STATE HIGHWAY 16 AT NORTH FM 1560 IN HELOTES, TX

Intersection Improvement Study

March 2008

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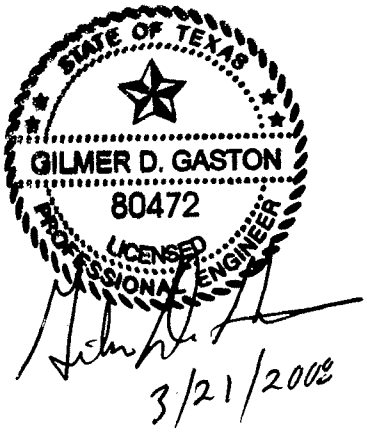

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EXECUTIVE SUMMARY

An Intersection Improvement Study was conducted at the intersection of State Highway 16 (Bandera Road) and Farm-to-Market (FM) 1560 (Galm Road) in Helotes, Texas. In the study area, State Highway 16 primarily runs in a general north/south direction, and FM 1560 runs in an east/west direction. The current alignment of the crossover road (between FM 1560 and State Highway 16), is Circle A Trail. Circle A Trail, which travels in a generally north/south direction, due to its irregular intersection with FM 1560 and the proximity of State Highway 16 results in traffic delays and poses traffic safety issues. This study analyzes the potential re-alignment of FM 1560 near its northern intersection with State Highway 16. Our analyses centered on a proposed alignment plan originally developed by the Texas Department of Transportation (TxDOT). Further development of the concept by was delayed by lack of funding.

This Intersection Improvement Study analyzes the following conditions, primarily under existing, year 2008, traffic volume conditions. We projected traffic volumes to 2013 and the delay values continued to increase; however, proportionally the measures of effectiveness for the three scenarios increase proportionally:

- Existing Conditions
- Mitigated Condition 1
- Mitigated Condition 2

Of the scenarios analyzed, Mitigated Condition 1 is recommended as the best alternative that results in the least amount of traffic delay. It reduces the capacity restriction for northbound State Highway 16 to westbound FM 1560 and maintains the existing, relatively high speed maneuver from eastbound FM 1560 to southbound State Highway 16.

Mitigated Condition 2 can be implemented after Mitigated Condition 1 has been constructed. We anticipate that continuing to allow the relatively high speed maneuvers from eastbound FM 1560 to southbound State Highway 16 is likely to produce undesirable results. In such cases, the

removal of the eastbound right-turn channelized bypass lane at Riggs Road and FM 1560 and the southbound slip-ramp from FM 1560 to State Highway 16 would likely remove high speed traffic from this section of what is currently FM 1560.

This study is not a comprehensive transportation planning study for Helotes, Texas and evaluates only the currently proposed reconfiguration of FM 1560 in the vicinity of State Highway 16. It is intuitive that further widening of FM 1560 to the west by widening the bridge over Helotes Creek will further improve traffic flow along FM 1560. Such a widening project would likely need to extend as far west as west Parrigin Road to maximize its effectiveness.

INTRODUCTION

An Intersection Improvement Study was conducted at the intersection of State Highway 16 (Bandera Road) and Farm-to-Market (FM) 1560 (Galm Road) in Helotes, Texas. In the study area, State Highway 16 primarily runs in a general north/south direction, and FM 1560 runs in an east/west direction. The current alignment of the crossover road (between FM 1560 and State Highway 16), is Circle A Trail. Circle A Trail, which travels in a generally north/south direction, due to its irregular intersection with FM 1560 and the proximity of State Highway 16 results in traffic delays and poses traffic safety issues. This study analyzes the potential re-alignment of FM 1560 near its northern intersection with State Highway 16. Our analyses centered on a proposed alignment plan originally developed by the Texas Department of Transportation (TxDOT). Further development of the concept by was delayed by lack of funding. This Intersection Improvement Study analyzes the following conditions:

- Existing Conditions
- Mitigated Condition 1
- Mitigated Condition 2

Existing turning movement traffic counts were gathered on Tuesday, December 4, 2007. Analysis of the data reveals that the northbound to westbound left-turn volumes from State Highway 16 to FM 1560 are extremely high and range from

- State Highway 16 at Circle A Trail
- FM 1560 at Circle A Trail
- FM 1560 at Riggs Road.

On Tuesday, December 4, 2007 daily traffic volumes were measured on both State Highway 16 and FM 1560 to document the daily traffic volumes. Findings of the daily counts were that State Highway 16 carries 31,500 vehicles per day south of Circle A Trail and carries 19,300 vehicles per day north of Circle A Trail. The counts reveal that FM 1560 is carrying 15,000 vehicles per day just west of State Highway 16.

Turning movement counts were gathered during the AM hours between 7:00 – 9:00 AM and during the PM hours of 4:00 – 6:00 PM. The AM Peak Hour occurs between 7:15 AM to 8:15 AM and the PM Peak Hour occurs between 5:00 PM to 6:00 PM. Detailed peak hour turning movement counts are presented later in the report.

Traffic growth on State Highway 16 and FM 1560 was analyzed over the eight years. Traffic growth values were determined by analyzing historical average daily traffic (ADT) counts obtained from the TxDOT Traffic Maps. Results of this traffic growth analyses are presented in **Table 1** for State Highway 16 and in **Table 2** for FM 1560. As illustrated, traffic growth on State Highway 16, has averaged just over four percent between 2000 and 2005. Traffic growth on FM 1560 has averaged approximately seven percent. While a non-scientific, non-weighted average growth for future conditions was estimated as five percent. While there have been years of tremendous growth in the area, given current economic conditions, those levels are likely to drop to a more sustainable level over the long-term. As such, five percent for future growth was assumed in this report. The existing turning movement counts were projected to 2013 using this value to provide a five-year projection of conditions.

Table 1: Rate of Traffic Growth (State Highway 16)

Location	Year	ADT	Rate of Growth (%)	Growth (%)
State Highway 16	2000	15,200	- -	**4.3%**
	2001	15,600	2.6%	
	2002	15,800	1.3%	
	2003	18,300	15.8%	
	2004	16,300	-10.9%	
	2005	18,340	12.5%	

Table 2: Rate of Traffic Growth (FM 1560)

Location	Year	ADT	Rate of Growth (%)	Growth (%)
FM 1560	2000	4,800	- -	**6.9%**
	2001	4,200	-12.5%	
	2002	5,000	19.0%	
	2003	5,500	10.0%	
	2004	6,300	14.5%	
	2005	6,500	3.2%	

As illustrated in **Figure 1**, Circle A Trail currently allows motorists to access State Highway 16 from FM 1560 and vice versa. There are two types of motorists currently using Circle A Trail: 1) local traffic accessing businesses and/or the fire station on FM 1560, and 2) all through traffic accessing State Highway 16.

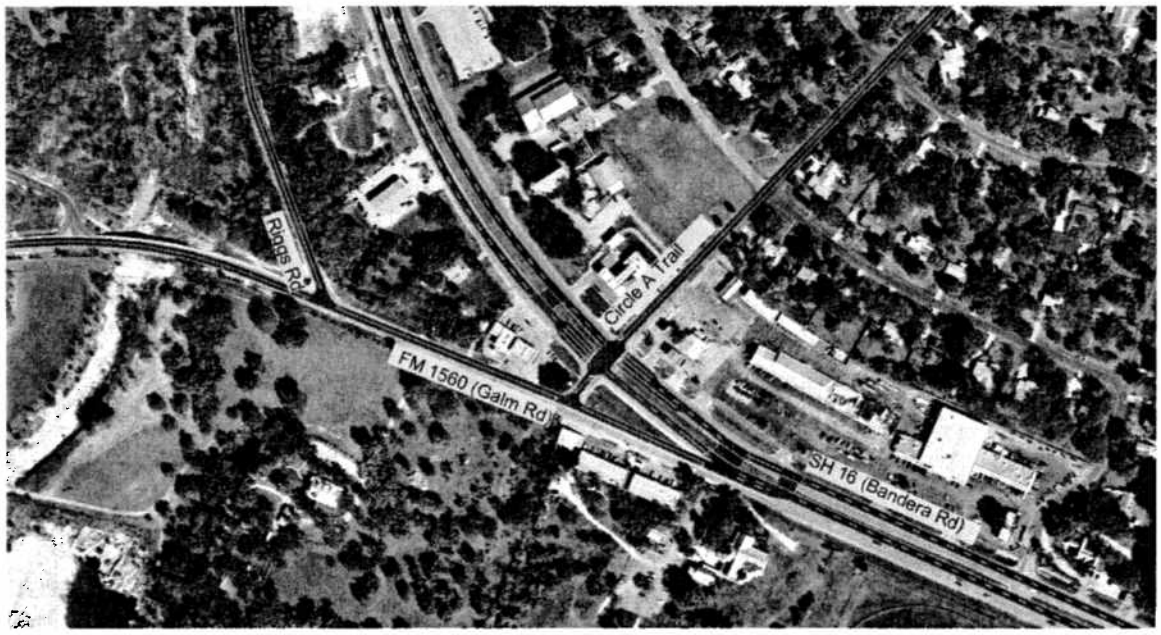


Figure 1: Existing Conditions

Analysis of Existing Conditions was prepared to provide a baseline for comparison of the various improvement alternatives. This simulation includes the existing configuration of State Highway 16, FM 1560, Circle A Trail, and Riggs Road.

The Proposed Conditions scenario analyzes the effects that a new crossover road, located 550 feet north on State Highway 16, will have on traffic in the study area. In this condition, the Circle A Trail crossover would remain open for fire station access and a single left-turn lane would be constructed on State Highway 16. Additionally, motorists traveling eastbound on FM 1560 would continue to utilize a right-turn bypass lane at Riggs Road to travel south on the existing FM 1560 alignment and proceed south on State Highway 16.

Mitigated Condition 1 was simulated to analyze the effects that the new roadway alignment, located 550 feet north on State Highway 16, would have on traffic in the area. This condition differs from the Proposed Conditions by adding a second left turn-lane on northbound State Highway 16 and by having a four-lane undivided road to the bridge crossing Helotes Creek on FM 1560. In the Mitigated Condition 1 simulation, eastbound traffic on FM 1560 requiring access to southbound State Highway 16 continues to use the right-turn bypass lane at Riggs Road and remains on FM 1560 until drivers reach the merge lane at FM 1560/State Highway 16. Eastbound traffic on FM 1560 requiring access to northbound State Highway 16 is directed to the new crossover instead of Circle A Trail.

Mitigated Condition 2 differs from Mitigated Condition 1 by directing all through traffic on FM 1560 to the new crossover. Additionally, at the farthest point east on FM 1560, the merge lane between FM 1560 and State Highway 16 will be removed and the existing FM 1560 in front of the Fire Station will become a low volume roadway providing only local access between the re-aligned FM 1560 and City Hall. The right-turn bypass lane at the intersection of FM 1560 and Riggs Road would be removed to further encourage traffic to access State Highway 16 via the re-aligned FM 1560.

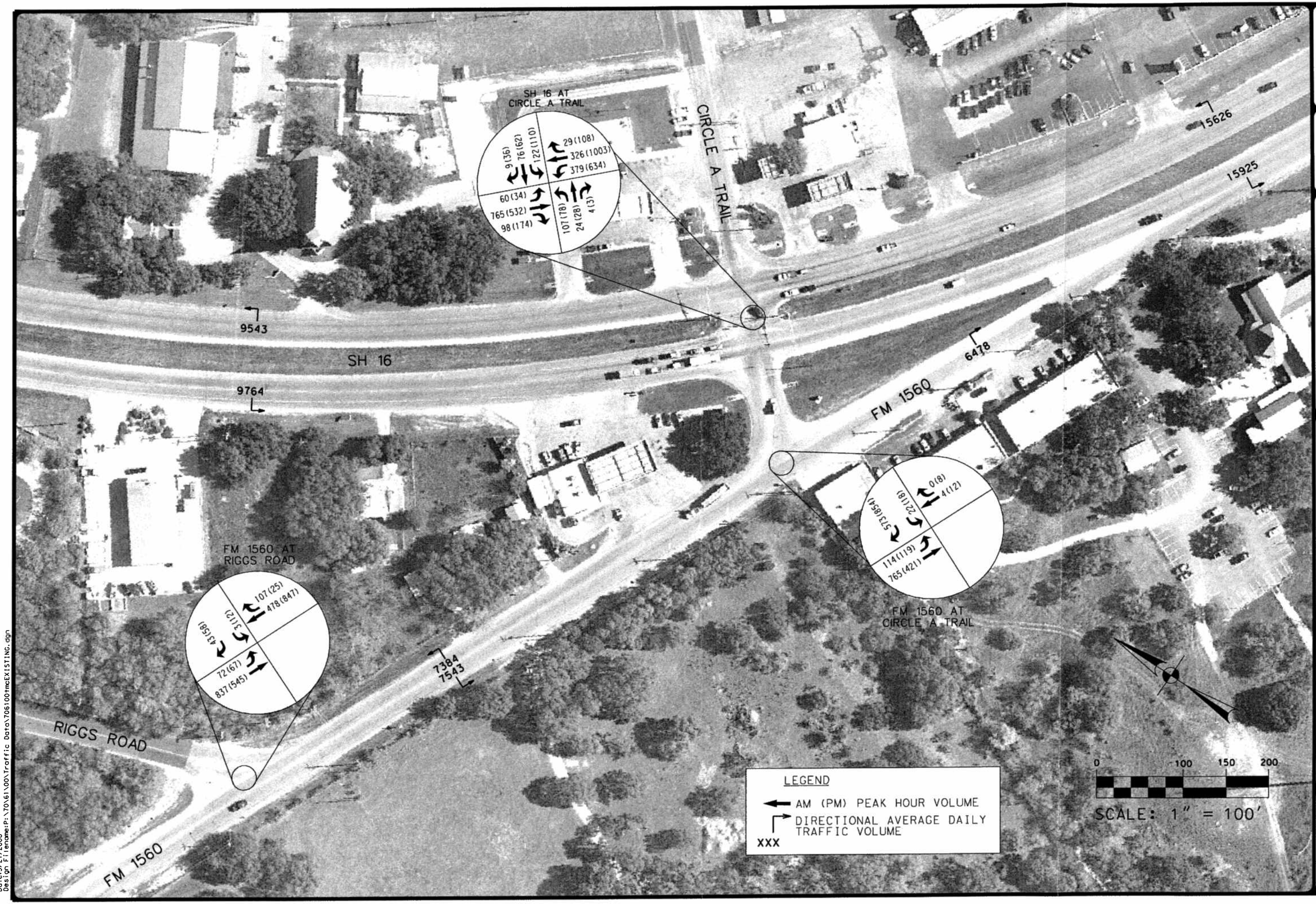
The traffic count data used to evaluate Existing Conditions, Proposed Conditions, and Mitigated Conditions 1 and 2 were performed using *Synchro Version 7*.[1] A total of 10 simulations were performed over 10-minute intervals then averaged for each condition.

[1] Trafficware® LTD. 2006. *Synchro Studio 7, Synchro Plus SimTraffic and 3D Viewer*. Sugar Land, Texas.

Figure 2 illustrates the Average Daily Traffic (ADT) and Turning Movement Count (TMC) data gathered on December 4, 2007. As illustrated in Figure 2, the northbound left-turn from State Highway 16 to the existing FM 1560 includes 379 vehicles per hour during the am peak hour and 634 vehicles per hour during the pm peak hour. Anytime a left-turn volume is greater than 200 vehicles per hour, dual left-turn lanes should be considered. When left-turn volumes exceed 300 vehicles per hour, it is a certainty that dual left-turn lanes are needed to improve signalized intersection operations. The volumes on Circle A Trail on the east side of State Highway 16 appear to be high enough to warrant the need for a traffic signal at State Highway 16 and Circle A Trail, even without the traffic from FM 1560.

At Riggs Road and FM 1560, there are a total of 46 vehicles per hour turning onto FM 1560 during the am peak hour (7:15-8:15) and a total of 70 vehicles per hour turning onto FM 1560 during the pm peak hour (5:00-6:00). The overwhelming majority (87%) of traffic on Riggs makes a right turn. A review of the am and pm traffic volumes on FM 1560 at Riggs Road illustrates a very heavily directional traffic pattern that clearly shows higher volumes of traffic, 837 vehicles per hour, during the am peak hour and a corresponding westbound volume of 847 vehicles per hour during the pm peak hour.

Figures 3 and 4 illustrate the vehicle turning movements projected for the two mitigated conditions and represent the traffic volumes modeled in the detailed simulation analyses. These projections move the various turning movements from the existing intersection to the future roadway.



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SH 16 AND FM 1560
FIGURE 2 - TMC AND ADT DATA
EXISTING CONDITIONS

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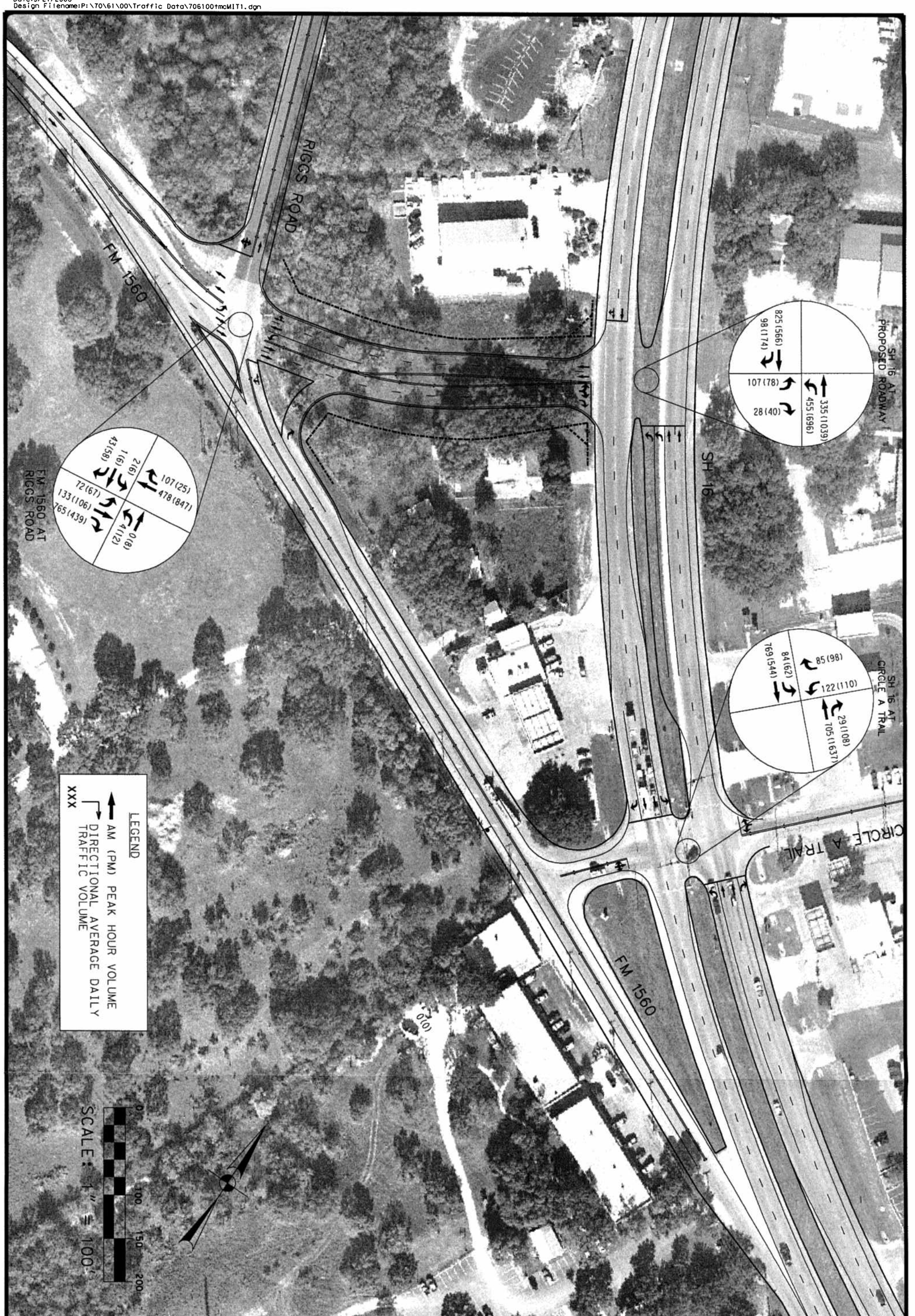

SH 16 AND FM 1560
FIGURE 3 - TMC AND ADT DATA
MITIGATED CONDITION 1

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SH 16 AND FM 1560
FIGURE 4 - TMC AND ADT DATA
MITIGATED CONDITION 2

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EXISTING CONDITIONS

Results from the traffic count data show that Circle A Trail is heavily used by motorists traveling northbound on State Highway 16 to access FM 1560. In its current condition, the Circle A Trail crossover presents several problems. The alignment of the roadway, as seen in **Figure 1**, requires motorists traveling on Circle A Trail to make an s-curve maneuver to turn onto westbound FM 1560. Due to the existing roadway widths, one vehicle turning left from FM 1560 onto Circle A Trail, or turning left from Circle A Trail onto FM 1560 can create serious queuing that poses a potential safety hazard. This crossover raises safety concerns because motorists on Circle A Trail must yield to traffic on FM 1560 causing traffic to backup onto State Highway 16. In addition, there is inadequate storage on the Circle A Trail crossover. These delays and safety issues are major concerns for motorists.

SimTraffic 7 estimates the total AM network delay to be 9.2 hours, and the total PM network delay to be 12.8 hours, as shown in **Table 3**.

Table 3: Existing Conditions of Network

	AM Existing	PM Existing
Total Delay (hr)	**9.2**	**12.8**
Delay/Veh (sec)	71.2	86.2
Travel Dist (mi)	362.7	416.0
Average Speed (mph)	20	18

PROPOSED CONDITIONS

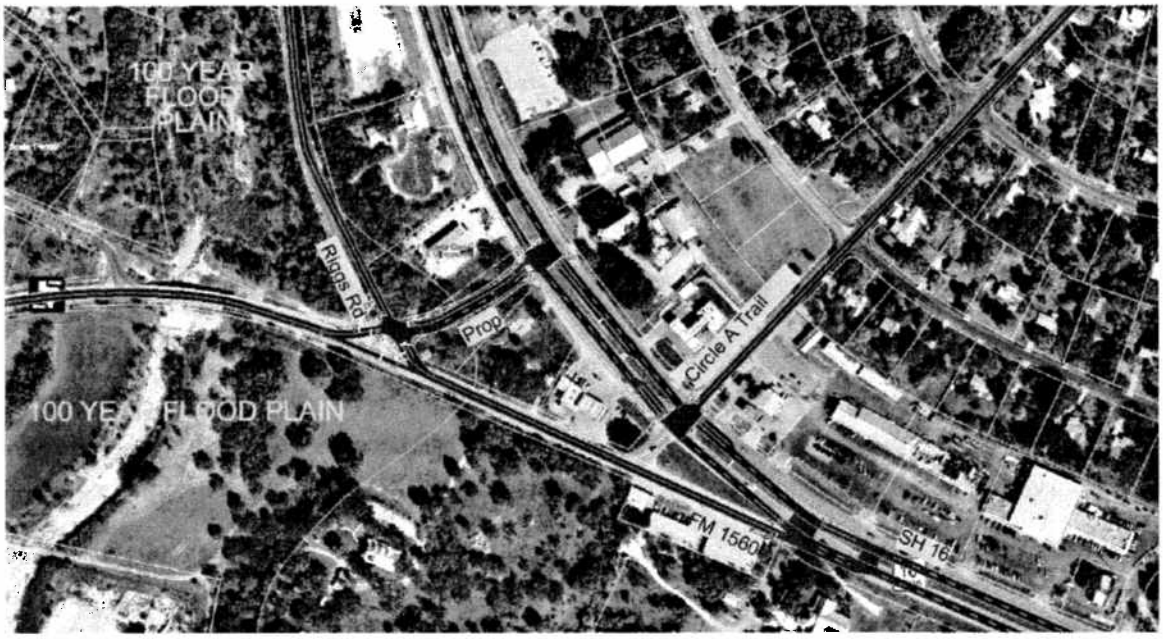

Figure 5: Proposed Conditions

Figure 5 shows the roadway design under Proposed Conditions. In this condition, the Circle A Trail crossover would be closed to through traffic via a gate for emergency vehicle use only and a left-turn lane would be constructed on State Highway 16, farther north of its current location. In addition, a proposed bypass lane at the Riggs Road and FM 1560 intersection allows motorists from FM 1560 to easily enter onto State Highway 16. Traffic delay is significantly reduced from Existing Conditions under this scenario. *SimTraffic 7* estimates the total AM network delay to be 5.5 hours and the total PM network delay to be 6.5 hours, as shown in **Table 4**.

Table 4: Proposed Conditions of Network

	AM PROPOSED	PM PROPOSED
Total Delay (hr)	**5.5**	**6.5**
Delay/Veh (sec)	40.0	41.5
Travel Dist (mi)	318.2	362.0
Average Speed (mph)	23	23

MITIGATED CONDITION 1

Figure 6 shows the roadway design under Mitigated Condition 1. In this scenario, the existing Circle A Trail crossover remains but is limited to local FM 1560 traffic only. The bypass lane on FM 1560 at Riggs Road would remain from the Proposed Conditions scenario. Additionally, a dual left-turn lane would be constructed on northbound State Highway 16. The proposed crossover would consist of four 12-foot lanes with a 2-foot shoulder and dedicated left-turn lanes at the Riggs Road intersection. The four-lane section would merge into a two-lane section prior to the bridge west of Riggs Road. On eastbound FM 1560, prior to the Helotes Fire Department, a flashing beacon would be installed to warn motorists of the fire station.

The simulation for this scenario was generated by directing eastbound FM 1560 traffic wanting to gain access to southbound State Highway 16 through the Riggs Road/FM 1560 bypass lane and using the FM 1560/State Highway 16 merge lane. Traffic traveling northbound on State Highway 16 accessing westbound FM 1560 can use the proposed roadway.

SimTraffic 7 estimates the total AM network delay to be 4.0 hours and the PM network delay to be 5.6 hours, as shown in **Table 5**.

Table 5: Mitigated Condition 1 of Network

	AM MITIGATED 1	PM MITIGATED 1
Total Delay (hr)	**4.0**	**5.6**
Delay/Veh (sec)	29.7	35.2
Travel Dist (mi)	342	364.2
Average Speed (mph)	26	24

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SH 16 AND FM 1560
FIGURE 6 - MITIGATED CONDITION 1

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MITIGATED CONDITION 2

Figure 7 shows the roadway design under Mitigated Condition 2. Mitigated Condition 2 differs from Mitigated Condition 1 by removing the bypass lane at FM 1560 and Riggs Road. Additionally, the FM 1560/State Highway 16 merge lane would be removed. All traffic in this simulation was directed along the proposed roadway. Removal of the southbound merge ramp and requiring all eastbound FM 1560 traffic traveling to southbound State Highway 16 to travel through the new traffic signal at State Highway 16 & FM 1560 (re-aligned) and the existing traffic signal at State Highway 16 & Circle A Trail, thereby leading to slightly higher vehicles delays for Mitigated Condition 2 over Mitigated Condition 1.

SimTraffic 7 estimates the total AM network delay to be 5.4 hours and the total PM network delay to be 5.8 hours, as shown in **Table 6**.

Table 6: Mitigated Condition 2 of Network

	AM MITIGATED 2	PM MITIGATED 2
Total Delay (hr)	**5.4**	**5.8**
Delay/Veh (sec)	39.5	35.4
Travel Dist (mi)	319.6	375.9
Average Speed (mph)	23	24

The removal of the bypass lane at Riggs Road and FM 1560 in Mitigated Condition 2 eliminates the possibility for high speed collisions at this location. Similarly, high speed collisions can be eliminated by removing the merge lane at eastbound FM 1560 and southbound State Highway 16. Overall delay is reduced from Existing and Proposed Conditions.

INTERSECTION LEVEL OF SERVICE

Capacity analyses were conducted at each intersection. Capacity analyses are presented in standard Level of Service (LOS) format. Level of service refers to the operational conditions within a traffic stream and their perception by motorist in terms of delay, freedom to maneuver, traffic interruptions, comfort, convenience, and safety. Level of service is designated from "A" to "F" with "A" representing the best traffic conditions and least delay, while "F" represents poor conditions and the highest delay. Evaluation of the peak hour capacity for each intersection and scenario were performed using *Synchro Version 7*.[2]

Level of Service (LOS) at unsignalized intersections is determined by the average delay a vehicle experiences on each intersection approach. Therefore, a different level of service is reported for each approach. The general characteristics associated with each level of service for unsignalized intersections are presented in **Table 8**.

Table 7: Highway Capacity Manual Level of Service at Unsignalized Intersections

Level of Service	Average Intersection Delay (sec/veh)	Description
A	≤ 10	Little or no delay
B	> 10 and ≤ 15	Short traffic delay
C	>15 and ≤ 25	Average traffic delay
D	> 25 and ≤ 35	Long traffic delay
E	>35 and ≤ 50	Very long traffic delay
F	> 50	Extreme delays, possibly severe congestion

Level of service at signalized intersections is determined by the average vehicle delay. Values can be reported for the intersection as a whole or each individual movement. For purposes of analysis, summary intersection level-of-service values are reported. The general characteristics

[2] Trafficware® Ltd. 2006. *Synchro Studio 7, Synchro Plus SimTraffic and 3D Viewer*. Sugar Land, Texas.

associated with each level of service for signalized intersections are presented in **Table 9**. Most agencies consider level of service D to be the minimum acceptable level of service for a signalized intersection.

Table 8: Level of Service at Signalized Intersections

Level of Service	Average Intersection Delay (sec/veh)	Description
A	≤ 10	No delays at intersection, smooth progression of traffic. Uncongested operations. All vehicles clear in a single signal cycle.
B	> 10 and ≤ 20	No delays at intersection, smooth progression of traffic. Uncongested operations. All vehicles clear in a single signal cycle.
C	> 20 and ≤ 35	Moderate delay, satisfactory to good progression of traffic. Light congestion, occasional backups on critical (high volume) approaches.
D	> 35 and ≤ 55	Little or no progression of traffic along the roadway with a high probability of stopping at signalized intersections operating at this level of service. Significant congestion on critical approaches, but intersection is functional. Vehicles required to wait through more than one cycle during short peak periods.
E	> 55 and ≤ 80	Heavy traffic flow conditions. Delays of two or more traffic signal cycles probably. No progression may occur if signal does not provide for protected turning movements.
F	> 80	Unstable traffic flow. Heavy congestion. Traffic moves in forced flow condition. Three or more cycles required to pass intersection. Total breakdown with stop and go conditions.
*	$>> 80$	Very unstable traffic flow. Very heavy congestion. Traffic moves in forced flow condition. More than three cycles required to pass intersection. Total breakdown. Stop and go only. Delays are beyond the range of the *Highway Capacity Manual* equations. Represents an extreme level of over saturation.

The AM Peak hour levels of service for each intersection and study condition are presented in **Table 9**. This table indicates that State Highway 16 at Circle A Trail currently operates at a Level of Service (LOS) E during the AM Peak hour and with a realignment of FM 1560, the

intersection is projected to operate at a level of service B, representing a significant improvement. The proposed intersection of State Highway 16 at the realigned FM 1560 will operate at a level of service C during AM Peak Hour and a LOS D under Mitigated Condition 2. This degradation in LOS is the result of the AM peak hour southbound traffic being routed through the intersection versus traveling south along the existing FM 1560. The existing intersection of Riggs Road at FM 1560 operates at a LOS of C during am peak hour that condition will range from LOS B for the southbound approach or C or E for the northbound approach under the mitigated scenarios.

Table 9: Level of Service For Key Intersections (AM Peak Hour)

	SH 16/Circle A Trail (TS)	SH 16/Proposed Roadway (TS)	Riggs Road/FM 1560 (TWSC)
Existing Condition	E	N/A	C(Southbound)
Mitigated Condition 1	B	C	C (Northbound) B (Southbound)
Mitigated Condition 2	B	D	E (Northbound) B (Southbound)

As indicated in **Table 10**, the PM Peak hour analysis indicates that the existing intersection of State Highway 16 at Circle A Trail operates at LOS E during the PM peak hour and this condition will further improve to LOS B under either roadway re-alignment scenario. The new intersection of State Highway 16 at the re-aligned FM 1560 will function at a respectable LOS of C during the pm peak hour. The Riggs Road FM 1560 intersection which currently operates at LOS D during the PM peak will operate at LOS C and E under either mitigated condition.

Table 10: Level of Service For Key Intersections (PM Peak Hour)

	SH 16/Circle A Trail (TS)	SH 16/Proposed Roadway (TS)	Riggs Road/FM 1560 (TWSC)
Existing Condition	E	N/A	D (Southbound)
Mitigated Condition 1	B	C	D (Northbound) C (Southbound)
Mitigated Condition 2	B	C	E (Northbound) C (Southbound)

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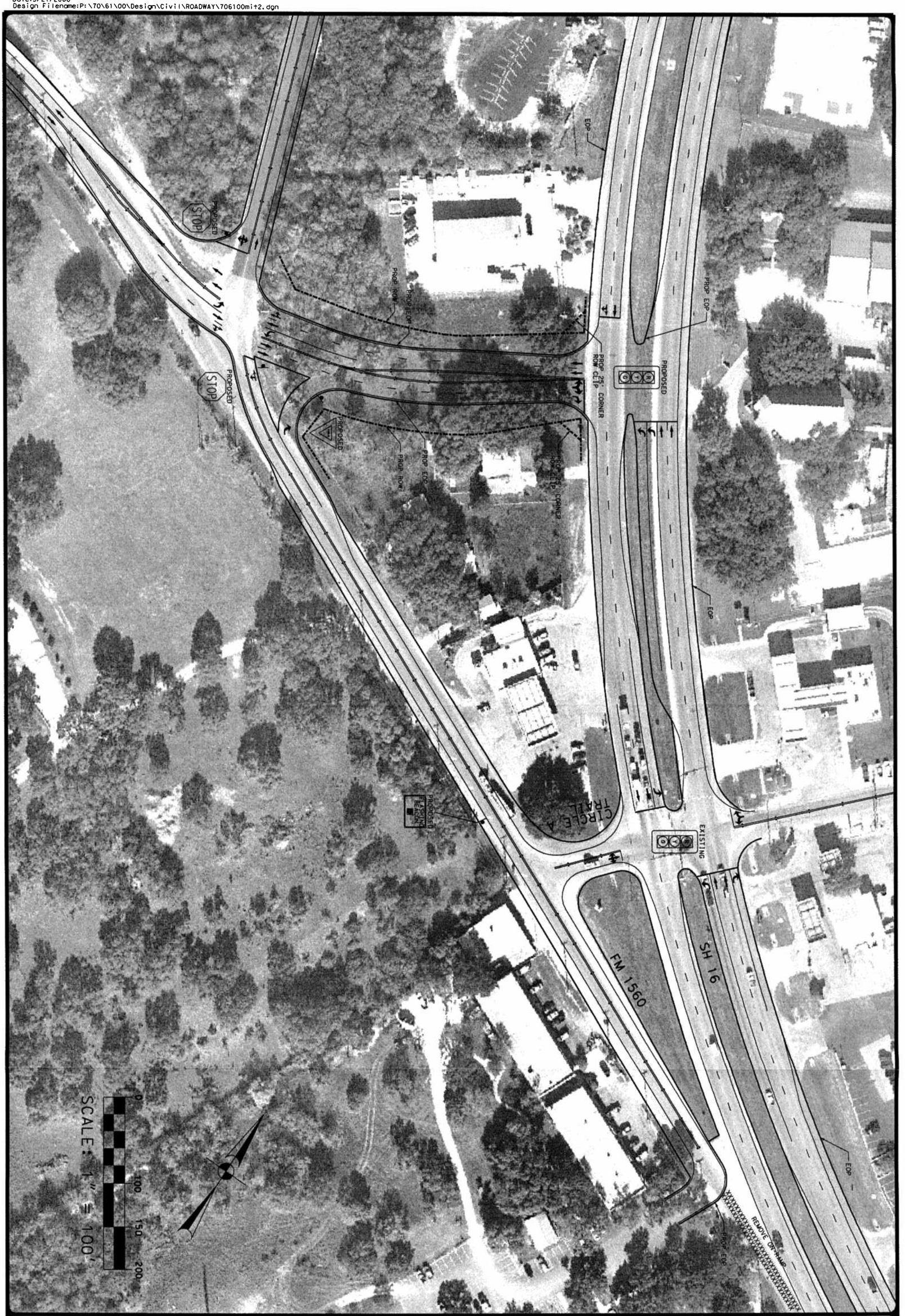

SH 16 AND FM 1560
FIGURE 7 - MITIGATED CONDITION 2

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OPINION OF PROBABLE CONSTRUCTION COSTS

Detailed opinions of probably construction costs are presented in **Table 11** shows the break down of cost by each proposed condition. All scenarios are for construction cost only and include a twenty percent contingency. As illustrated, both mitigation scenarios are projected to cost approximately one million dollars. These values do not include any right-of-way acquisition or engineering do not include engineering costs. Since the Texas Department of Transportation may fund the design costs, that could be an item that is handled by TxDOT. Engineering costs, if not provided by TxDOT will likely range from ten to fifteen percent of the construction costs.

Table 11: Opinion of Probable Construction Costs

Condition	Probable Cost
Existing Conditions	**$0**
Proposed Conditions	**$803,000**
Mitigated Condition 1	**$1,015,000**
Mitigated Condition 2	**$1,041,000**

A detailed breakdown of the costs for each condition is presented in the Appendix. Each of the proposed construction costs assumes signalization of the re-aligned FM 1560 at State Highway 16 and the construction of water pollution abatement prevention (WPAP) basin to treat run-off from the new roadway. The costs of Mitigation Condition 2 are slightly higher than the costs for Mitigation Condition 1 due to the pavement removal costs and additional signing and striping that are expected to be required to close the existing FM 1560 southbound ramp to State Highway 16.

CONCLUSIONS AND RECOMMENDATIONS

Of the scenarios analyzed, Mitigated Condition 1 is recommended as the best alternative that results in the least amount of traffic delay. It reduces the capacity restriction for northbound State Highway 16 to westbound FM 1560 and maintains the existing, relatively high speed maneuver from eastbound FM 1560 to southbound State Highway 16.

Mitigated Condition 2 can be implemented after Mitigated Condition 1 has been constructed. We anticipate that continuing to allow the relatively high speed maneuvers from eastbound FM 1560 to southbound State Highway 16 is likely to produce undesirable results. In such cases, the removal of the eastbound right-turn channelized bypass lane at Riggs Road and FM 1560 and the southbound slip-ramp from FM 1560 to State Highway 16 would likely remove high speed traffic from this section of what is currently FM 1560.

This study is not a comprehensive transportation planning study for Helotes, Texas and evaluates only the currently proposed reconfiguration of FM 1560 in the vicinity of State Highway 16. It is intuitive that further widening of FM 1560 to the west by widening the bridge over Helotes Creek will further improve traffic flow along FM 1560 the roadway should be widened all the way to Parrigin Road, approximately 2,500 feet west of Riggs Road.

Riggs Road at FM 1560 will operate at a reasonable level of service during the am and pm peak hours under the analysis scenarios. Its current proximity to State Highway 16 does not make it a good candidate for signalization; however the proposed signalization of FM 1560 at Antonio Drive will likely result in a greater number of gaps in the flow of traffic along FM 1560 thereby negating the potential need for additional traffic control at this intersection. It is projected that Riggs Road will be operated with stop sign control on Riggs Road and no control on FM 1560.

Due to the reduction in traffic delay, the cost to construct Mitigated Condition 1 can be justified over 4 years. During the AM peak hours, up to a 30-hour reduction in delay can be achieved and up to 36 hours during the PM peak hours. Over the course of one year, these reductions translate

to 17,160 hours in delay that is eliminated. At $13.50 per hour of delay, an annual savings of approximately $230,000 is generated during AM and PM peak hours under Existing Conditions. This cost-savings benefit could be even greater if non-peak weekday hours and weekends are taken into consideration.