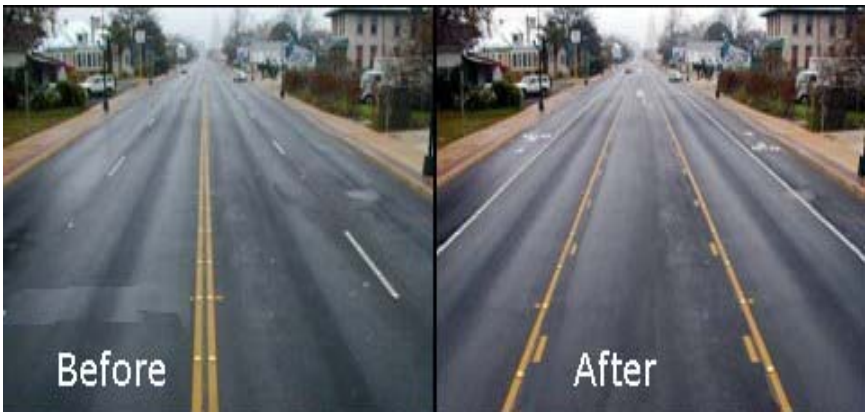
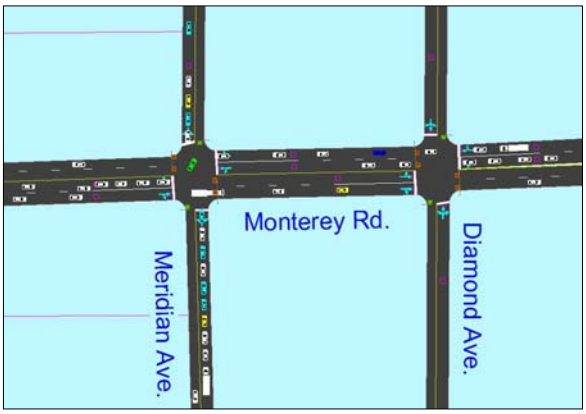
Traffic Study

for the

Feasibility of Road Diet Traffic Calming Improvements on Monterey Road between Pasadena Avenue and Fair Oaks Avenue

City of South Pasadena, CA





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22 Years of Excellence

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Executive Summary

The City of South Pasadena has expressed its desire to redesign Monterey Road between the Metro Gold Line LRT Crossing and Fair Oaks Avenue as a "Complete Street"; that is, one which is less auto-centric and more characteristic of a livable, walkable, and safer roadway that accommodates all modes of transportation. In 2012, a citizen committee commissioned by the South Pasadena City Council, in cooperation with an independent traffic consultant, conducted a study of Monterey Road to identify alternatives for a feasible future design of this segment. The "Monterey Road Committee Recommendations Report" introduced several possible improvements to Monterey Road with mixed unanimity on which measures should be implemented, including adding bicycle lanes, widening the sidewalks, relocating utilities obstructing walkways, implementing traffic calming measures, coordinating traffic signal, and installing higher visibility crosswalks.

Other considerations in the Monterey Road Committee Recommendations Report included adding exclusive left- and right-turn lanes to selected intersections; restricting on-street parking in certain areas; and/or implementing a "road diet" on Monterey Road. Road diets are essentially a reduction in the number of existing travel lanes, and a reassignment/redesign of the remaining roadway space for other safety features such as bicycle lanes, pedestrian crossing enhancements, traffic calming features and/or protected parking lanes/bays. These additional measures, however, were beyond the budget and scope of the Committee's study to analyze thoroughly.

The South Pasadena City Council subsequently approved the go-ahead for a study on the feasibility of a road diet on Monterey Road between Pasadena Avenue and Fair Oaks Avenue. Minagar & Associates, Inc. collected existing traffic data in the field, built a computerized traffic model and tested the effects of two alternative road diet concepts for this segment. The road diet concept would re-stripe the existing street cross-section from two lanes per direction to one lane per direction, and add a center two-way left turn lane, Class-II bikeways (marked bike lanes) and a striped parking lane on both sides of the street.

The results of the traffic model and microsimulation analysis showed that while a road diet on Monterey Road between Pasadena Avenue and Fair Oaks Avenue is geometrically feasible and would provide safety benefits to vehicles, bicyclists and pedestrians, corridor travel times, delay and arterial speeds would worsen during the weekday AM and PM peak hours. Alternative #1, which would implement a three-lane configuration across the full length of the corridor, would result in an average increase in delays by 36% and a 4-MPH decrease in travel speeds.

Alternative #2 would implement the same geometrics as Alternative #1, only on limited areas of Monterey Road west of Orange Grove Avenue and east of Meridian Avenue, while maintaining a four-lane cross-section with bike lanes at mid-segment. While the latter alternative minimizes the potential for peak hour traffic spillovers between adjacent intersections and increases traffic delays by only about 15%, it would also require the prohibition of on-street parking along a major portion of the segment in order to keep a continuous bicycle lane alongside the travel lanes.

Ultimately, while both of the road diet alternatives would negatively impact the travel performance of the corridor for autos during the peak hours, it would nevertheless provide certain offsetting benefits which may be preferred by the City and road users. For motorists accessing the adjacent abutting residential properties, a center two-way left turn lane would provide a refuge area for vehicles to enter or exit the traffic stream on Monterey Road, and reduce the likelihood of certain types of crashes.

For pedestrians and bicyclists, the slower and more consistent speeds of the road diet conversion would be more desirable given that the three-lane roadway would allow for fewer conflict points between vehicles and other, non-motorized users. In addition, providing a dedicated bicycle lane along this segment would serve to meet the goals and policies of the City's General Plan and Bicycle Master Plan by providing a continuous bikeway connection between the west and east segments of Monterey Road.

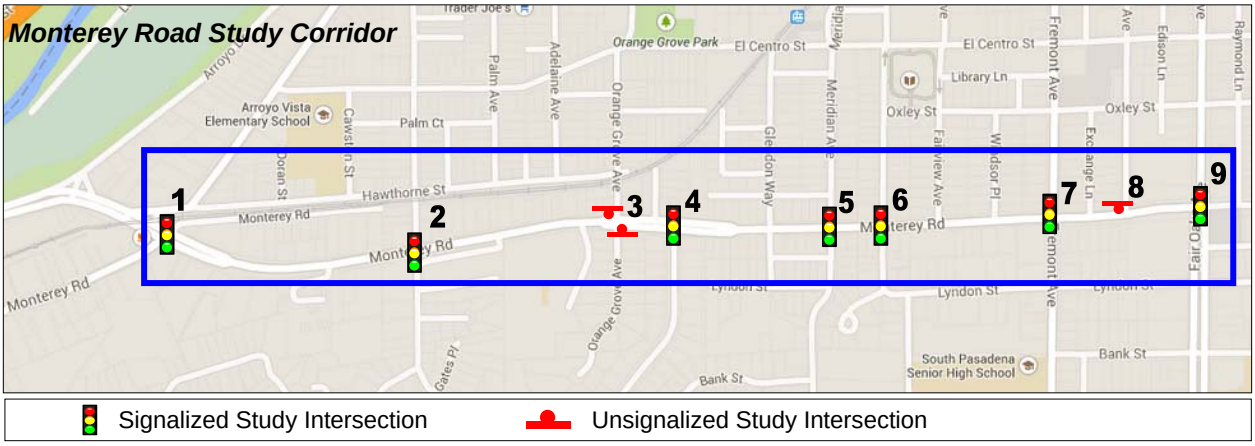
In light of the findings of the traffic study, Minagar & Associates, Inc. recommends that a trial road diet be considered before considering a complete redesign of the street. A basic "test project" of the road diet could be implemented through minimal re-striping of specific, shortened portions of Monterey Road. The project would serve to observe and validate the impacts on peak hour vehicular traffic with the reduced lane configuration, and include a "before and after" study of vehicle speeds, queue lengths, and observations of left-turn and bicycle interactions to determine the level of scalability of the road diet for the remaining portions on Monterey Road.

Introduction

This report summarizes the findings of a traffic study conducted by Minagar & Associates, Inc. which evaluates the feasibility of a "road diet" concept and other traffic calming measures on Monterey Road between Pasadena Avenue and Fair Oaks Avenue. The City of South Pasadena has requested that Minagar identify the potential impacts of re-striping this existing undivided four-lane portion of Monterey Road with a three-lane cross section consisting of a through travel lane in each direction plus a two-way left turn center lane. The study included the development of a representative, computer traffic model and microsimulation to analyze and compare the existing peak hour traffic conditions on Monterey Road with those after the implementation of the road diet configuration. The traffic simulation model was programmed on the basis of both field-collected and city-provided traffic data and measurements. The traffic simulation was then used to identify impacts to travel times, delays, and arterial speeds, and evaluate the possible trade-offs of implementing this type of road diet concept in relation to the mobility, access and safety of road users on Monterey Road.

Study Area

The study area is assumed to consist of the mile-long portion of Monterey Road extending from the intersection at the Metro Gold Line railroad crossing, on the west end, to the intersection with Fair Oaks Avenue, on the east end. The segment connects the adjacent westerly two-lane portion of Monterey Road leading into the City of Los Angeles with the easterly two-lane portion of Monterey Road leading into the neighboring City of San Marino.



Existing Conditions

This section provides a summary of the existing corridor conditions on Monterey Road within the context of the surrounding transportation system. Prior to evaluating potential options for an alternative conceptual cross-section/lane configuration, Minagar & Associates, Inc. staff conducted a field inventory of the existing roadway, roadside and traffic environment across the

study corridor. Traffic volume data collection consisted of 8-hour turning movement counts at nine (9) major intersections on Monterey Road.

Monterey Road is a 2.22-mile long Minor Arterial in the City of South Pasadena, stretching from the neighboring City of Los Angeles at the west city limit to the City of San Marino at the east city limits. Monterey Road is a primary east/west route through the City of South Pasadena connecting with Pasadena Avenue and nearby 110 Freeway to the west, and serving as an alternate route to Huntington Drive and Mission Street. The central 1.1-mile long portion of Monterey Road in the City that spans between Pasadena Avenue and Fair Oaks Avenue is a four-lane undivided roadway that carries an average daily traffic volume of about 15,700 vehicles per day. The street is characterized by a paved roadway width of between 60 and 84 feet, with four undivided travel lanes (two per direction), a striped centerline, and several intermittent raised medians along the wider sections near Fair Oaks Avenue, Via Del Rey, and the Gold Line Crossing.

The current posted speed limit on Monterey Road is 35 miles per hour. Surrounding land uses consists predominantly of mixed density residential properties with abutting driveway access onto Monterey Road, and some commercial uses at the east end of the segment near Fair Oaks Avenue. In determining the feasibility of Monterey for a road diet conversion, several parameters were considered and assessed, including: roadway function and environment; traffic volumes and corridor mobility/performance (e.g., travel time, delay and arterial speed); access points; turning volumes and patterns; frequency of stop and slow-moving vehicles; and pedestrian and bicycle activity.

Passenger Vehicle Traffic Conditions

Minagar & Associates, Inc. collected intersection turning movement traffic counts of passenger cars/autos and trucks at each of the nine study intersections. Several of the study intersections were surveyed by Minagar & Associates, Inc. in 2012 and 2013; consequently, this traffic count data was adjusted upwardly to reflect the current Year 2014 by considering local ambient traffic growth in the City of South Pasadena as well as the latest regional forecasts developed in the Southern California Association of Governments' (SCAG) Regional Transportation Plan.

From the field visits it was observed that auto conditions were generally free-flow along the Monterey Road corridor during the weekday off-peak hours. During the morning and afternoon peak hours, however, traffic conditions become gradually more congested, particularly at the intersections on the easterly end of Monterey Road at Meridian Avenue and Fremont Avenue. The highest time-of-day peak hour occurs during the afternoon, where eastbound/westbound traffic volumes average about 3,000 vehicles.

Table 1 summarizes the general characteristics of Monterey Road from the Metro Gold Line LRT crossing to Fair Oaks Avenue, and provides an estimate of peak hour traffic volumes for each intermediate roadway segment based on the intersection turning movement counts.

Pedestrian Conditions

Pedestrian facilities on Monterey Road are generally adequate, with paved sidewalks provided along both sides of the street, and marked crosswalks provided at signalized intersections and across most unsignalized side streets. There are two uncontrolled marked crosswalks at Orange Grove Avenue directing pedestrians north/south across Monterey Road which do not provide ideal refuge for pedestrians. This intersection, however, is planned for future signalization and will include protected signal phases for pedestrian movements over Monterey Road. A summary of pedestrian crossing volumes through the corridor is shown in ***Table 2***.

Pedestrian crossing volumes at intersections along Monterey Road are moderate during the peak hours. Most of the pedestrian volumes along the corridor are concentrated at intersections with access to major pedestrian destinations such as schools (e.g. South Pasadena High, Arroyo Vista Elementary) and downtown/commercial centers near the east end of the corridor. However, Monterey Road itself does not appear to be not an overwhelmingly bicyclist or pedestrian friendly area due to the number of vehicle lanes that must be crossed, vehicular speeds, the absence of bike lanes, and fewer pedestrian crossing options on the westerly portion of the corridor. The intersections on Monterey Road at Fair Oaks Avenue, Via Del Rey, and the Gold Line Crossing have curb-to-curb crossing distances in excess of 80 feet which require longer walks and signal phases for pedestrians of 20 seconds or more.

Bicycle Conditions

Monterey Road serves primarily as a cross-town regional bicycle route connecting with the existing Class-II striped bike lanes in Los Angeles on Monterey Road and Pasadena Avenue. While Monterey Road is a designated bikeway in the City's Bicycle Master Plan, there are no existing bicycle facilities in place between the Gold Line rail crossing and Fair Oaks Avenue. Bicyclists currently ride in the mixed-flow shoulder lanes due to the lack of a dedicated bike lane on-street and limited options to traverse the city east/west on nearby parallel routes.

In recent years the City has installed marked bicycle lanes on Mission Street and El Centro Street which provide some alternate parallel access routes north of Monterey Road. South of Monterey Road, however, there generally are no parallel bikeway alternatives due to the surrounding topography and alignment of the street network.

Transit Conditions

The Los Angeles County Metropolitan Transportation Authority (Metro) provides bus transit services in the City of South Pasadena. Several Metro bus lines traverse the City, including one Metro Rapid line, a Metro Express line, and other local service routes. Currently, there are no designated local bus routes or stops on this segment of Monterey Road. The nearest Metro Bus Route, Line 176, traverses east/west through the City along Pasadena Avenue and Mission Street and connecting the neighboring Cities of Los Angeles/Highland Park and San Marino.

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Table 1
Summary of Roadway Segment Characteristics and Vehicle Volumes

Street segment: Monterey Road from Metro Gold Line Rail Crossing (west end) to Fair Oaks Avenue (east end)
Length: 5,900 feet (1.12 miles)
General Plan Roadway Classification: Minor Arterial
Average Daily Traffic (ADT) volume: 15,700 vehicles per day
Posted Speed Limit: 35 MPH

Study segments:	Length	Paved Roadway Width	Peak Hour Volume* (PHV, in vehicles per hour)								
			AM Hour			Mid-day Hour			PM Hour		
			EB	WB	Total	EB	WB	Total	EB	WB	Total
1. Gold Line LRT Xing to Indiana Ave.	1,450’	82' to 60'	1,259	1,185	2,444	1,116	966	2,082	1,818	1,596	3,414
2. Indiana Ave. to Orange Grove Ave.	1,150’	60' to 64’	1,317	1,185	2,502	1,036	898	1,934	1,601	1,466	3,067
3. Orange Grove Ave. to Via Del Rey	320’	64' to 80'	1,538	1,434	2,972	845	852	1,697	1,678	1,422	3,100
4. Via Del Rey to Meridian Ave.	890’	80' to 60'	1,629	1,378	3,007	1,075	1,070	2,145	1,802	1,478	3,280
5. Meridian Ave. to Diamond Ave.	300’	60'	1,387	1,281	2,668	1,175	991	2,166	1,620	1,524	3,144
6. Diamond Ave. to Fremont Ave.	960’	60'	1,596	1,461	3,057	1,127	926	2,053	1,836	1,595	3,431
7. Fremont Ave. to Mound Ave.	410’	60'	1,284	1,258	2,542	821	900	1,721	1,506	943	2,449
8. Mound Ave. to Fair Oaks Ave.	420’	64 to 84'	1,013	1,144	2,157	690	851	1,541	1,247	1,022	2,269

Study Intersections	Control	Peak Hour		
		AM Hour	Mid-day Hour	PM Hour
1. Monterey Rd. at Metro Gold Line Xing	Signalized	7:30am - 8:30am	11:45am - 12:45pm	4:45pm - 5:45pm
2. Monterey Rd. at Indiana Ave.	Signalized	8:00am - 9:00am	12:00pm - 1:00pm	4:45pm - 5:45pm
3. Monterey Rd. at Orange Grove Ave.	Two-way Stop	7:30am - 8:30am	11:45am - 12:45pm	4:30pm - 5:30pm
4. Monterey Rd. at Via Del Rey	Signalized	7:30am - 8:30am	12:30pm - 1:30pm	4:45pm - 5:45pm
5. Monterey Rd. at Meridian Ave.	Signalized	7:30am - 8:30am	12:45pm - 1:45pm	4:45pm - 5:45pm
6. Monterey Rd. at Diamond Ave.	Signalized	7:30am - 8:30am	11:45am - 12:45pm	5:00pm - 6:00pm
7. Monterey Rd. at Fremont Ave.	Signalized	7:30am - 8:30am	11:45am - 12:45pm	4:45pm - 5:45pm
8. Monterey Rd. at Mound Ave.	Two-way Stop	7:45am - 8:45am	11:45am - 12:45pm	5:00pm - 6:00pm
9. Monterey Rd. at Fair Oaks Ave.	Signalized	7:45am - 8:45am	11:15am - 12:15pm	4:45pm - 5:45pm

* PHV based on the combination of bi-directional turning movements at major intersections along the corridor during the peak hours

Table 2
Pedestrian Crossing Volumes

Study segments	AM Peak Hour					Mid-day Peak Hour					PM Peak Hour					Total	
	WL	EL	SL	NL	All	WL	EL	SL	NL	All	WL	EL	SL	NL	All	Peds	Count Period
1. Monterey Rd. at Metro Gold Line Xing	-	48	13	17	**78**	-	24	16	2	**42**	-	14	6	0	**20**	385	7 hrs
2. Monterey Rd. at Indiana Ave.	5	9	3	8	**25**	6	7	10	21	**44**	0	17	3	17	**37**	185	6 hrs
3. Monterey Rd. at Orange Grove Ave.	0	0	28	21	**49**	1	6	15	13	**35**	1	0	10	11	**22**	297	8 hrs
4. Monterey Rd. at Via Del Rey	0	11	35	-	**46**	2	0	15	-	**17**	2	9	32	-	**43**	168	6 hrs
5. Monterey Rd. at Meridian Ave.	7	5	29	21	**62**	4	3	6	15	**28**	13	11	19	25	**68**	377	7 hrs
6. Monterey Rd. at Diamond Ave.	103	54	45	84	**286**	12	12	8	27	**59**	15	43	12	3	**73**	622	6 hrs
7. Monterey Rd. at Fremont Ave.	46	42	18	20	**126**	11	22	17	10	**60**	22	34	14	31	**101**	608	7 hrs
8. Monterey Rd. at Mound Ave.	3	1	30	11	**45**	0	2	12	9	**23**	3	0	21	39	**63**	244	6 hrs
9. Monterey Rd. at Fair Oaks Ave.	21	40	23	23	**107**	39	19	16	17	**91**	32	51	26	26	**135**	629	7 hrs

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Metro Local Line 260 and Rapid Line 762 cross Monterey Road in the north/south direction on Fair Oaks Avenue. Express Line 485 also crosses Monterey Road north/south along Fremont Avenue. The Metro Gold Line is a light rail service that runs parallel to Monterey Road (approximately 200 to 300 feet to the north) between the west city limit and Orange Grove Avenue, where the train alignment turns northeastward toward the Metro station at Mission Street and Meridian Avenue.

There is an existing grade crossing and railway signal where the Gold Line crosses between Monterey Road and Pasadena Avenue. The Gold Line runs on 5-minute headways in both directions throughout most of the day and peak hours, and 10-minute headways during the off-peak hours.

Related Plans and Studies

This section includes a summary of key findings from related plans and studies that formed the context for the proposed road diet strategy and other elements of this traffic study.

City of South Pasadena General Plan: *Circulation & Accessibility Element* (Amended February 2001)

- Principal Goals/Vision:
  - Provide for convenient and efficient mobility within the City, while reducing reliance on the automobile as the principal mode of travel.
  - City's policy direction will be to make South Pasadena a place where bicycling and walking are encouraged and fostered.

- Alternative Transportation Modes:
  - The City has identified a need to meet growing demands for safe places to ride bicycles.
  - Bicycle travel in the City of South Pasadena is increasing in popularity as a mode of travel for commuter and recreational purposes.
  - There is also an increasing awareness and desire for travelers to utilize clean-air travel methods, and the acceptance of the bicycle for personal health, exercise, and increased mobility.
  - The City reduce auto conflicts with pedestrians and bicyclists on public street by separating these modes to the extent possible

- Recommended Traffic Congestion Mitigation Strategies:
  - Prioritize the existing street network and promote a multi-mode/low-build concept.
  - Implement traffic calming in residential areas.

- Master Planning of City Streets:
  - Monitor and study existing arterials to determine how capacity can be increased, and how congestion and delay can be reduced.
  - Capacity and operational improvements could include, but are not limited to, signal timing and system upgrades, revised lane configurations, minor intersection improvements such as new turn lanes, traffic calming techniques, and elimination of conflicts such as multiple driveways.
  - The City's adopted street capacity standard should be used when evaluating the impact of roadway capacity modifications as a street improvement measure, and with respect to vehicle interactions with pedestrian, bicycle and transit services.

- Issues:
  - Bottlenecks at key locations in the City.
  - Principal transportation corridors within the City will carry transit vehicles, bicycles, pedestrians and auto traffic, rather than being principal streets for autos only.
  - "Pass through" trips in the City of South Pasadena should be managed and controlled so that they travel on designated routes and do not infiltrate residential neighborhoods
  - Local bike lanes are largely non-existent.
  - Need to coordinate improvements to the existing street network with transit, bike and pedestrian needs.

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City of South Pasadena General Plan: *Circulation & Accessibility Element* (Amended February 2001)

- Goals and Policies:
  - City's policy direction will be to make South Pasadena a place where bicycling and walking are encouraged and fostered.
  - Manage traffic flow into designated corridors.
  - Establish and maintain a citywide traffic count program to assure availability of data needed to monitor other policies and improvements.
  - City's policy direction will be to make South Pasadena a place where bicycling and walking are encouraged and fostered.
  - Manage traffic flow into designated corridors.
  - Establish and maintain a citywide traffic count program to assure availability of data needed to monitor other policies and improvements.
  - Promote traffic signal coordination where feasible to lessen congestion, delay, and to enhance safety.
  - Support the development of additional circulation routes through the City.
  - Develop and maintain a road system that is based upon and balanced with the Land Use Element of the General Plan.
  - Maintain existing pedestrian facilities.
  - Implement the Master Plan of Bikeways over a multi-year timeframe.
  - Provide bicycle connections in the street network system to transit-oriented development, commercial areas and transit stops.
  - Consider and evaluate various Transportation System Management (TSM) techniques and implement as appropriate, such as: Auxiliary (accel/decel) lanes; Intersection improvements such as turn lanes, channelization, and signal coordination; Restriction of peak hour parking; Commuter Information Systems (ITS related strategies).

City of South Pasadena Bicycle Master Plan Update (Adopted August 17, 2011)

- Purpose of the BMP:
  - Make bicycling a viable transportation options and reinforce the City's/region's commitment to multi-modal transportation solutions.
  - Updates the City's previous 2005 Bicycle Master Plan
  - Ensure multi-modal integration by connecting the bicycle network to the Gold Line through bicycle facilities such as lanes and routes.

- Proposed Tier I (short-term) Bikeway Project #8 – Monterey Road
  - Destinations include: Arroyo Seco Stables; Fair Oaks Commercial Corridor; and other areas serving the east/west regional and crosstown bikeway connection.
  - Class II bikeway (striped bike lanes) from the west city limit to Monterey Road/Gold Line.
  - Class III bikeway (shared use lane/bike route) from Fair Oaks Avenue to the east city limit
  - Monterey Road/Gold Line to Fair Oaks Avenue: To be determined; however, the City is committed to establishing a continuous and integrated bikeway facility along the entire Monterey Road corridor within the City. Potential options include CL-2 bike lanes, CL-3 bike routes, protected bike lanes, or a CL-1 cycle track on one side of the roadway.

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California Complete Streets Act (CCSA), per Assembly Bill 1358 (Last updated March 2010)

- State of California Requirements:
  - Local jurisdictions must establish a comprehensive program to reduce greenhouse gas emissions through the implementation of non-motorized transportation plans and developing a more balanced transportation network.

Traffic Signal Warrant Assessment for Monterey Road at Orange Grove Avenue (June 2014)

- Purpose:
  - Determine if the existing unsignalized (two-way stop controlled) intersection of Monterey Road at Orange Grove is warranted and recommended for signalization.
- Findings and Recommendations:
  - The subject intersection is both warranted and recommended for signalization based on California MUTCD warrants considering the prevailing weekday and weekend traffic conditions, pedestrian characteristics and physical characteristics of the location.

Monterey Road Intersection Capacity and Level of Service (LOS) Assessment at Pasadena Avenue, Meridian Avenue, Fremont Avenue and Fair Oaks Avenue (May 2012)

- Purpose:
  - Conduct a traffic assessment to determine the current weekday peak hour levels of service at four major signalized intersections on Monterey Road at Pasadena Ave., Meridian Ave., Fremont Ave., and Fair Oaks Ave.
- Findings:
  - All four (4) study intersections were found to be operating at deficient level of service (LOS) standards "E" or worse during the weekday AM and PM peak hours.

Citywide Engineering and Traffic Survey (E&TS) for the City of South Pasadena (November 2014)

- Purpose:
  - Field validate and update posted prima facie speed limits on City of South Pasadena streets.
- Findings:
  - The 85th percentile speed on Monterey Road between Pasadena Avenue and Fair Oaks Avenue is 40 miles per hour.
  - The 50th percentile speed on the segment is 36 miles per hour.
  - Due to numerous prevailing factors such as the uncontrolled pedestrian crosswalks, adjacent residential land use and frequency of signalized intersections, the .

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Monterey Road Committee Recommendations (August 2012)

- Purpose:
  - Present the recommendations of a South Pasadena citizen's committee for the future design of Monterey Road between Pasadena Road and Fair Oaks Avenue.
- Findings:

  Committee's Top Priorities for future use of Monterey Road:
  - Relatively wide (4-6') sidewalk, free of obstructions
  - ADA-compliant curb ramps
  - On-street bike lanes
  - Coordinated traffic signals

  Recommendations:
  - 1. Provide continuous 4' min. unobstructed sidewalk space, and construct bulb-outs where appropriate to relocate utility obstructions (e.g., vaults, vents, poles, risers) in the pedestrian walkway.
  - 2. Add a bicycle lane on Monterey Road, and restrict parking (or retain on one side only) where appropriate to facilitate bike lanes.
  - 3. Deploy traffic calming measures (e.g., speed feedback signs, textured crosswalks, "pinch" points, signal coordination, etc.) to reduce auto speeds along the corridor.
  - 4. Synchronize traffic signals on Monterey Road
  - 5. Install higher visibility crosswalk
  - 6. Consider additional turn left/right-turn lanes at selected locations (EB Right at Fremont, Indiana, Meridian and Diamond; EB/WB Lefts at Orange Grove, Glendon, Meridian, and Diamond.
  - 7. Consider parking restrictions on Glendon and Lyndon near Monterey Road to discourage Metro-related parking on those streets.
  - 8. Consider a new traffic signal at Orange Grove Avenue.

Analysis Scenarios

At the request of the City of South Pasadena, Minagar & Associates, Inc. has studied the viability to which a "road diet" would work on this portion of Monterey Road. Road diets are essentially a reduction in the number of travel lanes and reassignment of the remaining roadway space for other purposes. Road diets generally provide new opportunities for bike lanes, protected on-street parking bays, increased median refuge space, and pedestrian crossing enhancements at signalized intersections. Common benefits documented by numerous public agencies include improvement in traffic safety, reduction in rear-end and side-swipe crashes, improvement in speed limit compliance, decreasing crash severity when crashes do occur, improved accommodation of mid-block left-turning turning movements, enhanced multi-modal use of the street, and in many cases a reduction in vehicle throughput volumes.

Typical Road Diet Reconfiguration

(source: Federal Highway Administration, http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_013.cfm)

Monterey Road has the potential to be a complete street that accommodates motorists, bicycles and pedestrians, with a lane configuration that could be redesigned within the existing right-of-way to meet the City's goals of establishing a continuous and integrated bikeway facility along the entire Monterey Road corridor within the City. The paved traveled way along Monterey Road ranges from 60' to 84' between the Metro Gold Line LRT Crossing to Fair Oaks Avenue. Dimensionally, the roadway geometry is viable for considering a road diet cross section concept. A typical configuration would call for a reduction in the existing four-lane cross-section to a three-lane cross-section, resulting in one travel lane per direction plus a two-way left-turn lane (TWLTL) along the center. The remaining roadway space would be allocated for on-street parking lane along the shoulder, coupled with a dedicated Class-II bike lane on each side of the street. At signalized intersections, the center two-way left turn lane would gradually transition into a dedicated left-turn pocket for the eastbound and westbound approaches.

The analysis scenarios developed by Minagar & Associates, Inc. for the Monterey road diet evaluation are described below. Each analysis alternative was developed in consideration of current known plans to modify or improve the roadway conditions on this portion of Monterey Road, including a future traffic signal at Orange Grove Avenue, and the City's goal to implement appropriate class of bikeway on Monterey Road throughout the project limits as identified in the City's Bicycle Master Plan.

1. Scenario 1 – Existing Year 2014 Conditions. Reflects the current four-lane undivided cross-section conditions and traffic controls along Monterey Road.

2. Scenario 2 – Existing Plus Planned Improvements (No Build scenario). Considers the future installation of a traffic signal at the intersection of Monterey Road at Orange Grove Avenue, along with the existing four-lane section on Monterey Road (i.e., two travel lanes per direction). It is assumed that the traffic signal installation improvements would be completed on a two-year time frame by the Year 2016.

3. Scenario 3 – Existing Plus Road Diet Option #1. Under the Year 2016 conditions, reduce Monterey Road from four lanes to three lanes (one per direction plus a two-way left turn center lane) and install Class-II bike lanes with protected on-street parking bays from the Metro Gold Line crossing to Fair Oaks Avenue. Due the sufficient roadway width on Monterey Road at the west and east ends of the corridor, a four-lane cross-section would be maintained across the east leg at the Metro Gold Line crossing, and across the west leg at Fair Oaks Avenue.

4. Scenario 4 – Existing Plus Road Diet Option #2. Under the Year 2016 conditions, reduce Monterey Road from four lanes to three lanes (one per direction plus a two-way left turn center lane) and install Class-II bike lanes with protected on-street parking bays from the Metro Gold Line crossing to Fair Oaks Avenue. Maintain a four-lane undivided cross-section from just west of Orange Grove Avenue to just east of Meridian Avenue (remove the on-street parking and keep dedicated CL-2 bicycle lanes). The purpose of Option #2 is to provide a road diet that incorporates the three-lane concepts on Option #1, but also provides traffic congestion relief at the corridor midpoint where the simulation shows significant peak hour queuing between the closely-spaced intersections from Orange Grove Avenue to Diamond Avenue.

Existing Road Diet Configuration on Monterey Road in the City of Los Angeles

Several variations of the traffic model were developed to analyze the above alternative scenarios for the weekday AM, mid-day and PM peak hours. Intersection traffic volume and lane geometries data collected by Minagar were used to build the base traffic model network in Synchro 8.0. Lane utilization behaviors were coded into the model based on field observations from traffic data collection staff. De-facto right-turn lane movements at intersections were generally excluded from the traffic operations model unless a significant portion of turning vehicles were observed to use the shoulder as an unmarked turning lane; for example, eastbound right-turns from Monterey Road onto Fair Oaks Avenue. In all other cases, the shoulder lane was coded with the appropriate lane width depending on the alternative considered. The number 2 lane will generally be narrower (10' to 11', rather than the existing 13' to 18' width) with the addition of on-street parking bays and bicycle lanes.

The City of South Pasadena also provided Minagar & Associates, Inc. with the existing peak hour traffic signal timing plans for input into the simulation model. From a review of this data and discussions with the City, Minagar & Associates, Inc. determined that the existing traffic signals on this portion of Monterey Road are not synchronized, and that most operate on designated time-of-day timing plans during the weekday AM peak, PM peak and off-peak hours of the day. In order to minimize the impact of reducing the number of travel lanes dedicated to motorist travel (i.e., from 4 to 2) and optimize the remaining roadway capacity, careful attention was given proposing traffic signal timing and phasing adjustments at each intersection along the corridor as necessary to accommodate each road diet concept.

Due to the proximity of the Metro Gold Line LRT north of Monterey Road across Orange Grove Avenue, traffic simulation model was also programmed with an extra "dummy" node and relevant information to simulate the train and its effect on the future traffic signal at Monterey Road and Orange Grove Avenue. It is important to note that the Synchro/SimTraffic software in its present state is not designed to model rail interactions or traffic signal pre-emption. However, in order to better understand how vehicular and pedestrian traffic might be affected by the frequent railroad gate activations near the intersection, and to best replicate this interaction with the proposed signal operation, a simplistic version of the LRT signal was coded into the traffic simulation.

For these purposes, the simulation assumed a three-minute minimum headway between successive rail crossings, and a pre-timed signal with a long pre-timed cycle. The traffic simulation model was calibrated to ensure a 60-second gate down period, at which time the railroad activation signal goes "red", the Gold Line is "green", southbound traffic south of the rail is cleared of the track area along with pedestrians crossing north/south on Monterey Road, and southbound traffic north of the tracks is held until the train departs and the gates are up.

Analysis Method and Findings

Existing Conditions. Using the field collected data, Minagar & Associates, Inc. built the Synchro/SimTraffic traffic model and fine-tuned the simulation to reflect actual operations of the existing four-lane, undivided cross-section of Monterey Road for the weekday AM, mid-day and PM peak hours based on staff's field observations. The results of the travel time and delay

simulation runs indicate that Monterey Road corridor currently does not have good traffic progression. Since the traffic signals are independently timed and do not operate together, from the Gold Line Crossing to Fair Oaks Avenue. This is in part due to the lack of a synchronized timing plans, but is also the result of the signalized light rail at-grade crossings at the west end of the corridor near at Pasadena Avenue, Indiana Avenue and Orange Grove Avenue which activate frequently throughout the day and cause disruptions in progressive traffic flow on Monterey Road.

Observations of the traffic model also found that some congestion and spillback would occur in the Year 2016, prior to the implementation of any road diet lane modifications. Peak hour vehicle queues—which include both slow-moving (7 miles per hour or less) and stopped vehicles—were observed to extend significant distances upstream at a few locations in the traffic model simulation, including:

AM Peak Hour "Before" Queues:

- Orange Grove Avenue—Westbound 95th percentile queue (Q95) observed to reach the westerly side of the intersection at Monterey Road and Via Del Rey.
- Diamond Avenue—Eastbound Q95 observed to reach the easterly side of the intersection at Monterey Road and Meridian Avenue.
- Meridian Avenue—Westbound Q95 observed to reach the westerly side of the intersection at Monterey Road and Diamond Avenue.

Mid-day Peak Hour "Before" Queues:

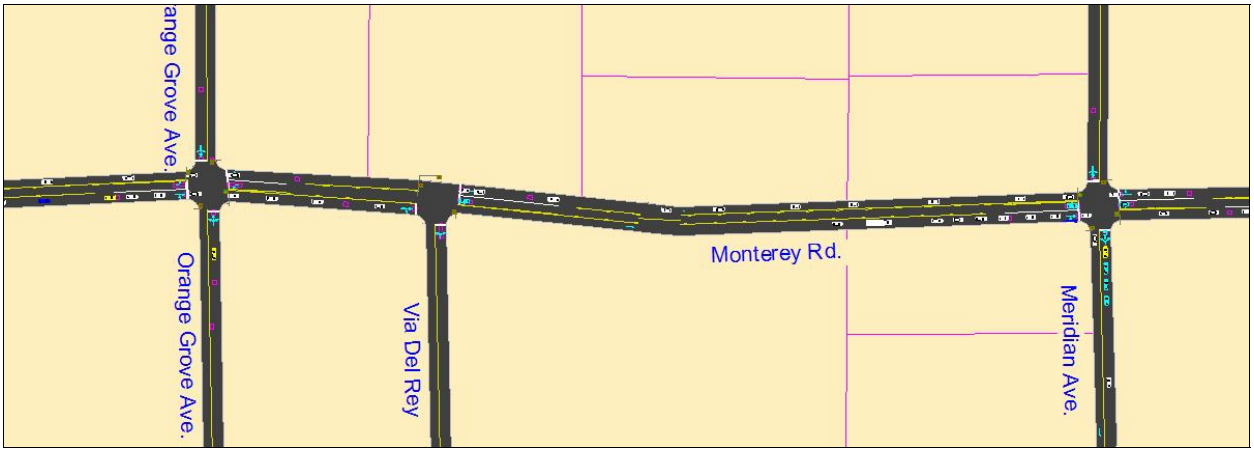
- Diamond Avenue—Eastbound Q95 observed to reach the easterly side of the intersection at Monterey Road and Meridian Avenue.

PM Peak Hour "Before" Queues:

- Monterey Road (two-lane portion, west of the study segment) turning northeast onto the primary four-lane portion Monterey Road.
- Fremont Avenue northbound approach
- Fair Oaks Avenue northbound-left movements, turning west onto Monterey Road
- Diamond Avenue—Eastbound Q95 observed to reach the easterly side of the intersection at Monterey Road and Meridian Avenue.

Proposed Road Diet Conditions. Using a combination of geometric and traffic signal timing adjustments, Minagar & Associates, Inc. modified the existing baseline traffic model to evaluate the peak hour conditions reflecting the road diet concepts. For the majority of the corridor, this required removing one through travel lane from the traffic model in each direction on Monterey Road. Exclusive left-turn lanes were also added where needed at each signalized intersection. Based on the volume of left-turning traffic on Monterey Road at these intersections, none of the proposed left-turns were justified for a protected left-turn signal turn phase and were maintained as running on the existing permissive signal phase system.

Synchro/SimTraffic Simulation Model (Existing 4-Lane Cross-section, AM peak hour)



Synchro/SimTraffic Simulation Model (Road Diet Option #1, MD peak hour)

The results of the traffic simulations showed that corridor travel times and delays would be substantially increased due to the loss of the two eastbound and westbound travel lanes. The traffic model simulation showed that the Q95 reached upstream signalized intersections at several few locations shown below due to the road diet modifications during the peak hours:

Peak Hour "After" Queues – Alternative 1:

- <u>AM Peak Hour</u>
  - Orange Grove Avenue: EB spillback to the intersection of Monterey/Indiana; WB spillback to the intersection of Monterey/Via Del Rey
  - Via Del Rey: EB spillback to the intersection of Monterey/Orange Grove
  - Meridian Avenue: WB spillback to the intersection of Monterey/Diamond
  - Diamond Avenue: EB spillback to the intersection of Monterey/Meridian
- <u>Mid-day Peak Hour</u>
  - Orange Grove Avenue: EB spillback to the intersection of Monterey/Indiana; WB spillback to the intersection of Monterey/Via Del Rey
  - Meridian Avenue: WB spillback to the intersection of Monterey/Diamond

- Diamond Avenue: EB spillback to the intersection of Monterey/Meridian

- PM Peak Hour
  - Indiana Avenue—WB spillback in Lane #1 reaches the east side of the intersection at Monterey Road at the Metro Gold Line Crossing
  - Orange Grove Avenue: EB spillback to the intersection of Monterey/Indiana; WB spillback to the intersection of Monterey/Via Del Rey
  - Via Del Rey: EB spillback to the intersection of Monterey/Orange Grove
  - Meridian Avenue: WB spillback to the intersection of Monterey/Diamond. Significant queuing would also occur on the northbound approach. This is partly attributable to the narrow lane width of the northbound approach, but also due to the proposed traffic signal cycle length adjustment from 40 seconds to 120 seconds to accommodate east/west traffic volumes on Monterey Road.
  - Diamond Avenue: EB spillback to the intersection of Monterey/Meridian

Peak Hour "After" Queues – Alternative 2:

- AM Peak Hour
  - Orange Grove Avenue: WB spillback to the intersection of Monterey/Via Del Rey
  - Via Del Rey: EB spillback to the intersection of Monterey/Orange Grove
  - Meridian Avenue: WB spillback to the intersection of Monterey/Diamond
  - Diamond Avenue: EB spillback to the intersection of Monterey/Meridian
  - Fremont Avenue: EB spillback to the intersection of Monterey/Diamond
- Mid-day Peak Hour
  - Orange Grove Avenue: WB spillback to the intersection of Monterey/Via Del Rey
  - Diamond Avenue: EB spillback to the intersection of Monterey/Meridian
- PM Peak Hour
  - Indiana Avenue—WB spillback in Lane #1 reaches the east side of the intersection at Monterey Road at the Metro Gold Line Crossing
  - Orange Grove Avenue: WB spillback to the intersection of Monterey/Via Del Rey
  - Via Del Rey: EB spillback to the intersection of Monterey/Orange Grove
  - Diamond Avenue: EB spillback to the intersection of Monterey/Meridian
  - Fremont Avenue: EB spillback to the intersection of Monterey/Diamond

It is important to note that the Q95 spillbacks listed at the locations above represent a theoretical queue length (rather than one that is observed in the simulation), calculated by SimTraffic as the average queue plus 1.65 standard deviations. This queue in theory has only a 5% probability of being exceeded during the peak analysis period. None of the *average queues* observed in the traffic model simulation exceeded the available lane capacity; in other words, on average, more vehicles were discharged from queues than entered. The performance results of the traffic model simulation are summarized in the table below. The "Before and After" evaluation is based on the metrics of the simulation program (i.e., travel time, delay, speed) rather than traditional intersection level of service (LOS). This is because LOS is intended to describe traffic operations at isolated intersections, and would not yield very meaningful results for a traffic signal system or corridor like Monterey Road which has mid- block pedestrian

Interactions, closely-spaced signalized intersections, variable lane widths and median types, turning pocket conditions, and other features which are tied to the overall performance of the corridor. Based on a comparison of Year 2016 ("before") conditions with the two alternative road diet scenarios, it was found that the implementation of a road diet lane configuration would increase corridor-wide travel times, delays and average speeds to varying degrees, depending on the alternative considered. As shown in ***Table 3,*** Option #2 would result in a lesser negative impact on arterial mobility than Option #1.

Table 3. Simulation Results Summary

EASTBOUND MONTEREY ROAD									
Analysis Scenario	AM Peak Hour			Mid-day Peak Hour			PM Peak Hour		
	Travel Time (mm:ss)	Delay (s/veh)	Avg. Speed (mph)	Travel Time (mm:ss)	Delay (s/veh)	Avg. Speed (mph)	Travel Time (mm:ss)	Delay (s/veh)	Avg. Speed (mph)
Existing Year 2014	6:39	284	12	4:57	178	15	8:28	347	10
Before — Year 2016 (4-lane)	6:34	250	13	5:42	227	13	10:12	469	8
After — Option #1 (3-lane)	16:26	587	7	8:27	344	10	14:43	634	6
Difference	9:52	337	-6	2:45	117	-3	4:31	165	-2
Percent Change	**60%**	**57%**	**-86%**	**33%**	**34%**	**-30%**	**31%**	**26%**	**-33%**
After — Option #2 (3-lane mod)	10:55	422	9	12:29	515	7	12:09	515	7
Difference	4:21	172	-4	6:47	288	-6	1:57	46	-1
Percent Change	**40%**	**41%**	**-44%**	**54%**	**56%**	**-86%**	**16%**	**9%**	**-14%**

WESTBOUND MONTEREY ROAD									
Analysis Scenario	AM Peak Hour			Mid-day Peak Hour			PM Peak Hour		
	Travel Time (mm:ss)	Delay (s/veh)	Avg. Speed (mph)	Travel Time (mm:ss)	Delay (s/veh)	Avg. Speed (mph)	Travel Time (mm:ss)	Delay (s/veh)	Avg. Speed (mph)
Existing Year 2014	3:01	284	15	3:43	122	19	6:00	231	13
Before — Year 2016 (4-lane)	3:30	210	14	4:35	163	16	6:36	202	14
After — Option #1 (3-lane)	8:25	249	12	7:38	329	10	10:37	303	11
Difference	4:55	39	-2	3:03	166	-6	4:01	101	-3
Percent Change	**58%**	**16%**	**-17%**	**40%**	**50%**	**-60%**	**38%**	**33%**	**-27%**
After — Option #2 (3-lane mod)	6:55	238	12	5:27	212	14	7:58	227	13
Difference	3:25	28	-2	0:52	49	-2	1:22	25	-1
Percent Change	**49%**	**12%**	**-17%**	**16%**	**23%**	**-14%**	**17%**	**11%**	**-8%**

Conclusions and Recommendations

Based on the results of a comprehensive data collection effort and traffic model simulation analysis of the Monterey Road corridor, Minagar & Associates, Inc. concludes that a three-lane cross-section road diet concept could function properly on this portion of Monterey Road, if implemented properly. While the arterial performance of the corridor (i.e., travel time, delay, speed) would be substantially diminished in the peak hour with the removal of a through lane in each direction, the average observed queue lengths of additional vehicles stacking at each signalized intersections were not shown to reach upstream intersections or exceed the available lane capacity.

Whether a road diet configuration on Monterey Road is acceptable to the City of South Pasadena would be dependent on several factors, two of the most important being: (1) that if a road diet is implemented, then peak period traffic signal timing plans at each signalized intersections affected by changes in traffic patterns and demands should also be revised and optimized; and (2) that the resulting increases in peak hour travel time and delays, and decreases in arterial travel speeds are found to be an acceptable tradeoff by the City in light of the converse benefits provided by the road diet (e.g., increased safety, improved bicycle access, protected on-street parking lanes, reduction in left turn gaps at mid-block locations, etc.).

Several factors were considered in the analysis, including: the residential character of the street; the driveway density along Monterey Road; the City of South Pasadena's vision and current plans for a dedicated bicycle connection between the west and east ends of Monterey Road within the city; the need for improved pedestrian facilities; the available paved roadway width along Monterey Road; the location and operational characteristics of intersections; and a comprehensive analysis of field-collected traffic and roadway data. On one hand, many of these baseline traffic and roadway characteristics appear to support the conversion. Numerous residential driveways with access to both single-family homes and apartment complexes abut the north and south sides of Monterey Road throughout the segment. And in several cases, field staff noted that the inside lane often served as a de-facto turning lane for motorists accessing these properties, which resulted in temporary traffic back-ups when peak hour through traffic volumes were large and less maneuverable.

In addition, Monterey Road is neither a designated truck route nor transit route, and is therefore not as susceptible to the frequent stopping and queue building of large, slow-moving vehicles on similar types of three-lane streets. Past research and case studies documented by the Federal Highway Administration (FHWA) also show that roadways with an ADT of less than 20,000 are likely to be good candidates for a road diet, and that road diets implemented on streets with 15,000 ADT or less have demonstrated very good results in the areas of safety, operations, and livability. The current average daily traffic (ADT) on Monterey Road is about 15,700 vehicles per day, which may indicate that the road diet concept could work from a traffic volume perspective.

Other studies, however, have suggested that urban streets with high bi-directional traffic volumes (i.e., in excess of 1,750 vehicles during the peak hour) are likely to experience a reduction in arterial level of service with the implementation of a road diet, and should be

analyzed in closer detail to determine if such a four-lane undivided to three-lane conversion is appropriate. Minagar & Associates, Inc.'s estimate of bi-directional peak hour volumes (PHV) on Monterey Road shows that the AM, mid-day and PM PHV ranges between 1,500 and 3,400 vehicles in both directions, which would suggest a probable decrease in arterial performance. The results of the traffic model and microsimulation analysis runs support this peak hour principle, in that the corridor travel times, delays and speeds on Monterey Road are all expected to worsen with the removal of an eastbound and westbound lane. Considering both lines of reasoning, the City should weigh the advantages and disadvantages of all alternatives, including the option to not construct any type of road diet improvement, and/or to explore other minor improvements or traffic calming measures at specific locations along the corridor. A summary of advantages and disadvantages of each scenario is provided below.

Summary of Advantages and Disadvantages of Alternatives

- **"No Build" Conditions (Year 2016 without Road Diet)**

Advantages:
- Shorter travel times, less delay and faster arterial speeds with a four-lane cross-section

Disadvantages:
- No designated/marked roadway space for bicyclists
- No protected lanes for on-street parking
- Lack of a center refuge area for left-turning vehicles at mid-block

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- **Road Diet Concept #1 (*3-Lane configuration across full length*)**

Advantages:
- Protected on-street parking lanes all throughout the corridor
- Striped bike lanes all throughout the corridor
- Bike lanes provide buffer for on-street parking
- Dedicated left-turning lanes at intersections and mid-block locations would improve the safety and operation to and from side streets on Monterey Road

Disadvantages:
- 31-60% increase in travel time, 16-57% increase in delays, 2-6 mph decrease in speed compared to "No Build"

- **Road Diet Concept #2 (*3-Lane Configuration with 4-Lane Section at Mid-Segment*)**

Advantages:
- Protected on-street parking lanes along major portions of the corridor
- Striped bike lanes all throughout the corridor
- Bike lanes provide buffer for on-street parking
- Dedicated left-turning lanes at intersections and mid-block locations would improve the safety and operation to and from side streets on Monterey Road
- Maintains a four-lane section and bicycle lanes at closely spaced intersections from Orange Grove Avenue to Meridian Avenue

- Less impact to travel times, delays and corridor speeds compared to Concept #1

Disadvantages:

- 16-54% increase in travel time, 9-56% increase in delays, 1-6 mph decrease in speed compared to "No Build"
- Removes on-street parking from mid-block areas from west of Orange Grove Avenue to east of Meridian Avenue

As described above, while the arterial performance of Monterey Road would substantially worsen, a road diet would also improve the safety and efficiency of mid-block turning movements, as well as provide dedicated areas for bicyclists, on-street parking and better options for multi-modal travel, as contemplated in the City of South Pasadena's General Plan and Bicycle Master Plan. In light of this, Minagar & Associates, Inc. recommends that the City consider a trial installation of one of the proposed road diet concepts by temporarily re-striping the pavement markings along select portions of the Monterey Road corridor. A "before and after study" would be conducted to verify corridor travel times, signal delay, vehicle stops, speeds and traffic queues in the vicinity of the road diet area by using a test car and GPS equipment (i.e., a "floating car study") to track the actual conditions prior to and following the implementation of the road diet test striping plan.

Depending on the City's position on this type of road diet trial project, and the timeframe for its implementation, a follow-up study would likely require re-collecting one or more of the intersection turning counts while schools are in session for a more accurate evaluation of its real effects on corridor traffic volumes. A comparative analysis would reveal if the City's desired outcomes are being achieved (e.g., reduction in left turn gaps from side streets at mid-block locations, observation that left-turners are utilizing the center lane for refuge and stacking without blocking the travel lanes on Monterey Road, an overall measured reduction in through traffic volumes, positive support and public perception from bicyclists, pedestrians and other road users on Monterey Road, etc.), and would validate if the road diet re-striping concept could be implemented permanently, as well as on a larger scale across the full length of the segment from the Gold Line LRT Crossing to Fair Oaks Avenue.

If the before-and-after study results are both positive and accepted by the City, then the final road diet design could be programmed into the capital improvements budget and later implemented as a part of the City's periodic repaving program the following year.