Kimley»Horn

TECHNICAL MEMORANDUM

To: Richard Herrera
County of Ventura

From: Monique Fuhrman, P.E.
Kimley-Horn and Associates, Inc.

Date: July 8, 2015

Subject: **Santa Rosa Road Signal Evaluation Study**

PURPOSE OF THIS STUDY

Kimley-Horn was retained by the County of Ventura to provide an evaluation of the current operational performance of eight traffic signals along Santa Rosa Road in County of Ventura jurisdiction. The study area is a 3.5 mile corridor along Santa Rosa Road between Yucca Drive and Moorpark Road. The scope of work included in this study was as follows:

- Existing Timing Assessment and Field Observation – Kimley-Horn visited the project site, drove the corridor several times, and generally observed the operations of the signal system before, during, and after both AM and PM peak hours. As a part of this effort, Kimley-Horn also measured crosswalk lengths to identify required pedestrian crossing times.
- Signal Timing Analysis – Kimley-Horn prepared an existing conditions Synchro model based on County staff input and field observations and notes. Following completion of the model, Kimley-Horn developed a list of potential improvement measures that would serve to enhance corridor operations.
- Existing Traffic Signal Timing Conditions Report - Kimley-Horn prepared this memorandum detailing the findings and recommendations as developed in the previous tasks.

The following data and recommendations represent the culmination of our investigation and our recommendations for improvements along the corridor.

EXISTING CONDITIONS

The corridor currently includes eight interconnected traffic signals. All but one of the signals (Moorpark Road) are coordinated together during the AM and PM peak periods. This corridor is used both as a through route by commuters and for local access by residents living in the neighborhoods adjacent to the corridor. Traffic signal timing splits were last developed at the time of initial implementation of signal coordination in early 2009. The corridor is currently coordinated between the AM hours of 6:45 am and 8:15 am, and the PM hours of 3 pm and 6 pm. The AM hours run on 100-second cycles, with a small period of time when Vista Grande is on a 130-second cycle, and the PM hours run on a 90-second cycle.

Overall Corridor

Volumes along the corridor are very high in both directions on Santa Rosa Road. The 100- and 90-second cycle lengths are too short to handle the peak flows along the corridor. An insufficient cycle length results in the cutting off of platoons and inefficient operations. By increasing the cycle length, green times along Santa Rosa Road can be increased, improving the throughput of the corridor and enlarging the corridor green bandwidth. Furthermore, the increase cycle lengths will allow for increased flashing don't walk times that are required for many of the pedestrian phases. In addition to increasing the pedestrian phases, many of the current yellow times on the side streets are non-compliant with the new 2014 MUTCD requirement of 3.6 seconds of yellow. Further discussion is provided by intersection below.

The corridor is currently coordinated to facilitate eastbound traffic flow in the morning peak period and westbound traffic flow in the evening peak period. However, volumes are fairly high in the reverse direction in both peak periods as well. In fact, in the peak of both peak periods, traffic flows are actually higher in the reverse direction than the coordinated direction. Offsets should result in more balanced prioritization for both directions of travel, or Offset B should be utilized to provide alternate progression priorities during periods when reverse traffic flows are highest. More efficient offsets reduce vehicle queuing, delays, and emissions

The corridor currently is only coordinated between 6:45 AM and 8:15 AM and 3 PM and 6 PM. However traffic volumes start building earlier and persist later in both peak periods. Coordination provides the benefits of increased throughput and reduced delay for roadway users. It is less desirable outside of periods of high traffic volumes due to increased delays that it may cause for vehicles on side-streets or accessing side-streets. However, given the current traffic volumes on this corridor, coordination will provide net user benefits for the "shoulder" periods of the peak periods.

The corridor timing was designed in 2009 for a design speed of 45 mph. Per field investigations and County data, the actual speeds along the corridor, even during peak periods, tend to be higher. A recent speed survey conducted by the County yielded an 85th percentile speed of 56 mph, which is significantly higher than the design speeds. It is not recommended to coordinate the corridor for a travel speed higher than the speed limit, however the currently observed speeds may result in more stops for the platoon than would be otherwise experienced if speeds were closer to the speed limit.

Furthermore, at cross streets, the County staff has received resident complaints that the delay is too high waiting for left turns. At present, the phasing provides a protected left turn on to the side streets from Santa Rosa Road. This issue may be mitigated by considering a protected-permissive phasing operation to allow the left turning traffic to find a gap in oncoming traffic as opposed to having to wait for the next protected left-turn phase. However, the speed of traffic and increasing through volumes should be considered carefully. Given the prevailing speed of traffic and heavy through traffic, it seems to be appropriate for consideration of fully protected left turn phasing.

Observed Deficiencies on the Corridor

- Short cycle lengths reduces the throughput and green bandwidth along the corridor
- Insufficient walk times for many pedestrian crossings, will may require a longer cycle length
- Side street yellow times are too short per 2014 MUTCD requirements

- Corridor is coordinated for the direction of travel that is not necessarily the highest
- Lengthy delays at Yucca Drive for the eastbound left turn movement.

Intersection #1: Moorpark Road

The intersection at Moorpark Road is currently running actuated-uncoordinated. The County staff indicated that the intersection had been previously coordinated, but free-operation was implemented at the time of some previous closures on the Norwegian Grade approaching the intersection, and coordination was never restored. The intersection previously had a 200-second cycle in the AM peak, and a 220-second cycle in the PM peak. Essentially the intersection was "double-cycled" relative to the other signals along this corridor. The long cycle length was associated with the heavy turning movements to/from each of the north, west, and east legs of the intersections. Throughout the peak periods, right-turn on red movements are specifically precluded from southbound Moorpark to westbound Santa Rosa Road. The County staff indicated that this restriction was implemented to provide gaps between vehicle platoons downstream to the west along Santa Rosa Road. A blank-out "No Right Turn" sign is activated to restrict the southbound right-turn movement on red. The preclusion of the southbound right-turn movement causes heavy queuing on southbound Moorpark Road and results in inefficient signal operation. The inefficient signal operation results in backups on the north, west, and east approaches.

The County staff informed Kimley-Horn that they've received some complaints from drivers using the east approach having to wait through three to four cycles before being able to get through the intersection or making a right onto Moorpark Road. This is in part associated with the very short right turn pocket that is frequently blocked with the westbound through queue. There is minimal pedestrian and bicycle traffic, though the intersection has pedestrian phases.

The County staff has implemented long maximum green times at this location due to the heavy traffic volumes. These long maximum green times result in a very long cycle length – the maximum cycle length is 265 seconds if the maximum times are fully served, and the actuated cycle length is 233 seconds in both the AM and PM peak periods. This results in very long queues and increased driver frustration if they are queued for multiple cycles.

Furthermore, the existing yellow times are insufficient on Moorpark Road at 3 seconds for phases 1, 3, 5, and 8. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Moorpark Road

- Significant queuing on all legs
- Does not provide any consistent bandwidth with other signals on Santa Rosa Road due to the lack of coordination
- Eastbound left-turn and southbound right-turn queues observed to persist across multiple cycles
- Very long actuated cycle lengths
- Insufficient pedestrian crossing time for phases 6 and 8 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phases 1, 3, 5, and 8.

Intersection #2: Vista Grande

The intersection at Vista Grande is currently running in coordination during the AM and PM peak hours. The intersection currently runs a 100-second cycle in the AM peak from 6:45 am to 7:30 am and a 130-second cycle for the remainder of the AM peak from 7:30 am to 8:15 am. This is due to the traffic increase during school drop-off at Santa Rosa Technology Magnet School. Traffic peaks shortly before the school start time of 8 AM and quickly dissipates following the school bell. During that period, traffic backs up into the school parking lot and queues persist across multiple cycles. In addition, there is very heavy demand for the eastbound right-turn movement into the school. A number of parents were observed pulling into the northern leg of the intersection and dropping their kids off on Vista Grande, requiring the children to cross the street on a subsequent pedestrian phase.

The intersection runs a 90-second cycle during the PM peak, in coordination with the rest of the corridor. There is no substantial congestion associated with school pickup during the PM coordination period. There is minimal pedestrian and bicycle traffic in the PM peak, and only noticeable pedestrian traffic during the AM peak immediately prior to school starting. Many students are dropped off across the street on the northern leg of Vista Grande and cross the street to the school.

Furthermore, the existing yellow times are insufficient on Vista Grade at 3 seconds for phases 3 and 4. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Vista Grande

- The 130-second cycle length during the AM peak does not align with any other signal and results in increased driver delay
- Queueing exiting the school is substantial and does not fully clear each cycle during the time period immediately surrounding school start time
- Insufficient initial green time on phases 2 and 6.
- Insufficient pedestrian crossing time for phases 4 and 6 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phases 3 and 4.

Intersection #3: Vista Arroyo Drive

The current offsets were observed to not be efficient in serving vehicle platoons. While driving the corridor, several back-ups were observed at this intersection where platoons were broken up. There is minimal pedestrian and bicycle traffic during peak hours. This intersection has horse push buttons in addition to pedestrian push buttons.

Furthermore, the existing yellow times are insufficient on Vista Arroyo Drive at 3 seconds for phases 1, 4, 5, and 8. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Vista Arroyo Drive

- Inefficient offset with adjacent intersections breaks up vehicle platoons.

- Insufficient pedestrian crossing time for phases 4 and 6 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phases 1, 4, 5, and 8.

Intersection #4: E. Las Posas Road

The current offsets were observed to not be efficient in serving vehicle platoons. The back-up at this intersection is similar to that at Vista Arroyo in that platoons are not being fully served, particularly in the westbound direction. There is minimal pedestrian and bicycle traffic during peak hours. This intersection has horse push buttons in addition to pedestrian push buttons.

Furthermore, the existing yellow times are insufficient on E. Las Posas Road at 3 seconds for phase 5. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at E. Las Posas Road

- Inefficient offset with adjacent intersections breaks up vehicle platoons.
- Insufficient pedestrian crossing time for phases 4 and 6 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phase 5.

Intersection #5: Applewood Lane

The current offsets were observed to not be efficient in serving vehicle platoons. The back-up at this intersection is similar to that at Vista Arroyo in that platoons are not being fully served, particularly in the eastbound direction. There is minimal pedestrian and bicycle traffic during peak hours. This intersection has horse push buttons in addition to pedestrian push buttons.

Furthermore, the existing yellow times are insufficient on Applewood Lane at 3 seconds for phases 1, 4, 5, and 8. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Applewood Lane

- Inefficient offset with adjacent intersections breaks up vehicle platoons.
- Insufficient pedestrian crossing time for phases 2 and 4 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phases 1, 4, 5, and 8.

Intersection #6: Brittany Park Road

Nothing unusual or in need of modification was observed at Brittany Park, likely because there is not much demand on side streets (likely due to the gated community), so the main phases 2 and 6 primarily rested in green during the coordination periods. There is minimal pedestrian and bicycle traffic during peak hours.

Furthermore, the existing yellow times are insufficient on Brittany Park Road at 3 seconds for phases 1, 4, 5, and 8. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Brittany Park Road

- Insufficient pedestrian crossing time for phase 2 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phases 1, 4, 5, and 8.

Intersection #7: Blanchard Road

The current offsets were observed to not be efficient in serving vehicle platoons. The deficiency is most pronounced in the PM peak and in the EB direction where platoons appear to be split. Otherwise, there is minimal pedestrian and bicycle traffic during peak hours.

Furthermore, the existing yellow times are insufficient on Blanchard Road at 3 seconds for phases 1, 4, 5, and 8. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Blanchard Road

- Inefficient offset with adjacent intersections breaks up vehicle platoons.
- Insufficient pedestrian crossing time for phase 4 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow time on phases 1, 4, 5, and 8.

Intersection #8: Yucca Drive

The current offsets were observed to not be efficient in serving vehicle platoons. The deficiency is most pronounced in the PM peak and in the EB direction where platoons appear to be split as they enter the coordinated corridor. Otherwise, there is minimal pedestrian and bicycle traffic during peak hours.

In addition, the existing yellow times are insufficient on Yucca Drive at 3 seconds for phases 4 and 5. Per the 2014 MUTCD, yellow times shall be a minimum of 3.6 seconds for prima facie speeds of 25 mph (since speed limit is not posted).

Observed Deficiencies at Yucca Drive

- Inefficient offset with adjacent intersections breaks up vehicle platoons.
- Insufficient pedestrian crossing time for phase 4 based on 2014 MUTCD pedestrian crossing speed.
- Insufficient yellow times on phases 4 and 5.

RECOMMENDATIONS FOR MITIGATION

The following table details the improvements recommended for each intersection and for the corridor as a whole.

Intersection	Deficiency	Suggested Improvement	Discussion
Whole Corridor	Current offsets result in platoons being stopped at intersections, introducing start-up loss time and introducing unnecessary delay	Revise all offsets in both peak periods.	It is suggested that all off-sets be revisited and adjusted per the current traffic patterns. Offsets can be fine-tuned to better handle vehicle platoons, reduce queuing, and vehicle emissions.
Whole Corridor	Vehicle platoons are being cut-off	Increase cycle lengths across the entire corridor. Kimley-Horn suggests 120s in the AM peak and 110s in the PM peak.	A longer cycle length will allow for more green time on Santa Rosa Road, improving intersection efficiency and corridor throughput. Our Synchro model recommends 150 seconds in the AM and 130 seconds in the PM, however those cycle lengths may not be acceptable to the community as they would increase side-street delay. Increasing the cycle length by 20 seconds from existing conditions would provide the benefits of increased bandwidth while limiting additional side-street delay.
Whole Corridor	Heavy volumes prior to the start of the coordination period do not gain the benefits of coordination	Extend AM plan to 6:30 AM to 9:30 AM. Extend PM plan to 2:30 PM to 6:30 PM.	Vehicle flow rates on Santa Rosa Road exceed 1,200 vph during the entirety of these windows. Increasing the span of coordination will increase the benefits reaped from coordination.
Whole Corridor	Roadway is coordinated for EB in AM and WB in PM. However, actual vehicle flows are more balanced	Prepare more balanced offsets, and/or use Offset A and Offset B within each peak period to adjust progression	Traffic flow is actually higher WB prior to 8:45 AM and EB between 4:45 PM and 5:30 PM. During these periods, the corridor would substantially benefit from

	or heavier in opposite directions	priority based on actual flows.	improved progression for these directions of travel.
Moorpark Road	Significant queues on multiple approaches	Reduce max green times to reduce queuing	It is recommended to keep this intersection in free operation as it requires a longer cycle length than other intersections along Santa Rosa Road. However, the current max green times require a very long cycle length. Reducing the max green times will reduce queuing and average delay.
Moorpark Road	Insufficient Pedestrian Crossing time, phases 6 and 8.	Φ6 – add 5s FDW Φ8 – add 4s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.
Moorpark Road	Insufficient yellow time on phases 1, 3, 5, and 8.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
Vista Grande	Using an AM plan with a different cycle length precludes the benefit of coordination during this period	Remove Plan 4 and allow signal to run free during the 15 minute period between 7:45 and 8 am (prior to school start)	Allowing the signal to run free will allow it to best handle the unique traffic patterns during this period. A 15-minute free operation should be sufficient to handle school traffic. Otherwise, keep the intersection in coordination with intersections to the west to best achieve the benefits of coordination
Vista Grande	Traffic exiting the school takes multiple cycles to clear	Use time-of-day parameters to call a Max 2 on phase 4 that is much higher during the school departure period	A higher maximum green time will allow the school traffic to dissipate quicker. This may also serve to shift some of the drop-off activity on Vista Grande back to the preferred location at the school entrance.
Vista Grande	Insufficient initial green time on phases 2 and 6.	Increase the initial green time to 10s.	This increase will match the initial green time at other locations along the corridor.

Vista Grande	Insufficient Pedestrian Crossing time, phases 4 and 6.	Φ4 – add 3s FDW Φ6 – add 2s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.
Vista Grande	Insufficient yellow time on phases 3 and 4.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
Vista Arroyo Drive	Insufficient Pedestrian Crossing time, phases 4 and 6.	Φ4 – add 3s FDW Φ6 – add 1s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.
Vista Arroyo Drive	Insufficient yellow time on phases 1, 4, 5, and 8.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
E. Las Posas Road	Insufficient Pedestrian Crossing time, phases 4 and 6.	Φ4 – add 3s FDW Φ6 – add 2s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.
E. Las Posas Road	Insufficient yellow time on phase 5.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
Applewood Lane	Insufficient Pedestrian Crossing time, phases 2 and 4.	Φ2 – add 1s FDW Φ4 – add 1s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower

			than the previous 4 feet per second, thus the need for increased walking time.
Applewood Lane	Insufficient yellow time on phases 1, 4, 5, and 8.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
Brittany Park Road	Insufficient Pedestrian Crossing time, phase 2.	Φ2 – add 2s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.
Brittany Park Road	Insufficient yellow time on phases 1, 4, 5, and 8.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
Blanchard Road	Insufficient Pedestrian Crossing time, phase 4.	Φ4 – add 2s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.
Blanchard Road	Insufficient yellow time on phases 1, 4, 5, and 8.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.
Yucca Drive	Insufficient Pedestrian Crossing time, phase 4.	Φ4 – add 1s FDW	Pedestrian times are insufficient based on the new MUTCD requirements that have a pedestrian walking speed of 3.5 feet per second, which is slower than the previous 4 feet per second, thus the need for increased walking time.

Yucca Drive	Insufficient yellow time on phases 4 and 5.	Increase yellow times to a minimum of 3.6 seconds.	The 2014 MUTCD requires a minimum yellow of 3.6 seconds for prima facie speed limits, which is assumed to be 25 mph when speed is not posted.