SOUTHLAKE

TEXAS

Traffic Engineering Study for Automated Enforcement

Southlake Blvd. (FM 1709) At Carroll, Davis (FM1938), and Kimball.

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Introduction

The Texas Legislature passed SB 1119 which became effective on September 1, 2007. This bill authorizes and controls the use of municipal red-light camera enforcement and was codified in the Texas Transportation Code, Section 707.003. This statute requires the completion of a traffic engineering study to validate the need and applicability of red-light camera enforcement and forms the basis for this report.

The City of Southlake, Texas has proposed the use of red-light cameras at several intersections within their jurisdiction. These intersections were proposed after an initial vetting process by the City's Law Enforcement staff. This study was commissioned by the City of Southlake, Texas to fulfill the requirements of the Texas statute.

The Texas statute requires an engineering study to evaluate engineering solutions that may be implemented to reduce the occurrence of driving violations for the red-light running. These solutions can involve geometric, signal hardware or timing improvements. Automated enforcement is a proven method that uses photography, and technology to detect, photograph and then a civil citation is issued to the violator.

The problem of red-light running is widespread and growing in Texas. State and municipal agencies have implemented numerous solutions to prevent and reduce these violations. The traditional three "E's" are typically used—engineering, enforcement and education. The media has helped educate the public about the consequences of red-light running as automated enforcement systems have been installed in Texas. Signing photographic enforcement at an intersection is one of the countermeasures that address all of the three "E's". However all of these techniques have the same goal to reduce crashes, injuries and save lives.

The use of red-light cameras for enforcement has been researched in the United States and abroad for many years, and recent studies in the United States indicate several interesting phenomena that accompany the application of red-light cameras.

It is intuitive that a reduction in red-light running will reduce traffic crashes and improve safety. Based on this assumption, a number of municipalities and state transportation agencies have begun programs to try to reduce red-light running using a variety of methods. One such method is using red-light cameras as an enforcement tool. The use of red-light cameras is common in much of the world and both the technology and impetus to use that technology has been available since the 1970's. This technology has evolved from wet film to the current digital and video systems in use today.

Texas Attorney General, John Cornyn, issued a ruling indicating that cities could implement photographic enforcement by their home rule authority. Several cities, such as Richardson, Garland and Plano proceeded with systems on this authority. The state then passed SB 1119 which sets forth specific requirements for the automated enforcement systems.

In a June, 2006 opinion, Texas Attorney General Greg Abbott issued Opinion GA 0440 indicating that TxDOT has the authority to install these systems on state highways.

Legislative Issues

The Texas State Legislature recently passed Senate Bill 1119, which became effective September 1, 2007. This bill created Chapter 707 of the Transportation Code, entitled "Photographic Traffic Enforcement System" and amends Subtitle I, Title 7. The act authorizes local authorities to enact ordinances that require civil penalties based on photographic signal enforcement systems. It provides that the owner of a motor vehicle is liable to the local authority for such civil (not criminal as a police citation) penalty if the vehicle violates the instructions of the traffic control signal.

It further authorizes the local authority to implement and operate a photographic enforcement system or contract for the implementation and operation of a system. It requires that the local authority conduct a traffic engineering study of each candidate approach for camera enforcement to determine if alternatives to the system are likely to reduce the number of red-light violations at the intersection.

The Act requires that the results of the traffic engineering study be reported to a citizen advisory committee established for that purpose and that the committee advise the local

authority on the installation and operation of the system. The bill further requires that the local authority install signs along each roadway that leads to an intersection at which the camera enforcement system is in active use.

The local authority is required, before installing the system, to compile a written report of the number and type of traffic accidents that have occurred at the intersection for at least 18 months prior to the date of the report. The statute also requires that the local authority submit to the Texas Department of Transportation (TxDOT) a copy of that report within six months of the implementation of that system. The local authority is further required to monitor and report to TxDOT the number and type of traffic accidents at each intersection to determine whether or not the system results in a reduction in accidents or a reduction in the severity of accidents. The report to TxDOT shall be in writing and according to a form prescribed by TxDOT. TxDOT has developed an on line reporting system for municipalities in 2008.

The Act specifically requires that signals subject to camera enforcement will have a change interval (yellow plus all red) that meets the requirements of the Texas Manual on Uniform Traffic Control Devices (TMUTCD). General surveillance using the system is prohibited so that only violations of the traffic signal are photographed. Normal police enforcement measures at traffic signals are not precluded.

The statute provides for revenue sharing from the collections of civil penalties with the local authority to retain an amount necessary to cover certain costs. Fifty percent of the additional revenue is to be sent to the State comptroller for deposit to the credit of the regional trauma account. It also caps the amount of civil penalty at $75 and late payment penalty of not greater than $25. The retained portion of the civil penalties over and above the costs must be spent to cover certain procedures for administration of the program of enforcement.

The Texas Transportation Code and the Texas Manual on Uniform Traffic Control Devices (TMUTCD) give guidelines and standards for traffic signals. The TMUTCD Chapter 4 is the accepted national and state guideline for traffic signals. It is important that the nation have uniform standards for traffic signals. Drivers constantly cross state and national boundaries and this universal communication to the driver is imperative for the safety of our communities. It is universally known that red means STOP. If other

colors were used, drivers would be confused by the need to stop. Simply this report will review these universal standards to determine if they are met and/or any enhanced solutions may be needed prior to the implementation of the automated enforcement. The purpose of these enhanced solutions would be to reduce the frequency of red-light running.

Some of the guidelines are recommended and may not be implemented. However, they have a direct relationship to red-light running. An example of this is the size of the signal head and light. Eight - inch heads are common throughout the state of Texas and the Dallas/Fort Worth Metroplex. However, twelve inch signal heads are also used. The larger, brighter red lights have been shown to reduce the occurrence of red-light running. Some of these engineering solutions are easy and cost effective to implement.

Without the enforcement or threat of enforcement, these "traffic laws" or engineering standards would not be at all achieved. They would be consistently or frequently violated. Enforcement is the key to ensure that they are obeyed. However, with the over-worked enforcement agencies in Texas, it is difficult to have enough visibility to ensure compliance. Automated enforcement is a mechanical method, reviewed by authorized police agencies that operate 24 hours a day, 365 days a year. Studies have also indicated that there is a halo effect on other intersections. The goal of this enforcement is to improve safety and prevent crashes by reducing the number of red-light violators. Other Metroplex cities have demonstrated that a reduction in violations occurs as they have turned off their cameras at some intersections and the number of monthly violations is reduced.

Traffic Engineering Study

The purpose of this report is to conduct a traffic engineering investigation to analyze the potential engineering solutions to prevent red-light running. This report will analyze the intersections to insure that the locations meet the requirements of the Texas Manual on Uniform Traffic Control Devices. There are also several countermeasures which can be implemented to accomplish this goal. This will be a comprehensive evaluation of the intersections to observe the frequency of red-light running and recommend the appropriate countermeasures to reduce this frequency. The following items are reviewed in this investigation:

- clear view of the traffic signal heads - this will ensure that the motorist can observe the red-yellow-green indications from an appropriate distance from all of the approaches
- traffic signal timing - this will ensure that the overall traffic signal is timed appropriately
- yellow clearance interval - this will ensure that the motorist has the approaching indication based on intersection geometric system is made aware that the red light is about to start
- all red clearance interval – a time period to insure that the motorists can completely clear the intersection prior to the opposing green indication
- traffic signal loops - to determine the functionality of the loop detection and ensure where appropriate a green extension is used where needed
- signal progression plan review - to ensure that the Que is not being clipped and is forcing unexpected stops
- pavement markings - to ensure the adequate markings are in place including stop bars
- intersection signing - to ensure that appropriate signs are in place at these locations
- urban distractions - any review of the area around the location to ensure nothing uniquely distracts the motorist

Red- Light Running Solutions

There are many engineering enhancements that may be implemented to reduce the occurrence of red-light running. Some of these solutions are simple and cost effective; although in most cases these are enhancements to the standard installation. Some of these solutions include:

- back plates - the use of black back plates increases the target value of a traffic signal head especially at times when the sun is directly behind the traffic signal lights.
- LED signal lights - these lights are 40% brighter than incandescent lights; a bigger brighter light will reduce the occurrence of red-light running.
- All red and yellow clearance times - these times are set by an engineering analysis of the intersection geometric and speed. These guidelines are highlighted below.

There are several other factors that need to be considered such as intersection geometrics, capacity, visibility, number of lanes, and intersection warrants.

Traffic Signal Timing

A key element relating to traffic signals is the signal timing. The timing falls into four categories.

1. Green time -- the amount time given to thru or turning traffic
2. Yellow time – the amount of time between the green and red intervals
3. Red time -- the amount of time the opposing traffic is stopped
4. All red time -- the amount of time all approaches are stopped

The timing of the traffic signals depends on many factors including volume, approach speed, intersection geometry, and vehicle detection. The critical time period is called the Clearance Interval: this is made up of the yellow and all red time. The state guidelines indicate that this time must be in conformance with the Texas Manual on Uniform Traffic and Control Devices. Detailed timing is calculated using guidelines from the Institute of Transportation Engineers (ITE). This agency gives precise engineering formulas to calculate the Clearance Interval. The TxDOT recommended method is to use the ITE formulas. Signal timing for each intersection should be monitored and adjusted as changes in volumes or geometric conditions occur.

Southlake Blvd. (FM 1709) @ Randol Mill Ave. / Davis Blvd. (FM1938)

Northbound Automated Enforcement

Intersection Configuration

Southlake Blvd. (FM 1709) is a 6 lane east-west arterial road with a continuous left-turn lane, generally in a 130 foot right-of way. As a farm-to-market road, it is maintained by the Texas Department of Transportation (TxDOT). Generally these types of roads are designed to carry large traffic volumes which have a long trip length. The development along the corridor is generally commercial and single family. The roadway connects several cities together in North Tarrant County. Randol Mill Ave. / Davis Blvd. (FM 1938) is also an arterial road. The roadway is typical of an urban type of construction. A photograph of these roadways is shown below in Figure R-1.

Figure R-1 FM 1709 at Randol Mill Ave. / Davis Blvd.

FM 1709 has an approach speed of 45mph which seems appropriate for this road. Randol Mill Ave. / Davis Blvd. has a speed of 35mph.

Traffic Volumes

Southlake Blvd. is handling a moderate amount of traffic. Daily traffic counts in the eastbound direction are 18,800 and in the westbound direction are 17,700. This daily average of 35,500 vehicles per day is less than the design roadway capacity of 42,000 - 48,000 vehicles per day. Randol Mill Ave. / Davis Blvd traffic is considerably less; the daily volume is NB 14,500 and SB 17,100 with the capacity of 38,000 south of the intersection and 8, 000 (both directions) north of the intersection.

Peak (Am &PM) hour traffic is the critical volume throughout the day. This intersection still has plenty of extra capacity to handle future traffic growth. The configuration shown above with 3 thru lanes and left turn lane on Southlake Lake Blvd. provide an acceptable Level-of Service even in the peak hours (AM & PM).The north bound approach is the critical direction with 3 lanes: left, left - thru, and right turn lane.

Crash Data

Although we strive to have zero crashes at an intersection, due to human factors it is highly improbable. Many factors contribute to a crash. Any analysis of the intersection crash data will allow engineers to determine what factors caused these crashes. Generally driver error or inattention is a contributing factor to most crashes. By ensuring that traffic control devices are communicating appropriately to the driver, crashes can be minimized through these engineering solutions. Enforcement is another key element to ensure drivers obey the traffic laws. A combination of education, engineering and enforcement are key elements in reducing crashes. The following table summarizes the crash data for this intersection:

Reported Crash Data Summary *

Year	FM 1709 Randol Mill Ave. / Davis Blvd	FM 1709 Randol Mill Ave. / Davis Blvd
	Total	Red - Light Running**
2007	11	2
2006	11	6
2005	6	2
2004	6	3

*Reported by the Southlake Police Dept.
**Cause factors 15, 37, and 38

Crash data should be carefully used. Not all crashes are reported, as many cities do not even investigate non-injury crashes. Many crashes are also minor and just driven away by the drivers. However, crash data is still a valuable tool to indicate overall intersection safety.

Traffic Signal

The traffic signal at the intersection is of a modern design. This includes functions to detect oncoming traffic and extend green times appropriately. The signal operates a split phase configuration. East and westbound traffic goes simultaneously with a separate protected east and westbound left turn phase. The north and southbound movements do not occur simultaneously. The EB/WB turning movements may also occur on a green ball. The video detection is designed to allow for the left turn phases if required. The green time for each phase is adjusted according to the volume of oncoming traffic based on the video detection. The north bound traffic signal indications are Figures R-3 and R-4.

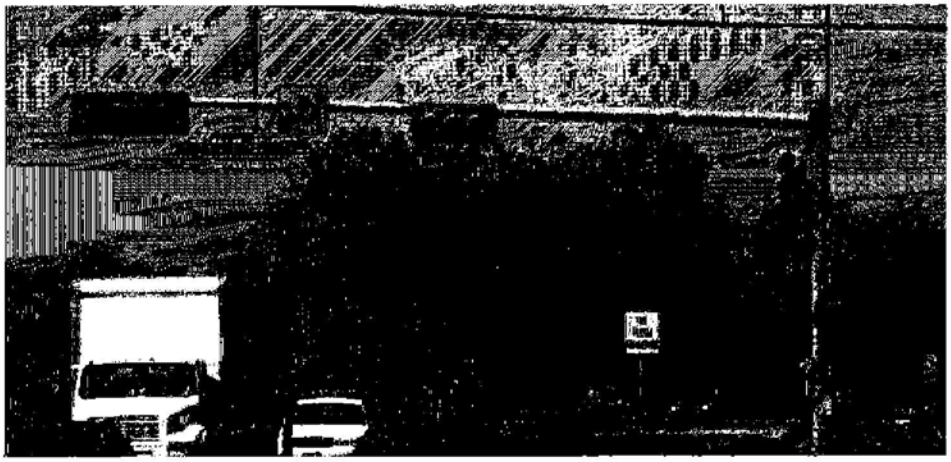

Figure R-3 Northbound approach

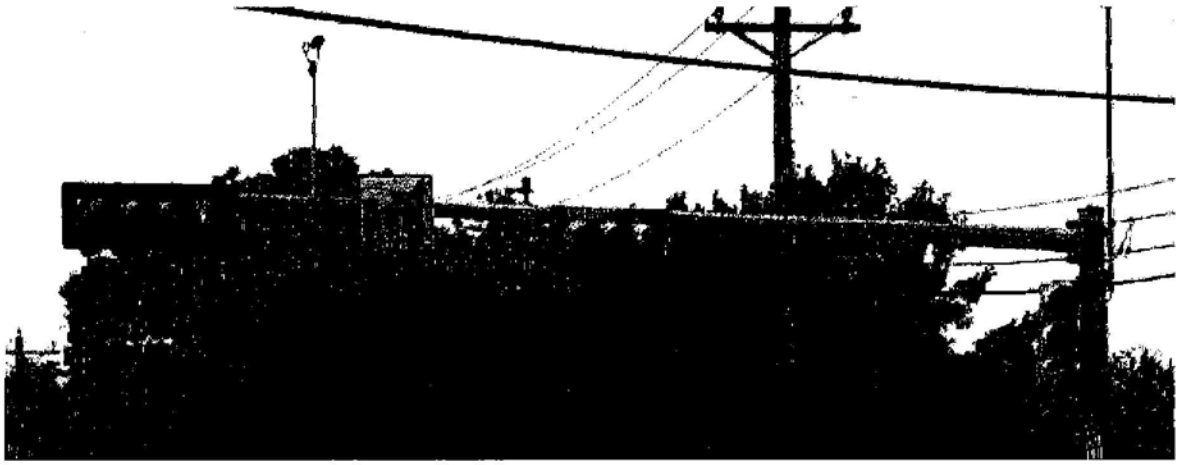

Figure R-4 Northbound approach

Traffic Signal Visibility

As can be seen by the above photographs; the visibility of the signal indications is good. The vehicle detection system at this location is a video detector mounted on top of the mast arm. This type of detection system has a good record of detecting approaching vehicles and extending the green times as appropriate. The signal indications are incadesent bulbs. The bulbs should be replaced with the brighter LED bulbs as they tend to be 40% brighter than the incandescent bulbs. The traffic signal heads are located over the lane lines to minimize occlusion (blockage of view by large trucks). The Signal Heads are large 12 inch heads. Back plates are used to increase the visibility of

the indications.They are on all the indications except the far right indication (see above photo). The existing back plates have weathered and need to be repainted as can be seen in Figure R-5.

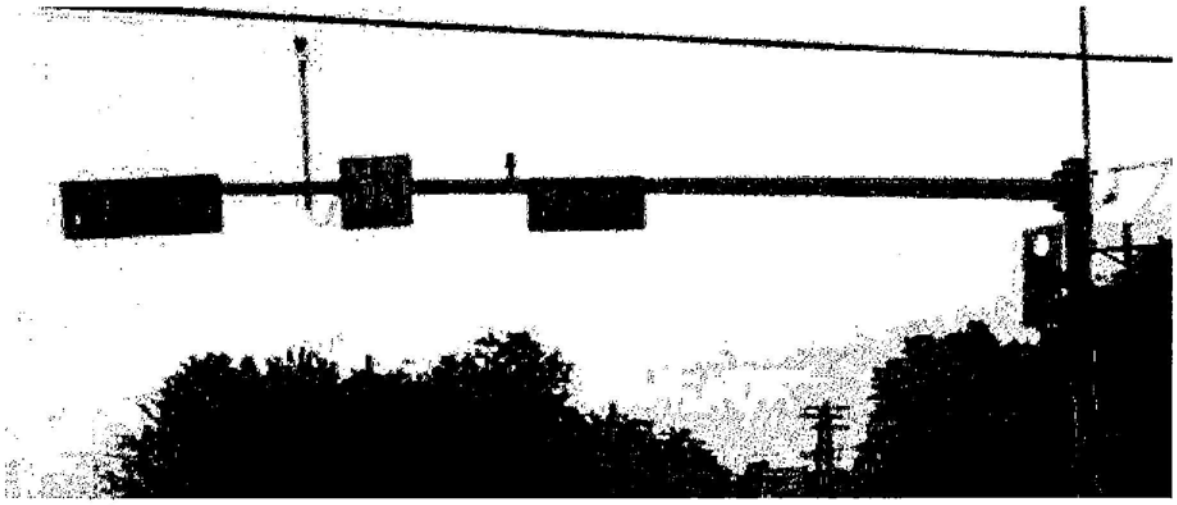

Figure R-5 Northbound approach

The Signal Timing

The signal timing was reviewed as a part of this study. The green timing is set with the appropriate time to allow minimal delays at the various time periods throughout the day. The data shows some minimal capacity problems. The intersection has 6 timing plans that are used through the day. The cycle lengths vary from 90 to 120 seconds.

The vehicle change interval is the critical factor in implementing automated enforcement. It is made up of the yellow plus the all red time. The yellow time clearance time is 4.5 seconds for the east-west and north-south movements. These values are in conformance with the TMUTCD. They exceed the ITE calculations of 4.2 seconds. The existing settings are within acceptable parameters.

The all red time is set at 2.0 seconds for north-south and east-west traffic. These exceed the ITE and TMUTCD values for both directions.

Signing

The intersection is signed properly to inform the motorists about the operating conditions and location. Advance Signal ahead indications with a photo enforcement plate will need to be installed prior to the start of the photo enforcement. These signings need to be placed on all four approaches and about 150 feet prior to the intersection.

Pavement Markings

The pavement markings are well above standards for the intersection and the paving is in great shape. Except for the north to east bound right turn only lane (see below), there are stop bars to indicate where the motorist needs to stop. These bars are large enough on the intersection provide motorists an adequate target. They are also located properly. These can be seen in Figure R-6.

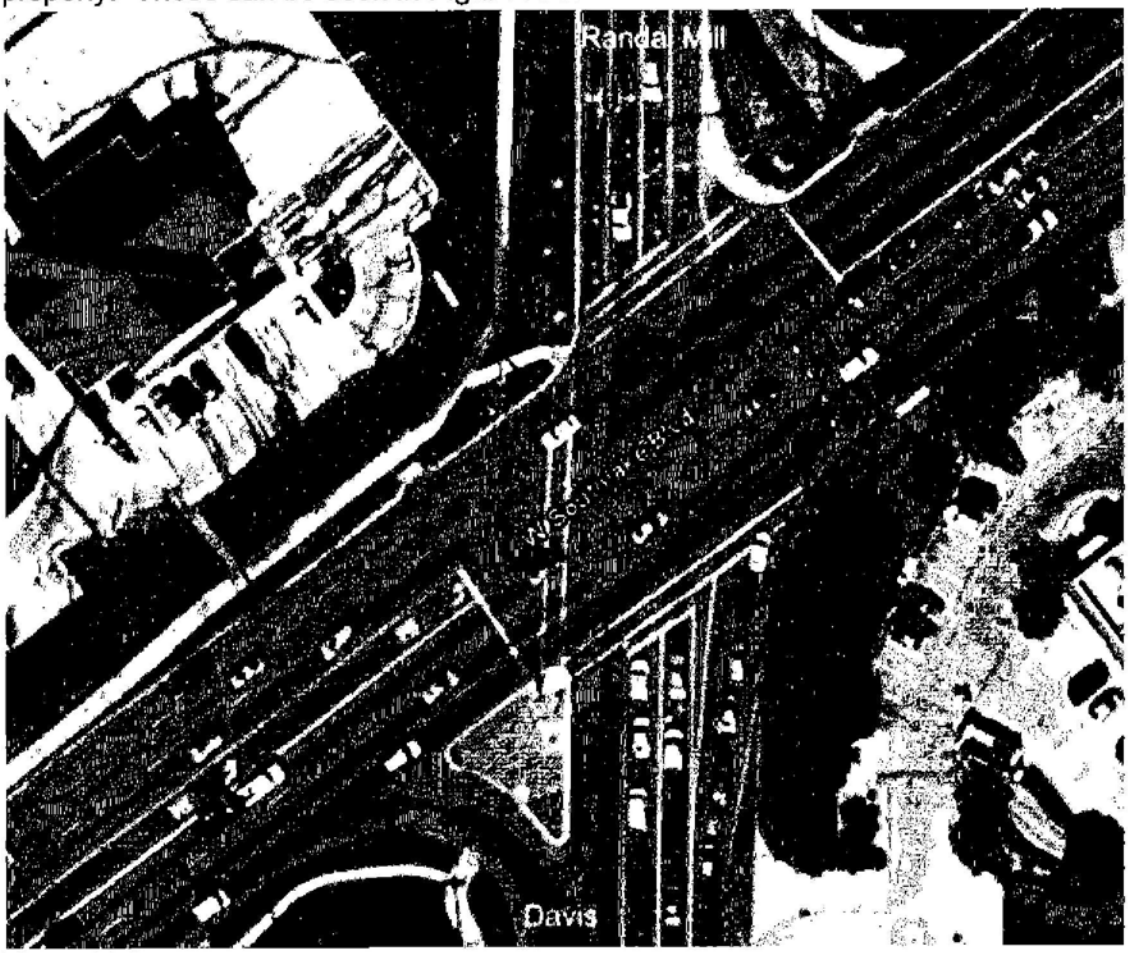

Figure R-6

The crosswalks (except for the east side) at the intersection also highlight the pedestrian crossings. Periodic maintenance should be conducted on all of the pavement markings to ensure they maintain adequate reflectivity and target value.

Conclusions and Recommendations

The intersection of FM 1709 at Randol Mill Ave. / Davis Blvd. (FM 1938) has a history of red light-running crashes. Analysis data and observation indicate that red-light running is occurring frequently. Automated enforcement is a proven tool that will reduce these violations.

The intersection will need to have signal advance signs and photo enforcement signs installed on all approaches. The pavement markings should be maintained to continue the bright appearance. A stop bar is needed for the northbound right turn only lane. The incandescent light bulbs should be upgraded to LED bulbs. A back plate is needed on the far right signal head to match the others on the north bound approach. Signal timing should be reviewed and adjusted annually to account for changes in the growth of the area.

A public information campaign or driver awareness program would be beneficial to educate all motorists prior to activation.

Southlake Blvd. (FM 1709) @ Carroll Ave.

Westbound Automated Enforcement

Intersection Configuration

Southlake Blvd. is a 6 lane east-west arterial road with a continuous left-turn lane. As a farm-to-market road, it is maintained by the Texas Department of Transportation (TxDOT). Generally these types of roads are designed to carry large traffic volumes which have a long trip length. The development along the corridor is generally commercial and single family. The roadway connects several cities together in North Tarrant County. Carroll Ave. is a minor arterial road. The road is designed to carry long intercity trips. The roadway is of modern construction in an urbanized area. Southlake Blvd. is widened for EB/WB right turn only lanes at the intersection. The roadways are shown below in Figure C-1.

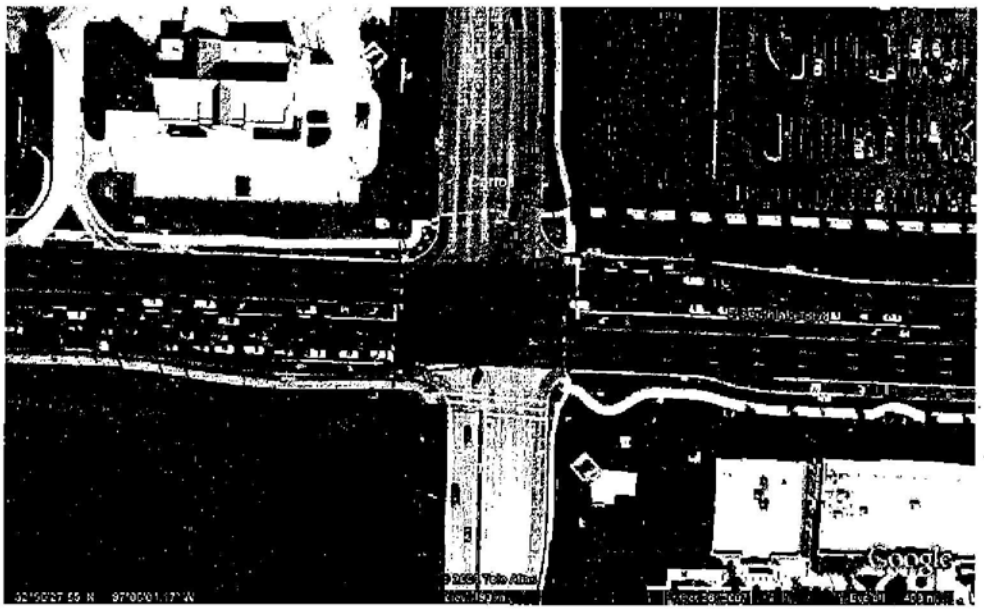

Figure C-1 FM 1709 at Carroll Ave.

FM 1709 has an approach speed of 45mph which seems appropriate for this road. Carroll has a speed of 30mph.

Traffic Volumes

Southlake Blvd. is handling a moderate amount of traffic. Daily traffic counts in the eastbound direction are 22,500 and in the westbound direction are 24,200. This daily average of 46,700 vehicles per day is less than the design roadway capacity of 42,000 - 48,000 vehicles per day. Carroll Ave. traffic is considerably less; NB is 6500 and SB is 7600; the daily volume is 14,100 with the capacity of 38,000.

Peak (AM & PM) hour traffic is the critical volume throughout the day. This intersection still has plenty of extra capacity to handle future traffic growth. The configuration shown above with 3 thru lanes and left and right turn lane on Southlake Lake Blvd. provide an acceptable Level-of Service even in the peak hours (AM & PM).

Crash Data

Although we strive to have zero crashes at an intersection, due to human factors it is highly improbable. Many factors contribute to a crash. Any analysis of the intersection crash data will allow engineers to determine what factors caused these crashes. Generally driver error or inattention is a contributing factor to most crashes. By ensuring that traffic control devices are communicating appropriately to the driver, crashes can be minimized through these engineering solutions. Enforcement is another key element to ensure drivers obey the traffic laws. A combination of education, engineering and enforcement are key elements in reducing crashes. The following table summarizes the crash data for this intersection:

Reported Crash Data Summary *

Year	FM 1709 Carroll Ave.	FM 1709 Carroll Ave.
	Total	Red - Light Running**
2007	5	0
2006	8	3
2005	4	3
2004	5	2

*Reported by the Southlake Police Dept.
**Cause factors 15, 37, and 38

Crash data should be carefully used. Not all crashes are reported, as many cities do not even investigate non-injury crashes. Many crashes are also minor and just driven away by the drivers. However, crash data is still a valuable tool to indicate overall intersection safety.

Traffic Signal

The traffic signal at the intersection is of a modern design. This includes functions to detect oncoming traffic and extend green times appropriately. The signal operates an eight phase configuration. East and westbound traffic goes simultaneously with a separate protected east and westbound left turn phase. This is the same for north and southbound movements. The turning movements may also occur on a green ball. The video detection is designed to allow for the left turn phases if required. The green time for each phase is adjusted according to the volume of oncoming traffic based on the video detection. The west and eastbound traffic signal indications are Figures C-3 and C-4.

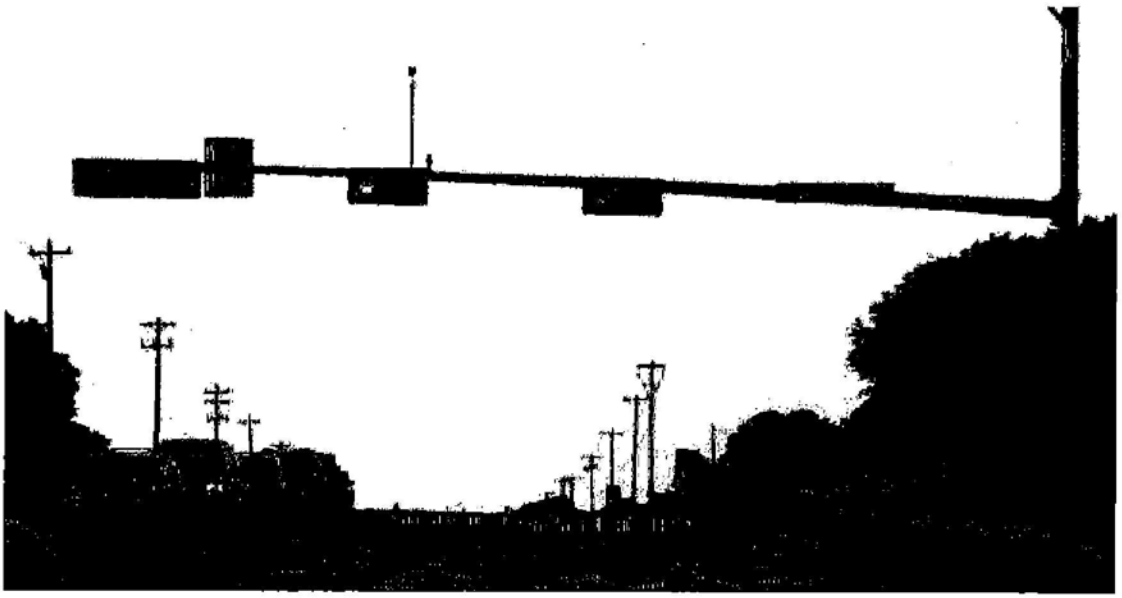

Figure C-3 West Bound approach

Figure C-4 East Bound approach

Traffic Signal Visibility

As can be seen by the above photographs; the visibility of the signal indications is excellent. The vehicle detection system at this location is a video detector mounted on top of the mast arm. This type of detection system has a good record of detecting approaching vehicles and extending the green times as appropriate. The signal indications are the more modern LED bulbs. The LED bulbs tend to be 40% brighter than the incadesent bulbs. The traffic signal heads are located over the lane lines to minimize occlusion (blockage of view by large trucks). The Signal Heads are large 12 inch heads with back plates to increase the visibility of the indications.

The signal lenses and back plates are also in good shape, as can be seen in

Figure C-5.

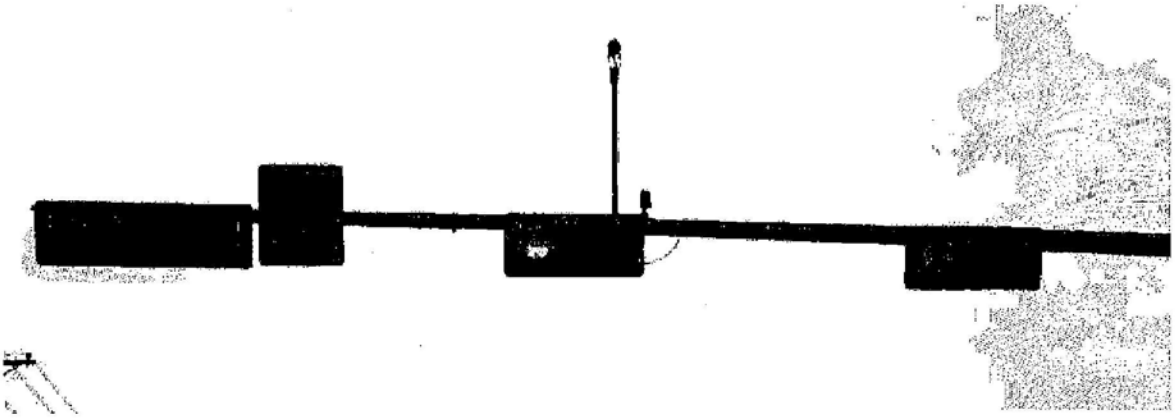

Figure C-5

The Signal Timing

The signal timing was reviewed as a part of this study. The green timing is set with the appropriate time to allow minimal delays at the various time periods throughout the day. The data shows some minimal capacity problems. The majority of the traffic clears the intersection even in the peak hours. The intersection has 6 timing plans that are used through the day. The cycle lengths vary from 90 to 120 seconds.

The vehicle change interval is the critical factor in implementing automated enforcement. It is made up of the yellow plus the all red time. The yellow time is four seconds for north-south and five seconds for the east-west movements. These values are in conformance with the TMUTCD. They exceed the ITE calculations of 3.5 seconds and 4.3 seconds. The existing settings are within acceptable parameters.

The all red time is set at 2.0 seconds for north-south and 2.0 seconds east-west. These exceed the ITE and TMUTCD values for both directions.

Signing

The intersection is signed properly to inform the motorists about the operating conditions and location. Advance Signal ahead indications with a photo enforcement plate will need to be installed prior to the start of the photo enforcement. These signings need to be placed on all four approaches and about 150 feet prior to the intersection.

Pavement Markings

The pavement markings are well above standards for the intersection and the paving is in great shape. There are stop bars to indicate where the motorist needs to stop. These bars are large enough on FM 1709 provide motorists an adequate target. They are also located properly. These can be seen in Figure C-6.

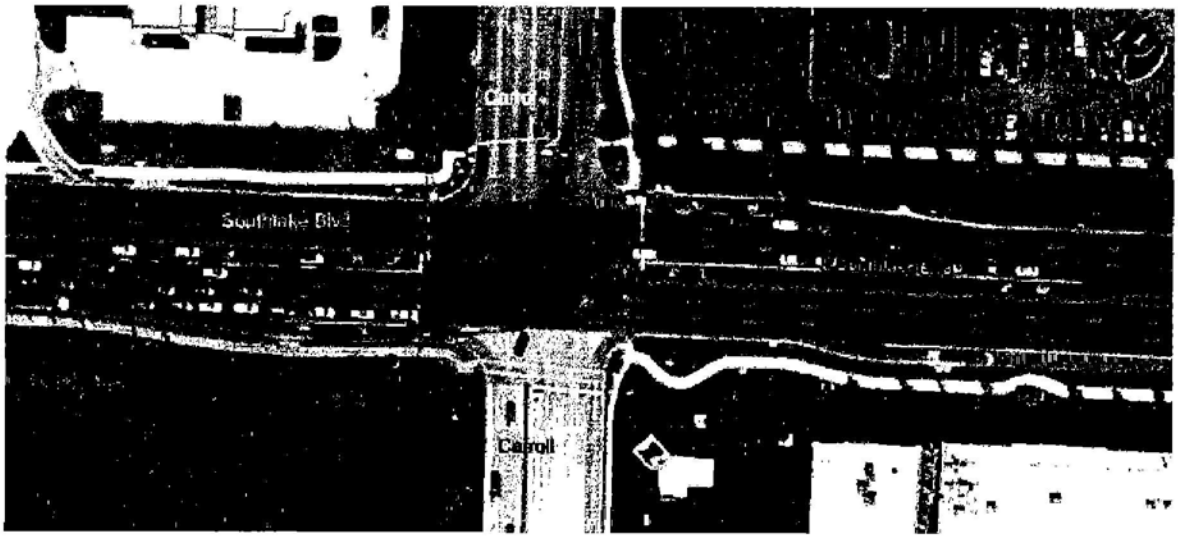

Figure C-6

The crosswalks cross Carroll. Periodic maintenance should be conducted on all of the pavement markings to ensure they maintain adequate reflectivity.

Conclusions and Recommendations

The intersection of FM 1709 at Carroll has a history of red light-running crashes. Analysis data and observation indicate that red-light running is occurring frequently. Automated enforcement is a proven tool that will reduce these violations.

The intersection will need to have signal advance signs and photo enforcement signs installed on all approaches. The pavement markings should be maintained to continue the bright appearance. Signal timing should be reviewed and adjusted annually to account for changes in the growth of the area.

A public information campaign or driver awareness program would be beneficial to educate all motorists prior to activation.

Southlake Blvd. (FM 1709) @ Kimball Ave.

Westbound Automated Enforcement

Intersection Configuration

Southlake Blvd. is a 6 lane east-west arterial road with a continuous left-turn lane. As a farm-to-market road, it is maintained by the Texas Department of Transportation (TxDOT). Generally these types of roads are designed to carry large traffic volumes which have a long trip length. The development along the corridor is generally commercial. The roadway connects several cities together in North Tarrant County. Kimball Ave. is also a minor arterial road. This type of roadway generally brings traffic from the more residential area to the arterial system. The roadway is of a modern urban design. The intersection with Southlake Blvd. it is also widened for additional turn lanes. A photograph of these roadways is shown below in Figure K-1.

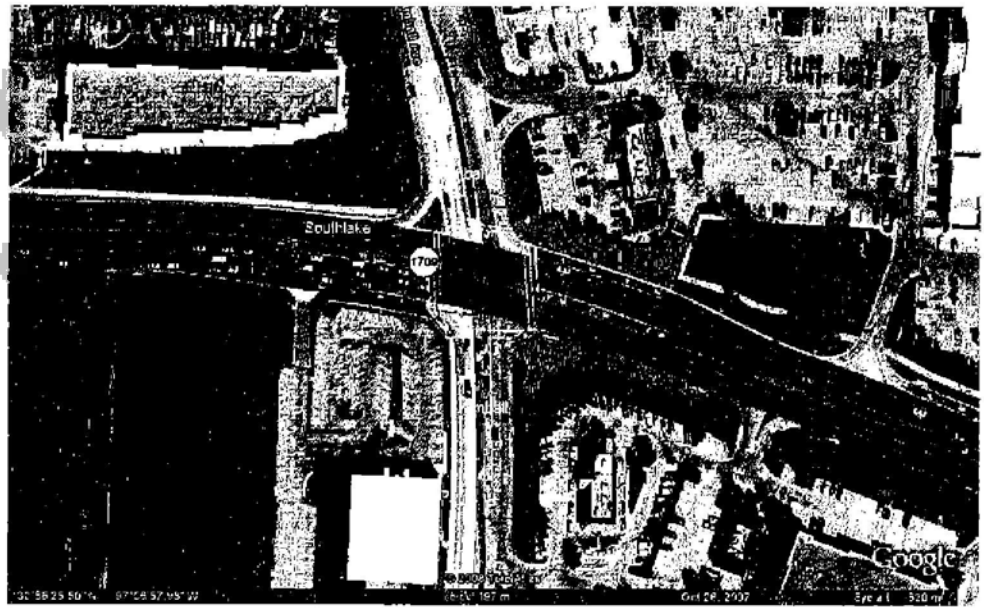

Figure K-1 FM 1709 at Kimball Ave.

FM 1709 has an approach speed of 45mph which seems appropriate for this road. Kimball has a speed of 35mph.

Traffic Volumes

Southlake Blvd. is handling a moderate amount of traffic. Daily traffic counts in the eastbound direction are 20,200 and in the westbound direction are 19,700. This daily average of 39,900 vehicles per day is less than the design roadway capacity of 42,000 - 48,000 vehicles per day. Kimball Ave. traffic is considerably less; the daily volume is NB is 11,500 and SB is 8,100 with the capacity of 42,000.

Peak (AM & PM) hour traffic is the critical volume throughout the day. This intersection still has plenty of extra capacity to handle future traffic growth. The configuration shown above with 3 thru lanes and left and right turn lane on Southlake Lake Blvd. provide an acceptable Level-of Service even in the peak hours (AM & PM).

Crash Data

Although we strive to have zero crashes at an intersection, due to human factors it is highly improbable. Many factors contribute to a crash. Any analysis of the intersection crash data will allow engineers to determine what factors caused these crashes. Generally driver error or inattention is a contributing factor to most crashes. By ensuring that traffic control devices are communicating appropriately to the driver, crashes can be minimized through these engineering solutions. Enforcement is another key element to ensure drivers obey the traffic laws. A combination of education, engineering and enforcement are key elements in reducing crashes. The following table summarizes the crash data for this intersection:

Reported Crash Data Summary *

Year	FM 1709 Kimball Ave.	FM 1709 Kimball Ave
	Total	Red - Light Running**
2007	10	7
2006	5	2
2005	4	2
2004	4	2

*Reported by the Southlake Police Dept.

**Cause factors 15, 37, and 38

Crash data should be carefully used. Not all crashes are reported, as many cities do not even investigate non-injury crashes. Many crashes are also minor and just driven away by the drivers. However, crash data is still a valuable tool to indicate overall intersection safety.

Traffic Signal

The traffic signal at the intersection is of a modern design. This includes functions to detect oncoming traffic and extend green times appropriately. The signal operates an eight phase configuration. East and westbound traffic goes simultaneously with a separate protected east and westbound left turn phase. This is the same for north and southbound movements. The turning movements may also occur on a green ball. The video detection is designed to allow for the left turn phases if required. The green time for each phase is adjusted according to the volume of oncoming traffic based on the video detection. The west and eastbound traffic signal indications are Figures K-3 and K-4.

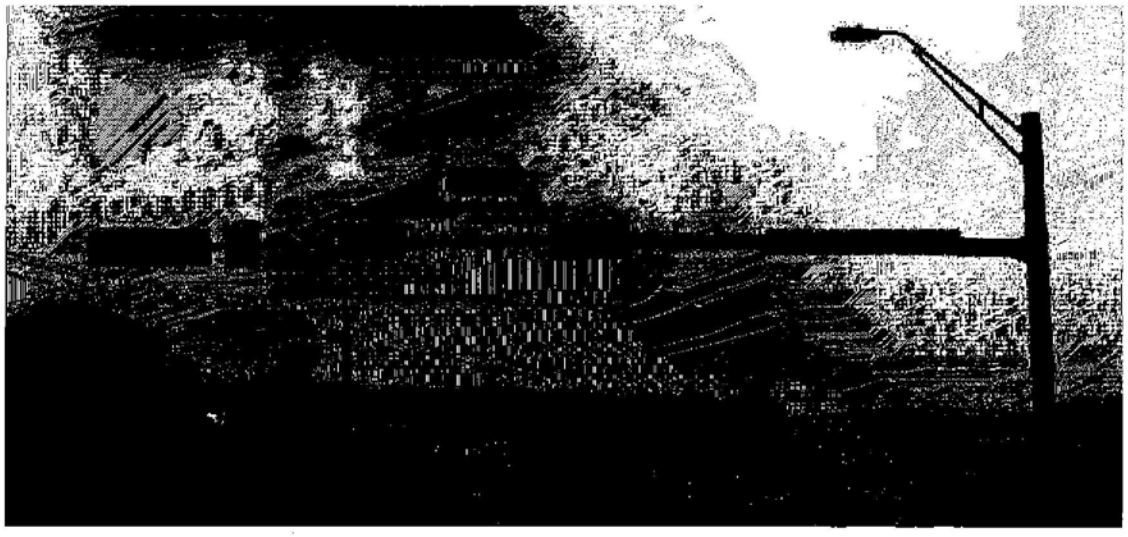

Figure K-3 West Bound approach

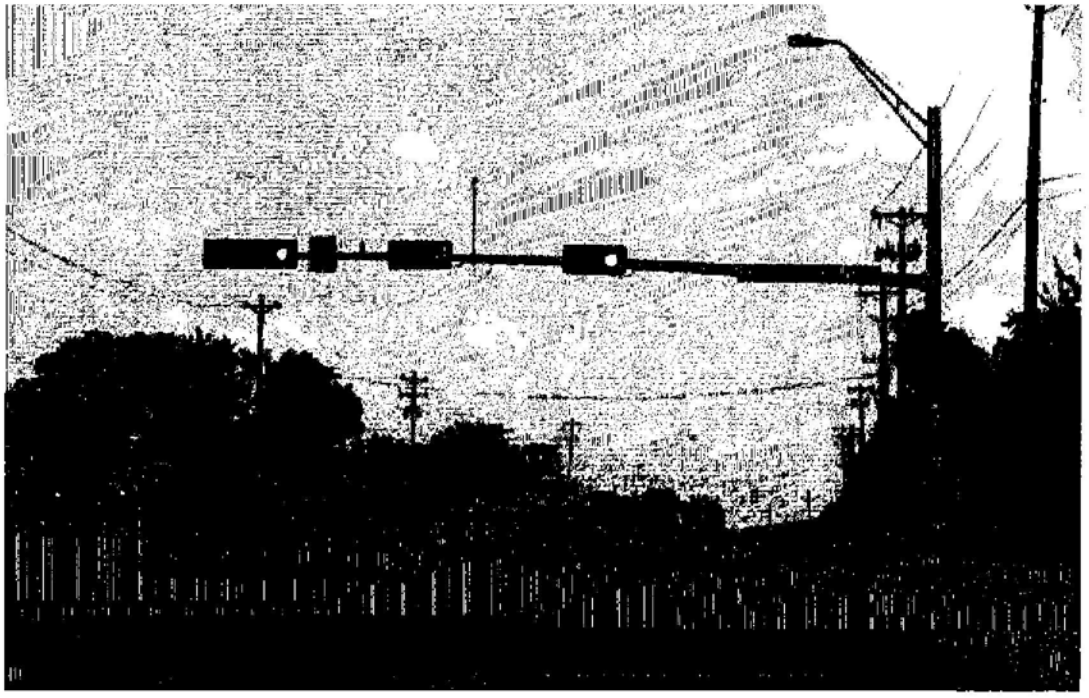

Figure K-4 East Bound approach

Traffic Signal Visibility

As can be seen by the above photographs; the visibility of the signal indications is excellent. The vehicle detection system at this location is a video detector mounted on top of the mast arm. This type of detection system has a good record of detecting approaching vehicles and extending the green times as appropriate. The signal indications are the more modern LED bulbs. The LED bulbs tend to be 40% brighter than the incadesent bulbs. The traffic signal heads are located over the lane lines to minimize occlusion (blockage of view by large trucks). The Signal Heads are large 12 inch heads with back plates to increase the visibility of the indications.

The signal lenses and back plates are also in good shape, as can be seen in Figure K-5.

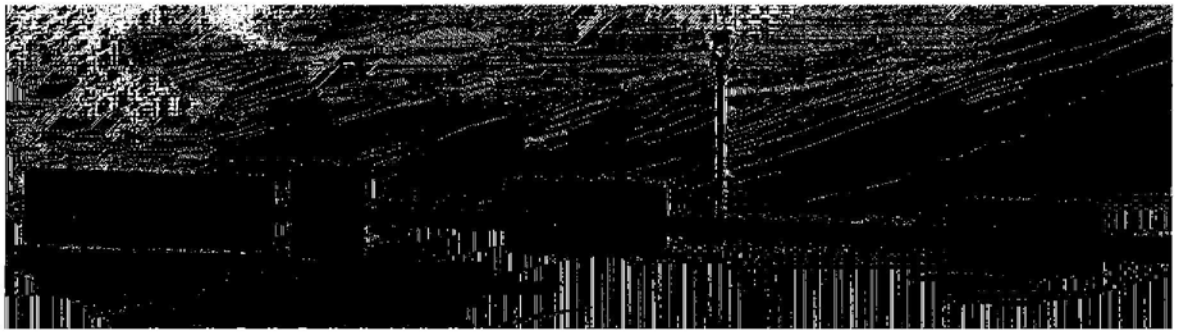

Figure K-5

The Signal Timing

The signal timing was reviewed as a part of this study. The green timing is set with the appropriate time to allow minimal delays at the various time periods throughout the day. The data shows some minimal capacity problems. The majority of the traffic clears the intersection even in the peak hours. The intersection has 6 timing plans that are used through the day. The cycle lengths vary from 90 to 120 seconds.

The vehicle change interval is the critical factor in implementing automated enforcement. It is made up of the yellow plus the all red time. The yellow time is 4.5 seconds for north-south and 4.5 seconds for the east-west movements. These values are in conformance with the TMUTCD. They exceed the ITE calculations of 3.5 seconds and 4.3 seconds. The existing settings are within acceptable parameters.

The all red time is set at 1.5 seconds for north-south and 1.5 seconds east-west. These exceed the ITE and TMUTCD values for both directions.

Signing

The intersection is signed properly to inform the motorists about the operating conditions and location. Advance Signal ahead indications with a photo enforcement plate will need to be installed prior to the start of the photo enforcement. These signings need to be placed to on all four approaches and about 150 feet prior to the intersection.

Pavement Markings

The pavement markings are well above standards for the intersection and the paving is in great shape. There are stop bars to indicate where the motorist needs to stop. These bars are large enough on FM 1709 provide motorists an adequate target. They are also located properly. These can be seen in Figure K - 6.

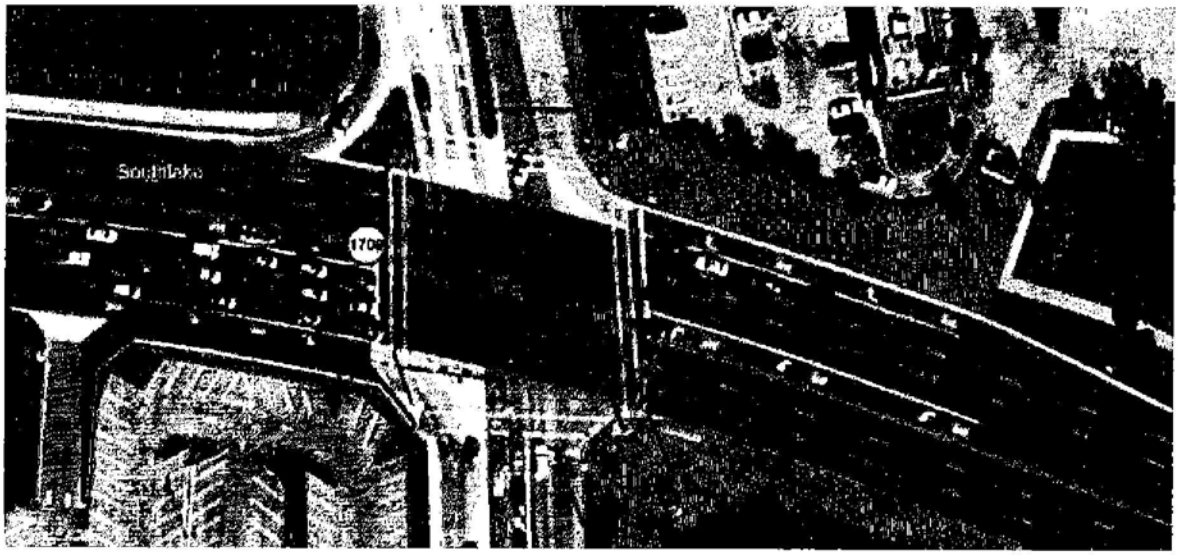

Figure K-6

The crosswalks crossing Southlake Blvd. also highlight the intersection. Periodic maintenance should be conducted on all of the pavement markings to ensure they maintain adequate reflectivity.

Conclusions and Recommendations

The intersection of FM 1709 at Kimball has a history of red light-running crashes. Analysis data and observation indicate that red-light running is occurring frequently. Automated enforcement is a proven tool that will reduce these violations.

The intersection will need to have signal advance signs and photo enforcement signs installed on all approaches. The pavement markings should be maintained to continue

the bright appearance. Signal timing should be reviewed and adjusted annually to account for changes in the growth of the area.

A public information campaign or driver awareness program would be beneficial to educate all motorists prior to activation.

SOUTHLAKE
TEXAS

Traffic Engineering Study for Automated Enforcement

FM 1709 at Pearson Lane and SH114 at Gateway Drive

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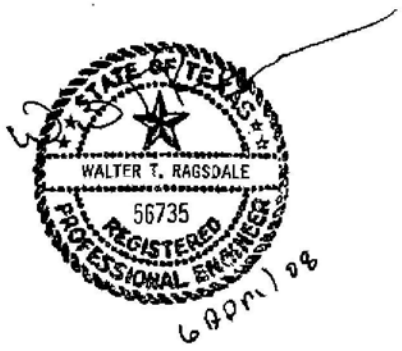

April 2008

Introduction

The Texas Legislature passed SB 1119 which became effective on September 1, 2007. This bill authorizes and controls the use of municipal red-light camera enforcement and was codified in the Texas Transportation Code, Section 707.003. This statute requires the completion of a traffic engineering study to validate the need and applicability of red-light camera enforcement and forms the basis for this report.

The City of Southlake, Texas has proposed the use of red-light cameras at two intersections within their jurisdiction. These intersections were proposed after an initial vetting process by the City's Law Enforcement staff. This study was commissioned by the City of Southlake, Texas to fulfill the requirements of the Texas statute.

The Texas statute requires an engineering study to evaluate engineering solutions that may be implemented to reduce the occurrence of driving violations for the red-light running. These solutions can involve geometric, signal hardware or timing improvements. Automated enforcement is a proven method that uses photography, and technology to detect, photograph and then a civil citation is issued to the violator.

The problem of red-light running is widespread and growing in Texas. State and municipal agencies have implemented numerous solutions to prevent and reduce these violations. The traditional three "E's" are typically used—engineering, enforcement and education. The media has helped educate the public about the consequences of red-light running as automated enforcement systems have been installed in Texas. Signing photographic enforcement at an intersection is one of the countermeasures that address all of the three "E's". However all of these techniques have the same goal to reduce crashes, injuries and save lives.

The use of red-light cameras for enforcement has been researched in the United States and abroad for many years, and recent studies in the United States indicate several interesting phenomena that accompany the application of red-light cameras.

It is intuitive that a reduction in red-light running will reduce traffic crashes and improve safety. Based on this assumption, a number of municipalities and state transportation agencies have begun programs to try to reduce red-light running using a variety of methods. One such method is using red-light cameras as an enforcement tool. The use of red-light cameras is common in much of the world and both the technology and impetus to use that technology has been available since the 1970's. This technology has evolved from wet film to the current digital and video systems in use today.

Texas Attorney General, John Cornyn, issued a ruling indicating that cities could implement photographic enforcement by their home rule authority. Several cities, such as Richardson, Garland and Plano proceeded with systems on this authority. The state then passed SB 1119 which sets forth specific requirements for the automated enforcement systems.

In a June, 2006 opinion, Texas Attorney General Greg Abbott issued Opinion GA 0440 indicating that TxDOT has the authority to install these systems on state highways.

Legislative Issues

The Texas State Legislature recently passed Senate Bill 1119, which became effective September 1, 2007. This bill created Chapter 707 of the Transportation Code, entitled "Photographic Traffic Enforcement System" and amends Subtitle I, Title 7. The act authorizes local authorities to enact ordinances that require civil penalties based on photographic signal enforcement systems. It provides that the owner of a motor vehicle is liable to the local authority for such civil (not criminal as a police citation) penalty if the vehicle violates the instructions of the traffic control signal.

It further authorizes the local authority to implement and operate a photographic enforcement system or contract for the implementation and operation of a system. It requires that the local authority conduct a traffic engineering study of each candidate approach for camera enforcement to determine if alternatives to the system are likely to reduce the number of red-light violations at the intersection.

The Act requires that the results of the traffic engineering study be reported to a citizen advisory committee established for that purpose and that the committee advise the local

authority on the installation and operation of the system. The bill further requires that the local authority install signs along each roadway that leads to an intersection at which the camera enforcement system is in active use.

The local authority is required, before installing the system, to compile a written report of the number and type of traffic accidents that have occurred at the intersection for at least 18 months prior to the date of the report. The statute also requires that the local authority report to the Texas Department of Transportation (TxDOT) a copy of that report within six months of the implementation of that system. The local authority is further required to monitor and report to TxDOT the number and type of traffic accidents at each intersection to determine whether or not the system results in a reduction in accidents or a reduction in the severity of accidents. The report to TxDOT shall be in writing and according to a form prescribed by TxDOT. Reporting is to begin in 2008.

The Act specifically requires that signals subject to camera enforcement will have a change interval (yellow plus all red) that meets the requirements of the Texas Manual on Uniform Traffic Control Devices (TMUTCD). General surveillance using the system is prohibited so that only violations of the traffic signal are photographed. Normal police enforcement measures at traffic signals are not precluded.

The statute provides for revenue sharing from the collections of civil penalties with the local authority to retain an amount necessary to cover certain costs. Fifty percent of the additional revenue is to be sent to the State comptroller for deposit to the credit of the regional trauma account. It also caps the amount of civil penalty at $75 and late payment penalty of not greater than $25. The retained portion of the civil penalties over and above the costs must be spent to cover certain procedures for administration of the program of enforcement.

The Texas Transportation Code and the Texas Manual on Uniform Traffic Control Devices (TMUTCD) give guidelines and standards for traffic signals. The TMUTCD Chapter 4 is the accepted national and state guideline for traffic signals. It is important that the nation have uniform standards for traffic signals. Drivers constantly cross state and national boundaries and this universal communication to the driver is imperative for the safety of our communities. It is universally known that red means STOP. If other colors were used, drivers would be confused by the need to stop. Simply this report will

review these universal standards to determine if they are met and/or any enhanced solutions may be needed prior to the implementation of the automated enforcement. The purpose of these enhanced solutions would be to reduce the frequency of red-light running.

Some of the guidelines are recommended and may not be implemented. However, they have a direct relationship to red-light running. An example of this is the size of the signal head and light. Eight - inch heads are common throughout the state of Texas and the Dallas/Fort Worth Metroplex. However, twelve inch signal heads are also used. The larger, brighter red lights have been shown to reduce the occurrence of red-light running. Some of these engineering solutions are easy and cost effective to implement.

Without the enforcement or threat of enforcement, these "traffic laws" or engineering standards would not be at all achieved. They would be consistently or frequently violated. Enforcement is the key to ensure that they are obeyed. However, with the over-worked enforcement agencies in Texas, it is difficult to have enough visibility to ensure compliance. Automated enforcement is a mechanical method, reviewed by authorized police agencies that operate 24 hours a day, 365 days a year. Studies have also indicated that there is a halo effect on other intersections. The goal of this enforcement is to improve safety and prevent crashes by reducing the number of red-light violators. Other Metroplex cities have demonstrated that a reduction in violations occurs as they have turned off their cameras at some intersections and the number of monthly violations is reduced.

Traffic Engineering Study

The purpose of this report is to conduct a traffic engineering investigation to analyze the potential engineering solutions to prevent red-light running. This report will analyze the intersections to insure that the locations meet the requirements of the Texas Manual on Uniform Traffic Control Devices. There are also several countermeasures which can be implemented to accomplish this goal. This will be a comprehensive evaluation of the intersections to observe the frequency of red-light running and recommend the appropriate countermeasures to reduce this frequency. The following items are reviewed in this investigation:

- clear view of the traffic signal heads - this will ensure that the motorist can observe the red-yellow-green indications from an appropriate distance from all of the approaches
- traffic signal timing - this will ensure that the overall traffic signal is timed appropriately
- yellow clearance interval - this will ensure that the motorist has the approaching indication based on intersection geometric system is made aware that the red light is about to start
- all red clearance interval – a time period to insure that the motorists can completely clear the intersection prior to the opposing green indication
- traffic signal loops - to determine the functionality of the loop detection and ensure where appropriate a green extension is used where needed
- signal progression plan review - to ensure that the Que is not being clipped and is forcing unexpected stops
- pavement markings - to ensure the adequate markings are in place including stop bars
- intersection signing - to ensure that appropriate signs are in place at these locations
- urban distractions - any review of the area around the location to ensure nothing uniquely distracts the motorist

Red- Light Running Solutions

There are many engineering enhancements that may be implemented to reduce the occurrence of red-light running. Some of these solutions are simple and cost effective; although in most cases these are enhancements to the standard installation. Some of these solutions include:

- back plates - the use of black back plates increases the target value of a traffic signal head especially at times when the sun is directly behind the traffic signal lights.
- LED signal lights - these lights are 40% brighter than incandescent lights; a bigger brighter light will reduce the occurrence of red-light running.
- All red and yellow clearance times - these times are set by an engineering analysis of the intersection geometric and speed. These guidelines are highlighted below.

There are several other factors that need to be considered such as intersection geometrics, capacity, visibility, number of lanes, and intersection warrants.

Traffic Signal Timing

A key element relating to traffic signals is the signal timing. The timing falls into four categories.

1. Green time -- the amount time given to thru or turning traffic
2. Yellow time -- the amount of time between the green and red intervals
3. Red time -- the amount of time the opposing traffic is stopped
4. All red time -- the amount of time all approaches are stopped

The timing of the traffic signals depends on many factors including volume, approach speed, intersection geometry, and vehicle detection. The critical time period is called the Clearance Interval: this is made up of the yellow and all red time. The state guidelines indicate that this time must be in conformance with the Texas Manual on Uniform Traffic and Control Devices. Detailed timing is calculated using guidelines from the Institute of Transportation Engineers (ITE). This agency gives precise engineering formulas to calculate the Clearance Interval. The TxDOT recommended method is to use the ITE formulas. Signal timing for each intersection should be monitored and adjusted as changes in volumes or geometric conditions occur.

Crash Data

Although we strive to have zero crashes at an intersection, due to human factors it is highly improbable. Many factors contribute to a crash. Any analysis of the intersection crash data will allow engineers to determine what factors caused these crashes. Generally driver error or inattention is a contributing factor to most crashes. By ensuring that traffic control devices are communicating appropriately to the driver, crashes can be minimized through these engineering solutions. Enforcement is another key element to ensure drivers obey the traffic laws. A combination of education engineering and enforcement are key elements in reducing crashes. The following table summarizes the crash data for these locations:

Reported Crash Data Summary

Year	FM 1709 Pearson	FM 1709 Pearson	SH 114 Gateway	SH114 Gateway
	Total	Red - Light Running*	Total	Red - Light Running*
2007	3	1	0	0
2006	1	1	6	1
2005	2	2	13	8
2004	1	1	5	3

Cause factors 15, 37, and 38

Crash data should be carefully used. Not all crashes are reported, as many cities do not even investigate non-injury crashes. Many crashes are also minor and just driven away by the drivers. However, crash data is still a valuable tool to indicate overall intersection safety.

FM 1709 (Southlake Blvd.) @ Pearson Lane

Intersection Configuration

Southlake Blvd. is a 6 lane east-west arterial road with a continuous left-turn lane. As a farm-to-market road, it is maintained by the Texas Department of Transportation (TxDOT). Generally these types of roads are designed to carry large traffic volumes which have a long trip length. The development along the corridor is generally commercial and multi-family. The roadway connects several cities together in North Tarrant County. Pearson Lane is a collector road serving as the western boundary of Southlake. This type of roadway generally brings traffic from the more residential area to the arterial system. The roadway is typical of a county type construction that has been urbanized. This accounts for the widening out of the intersection. A photograph of these roadways is shown below in Figure 1.

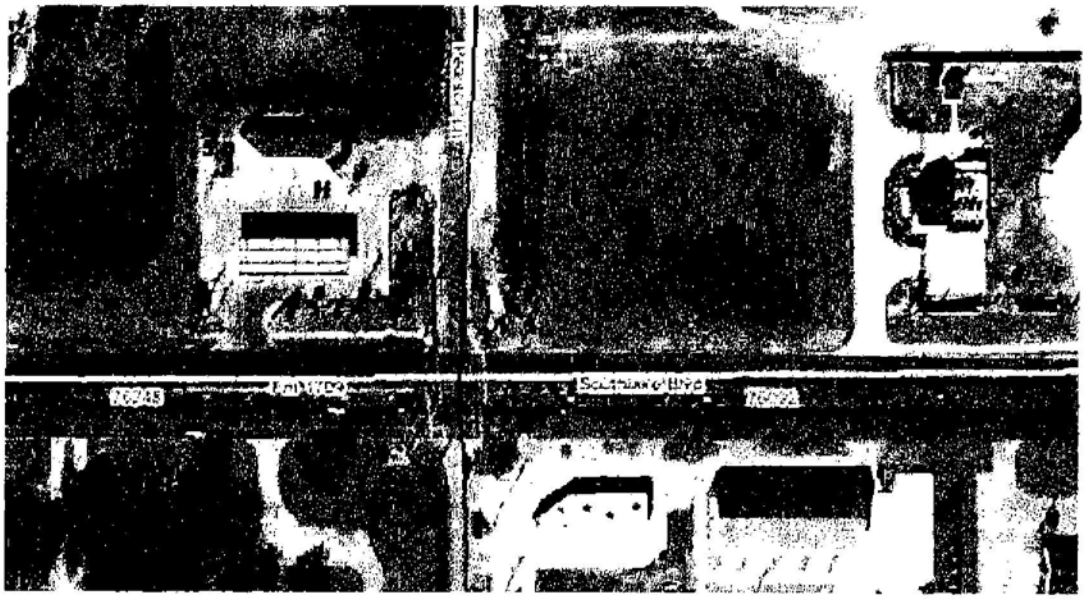

Figure 1 FM 1709 at Pearson Lane

FM 1709 has an approach speed of 45mph which seems appropriate for this road.

Traffic Volumes

Southlake Blvd. is handling a moderate amount of traffic. Daily traffic counts in the eastbound direction are 17,800 and in the westbound direction are 18,900. This daily average of 36,700 vehicles per day is considerably less than the design roadway capacity of 42,000 - 48,000 vehicles per day. Pearson Lane traffic is considerably less; the daily volume is about 5500 with the capacity of 14,000.

Peak hour traffic is the critical volume throughout the day. This intersection still has plenty of extra capacity to handle future traffic growth. The configuration shown above with 3 thru lanes and a turn lane on Southlake Lake Blvd. is typical of this type of roadway.

City Limits

This intersection is the boundary between Keller and Southlake. Figure 2 shows the City of Southlake's city limit along the west ROW of Pearson. The city limit is depicted by the double yellow line. As can be seen in this exhibit, some of the signal elements (west bound signal head and east bound stop bar) are outside the city limits of Southlake.

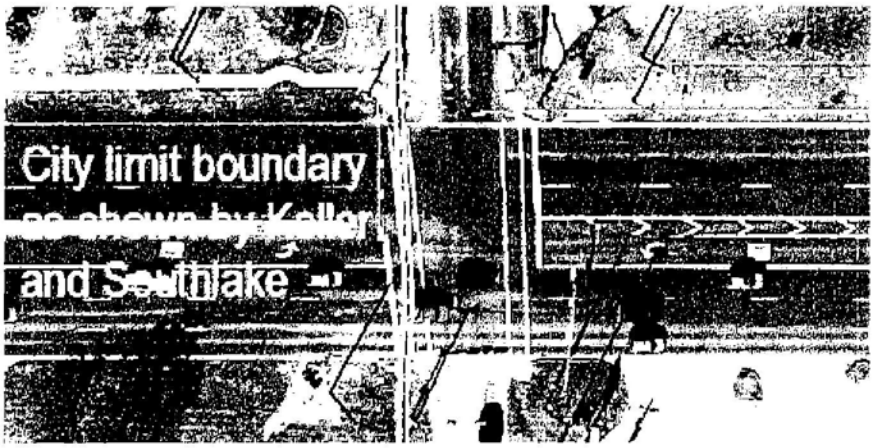

Figure 2

More investigation needs to be conducted as to the exact location of the city limits to ensure that all of the area to be enforced is actually in the jurisdiction of the city of Southlake. Boundary or other adjustments may be necessary to ensure this.

Traffic Signal

The traffic signal at the intersection is of a fairly modern design. This includes functions to detect oncoming traffic and extend green times appropriately. The signal operates a split phase. The northbound traffic goes and then the southbound traffic proceeds. East and westbound traffic goes simultaneously with a separate protected east and westbound left turn phase. These turning movements may also occur on a green ball. The video detection is designed to allow for the left turn phases if required. The east and westbound traffic signal indications are Figures three and four.

Figure 3

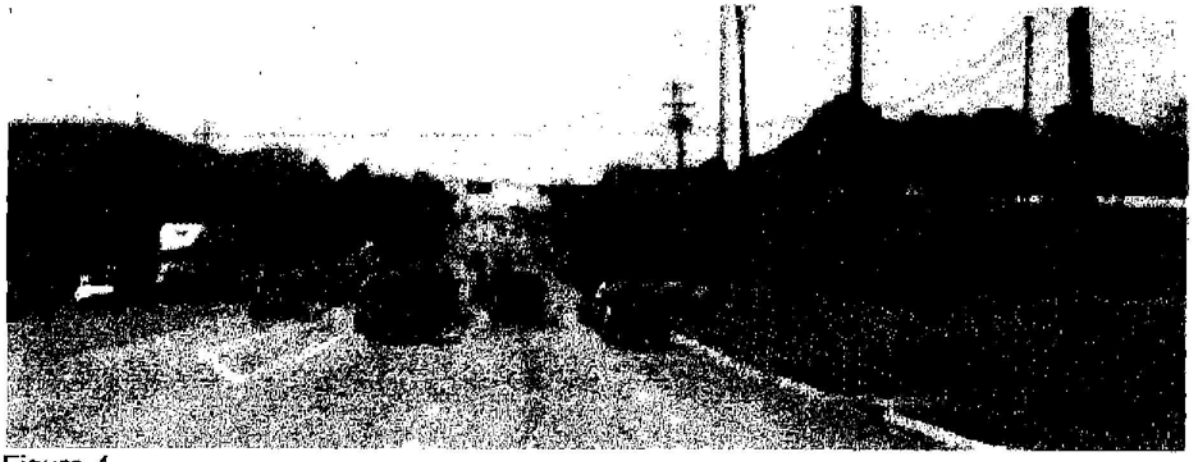

Figure 4

Traffic Signal Visibility

As can be seen by the above photographs; the visibility of the signal indications is excellent. The vehicle detection system at this location is a video detecor mounted on top of the mast arm. This type of detection system has a good record of detecting approaching vehicles and extending the green times as appropriate. The signal indications are a mixture of incandescent bulbs and the more modern LED bulbs. The LED bulbs tend to be 40% brighter than the incandescent bulbs. Consideration should be given to upgrade this intersection to LED bulbs. The traffic signal heads are located over the lane lines to minimize occlusion (blockage of view by large trucks).

The signal lenses are also showing some age. As can be seen in Figure 5 there are some burned spots on these lenses. The back plates have also weathered and need to be repainted to enhance the target value of the signal indications.

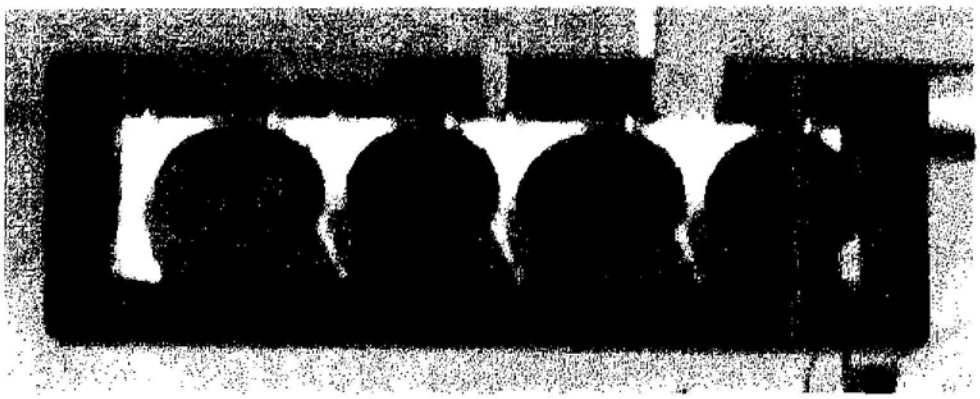

Figure 5

The Signal Timing

The signal timing was reviewed as a part of this study. The Green timing is set with the appropriate time to allow minimal delays at the various time periods throughout the day. The data shows some minimal capacity problems.

The vehicle change interval is the critical factor in implementing automated enforcement. It is made up of the yellow plus the all red time. The yellow time is four seconds for north-south and 4.5 seconds for the east-west movements. These values are in conformance with the TMUTCD. They exceed the ITE calculations of 3.5 seconds and 4.3 seconds. The existing settings are within acceptable parameters.

The all red time is set at one second for north-south and two seconds east-west. The ITE calculations for the north-south direction are 1.6 seconds and east-west is one second. These timings should be readjusted based on the intersection geometry.

Signing

The intersection is signed properly to inform the motorists about the operating conditions and location. Advance Signal ahead indications with a photo enforcement plate will need to be installed prior to the start of the photo enforcement. These signings need to be placed to on all four approaches and about 150 feet prior to the intersection.

Pavement Markings

The pavement markings are adequate for the intersection and the paving is in good shape. There are stop bars to indicate where the motorist needs to stop. These bars are large enough on FM 1709 provide motorists an adequate target. They are also located properly. These can be seen in Figure 6.

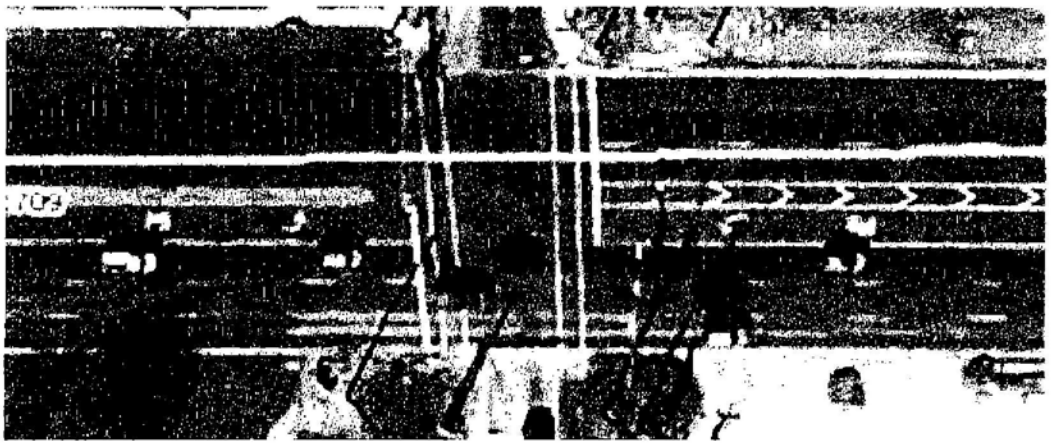

Figure 6

The crosswalks crossing Southlake Blvd. also highlight the intersection. Periodic maintenance should be conducted on all of the pavement markings to ensure they maintain adequate reflectivity.

SH 114 Frontage Road and Gateway

Intersection Configuration

This is a frontage road/collector intersection. The frontage road along State Highway 114 is maintained by the Texas Department of Transportation (TxDOT). The purpose of frontage roads is to provide access from freeways to adjacent businesses and city streets. The 114 Frontage Road has been recently constructed. The pavement is in excellent shape. Gateway is a four lane roadway that carries traffic to cross the freeway and into Grapevine and to access the state highway system. The intersection configuration is shown below in figure 7.

Figure 7

The SH 114 Frontage Road has an approach speed of 40 mph which is appropriate for this type of roadway, especially considering the weaving that occurs on a frontage road. The speed on Gateway is 30 mph which is also appropriate.

Traffic Volumes

Analyses of traffic volumes do not indicate that the eastbound frontage road or Gateway is having daily capacity issues. Most of the traffic signal Ques seem to have enough green time to allow them through the intersection. A review of the hourly counts also indicates that there is excess capacity for this movement. The northbound daily volume for Gateway is 3,900 and southbound is 6,000 and the capacities for these movements are in the range of 24,000 vehicles per day. The eastbound frontage road is currently carrying about 5,400 vehicles per day. This capacity should be around 30,000 vehicles per day.

City Limits

This intersection is close to the city of Grapevine. However, it can be seen by Figure 8 that the intersection line is totally within the city limits of Southlake. The figure below from Southlake's city limit and zoning map depicts the city limit by the line (green) and circle symbol.

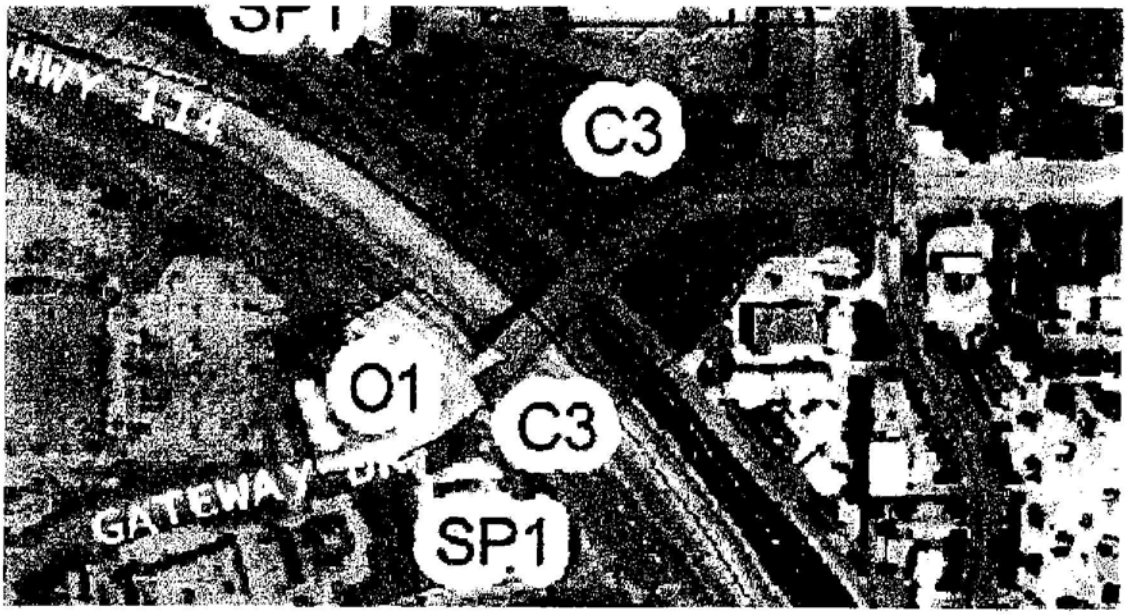

Figure 8

Traffic Signal

The traffic signal at Gateway and the frontage road of State Highway 114 is a very modern design that has unique architectural features incorporated into it. The signal operates as a TTI four phase diamond configuration. This is a standard operation in the Dallas / Fort Worth Metroplex. The detection occurs by the traditional and pavement loop detection and extends the green face time accordingly. Figure 9 depicts a photograph of the eastbound approach.

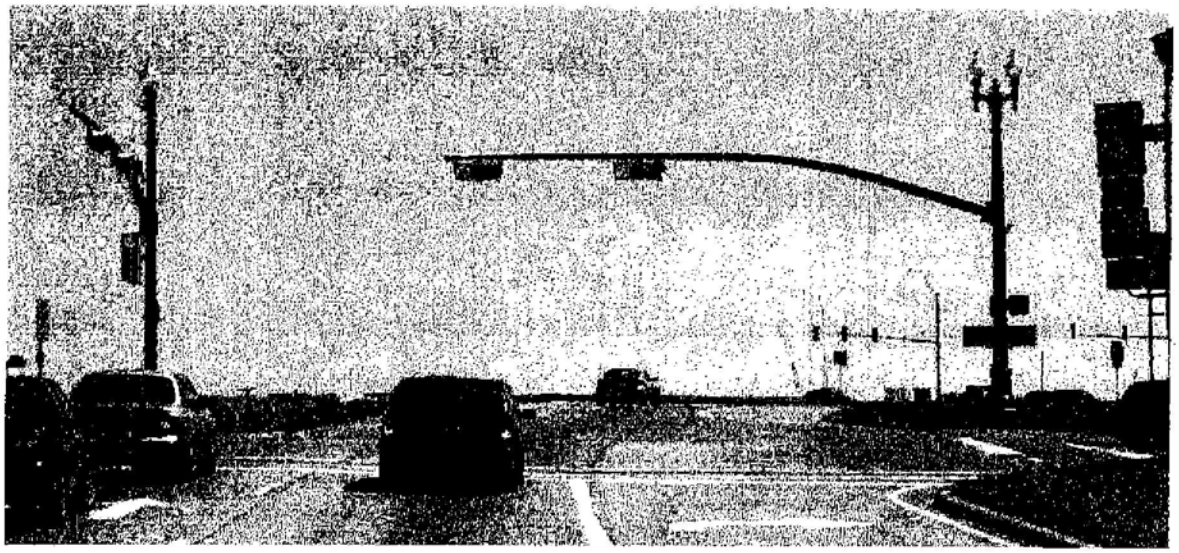

Figure 9

It can be seen by the above photograph the visibility of the indication is excellent. The approach is up grade on a curve. To decrease occlusion, this direction an additional signal head is mounted on the far side. All of these signal heads have LED lights which produce 40% greater illumination than incandescent bulbs.

Traffic Signal Visibility

Backplates are not used at this location. They may be considered to improve the target value of the signal heads.

Signal Timing

This traffic signal is interconnected with Northwest Highway in Grapevine. The purpose of this interconnection is to improve mobility by reducing delay and stops to the motorist.

This coordinated phase occurs in the morning and afternoon peaks and midday. When traffic volumes are light it operates like an isolated intersection. However the yellow and all red clearance intervals are set based on the intersection geometry and remain constant. The current yellow interval is four seconds and the all red time is 2.5 seconds. This is in conformance with the TMUTCD. The ITE calculation for the yellow is 3.9 seconds. The all red clearance interval is 1.5 seconds. The all red time may need to be reviewed.

Signing

The intersection is signed properly to inform the motorists about the operating conditions of this location. Advance signal ahead indications with a photo enforcement plate will need to be installed prior to the start of photo enforcement. These signings need to be placed on all approaches about 150 feet prior to the intersection.

Pavement Markings

The pavement markings are great for this intersection. The 24-inch stop bars and crosswalk adequately depict the stopping location. The brick crosswalk texture and color enhance this intersection feel. Lane indicators are also present and are depicted in Figure 10.

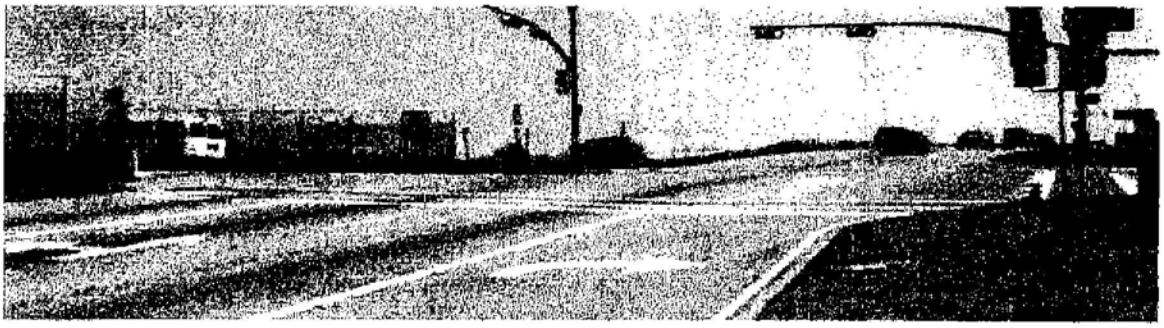

Figure 10

Periodic maintenance should be conducted on all pavement markings to ensure they maintain adequate reflectivity.

Conclusions and Recommendations

Both Intersections

The intersections of FM 1709 at Pearson and SH114 Frontage at Gateway have a history of red light-running crashes. Analysis data and observation indicate that red-light running is occurring frequently. Automated enforcement is a proven tool that will reduce these violations.

Both intersections need to have signal advance signs and photo enforcement signs installed on all approaches. The pavement markings should be maintained to continue the bright appearance. Signal timing should be reviewed and adjusted annually to account for changes in the growth of the area.

A public information campaign or driver awareness program would be beneficial to educate all motorists prior to activation.

FM 1709 at Pearson

At this intersection, the signal lenses and lights should be upgraded to LED's. The back plates should be repainted black or replaced. The all red clearance times should be adjusted to conform to the ITE recommended times as per the TxDOT guidelines. The issue with the city limit line may also need to be resolved.

SH114 Frontage at Gateway

At this intersection back plates should be installed. The all red clearance times should be adjusted to conform to the ITE recommended times as per the TxDOT guidelines.