either side. However, contrary to many other locations in the El Camino right-of-way, the vacant parcel on the northwest side of the street presented the ability to add the needed 11 feet to the right-of-way (*see figure 5.30*). This occurred when the community playing fields were designed and built in 2006. At Arastradero/West Charleston the condition is not as constrained and can relatively easy be resolved by either changing the standard dimensions for the pedestrian refuge from 8 feet to 6 feet, or by reducing the width of the bicycle lane in this location from 5 feet to 4 feet.

C. Cross Section at University Avenue Underpass

Between the northern and southern ends of the access ramps that connect El Camino to University Avenue, the roadway for each direction of travel tapers down to a total width of 33 feet at its narrowest point between the supports of the overpass. The roadway passing through the underpass accommodates six 11-foot wide lanes and a median of 5-foot width. This narrow width does not allow for the continuation of the bicycle lane through the underpass. El Camino's sidewalk on the eastern side and the dirt path along Stanford Campus follow the vehicular access ramps up to University Avenue. It is therefore recommended that a bicycle accommodation be provided in conjunction with the access ramps to University Avenue (Figure 5.32). Here bicyclists (and pedestrians) would cross this street at the existing traffic lights and then follow the opposite ramp back down onto the bicycle lanes on El Camino. This approach would require the design of a safe bicycle accommodation (within the travel lane or as a separate bike lane) and changes to the intersection signalization at the northbound ramp at University Avenue. Currently, the signal there does not allow for a straight-movement by bicycles (or pedestrians) and no crosswalk exists. However, a redesign called for in the Palo Alto Intermodal Transit Center (PAITC) project, accommodates signal-protected through bicycle movement at this location.

It can be expected that some bicyclists will continue to ride their bicycles through the underpass. The outside lane should therefore be striped as wide as possible to provide the best possible margin of safety for those bicyclists. This could only be achieved by striping the remaining two lanes per direction of travel at 10-foot width.

Figure 5.31: El Camino Real at University Avenue Overpass. Bicycle lanes cannot be added to this portion of the Corridor.

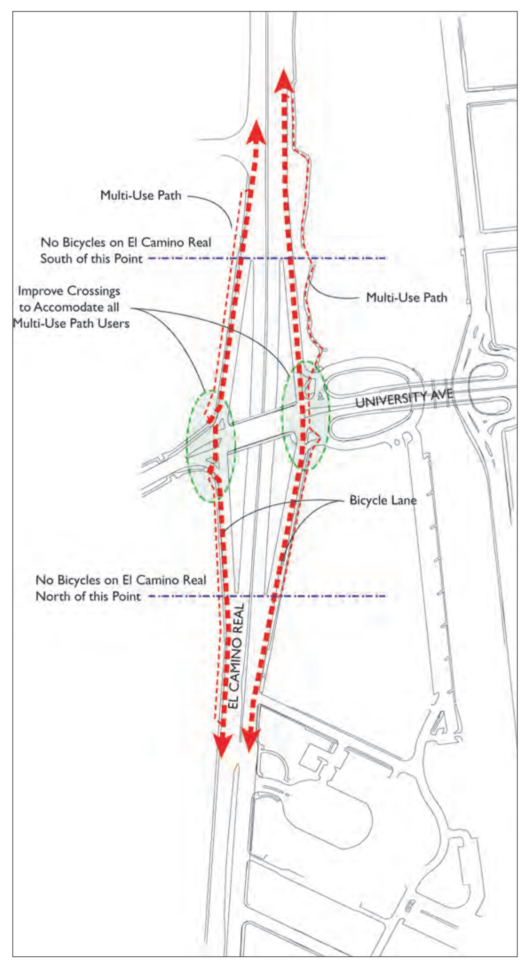


Figure 5.32: A multi-use path above ground which crosses University Avenue can be added as part of the intersection redesign called for in the PAITC.

D. Local Access Lane Alternative at El Camino Way Triangle

Figure 5.33 illustrates how El Camino between Maybell and Los Robles Avenues could be configured to include a local access lane as first explored in a section of Palo Alto's Comprehensive Plan that addresses this area (Page L-26). The concept of a local access lane is only compatible with the 4-lane configuration of El Camino at his location. In light of the fact that the existing right-of-way width of 120 feet does not allow for more than parallel parking on one side along the access lane, configuring the street in this way does not seem very efficient. The proposed typical 4-lane cross section with its wider sidewalks appears to be better suited for the expected future increase in commercial activity in this area.

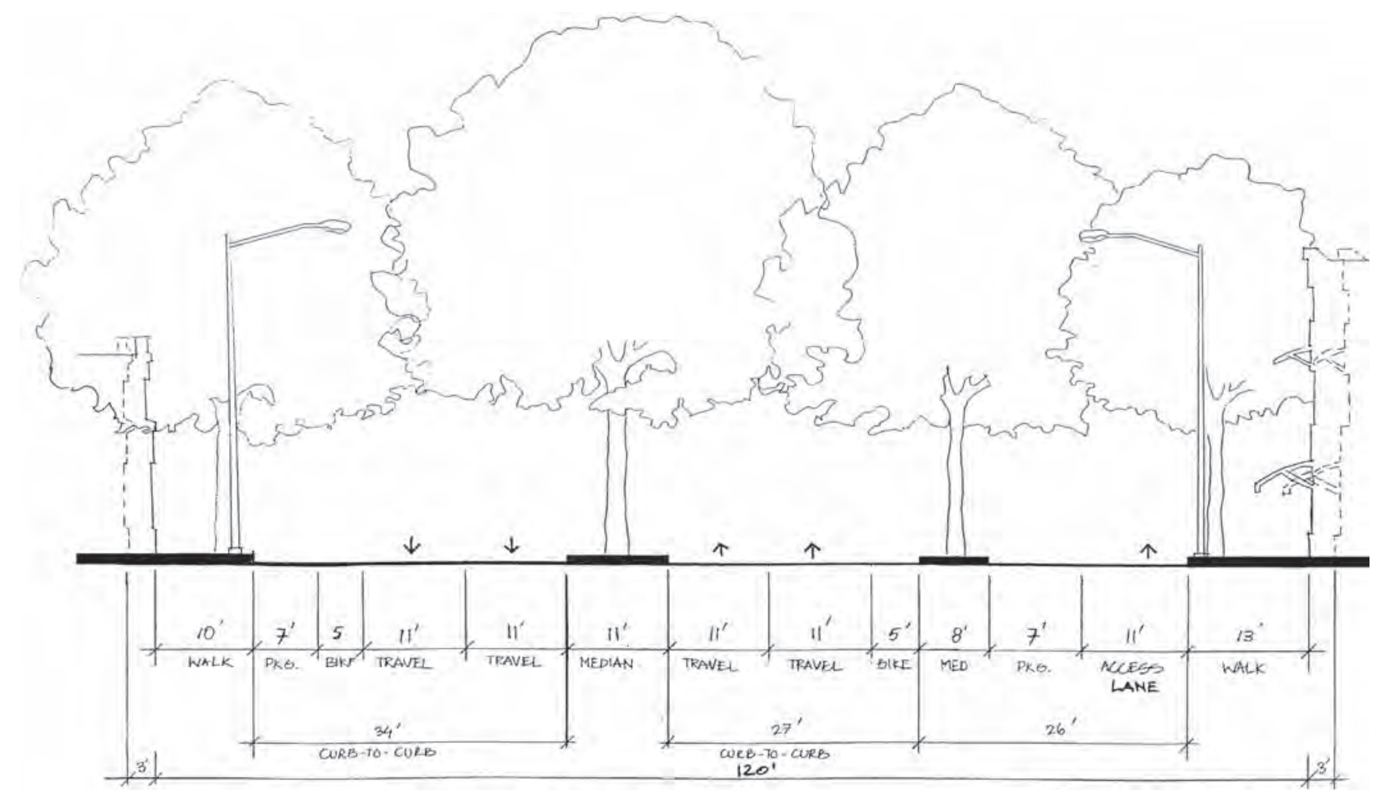


Figure 5.33: 4-Lane cross section w/ local access lane (not recommended)

5.3.4 Design Characteristics of Crosswalk Improvements at Intersections

A. Typical Crosswalk Improvements

Using Stanford Avenue as an example Figure 5.34 illustrates a prototypical set of crosswalk improvements as recommended for use throughout the Corridor. Key improvements for six, five, or four-lane roadways are:

- 6-foot corner bulb-outs (curb extensions) to shorten crossing distances;
- Special paving material such as (colored) concrete brick pavers for crosswalks with higher pedestrian crossing volumes (this should include crosswalks across the intersecting streets);
- 8-foot pedestrian refuge protected by the median and an 8-foot by 4-foot wide concrete curb on the opposite side;
- Two in-pavement light fixtures mounted on the 8-foot by 4-foot concrete curb (which, at night, provides a wash of light on the pedestrian refuge). A single pedestrian-scale fixture located on the median side of the refuge (which provides general lighting of the pedestrian refuge area);
- Bollard on the 8-foot by 4-foot wide curb; and,
- New combined roadway and pedestrian-scale light fixtures at all intersection corners.

Figures 5.35 through 5.37 illustrate the existing conditions as well as the difference in crossing distance between the potential 4-Lane and the 6-Lane configurations of the Stanford Avenue intersection.

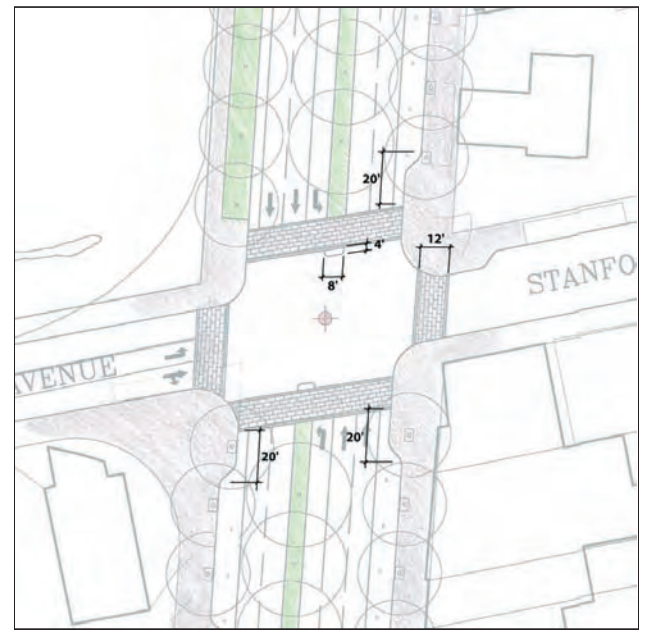


Figure 5.34: Key dimensions of typical intersection improvements (as applied at Stanford Avenue).

Figure 5.35: Photo simulation of crosswalk across 6 lanes on El Camino.

Figure 5.36: Photo simulation of crosswalk across 4 lanes on El Camino.

Figure 5.37: Existing conditions.

B. Pedestrian Refuge at T-intersection Medians and mid-block Crossing at Palo Alto High School

It is recommended that City staff continue to discuss and pursue with Caltrans the implementation of a mid-block crossing in one particular location on El Camino. The proposed crossing should be located approximately at the halfway point between the Churchill Avenue and Embarcadero Road intersections, close to where the existing median is interrupted by a gap. This mid-block crossing is desired for several reasons:

- Bus stops are located on either side of El Camino. In absence of a crosswalk, these stops currently cannot safely be accessed from the opposite side of the street and jaywalking students and other pedestrians have frequently been observed.
- The distance between the pedestrian crossings provided at the Churchill Avenue and Embarcadero Road intersections is over 2,300 feet, the longest distance between crosswalks anywhere in the Corridor;
- Speeding by vehicular traffic is frequent in this part of the Corridor (see speed study) and encouraged by the long distance between signals in this particular location.
- The Consultant Team recommends to explore whether a signal could be warranted for this location even if current pedestrian volumes do not fully justify such a signal. In addition, it is recommended to close the gap in the existing median and configure the mid-block crosswalk in the "corral" configuration illustrated in Figure 5.38. This configuration proposes an arrangement of walking surface and rails within the pedestrian refuge that guide the crossing pedestrian to a path that improves visibility of and by on-coming traffic while still within the safety of the refuge. This lends additional safety to the mid-block crossing.

Figure 5.39 and the photo simulation of the proposed mid-block crosswalk in Figure 5.40 illustrate the proposed character of the crossing in comparison to the existing conditions.

In addition, it is recommended that the "corral" crosswalk design be used to maintain pedestrian crossings in locations of the Corridor where median closures may be implemented at unsignalized T-intersection where standard marked crosswalks are present today (*also see Chapter 4.1.3-A.*).

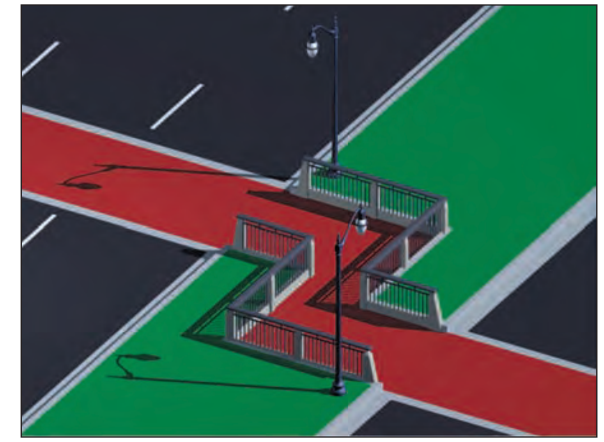


Figure 5.38: Diagram of "corral" configuration for mid-block crossing through the center median.

Figure 5.39: Photo simulation of El Camino at the mid-block crossing location.

Figure 5.40: Before-after illustration of proposed mid-block crossing between Embarcadero Road and Churchill Avenue.

C. Elimination of 'Pork Chops'

Several intersections along El Camino Real including Stanford Avenue and Page Mill Road have "pork chop" shaped pedestrian islands offset from the curbs. Pork chop islands are generally paired with wide turn radii which in turn encourage higher speeds among turning vehicles. An example of a pork chop is shown below:

Figure 5.41: Free right turns and "pork chop" islands complicate pedestrian circulation at intersections.

The Consultant Team recommends the removal of pork chops in the Corridor where feasible. This removal would reduce the turn radii at a number of the Corridor intersections that would slow vehicles turning to and from El Camino Real. An additional benefit would be the increase in pedestrian comfort and safety. With the removal of the pork chops, additional space would be provided for pedestrians. It should be noted that while pork chops were common roadway design elements during previous times (1960's and earlier), cities are typically removing pork chops as part of improvement projects.

5.3.5 Refined Travel Time Analysis of Design Recommendations

Using the CORSIM model discussed in section 5.2.2.A, FPA analyzed the travel time performance of alternative improvements under future (2020) conditions. This analysis concluded the following:

- Signal timing and coordination changes would improve the corridor wide travel times in the future
- Reducing the number of lanes in some limited roadway segments, in conjunction with the signal coordination, would not significantly increase the overall travel time.

These predicted travel times are shown in Figure 5.42.

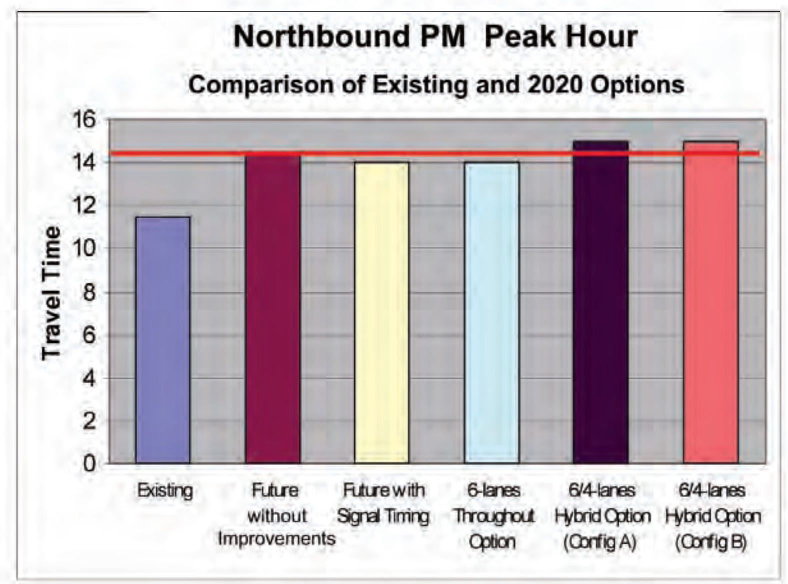


Figure 5.42: Comparison of 2020 Corridor Travel Times.

A major reason why reducing the number of lanes in selected segments along El Camino Real does not greatly increase the travel time is that capacity is preserved at the major intersections. All of the proposed alternatives retain the necessary turn lanes and length of lanes carrying traffic into the intersection (i.e.; 'queuing distance') at locations such as Page Mill Road and Embarcadero. Lane reductions to the 4 or 5-lane cross sections only occur at minor side streets where there is good intersection performance (LOS C or better) and excess capacity.

Another consideration is the positive impact a lane reduction can have on intersection operation. At many of the minor intersections, the allocation of green time for El Camino traffic is reduced by the amount of green time needed for side streets. This side street green time is in turn affected by the amount of time required for pedestrians to cross El Camino Real. For example, if a pedestrian pushes the button at the crosswalk at Cambridge Avenue, he or she is allocated approximately 30 seconds to cross El Camino Real. This 30-second interval is a time in which traffic traveling north/south on El Camino would be stopped by a red light. In many cases, the side street traffic does not warrant this full time, and all traffic movement is stopped while pedestrians finish crossing. Reducing from six to four lanes on El Camino would reduced the pedestrian crossing width and reduce the time required to cross an intersection by as much as 28%. This reduction would translate into increased "green time" for traffic on El Camino and improved Corridor traffic efficiency.

Additionally, lane reductions and signal coordination can be used to meter or pace traffic flow along El Camino, temporally dispersing the large platoons of traffic that currently arrive at the most critical intersections such as Page Mill and Embarcadero. This dispersion would reduce queue lengths, stopping and delays at the most critical locations.

The changes introduced by reducing numbers of lanes in the four- and five-lane concepts affect only relatively short, strategically selected segments of the Corridor. The length of the roadway that is reduced from six lanes to four lanes in Hybrid Configuration A is only 18% of the total corridor length. Approximately 4% of the corridor length has a lane reduction from six lanes to five lanes where only one side of the roadway experiences a lane reduction. Therefore, nearly 78% of the Corridor would still have six lanes in both directions. In Hybrid Configuration B, 27% of the corridor length would have four lanes, 15% five lanes, maintaining 58% of the Corridor at six-lane capacity.

5.3.6 Comparative Analysis of 4 and 6 Lane Cross Sections

While Table 5.1 gives an overview of the difference in dimensions between design elements in the different Corridor Options, Table 5.2 provides a relative comparison of parameters, grouped by mode of travel. The latter table compares the 6-Lane Throughout and the two 6/4-Lane Hybrid Options with a base condition ("Future without any Improvements"). "Future without any Improvements" was chosen as baseline instead of "Existing Conditions" as this category appropriately takes into account that traffic volumes on El Camino will increase over the years (the table is based on 2020 forecasts), which a comparison with the existing conditions would not have achieved.

The table (5.2) clearly shows that travel times will increase over the next 17 years. However, in that context, it also illustrates that relatively small differences exist between the proposed alternatives for a redesign of El Camino. Compared with the future baseline, the increases in travel time for the entire length of the Corridor are only about 3% to 4% for Option A, and 3% to 11% for Option B. All proposed alternatives improve the multi-modal experience of the Corridor, with the 6/4-Lane Hybrid options producing relatively higher benefits for pedestrians, bicyclists, and transit users.

Figures 5.43 through 5.45, provide a 'before' and 'after'-type comparison between the existing conditions on El Camino today and those conditions that would exist if the proposed alternatives were implemented. This comparison was achieved by translating the design parameters of the proposed design alternatives into photo simulations.

	Existing Condition	*6-Lane Throughout Option*	*Hybrid 6/4 Lane Option*
Travel lane width	12 feet	11 feet	11 feet
Sidewalk width	8 feet	10 feet, except 7 feet at parking pockets	17 feet
Sidewalk width at corner bulbout	8 feet	14 to 16 feet	23 feet
Pedestrian crossing distance Crossing time	104 feet 30 seconds	92 feet (for 14 foot sidewalk) 27 seconds (10% reduction)	75 feet 21.5 seconds (28% reduction)
Median width	2-14 feet	8–11 feet	9–19 feet
Pedestrian refuge At median	2–4 feet	8 feet	9 feet

Table 5.1: Comparison of key design elements.

	Existing Conditions	BASELINE Future without any Improvements	Future with Signal Timing Changes Only	6-Lane Throughout Option with Signal Timing Improvements	6-lane/4-Lane Hybrid Option - Configuration A	6-lane/4-Lane Hybrid Option - Configuration B
Overall and Multi-Modal Corridor Experience for all Users						
Positive and Distinct Identity for El Camino	—	—	—	+	++	++
Safety for all Travel Modes	—	— —	O	+	++	+++
Opportunity to Plant More Trees	O	O	O	++	+++	+++
Opportunity to Improve Growing Conditions for Canopy Trees	—	—	—	+	++	++
Driving Experience						
Length of Travel Time at Peak Hour in 2020 compared to FUTURE WITHOUT ANY IMPROVEMENTS						
North-bound Peak	minus 3 min.	14.5 min.	minus 0.5 min.	minus 0.5 min.	plus 0.5 min.	plus 0.5 min.
	+++	O	+	+	—	—
South-bound Peak	minus 1.5 min.	14 min.	minus 2 min.	minus 2 min.	plus 0.5 min.	plus 1.5 min.
	++	O	++	++	+	—
Aesthetic Quality of Streetscape	—	—	—	+	++	+++
Shade from Canopy Trees	—	—	—	+	++	+++
Pedestrian Experience						
Available Sidewalk Width	—	—	—	+	++	+++
Crossing Distance at Crosswalks	—	—	—	+	++	+++
Added Safety from Refuge at Median	no	no	no	+	+	+
Aesthetic Quality of Streetscape	—	—	—	+	++	+++
Shade from Canopy Trees	—	—	—	+	++	+++
Transit Experience						
Accessibility of Transit on Foot	—	— —	—	+	++	++
Ease of Crossing to Bus Stops	—	—	O	+	++	++
Quality of Bus Stop Areas	—	—	—	+	++	++
Aesthetic Quality of Streetscape	—	—	—	+	++	+++
Shade from Canopy Trees	—	—	—	+	++	+++
Bicycling Experience						
Bicycle Accommodation	O	—	—	+	++	++
Crossing Distance at Crosswalks	O	O	O	+	++	+++
Added Safety from Refuge at Median	no	no	no	+	+	+
Aesthetic Quality of Streetscape	—	—	—	+	++	+++
Shade from Canopy Trees	—	—	—	+	++	+++

Table 5.2: Comparison of Corridor Concept Alternatives.

Figure 5.43: Photo simulation of improvements associated with 6 lane option.

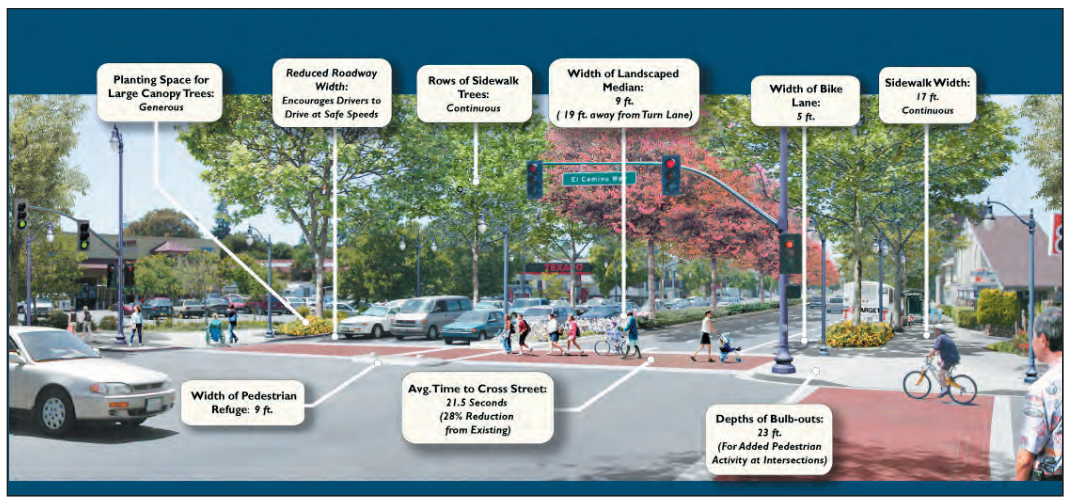


Figure 5.44: Photo simulation of improvements associated with 6/4 lane hybrid option.

Figure 5.45: Existing conditions.

5.3.7 Potential Conflicts between Proposed Improvements and Existing Utilities

Based upon the data gathered for this study and discussions with City staff, there is good certainty that trees and lamps can be located as indicated in the design concepts. However, it should be noted that a difference in location of about 2 feet from what was assumed by using City utility maps can significantly affect feasibility of the design concepts. Only the more detailed process of locating underground utilities, typically performed prior to the final design and construction phases will allow a final judgement of whether modifications of the proposed designs or moving of some utilities may be necessary. Another option in some cases, with consent of the utility owner (the City of Palo Alto in all cases except telephone and some major water mains) trees and light standards may be located close to or on top of deeper underground facilities. Utilities in the roadway by virtue of a franchise agreement (telephone, CATV) may be relocated if required at the expense of their respective owners. The existing agreements should therefore be consulted to verify whether this is the case on El Camino.

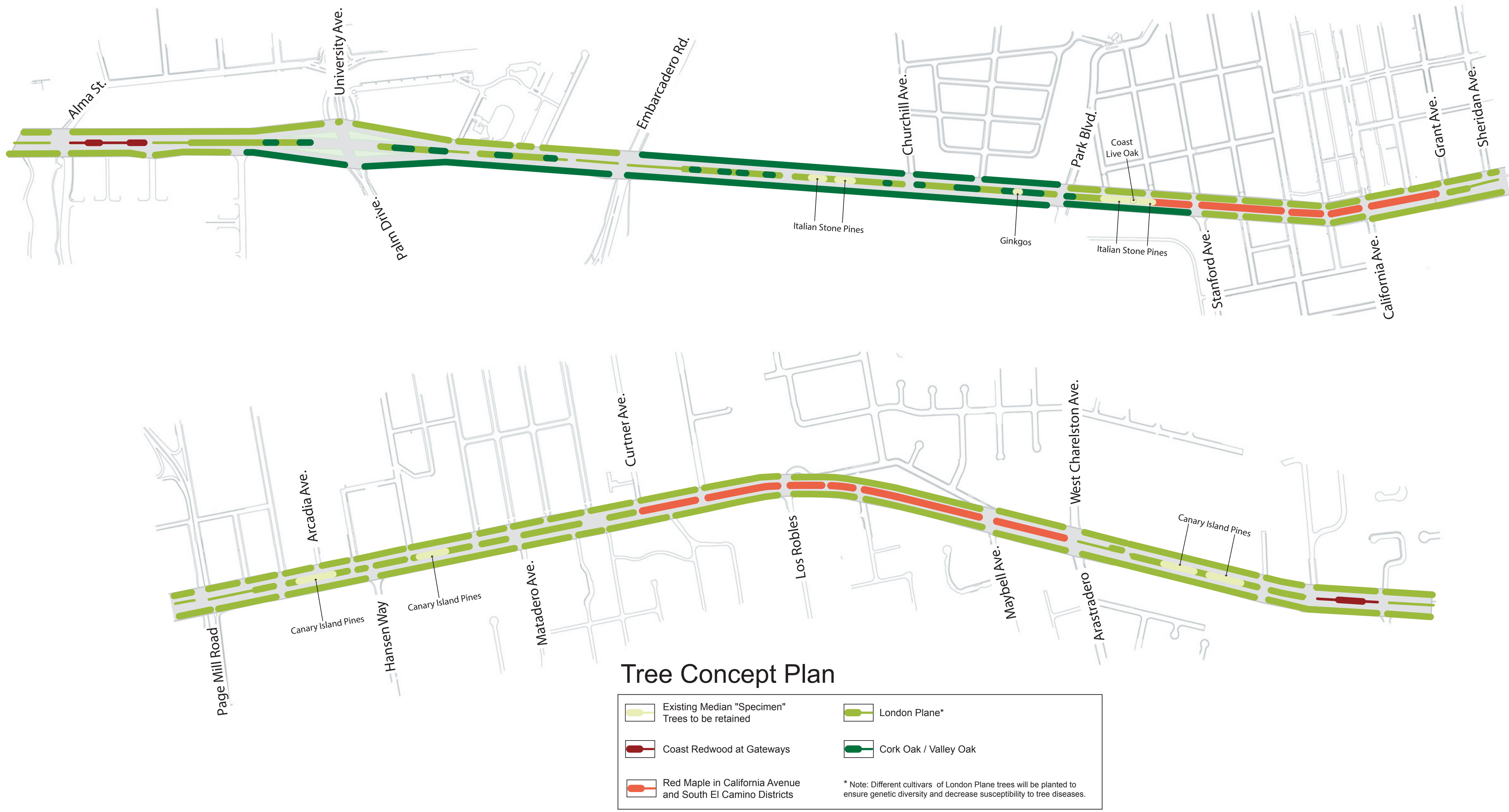
5.4 Proposed Street Trees Plantings and Improvements

5.4.1 Street Tree Concept Plan

A. Design Approach

As was pointed out earlier, large canopy street trees are a prominent feature along many grand boulevards throughout the world. The quality and character of landscaping with large canopy trees can also be a very cost effective tool and bring a short-term significant change to the character of the El Camino Corridor, and over time make for a dramatic transformation of a streetscape. Large canopy trees also provide a variety of environmental benefits from improving air quality to shading to reducing peak storm water flows. However, such a transformation will only be as successful as the adequacy of species selection, growing conditions and maintenance these trees are afforded.

The approach to the tree concept plan (*see Figure 5.46*) was guided by the difference in character of the El Camino segments (and nodes) described earlier in the Existing Conditions Assessment. The concept plan acknowledges and builds on the significant difference between the 'Stanford' segment of El Camino, along the Stanford Campus frontage (including the area between University Avenue and Sand Hill Road) and the 'Urban' segment between Stanford Avenue/Leland Avenue and the southern City limit. The first has almost rural appearance and is dominated by deep



EL CAMINO REAL MASTER SCHEMATIC DESIGN PLAN

A JOINT PROJECT OF THE CITY OF PALO ALTO & CALTRANS

CONSULTANT TEAM: Community Design + Architecture • Fehr & Peers Associates • Reid Ewing • Joe Mc Bride • LCC, Inc. • Urban Advantage

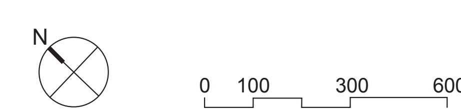


Figure 5.46 Tree Concept Plan

building setbacks and generous landscaping, while the second is characterized by buildings that come up to the property line and the more urban landscape character of street trees in sidewalks and median.

For the **'Stanford' area**, the plan proposes a landscape treatment that reflects the 'looseness' of the adjacent landscaping on the Stanford Campus, the Palo Alto High School and other properties in this area. Here, the proposed tree species of Valley Oak and Cork Oak (*see Figures 5.48 and 5.49*) blend in with existing oak trees on both sides of the street (over time Stanford University plans to plant additional Oak trees in the Arboretum area and remove the existing Eucalyptus trees on the campus). It is recommended that the new trees in this area not be planted as a straight row of trees with a consistent distance between tree trunks *(see Figure 5.47)*. Instead trees on either side of the street and in the median should be planted with offsets from the centerline of the planting strip or median and 'on-center' distances should vary to give the trees a clustered appearance more reminiscent of an Oak-Woodland landscape character.

For the medians of this area the plan proposes a combined use of London Plane (*see Figure 5.50*) trees and Valley Oaks. While the predominant London Plane trees lend continuity to the visual appearance of the overall Corridor, where this species is the dominant street tree, the occasional occurrence of clusters of Valley Oaks will provide a visual and horticultural 'bridge' across El Camino and connect the landscaped areas on either side of the street.

Planting strips and the center median in this area should both be landscaped with low native shrubs and ground cover to match the oak woodland character of the selected trees and adjacent portions of the Stanford University campus.

Figure 5.47: Photo simulation of informal tree planting in the center median of the 'Stanford' segment.

Valley Oak on Crow Canyon Road in Danville.

Figure 5.48: Valley Oak 'Quercus Lobator'

Figure 5.49: Cork Oak 'Quercus Sober;

Since the initial writing of this Plan several tree planting efforts have taken place in medians of the 'Stanford' area. The implementation of these improvements, which include landscaping and irrigation in existing medians was conducted as a City of Palo Alto Capital Improvement Project.

Phase I included all medians between Embarcadero Road and Park Boulevard. These medians were planted with a native plant palette in conformance with the recommendations of this Plan. Young volunteer oaks that had begun to grow in the medians were given structural pruning and incorporated into the design whenever possible. The understory shrubs included arctostaphylos, rhamnus and mahonia.

Phase II included the median between Park Boulevard and Stanford Avenue, which also fronts Lands of Stanford University, and contains several mature Italian Stone Pines that were retained in place. The plant palette for this median was the same as that used for Phase I.

A Phase III - slated for implementation in 2007 - will include two medians between Wells Ave. and Encina Ave. that front the Palo Alto Medical Clinic on one side and Stanford University on the other. The existing non-native shrubs in these medians will be removed and replaced with the Stanford palette identified above.

Throughout the '**Urban' area** the street tree concept plan proposes the use of London Plane trees in sidewalks and medians. However, this approach is modified and varied by the intention to emphasize the importance of two areas that are today and potentially will be even more so in the future with respect to commercial and pedestrian activity. The plan recommends that either Red Maples *(see Figure 5.51)* or American Elms be planted in the medians throughout these two areas, between Leland and Grant Avenues and between Curtner Avenue and south of Maybell Avenue. Either species would provide a strong color in the fall while they are otherwise very compatible with the London Plane trees of the sidewalks.

Since the initial writing of this Plan a couple of medians were planted with London Planes only (no oaks or other existing trees) and native shrub understory. One median between Vista and Maybell was planted with the median plant palette recommended in this Plan for the South El Camino District. This included Red Maples planted at 20' o.c. with an understory of low growing, compact nandina and white rockrose. In keeping with the precedent established in Phase I, several mature existing Ginkos and one large Valley Oak were incorporated into the design. In both cases, the Ginkgos repeat in a regular pattern of small groups that serve as a minor accent rather than a dominant component.

The total of the London Plane trees planted in the 'Urban' and 'Stanford' segments should be made up of the three genetically somewhat different but visually rather similar cultivars *Platanus x acerifolia 'Yarwood', Bloodgood',* and *'Columbia.* This practice is recommended to provide genetic diversity and reduce the susceptibility to tree diseases.

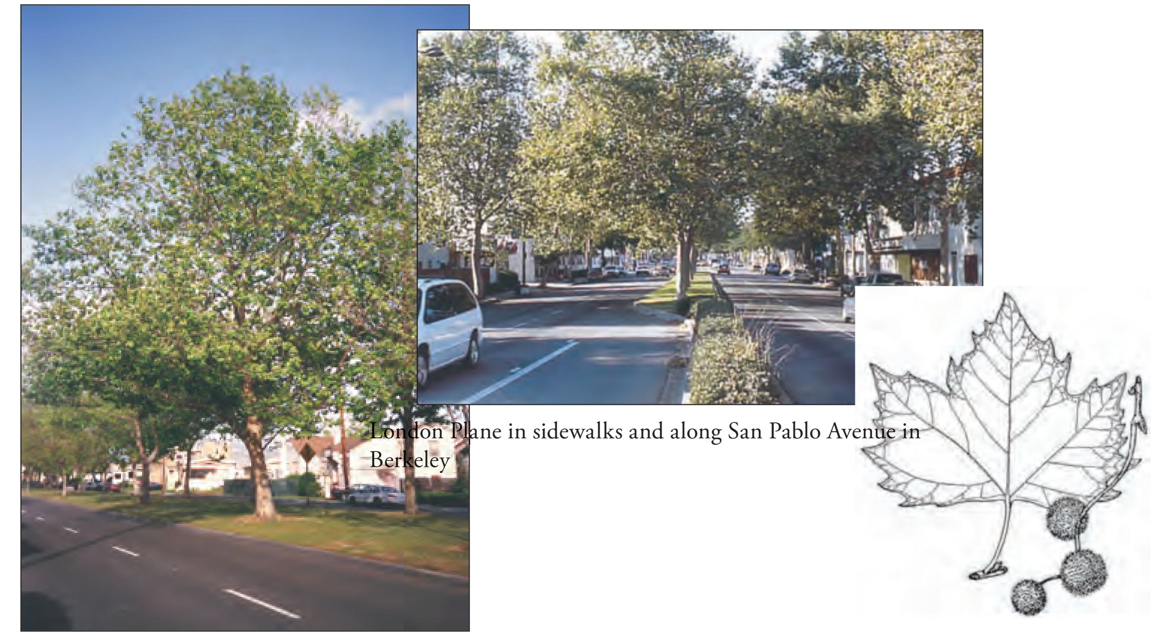


Figure 5.50: London Plane 'Plantusxacerifolia'

Figure 5.51: Red Maple 'Acerrubrum'

Figure 5.52: Coast Redwood 'Sequoia sempervirens'

Tree locations in sidewalks throughout the 'Urban' portion of the Corridor should be coordinated with on-street parking. Trees should be planted at 22 to 33 feet on-center (o.c.), with trees located between two parking spaces (parking spaces should be striped at 22 feet length for each stall). Trees at the ends of blocks should be planted as close to the corner on El Camino and side streets as this is possible under the different Caltrans' standards for sight lines at signalized and unsignalized intersections. In general, trees are to be pruned to provide a clearance of 14 feet below the lowest branches to accommodate trucks and busses. Pruning should also occur to provide adequate visibility of all traffic signals.

Trees in medians of the 'Urban' segments should be planted at 20 feet on-center, with distances to increase toward unsignalized intersections. Caltrans representatives have indicated that this increase in tree spacing would aid justifying tree locations closer to the intersection, as the wider spacing would lessen the sight-blocking effect of tree trunks.

Furthermore, the tree concept plan suggests to give visual emphasis to the beginnings and ends of the Corridor through Palo Alto by planting stands of the City's symbol tree, the Coast Redwood (*see Figure 5.52*) tree, in the medians closest to San Franciscquito and Adobe Creeks (between Alma Street and the central access road to the Stanford Shopping Center in the north, and Monroe Drive and Cesano Court in the south).

Figure 5.53: Significant stands existing of Italian Stone Pines (above) and Canary Island Pines (below)

The concept plan also recognizes the community's interest in retaining in the long-term some significant stands of Italian Stone Pines, Canary Island Pines (*see Figure 5.53*), Ginkgos as well as some individual trees (*also see Chapter 5.4.3 for a discussion about the transition between existing and proposed trees*).

B. Analysis of Median Tree Plantings w/ Respect to Possible Median Closures

The southern half of the Corridor is characterized by the occurrence of T-intersections and their left-turn pockets. Many of the side streets are local residential streets. In several locations the frequency of this condition diminishes the consistent appearance of the center median, i.e. between Fernando and Ventura Avenues. One of the design explorations conducted for this study looked at the benefits and general possibility of continuing some of the raised medians through such intersections. The exploratory designs showed that closing gaps in medians at T-intersections (therefore 'median closures') would allow for a significant number of additional trees to be planted in wide medians, which in turn would enhance the visual consistency of the tree-lined median in this area.

C. Tree Selection Characteristics and Recommended Tree Species

The existing conditions along El Camino Real are suitable for a number of tree species, which can be used as median and/or sidewalk trees. A series of community goals for street trees informed the preliminary list of trees. Subsequently, this list was further refined using a number of horticultural and design criteria also listed below:

Key criteria expressed by the community and City staff:

- Maximize the shading provided by planting broad canopies;
- Create an identity for El Camino in Palo Alto; and,
- Create an attractive streetscape;
- Retain some existing 'Specimen' Trees that are important to the community.

Key horticultural and design criteria:

- At their mature size, the crowns of median and sidewalk trees should be close to touching;
- The selected species has to be appropriate for Palo Alto's climate;
- Maintenance costs should be minimal as it cannot be anticipated that the City will have funding for maintenance of species requiring a high level of care;
- The selected species has to be appropriate for the particular soil conditions along El Camino;
- The selected species should be capable of surviving the rare occurrence of a 'hard drought';
- Branching habit, leaf color and texture and other visual characteristics should complement the existing landscape and built context; and,
- Crowns and foliage of the selected trees should create 'filtered' light rather than dark shadows.

All of the above criteria were considered in establishing the following list of selected tree species:

Stanford Segments (between northern city limit and Park/ Serra):

- Sides: Cork Oak (*Quercus suber*) (primary) and Valley Oaks (*Quercus lobata*) (secondary)
- Medians: London Plane Trees with occasional Valley Oaks

Urban Segments (between Park/Serra and southern city limit):

- Sides: London Plane Trees (*Platanus x acerifolia*)*
- Medians (except as noted below): London Plane Trees
- Medians between Leland and Grant Avenues and between Curtner Avenue and West Charleston Road (Commercial Activity Areas): Red Maple (*Acer rubrum*) and American Elm (*Ulmus americana 'Frontier'*)

■ Note: the use of three different cultivars of London Plane (*Platanus x acerifolia 'Yarwood', Bloodgood', and 'Columbia'*) is recommended to provide genetic diversity and reduce the susceptibility to tree diseases.

Gateway Medians:

- between Alma Street and access road to the Stanford Shopping Center: Coast Redwood Trees (*Sequoia sempervirens*)
- between Monroe Drive and Cesano Court: Coast Redwood Trees

Existing 'Specimen' Trees in Medians:

- Retain significant stands of Italian Stone Pines (*'Pinus pinea'*), Canary Island Pines (*'Pinus canariensis'*), some large diameter Ginkgo Trees (*'Ginkgo biloba'*), and any existing Oak Trees in medians throughout the Stanford street segment.

5.4.2 Recommended Tree Planting Practices

Dr. Joe McBride, the Consultant Team's arborist and forester, and the City's forestry staff conducted tree root explorations to determine why many of the London Plane trees planted along El Camino Real in 1984-85 have exhibited slow rates of growth (see Appendix for the full report). The following conclusions can be drawn from this analysis: (1) future tree planting must consider the differences in the soils along El Camino real as they effect tree growth and mitigate soils as needed, and (2) remedial action needs to be taken in the case of existing trees to improve soil condition for tree growth. The following is a summary of the key recommendations contained in the more detailed report which has been prepared for this study (See Appendix .)

- Ten soil types occur along El Camino Real (*see Figure 4.28 in Chapter 4.1.4 on page 4.11*). Four of these soils (Clear Lake clay, Dublin clay loam (adobe), Pleasanton clay loam, and San Ysidro clay loam) have subsoils which interfere with water infiltration and in some cases with root penetration which will retard the growth of the trees.

New Tree Planting

Future tree planting on these soils will be enhanced by the excavation of larger volumes of the native soil and its replacement with more permeable fill soil. Urban (1989) has suggested a minimum soil volume of 100 cubic feet for larger trees such as London Plane. To the extent possible, this volume of soil should be provided for sidewalk trees along El Camino Real where some of the native subsoils restrict root penetration or impede water infiltration. Where redesigned sidewalks can provide space, a minimum tree well of 4-foot by 6-foot dug to a depth of 3 foot will provide 72 cubic feet of soil volume. Kopina (1985) found that cubic feet was adequate (but not optimum) for the growth of large trees. (*see Figure 5.54*)

- Clay pans result in the slow rate of water infiltration in two of the four soils identified above. These are the Dublin clay loam (adobe) and the San Ysidro clay loam. Poor infiltration can be remedied in these soils by boring two 4 to 6 inch diameter drain holes through the hard pan beneath each tree planting well. These holes should be backfilled with medium sand (0.25 to 0.5 mm) or fine gravel. Additional treatments must be installed to ensure proper drainage as described below.
- Drain holes will offer some relief during the dry season by providing space for excess irrigation water. However, they will not be very effective where a heavy textured, compacted-subsoil prevents infiltration of water during the rainy season. Larger volumes of fill soil or the development of internal soil drainage can best help alleviate the seasonal high water tables of these soils. Along El Camino Real Pleasanton clay loam and Clear Lake clay are the two soils where heavy textured and compacted subsoils present this problem. New tree wells should be at least 4 foot by 6 foot and 3 feet deep whenever possible when planting new trees in these soil types.

Soil Volume for Various Sized Tree Wells

Planting Space	Soil Volume (cu.ft.**)	% of Ideal for Med. Tree	% of Ideal For Lrg. Tree
Existing Conditions (assuming a depth of 15.2"*)			
2 x 4	10	19%	12%
3 x 3	11.5	21%	14%
3 x 4	15	28%	19%
4 x 4	20	37%	25%
4 x 5	25	46%	31%
4 x 6	30.5	56%	38%
5 x 6	38	70%	47%
5 x 7	44	81%	54%
Target Min.			
4 x 6 x 3 deep	72	133%	89%

* Average soil depth in tree wells along El Camino Real
** Minimum volume needed for medium sized trees = 54 cu.ft.

Figure 5.54: Large-Canopy trees require large soil volumes

- In locations along El Camino Real where a gravel bed was laid down as a part of the expansion of El Camino Real in the early 1960s, it will be necessary to remove this gravel layer and replace it with a sandy loam soil to insure proper root development and adequate tree growth of newly planted trees.

Remedial Action to Improve Health of Existing Trees

Many existing trees along El Camino Real would show increased rates of growth if remedial actions were taken to provide a better root environment. The most effective measure would be to increase the size of the tree wells. Tree wells should be increased to 4 foot by 6 foot where future sidewalk expansion will permit enlarging tree wells. Where sidewalk expansion is not possible the sidewalks should be removed to provide an 8 to 10 foot long planting well with a width that leaves the required ADA width within the sidewalk. The exposed space around the existing tree well should be excavated to a depth of 3 feet and back filled with natural "compaction resistant" sandy loan soils topped with 6 inches of small gravel compacted to 95% Procter density. Appropriate drain holes and aeration tubes should be installed before refilling the enlarged tree wells.

If expanded tree wells are excavated under the adjacent street it will be necessary to use an artificial structural soil composed of aggregate in order to support traffic on the street.

Structural soils are soils made up of angular or rounded aggregate of roughly equal size. These aggregates form a matrix that locks together to provide a structure capable of supporting a load (sidewalk or street) without sacrificing the spaces between the aggregates. Structural soil not only provide for greater load bearing, they also often improve soil drainage and soil aeration.

Along some section of El Camino Real there is a gravel layer at a depth of 12 inches dating from the expansion of El Camino real in the 1960s. For these trees that were planted over this gravel layer it is recommended that four holes (4 to 6 inches in diameter) be drilled through this layer and filled with sandy loam. These holes will allow roots to reach native soil beneath the gravel layer. These holes will not be necessary where it is possible to expand the tree wells and remove the existing soil and gravel layer adjacent to the existing tree well.

Irrigation

More summer irrigation is needed to increase the growth of many of the existing trees along El Camino Real. The limited soil volume beneath these trees does not provide for enough soil moisture storage between watering to support adequate growth. If tree wells can be enlarged, as suggest above, more water storage in the root zone can be achieved. An increased frequency of watering is recommended for those existing trees where tree well enlargement may not be possible. More frequent irrigation should improve tree growth on those sites where the water holding capacity of the tree wells is limited. Where soils in the tree wells are poorly drained, less frequent irrigation will help to improve tree growth.

5.4.3 Recommended Approach to Transition from Existing to Proposed Trees

Today many street trees exist along El Camino accommodated in medians as well as in sidewalk locations. This raises the question of how to transition from the existing to the new trees proposed in the tree concept plan described in the previous chapter.

Sidewalk Trees

The fact that most of the existing trees in sidewalk locations are London Plane trees provides the basis for visual consistency during the incremental rebuilding of the street and is one of the reasons why London Plane was selected to remain the signature street tree for El Camino in Palo Alto. Existing London Plane sidewalk trees should be evaluated on a case-by-case basis to determine whether they should be replaced, retained or relocated. Where existing trees have not developed adequately, it is recommended to incrementally replace the existing sidewalk trees with new London Plane trees within a given segment of the street that is rebuilt in the future. Also, where curbs are moved by more than 2 feet, the location of the existing sidewalk trees may not allow for retention of these trees, as they would continue to constrict space available for pedestrian circulation and other sidewalk activities. In addition, only new trees planted in much improved tree wells (as described in the preceding section) will be able to reach crown diameters that significantly shade the paved roadway and otherwise provide their full breadth of environments benefits.

Median Trees

It is recommended to retain the two significant stands of Italian Stone Pines (*'Pinus pinea'*), in the Corridor as well as stands of Canary Island Pines (*'Pinus canariensis'*), some groups of Ginkgo Trees (*'Ginkgo biloba'*), and any existing well-developed Oak Trees in medians throughout the Stanford street segment. These trees have been identified by the community as significant to the 'mental' image of El Camino. If a tree within the stands should fail it should be replaced with a tree of the same species to maintain the overall integrity of the stand.

All remaining existing median trees should be incrementally replaced according to the concept plan as the street is being rebuilt or as medians are being replanted in an advance tree planting effort. Excepted from this rule should be existing median trees that have a diameter (DBH - Diameter at Breast Height) of more than 4 inches and are in good health condition (for health condition see Median Tree Survey conducted for this study). However, when such trees fail in the future they should be replaced with a tree of the species recommended for the respective segment by the concept plan.

5.5 Some Recommendations for Design and Selection of Other Streetscape Improvements

The previous chapters of the Master Planning Study have described the community's goals for a redesign of El Camino and developed design concepts and typical cross sections that would make the desired transformation of the street feasible. There are, however, streetscape design elements that so far have not been addressed in greater detail; these include street lighting, street furnishings, and public art. Without proper consideration of these design elements a redesign of El Camino Real would fall short of its full potential. It should be emphasized that this consideration can most efficiently occur during the design development and detail design phases of the project. However, the following paragraphs summarize some recommendation with regard to design and selection criteria for these above mentioned important streetscape design elements.

A. Street Lighting

Second only to the introduction of canopy street trees, the installation of new roadway and pedestrian-scaled lighting has the most significant potential of any design element to positively impact function and visual appearance of a street.

As described in the Summary of the Existing Conditions Assessment, the only lighting provided along El Camino today is roadway lighting coming from "cobra-head" light fixtures. It is strongly recommended that as part of the future redesign of the street the entire lighting system along the street be changed to include new fixtures for roadway and sidewalk lighting. Fixtures of different styles and designs are available for this purpose. The Consultant Team recommends the following approach:

- Signal poles at street corners that combine lighting, signals, and street signs.
- Install "combined" light fixtures at street corners that feature on a single post a roadway fixture and, at a height between 12 and 14 feet, a pedestrian-scale fixture (see Figure 5.55).
- As the spacing of roadway light fixtures typically ranges between 90 and 110 feet, additional pedestrian-scale fixtures should therefore be provided between road fixture locations. This should occur at a spacing of about every 30 to 35 feet. In addition, the spacing of fixtures should be closely correlated to that of the proposed street trees. This will maximize the aesthetic coherence of the streetscape as well as increase the efficiency of the lighting system.

Light sources of the pedestrian –scale fixtures should not be higher than 14 feet to maximize the light provided for pedestrian under the tree canopy. This dimension is related to the 14-foot clearance required by Caltrans between the roadway surface and the lowest branches of street trees.

It should also be strongly considered to install roadway light fixtures in both sidewalk and median locations to ensure proper lighting of the roadway. If fixtures were only provided in sidewalk locations, the canopies of the closely planted trees in medians may block some of the light from these fixtures that otherwise would contribute to lighting levels on the opposite side of the roadway. A lighting study should be conducted to determine final recommendations on this subject.

The design and color of traffic signal masts and mast arms throughout the corridor should be coordinated with the design and color scheme for roadway/pedestrian-scale fixtures. Examples of the effect of such approach are illustrated in the photo simulations of intersections and crosswalks throughout this report.

As described in Chapter 5.3.4, low in-pavement fixtures (see Figure 5.56) should be installed to provide a wash of light on the median refuge. In addition, a pedestrian-scale fixture should be provided at each median refuge to add general lighting.

Figure 5.55: In a "combined" light fixture, both roadway and pedestrian fixtures share the same pole.

Figure 5.56: Low in-pavement lights could be used to light the median refuge for pedestrians at night.

B. Street 'Furnishings'

Street furnishings such as bus shelters, benches, bollards, trash receptacles and others, have the potential to greatly enhance the experience of the street afforded particularly to pedestrians, bicyclists, transit users. Following are a few general comments and recommendations with regard to street furnishings:

It is important that decisions about the selection of such furnishings are made with the street design as whole in mind. The selected elements should form a group or "family" of furnishings. This does not imply that all furnishings have to come from one manufacturer or need to be of exactly the same style. Rather is it important for all elements to complement one another, to speak one "language". In this context, it is recommended that one color scheme be generated which the can be applied to all furnishings selected for use in the Corridor. The color scheme may involve more than one color, but should be coherently applicable for all streetscape elements. The color scheme should include all lighting fixtures and signal masts and mast arms.

It is recommended that throughout the selection process review of applicable ADA guidelines be consulted in order to assure compliance and costs from the need for later modifications.

Figure 5.57: Benches provide comfort for waiting transit riders and encourage pedestrians to stop and linger in public spaces.

Seating/Benches

Benches or other forms of seating should be integral part of any future bus stop improvements throughout the corridor. In addition, it should be considered to provide additional seating in locations throughout the corridor segments with higher pedestrian activities. Seating could be accommodated in the additional space provided by curb bulb-outs or in the Furnishings Zone of the widened sidewalks. Examples for such seating exist on University Avenue in Palo Alto, on Santa Cruz Avenue in Menlo Park, and on Castro Street in Mountain View. Although these streets have more of a main street character they still can serve as a model for particular locations on El Camino where present and future pedestrian volumes make such amenities desirable and feasible. Although loitering is not an unavoidable consequence of the installation of every bench it is advised that benches/seating not be installed without prior consultation of residents of adjacent neighborhood streets.

It should be noted that the new ADA draft guidelines require that benches/seating comply with new regulations on height and depth of the seating surface as well as the back portion of the bench. 50% of all benches in a given location have to be compliant with these new standards. Where only one bench is provided, it has to be compliant.

Figure 5.58: This array of bollards shows an assortment of simple but elegant options. (source: FairWeather, Inc)

Figure 5.59: Trash receptacles add convenience to pedestrians and can be attractive too..

Bollards

The use of bollards can enhance the pedestrian experience if their location is coherently applied throughout the pedestrian circulation system of the corridor. For instance, curb ramps of crosswalks at T-intersections located at the opposite side from the intersecting street could be highlighted by placements of bollards on either side of the ramp. The same treatment could occur at the mid-block crossing proposed for the block between Embarcadero Road and Churchill Avenue. It should also be considered to place one bollard each at the center of the two edges to the proposed pedestrian median-refuges. The bollards would prevent drivers from making U-turns or other turning maneuvers through this area.

Trash Receptacles

Trash receptacles should be installed at all street corners in areas or at specific intersections with higher pedestrian activity and at two street corners (located diagonally across from one another) outside of such areas. At T-intersection one receptacle should be installed on the side of the intersecting street, the other in a location close to the end of the pedestrian crossing across El Camino.

Figure 5.60: Safe bicycle parking encourages people to ride their bikes for errands, commuting, and fun.

Trash and recycling receptacles should have side doors for content removal. This feature is already required by many municipalities and intended to make content removal more ergonomic. If recycling is desired this could either occur by selecting a combined trash/recycling receptacle or by installing one separate recycling receptacle at each intersection in areas of higher pedestrian volumes.

Bicycle Parking

To further enhance the bicycle experience on El Camino, it is recommended to install bicycle parking facilities where this is desired by individual shop owners or warranted by generally high commercial or employment activity. Uniformly designed bicycle parking should be incorporated in the furnishing zone of the sidewalk or in bulb-outs where such facilities are desired or needed. Different designs for bicycle parking are available and the final selection should occur with involvement of Palo Alto's bicycling community.

Figure 5.61: Tree grates and tree guards can add to the life of the tree and the aesthetics of the streetscape The upper image shows a retrofit tree grate, while the lower shows new construction.

Tree Grates and Tree Guards

A wide selection of well-designed tree grates and tree guards is available. Key criteria in the selection and installation process should be the durability and accuracy of installation with respect to the connection between concrete, steel frame and the grate itself. This connection should remain flush with the surrounding walking surface for many years after the initial installation and therefore warrants particular attention in product selection and installation. Openings in the tree grates should be ADA compliant. The use of tree grates is recommended throughout all 'Urban' segments of El Camino, except where trees along residential frontages are planted in planting strips rather than tree wells. The use of decomposed granite or mulch is not recommended, as this application often leads to untidy conditions around tree wells. Although the use of tree guards is not a necessity (proper tree staking is), they can lend additional character to the streetscape of a particular area It is therefore recommended that the use of tree guards be reserved to commercial and pedestrian activity nodes.

Figure 5.62: A variety of streetscape amenities are proposed for the VTA line 22 BRT Corridor (Conceptual Illustration November, 2001, DKS Associates/Amphion)

Figure 5.63: Wayfinding signage, such as this sign in San Francisco, can improve the pedestrian experience and add to the identity of an area. (source: Forms & Surfaces)

Bus Stop Improvements

Bus stop improvements for Bus Rapid Transit and local bus stops along El Camino are a long-term goal for VTA, pending availability of funding. Palo Alto should approach VTA with the request for close cooperation on the design of the improvements that are likely to include shelters, seating, trash receptacles, and information kiosks. In its coordination with VTA, Palo Alto should emphasize the importance of high quality, well designed shelters and furnishing as well as their proper maintenance. The advertisement panels and signs included with many shelter designs should be sized so as to not dominate the overall appearance of the shelter and be of pedestrian scale.

Signage

It should be considered to create way finding signage particular to the El Camino Corridor. Such special signage could further enhance the street's identity not only for Palo Alto residents but for regional travelers on the street as well. The signage system should be designed such that some signs could be adequately sized to be visible to people traveling. However, the majority of signs should be sized to pedestrian scale and none of the signs should be internally lit.

Figure 5.64: This utility box in Palo Alto was painted as part of a streetscape public art project to add color and interest to the public realm. (source: Palo Alto Public Art Community)

C. Public Art

Public art provides the opportunity to further enhance the experience of all users of the "new El Camino " and should be an integral part of the final designs for the streetscape. While the two gateways present major opportunities for larger scale public art projects, many of the individual design elements of the street present the opportunity for involving public art at a more pervasive level throughout the Corridor, such elements include special paving at crosswalk locations and in bulb-outs, bus stop design (shelters, seating and signage, tree grates and tree guards, railings at median "corrals", special signage, newsracks pedestals or corrals, walls in conjunction with seating and others. Public art should be used to further highlight the more pedestrian active parts of the corridor and perhaps distinguish between different nodes (i.e. the California Avenue node and the El Camino Way triangle) from one another. This will lend another level of detail to the creation of a sense of place, which can also contribute to people's orientation within the Corridor.

Whenever special paving is designed this should occur in coordination with representatives of the disabled community, as there are increasing concerns about some surface treatments not being compatible with special needs of the blind.

6 Implementation & Phasing

This chapter describes suggestions for a decision making, design, and implementation process for moving the *Master Planning Study* for El Camino Real in Palo Alto toward construction *(see Figure 6.2)*.

At this point the uncertainties of the fund-raising and decision making processes do not allow for establishing a concrete timeline for the implementation of the project. However, Figure 6.2 indicates the approximate time, estimated in number of months, needed to complete a set of initial tasks as well as key design and construction steps involved in moving towards full construction. In addition, an initial indication of possible funding sources for each implementation phase is included at the end of each phasing section below.

As a first step toward the transformation of El Camino Real into a street that better serves the goals expressed by Palo Alto citizens and other stakeholders, as described earlier in this plan, the City and Caltrans have cosponsored the preparation of this Master Planning Study. This step concludes with the completion of the master plan document and Caltrans and the City signing on to a Memorandum of Understanding (MOU) about key design elements of the future street and how to proceed with the implementation of improvements to El Camino Real.

6.1 Phase I: Initial Improvements

It is recommended that after completion of the Master Planning Study, work on the project continues on several levels in order to allow timely implementation of the plan with improvements moving forward incrementally. Some key initial improvements would help to move implementation forward. Such improvements include: the re-timing and coordination of existing traffic signals; the interim re-striping of El Camino (without moving curbs) to a 6-lane configuration that result in a continuous set of bicycle lanes; and the construction of model crossing improvements.

Signal Re-timing/Coordination and Corridor Re-striping will:

- Improve the flow of traffic through the Corridor;
- Achieve better 'platooning' of cars, which will in turn begin to ease pedestrian crossings movements at unsignalized, marked crosswalks;
- Improve safety for vehicles as well as pedestrians and bicyclists by beginning to implement 'speed management' concepts in the Corridor to ensure that drivers drive at safe speeds and do not exceed the speed limit;
- Introduce a bike lane throughout the Corridor;

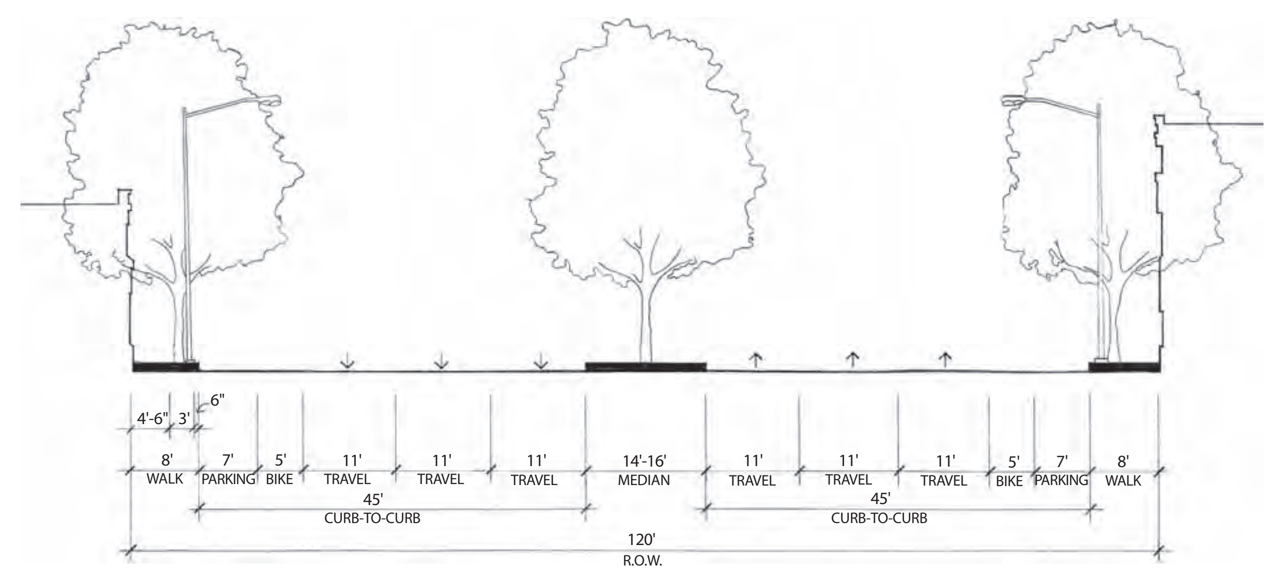


Figure 6.1: The northbound and southbound roadway between existing sidewalks and the median should be re-striped according to the dimensions shown in this cross-section.

El Camino Real Master Schematic Design Plan Implementation and Phasing Diagram

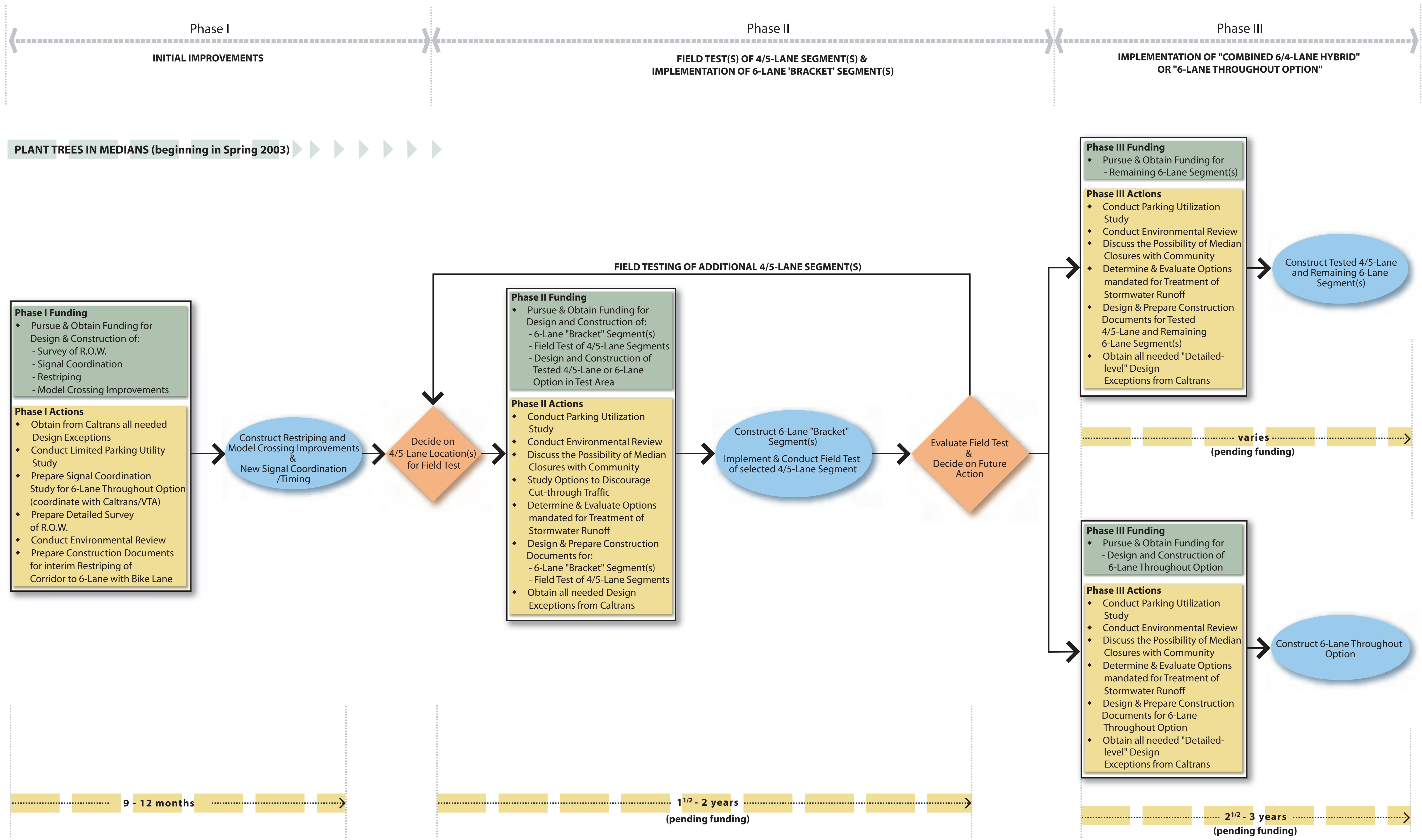


Figure 6.2: Implementation and Phasing Diagram

- Simplify incremental implementation of 6-Lane segments (whether 6-Lane Throughout Option or any of the 6-Lane 'bracket' segments discussed below), because each segment that is built can be easily tied back into the re-striped segments. The approvals process with Caltrans for the re-striping will include most of the exceptions required for a 6-lane fully improved segment. At the same time, a re-striped corridor provides consistency in approach to speed management, lane width, and the presence of a bike lane; and,
- Simplify the execution of field tests for 4/5-lane segments described in the 6/4-Lane Hybrid Options of the master plan for the same reasons as mentioned in the previous paragraph.

Key steps for Phase I include the following:

Step 1: Pursue and obtain funding for additional studies, and design and construction of Initial Improvements;

Step 2: Begin planting new street trees and installation of irrigation improvements in existing medians (Observe any offsets as discussed below under "Related Issues").

Step 3: Conduct a corridor-wide, detailed study for the coordination and re-timing of traffic signals, based on recommendations and findings by Fehr & Peers Associates, to work with the temporary re-striping of the existing roadway to 6-lane with bike lane and VTA bus rapid transit prioritization;

Step 4: Obtain detailed survey and aerial photos of El Camino's right-of-way from Caltrans or commission a civil engineer to conduct a survey (survey is needed for construction documents, including plans for re-striping, within the existing roadway);

Step 5: Conduct a limited Parking Utilization Study to determine where on-street parking may not be needed and thus would allow for implementation of model crossing improvements;

Step 6: Prepare construction documents for re-striping of the full corridor to 6-lanes with a bike lane (without moving curb lines of existing medians and sidewalks). This work should include obtaining all necessary "detail-level" design exceptions from Caltrans;

Step 7: Conduct Environmental Review;

Step 8: Implement traffic signal coordination/re-timing, interim re-striping, and model crosswalk improvements.

Funding for Implementation

Phase I could be funded by the City. Alternate or shared funding through Congestion Management Agency (VTA) and/or MTC should be explored. This project supports the VTA's "Cores and Corridors" concepts and BRT prioritization plan, and MTC's Livable Communities program.

6.2 Phase II: Field Testing

The Concept of Field Testing Improvements

Through discussions with the Advisory and Technical Groups, the Consultants and City Staff are recommending that a set of 4/5-Lane recommended improvements be 'tested.' This is in response to concerns by a segment of the community over whether the recommended improvements indicated by this study will achieve their stated goal, even though the study's technical analysis has indicated that the reconfiguration will allow El Camino Real to function effectively for traffic, while improving its function for pedestrians and bicyclists, and the general quality of life along the corridor.

While the detailed design of the test segments is yet to be determined, it is expected that they would consist of 'temporary' improvements that would simulate what the street would look like when final improvements are made.

Measuring Success of 4/5-Lane Improvements

To test the benefits and other consequences of the 4/5-lane reduction concept, a series of before and after evaluations should be conducted. They should monitor key travel patterns and corridor performance factors under the following circumstances:

1) before implementation of signal coordination and re-timing;

2) following coordination and retiming, but prior to lane reduction;

3) following lane reduction.

Data collection and analysis should address traffic volumes on El Camino and parallel routes; travel times and speeds through the corridor, along individual segments, and on parallel routes; queue lengths and intersection blockages; pedestrian crossing time adequacy; and accident records by type of accident.

The success of the lane reductions would be judged based upon their ability to maintain corridor travel times; reduce maximum speeds, traffic stops, and delays; improve pedestrian crossing intervals; minimize intersection blockages; avoid accident increases; and avoid increased traffic diversion and speeds on parallel routes. The level of success would be based on a comparison between conditions from Case #2 (following lane reduction) to Case #3 (prior to signal coordination and re-timing).

It is, therefore, strongly recommended that every effort be made to install temporary improvements such as wider sidewalks, shorter pedestrian crossings (achieved through installation of curb extensions), and greater opportunity for trees and other landscaping at the highest level of quality possible. For instance, temporary curbs made of concrete would be only marginally more expensive than those made of asphalt. Even curb ramps will have to be made of concrete, whether they are temporary or permanent. Therefore, it should be considered that the entire curb of the bulb-out be poured in concrete rather than asphalt. Also, while new landscaping would not be planted in proposed locations, 'boxed' trees could be set along sidewalks, within medians, and on bulb-outs to simulate future landscaping conditions. This temporary landscaping could be planted in El Camino medians or along other streets in Palo Alto if the test proves unsuccessful and they are not used for permanent landscaping.

Field Testing of 4/5-Lane Improvements and Implementation of 6-Lane 'Bracket' Segments

It is recommended that fully improved 6-Lane 'bracket' segments be built in conjunction with particular 4/5-Lane field test segments. These fully rebuilt 'bracket' segments of 6-lane roadway (applying the Urban and Stanford 6-Lane cross sections) will provide a tangible illustration of the level of improvement that can be expected throughout the entire Corridor in terms of landscaping, pedestrian median refuges, pedestrian lighting, street furnishings, etc. regardless of the number of travel lanes within a segment. Figure 6.3 illustrates the locations of potential field tests and 'bracket' segments. Phase II would consist of the following key steps:

Street Concept Plan: Potential 6-Lane 'Bracket' Segments and Areas of Potential Field Tests

Existing 6-Lane Roadway	Areas for Potential Field Testing of 4/5 Lane Segment (Config. A)
6-Lane 'Bracket' Segments recommended for implementation with possible field tests	Areas for Potential Field Testing of 4/5 Lane Segment (Config. B)
Major Commercial Activity Area	

N

Not to Scale

EL CAMINO REAL MASTER SCHEMATIC DESIGN PLAN

A JOINT PROJECT OF THE CITY OF PALO ALTO & CALTRANS

CONSULTANT TEAM: Community Design + Architecture • Fehr & Peers Associates • Reid Ewing • Joe Mc Bride • LCC, Inc. • Urban Advantage

Figure 6.3: "Bracket" Segments and Areas of Potential Field Tests

Step 1: Determine which potential 4/5-Lane Segment(s) to put to a field test. Basic choices include the following:

- Test southern 4/5-Lane Segment (between Los Robles and Maybell) as per Configuration A and build fully improved 6-lane 'bracket' segment to the south between Maybell and Adobe Creek;
- Test northern 4/5-Lane Segment (between Park Blvd. and California Ave.) as per Configuration A and build fully improved 6-lane 'bracket' segment to the south between California Ave. and Acacia Ave;
- Test and build both of the above.

Step 2: Pursue and obtain funding for design and construction of the 6-Lane 'Bracket' Segment(s), the Field Test, and the construction of 4/5-Lane or 6-Lane segment in the test area (which is dependent on the outcome of the field test);

Step 3: Undertake special studies to inform the design of the selected improvements, including:

- Conduct a limited Parking Utilization Study to determine where in the 'bracket' and test segments on-street parking on El Camino is needed today and in the future. This study will be used to determine where, if any, parking can possibly be eliminated to allow for wider sidewalks. The study will provide the opportunity for specific input from businesses and property owners along El Camino and from adjacent residents;
- Initiate discussions with neighborhoods adjoining El Camino about the possibility of continuing some medians through intersections (median closures), particularly 'T' intersections, in favor of additional tree planting in such medians; and,
- Determine and evaluate options for the treatment of storm water runoff from El Camino Real mandated by the Urban Run-off Pollution Prevention Program ('bracket' segments only).
- While the analysis of the alternative design concepts has indicated that the redesign of El Camino Real would not encourage cut-through traffic in neighborhoods, there may be a constituency that does not believe this analysis. Therefore, it would be prudent to study options for discouraging cut-through traffic in neighborhoods adjacent to El Camino Real, including traffic calming measures on neighborhood streets, restricting some turning movements, etc.

Step 4: Design and prepare Construction Documents. This work should include obtaining all necessary "detailed-level" design exceptions from Caltrans;

Step 5: Implement Field Test Improvements and construct 6-Lane 'Bracket' Segment(s); and,

Step 6: Gather needed data for selected 'test package' and decide on future action.

Funding and Implementation

Pursue broad range of funding from VTA, MTC, possibly from the State (State budget issues make near-term provision of funding more uncertain than typically) and other funding sources. City contributes matching funds.

6.3 Phase III: Incremental Construction of Option Adopted after Field Test

The possible outcomes of the first Field Test have a bearing on the work that would occur in this Phase. The following list includes the most likely possible test outcomes:

- Tested 4/5-Lane Segment is not approved for implementation and it is decided to go ahead with the 6-Lane Throughout Option instead.
- Tested 4/5-Lane Segment and remaining 6-Lane Segments are approved for implementation;
- Tested 4/5-Lane Segment is successful, yet the decision is made to field test additional 4/5-Lane Segment(s) proposed in Configuration A or B of the Hybrid Option; or the tested 4/5-Lane Segment is not approved, yet the testing of other 4/5-Lane Segment(s) proposed in Configuration A or B of the Hybrid Option is desired.

6.3.1 Tested 4/5-Lane Segment is not Approved for Implementation: Build 6-Lane Throughout Option

If the 6-Lane Throughout Option is chosen Phase III would consist of four key steps:

Step 1: Pursue and obtain funding for design and implementation of the remaining segments of the 6-Lane Throughout Option;

Step 2: Undertake special studies to inform the design of the selected improvements, including:

- Conduct a Parking Utilization Study to determine where on-street parking on El Camino is needed today and in the future. This study will be used to determine where, if any, parking can possibly be eliminated to allow for wider sidewalks. The study will provide the opportunity for specific input from businesses and property owners along El Camino and from adjacent residents.
- Initiate discussions with neighborhoods adjoining El Camino about the possibility of continuing some medians through intersections (median closures), particularly 'T' intersections, in favor of additional tree planting in such medians.
- Determine and evaluate options for the treatment of storm water runoff from El Camino Real mandated by the Urban Run-off Pollution Prevention Program.

Step 3: Design and prepare Construction Documents for this Option. This work should include obtaining all necessary "detailed-level" design exceptions from Caltrans; and,

Step 4: Construct 6-Lane Throughout Option (this may occur incrementally).

Funding and Implementation

Pursue broad range of funding from VTA, MTC, possibly from the State and other funding sources, including federal funds. City contributes matching funds.

6.3.2 Tested 4/5-Lane Segment(s) and Remaining 6-Lane Segments are Approved for Implementation

Phase III for this Option would consist of the following key steps:

Step 1: Pursue and obtain funding for Design and Implementation of the remaining 6-Lane Segments;

Step 2: Undertake special studies to inform the design of the selected improvements, including:

- Conduct a Parking Utilization Study to determine where in the 6-Lane and test segments on-street parking on El Camino is needed today and in the future. This study will be used to determine where, if any, parking can possibly be eliminated to allow for wider sidewalks. The study will provide the opportunity for specific input from businesses and property owners along El Camino and from adjacent residents.
- Initiate discussions with neighborhoods adjoining El Camino about the possibility of continuing some medians through intersections (median closures), particularly 'T' intersections, in favor of additional tree planting in such medians; and,
- Determine and evaluate options for the treatment of storm water runoff from El Camino Real mandated by the Urban Run-off Pollution Prevention Program.

Step 3: Design and prepare Construction Documents for this Option. This work should include obtaining all necessary "detailed-level" design exceptions from Caltrans;

Step 4: Construct tested 4/5-Lane Segment and remaining 6-Lane Segments (this may occur incrementally).

Funding and Implementation

Pursue broad range of funding from VTA, MTC, possibly from the State and other funding sources, including federal funds. City contributes matching funds.

6.3.3 Field Testing of Additional 4/5-Lane Segment(s)

If it is decided to conduct field testing of additional 4/5-Lane Segments and the tested segment is approved, fund raising, design, and construction steps for implementation of the approved 4/5-Lane Segment should move forward while the selected additional 'test package' loops through Phase II and eventually into Phase III.

If it is decided to conduct field testing of additional 4/5-Lane Segments and the tested segment has not been approved the process would loop back into the selection of an additional 'test package' from where it would run through the steps of Phase II and Phase III as outlined above.

6.4 Issues Related to Phasing

6.4.1 Planting of new Trees

A. In Sidewalks

Planting of new trees in sidewalks should only occur when a segment of El Camino is reconstructed as a final improvement of 'bracket segments' or other fully reconstructed street segments, when adequate growing conditions can be provided for a broad canopy trees. An exception may be trees planted in sidewalks as part of streetscape improvements required in conjunction with development projects on the corridor. In such cases trees should be planted in proper 4 x 6-foot tree wells. When the respective street segment is rebuilt the trees may be moved into the desired location within the widened sidewalk, if feasible.

B. In Medians

Planting of trees in medians could occur within existing curbed medians. It is recommended that trees not be planted in existing medians located within potential 5-lane segments identified in the Master Planning Study. However, if plantings in the two potential 5-lane segments should be necessary, it should occur in accordance with the recommended offsets from the centerline of the existing medians as spelled out in the master plan. In all medians along the Stanford Campus, a one-foot off-set from the current median centerline toward the east should be observed to account for the slight shift of the centerline in the proposed cross sections for this segment of the street.

6.4.2 El Camino Real North of the Medical Foundation

Given that the majority of this section of El Camino Real has recently been reconstructed initial work should include re-striping as proposed in cross section Stanford 6 in order to provide a continuous bicycle lane on El Camino and to support the speed management goals of the Master Planning Study. Rebuilding of this segment does not have the same priority as the remainder of Corridor and can occur at later point. However, it should be noted that bicycle lanes cannot be accommodated throughout El Camino's University Avenue overpass section for lack of available roadway width between the bridge supports. An alternative accommodation along the access ramps to University Avenue should therefore be pursued (see discussion in **Chapter 5.3.3)**

6.4.3 Additional Studies

A. Design-level Exceptions

Caltrans requires 'Design Exceptions' for all roadway design elements proposed for a given project that deviate from standard dimensions or characteristics (or ranges thereof) as described in the Highway Design Manual. Two levels of design exceptions can be granted at the planning or detail design level, with the latter being the more common of the two. Planning-level design exceptions can be granted during the schematic planning stage of a project while detail design-level exceptions can only be granted as part of a Project Study Report or Project Report.

All key design elements proposed for El Camino that need a design exception have been discussed and coordinated with Caltrans as part of this project. However, the level of planning, design, and analysis undertaken in the study did not allow for every one of these elements to be taken through the design exceptions process. It is therefore recommended that the City of Palo Alto continue working with Caltrans on all needed design exceptions that can be granted at the planning-level. As improvements are proposed and designed in more detail the City and the project designers will work with Caltrans to receive exceptions that can only be granted for elements that are designed in detail. For instance, the reduction of the typical travel lane from 12 feet to 11 feet will require a design exception, even though many examples of such lane width exist within the state highway system. This design exception can be made at the planning level. This exception is integral to all of the design proposals for this plan, because the narrower lanes allow for the width of the street to be allocated to other elements, such as medians, sidewalks, and bicycle lanes.

The *'Design Exceptions Matrix'* in the appendix lists all key design elements and indicates whether a planning or detail design-level exception is needed for its implementation.

B. Environmental Review

Environmental review will be a required step for the implementation of each phase of the El Camino improvements project. City staff and/or the designer of the street improvements would prepare an environmental checklist and depending upon the outcome of this either prepare a negative declaration of no significant environmental impact or move forward to prepare an environmental impact report (EIR per CEQA standards), and if federal funds are used an environmental impact statement (EIS per NEPA standards).

C. Parking Utilization Studies

One area requiring further analysis is the actual utilization of on-street parking along portions of El Camino. Field visits have indicated that on-street parking is heavily utilized in certain areas, such as the commercial areas adjacent to California Avenue, and not highly utilized in others. It is therefore recommended that parking utilization surveys be conducted for segments of the street as they enter the detailed design process described earlier in this chapter.

This utilization study would analyze a number of factors. First, the parking occupancy would be calculated to estimate the number of excess parking spaces and their location. Second, the use of the parking spaces would be studied further. For example, parking of cars for sale occasionally occurs along the curb adjacent to the Stanford University Athletic Fields. As part of this process, the use of parking spaces for long-term parking or storage would be evaluated. Third, the future parking demand will be estimated. This future demand would be based on the existing demand, the future zoning, proposed developments, and other factors.

A focused parking study will also provide opportunities for discussions with property owners and businesses that are adjacent to the areas being studied, as well as meetings with residents of the neighborhoods adjacent to El Camino Real.

Based on this parking analysis, recommendations would be made regarding where parking would be maintained, provisions for parking meters and/or time limits on parking, and any locations where parking could be removed. This parking information would then be incorporated into the final design studies.

D. Neighborhood Traffic Studies

Another additional study would be an analysis of any traffic diversion into adjacent neighborhoods that might result from changes on El Camino Real. These neighborhood traffic studies could be conducted as detailed designs are prepared for segments or concurrently with field-testing that would occur on El Camino Real.

A major element of these traffic studies would be data collection along parallel and diversion routes. These routes could include:

- Alma
- Middlefield Road
- Waverly/Cowper
- Churchill
- College Terrace roadways (College Avenue, California Avenue, etc).

Please note that the analysis undertaken in this study has not concluded or shown evidence that any of the specified changes to El Camino Real would increase traffic on these or other routes. This study has concluded that any diversion is unlikely to occur given the recommended improvements such as the signal re-timing and coordination along El Camino Real.. However, monitoring for any potential diversion would be prudent given the desire of policy makers to minimize impacts on residents.

A comprehensive data collection effort should occur concurrently with any construction of improvements to monitor for potential impacts. This data collection effort would occur during any significant modifications including the construction of the four-lane test segments or other physical improvements.

This monitoring effort would include before and after traffic counts (peak hour intersection counts), daily traffic counts (selected roadway segments), and comparative travel time studies. To assuage resident concerns the actual design of the monitoring effort should be coordinated with citizen representatives. If significant impacts do occur, the City would then prepare a neighborhood traffic calming plan to redirect additional traffic back to El Camino before proceeding with permanent implementation of the lane reductions or median closures on El Camino Real.

E. Potential Median Closure Studies

The southern half of the Corridor is characterized by the occurrence of T-intersections and their left-turn pockets. Many of the side streets are local residential streets. In several locations the frequency of this condition diminishes the consistent appearance of the center median, i.e. between Fernando and Ventura Avenues. Therefore, the design explorations conducted for this study looked at the benefits and general possibility of continuing some of the raised medians through such intersections. The exploratory designs showed that closing the gaps at T-intersections (hence 'median closures') would allow for a significant number of additional trees to be planted in <u>wide</u> medians, which in turn would enhance the visual consistency of the raised median in this area.

However, it was also recognized that median closures would also:

- reduce direct access to side streets, and
- result in U-turns at intersections beyond the location of the median closure.

It was not possible as part of this study to determine the traffic impacts that altered circulation patterns would have on intersections on El Camino and streets within adjacent neighborhoods. It is therefore recommended that the possibility of median closures be explored further as part of the final streetscape design process. This process should include representatives of adjacent neighborhoods and their residents and will require additional traffic studies to help the community determine whether median closures are acceptable at a specific location.

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7 Order of Magnitude Cost Estimates

The Consultant Team has prepared 'order-of-magnitude' cost estimates for the El Camino Real improvement options. The estimates are intended to provide elected officials, city staff, and the public with an initial understanding of costs involved with undertaking the improvements described in the "Master Planning Study."

7.1 How the Cost Estimates were Prepared

For each cross section a detailed estimate was made for a one foot long segment of the street section. One foot of each type of curb, one square foot of sidewalk, pavement or landscape area for each lineal foot of each item as it occurs in the cross section was totaled and multiplied by the appropriate cost per foot and summed to produce a cost per linear foot of roadway section.

For features that do not appear in each linear foot of roadway, such as trees or light standards, a 300-foot long interval of each typical section was used to calculate an average per linear foot cost. The number of features that occur in that 300-foot segment were counted and multiplied by their appropriate unit costs. The total cost for those features was then divided by the 300-foot length to determine a cost per linear foot of cross section.

A separate computation was made for curb bulb outs using similar methods. A cost per lineal foot for a cross section including bulb outs on both sides was computed. The typical cost per linear foot for a cross section without bulb outs (estimated per above) was subtracted. The difference was the estimated additional cost per linear foot of cross section with bulb outs on both sides.

The estimated costs per linear foot for each different cross section was then applied to the length of each cross section as it occurs in each of the design options for El Camino Real to determine the estimated costs for the entire option. The costs of a typical intersection, excluding traffic signals were also calculated. The cost per linear foot cost for the street within the intersection was calculated and compared to the linear foot costs for the typical cross sections. Since the costs per linear foot of El Camino through the intersection were comparable to the costs per lineal foot for the typical sections, we did not make an adjustment for cost differential through intersections.

For the purpose of estimating the approximate cost per linear foot of street subject to field testing, a mid-level set of improvements was assumed. This included the installation of temporary curbs at sidewalks and medians, temporary drainage, temporary bulb-outs with curb ramps, and the placement of additional trees in boxes or planters. The total cost for each field test segments was calculated in the same way as for the permanent improvements discussed above. More or less costly sets of temporary improvements are conceivable, but were not considered here.

7.2 Order-of-Magnitude Cost Estimates for Initial Improvements, Field testing and Key Design Alternatives

Following is an outline of the results of the order-of-magnitude cost estimates for rebuilding El Camino Real using the approach described above and the designs proposed in the Master Plan. All figures are in 2003 dollars and include a 30% contingency on capital cost items (excluding any "soft" costs such as design and engineering). Using this relatively high contingency is justified by the built up nature of this urban corridor, where potential complicating factors can result during detailed design and final Caltrans review, and where currently unknown conditions including, r.o.w. encroachments, or conditions can complicate the engineering and construction stages. It should also be noted that the overall cost figures for the alternative options include a significant amount for the construction of a completely new lighting system (roadway and pedestrian) throughout the Corridor.

All presently anticipated "soft" cost items, such as surveying, a signal timing study and its implementation, a parking utilization study, and design and engineering were accounted for after the 30% contingency was applied to the subtotal of all capital improvement costs.

The following order-of-magnitude cost estimates address:

- Overall Cost for Alternative Options: 6-Lane Throughout Option, 6/4-Lane Hybrid Option – Configurations A & B;
- Cost for Initial Improvements;
- Approximate Cost for Field Tests; and
- Cost for individual recommended "Bracket Segments' (See Chapter 6.2.)

A. Alternative Options: 6-Lane Throughout or 6/4-Lane Hybrid Options

	OVERALL COST FOR ALTERNATIVE OPTIONS		
	6-Lane Throughout Option (w/o Segment North of University Avenue)	6/4-Lane Hybrid Option Configuration A (w/o Segment North of University Avenue)	6/4-Lane Hybrid Option Configuration B (w/o Segment North of University Avenue)
Total of Capital Cost Items	$ 29,950,000	$ 30,350,000	$ 30,800,000
Total of "Soft" Costs Items	$ 2,350,000	$ 2,500,000	$ 2,450,000
Subtotal	***$ 32,300,000***	***$ 32,850,000***	***$ 33,250,000***
30% Contingency on Capital Cost Items	$ 8,985,000	$ 9,105,000	$ 9,240,000
Rounded Total	**$ 41,300,000**	**$ 42,000,00**	**$ 42,500,000**

All cost figures in this table are in 2003 dollars.

This includes the following key items:

- Additional Survey of Detail Features;
- 2nd Signal Timing Study and Implementation of Re-timing;
- Parking Utilization Study;
- Design and Construction Drawings for fully improved Option;
- Utility Add-on for the relocation of some existing utilities between Maybell and Adobe Creek.
- Construction of fully improved 6-Lane Throughout or 6/4-Lane Hybrid Option.

B. Initial Improvements

	COST FOR INITIAL IMPROVEMENTS
	Initial Improvements
Total of Capital Cost Items	$ 850,000
Total of "Soft" Costs Items	$ 350,000
Subtotal	***$ 1,200,000***
30% Contingency on Capital Cost Items	$ 255,000
Rounded Total	**$ 1,450,000**

This cost includes the following key items:

- Initial survey and aerial;
- Signal Coordination Study and Implementation of Signal Re-timing;
- Limited Parking Utilization Study;
- Design and construction drawings for re-striping and model crosswalk improvements at one intersection;
- Construction of model crosswalk improvements at one intersection; and
- Re-striping of the entire Corridor and scraping off the old markings from the roadway surface (resulting in a cost at the lower end of the range given above); <u>or</u>
- Re-striping of the entire Corridor and covering of old markings by applying a thin layer of asphalt across the entire roadway surface (resulting in a cost at the higher end of the range given above).

C. Estimated Cost for Possible Field Tests

	APPROXIMATE COST FOR FIELD TESTS	
	Field Test between Park Blvd./California Avenue	Field Test between Los Robles/Maybell
Total of Capital Cost Items	$ 660,000	$ 460,000
Total of "Soft" Costs Items	$ 80,000	$ 50,000
Subtotal	***$ 740,000***	***$ 510,000***
30% Contingency on Capital Cost Items	$ 198,000	$ 138,000
Rounded Total	**$ 940,000**	**$ 650,000**

This cost includes the following key items:

- Additional Survey of Detail Features;
- Limited Parking Utilization Study;
- Design and Construction Drawings for Field Test Segment(s);
- Implementation of 4/5-Lane Field Test(s).

D. Estimated Cost for Recommended 'Bracket' Segments

	COST FOR 'BRACKET' SEGMENTS		
	Bracket Segment north of Churchill Ave.	Bracket Segment between California/Acacia Ave.	Bracket Segment between Maybell/Adobe Creek
Total of Capital Cost Items	$ 2,000,000	$ 3,600,000	$ 4,200,000
Total of "Soft" Costs Items	$ 150,000	$ 270,000	$ 310,000
Subtotal	***$ 2,150,000***	***$ 3,870,000***	***$ 4,510,000***
30% Contingency on Capital Cost Items	$ 600,000	$ 1,080,000	$ 1,240,000
Rounded Total	**$ 2,750,000**	**$ 4,950,000**	**$ 5,750,000**

This cost includes the following key items:

- Additional Survey of Detail Features;
- Design and Construction Drawings for 'Bracket' Segment(s);
- Implementation of 'Bracket' Segment(s)
- Utility Add-on for the segment between Maybell and Adobe Creek.