



TRANSPORTATION DIVISION

STAFF REPORT

TO: PLANNING & TRANSPORTATION COMMISSION

FROM: DEPARTMENT: Planning

AGENDA DATE: November 8, 2000

**SUBJECT: EMBARCADERO ROAD TRAFFIC CALMING PROJECT –
PHASE I**

RECOMMENDATION

Staff recommends that the Planning and Transportation Commission find the proposed Base Plan consistent with Programs T-41 and T-42 of the 1998-2010 Palo Alto Comprehensive Plan and recommend that the City Council:

1. Approve in principal a Traffic Calming Base Plan for the Embarcadero Road Traffic Calming Project to include:
 - (a) reduction of two through lanes in each direction to one through lane in each direction with left-turn lanes at intersections, with the exception of maintaining the four-lane section in proximity to Middlefield due to capacity constraints;
 - (b) replacement of traffic signals at St. Francis, Newell and Waverley with one-lane roundabouts; (traffic signals would be maintained at Middlefield, Louis, Greer and Bryant);
 - (c) installation of on-street bike lanes in each direction from Alma to St. Francis, except close to Middlefield;
 - (d) construction of a roundabout on Embarcadero Road at West Bayshore Road as a gateway feature;
 - (e) construction of a raised median in the center of the street; and
 - (f) maintenance of existing parking between St. Francis and Alma.

2. Implement the Base Plan in two phases. Phase I would include a trial implementation, and Phase II would include making the trial installation permanent. Staff would report back to both the Planning and Transportation Commission and Council on the results of Phase I before Council authorizes Phase II. There would be no Phase II until authorized by Council.
3. Direct staff, in conjunction with residents of each street, to prepare traffic calming plans for Channing and North California Avenues. The plans are to be completed before - and their implementation on a trial basis is to begin at the same time as - the trail implementation (Phase I) of Embarcadero Road traffic calming.
4. Endorse in concept the long-term Master Plan recommended by the Embarcadero Road Traffic Calming Advisory Group. Due to its complexity and cost, the Master Plan may require twenty years or more to fully implement. As such, staff does not recommend its implementation at this time.
5. Direct staff to work with the Public Art Commission to integrate public art into the project, both in Phase I and, if implemented, Phase II of this project.

BACKGROUND

Traffic safety has been a Council priority for several years, and traffic speeds have been a citywide issue. In 1995, staff brought to Council several proposals to address citywide traffic issues. The Council approved several of these recommendations, including increased traffic patrols, motorcycles, and citizen radar guns. In addition, the Transportation Division and the Police Department are currently implementing a coordinated traffic safety education and enforcement initiative funded through a grant from the state Office of Traffic Safety.

In November 1995, in response to a memo from Council Members Fazzino, Huber and Kniss (Attachment 1), Council discussed the issue of calming traffic along Embarcadero. Council decided that the most effective way of addressing Embarcadero traffic issues on a long-term basis would be to explore alternatives to change the physical character of the road, so that the roadway would be consistent with the residential areas adjoining it. Alternatives might include narrowing of lanes, median strips, parking bays, landscaping, etc.

Given its complexity and cost, subsequently the funding for planning, feasibility, and schematic design work for developing traffic calming for Embarcadero was included in the 1997-98 Capital improvement Program (CIP). The goal of this project is to reduce the impact of traffic and improve the quality of life along a residential arterial street through physical changes to the roadway environment. Project objectives may be summarized as follows:

1. Reduce traffic speed.
2. Enhance traffic safety.
3. Improve bicycle and pedestrian safety and convenience.

4. Enhance the aesthetic character of the street.
5. Retain the function of Embarcadero as a carrier of through traffic and an important link between Palo Alto and the region's road network.
6. Avoid shifting traffic from Embarcadero to other residential streets. The Embarcadero Road Traffic Calming Project is the first phase of the City's multi-year Residential Arterial Traffic Calming project, which is mandated in the Palo Alto 1998-2010 Comprehensive Plan as follows: "Policy T-30: Reduce the impacts of through-traffic on residential areas by designating certain streets as residential arterials." Program T-41 of the Comprehensive Plan identifies five Residential Arterials: Embarcadero, Middlefield, Charleston, Arastradero, and University. These streets are to be considered for design and construction of physical changes to the roadway for the purpose of reducing traffic speeds.

A Project Advisory Group (PAG) was formed to help evaluate and select a consultant to conduct the study, review and comment on the consultant's work, and provide guidance to staff throughout the study process. The PAG has included the members listed below.

Citizen Members:

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|----------------------|--|
| 1. Rosemary Bednar | Palo Alto Unified School District |
| 2. Joseph Bellomo | Architectural Review Board |
| 3. Phyllis Cassel | Planning and Transportation Commission |
| 4. Yoriko Kishimoto | Resident of Embarcadero Road |
| 5. Iris Kriegler | Duveneck Neighborhood Association |
| 6. Auggie Lavagnino | Palo Alto Unified School District |
| 7. Ruth Lizak | Resident of Embarcadero Road |
| 8. Doug Mueller | Resident of Embarcadero Road |
| 9. Bob Peterson | Architectural Review Board |
| 10. Richard Swent | Palo Alto Bicycle Advisory Committee |
| 11. Alan Wachtel | Palo Alto Bicycle Advisory Committee |
| 12. Judith Wasserman | Public Arts Commission |
| 13. Natalie Wells | Public Arts Commission |

City Staff:

Ashok Aggarwal Transportation Division
 Karen Bengard, Public Works Department
 Ruben Grijalva, Palo Alto Fire Department
 Lynne Johnson, Palo Alto Police Department
 Leon Kaplan, Palo Alto Art Center
 Joseph Kott, Transportation Division
 Virginia Warheit, Planning Division

Following an extensive consultant selection process, including written proposals and oral interviews, Scott Sebastian of Sebastian & Associates was selected to conduct the study.

Michael Wallwork, a nationally know traffic calming expert, is part of the consultant team. Other consultant team members included Michele DeRobertis, a traffic engineer with Wilbur Smith & Associates of San Francisco, and Patrick Siegman, a transportation planner based in Palo Alto. On October 5, 1998, the Council approved an agreement with Sebastian & Associates for the feasibility study and development of a schematic plan.

DISCUSSION

The study is now complete and a draft summary report prepared by the consultant is attached (Attachment 2). An extensive public process was used to develop a Master Schematic Plan as described in the consultants' report. In addition to working with the advisory group closely, two public workshops were held. The first workshop was held January 23, 1999 and the other March 20, 1999. The purpose of the workshops was to share information and seek public input, as well as ensure that community members had an appropriate opportunity to understand the issues and participate in the development of alternative designs for Embarcadero Road. Approximately 870 notices were mailed to the residents of Embarcadero Road, Channing Avenue, California Avenue, Seale Avenue, St. Francis Drive, and Newell Road, as well as every cross street adjacent to Embarcadero between St. Francis Drive and Alma Street. The notice was also placed in the Council packet, and sent to the Planning Commission, Architectural Review Board, Historic Resources Board, and Public Arts Commission; the list of Neighborhood and Community Associations; schools, community groups, and businesses adjacent to Embarcadero; Stanford University; Stanford Hospital; the Palo Alto Bicycle Advisory Committee; and the City/School Traffic Safety Committee. In addition, a press release was issued to the Palo Alto Daily, Palo Alto Weekly, San Jose Mercury News, and San Francisco Chronicle, and an ad run in the Palo Alto Daily and Palo Alto Weekly. Approximately 100 and 60 people attended the first and second workshops, respectively. A similar outreach effort has been undertaken to notify the public prior to the November 8, 2000. Planning & Transportation Commission public hearing on the Embarcadero Road project. In addition, the Transportation Division sponsored two public informational sessions on the topic of roundabouts: a noontime video show and discussion program in the Council Conference Room on June 23, 2000 and an evening slide show, lecture, and discussion program at Cubberley Community Center on November 1, 2000. The draft final report and the Planning & Transportation Commission staff report on the Embarcadero Road traffic calming project has been posted on the Transportation Division web site. Staff has also responded to numerous telephone calls and e-mail notes on the proposed traffic calming plan and related topics.

Existing Situation

Currently the residential portion of Embarcadero between St. Francis Drive and Alma Street has two through lanes in each direction, with left-turn lanes at St. Francis, Newell, Middlefield, Waverley and Bryant. Single residential homes, two parks and two schools border this segment of Embarcadero. The street carries approximately 25,000 vehicles

per day. Embarcadero Road between St. Francis and Newell is 56 feet wide, with parking allowed on both sides. The planting strip in this section is approximately 10 feet wide and has a regular planting of camphor trees. The section between Newell and Middlefield is 52 feet wide and has parking only on the north side in front of Rinconada Park. The section west of Middlefield is 46 feet wide and parking is prohibited on both sides of the street. The planting strip in this section is approximately 5 feet wide and has relatively few trees. While Embarcadero Road carries a substantial amount of bike traffic to and from Palo Alto High School, Walter Hayes School, and recreational biking, no on-street bike lanes exist on Embarcadero. Traffic signals exist at St. Francis, Louis, Greer, Newell, Middlefield, Waverley, and Bryant.

Master Schematic Traffic Improvement Plan

Based on public input, the intent of the project, and Comprehensive Plan policies, the consultant team has developed a Master Schematic Plan. Copies of the Master Plan, contained in the draft final report, are available in the Transportation Division. The Master Plan is also available as part of the draft final report posted on the Transportation Division web site. While there are several references in the consultant's draft report to two alternatives (Alternatives 1 and 2), the two alternatives are essentially the same, with the exception that Alternative 1 has a two-way left-turn lane in the center of the street and Alternative 2 has a raised median with street trees and planting instead of pavement. The Master Schematic Plan is described below and it includes the raised median. The elements of the plan are:

1. Reduction of two through lanes in each direction to one through lane in each direction with left-turn lanes at intersections, with the exception of maintaining the four-lane section in proximity to Middlefield due to capacity constraints (Exhibit 1).
2. Replacement of traffic signals at St. Francis, Greer, Newell, and Waverley with one-lane roundabouts. Traffic signals would be maintained at Middlefield, Louis and Bryant (Exhibit 2).
3. A Roundabout on Embarcadero at West Bayshore Road (Exhibit 3).
4. Installation of on street bike lanes in each direction from Alma to St. Francis, except close to Middlefield (Exhibit 1).
5. Geometric modifications of the intersections to make them intersect Embarcadero at right angles (Exhibit 4).
6. Maintenance of existing parking between St. Francis and Alma, and provision of new bulbouts to protect the parking lanes (Exhibit 2).
7. Installation of new lighting fixtures in order to better illuminate pedestrians.
8. Provision of a raised, landscaped median in the middle of the street (Exhibit 1).
9. Widening of the narrow planting strip east of Middlefield by reconstructing and moving the curb and gutter outwards toward the street, and the sidewalk inwards toward the houses.

Reduction of Lanes

Reduction in the number of through lanes from four to two, is considered essential to (a) provide on-street bike lanes, (b) reduce speeds on Embarcadero Road and (c) maintain parking. While Embarcadero Road carries a substantial amount of school-related (Palo Alto High and Walter Hays School) and recreational bicycle traffic in both directions, no on-street bike lanes exist on Embarcadero. Bicyclists generally use the sidewalks, which is inherently considered unsafe for both pedestrians and bicyclists. On-street bike lanes will improve bicyclist and pedestrian safety. Consideration of on-street bike lanes on Embarcadero Road was also included in the School Commute Corridor Study. In addition to bike/pedestrian safety, reduction in the number of lanes is also considered a speed-reduction measure.

Traffic Impacts of a Two-Lane Embarcadero Road

The traffic analysis for a two-lane section of Embarcadero Road with traffic signals maintained indicates that all of the signalized intersections (except Middlefield, with existing volumes), would continue to operate at a Level of Service (LOS) of D or better, which is acceptable (Exhibit 5). A four-lane section would need to be maintained close to Middlefield for that intersection to continue operating at an acceptable LOS. However, the queue lengths will increase by 300 to 400 percent, resulting in queues of up to 1,000 feet at Waverley, 1,200 feet at Newell, and 1,300 feet at St. Francis (Exhibit 6). While traffic would continue to move through the intersections, staff believes that such long queue lengths would result in traffic shifting to other streets such as Channing Avenue, North California Avenue, etc.

Replacement of traffic signals with roundabouts would reduce these maximum queues approximately in half, to under 500 feet at Waverley and under 600 feet at both Newell and St. Francis. The pattern of queue lengths in a two-lane section with roundabouts would not differ substantially from the pattern for the current four-lane section. Overall queue lengths would shorten somewhat.

The traffic data include analysis for the year 2010 using projected volumes based on the Comprehensive Plan. The 2010 analysis indicates that all of the signalized intersections would continue to operate at LOS D or better, which is acceptable, except for Newell, which will operate at LOS E. The queue lengths would be even longer at Waverley, Newell, and St. Francis, than projected for current traffic volumes. Queue lengths with 2010 volumes would be substantially lower for a two-lane section with roundabouts compared to the same number of lanes with signals. In contrast, year 2010 queue lengths for the two-lane section with roundabouts would be roughly the same for a four-lane section with signals.

While the master plan includes roundabouts at several locations, they are, only essential at Waverley, Newell, and St. Francis to reduce queuing and improving the LOS at Newell from E to D, which would help minimize traffic diversion to other streets. Roundabouts,

due to their nearly continuous vehicular flow, offer greater efficiency than conventional signalized intersections. Replacement of signals with roundabouts generally would result in substantial decreases in seconds of delay, both with existing volumes and with year 2010 volumes. These efficiency improvements would hold both in comparison to the current four-lane section or a hypothetical two-lane section with all signals remaining.

Roundabouts

Roundabouts are proposed for several intersections to (a) reduce speeding, (b) reduce delay and queuing, (c) improve LOS and (d) improve safety. A roundabout is a circular shaped raised island that sits in the middle of an intersection. Entering and departing traffic at each of the four approaches to the roundabout is separated by a triangular-shaped "splitter island" set back from the curb line. This "splitter island" also provides a median refuge for pedestrians. There are between 80,000 and 100,000 roundabouts worldwide. They are most extensively used in Western Europe and Australia. Installations of modern roundabouts in the U.S. are increasing sharply. California examples include roundabouts in Santa Barbara, Petaluma, Davis, and Milpitas. Motorists approaching a roundabout yield to the traffic within the roundabout going in a counter clockwise direction, make a right turn into the traffic flow, and then another right to exit. The number of conflict points at a roundabout is reduced to eight (compared to 32 conflict points at a four-way signal- or stop-controlled intersection), thus reducing the potential for accidents and improving safety. Roundabouts are generally designed for slower speeds, which results in vehicle speeds of 20 mph or less, as well as fewer and less severe accidents. Pedestrian safety is enhanced because (a) the splitter islands at roundabouts, which channel traffic safely into the roundabout, act as refuge islands, (b) pedestrians have to look only one way, (c) the crossing distance is small, about 12 feet, as a person is crossing only half of the street at a time, and (d) the speed is slow. Bicyclists are able to circulate in the roundabouts at speeds equal to or faster than vehicles. The recent Insurance Institute for Highway Safety Study of safety effects of roundabouts, the most comprehensive U.S. analysis to date, found reductions of 39 percent for all crashes, 76 percent for all injury crashes, and about 90 percent for crashes resulting in death or incapacitating injury after roundabouts replaced signals or stop signs at 24 intersections in 8 states (Attachment 3).

While roundabouts seem to have many advantages, they are new. People are generally not familiar with them, which may create initial difficulties. The difficulties may be minimized through good design. While there was strong support for roundabouts during the two workshops, general public acceptance is unknown. Unlike traffic signals, roundabouts do not provide positive right-of-way-control, so that, for example, pedestrians may need to use their judgment and be patient to make sure that drivers are going to stop for them prior to crossing. A recent Atlanta Journal and Constitution article (Attachment 4) contains an excellent summary of the safety, efficiency, and financial effects of roundabouts.

Roundabout at West Bayshore Road

A roundabout on Embarcadero at West Bayshore would act as gateway feature. It would slow the high-speed traffic coming off the freeway exit ramps. It would announce to motorists that the character of the street changes at that point. Given the large amount of right-of-way needed to install a roundabout at this location, it would be possible to do all sorts of entry features, from landscaping to public art. However, any modifications to this area, including modifying the roundabout at St. Francis, will require Caltrans' cooperation and approval, since Embarcadero, east of St. Francis is within the State right-of-way.

Central Median

Continuous raised medians in the center of the street with landscaping and trees have several distinct advantages that are important to meeting the project objectives. Medians are aesthetically pleasing and add to the urban design values of the community. They are used as speed control measures. They tend to reduce left-turn, head-on, and speed-related types of collisions, thus improving safety. Medians facilitate pedestrian crossings by providing refuge in the middle of the street. However, a continuous landscaped median on Embarcadero Road also raises several issues. There may be long-term, high maintenance costs due to planting and irrigation that would require a high level of maintenance. This may be partially offset by savings in maintenance of the paving area replaced by the median. Maintenance vehicles would block the travel lanes next to the median when maintenance work is required, which would force regular traffic to use the bike lanes. Tree roots from mature trees may puncture sanitary sewer lines, which are located in the middle of the street. Should there ever be a need for major utility work, like the work recently conducted on Embarcadero and Middlefield Roads, traffic would be diverted to other streets.

In contrast, the two-way left-turn lane option provides easier access to residential driveways and additional space for directing traffic around traffic accidents, and is preferred by the Fire Department due to better maneuvering room for emergency vehicles. Past experience, however, shows that some drivers use two-way left-turn lanes as passing lanes. Providing small landscaped islands at strategic locations can discourage this type of behavior. However, two-way left-turn lanes are not as effective as a landscaped median in reducing travel speeds or improving safety, and would do very little to enhance urban design aspects.

Geometric Modifications to the Intersections

These modifications would tend to slow traffic as it enters and leaves Embarcadero and reduce the crossing distance on the side streets for pedestrians. This modification could be problematic because it would force through drivers to make a left turn and then an immediate right. It would have minimal safety improvement and speed reduction benefits and would be very expensive to implement due to extensive storm drainage work.

Bulbouts

Bulb outs in the parking lanes, from Newell to St. Francis, would protect the parked cars and reduce pedestrian crossing distances. Similar to geometric modifications, bulbouts would have minimal safety improvement and speed reduction benefits, and would be very expensive to implement due to extensive storm drainage work.

Street Lights

The Master Schematic Plan includes replacing the existing street light poles and fixtures with pole mounted luminaires, similar in design to those used Downtown on University Avenue, and replacing existing monochromatically yellow high-pressure sodium lamps with metal halide lamps. The consultant's scope of work did not include an in-depth study of this issue. The consultant's suggestion raises several issues including lighting levels, aesthetics, maintenance, neighborhood ambience, safety, etc. Lighting is a citywide issue and staff believes that lighting along Embarcadero Road should be studied as part of the citywide issue.

Widening Planting Strip

East of Middlefield, the planting strip is 10 feet wide, and has a regular planting of healthy camphor trees. West of Middlefield, the planting strip is 5 feet wide. So it is narrow and has no buffer between the vehicular traffic and the trees. As a result, the trees in this area are not healthy. Therefore, the consultant's plan includes widening the narrow planting strip by reconstructing and moving the curb and gutter outward toward the street and the sidewalk inward toward the houses. Such a change would cost over \$1 million to design and construct. Staff believes that this improvement would provide minimal benefits and is not essential. The proposed plan includes provision of 5-foot wide bike lanes, which could provide sufficient buffer for the healthy growth of trees. In addition, the existing soil could be replaced with industrial soil for even healthier trees.

Base Plan

As discussed above, all elements of the master plan provide some benefits. However, geometric modifications, parking lane

3. Installation of on street bike lanes in each direction from Alma to St. Francis, except close to Middlefield.
4. Construction of a roundabout on Embarcadero Road at West Bayshore Road as a gateway feature.
5. Construction of a raised, landscaped median in the center of the street.
6. Maintenance of existing parking between St. Francis and Alma.

Phasing

Given the size and complexity of this project, the newness of roundabouts, and concern that lane reduction may cause congestion along Embarcadero Road, thus shifting traffic to other streets, staff suggests implementing the Base Plan in Phases. Phase I would be implemented on a one-year trial basis, and would include restriping the road, thus reducing the number of through lanes from four to two, installation of on-street bike lanes, and construction of roundabouts at Newell, Waverley and St. Francis and a raised, non-landscaped median using temporary materials such as asphalt curbing, as well as covering traffic signal equipment and related signing. During this phase, staff would monitor and collect the necessary data to determine the effectiveness of the Base Plan in calming traffic on Embarcadero Road, and identify any problems associated with it including the possible shift of traffic to other streets. Phase I would also include preparation of traffic calming plan and trail installations of traffic calming measures on Channing Avenue and North California Avenue. While staff does not believe that there will be any significant traffic shift onto these streets due to traffic calming on Embarcadero. Staff recommends these measures as proactive steps to insure that these shifts do not occur. At the end of Phase I, staff would forward an evaluation report to the Council. Following discussion of the evaluation report and Council direction, staff would proceed further to make any adjustments deemed necessary and make the Base Plan permanent or, in at Council direction, discontinue the project.

Issues

Traffic Diversion: Embarcadero Road could be reduced to two through lanes, under the current conditions, with maintaining all the traffic signals. While the average delay and queuing at Bryant, Louis and Greer would be greater than with four lanes, congestion at the intersections would not significantly increase and traffic would not be diverted to other streets. However, long queues would form at Waverley, Newell and St. Francis, likely causing traffic to shift to streets such as Channing and California. Therefore, it is essential to construct roundabouts at these three locations to reduce queuing and likely traffic diversion.

Staff believes that with roundabouts at Waverley, Newell and St. Francis, traffic should not shift to other streets. Nevertheless, staff would monitor traffic conditions before and after implementing changes on Embarcadero, to determine any possible shift of traffic and take appropriate action based on the problem and its extent. In addition, staff will work with residents of Channing Avenue and North California Avenue to develop trial

traffic calming projects for those streets to be implemented at the same time as a trail program begins on Embarcadero Road.

Emergency Response: Embarcadero Road is an emergency response route and must continue to function effectively for police and fire vehicles. Traffic would be able to pull into bicycle lanes and parking lanes to allow emergency vehicles to get by. Fire personnel are concerned that some of the drivers may freeze in the travel lane thus restricting or delaying their passage. Fire personnel prefers a continuous two-way left-turn lane with intermittent medians, to permit added flexibility in getting around any vehicle that fails to yield the right-of-way to emergency vehicles.

Stanford Football and Special Events: The Police Department converts all four lanes on Embarcadero Road, between Middlefield and Alma, to one-way, east- or westbound traffic to handle the excess traffic generated by special events at Stanford. This occurs six or seven times a year. With two lanes on Embarcadero and a median, drivers passing through this corridor would experience an increased amount of delay or shift to other parallel streets, including Sand Hill Road, Oregon Expressway and University Avenue. Staff will need to develop a mitigation program for these events. Such a program would likely include added green time for remaining signals on Embarcadero Road and - in conjunction with Stanford - both encouraging the use of Oregon Expressway as an alternative route and the use of alternatives modes of travel, including public transport, to and from the games.

Embarcadero/Middlefield Intersection: it is essential to maintain all four through lanes, left-turn lanes, and the traffic signal on Embarcadero in the vicinity of Middlefield, due to capacity constraints. This means there would be no on-street bike lanes or raised median in this area. Both Embarcadero and Middlefield carry a large amount of traffic. The intersection would operate at LOS F, which is unacceptable, with two lanes of through traffic and a traffic signal. A one-lane roundabout with two through lanes, similar to other locations, would also cause significant delays to traffic and long queues. A two-lane roundabout with two through lanes would operate at an acceptable LOS and would reduce delays. However, it would require additional right-of-way and encroach into three of the corner properties. Additionally, a two-lane roundabout would be complex, more difficult to negotiate, and larger in size. Therefore staff suggests maintaining four lanes of traffic and the traffic signal on Embarcadero in the vicinity of Middlefield. This issue will need to be re-visited if and when a conceptual plan and feasibility study is undertaken for traffic calming on Middlefield Road.

Probable Outcomes Based on Project Objectives

Speed: Eighty-fifth percentile Speeds in the range of 37 and 38 mph have been recorded in the past on Embarcadero Road. Staff estimates that roundabouts and a continuous landscaped median would reduce this speed by 6 to 7 mph, to about 31/32 mph range.

On the other hand, a two-way left-turn lane with intermittent islands is expected to reduce speeds by 4 to 5 mph, to 33/34 range.

Safety: A total of 119 accidents were reported on Embarcadero Road, between Alma and St. Francis, from January 1, 1995 to December 31, 1997. Of the 119 accidents, 12 accidents occurred mid-block, and the remaining 107 accidents at or close to the intersections and side streets. Of the 12 mid-block accidents, 10 are susceptible to correction by installation of a median. Of the 107 accidents, 28 accidents are susceptible to correction by installation of a roundabout. The total number of accidents susceptible to correction under the base plan would be 35 (10 + 28 minus the 3 at Greer, since the base plan does not include a roundabout at Greer). Normally 100 percent of the accidents susceptible to correction by any engineering solution are not eliminated. Staff expects that 50 to 80 percent of the 35 accidents susceptible to correction by the median and the roundabouts may be eliminated.

Traffic Volumes: Staff does not believe that there would be any substantial shift of traffic to other streets or reduction in traffic volumes on Embarcadero Road as a result of either the master plan or base plan. Technically, traffic shifts to other streets due to long delays, queues or congestion along a certain corridor. As indicated earlier in this report, all the intersections would continue to operate at acceptable LOS and queues due to the proposed roundabouts at Waverley, Newell and St. Francis. Traffic analysis also indicates that, with existing traffic volumes, implementing either of the Base Plan or the Master Schematic Plan would reduce peak hour delay by approximately 37 to 46 percent (not considering the Embarcadero/Middlefield intersection). Year 2010 analysis assumes 14 percent higher traffic volumes, as per Comprehensive Plan projections. For this case both the master and the base plans reduce the delay minimally, and the overall delay would essentially be the same as if the existing signals with four-lane configuration were kept unchanged.

ALTERNATIVES TO STAFF RECOMMENDATION

As an alternative to the Base Plan proposed by staff, the Planning Commission could consider the following:

1. Maintain four lanes on Embarcadero Road, synchronize traffic signals at 25 mph, and install dynamic signs informing motorists that the signals are timed at 25 mph. This is the least expensive alternative. However, it will not affect the current traffic patterns or volumes, improve pedestrian/bicycle safety, or enhance the aesthetic character of the street. In addition, timing the signals at 25 mph does not mean drivers will comply with the progression speed of 25 mph. As a result, this alternative may not reduce speeds between signals on Embarcadero Road.
2. This option is the same as the Base Plan proposed by staff except the continuous raised landscaped median could be replaced with a continuous two-way left-turn lane and

small hardscaped or landscaped islands at strategic locations. This option strives to achieve the project goals at a minimal cost. It would result in further savings in design and construction costs. It will reduce speeding somewhat less than the recommended plan with a median. In addition, replacing the median with a two-way left-turn lane may result in somewhat reduced improvements in bicycle and vehicular safety compared to a median. This is due to the allowance of left turns out of driveways. This option, however, does little to enhance the aesthetic character of the street.

RESOURCE IMPACT

The 1997-98 Capital Improvement Program includes \$125,000 for a planning, feasibility, and schematic design study for calming traffic on Embarcadero Road. The total estimated construction cost, based upon currently developed information for the Base Plan recommended by staff is \$3.1 million and for the Master Plan is \$7.9 million. Inflation, use of any special landscaping, construction materials, artwork, etc., would add further to the construction costs. A breakdown of the construction cost for each of the major design elements for each alternative is shown in below:

Base Plan

	Center Median	Roundabouts	Signing & Striping	Total
Alma – Middlefield	\$501,000	\$362,000	\$70,000	\$933,000
Middlefield – Bayshore	\$583,000	\$1,086,000	\$100,000	\$1,769,000
Total	\$1,084,000	\$1,448,000	\$170,000	\$2,702,000

Estimated Construction Cost = \$2,702,000
 Design Contingencies , 15 percent = \$405,000
 Total Construction cost = \$3,107,000

Master Plan

	Center Median	Lighting	Widen Planting strip	Roundabouts	Geometric Modifications	Signing Striping	Total
Alma – Middlefield	\$501,000	\$373,000	\$978,000	\$362,000	\$412,000	\$70,000	\$2,696,000
Middlefield – Bayshore	\$583,000	\$538,000	-----	\$1,449,000	\$1,508,000	\$100,000	\$4,178,000
Total	\$1,084,000	\$911,000	\$978,000	\$1,811,000	1,920,000	\$170,000	\$6,874,000

Estimated Construction Cost = \$6,874,000
 Design Contingencies, 15 percent = \$1,031,000
 Total Construction Cost = \$7,905,000

- Notes: 1. Does not include design, testing, inspection contract administration, and ongoing maintenance costs
 2. Typical roundabout cost is estimated at \$363,342.

No funds are available for design or construction of any of the schematic design elements on Embarcadero Road or conducting such a study for any one of the other residential arterial streets. In the past, traffic-calming strategies have been funded through gas tax funds (Street Improvement Funds). Subsequent design and construction of improvements to Embarcadero Road, and feasibility studies for the remaining residential arterials, would require substantial financial commitment by the City. However, this project, and a variety of other important projects including the library master plan, a new public safety building and citywide infrastructure needs, exceeds the City's funding capability.

In July 1998, the Council approved a General Fund infrastructure financing and prioritization plan, which indicated that such projects should be funded through general obligation bonds, grants, new or increased taxes, and assessment or special tax districts. Since roundabouts induce lower and more even vehicle speeds--and thus reduce mobile source air pollution in contrast to traffic signals--grant funds may be available through the Bay Area Air Quality Management District to defray the costs of one or two of the proposed roundabouts. The Residential Arterial Streets Traffic Calming Project would need to be financed from one of the above revenue sources.

In addition to the design and construction costs, the project would require management staff resources that exceed the current availability of time, and it will result in increased maintenance costs. It will be necessary for the Public Works Department to retain the services of a project management firm to provide day-to-day staffing needs for this project to oversee the design and construction stages of the project. These outside management services will reduce, but not eliminate, the need for City staff involvement and review during all phases of the project. The design and construction management costs are not included in the construction costs and are estimated to be approximately 16 percent of the construction costs.

This project will result in increased maintenance costs. Such costs include repair and replacement, water, electricity, etc. While the actual cost cannot be determined at present, it is important that the City be committed to securing the necessary staff and/or contract services to provide for the additional maintenance work. It may be important to note that the Insurance Institute for Highway Safety estimates annual savings of up to \$5,000 a year in electricity and maintenance costs when a traffic signal replace

POLICY IMPLICATIONS

The Transportation Element of the 1998-2010 Palo Alto Comprehensive Plan contains numerous policies related to traffic calming including the following Policy and Programs which specifically relate to calming traffic on residential arterial streets.

Policy T-30: "Reduce the impacts of through-traffic on residential areas by designating certain streets as residential arterials."

Program T-41: “The following roadways are designated as residential arterials. Treat these streets with landscaping, medians, and other visual improvements to distinguish them as residential streets, in order to reduce traffic speeds....”

Program T-42: “Use landscaping and other improvements to establish clear “gateways” at the points where University Avenue and Embarcadero Road transition from freeways to neighborhoods.”

ENVIRONMENTAL REVIEW

An Environmental Assessment will be prepared prior to implementation of a Traffic calming Project.

ATTACHMENTS

1. November 1995 Council Memo
2. Embarcadero Road Traffic Calming Project Draft Final Report

PREPARED BY: Ashok Aggarwal, City Traffic Engineer
Joseph Kott, Chief Transportation Official

COURTESY COPIES:

City Council
Project Advisory Group

Prepared by: Ashok Aggarwal, City Traffic Engineer
Joseph Kott, Chief Transportation Official

Division Head Approval: _____
Joseph Kott, Chief Transportation Official