THORNDALE TRAIN STATION TRAFFIC STUDY

JUNE 1992

DELAWARE VALLEY
REGIONAL PLANNING COMMISSION

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DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Publication Abstract

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Caln Township, Chester County, Pennsylvania.

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SEPTA, R-5 Regional Rail Line, Thorndale Train Station, existing and future traffic conditions, level of service analysis, trip generation methodology, traffic signal warrant analysis.

ABSTRACT

This study investigates traffic impacts associated with SEPTA's proposed Thorndale Train Station. This R-5 Regional Rail Line station, to be located in Caln Township, Chester County, is projected to open in 1993. Roads and intersections impacted by the construction of the train station were identified and analyzed. Future traffic volumes were calculated. Existing and future peak hour traffic volumes are presented. Level of service analyses were conducted at the intersections in the study area under existing conditions and future scenarios. Possible strategies for rectifying deficiencies within the study area are discussed.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This study investigates traffic impacts of the proposed Thorndale Train Station. The station is one component of a larger Southeastern Pennsylvania Transportation Authority (SEPTA) program to construct new stations with funding provided through a Federal Transit Administration (FTA) grant.

The Thorndale Train Station will be located on South Bailey Road just west of the intersection of South Bailey Road and Hazelwood Avenue in Caln Township. The station is projected to open in 1993. It will be located on SEPTA's R-5 Regional Rail Line which connects Parkesburg/Paoli and Center City. SEPTA plans to construct approximately 500 parking spaces, although the exact number is contingent upon final engineering and the desire to reach mutually agreeable parking standards with Caln Township.

At the township's request, three intersections were analyzed in the study: US 30 (Lincoln Highway)/South Bailey Road, US 30/North Bailey Road, and South Bailey Road/Hazelwood Avenue. The North Bailey Road intersection is signalized, while the other two are not. Intersections created by construction of the parking lot and the kiss-and-ride area at the proposed Thorndale Train Station were analyzed under future conditions.

For the traffic impact analysis, AM and PM peak period turning movements at the three intersections were collected. A level of service analysis was conducted to determine how the intersections currently operate. Future traffic volumes were projected and analyzed. Potential deficiencies were identified.

The US 30/North Bailey Road and South Bailey Road/Hazelwood Avenue intersections currently operate with acceptable level of service. The US 30/South Bailey Road intersection presently operates with poor level of service in the PM peak due to high traffic volumes on US 30. A narrow approach and poor site distance on South Bailey Road further contribute to the problem.

Future train station activity will have a minimum impact on the study area because the traffic peak hours (8:00 AM to 9:00 AM and 4:30 PM to 5:30 PM) are significantly different from the train peak hours (6:15 AM to 7:15 AM and 5:45 PM to 6:45 PM). In the AM, only 5 percent of the train passengers are projected to board a train during the auto peak while 65 percent are projected to board during the train peak. Thus, the new station adds only 35 new vehicles, including kiss-and-ride activity, to the highway system during the AM peak hour. A comparison of PM peak hour alighting patterns show similar percentages, with approximately 87 more trips added to the highway network. Boarding and alightings were estimated from train activity at nearby train stations. Kiss-and-ride refers to the dropping off and picking up of passengers.

It is important to identify if future train station activity at the proposed Thorndale Train Station will shift the peak hour from the current traffic peak hour to the future transit peak hour at each intersection in the study area. This "Shifting Peak" analysis was completed simply by calculating future traffic volumes during the AM and PM transit peak hours and comparing these values to future traffic projections during the AM and PM traffic peak hours, respectively. At each intersection the peak hour with the higher projected traffic volumes will be most representative of the worst case traffic conditions. The "Shifting Peak" analysis confirmed that the traffic peak hour represents the worst case conditions at the US 30/North Bailey Road intersection and the US 30/South Bailey Road intersection. However, at the South Bailey Road/Hazelwood Avenue intersection, the AM and PM peak hours will "shift" to the respective transit peak hours. At the intersections created by the driveways to the proposed parking lot and kiss-and-ride area, the transit peak hours were analyzed.

Under future conditions with the Thorndale Train Station in operation, the US 30/South Bailey Road intersection will operate with unsatisfactory service levels during the AM and PM traffic peak hours. The US 30/North Bailey Road intersection will still operate in a very satisfactory manner. At the South Bailey Road/Hazelwood Avenue intersection, the level of service on South Bailey Road will operate at level of service C, a satisfactory service level.

To rectify existing and future deficiencies at US 30/South Bailey Road a new traffic signal is proposed. Due to their close proximity, the traffic signals at the South Bailey Road and North Bailey Road intersections need to be coordinated. Based upon traffic counts taken for this study, the intersection presently meets volume warrants for a traffic signal. A level of service analysis of future conditions with the new traffic signal and a traffic simulation of signal coordination, indicate that the signals will operate in a satisfactory manner.

INTRODUCTION

The Thorndale Train Station will be located on South Bailey Road just west of the South Bailey Road/Hazelwood Avenue intersection in Caln Township (Figure 1). The projected opening date for the station is 1993. The station will serve the Southeastern Pennsylvania Transportation Authority's (SEPTA) R-5 Regional Rail Line which connects Parkesburg/Paoli and Center City.

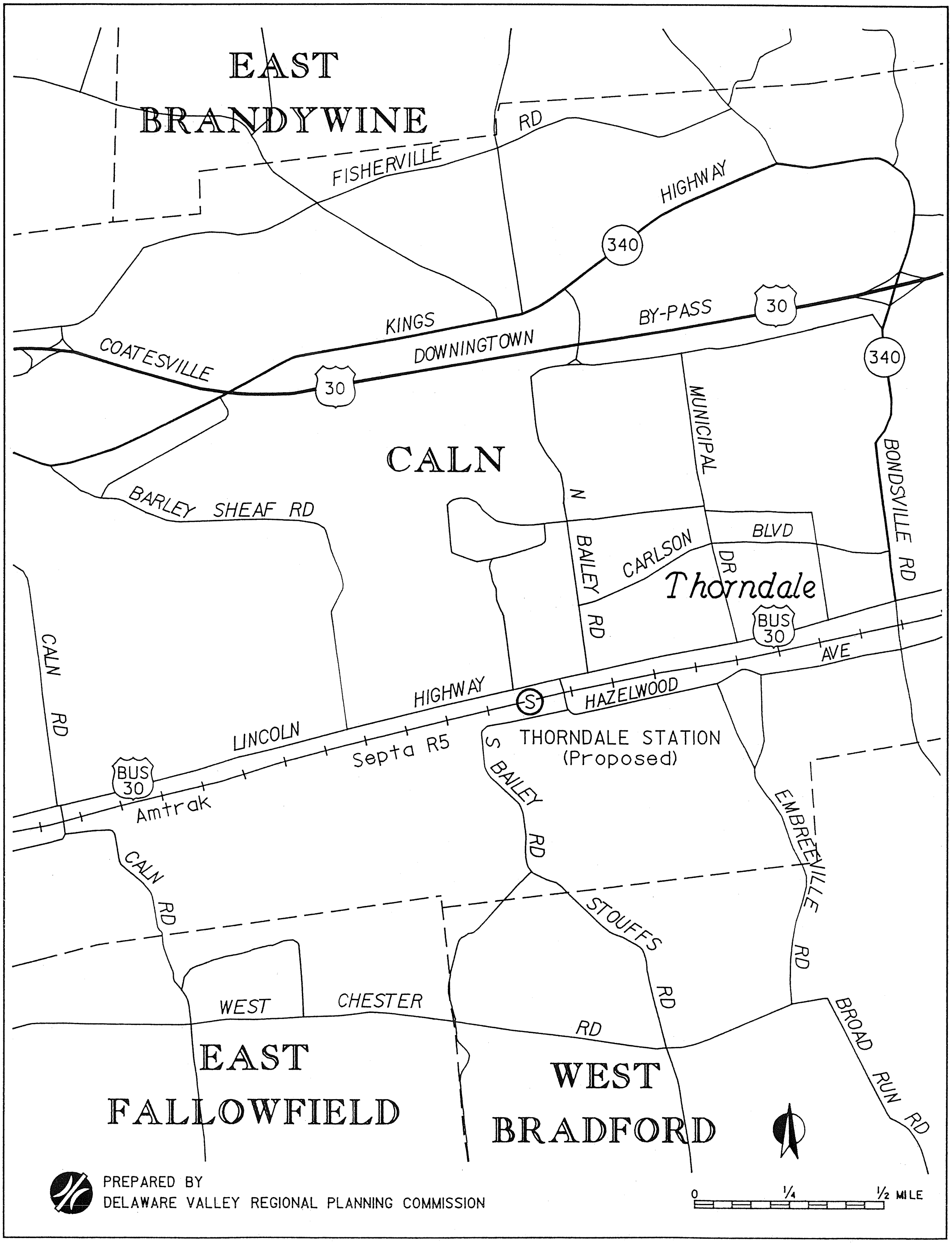
SEPTA is proposing to construct 500 parking spaces as part of the station, although the exact number of spaces is contingent upon final design and a mutual agreement between SEPTA and Caln Township on parking standards. To determine the impacts of the proposed station on adjacent intersections in Caln Township, SEPTA requested that the Delaware Valley Regional Planning Commission (DVRPC) undertake a traffic impact study. Existing and future AM and PM traffic conditions were investigated as part of this study.

Roads affected by the proposed station include US 30 (Lincoln Highway), South Bailey Road, North Bailey Road, and Hazelwood Avenue. US 30 is an east-west two-lane arterial linking Philadelphia and Lancaster. South Bailey Road and North Bailey Road are two-lane collector roads oriented in a north-south direction. There is an approximate 350 ft. off-set between the two roads when they intersect US 30. Hazelwood Avenue is an east-west two-lane local road paralleling US 30 to the south. It intersects South Bailey Road adjacent to the proposed station.

Caln Township officials identified three key intersections impacted by the proposed rail station: US 30/South Bailey Road, US 30/North Bailey Road, and South Bailey Road/Hazelwood Avenue. The traffic impact analysis focused on these three intersections. Intersections created by the construction of the parking lot and the proposed kiss-and-ride area at the proposed Thorndale Train Station were analyzed for future conditions.

DVRPC staff collected existing AM and PM peak period turning movements for these intersections on July 9, 1991, between 6:15 AM to 9:00 AM and 4:00 PM to 6:45 PM. Twenty-four hour automatic traffic recorder (ATR) counts were taken on US 30, South Bailey Road and Hazelwood Avenue in the Thorndale Train Station study area. A level of service analysis for existing conditions was conducted. Existing deficiencies were identified. In addition, a traffic signal warrant analysis for the US 30/South Bailey Road intersection was conducted.

Figure 1: STUDY AREA



AM and PM future traffic volumes were projected. They are based on existing traffic, background growth, and train station generated traffic. These traffic estimates were analyzed to determine the impact of the new rail station. A level of service analysis of future conditions was also conducted.

Possible strategies for improving the existing and future traffic conditions within the study area were also briefly addressed. The primary recommendation is to install a traffic signal at the US 30/South Bailey Road intersection. Since the traffic signals in this section of US 30 are interconnected, the new traffic signal at the US 30/South Bailey Road intersection should be interconnected with the other signals in the US 30 corridor. The traffic signals at the US 30/North Bailey Road intersection and US 30/South Bailey Road intersection will be coordinated through a hard wire connection. A level of service analysis of future conditions with the recommended improvements evaluates the effectiveness of the improvements.

EXISTING TRAFFIC CONDITIONS

DESCRIPTION OF ROADS AND INTERSECTIONS

US 30, South Bailey Road, North Bailey Road, and Hazelwood Avenue are the main roads in the study area. They will also be the principal access routes to the Thorndale Train Station when it is completed.

US 30, oriented in an east-west direction, is a two-lane arterial. It connects Philadelphia and Lancaster. Commercial development lines the north side of US 30 in the study area, the south side is largely vacant because of the railroad. In the vicinity of the proposed Thorndale Train Station, left-turn lanes provide access to shopping center driveways and other crossroads on the north side of US 30. The posted speed limit on this section of US 30 is 40 miles per hour.

South Bailey Road is a two-lane north-south collector road connecting East Fallowfield and West Bradford Townships to the shopping centers on US 30. It is also the main access road to the Caln Industrial Park. Approximately 30 ft. south of the US 30 intersection is a tunnel under the Amtrak Harrisburg Line. The tunnel is fairly narrow, less than 30 ft. wide. There are two sharp curves on South Bailey Road in the immediate vicinity of the proposed station, one just south of the rail tunnel at the Hazelwood Avenue intersection, and the other by the Caln Industrial Park. The posted speed limit on South Bailey Road is 25 miles per hour.

North Bailey Road is a two-lane north-south collector road connecting US 322 to US 30. It is primarily used as a connector between Carlson Boulevard and US 30 and as an entry way into the Ingleside Shopping Center. There is approximately a 350 ft. offset between South Bailey Road and North Bailey Road where they intersect US 30.

Hazelwood Avenue is a two-lane local road oriented in an east-west direction paralleling US 30. Its terminal points are South Bailey Road to the west and Gallagherville Road to the east. Land use along the road is mainly residential in character. The posted speed limit is 25 miles per hour.

The intersection of US 30 and South Bailey Road is an unsignalized T-intersection, South Bailey Road is under stop control. The westbound approach of US 30 consists of a through lane and an exclusive left-turn lane; its eastbound approach consists of one travel lane, however right turning vehicles frequently use the unimproved shoulder as a turn lane. There is a one approach lane on South Bailey Road because of the narrow Amtrak tunnel, while the intersection flares out north of the tunnel it still effectively operates as a one-lane approach.

The intersection of US 30 and North Bailey Road is a T-intersection. It operates under a three phase traffic signal, the eastbound approach has a leading green phase. The westbound US 30 approach consists of an exclusive right-turn lane and a through lane, the eastbound approach consists of an exclusive left-turn lane and a through lane. North Bailey Road has two approach lanes, an exclusive left-turn lane and an exclusive right-turn lane.

The intersection of South Bailey Road and Hazelwood Avenue is an unsignalized T-intersection with southbound Bailey Road and northbound Hazelwood Avenue forming the top of the "T" and eastbound South Bailey Road the stem of the "T". The intersection is situated on a curve. Hazelwood Avenue which is generally oriented in an east-west direction approaches the intersection in a northerly direction because of the curve just prior to the intersection. The eastbound South Bailey Road approach is under stop control. All three legs of the intersection consist of one-lane approaches; in fact none of the roads have pavement markings to delineate opposing lanes.

EXISTING TRAFFIC VOLUMES

DVRPC staff collected and analyzed existing peak hour turning movements for the three intersections in the Thorndale Train Station study area.

Manual turning movement counts were collected at these intersections on Tuesday, July 9, 1991. The counts were conducted between 6:15 AM to 9:00 AM and 4:00 PM to 6:45 PM. The elongated hours for data collection encompassed traditional peak traffic conditions, as well as the typical regional rail transit ridership peak. A summary of the turning movement data for the AM and PM peak periods is presented in Figures 2 and 3, respectively. Detailed turning movement tabulations for the three intersections are presented in Appendix A. In addition, 24-hour ATR counts were taken on US 30, South Bailey Road and Hazelwood Avenue in the study area on the same day as the manual turning movement counts. Specifically, machines were placed on US 30 between North and South Bailey Roads, on South Bailey Road between US 30 and Hazelwood Avenue and on Hazelwood Avenue just south of South Bailey Road. These data were used to identify daily traffic patterns in the study area. The peak hour of auto usage is between 8:00 AM to 9:00 AM and 4:30 AM to 5:30 PM.

Figure 2: EXISTING AM PEAK HOUR TRAFFIC VOLUMES

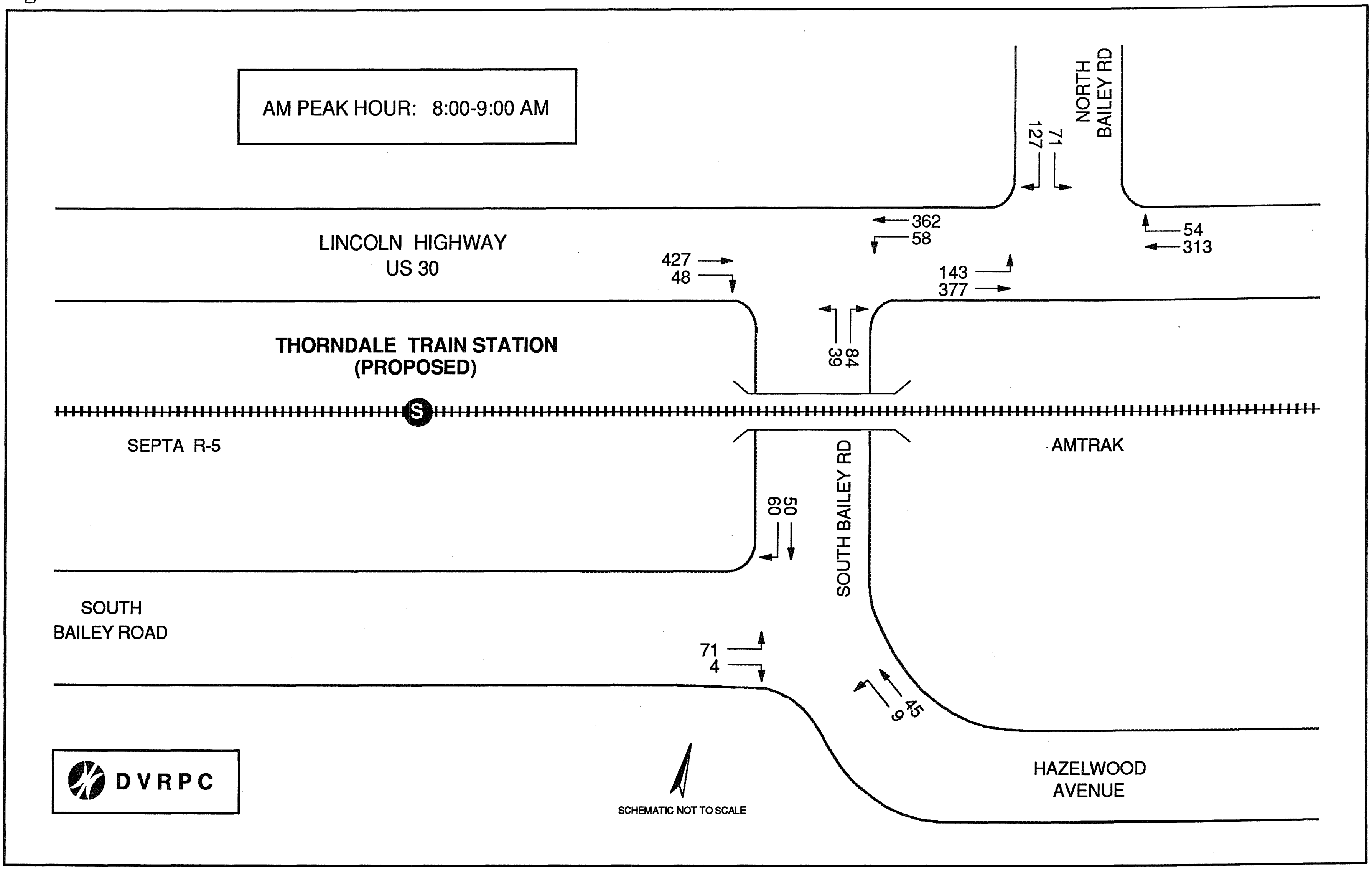
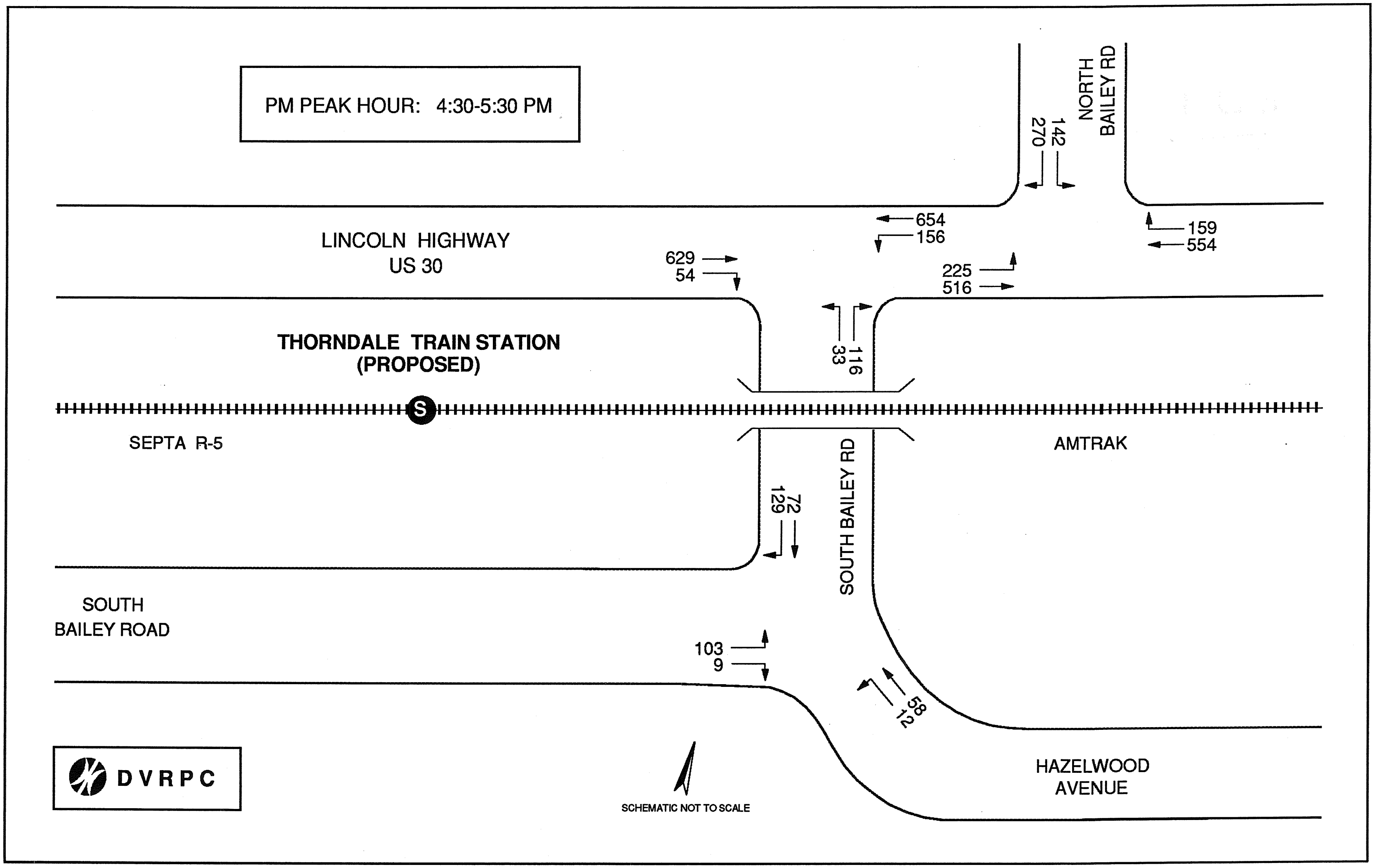


Figure 3: EXISTING PM PEAK HOUR TRAFFIC VOLUMES



Peak hour traffic volumes represent the four highest consecutive 15-minute periods. However, from previous train station studies conducted by DVRPC for SEPTA, it is known that the peak hours of transit usage at a suburban train station are traditionally earlier in the AM and later in the PM than the traffic peak hours. For existing conditions, the current traffic peak hour will be used. For future conditions, this study will include a "Shifting Peak" analysis to determine which peak hour will be most representative of the true peak hour experienced by motorists.

EXISTING LEVEL OF SERVICE ANALYSIS

To quantitatively evaluate existing intersection operations, a level of service analysis was conducted for the three study area intersections.

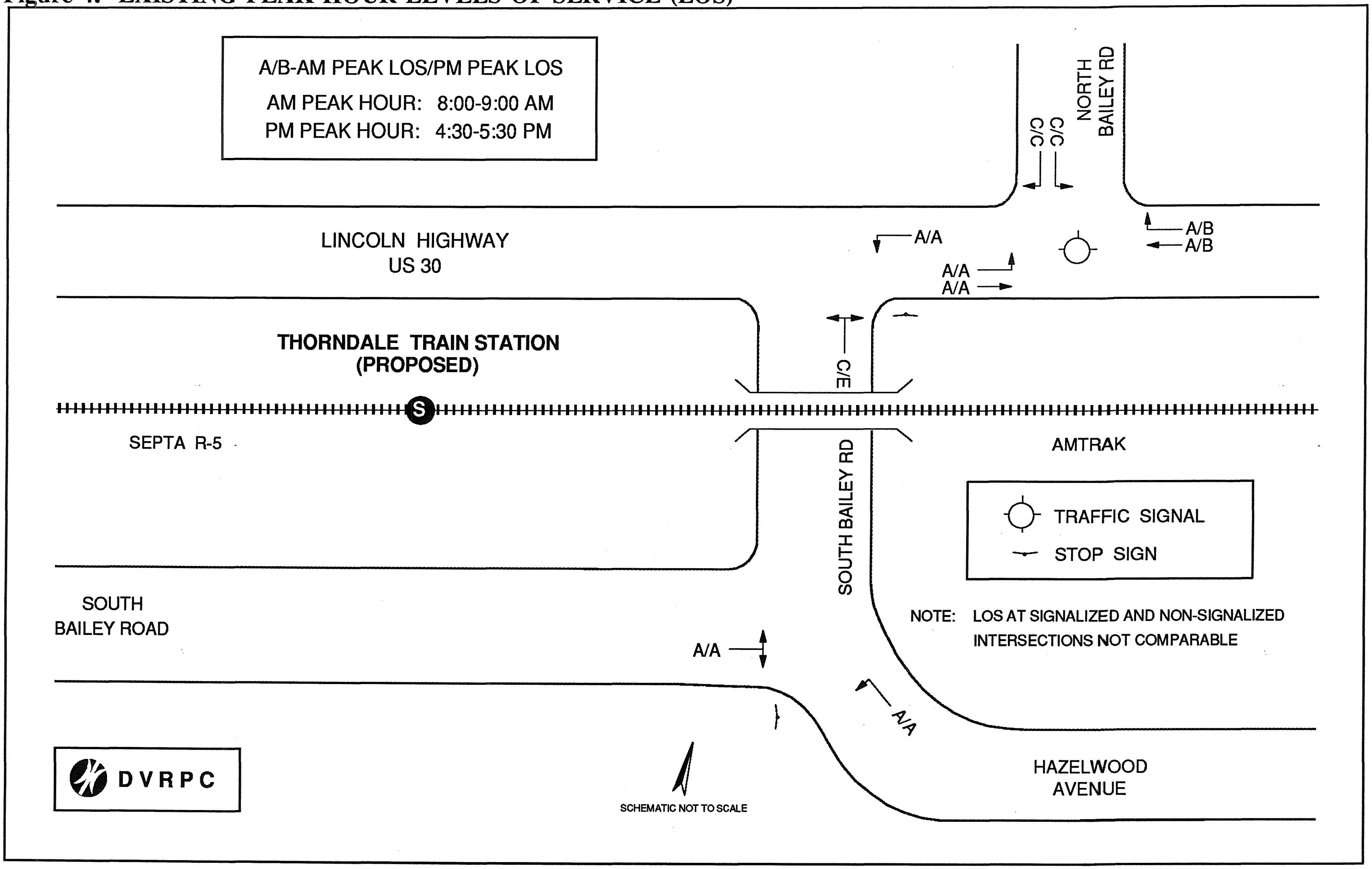
The concept of level of service is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists in terms of speed and travel time, traffic interruptions, freedom to maneuver, comfort, and convenience. Six levels of service are defined; they are given letter designations, A to F, with level of service A representing the best operating conditions and level of service F the worst. Level of service C is the minimum desirable condition; however, jurisdictions frequently tolerate level of service D when the cost to upgrade the highway facility becomes prohibitive.

Methodology to determine level of service is presented in the Highway Capacity Manual, Transportation Research Board Special Report 209. Different methodologies are specified for signalized and unsignalized intersections. A detailed description of the methodology used is presented in Appendix B.

All intersections were analyzed using the Highway Capacity Software (HCS). Because the Highway Capacity Manual employs different methodologies to calculate levels of service at signalized and unsignalized intersections, the results are not comparable. The existing levels of service in the vicinity of the proposed Thorndale Train Station are presented on Figure 4.

The US 30/North Bailey Road intersection presently operates at overall level of service B in both the AM and PM traffic peak hours. In the AM peak hour, all travel lanes on US 30 operate at level of service A. The exclusive left-turn and right-turn lanes on the southbound North Bailey Road approach operate at level of service C. In the PM peak hour, the lanes on the eastbound US 30 approach operate at level of service A, the lanes on the westbound US 30

Figure 4: EXISTING PEAK HOUR LEVELS OF SERVICE (LOS)



approach operate at level of service B, and the North Bailey Road approach lanes operate at level of service C.

The unsignalized US 30/South Bailey Road intersection operates in a satisfactory manner in the AM peak hour, and in an unsatisfactory manner in the PM peak hour. In the morning, the South Bailey Road approach operates at level of service C, in the PM it operates at level of service E. The high PM traffic volumes are responsible for the lower level of service. Poor sight distance and the single lane approach of South Bailey Road also contribute to the poor service level. The left-turn lane on westbound US 30 operates at level of service A in both the AM and PM peak hours.

All approaches at the South Bailey Road/Hazelwood Avenue intersection operate at level of service A during the AM and PM peak hours. This is due to the low traffic volumes passing through the intersection.

TRAFFIC SIGNAL WARRANT ANALYSIS FOR EXISTING CONDITIONS

A traffic signal warrant analysis was conducted to determine if a traffic signal is justified at the US 30/South Bailey Road intersection. Pennsylvania Department of Transportation (PennDOT) Publication 201, titled Engineering and Traffic Studies, specifies 12 warrants that should be investigated when evaluating the need for a traffic signal. The warrants set forth in the publication are based upon traffic volumes, pedestrian activity, and accident experience. PennDOT will not authorize installation of a traffic signal unless one or more of the signal warrants is met.

The US 30/South Bailey Road intersection meets Warrant 2 - interruption of continuous traffic. This volume warrant applies to operating conditions where the traffic volumes on a major street (e.g., US 30) is so heavy that traffic on a minor intersecting street (e.g., South Bailey Road) suffers excessive delay or hazard in entering or crossing the major street. The warrant is satisfied when, for each of eight hours of an average day, the following traffic volumes exist on the one-lane approaches of the major street and on the higher-volume one-lane minor street approach to the intersection and the signal installation will not seriously disrupt progressive traffic flow: a total of 750 vehicles per hour on the major street and 75 vehicles per hour on the higher volume minor street approach. Based upon the ATR counts taken on the approaches to the intersection, it meets signal Warrant 2 for 14 hours over an average day. The warrant analysis is summarized in Appendix C. Because the northbound South Bailey Road approach is very narrow, the approach volumes used in the analysis were slightly adjusted downward to reflect inadvertent counting of southbound vehicles.

After it was determined from the ATR counts that a traffic signal at the US 30/South Bailey Road intersection was warranted, manual traffic counts were taken at the intersection between 9:00 AM to 4:00 PM to further substantiate the analysis. These counts do confirm that the US 30/South Bailey Road intersection does meet Warrant 2, justifying the need for a traffic signal. See Appendix D for these manual traffic counts at the intersection.

A quick check of Warrant 1 - minimum vehicular volume and Warrant 10 - short-term minimum vehicular and pedestrian volumes (for one and four hour periods) revealed that the warrants were not satisfied. Accident experience, Warrant 6, was not investigated.

FUTURE TRAFFIC CONDITIONS

TRIP GENERATION METHODOLOGY

There were a number of steps involved in generating future trips at the Thorndale Train Station. The first step was to estimate AM and PM peak hour arrival and departure patterns at the proposed station by evaluating the boarding and alighting patterns at adjacent stations on the R-5 Line. Next, the directional distribution to the station was determined by first identifying the station service area and then proportioning traffic to the station among ingress/egress routes based upon population densities. Background growth consisting of proposed commercial and industrial development and general background growth was also calculated. Finally, total future traffic volume was estimated by summing existing turning movements, background growth, and train station generated traffic.

Background growth consists of two separate components, specific development and general background growth. According to Caln Township officials, two new shopping centers are planned in the study area - a 120,000 sf shopping center at the northwest corner of US 30/PA 340 (Bondsville Road) intersection, and a 45,000 sf shopping center at the northwest corner of the US 30/Caln Road intersection. They also reported that ten to twelve parcels have been approved in the Caln Industrial Park. However, no development has occurred in the industrial park for a while, and its site plan approval may elapse if a new connector road to Caln Road is not constructed. For study purposes we conservatively assumed four parcels will be completed by the opening of the Thorndale Train Station (two parcels constructed each year). AM and PM peak hour trips from these developments were calculated and added to the study area highway network.

General background growth is a reflection of the influence of population and other development on the highway system. This report used a rate of 3 percent per year. This rate is consistent with other studies and is generally acceptable as a regional growth rate.

The next step of this process was to calculate train station generated trips. For most new projects, it is a relatively simple procedure to estimate peak hour trips using the Institute of Transportation Engineers (ITE) Trip Generation Manual. However, train stations are not a category covered in the manual. Parking demand at train stations is difficult to estimate because many external factors must be considered. In fact, demand varies by rail line and even among stations along the line.

Because Thorndale is a proposed train station, the existing parking lot usage and passenger arrival and departure patterns were not available. Therefore, it was determined that the most effective means to identify future train station activity at Thorndale was to examine boardings and alightings at similar stations in the vicinity of Thorndale on SEPTA's R-5 Regional Rail Line. The stations chosen - Downingtown, Whitford, Exton and Malvern - are all east of the proposed Thorndale Train Station.

Commutation at suburban rail stations is influenced by office schedules. Commuters bound for Philadelphia must use a train that allows them ample time to reach Center City, exit the station, and arrive at work on time, be it 8:00 AM or 8:30 AM. In the PM the reverse is true. Under the present SEPTA rail schedule, only two trains extend past the Downingtown Station in the AM and PM peak periods. Neither train arrives during the AM and PM vehicular peak hour. In fact, the last AM train which would leave the Thorndale Station at approximately 7:32 AM, considerably earlier than the vehicular peak hour which begins at 8:00 AM, arrives at Suburban Station at 8:35 AM.

To demonstrate the maximum impact of future parking lot usage on local traffic, two key assumptions were made. The first key assumption is that the train station parking lot will be filled by 9:00 AM. This may be an overestimate of future parking lot usage, therefore representative of a worst case scenario. The second key assumption is that trains terminating at the Downingtown Train Station will be extended to serve the proposed Thorndale Station. This scenario will generate considerably more vehicles during the traffic peak hour than the present train schedule.

Based upon 1990 SEPTA boarding and alighting activity at Downingtown, Whitford, Exton and Malvern train stations, an average of 5 percent of the AM boardings will occur during the AM traffic peak hour and 13 percent of the total daily alightings will occur during the PM traffic peak hour. Since the proposed Thorndale Station parking lot will contain 500 spaces, it is therefore expected that 25 vehicles will arrive in AM peak traffic hour and 65 vehicles will depart during the PM peak traffic hour.

Train station generated trips also include kiss-and-ride activity. Based upon a previous DVRPC study, which included SEPTA R-5 Line stations, kiss-and-ride activity in a area similar to Thorndale is approximately 16 percent of total train station ridership. Therefore, 5 kiss-and-ride vehicles will arrive at the Thorndale Train Station during the AM traffic peak hour and 11 will depart during the PM peak hour.

The next step in the process was to identify the station service area. This was accomplished using the Station Access Travel Patterns for the SEPTA Regional High Speed Lines, published by DVRPC in 1984, as a guide. This report identified service areas of rail stations in the Delaware Valley region. Adhering to the general shape and size of train station service areas displayed in the report, the basic service area for the Thorndale Train Station was identified. This catchment area was modified slightly to reflect potential natural barriers. As an example, US 322 divides the service areas between the Thorndale and Downingtown train stations.

The service area was then subdivided into sub-zones reflecting the actual routes to be used to access the rail station. Population data from the 1990 census and aerial photographs were used to estimate the percentage of population in each sub-zone. Figure 5 identifies the resulting arrival percentages. As an example, 28 percent of the vehicles will arrive via eastbound US 30. Conversely, in the PM, 28 percent will exit the station via westbound US 30 in the PM.

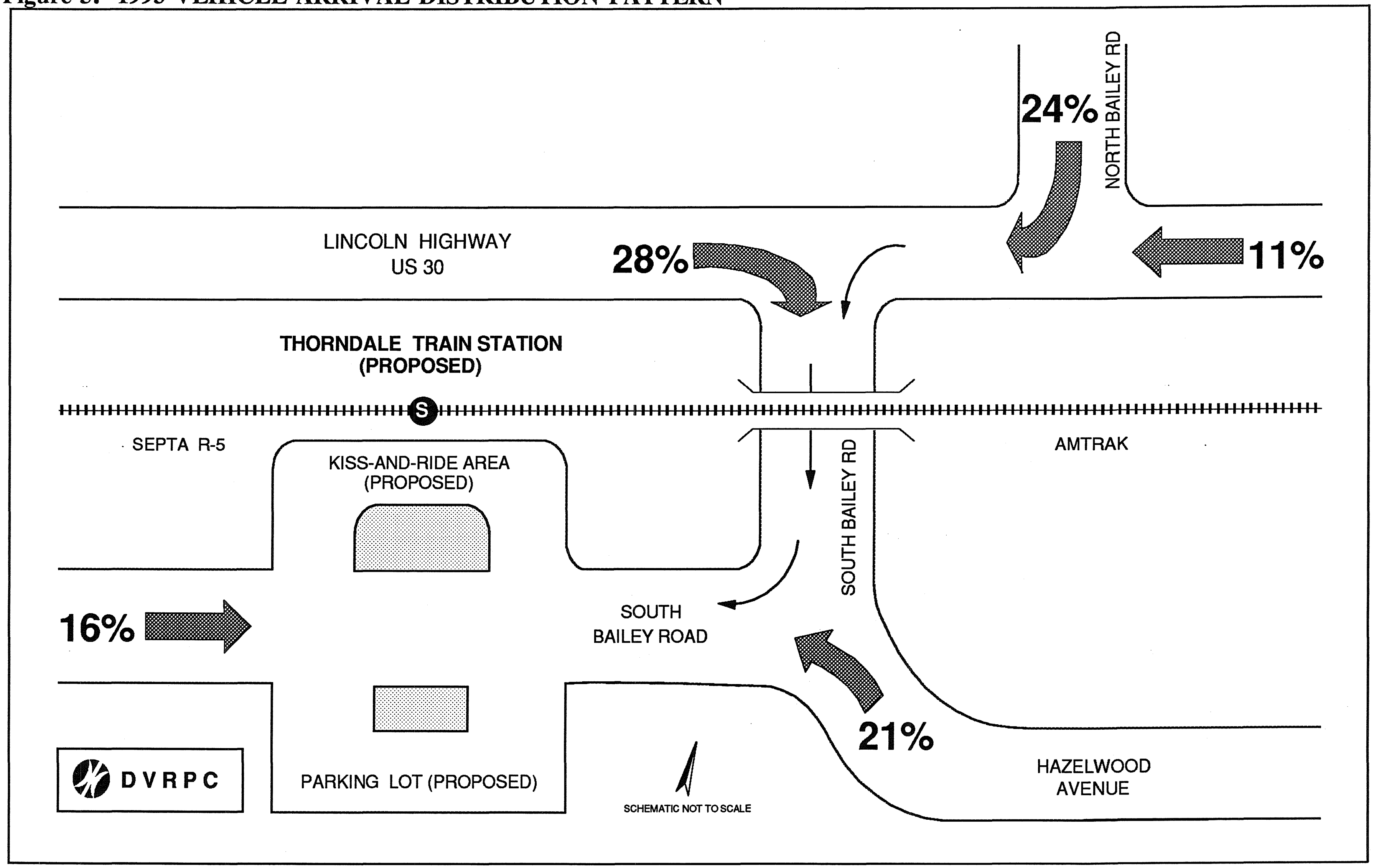
With the individual steps of the process completed, each element - general background growth, industrial and commercial development, train station parking lot generated trips, and kiss-and-ride trips - were added to existing turning movements. The result is 1993 AM and PM peak hour traffic volumes.

FUTURE TRAFFIC VOLUMES

It is important to identify if future train station activity at the proposed Thorndale Train Station will shift the peak hour from the current traffic peak hour to the future transit peak hour at each intersection in the study area. This "Shifting Peak" analysis was completed simply by calculating future traffic volumes during the AM and PM transit peak hours and comparing these values to future traffic projections during the AM and PM traffic peak hours, respectively. The "Shifting Peak" analysis confirmed that the traffic peak hour represents the worst case conditions at the US 30/North Bailey Road and the US 30/South Bailey Road intersections. Non-train station traffic levels on US 30 are so high that they will overwhelm any train station impact.

However, at the South Bailey Road/Hazelwood Avenue intersection, the AM and PM peak traffic hours will "shift" to the respective transit peak hours. Level of service analyses during the AM and PM traffic and transit peak hours confirm that lower service levels occur will occur during the transit peak hour. Because it is a fairly low volume intersection, and the vast

Figure 5: 1993 VEHICLE ARRIVAL DISTRIBUTION PATTERN



majority of passengers destined to the station will pass through it, the peak hour will shift to reflect train station activity. All 1993 traffic projections and analyses for the intersection are based on peak train conditions. At the intersections created by the driveways to the proposed parking lot and kiss-and-ride area, the transit peak hours were analyzed.

Figures 6-A and 6-B graphically display transit activity at the selected SEPTA R-5 Regional Rail Line train stations adjacent to the proposed Thorndale Train Station. The figures demonstrate that the traffic peak hours in the study area and the regional transit peak hours do not coincide. Figure 6-A displays that the AM transit peak hour occurs earlier than the AM traffic peak hour. As shown in Figure 6-B, the PM traffic peak hour occurs before the PM transit peak hour.

It is also clearly evident in Figures 6-A and 6-B that there are limited trains daily to/from Philadelphia on this section of the R-5 Regional Rail Line, with the most frequent inbound service clustered in the early morning and outbound service clustered in the late afternoon to early evening. Thus, the claim that commuters must use certain trains to arrive at work in Center City by 8:00 AM or 8:30 AM is substantiated.

Traffic volumes were calculated at the driveways to the parking lot and the kiss-and-ride area at the proposed Thorndale Train Station. In order to calculate future traffic volumes, several assumptions were made concerning the design of the station. It was assumed that the parking lot will be situated on the south side of South Bailey Road and two two-lane driveways will provide access to it. It was also assumed the kiss-and-ride drop-off area will be situated on the north side of South Bailey Road adjacent to the station, a one-way loop will serve the kiss-and-ride. It is important to note however, that the conceptual design of the Thorndale Train Station will be completed by a design consultant.

The increase in traffic volumes in the study area is more attributable to background growth than train station activity. This can be readily observed by comparing the train station generated traffic to existing and future volumes. The difference between existing and future volumes far exceed traffic generated by the station. The one exception is the intersection of South Bailey Road/Hazelwood Avenue where train station generated trips exceed background growth. However, during the traffic peak hour the reverse would be true. Generally, within the study area, traffic generated by the Caln Industrial Park is the largest contributor to the increase in AM traffic, and the approved shopping centers are the largest contributors to the increase in PM traffic.

Figure 6-A: AM TRANSIT ACTIVITY AT ADJACENT R-5 REGIONAL RAIL LINE TRAIN STATIONS

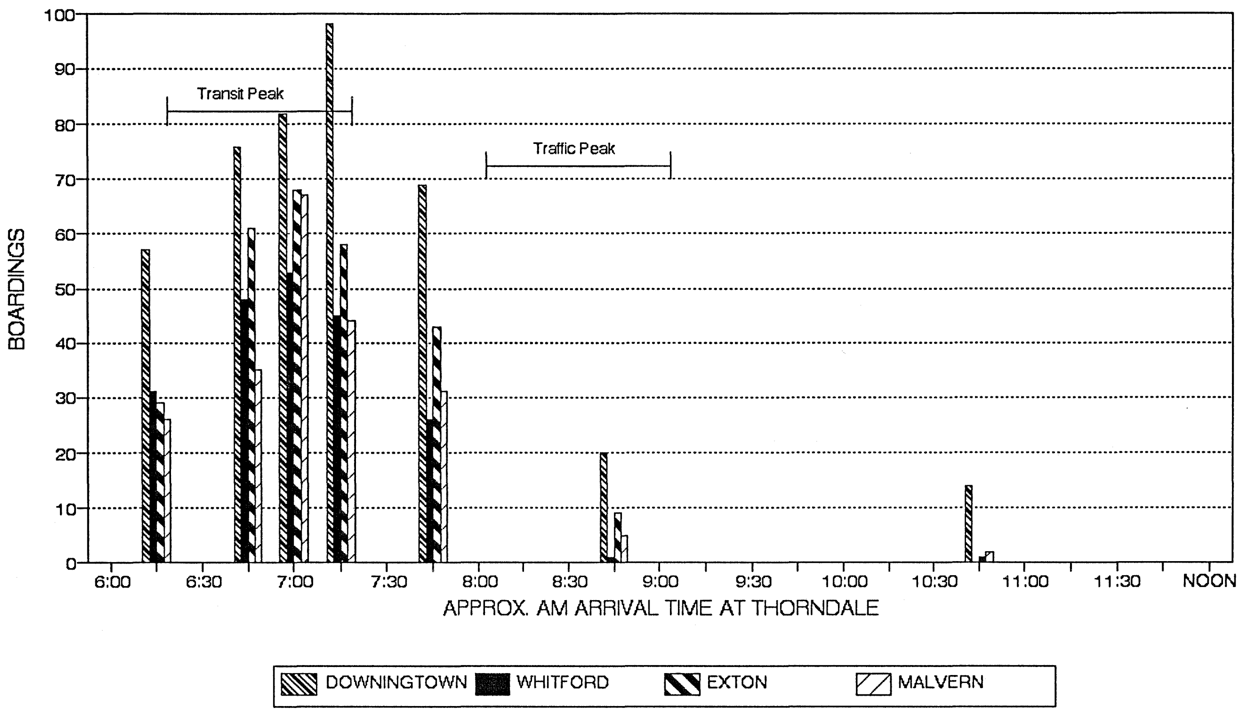
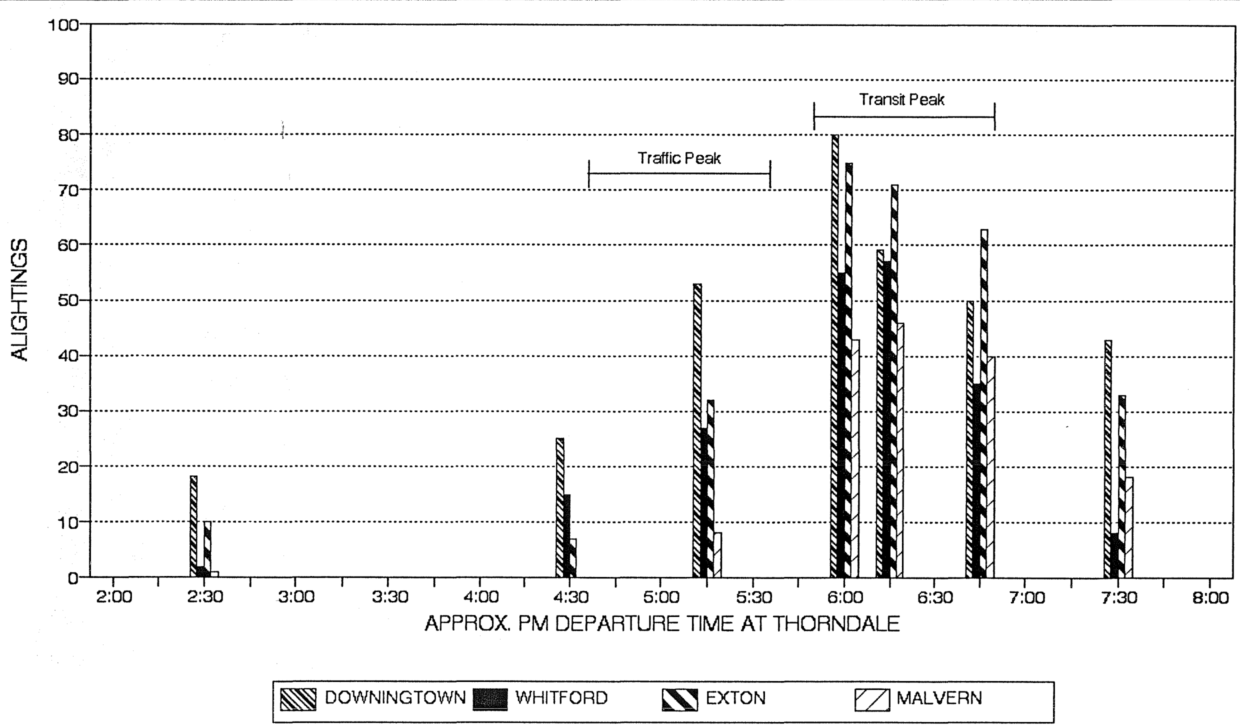


Figure 6-B: PM TRANSIT ACTIVITY AT ADJACENT R-5 REGIONAL RAIL LINE TRAIN STATIONS



At the parking lot and kiss-and-ride driveways, the future AM and PM train peak volumes were representative of worst case conditions. Thus, the transit peak hour volumes were assigned to the driveways. Because a disproportionate number of passengers arrive from the east and parking spaces in that section of the lot will fill rapidly, vehicles from that direction were proportioned among both driveways. Eastbound vehicles will use the first driveway into the lot.

Traffic generated by the train station is shown in Figures 7 and 8 for the AM and PM peak traffic hours. Included is traffic generated by park-and-ride as well as kiss-and-ride activity.

Total 1993 AM and PM traffic volumes in the proposed Thorndale Train Station study area are shown in Figures 9 and 10.

FUTURE LEVEL OF SERVICE ANALYSIS

Future level of service without improvements at the intersections in the Thorndale Train Station study area are shown graphically in Figure 11. Again, the analysis examines worst case conditions - auto peak hour along US 30 and train peak hour at South Bailey Road/Hazelwood Avenue and the driveways to the parking lot and kiss-and-ride area.

In the future, level of service at the US 30/North Bailey Road intersection will not experience any deterioration from existing service levels. The eastbound left-turn lane and through lane will operate at level of service A during the AM and PM peak hours. The westbound right-turn lane and through lane will operate at level of service A during the AM and level of service B during the PM peak hour. Both lanes on the North Bailey Road approach will operate at level of service C during both peak periods.

Level of service at US 30/South Bailey Road will deteriorate from existing service levels. The South Bailey Road approach will operate at level of service E during the AM and level of service F during the PM peak hour. It presently operates at level of service C in the AM and level of service E in the PM. The westbound left-turn lane will operate at level of service A in the AM and level of service B in the PM. This analysis does not consider signalization of the intersection.

The eastbound approach of South Bailey Road/Hazelwood Avenue will operate at level of service A in the AM peak hour and level of service C during the PM peak hour. Although

Figure 7: 1993 AM PEAK HOUR TRAIN STATION GENERATED TRIPS

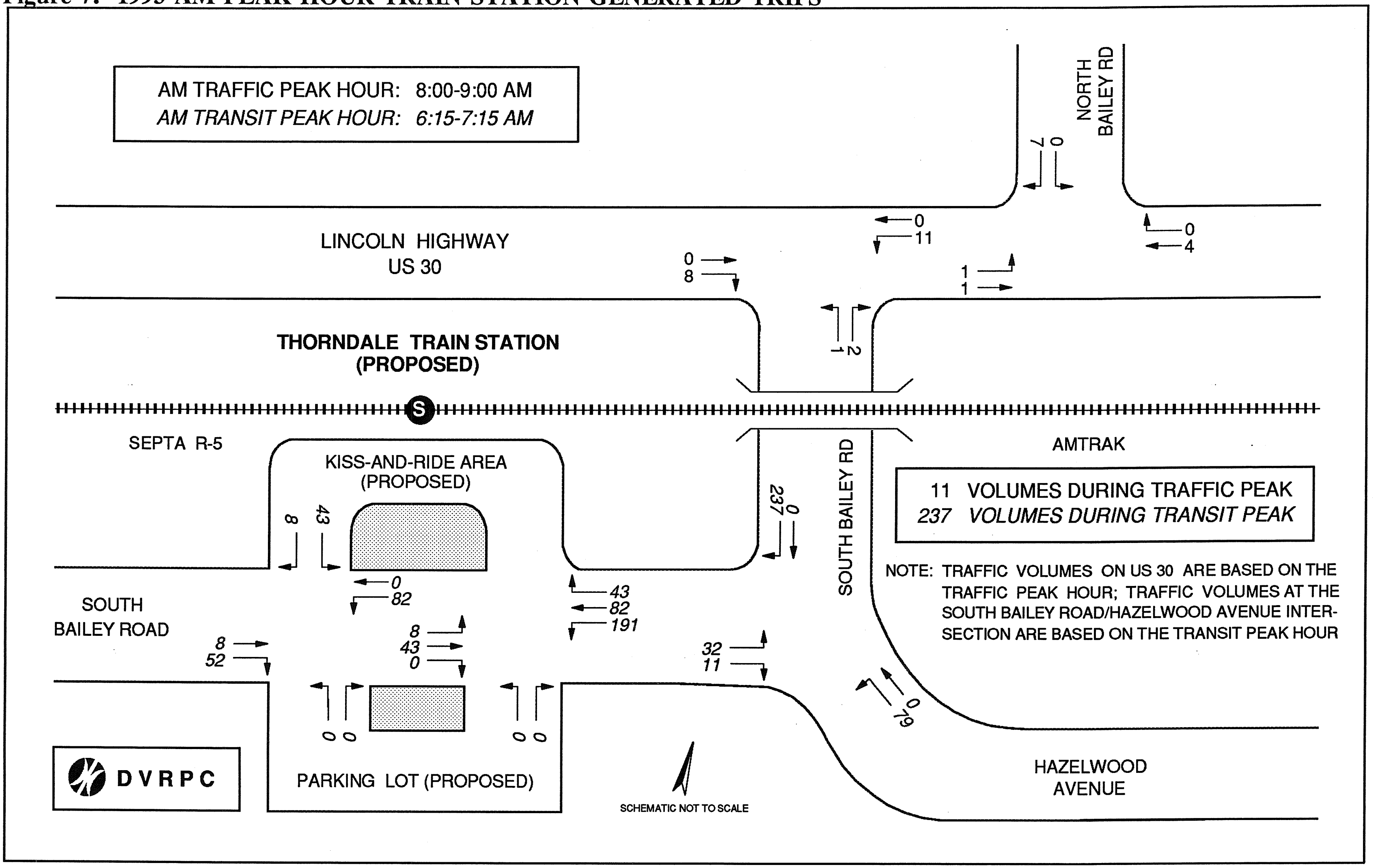


Figure 8: 1993 PM PEAK HOUR TRAIN STATION GENERATED TRIPS

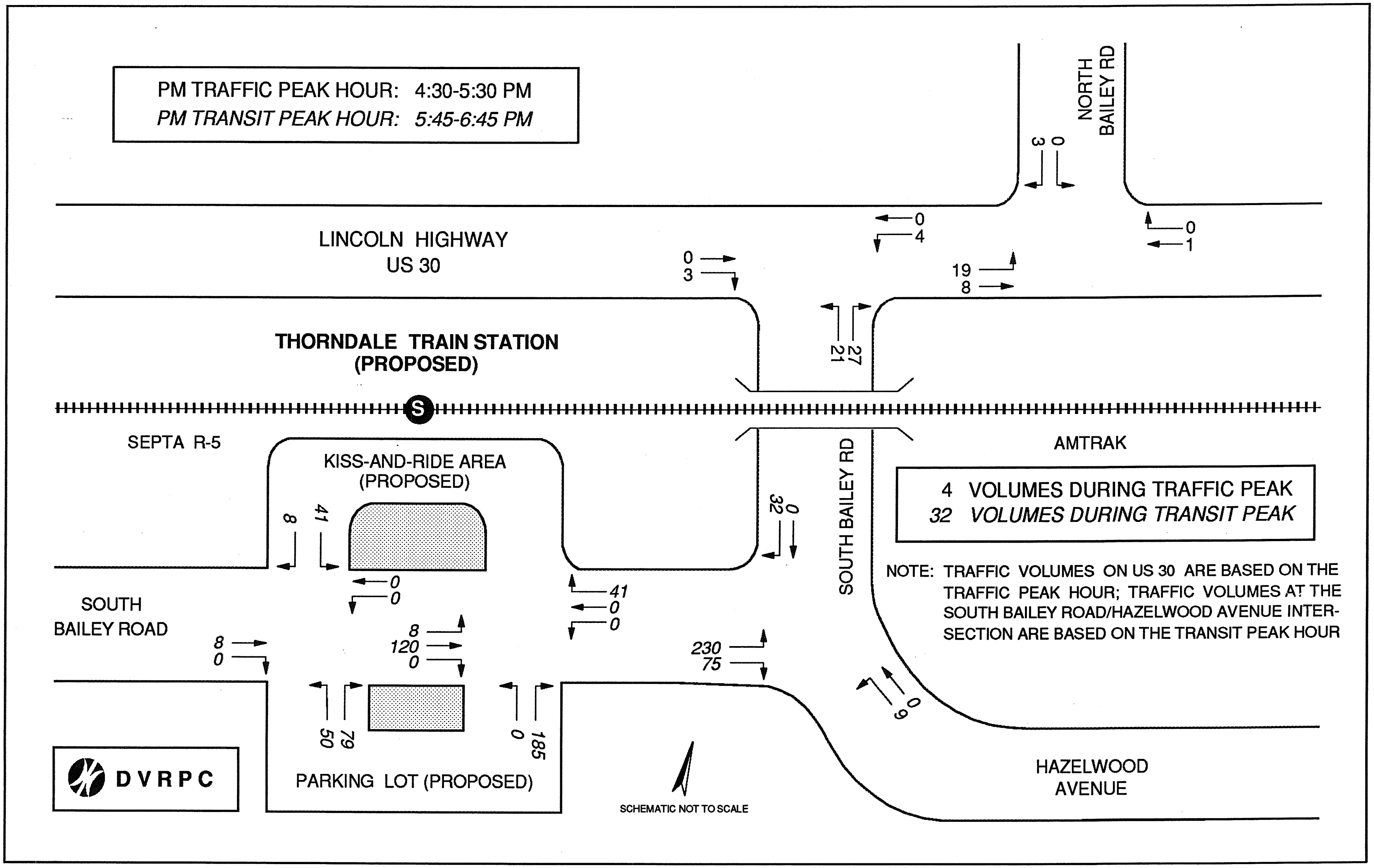


Figure 9: TOTAL 1993 AM PEAK HOUR TRAFFIC VOLUMES

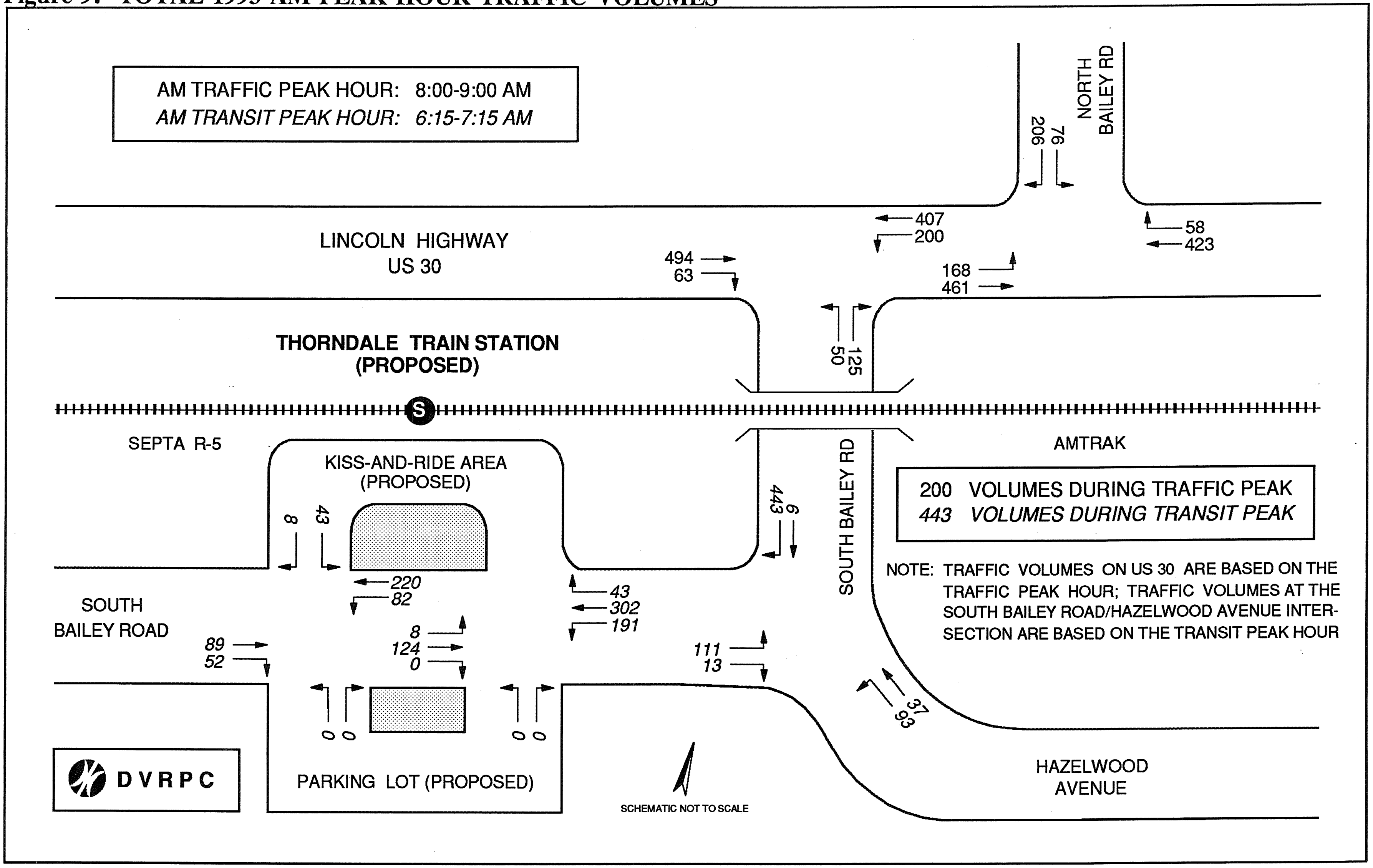


Figure 10: TOTAL 1993 PM PEAK HOUR TRAFFIC VOLUMES

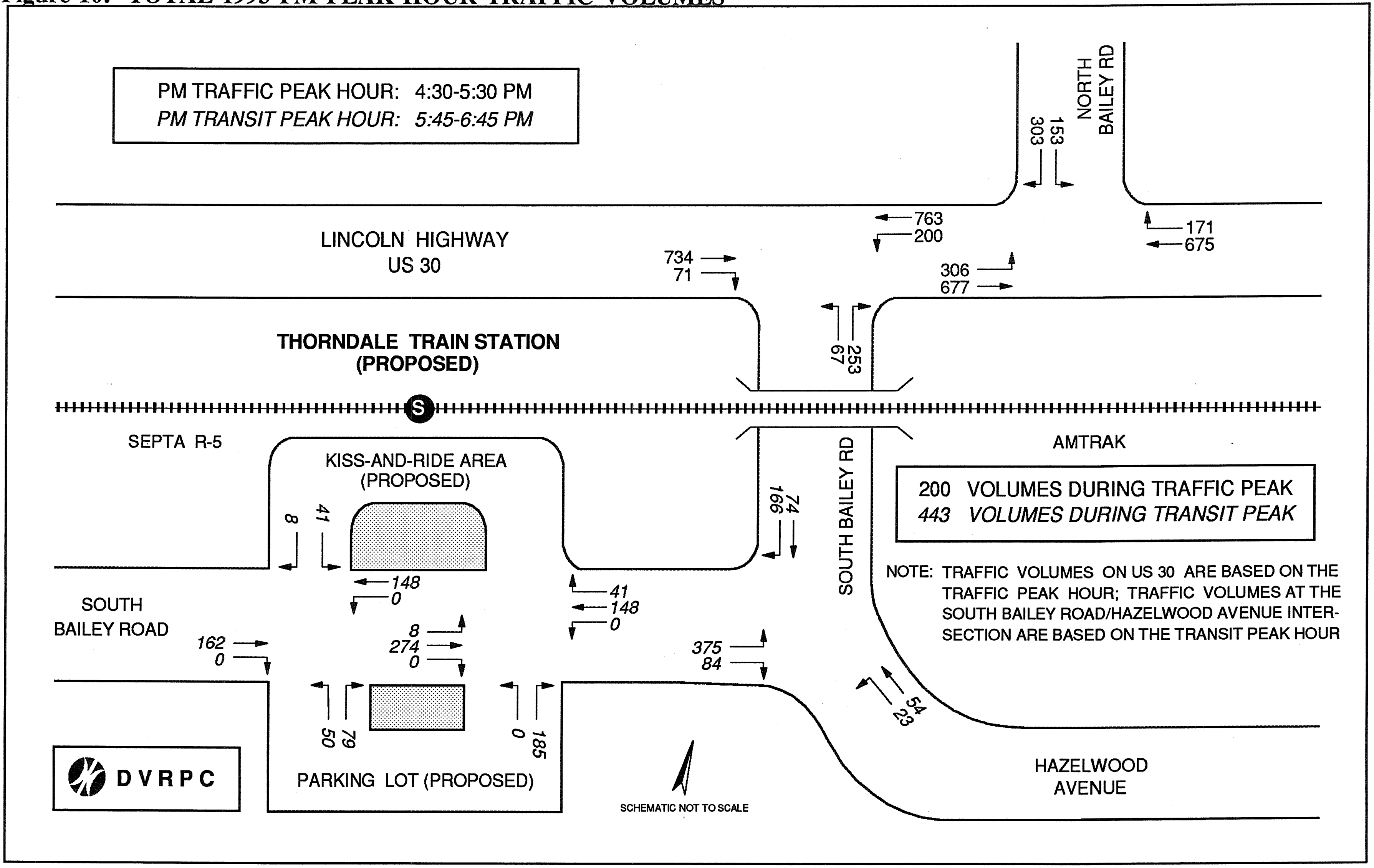
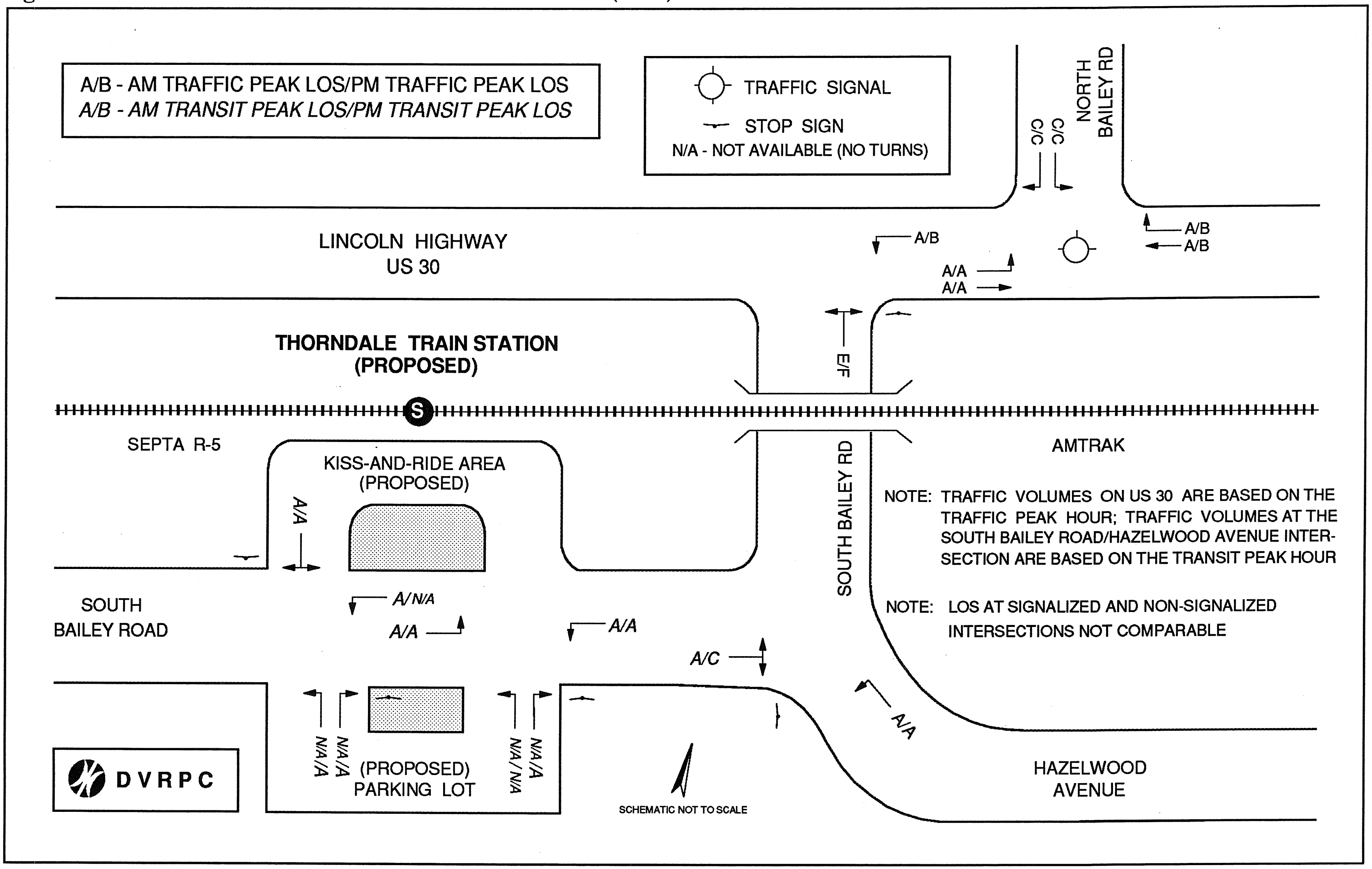


Figure 11: 1993 PEAK HOUR LEVELS OF SERVICE (LOS)



the eastbound approach is projected to experience a deterioration of PM service levels from level of service A to level of service C, it is still a satisfactory service level. This is representative of worst case conditions with passengers exiting the train station. An analysis of the AM and PM auto peak hour indicates level of service A operating conditions (not shown in the report).

Level of service analyses indicate all driveways to the parking lot and kiss-and-ride area will function at level of service A during the AM and PM peak periods.

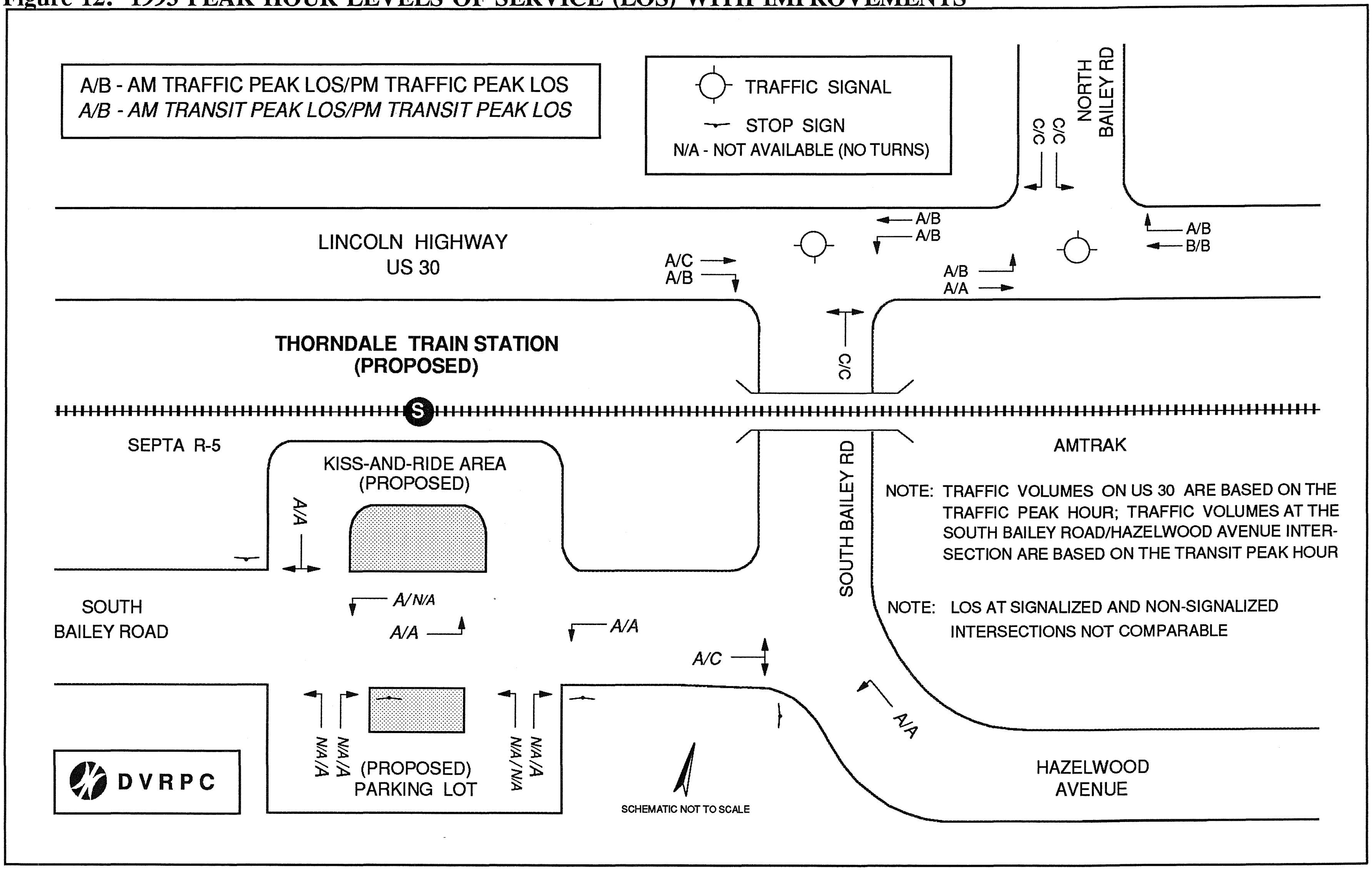
FUTURE LEVEL OF SERVICE ANALYSIS WITH IMPROVEMENTS

A level of service analysis of future conditions with improvements was conducted for the intersections in the study area. The main improvements modeled were installation of a traffic signal at US 30/South Bailey Road, widening the shoulder on the eastbound approach of US 30 at South Bailey Road to serve right turning vehicles, and coordinating the traffic signals at the South Bailey Road and North Bailey Road intersections. Future level of service with improvements are shown graphically in Figure 12. Again, the analysis examined auto peak conditions along US 30 and train peak conditions at the South Bailey Road/Hazelwood Avenue intersection.

The feasibility of coordinating the two intersections, optimizing their signal timings, and evaluating the capacity of the left-turn lanes, was evaluated using a TRANSYT-7F traffic simulation model. TRANSYT-7F, a model sponsored by the Federal Highway Administration (FHWA), is used by PennDOT to evaluate traffic signal timing and coordination. This section of US 30 has a background cycle for traffic signals of 80 seconds. To remain consistent with the existing background cycle length of the corridor, this cycle length was employed to optimize the phasing for the existing US 30/North Bailey Road intersection traffic signal and the recommended traffic signal at the US 30/South Bailey Road intersection. The TRANSYT-7F model showed that effective coordination will result. TRANSYT-7F did indicate that the eastbound exclusive left-turn lane at the US 30/North Bailey Road intersection may not have adequate storage capacity. However, this problem is relatively minor and since this movement has a protected phase, the queues will dissipate quickly during the next green phase. The analysis indicated a lesser problem will be encountered on the westbound US 30 left-turn to South Bailey Road.

With construction of a new traffic signal at South Bailey Road, the US 30 approaches to the intersection are projected to operate at level of service A during the AM traffic peak hour.

Figure 12: 1993 PEAK HOUR LEVELS OF SERVICE (LOS) WITH IMPROVEMENTS



During the PM traffic peak hour the eastbound US 30 through-lane will operate at level of service C and the right-turn lane will operate at level of service B. With the traffic signal improvement, both US 30 westbound lanes will operate at level of service B during the PM traffic peak hour. The South Bailey Road approach will operate at level of service C during both peak hours.

Level of service analyses at the US 30/North Bailey Road intersection using the optimized signal timing from the TRANSYT-7F model runs, indicated that service levels will be indistinguishable from service levels prior to the signal modification. Two movements, the westbound through lane during the AM traffic peak hour and the eastbound left-turn lane in the PM traffic peak hour, will experience an insignificant reduction in service levels from service level A to level of service B.

At the South Bailey Road/Hazelwood Avenue intersection and the intersections created by construction of the parking lot and kiss-and-ride area at the proposed Thorndale Train Station, no capacity improvements are envisioned. Therefore no change in level of service is expected.

FINDINGS AND RECOMMENDATIONS

FINDINGS

Based upon the analyses conducted, the following conclusions are presented regarding traffic impacts associated with construction of the Thorndale Train Station:

- The US 30/North Bailey Road and South Bailey Road/Hazelwood Avenue intersections currently operate with acceptable level of service. The US 30/South Bailey Road intersection presently operates with poor level of service, service level E in the PM peak hour.

- Based on existing traffic volumes, a traffic signal at the intersection of US 30 and South Bailey Road is warranted. According to hourly traffic counts taken by this study, it satisfies Warrant 2 - interruption of continuous traffic.

- Future train station activity will have a minimum impact on the study area because the train and traffic peak periods will not coincide. Based upon train boarding and alighting patterns at nearby stations, commuters will board trains prior to the AM auto peak and alight trains after the PM peak. For example, in the AM, only 5 percent of the train passengers are projected to board a train during the auto peak (8:00 AM to 9:00 AM) while 65 percent are projected to board during the train peak (6:15 AM to 7:15 AM).

- The intersection most adversely impacted by the proposed train station is the South Bailey Road/Hazelwood Road intersection. Because it is currently a fairly low volume intersection, and the vast majority of passengers destined to the station will pass through it, the peak hour at the intersection will "shift" to reflect train station activity. Even under these worst case conditions, it will still operate at service level C or better.

- Under future conditions, US 30/North Bailey Road will operate with essentially the same level of service as it presently experiences. Level of service on the South Bailey Road approach of the US 30/South Bailey Road intersection will deteriorate from level of service C to level of service E in the AM, and level of service E to level of service F in the PM. Traffic increases attributable to commercial and industrial development previously approved by Caln Township far surpasses new traffic generated by the train station.

- When the Thorndale Train Station is completed, the driveways to the parking lot and kiss-and-ride area will operate at superior levels of service.

- With installation of a traffic signal at US 30/South Bailey Road, the intersection will function in a satisfactory manner. The South Bailey Road approach will operate with level of service C in the AM and PM while the US 30 approaches will generally operate with level of service A and level of service B.

- As indicated in the TRANSYT-7F runs, coordination - using the existing 80 second background cycle length - between the US 30/North Bailey Road and US 30/South Bailey Road intersections will be very effective.

- Because the signal phasing was optimized using the existing background cycle length, service levels at the US 30/North Bailey Road intersection will not be adversely effected.

- The exclusive left-turn lane on eastbound US 30 at North Bailey Road may have inadequate storage capacity. However, these queues will quickly dissipate. To a lesser extent, this problem will also exist at the US 30 westbound left-turn lane to South Bailey Road at the US 30/South Bailey Road intersection. The westbound US 30 shoulder will allow for westbound US 30 through vehicles to pass the queued vehicles.

RECOMMENDATIONS

New Traffic Signal at the US 30/South Bailey Road Intersection

To rectify congestion problems at the US 30/South Bailey Road intersection, a new traffic signal is recommended. The intersection presently meets traffic signal Warrant 2 - interruption of continuous traffic (see Appendix C). It is recommended that the signalization improvement incorporate the following elements:

- Building up the eastbound US 30 shoulder at the intersection for right-turns to South Bailey Road intersection. This improved shoulder will serve as a short right-turn lane; a level of service analysis indicated an exclusive right-turn lane is needed.

- Provision of a leading green phase for the westbound left-turn lane on US 30 at South Bailey Road. A conflict factor analysis shows the intersection exceeds the warrants specified by PennDOT.

- Installation of "Signal Ahead" signs on the South Bailey Road approach. Although it does meet minimum visibility distance standards for a traffic signal as specified in the Manual On Uniform Traffic Control Devices (MUTCD), supplemental "Signal Ahead" signs will improve safety.

- Coordination of the traffic signals at South Bailey Road and North Bailey Road. This can be accomplished through a physical hard wire connection.

- Striping of a crosswalk on the eastbound US 30 approach with pedestrian push button actuation at the recommended traffic signal.

US 30/North Bailey Road Intersection

Due to their close proximity, the existing US 30/North Bailey Road intersection and the proposed US 30/South Bailey Road intersection traffic signals need to be coordinated. As mentioned, this can be accomplished through a physical hard wire connections. Using the existing 80 second background cycle length in this section of US 30, the TRANSYT-7F runs indicated that signal phasing at the US 30/North Bailey Road intersection needs to be adjusted.

No recommendations are offered for the potential storage capacity problem of the eastbound left-turn lane at North Bailey Road. Shortening the back-to-back westbound left-turn lane at South Bailey Road is not a viable solution. If left-turn vehicles spill back into the eastbound through lane, it will cause a short-term disruption. Because the traffic signal will change so frequently, the left-turn lane queue will quickly dissipate. Furthermore, some of the vehicles currently performing this movement will be diverted to Carlson Boulevard when it is completed. Caln Township is in the process of constructing Carlson Boulevard, a northern parallel route to US 30. When the last phase is completed, it will provide a continuous link between Caln Road and US 322 via Lloyd Avenue. Thus, eastbound US 30 vehicles will have more opportunities to make this left-turn at other less congested intersections.

South Bailey Road/Hazelwood Avenue Intersection

Even though the intersection will operate with acceptable service levels, a number of physical improvements are called for. The improvements are listed below:

- All approaches to the intersection should be marked with center lines. There are no center lines on any of the approaches at the present time.

- A modified "Side Road" sign should be erected on Hazelwood Avenue to give motorists advance warning of the South Bailey Road intersection. Because the intersection is situated on a curve, warning signage will give advance notice of possible turning vehicles. Train station signs should also be posted on Hazelwood Avenue in advance of the intersection.

- Consideration should be given to cutting back the eastern curb line of the intersection and/or the southwest corner. This will permit Hazelwood Avenue through traffic to by-pass vehicles turning onto South Bailey Road. Opening up the intersection will also make it easier for two vehicles to make concurrent turns.

- Consideration should also be given to constructing a second eastbound approach lane on South Bailey Road. The cost effectiveness of constructing additional capacity to handle the surge of vehicles exiting the lot only once or twice a day must be balanced with the added construction cost.

APPENDIX A

EXISTING PEAK PERIOD TRAFFIC VOLUMES

Table A-1: PEAK PERIOD TRAFFIC COUNTS US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD

AM PEAK PERIOD

Date: Tuesday, July 9, 1991
Weather: Clear

	N. BAILEY RD SOUTHBOUND		US 30 EASTBOUND		US 30 WESTBOUND		
TIME	L	R	L	S	S	R	TTL
6:15 - 6:30	9	11	15	74	25	4	138
6:30 - 6:45	10	16	20	91	42	4	183
6:45 - 7:00	7	17	21	80	64	2	191
7:00 - 7:15	9	19	23	95	57	5	208
7:15 - 7:30	14	31	22	88	58	11	224
7:30 - 7:45	14	30	32	94	77	16	263
7:45 - 8:00	10	40	34	84	71	8	247
8:00 - 8:15	**13**	**28**	**30**	**87**	**73**	**10**	**241**
8:15 - 8:30	**12**	**38**	**33**	**102**	**73**	**12**	**270**
8:30 - 8:45	**19**	**31**	**29**	**95**	**85**	**14**	**273**
8:45 - 9:00	**27**	**30**	**51**	**93**	**82**	**18**	**301**
6:15 - 9:00	144	291	310	983	707	104	2,359
PEAK HR	71	127	143	377	313	54	1,085

PM PEAK PERIOD

Date: Tuesday, July 9, 1991
Weather: Clear

	N. BAILEY RD SOUTHBOUND		US 30 EASTBOUND		US 30 WESTBOUND		
TIME	L	R	L	S	S	R	TTL
4:00 - 4:15	35	66	54	106	134	39	434
4:15 - 4:30	29	67	51	119	129	29	424
4:30 - 4:45	**34**	**65**	**49**	**125**	**138**	**35**	**446**
4:45 - 5:00	**41**	**80**	**59**	**122**	**133**	**34**	**469**
5:00 - 5:15	**34**	**59**	**60**	**136**	**140**	**47**	**476**
5:15 - 5:30	**33**	**66**	**57**	**133**	**143**	**43**	**475**
5:30 - 5:45	26	63	48	111	131	34	413
5:45 - 6:00	24	71	34	114	133	23	399
6:00 - 6:15	31	53	40	106	134	38	402
6:15 - 6:30	36	57	51	110	117	21	392
6:30 - 6:45	29	49	37	113	108	21	357
4:00 - 6:45	352	696	540	1,295	1,440	364	4,687
PEAK HR	142	270	225	516	554	159	1,866

[shaded] **PEAK HOUR**

Table A-2: PEAK PERIOD TRAFFIC COUNTS US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD

AM PEAK PERIOD

Date: Tuesday, July 9, 1991
Weather: Clear

TIME	S. BAILEY RD NORTHBOUND L	S. BAILEY RD NORTHBOUND R	US 30 EASTBOUND S	US 30 EASTBOUND R	US 30 WESTBOUND L	US 30 WESTBOUND S	TTL
6:15 - 6:30	1	7	80	2	8	18	116
6:30 - 6:45	3	10	93	14	10	41	171
6:45 - 7:00	5	21	83	16	23	48	196
7:00 - 7:15	5	23	93	8	8	70	207
7:15 - 7:30	5	20	94	13	14	65	211
7:30 - 7:45	12	19	100	15	14	88	248
7:45 - 8:00	10	21	95	15	15	80	236
8:00 - 8:15	**12**	**15**	**103**	**14**	**13**	**85**	**242**
8:15 - 8:30	**12**	**23**	**107**	**9**	**17**	**84**	**252**
8:30 - 8:45	**8**	**20**	**110**	**13**	**17**	**90**	**258**
8:45 - 9:00	**7**	**26**	**107**	**12**	**11**	**103**	**266**
6:15 - 9:00	80	205	1,065	131	150	772	2,403
PEAK HR	39	84	427	48	58	362	1,018

PM PEAK PERIOD

Date: Tuesday, July 9, 1991
Weather: Clear

TIME	S. BAILEY RD NORTHBOUND L	S. BAILEY RD NORTHBOUND R	US 30 EASTBOUND S	US 30 EASTBOUND R	US 30 WESTBOUND L	US 30 WESTBOUND S	TTL
4:00 - 4:15	8	30	130	11	39	165	383
4:15 - 4:30	10	25	139	15	31	166	386
4:30 - 4:45	**7**	**25**	**151**	**13**	**31**	**175**	**402**
4:45 - 5:00	**8**	**27**	**154**	**11**	**38**	**167**	**405**
5:00 - 5:15	**13**	**32**	**173**	**13**	**46**	**152**	**429**
5:15 - 5:30	**5**	**32**	**151**	**17**	**41**	**160**	**406**
5:30 - 5:45	7	34	129	14	34	158	376
5:45 - 6:00	12	29	108	11	40	152	352
6:00 - 6:15	5	27	116	15	41	140	344
6:15 - 6:30	6	29	126	8	30	143	342
6:30 - 6:45	9	22	128	10	26	131	326
4:00 - 6:45	90	312	1,505	138	397	1,709	4,151
PEAK HR	33	116	629	54	156	654	1,642

(shaded) **PEAK HOUR**

Table A-3: PEAK PERIOD TRAFFIC COUNTS SOUTH BAILEY ROAD/HAZELWOOD AVENUE

AM PEAK PERIOD

Date: Tuesday, July 9, 1991
Weather: Clear

	HAZELWOOD AVE NORTHBOUND		S. BAILEY RD SOUTHBOUND		S. BAILEY RD EASTBOUND		
TIME	L	S	S	R	L	R	TTL
6:15 - 6:30	0	5	0	11	6	0	22
6:30 - 6:45	2	7	0	24	8	0	41
6:45 - 7:00	1	10	4	28	14	0	57
7:00 - 7:15	0	9	0	12	16	0	37
7:15 - 7:30	2	5	7	16	21	1	52
7:30 - 7:45	3	6	10	18	20	0	57
7:45 - 8:00	3	6	11	21	22	0	63
8:00 - 8:15	**3**	**12**	**13**	**18**	**12**	**1**	**59**
8:15 - 8:30	**3**	**13**	**13**	**13**	**22**	**0**	**64**
8:30 - 8:45	**1**	**10**	**13**	**16**	**12**	**1**	**53**
8:45 - 9:00	**2**	**10**	**11**	**13**	**25**	**2**	**63**
6:15 - 9:00	20	93	82	190	178	5	568
PEAK HR	9	45	50	60	71	4	239

PM PEAK PERIOD

Date: Tuesday, July 9, 1991
Weather: Clear

	HAZELWOOD AVE NORTHBOUND		S. BAILEY RD SOUTHBOUND		S. BAILEY RD EASTBOUND		
TIME	L	S	S	R	L	R	TTL
4:00 - 4:15	2	8	17	33	29	1	90
4:15 - 4:30	2	11	18	27	25	3	86
4:30 - 4:45	**2**	**10**	**17**	**24**	**25**	**2**	**80**
4:45 - 5:00	**6**	**17**	**16**	**31**	**22**	**2**	**94**
5:00 - 5:15	**1**	**18**	**19**	**39**	**26**	**1**	**104**
5:15 - 5:30	**3**	**13**	**20**	**35**	**30**	**4**	**105**
5:30 - 5:45	0	16	16	27	25	4	88
5:45 - 6:00	2	14	14	31	23	1	85
6:00 - 6:15	0	9	25	31	15	1	81
6:15 - 6:30	3	9	10	24	20	1	67
6:30 - 6:45	2	10	12	19	16	0	59
4:00 - 6:45	23	135	184	321	256	20	939
PEAK HR	12	58	72	129	103	9	383

PEAK HOUR (shaded)

APPENDIX B

LEVEL OF SERVICE (LOS) CRITERIA

LEVEL OF SERVICE (LOS)

The concept of level of service is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists in terms of speed and travel time, traffic interruptions, freedom to maneuver, comfort, and convenience. Six levels of service are defined; they are given letter designations, A to F, with level of service A representing the best operating conditions and level of service F the worst. Level of service C is the minimum desirable condition; however, jurisdictions frequently tolerate level of service D when the cost to upgrade the highway facility becomes prohibitive.

Methodology to determine level of service is presented in the Highway Capacity Manual, Transportation Research Board Special Report 209. Different methodologies are specified for signalized and unsignalized intersections.

SIGNALIZED INTERSECTIONS

Level of service for signalized intersections is defined in terms of delay. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. Delay is a complex measure dependent upon a number of variables, including the quality of signal progression, cycle length, and the volume to capacity (V/C) ratio. Level of service criteria is stated in terms of the average stopped delay per vehicle on an approach or lane basis. Table C-1 gives a subjective description of each level of service and its delay range. It is important to note that delay (i.e., level of service) is not related to capacity in a simple fashion. Thus, the designation of level of service F does not automatically imply the approach is overloaded. Long cycle length and poor signal progression can result in excessive delays. Conversely, an overloaded approach with a short cycle length may result in a high level of service.

UNSIGNALIZED INTERSECTIONS

Level of service criteria for unsignalized intersections are defined in terms of reserved or unused capacity. Reserve capacity is related to general delay ranges (see Table C-2). Since delay is stated in general terms, without specific numeric values, it is not possible to compare or associate unsignalized level of service with signalized level of service. The potential capacity of a lane is based upon two factors: (1) distribution of gaps in the cross traffic stream and (2) driver judgement in selecting gaps through which to execute the desired maneuvers. Reserve capacity represents the difference between the approach volume and potential capacity. The analysis focuses on lanes on the minor stopped street and left turn maneuvers from the major street.

Table B-1: LEVEL OF SERVICE (LOS) CRITERIA SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE A - Very low delay, good progression; most vehicles do not stop at intersection. Delay less than 5 seconds per vehicle.

LEVEL OF SERVICE B - Generally good signal progression and/or short cycle length; more vehicles stop at intersection than Level of Service A. Delay range 5-15 seconds per vehicle.

LEVEL OF SERVICE C - Fair progression and/or longer cycle length; significant number of vehicles stop at intersection. Delay range 15-25 seconds per vehicle.

LEVEL OF SERVICE D - Congestion becomes noticeable; individual cycle failures; longer delays from unfavorable progression, long cycle length, or high volume/capacity ratios; many vehicles stop at signal. Delay range 25-40 seconds per vehicle.

LEVEL OF SERVICE E - Considered limit of acceptable delay, indicative of poor progression, long cycle length, high volume/capacity ratio; frequent individual cycle failures. Delay range 40-60 seconds per vehicle.

LEVEL OF SERVICE F - Unacceptable delay, indication of oversaturation (i.e., arrival flow exceeds capacity). Average delay exceeds 60 seconds per vehicle.

Table B-2: LEVEL OF SERVICE (LOS) CRITERIA UNSIGNALIZED INTERSECTIONS

Level of Service	Reserve Capacity	Expected Delay to Minor Street Traffic
A	Greater than 400	Little or no delay
B	300-400	Short traffic delays
C	200-299	Average traffic delays
D	100-199	Long traffic delays
E	0-99	Very long traffic delays
F	*	*

* When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection.

APPENDIX C

TRAFFIC SIGNAL WARRANT ANALYSIS
US 30/SOUTH BAILEY ROAD INTERSECTION
AUTOMATIC TRAFFIC RECORDER (ATR) COUNTS

Table C-1: TRAFFIC SIGNAL WARRANT ANALYSIS US 30/SOUTH BAILEY ROAD INTERSECTION AUTOMATIC TRAFFIC RECORDER (ATR) COUNTS

	US 30			N BAILEY ROAD		MEET
HOUR	EB	WB	TOTAL	NB	ADJ NB	WARRANT 2?
12-1	68	102	170	9	8	N
1-2	35	31	66	9	8	N
2-3	13	25	38	6	5	N
3-4	18	18	36	5	4	N
4-5	44	29	73	12	11	N
5-6	146	56	202	32	28	N
6-7	385	201	586	70	61	N
7-8	493	387	880	143	126	Y
8-9	554	471	1025	143	126	Y
9-10	680	536	1216	133	117	Y
10-11	709	613	1322	125	110	Y
11-12	779	763	1542	145	127	Y
12-1	838	866	1704	160	140	Y
1-2	699	761	1460	122	107	Y
2-3	677	742	1419	135	118	Y
3-4	760	774	1534	166	146	Y
4-5	696	819	1515	160	140	Y
5-6	705	783	1488	181	159	Y
6-7	626	726	1352	150	132	Y
7-8	584	697	1281	120	105	Y
8-9	501	596	1097	111	97	Y
9-10	335	460	795	54	47	N
10-11	230	271	501	33	29	N
11-12	130	200	330	55	48	N
TOT	10705	10927	21632	2279	1999	

APPENDIX D

TRAFFIC SIGNAL WARRANT ANALYSIS
US 30/SOUTH BAILEY ROAD INTERSECTION
MANUAL TURNING MOVEMENT COUNTS

Table D-1: TRAFFIC SIGNAL WARRANT ANALYSIS US 30/SOUTH BAILEY ROAD INTERSECTION MANUAL TURNING MOVEMENT COUNTS

	S BAILEY RD NORTH			US 30 EAST			US 30 WEST			INT
AM	L	R	TOT	S	R	TOT	L	S	TOT	TOT
6:15- 6:30	1	7	8	80	2	82	8	18	29	119
6:30- 6:45	3	10	13	93	14	107	10	41	54	174
6:45- 7:00	5	21	26	83	16	99	23	48	73	198
7:00- 7:15	5	23	28	93	8	101	8	70	79	208
7:15- 7:30	5	20	27	94	13	107	14	65	80	214
7:30- 7:45	12	19	31	100	15	115	14	88	104	250
7:45- 8:00	10	21	32	95	15	110	15	80	97	239
8:00- 8:15	12	15	27	103	14	117	13	85	99	243
8:15- 8:30	12	23	36	107	9	116	17	84	103	255
8:30- 8:45	8	20	28	110	13	123	17	90	109	260
8:45- 9:00	7	26	36	107	12	119	11	103	120	275
MID-DAY										
9:00- 9:30	10	55	65	302	9	311	23	220	243	619
9:30-10:00	14	37	51	302	13	315	36	270	306	672
10:00-10:30	15	48	63	326	20	346	29	276	305	714
10:30-11:00	7	42	49	320	15	335	28	318	346	730
11:00-11:30	14	68	82	314	16	330	60	239	299	711
11:30-12:00	13	51	64	325	11	336	57	369	426	826
12:00-12:30	18	57	75	375	16	391	65	391	456	922
12:30- 1:00	10	60	70	362	11	373	49	347	396	839
1:00- 1:30	9	56	65	301	12	313	53	394	447	825
1:30- 2:00	17	32	49	283	13	296	43	306	349	694
2:00- 2:30	10	44	54	304	21	325	38	336	374	753
2:30- 3:00	10	41	51	384	22	406	59	352	411	868
3:00- 3:30	20	49	69	325	14	339	68	381	449	857
3:30- 4:00	20	47	67	357	20	377	51	364	415	859
PM										
4:00- 4:15	8	30	38	130	11	141	39	165	206	385
4:15- 4:30	10	25	35	139	15	154	31	166	199	388
4:30- 4:45	7	25	32	151	13	164	31	175	210	406
4:45- 5:00	8	27	36	154	11	165	38	167	207	408
5:00- 5:15	13	32	45	173	13	186	46	152	202	433
5:15- 5:30	5	32	38	151	17	168	41	160	202	408
5:30- 5:45	7	34	41	129	14	143	34	158	196	380
5:45- 6:00	12	29	42	108	11	119	40	152	198	359
6:00- 6:15	5	27	33	116	15	131	41	140	186	350
6:15- 6:30	6	29	35	126	8	134	30	143	178	347
6:30- 6:45	9	22	31	128	10	138	26	131	162	331
DAILY TOTAL	357	1,204	1,572	7,150	482	7,632	1,206	7,044	8,315	17,519

APPENDIX E

TRAFFIC SIGNAL COORDINATION ANALYSIS

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
  2) * COMMENT:     US 30/NORTH BAILEY ROAD INTERSECTION
1          T R A N S Y T - 7 F  --  T R A F F I C   S I G N A L   S Y S T E M   O P T I M I Z A T I O N   P R O G R A M

RELEASE 5   JULY, 1987                                                                          VERSION 2.0

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OFFICE OF TRAFFIC OPERATIONS                                                         UNITED KINGDOM AND
                                                                        TRANSPORTATIONRESEARCHCENTER
                                                                              UNIVERSITYOFFLORIDA

                              ---------------------------------------------------
                              I N P U T   D A T A   R E P O R T   F O R   R U N   1
                              ---------------------------------------------------

FIELDS:  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16
        ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----

LINE                                             RUN  TITLE  CARD
 NO.    TITLE

  2)        US 30:  N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE

                                          NETWORK  CONTROL  CARD
                                SEC/     SEC/
LINE   CARD    MIN     MAX    CYCLE    STEP     STEP     LOST    GREEN    STOP   OUTPUT INITIAL  PERIOD  SEC(0)  SPD(0) ENGL(0)  PNCH
 NO.   TYPE   CYCLE   CYCLE   INCR.    CYCLE   NORMAL    TIME   EXTEN.  PENALTY  LEVEL  TIMINGS  LENGTH  PERC(1) TIME(1) METR(1)  DECK

  3)     1      80      80      0        3        1        3       2       -1       1       0       60      0       0       0      0

+++ 104 +++ WARNING +
+                    THE SEC/STEP FACTOR IN FIELD 5 IS IGNORED
                     IN A SINGLE CYCLE RUN.

+++ 106 +++ WARNING +
+                    THE SEC/STEPS FACTOR IN FIELD 6 IS TOO SMALL FOR CYCLE
                     LENGTHS ABOVE  60 SECONDS. IT WILL BE INCREASED TO
                     ALLOW A MAXIMUM OF 60 STEPS/CYCLE.

+++ 107 +++ WARNING +
+                    A STOP PENALTY OF "-1" WILL RESULT IN AUTOMATIC
                     CALCULATION OF THE PI TO MINIMIZE FUEL CONSUMPTION.
                     LINK SPECIFIC DELAY OR STOP WEIGHTS ON CARD
                     TYPE 37 & 38 WILL STILL BE APPLIED, HOWEVER.

LINE   CARD                              LIST  OF  NODES  TO  BE  OPTIMIZED
 NO.   TYPE

  4)     2      1       2       0        0        0        0       0        0       0       0       0       0       0       0      0

                                                     SYSTEM  MASTER   DATA
LINE   CARD  MASTER  SYSTEM DEFAULTS  SYSTEM  EXTERNAL  SYSTEM   FUEL   VEHICLE   ORIEN-
 NO.   TYPE   NODE   YELLOW  ALL-RED  SATFLOW   SPEED     PDF    FACTOR  LENGTH   TATION

  5)    10      1       3       2      1800      40       35      100      25       0       0       0       0       0       0      0
```

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN (Continued) US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1TRANSYT-7F: US 30: N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE PAGE 2

FIELDS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

INTERSECTION 1

CONTROLLER TIMING DATA: INTERVAL DURATIONS (SECS. OR PERCENT)

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
6)	13	1	0	0	7	3	47	3	2	13	3	2	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT FLAG
7)	21	1	1	1	2	0	10	103	104	0	0	0	0	0	0	0
8)	22	1	3	3	4	5	20	101	102	103	-104	0	0	0	0	0
9)	23	1	6	6	7	8	10	105	106	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST NO.	INPUT VOL.	LINK SPD/TT	SECOND NO.	INPUT VOL.	LINK SPD/TT	THIRD NO.	INPUT VOL.	LINK SPD/TT	QUEUE CAP.
10)	28	101	0	1500	58	0	0	0	0	0	0	0	0	0	0	0
11)	28	102	0	1755	423	0	0	0	0	0	0	0	0	0	0	0
12)	28	103	360	1775	461	0	203	50	20	205	411	40	0	0	0	0
13)	28	104	150	0	168	0	203	75	20	205	83	40	0	0	0	0

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	GREEN EXTENS.	ADJUST. MFR	SNEAKERS	FOURTH NO.	INPUT VOL.	LINK SPD/TT	OPPOSING LINKS AND PERCENTAGES LINK 1	%	LINK 2	%	LINK 3	%	PERM MODEL
14)	29	104	0	0	0	2	0	0	0	102	100	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST NO.	INPUT VOL.	LINK SPD/TT	SECOND NO.	INPUT VOL.	LINK SPD/TT	THIRD NO.	INPUT VOL.	LINK SPD/TT	QUEUE CAP.
15)	28	105	0	1500	206	0	0	0	0	0	0	0	0	0	0	0
16)	28	106	0	1450	76	0	0	0	0	0	0	0	0	0	0	0

17) * COMMENT: US 30/SOUTH BAILEY ROAD INTERSECTION

INTERSECTION 2

CONTROLLER TIMING DATA: INTERVAL DURATIONS (SECS. OR PERCENT)

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
18)	13	2	0	0	7	3	47	3	2	13	3	2	0	0	0	0

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
1TRANSYT-7F:     US 30:  N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE                                                          PAGE  3
 FIELDS:  1        2        3        4        5        6        7        8        9       10       11       12       13       14       15       16
         ----     ----     ----     ----     ----     ----     ----     ----     ----     ----     ----     ----     ----     ----     ----     ----

                                                         PHASE   TIMING   DATA
 LINE    CARD     NODE     START   VARIAB.  YELLOW   ALL-RED  MINIM.                                                                         CONT
  NO.    TYPE      NO.     INTVL    INTVL    INTVL    INTVL    SECS.   LINKS MOVING IN THIS PHASE ..............................          FLAG

  19)     21        2        1        1        2        0       10      201      202        0        0        0        0        0        0        0
  20)     22        2        3        3        4        5       20      201     -202      204      205        0        0        0        0        0
  21)     23        2        6        6        7        8       10      203        0        0        0        0        0        0        0        0

                                                                   LINK   DATA
 LINE    CARD     LINK    LINK      SAT.    TOTAL   MID-BLK.  FIRST  INPUT  LINK....    SECOND  INPUT  LINK....    THIRD  INPUT  LINK....   QUEUE
  NO.    TYPE      NO.   LENGTH     FLOW     VOL.     VOL.     NO.     VOL.    SPD/TT     NO.    VOL.    SPD/TT     NO.    VOL.    SPD/TT    CAP.

  22)     28      201      360     1780      407        0      102      297       40      105      110       25        0        0        0        0
  23)     28      202      150        0      200        0      102      104       40      105       96       25        0        0        0        0

                                                              LINK    DATA   (CONTINUED)
 LINE    CARD     LINK ADD START  GREEN   ADJUST.              FOURTH  INPUT  LINK      OPPOSING LINKS AND PERCENTAGES..............      PERM
  NO.    TYPE      NO.  LOST-TIME  EXTENS. MFR   SNEAKERS      NO.     VOL.    SPD/TT    LINK 1     %     LINK 2     %     LINK 3     %     MODEL

  24)     29      202        0        0        0        2        0        0        0      205      100        0        0        0        0        0

                                                                   LINK   DATA
 LINE    CARD     LINK    LINK      SAT.    TOTAL   MID-BLK.  FIRST  INPUT  LINK....    SECOND  INPUT  LINK....    THIRD  INPUT  LINK....   QUEUE
  NO.    TYPE      NO.   LENGTH     FLOW     VOL.     VOL.     NO.     VOL.    SPD/TT     NO.    VOL.    SPD/TT     NO.    VOL.    SPD/TT    CAP.

  25)     28      203        0     1282      175        0        0        0        0        0        0        0        0        0        0        0
  26)     28      204        0     1514       63        0        0        0        0        0        0        0        0        0        0        0
  27)     28      205        0     1808      494        0        0        0        0        0        0        0        0        0        0        0

 LINE    CARD                                              RUN   CARD
  NO.    TYPE

  28)     52        0        0        0        0        0        0        0        0        0        0        0        0        0        0        0

 --- PROGRAM NOTE --- A CARD TYPE 52 CAUSES RUN TO BE OPTIMIZED USING THE
                      DEFAULT NORMAL OPTIMIZATION STEP SIZES.
                      IF CARD TYPE 4 WAS INPUT, IT IS IGNORED.

 --- PROGRAM NOTE --- NO ERRORS DETECTED. TRANSYT-7F PERFORMS FINAL PROCESSING.
                      IF ERRORS ARE DETECTED, FURTHER PROCESSING IS SUSPENDED.

 --- PROGRAM NOTE --- THERE ARE A TOTAL OF    2 NODES AND   11 LINKS,
                      INCLUDING BOTTLENECKS, IF ANY, IN THIS RUN.

 --- PROGRAM NOTE --- THERE WERE A TOTAL OF    3 WARNING MESSAGES ISSUED
                      IN THE ABOVE REPORT.
```

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN (Continued) US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1 US 30: N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE CYCLE: 80 SECONDS, 60 STEPS PAGE 4

<PERFORMANCE WITH OPTIMAL SETTINGS>

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	DELAY UNIFORM	DELAY RANDOM (VEH-H/H)	DELAY TOTAL	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)		QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
1	101	58	1500	7	.00	.13	.13	.00	.13	8.1	24.5(42%)	1	>	0	.34	50	101
1	102	423	1755	44	.00	1.27	1.19	.09	1.27	10.8	224.3(53%)	5	>	0	3.13	50	102
1	103	461	1775	38	31.51	1.17	.24	.06	.30	2.4	48.0(10%)	1		14	1.79	60	103
1	104	168	500	52	4.80	.44	.13	.14	.26	5.6	43.3(26%)	1		6	.60	60	104
1	105	206	1500	78	.00	2.44	1.75	.69	2.44	42.7	185.8(90%)	4	>	0	3.61	20	105
1	106	76	1450	30	.00	.62	.59	.03	.62	29.4	62.5(82%)	1	>	0	1.07	20	106
1 :		1392	MAX =	78	36.31	6.06	4.02	1.00	5.03	13.0	588.4(42%)				10.55	PI =	9.2
2	201	407	1780	35	27.82	1.26	.41	.05	.46	4.1	86.9(21%)	2		14	2.05	58	201
2	202	200	500	74	5.72	1.36	.68	.51	1.18	21.3	185.0(92%)	4		6	2.22	58	202
2	203	175	1282	68	.00	1.79	1.43	.36	1.79	36.8	154.3(88%)	4	>	0	2.83	22	203
2	204	63	1514	8	.00	.16	.16	.00	.16	9.0	27.7(44%)	1	>	0	.39	48	204
2	205	494	1808	52	.00	1.77	1.63	.14	1.77	12.9	290.9(59%)	7	>	0	4.15	48	205
2 :		1339	MAX =	74	33.54	6.33	4.30	1.06	5.35	14.4	744.8(56%)				11.64	PI =	10.3

<SYSTEM WIDE TOTALS INCLUDING ALL LINKS>

TOTAL DISTANCE TRAVELED (VEH-MI/H)	TOTAL TRAVEL TIME (VEH-H/H)	TOTAL UNIFORM DELAY (VEH-H/H)	TOTAL RANDOM DELAY (VEH-H/H)	TOTAL DELAY (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	TOTAL UNIFORM STOPS (VEH/H-%)	TOTAL FUEL CONSUM (GA/H)	PERFORMANCE INDEX	SPEED (MI/H)	
69.85	12.40	8.32	2.06	10.38	13.69	1333.1(49%)	22.18	19.51	16.53	<TOTALS>

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
1     US 30:  N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE                    CYCLE:   80 SECONDS,     60 STEPS    PAGE  5

 TRANSYT-7F  SIGNAL  CONTROLLER  SETTINGS

 NETWORK-WIDE  SIGNAL  TIMING  DATA

 SYSTEM  CYCLE  LENGTH  =    80  SECONDS
 MASTER  OFFSET  REFERENCE  LOCATION  =  INTERSECTION  NO.     1
 ALL  OFFSETS  ARE  REFERENCED  TO  THE  START  OF  INTERVAL  NO.  1  AT  THIS  SIGNAL.

 INTERSECTION  CONTROLLER  SETTINGS

 INTERSECTION      1

 INTERVAL   NUMBER  :      1    2    3    4    5    6    7    8
 INTVL  LENGTH(SEC):      7    3   45    3    2   15    3    2
 INTVL  LENGTH   (%):     9    4   54    4    3   19    4    3
 PIN SETTINGS   (%):  100/0    9   13   67   71   74   93   97
 PHASE  START  (NO.):     1         2              3
 INTERVAL    TYPE  :      V    Y    V    Y    R    V    Y    R

 LINKS   MOVING   :     103       101            105
                        104       102            106
                                  103
                                 -104

 OFFSET  =    0 SEC.    0 %.
 THIS  IS  THE  MASTER  CONTROLLER.
 +++ 193 +++ WARNING +
+                      THE  OFFSET  FALLS  WITHIN  1% OF  AN  INTERVAL
                       CHANGE  POINT  AT  THE  START  OF  INTERVAL  NO.   1.
```

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN (Continued) US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1 US 30: N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE CYCLE: 80 SECONDS, 60 STEPS PAGE 6

INTERSECTION 2

INTERVAL NUMBER :	1	2	3	4	5	6	7	8
INTVL LENGTH(SEC):	7	3	43	3	2	17	3	2
INTVL LENGTH (%):	9	4	52	4	3	21	4	3
PIN SETTINGS (%):	100/0	9	13	65	69	72	93	97
PHASE START (NO.):	1		2			3		
INTERVAL TYPE :	V	Y	V	Y	R	V	Y	R
LINKS MOVING :	201 202		201 -202 204 205			203		

OFFSET = 66 SEC. 83 %.

Table E-1: AM TRAFFIC SIGNAL COORDINATION RUN
US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
1      US 30:  N. BAILEY RD TO S. BAILEY RD AM OPTIMIZE                              CYCLE:   80 SECONDS,     60 STEPS    PAGE  7
 LINE    CARD                                                  TERMINATION  CARD
  NO.    TYPE

  29)     90       0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
 --- PROGRAM NOTE --- END OF JOB!
1
```

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
  2) * COMMENT:     US 30/NORTH BAILEY ROAD INTERSECTION
1          T R A N S Y T - 7 F  --  T R A F F I C   S I G N A L   S Y S T E M   O P T I M I Z A T I O N   P R O G R A M

 RELEASE 5   JULY, 1987                                                                                      VERSION 2.0

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 OFFICE OF TRAFFIC OPERATIONS                                                                      UNITED KINGDOM AND
                                                                                          TRANSPORTATIONRESEARCHCENTER
                                                                                                  UNIVERSITYOFFLORIDA

                                        ----------------------------------------------------
                                        I N P U T   D A T A   R E P O R T   F O R   R U N   1
                                        ----------------------------------------------------

 FIELDS:  1      2      3      4      5      6      7      8      9     10     11     12     13     14     15     16
         ----   ----   ----   ----   ----   ----   ----   ----   ----   ----   ----   ----   ----   ----   ----   ----

 LINE                                                    RUN  TITLE  CARD
  NO.     TITLE

   2)        US 30:  N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE

                                                  NETWORK  CONTROL  CARD
                                       SEC/    SEC/
 LINE   CARD    MIN    MAX   CYCLE    STEP    STEP    LOST   GREEN    STOP  OUTPUT INITIAL  PERIOD SEC(0) SPD(0) ENGL(0)  PNCH
  NO.   TYPE  CYCLE  CYCLE   INCR.   CYCLE  NORMAL    TIME  EXTEN. PENALTY   LEVEL TIMINGS  LENGTH PERC(1) TIME(1) METR(1) DECK

   3)     1     80     80      0       3       1       3      2      -1       1      0      60      0      0      0      0

 +++ 104 +++ WARNING +
+                        THE SEC/STEP FACTOR IN FIELD 5 IS IGNORED
                         IN A SINGLE CYCLE RUN.

 +++ 106 +++ WARNING +
+                        THE SEC/STEPS FACTOR IN FIELD 6 IS TOO SMALL FOR CYCLE
                         LENGTHS ABOVE  60 SECONDS. IT WILL BE INCREASED TO
                         ALLOW A MAXIMUM OF 60 STEPS/CYCLE.

 +++ 107 +++ WARNING +
+                        A STOP PENALTY OF "-1" WILL RESULT IN AUTOMATIC
                         CALCULATION OF THE PI TO MINIMIZE FUEL CONSUMPTION.
                         LINK SPECIFIC DELAY OR STOP WEIGHTS ON CARD
                         TYPE 37 & 38 WILL STILL BE APPLIED, HOWEVER.

 LINE   CARD                                  LIST  OF  NODES  TO  BE  OPTIMIZED
  NO.   TYPE

   4)     2      1      2      0      0      0      0      0      0      0      0      0      0      0      0      0

                                                    SYSTEM  MASTER   DATA
 LINE   CARD  MASTER  SYSTEM DEFAULTS SYSTEM  EXTERNAL SYSTEM  FUEL   VEHICLE   ORIEN-
  NO.   TYPE   NODE   YELLOW  ALL-RED SATFLOW   SPEED    PDF  FACTOR  LENGTH   TATION

   5)    10      1      3      2    1800      40      35    100      25       0      0      0      0      0      0      0
```

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN (Continued)
US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1TRANSYT-7F: US 30: N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE PAGE 2

FIELDS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

INTERSECTION 1

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
6)	13	1	0	0	9	3	41	3	2	17	3	2	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT FLAG
7)	21	1	1	1	2	0	12	103	104	0	0	0	0	0	0	0
8)	22	1	3	3	4	5	20	101	102	103	-104	0	0	0	0	0
9)	23	1	6	6	7	8	10	105	106	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST NO.	INPUT VOL.	LINK.... SPD/TT	SECOND NO.	INPUT VOL.	LINK.... SPD/TT	THIRD NO.	INPUT VOL.	LINK.... SPD/TT	QUEUE CAP.
10)	28	101	0	1515	171	0	0	0	0	0	0	0	0	0	0	0
11)	28	102	0	1782	675	0	0	0	0	0	0	0	0	0	0	0
12)	28	103	360	1773	677	0	203	119	20	205	558	40	0	0	0	0
13)	28	104	150	0	306	0	203	134	20	205	176	40	0	0	0	0

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	GREEN EXTENS.	ADJUST. MFR	SNEAKERS	FOURTH NO.	INPUT VOL.	LINK SPD/TT	OPPOSING LINKS AND PERCENTAGES LINK 1	%	LINK 2	%	LINK 3	%	PERM MODEL
14)	29	104	0	0	0	2	0	0	0	102	100	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST NO.	INPUT VOL.	LINK.... SPD/TT	SECOND NO.	INPUT VOL.	LINK.... SPD/TT	THIRD NO.	INPUT VOL.	LINK.... SPD/TT	QUEUE CAP.
15)	28	105	0	1522	303	0	0	0	0	0	0	0	0	0	0	0
16)	28	106	0	1477	153	0	0	0	0	0	0	0	0	0	0	0

17) * COMMENT: US 30/SOUTH BAILEY ROAD INTERSECTION

INTERSECTION 2

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
18)	13	2	0	0	9	3	41	3	2	17	3	2	0	0	0	0

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1TRANSYT-7F: US 30: N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE PAGE 3

PHASE TIMING DATA

LINE NO.	FIELDS: 1 CARD TYPE	2 NODE NO.	3 START INTVL	4 VARIAB. INTVL	5 YELLOW INTVL	6 ALL-RED INTVL	7 MINIM. SECS.	8 LINKS MOVING IN THIS PHASE	9	10	11	12	13	14	15	16 CONT FLAG
19)	21	2	1	1	2	0	12	201	202	0	0	0	0	0	0	0
20)	22	2	3	3	4	5	20	201	-202	204	205	0	0	0	0	0
21)	23	2	6	6	7	8	10	203	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST NO.	INPUT VOL.	LINK.... SPD/TT	SECOND NO.	INPUT VOL.	LINK.... SPD/TT	THIRD NO.	INPUT VOL.	LINK.... SPD/TT	QUEUE CAP.
22)	28	201	360	1818	763	0	102	575	40	105	203	25	0	0	0	0
23)	28	202	150	0	200	0	102	100	40	105	100	25	0	0	0	0

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	GREEN EXTENS.	ADJUST. MFR	SNEAKERS	FOURTH NO.	INPUT VOL.	LINK SPD/TT	OPPOSING LINKS AND PERCENTAGES LINK 1	%	LINK 2	%	LINK 3	%	PERM MODEL
24)	29	202	0	0	0	2	0	0	0	205	100	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST NO.	INPUT VOL.	LINK.... SPD/TT	SECOND NO.	INPUT VOL.	LINK.... SPD/TT	THIRD NO.	INPUT VOL.	LINK.... SPD/TT	QUEUE CAP.
25)	28	203	0	1282	320	0	0	0	0	0	0	0	0	0	0	0
26)	28	204	0	1537	71	0	0	0	0	0	0	0	0	0	0	0
27)	28	205	0	1835	734	0	0	0	0	0	0	0	0	0	0	0

RUN CARD

LINE NO.	CARD TYPE															
28)	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

--- PROGRAM NOTE --- A CARD TYPE 52 CAUSES RUN TO BE OPTIMIZED USING THE DEFAULT NORMAL OPTIMIZATION STEP SIZES. IF CARD TYPE 4 WAS INPUT, IT IS IGNORED.

--- PROGRAM NOTE --- NO ERRORS DETECTED. TRANSYT-7F PERFORMS FINAL PROCESSING. IF ERRORS ARE DETECTED, FURTHER PROCESSING IS SUSPENDED.

--- PROGRAM NOTE --- THERE ARE A TOTAL OF 2 NODES AND 11 LINKS, INCLUDING BOTTLENECKS, IF ANY, IN THIS RUN.

--- PROGRAM NOTE --- THERE WERE A TOTAL OF 3 WARNING MESSAGES ISSUED IN THE ABOVE REPORT.

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN (Continued) US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1 US 30: N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE CYCLE: 80 SECONDS, 60 STEPS PAGE 4

<PERFORMANCE WITH OPTIMAL SETTINGS>

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	DELAY UNIFORM	DELAY RANDOM (VEH-H/H)	DELAY TOTAL	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)	QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
1	101	171	1515	24	.00	.58	.56	.02	.58	12.2	92.0(54%)	2	> 0	1.33	44	101
1	102	675	1782	80	.00	4.02	3.24	.77	4.02	21.4	524.1(78%)	12	> 0	8.09	44	102
1	103	677	1773	61	46.27	2.10	.52	.24	.76	4.0	129.5(19%)	3	14	3.28	56	103
1	104	306	500	153*	8.75	57.91	4.10	53.51	57.60	677.7	199.9(65%)	14	> 6C	43.55	56	104
1	105	303	1522	88	.00	3.99	2.44	1.54	3.99	47.4	274.6(91%)	6	> 0	5.62	24	105
1	106	153	1477	46	.00	1.20	1.10	.10	1.20	28.2	123.5(81%)	3	> 0	2.09	24	106
1 :		2285	MAX =	153*	55.02	69.80	11.97	56.18	68.15	107.4	1343.6(59%)			63.96	PI =	61.8
2	201	763	1818	73	52.15	3.38	1.40	.49	1.89	8.9	276.9(36%)	6	14	5.46	52	201
2	202	200	500	110*	5.72	12.84	1.33	11.33	12.66	227.8	181.2(91%)	7	> 6C	10.59	52	202
2	203	320	1282	91	.00	4.35	2.40	1.94	4.35	48.9	288.2(90%)	7	> 0	6.02	28	203
2	204	71	1537	11	.00	.27	.26	.00	.27	13.4	39.5(56%)	1	> 0	.58	40	204
2	205	734	1835	94	.00	7.64	4.40	3.24	7.64	37.5	652.1(89%)	15	> 0	12.00	40	205
2 :		2088	MAX =	110*	57.87	28.47	9.79	17.01	26.80	46.2	1437.8(69%)			34.65	PI =	32.4

<SYSTEM WIDE TOTALS INCLUDING ALL LINKS>

TOTAL DISTANCE TRAVELED (VEH-MI/H)	TOTAL TRAVEL TIME (VEH-H/H)	TOTAL UNIFORM DELAY (VEH-H/H)	TOTAL RANDOM DELAY (VEH-H/H)	TOTAL DELAY (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	TOTAL UNIFORM STOPS (VEH/H-%)	TOTAL FUEL CONSUM (GA/H)	PERFORMANCE INDEX	SPEED (MI/H)	
112.89	98.27	21.76	73.19	94.95	78.16	2781.4(64%)	98.61	94.25	1.48	<TOTALS>

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

1 US 30: N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE CYCLE: 80 SECONDS, 60 STEPS PAGE 5

TRANSYT-7F SIGNAL CONTROLLER SETTINGS

NETWORK-WIDE SIGNAL TIMING DATA

SYSTEM CYCLE LENGTH = 80 SECONDS

MASTER OFFSET REFERENCE LOCATION = INTERSECTION NO. 1

ALL OFFSETS ARE REFERENCED TO THE START OF INTERVAL NO. 1 AT THIS SIGNAL.

INTERSECTION CONTROLLER SETTINGS

INTERSECTION 1

INTERVAL NUMBER :	1	2	3	4	5	6	7	8
INTVL LENGTH(SEC):	9	3	39	3	2	19	3	2
INTVL LENGTH (%):	11	4	47	4	3	24	4	3
PIN SETTINGS (%):	100/0	11	15	62	66	69	93	97
PHASE START (NO.):	1		2			3		
INTERVAL TYPE :	V	Y	V	Y	R	V	Y	R
LINKS MOVING :	103 104		101 102 103 -104			105 106		

OFFSET = 0 SEC. 0 %.

THIS IS THE MASTER CONTROLLER.

+++ 193 +++ WARNING +
+ THE OFFSET FALLS WITHIN 1% OF AN INTERVAL CHANGE POINT AT THE START OF INTERVAL NO. 1.

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN (Continued)
US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
1     US 30:  N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE                    CYCLE:   80 SECONDS,     60 STEPS   PAGE  6


 -----------------
 INTERSECTION     2
 -----------------

 INTERVAL   NUMBER :      1    2    3    4    5    6    7    8
 INTVL LENGTH(SEC):       9    3   35    3    2   23    3    2
 INTVL LENGTH   (%):     11    4   42    4    3   29    4    3
 PIN SETTINGS   (%): 100/0   11   15   57   61   64   93   97
 PHASE START (NO.):       1         2              3
 INTERVAL    TYPE  :      V    Y    V    Y    R    V    Y    R

 LINKS   MOVING   :     201       201            203
                        202      -202
                                  204
                                  205

 OFFSET =    0 SEC.    0 %.

 +++ 193 +++ WARNING +
+                      THE OFFSET FALLS WITHIN 1% OF AN INTERVAL
                       CHANGE POINT AT THE START OF INTERVAL NO.  1.
```

Table E-2: PM TRAFFIC SIGNAL COORDINATION RUN US 30 (LINCOLN HIGHWAY) AT NORTH AND SOUTH BAILEY ROADS

```
1     US 30:  N. BAILEY RD TO S. BAILEY RD PM OPTIMIZE                        CYCLE:   80 SECONDS,     60 STEPS    PAGE  7
 LINE    CARD                                                   TERMINATION  CARD
  NO.    TYPE

  29)     90     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
 --- PROGRAM NOTE --- END OF JOB!
1
```

APPENDIX F

TRAFFIC VOLUMES AND LEVEL OF SERVICE (LOS) SUMMARY SHEETS

Table F-1: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD

AM PEAK HOUR EXISTING AND FUTURE TRAFFIC VOLUMES

LANE GROUP	EXISTING	1993 NO BUILD	1993 BUILD
EASTBOUND			
LEFT	143	167	168
THROUGH	377	460	461
WESTBOUND			
THROUGH	313	419	423
RIGHT	54	58	58
SOUTHBOUND			
LEFT	71	76	76
RIGHT	127	199	206

PM PEAK HOUR EXISTING AND FUTURE TRAFFIC VOLUMES

LANE GROUP	EXISTING	1993 NO BUILD	1993 BUILD
EASTBOUND			
LEFT	225	287	306
THROUGH	516	669	677
WESTBOUND			
THROUGH	554	674	675
RIGHT	159	171	171
SOUTHBOUND			
LEFT	142	153	153
RIGHT	270	300	303

Table F-2: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD

AM PEAK HOUR EXISTING AND FUTURE TRAFFIC VOLUMES

LANE GROUP	EXISTING	1993 NO BUILD	1993 BUILD
EASTBOUND			
THROUGH	427	494	494
RIGHT	48	55	63
WESTBOUND			
LEFT	58	189	200
THROUGH	362	407	407
NORTHBOUND			
LEFT	39	49	50
RIGHT	84	123	125

PM PEAK HOUR EXISTING AND FUTURE TRAFFIC VOLUMES

LANE GROUP	EXISTING	1993 NO BUILD	1993 BUILD
EASTBOUND			
THROUGH	629	734	734
RIGHT	54	68	71
WESTBOUND			
LEFT	156	196	200
THROUGH	654	763	763
NORTHBOUND			
LEFT	33	46	67
RIGHT	116	226	253

Table F-3: SOUTH BAILEY ROAD/HAZELWOOD AVENUE

AM PEAK HOUR EXISTING AND FUTURE TRAFFIC VOLUMES

LANE GROUP	EXISTING	1993 NO BUILD	1993 BUILD*
EASTBOUND			
LEFT	71	79	111
RIGHT	4	2	13
NORTHBOUND			
LEFT	9	14	93
THROUGH	45	37	37
SOUTHBOUND			
THROUGH	50	6	6
RIGHT	60	206	443

PM PEAK HOUR EXISTING AND FUTURE TRAFFIC VOLUMES

LANE GROUP	EXISTING	1993 NO BUILD	1993 BUILD*
EASTBOUND			
LEFT	103	145	375
RIGHT	9	9	84
NORTHBOUND			
LEFT	12	14	23
THROUGH	58	54	54
SOUTHBOUND			
THROUGH	72	74	74
RIGHT	129	134	166

* BASED ON THE TRANSIT PEAK HOUR

Table F-4: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD

AM PEAK HOUR EXISTING AND FUTURE LEVELS OF SERVICE

LANE GROUP	EXISTING	1993 BUILD	1993 BUILD W/ IMPTS
EASTBOUND			
LEFT	A	A	A
THROUGH	A	A	A
WESTBOUND			
THROUGH	A	A	B
RIGHT	A	A	A
SOUTHBOUND			
LEFT	C	C	C
RIGHT	C	C	C
INTERSECTION	B	B	B

PM PEAK HOUR EXISTING AND FUTURE LEVELS OF SERVICE

LANE GROUP	EXISTING	1993 BUILD	1993 BUILD W/ IMPTS
EASTBOUND			
LEFT	A	A	B
THROUGH	A	A	A
WESTBOUND			
THROUGH	B	B	B
RIGHT	B	B	B
SOUTHBOUND			
LEFT	C	C	C
RIGHT	C	C	C
INTERSECTION	B	B	B

Table F-5: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD

AM PEAK HOUR EXISTING AND FUTURE LEVELS OF SERVICE

LANE GROUP	EXISTING	1993 BUILD	1993 BUILD W/ IMPTS
EASTBOUND			
THROUGH	-	-	A
RIGHT	-	-	A
WESTBOUND			
LEFT	A	A	A
THROUGH	-	-	A
NORTHBOUND	C	E	C
INTERSECTION	-	-	A

PM PEAK HOUR EXISTING AND FUTURE LEVELS OF SERVICE

LANE GROUP	EXISTING	1993 BUILD	1993 BUILD W/ IMPTS
EASTBOUND			
THROUGH	-	-	C
RIGHT	-	-	B
WESTBOUND			
LEFT	A	B	B
THROUGH	-	-	B
NORTHBOUND	E	F	C
INTERSECTION	-	-	B

NOTE: 1993 IMPROVEMENTS CALL FOR SIGNALIZATION OF THE US 30/SOUTH BAILEY ROAD INTERSECTION. THEREFORE, LEVEL OF SERVICE IS NOT COMPARABLE BETWEEN EXISTING AND FUTURE CONDITIONS BECAUSE THE HIGHWAY CAPACITY METHODOLOGY FOR SIGNALIZED AND UNSIGNALIZED INTERSECTIONS IS DIFFERENT.

Table F-6: SOUTH BAILEY ROAD/HAZELWOOD AVENUE

AM PEAK HOUR EXISTING AND FUTURE LEVELS OF SERVICE

LANE GROUP	EXISTING	1993 BUILD*	1993 BUILD W/ IMPTS*
EASTBOUND	A	A	A
NORTHBOUND LEFT	A	A	A

PM PEAK HOUR EXISTING AND FUTURE LEVELS OF SERVICE

LANE GROUP	EXISTING	1993 BUILD*	1993 BUILD W/ IMPTS*
EASTBOUND	A	C	C
NORTHBOUND LEFT	A	A	A

* BASED ON THE TRANSIT PEAK HOUR

APPENDIX G

LEVEL OF SERVICE (LOS) CALCULATION WORKSHEETS

US 30 (LINCOLN HIGHWAY)/N BAILEY ROAD

INCLUDES:

EXISTING CONDITIONS
1993 WITH TRAIN, NO IMPROVEMENTS
1993 WITH TRAIN, WITH IMPROVEMENTS

Table G-1: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD
TIME: AM PEAK HOUR
COMMENT: EXISTING CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes				1		1	1	1			1	1
Volumes				71		127	143	377			313	54
Lane Width				11.0		12.0	12.0	12.0			12.0	12.0
RTOR Vols						0			0			0

Signal Operations

Phase combination		1	2	3	4
NB	Left				
	Thru				
	Right				
	Peds				
SB	Left	*			
	Thru				
	Right	*			
	Peds				
EB	Right				
WB	Right				
Green		13A			
Yellow/A-R		5			
Lost Time		1.5			

		5	6	7	8
EB	Left	*	*		
	Thru	*	*		
	Right				
	Peds				
WB	Left				
	Thru		*		
	Right		*		
	Peds				
NB	Right				
SB	Right				
Green		6A	48A		
Yellow/A-R		3	5		
Lost Time		0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	Approach: LOS
SB	L	1454	300	0.26	0.21	20.4	C	19.2	C
	R	1499	309	0.46	0.21	18.6	C		
EB	L	1684	189	0.00	0.78	0.0	A	1.3	A
	T	1773	1374	0.30	0.77	1.7	A		
WB	T	1755	1130	0.31	0.64	4.1	A	4.0	A
	R	1492	960	0.06	0.64	3.4	A		

Intersection Delay = 5.5 (sec/veh) Intersection LOS = B

Table G-2: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD
TIME: PM PEAK HOUR
COMMENT: EXISTING CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes				1		1	1	1			1	1
Volumes				142		270	225	516			554	159
Lane Width				11.0		12.0	12.0	12.0			12.0	12.0
RTOR Vols						0			0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left					EB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
SB Left	*				WB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	17A				Green	9A	41A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
SB	L	1477	378	0.38	0.26	19.0	C	20.2	C
	R	1522	390	0.71	0.26	20.8	C		
EB	L	1684	253	0.00	0.72	0.0	A	2.0	A
	T	1773	1285	0.41	0.73	2.9	A		
WB	T	1782	991	0.57	0.56	8.0	B	7.5	B
	R	1515	843	0.19	0.56	5.7	B		

Intersection Delay = 8.1 (sec/veh) Intersection LOS = B

Table G-3: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD
TIME: AM PEAK HOUR
COMMENT: 1993 WITH TRAIN, NO IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes				1		1	1	1			1	1
Volumes				76		206	168	461			423	58
Lane Width				11.0		12.0	12.0	12.0			12.0	12.0
RTOR Vols						0			0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left					EB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
SB Left	*				WB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	13A				Green	6A	48A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
SB	L	1454	300	0.28	0.21	20.5	C	23.4	C
	R	1499	309	0.74	0.21	24.5	C		
EB	L	1684	189	0.00	0.78	0.0	A	1.4	A
	T	1773	1374	0.37	0.77	1.9	A		
WB	T	1755	1130	0.42	0.64	4.6	A	4.5	A
	R	1492	960	0.07	0.64	3.4	A		

Intersection Delay = 6.9 (sec/veh) Intersection LOS = B

Table G-4: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD
TIME: PM PEAK HOUR
COMMENT: 1993 WITH TRAIN, NO IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes				1		1	1	1			1	1
Volumes				153		303	306	677			675	171
Lane Width				11.0		12.0	12.0	12.0			12.0	12.0
RTOR Vols						0			0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left					EB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
SB Left	*				WB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	17A				Green	9A	41A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
SB	L	1477	378	0.41	0.26	19.2	C	22.5	C
	R	1522	390	0.79	0.26	24.1	C		
EB	L	1684	253	0.44	0.72	4.2	A	3.7	A
	T	1773	1285	0.54	0.73	3.5	A		
WB	T	1782	991	0.70	0.56	9.6	B	8.8	B
	R	1515	843	0.21	0.56	5.8	B		

Intersection Delay = 9.4 (sec/veh) Intersection LOS = B

Table G-5: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD
TIME: AM PEAK HOUR
COMMENT: 1993 WITH TRAIN, WITH SIGNAL IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes				1		1	1	1			1	1
Volumes				76		206	168	461			423	58
Lane Width				11.0		12.0	12.0	12.0			12.0	12.0
RTOR Vols						0			0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left					EB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
SB Left	*				WB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	15A				Green	7A	45A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
SB	L	1454	336	0.25	0.23	19.2	C	20.3	C
	R	1499	347	0.66	0.23	20.7	C		
EB	L	1684	210	0.00	0.75	0.0	A	1.7	A
	T	1773	1330	0.39	0.75	2.4	A		
WB	T	1755	1064	0.44	0.61	5.6	B	5.5	B
	R	1492	905	0.07	0.61	4.2	A		

Intersection Delay = 6.8 (sec/veh) Intersection LOS = B

Table G-6: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/NORTH BAILEY ROAD
TIME: PM PEAK HOUR
COMMENT: 1993 WITH TRAIN, WITH SIGNAL IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes				1		1	1	1			1	1
Volumes				153		303	306	677			675	171
Lane Width				11.0		12.0	12.0	12.0			12.0	12.0
RTOR Vols						0			0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left					EB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
SB Left	*				WB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	19A				Green	9A	39A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
SB	L	1477	415	0.38	0.28	17.8	C	19.4	C
	R	1522	428	0.72	0.28	20.2	C		
EB	L	1684	253	0.56	0.70	6.6	B	4.9	A
	T	1773	1241	0.56	0.70	4.2	A		
WB	T	1782	947	0.73	0.53	10.9	B	10.0	B
	R	1515	805	0.22	0.53	6.4	B		

Intersection Delay = 9.7 (sec/veh) Intersection LOS = B

US 30 (LINCOLN HIGHWAY)/S BAILEY ROAD

INCLUDES:

EXISTING CONDITIONS
1993 WITH TRAIN, NO IMPROVEMENTS
1993 WITH TRAIN, WITH IMPROVEMENTS

Table G-7: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD
TIME: AM PEAK HOUR
COMMENT: EXISTING CONDITIONS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTENTIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)		SHARED CAPACITY c_{SH} (pcph)		RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET								
NB LEFT	40	232	222	>	222	>	182 >	D
				>	390	>	265	>C
RIGHT	85	600	600	>	600	>	515 >	A
MAJOR STREET								
WB LEFT	60	794	794		794		734	A

Table G-8: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD
TIME: PM PEAK HOUR
COMMENT: EXISTING CONDITIONS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTEN-TIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)	SHARED CAPACITY c_{SH} (pcph)	RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET						
NB LEFT	33	91	75	> 75	> 41	> E
				> 215	> 64	>E
RIGHT	117	462	462	> 462	> 345	> B
MAJOR STREET						
WB LEFT	157	631	631	631	474	A

Table G-9: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD
TIME: AM PEAK HOUR
COMMENT: 1993 WITH TRAIN, NO IMPROVEMENTS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTENTIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)		SHARED CAPACITY c_{SH} (pcph)		RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET								
NB LEFT	51	152	119	>	119	>	68 >	E
				>	270	>	92	>E
RIGHT	127	548	548	>	548	>	421 >	A
MAJOR STREET								
WB LEFT	206	724	724		724		518	A

Table G-10: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD
TIME: PM PEAK HOUR
COMMENT: 1993 WITH TRAIN, NO IMPROVEMENTS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTENTIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)	SHARED CAPACITY c_{SH} (pcph)	RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET						
NB LEFT	68	72	51	> 51 >	-17 >	F
				> 163 >	> -160	>F
RIGHT	256	395	395	> 395 >	139 >	D
MAJOR STREET						
WB LEFT	201	548	548	548	347	B

Table G-11: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD
TIME: AM PEAK HOUR
COMMENT: 1993 WITH TRAIN, WITH SIGNAL IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	>		<					1	1	1	1	
Volumes	50		125					494	63	200	407	
Lane Width		13.0						13.0	12.5	10.5	12.5	
RTOR Vols			0						0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left	*				EB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
SB Left					WB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	17A				Green	7A	43A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
NB	LR	1283	329	0.57	0.26	18.2	C	18.2	C
EB	T	1808	1051	0.50	0.58	4.9	A	4.7	A
	R	1514	880	0.08	0.58	3.5	A		
WB	L	1584	198	0.00	0.71	0.0	A	1.3	A
	T	1781	1291	0.34	0.73	1.9	A		

Intersection Delay = 4.9 (sec/veh) Intersection LOS = A

Table G-12: LEVEL OF SERVICE (LOS) ANALYSIS SIGNALIZED INTERSECTIONS

INTERSECTION: US 30 (LINCOLN HIGHWAY)/SOUTH BAILEY ROAD
TIME: PM PEAK HOUR
COMMENT: 1993 WITH TRAIN, WITH SIGNAL IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	>		<					1	1	1	1	
Volumes	67		253					734	71	200	763	
Lane Width		13.0						13.0	12.5	10.5	12.5	
RTOR Vols			0						0			0

Signal Operations

Phase combination	1	2	3	4		5	6	7	8
NB Left	*				EB Left				
Thru					Thru		*		
Right	*				Right		*		
Peds					Peds				
SB Left					WB Left	*	*		
Thru					Thru	*	*		
Right					Right				
Peds					Peds				
EB Right					NB Right				
WB Right					SB Right				
Green	23A				Green	9A	35A		
Yellow/A-R	5				Yellow/A-R	3	5		
Lost Time	1.5				Lost Time	0.0	1.5		

Cycle Length: 80 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/c Ratio	Delay	LOS	Approach: Delay	LOS
NB	LR	1282	425	0.79	0.33	21.5	C	21.5	C
EB	T	1835	883	0.88	0.48	16.5	C	15.5	C
	R	1537	740	0.10	0.48	5.3	B		
WB	L	1616	242	0.50	0.63	7.4	B	5.9	B
	T	1818	1182	0.68	0.65	5.5	B		

Intersection Delay = 12.0 (sec/veh) Intersection LOS = B

SOUTH BAILEY ROAD/HAZELWOOD AVENUE

INCLUDES:

EXISTING CONDITIONS
1993 WITH TRAIN, NO IMPROVEMENTS

Table G-13: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: SOUTH BAILEY ROAD/HAZELWOOD AVENUE
TIME: AM PEAK HOUR
COMMENT: EXISTING CONDITIONS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTEN-TIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)	SHARED CAPACITY c_{SH} (pcph)	RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET						
EB LEFT	73	786	782	> 782	> 709 >	A
				> 791	> 714	>A
RIGHT	4	996	996	> 996	> 992 >	A
MAJOR STREET						
NB LEFT	9	999	999	999	990	A

Table G-14: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: SOUTH BAILEY ROAD/HAZELWOOD AVENUE
TIME: PM PEAK HOUR
COMMENT: EXISTING CONDITIONS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTENTIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)	SHARED CAPACITY c_{SH} (pcph)	RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET						
EB LEFT	104	714	709	> 709	> 605	> A
				> 724	> 611	>A
RIGHT	9	957	957	> 957	> 948	> A
MAJOR STREET						
NB LEFT	12	984	984	984	972	A

Table G-15: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: SOUTH BAILEY ROAD/HAZELWOOD AVENUE
TIME: AM PEAK HOUR
COMMENT: 1993 WITH TRAIN, NO IMPROVEMENTS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTENTIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)		SHARED CAPACITY c_{SH} (pcph)			RESERVE CAPACITY $c_R = c_{SH} - v$			LOS
MINOR STREET											
EB LEFT	114	592	545	>		545	>		464	>	A
				>	550		>	467			>A
RIGHT	13	863	863	>		863	>		860	>	A
MAJOR STREET											
NB LEFT	93	755	755			755			662		A

Table G-16: LEVEL OF SERVICE (LOS) ANALYSIS UNSIGNALIZED INTERSECTIONS

INTERSECTION: SOUTH BAILEY ROAD/HAZELWOOD AVENUE
TIME: PM PEAK HOUR
COMMENT: 1993 WITH TRAIN, NO IMPROVEMENTS

CAPACITY AND LEVEL-OF-SERVICE

MOVEMENT	FLOW-RATE v(pcph)	POTENTIAL CAPACITY c_p (pcph)	ACTUAL MOVEMENT CAPACITY c_M (pcph)	SHARED CAPACITY c_{SH} (pcph)	RESERVE CAPACITY $c_R = c_{SH} - v$	LOS
MINOR STREET						
EB LEFT	379	712	706	> 706 >	> 327 >	B
				> 741 >	> 278	>C
RIGHT	85	952	952	> 952 >	> 867 >	A
MAJOR STREET						
NB LEFT	23	977	977	977	963	A