Attachment D

Transportation Setting

Operational Analysis

Study Area and Periods

The study area consists of the following intersections:

1. Serramonte Boulevard/I-280 Southbound Ramps
2. Serramonte Boulevard/I-280 Northbound Ramps
3. Serramonte Boulevard/Junipero Serra Boulevard
4. Serramonte Boulevard /Collins Avenue
5. Serramonte Boulevard/Serra Center Driveway
6. El Camino Real/Serramonte Boulevard
7. Serramonte Boulevard/Hillside Boulevard
8. El Camino Real/Collins Avenue
9. Junipero Serra Boulevard/Serra Center Driveway

Operating conditions during the weekday a.m. and p.m. peak periods were evaluated to capture the highest volumes on the local transportation network during the work week. The morning peak period occurs between 7:00 and 9:00 a.m. and reflects conditions during the home to work or school commute. The p.m. peak period occurs between 4:00 and 6:00 p.m. and typically reflects the highest level of congestion during the homeward bound commute.

Operating conditions during the weekday midday and weekend p.m. peak periods were evaluated as these time periods reflect the highest traffic volumes area wide and for the proposed project based the surrounding land uses. The weekend evening peak period occurs between 4:00 and 6:00 p.m., while the weekend midday peak period occurs between 12:00 and 2:00 p.m.

Traffic volumes collected for the purpose of this study were collected at study intersections and driveways by Kittleson & Associates and W-Trans on November 1st & 30th, 2017, as well as December 02, 2017. Turning movement counts at driveways were determined based on the number of vehicles enter and exiting the driveways and the directional breakdown of vehicle traveling passed the driveway. Turning movement counts were balanced using engineering judgement in order to reconcile the data collected on three separate days over the course of two months. The new data collected by W-Trans was provided to the Town in excel spreadsheets.

Study Intersections

Serramonte Blvd/I-280 Southbound Ramps is a signalized tee intersection with protected left-turns and a channelized right-turn for the southbound approach. There are no pedestrian or bicycle facilities at this intersection.

Serramonte Blvd/ I-280 Northbound Ramps is a signalized tee intersection with protected left-turns on the eastbound approach. There are no pedestrian or bicycle facilities at this intersection

Serramonte Boulevard/Junipero Serra Boulevard is a signalized four-legged intersection with protected left-turns on all four approaches. There are pedestrian crossings on the east and south legs. These crosswalks include a pedestrian refuge island with pedestrian push buttons. Additionally, there are Class II bike facilities on the northbound and southbound approaches.

Serramonte Boulevard /Collins Ave is a tee intersection with stop control on the Collins Avenue approach. A channelized right-turn is present for vehicles traveling eastbound. No marked pedestrian crossing points or bicycle facilities are present at this intersection.

Serramonte Boulevard/Serra Center Driveway is an all-way stop controlled tee intersection. Pedestrian crossings are present on the north and east legs of the intersection. No bicycle facilities are present at this intersection.

El Camino Real/Serramonte Blvd is a signalized four-legged intersection with protected left-turn phasing on the northbound and southbound approaches. The eastbound and westbound approaches operate with split phasing. There are crosswalks with pedestrian signal heads on all four approaches. There are no bicycle facilities present at this intersection.

Serramonte Blvd/Hillside Ave is a four-legged signalized intersection; however, the east leg is a private driveway to Cypress Lawn Cemetery. There are crosswalks with pedestrian signal heads on all four approaches. The northbound and southbound approaches have protected left-turn phasing. The eastbound and westbound approaches operate with protected/permitted left-turn phasing. Class II bicycle lanes are present on Hillside Boulevard in the north-south direction.

El Camino Real/Collins Avenue is a two-way stop controlled four-legged intersection with a private driveway as the east leg. The east and westbound legs of the intersection are stop controlled. Pedestrian crossings exist on the north and west leg. The northbound left turn lane has storage for approximately 5 vehicles. There are no bicycle facilities present at this intersection.

Junipero Serra Boulevard/Serra Center Driveway is a signalized tee intersection with protected left-turn phasing on the southbound approach. There are crosswalks with pedestrian signal heads on the westbound and southbound approaches. Class II bicycle lanes are present on Junipero Serra Boulevard in the north-south direction.

The locations of the study intersections and the existing lane configurations and controls are shown in Figure 1.

Study Roadways

Serramonte Boulevard is a four-lane east-west oriented arterial with 11 foot travel lanes. A raised median is present from the I-280 Southbound ramp to the intersection of Collins Avenue. The posted speed limit along Serramonte Boulevard is 30 mph. There are many driveways located along Serramonte Boulevard between Junipero Serra Boulevard and Hillside Avenue, however no center two-way left turn lane is present. Drivers wishing to make a left-turn into any of these driveways have to slow or stop in the travel lane to wait for an adequate gap in traffic.

Collins Avenue is a two-lane east-west collector with 12 foot travel lanes. There is on-street parking along Collins Avenue between Serramonte Boulevard and El Camino Real. Collins is a heavily traveled cut through route to access El Camino Real. The posted speed limit is 25 mph.

Junipero Serra Boulevard is a four to five lane north-south oriented arterial with 11-foot travel lanes. A raised median is present along the roadway and the posted speed limit is 40 mph.

El Camino Real is a six-lane north-south oriented regional connector with 10 foot travel lanes. A raised median is present along the roadway segment and the posted speed limit is 40 mph.

Hillside Avenue is a two-lane north-south oriented roadway with 12 foot travel lanes. The posted speed limit along Hillside Avenue is 30 mph.

Study Driveways

1. **Hyundai Auto Dealership Driveway** is located south of the intersection Serramonte Boulevard and Collins Avenue on Collins Avenue.
2. **Ford Auto Dealership Driveway** is located on the south side of Serramonte Boulevard approximately 100 feet east of the intersection of Serramonte Boulevard and Collins Avenue.
3. **Starbucks Driveway** is located on the north side of Serramonte Boulevard approximately 150 feet east of the intersection of Serramonte Boulevard and Collins Avenue.
4. **Serramonte Boulevard Serra Center Driveway** is located on the north side of Serramonte Boulevard approximately 125 west of the stop controlled intersection of Serramonte Boulevard and Serra Center Driveway.
5. **Ford Auto Dealership Driveway** is located on the south side of Serramonte Boulevard across from the Serra Center Driveway (Driveway #4) approximately 150 feet west of the stop controlled intersection of Serramonte Boulevard and Serra Center Driveway.
6. **Stewart Chevrolet Auto Dealership** is located on the north side of Serramonte Boulevard approximately 800 feet east of the intersection of Serramonte Boulevard and Serra Center Driveway.
7. **Serramonte Subaru Driveway** is located on the south side of Serramonte Boulevard approximately 850 feet west of the intersection of Serramonte Boulevard and El Camino Real. The driveway is approximately 50 feet wide.
8. **Serramonte Boulevard Kohl's Driveway** is located on the south side of Serramonte Boulevard approximately 300 feet west of the intersection of Serramonte Boulevard and El Camino Real.
9. **Honda of Serramonte Driveway** is located on the south side of Serramonte Boulevard approximately 350 feet east of the intersection of Serramonte Boulevard and El Camino Real. The driveway is approximately 60 feet wide.
10. **Acura of Serramonte Driveway** is also located on the south side of Serramonte Boulevard approximately 750 feet east of the Serramonte Boulevard and El Camino Real intersection.
11. **Car Max Driveway** is also located on the south side of Serramonte Boulevard approximately 1,100 feet east of the Serramonte Boulevard and El Camino Real intersection.
12. **El Camino Real Kohl's Driveway** is located on El Camino Real approximately a 325 feet south of the intersection of Serramonte Boulevard and El Camino Real. The driveways is approximately 50 feet wide.
13. **Serra Center Driveway** is located on east side of Junipero Serra Boulevard north of the signalized Serra Center Driveway on Junipero Serra Boulevard. The signalized driveway was analyzed as a study intersection.

Alternative Modes

Pedestrian Facilities

Pedestrian facilities include sidewalks, crosswalks, pedestrian countdown heads, curb ramps, and various streetscape amenities such as lighting, benches, etc. In general, a network of sidewalks, crosswalks, pedestrian countdown heads, and curb ramps provide access for pedestrians in the vicinity of the Serramonte Boulevard and Collins Avenue Master Plan project area; however, sidewalk gaps, obstacles, and barriers can be found along some of the roadways within the study area. Existing gaps and obstacles along the roadways impact convenient and continuous access for pedestrians. The lack of infrastructure or presence of obstacles present safety concerns in locations where appropriate pedestrian infrastructure should be present.

- **Serramonte Boulevard** – Intermittent sidewalk coverage is provided on Serramonte Boulevard with significant gaps along the northern portion of the roadway between Gellert Boulevard and Junipero Serra Boulevard where pedestrians are prohibited near the freeway ramp intersections. However, sidewalks are provided along the property frontages on the southern side of the street. Curb ramps and crosswalks at side street approaches are not present at every intersection along Serramonte Boulevard. Pedestrian crosswalks are present on the east and south legs of the intersection at Junipero Serra Boulevard to allow pedestrians to

bypass the freeway ramp intersections. No crosswalks are present at the tee intersection of Collins Avenue and Serramonte Boulevard which represents a major gap in pedestrian connectivity. Pedestrian crosswalks are present on the south and west legs of the intersection at Serra Center Driveway. Pedestrian crosswalks are also present on all four approaches at the intersection of Serramonte Boulevard/El Camino Real and Serramonte Boulevard/Hillside Boulevard. There are no pedestrian crossing opportunities between the Serra Center Driveway and El Camino Real along Serramonte Boulevard, a distance of approximately 2,000 feet. Lighting along the roadway is provided by overhead street lights.

- **Junipero Serra Boulevard** – Continuous sidewalks are provided along Junipero Serra Boulevard within the study area, with the exception of the west side of the roadway north of Serramonte Boulevard where pedestrians are prohibited near the freeway ramp intersections. Lighting along the roadway is provided by overhead street lights.

- **Hillside Boulevard** – Continuous sidewalks are present within study area on both sides of Hillside Boulevard between Villa Avenue and Collins Avenue. Curb ramps and marked crosswalks are present at all pedestrian crossing opportunities within the study area. Additionally, overhead street lights provide lighting along the roadway.

- **El Camino Real** – Continuous sidewalks are provided on El Camino Real within study area. Curb ramps and marked crosswalks are present at the intersection of El Camino Real and Serramonte Boulevard. However, truncated domes are only present on curb ramps at the northeast and southeast corners of the intersection. Lighting along the roadway is provided by overhead lighting.

- **Collins Avenue** – Continuous sidewalks are present along Collins Avenue with the exception of a 0.20 mile section near Serramonte Boulevard. It should be noted that continuous sidewalk access is blocked by a fence extending into the roadway from a service driveway at 1500 Collins Avenue. Curb cuts are present at the driveways along the roadway. Overhead street lights are present along the corridor.

Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2017, classifies bikeways into four categories:

- **Class I Multi-Use Path** – a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- **Class II Bike Lane** – a striped and signed lane for one-way bike travel on a street or highway.
- **Class III Bike Route** – signing only for shared use with motor vehicles within the same travel lane on a street or highway.
- **Class IV Bikeway** – also known as a separated bikeway, a Class IV Bikeway is for the exclusive use of bicycles and includes a separation between the bikeway and the motor vehicle traffic lane. The separation may include, but is not limited to, grade separation, flexible posts, inflexible physical barriers, or on-street parking.

Within the study area, no marked bicycle facilities are provided on Serramonte Boulevard between Gellert Boulevard and Hillside Boulevard. Bicyclists must ride in the roadway and/or on sidewalks. Table 1 summarizes the existing bicycle facilities located near the study area.

Table 1 – Bicycle Facility Summary				
Status **Facility**	**Class**	**Length (miles)**	**Begin Point**	**End Point**
Existing				
Serramonte Boulevard	II	0.23	Callan Boulevard	Serramonte Center
Junipero Serra Boulevard	II	0.56	Town Limits	Town Limits
Hillside Boulevard	II	1.71	Town Limits	Town Limits

Transit Facilities

The Colma BART Station is located approximately a mile north of Serramonte Boulevard and Collins Avenue Master Plan project area. Commuter rail service is provided via BART throughout Alameda, Contra Costa, San Francisco, San Mateo, Santa Clara County. Service is provided seven days a week between the hours of 4:00 a.m. and 1:00 a.m. and operates on headways of 15-60 minutes depending on the day of the week.

The Sam Mateo County Transit District (SamTrans) provides fixed route bus service in the Town of Colma. SamTrans Local Route 112 provides service to between the Colma Bay Area Rapid Transit (BART) Station and the Linda Mar Shopping Center in the City of Pacifica. Within the Town of Colma, Route 112 stops at the intersection of Serramonte Boulevard and Junipero Serra Boulevard, west of the Chipotle drive-through entrance. Route 112 operates Monday through Friday on approximately 60 minute headways between 6:30 a.m. and 8:00 p.m. Saturday and Sunday service operates on approximately 60 minute headways between 8:30 a.m. and 6:30 p.m.

SamTrans Local Route 120 provides service between Colma BART Station and the Daily City BART Station. The route stops at the intersection of Serramonte Boulevard and Junipero Serra Boulevard, west of the Chipotle drive-through entrance. Route 120 operates Monday through Friday on approximately 15 minute headways between 5:00 a.m. and 12:00 a.m. Saturday service operates on approximately 60 minute headways between 6:00 a.m. and 12:00 a.m. Sunday service operates on approximately 30-minute headways between 6:00 a.m. and 11:00 p.m.

SamTrans Local Route 122 provides service between the South San Francisco BART Station and the Stonestown Shopping Center. The route stops at the intersection of Serramonte Boulevard and Junipero Serra Boulevard, west of the Chipotle drive through entrance. Route 122 operates Monday through Friday on approximately 30 minute headways between 5:00 a.m. and 11:30 p.m. Saturday and Sunday service operates on approximately 30 minute headways between 8:00 a.m. and 11:30 p.m.

SamTrans Route ECR provides service between the Palo Alto Transit Center and the Daly City BART Station. The route stops at the intersection of Serramonte Boulevard and El Camino Real. Route ECR operates Monday through Friday on approximately 15 minute headways between 4:00 a.m. and 2:00 a.m. Saturday and Sunday service operates on approximately 20-30 minute headways between 4:30 a.m. and 2:00 a.m.

Two bicycles can be carried on most SamTrans buses. Bike rack space is on a first come, first served basis. Additional bicycles are allowed on SamTrans buses at the discretion of the driver with a limit of two bicycles inside the bus.

Dial-a-ride, also known as paratransit, or door-to-door service, is available for those who are unable to independently use the transit system due to a physical or mental disability. SamTrans Paratransit is designed to serve the needs of individuals with disabilities within the Town of Colma.

Capacity Analysis

Intersection Level of Service Methodologies

Level of Service (LOS) is used to rank traffic operation on various types of facilities based on traffic volumes and roadway capacity using a series of letter designations ranging from A to F. Generally, Level of Service A represents free flow conditions and Level of Service F represents forced flow or breakdown conditions. A unit of measure that indicates a level of delay generally accompanies the LOS designation.

The study intersections were analyzed using methodologies published in the *Highway Capacity Manual* (HCM), Transportation Research Board, 2000. This source contains methodologies for various types of intersection control, all of which are related to a measurement of delay in average number of seconds per vehicle.

The Levels of Service for the intersections with side-street stop controls, or those which are unsignalized and have one or two approaches stop controlled, were analyzed using the "Two-Way Stop-Controlled" intersection capacity method from the HCM. This methodology determines a level of service for each minor turning movement by estimating the level of average delay in seconds per vehicle. Results are presented for individual movements together with the weighted overall average delay for the intersection.

The study intersections with stop signs on all approaches were analyzed using the "All-Way Stop-Controlled" Intersection methodology from the HCM. This methodology evaluates delay for each approach based on turning movements, opposing and conflicting traffic volumes, and the number of lanes. Average vehicle delay is computed for the intersection as a whole and is then related to a Level of Service.

The study intersections that are currently controlled by a traffic signal were evaluated using the signalized methodology from the HCM. This methodology is based on factors including traffic volumes, green time for each movement, phasing, whether or not the signals are coordinated, truck traffic, and pedestrian activity. Average stopped delay per vehicle in seconds is used as the basis for evaluation in this LOS methodology. For purposes of this study, delays were calculated using optimized signal timing.

The ranges of delay associated with the various levels of service are indicated in Table 2.

Table 2 – Intersection Level of Service Criteria			
LOS	**Two-Way Stop-Controlled**	**All-Way Stop-Controlled**	**Signalized**
A	Delay of 0 to 10 seconds. Gaps in traffic are readily available for drivers exiting the minor street.	Delay of 0 to 10 seconds. Upon stopping, drivers are immediately able to proceed.	Delay of 0 to 10 seconds. Most vehicles arrive during the green phase, so do not stop at all.
B	Delay of 10 to 15 seconds. Gaps in traffic are somewhat less readily available than with LOS A, but no queuing occurs on the minor street.	Delay of 10 to 15 seconds. Drivers may wait for one or two vehicles to clear the intersection before proceeding from a stop.	Delay of 10 to 20 seconds. More vehicles stop than with LOS A, but many drivers still do not have to stop.
C	Delay of 15 to 25 seconds. Acceptable gaps in traffic are less frequent, and drivers may approach while another vehicle is already waiting to exit the side street.	Delay of 15 to 25 seconds. Drivers will enter a queue of one or two vehicles on the same approach and wait for vehicle to clear from one or more approaches prior to entering the intersection.	Delay of 20 to 35 seconds. The number of vehicles stopping is significant, although many still pass through without stopping.
D	Delay of 25 to 35 seconds. There are fewer acceptable gaps in traffic, and drivers may enter a queue of one or two vehicles on the side street.	Delay of 25 to 35 seconds. Queues of more than two vehicles are encountered on one or more approaches.	Delay of 35 to 55 seconds. The influence of congestion is noticeable, and most vehicles have to stop.
E	Delay of 35 to 50 seconds. Few acceptable gaps in traffic are available, and longer queues may form on the side street.	Delay of 35 to 50 seconds. Longer queues are encountered on more than one approach to the intersection.	Delay of 55 to 80 seconds. Most, if not all, vehicles must stop and drivers consider the delay excessive.
F	Delay of more than 50 seconds. Drivers may wait for long periods before there is an acceptable gap in traffic for exiting the side streets, creating long queues.	Delay of more than 50 seconds. Drivers enter long queues on all approaches.	Delay of more than 80 seconds. Vehicles may wait through more than one cycle to clear the intersection.

Reference: *Highway Capacity Manual,* Transportation Research Board, 2000

Existing Conditions Intersection Levels of Service

Under existing conditions, all intersections operate at LOS D or better with the exception of the all-way stop controlled intersection of Serramonte Boulevard and Serra Center Driveway which operates at LOS E during the weekday p.m., weekend midday, and weekend p.m. peak periods. The existing traffic volumes are shown in Figure 2 for the weekday peak periods and in Figure 3 for the weekend peak periods. A summary of the intersection level of service calculations is contained in Table 3 for the weekday peak periods and in Table 4 for the weekend peak periods and copies of the Level of Service calculations are provided in Attachment A.

The location of the study driveways is shown in Figure 4. The existing traffic volumes at the study driveways are shown in Figure 5 for the weekday peak periods and in Figure 6 for the weekend peak periods.

Table 3 – Existing Weekday Peak Hour Intersection Levels of Service

Study Intersection *Approach*	AM Peak		PM Peak	
	Delay	**LOS**	**Delay**	**LOS**
1. Serramonte Blvd/I-280 Southbound Ramps	10.8	B	12.6	B
2. Serramonte Blvd/I-280 Northbound Ramps	1.6	A	3.7	A
3. Serramonte Boulevard/Junipero Serra Blvd	26.1	C	33.6	C
4. Serramonte Blvd/Collins Ave	0.7	A	1.1	A
Northbound Approach	*13.7*	*B*	*16.8*	*C*
5. Serramonte Blvd/Serra Center Driveway	16.6	C	**40.7**	**E**
6. El Camino Real/Serramonte Blvd	26.6	C	35.1	D
7. Serramonte Blvd/Hillside Blvd	27.5	C	28.0	C
8. El Camino Real/Collins Ave	2.7	A	1.7	A
Eastbound Approach	*10.3*	*B*	*11.3*	*B*
Westbound Approach	*12.3*	*B*	*11.4*	*B*
9. Junipero Serra Blvd / Serra Center Driveway	11.6	B	10.0	B

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics;* **Bold** text = deficient operation

Table 4 – Existing Weekend Peak Hour Intersection Levels of Service

Study Intersection *Approach*	Weekend Midday Peak		Weekend PM Peak	
	Delay	**LOS**	**Delay**	**LOS**
1. Serramonte Blvd/I-280 Southbound Ramps	15.7	B	16.0	B
2. Serramonte Blvd/I-280 Northbound Ramps	3.7	A	4.4	A
3. Serramonte Boulevard/Junipero Serra Blvd	41.5	D	40.4	D
4. Serramonte Blvd/Collins Ave	0.8	A	0.6	A
Northbound Approach	*17.3*	*C*	*15.0*	*B*
5. Serramonte Blvd/Serra Center Driveway	**48.9**	**E**	**41.4**	**E**
6. El Camino Real/Serramonte Blvd	34.4	C	33.9	C
7. Serramonte Blvd/Hillside Blvd	23.9	C	18.8	B
8. El Camino Real/Collins Ave	1.6	A	1.3	A
Eastbound Approach	*10.7*	*B*	*10.1*	*B*
Westbound Approach	*29.4*	*D*	*0.0*	*A*
9. Junipero Serra Blvd / Serra Center Driveway	10.7	B	10.6	B

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics;* **Bold** text = deficient operation

Queuing

Under Existing Conditions, the projected maximum queues in left-turn lanes at the study intersections were determined using the SIMTRAFFIC application of Synchro and averaging the 95th percentile queues projected queue for each of ten runs. Summarized in Table 5 are the 95th percentile left turn queues at the study intersections where left-turn lanes are present, and the queue spillback has the potential to impede the flow of traffic in the adjacent travel lane. Copies of the SIMTRAFFIC projections are contained in Attachment A.

Table 5 – 95th Percentile Left Turn Queues at Study Intersections with Left-Turn Lanes

Study Intersection Approach	Available Storage	95th Percentile Queues			
		Weekday AM	Weekday PM	Weekend Mid	Weekend PM
2. Serramonte Blvd/I-280 Northbound Ramp					
Eastbound Left	400	74	195	318	**536**
3. Serramonte Blvd/Junipero Serra Blvd					
Northbound Left	590	267	389	404	373
Eastbound Left	500	141	326	**512**	452
Southbound Left	320	108	119	184	209
Westbound Left	145	112	**176**	**173**	**175**
6. El Camino Real/Serramonte Blvd					
Northbound Left	200	114	**240**	**247**	**244**
Southbound Left	300	139	123	93	101
7. Serramonte Blvd/Hillside Ave					
Northbound Left	300	236	300	196	157
Southbound Left	75	34	62	37	28
8. El Camino Real/Collins Ave					
Northbound Left	130	36	36	36	30
9. Junipero Serra Blvd / Serra Center Driveway					
Southbound Left	210	50	65	76	95

Notes: Maximum Queue based on the average of the maximum value from ten SIMTRAFFIC runs; all distances are measured in feet; **Bold** text = queue length exceeds available storage

Left-turn storage exceeds existing storage capacity at three study intersections during at least one peak period. At the Serramonte Boulevard and I-280 Northbound Ramp intersection, the eastbound left-turn queue exceeds the capacity during the weekend p.m. peak period. The westbound left-turn queues at the Serramonte Boulevard and Junipero Serra Boulevard intersection extend through the Serramonte Boulevard and Collins Avenue intersection and could impede vehicles attempting to turn left off of Collins Avenue on to Serramonte Boulevard during all peak periods except for during the weekday a.m. peak period. The northbound left-turn queues at the El Camino Real and Serramonte Boulevard intersection exceed the storage capacity during all peak periods except for during the weekday a.m. peak period.

Signal Warrants

A signal warrant analysis was performed to determine potential need for a traffic signal at the unsignalized study intersections: Serramonte Blvd and Collins Avenue, Serramonte Boulevard and Serra Shopping Center Driveway, and El Camino Real and Collins Avenue.

Chapter 4C of the *California Manual on Uniform Traffic Control Devices* (CA-MUTCD) provides guidance on when a traffic signal should be considered. There are nine different warrants, or criteria, presented, as follows:

- Warrant 3, Peak Hour Volume

Warrant 3, which is often the first warrant to be met, has a notice that this signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time. Under the Peak Hour Warrant the need for a traffic control signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:

A. If all three of the following conditions exist for the same one hour (any four consecutive 15-minute periods) of an average day:

    1. The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: four vehicle-hours for a one-lane approach; or five vehicle-hours for a two-lane approach, and
    2. The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes, and
    3. The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.

B. The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for one hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 for the existing combination of approach lanes.

Additionally, the Highway Capacity Manual states, "If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-4 may be used in place of Figure 4C-3 to evaluate the criteria in the second category of the Standard." While the Town of Colma is comprised of a population under 10,000 residents, it is not an isolated community. Both South San Francisco and Daly City are considered "built-up areas" within significantly larger populations which border the town limits of Colma. For this reason, Figure 4C-3 was used to conduct signal warrants at study intersections.

For the purposes of this study, Warrant 3, the Peak Hour volume warrant, which determines the need for traffic control based on the highest volume hour of the day, was used as an initial indication of traffic control needs. The use of this signal warrant is common practice for planning studies. Other warrants, which are more generally applicable to existing traffic issues, require collection of traffic volumes for the highest four or eight hours of the day, review of the collision history, and evaluation of the system surrounding the location.

The intersection of Serramonte Boulevard and Serra Center Driveway satisfies Warrant 3 during all peak periods except during the a.m. peak period. Additional data collection should be completed to review Warrant 1 and Warrant 2 prior to recommending the installation of a traffic signal at this intersection. Similarly, a signal warrant was met for all peak periods at the intersection of El Camino Real and Collins Avenue. Additional data should be

collected to further analyze the need for a signal at the intersection. The intersection of Serramonte Boulevard and Collins Avenue does not satisfy the conditions of Warrant 3 during any peak period.

Corridor Travel Time

The SIMTRAFFIC application of Synchro was used to model the corridor travel time. Table 6 provides a summary of modeled existing travel time and average speed from the microsimulation model along Serramonte Boulevard between the I-280 Southbound Ramp intersection and the Hillside Avenue intersection. This information is provided for reference and will be used to understand the potential impact of roadway configuration changes along Serramonte Boulevard as part of this project.

Table 6 – Peak Hour Travel Time

Direction of Travel	Weekday AM Peak		Weekday PM Peak		Weekend Midday Peak		Weekend Evening Peak	
	Average TT	Average Speed	Average TT	Average Speed	Average TT	Average Speed	Average TT	Average Speed
EB Serramonte Blvd	4:06	20	4:33	18	4:32	18	4:51	17
WB Serramonte Blvd	3:49	18	4:36	15	4:54	14	4:44	15

Notes: TT (Travel Time) is measured in minutes: seconds; Average Speed is measured in miles per hour (mph)

Study Participants and Reference

Study Participants

Principal in Charge	Steve Weinberger, PE, PTOE
Assistant Engineer	**Nick** Bleich EIT
Assistant Planner	Andre Huff
Graphics	Hannah Yung-Boxdell
Editing/Formatting	Hannah Yung-Boxdell
Report Review	Mark E. Spencer, TE

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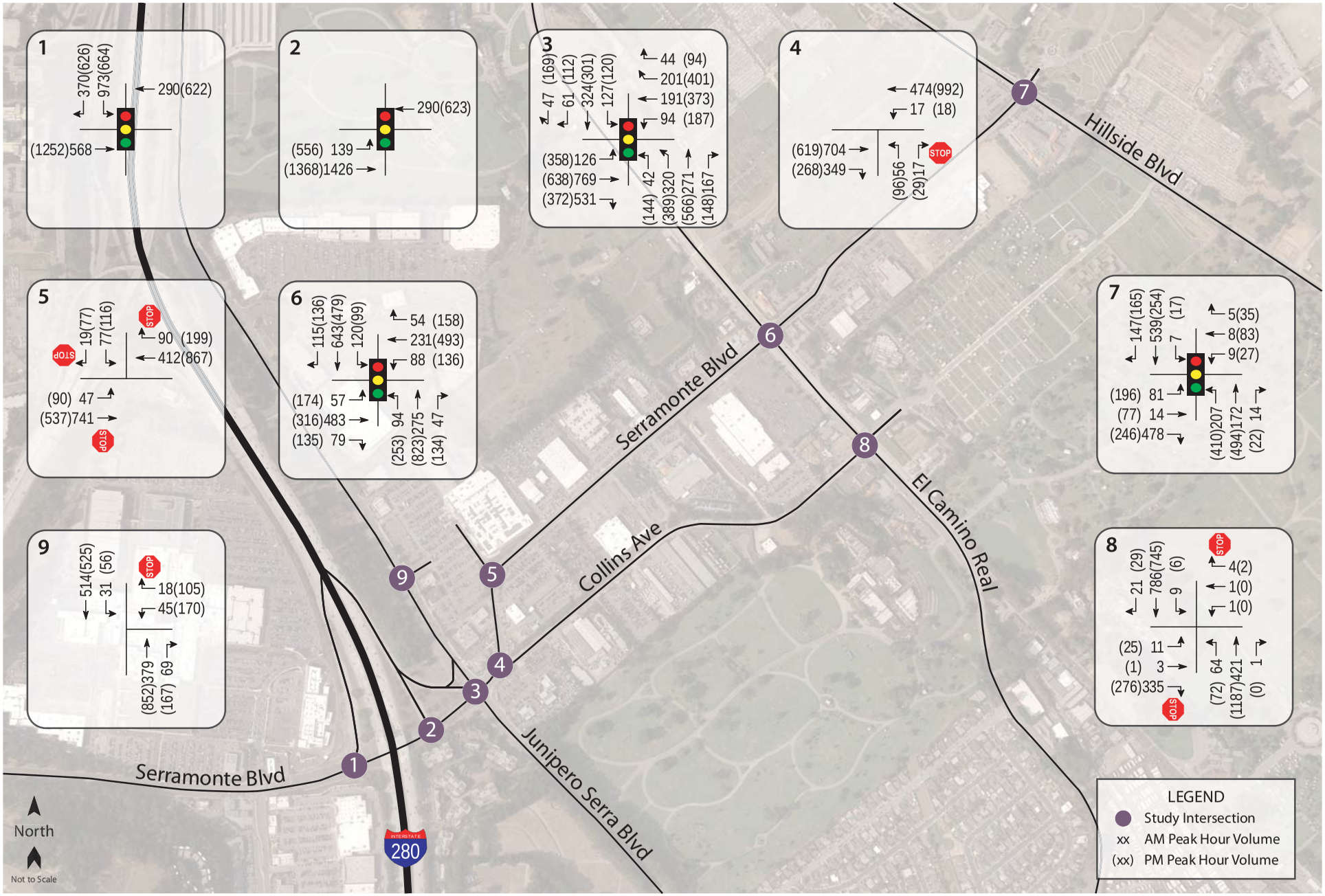
Serramonte Boulevard/Collins Avenue Master Plan

Figure 1 – Study Area and Lane Configurations



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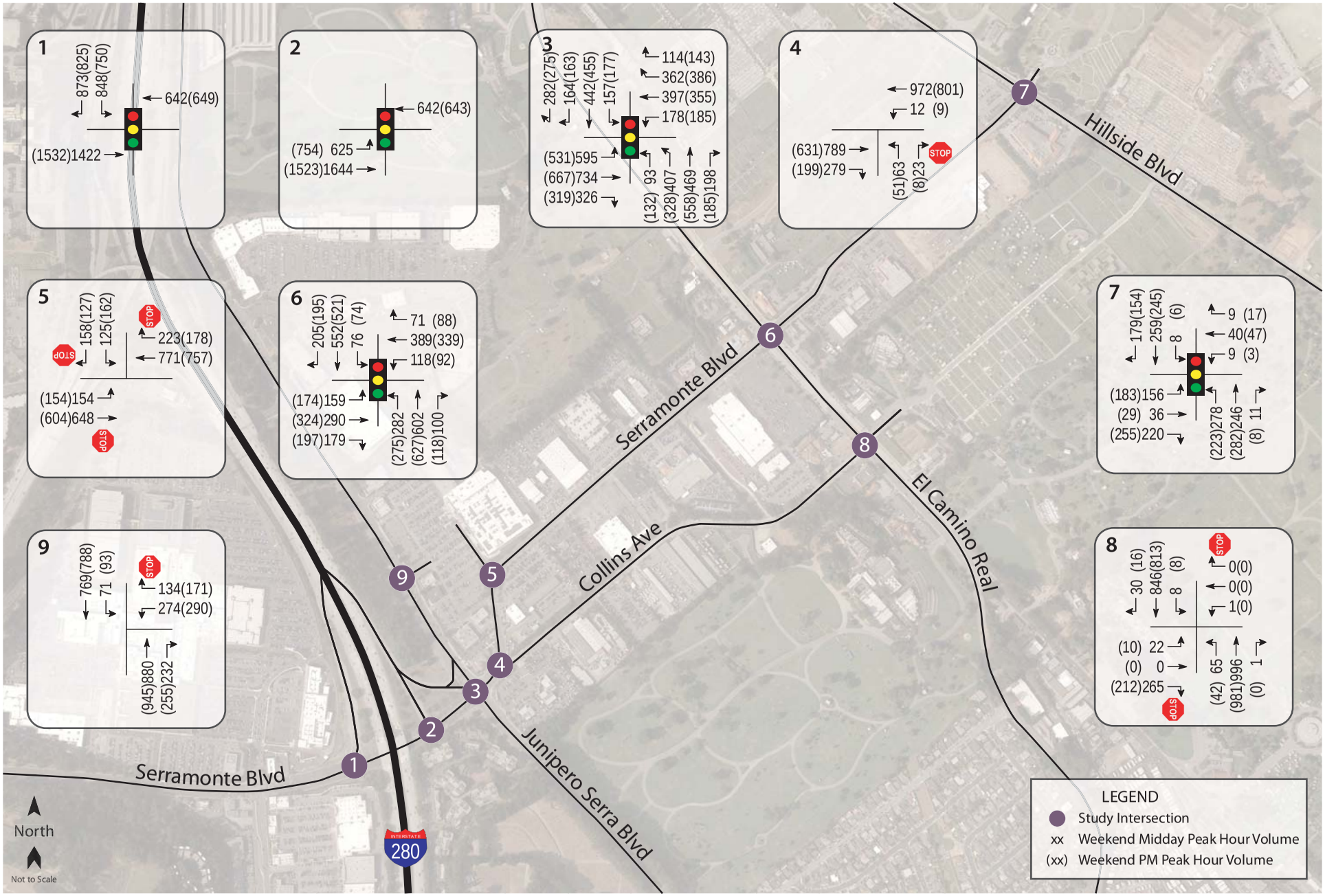
Serramonte Boulevard/Collins Avenue Master Plan

Figure 2 – Existing Weekday Traffic Volumes



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Serramonte Boulevard/Collins Avenue Master Plan

Figure 3 – Existing Weekend Traffic Volumes

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Serramonte Boulevard/Collins Avenue Master Plan

Figure 4 – Study Driveway Locations

W-Trans

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Serramonte Boulevard/Collins Avenue Master Plan

Figure 5 – Existing Weekday Driveway Ins and Outs

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Serramonte Boulevard/Collins Avenue Master Plan

Figure 6 – Existing Weekend Driveway Ins and Outs

Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Collins Ave

	Major Street	Minor Street
Street Name	Serramonte Blvd	Collins Ave
Direction	E-W	E-W
Number of Lanes	2	2
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: AM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **No**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.28 vehicle-hours

Condition A2 — Not Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 73 vph

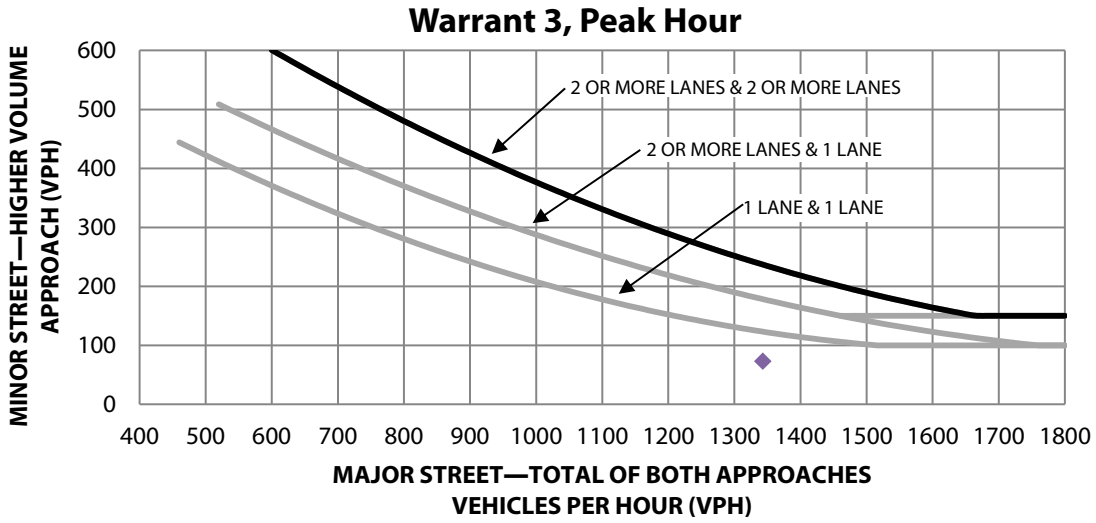
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1416 vph

Condition B — Not Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Collins Ave

	Major Street	Minor Street
Street Name	Serramonte Blvd	Collins Ave
Direction	E-W	E-W
Number of Lanes	2	2
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: Wknd PM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **No**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.25 vehicle-hours

Condition A2 — Not Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 59 vph

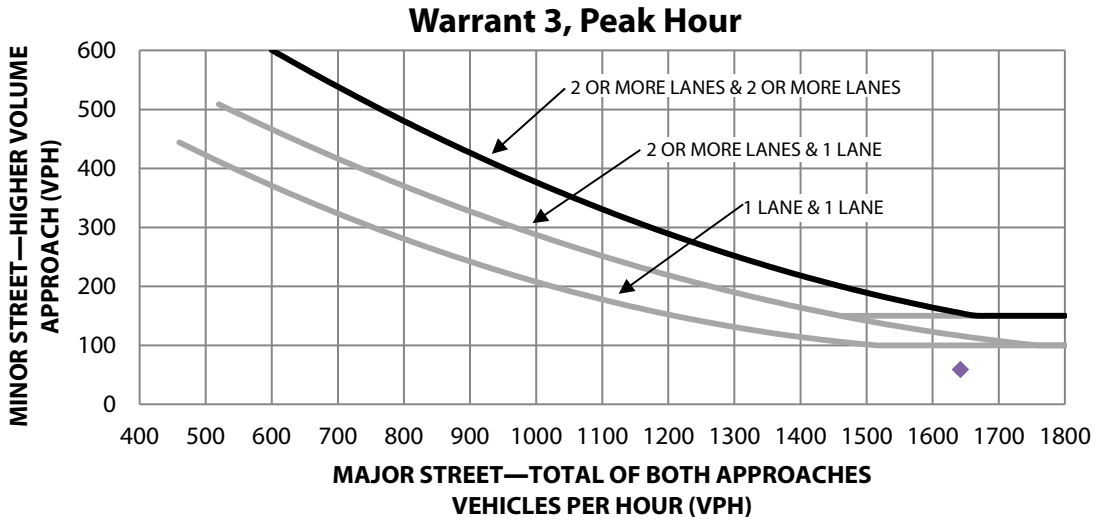
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1701 vph

Condition B — Not Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Collins Ave

	Major Street	Minor Street
Street Name	Serramonte Blvd	Collins Ave
Direction	E-W	E-W
Number of Lanes	2	2
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Saturday, December 2, 2017
Scenario: Wknd Midday Existing

Warrant 3 Met?: Met when either Condition A or B is met — **No**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.41 vehicle-hours

Condition A2 — Not Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 86 vph

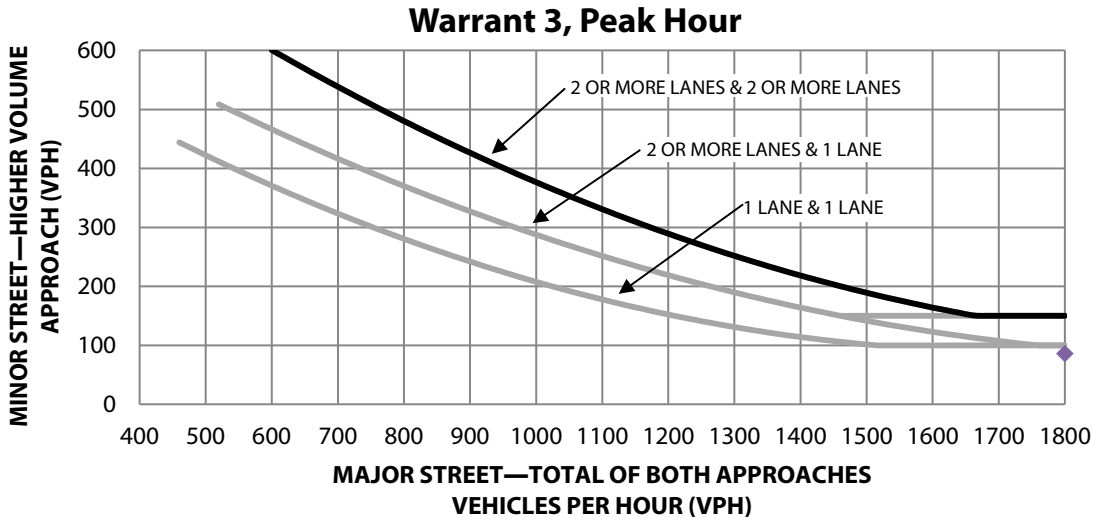
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 2139 vph

Condition B — Not Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Collins Ave

	Major Street	Minor Street
Street Name	Serramonte Blvd	Collins Ave
Direction	E-W	N-S
Number of Lanes	2	2
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: Wknd PM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **No**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.25 vehicle-hours

Condition A2 — Not Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 59 vph

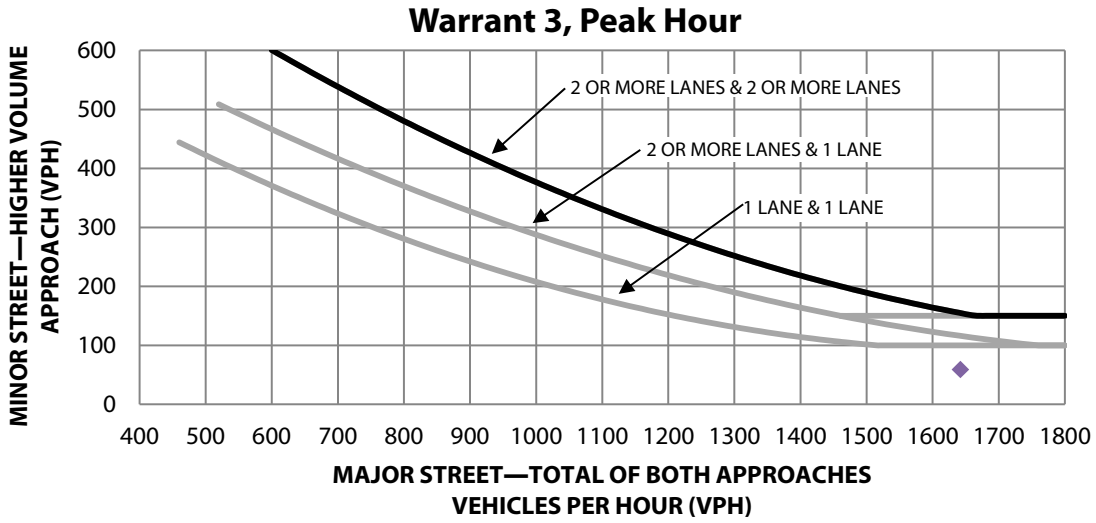
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1701 vph

Condition B — Not Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Serra Center Driveway

	Major Street	Minor Street
Street Name	Serramonte Blvd	Serra Center Driveway
Direction	E-W	N-S
Number of Lanes	2	1
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: AM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **No**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.29 vehicle-hours

Condition A2 — Not Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 96 vph

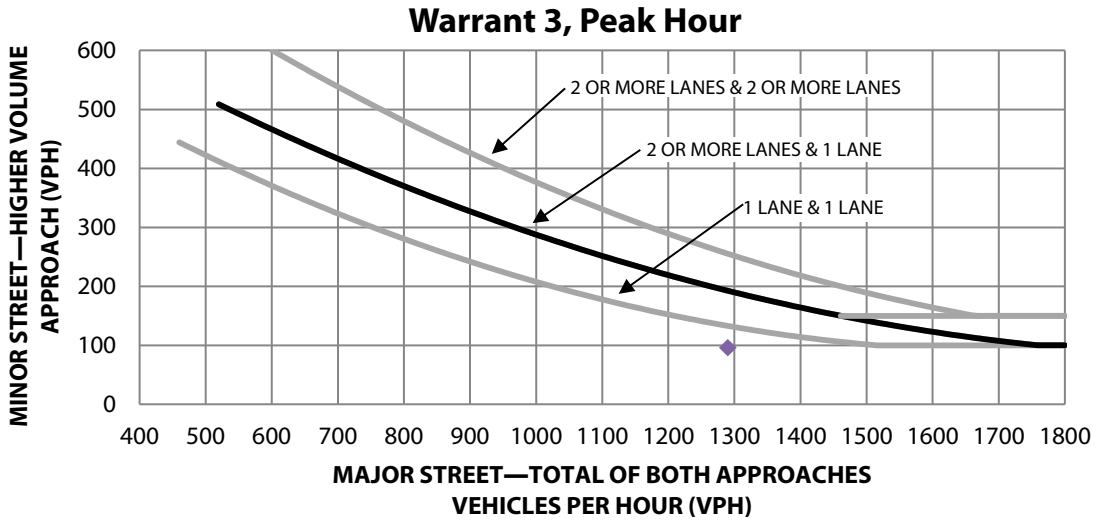
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1386 vph

Condition B — Not Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Serra Center Driveway

	Major Street	Minor Street
Street Name	Serramonte Blvd	Serra Center Driveway
Direction	E-W	N-S
Number of Lanes	2	1
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: PM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.73 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 193 vph

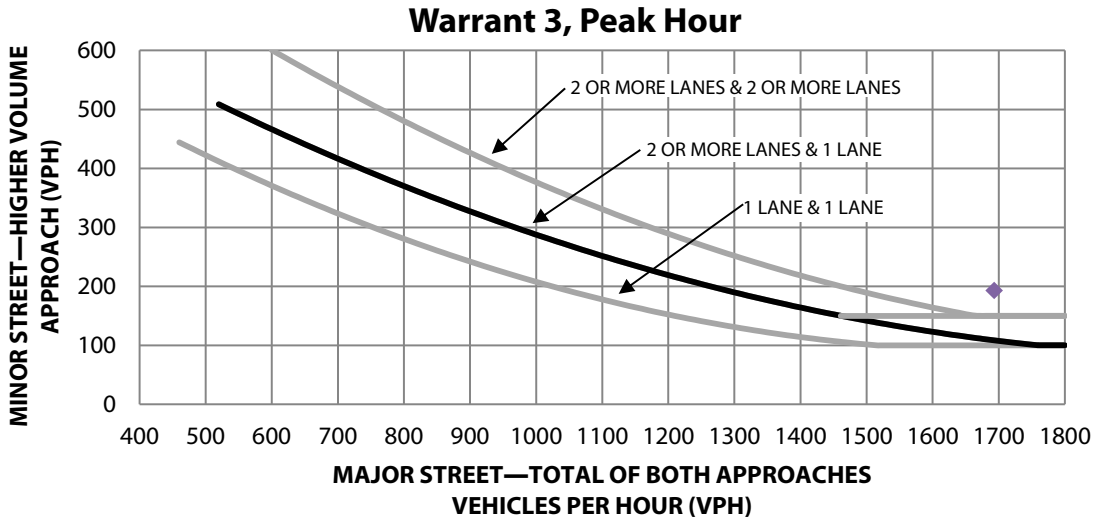
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1886 vph

Condition B — Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Serra Center Driveway

	Major Street	Minor Street
Street Name	Serramonte Blvd	Serra Center Driveway
Direction	E-W	N-S
Number of Lanes	2	1
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Saturday, December 2, 2017
Scenario: Wknd Midday Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 1.39 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 283 vph

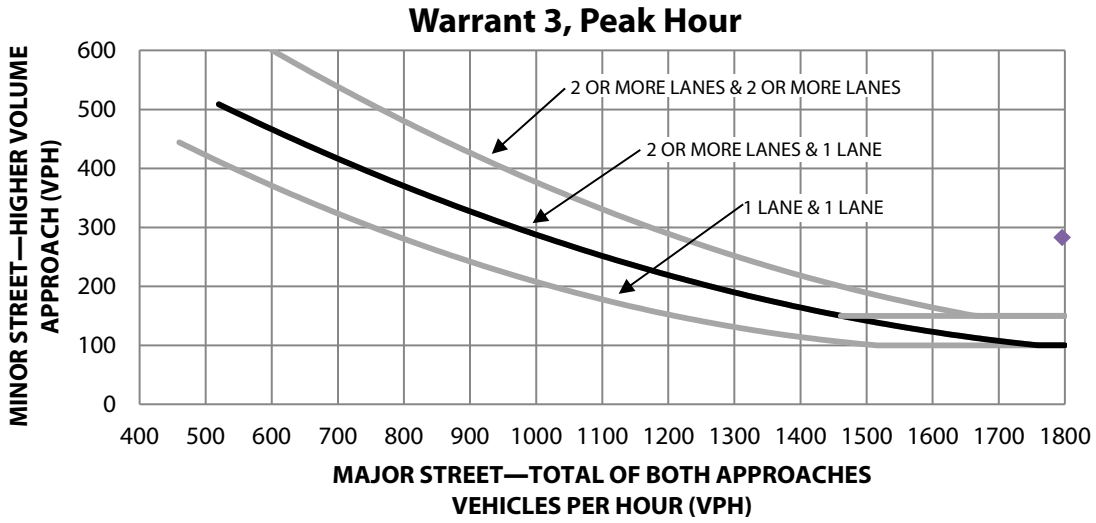
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 2079 vph

Condition B — Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
Serramonte Blvd & Serra Center Driveway

	Major Street	Minor Street
Street Name	Serramonte Blvd	Serra Center Driveway
Direction	E-W	N-S
Number of Lanes	2	1
Approach Speed	30	25

Population less than 10,000? No
Date of Count: Saturday, December 2, 2017
Scenario: Wknd PM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 1.48 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 289 vph

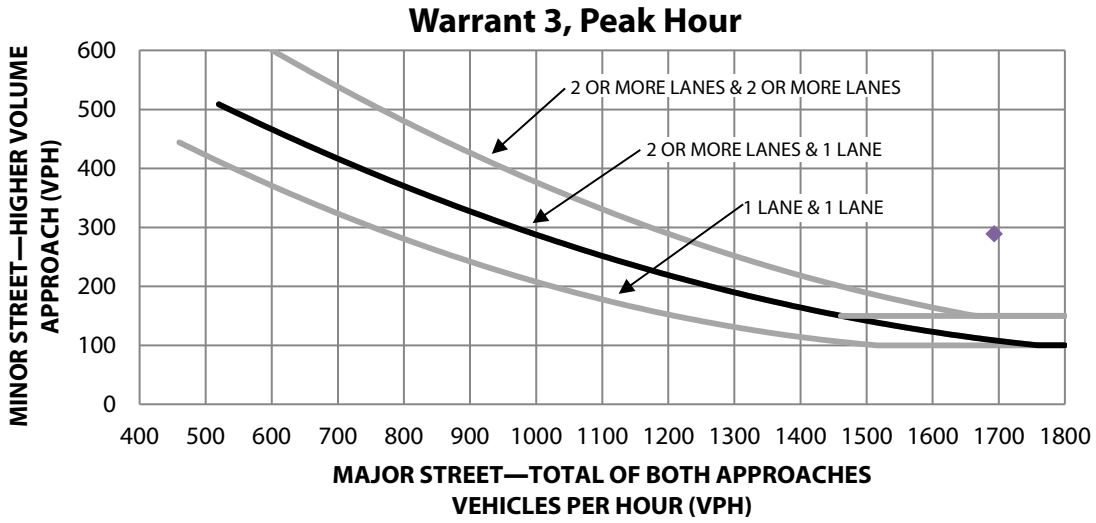
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1982 vph

Condition B — Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
El Camino Real & Collins Avenue

	Major Street	Minor Street
Street Name	El Camino Real	Collins Avenue
Direction	N-S	E-W
Number of Lanes	3	2
Approach Speed	40	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: AM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 1.05 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 349 vph

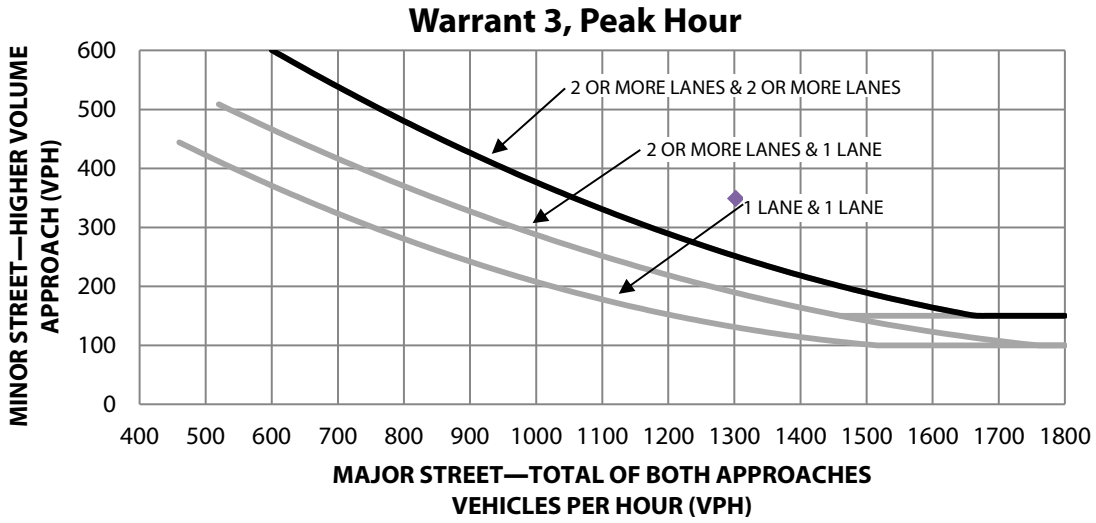
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 1657 vph

Condition B — Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
El Camino Real & Collins Avenue

	Major Street	Minor Street
Street Name	El Camino Real	Collins Avenue
Direction	N-S	E-W
Number of Lanes	3	2
Approach Speed	40	25

Population less than 10,000? No
Date of Count: Thursday, November 30, 2017
Scenario: PM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.95 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 302 vph

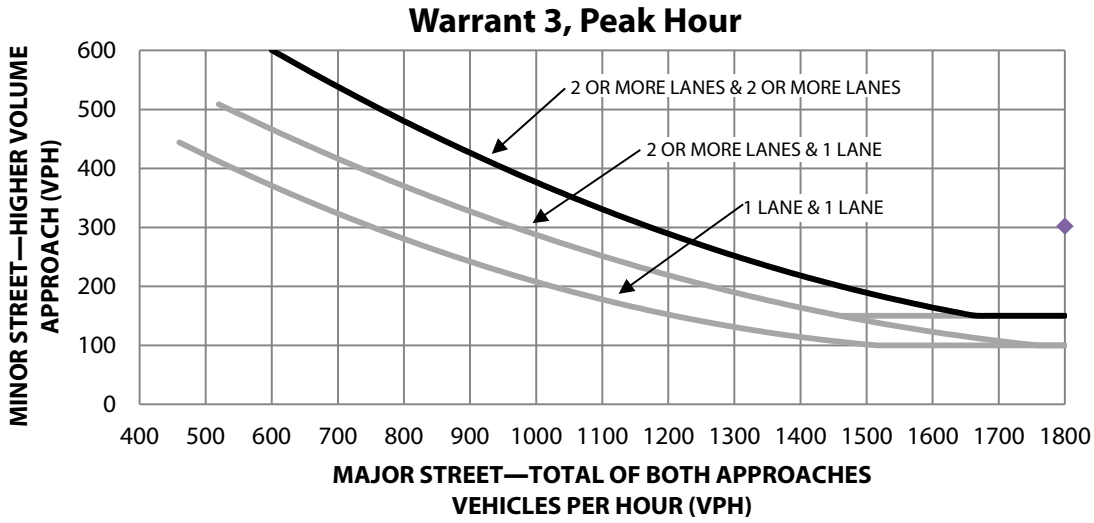
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 2343 vph

Condition B — Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Master Plan 0
El Camino Real & Collins Avenue

	Major Street	Minor Street
Street Name	El Camino Real	Collins Avenue
Direction	N-S	E-W
Number of Lanes	3	2
Approach Speed	40	25

Population less than 10,000? No
Date of Count: Saturday, December 2, 2017
Scenario: Wknd Midday Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.85 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 287 vph

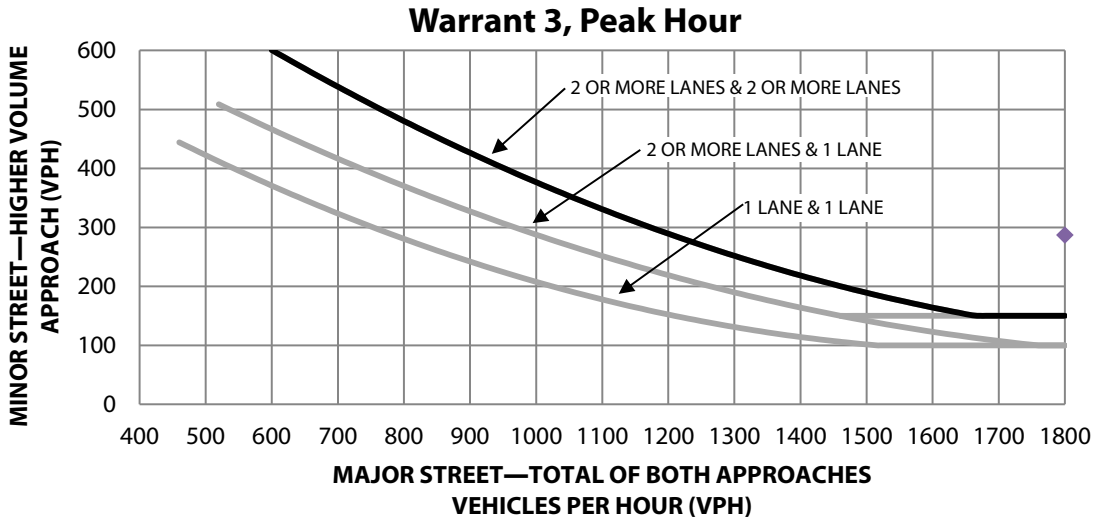
Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 2234 vph

Condition B — Met

The plotted point falls above the curve



Warrant 3: Peak-Hour Volumes and Delay

Serramonte Blvd/Collins Ave Master Plan 0
El Camino Real & Collins Avenue

	Major Street	Minor Street
Street Name	El Camino Real	Collins Avenue
Direction	N-S	E-W
Number of Lanes	3	2
Approach Speed	40	25

Population less than 10,000? No
Date of Count: Saturday, December 2, 2017
Scenario: Wknd PM Existing

Warrant 3 Met?: Met when either Condition A or B is met — **Yes**

Condition A: Met when conditions A1, A2, and A3 are met — Not Met

Condition A1 — Not Met

The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one lane approach, or five vehicle-hours for a two-lane approach

Minor Approach Delay: 0.62 vehicle-hours

Condition A2 — Met

The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic of 150 vph for two moving lanes

Minor Approach Volume: 222 vph

Condition A3 — Met

The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more appraches or 650 vph for intersections with three approaches

Total Entering Volume: 2082 vph

Condition B — Met

The plotted point falls above the curve