



City of Palo Alto

City Council Staff Report

(ID # 7066)

Report Type: Action Items

Meeting Date: 1/23/2017

Summary Title: Middlefield Rd North Pilot Project and Transfer of Contingency Funds

Title: Discussion and Direction to Staff to Implement a One-year Traffic Safety Pilot Project Along Middlefield Road Between the Menlo Park City Limits and Forest Avenue, Find the Project Exempt From the California Environmental Quality Act (CEQA) and Approve a Budget Amendment in the General Fund

From: City Manager

Lead Department: Planning and Community Environment

Recommendation

Staff recommends that Council:

1. Review Alternative Concept Plans 7A and 7B for Middlefield Road between the Menlo Park city limits and Forest Avenue and identify a preferred alternative concept plan to implement as a one-year pilot project;
2. Amend the Fiscal Year 2017 Budget Appropriation Ordinance for
 - a. the General Fund by:
 - i. Increase the transfer to the Capital Fund in the amount of \$200,000; and,
 - ii. Decrease the Planning and Transportation Contingency in the amount of \$200,000;
 - b. the General Capital Improvement Fund by:
 - i. Increase the transfer from the General Fund in the amount of \$200,000; and
 - ii. Increase the appropriation to Transportation and Parking Project (CIP PL-12000) by \$200,000; and
3. Find the preferred Alternative Concept Plan exempt from environmental review as a minor change to existing roadways that would not result in significant environmental impacts.

Executive Summary

Beginning in early 2015, residents who live on or near the north end of Middlefield Road have corresponded with Staff regarding traffic conditions along Middlefield Road from Forest Avenue

to the Menlo Park city limits. The residents have cited a history of collisions, congestion during the peak hours, and speeding in the off-peak hours as recurring issues along the corridor. Of particular concern was the number of collisions occurring at the intersection of Middlefield Road and Everett Avenue and the amount of left-turning traffic at the intersection.

As a result of these concerns, the Planning and Community Environment Department authorized a study of the intersection and adjacent Middlefield Road corridor. This study was completed in June 2015 and Alternative II identified in the report was implemented immediately as a one-year pilot. Alternative II includes time-of-day turn restrictions at both the Hawthorne Avenue and Everett Avenue intersections through added signage.

Throughout late 2015 and early 2016, Staff continued to receive communications from residents voicing their concerns regarding the safety and operation of the corridor. Much of this feedback was related to an ongoing resurfacing project being completed by the Public Works Department along Middlefield Road. Many residents believed that this project offered the City a key opportunity to implement a lane reduction and other changes.

In March 2016, City staff, including police and transportation staff (Councilmember Kniss was also in attendance), held a stakeholder's meeting to listen to the concerns of the residents, discuss what Staff had done to-date and identify next steps. Several of the action items identified in this meeting were completed shortly afterwards, including: encouraging Menlo Park staff to remove the NO TURN ON RED restriction at Willow Road, replacing the turn-restriction signage to enhance clarity, utilizing traffic paint in lieu of thermoplastic to delineate lanes along Middlefield Road as part of the resurfacing project (traffic paint is much easier to remove than thermoplastic). At this stakeholder meeting, Staff also agreed to initiate a Traffic Safety Project in July 2016, upon the conclusion of the one-year turn-restriction pilot. In May 2016, City Council received a request for a lane reduction from the area residents in the form of a signed petition presented at a Council meeting.

In July 2016, Staff initiated the *Middlefield Road North Traffic Safety Project* and began collecting and analyzing comprehensive traffic volume, speed and collision data. In August 2016, Staff convened a meeting with the local residents group behind the petition to identify and prioritize issues of concern along Middlefield Road.

During this first meeting, residents cited traffic congestion, safety, high travel speeds, collisions, and noise as concerns and identified improved safety and quality of life as the primary goals of the project. Staff presented existing conditions and discussed the results of the previous study, which identified the potential for significant environmental impacts to the intersection of Middlefield Road and Lytton Avenue with the implementation of a lane reduction.

The primary issues that were discussed at the meeting are below:

Safety – A relatively high number of unreported collisions occur on this stretch of Middlefield

Road. Some collisions have resulted in encroachment into adjacent residential properties and injuries. Heavy foliage and limited sight lines contribute to some of the safety concerns.

Quality of Life – Residents along this Residential Arterial have concerns that Middlefield Road and traffic congestion has created nuisances, including: difficulty accessing their properties, and increased noise levels due to motorists honking, engine noise, and collisions. With no buffer between the adjacent travel lanes and the curb, the comfort of the adjacent sidewalks is negatively impacted.

Traffic Congestion – Over the past couple of years, there has been a perceived increase in traffic congestion. Congestion may be related to various projects underway along US 101 or within Menlo Park and the Stanford Medical Center. However, residents have concerns that increased congestion has led to the previously-mentioned degradation of safety and quality of life.

As part of the Planning and Community Environment Department’s Traffic Safety Program, Staff worked with the neighborhood group to identify potential options and ideas, and held a community workshop on October 6, 2016 at the Downtown Library. During the community workshop, Staff presented five (5) alternative concept plans with the option to mix and match various features from each alternative concept plan to address the identified concerns (Concept Alternative Plans 1 through 5). As a result of this community-driven process, Staff identified two alternative concept plans that would address the bulk of the community concerns (Concept Alternative Plans 6A and 6B). Slight modifications to the final two alternative concept plans to improve traffic operations and limit impact to motor vehicle level of service (LOS) and better address pedestrian safety resulted in the development of Alternative Concept Plans 7A and 7B.

Both Alternative Concept Plans 7A and 7B include traffic safety countermeasures that address concerns related to turning traffic to and from Everett Avenue, Hawthorne Avenue, and residential driveways. In general, Alternative 7A includes changes that address safety but reduces the capacity of Middlefield Road for motor vehicle traffic, while Alternative 7B addresses the safety concerns, but maintains as much of the existing traffic capacity along Middlefield Road as possible.

Staff recommends implementing one of these alternative concept plans as a one-year pilot with extensive ongoing monitoring of the corridor and immediate project area. With this monitoring, there is an opportunity to partner with Carnegie Mellon University to test a new low-cost internet enabled roadway monitoring device that could be utilized throughout the City if successful. Staff would return to Council one-year after the implementation of the pilot for direction on whether to make the improvements permanent or modify the alternative and complete additional monitoring.

Background

The Middlefield Road North corridor provides a major connection between Palo Alto and Menlo Park, as well as connections to US 101 north of Palo Alto and connections to the East Bay.

Vehicles access this section Middlefield Road from Palo Alto Avenue, Hawthorne Avenue, Everett Avenue, Lytton Avenue, University Avenue, Hamilton Avenue, and Forest Avenue. The intersections of Lytton Avenue, University Avenue and Hamilton Avenue are signalized.

Currently the only public transit service that travels along Middlefield Road between University Avenue and the Menlo Park city limits is the Dumbarton Express bus, which provides service between the Palo Alto Transit Center and the East Bay via the Dumbarton Bridge. On weekdays, there are approximately three Dumbarton Express buses in each direction during the morning peak-hour, and two in each direction during the evening peak-hour.

Hawthorne Avenue ends at Middlefield Road forcing vehicles to turn left or right, whereas Everett Avenue is a through street across Middlefield Road. Everett Avenue is designated as a future bicycle boulevard in the *Bicycle and Pedestrian Transportation Plan (2012)*, and provisions for bicyclists crossing Middlefield Road will need to be provided as part of this future unfunded project. Program T-39 in the *Comprehensive Plan* specifically discourages the installation of “traffic signals on[...] Middlefield Road north of Lytton Avenue and south of Channing Avenue to Embarcadero Road.”

This segment of Middlefield Road carries about 18,000 motor vehicles during a typical weekday (approximately 10,000 southbound and 8,000 northbound). During both the morning and evening peak periods, there are approximately 1,400 vehicles travelling along this segment of Middlefield Road in both directions combined. The signalized intersection of Middlefield Road at Lytton Avenue operates as the primary constraint in capacity, and it currently operates at a motor vehicle level of service D during both the morning and evening peak-hours.

Middlefield Road is classified as a Residential Arterial and has four general purpose travel lanes, with no shoulders. Both sides of Middlefield Road have a tree-lined planter strip that separates the sidewalk from the travel lanes. Program T-41 in the *Comprehensive Plan*, includes recommendations for Residential Arterials, which include “landscaping, medians, and other visual improvements to distinguish them as residential streets, in order to reduce traffic speeds.”

Due to the tree-lined planting strips that are immediately adjacent to the travel lanes along Middlefield Road, sight lines from the side-street approaches are greatly impaired. This is particularly acute at the eastbound Everett Avenue approach to Middlefield Road, where sight distance looking north is severely limited by a row of large trees, which begin only 50 feet north of Everett Avenue. At Hawthorne Avenue, the first tree is approximately 80 feet from Hawthorne Avenue, which provides better sight lines for motorists and bicyclists travelling on east on Hawthorne Avenue approaching Middlefield Road.

In recent years, there have been a number of collisions, both reported and unreported. According to data assembled by the California Highway Patrol, using the SWITRS database, the segment of Middlefield Road between the Menlo Park city limits and Lytton Avenue had

approximately 33 reported collisions over a five-year period from January 2009 to December 2013. For this type of collision history analysis, the last five years of complete data is typically used. In reviewing the reported-collision history and primary collision factors, Staff determined that most collisions were caused by right-of-way violations and the prevailing crash type was angle or broadside, which can likely be attributed to vehicles turning left or going straight from the stop-controlled side street approaches or to vehicles turning left from Middlefield Road into these side streets. Several of the collisions have resulted in injuries and/or have encroached onto the sidewalk area or private properties, creating safety and quality of life concerns for the residents that live and travel along Middlefield Road.

In 2015, Staff initiated a peak-hour left-turn restriction prohibiting motorists and bicyclists from turning left from Hawthorne Avenue and Everett Avenue onto Middlefield Road in an effort to reduce the number of collisions. Motorists and bicyclists on Everett Avenue are also prohibited from going straight and must turn right during the peak hours. Although limited police enforcement was included with implementation, Staff continues to see consistent violations of the left-turn restrictions. At Middlefield Road and Hawthorne Avenue, the number of eastbound left-turns during the evening peak-hour actually increased from 42 to 57 after they were prohibited by signage.

Table 1: Peak-hour Turning Movement Counts

Intersection	Direction of Travel	Peak-hour Period	Left-turns 2016 (2015)	Through-movements 2016 (2015)
Middlefield/Hawthorne	Eastbound	8-9 AM	43 (58)	N/A
Middlefield/Hawthorne	Eastbound	5-6 PM	57 (42)	N/A
Middlefield/Everett	Eastbound	8-9 AM	5 (21)	3(6)
Middlefield/Everett	Westbound	8-9 AM	0 (1)	2 (11)
Middlefield/Everett	Eastbound	5-6 PM	10 (23)	10 (30)
Middlefield/Everett	Westbound	5-6 PM	0 (1)	2 (5)

Source: Traffic Data Services, July 2016

Although not directly reported in most of the collision reports, the 85th-percentile speeds observed along this segment of Middlefield Road are typically between 31 and 34 miles per hour. The current certified speed limit is 25 miles per hour.

A separate complete street project in the section of Middlefield Road south of Forest Avenue is currently in the final design phase and will be constructed in summer 2017 as part of a Public Works Department resurfacing project.

Discussion

This Middlefield Road North Traffic Safety project is intended to address concerns brought to Staff by local residents that live on or near Middlefield Road, north Forest Avenue. The areas of concerns and focus of this current project is targeted at four main goals:

- Reduce neighborhood impacts from through traffic and improve quality of life for local residents;
- Improve access and mobility of all modes of travel;
- Reduce vehicular collisions and improve corridor safety; and
- Rationalize traffic operations.

Staff also sought to identify an alternative concept plan that could be implemented on a pilot basis and not reduce motor vehicle level of service to a point that would result in significant environmental impacts and require a detailed and time-consuming Environmental Impact Report (EIR). The preparation of an EIR could delay the implementation of a project along this corridor by 12 months or more.

Neighborhood Concerns:

Staff has held three meetings with the stakeholder group, as well as one community open house. A significant area of concern for the stakeholder group is the quality of life along Middlefield Road. Their primary concerns include: noise, inability to maneuver in and out of private properties, proximity of fast moving traffic to sidewalks, lack of comfortable bicycle accommodations and a lack of crosswalks across Middlefield Road.

Rationalize Traffic Operations:

Middlefield Road is relatively narrow for a Residential Arterial and is generally 40 feet wide with four 10-foot-wide travel lanes. Left-turning vehicles on Middlefield Road typically block the inside travel lane, resulting in unsafe weaving between travel lanes. A relatively abrupt northbound lane-drop before Hawthorne Avenue results in aggressive lane-changing and conflicts between motorists. The southbound lanes on the curve departing the San Francisquito Creek bridge are extremely narrow and lack an adequate buffer for large vehicles. A goal of this project is to rationalize the current traffic operations and to follow the City's complete streets policies and strategy to improve bicycle and pedestrian accommodations as well as improve traffic flow and better manage turning movements in an effort to improve the overall operation and safety of the corridor.

Proven Traffic Safety Countermeasures Considered:

Beginning in August 2016, Staff coordinated with the local stakeholder group and evaluated the most current traffic data (traffic volumes, speeds, collision history, etc.). Focusing on the identified areas of concern, Staff and the stakeholders group discussed various proven traffic safety countermeasure and organized preliminary alternative concept plans, with options of mixing and matching various countermeasures. Some of the proven traffic safety countermeasures considered include:

- *Class II Bicycle Lanes:* Class II Bicycle Lanes are a four- to six-foot-wide lanes on a roadway dedicated to use by on-road bicyclists traveling in the same direction as adjacent traffic. Class II Bicycle Lanes are typically located between the general purpose travel lanes and the edge of the roadway or on-street parking (if present) and installed in both directions of travel. Though the evidence is limited, a study by Rodegerdts et al. (2004) suggested adding a bicycle lane reduces bicycle-related crashes by 35%. A more recent study by Abdel-Aty et al. (2014) found that bicycle lanes in Florida reduced the frequencies of all crash types by 27-32% and bicycle-related collisions by 58-60%.
- *Corridor Access Management:* Corridor Access Management is a set of techniques used to control access to highways, major arterials, and other roadways. The benefits of corridor access management include improved movement of traffic, reduced crashes, and fewer vehicle conflicts. Corridor Access Management principles are applicable to roadways of all types, ranging from fully access-controlled facilities, such as freeways, to those with little or no access control, such as local streets. Successful Corridor Access Management, managed by change in access density, seeks to simultaneously enhance safety, preserve capacity, and provide for pedestrian and bicycle needs. According to the Federal Highway Administration, Corridor Access Management may reduce severe (injury/fatal) crashes along urban/suburban arterials by 25-31%. Corridor Access Management tools considered for Middlefield Road included restricted-movement designs for driveways (such as right-in/right-out only) and restricted-movement and alternative designs for intersections such as left-overs and median u-turns.
- *Median:* A Median is an area between opposing lanes of traffic, excluding turn lanes. Medians in urban and suburban areas can either be open (pavement markings only) or they can be channelized (raised medians or islands) to separate various road users. According to the Federal Highway Administration, medians may reduce pedestrian crashes by 46% and motor vehicle crashes by up to 39%.
- *Paved Shoulder:* A Paved Shoulder is a one- to 12-foot-wide area on a roadway that provides a buffer between the travel lanes and the edge of the roadway or on-street parking. Paved Shoulders provide an area for drivers to maneuver to avoid crashes. This is particularly important on high-speed, high-volume highways or at locations where there is limited stopping sight distance. According to the Federal Highway Administration, Paved Shoulder widths of approximately eight feet or greater are normally required for this function. Shoulders also improve bicycle accommodations. On most roadways, bicyclists are legally allowed to ride in the travel lanes. A Paved Shoulder offers cyclists an alternative to ride with some separation from motor vehicle traffic. This type of shoulder can also reduce risky passing maneuvers by motorists. Shoulders also improve stopping sight distance at horizontal curves by providing an offset to objects such as barrier and bridge piers. Data regarding the crash reduction factor for Paved Shoulders on urban and suburban arterials is unavailable.

- *Road Diet*: A roadway reconfiguration known as a Road Diet offers several high-value improvements at a low cost when applied to traditional four-lane undivided roadways. In addition to low cost, the primary benefits of a Road Diet include enhanced safety, mobility and access for all road users and a complete streets environment to accommodate a variety of transportation modes. A classic Road Diet typically involves converting an existing four-lane, undivided roadway segment to a three-lane segment consisting of two through lanes and a center, two-way left-turn lane. According to the Federal Highway Administration, the resulting benefits include a crash reduction of 19-47%, reduced vehicle speed differential, improved mobility and access by all road users, and integration of the roadway into surrounding uses that results in an enhanced quality of life. A key feature of a Road Diet is that it allows reclaimed space to be allocated for other uses, such as turn lanes, bus lanes, pedestrian refuge islands, bike lanes, sidewalks, bus shelters, parking or landscaping.
- *New Traffic Signal*: A New Traffic Signal is a traffic control device installed at a previously-uncontrolled or STOP-controlled intersection. A New Traffic Signal assigns right-of-way to intersections users and can be programmed to provide protected movements for different roadway users and motorists and bicyclists making left and right turns across opposing traffic. A New Traffic Signal also provides significant access and mobility improvements for pedestrians, particularly those crossing the main street. According to the Federal Highway Administration, installation of a New Traffic Signal on roadways with more than 5,000 vehicles per lane per day may reduce all-types of crashes by 20-43%, left-turn crashes by 38%, and angle crashes by 29%. However, rear-end collisions have been shown to increase by 48% in some studies.

Additional countermeasures and treatments are described in more detail below in the descriptions of the alternative concept plans.

Preliminary Alternative Concept Plans:

Working with the stakeholder group, staff initially came up with approximately ten different alternative concepts for this corridor. After a very high-level feasibility analysis, the alternative concepts were reduced to five (5) preliminary alternative concept plans that could reasonably be implemented within the existing constraints. Each of the alternative concept plans evaluated in detail are included in Attachment A. The following five (5) preliminary alternative concept plans were developed and presented at a community workshop held at the Downtown Library on October 6. All of them conform to two constraints: 1) no trees would be removed, and 2) the existing roadway would not be widened.

Alternative Concept Plan 1: Concept Plan 1 is a hybrid road diet which includes conversion of the inside northbound travel lane into a two-way left-turn lane. Two southbound travel lanes and one northbound travel lane would be maintained. As presented, the concept would allow left turns out of the side streets as an option.

Pros: Address safety concerns and provides left-turn access to most driveways and side streets from Middlefield Road without blocking a shared through-lane. This concept also improves vehicle access from side streets by providing ability to make left-turns in two stages.

Cons: Does not address bulk of stakeholders' quality of life concerns. Small/minimal improvement for pedestrian and bicycle access. This concept would reduce northbound traffic capacity, which may result in longer queues on Lytton Avenue.

Alternative Concept Plan 2: Alternative Concept Plan 2 is a hybrid road diet which includes conversion of the inside northbound travel lane to a raised median with left-turn pockets at Hawthorne Avenue and Everett Avenue. Option to extend median through intersections or provide left overs to side streets only. Could provide protected refuge island in median to improve pedestrian and bicycle access.

Pros: Addresses safety concerns and could provide left turn access to side streets from Middlefield Road. Maintains uncontrolled pedestrian and bicycle crossing but provides a refuge island to allow for crossing in two stages. This concept plan provides option to prohibit left turns out of side streets and opportunities for landscaped medians.

Cons: Does not address bulk of stakeholders' quality of life concerns. Removes left turn access to/from private driveways.

Alternative Concept Plan 3: Concept Plan 3 is a traditional road diet that removes one travel lane in each direction and includes two bicycle lanes or paved shoulders (up to five feet wide) and a two-way left-turn lane.

Pros: Addresses safety concerns and provides left-turn lane for access to side streets from Middlefield Road and a refuge for two-stage left-turns out of side streets. Moves travel lanes five feet away from curb and provides buffer for motor vehicles exiting private driveways (limited with bicycle lane option).

Cons: Reduces traffic capacity in both directions, with potentially significant traffic impacts at the intersection of Middlefield Road at Lytton Avenue unless a second southbound lane is added just before intersection. Continuous bicycle lane south of Everett Avenue may not be possible without substantial traffic capacity loss at signalized intersections (Lytton Avenue, University Avenue and Hamilton Avenue).

Alternative Concept Plan 4: Concept Plan 4 is a traditional road diet that removes one travel lane in each direction and includes two bicycle lanes or paved shoulders (up to five feet wide), and a raised median with optional left-turn pockets at the intersections of Hawthorne Avenue and Everett Avenue.

Pros: Address safety concerns and provides left-turn lane for access to side streets from Middlefield Road and refuge for two-stage left turns out of side streets. Moves travel lanes five feet away from curb and provides buffer for motor vehicles exiting private driveways (limited with bicycle lane option). This concept provides a beautification opportunity with a landscaped median.

Cons: Reduces traffic capacity in both directions, with potentially significant environmental impacts at the intersection of Middlefield Road and Lytton Avenue unless second southbound lane is added just before intersection. Continuous bicycle lane south of Everett Avenue may not be possible without substantial traffic capacity loss at signalized intersections (Lytton Avenue, University Avenue and Hamilton Avenue). Median prevents residents from accessing turning left into their driveways. A raised median between intersections would result in increased U-turns by Middlefield Road residents at intersections where width limitations may restrict U-turn ability, or would require them to travel through adjacent streets and neighborhoods. Left-turn restrictions out of Hawthorne and Everett would require vehicles to divert through neighborhoods and travel to Lytton Avenue; however, speculation is that much of the current left turn traffic does not originate from the Downtown North neighborhood and restrictions may result in a decrease in neighborhood traffic.

Alternative Concept Plan 5: Concept Plan 5 is a hybrid road diet which includes conversion of the outside travel lanes to full-time or part-time on-street parking. Left-turn pockets could be installed with the full-time parking option by eliminating the on-street parking in advance of intersections.

Pros: Addresses safety concerns by reducing the number of travel lanes that turning vehicles need to cross and likely reducing travel speeds long Middlefield Road. Moves travel lanes seven to ten feet away from curb and provides buffer for motor vehicles exiting private driveways (limited with part-time parking option). Single travel lane in each direction is a safety improvement for pedestrians crossing Middlefield Road.

Cons: Substantially reduces traffic capacity in both directions and likely results in potentially significant environmental impacts unless additional travel lanes are introduced before the signalized intersections.

Existing Traffic Signal Analysis

Using the recent traffic counts included as Attachment B, Staff evaluated the intersections of 1) Middlefield Road at Lytton Avenue and 2) Middlefield Road at University Avenue as they would operate under the various preliminary alternative concept plans (see below for an explanation of the analysis with future traffic volumes).

In 2015, Staff had contracted with the consultant firm Stantec, to analyze existing operating conditions and to evaluate turn restrictions at the intersections of Middlefield Road and

Hawthorne Avenue and Middlefield Road and Everett Avenue. This report (included as Attachment C) concluded that turn restrictions could be implemented for vehicles turning out of Everett Avenue and Hawthorne Avenue onto Middlefield Road without triggering potentially significant environmental impacts. The Stantec report did not evaluate lane reductions on Middlefield Road or lane changes to the intersection of Middlefield Road and Lytton Avenue.

Using the City's adopted standards of significance for increased delays at signalized intersections and existing traffic volumes, staff evaluated the preliminary alternative concept plans described above and determined that a reduction from two to one general purpose travel lane on the southbound Middlefield Road approach to Lytton Avenue would trigger a potentially significant environmental impact at the intersection. Thus, any alternative concept plans with a southbound lane reduction would need to include the reintroduction of a second southbound lane between Everett Avenue and Lytton Avenue to avoid a potentially significant environmental impact.

As part of this analysis, the northbound Middlefield Road approach to Lytton Avenue was also evaluated in conjunction with the eastbound approach of Lytton Avenue, where there are currently two lanes available to turn left onto Middlefield Road northbound. Northbound Middlefield Road through the intersection could be reduced to one through-lane and still operate at an acceptable level of service. This modification would require that the Lytton Avenue eastbound approach be reconfigured to include only one left-turn lane. With these changes, the intersection of Middlefield Road and Lytton Avenue would continue to operate at Level of Service D. However, other issues, such as extended motor vehicle queues, may occur on Lytton Avenue and/or northbound Middlefield Road.

Refined Alternative Concept Plans:

During the public open house on October 6, the five (5) preliminary alternative concepts were presented with various, interchangeable features, such as turn restrictions at the intersections or directional lane reductions. The goal was to get an understanding of the community's preferences, which included the following:

- Maintain left-turn access into private driveways;
- Left-turns out of side streets could be restricted (requires detour to the Lytton Avenue intersection), but maintain left-turns from Middlefield Road onto side streets;
- Calm Middlefield Road traffic; and
- Provide a buffer between moving motor vehicles and the sidewalk area.

Following the public open house and existing traffic signal analysis, Staff reviewed the pros and cons of each alternative concept plan with respect to the goals of the project as well as neighborhood stakeholder feedback. Staff developed two (2) refined alternative concept plans (6A and 6B) to advance into additional operational and feasibility study. These revised alternative concept plans drew elements from many of the five (5) preliminary alternative concept plans. Due to the limited right-of-way width and other constraints, one ideal solution to solve all of the issues is not feasible. Therefore, Alternative Concept Plan 6A primarily

addresses the safety concerns and the neighborhood quality of life needs, while Alternative Concept Plan 6B primarily addresses the safety concerns while maintaining as much of the current traffic flow operations as possible. In addition, consideration was given to the potential for significant environmental impacts at the intersection of Middlefield Road and Lytton Avenue.

After additional analysis of operational conditions at the intersection of Middlefield Road and Lytton Avenue, Alternative Concept Plans 6A and 6B were modified slightly to avoid potentially significant impacts; resulting in Final Alternative Concept Plans 7A and 7B. These concepts can be implemented as a pilot project with minimal investment and could be limited to revised striping, temporary curb materials, and minimal traffic signal changes. Table 2 summarizes the performance of each Alternative Concept Plan with respect to the project goals.

Table 2: Performance of Alternative Concept Plans against Project Goals

Goals		Preliminary Concepts					Revised		Final	
		1	2	3	4	5	6A	6B	7A	7B
1	Reduce collisions and improve corridor safety	●	●	●	●	●	●	●	●	●
2	Reduce neighborhood impacts from through traffic and improve quality of life for local residents	●	-	●	●	●	●	-	●	●
3	Improve access and mobility for all modes of travel	-	●	●	●	●	●	●	●	●
4	Rationalize traffic operations	●	●	-	-	-	-	●	●	●
5	Avoid potentially significant environmental impact	●	●	-	-	●	-	●	●	●

- Mostly addresses or accomplishes goal
- Partially addresses goal
- Does not accomplish or address goal

Source: Planning and Community Environment Department, January 2017

Alternative Concept Plans 6A/7A: These alternative concept plans are most closely related to Alternative Concept Plan 3 and include a traditional road diet. At the intersections with Hawthorne Avenue and Everett Avenue, all cars approaching Middlefield Road would be required to make a right-turn, while left-turns and through movements would be restricted by raised medians and signage. These concept plans may include two five-foot-wide bicycle lanes or paved shoulders. Bicycle lanes between Palo Alto Avenue and Everett Avenue are feasible with this option, but because bicycle lanes do not currently exist north or south of the project area, a short two-block section would have little benefit as compared to a paved shoulder.

Because Alternative Concept Plan 6A only includes one southbound travel lane approaching the Lytton Avenue intersection, the preliminary traffic analysis predicts an increase in intersection delay that would trigger a potentially significant environmental impact and require additional environmental analysis such as an Environmental Impact Report (EIR). In general, traffic signals create the capacity bottleneck along most roadways. Currently, the traffic demand along Middlefield Road in both the northbound and southbound direction is close to the effective

capacity of the traffic signals at both Lytton Avenue and University Avenue. Evaluation of the traffic signals with only one northbound and/or one southbound travel lane on Middlefield Road led to increased vehicular delays that would exceed the City's standards of significance. The motor vehicle level of service analysis is included as Attachment D. Lane reductions on Middlefield Road could trigger potentially significant environmental impacts at both Lytton Avenue and University Avenue. Therefore, staff modified the concept plans such that they would maintain two approach lanes for each direction of Middlefield Road through these intersections.

Concept Plan 7A incorporates necessary modifications to 6A to address the potentially significant environmental impact at the Lytton Avenue intersection by adding a second southbound lane that would start in the block between Everett Avenue and Lytton Avenue. Based on a preliminary traffic analysis, these changes would keep the intersection operations at an acceptable motor vehicle level of service D. Because the northbound Middlefield Road departure is reduced to one travel lane, the northbound approach is modified to have one left-turn-only lane and one through-/right-turn lane. The change in the northbound direction would result in an average increase in delay of approximately seven seconds, but would remain at an acceptable level of service D.¹ Eastbound Lytton Avenue would also be modified to only have one left-turn lane and one shared through-/right-turn lane. The modifications on Lytton Avenue would have a negligible effect on the intersection delay and level of service.

With the lane reductions, traffic queues may temporarily extend back into Menlo Park along southbound Middlefield Road; however the merging operations are not anticipated to cause queues to back up to the Willow Road intersection, which is signalized. An additional drawback of Concept 7A is that there would be a new southbound merge and lane reduction just south of the Menlo Park city limits and a new lane would begin just north of Lytton Avenue. This could lead to driver confusion and/or aggressive driving in the merge and taper areas.

For the pilot project, no changes are proposed for the segment between Lytton Avenue and Forest Avenue, with the exception of the modifications to the northbound Middlefield Road approach to Lytton Avenue as described above. Any lane configuration changes south of Lytton Avenue would either degrade the motor vehicle level of service or require substantial infrastructure and traffic signal modifications. This could be re-evaluated if the project is made permanent, but is not included in any of the Alternative Concept Plans for the one-year pilot.

Alternative Concept Plans 6B/7B: These alternative concept plans are most closely related to Alternative Concept Plan 1, with the addition of turn restrictions at Hawthorne Avenue and Everett Avenue (right-turn only). While vehicles that currently turn left onto or across Middlefield Road from Everett Avenue or Hawthorne Avenue would need to travel to Lytton

¹ Please note that some Councilmembers have expressed an interest in modifying the City's threshold for significant impacts at signalized intersection such that degrading from level of service C to D would be considered a significant environmental impact. This change has not been approved by the City Council as a whole and has not been used in this analysis.

Avenue to turn left onto Middlefield Road, Concept 7B would generally maintain the existing roadway operations along Middlefield Road in the southbound direction.

Alternative Concept Plan 6B primarily focuses on addressing the safety concerns related to collision history and maintaining current traffic capacity; however it has less emphasis on residents' concerns related to quality of life. The neighborhood stakeholder group has expressed their opinion that Alternative Concept Plan 6B (and presumably 7B) is not acceptable from their standpoint. Alternative Concept Plan 7B is similar to 6B, with the exception that only one northbound lane proceeds straight at the intersection with Lytton Avenue and only one lane turns left from eastbound Lytton Avenue to northbound Middlefield Road. Alternative Concept Plan 7B extends the two-way left-turn lane to Lytton Avenue and maintains the current ability for residents to turn left into their private driveways from Middlefield Road.

The lane configuration of Middlefield Road south of Lytton Avenue would remain four lanes (two in each direction) for both Alternative Concept Plan 6B and 7B, however the northbound approach to Lytton Avenue would be converted to one left-turn only lane and one shared through-/right-turn lane.

For the pilot project, no changes are proposed for the segment between Lytton Avenue and Forest Avenue, with the exception of the modifications to the northbound Middlefield Road approach to Lytton Avenue as described above. Any lane configuration changes south of Lytton Avenue would either degrade the motor vehicle level of service or require substantial infrastructure and traffic signal modifications. This could be re-evaluated if the project is made permanent, but is not included in any of the Alternative Concept Plans for the one-year pilot.

Trial Implementation and Monitoring

Staff recommends implementing either Alternative Concept Plan 7A or 7B as a one-year pilot. With the implementation of the pilot, Staff will undertake extensive data collection before and during the pilot. Ongoing monitoring is anticipated to include the following data:

- Intersection turning movement counts and intersection level of service at the Lytton Avenue and University Avenue signalized intersections;
- Traffic volumes, vehicle classifications, and speeds on Middlefield Road, Palo Alto Avenue, Hawthorne Avenue, Everett Avenue, Lytton Avenue, University Avenue, Byron Street, Fulton Street, Webster Street, and Guinda Street;
- Travel times along Middlefield Road (perhaps using Bluetooth or GPS technology);
- Pedestrian and bicycle volumes at the Hawthorne Avenue and Everett Avenue intersections;
- Ambient noise/decibel levels at various times of day;
- Queuing lengths during the morning, mid-day, and evening peak-hours at the Lytton Avenue and University Avenue signalized intersections; and
- Collision history.

With this monitoring, there is an opportunity to partner with Carnegie Mellon University to test a new low-cost internet enabled roadway monitoring device that could be utilized throughout the City if successful. If feasible, this technology will supplement, not replace, proven data collection methods.

Following a one-year pilot, Staff will bring a recommendation to the Planning and Transportation Commission and City Council for direction on a permanent solution or modifications to the pilot.

Long Term Traffic Growth

The Alternative Concept Plans were evaluated with respect to future growth projections and potentially significant environmental impacts are not anticipated. The traffic analyses estimate that the expected delay due to projected growth by the year 2035 would cause the intersection of Middlefield Road and Lytton Avenue to decrease to Level of Service F; however the delay increases would be approximately the same with both the existing geometric configuration and the configurations included in the Alternative Concept Plans.

Policy Implications

Comprehensive Plan goals, policies, and programs that support the implementation of a one-year pilot include:

Policy T-2: Consider economic, environmental, and social cost issues in local transportation decisions.

Goal T-3: Facilities, Services, and Programs that Encourage and Promote Walking and Bicycling.

Policy T-14: Improve pedestrian and bicycle access to and between local destinations, including public facilities, schools, parks, open space, employment districts, shopping centers, and multi-modal transit stations.

Program T-22: Implement a network of bicycle boulevards, including extension of the southern end of the Bryant Street bicycle boulevard to Mountain View.

Policy T-24: Maintain a hierarchy of streets that includes freeways, expressways, arterials, residential arterials, collectors, and local streets.

Policy T-25: When constructing or modifying roadways, plan for usage of the roadway space by all users, including motor vehicles, transit vehicles, bicyclists, and pedestrians.

Program T-34: Establish procedures for considering the effects of street modifications on emergency vehicle response time.

Policy T-28: Make effective use of the traffic-carrying ability of Palo Alto's major street network without compromising the need of pedestrians and bicyclists also using this network.

Program T-39: Maintain the current program of not adding traffic signals on Alma Street north of Lytton Avenue and south of Channing Avenue to Churchill Avenue and on Middlefield Road north of Lytton Avenue and south of Channing Avenue to Embarcadero Road.

Goal T-5: A Transportation System with Minimal Impacts on Residential Neighborhoods

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.

- Middlefield Road (between San Francisquito Creek and San Antonio Road)

Policy T-33: Keep all neighborhood streets open unless there is a demonstrated safety or overwhelming through-traffic problem and there are no acceptable alternatives, or unless a closure would increase the use of alternative transportation modes.

Goal T-6: A High Level of Safety for Motorists, Pedestrians, and Bicyclists on Palo Alto Streets.

Policy T-39: To the extent allowed by law, continue to make safety the first priority of citywide transportation planning. Prioritize pedestrian, bicycle, and automobile safety over vehicle level-of-service at intersections.

Resource Impact

Staff requests City Council approval for the transfer of funds in the amount of \$200,000 from the Fiscal Year 2017 General Fund Planning and Transportation Contingency to CIP project PL-12000 to fund the estimated cost of the pilot project. This is based on planning-level cost estimates that include design, installation and monitoring before and after installation.

Staff estimates that the cost to implement and monitor either alternative would be approximately the same. The cost for final design and implement the striping changes and temporary rubber medians is approximately \$129,000. The anticipated monitoring and reporting cost is approximately \$52,000. Staff has included approximately 10% for contingency expenses for a total of \$200,000.

Timeline

Upon direction from City Council on the preferred Alternative Concept Plan, Staff will work with on-call consultants to develop plans for installation of the pilot. Final designs are scheduled to be completed by spring 2017. Construction will begin shortly thereafter.

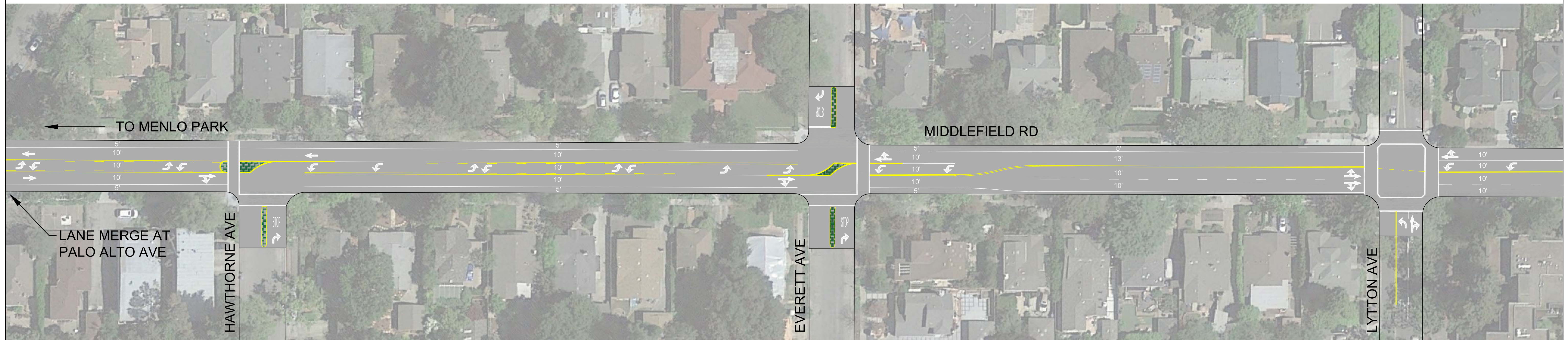
Environmental Review

Given the nature of the proposed improvements for either Alternative Concept Plan 7A or 7B, the project qualifies for a Class 1 Categorical Exemption. The Class 1 exemption covers minor alterations to existing facilities so long as they involve no or negligible expansion of use. Although the pilot project could potentially include a lane reduction on Middlefield Road, the overall roadway capacity change would be negligible because two lanes would be maintained at the intersections with Lytton Avenue and University Avenue and the signalized intersections are anticipated to operate at approximately the same motor vehicle level of service as they do under existing conditions. Also, queueing conditions may change, but are not anticipated to interfere with traffic signal operations of adjacent intersections under normal conditions.

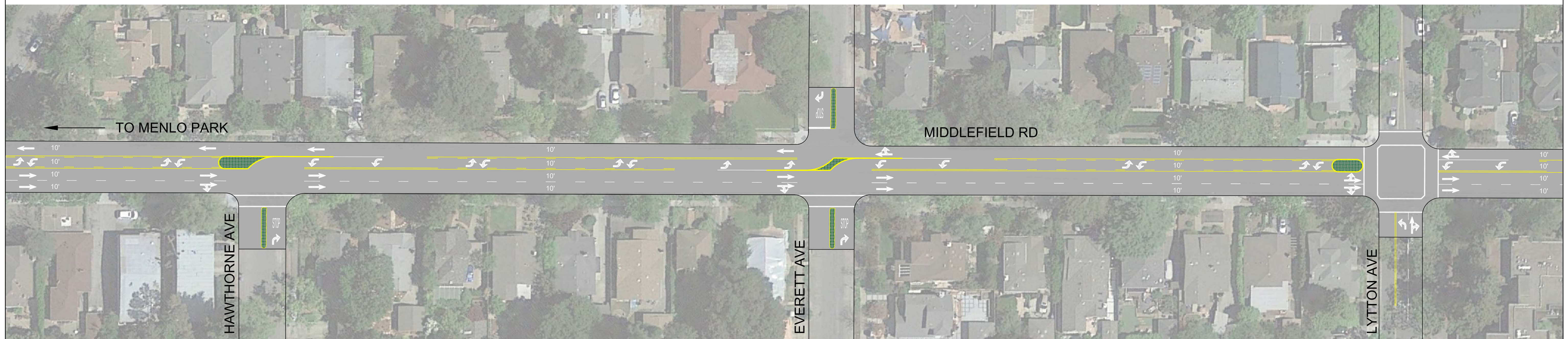
Attachments:

- Attachment A - Alternative Concept Plans
- Attachment B - Existing Traffic Volumes
- Attachment C - Stantec Final Report
- Attachment D - Middlefield Rd and Lytton Ave LOS Analysis
- Attachment E - Middlefield Rd (Lytton Ave to Hawthorne Ave) Collision History

CONCEPT 7A - TWLTL AND LEFT-OVERS WITH BIKE LANES



CONCEPT 7B - TWLTL AND LEFT-OVERS WITH NO BIKE LANES





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Concept 1 - TWLTL

Two southbound travel lanes, one northbound travel lane and a two-way turn lane

MIDDLEFIELD ROAD NORTH TRAFFIC SAFETY PROJECT



NOTES:



Two Southbound Lanes

To accommodate existing higher traffic volumes in this direction (ADT=approximately 10,000 vehicles)



Northbound Lane

Traffic volumes are slightly lower for this direction. (ADT=approximately 8,500 vehicle)



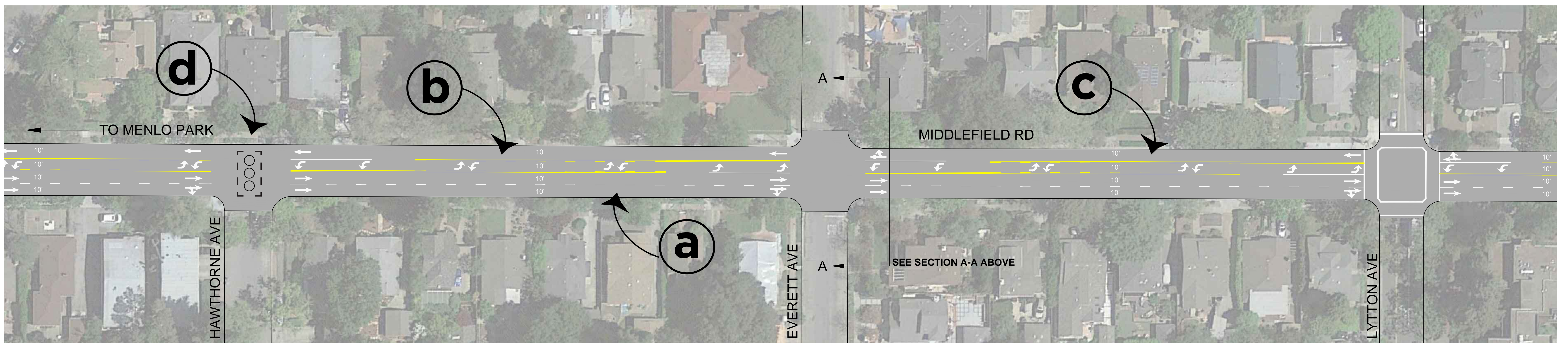
Two Way Turn Lane

A striped two-way left turn lane helps maintain access to all driveways. The lane also provides drivers with the ability to slow down in turn lane prior to entering a driveway.



Optional Traffic Signal

Install a new signal at Hawthorne Ave to improve safety and operation at the intersection.





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ALTO**

Concept 2 - Median

Two southbound travel lanes, one northbound travel lane and a continuous median

MIDDLEFIELD ROAD NORTH TRAFFIC SAFETY PROJECT



NOTES:



Two Southbound Lanes

To accommodate existing higher traffic volumes in this direction (ADT=approximately 10,000 vehicles)



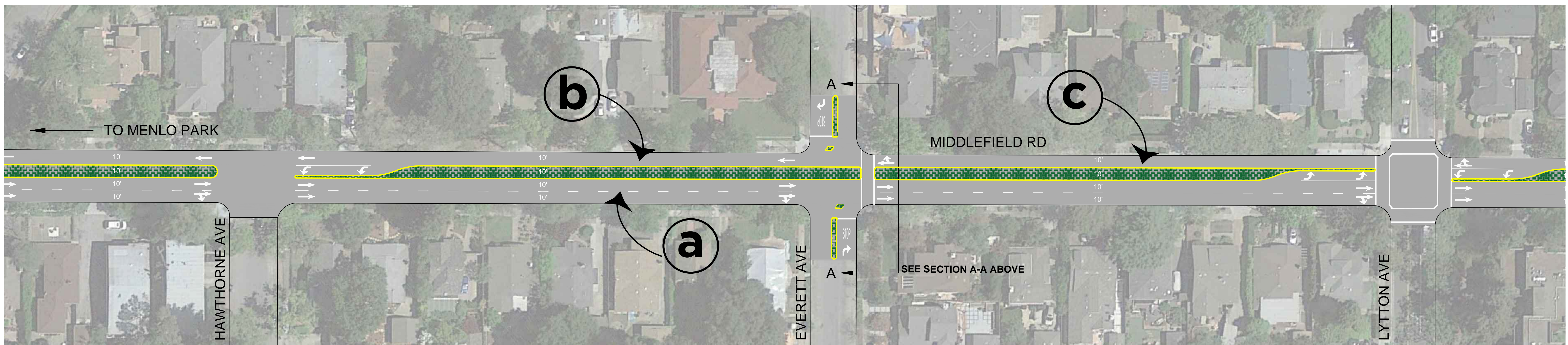
One Northbound Lane

Traffic volumes are slightly lower for this direction. (ADT=approximately 8,500 vehicle)



Continuous Median

Provides continuous landscaped median that restricts mid-block access to driveways, and left turns onto Everett Ave from Middlefield Rd.





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Concept 3 - Bike Lanes/TWLTL

One southbound travel lane, one northbound travel lane,
two-way turn lane and two bicycle lanes

MIDDLEFIELD ROAD NORTH TRAFFIC SAFETY PROJECT



NOTES:



Bicycle Lanes

Add bicycle lanes in both directions to promote and encourage biking



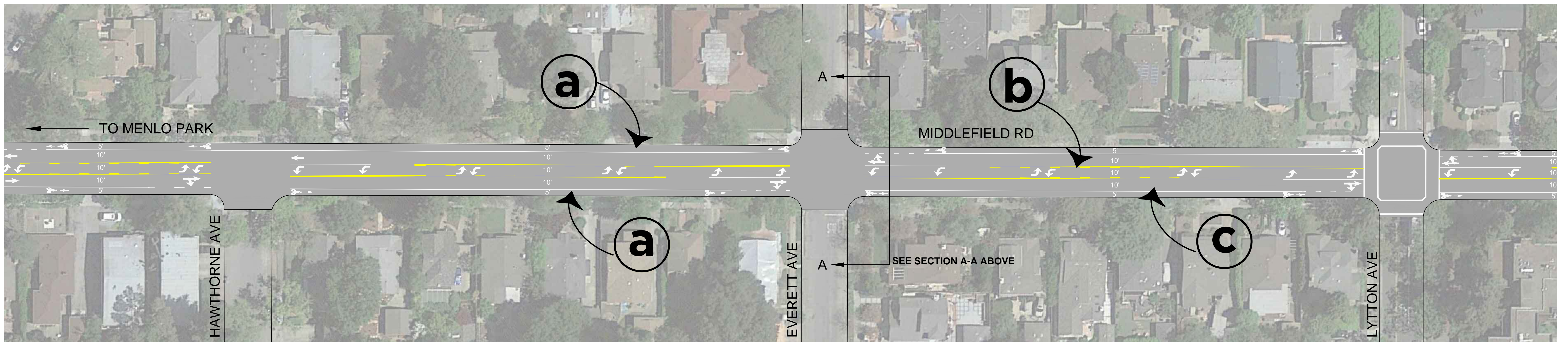
Striped Two-Way Turn Lane

Maintains access to all driveways



Reduced Travel Lanes

Remove one travel lane to help reduce roadway speed. A slower corridor would improve safety for all users-bikes, pedestrians and vehicles.





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Concept 4 - Bike Lanes/Median

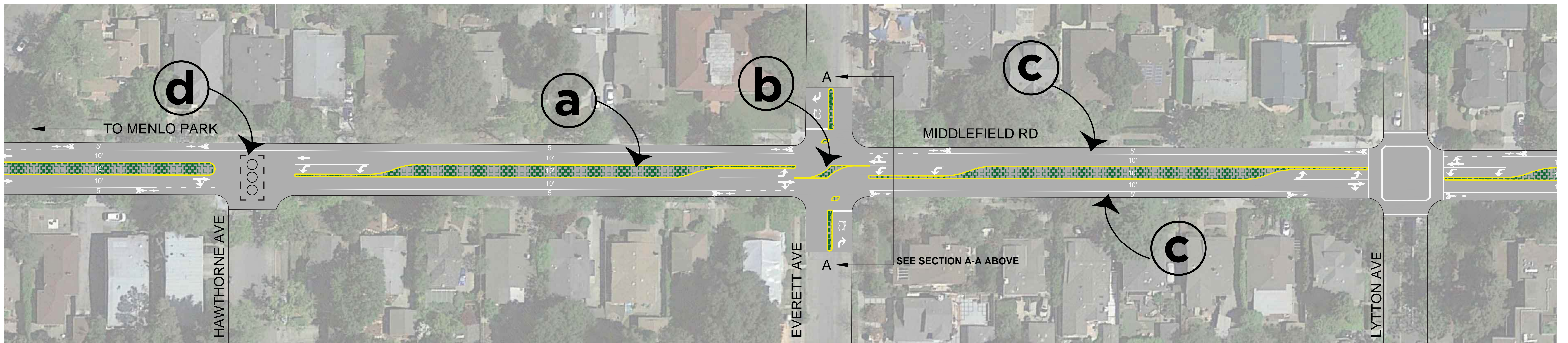
One southbound travel lane, one northbound travel lane,
a continuous median and two bicycle lanes

MIDDLEFIELD ROAD NORTH TRAFFIC SAFETY PROJECT



NOTES:

- a** **Reduced Travel Lanes**
Remove one travel lane to help decrease roadway speed. A slower corridor will improve safety for all users, bikes, pedestrians and vehicles
- b** **Left -turns Restricted Out of Neighborhood**
At the intersection of Everett/Middlefield left turns are restricted to reduce impacts of traffic in the neighborhood, reducing collisions and increasing safety.
- c** **Bicycle Lanes**
Add bicycle lanes in both directions to promote and encourage ridership
- d** **Optional Traffic Signal**
Install a new signal at Hawthorne Ave to improve safety and operation at the intersection





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Concept 5 - Parking

One southbound travel lane, one northbound travel lane, two on-street parking lanes

MIDDLEFIELD ROAD NORTH TRAFFIC SAFETY PROJECT



NOTES:

a

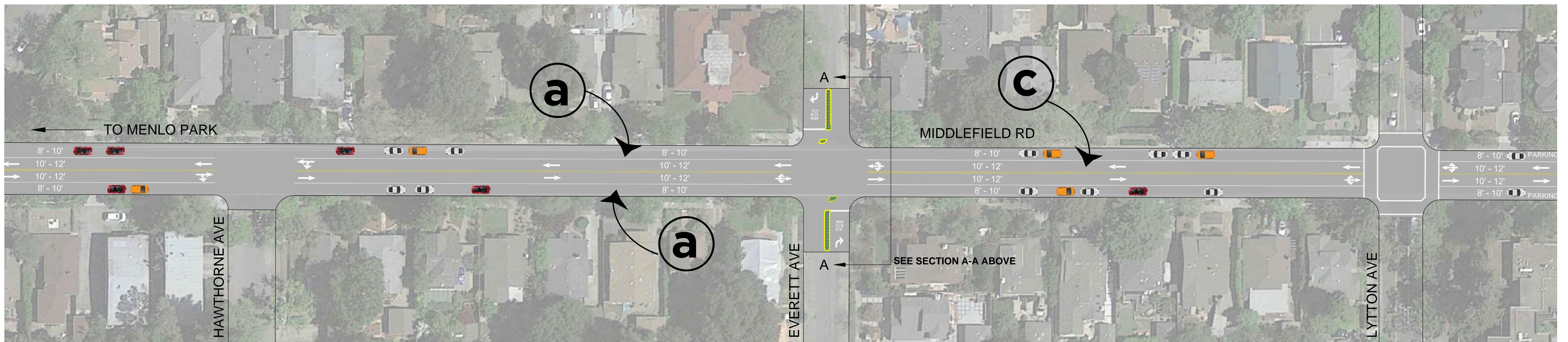
On-Street Parking

To help in reduced travel speeds, minimize collisions and maintain the residential character of this neighborhood without backing out of driveways. Optional 24-hour parking or parking available during off-peak hours only, allowing for 4-lane roadway during peak hours

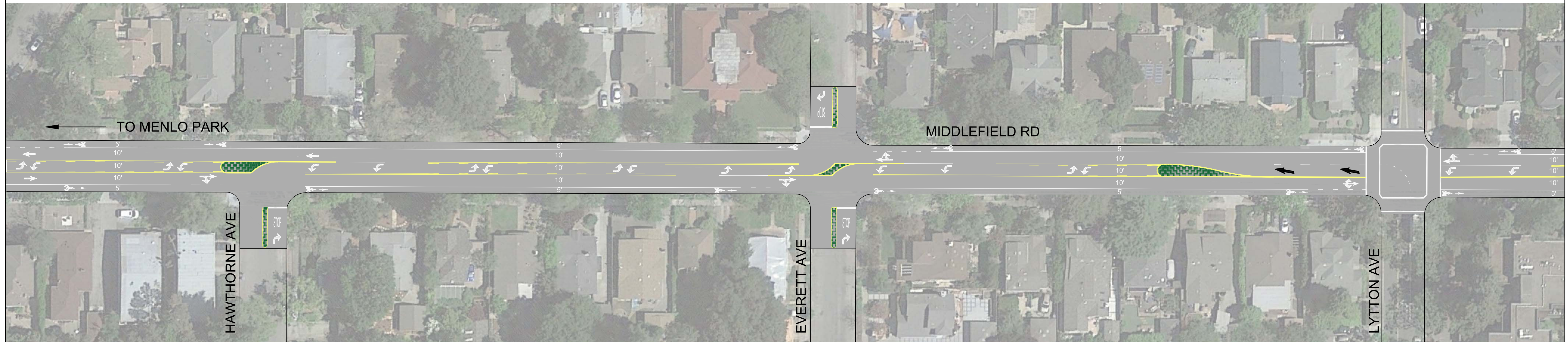
b

Reduced Travel Lanes

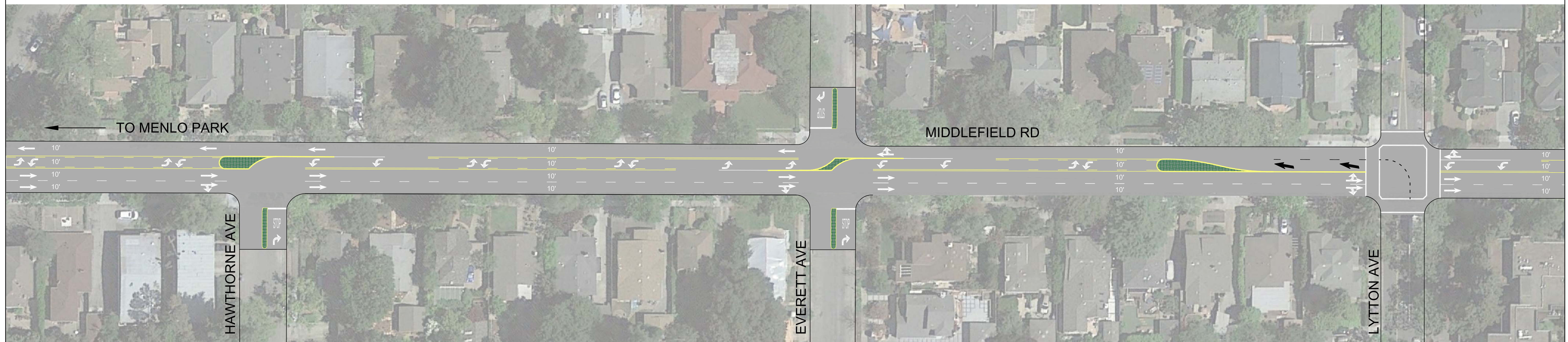
Remove one travel lane to help decrease roadway speed. A slower corridor will improve safety for all users, bikes, pedestrian and vehicles

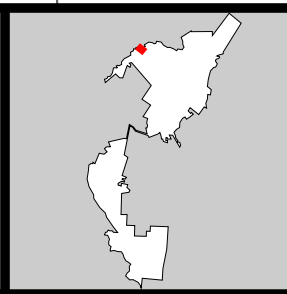
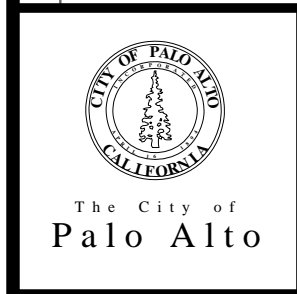
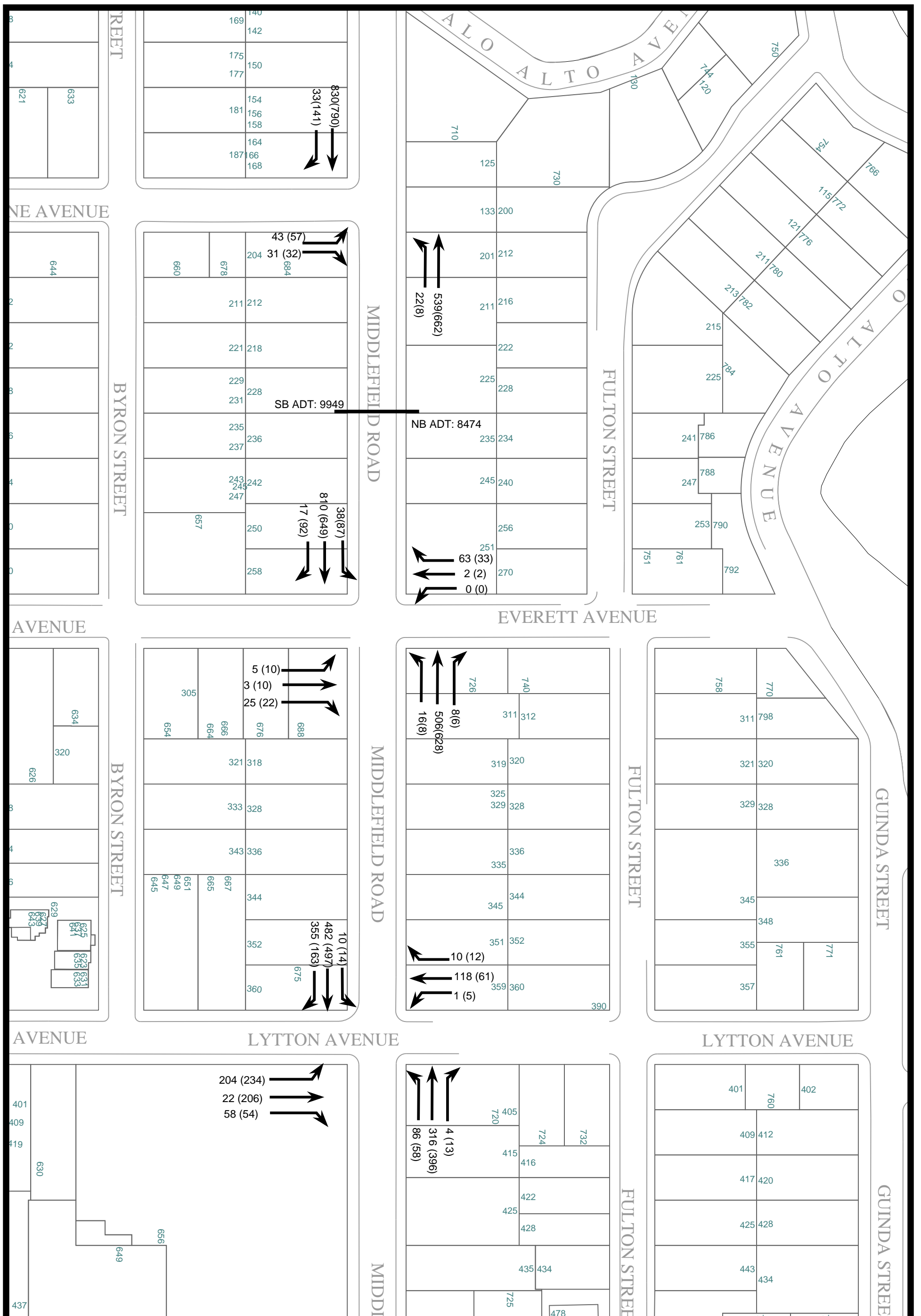


CONCEPT 6A - TWLTL AND LEFT-OVERS WITH BIKE LANES



CONCEPT 6B - TWLTL AND LEFT-OVERS WITH NO BIKE LANES





Middlefield North Traffic Safety

XX (XX): AM (PM) Peak Hour Turning Movement Counts
 AM Peak Hour: 8-9 am; PM Peak hour: 5-6pm
 ADT: Average Daily Traffic
 Data collected July 2016

This map is a product of the City of Palo Alto GIS

0' 100'

Final Report

A Focus Traffic Operations Study of Middlefield Road near Everett Avenue

In the City of Palo Alto

June 30, 2015



A FOCUS TRAFFIC OPERATIONS
STUDY OF MIDDLEFIELD ROAD
NEAR EVERETT AVENUE

Final Report

Prepared for:
The City of Palo Alto

Prepared by:
Stantec Consulting Services

June 30, 2015

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1.0 EXECUTIVE SUMMARY

The purpose of this study is to conduct a focus traffic study of Middlefield Road near Everett Avenue. The specific tasks include:

- Evaluate potential impacts of moving the existing northbound lane drop on Middlefield Road from north of Everett Avenue to south of Everett Avenue.
- Evaluate safety improvements at the intersection of Middlefield Road/Everett Avenue.

Stantec obtained a.m. and p.m. peak hours intersection turning movement counts at three study intersections:

- Middlefield Road/Hawthorne Avenue
- Middlefield Road/Everett Avenue
- Middlefield Road/Lytton Avenue

The level of service (LOS) for the intersection of Middlefield Road/Lytton Avenue operate at acceptable LOS D or better while the LOS at the other two intersections operate at unacceptable LOS F.

Alternative I: Move Northbound Lane Drop to South of Everett Avenue

Under this alternative, the LOS at the intersection of Middlefield Road/Hawthorne Avenue would deteriorate from LOS E to LOS F during the p.m. peak hour. And the LOS at the intersection of Middlefield Road/Lytton Avenue would deteriorate from LOS D to LOS E during the a.m. peak hour.

The City of Menlo Park has recently changed the signal timing at the intersection of Willow Road/Middlefield Road. It might take some time for the City of Menlo Park to monitor and make any appropriate adjustments to better serve the traffic demands. Due to all the factors above, it is recommended the City work with Menlo Park for any further adjustments to the signal timing at Willow/Middlefield and follow up to conduct additional study as appropriate before taking further action.

Alternative II: Right-In and Right-Out Only At Everett Avenue

Based on review of the collision data, field observations and discussions with city staff and residents, Stantec recommends restricting the movements on Hawthorne Avenue to right-turn only during the a.m. (7 – 9) and p.m. (4 – 6) peak hours on weekdays, Monday to Friday.

Together with some enforcement, the implementation of the time limited right-turn only restriction on Everett Avenue at the intersection could be effective.

2.0 FOCUS OF PROJECT AND STUDY APPROACH

2.1 PROJECT OBJECTIVES DESCRIPTION

One of the purpose of this focus traffic operation study is to evaluate the potential impacts of moving the existing northbound lane drop on Middlefield Road from north of Everett Avenue near Hawthorne Avenue to south of Everett Avenue. This is based on a draft plan line concept drawing provided by the City (see Appendix A).

It is our understanding that the existing crash data indicated traffic on Everett Avenue making an eastbound left-turn to travel northbound on Middlefield Road towards Menlo Park being struck by northbound traffic. The study will also analyze if making Everett Avenue into Right-In and Right-Out only might significantly impact traffic on Lytton Avenue and Middlefield Road.

Lastly, it is our understanding that there is an interest in the community to improve pedestrian connections across Middlefield Road. Stantec will discuss potential pedestrian improvement measures that could enhance pedestrians' safety at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts.



Study Vicinity

2.2 STUDY APPROACH

Stantec collected the existing a.m. and p.m. peak hour intersection turning movement counts for auto and pedestrians for the study intersections of Middlefield Road/Everett Avenue, Middlefield Road/Lytton Avenue and Middlefield Road/Hawthorne Avenue. The counts would be utilized in computing the base and future alternative level of service (LOS) analysis. Field observations were conducted for two days during the a.m. and p.m. peak period.

Stantec created a Synchro traffic model to evaluate the potential impacts of moving the existing northbound lane drop on Middlefield Road from north of Everett Avenue near Hawthorne Avenue to south of Everett Avenue.

3.0 SETTING

The following section describes the existing transportation conditions in the vicinity of the study area, including descriptions of the existing street system and intersection operating conditions.

3.1 EXISTING STREET SYSTEM

Middlefield Avenue is generally a four lane north-south arterial roadway that connects downtown Palo Alto near University Avenue in the south to Menlo Park in the north near Willow Road. The existing average daily traffic (ADT) is approximately 14,000 vehicles per day (vpd).

Lytton Avenue is generally a four lane east-west arterial roadway that connects Alma Street near the Caltrain Station in the west to Middlefield Road in the east. The existing ADT is approximately 9,000 vpd.

Everett Avenue is a two lane local residential street that connects from Alma Street in the west to Middlefield Road in the east. The ADT volumes near Middlefield Road are approximately 2,400 vpd.

Hawthorne Avenue is a two lane local residential street that connects from Alma Street in the west to Middlefield Road in the east. The ADT volumes near Middlefield Road are approximately 2,600 vpd.

3.1.1 Traffic Data Collection

The a.m. and p.m. peak hours intersection turning movement counts for auto and pedestrians were obtained for three study intersections:¹

- Middlefield Road/Hawthorne Avenue
- Middlefield Road/Everett Avenue
- Middlefield Road/Lytton Avenue

The counts would be utilized in computing the base and future alternative level of service (LOS), queuing and travel time analysis. In addition, field observations were conducted for two days during the a.m. and p.m. peak periods.

48-hours Average Daily Traffic (ADT) counts were obtained at six roadway segments (two each on Byron Street and Webster Street; and one each on Everett Avenue and Hawthorne Avenue).

¹ Traffic counts collected on March 17-18, 2015

3.2 ROADWAY AND INTERSECTION OPERATING CONDITIONS

This section summarizes existing roadway and intersection operating conditions. The analysis is based on recent intersection turning movement counts data collected as described in Section 3.1.1 (Traffic Data Collection), intersection lane configurations, and signal timing data.

Figure 1 shows the turning movement volumes at each study intersection. Intersection turning movement counts collected by Stantec are included in **Appendix B**. The heaviest movement for both peak hours is in the southbound direction. Field observations showed that frequently there is a queue on Middlefield Road in the southbound that starts at Lytton Avenue and could backup to slightly past Everett Avenue as shown in Exhibit I.



Exhibit I: Middlefield Rd - Looking South near Everett Ave

In the northbound, it was observed that occasionally the queue that starts at the intersection of Willow Avenue/Middlefield Road could backup and overflow to slightly south of Hawthorne Avenue as shown in Exhibit II. Based on discussions with City staff, it was also noted that occasionally the northbound queuing could also overflow and extend to Lytton Avenue.



Exhibit II: Middlefield Road – Looking North Near Hawthorne Ave

3.3 SIGNIFICANCE CRITERIA

The following is the City’s criteria of significance to determine the potential impacts associated with a proposed project or action: the operational impacts on intersections are considered significant when project-related traffic causes the intersection level of service to deteriorate from LOS D or better to LOS E or LOS F, or from LOS E to LOS F.

Traffic operating conditions are evaluated through the determination of Level of Service (LOS), a qualitative measure describing operational conditions. In Palo Alto, LOS A through D are considered acceptable, and LOS E and LOS F are considered unacceptable service levels. A description of the level of service grades and their associated ranges of average controlled delay for signalized intersections is included in **Appendix C**.

3.3.1 Intersection Level of Service

The results of the LOS analysis for the study intersections are shown in **Table 1**. The LOS for the intersection of Middlefield Road/Lytton Avenue operate at acceptable LOS D or better while the LOS at the other two intersections operate at unacceptable LOS F.

Table 1: Existing LOS of Study Intersections

ID	Intersection	Existing Control	A.M.		P.M.	
			Delay	LOS	Delay	LOS
1	Middlefield Road/Hawthorne Avenue	One-Way Stop	126.9	F	44.8	E
2	Middlefield Road/Everett Avenue	Two-Way Stop	32.7	D	57.9	F
3	Middlefield Road/Lytton Avenue	Signal	51.0	D	48.0	D

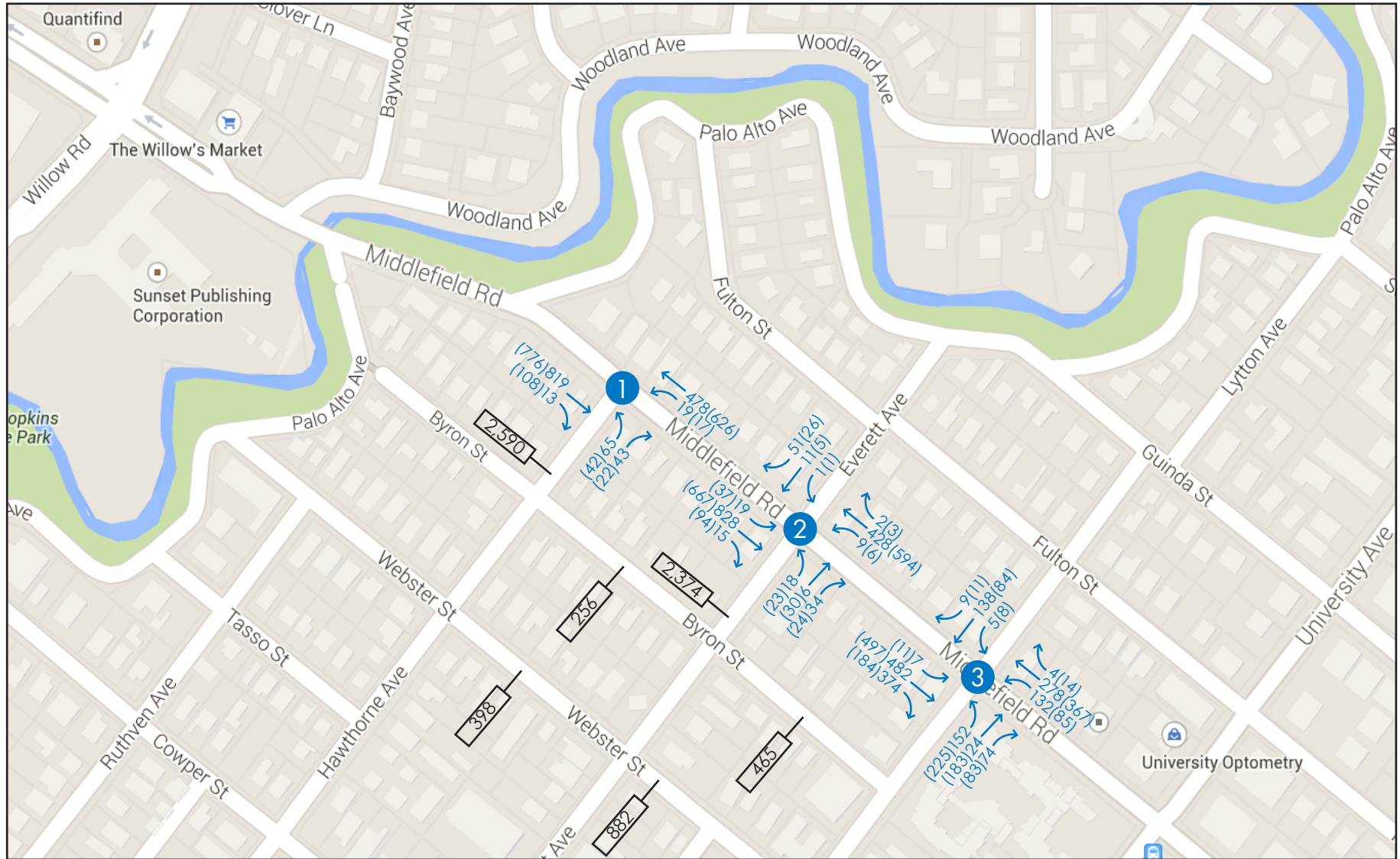
The turning movement counts collected for the three study intersections and ADT volumes are included in **Appendix B**. Detailed level of service worksheets are provided in **Appendix B**.

The primary causes of the congestion (and associated long delays and low service levels) at the two LOS F intersections are:

- Middlefield Road/Hawthorne Avenue – the outbound left-turn volumes from the side street operates at LOS F due to heavy traffic on Middlefield Road. Sight visibility to the north is limited.
- Middlefield Road/Everett Avenue – the outbound left-turn volumes from the side street operates at LOS F due to heavy traffic on Middlefield Road. Sight visibility could be impaired due to the frequent queueing to the south of the intersection.

Focus Traffic Operation Study of Middlefield Road near Everett Avenue
EXISTING TRAFFIC VOLUMES

FIGURE 1



Legend

- XXXX Average Daily Traffic (ADT)
- XX(XX) AM (PM) Peak Hour Turning Movement Volumes
- (X) Study Intersections

4.0 PROJECT ALTERNATIVE TRAFFIC OPERATIONAL ANALYSIS

This section presents the assessment of potential transportation impacts of alternatives in terms of traffic, pedestrians and bicycles access.

As indicated previously, the study focusses on a few issues:

- Evaluate the potential impacts of moving the existing northbound lane drop on Middlefield Road from north of Everett Avenue near Hawthorne Avenue to south of Everett Avenue.
- Analyze pros and cons of making Everett Avenue approaches at Middlefield Road into Right-In and Right-Out Only.
- Discuss potential pedestrian improvement measures for crossing Middlefield Road.

4.1 ALTERNATIVE I: MOVE NORTHBOUND LANE DROP TO SOUTH OF EVERETT AVENUE

This scenario is based on a conceptual alternative provided by the City that moved the new lane drop to just south of Everett Avenue.

Currently, the two northbound lanes on Middlefield is reduced or merged into a single lane at approximately 200 feet south of Hawthorne Avenue.

Stantec created a Synchro traffic model to analyze the alternative. Under this alternative, it was assumed that a median would be constructed on Middlefield Road across Everett Avenue as shown in Exhibit III. Traffic approaching Hawthorne Avenue at Middlefield Road could only be making a right-turn in or right-turn out. Existing left-turn or through traffic in Everett Avenue would be diverted to use either Lytton Avenue or Hawthorne Avenue. It is assumed that most of these traffic would use Lytton Avenue since it is signalized.

Based on the analysis, the results of LOS analysis is shown in Table 2. The LOS at the interseciton of Middlefield Road/Hawthorne Avenue would deteriorate from LOS E to LOS F during the p.m. peak hour.

The LOS at the interseciton of Middlefield Road/Lytton Avenue would deteriorate from LOS D to LOS E during the a.m. peak hour.

The LOS at the interseciton of Middlefield Road/Everett Avenue would improve from LOS F to LOS B. The travel speed of the segment would also improve since there would not be any left or through movement from side street traffic at Everett Avenue. However, as noted above the

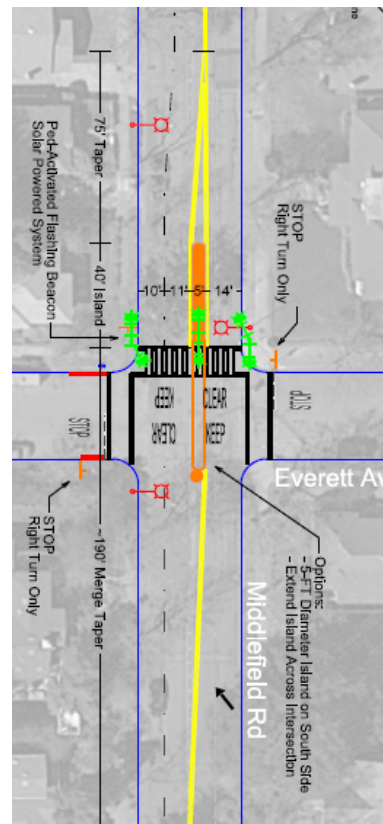


Exhibit III: Alternative - New Lane Drop To Just South Of Everett Avenue

LOS at the other two study intersections would be negatively impacted. In addition, it is also anticipated that it would be more difficult for vehicles on the eastside of Middlefield Road to back out of their driveway when the existing two-lane northbound Middlefield Road is changed to one-lane in this scenario.

The City of Menlo Park recently changed the signal timing at the intersection of Willow Road/Middlefield Road. It might take some time for the City of Menlo Park to monitor and make any appropriate adjustments to better serve the traffic demands. Due to these factors, it is recommended the City work with Menlo Park for any further adjustments to the signal timing at Willow/Middlefield and follow up to conduct additional study as appropriate before taking further action.

Table 2: Existing and Lane Drop Alternative LOS of Study Intersections

ID	Intersection	Existing Control	Existing Condition				Lane Drop Alternative			
			A.M.		P.M.		A.M.		P.M.	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Middlefield Rd/Hawthorne Ave	One-Way Stop	126.9	F	44.8	E	123.5	F	59.9	F
2	Middlefield Rd/Everett Ave	Two-Way Stop	32.7	D	57.9	F	12.6	B	14.9	B
3	Middlefield Rd/Lytton Ave	Signal	51.0	D	48.0	D	57.7	E	52.9	D

4.2 ALTERNATIVE II: RIGHT-IN AND RIGHT-OUT ONLY AT EVERETT AVENUE TRAFFIC CONDITIONS

As mentioned earlier, field observations showed that there is frequently a queue that developed on Middlefield Road in the southbound that starts at Lytton Avenue and could backup to slightly past Everett Avenue as shown in Exhibit I. When that happens, the queue on both southbound lanes could block the visibility of eastbound vehicles on Everett Avenue waiting to make a left or through movement.

Since the northbound traffic on Middlefield Road during the peak hour could be quite heavy and traveling at high speed, it is generally difficult for the eastbound or westbound traffic on Hawthorne Avenue to execute the movement (either a left or through movement) during the peak hours.

Based on a review of the collision data, our field observations and discussions with city staff and residents, Stantec recommends restricting the movements on Hawthorne Avenue to right-turn only during the a.m. and p.m. peak hours on weekdays (Monday to Friday) with a sign similar to that shown in Exhibit IV. Pedestrian safety might also be improved under this

scenario since the potential conflicts between pedestrians crossing Middlefield Road and vehicles on Everett Avenue making eastbound left-turn or westbound right-turn would be eliminated.

Together with some enforcement, the implementation of the time limited right-turn only restriction on Everett Avenue at the intersection could be effective.



Exhibit IV: Example Right-Turn Only Sign at Alma Street/Ravenswood Avenue, Menlo Park, Ca

4.3 POTENTIAL PEDESTRIAN IMPROVEMENT MEASURES FOR CROSSING MIDDLEFIELD ROAD

Based on the peak hour counts, the maximum number of pedestrians that cross Middlefield Road (to the north of Everett Avenue) was 10 during the a.m. peak hour.

An improved pedestrian crossing was assumed under Alternative I as discussed above. A five-foot pedestrian refuge was assumed for the median. In addition, a Rectangular Rapid Flash Beacons (RRFB) was proposed. RRFB can enhance safety by reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts.



RRFB

Typically together with RRFB, a pedestrian refuge at the median is also recommended for crossing three or more lanes of roadway. The pedestrian refuge would provide some protection as pedestrians cross the street. Since Alternative I is not the recommended alternative in the short-term, it was the consensus of the group during the public meeting² to not recommend installation of RRFB at the existing intersection.

5.0 CONCLUSION

The purpose of this study is to conduct a focus traffic study of Middlefield Road near Everett Avenue. The specific tasks include:

- Evaluate potential impacts of moving the existing northbound lane drop on Middlefield Road from north of Everett Avenue to south of Everett Avenue.
- Evaluate safety improvements at the intersection of Middlefield Road/Everett Avenue.

Stantec obtained a.m. and p.m. peak hours intersection turning movement counts at three study intersections:

- Middlefield Road/Hawthorne Avenue
- Middlefield Road/Everett Avenue
- Middlefield Road/Lytton Avenue

The level of service (LOS) for the intersection of Middlefield Road/Lytton Avenue operate at acceptable LOS D or better while the LOS at the other two intersections operate at unacceptable LOS F.

Alternative I: Move Northbound Lane Drop to South of Everett Avenue

Under this alternative, the LOS at the intersection of Middlefield Road/Hawthorne Avenue would deteriorate from LOS E to LOS F during the p.m. peak hour. And the LOS at the intersection of Middlefield Road/Lytton Avenue would deteriorate from LOS D to LOS E during the a.m. peak hour.

The City of Menlo Park has recently changed the signal timing at the intersection of Willow Road/Middlefield Road. It might take some time for the City of Menlo Park to monitor and make any appropriate adjustments to better serve the traffic demands. Due to all the factors above, it is recommended the City work with Menlo Park for any further adjustments to the signal timing at Willow/Middlefield and follow up to conduct additional study as appropriate before taking further action.

² April 16, 2015 meeting at City Hall

Alternative II: Right-In and Right-Out Only At Everett Avenue

Based on review of the collision data, field observations and discussions with city staff and residents, Stantec recommends restricting the movements on Hawthorne Avenue to right-turn only during the a.m. (7 – 9) and p.m. (4 – 6) peak hours on weekdays, Monday to Friday.

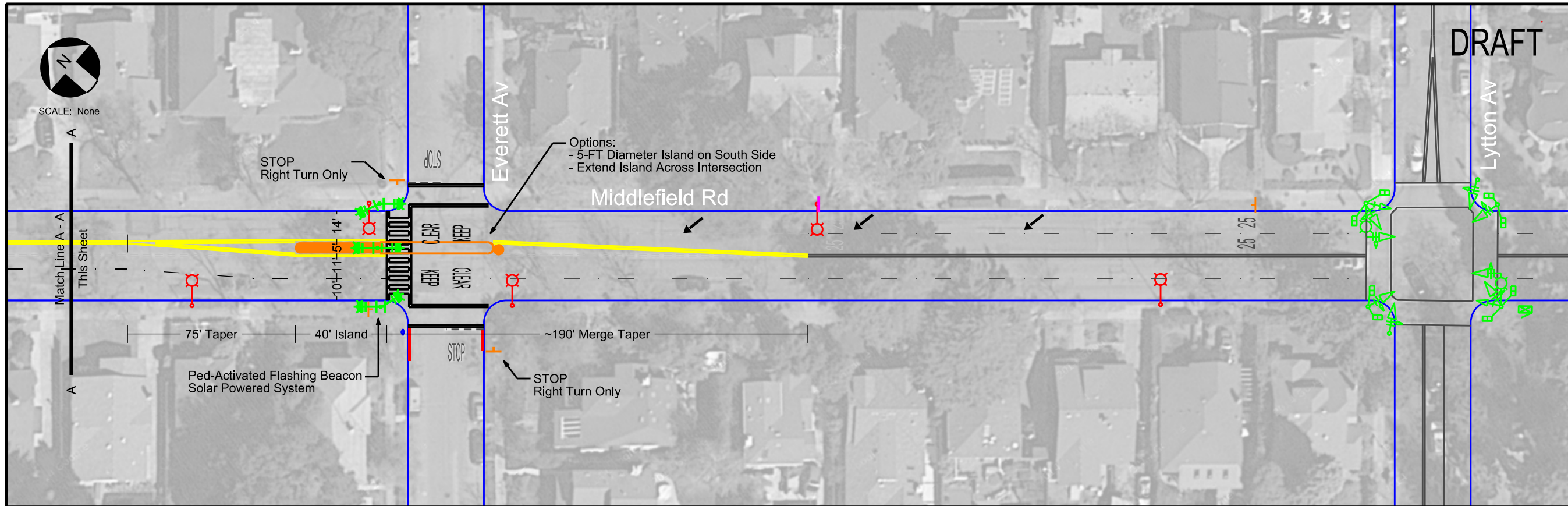
Together with some enforcement, the implementation of the time limited right-turn only restriction on Everett Avenue at the intersection could be effective.

Appendix A Proposed Project Alternative

Middlefield Rd - Palo Alto Av to Hawthorne Av



Middlefield Rd - Everett Av to Lytton Av



PROJECT NO.
SCALE: None
SHEET NO.

DRAWN BY:

REVIEWED BY:

APPROVED BY:

City of Palo Alto
Plan Line Concept Drawing
Northbound Lane Drop Concept
Lytton Avenue to Palo Alto Avenue

ENGINEER'S STAMP

NO.	DESCRIPTION	DATE

City of Palo Alto
Planning & Community Development Dept.
Transportation Division
250 Hamilton Avenue
Palo Alto, CA 94301
O: (650) 329-2441
F: (650) 329-2154

Appendix B Traffic Volume Counts

ALL TRAFFIC DATA

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-001 Middlefield Road-Hawthorne Avenue.ppd

Date : 3/17/2015

Unshifted Count = All Vehicles

START TIME	Middlefield Road Southbound					Westbound					Middlefield Road Northbound					Hawthorne Avenue Eastbound					Total	Uturn Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL		
07:00	0	138	8	0	146	0	0	0	0	0	4	69	0	0	73	2	0	4	0	6	225	0
07:15	0	145	4	0	149	0	0	0	0	0	1	75	0	0	76	12	0	4	0	16	241	0
07:30	0	177	0	0	177	0	0	0	0	0	0	88	0	0	88	14	0	5	0	19	284	0
07:45	0	226	5	0	231	0	0	0	0	0	4	117	0	0	121	19	0	13	0	32	384	0
Total	0	686	17	0	703	0	0	0	0	0	9	349	0	0	358	47	0	26	0	73	1134	0
08:00	0	180	4	0	184	0	0	0	0	0	4	104	0	0	108	14	0	13	0	27	319	0
08:15	0	214	1	0	215	0	0	0	0	0	5	138	0	0	143	20	0	10	0	30	388	0
08:30	0	190	3	0	193	0	0	0	0	0	6	118	0	0	124	12	0	7	0	19	336	0
08:45	0	224	6	0	230	0	0	0	0	0	5	125	0	0	130	12	0	5	0	17	377	0
Total	0	808	14	0	822	0	0	0	0	0	20	485	0	0	505	58	0	35	0	93	1420	0
16:00	0	152	6	0	158	0	0	0	0	0	3	169	0	0	172	22	0	6	0	28	358	0
16:15	0	162	13	0	175	0	0	0	0	0	3	157	0	0	160	16	0	4	0	20	355	0
16:30	0	180	15	0	195	0	0	0	0	0	2	177	0	0	179	10	0	8	0	18	392	0
16:45	0	174	23	0	197	0	0	0	0	0	2	153	0	0	155	10	0	5	0	15	367	0
Total	0	668	57	0	725	0	0	0	0	0	10	656	0	0	666	58	0	23	0	81	1472	0
17:00	0	177	24	0	201	0	0	0	0	0	5	158	0	0	163	9	0	9	0	18	382	0
17:15	0	192	22	0	214	0	0	0	0	0	5	148	0	0	153	13	0	3	0	16	383	0
17:30	0	220	26	0	246	0	0	0	0	0	2	167	0	0	169	8	0	6	0	14	429	0
17:45	0	187	36	0	223	0	0	0	0	0	5	155	0	0	160	12	0	4	0	16	399	0
Total	0	776	108	0	884	0	0	0	0	0	17	628	0	0	645	42	0	22	0	64	1593	0
Grand Total	0	2938	196	0	3134	0	0	0	0	0	56	2118	0	0	2174	205	0	106	0	311	5619	0
Apprch %	0.0%	93.7%	6.3%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	2.6%	97.4%	0.0%	0.0%		65.9%	0.0%	34.1%	0.0%			
Total %	0.0%	52.3%	3.5%	0.0%	55.8%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	37.7%	0.0%	0.0%	38.7%	3.6%	0.0%	1.9%	0.0%	5.5%	100.0%	

ALL TRAFFIC DATA

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-001 Middlefield Road-Hawthorne Avenue.ppd

Date : 3/17/2015

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

Unshifted Count = All Vehicles

AM PEAK HOUR	Middlefield Road Southbound					Westbound					Middlefield Road Northbound					Hawthorne Avenue Eastbound					Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	
Peak Hour Analysis From 07:45 to 08:45																					
Peak Hour For Entire Intersection Begins at 07:45																					
07:45	0	226	5	0	231	0	0	0	0	0	4	117	0	0	121	19	0	13	0	32	384
08:00	0	180	4	0	184	0	0	0	0	0	4	104	0	0	108	14	0	13	0	27	319
08:15	0	214	1	0	215	0	0	0	0	0	5	138	0	0	143	20	0	10	0	30	388
08:30	0	190	3	0	193	0	0	0	0	0	6	118	0	0	124	12	0	7	0	19	336
Total Volume	0	810	13	0	823	0	0	0	0	0	19	477	0	0	496	65	0	43	0	108	1427
% App Total	0.0%	98.4%	1.6%	0.0%		0.0%	0.0%	0.0%	0.0%		3.8%	96.2%	0.0%	0.0%		60.2%	0.0%	39.8%	0.0%		
PHF	.000	.896	.650	.000	.891	.000	.000	.000	.000	.000	.792	.864	.000	.000	.867	.813	.000	.827	.000	.844	.919

PM PEAK HOUR	Middlefield Road Southbound					Westbound					Middlefield Road Northbound					Hawthorne Avenue Eastbound					Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	
Peak Hour Analysis From 17:00 to 18:00																					
Peak Hour For Entire Intersection Begins at 17:00																					
17:00	0	177	24	0	201	0	0	0	0	0	5	158	0	0	163	9	0	9	0	18	382
17:15	0	192	22	0	214	0	0	0	0	0	5	148	0	0	153	13	0	3	0	16	383
17:30	0	220	26	0	246	0	0	0	0	0	2	167	0	0	169	8	0	6	0	14	429
17:45	0	187	36	0	223	0	0	0	0	0	5	155	0	0	160	12	0	4	0	16	399
Total Volume	0	776	108	0	884	0	0	0	0	0	17	628	0	0	645	42	0	22	0	64	1593
% App Total	0.0%	87.8%	12.2%	0.0%		0.0%	0.0%	0.0%	0.0%		2.6%	97.4%	0.0%	0.0%		65.6%	0.0%	34.4%	0.0%		
PHF	.000	.882	.750	.000	.898	.000	.000	.000	.000	.000	.850	.940	.000	.000	.954	.808	.000	.611	.000	.889	.928

ALL TRAFFIC DATA

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-001 Middlefield Road-Hawthorne Avenue.ppd

Date : 3/17/2015

Bank 1 Count = Peds & Bikes

START TIME	Middlefield Road Southbound					Westbound					Middlefield Road Northbound					Hawthorne Avenue Eastbound					Total	Ped Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL		
07:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3
07:15	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	1	0	0	3
07:30	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	1	0	2	1	3	5	1
07:45	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	3	0
Total	0	3	2	0	5	0	0	0	0	0	0	3	0	0	3	1	0	2	5	3	11	5
08:00	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0
08:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
08:30	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0
08:45	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Total	0	4	1	0	5	0	0	0	0	0	0	1	0	0	1	0	0	2	0	2	8	0
16:00	0	1	0	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	1
16:15	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	3	0
16:30	0	1	1	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	3	1
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	4	1	1	5	0	0	0	0	0	0	3	0	0	3	0	0	0	1	0	8	2
17:00	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	0
17:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0
17:30	0	3	0	0	3	0	0	0	0	0	0	2	0	0	2	0	0	0	1	0	5	1
17:45	0	2	0	1	2	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	6	1
Total	0	7	0	1	7	0	0	0	0	0	0	7	0	0	7	1	0	0	1	1	15	2
Grand Total	0	18	4	2	22	0	0	0	0	0	0	14	0	0	14	2	0	4	7	6	42	9
Apprch %	0.0%	81.8%	18.2%			0.0%	0.0%	0.0%			0.0%	100.0%	0.0%			33.3%	0.0%	66.7%				
Total %	0.0%	42.9%	9.5%		52.4%	0.0%	0.0%	0.0%		0.0%	0.0%	33.3%	0.0%		33.3%	4.8%	0.0%	9.5%		14.3%	100.0%	

ALL TRAFFIC DATA

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-001 Middlefield Road-Hawthorne Avenue.ppd

Date : 3/17/2015

Bank 1 Count = Peds & Bikes

AM PEAK HOUR	Middlefield Road Southbound					Westbound					Middlefield Road Northbound					Hawthorne Avenue Eastbound					Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	
Peak Hour Analysis From 07:45 to 08:45																					
Peak Hour For Entire Intersection Begins at 07:45																					
07:45	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	3
08:00	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3
08:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
08:30	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2
Total Volume	0	5	0	0	5	0	0	0	0	0	0	2	0	0	2	0	0	2	0	2	9
% App Total	0.0%	100.0%	0.0%			0.0%	0.0%	0.0%			0.0%	100.0%	0.0%			0.0%	0.0%	100.0%			
PHF	.000	.625	.000		.625	.000	.000	.000		.000	.500	.000		.500	.000	.000	.500		.500		.750

PM PEAK HOUR	Middlefield Road Southbound					Westbound					Middlefield Road Northbound					Hawthorne Avenue Eastbound					Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	
Peak Hour Analysis From 17:00 to 18:00																					
Peak Hour For Entire Intersection Begins at 17:00																					
17:00	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3
17:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
17:30	0	3	0	0	3	0	0	0	0	0	0	2	0	0	2	0	0	0	1	0	5
17:45	0	2	0	1	2	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	6
Total Volume	0	7	0	1	7	0	0	0	0	0	0	7	0	0	7	1	0	0	1	1	15
% App Total	0.0%	100.0%	0.0%			0.0%	0.0%	0.0%			0.0%	100.0%	0.0%			100.0%	0.0%	0.0%			
PHF	.000	.583	.000		.583	.000	.000	.000		.000	.438	.000		.438	.250	.000	.000		.250		.625

ALL TRAFFIC DATA

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-002 Middlefield Road-Everett Avenue.ppd

Date : 3/17/2015

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

Unshifted Count = All Vehicles

START TIME	Middlefield Road Southbound					Everett Avenue Westbound					Middlefield Road Northbound					Everett Avenue Eastbound					Total	Uturn Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL		
07:00	2	137	3	0	142	0	5	4	0	9	0	59	0	0	59	9	0	5	0	14	224	0
07:15	1	150	2	0	153	0	5	7	0	12	3	61	0	0	64	6	0	1	0	7	236	0
07:30	4	171	4	0	179	1	3	9	0	13	2	82	0	0	84	0	0	5	0	5	281	0
07:45	5	230	5	0	240	0	4	12	0	16	3	102	0	0	105	4	1	6	0	11	372	0
Total	12	688	14	0	714	1	17	32	0	50	8	304	0	0	312	19	1	17	0	37	1113	0
08:00	7	187	2	0	196	0	3	12	0	15	3	97	0	0	100	3	2	16	0	21	332	0
08:15	5	217	2	0	224	0	2	10	0	12	2	124	2	0	128	6	0	5	0	11	375	0
08:30	2	194	6	0	202	1	2	17	0	20	1	105	0	0	106	5	3	7	0	15	343	0
08:45	3	218	3	0	224	0	4	9	0	13	3	114	1	0	118	7	1	7	0	15	370	0
Total	17	816	13	0	846	1	11	48	0	60	9	440	3	0	452	21	6	35	0	62	1420	0
16:00	8	131	19	0	158	1	0	5	0	6	0	152	3	0	155	14	14	4	0	32	351	0
16:15	3	140	23	0	166	0	3	4	0	7	3	136	1	0	140	15	10	3	0	28	341	0
16:30	4	167	16	0	187	1	1	2	0	4	1	176	1	0	178	6	14	1	0	21	390	0
16:45	10	159	12	0	181	0	4	6	0	10	3	148	2	0	153	6	9	2	0	17	361	0
Total	25	597	70	0	692	2	8	17	0	27	7	612	7	0	626	41	47	10	0	98	1443	0
17:00	5	157	24	0	186	0	2	8	0	10	1	144	0	0	145	6	11	4	0	21	362	0
17:15	9	168	19	0	196	0	1	6	0	7	1	144	1	0	146	8	10	8	0	26	375	0
17:30	15	181	27	0	223	1	1	4	0	6	2	173	1	0	176	7	2	5	0	14	419	0
17:45	8	161	24	0	193	0	1	8	0	9	2	133	1	0	136	2	7	7	0	16	354	0
Total	37	667	94	0	798	1	5	26	0	32	6	594	3	0	603	23	30	24	0	77	1510	0
% App Total	4.6%	83.6%	11.8%	0.0%		3.1%	15.6%	81.3%	0.0%		1.0%	98.5%	0.5%	0.0%		29.9%	39.0%	31.2%	0.0%			
PHF	.617	.921	.870	.000	.895	.250	.625	.813	.000	.800	.750	.858	.750	.000	.857	.719	.682	.750	.000	.740	.901	
Grand Total	91	2768	191	0	3050	5	41	123	0	169	30	1950	13	0	1993	104	84	86	0	274	5486	0
Apprch %	3.0%	90.8%	6.3%	0.0%		3.0%	24.3%	72.8%	0.0%		1.5%	97.8%	0.7%	0.0%		38.0%	30.7%	31.4%	0.0%			
Total %	1.7%	50.5%	3.5%	0.0%	55.6%	0.1%	0.7%	2.2%	0.0%	3.1%	0.5%	35.5%	0.2%	0.0%	36.3%	1.9%	1.5%	1.6%	0.0%	5.0%	100.0%	

ALL TRAFFIC DATA

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-002 Middlefield Road-Everett Avenue.ppd

Date : 3/17/2015

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

Unshifted Count = All Vehicles

AM PEAK HOUR	Middlefield Road Southbound					Everett Avenue Westbound					Middlefield Road Northbound					Everett Avenue Eastbound					Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	
Peak Hour Analysis From 07:45 to 08:45																					
Peak Hour For Entire Intersection Begins at 07:45																					
07:45	5	230	5	0	240	0	4	12	0	16	3	102	0	0	105	4	1	6	0	11	372
08:00	7	187	2	0	196	0	3	12	0	15	3	97	0	0	100	3	2	16	0	21	332
08:15	5	217	2	0	224	0	2	10	0	12	2	124	2	0	128	6	0	5	0	11	375
08:30	2	194	6	0	202	1	2	17	0	20	1	105	0	0	106	5	3	7	0	15	343
Total Volume	19	828	15	0	862	1	11	51	0	63	9	428	2	0	439	18	6	34	0	58	1422
% App Total	2.2%	96.1%	1.7%	0.0%		1.6%	17.5%	81.0%	0.0%		2.1%	97.5%	0.5%	0.0%		31.0%	10.3%	58.6%	0.0%		
PHF	.679	.900	.625	.000	.898	.250	.688	.750	.000	.788	.750	.863	.250	.000	.857	.750	.500	.531	.000	.690	.948

PM PEAK HOUR	Middlefield Road Southbound					Everett Avenue Westbound					Middlefield Road Northbound					Everett Avenue Eastbound					Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	
Peak Hour Analysis From 16:45 to 17:45																					
Peak Hour For Entire Intersection Begins at 16:45																					
16:45	10	159	12	0	181	0	4	6	0	10	3	148	2	0	153	6	9	2	0	17	361
17:00	5	157	24	0	186	0	2	8	0	10	1	144	0	0	145	6	11	4	0	21	362
17:15	9	168	19	0	196	0	1	6	0	7	1	144	1	0	146	8	10	8	0	26	375
17:30	15	181	27	0	223	1	1	4	0	6	2	173	1	0	176	7	2	5	0	14	419
Total Volume	39	665	82	0	786	1	8	24	0	33	7	609	4	0	620	27	32	19	0	78	1517
% App Total	5.0%	84.6%	10.4%	0.0%		3.0%	24.2%	72.7%	0.0%		1.1%	98.2%	0.6%	0.0%		34.6%	41.0%	24.4%	0.0%		
PHF	.650	.919	.759	.000	.881	.250	.500	.750	.000	.825	.583	.880	.500	.000	.881	.844	.727	.594	.000	.750	.905

ALL TRAFFIC DATA

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-002 Middlefield Road-Everett Avenue.ppd

Date : 3/17/2015

Bank 1 Count = Peds & Bikes

START TIME	Middlefield Road Southbound					Everett Avenue Westbound					Middlefield Road Northbound					Everett Avenue Eastbound					Total	Ped Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL		
07:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	3	0	1	3
07:15	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	2	1	2	4
07:30	2	0	0	0	2	0	2	0	0	2	0	0	0	1	0	0	0	0	1	0	4	2
07:45	0	2	0	0	2	0	6	1	1	7	0	0	0	0	0	0	0	0	0	0	9	1
Total	3	2	0	1	5	0	8	1	1	9	0	1	0	2	1	1	0	0	6	1	16	10
08:00	0	3	0	0	3	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	4	2
08:15	0	1	0	0	1	0	2	0	3	2	0	0	0	0	0	0	0	0	0	0	3	3
08:30	0	1	0	0	1	0	0	0	4	0	0	1	0	0	1	0	0	1	0	1	3	4
08:45	0	1	0	0	1	0	1	0	2	1	0	0	0	0	0	0	0	0	2	0	2	4
Total	0	6	0	0	6	0	4	0	11	4	0	1	0	0	1	0	0	1	2	1	12	13
16:00	0	1	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	1	0	1	3	1
16:15	1	2	0	1	3	0	1	0	0	1	1	2	0	0	3	0	0	0	1	0	7	2
16:30	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	3	1	1	5	0	1	1	0	2	1	3	0	1	4	0	0	1	1	1	12	3
17:00	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0
17:15	1	0	0	0	1	0	0	1	0	1	0	1	0	1	1	0	0	0	0	0	3	1
17:30	0	3	0	0	3	0	0	0	0	0	1	2	0	1	3	0	1	0	1	1	7	2
17:45	1	1	0	0	2	0	0	0	0	0	0	4	0	0	4	0	1	0	0	1	7	0
Total	3	4	0	0	7	0	1	1	0	2	1	7	0	2	8	0	2	0	1	2	19	3
Grand Total	7	15	1	2	23	0	14	3	12	17	2	12	0	5	14	1	2	2	10	5	59	29
Apprch %	30.4%	65.2%	4.3%			0.0%	82.4%	17.6%			14.3%	85.7%	0.0%			20.0%	40.0%	40.0%				
Total %	11.9%	25.4%	1.7%		39.0%	0.0%	23.7%	5.1%		28.8%	3.4%	20.3%	0.0%		23.7%	1.7%	3.4%	3.4%		8.5%	100.0%	

ALL TRAFFIC DATA

(916) 771-8700

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File Name : 15-7226-002 Middlefield Road-Everett Avenue.ppd

Date : 3/17/2015

City of Palo Alto
All Vehicles on Unshifted
Peds & Bikes on Bank 1
Nothing on Bank 2

Bank 1 Count = Peds & Bikes

AM PEAK HOUR	Middlefield Road Southbound					Everett Avenue Westbound					Middlefield Road Northbound					Everett Avenue Eastbound					Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	
Peak Hour Analysis From 07:45 to 08:45																					
Peak Hour For Entire Intersection Begins at 07:45																					
07:45	0	2	0	0	2	0	6	1	1	7	0	0	0	0	0	0	0	0	0	0	9
08:00	0	3	0	0	3	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	4
08:15	0	1	0	0	1	0	2	0	3	2	0	0	0	0	0	0	0	0	0	0	3
08:30	0	1	0	0	1	0	0	0	4	0	0	1	0	0	1	0	0	1	0	1	3
Total Volume	0	7	0	0	7	0	9	1	10	10	0	1	0	0	1	0	0	1	0	1	19
% App Total	0.0%	100.0%	0.0%			0.0%	90.0%	10.0%			0.0%	100.0%	0.0%			0.0%	0.0%	100.0%			
PHF	.000	.583	.000		.583	.000	.375	.250		.357	.000	.250	.000		.250	.000	.000	.250		.250	.528

PM PEAK HOUR	Middlefield Road Southbound					Everett Avenue Westbound					Middlefield Road Northbound					Everett Avenue Eastbound					Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	
Peak Hour Analysis From 16:45 to 17:45																					
Peak Hour For Entire Intersection Begins at 16:45																					
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
17:15	1	0	0	0	1	0	0	1	0	1	0	1	0	1	1	0	0	0	0	0	3
17:30	0	3	0	0	3	0	0	0	0	0	1	2	0	1	3	0	1	0	1	1	7
Total Volume	2	3	0	0	5	0	1	1	0	2	1	3	0	2	4	0	1	0	1	1	12
% App Total	40.0%	60.0%	0.0%			0.0%	50.0%	50.0%			25.0%	75.0%	0.0%			0.0%	100.0%	0.0%			
PHF	.500	.250	.000		.417	.000	.250	.250		.500	.250	.375	.000		.333	.000	.250	.000		.250	.429

ALL TRAFFIC DATA

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-003 Middlefield Road-Lytton Avenue.ppd

Date : 3/17/2015

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

Unshifted Count = All Vehicles

START TIME	Middlefield Road Southbound					Lytton Avenue Westbound					Middlefield Road Northbound					Lytton Avenue Eastbound					Total	Uturn Total
	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL		
07:00	2	55	86	0	143	1	19	3	0	23	23	40	0	0	63	18	2	9	0	29	258	0
07:15	0	58	88	0	146	0	18	2	0	20	13	45	1	0	59	16	2	13	0	31	256	0
07:30	1	89	81	0	171	1	18	0	0	19	21	68	2	0	91	20	3	13	0	36	317	0
07:45	2	135	115	0	252	4	38	1	0	43	27	65	1	0	93	36	3	18	0	57	445	0
Total	5	337	370	0	712	6	93	6	0	105	84	218	4	0	306	90	10	53	0	153	1276	0
08:00	1	131	70	0	202	1	37	2	0	40	33	56	0	0	89	40	2	19	0	61	392	0
08:15	2	128	90	0	220	0	31	3	0	34	28	85	2	0	115	40	10	18	0	68	437	0
08:30	2	103	99	0	204	0	32	3	0	35	44	67	1	0	112	36	9	19	0	64	415	0
08:45	2	127	89	0	218	2	34	1	0	37	31	79	3	0	113	37	5	15	0	57	425	0
Total	7	489	348	0	844	3	134	9	0	146	136	287	6	0	429	153	26	71	0	250	1669	0
16:00	5	93	49	0	147	1	12	4	0	17	21	77	1	0	99	78	49	21	0	148	411	0
16:15	1	110	34	0	145	3	11	3	0	17	20	78	4	0	102	63	30	26	0	119	383	0
16:30	2	110	50	0	162	1	13	8	0	22	16	100	4	0	120	66	48	17	0	131	435	0
16:45	4	103	40	0	147	2	16	5	0	23	22	99	3	0	124	56	50	21	0	127	421	0
Total	12	416	173	0	601	7	52	20	0	79	79	354	12	0	445	263	177	85	0	525	1650	0
17:00	4	125	42	0	171	4	22	1	0	27	17	82	5	0	104	55	53	24	0	132	434	0
17:15	1	116	49	0	166	0	12	6	0	18	22	94	5	0	121	60	47	14	0	121	426	0
17:30	3	153	45	0	201	2	16	2	0	20	19	93	2	0	114	62	36	17	0	115	450	0
17:45	3	121	48	0	172	0	14	2	0	16	27	93	2	0	122	48	47	28	0	123	433	0
Total	11	515	184	0	710	6	64	11	0	81	85	362	14	0	461	225	183	83	0	491	1743	0
Grand Total	35	1757	1075	0	2867	22	343	46	0	411	384	1221	36	0	1641	731	396	292	0	1419	6338	0
Apprch %	1.2%	61.3%	37.5%	0.0%		5.4%	83.5%	11.2%	0.0%		23.4%	74.4%	2.2%	0.0%		51.5%	27.9%	20.6%	0.0%			
Total %	0.6%	27.7%	17.0%	0.0%	45.2%	0.3%	5.4%	0.7%	0.0%	6.5%	6.1%	19.3%	0.6%	0.0%	25.9%	11.5%	6.2%	4.6%	0.0%	22.4%	100.0%	

ALL TRAFFIC DATA

(916) 771-8700

orders@atdtraffic.com

File Name : 15-7226-003 Middlefield Road-Lytton Avenue.ppd

Date : 3/17/2015

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

Unshifted Count = All Vehicles

AM PEAK HOUR	Middlefield Road Southbound					Lytton Avenue Westbound					Middlefield Road Northbound					Lytton Avenue Eastbound					Total	
	START TIME	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS		APP.TOTAL
Peak Hour Analysis From 07:45 to 08:45																						
Peak Hour For Entire Intersection Begins at 07:45																						
07:45	2	135	115	0	252	4	38	1	0	43	27	65	1	0	93	36	3	18	0	57	445	
08:00	1	131	70	0	202	1	37	2	0	40	33	56	0	0	89	40	2	19	0	61	392	
08:15	2	128	90	0	220	0	31	3	0	34	28	85	2	0	115	40	10	18	0	68	437	
08:30	2	103	99	0	204	0	32	3	0	35	44	67	1	0	112	36	9	19	0	64	415	
Total Volume	7	497	374	0	878	5	138	9	0	152	132	273	4	0	409	152	24	74	0	250	1689	
% App Total	0.8%	56.6%	42.6%	0.0%		3.3%	90.8%	5.9%	0.0%		32.3%	66.7%	1.0%	0.0%		60.8%	9.6%	29.6%	0.0%			
PHF	.875	.920	.813	.000	.871	.313	.908	.750	.000	.884	.750	.803	.500	.000	.889	.950	.600	.974	.000	.919	.949	

PM PEAK HOUR	Middlefield Road Southbound					Lytton Avenue Westbound					Middlefield Road Northbound					Lytton Avenue Eastbound					Total	
	START TIME	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS	APP.TOTAL	LEFT	THRU	RIGHT	UTURNS		APP.TOTAL
Peak Hour Analysis From 17:00 to 18:00																						
Peak Hour For Entire Intersection Begins at 17:00																						
17:00	4	125	42	0	171	4	22	1	0	27	17	82	5	0	104	55	53	24	0	132	434	
17:15	1	116	49	0	166	0	12	6	0	18	22	94	5	0	121	60	47	14	0	121	426	
17:30	3	153	45	0	201	2	16	2	0	20	19	93	2	0	114	62	36	17	0	115	450	
17:45	3	121	48	0	172	0	14	2	0	16	27	93	2	0	122	48	47	28	0	123	433	
Total Volume	11	515	184	0	710	6	64	11	0	81	85	362	14	0	461	225	183	83	0	491	1743	
% App Total	1.5%	72.5%	25.9%	0.0%		7.4%	79.0%	13.6%	0.0%		18.4%	78.5%	3.0%	0.0%		45.8%	37.3%	16.9%	0.0%			
PHF	.688	.842	.939	.000	.883	.375	.727	.458	.000	.750	.787	.963	.700	.000	.945	.907	.863	.741	.000	.930	.968	

ALL TRAFFIC DATA

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

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File Name : 15-7226-003 Middlefield Road-Lytton Avenue.ppd

Date : 3/17/2015

Bank 1 Count = Peds & Bikes

START TIME	Middlefield Road Southbound					Lytton Avenue Westbound					Middlefield Road Northbound					Lytton Avenue Eastbound					Total	Ped Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL		
07:00	0	0	0	0	0	0	2	0	0	2	0	0	0	2	0	0	0	0	2	0	2	4
07:15	0	0	0	3	0	0	2	0	2	2	1	0	0	5	1	1	0	0	0	1	4	10
07:30	1	0	0	1	1	1	5	0	1	6	0	0	0	1	0	0	1	0	0	1	8	3
07:45	0	1	1	0	2	0	5	0	1	5	1	0	0	3	1	0	1	1	0	2	10	4
Total	1	1	1	4	3	1	14	0	4	15	2	0	0	11	2	1	2	1	2	4	24	21
08:00	1	2	0	5	3	0	2	0	1	2	0	0	0	5	0	0	0	0	1	0	5	12
08:15	0	1	0	0	1	1	4	0	0	5	1	0	0	6	1	0	0	0	0	0	7	6
08:30	0	0	2	0	2	0	8	0	0	8	1	1	0	3	2	0	1	1	0	2	14	3
08:45	0	0	0	1	0	1	5	0	2	6	0	0	0	4	0	0	0	1	0	1	7	7
Total	1	3	2	6	6	2	19	0	3	21	2	1	0	18	3	0	1	2	1	3	33	28
16:00	0	0	1	3	1	0	2	0	5	2	0	0	0	6	0	0	2	1	0	3	6	14
16:15	0	3	0	0	3	0	0	0	0	0	0	2	0	2	2	1	1	0	0	2	7	2
16:30	0	0	0	0	0	0	0	0	1	0	0	1	0	4	1	0	3	0	0	3	4	5
16:45	0	0	0	2	0	0	0	0	4	0	0	0	0	3	0	0	1	0	1	1	1	10
Total	0	3	1	5	4	0	2	0	10	2	0	3	0	15	3	1	7	1	1	9	18	31
17:00	0	0	0	5	0	0	0	0	0	0	0	0	0	8	0	0	3	2	0	5	5	13
17:15	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	3	0	0	3	4	2
17:30	0	1	0	1	1	0	0	0	3	0	0	2	0	2	2	0	0	0	1	0	3	7
17:45	0	1	1	1	2	0	1	1	3	2	0	1	0	2	1	1	4	1	1	6	11	7
Total	0	2	1	7	3	0	1	1	6	2	0	4	0	14	4	1	10	3	2	14	23	29
Grand Total	2	9	5	22	16	3	36	1	23	40	4	8	0	58	12	3	20	7	6	30	98	109
Apprch %	12.5%	56.3%	31.3%			7.5%	90.0%	2.5%			33.3%	66.7%	0.0%			10.0%	66.7%	23.3%				
Total %	2.0%	9.2%	5.1%		16.3%	3.1%	36.7%	1.0%		40.8%	4.1%	8.2%	0.0%		12.2%	3.1%	20.4%	7.1%		30.6%		100.0%

ALL TRAFFIC DATA

City of Palo Alto
 All Vehicles on Unshifted
 Peds & Bikes on Bank 1
 Nothing on Bank 2

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File Name : 15-7226-003 Middlefield Road-Lytton Avenue.ppd

Date : 3/17/2015

Bank 1 Count = Peds & Bikes

AM PEAK HOUR	Middlefield Road Southbound					Lytton Avenue Westbound					Middlefield Road Northbound					Lytton Avenue Eastbound					Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	
Peak Hour Analysis From 07:45 to 08:45																					
Peak Hour For Entire Intersection Begins at 07:45																					
07:45	0	1	1	0	2	0	5	0	1	5	1	0	0	3	1	0	1	1	0	2	10
08:00	1	2	0	5	3	0	2	0	1	2	0	0	0	5	0	0	0	0	1	0	5
08:15	0	1	0	0	1	1	4	0	0	5	1	0	0	6	1	0	0	0	0	0	7
08:30	0	0	2	0	2	0	8	0	0	8	1	1	0	3	2	0	1	1	0	2	14
Total Volume	1	4	3	5	8	1	19	0	2	20	3	1	0	17	4	0	2	2	1	4	36
% App Total	12.5%	50.0%	37.5%			5.0%	95.0%	0.0%			75.0%	25.0%	0.0%			0.0%	50.0%	50.0%			
PHF	.250	.500	.375		.667	.250	.594	.000		.625	.750	.250	.000		.500	.000	.500	.500		.500	.643

PM PEAK HOUR	Middlefield Road Southbound					Lytton Avenue Westbound					Middlefield Road Northbound					Lytton Avenue Eastbound					Total
	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	LEFT	THRU	RIGHT	PEDS	APP.TOTAL	
Peak Hour Analysis From 17:00 to 18:00																					
Peak Hour For Entire Intersection Begins at 17:00																					
17:00	0	0	0	5	0	0	0	0	0	0	0	0	0	8	0	0	3	2	0	5	5
17:15	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	3	0	0	3	4
17:30	0	1	0	1	1	0	0	0	3	0	0	2	0	2	2	0	0	0	1	0	3
17:45	0	1	1	1	2	0	1	1	3	2	0	1	0	2	1	1	4	1	1	6	11
Total Volume	0	2	1	7	3	0	1	1	6	2	0	4	0	14	4	1	10	3	2	14	23
% App Total	0.0%	66.7%	33.3%			0.0%	50.0%	50.0%			0.0%	100.0%	0.0%			7.1%	71.4%	21.4%			
PHF	.000	.500	.250		.375	.000	.250	.250		.250	.000	.500	.000		.500	.250	.625	.375		.583	.523

Appendix C Intersection LOS Analysis










Appendix C1: Level of Service Definitions

Table C1 – Intersection Level of Service Criteria

Level of Service (LOS)	Type of Intersection Control	
	Stop Controlled	Signalized
	Average Control Delay (sec/veh)	Control Delay per Vehicle (sec/veh)
A	≤ 10	≤ 10
B	> 10 – 15	> 10 – 20
C	> 15 – 25	> 20 – 35
D	> 25 – 35	> 35 – 55
E	> 35 – 50	> 55 – 80
F	> 50	> 80

















Source: Special Report 209: Highway Capacity Manual, 4th ed. (2000 update).
TRB. National Research Council, Washington, D.C., 2000.

Appendix C2: Intersection Level of Service Calculation Worksheets – Existing

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	65	43	19	478	819	13
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.84	0.84	0.87	0.87	0.89	0.89
Hourly flow rate (vph)	77	51	22	549	920	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				918	1159	
pX, platoon unblocked	0.86					
vC, conflicting volume	1521	467	935			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1524	467	935			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	15	91	97			
cM capacity (veh/h)	91	542	728			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	129	571	613	321		
Volume Left	77	22	0	0		
Volume Right	51	0	0	15		
cSH	136	728	1700	1700		
Volume to Capacity	0.95	0.03	0.36	0.19		
Queue Length 95th (ft)	163	2	0	0		
Control Delay (s)	126.9	0.8	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	126.9	0.8	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			10.3			
Intersection Capacity Utilization		53.5%		ICU Level of Service	A	
Analysis Period (min)			15			



















Palo Alto Middlefield Road Traffic Operation Study
2: Middlefield Rd & Everett Ave










Existing AM Peak Hour
4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	6	34	1	11	51	9	428	2	19	828	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.69	0.69	0.69	0.79	0.79	0.79	0.86	0.86	0.86	0.90	0.90	0.90
Hourly flow rate (vph)	26	9	49	1	14	65	10	498	2	21	920	17
Pedestrians					10						9	
Lane Width (ft)					12.0						12.0	
Walking Speed (ft/s)					3.5						3.5	
Percent Blockage					1						1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								455				
pX, platoon unblocked	0.92	0.92		0.92	0.92	0.92				0.92		
vC, conflicting volume	1321	1501	468	1086	1509	269	937			510		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1179	1375	468	924	1383	38	937			300		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	76	93	91	99	89	93	99			98		
cM capacity (veh/h)	110	127	541	171	126	928	727			1149		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	84	80	259	251	481	477						
Volume Left	26	1	10	0	21	0						
Volume Right	49	65	0	2	0	17						
cSH	212	425	727	1700	1149	1700						
Volume to Capacity	0.40	0.19	0.01	0.15	0.02	0.28						
Queue Length 95th (ft)	44	17	1	0	1	0						
Control Delay (s)	32.7	15.4	0.6	0.0	0.6	0.0						
Lane LOS	D	C	A		A							
Approach Delay (s)	32.7	15.4	0.3		0.3							
Approach LOS	D	C										
Intersection Summary												
Average Delay			2.7									
Intersection Capacity Utilization			53.7%		ICU Level of Service					A		
Analysis Period (min)			15									

Palo Alto Middlefield Road Traffic Operation Study
3: Middlefield Rd & Lytton Ave

















Existing AM Peak Hour
4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	152	24	74	5	138	9	132	278	4	7	482	374
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.7			4.7	
Lane Util. Factor	0.95	0.95			1.00			0.95			*0.75	
Frbp, ped/bikes	1.00	0.97			1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.91			0.99			1.00			0.93	
Flt Protected	0.95	0.99			1.00			0.98			1.00	
Satd. Flow (prot)	1681	1551			1839			3478			2580	
Flt Permitted	0.95	0.99			1.00			0.98			1.00	
Satd. Flow (perm)	1681	1551			1839			3478			2580	
Peak-hour factor, PHF	0.92	0.92	0.92	0.88	0.88	0.88	0.89	0.89	0.89	0.87	0.87	0.87
Adj. Flow (vph)	165	26	80	6	157	10	148	312	4	8	554	430
RTOR Reduction (vph)	0	47	0	0	2	0	0	1	0	0	44	0
Lane Group Flow (vph)	140	84	0	0	171	0	0	463	0	0	948	0
Confl. Peds. (#/hr)	5		17	17		5	1		2	2		1
Confl. Bikes (#/hr)			2			19			1			4
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	4	4		2	2		1	1		3	3	
Permitted Phases												
Actuated Green, G (s)	15.0	15.0			14.6			20.0			40.8	
Effective Green, g (s)	15.0	15.0			14.6			20.0			40.8	
Actuated g/C Ratio	0.14	0.14			0.14			0.19			0.38	
Clearance Time (s)	4.0	4.0			4.0			4.7			4.7	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	233	215			249			645			976	
v/s Ratio Prot	c0.08	0.05			c0.09			c0.13			c0.37	
v/s Ratio Perm												
v/c Ratio	0.60	0.39			0.69			0.72			0.97	
Uniform Delay, d1	43.6	42.2			44.4			41.3			32.9	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	4.3	1.2			7.7			3.8			22.1	
Delay (s)	47.9	43.4			52.1			45.1			55.0	
Level of Service	D	D			D			D			E	
Approach Delay (s)		45.7			52.1			45.1			55.0	
Approach LOS		D			D			D			E	
Intersection Summary												
HCM 2000 Control Delay			51.0					HCM 2000 Level of Service			D	
HCM 2000 Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			107.8					Sum of lost time (s)		17.4		
Intersection Capacity Utilization			72.5%					ICU Level of Service		C		
Analysis Period (min)			15									
c Critical Lane Group												

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	42	22	17	626	776	108
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.95	0.95	0.90	0.90
Hourly flow rate (vph)	47	25	18	659	862	120
Pedestrians	1				1	
Lane Width (ft)	12.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				0	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				918	1159	
pX, platoon unblocked	0.87	0.94	0.94			
vC, conflicting volume	1619	492	983			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1379	332	855			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	59	96	98			
cM capacity (veh/h)	115	623	733			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	72	677	575	407		
Volume Left	47	18	0	0		
Volume Right	25	0	0	120		
cSH	160	733	1700	1700		
Volume to Capacity	0.45	0.02	0.34	0.24		
Queue Length 95th (ft)	52	2	0	0		
Control Delay (s)	44.8	0.7	0.0	0.0		
Lane LOS	E	A				
Approach Delay (s)	44.8	0.7	0.0			
Approach LOS	E					
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization			57.0%	ICU Level of Service	B	
Analysis Period (min)			15			



















Palo Alto Middlefield Road Traffic Operation Study
 2: Middlefield Rd & Everett Ave

Existing PM Peak Hour
 4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	23	30	24	1	5	26	6	594	3	37	667	94
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.74	0.74	0.74	0.80	0.80	0.80	0.86	0.86	0.86	0.90	0.90	0.90
Hourly flow rate (vph)	31	41	32	1	6	32	7	691	3	41	741	104
Pedestrians		1						2				
Lane Width (ft)		12.0						12.0				
Walking Speed (ft/s)		3.5						3.5				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								455				
pX, platoon unblocked	0.89	0.89		0.89	0.89	0.89				0.89		
vC, conflicting volume	1271	1585	426	1214	1635	347	847			694		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1065	1416	426	1000	1472	30	847			419		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	78	65	94	99	94	96	99			96		
cM capacity (veh/h)	140	116	575	116	107	927	786			1016		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	104	40	352	349	412	475						
Volume Left	31	1	7	0	41	0						
Volume Right	32	32	0	3	0	104						
cSH	165	383	786	1700	1016	1700						
Volume to Capacity	0.63	0.10	0.01	0.21	0.04	0.28						
Queue Length 95th (ft)	87	9	1	0	3	0						
Control Delay (s)	57.9	15.5	0.3	0.0	1.3	0.0						
Lane LOS	F	C	A		A							
Approach Delay (s)	57.9	15.5	0.1		0.6							
Approach LOS	F	C										
Intersection Summary												
Average Delay			4.2									
Intersection Capacity Utilization			60.4%		ICU Level of Service					B		
Analysis Period (min)			15									

Palo Alto Middlefield Road Traffic Operation Study
 3: Middlefield Rd & Lytton Ave

Existing PM Peak Hour
 4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	225	183	83	6	64	11	85	367	14	11	497	184
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.7			4.7	
Lane Util. Factor	0.95	0.95			1.00			0.95			*0.75	
Frbp, ped/bikes	1.00	0.99			1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.96			0.98			1.00			0.96	
Flt Protected	0.95	1.00			1.00			0.99			1.00	
Satd. Flow (prot)	1681	1665			1814			3479			2654	
Flt Permitted	0.95	1.00			1.00			0.99			1.00	
Satd. Flow (perm)	1681	1665			1814			3479			2654	
Peak-hour factor, PHF	0.93	0.93	0.93	0.75	0.75	0.75	0.95	0.95	0.95	0.88	0.88	0.88
Adj. Flow (vph)	242	197	89	8	85	15	89	386	15	12	565	209
RTOR Reduction (vph)	0	11	0	0	4	0	0	2	0	0	17	0
Lane Group Flow (vph)	218	299	0	0	104	0	0	488	0	0	769	0
Confl. Peds. (#/hr)	7		14	14		7	2		6	6		2
Confl. Bikes (#/hr)			10			1			4			2
Bus Blockages (#/hr)	0	0	0	0	0	0	0	1	0	0	1	0
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	4	4		2	2		1	1		3	3	
Permitted Phases												
Actuated Green, G (s)	26.0	26.0			12.1			22.1			39.2	
Effective Green, g (s)	26.0	26.0			12.1			22.1			39.2	
Actuated g/C Ratio	0.22	0.22			0.10			0.19			0.34	
Clearance Time (s)	4.0	4.0			4.0			4.7			4.7	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	374	370			187			658			890	
v/s Ratio Prot	0.13	c0.18			c0.06			c0.14			c0.29	
v/s Ratio Perm												
v/c Ratio	0.58	0.81			0.55			0.74			0.86	
Uniform Delay, d1	40.6	43.0			49.8			44.7			36.3	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	2.3	12.2			3.5			4.5			8.8	
Delay (s)	42.9	55.3			53.3			49.2			45.1	
Level of Service	D	E			D			D			D	
Approach Delay (s)		50.1			53.3			49.2			45.1	
Approach LOS		D			D			D			D	
Intersection Summary												
HCM 2000 Control Delay			48.0								HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			116.8								Sum of lost time (s)	17.4
Intersection Capacity Utilization			65.1%								ICU Level of Service	C
Analysis Period (min)			15									

c Critical Lane Group

**Appendix C3: Intersection Level of Service Calculation Worksheets –
Existing plus Project**






































Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	69	43	19	474	819	13
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.84	0.84	0.87	0.87	0.89	0.89
Hourly flow rate (vph)	82	51	22	545	920	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				406	1159	
pX, platoon unblocked	0.91					
vC, conflicting volume	1516	467	935			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1518	467	935			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	15	91	97			
cM capacity (veh/h)	96	542	728			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	133	567	613	321		
Volume Left	82	22	0	0		
Volume Right	51	0	0	15		
cSH	141	728	1700	1700		
Volume to Capacity	0.95	0.03	0.36	0.19		
Queue Length 95th (ft)	165	2	0	0		
Control Delay (s)	123.5	0.8	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	123.5	0.8	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			10.4			
Intersection Capacity Utilization			53.5%	ICU Level of Service	A	
Analysis Period (min)			15			










Palo Alto Middlefield Road Traffic Operation Study
 2: Middlefield Rd & Everett Ave

Lane Drop Alternative - AM Peak Hour

4/6/2015


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	40	0	0	51	0	442	2	0	847	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.69	0.69	0.69	0.79	0.79	0.79	0.86	0.86	0.86	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	58	0	0	65	0	514	2	0	941	17
Pedestrians						10						
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					1							
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								455			57	
pX, platoon unblocked	0.91	0.91	0.91	0.91	0.91	0.86	0.91			0.86		
vC, conflicting volume	1529	1476	479	1054	1483	525	958			526		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1164	1105	233	640	1113	369	759			370		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	92	100	100	88	100			100		
cM capacity (veh/h)	118	188	701	295	186	536	773			1011		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2							
Volume Total	58	65	516	627	330							
Volume Left	0	0	0	0	0							
Volume Right	58	65	2	0	17							
cSH	701	536	1700	1700	1700							
Volume to Capacity	0.08	0.12	0.30	0.37	0.19							
Queue Length 95th (ft)	7	10	0	0	0							
Control Delay (s)	10.6	12.6	0.0	0.0	0.0							
Lane LOS	B	B										
Approach Delay (s)	10.6	12.6	0.0	0.0								
Approach LOS	B	B										
Intersection Summary												
Average Delay			0.9									
Intersection Capacity Utilization			33.9%			ICU Level of Service				A		
Analysis Period (min)			15									



















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	24	74	6	149	9	141	269	4	32	481	374
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.7			4.7	
Lane Util. Factor	0.95	0.95			1.00			0.95			*0.75	
Frbp, ped/bikes	1.00	0.98			1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.91			0.99			1.00			0.94	
Flt Protected	0.95	0.99			1.00			0.98			1.00	
Satd. Flow (prot)	1681	1558			1841			3475			2582	
Flt Permitted	0.95	0.99			1.00			0.98			1.00	
Satd. Flow (perm)	1681	1558			1841			3475			2582	
Peak-hour factor, PHF	0.92	0.92	0.92	0.88	0.88	0.88	0.89	0.89	0.89	0.87	0.87	0.87
Adj. Flow (vph)	180	26	80	7	169	10	158	302	4	37	553	430
RTOR Reduction (vph)	0	41	0	0	2	0	0	1	0	0	41	0
Lane Group Flow (vph)	148	97	0	0	184	0	0	463	0	0	979	0
Confl. Peds. (#/hr)	5		17	17		5	1		2	2		1
Confl. Bikes (#/hr)			2			19			1			4
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	4	4		2	2		1	1		3	3	
Permitted Phases												
Actuated Green, G (s)	15.5	15.5			15.3			20.1			40.8	
Effective Green, g (s)	15.5	15.5			15.3			20.1			40.8	
Actuated g/C Ratio	0.14	0.14			0.14			0.18			0.37	
Clearance Time (s)	4.0	4.0			4.0			4.7			4.7	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	238	221			258			640			965	
v/s Ratio Prot	c0.09	0.06			c0.10			c0.13			c0.38	
v/s Ratio Perm												
v/c Ratio	0.62	0.44			0.71			0.72			1.01	
Uniform Delay, d1	44.0	42.8			44.8			41.9			34.1	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	5.0	1.4			9.0			4.1			32.7	
Delay (s)	49.0	44.2			53.8			45.9			66.9	
Level of Service	D	D			D			D			E	
Approach Delay (s)		46.7			53.8			45.9			66.9	
Approach LOS		D			D			D			E	
Intersection Summary												
HCM 2000 Control Delay			57.7								HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio			0.83									
Actuated Cycle Length (s)			109.1								Sum of lost time (s)	17.4
Intersection Capacity Utilization			73.9%								ICU Level of Service	D
Analysis Period (min)			15									
c Critical Lane Group												

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	49	22	17	619	776	108
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.95	0.95	0.90	0.90
Hourly flow rate (vph)	55	25	18	652	862	120
Pedestrians	1				1	
Lane Width (ft)	12.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				0	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				411	1159	
pX, platoon unblocked	0.88	0.96	0.96			
vC, conflicting volume	1612	492	983			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1449	383	895			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	47	96	98			
cM capacity (veh/h)	105	589	721			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	80	669	575	407		
Volume Left	55	18	0	0		
Volume Right	25	0	0	120		
cSH	140	721	1700	1700		
Volume to Capacity	0.57	0.02	0.34	0.24		
Queue Length 95th (ft)	72	2	0	0		
Control Delay (s)	59.9	0.7	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	59.9	0.7	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			3.0			
Intersection Capacity Utilization			57.0%	ICU Level of Service		B
Analysis Period (min)			15			













Palo Alto Middlefield Road Traffic Operation Study
2: Middlefield Rd & Everett Ave

New Lane Drop Alt - PM Peak Hour
4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	54	0	0	26	0	610	3	0	704	94
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.74	0.74	0.74	0.80	0.80	0.80	0.86	0.86	0.86	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	73	0	0	32	0	709	3	0	782	104
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								455			52	
pX, platoon unblocked	0.88	0.88	0.92	0.88	0.88	0.84	0.92			0.84		
vC, conflicting volume	1579	1548	444	1175	1599	711	888			713		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1268	1233	236	808	1290	561	715			563		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	90	100	100	92	100			100		
cM capacity (veh/h)	101	154	707	214	142	396	814			844		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2							
Volume Total	73	32	713	521	365							
Volume Left	0	0	0	0	0							
Volume Right	73	32	3	0	104							
cSH	707	396	1700	1700	1700							
Volume to Capacity	0.10	0.08	0.42	0.31	0.21							
Queue Length 95th (ft)	9	7	0	0	0							
Control Delay (s)	10.7	14.9	0.0	0.0	0.0							
Lane LOS	B	B										
Approach Delay (s)	10.7	14.9	0.0	0.0								
Approach LOS	B	B										
Intersection Summary												
Average Delay			0.7									
Intersection Capacity Utilization			42.3%			ICU Level of Service				A		
Analysis Period (min)			15									

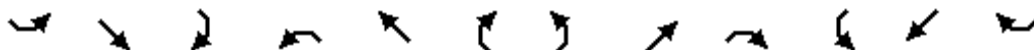
												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	241	183	83	7	69	11	91	361	14	78	496	184
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.7			4.7	
Lane Util. Factor	0.95	0.95			1.00			0.95			*0.75	
Frbp, ped/bikes	1.00	0.99			1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.96			0.98			1.00			0.96	
Flt Protected	0.95	1.00			1.00			0.99			0.99	
Satd. Flow (prot)	1681	1665			1816			3477			2654	
Flt Permitted	0.95	1.00			1.00			0.99			0.99	
Satd. Flow (perm)	1681	1665			1816			3477			2654	
Peak-hour factor, PHF	0.93	0.93	0.93	0.75	0.75	0.75	0.95	0.95	0.95	0.88	0.88	0.88
Adj. Flow (vph)	259	197	89	9	92	15	96	380	15	89	564	209
RTOR Reduction (vph)	0	11	0	0	4	0	0	2	0	0	14	0
Lane Group Flow (vph)	233	301	0	0	112	0	0	489	0	0	848	0
Confl. Peds. (#/hr)	7		14	14		7	2		6	6		2
Confl. Bikes (#/hr)			10			1			4			2
Bus Blockages (#/hr)	0	0	0	0	0	0	0	1	0	0	1	0
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	4	4		2	2		1	1		3	3	
Permitted Phases												
Actuated Green, G (s)	26.2	26.2			12.5			22.3			41.0	
Effective Green, g (s)	26.2	26.2			12.5			22.3			41.0	
Actuated g/C Ratio	0.22	0.22			0.10			0.19			0.34	
Clearance Time (s)	4.0	4.0			4.0			4.7			4.7	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	368	365			190			649			911	
v/s Ratio Prot	0.14	c0.18			c0.06			c0.14			c0.32	
v/s Ratio Perm												
v/c Ratio	0.63	0.82			0.59			0.75			0.93	
Uniform Delay, d1	42.2	44.4			51.0			46.0			37.8	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	3.5	14.0			4.9			5.0			15.7	
Delay (s)	45.8	58.4			55.9			50.9			53.6	
Level of Service	D	E			E			D			D	
Approach Delay (s)		53.0			55.9			50.9			53.6	
Approach LOS		D			E			D			D	
Intersection Summary												
HCM 2000 Control Delay			52.9								HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			119.4								Sum of lost time (s)	17.4
Intersection Capacity Utilization			67.4%								ICU Level of Service	C
Analysis Period (min)			15									

c Critical Lane Group

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								↑			↑↑	
Volume (vph)	0	0	0	0	0	0	0	636	0	0	798	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)								4.7			4.7	
Lane Util. Factor								1.00			0.95	
Flt								1.00			1.00	
Flt Protected								1.00			1.00	
Satd. Flow (prot)								1863			3539	
Flt Permitted								1.00			1.00	
Satd. Flow (perm)								1863			3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.86	0.86	0.86	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	0	0	0	740	0	0	887	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	0	0	0	740	0	0	887	0
Turn Type								NA			NA	
Protected Phases								2			6	
Permitted Phases												
Actuated Green, G (s)								31.0			31.0	
Effective Green, g (s)								31.0			31.0	
Actuated g/C Ratio								0.78			0.78	
Clearance Time (s)								4.7			4.7	
Vehicle Extension (s)								3.0			3.0	
Lane Grp Cap (vph)								1443			2742	
v/s Ratio Prot								c0.40			0.25	
v/s Ratio Perm												
v/c Ratio								0.51			0.32	
Uniform Delay, d1								1.7			1.4	
Progression Factor								1.00			1.00	
Incremental Delay, d2								0.3			0.1	
Delay (s)								2.0			1.4	
Level of Service								A			A	
Approach Delay (s)		0.0			0.0			2.0			1.4	
Approach LOS		A			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			1.7					HCM 2000 Level of Service			A	
HCM 2000 Volume to Capacity ratio			0.49									
Actuated Cycle Length (s)			40.0					Sum of lost time (s)			7.7	
Intersection Capacity Utilization			37.4%					ICU Level of Service			A	
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
23: Lytton & Middlefield

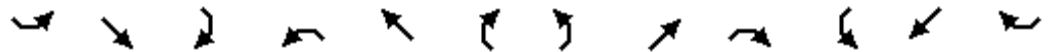
11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↕		↕	↕		↕	↕			↕	
Traffic Volume (vph)	10	482	355	86	316	4	252	22	58	1	120	10
Future Volume (vph)	10	482	355	86	316	4	252	22	58	1	120	10
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	80		0	0		0
Storage Lanes	0		0	1		0	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.943			0.998			0.891			0.990	
Flt Protected		0.999		0.950			0.950					
Satd. Flow (prot)	0	1755	0	1770	1859	0	1770	1660	0	0	1844	0
Flt Permitted		0.999		0.950			0.950					
Satd. Flow (perm)	0	1755	0	1770	1859	0	1770	1660	0	0	1844	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		32						63				3
Link Speed (mph)		30			30			25				30
Link Distance (ft)		466			467			565				576
Travel Time (s)		10.6			10.6			15.4				13.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	524	386	93	343	4	274	24	63	1	130	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	921	0	93	347	0	274	87	0	0	142	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane								Yes				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94				94
Detector 2 Size(ft)		6			6			6				6
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	2	2		1	1		8	8		7	7	
Permitted Phases												

Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector Phase	2	2		1	1		8	8		7	7	
Switch Phase												
Minimum Initial (s)	10.0	10.0		8.0	8.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	26.0	26.0		25.0	25.0		26.0	26.0		26.0	26.0	
Total Split (s)	53.0	53.0		25.0	25.0		26.0	26.0		26.0	26.0	
Total Split (%)	40.8%	40.8%		19.2%	19.2%		20.0%	20.0%		20.0%	20.0%	
Maximum Green (s)	48.0	48.0		20.0	20.0		22.0	22.0		22.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)		5.0		5.0	5.0		4.0	4.0			4.0	
Lead/Lag	Lag	Lag		Lead	Lead		Lag	Lag		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Flash Dont Walk (s)	13.0	13.0		12.0	12.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effect Green (s)		48.1		20.0	20.0		21.3	21.3			14.4	
Actuated g/C Ratio		0.39		0.16	0.16		0.17	0.17			0.12	
v/c Ratio		1.30		0.32	1.14		0.89	0.25			0.65	
Control Delay		174.4		49.8	140.1		79.2	18.6			63.9	
Queue Delay		0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay		174.4		49.8	140.1		79.2	18.6			63.9	
LOS		F		D	F		E	B			E	
Approach Delay		174.4			121.0			64.6			63.9	
Approach LOS		F			F			E			E	
Queue Length 50th (ft)		-924		66	-321		213	16			107	
Queue Length 95th (ft)		#1253		124	#541		#388	65			175	
Internal Link Dist (ft)		386			387			485			496	
Turn Bay Length (ft)							80					
Base Capacity (vph)		711		290	305		319	351			335	
Starvation Cap Reductn		0		0	0		0	0			0	
Spillback Cap Reductn		0		0	0		0	0			0	
Storage Cap Reductn		0		0	0		0	0			0	
Reduced v/c Ratio		1.30		0.32	1.14		0.86	0.25			0.42	

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	121.9
Natural Cycle:	145
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.30
Intersection Signal Delay:	132.1
Intersection LOS:	F
Intersection Capacity Utilization:	92.5%
ICU Level of Service:	F
Analysis Period (min):	15
~ Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	

Lanes, Volumes, Timings

23: Lytton & Middlefield

11/16/2016

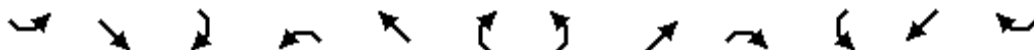
95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 23: Lytton & Middlefield



Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	14	497	163	58	396	13	301	206	54	5	63	12
Future Volume (vph)	14	497	163	58	396	13	301	206	54	5	63	12
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	80		0	0		0
Storage Lanes	0		0	1		0	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.995			0.969			0.980	
Flt Protected		0.999		0.950			0.950				0.997	
Satd. Flow (prot)	0	1799	0	1770	1853	0	1770	1805	0	0	1820	0
Flt Permitted		0.999		0.950			0.950				0.997	
Satd. Flow (perm)	0	1799	0	1770	1853	0	1770	1805	0	0	1820	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		13			1			9				6
Link Speed (mph)		30			30			30				30
Link Distance (ft)		466			467			565				576
Travel Time (s)		10.6			10.6			12.8				13.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	540	177	63	430	14	327	224	59	5	68	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	732	0	63	444	0	327	283	0	0	86	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane								Yes				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94				94
Detector 2 Size(ft)		6			6			6				6
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	2	2		1	1		8	8		7	7	
Permitted Phases												

Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector Phase	2	2		1	1		8	8		7	7	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	26.0	26.0		26.0	26.0		26.0	26.0		26.0	26.0	
Total Split (s)	47.0	47.0		31.0	31.0		26.0	26.0		26.0	26.0	
Total Split (%)	36.2%	36.2%		23.8%	23.8%		20.0%	20.0%		20.0%	20.0%	
Maximum Green (s)	42.0	42.0		26.0	26.0		22.0	22.0		22.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)		5.0		5.0	5.0		4.0	4.0			4.0	
Lead/Lag	Lag	Lag		Lead	Lead		Lag	Lag		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Flash Dont Walk (s)	13.0	13.0		13.0	13.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effect Green (s)		42.0		26.0	26.0		22.0	22.0			10.5	
Actuated g/C Ratio		0.35		0.22	0.22		0.19	0.19			0.09	
v/c Ratio		1.13		0.16	1.09		1.00	0.83			0.52	
Control Delay		114.0		39.8	115.3		97.9	66.1			58.9	
Queue Delay		0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay		114.0		39.8	115.3		97.9	66.1			58.9	
LOS		F		D	F		F	E			E	
Approach Delay		114.0			105.9			83.2			58.9	
Approach LOS		F			F			F			E	
Queue Length 50th (ft)		-646		39	-383		252	204			59	
Queue Length 95th (ft)		#932		82	#620		#464	#367			113	
Internal Link Dist (ft)		386			387			485			496	
Turn Bay Length (ft)							80					
Base Capacity (vph)		646		388	407		328	342			342	
Starvation Cap Reductn		0		0	0		0	0			0	
Spillback Cap Reductn		0		0	0		0	0			0	
Storage Cap Reductn		0		0	0		0	0			0	
Reduced v/c Ratio		1.13		0.16	1.09		1.00	0.83			0.25	

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	118.6
Natural Cycle:	145
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.13
Intersection Signal Delay:	99.7
Intersection LOS:	F
Intersection Capacity Utilization:	78.5%
ICU Level of Service:	D
Analysis Period (min):	15
~ Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	

Lanes, Volumes, Timings

23: Lytton & Middlefield

11/16/2016

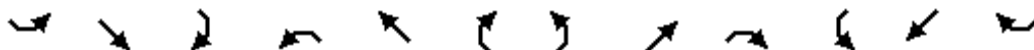
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 23: Lytton & Middlefield



Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↕↕		↕	↕		↕	↕			↕↕	
Traffic Volume (vph)	10	482	355	86	316	4	252	22	58	1	120	10
Future Volume (vph)	10	482	355	86	316	4	252	22	58	1	120	10
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	80		0	0		0
Storage Lanes	0		0	1		0	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.937			0.998			0.891			0.990	
Flt Protected		0.999		0.950			0.950					
Satd. Flow (prot)	0	3313	0	1770	1859	0	1770	1660	0	0	1844	0
Flt Permitted		0.999		0.950			0.950					
Satd. Flow (perm)	0	3313	0	1770	1859	0	1770	1660	0	0	1844	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		143						63				3
Link Speed (mph)		30			30			25				30
Link Distance (ft)		466			467			565				576
Travel Time (s)		10.6			10.6			15.4				13.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	524	386	93	343	4	274	24	63	1	130	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	921	0	93	347	0	274	87	0	0	142	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane								Yes				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94				94
Detector 2 Size(ft)		6			6			6				6
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	2	2		1	1		8	8		7	7	
Permitted Phases												

Lanes, Volumes, Timings

23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector Phase	2	2		1	1		8	8		7	7	
Switch Phase												
Minimum Initial (s)	10.0	10.0		8.0	8.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	26.0	26.0		25.0	25.0		26.0	26.0		26.0	26.0	
Total Split (s)	44.0	44.0		34.0	34.0		26.0	26.0		26.0	26.0	
Total Split (%)	33.8%	33.8%		26.2%	26.2%		20.0%	20.0%		20.0%	20.0%	
Maximum Green (s)	39.0	39.0		29.0	29.0		22.0	22.0		22.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)		5.0		5.0	5.0		4.0	4.0			4.0	
Lead/Lag	Lag	Lag		Lead	Lead		Lag	Lag		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Flash Dont Walk (s)	13.0	13.0		12.0	12.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effect Green (s)		36.8		26.7	26.7		21.1	21.1			14.3	
Actuated g/C Ratio		0.31		0.23	0.23		0.18	0.18			0.12	
v/c Ratio		0.81		0.23	0.82		0.86	0.25			0.63	
Control Delay		38.3		40.5	60.7		73.6	18.9			61.9	
Queue Delay		0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay		38.3		40.5	60.7		73.6	18.9			61.9	
LOS		D		D	E		E	B			E	
Approach Delay		38.3			56.4			60.4			61.9	
Approach LOS		D			E			E			E	
Queue Length 50th (ft)		301		60	259		213	16			107	
Queue Length 95th (ft)		411		113	#429		#388	65			175	
Internal Link Dist (ft)		386			387			485			496	
Turn Bay Length (ft)							80					
Base Capacity (vph)		1212		444	466		336	366			353	
Starvation Cap Reductn		0		0	0		0	0			0	
Spillback Cap Reductn		0		0	0		0	0			0	
Storage Cap Reductn		0		0	0		0	0			0	
Reduced v/c Ratio		0.76		0.21	0.74		0.82	0.24			0.40	

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 117.2
 Natural Cycle: 105
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.86
 Intersection Signal Delay: 48.7
 Intersection LOS: D
 Intersection Capacity Utilization 77.8%
 ICU Level of Service D
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016

Splits and Phases: 23: Lytton & Middlefield



Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↕↕		↖	↗		↖	↗			↕↕	
Traffic Volume (vph)	14	497	163	58	396	13	301	206	54	5	63	12
Future Volume (vph)	14	497	163	58	396	13	301	206	54	5	63	12
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	80		0	0		0
Storage Lanes	0		0	1		0	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.964			0.995			0.969			0.980	
Flt Protected		0.999		0.950			0.950				0.997	
Satd. Flow (prot)	0	3408	0	1770	1853	0	1770	1805	0	0	1820	0
Flt Permitted		0.999		0.950			0.950				0.997	
Satd. Flow (perm)	0	3408	0	1770	1853	0	1770	1805	0	0	1820	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		30			1			9				6
Link Speed (mph)		30			30			30				30
Link Distance (ft)		466			467			565				576
Travel Time (s)		10.6			10.6			12.8				13.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	540	177	63	430	14	327	224	59	5	68	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	732	0	63	444	0	327	283	0	0	86	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane								Yes				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94				94
Detector 2 Size(ft)		6			6			6				6
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Split	NA		Split	NA		Split	NA		Split	NA	
Protected Phases	2	2		1	1		8	8		7	7	
Permitted Phases												

Lanes, Volumes, Timings

23: Lytton & Middlefield

11/16/2016



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector Phase	2	2		1	1		8	8		7	7	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	26.0	26.0		26.0	26.0		26.0	26.0		26.0	26.0	
Total Split (s)	33.0	33.0		40.0	40.0		31.0	31.0		26.0	26.0	
Total Split (%)	25.4%	25.4%		30.8%	30.8%		23.8%	23.8%		20.0%	20.0%	
Maximum Green (s)	28.0	28.0		35.0	35.0		27.0	27.0		22.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)		5.0		5.0	5.0		4.0	4.0			4.0	
Lead/Lag	Lag	Lag		Lead	Lead		Lag	Lag		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Flash Dont Walk (s)	13.0	13.0		13.0	13.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effect Green (s)		28.4		32.6	32.6		25.2	25.2			10.4	
Actuated g/C Ratio		0.25		0.29	0.29		0.22	0.22			0.09	
v/c Ratio		0.83		0.12	0.82		0.82	0.69			0.49	
Control Delay		49.1		32.4	52.4		60.9	49.8			57.3	
Queue Delay		0.0		0.0	2.7		0.0	0.0			0.0	
Total Delay		49.1		32.4	55.1		60.9	49.8			57.3	
LOS		D		C	E		E	D			E	
Approach Delay		49.1			52.3			55.8			57.3	
Approach LOS		D			D			E			E	
Queue Length 50th (ft)		275		35	313		238	193			59	
Queue Length 95th (ft)		#404		74	#504		#404	303			113	
Internal Link Dist (ft)		386			387			485			496	
Turn Bay Length (ft)							80					
Base Capacity (vph)		887		561	588		433	448			367	
Starvation Cap Reductn		0		0	66		0	0			0	
Spillback Cap Reductn		0		0	0		0	0			0	
Storage Cap Reductn		0		0	0		0	0			0	
Reduced v/c Ratio		0.83		0.11	0.85		0.76	0.63			0.23	

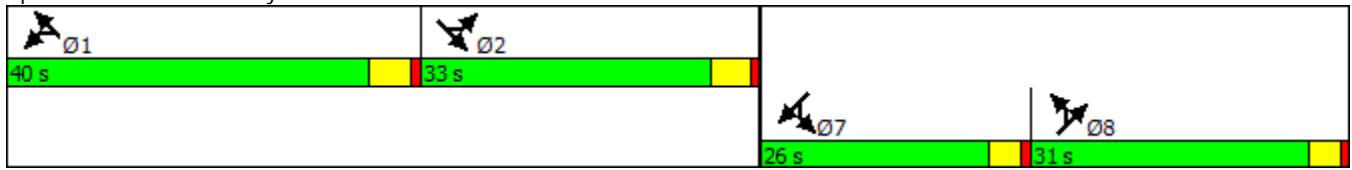
Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	112.3
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.83
Intersection Signal Delay:	52.4
Intersection LOS:	D
Intersection Capacity Utilization:	76.0%
ICU Level of Service:	D
Analysis Period (min):	15
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Lanes, Volumes, Timings
23: Lytton & Middlefield

11/16/2016

Splits and Phases: 23: Lytton & Middlefield



**City of Palo Alto
Transportation Department**

From 1/1/2009 to 12/31/2013

**Total Collisions: 33
Injury Collisions: 16
Fatal Collisions: 1**

Collision Summary Report

11/30/16

MIDDLEFIELD RD from HAWTHORNE AVE to LYTTON AVE

Page 1 of 7

4110951	2/10/2009	18:17	Tuesday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Dark - Street Light	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		East	Proceeding Straight	Female	Age: 80			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Not Deployed		Not Stated		
Party 2	Driver		North	Proceeding Straight	Female	Age: 29			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Deployed		Not Stated		
4086391	3/17/2009	16:33	Tuesday	LYTTON AVE & MIDDLEFIELD RD	0'	Direction: Not State	Daylight	Clear	Pty at Fault:
	Sideswipe		Other Motor Vehicle	Unknown		Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Making Left Turn	Male	Age: 64			
Veh Type:	Passenger Car		Sobriety: HBD Not Under Influ	Assoc Factor: Not Stated	Air Bag Not Deployed		Not Stated		
Party 2	Driver		East	Making Left Turn	Female	Age: 32			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Not Deployed		Not Stated		
4242690	5/17/2009	10:04	Sunday	MIDDLEFIELD RD & LYTTON AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Traffic Signals and Signs	21453A	Hit & Run: No	Complaint of Pain	# Inj: 2	# Killed: 0
Party 1	Driver		South	Proceeding Straight	Male	Age: 21			
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Deployed		Not Stated		
Party 2	Driver		East	Proceeding Straight	Female	Age: 61			
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Not Deployed		Not Stated		
4504797	12/13/2009	18:04	Sunday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Dark - Street Light	Cloudy	Pty at Fault:1
	Broadside		Motor Vehicle on Othe	Auto R/W Violation	21802A	Hit & Run: No	Complaint of Pain	# Inj: 2	# Killed: 0
Party 1	Driver		East	Proceeding Straight	Male	Age: 50			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Not Deployed		Not Stated		
Party 2	Driver		North	Proceeding Straight	Male	Age: 23			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Deployed		Not Stated		
4566850	2/23/2010	07:36	Tuesday	MIDDLEFIELD RD & LYTTON AVE	3'	Direction: North	Daylight	Cloudy	Pty at Fault:1
	Sideswipe		Other Motor Vehicle	Improper Turning	22100A	Hit & Run: Misde	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		West	Making Right Turn	Not State	Age:			
Veh Type:	Truck		Sobriety: HBD Impairment Un	Assoc Factor: Not Stated	Not Stated		Not Stated		
Party 2	Driver		South	Stopped in Road	Female	Age: 43			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag Not Deployed		Not Stated		

MIDDLEFIELD RD from HAWTHORNE AVE to LYTTON AVE

4859592	8/30/2010	02:57	Monday	MIDDLEFIELD RD & EVERETT AVE	50'	Direction: South	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Unsafe Starting or Backing	22106	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Backing		Male	Age: 46		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Lap/Shoulder Harness Used	Not Stated		
Party 2	Driver		South	Stopped in Road		Female	Age: 33		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Lap/Shoulder Harness Used	Not Stated		
5019961	12/17/2010	14:08	Friday	MIDDLEFIELD RD & HAWTHORNE AVE	13'	Direction: East	Daylight	Cloudy	Pty at Fault:1
	Hit Object		Fixed Object	Unsafe Speed	22350	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		North	Making Left Turn		Female	Age: 20		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed	Not Stated		
4990468	12/18/2010	00:49	Saturday	MIDDLEFIELD RD & HAWTHORNE AVE	0'	Direction: Not State	Dark - Street Light	Raining	Pty at Fault:1
	Hit Object		Fixed Object	Driving Under Influence	23152A	Hit & Run: No	Fatal	# Inj: 0	# Killed: 1
Party 1	Driver		South	Proceeding Straight		Male	Age: 25		
Veh Type:	Passenger Car		Sobriety: HBD Under Influen	Assoc Factor: Not Stated		Air Bag Deployed	Not Stated		
Party 2	Parked Vehicle		East	Parked		Not State	Age:		
Veh Type:	Passenger Car		Sobriety: Not Applicable	Assoc Factor: Not Stated		Not Stated	Not Stated		
5057911	1/13/2011	20:40	Thursday	MIDDLEFIELD RD & EVERETT AVE	90'	Direction: South	Dark - Street Light	Raining	Pty at Fault:1
	Rear-End		Bicycle	Driving Under Influence	23152A	Hit & Run: Felony	Severe Injury	# Inj: 1	# Killed: 0
Party 1	Driver		North	Proceeding Straight		Male	Age: 47		
Veh Type:	Passenger Car		Sobriety: HBD Under Influen	Assoc Factor: Not Stated		Air Bag Not Deployed	Not Stated		
Party 2	Bicyclist		North	Proceeding Straight		Male	Age: 28		
Veh Type:	Bicycle		Sobriety: HNBD	Assoc Factor: Not Stated		Not Stated	Not Stated		
5068336	2/10/2011	18:20	Thursday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Dark - No Street Li	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Traffic Signals and Signs	22450A	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		East	Stopped in Road		Female	Age: 23		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Not Required	Not Stated		
Party 2	Driver		South	Proceeding Straight		Male	Age: 46		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed	Not Stated		
5173713	4/3/2011	12:40	Sunday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Unsafe Speed	22350	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		East	Proceeding Straight		Female	Age: 74		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed	Not Stated		
Party 2	Driver		North	Proceeding Straight		Male	Age: 29		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Deployed	Not Stated		

MIDDLEFIELD RD from HAWTHORNE AVE to LYTTON AVE

5341024	10/6/2011	10:11	Thursday	MIDDLEFIELD RD & EVERETT AVE	8'	Direction: East	Daylight	Cloudy	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		West	Proceeding Straight	Female	Age: 16			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Proceeding Straight	Female	Age: 45			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
5357764	10/19/2011	09:10	Wednesday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21801A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Making Left Turn	Male	Age: 49			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		
Party 2	Driver		South	Proceeding Straight	Female	Age: 59			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		
5368318	10/27/2011	16:33	Thursday	MIDDLEFIELD RD & LYTTON AVE	60'	Direction: North	Daylight	Clear	Pty at Fault:1
	Rear-End		Other Motor Vehicle	Unsafe Speed	22350	Hit & Run: Misde	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		South	Proceeding Straight	Female	Age: 26			
Veh Type:	Passenger Car		Sobriety: Impairment Not Kno	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Stopped in Road	Female	Age: 45			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Not Stated		Not Stated		
5466643	1/9/2012	08:52	Monday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Unsafe Speed	22350	Hit & Run: No	Other Visible Injury	# Inj: 1	# Killed: 0
Party 1	Driver		East	Proceeding Straight	Female	Age: 21			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		Not State	Proceeding Straight	Female	Age: 75			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		
5591125	4/13/2012	09:20	Friday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Cloudy	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Making Left Turn	Female	Age: 24			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Proceeding Straight	Female	Age: 38			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
5632099	5/19/2012	14:37	Saturday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Unsafe Speed	22350	Hit & Run: No	Complaint of Pain	# Inj: 2	# Killed: 0
Party 1	Driver		South	Proceeding Straight	Female	Age: 55			
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		East	Proceeding Straight	Female	Age: 32			
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		

MIDDLEFIELD RD from HAWTHORNE AVE to LYTTON AVE

5725974	7/5/2012	19:23	Thursday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Entering Traffic		Female	Age: 24		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	
Party 2	Driver		South	Proceeding Straight		Male	Age: 23		
Veh Type:	Pickup Truck		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	
5748569	7/26/2012	14:09	Thursday	LYTTON AVE & MIDDLEFIELD RD	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Sideswipe		Other Motor Vehicle	Improper Turning	22107	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Making Left Turn		Male	Age: 39		
Veh Type:	Other Bus		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	
Party 2	Driver		East	Making Left Turn		Female	Age: 27		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	
5763015	9/25/2012	07:41	Tuesday	EVERETT AVE & MIDDLEFIELD RD	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Other Visible Injury	# Inj: 4	# Killed: 0
Party 1	Driver		West	Proceeding Straight		Female	Age: 18		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	
Party 2	Driver		South	Proceeding Straight		Female	Age: 32		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Deployed		Not Stated	
Party 3	Driver		East	Stopped in Road		Male	Age: 51		
Veh Type:	Truck		Sobriety: HNBD	Assoc Factor: Not Stated		Not Required		Not Stated	
5828704	9/27/2012	12:38	Thursday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Proceeding Straight		Male	Age: 29		
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Deployed		Not Stated	
Party 2	Driver		North	Proceeding Straight		Female	Age: 35		
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	
5807482	10/3/2012	14:42	Wednesday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21800A	Hit & Run: No	Other Visible Injury	# Inj: 1	# Killed: 0
Party 1	Driver		West	Proceeding Straight		Female	Age: 33		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Deployed		Not Stated	
Party 2	Driver		North	Proceeding Straight		Male	Age: 59		
Veh Type:	Motorcycle		Sobriety: HNBD	Assoc Factor: Not Stated		Not Required		Not Stated	
Party 3	Driver		North	Stopped in Road		Male	Age: 55		
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated		Air Bag Not Deployed		Not Stated	

MIDDLEFIELD RD from HAWTHORNE AVE to LYTTON AVE

5855576	10/24/2012	08:30	Wednesday	MIDDLEFIELD RD & LYTTON AVE	30'	Direction: North	Daylight	Raining	Pty at Fault:1
	Rear-End		Other Motor Vehicle	Unsafe Speed	22350	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		South	Proceeding Straight	Female	Age: 59			
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Stopped in Road	Male	Age: 29			
Veh Type:	Not Stated		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6059728	4/29/2013	19:26	Monday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Making Left Turn	Male	Age: 42			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Proceeding Straight	Female	Age: 28			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6109122	6/10/2013	17:58	Monday	EVERETT AVE & MIDDLEFIELD RD	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Stopped in Road	Male	Age: 54			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		North	Proceeding Straight	Female	Age: 45			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		
6182440	8/18/2013	17:36	Sunday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Sideswipe		Other Motor Vehicle	Traffic Signals and Signs	22450A	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		East	Proceeding Straight	Male	Age: 22			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		
Party 2	Driver		North	Proceeding Straight	Male	Age: 46			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 3	Parked Vehicle		Not State	Parked	Not State	Age:			
Veh Type:	Passenger Car		Sobriety: Not Applicable	Assoc Factor: Not Stated	Not Stated		Not Stated		
6182428	8/21/2013	15:39	Wednesday	LYTTON AVE & MIDDLEFIELD RD	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Bicycle	Other Hazardous Movement	21200A	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Bicyclist		South	Proceeding Straight	Male	Age: 14			
Veh Type:	Bicycle		Sobriety: HNBD	Assoc Factor: Not Stated	Not Stated		Not Stated		
Party 2	Driver		West	Making Left Turn	Female	Age: 47			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6232729	10/4/2013	09:24	Friday	MIDDLEFIELD RD & HAWTHORNE AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Complaint of Pain	# Inj: 2	# Killed: 0
Party 1	Driver		East	Making Left Turn	Female	Age: 78			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Proceeding Straight	Female	Age: 34			
Veh Type:	Passenger Car		Sobriety: HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		

MIDDLEFIELD RD from HAWTHORNE AVE to LYTTON AVE

6296809	11/5/2013	17:53	Tuesday	MIDDLEFIELD RD & EVERETT AVE	20'	Direction: North	Dark - Street Light	Clear	Pty at Fault:1
	Sideswipe		Other Motor Vehicle	Improper Turning	22107	Hit & Run: Misde	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		North	Other Unsafe Turning	Male	Age: 78			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		North	Stopped in Road	Female	Age: 29			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6296873	11/7/2013	16:32	Thursday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Proceeding Straight	Female	Age: 25			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		North	Proceeding Straight	Female	Age: 45			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 3	Driver		North	Proceeding Straight	Male	Age: 38			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6325030	12/1/2013	12:51	Sunday	MIDDLEFIELD RD & EVERETT AVE	0'	Direction: Not State	Daylight	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Proceeding Straight	Female	Age: 76			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Deployed	Not Stated		
Party 2	Driver		North	Proceeding Straight	Male	Age: 41			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6350982	12/9/2013	19:13	Monday	MIDDLEFIELD RD & HAWTHORNE AVE	0'	Direction: Not State	Dark - Street Light	Clear	Pty at Fault:1
	Broadside		Other Motor Vehicle	Auto R/W Violation	21802A	Hit & Run: No	Property Damage Only	# Inj: 0	# Killed: 0
Party 1	Driver		East	Making Right Turn	Male	Age: 49			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Proceeding Straight	Male	Age: 35			
Veh Type:	Truck	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
6331820	12/31/2013	21:08	Tuesday	MIDDLEFIELD RD & LYTTON AVE	75'	Direction: North	Dark - Street Light	Clear	Pty at Fault:1
	Rear-End		Other Motor Vehicle	Unsafe Speed	22350	Hit & Run: No	Complaint of Pain	# Inj: 1	# Killed: 0
Party 1	Driver		South	Proceeding Straight	Male	Age: 20			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		
Party 2	Driver		South	Stopped in Road	Male	Age: 17			
Veh Type:	Passenger Car	Sobriety:	HNBD	Assoc Factor: Not Stated	Air Bag	Not Deployed	Not Stated		

Segment Length: 0.17 miles (920')

Settings for Query:

Start Date: 1/1/2009, End Date: 12/31/2013 (on SWITRS Data)

Street: MIDDLEFIELD RD between HAWTHORNE AVE and LYTTON AVE

Include Intersection Related: True

City Reported: Palo Alto

City: Palo Alto

Sorted By: Date and Time