INTERSECTION ASSESSMENT

98TH STREET SW/BENAVIDES ROAD SW
ALBUQUERQUE, NEW MEXICO

Prepared For:

Department of Municipal Development
Project No. 7703.25
Task 17

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1 INTRODUCTION

The City of Albuquerque has requested an assessment of the 98th Street/Benavides Road intersection located in Albuquerque, New Mexico. The intersection was evaluated due to concern for pedestrian safety attributable to its proximity to Truman Middle School, located in the southeast quadrant of the intersection, and West Gate Community Center, located south of the intersection. This assessment evaluates existing site conditions, traffic operations, and historical crash data and identifies potential mitigative improvements to identified deficiencies at the intersection.

1.1 STUDY PURPOSE

The 98th Street / Benavides Road intersection is a vital link from the surrounding Westgate Heights neighborhoods including the West Gate multi-use trail, located west of the intersection, helping to these destinations. This study evaluates the existing operational conditions of the intersection, pedestrian infrastructures compliance with relevant design standards and its connectivity for serving users. In addition, the City of Albuquerque Parks and Recreation has expressed interest in relocating the multi-use path that is currently within the median of 98th Street south of the intersection between the intersection's pedestrian facilities and West Gate Community Center to the west side of 98th Street along the AMAFCA Snow Vista Channel.

There are multiple pedestrian attractions within the study area including:

- Sage Marketplace Shopping Center, 975-feet north of the intersection
- Truman Middle School, 500-feet east of the intersection
- West Gate Community Center, 1,000-feet south of the intersection

Photo 1- 98th Street SW/Benavides Road SW Study Intersection

2 STUDY AREA

The study intersection is located northeast of the Westgate Heights approximately 7,500-feet south of Central Ave (Route 66) along 98th Street. The intersection is adjacent to residential areas and Truman Middle School which is located east of the intersection along Benavides Road. Signalized intersections are located 1,300-feet north (De Vargas Road/Sage Road) and 2-miles south (Dennis Chavez Boulevard) along 98th Street. The study area examined included intersection proximity connecting the previously mentioned pedestrian attractions.

98th Street is classified as a principal arterial (per MRCOG's *Current Roadway Functional Classification System, 2016*) that runs from north-to-south and provides connectivity from Rio Bravo Boulevard to Interstate 40.

Benavides Road is classified as a local road (per MRCOG's *Current Roadway Classification System, 2016*) that's runs east-to-west, and functions as a collector for the residential areas adjacent to the intersection. A vicinity map for the study area is shown in **Figure 1**.

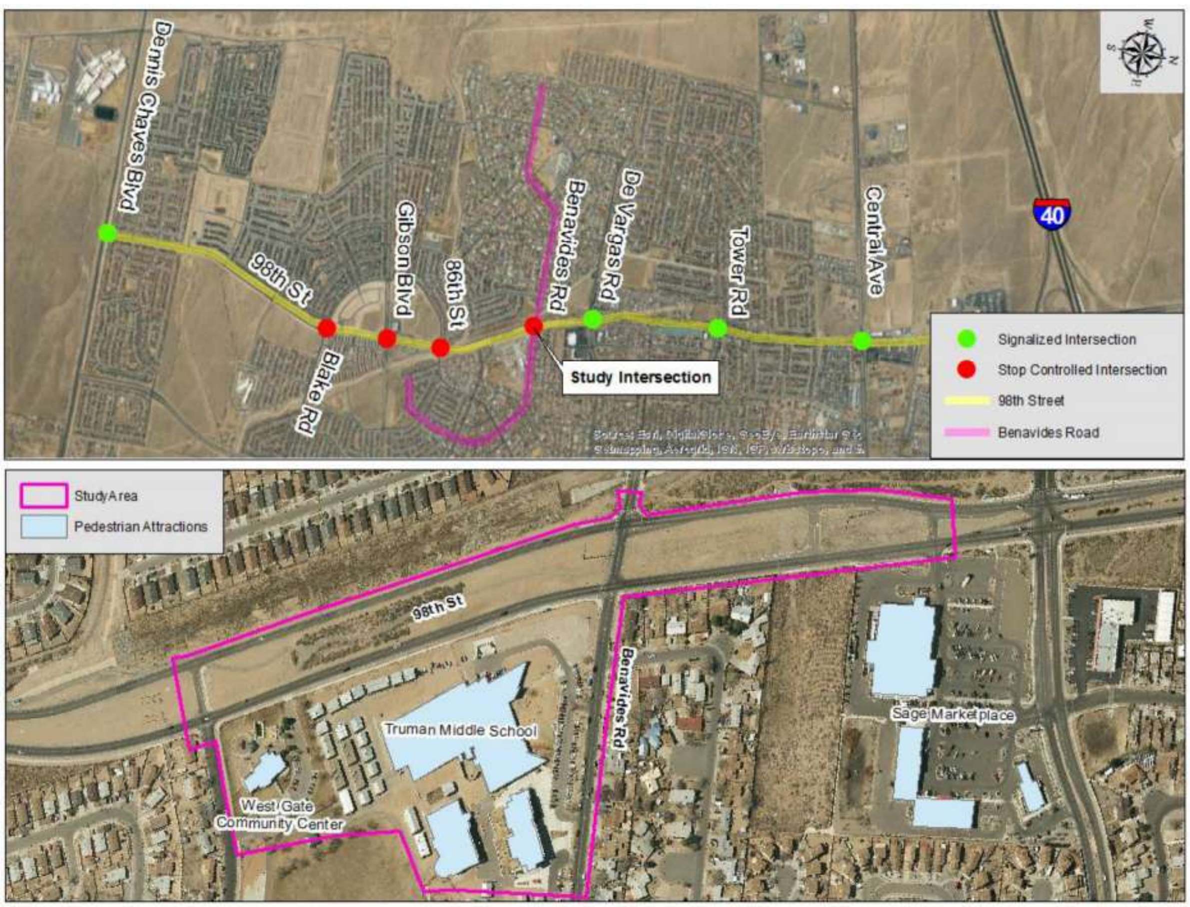

Figure 1 - Study Area

The split study intersections are directional three-way stop controlled and maintained by the City of Albuquerque. Mid Region Council of Governments (MRCOG) planning maps (Functional Classification and Daily Traffic Flows) for the City of Albuquerque highlighting the intersection are included in **Appendix A**.

3 INTERSECTION ASSESSMENT

3.1 GEOMETRIC ASSESSMENT

The existing intersection and approach roadways were evaluated with City of Albuquerque geometric standards identified in the DPM. The excerpts used from the DPM for this evaluation are in included in **Appendix B**.

Figure 2 - Study Intersection

3.1.1 INTERSECTION LAYOUT

Approaching the intersection, the 98th Street median width increases significantly resulting in a split configuration with two independent intersections, one in the northbound direction and one in the southbound direction. The intersections are three-way stop controlled intersections with 160-feet between them. North of the intersection the median transitions from 115-feet width to 40-feet width and south of the intersection the median transitions from 115-feet width to 60-feet width. With the narrower 40-foot to 60-foot medians, adjacent intersections north and south operate as single point intersections versus the split configuration that occurs at this intersection.

All legs of the intersection are relatively flat and have no discernable vertical curvature. In addition, there is limited horizontal curvature near the intersection. Horizontal and vertical geometry at the intersection would appear to be compliant with applicable City of Albuquerque design standards.

3.1.2 TYPICAL SECTION

Near the intersection, 98th Street is a 4-lane urban divided roadway with two (2) 11-foot travel lanes in each direction. At the intersection, there is a southbound 20-foot tapered left-turn lanes, 115-foot median, no shoulders, and bike lanes. In the northbound direction, the bike lane extends north and south of the intersection whereas southbound the bike lane only exists north of the intersection.

Near the intersection, Benavides Road is a 2-lane urban undivided roadway with 18-foot travel lanes, and no shoulders or bike lanes. Reduction of the travel lane width for traffic calming can be accomplished by delineating a standard 11-foot lane with shoulder striping and should be considered as a corridor treatment.

3.1.3 ANGLE OF INTERSECTION

The City of Albuquerque Development Process Manual (DPM) states that "streets must be designed to intersect at right angles (as nearly as practical) consistent with topography and sound design. The acute angles at intersections shall be 80° or greater." (*Chapter 23, Section 3, D., 1.*). All legs of the 98th Street/Benavides Road intersection are within the DPM criteria and the existing angle of intersection is acceptable.

3.1.4 CURB RETURN RADII

Minimum acceptable curb radii are presented in *Table 23.3.3-Standard Curb Return (At Flowline) and Right-of-Way at Intersections* of the DPM (**Appendix B**). The selection of appropriate curb return radii at intersection should depend upon the governing design vehicle expected to negotiate turning movements about the return and its effect on traffic flow. Streets commonly expected to experience large commercial vehicles or bus traffic will require large radii at intersections. Per DPM *Table 23.3.3-Standard Curb Return Radii (at Flowline) and Right-of-Way at Intersections*, the curb return radii for a principal arterial to a local residential road is 30-feet. Introducing a smaller curb return radii, such as 25-feet, will result in shorter crossing distances for pedestrians.

As shown in **Figure 3**, the existing curb returns at the intersection range from 15-feet to 40-feet. On the north side of the intersection, there are two curb returns that do not meet the DPM criteria however vehicles do not turn directly through these returns; with no off-tracking expected, the deficient curb returns on the north side of the intersection do not warrant reconstruction. On the south side of the intersection there are two curb returns that are deficient, however there is benefit to the smaller curb return radii with respect to crossing distance. Reduction of the curb return to benefit pedestrian crossing distance considerations should be given to the returns with 40-foot radii on the south side of the intersection

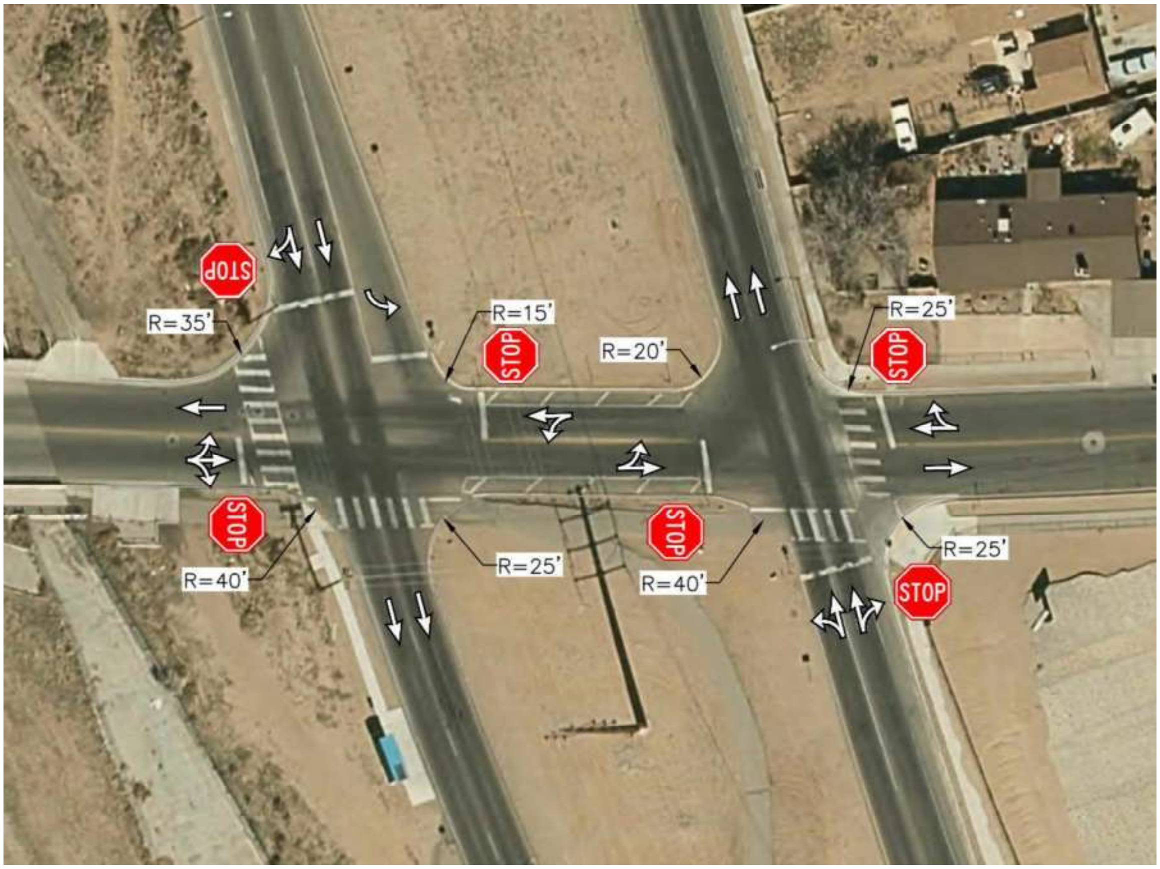

Figure 3 – Intersection Control and Curb Return Radii

When the radius is too small, longer vehicles will likely encroach either onto the curb and beyond or into the opposing lane. The existing intersection has a heavy vehicle percentage of 2.6%. Based upon site observation and traffic counts, it is not uncommon for heavy vehicles (WB-40 – WB-67) to negotiate the intersection.

3.2 INTERSECTION LAYOUT

The existing intersection and approach roadways were evaluated with City of Albuquerque criteria identified in the DPM. The excerpts used from the DPM for this evaluation are in included in **Appendix B**.

3.2.1 ACCESS AND DRIVEWAY SPACING

The DPM states that the number of intersection of streets along arterial streets are to be minimized. For continuous intersecting streets, the DPM recommends that intersections shall be no closer than 900-feet on center. Non-continuous streets must be spaced at least 400-feet on all arterial streets. The east leg of the intersection has a non-continuous street, Pearl Street, that intersects the north side of Benavides Road 200-feet west of the 98th Street/Benavides intersection and does not meet DPM intersection spacing criteria.

The DPM also identified minimum distances for driveways to be spaced from an intersection to better facilitate movements at the intersection and ingress and egress at driveways. The spacing is based upon roadway classification for both the approach and departure sides of the intersection. As shown in **Figure 4**, there are multiple driveways access points along the east and west legs of the intersection that do not meet DPM criteria.

The west leg of the intersection has two driveways immediately west of the intersections on the north and south side; both driveways serve as AMAFCA maintenance access to the Snow Vista Channel and north driveway also serves as multimodal access to the Westgate trail that do not meeting DPM criteria. The east leg has four driveways serving Truman Middle School on the south side of Benavides Road that do not meet DPM criteria. Additionally, it has been observed that the operation of perceived delays of the on-site pick-up/drop-off loop operated by Truman Middle School results in the utilization of the curb line along the east departure to the intersection also being used as an off-site drop-off by parents avoiding the on-site drop-off loop that results in "ingress/egress-like" movements near the intersection.

Figure 4 – Driveways Based on Proximity to the Intersection

3.2.2 INTERSECTION SIGHT DISTANCE

The DPM *Section 23.3.5-Intersection Site Distance*, indicates that intersection design must provide clear sight distance in the horizontal plane within a triangular street corning with no obstructions within this area between 3- and 8-feet (**Appendix B**). The triangle is defined either based upon a projection from the right-of-way line or curb line. The sight triangles in each of the quadrants of the 98th Street/Benavides contain no permanent vertical obstructions.

As previously mentioned, the intersection layout includes a short link connecting the northbound and southbound intersections. The short length of the link limits the storage of vehicles. It was observed that left turning movements from southbound 98th Street do not have sight distance to perceive the school drop off queue and judge the amount of available space, resulting in queues encroaching into the intersections.

3.2.3 MULTI-MODAL FACILITIES

The northbound 98th Street/Benavides Road intersection has sidewalk and pedestrian curb ramps on the east leg. The southbound 98th Street/Benavides Road intersection has sidewalk and pedestrian curb ramps on the south side of the west leg, while the north side of the west leg has concrete sidewalk that connects to the West Gate Trail but is not connected to the intersection with a paved or concrete surface. There is an asphalt multi-use path connecting the split intersections on the south side of 98th Street within the median (Snow Vista Trail) that extends 1,250-feet south along 98th Street to Cam San Martin SW. City of Albuquerque Parks and Recreation has expressed interest in removing/relocating the median trail. The pedestrian facilities are shown in the graphic below, which indicates that the facilities are not consistently linked within the study area.

Figure 5 –Multi-Modal Facilities

Per *Table 23.2.1A-Public Right-of-Way and Pavement Width Standards* of the DPM (**Appendix B**), the minimum required sidewalk width should be 6-feet with a 6-foot setback. The existing sidewalks range from 4-feet to 7-feet wide with setbacks of approximately 5-feet. Additionally, the pedestrian facilities do not meet standards established by the Proposed Guidelines for Accessible Right-of-Way (PROWAG).

- Per PROWAG, curb ramps should include detectable warning surfaces to alert users of entering the traveled way. At the 98th Street/Benavides Road intersection there are a total of five ramps leading from sidewalk into to traveled way and only two of the ramps have detectable warning surfaces.
- PROWAG requires the placement of curb ramps to direct pedestrians to the center of the striped crosswalk. The curb ramp in the northwest quadrant of the northbound intersection is placed to serve both crossing directions with only the north-south crosswalk striped.
- Based an evaluation with hand levels, there are apparent slope issues in which the ramps exceed the PROWAG maximum allowed running slope of 5.3% and maximum allowed cross slope of 2%.

Photo 2- Existing Non-ADA Compliant Curb Ramps

The roadway typical section at the north approach includes bike lane both north and south of the study intersection. The roadway typical section at the south approach includes bike lane in the north direction, the bike lane does not continue south of the study intersection. The bike lanes are 4-feet in width and are adjacent to City standard curb and gutter and are consistent with City standard for bike lanes. The bike lanes and multiuse path are identified in the 2040 Metropolitan Transportation Plan (MTP) Long Range Bikeway System (**Appendix A**). The MTP Long Range Bike Plan also shows a proposed bike lane through the study intersection.

Northbound and southbound bus stops (Route 54- Bridge/Westgate) are located north and south of the study intersection. The stops are located along the existing sidewalk and do not include bus pullouts.

3.2.4 STREET LIGHTING

The intersection is illuminated by two luminaires located in the northeast and northwest quadrants of the intersection. There is additional Truman Middle School parking lot lighting on the east side of the intersection, however the lighting is intended for the parking lot and provides little to no benefit to the intersection. The DPM does not set forth any guidance on illumination standards for an intersection outside of a recommendation to follow Illuminating Engineering Society for arterial streets. The intersection does not meet those established standards or provide adequate lighting for the pedestrian crossings. Given that the highest number of pedestrian crossings occur during daylight hours, the existing lighting is adequate for the form and function of the intersection.

3.2.5 UTILITIES

There are substantial overhead service lines running on the west and south side of the intersection as well as centrally through the median. The utilities are comprised of overhead wiring for electrical along the west side of 98th Street and the south side of Benavides Road, and transmission poles/overhead wiring running north along 98th Street in the median. The utility pole placement does not impact pedestrian facilities.

Photo 3- Existing Transmission Poles in Median

3.2.6 PAVEMENT CONDITION

Based on visual observation, the pavement at the intersection is in generally fair condition. Polished aggregate exists on the pavement, meaning surface binder has worn away to expose coarse aggregate. Several transverse and longitudinal cracking has developed. Bleeding of low severity was found along all legs of the intersections.

The asphalt curb and gutter within the project area is generally in poor condition; there are several areas of major transverse cracking, and major deterioration/abrasion. The concrete curb and gutter on the east leg of the northbound intersection is in good condition.

3.2.7 SIGNING AND STRIPING

The overall striping at the intersection appears to be in fair condition. Lane and centerline striping at each intersection approach is visible There are two types of crosswalk striping as shown in **Photo 4:** the northbound south approach and west approach are ladder style and the southbound south approach and east approach are continental style. The ladder style crosswalk is worn where vehicles track through it. The continental style of crosswalk striping is consistent with City of Albuquerque standards.

Existing signing at the intersection is adequate and complaint with the MUTCD however the level of reflectivity has not been determined and compliance with MUTCD should be further evaluated. It is anticipated that the reflectivity does not meet current standards as the signs appear to be older. There is a school zone for Truman Middle School Zone downstream eastbound Benavides Road and is not currently part of the intersection as shown in **Photo 4**.

Photo 4- Crosswalk Striping and School Zone Beyond Intersection

4 OPERATIONS ASSESSMENT

Operational analyses were conducted for the existing unsignalized intersection. The objective of this analysis was to evaluate how the intersection operated under existing traffic volumes. The data and methodology used for the analysis and findings are discussed below.

4.1 DATA COLLECTION

Intersection and approach traffic volume data was collected in September 2018. This data included approach counts and intersection turning movement counts. Approach counts are collected to determine the volume and types of vehicles using a roadway throughout the day. They are collected using pneumatic tubes placed across the traffic lanes. The standard practice for roadway approach counts are continuous over 48 hours, it allows traffic volumes to be examined by direction in 15-minute increments. Approach counts also provide supplementary data on vehicle classification. In contrast, turning movement counts are used to quantify the traffic volume for each specific movement at an intersection (i.e., left-turn, thru- or right-turn). Turning movement counts are manually collected in 15-minute intervals during the morning, noon, and evening peak hours of the day. The count data is included in **Appendix C**.

4.2 TRAFFIC SIGNAL WARRANT STUDY

A simplified traffic signal warrant analysis was conducted to determine if a signal is warranted based upon the Manual of Uniform Traffic Control Devices (MUTCD) criteria. The existing intersection was evaluated for the traffic volume and pedestrian volume warrants at the intersection to see if any of the warrant thresholds were met. At least one of the traffic signal warrants identified in the MUTCD should be met for the intersection to be eligible for the placement of a traffic signal. However, the satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal but may be good practice. The intersection was evaluated based on the following warrants:

Warrant 1, Eight-Hour Vehicular Volume

Warrant 2, Four-Hour Vehicular Volume

Warrant 3, Peak Hour

Warrant 4, Pedestrian Volume

Warrant 5, School Crossing

Warrant 8, Roadway Network

As indicated in the MUTCD, vehicular volume warrants can be evaluated with no modification (base criteria) or with 70% factor when operating speeds are above 40 mph on major street. The posted speed limit on 98th Street is 35mph and given the character of the roadway it is anticipated that the operating speeds are greater than 40mph. However, a speed study is required to validate this assumption. The application of the 70% factor will result in justifiable signal warrant at lower traffic volumes and is conservatively evaluated at the study intersection in addition to the base MUTCD criteria. The evaluation of vehicular volume warrants (Warrants 1-3) under base criteria are summarized in **Table 1**. The evaluation of the warrants with 70% factor applied are summarized in **Table 2**.

Table 1: Traffic Volume Signal Warrant Summary

Warrant	Southbound Intersecton	Northbound Intersection
Warrant 1 - 8 Hour Vehicluar Volume		
Condition A Hours Met	1	4
Condition B Hours Met	2	1
Comination Hours Met	3	2
Warrant 1 Conclusion	Not Met	Not Met
Warrant 2 - 4 Hour Vehicular Volume		
Hours Met	2	1
Warrant 2 Conclusion	Not Met	Not Met
Warrant 3 - Peak Hour		
AM Peak	No	No
PM Peak	No	No
Warrant 3 Conclusion	Not Met	Not Met

The southbound and northbound intersections did not meet the criteria for traffic volume warrants under base criteria. This would not support the implementation of a traffic signal at the intersection.

Table 2: Traffic Volume Signal Warrant Summary (with 70% Factor)

Warrant	Southbound Intersecton	Northbound Intersection
Warrant 1 - 8 Hour Vehicluar Volume		
Condition A Hours Met	6	6
Condition B Hours Met	4	6
Comination Hours Met	5	7
Warrant 1 Conclusion	Not Met	Not Met
Warrant 2 - 4 Hour Vehicular Volume		
Hours Met	4	4
Warrant 2 Conclusion	**Met**	**Met**
Warrant 3 - Peak Hour		
AM Peak	No	Yes
PM Peak	Yes	No
Warrant 3 Conclusion	**Met**	**Met**

The southbound intersection met the criteria for four-hour vehicular volume (Warrant 2) and peak hour volume (Warrant 3) in the PM, the eight-hour vehicular volume (Warrant 1) was not met. The northbound intersection met the criteria for four-hour vehicular volume (Warrant 2) and peak hour volume (Warrant 3) in the AM, the eight-hour vehicular volume (Warrant 1) was not met. Application of the 70% factor would support the implementation of a traffic signal at the intersection.

Table 3: Southbound 98th Street & Benavides Road - Warrant 1 Summary

Condition A - Minimum Vehicular Volume					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
17:00 - 18:00	1,188	600	134	150	Not Met
16:00 - 17:00	1,123	600	139	150	Not Met
15:00 - 16:00	885	600	119	150	Not Met
14:00 - 15:00	762	600	151	150	Met
7:00 - 8:00	587	600	208	150	Not Met
18:00 - 19:00	580	600	69	150	Not Met
8:00 - 9:00	473	600	147	150	Not Met
13:00 - 14:00	535	600	84	150	Not Met

Condition B - Interruption of Continuous Traffic					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
17:00 - 18:00	1,188	900	134	75	Met
16:00 - 17:00	1,123	900	139	75	Met
15:00 - 16:00	885	900	119	75	Not Met
14:00 - 15:00	762	900	151	75	Not Met
7:00 - 8:00	587	900	208	75	Not Met
18:00 - 19:00	580	900	69	75	Not Met
8:00 - 9:00	473	900	147	75	Not Met
13:00 - 14:00	535	900	84	75	Not Met

Combination Condtion A and Condition B							
Time Period	Vehicles per Hour on Major Street	Threshold		Vehicles per Hour on High-Volume Minor Street Approach	Threshold		Condition Met
		A	B		A	B	
17:00 - 18:00	1,188	480	720	134	120	60	Met
16:00 - 17:00	1,123	480	720	139	120	60	Met
15:00 - 16:00	885	480	720	119	120	60	Not Met
14:00 - 15:00	762	480	720	151	120	60	Met
7:00 - 8:00	587	480	720	208	120	60	Not Met
18:00 - 19:00	580	480	720	69	120	60	Not Met
8:00 - 9:00	473	480	720	147	120	60	Not Met
13:00 - 14:00	535	480	720	84	120	60	Not Met

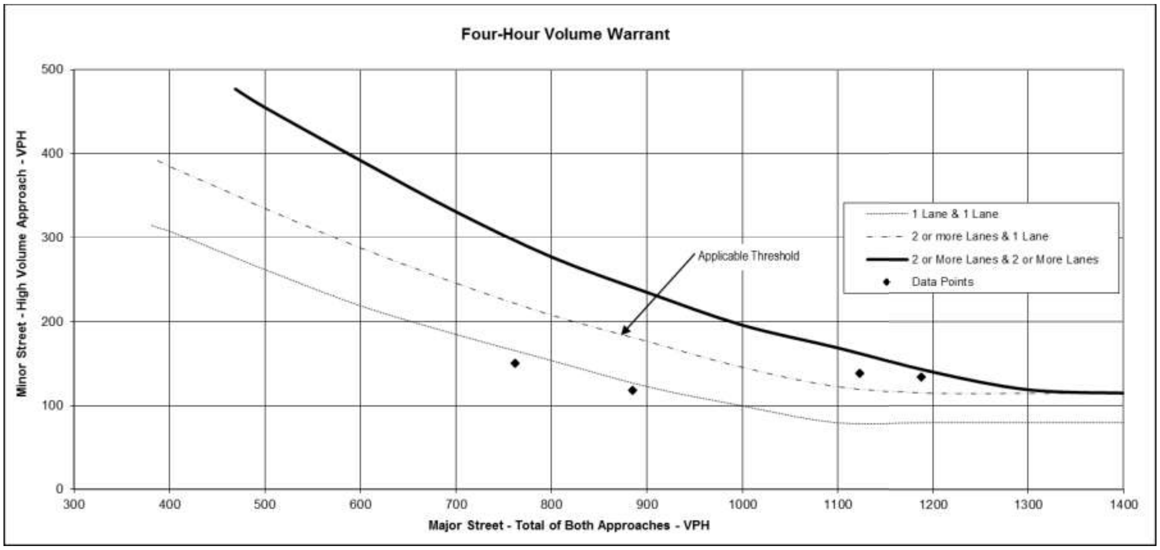

Figure 6 – Southbound 98th Street & Benavides Road - Warrant 2 Summary

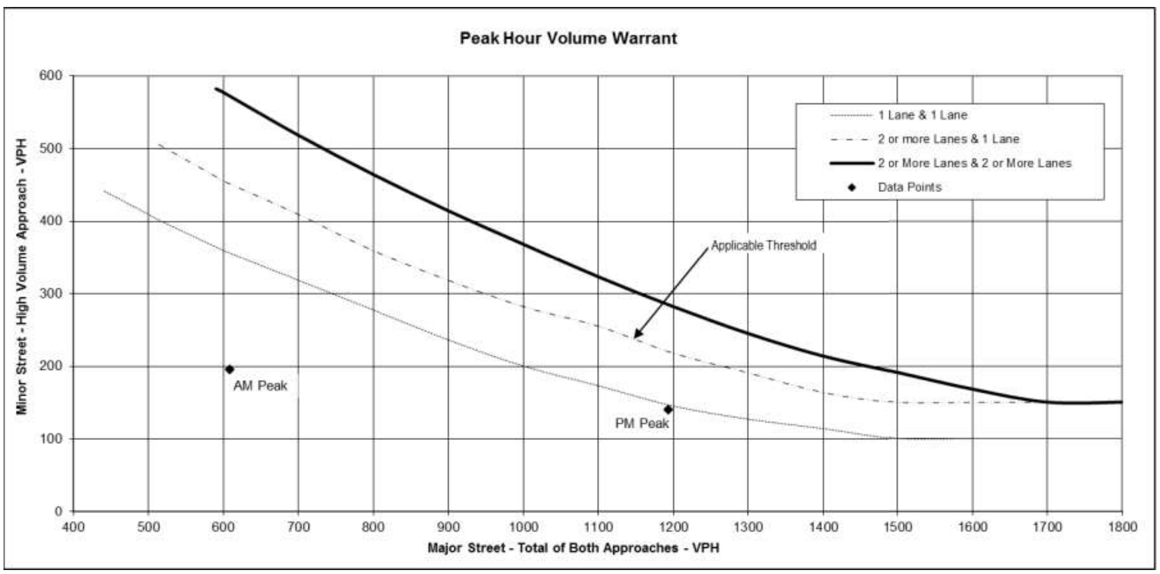

Figure 7 – Southbound 98th Street & Benavides Road - Warrant 3 Summary

Table 4: Northbound 98th Street & Benavides Road - Warrant 1 Summary

Condition A - Minimum Vehicular Volume					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
7:00 - 8:00	1,037	600	268	150	Met
8:00 - 9:00	729	600	194	150	Met
15:00 - 16:00	657	600	156	150	Met
14:00 - 15:00	714	600	170	150	Met
17:00 - 18:00	685	600	141	150	Not Met
16:00 - 17:00	674	600	139	150	Not Met
9:00 - 10:00	514	600	103	150	Not Met
13:00 - 14:00	486	600	84	150	Not Met

Condition B - Interruption of Continuous Traffic					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
7:00 - 8:00	1,037	900	268	75	Met
8:00 - 9:00	729	900	194	75	Not Met
15:00 - 16:00	657	900	156	75	Not Met
14:00 - 15:00	714	900	170	75	Not Met
17:00 - 18:00	685	900	141	75	Not Met
16:00 - 17:00	674	900	139	75	Not Met
9:00 - 10:00	514	900	103	75	Not Met
13:00 - 14:00	486	900	84	75	Not Met

Combination Condition A and Condition B							
Time Period	Vehicles per Hour on Major Street	Threshold		Vehicles per Hour on High-Volume Minor Street Approach	Threshold		Condition Met
		A	B		A	B	
7:00 - 8:00	1,037	480	720	268	120	60	Met
8:00 - 9:00	729	480	720	194	120	60	Met
15:00 - 16:00	657	480	720	156	120	60	Not Met
14:00 - 15:00	714	480	720	170	120	60	Not Met
17:00 - 18:00	685	480	720	141	120	60	Not Met
16:00 - 17:00	674	480	720	139	120	60	Not Met
9:00 - 10:00	514	480	720	103	120	60	Not Met
13:00 - 14:00	486	480	720	84	120	60	Not Met

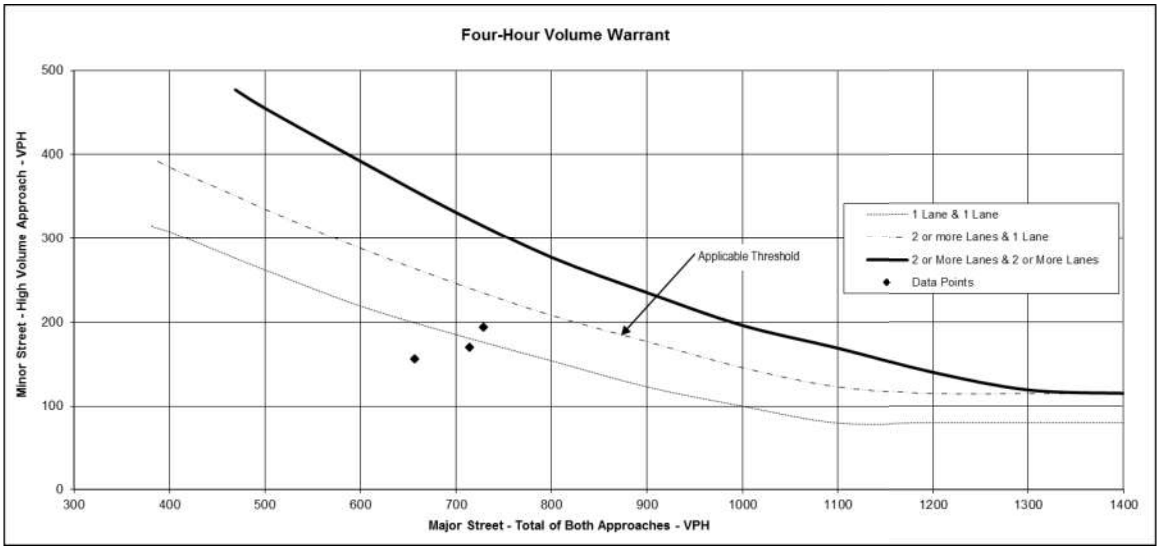

Figure 8 – Northbound 98th Street & Benavides Road - Warrant 2 Summary

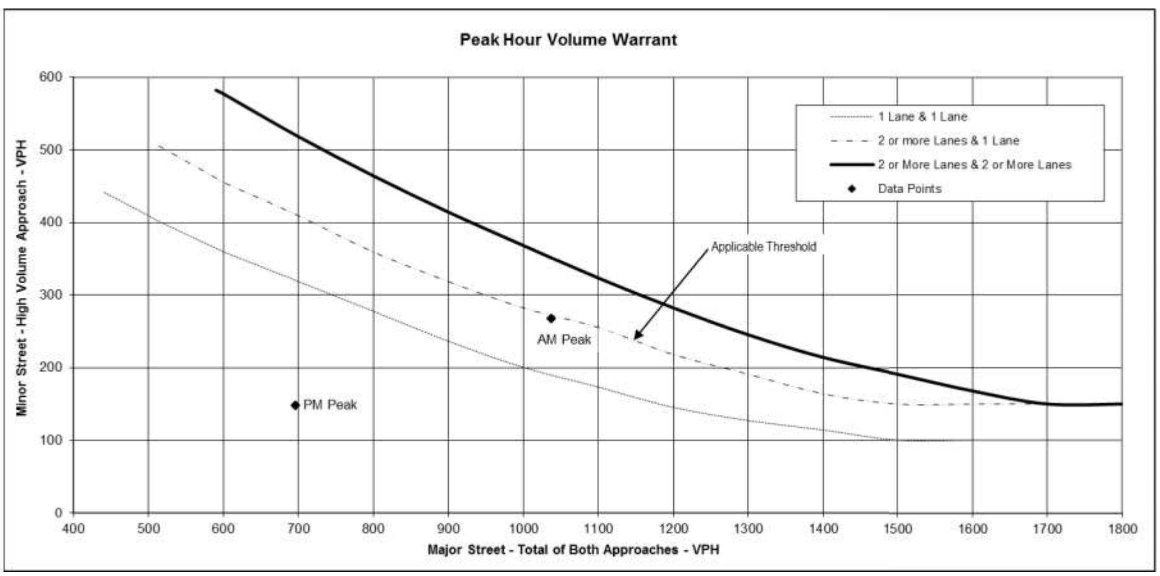

Figure 9 – Northbound 98th Street & Benavides Road - Warrant 3 Summary

Table 5: Southbound 98th Street & Benavides Road - Warrant 1 Summary (70% Factor)

Condition A - Minimum Vehicular Volume					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
17:00 - 18:00	1,188	420	134	105	Met
16:00 - 17:00	1,123	420	139	105	Met
15:00 - 16:00	885	420	119	105	Met
14:00 - 15:00	762	420	151	105	Met
7:00 - 8:00	587	420	208	105	Met
18:00 - 19:00	580	420	69	105	Not Met
8:00 - 9:00	473	420	147	105	Met
13:00 - 14:00	535	420	84	105	Not Met

Condition B - Interruption of Continuous Traffic					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
17:00 - 18:00	1,188	630	134	53	Met
16:00 - 17:00	1,123	630	139	53	Met
15:00 - 16:00	885	630	119	53	Met
14:00 - 15:00	762	630	151	53	Met
7:00 - 8:00	587	630	208	53	Not Met
18:00 - 19:00	580	630	69	53	Not Met
8:00 - 9:00	473	630	147	53	Not Met
13:00 - 14:00	535	630	84	53	Not Met

Combination Condtion A and Condition B							
Time Period	Vehicles per Hour on Major Street	Threshold		Vehicles per Hour on High-Volume Minor Street Approach	Threshold		Condition Met
		A	B		A	B	
17:00 - 18:00	1,188	336	504	134	84	42	Met
16:00 - 17:00	1,123	336	504	139	84	42	Met
15:00 - 16:00	885	336	504	119	84	42	Met
14:00 - 15:00	762	336	504	151	84	42	Met
7:00 - 8:00	587	336	504	208	84	42	Met
18:00 - 19:00	580	336	504	69	84	42	Not Met
8:00 - 9:00	473	336	504	147	84	42	Not Met
13:00 - 14:00	535	336	504	84	84	42	Not Met

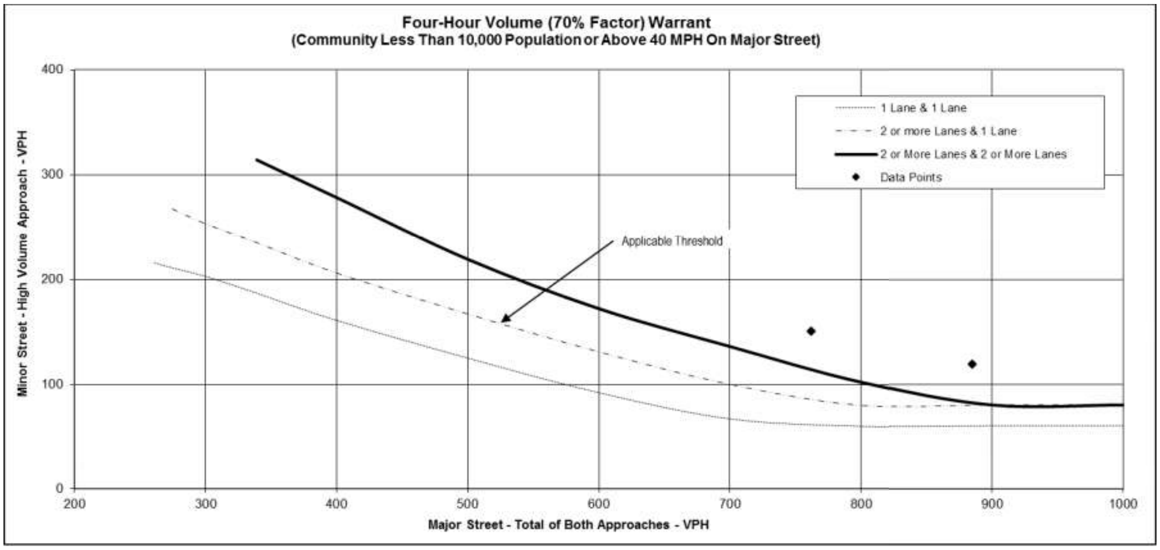

Figure 10 – Southbound 98th Street & Benavides Road - Warrant 2 Summary (70% Factor)

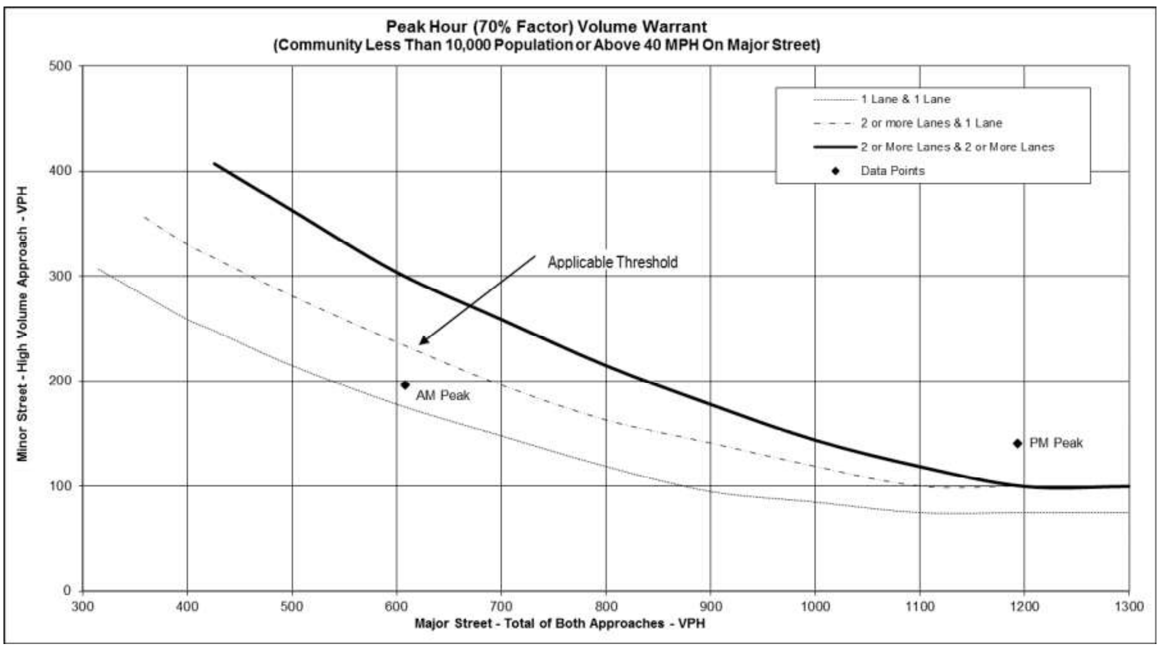

Figure 11 – Southbound 98th Street & Benavides Road - Warrant 3 Summary (70% Factor)

Table 6: Northbound 98th Street & Benavides Road - Warrant 1 Summary (70% Factor)

Condition A - Minimum Vehicular Volume					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
7:00 - 8:00	1,037	420	268	105	Met
8:00 - 9:00	729	420	194	105	Met
15:00 - 16:00	657	420	156	105	Met
14:00 - 15:00	714	420	170	105	Met
17:00 - 18:00	685	420	141	105	Met
16:00 - 17:00	674	420	139	105	Met
9:00 - 10:00	514	420	103	105	Not Met
13:00 - 14:00	486	420	84	105	Not Met

Condition B - Interruption of Continuous Traffic					
Time Period	Vehicles per Hour on Major Street	Threshold	Vehicles per Hour on High-Volume Minor Street Approach	Threshold	Condition Met
7:00 - 8:00	1,037	630	268	53	Met
8:00 - 9:00	729	630	194	53	Met
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14:00 - 15:00	714	630	170	53	Met
17:00 - 18:00	685	630	141	53	Met
16:00 - 17:00	674	630	139	53	Met
9:00 - 10:00	514	630	103	53	Not Met
13:00 - 14:00	486	630	84	53	Not Met

Combination Condtion A and Condition B							
Time Period	Vehicles per Hour on Major Street	Threshold		Vehicles per Hour on High-Volume Minor Street Approach	Threshold		Condition Met
		A	B		A	B	
7:00 - 8:00	1,037	336	504	268	84	42	Met
8:00 - 9:00	729	336	504	194	84	42	Met
15:00 - 16:00	657	336	504	156	84	42	Met
14:00 - 15:00	714	336	504	170	84	42	Met
17:00 - 18:00	685	336	504	141	84	42	Met
16:00 - 17:00	674	336	504	139	84	42	Met
9:00 - 10:00	514	336	504	103	84	42	Met
13:00 - 14:00	486	336	504	84	84	42	Not Met

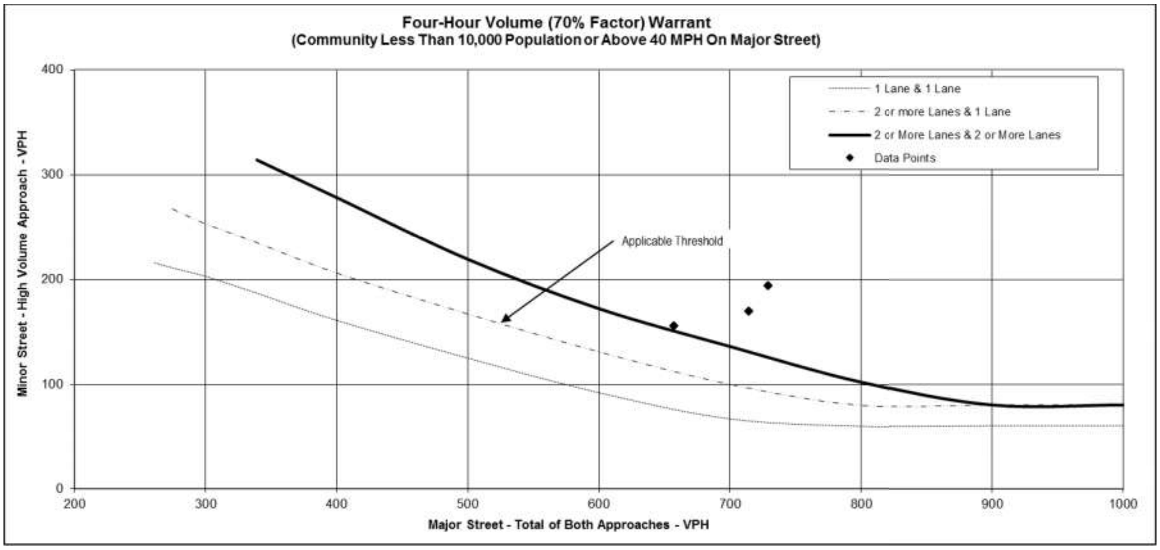

Figure 12 – Northbound 98th Street & Benavides Road - Warrant 2 Summary (70% Factor)

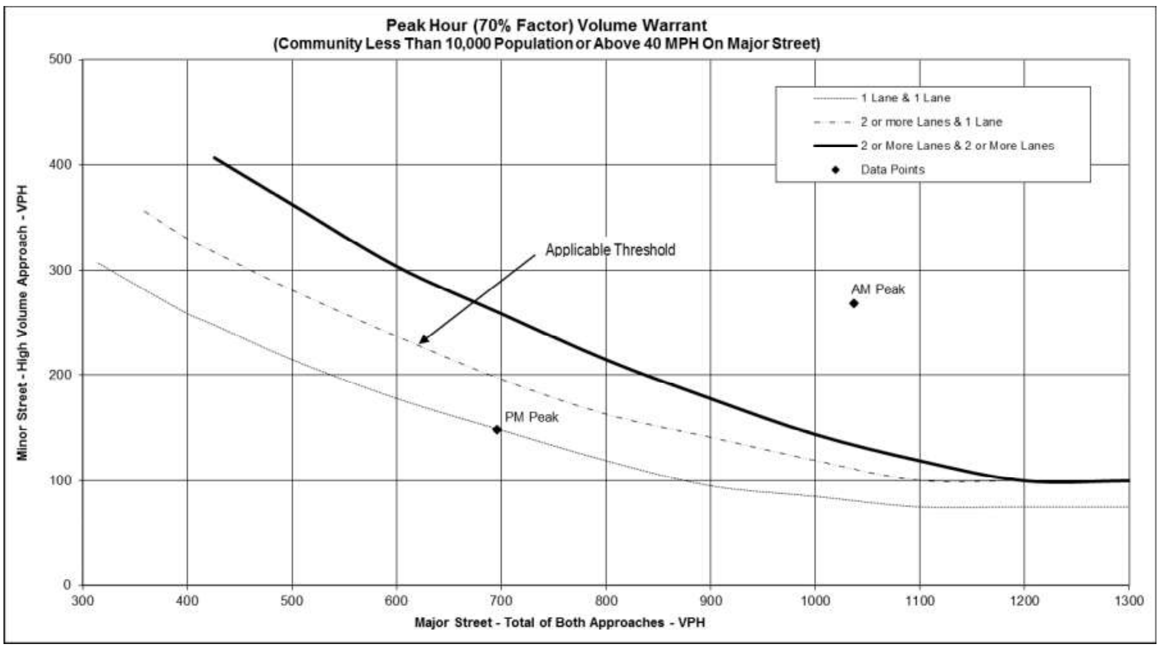

Figure 13 – Northbound 98th Street & Benavides Road - Warrant 3 Summary (70% Factor)

The pedestrian volume warrant was not met (Warrant 4). The pedestrian volume warrant was evaluated for the intersection due to need of pedestrians crossing 98th Street to cross both intersections. The intersection does not meet criteria for school crossing (Warrant 5); there are adequate gaps for crossing due to the nature of four-way stopped controlled intersections. However, the threshold for number of children crossing during the highest crossing hour was met.

The worksheets used in the evaluation of the signal warrants are included in **Appendix D**.

4.3 OPERATIONS ANALYSIS

The acceptable measure of traffic operational performance is Level of Service (LOS), which is a traffic term used to classify or grade how effectively a roadway capacity is serving the demand vehicular traffic. LOS is expressed as a letter designation raging from “A” to “F” with each letter representing the amount of average delay (measured in seconds) encountered by motorists at the intersection. LOS A represent traffic conditions with essentially free flow and minimal delay, whereas LOS F described traffic conditions that have significant congestion and long delay. LOS is calculated for the overall intersection and for each specific movement within the intersection. For most urban intersections, LOS D or better is a reasonable expectation for the overall intersection and each movement at the intersection should provide LOS E or better. **Table 7** summarizes the LOS criteria for unsignalized intersections.

Table 7: Level of Service Definitions for Unsignalized Intersections

Level of Service	Definition	Delay (sec/veh)
A	Most vehicles do not stop	<10
B	Some vehicle stop	>10 and <15
C	Significant number of vehicle stop	>15 and <25
D	Many vehicle stop	>25 and <35
E	Limit of acceptable delay	>35 and <50
F	Unacceptable delay	>50

The analysis of traffic operations at the intersection was completed using the latest traffic count data and most version current of Synchro- an industry accepted transportation analysis software tool. The software uses the specific intersection lane configuration, control method, traffic volume, and other site criteria. The model outputs include delay and level of service for each movement as well as the overall intersection.

The study intersection was modeled as (2) three-way stop controlled intersections. The analyses were conduction for AM and PM peak hours. A summary of the analyses for each of the peak periods is shown below in **Table 8** and **Table 9**. Sychro output reports for each of the periods analyzed are provided in **Appendix E**.

Table 8: Northbound Unsignalized Intersection Operations Summary

Northbound						Eastbound		Westbound		Intersection	
Thru-Right		Thru-Left		Approach		Approach		Approach			
Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak Hour											
177.2	F	123.4	F	158.9	F	208	F	25.8	D	149.0	F
PM Peak Hour											
15.9	C	16.4	C	16.1	C	11.3	B	9.8	A	14.7	B

The analysis found that the overall northbound intersection operates at LOS F during the AM Peak period and LOS B during the PM Peak period. In the AM peak period, the majority of the individual movements operate at LOS F, the westbound lane operates at LOS D. In the PM peak period, all the individual movements within the northbound intersection operate at LOS C or better.

Table 9: Southbound Unsignalized Intersection Operations Summary

Southbound								Eastbound		Westbound		Intersection	
Thru-Right		Thru		Left		Approach		Approach		Approach			
Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak Hour													
11	B	14.8	B	10.8	B	15.0	B	12.7	B	10.5	B	13.0	B
PM Peak Hour													
26.8	D	114.3	F	9.3	A	70.2	F	13.9	B	12.5	B	59.8	F

The analysis found that the overall southbound operates at LOS B during AM Peak period and LOS F during the PM Peak period. In the AM peak period, all of the individual movements within the southbound intersection operate at LOS C or better. In the PM peak period, the majority of the individual movements operate at LOS F, the eastbound lane operates at LOS B. Although the northbound thru-right lane failed during the AM peak hour, it should be noted that the volume of turning movements do not warrant additional dedicated lanes for turning movements.

4.4 QUEUING ANALYSIS

Utilizing the Synchro model developed for the operations analyses, a queuing assessment was completed for the AM and PM peak hours. The analyses identified the anticipated queue length for each of the travel lanes based upon existing peak hour volumes. A summary of the analyses for each of the peak periods is shown in **Table 10**. Synchro output reports for each of the periods analyzed are provided in **Appendix F**.

Table 10: Unsignalized Intersection Queue Summary

Intersection	Approach	AM Peak Hour Queue (feet)	PM Peak Hour Queue (feet)
Northbound 98th Street	Northbound		
	Thru-Right	120	115
	Thru-Left	118	74
	Eastbound	90	28
	Westbound	23	22
Southbound 98th Street	Southbound		
	Thru-Right	53	107
	Thru	62	124
	Left	20	10
	Eastbound	38	47
	Westbound	12	26

The analysis found adequate storage capacity at the intersection. One potential issues are queues from the Truman Middle School pick up/drop off driveways impacting the ability of vehicles to move eastbound. This condition results in vehicular conflicts, perhaps in the form on rear-end collisions and increased delay for vehicles trying to travel eastbound. Based on a site visit in November 2018, queues up to 600-feet northbound were observed.

Photo 5- Observed Northbound Queues

Photo 6- Observed Southbound Queues

Photo 7- Observed School Drop Off Queues

5 CRASH ASSESSMENT

Crash data specific to the intersection was assembled and reviewed to determine the current crash rate, crash severity, and relevant statistics for the intersection. The data set used was crash summaries maintained by the NMDOT for the years 2012 through 2016 and is included in **Appendix G**. Due to the limited information about location of the incidents, the data is analyzed for the complete intersection and was not split by northbound/southbound intersections.

It should be noted that the crash analysis is based on reported collisions. It is likely that the actual number of collisions at the intersection over the five years evaluated is higher than reported.

5.1 SUMMARY DATA

A summary of the crash data for five-year period is summarized below.

Table 11: Crash History Summary

	Year 2012	Year 2013	Year 2014	Year 2015	Year 2016	Total	
	No	No	No	No	No	No	%
Accident Type							
Rear End		1		2		3	14%
Sideswipe: Same Direction	2		1	1		4	19%
Head On		1		1	1	3	14%
Left Turn				1		1	5%
Right Turn	1	1	2	1	1	6	29%
Sideswipe: Opposite Direction					1	1	5%
Pedestrian/Bicyclist				2		2	10%
Other				1		1	5%
Total	**3**	**3**	**3**	**9**	**3**	**21**	**100%**
Accident Severity							
Property Damage Only (PDO)	3	2	2	6	1	14	67%
Injury/Non-Fatal		1	1	3	2	7	33%
Fatal						0	0%
Total	**3**	**3**	**3**	**9**	**3**	**21**	**100%**

Contributing Circumstance							
Following Too Close				1		1	5%
Drive Inattention	1	1	1	2	1	6	29%
Excessive Speed			1			1	5%
Improper Driving	2	1		4		7	33%
Disregard Traffic Control Device		1	1	1	2	5	24%
Pedestrian Error				1		1	5%
Total	**3**	**3**	**3**	**9**	**3**	**21**	**100%**
Hour of Day							
0:00 - 6:00							
6:00 - 11:00	1	1	1	3	1	7	33%
11:00 - 15:00	1		1	2		4	19%
15:00 - 19:00		1	1	2		4	19%
19:00 - 24:00	1	1		2	2	6	29%
Total	**3**	**3**	**3**	**9**	**3**	**21**	**100%**

It can be observed that the number of crashes at the intersection is relatively high for the five-year analysis period. Additional pertinent crash statistics are:

- The dominant type of crash was right turn, side swipe same direction, head on, and rear end representing 79% among all crash types
- The percentage of PDO and Injury was 67% and 33% respectively.
- The dominant contributing circumstances were Driver Inattention, Improper driving, and Disregarded Control Device.
- There were no crashes involving alcohol

6 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSIONS

Existing operational and access deficiencies have been identified at the 98th Street/Benavides Road intersection. The arrangement of the intersection experiences high congestion on 98th Street approaching Benavides Road in the due to the volume of northbound traffic in AM peak hour and volume of southbound traffic in PM peak hour. Furthermore, expected future growth within the region will impact travel conditions at the intersection.

The pedestrian infrastructure network is not consistent south of the intersection and does not provide connectivity between the residential area and pedestrian attractions (shopping center, Truman Middle School, community center). There are intersection improvements that can be implemented to enhance operations and safety, and accommodate future increase in travel demand.

6.2 RECOMMENDATIONS

The following recommendations were formed to address the operations and safety issues identified at the intersection based on feasibility of implementation to the existing footprint.

6.2.1 INTERSECTION CONFIGURATONS

CONFIGURATION 1: SIGNALIZED SPLIT INTERSECTION

An intersection treatment to address to operational deficiencies identified in Section 4.2 and Section 4.3 is implementation of traffic signals at the northbound and southbound intersections within the existing roadway footprint. This would entail removing the three-way stop controlled devices and replacing will traditional traffic signals. These signals would be coordinated to optimally move platoons through the intersection and reduce the queuing issue seen at the intersection. Potential location to implement standard traffic signals are shown in **Figure 14**.

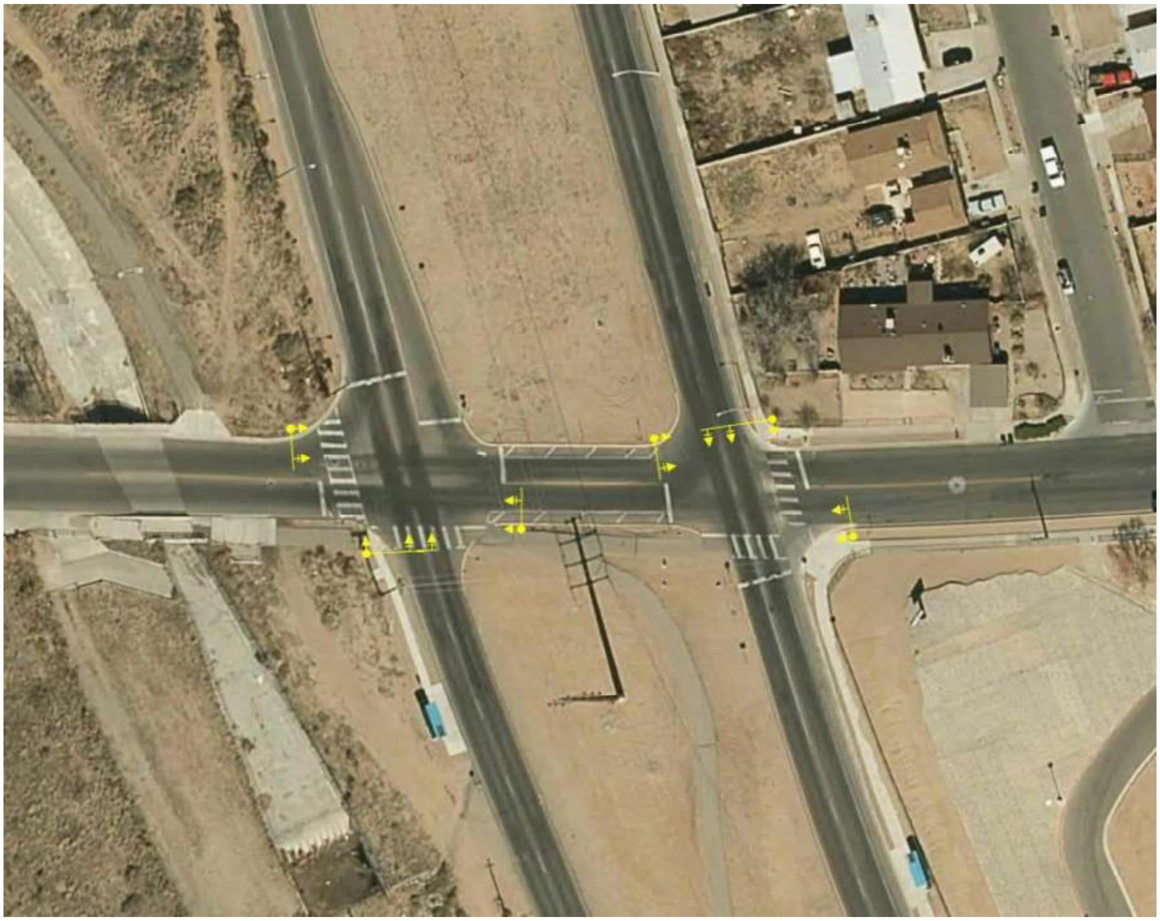

Figure 14 – Intersection Signalization

EVALUATION OF SIGNALIZED SPLIT INTERSECTION CONFIGURATION AT STUDY INTERSECTION

There would be an operational benefit to implementing a traffic signal at the intersection. All movements would operate at an acceptable level of service and this alternative would be compliant with the demonstrated warranted signalization. Vehicular safety would be improved at the intersection from use of traffic signals; research compiled by the Crash Modification Factor Clearinghouse indicates that installation of a traffic signal in urban areas results in reduction if number of anticipated crashes. Pedestrian safety would also be improved from this treatment by providing a shared phase with thru traffic for crossing. The crossing would be accomplished in two-stages and the median would serve as refuge.

CONFIGURATION 2: SIGNALIZED SINGLE INTERSECTION

As demonstrated above, although the safety and operation of the intersections would be improved by implementation traffic signals, the spacing between the northbound and southbound intersections is maintained. One method to address this is to realign 98th Street so that the intersection can be controlled at a single point as shown in **Figure 15** and **Figure 19**. This would entail complete realignment and reconstruction of the 98th Street approaches north and south of the intersection. Additionally, the existing median crossovers north of Benavides Road would need to maintained and may require realignment.

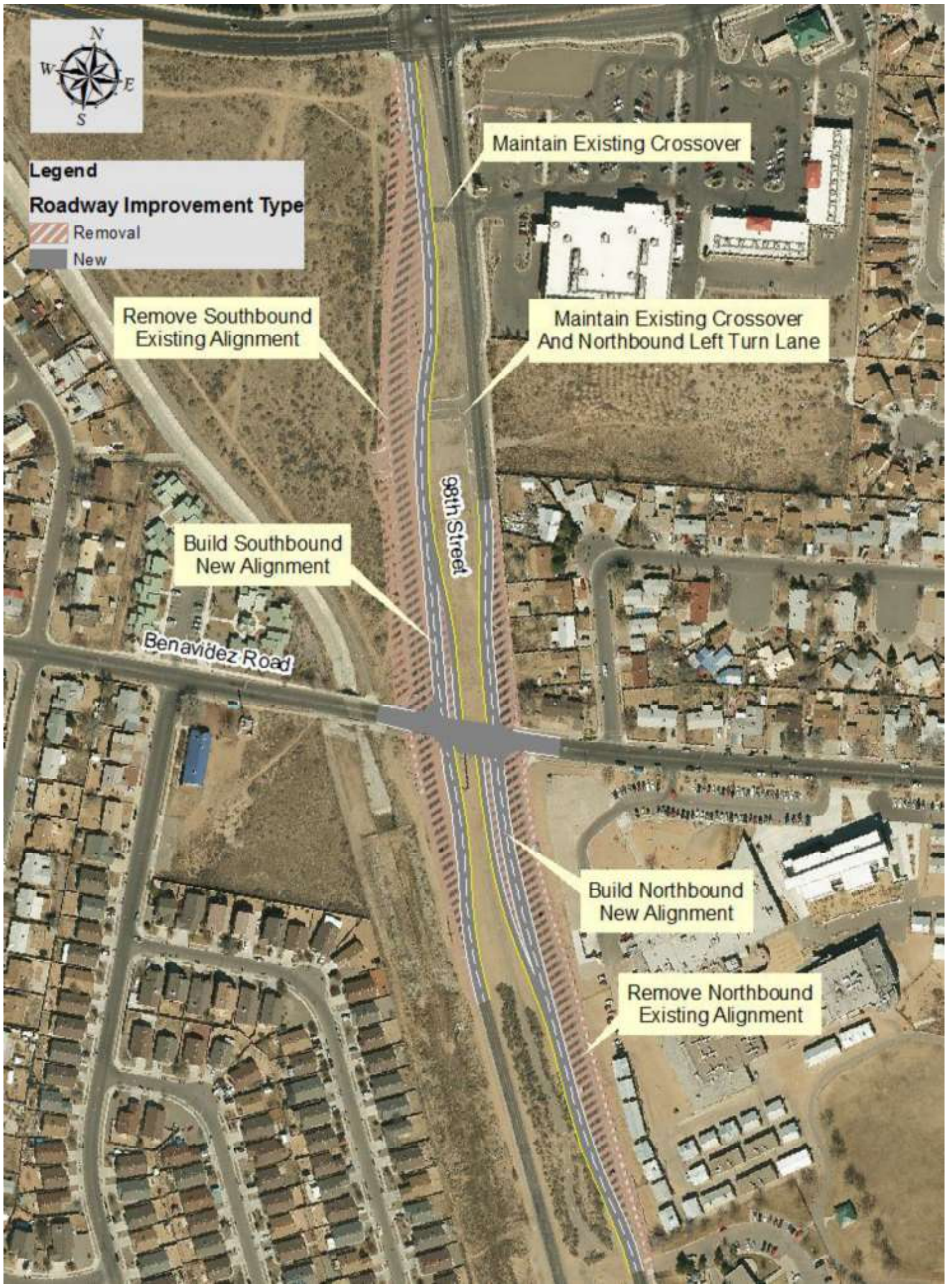

Figure 15 – Realignment of 98th Street for Single Point Intersection

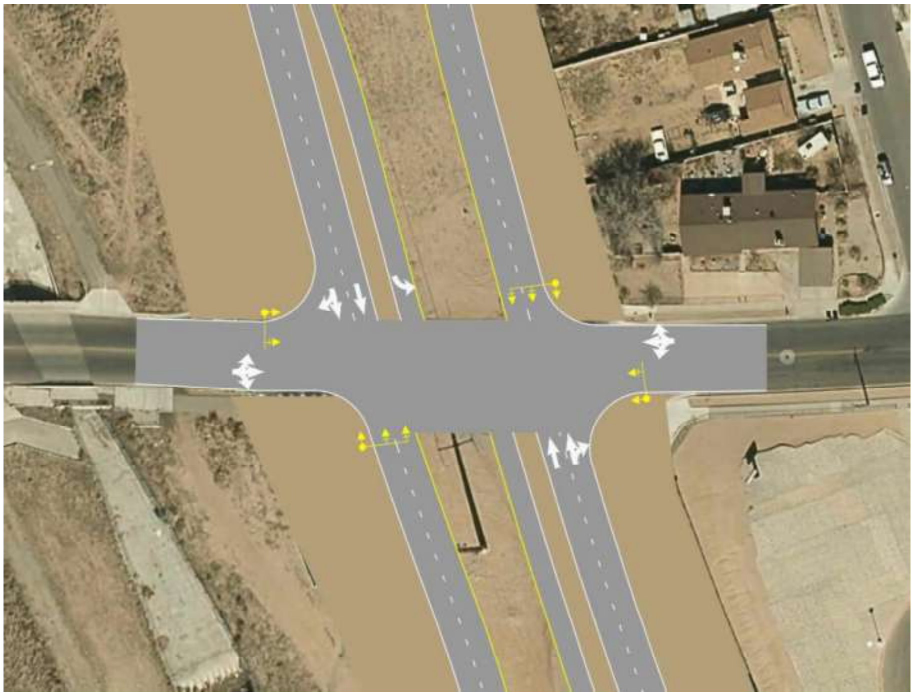

Figure 16 – Single Point Intersection Signalization

EVALUATION OF SIGNALIZED SPLIT INTERSECTION CONFIGURATION AT STUDY INTERSECTION

The previously mentioned benefits of signalized split intersection configuration also apply to this recommendation. However, utilizing a single signal controller instead of coordinated signals between the two intersection would result in additional signal efficiency and better operations. In addition, the crossing distance for pedestrians would be significantly increased as this treatment would require the crossing to be completed in a single stage.

CONFIGURATION 3: INDIRECT LEFT TREAMTENT (MICHIGAN LEFT)

Indirect Left Treatment, known as a Michigan Left, is a transportation engineering technique that eliminates direct left turns and allows the maneuver to be made via median crossovers beyond the intersection as shown in **Figure 17**. Typical lane configurations for Indirect Left Treatment usage are shown in **Figure 18**. Alternatively, the traditional Indirect Left Treatment configuration can be modified to eliminate east/westbound thru movement access through the median and convert the Benavides Road to T-intersection configurations; this configuration will be referred to as modified Indirect Left Treatment configuration. As demonstrated in Sections 4.2 - 4.3 and previous alternatives, signalization is warranted to address operational deficiencies with or without thru median access for Benavides Road. The major safety benefit is a reduction in number of conflict points within the intersection and the reduction in the probability of head-on/angle collisions. A standard intersection contains 32 conflict points while the standard Indirect Left Treatment contains 16 conflict points. This treatment is recommended for junctions on arterials where relatively high thru volumes conflict with moderate to low left-turn volumes.

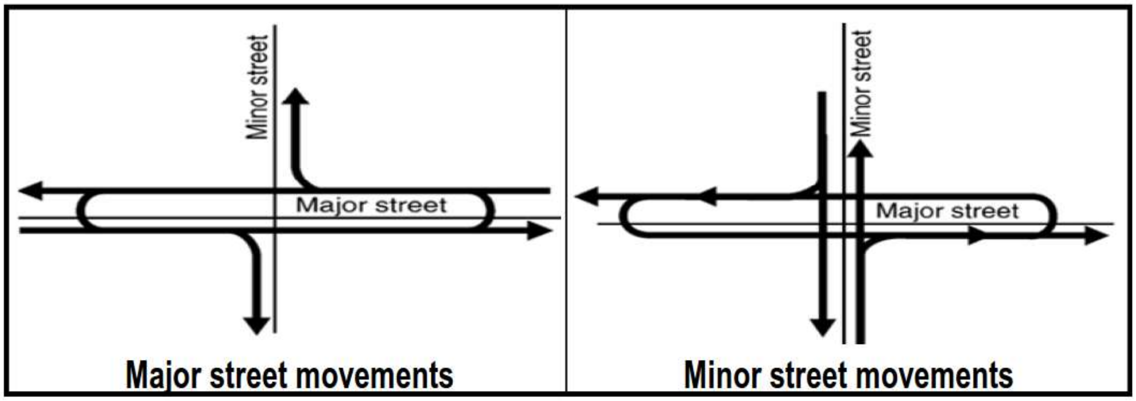

Figure 17 – Vehicle Movements through Indirect Left Treatment

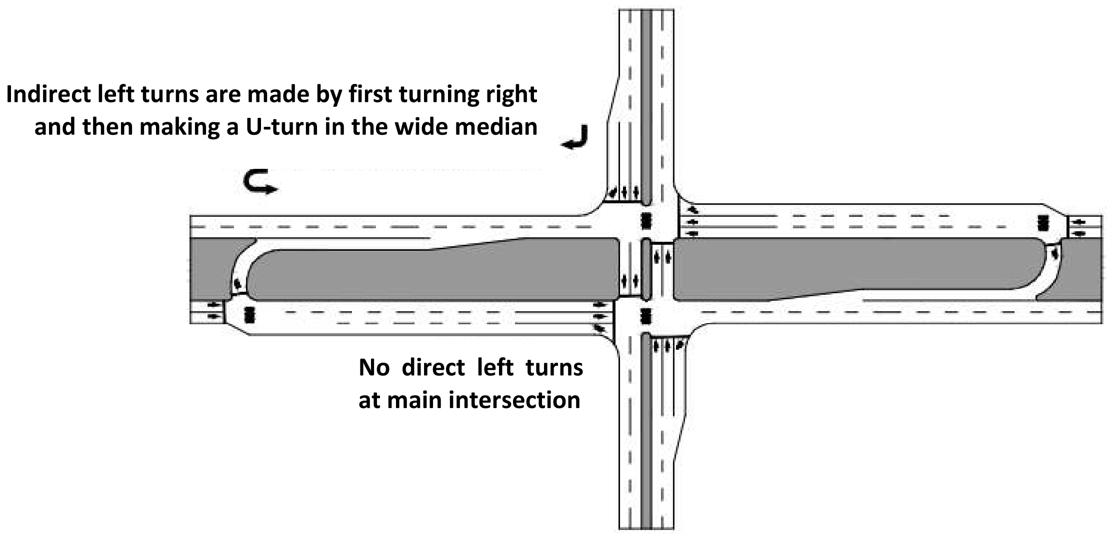

Figure 18 – Indirect Left Typical Lane Configuration

The placement of the median U-turns at the intersection should consider planned adjacent land use, geometric design considerations, and meet criteria of access spacing defined by the DPM. As shown in the City Zoning Maps (**Figure 19**), the existing median access north of the intersection should remain because it is the intended access point for planned residential use in the lot east of the opening and utilization of the existing access point for Indirect Left Treatment median U-turns would negatively impact full access to the track. Using the existing north median access point would result in partial right-in-right-out access to the R-7 lot; vehicles entering the lot from southbound and vehicles leaving the lot would be required to travel out of direction to make a left turn maneuver.

With respect to geometric design considerations, the minimum distance from the intersection for placement of a U-turn opening, as depicted in **Figure 20**, should accommodate deceleration and storage for the left turn movements. As stated in the AASHTO Green Book Table 9-20 guidance for 45-mph design speed, an appropriate deceleration length is 340-feet. The AASHTO Green Book Table 9-21 guidance for the existing volumes recommends a minimum storage length of 50-feet; the recommended minimum distance from the study intersection is 390-feet for deceleration and storage. As shown in **Figure 21**, placement of the median U-turn in accordance with the Green Book deceleration and storage requirements would result in 190-feet spacing to the existing north median access point.

As stated in the DPM (*Chapter 23, Section 5, C.,1*), the allowable minimum distance between the ends of adjacent median cuts on arterials is 400-feet (**Appendix B**). As shown in **Figure 21**, placement of the median U-turn in accordance with the DPM would result in 150-feet of available space for deceleration and storage. The AASHTO Green Book guidance for Indirect Left Treatment configurations, Section 6.5.5, recommends the placement of U-turn at least 100-feet in advance of the next downstream left-turn lane. As shown in **Figure 21**, placement of the median U-turn in accordance with the Green Book access spacing recommendations would result in 160-feet available for deceleration and storage.

As shown in **Figure 21**, placement of a new median U-turn between the study intersection and existing north median access point will not accommodate the required spacing requirements for Indirect Left Treatment intersection configuration.

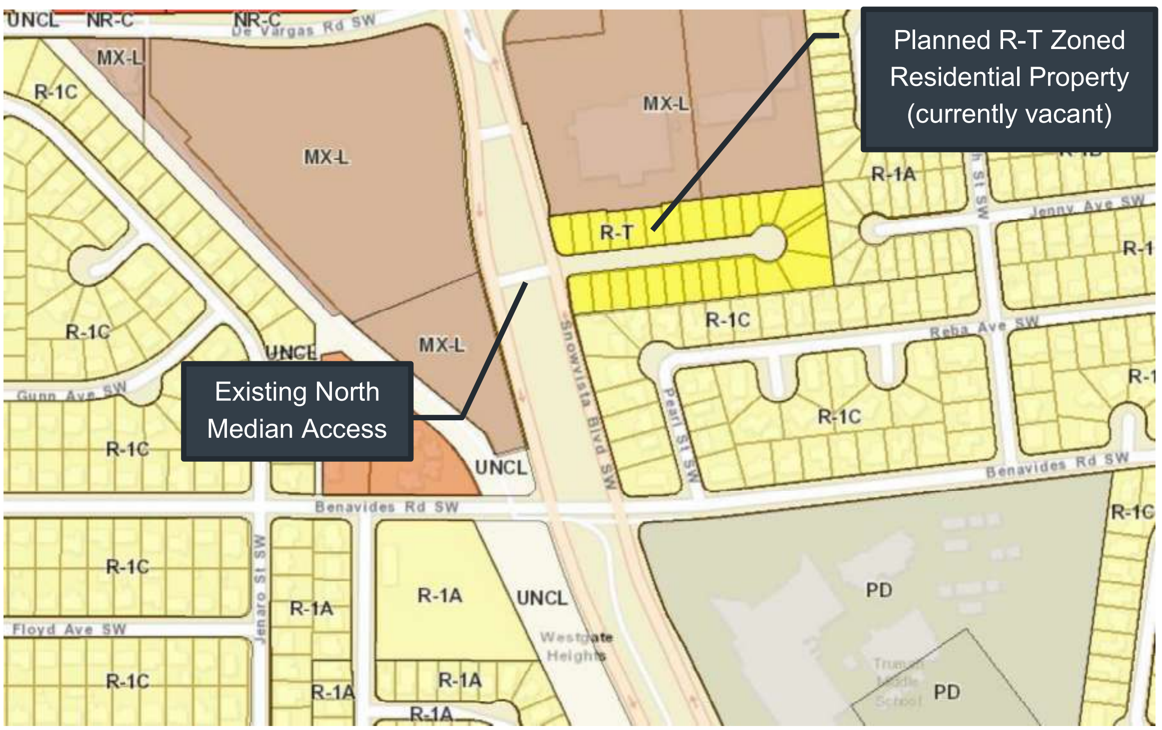

Figure 19 – Planned Residential Property North of Intersection

Based on the available median width at the 98th Street/Benavides Road intersection, Indirect Left Treatment could be built, however, the spacing between the existing north median access point (opposite R-T zoned property as shown above) and the new median U-turn will not meet DPM access spacing requirements.

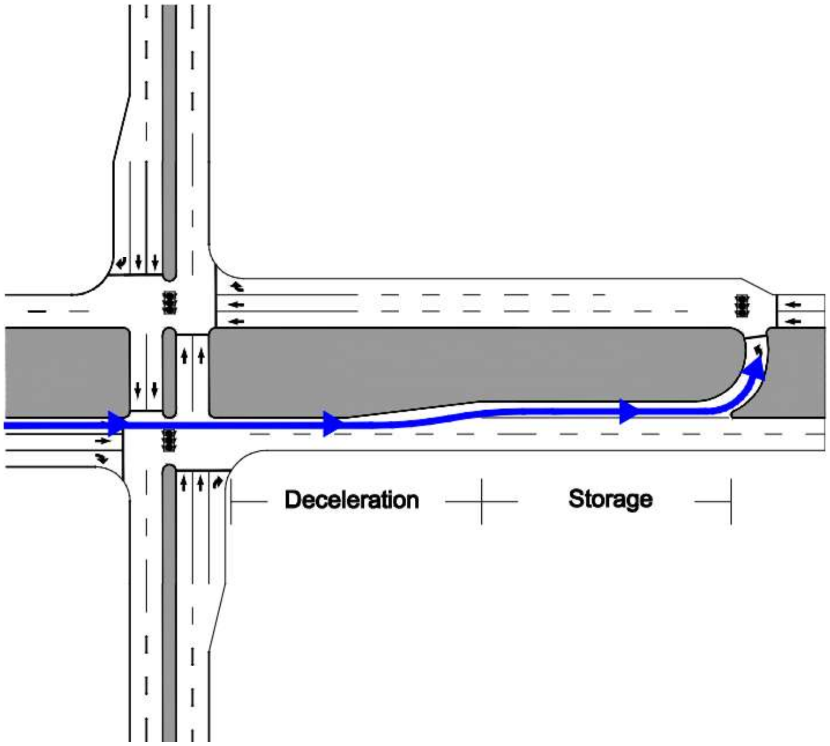

Figure 20 – Placement of Median U-turn

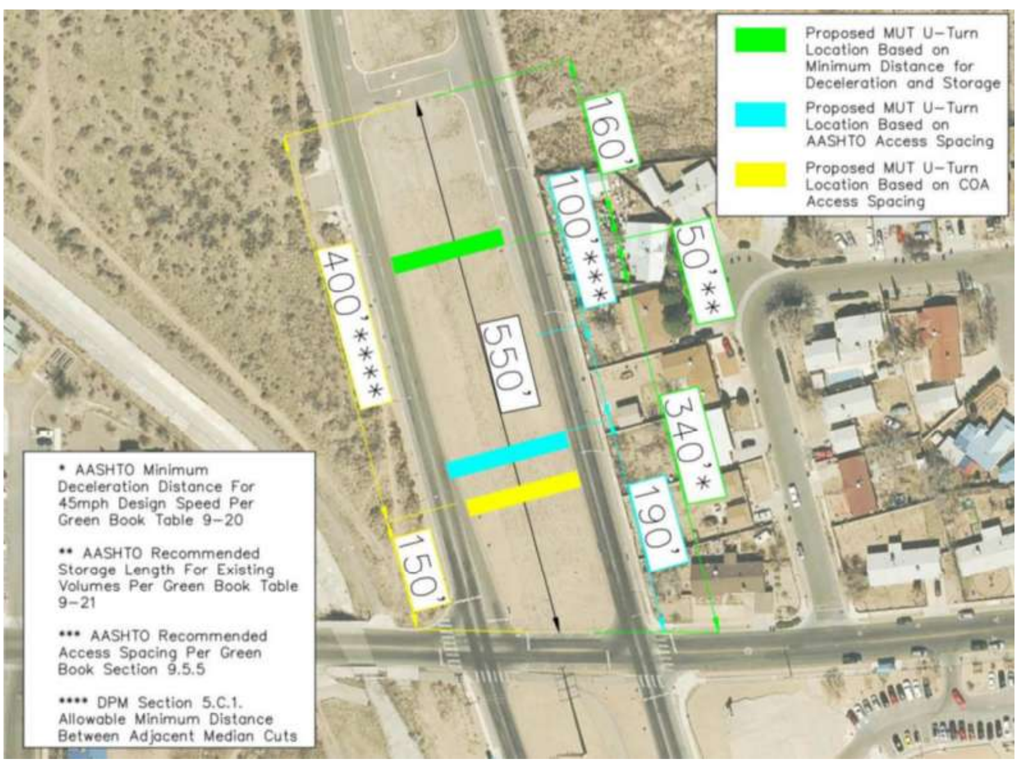

Figure 21 – Existing Median Access Spacing

EVALUATION OF MUT CONFIGURATION AT STUDY INTERSECTION

As previously described, Indirect Left Treatment configuration is not recommended at the study intersection due to the limited spacing between the study intersection and existing north median access.

Under the standard Indirect Left configuration, the main intersection should be operated with signalization. This would address the operational deficiencies previously identified and increase pedestrian safety by providing a dedicated phase for crossing.

Under the Modified Indirect Left Treatment configuration (no thru access on minor street), the main T-intersections could remain stop controlled and supplemented with a pedestrian hybrid beacon (HAWK) (see Section 6.2.2), or controlled by standard signalization. The Modified Indirect Left Treatment configuration will not address operation deficiencies previously identified if the intersection remains stop controlled. Implementation of a traffic signal at each of the T-intersection will address the operational deficiencies and increase pedestrian safety by providing a dedication two-stage phase for crossing. Application of a standard signal at a T-intersection is shown in **Photo 8**.

Photo 8- Signalized T-Intersection at San Pedro Dr / Haines Ave

CONFIGURATION 4: ROUNDABOUT

Implementation of a roundabout at the 98th Street/Benavidez Road intersection would address operation and safety issues. Vehicular safety would be improved by lowering travel speeds, reducing number of conflict points, and reduce safety implications related to congestion. Pedestrian safety would also benefit from the reduced travel speeds as well as providing accessible paths through the intersection that can be completed in multiple stages. The use of splitter islands in the roundabout configuration would provide pedestrians with refuge area as well as shorten the required crossing distance and improve visibility.

The roundabout treatment would moderately improve driver expectation by reducing the number of intersections. However, it would be an isolated treatment along the corridor. Implementation of a roundabout would require significant roadway reconstruction (**Figure 22**). The northbound and southbound legs of the roundabout configuration can be designed with buffers between the travel lanes and a detailed design would need to be completed to determine if the existing median transmission pole would need to be relocated.

Figure 22 – Roundabout Footprint

6.2.2 MULTI-MODAL ENHANCEMENTS

ENHANCEMENT 1: PEDESTRIAN CONNECTIVITY

Reconstruction/extension of the sidewalk and pedestrian ramps near the intersection to adhere to ADA and PROWAG guidance will result in improved pedestrian facilities, improved visibility at each curb return, and improved connectivity between the previously mention pedestrian attractions. The issues that should be addressed are summarized in **Figure 23** and include the following:

- Extension of sidewalk in the northwest quadrant of the southbound intersection to the striped crosswalk
- Level Landings
- Ramp Slopes
- Detectable Warning Surfaces
- Extension of West Gate Multi-Use Path along the AMAFCA Snow Vista Channel

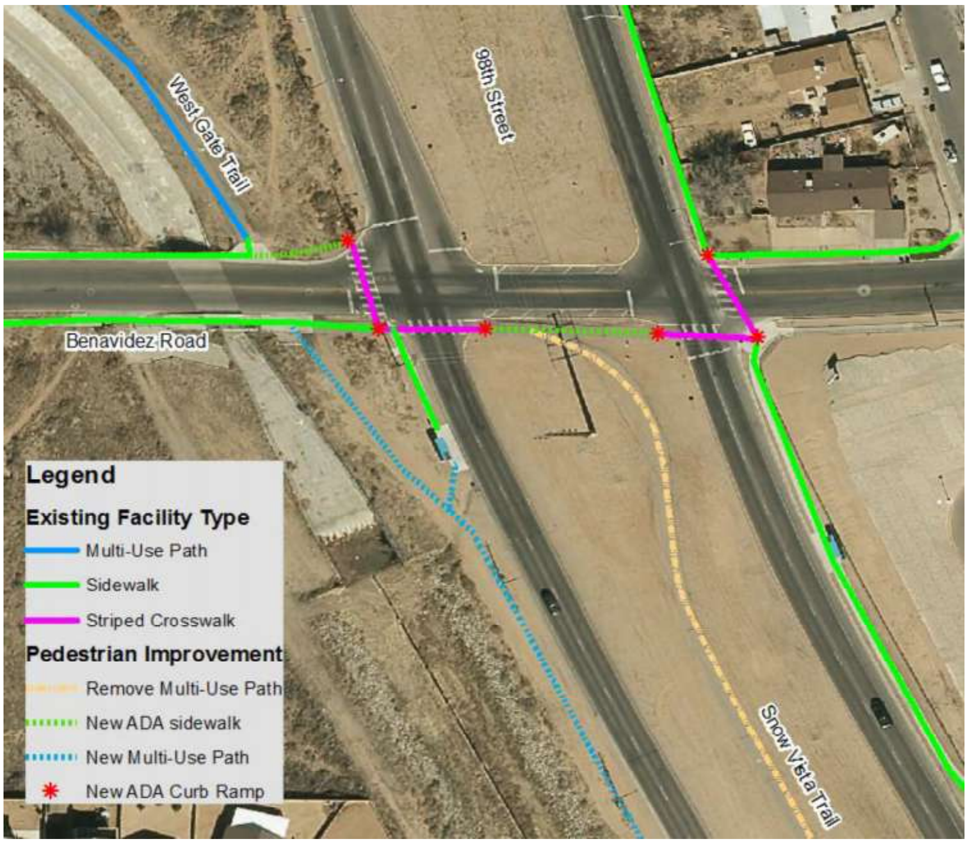

Figure 23 – Pedestrian Improvements

ENHANCEMENT 2: ENHANCED SCHOOL CROSSING WARNING SIGNAGE

As previously stated, the 98th Street/Benavides Road intersection is adjacent to Truman Middle School and connects the West Gate Residential Areas with multiple pedestrian attractions. Given the presence of pedestrians crossing 98th Street, implementation of supplemental school warning signing at the intersection will increase driver awareness and improve multimodal safety. Installation of the School Warning Signing (S1-1) at the intersection would meet MUTCD criteria which recognizes that there is benefit to advise road users that they are approaching a school area, where additional care is needed, even though no school crossing is involved and the speed limits remains unchanged. This would entail