

ANALYSIS AND EVALUATION OF TRAFFIC CONGESTION AT
SUNNY ISLE AND SION FARM INTERSECTIONS IN ST. CROIX,
VIRGIN ISLANDS

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Abstract

This project presents the results of the analysis and evaluation of traffic conditions at two congested intersections Sunny Isle and Sion Farm in Saint Croix, Virgin Islands. They are among the busiest intersections in the island. Traffic signal timings have not been reviewed or modified in recent times. Vehicles are driven on the left side of the road but most of the automobiles on the island have left side steering wheels. Traffic analysis performed reveal that both intersections have a problem of excessive delays and insufficient capacity, particularly in right turn lanes. Alternatives to improve traffic conditions were generated and simulated using AASIDRA and SYNCHRO. Results were analyzed considering several performance measures. At the end of the evaluation process, the best alternative was selected to improve the congestion situation studied.

Resumen

Este informe presenta los resultados del análisis y la evaluación de las condiciones de tránsito realizada para dos intersecciones, Sunny Isle y Sion Farm, en la isla de Santa Cruz en las Islas Vírgenes. Los tiempos de los semáforos no han sido revisados ni actualizados en mucho tiempo. Los vehículos son conducidos por el lado izquierdo de la carretera pero la mayoría de los vehículos tienen el guía en el lado izquierdo. El análisis realizado indica que ambas intersecciones tienen un problema de capacidad insuficiente y demoras excesivas, especialmente en los virajes a la derecha en toda la intersección. Se generaron y simularon alternativas para resolver estos problemas utilizando AASIDRA y SYNCHRO. Los resultados fueron analizados considerando diferentes medidas de desempeño. Al final del proceso de evaluación se seleccionó la mejor alternativa que soluciona el problema de congestión estudiado.

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“Some people come into our lives
and leave footprints on our hearts
and we are never ever the same.

Some people come into our lives
and quickly go...Some stay for a while
and embrace our silent dreams.”

Flavia Weedn

"Todo lo puedo en Cristo que me fortalece." (Fil. 4:13)
“I can do all things through Him who strengthens me.”

Acknowledgements

“Some people come into our lives
to cast a steady light
upon our path and guide our every step
their shining belief in us
helps us to believe in ourselves.”

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1 Introduction

1.1 Background

Saint Croix is an island in the Caribbean Sea, located about 70 miles from the Southeast of Puerto Rico. It is the largest of the United States Virgin Islands, with an area of 82.88 square miles and a population of 53,234, according to the 2000 US Bureau Census. Saint Croix is divided in eight districts Anna's Hope Village, Christiansted, East End, Frederiksted, Northcentral, NorthWest, Sion Farm, Southcentral, SouthWest.; being Christiansted and Frederiksted major towns. Table 1 shows a high variation in districts population. Sion Farm district has a population of 13,565 while the East End population is 2,341. The area of interest for this project is located in Sion Farm district.

Roads in St. Croix are very old; some of them were built on trails where people used to walk to get from one place to another. These trails were paved and became the new roads for motor vehicles. To comply with today standards posted speed limit is less than 30 miles per hour in most of the island. All roads are two-lanes, except Route 66 which is a four-lane highway, it has posted speed limit of 55 miles per hours in some segments and 30 mph in other segments. Is important to mention that vehicles are driven on the left hand side of the road, but most of the automobiles on the island have left side steering wheels.

A good amount of the conflicts at intersections are solved using traffic signs such as STOP and YIELD. When intersections are complicated or traffic volumes are high, traffic light signals are used to solve conflicts and avoid collisions.



Figure 1 : Location of Saint Croix, VI in the Caribbean Sea

Queen Mary Highway or Route 70 is one of the most important roads in Saint Croix. It connects major towns, Frederiksted at the West and Christiansted located at the Northeast of the island. It provides access to principal educational and commercial areas of the island including the University of the Virgin Islands, Saint Croix Educational Complex, Sunshine Mall and Sunny Isle Shopping Center among others. Melvin Evans Highway or Route 66 was built as an alternative to reduce the volume of traffic that goes through Route 70. These two roads intersect each other in a highly transited segment

shown in Figure 2. This meeting point is known as Sunny Isle intersection and is followed by another highly transited intersection known as Sion Farm.



Figure 2: Road map of Saint Croix

Sunny Isle and Sion Farm are among the busiest intersections in the island. Mainly because they are surrounded by major shopping areas; and Hovensa, one of the largest refineries in the world, with a capacity of processing 495,000 barrels per day (Hovensa, 2008) and one of the largest employers on St. Croix. Figure 3 illustrates the proximity of Hovensa facilities to the area of interest and its extent.

Table 1: Saint Croix subdivision and population as per 2000 US Census

| Districts | Population |
|---------------------|------------|
| Anna's Hope Village | 4,192 |
| Christiansted | 2,865 |
| East End | 2,341 |
| Frederiksted | 3,767 |
| Northcentral | 5,760 |
| Northwest | 4,919 |
| Sion Farm | 13,565 |
| Southcentral | 8,125 |
| Southwest | 7,700 |

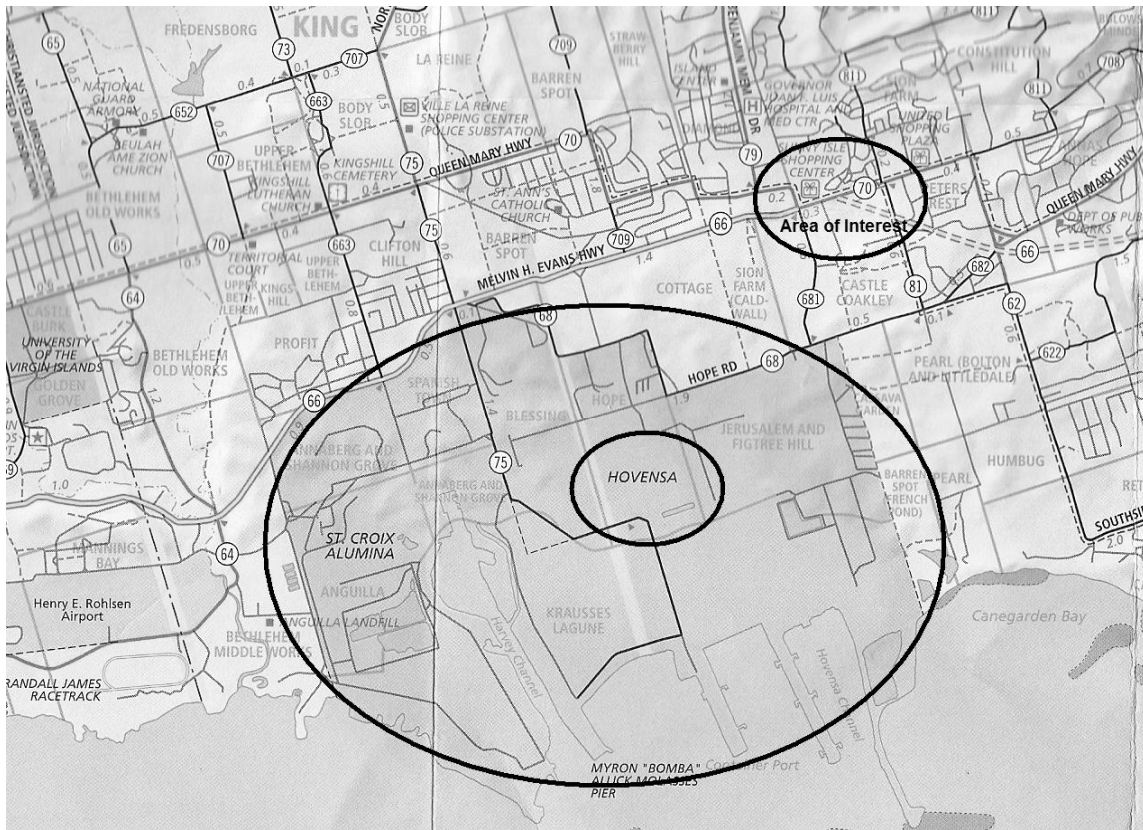


Figure 3: Localization of intersections of interest and Hovensa

According to the US Census Bureau (2008b), Saint Croix population has grown more than 40% since 1970. This significant increase in population had a big impact in the infrastructure of the island. It means a higher demand of energy, potable water, and the need to improve the sewer system as well as the road system. Traffic signal timings have not been reviewed or modified in recent times considering that, as population grows congestion problems increase.

This project will present the results of the analysis and evaluation of traffic conditions in this segment, particularly at the Sunny Isle and Sion Farm intersections. These results were used to evaluate and recommend alternatives to improve traffic conditions.

1.2 Objectives

The main objective of this project is to develop practical alternatives to alleviate congestion at the Sunny Isle and Sion Farm intersections located along Route 70. Current and future traffic conditions were analyzed with computer simulation programs to identify possible causes of traffic congestion and suggest potential alternatives to reduce congestion.

1.3 Methodology

To carry out the objective presented before, methodology described by Valdés (2000) and applied by Diaz (2004) was followed. This methodology is resumed in Figure 4.

- Data collection. Gather relevant field data necessary to simulate the traffic conditions. Some of these data include traffic volumes, signal timing and the geometry of each intersection.
- Problem identification. Field observation and computer simulation programs help to identify possible causes for traffic congestions.
- Analysis of current situation. Simulation results such as; delays, queue lengths, level of service (LOS) among others, are used to determine current traffic conditions.
- Generation of alternatives. Alternatives to reduce traffic problems previously identified are proposed.
- Evaluation of alternatives. Not all proposed alternatives will improve traffic conditions; some might alleviate part of the situation but could make part of it worst than before.
- Selection of alternatives. Selection will be based in reduction of delays, queues and cost among others.
- Design. Drawings should specify existing structures, typical sections, profiles, special considerations, among others.

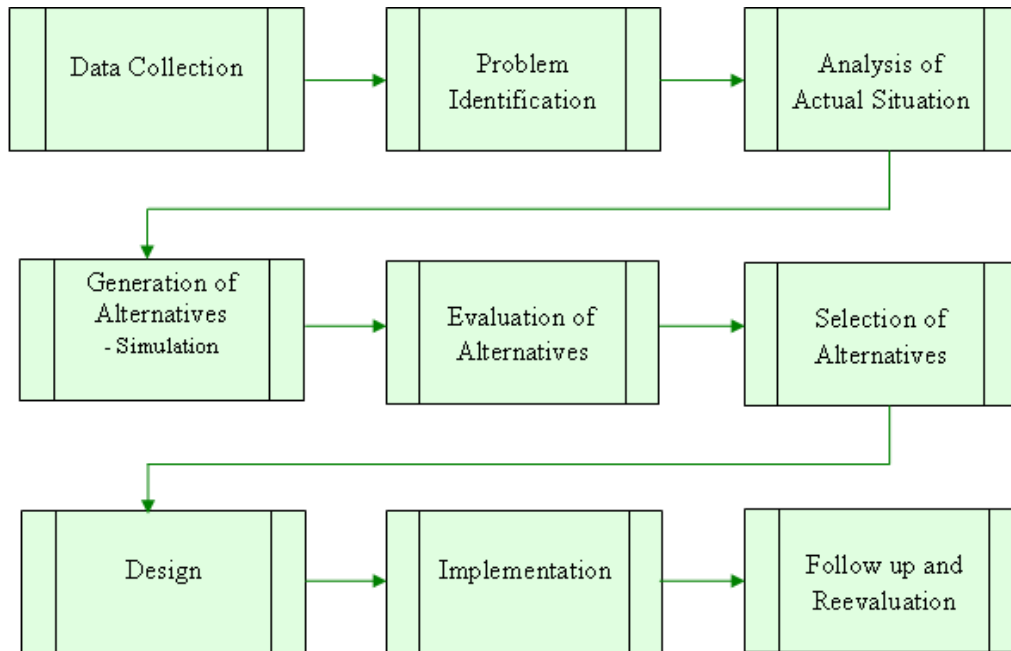


Figure 4: Steps to redesign existing facilities according to Valdés (2000)

1.4 Summary of Following Chapters

The succeeding chapters of this project are organized as follow: Chapter 2 describes area of interest, featuring road inventory, geometric and operational data and traffic count procedure. Chapter 3 includes traffic counts at peak hours and analysis of the simulation results using AASIDRA and SYNCHRO. Chapter 4 presents the discussion of the traffic forecast. Chapter 5 discusses traffic problems observed and recommendations to improve traffic conditions. These alternatives were evaluated and the most favorable alternative was selected and preliminary designed in Chapter 6. Conclusions and recommendations are in Chapter 7.

2 Traffic Study

2.1 Description of Area of Interest

The Sunny Isle - Sion Farm area includes a concentration of the largest shopping center, a number of smaller shopping areas and a concentration of strip commercial developments along Route 70. These two intersections are approximately 2,000 feet apart and only one lane in each direction. As shown in Figure 5, this highly transited area has a number of driveways and entrances which contributes to the interruption of the traffic flow.



Figure 5: Aerial view of intersections of interest on Route 70

Sunny Isle intersection gets its name from the shopping center adjacent to the intersection of roads 70, 66 and 681; it is a four way intersection. The Sunny Isle Shopping Center is the largest on the island and offers a wide variety of consumer services such as banking, medical offices, government agencies and department stores. This shopping center and Hovensha are the major traffic generators in the area.

Sion Farm is a large residential community comprised of single family homes, schools and other facilities. It lies adjacent and immediately east of the Sunny Isle Shopping Center. Sion Farm is a four leg intersection as well.

2.2 Existing Information

Existing information includes aerial views, plans and reports. Aerial views were obtained from Google Earth™, plans of intersections were obtained from the Department of Public Works of Virgin Islands and the report “Sunny Isle – Sion Farm Traffic Congestion” (McGregor K.E., 2002) was obtained from the Office of State Planning and Research of Saint Croix. Accident data was obtained from the Virgin Island Police Department. This information was used to obtain basic facts about the operation and geometry of the intersections.

2.3 Collection of Traffic Data

2.3.1 Streets and Roadway Inventory

Route 70 is a two-lane roadway that goes from West to East. It is not a straight road; sometimes it turns south and turns east again to keep its way. This is the case at Sunny Isle, north road is Route 70 and the east road is also Route70. All entrances and exits to the Sunny Isle Shopping Center are located along Route 70. Figure 6 is an aerial

view of Sunny Isle intersection. It has a posted speed limit of 30 mph on two approaches and 20 mph in others, lane width varies from 12 to 13 feet. The south approach provides access to and from Hovensa, the oil refinery. As mentioned before, Route 66, the west approach, is a four-lane divided highway that ends at this intersection. All approaches except Route 681 have a right turn lane their length varies from 159 up to 300 feet.

Route 70 continues east about 2,000 feet after Sunny Isle Shopping Center it intersects with Route 811 and Route 81, at Sion Farm. Posted speed limit is 20 mph on all approaches; lane width varies from 10 to 11 feet. Figure 7 presents an aerial view of this intersection. Route 811 on the North gives access to Estate Sion Farm, a residential area. On the South, Route 81 is an alternate access to Hovensa and other residential areas. This intersection has a right turn lane on all approaches with storage lengths from 125 to 170 feet.



Figure 6: Aerial view of Sunny Isle intersection



Figure 7: Aerial view of Sion Farm intersection

2.3.2 Geometric and Operational Data

Geometric and operational data, including signal timing and phases were collected for both intersections. Figure 8 presents a diagram of current geometry of both intersections.

These are actuated signalized intersections, when congested they perform like pre-timed intersections. Figure 9 and 10 show the phasing diagrams for Sunny Isle and Sion Farm intersections respectively. At peak hours these traffic lights show only four phases in both intersections. During the rest of the day, signals can show up to six different phases in Sunny Isle and eight in Sion Farm according to the traffic actuations, but not all the phases are shown on the same cycle. Fewer phases result in smaller delays,

but it can increase the amount of accidents, so care must be taken. When the cycle length is too long, there is too much unused green time built into the cycle, and delay will increase gradually (Roess et al., 2004). Cycle length is 174 seconds at peak hours in Sunny Isle and 165 seconds in Sion Farm. Long cycles, as well as having many phases, contribute to increase delays at intersections, increasing discomfort to drivers.

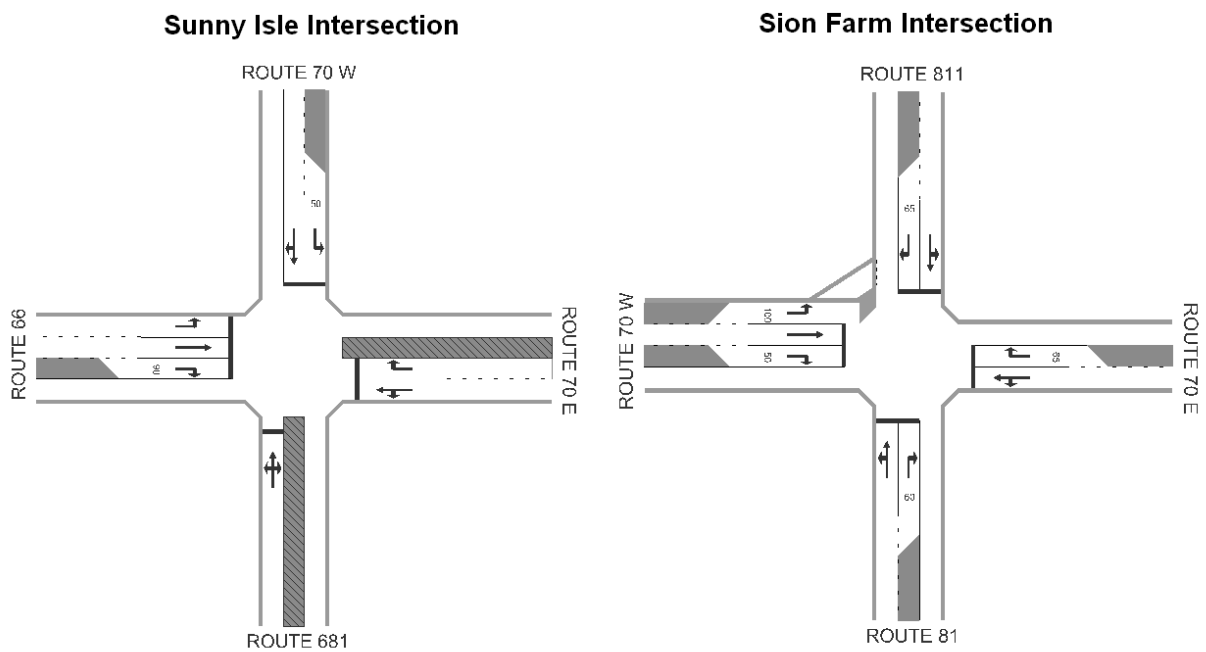


Figure 8: Diagram of intersection studied

| | | | |
|------------------------|------------------------|------------------------|------------------------|
| | | | |
| PHASE A | PHASE B | PHASE C | PHASE D |
| G = 30 A = 4 R=2 | G = 40 A = 4 R=2 | G = 40 A = 4 R=2 | G = 40 A = 4 R=2 |

Figure 9: Phase sequence and timings for Sunny Isle intersection

During peak hour long queues were observed, through lanes were blocked by vehicles on the turn lanes and vice versa, flow was obstructed by vehicles entering or exiting driveways along the road. On the north approach a sign prohibits left turns on red from 7:00 A.M to 9:00 A.M. and from 4:00 P.M. to 6:00 P.M. Its purpose is to impede vehicles turning left block the thru traffic coming from Route 66. According to field observation drivers usually follow this regulation, for current situation simulation purposes, left turn on red was not allowed. For the analysis of alternatives left turn on red was permitted, assuming that Sion Farm intersection is improved and turning traffic will not block through traffic.

Accident data records of the Virgin Islands Police Department for the year 2007 do not show a significant amount of crashes at the area of study. Only three collisions reported at the intersections of interest and two on the segment between them, none of them were fatal.

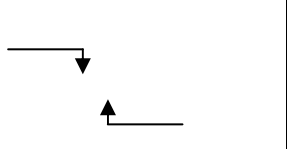
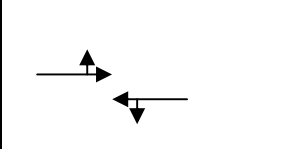
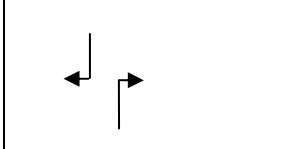
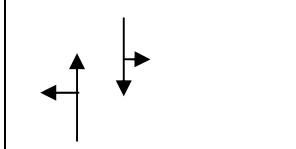
| | | | |
|---|---|--|---|
|  |  |  |  |
| PHASE A | PHASE B | PHASE C | PHASE D |
| G = 35 A = 3 R=2 | G = 50 A = 3 R=2 | G = 30 A = 3 R=2 | G = 30 A = 3 R=2 |

Figure 10: Phase sequence and timings for Sion Farm intersection

2.3.3 Traffic Count

A traffic counting study at an intersection measures the amount of vehicles that goes through; movements and maneuvers on the intersection are observed and collected. Traffic studies and observation has shown that although a traffic volume varies from time to time, this variation is repetitive and rhythmic. Based on these observations is recommendable to perform traffic studies Tuesdays, Wednesdays or Thursdays, care must be taken to avoid special events, holidays or days when school is not in session.

Traffic counts for the Sunny Isle intersection were performed on Wednesday, January 16, 2008 and on Thursday, January 24, 2008 for the Sion Farm intersection. Both studies were performed from 6:00 A.M. to 9:00 A.M. and from 3:00 P.M. to 6:00 P.M. Traffic data was collected manually, it was reduced using a spreadsheet created in Excel™ for this particular study.

2.4 Data Preparation

Data collected from the traffic counting was summarized and tabulated to simulate current traffic conditions using mainly two software packages: AASIDRA and SYNCHRO. AASIDRA uses detailed analytical traffic models coupled with an iterative approximation method to provide estimates of performance measures. This software is used to analyze many design alternatives; optimize the intersection geometry, signal phasing and timings specifying different strategies for optimization. SYNCHRO is a computer program, like AASIDRA, used to model and optimize traffic light timings. It was used as an aid to visualize traffic behavior.

3 Traffic Analysis

3.1 Introduction

Information previously collected was used as input for AASIDRA and SYNCHRO simulation software to perform traffic analysis for current conditions and estimate delays, capacity and level of service for each intersection. Software results helped to identify possible causes for traffic congestions.

Figure 11 shows traffic flow during peak hour periods in the morning and in the afternoon for Sunny Isle intersection. No significant variations in the traffic flow during peak hours were observed. This means there is a good possibility that any alternative considered to improve traffic conditions will be effective for both periods of the day. Traffic flows for opposite through movements are comparable. Right turns from east and west approach are comparable as well, but their values are as high as the through movements, this situation adds a considerable amount of time to cycle length.

Figure 12 shows high volumes of vehicles going through Route 70 in both directions. On the other hand, opposite right turn flows are not similar. This discrepancy adds green time on each phase to allow vehicles go through the intersection causing long cycles and increasing delays. Telescope diagrams in Figures 13 and 14 shows the magnitude of the flows and the discrepancies on opposed turns for both intersections.

The amount of heavy vehicles going through these intersections was ignored because it was less than one percent of the total vehicles during peak hours. Pedestrians were ignored as well, because there was not a significant amount present during the study. Refer to Appendix A for complete traffic counts.

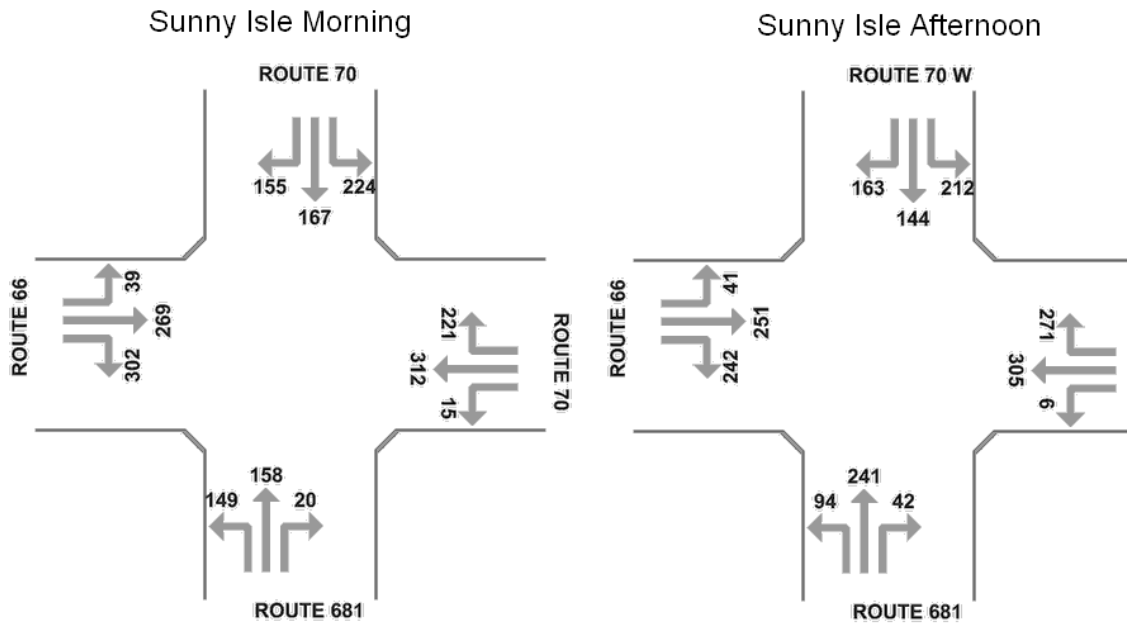


Figure 11: Traffic volume for peak periods at Sunny Isle intersection

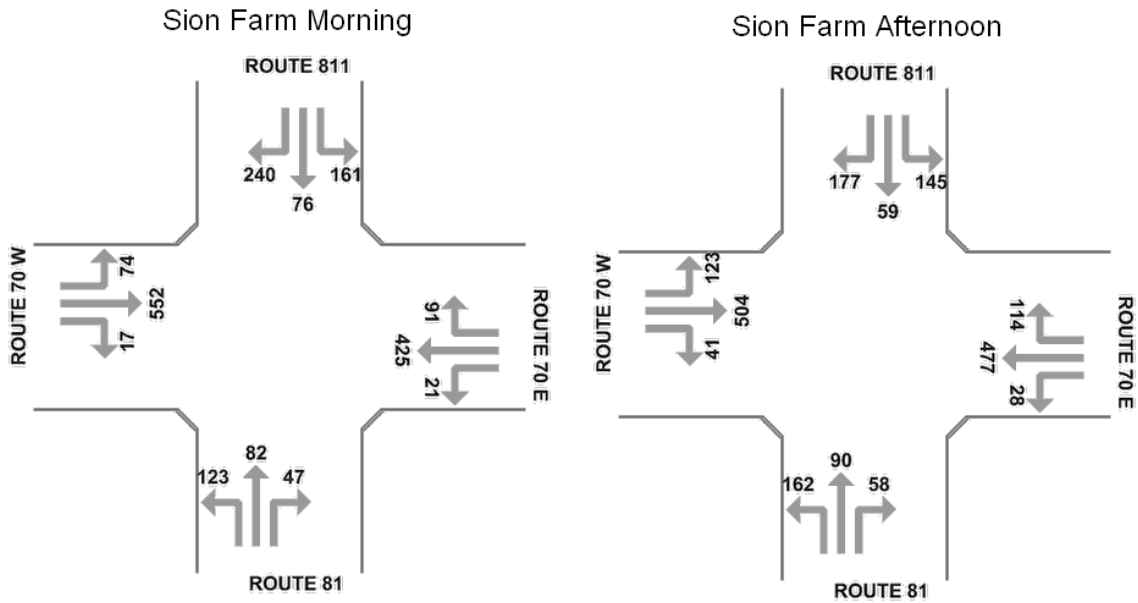


Figure 12: Traffic volume for peak periods at Sion Farm intersection

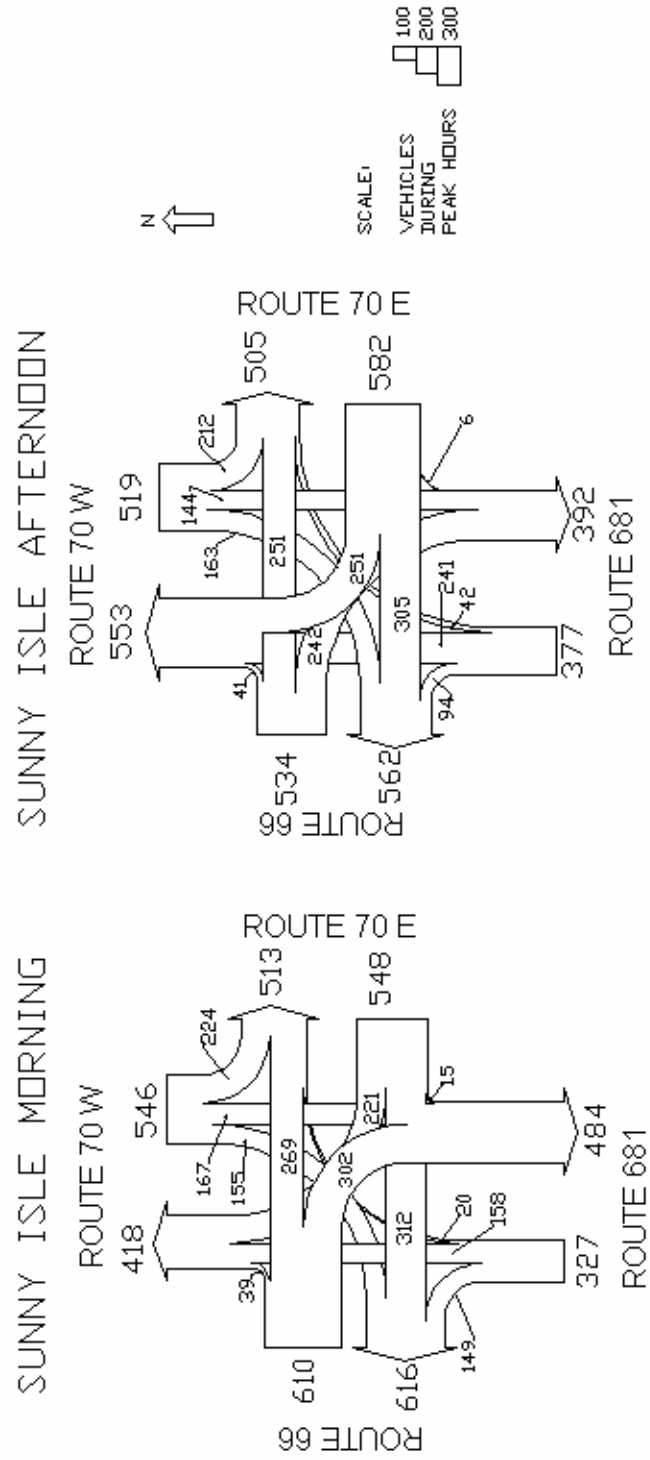


Figure 13: Telescope diagram for peak periods at Sunny Isle Intersection

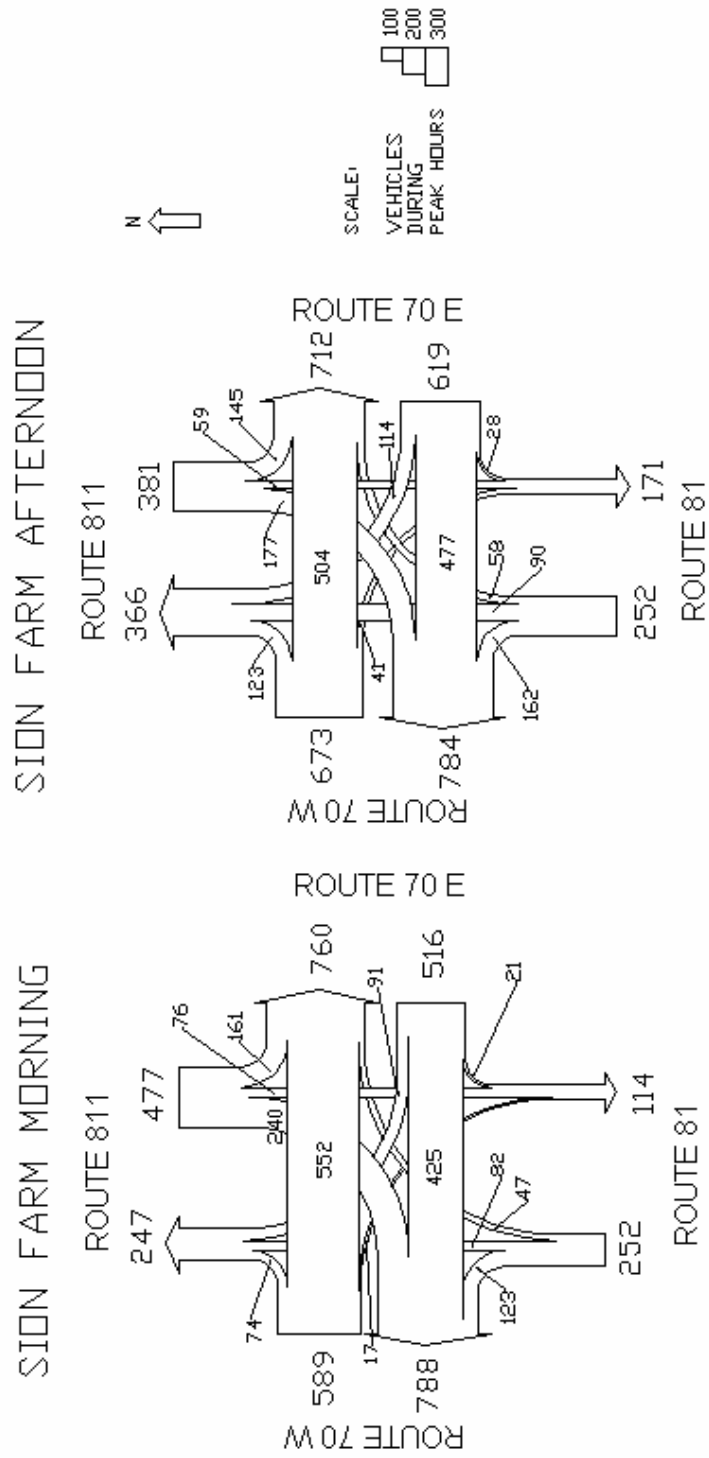


Figure 14: Telescope diagram for peak periods at Sion Farm intersection

3.2 Peak Hour Volumes

Traffic counting was used to identify morning and afternoon peak periods and to calculate the Peak Hour Factor (PHF), a measure of the variability of demand during the peak hour (Garber, N.J. and Hoel L.A., 1996).

Traffic counting for the Sunny Isle intersection shows a maximum hourly volume of 2,031 vehicles between 7:25 A.M. and 8:25 A.M. and a peak hour factor of 0.91. Vehicle flow in the afternoon is almost constant from 3:25 P.M. to 5:40 P.M. with an average of 1,974 vehicles crossing the intersection. The maximum hourly volume was 2,012 vehicles observed between 4:25 P.M. and 5:25 P.M. with a Peak Hour Factor of 0.94.

Table 2 shows traffic volumes for the morning and afternoon periods at the Sunny Isle intersection. Vehicle flow for both peak periods is very similar in all approaches. A detailed tabulation by approaches at peak periods is available in Appendix B.

Table 2: Morning and peak period traffic count at Sunny Isle intersection

| Morning Count at Peak Hour | | | | Afternoon Count at Peak Hour | | | |
|-----------------------------------|------|----------|-------------|-------------------------------------|------|----------|-------------|
| From | Left | Straight | Right | From | Left | Straight | Right |
| 70E | 15 | 312 | 221 | 70E | 6 | 305 | 271 |
| 70 W | 224 | 167 | 155 | 70 W | 212 | 144 | 163 |
| 66 | 39 | 269 | 302 | 66 | 41 | 251 | 242 |
| 681 | 149 | 158 | 20 | 681 | 94 | 241 | 42 |
| Total Volume | | | 2031 | Total Volume | | | 2012 |

Traffic counting for the Sion Farm shows a maximum hourly volume of 1,909 vehicles between 7:25 A.M. and 8:25 A.M. with a Peak Hour Factor of 0.96. On the afternoon, the maximum hourly volume was 1,978 vehicles between 3:00 P.M. and 4:00 P.M. with a Peak Hour Factor of 0.96 as well.

Table 3 presents traffic volumes for the morning and afternoon periods at the Sion Farm intersection. Vehicle flow is slightly higher in the afternoon peak period. A detailed tabulation by approaches and PHF calculation is available in Appendix B.

Table 3: Morning and afternoon peak period traffic count at Sion Farm intersection

| Morning Count at Peak Hour | | | | Afternoon Count at Peak Hour | | | |
|-----------------------------------|------|----------|-------------|-------------------------------------|------|----------|-------------|
| From | Left | Straight | Right | From | Left | Straight | Right |
| 70E | 21 | 425 | 91 | 70E | 28 | 477 | 114 |
| 70 W | 74 | 552 | 17 | 70 W | 123 | 504 | 41 |
| 81 | 123 | 82 | 47 | 81 | 162 | 90 | 58 |
| 811 | 161 | 76 | 240 | 811 | 145 | 59 | 177 |
| Total Volume | | | 1909 | Total Volume | | | 1978 |

3.3 Analysis of Intersections

3.3.1 Introduction

Performance of a transportation system can be measured by a combination of its capacity or volume to capacity ratio and the level of service. The capacity can change because of weather, work zones, traffic incidents, or other non-recurring events. Procedure to determine the level of service at the intersection approaches and the level of service of the intersection as a whole is presented in the Highway Capacity Manual (2000). This procedure determines the performance of the intersection in terms of delay, which is then related to the level of service at the intersection, Table 4 summarizes this

information. Factors that affect the level of service at intersections include flow and distribution of traffic, geometric characteristics, and signalization system.

Table 4: Level of Service criteria for signalized intersections

| Level of Service | Stopped Delay Per Vehicle (sec) | Qualitative Description |
|-------------------------|--|---|
| A | ≤ 10 | Good Progression, few stops, and short cycle lengths |
| B | > 10 and ≤ 20.0 | Good progression and/or short cycle lengths; more vehicle stops. |
| C | > 20.0 and ≤ 35.0 | Fair progression and/or longer cycle lengths, some cycle failures; significant portion of vehicles must stop. |
| D | > 35.0 and ≤ 55.0 | Congestion becomes noticeable; high volume-to-capacity ratio, longer delays, noticeable cycle failures. |
| E | > 55.0 and ≤ 80.0 | At or beyond limit of acceptable delay; poor progression, long cycles, high volumes, long queues. |
| F | > 80 | Unacceptable to driver. Arrival volumes higher than discharge capacity; long cycle lengths, unstable/unpredictable flows. |

SOURCE: Highway Capacity Manual, Transportation Research Board, Washington, D.C. 2000

3.3.2 Simulation Results

Previous presented data was used as input for AASIDRA and SYNCHRO to simulate current traffic conditions. Both programs performed well estimating delays, results were similar in most of the cases but AASIDRA was selected over SYNCHRO to present simulation results because it represents best the queues during peak hours, refer to Appendix F for more details. SYNCHRO was used as a tool to complement analysis and observe with the animation interface traffic behavior at the intersections.

Table 5 summarizes simulation results obtained from AASIDRA for current conditions for the morning and afternoon peak period of each intersection. Results indicate level of service E and F for the intersections at peak periods. Table 4 indicates a LOS E that delays are at or beyond acceptable limits due to the following reasons; long cycles, high volumes and long queues. A LOS F is unacceptable to drivers. Arrival volumes higher than discharge capacity; long cycle lengths and unstable/unpredictable flows. Complete reports of the computer software outputs are presented in Appendix C.

Table 5: Simulation results for current conditions at intersections

| Intersection | Sunny Isle Morning | Sunny Isle Afternoon | Sion Farm Morning | Sion Farm Afternoon |
|--------------------|--------------------|----------------------|-------------------|---------------------|
| Demand Flow (vph) | 2392 | 2335 | 2269 | 2313 |
| Capacity Ratio v/c | 1.105 | 1.050 | 1.076 | 1.00 |
| Delay (s) | 99.6 | 87.9 | 84.3 | 66.1 |
| Level of Service | F | F | F | E |
| Queue (veh) | 57.6 | 42 | 65.7 | 48.2 |

Simulation results indicate delays at Sunny Isle intersection were up to 99.6 seconds and a maximum of 57 vehicles in queue. On the Sion Farm intersection delays were up to 84.3 seconds and up to 65 vehicles in queue. Is very important to observe the capacity ratios or degree of saturation, they will help to determine if lanes are operating under capacity or over capacity. For insufficient capacity, changes to infrastructure are recommended. It includes changes to controls, geometric changes, among others. For lanes operating under capacity is necessary to eliminate whatever is causing a reduction in capacity.

Tables 6 to 9 present simulation results for each lane group in each intersection; demand flow, capacity ratio (v/c ratio), the delay in seconds, the level of service and the queue in vehicles.

Table 6: AASIDRA simulation results for Sunny Isle intersection at morning peak.

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|-------------------|------|---------------------|----------------|----------------------|---------------------|------------------|-----------------------|
| ROUTE 681 | | | | | | | |
| 1 | L | 194 | 211 | 0.918 | 90.2 | LOS F | 263 |
| 2 | T | 205 | 252 | 0.918 | 85.9 | LOS F | 263 |
| 2 | R | 26 | 252 | 0.918 | 85.9 | LOS F | 263 |
| Approach | | 425 | 463 | 0.918 | 87.9 | LOS F | 263 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 18 | 18 | 0.99 | 116.9 | LOS F | 306 |
| 5 | T | 328 | 427 | 0.981 | 113.5 | LOS F | 306 |
| 6 | R | 270 | 179 | 1 | 75.8 | LOS E | 107 |
| Approach | | 616 | 624 | 1 | 102.6 | LOS F | 306 |
| ROUTE 70 W | | | | | | | |
| 7 | L | 284 | 163 | 1.001 | 70.6 | LOS E | 92 |
| 8 | T | 211 | 300 | 1.105 | 144.8 | LOS F | 403 |
| 9 | R | 163 | 148 | 1.104 | 152.8 | LOS F | 403 |
| Approach | | 658 | 611 | 1.105 | 128.3 | LOS F | 403 |
| ROUTE 66 | | | | | | | |
| 10 | L | 44 | 995 | 0.044 | 10.3 | LOS B | 9 |
| 11 | T | 306 | 448 | 0.879 | 80.7 | LOS F | 241 |
| 12 | R | 343 | 256 | 1 | 82.4 | LOS F | 151 |
| Approach | | 693 | 1698 | 1 | 76.9 | LOS E | 241 |

Table 7: AASIDRA simulation results for Sunny Isle intersection at afternoon peak.

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|-------------------|------|---------------------|----------------|----------------------|---------------------|------------------|-----------------------|
| ROUTE 681 | | | | | | | |
| 1 | L | 109 | 114 | 0.96 | 105.5 | LOS F | 294 |
| 2 | T | 280 | 343 | 0.961 | 101.3 | LOS F | 294 |
| 2 | R | 49 | 343 | 0.961 | 101.3 | LOS F | 294 |
| Approach | | 438 | 456 | 0.961 | 102.3 | LOS F | 294 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 7 | 7 | 1.045 | 106.1 | LOS F | 292 |
| 5 | T | 339 | 439 | 1.05 | 101.2 | LOS F | 292 |
| 6 | R | 301 | 179 | 1 | 75.8 | LOS E | 107 |
| Approach | | 647 | 624 | 1.051 | 94.2 | LOS F | 292 |
| ROUTE 70 W | | | | | | | |
| 7 | L | 241 | 163 | 1.001 | 70.6 | LOS E | 92 |
| 8 | T | 164 | 252 | 0.957 | 94 | LOS F | 288 |
| 9 | R | 185 | 193 | 0.958 | 98.5 | LOS F | 288 |
| Approach | | 590 | 609 | 1 | 88.9 | LOS F | 288 |
| ROUTE 66 | | | | | | | |
| 10 | L | 51 | 950 | 0.054 | 12.1 | LOS B | 12 |
| 11 | T | 310 | 450 | 0.786 | 71.6 | LOS E | 200 |
| 12 | R | 299 | 256 | 1 | 82.4 | LOS F | 151 |
| Approach | | 660 | 1655 | 1 | 71.2 | LOS E | 200 |

Table 8: AASIDRA simulation results for Sion Farm intersection at morning peak.

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|-------------------|------|---------------------|----------------|----------------------|---------------------|------------------|-----------------------|
| ROUTE 81 | | | | | | | |
| 1 | L | 158 | 225 | 0.702 | 62.9 | LOS E | 127 |
| 2 | T | 105 | 150 | 0.702 | 64.1 | LOS E | 127 |
| 3 | R | 60 | 199 | 0.302 | 60.3 | LOS E | 37 |
| Approach | | 323 | 573 | 0.702 | 62.8 | LOS E | 127 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 23 | 27 | 0.842 | 66.3 | LOS E | 268 |
| 5 | T | 472 | 559 | 0.844 | 67.5 | LOS E | 268 |
| 6 | R | 101 | 161 | 0.626 | 67.1 | LOS E | 61 |
| Approach | | 596 | 748 | 0.844 | 67.4 | LOS E | 268 |
| ROUTE 811 | | | | | | | |
| 7 | L | 212 | 197 | 1.076 | 102.8 | LOS F | 227 |
| 8 | T | 100 | 190 | 1.076 | 104 | LOS F | 227 |
| 9 | R | 316 | 211 | 1 | 68.3 | LOS E | 114 |
| Approach | | 628 | 599 | 1.076 | 91.6 | LOS F | 227 |
| ROUTE 70 W | | | | | | | |
| 10 | L | 83 | 1551 | 0.054 | 1.7 | LOS A | 2 |
| 11 | T | 620 | 587 | 1.056 | 116.2 | LOS F | 460 |
| 12 | R | 19 | 163 | 0.116 | 63.2 | LOS E | 13 |
| Approach | | 722 | 2301 | 1.056 | 101.7 | LOS F | 460 |

Table 9: AASIDRA simulation results for Sion Farm intersection at afternoon peak.

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|-------------------|------|---------------------|----------------|----------------------|---------------------|------------------|-----------------------|
| ROUTE 81 | | | | | | | |
| 1 | L | 249 | 294 | 0.848 | 68.6 | LOS E | 171 |
| 2 | T | 95 | 112 | 0.847 | 69.8 | LOS E | 171 |
| 3 | R | 89 | 198 | 0.449 | 61.3 | LOS E | 53 |
| Approach | | 433 | 604 | 0.847 | 67.3 | LOS E | 171 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 30 | 33 | 0.91 | 75.6 | LOS E | 314 |
| 5 | T | 502 | 553 | 0.907 | 76.8 | LOS E | 314 |
| 6 | R | 124 | 204 | 0.607 | 67.6 | LOS E | 73 |
| Approach | | 656 | 791 | 0.907 | 75 | LOS E | 314 |
| ROUTE 811 | | | | | | | |
| 7 | L | 196 | 280 | 0.7 | 51.4 | LOS D | 118 |
| 8 | T | 62 | 128 | 0.7 | 52.6 | LOS D | 118 |
| 9 | R | 239 | 211 | 1 | 68.3 | LOS E | 114 |
| Approach | | 497 | 620 | 1 | 58.8 | LOS E | 118 |
| ROUTE 70 W | | | | | | | |
| 10 | L | 134 | 1502 | 0.089 | 1.8 | LOS A | 5 |
| 11 | T | 548 | 587 | 0.933 | 76.9 | LOS E | 337 |
| 12 | R | 45 | 162 | 0.277 | 64.4 | LOS E | 30 |
| Approach | | 727 | 2252 | 0.933 | 62.3 | LOS E | 337 |

4 Traffic Forecast

Future developments must be considered when performing traffic studies, they will add more traffic to the intersection making current situation worse. According to the Department of Planning and Natural Resources of Virgin Islands, there are no future developments proposed in the surrounding areas.

Projections of the US Census Bureau (2008a) for the Virgin Islands indicate a decrease of the population of 1.36 % in the next five years. They estimate that in the year 2025 US Virgin Islands will have less population than it has today, refer to Table 10.

Other factors such as economical growth and shift changes can influence the amount of traffic that goes through the intersections. At the time of this study no statistical data was available to calculate the impact of these factors in traffic behavior. Therefore, future traffic increase was not considered in this project.

Table 10: Population projection for the US Virgin Islands

Total Midyear Population

| Country or area | Year | Population |
|-----------------|------|------------|
| Virgin Islands | 1995 | 107,817 |
| Virgin Islands | 2005 | 108,708 |
| Virgin Islands | 2010 | 107,560 |
| Virgin Islands | 2015 | 106,521 |
| Virgin Islands | 2020 | 106,913 |
| Virgin Islands | 2025 | 107,559 |

Source: U.S. Census Bureau, International Data Base.

5 Generation and Evaluation Alternatives

5.1 Traffic problems

Traffic simulation using SYNCHRO and field observation were used to identify possible causes for traffic congestion in this area. In general, traffic in Sunny Isle and Sion Farm intersections area is affected because of the amount of vehicles that travel thru these intersection is higher than its capacity. Also, a substantial amount of right turns causes blockage of traffic on the through lanes by vehicles on the turn lanes and vice versa.

A problem of insufficient capacity is usually solved increasing capacity by adding more lanes or redirecting traffic flow. These intersections in particular have heavy right turn movements making it more difficult to find a solution.

Proposed alternatives not only must improve traffic condition they have to be costs effective. Politics and lack of available funds makes the generation of practical alternatives a complex process. Recommendations not necessarily will have public acceptance, a tradeoff between benefits and costs should be made. A large amount of land surrounding these intersections has commercial use; this is important when considering alternatives.

5.2 Alternatives

Recommendations include changes in the operation of intersection and/or changes in the infrastructure of the intersections. There are multiple solutions for these problems but only viable alternatives with less impact to the environment and surrounding commercial area were considered.

Each of the proposed alternatives was simulated using AASIDRA and SYNCHRO to decide which alternative is more effective improving traffic conditions. Results were analyzed in terms of delays and degree of saturation.

Tables 11 to 14 summarize the proposed alternatives in terms of delays, degree of saturation, level of service and queue for each intersection. A complete output of computer simulation is available in Appendix D.

5.2.1 Sunny Isle

5.2.1.1 Alternative 1

First alternative is the optimization of the signalized intersection using AASIDRA. Considering the posted speed limit, road width, slopes and typical driver behavior intergreen time was reduced from 6 to 5 seconds. This alternative provides an immediate solution to congestion reducing intersection delays by 42 and 35 seconds for the morning and afternoon period respectively. Resulting level of service for the overall intersection is E and D for each period. Although it provides some benefits, a level of service C is preferable. Degree of saturation exceeds 1.00, indicating that a capacity problem is present.

5.2.1.2 Alternative 2

Alternative 2 provides an additional right turn lane and a through lane on Route 66 and Route 70 E. This will help to increase the amount of vehicles that are allowed to do a right turn during green phase. This alternative adds a downstream short lane on Route 681 and Route 70 E to accommodate turning traffic. It also includes a left short lane on the northbound approach. Figure 15 shows a diagram with proposed geometry.

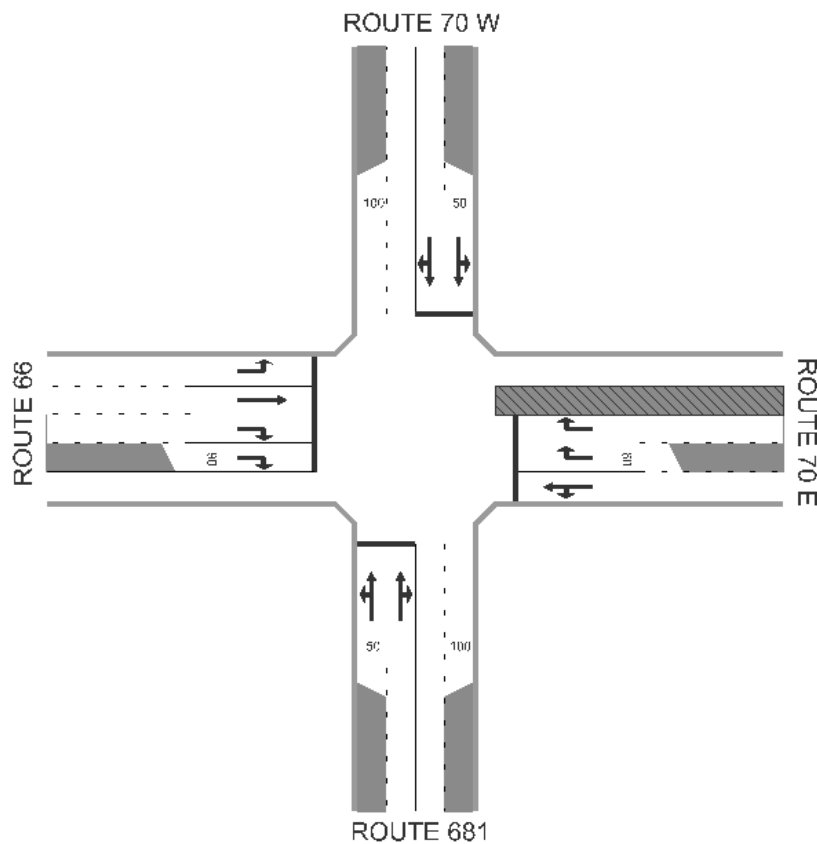


Figure 15: Diagram of Alternative 2 proposed for Sunny Isle intersection

This alternative improves considerably traffic conditions. Delays are reduced to a maximum of 34.1 seconds with an overall level of service C in both peak periods. Degrees of saturation are less than 1.00 in all approaches but still considerable high.

5.2.1.3 Alternative 3

A Jug-Handle design is proposed as the third alternative. This design is used to redirect right turns through a left lane before getting to the intersection. Figure 16 shows a typical Jug-Handle design.

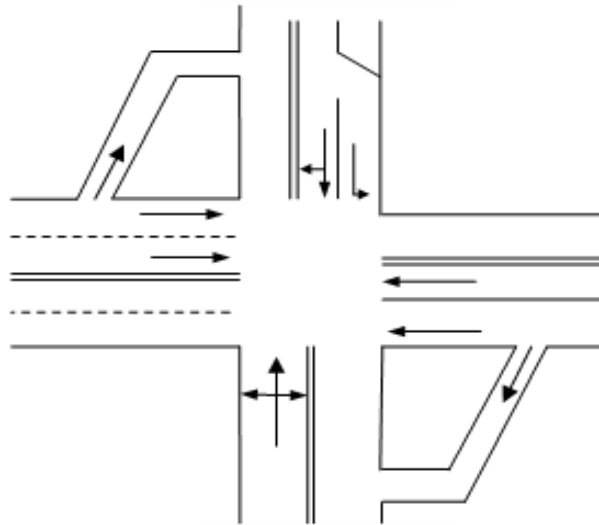


Figure 16: Diagram of a typical Jug-Handle design

This alternative was simplified for simulation purposes; traffic flow of vehicles turning right was added to the flow on the approach opposite to the turn. Now through lanes have two lanes. Figure 17 shows improvements to the intersection, a short downstream lane was added to the north and south approach and a left shared lane was added to the northbound approach.

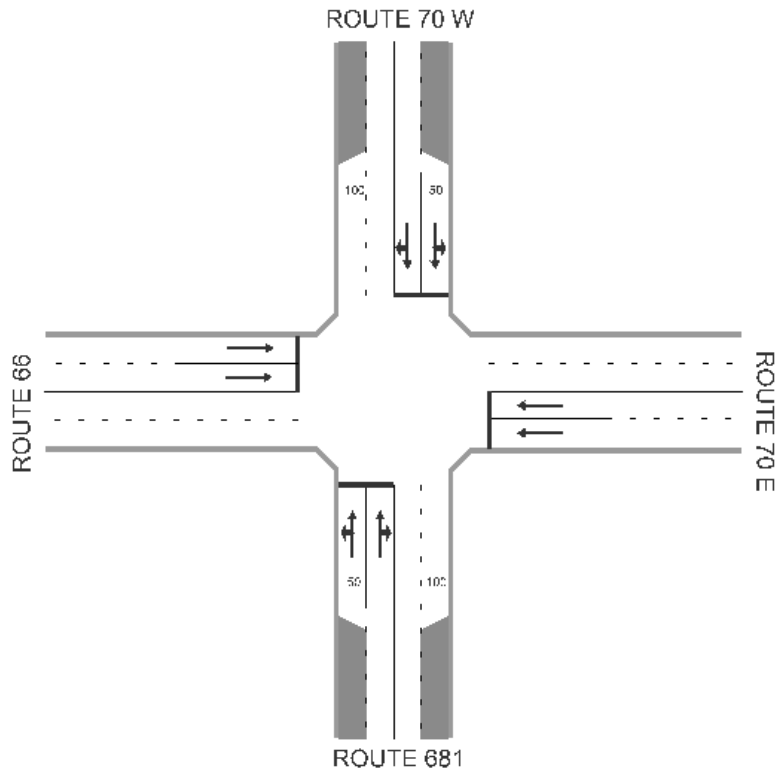


Figure 17: Diagram of Alternative 3 proposed for Sunny Isle intersection

A Jug – Handle design improves traffic conditions good results reducing delays. Delays in the morning period are 32.3 seconds with a level of service C, not too different from results in alternative 2. It also has degrees of saturation close to 1.00. This type of design has other complications, it requires new access to redirect left turn movements and creates new intersections in the north and south approaches.

5.2.1.4 Alternative 4

Alternative 4 consist of constructing a two way overpass on the East - West direction connecting Route 66 and Route 70 E. This will create a single point interchange underneath controlled by a single traffic light as shown on Figure 18.

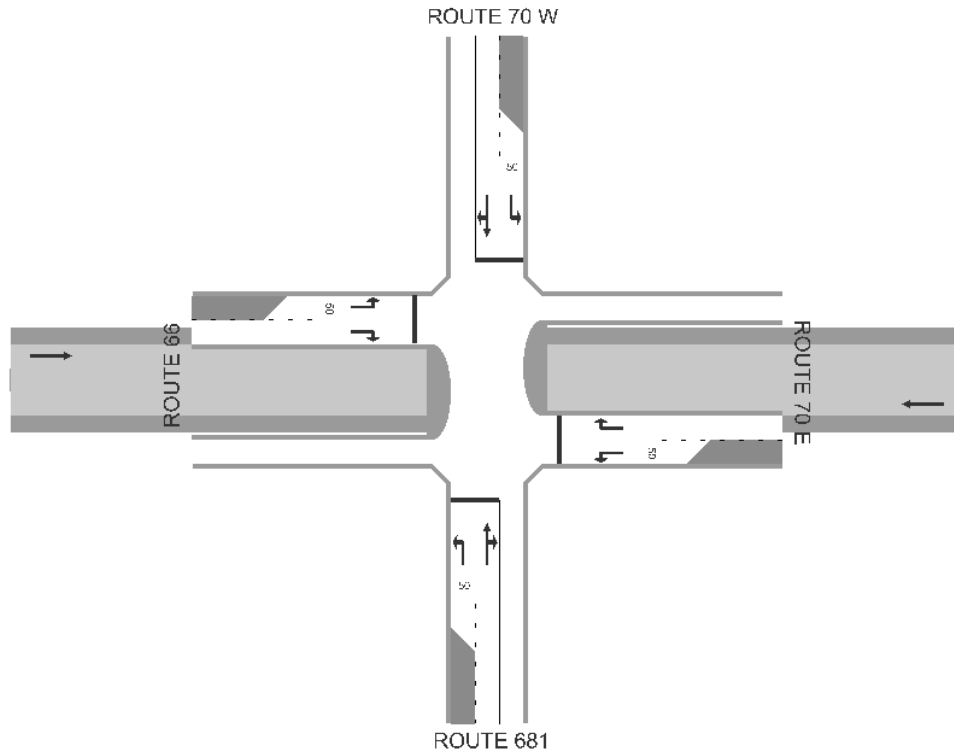


Figure 18: Diagram of Alternative 4 proposed for Sunny Isle intersection

Alternative 4 improves overall performance up to a level of service B and a degree of saturation of 0.66. Single point intersections are ideal where right of way is limited, but construction costs are high.

5.2.2 Sion Farm

5.2.2.1 Alternative 1

Similar to in Sunny Isle, first alternative is the optimization of the signalized intersection using computer simulation, in this case, AASIDRA.

Telescope diagrams in Figure 14 showed that opposed traffic flow in north and south approach is unbalance. A change in the phases is proposed as alternative 1, refer to Figure 19.

This change in the phases allows a change in the geometry of the south approach.
 An exclusive left turn lane and a shared right and thru lane, as shown in Figure 20.

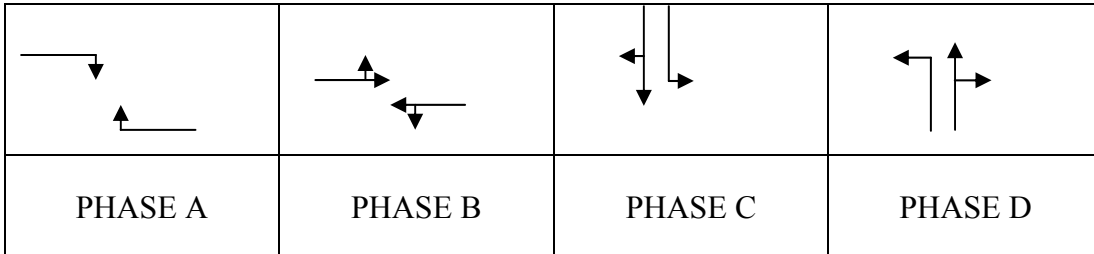


Figure 19: Phase diagram proposed for Sion Farm intersection.

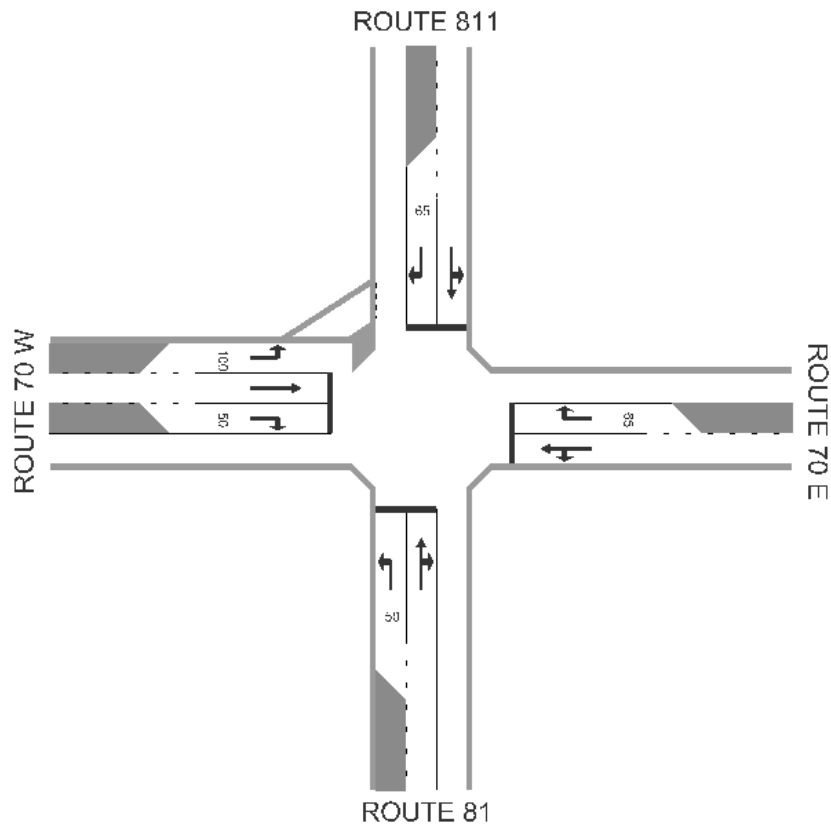


Figure 20: Geometry proposed as Alternative 1 for Sion Farm intersection

These changes reduce notably the average intersection delay to 30.3 and 29.4 seconds for the morning and afternoon period respectively. The overall level of service is C for both periods. This alternative is an immediate solution that does not require a significant amount of money.

5.2.2.2 Alternative 2

This alternative increases the amount of through lanes, one lane each direction along Route 70. Figure 21 presents proposed geometry. It will allow more vehicles go through the intersection during green periods.

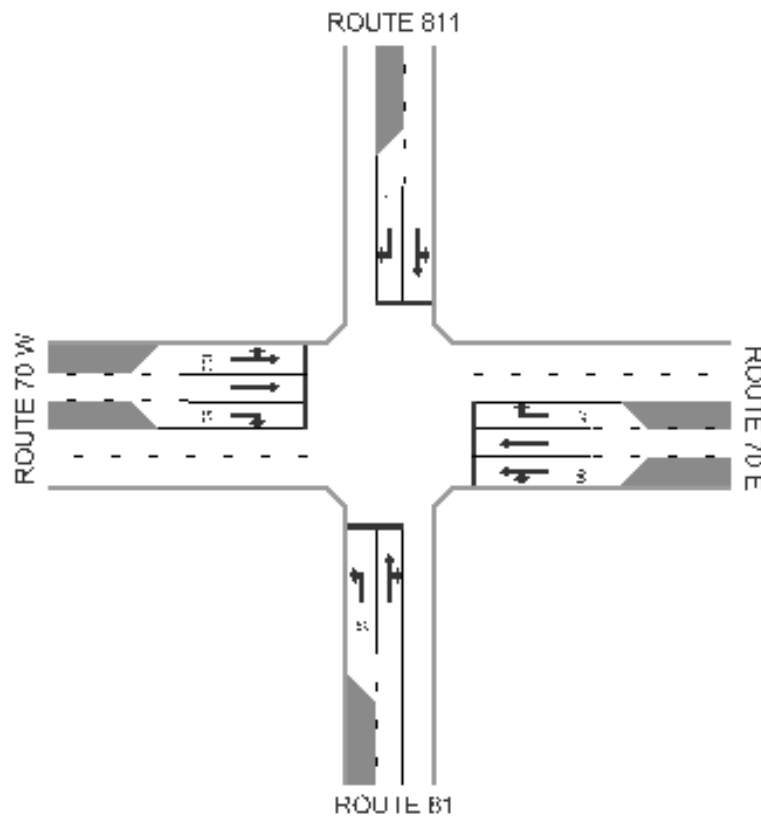


Figure 21: Diagram of current geometry and proposed as Alternative 2 for Sion Farm intersection

Alternative 2 provides a level of service C as well with delays of 25.1 and 23.9 for the intersection. This alternative provides better results improving traffic conditions.

5.2.2.3 Alternative 3

This alternative suggests a Jug-Handle design to eliminate right turns from Route 70 at the Sion Farm intersection to reduce delays, refer to Figure 16. As mentioned before, this alternative was simplified for simulation purposes; traffic flow of vehicles turning right was added to the flow on the approach opposite to the turn. Figure 22 shows a diagram of the proposed alternative.

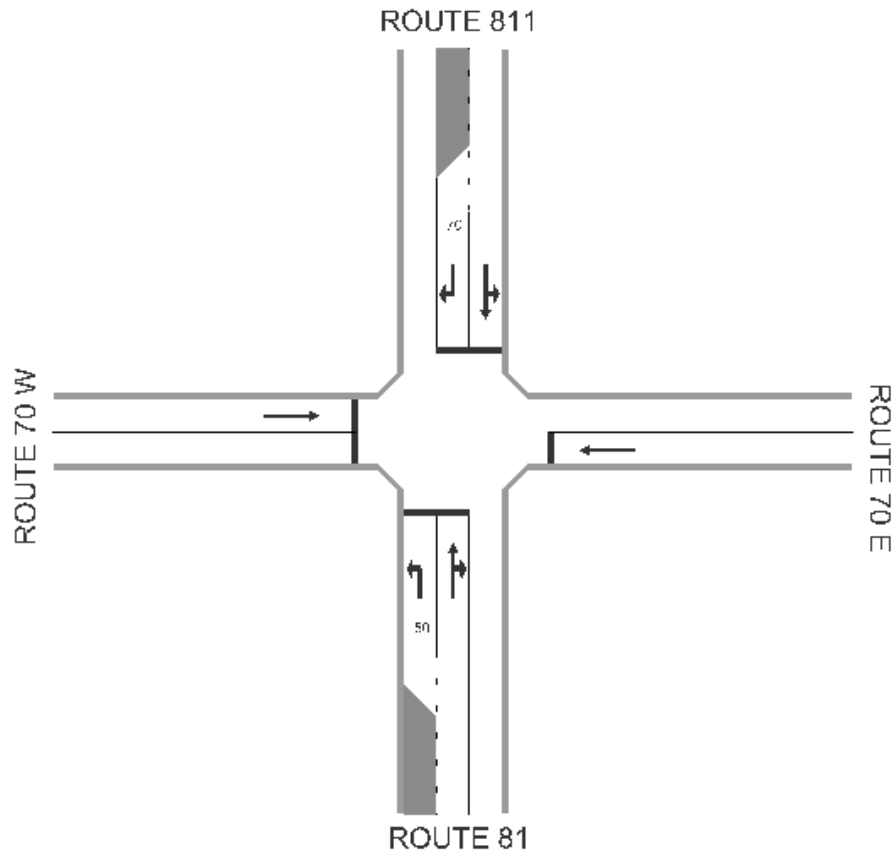


Figure 22: Diagram of proposed Alternative 3 for Sion Farm intersection

Different from Sunny Isle, this design improves level of service of the intersection to C. Delay for both peak periods is around 24.8 seconds. Better result can be achieved if Route 70 is widened to four lanes.

5.2.2.4 Alternative 4

Alternative 4 consist of constructing a two way overpass on the East - West direction on Route 70 with a single point interchange underneath.

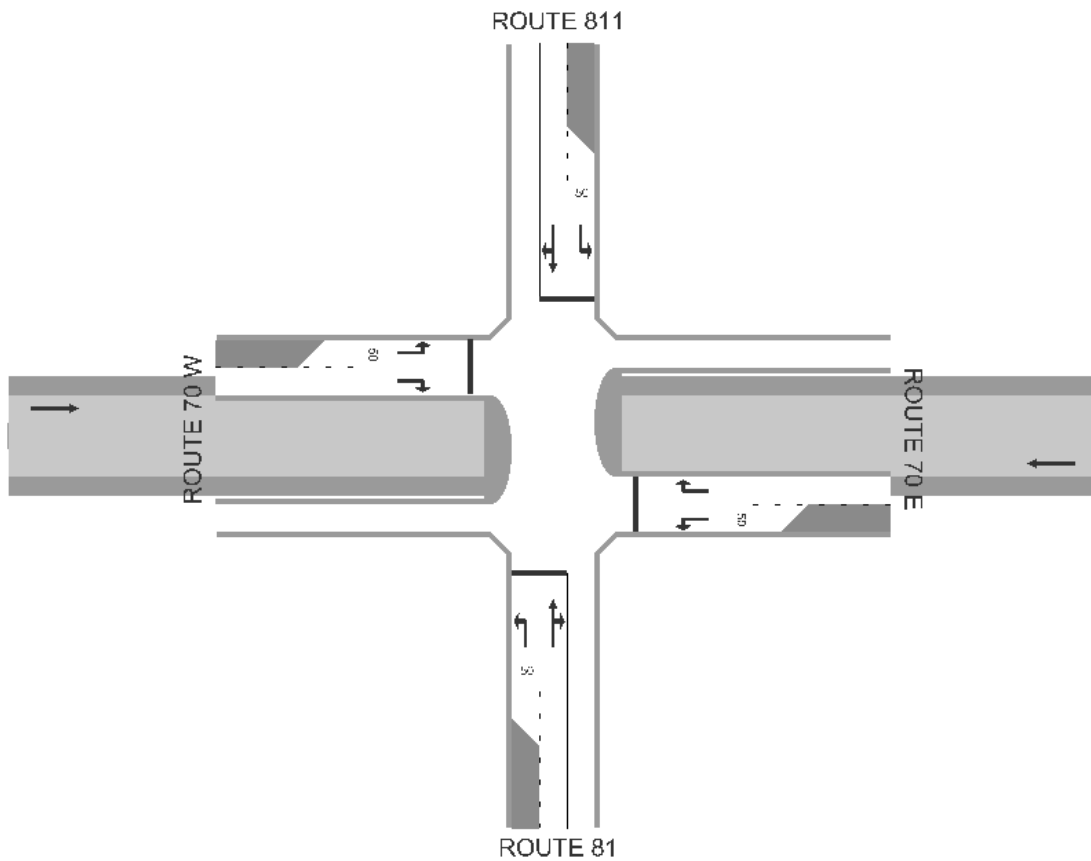


Figure 23: Diagram of geometry proposed as Alternative 4 for Sion Farm intersection

Alternative 4 improves overall performance up to a level of service A and a degree of saturation of 0.48. The implementation of this alternative requires more founding than any other alternative.

Table 11: Simulation results summary for Sunny Isle during morning peak period.

Sunny Isle Intersection A.M. Peak Hour

| Alternative | Average Delay (s) | Degree of Saturation (v/c) | Queue (veh) | LOS |
|--------------------|--------------------------|-----------------------------------|--------------------|------------|
| Current | 99.6 | 1.105 | 57.6 | F |
| 1 | 56.8 | 1.036 | 25.0 | E |
| 2 | 32.8 | 0.908 | 17.1 | C |
| 3 | 32.3 | 0.971 | 29.5 | C |
| 4 | 15.2 | 0.701 | 12.7 | B |

Table 12: Simulation results summary for Sunny Isle during afternoon peak period.

Sunny Isle Intersection P.M. Peak Hour

| Alternative | Average Delay (s) | Degree of Saturation (v/c) | Queue (veh) | LOS |
|--------------------|--------------------------|-----------------------------------|--------------------|------------|
| Current | 87.9 | 1.050 | 42.0 | F |
| 1 | 52.8 | 1.040 | 20.9 | D |
| 2 | 34.1 | 0.894 | 13.9 | C |
| 3 | 27.4 | 0.887 | 20.3 | C |
| 4 | 16.8 | 0.699 | 11.3 | B |

Table 13: Simulation results summary for Sion Farm during morning peak period.

Sion Farm Intersection A.M. Peak Hour

| Alternative | Average Delay (s) | Degree of Saturation (v/c) | Queue (veh) | LOS |
|--------------------|--------------------------|-----------------------------------|--------------------|------------|
| Current | 84.3 | 1.076 | 65.7 | F |
| 1 | 30.3 | 0.898 | 25.8 | C |
| 2 | 23.9 | 0.856 | 11.7 | C |
| 3 | 24.7 | 0.888 | 20.6 | C |
| 4 | 9.1 | 0.483 | 10.3 | A |

Table 14: Simulation results summary for Sion Farm during morning peak period.

Sion Farm Intersection P.M. Peak Hour

| Alternative | Average Delay (s) | Degree of Saturation (v/c) | Queue (veh) | LOS |
|--------------------|--------------------------|-----------------------------------|--------------------|------------|
| Current | 66.1 | 1.000 | 42.8 | E |
| 1 | 29.4 | 0.945 | 20.9 | C |
| 2 | 25.1 | 0.970 | 10.7 | C |
| 3 | 24.8 | 0.868 | 18.1 | C |
| 4 | 9.4 | 0.476 | 9.1 | A |

6 Selection of Best Alternative

As mentioned before, for the analysis of alternatives left turn on red was permitted, is assumed that Sion Farm intersection is improved and turning traffic will not block through traffic. Also, intergreen time was reduced from 6 to 5 seconds in all proposed alternatives based in the following equation (Garber, N.J. and Hoel L.A., 1996).

$$\tau_{\min} = \delta + \frac{W + L}{u_0} + \frac{u_0}{2a + 64.4G} \quad (1)$$

Where,

τ_{\min} = yellow + all red interval (sec)

δ = perception – reaction time (1sec)

W = width of intersection (ft)

L = length of vehicle (ft)

u_0 = speed limit (ft/sec)

a = deceleration of vehicle (10 ft/sec²)

G = grade of the approach

$$1 + \frac{54 + 20}{44} + \frac{44}{(2 \times 10) + (64.4 \times 0)} = 4.88$$

Although all proposed alternatives improve current traffic conditions of the Sunny Isle intersection a level of service C or better is preferable. Alternatives 2 and 3 have a LOS C but have a high degree of saturation, meaning that a capacity problem still present. Also, alternative 3 has longer queues than alternative 2. Alternative 4, in the other hand, provides a LOS B with a degree of saturation near 0.70 and queues of less than 13 vehicles. Sunny Isle intersection has a capacity problem, all these alternatives requires a big acquisition of land.

For Sion Farm a change in phases and geometry was recommended and all proposed alternatives are based in those changes. Similar to Sunny Isle, all proposed alternatives for Sion Farm intersection improve traffic conditions with a LOS C or better. Alternative 1 consists of an optimization of the cycle length with the changes mentioned above. This alternative improves traffic conditions reducing delays up to 35 seconds and queues by half. Alternative 2 and 3 reduces delays and queues considerably. Degrees of saturation are acceptable in most of the lane movements, refer to simulation output in Appendix D. Alternative 4 similar to Sunny Isle, provide the best result with a LOS A and very low degree of saturation.

This is an important commercial area, and a tradeoff between impact to business, cost and improve traffic conditions should be made. Alternative 2 presents an adequate LOS C and has less impact to business around than any other proposed alternative. For Sion Farm Alternative 1, optimization and geometric changes in south approach represents the best alternative. It improves the LOS to C and is more economical than other options that have similar results.

These alternatives were simulated simultaneously using SYCHRO, similar to the current situation scenario. Traffic simulation showed an evident decrease of queues in both intersections and significant reductions on delays. Complete results are presented in Appendix E.

6.1 Proposed Design

Based in the traffic analysis in the previous chapters schematic drawings containing horizontal alignment are shown in Figures 24 and 25. Other design criteria

such as sight distance, clear zone, drainage should be taken into account in a detail design.

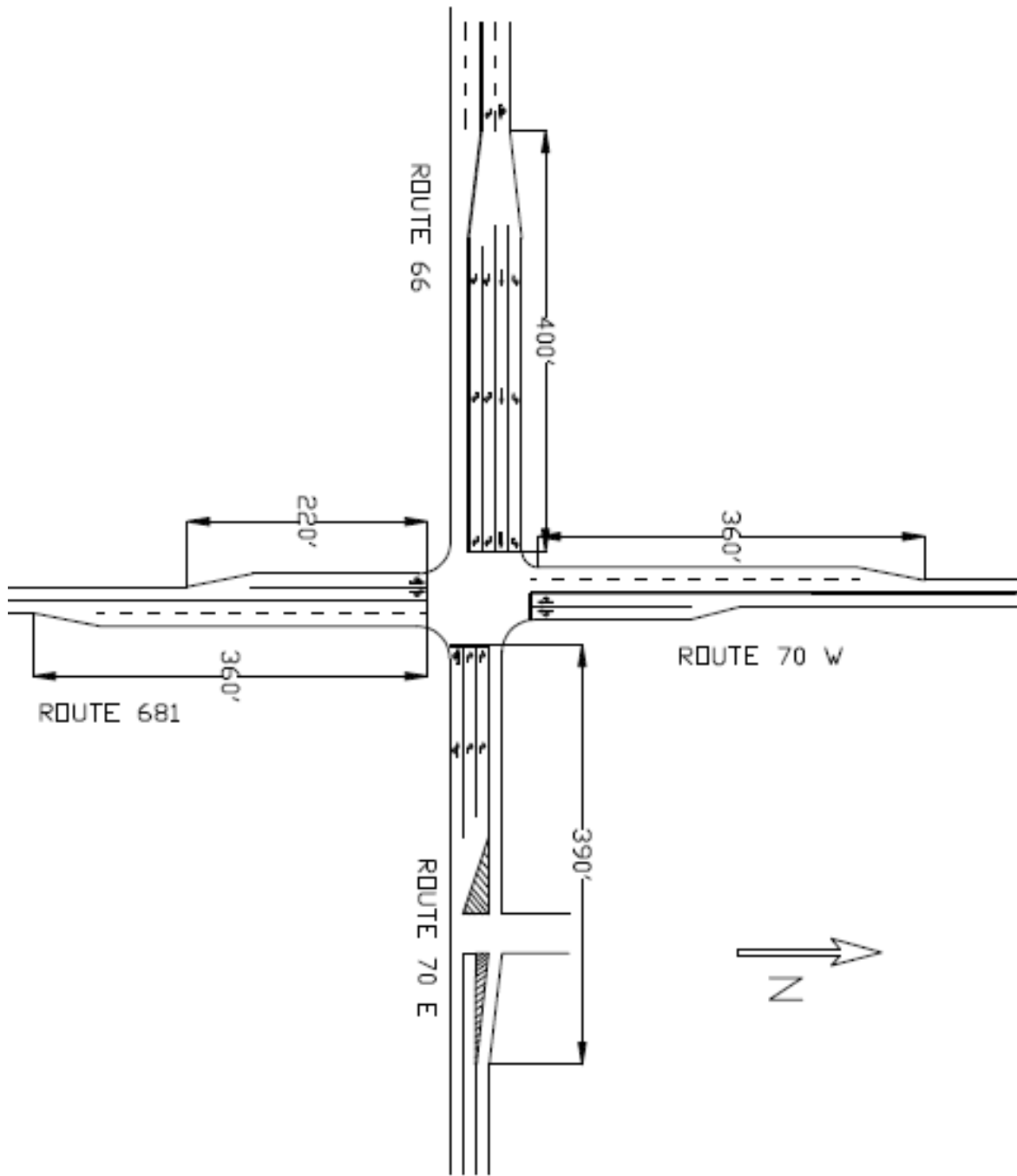


Figure 24: Recommended design for Sunny Isle intersection

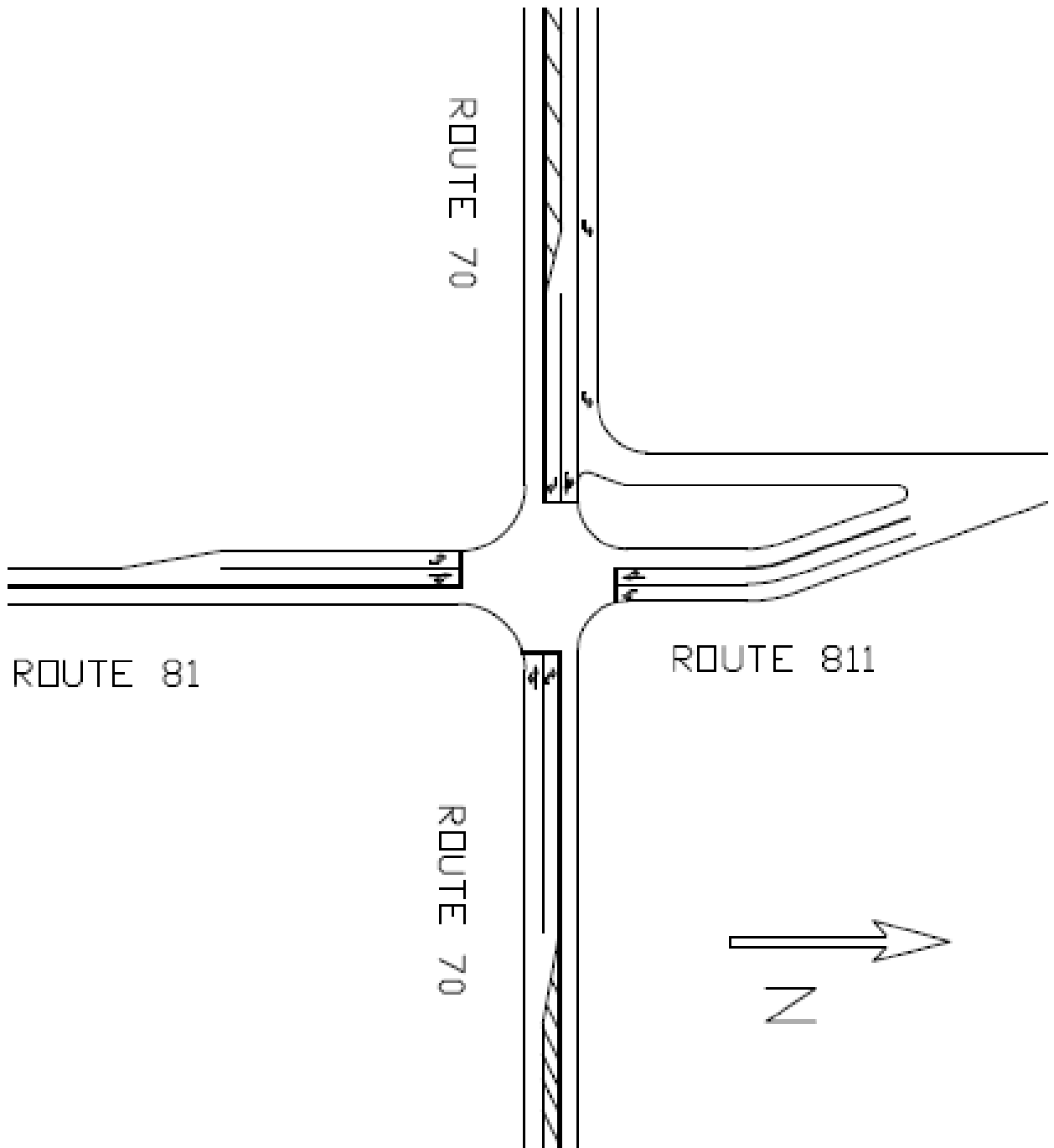


Figure 25: Recommended layout for Sion farm intersection.

6.2 Maintenance of Traffic

To avoid traffic interruption during construction these improvements should be done in stages. North and south approaches should be completed first, then east and west. During construction it is recommended to follow Typical Application 6 from the Manual on Uniform Traffic Devices (2000) shown in Figure 26. Lane widths shall be reduced to 10 feet to accommodate channelizing devices.

For the Sion Farm intersections no maintenance of traffic is planned because of the short duration of the work. However, general public should be warned about changes in geometry on the south approach.

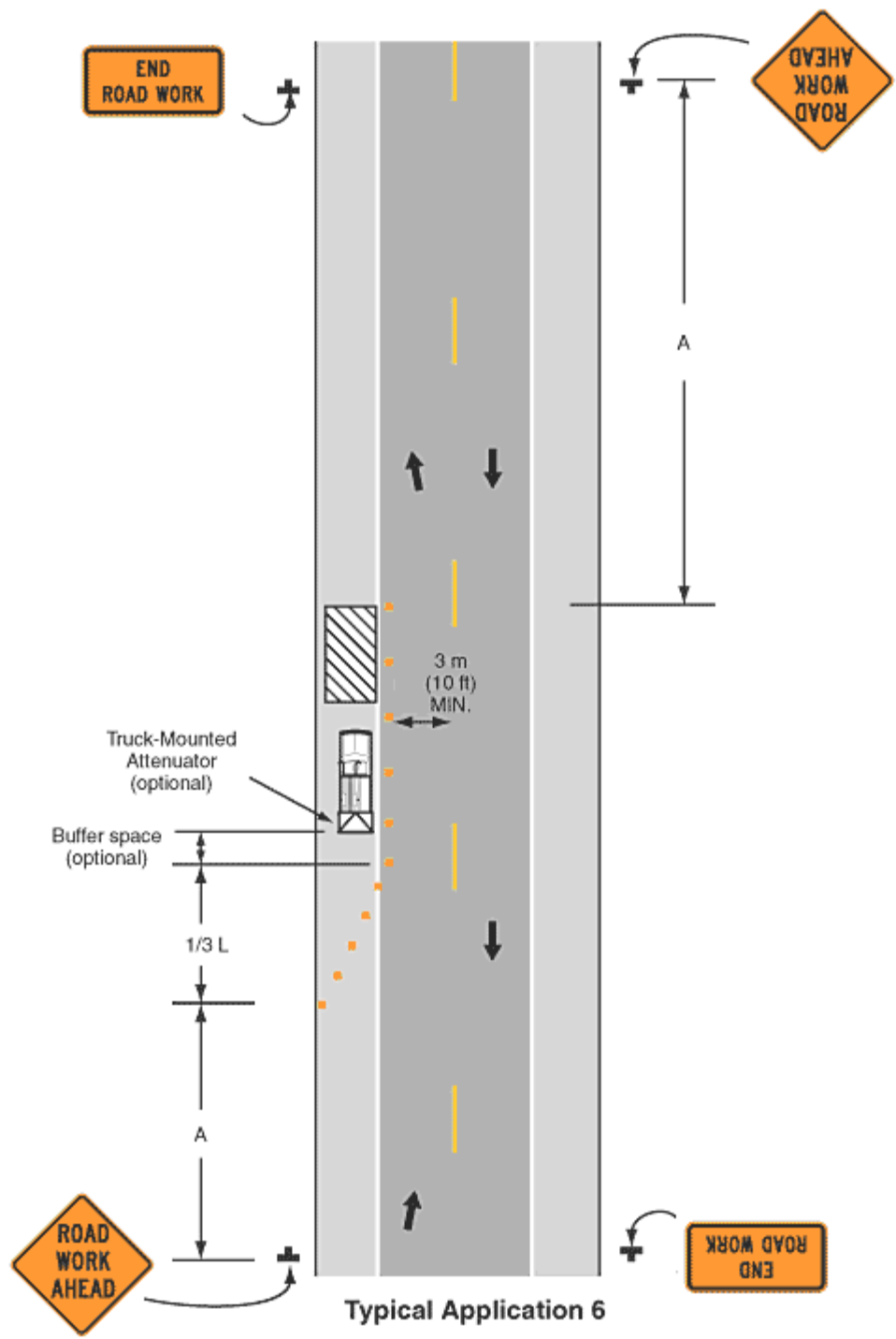


Figure 26: Typical application for maintenance of traffic.

6.3 Cost Analysis

Table 15 shows a preliminary estimate of the cost of the improvements for the Sunny Isle intersection. It includes land acquisition, excavation and pavement.

Government will buy only land needed for the extension of the road, is assumed that land surrounding the intersection is privately owned.

Table 15: Preliminary cost estimate for Sunny Isle intersection improvements.

| Item Description | Unit | Approximate Quantity | Unit Price | Amount |
|---|-------------|-----------------------------|-------------------|---------------------|
| Land Acquisition | S.F. | 20,760 | \$10.00 | \$207,600.00 |
| Demolition and Disposal of Current Infrastructure | C.Y. | 9,227 | \$10.00 | \$92,266.67 |
| Excavation | C.Y. | 1,318 | \$25.00 | \$32,955.56 |
| Pavement | | | | |
| Rotten Rock Sub base Course (10" thickness) | C.Y. | 549 | \$15.00 | \$8,238.89 |
| Untreated Aggregate Base Course (8" thickness) | C.Y. | 513 | \$68.00 | \$34,856.30 |
| Asphalt Base Course (4") | TONS | 517 | \$250.00 | \$84,755.79 |
| Asphalt Surface Course (2") | TONS | 258 | \$250.00 | \$42,894.70 |
| Tack Coat | GAL | 416 | \$8.00 | \$2,600.00 |
| Temporary Traffic Control | L.S. | 1 | \$30,000.00 | \$30,000.00 |
| TOTAL | | | | \$536,167.90 |

Sion Farm intersection does not require a cost estimate because Department of Public Works has the resources and personnel to perform the improvements in this intersection.

7 Conclusion and Recommendations

Current and future traffic conditions were analyzed with computer simulation programs to identify possible causes of traffic congestion and suggest potential alternatives to reduce congestion at the Sunny Isle and Sion Farm intersections located along Route 70. Vehicles in the Virgin Islands are driven on the left hand side of the road, but most of the automobiles on the island have left side steering wheels.

Traffic analysis revealed that both intersections have a problem of excessive delays and insufficient capacity, particularly in right turn lanes.

Even though the intersections are 2,000 feet apart the number of driveways and entrances between them make it a complex network to simulate. To simplify the study each intersection was analyzed as isolated being sure that they represent real traffic conditions. This analysis does not consider any effect that these recommendations will have in nearby intersections or approaches.

Intergreen time was reduced in both intersections from 6 to 5 seconds based in the posted speed limit, road width, slopes and typical driver behavior. Once these alternatives are implemented is necessary to verify that 5 seconds is enough time to clear the intersection.

Generated alternatives were simulated using AASIDRA and SYNCHRO to decide which alternative was more effective improving traffic conditions. Results were analyzed in terms of delays, degree of saturation and level of service.

For the Sunny Isle intersection, alternative 2 was selected. It provides an additional right turn lane on Route 66 and Route 70 E. This will help to increase the amount of vehicles that are allowed to do a right turn during green phase. A 100 feet

downstream lane is added on Route 681 and Route 70 E to accommodate turning traffic and a short lane is added in Route 681, this reduces intersection delays resulting in a level of service C.

For the Sion Farm intersection the optimization alternative of the signalized intersection using computer simulation, was chosen as the best alternative. Telescope diagram for this intersection showed disequilibrium in opposite approaches. As a result, a change in phases and a change in the lane operation of the south approach are recommended to improve traffic conditions. This alternative provides a level of service C with a minimal investment.

Since traffic behavior change from one place to another is recommended to measure the saturation flow prior the implementation of any of these alternatives to verify the values used.

There were other options evaluated with better results but because this is an important commercial area, a tradeoff between impact to business, cost and improve traffic conditions has to be made. Although these alternatives result in an adequate LOS some of the maneuvers presented high degrees of saturation indicating that eventually a capacity problem will show again.

Construction of new roads is not always an alternative because of the cost or limited space but extension of Route 66 should be considered to provide drivers an alternative to avoid driving through this highly transited area.

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Valdés, D. 2000. “Introducción al Diseño Geométrico Conceptual en Carreteras”. Departamento de Ingeniería Civil, Recinto Universitario de Mayagüez, P.R.

Appendix A

Traffic Counting

Sunny Isle Intersection AM

| TIME | NBR | NBT | NBL | SBL | SBT | SBR | EBR | WBR | EBT | WBT | EBL | WBL |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 6:05 | 0 | 5 | 3 | 15 | 17 | 4 | 5 | 4 | 9 | 7 | 2 | 1 |
| 6:10 | 0 | 4 | 6 | 4 | 14 | 2 | 4 | 11 | 19 | 9 | 1 | 2 |
| 6:15 | 1 | 8 | 0 | 16 | 16 | 6 | 5 | 14 | 16 | 9 | 6 | 0 |
| 6:20 | 0 | 7 | 3 | 22 | 23 | 6 | 7 | 15 | 6 | 14 | 5 | 0 |
| 6:25 | 0 | 4 | 2 | 12 | 14 | 5 | 7 | 9 | 23 | 8 | 0 | 0 |
| 6:30 | 0 | 10 | 3 | 10 | 26 | 10 | 10 | 9 | 8 | 5 | 1 | 1 |
| 6:35 | 0 | 7 | 2 | 11 | 27 | 4 | 5 | 19 | 9 | 21 | 2 | 2 |
| 6:40 | 0 | 5 | 4 | 12 | 13 | 3 | 15 | 27 | 14 | 16 | 1 | 0 |
| 6:45 | 3 | 9 | 14 | 17 | 27 | 12 | 8 | 17 | 22 | 14 | 3 | 1 |
| 6:50 | 1 | 10 | 3 | 19 | 15 | 3 | 16 | 22 | 23 | 27 | 2 | 0 |
| 6:55 | 0 | 5 | 8 | 21 | 24 | 7 | 15 | 10 | 28 | 25 | 0 | 0 |
| 7:00 | 0 | 3 | 8 | 24 | 14 | 5 | 12 | 12 | 21 | 12 | 0 | 0 |
| 7:05 | 1 | 9 | 5 | 24 | 13 | 6 | 17 | 9 | 23 | 16 | 3 | 3 |
| 7:10 | 0 | 7 | 9 | 13 | 14 | 8 | 16 | 12 | 11 | 15 | 0 | 4 |
| 7:15 | 1 | 12 | 18 | 23 | 25 | 7 | 10 | 6 | 29 | 33 | 0 | 1 |
| 7:20 | 1 | 3 | 13 | 8 | 10 | 5 | 21 | 17 | 35 | 20 | 1 | 0 |
| 7:25 | 1 | 10 | 10 | 17 | 22 | 13 | 24 | 23 | 36 | 37 | 0 | 1 |
| 7:30 | 0 | 7 | 13 | 29 | 16 | 13 | 17 | 27 | 18 | 18 | 1 | 3 |
| 7:35 | 0 | 12 | 23 | 22 | 20 | 21 | 19 | 22 | 26 | 18 | 0 | 2 |
| 7:40 | 3 | 8 | 8 | 13 | 9 | 10 | 14 | 32 | 28 | 34 | 4 | 0 |
| 7:45 | 2 | 13 | 15 | 24 | 13 | 19 | 20 | 33 | 20 | 23 | 1 | 4 |
| 7:50 | 0 | 9 | 17 | 19 | 17 | 13 | 7 | 18 | 25 | 11 | 2 | 5 |
| 7:55 | 3 | 10 | 10 | 9 | 10 | 5 | 30 | 36 | 15 | 10 | 2 | 4 |
| 8:00 | 0 | 22 | 17 | 20 | 22 | 17 | 19 | 19 | 28 | 19 | 1 | 2 |
| 8:05 | 2 | 24 | 11 | 15 | 7 | 23 | 15 | 16 | 33 | 32 | 1 | 4 |
| 8:10 | 4 | 17 | 9 | 21 | 12 | 7 | 24 | 32 | 32 | 21 | 0 | 9 |
| 8:15 | 0 | 9 | 9 | 10 | 5 | 5 | 24 | 30 | 37 | 25 | 1 | 4 |
| 8:20 | 5 | 17 | 7 | 25 | 14 | 9 | 8 | 14 | 14 | 21 | 2 | 1 |
| 8:25 | 4 | 22 | 6 | 11 | 7 | 1 | 21 | 35 | 38 | 31 | 0 | 2 |
| 8:30 | 0 | 7 | 6 | 22 | 17 | 10 | 26 | 22 | 20 | 16 | 0 | 3 |
| 8:35 | 5 | 21 | 9 | 19 | 13 | 9 | 17 | 14 | 18 | 26 | 2 | 3 |
| 8:40 | 1 | 2 | 9 | 21 | 20 | 10 | 6 | 8 | 9 | 13 | 0 | 2 |
| 8:45 | 5 | 23 | 9 | 10 | 11 | 1 | 29 | 18 | 22 | 24 | 0 | 2 |
| 8:50 | 0 | 8 | 2 | 19 | 3 | 11 | 21 | 13 | 13 | 19 | 0 | 5 |
| 8:55 | 3 | 7 | 4 | 7 | 6 | 4 | 7 | 3 | 10 | 15 | 0 | 3 |
| 9:00 | 0 | 4 | 2 | 12 | 14 | 5 | 7 | 9 | 23 | 8 | 0 | 0 |

Sunny Isle Intersection PM

| TIME | NBR | NBT | NBL | SBL | SBT | SBR | EBR | WBR | EBT | WBT | EBL | WBL |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 15:05 | 1 | 14 | 7 | 25 | 11 | 11 | 27 | 17 | 16 | 13 | 0 | 4 |
| 15:10 | 2 | 13 | 19 | 28 | 19 | 13 | 9 | 6 | 21 | 24 | 1 | 3 |
| 15:15 | 2 | 21 | 13 | 21 | 2 | 7 | 33 | 28 | 11 | 19 | 1 | 4 |
| 15:20 | 1 | 8 | 9 | 11 | 20 | 15 | 26 | 24 | 32 | 32 | 1 | 1 |
| 15:25 | 1 | 23 | 9 | 19 | 15 | 17 | 21 | 26 | 14 | 11 | 1 | 3 |
| 15:30 | 3 | 11 | 23 | 16 | 12 | 5 | 11 | 11 | 23 | 21 | 2 | 7 |
| 15:35 | 1 | 10 | 6 | 20 | 20 | 8 | 19 | 30 | 24 | 23 | 2 | 4 |
| 15:40 | 1 | 26 | 11 | 30 | 15 | 15 | 24 | 28 | 15 | 10 | 0 | 5 |
| 15:45 | 0 | 18 | 5 | 18 | 12 | 6 | 16 | 17 | 24 | 11 | 1 | 11 |
| 15:50 | 4 | 24 | 2 | 21 | 15 | 8 | 33 | 35 | 25 | 21 | 1 | 2 |
| 15:55 | 0 | 8 | 2 | 19 | 20 | 7 | 26 | 34 | 29 | 10 | 2 | 9 |
| 16:00 | 1 | 22 | 6 | 11 | 16 | 12 | 14 | 17 | 14 | 12 | 1 | 11 |
| 16:05 | 0 | 18 | 12 | 24 | 14 | 5 | 23 | 31 | 35 | 23 | 0 | 9 |
| 16:10 | 3 | 13 | 4 | 26 | 21 | 11 | 23 | 31 | 16 | 13 | 1 | 5 |
| 16:15 | 1 | 25 | 9 | 19 | 20 | 11 | 18 | 18 | 31 | 9 | 1 | 6 |
| 16:20 | 1 | 22 | 13 | 3 | 15 | 7 | 30 | 35 | 29 | 19 | 1 | 2 |
| 16:25 | 0 | 14 | 4 | 26 | 10 | 15 | 19 | 19 | 10 | 14 | 1 | 2 |
| 16:30 | 4 | 21 | 9 | 20 | 14 | 12 | 28 | 25 | 26 | 20 | 0 | 5 |
| 16:35 | 4 | 20 | 12 | 14 | 7 | 7 | 13 | 12 | 31 | 19 | 0 | 3 |
| 16:40 | 2 | 14 | 5 | 11 | 11 | 11 | 31 | 15 | 29 | 16 | 3 | 1 |
| 16:45 | 4 | 21 | 9 | 27 | 12 | 12 | 28 | 24 | 18 | 5 | 0 | 2 |
| 16:50 | 5 | 23 | 10 | 26 | 15 | 12 | 11 | 12 | 30 | 24 | 1 | 7 |
| 16:55 | 5 | 9 | 3 | 16 | 10 | 7 | 20 | 21 | 27 | 28 | 0 | 2 |
| 17:00 | 4 | 24 | 10 | 28 | 21 | 13 | 31 | 19 | 12 | 5 | 1 | 4 |
| 17:05 | 2 | 29 | 6 | 23 | 6 | 24 | 12 | 12 | 32 | 22 | 0 | 2 |
| 17:10 | 3 | 27 | 4 | 9 | 7 | 12 | 29 | 30 | 23 | 31 | 0 | 6 |
| 17:15 | 2 | 15 | 4 | 13 | 12 | 27 | 21 | 27 | 27 | 31 | 0 | 4 |
| 17:20 | 5 | 22 | 8 | 11 | 19 | 16 | 15 | 14 | 20 | 17 | 1 | 3 |
| 17:25 | 2 | 16 | 14 | 14 | 10 | 10 | 32 | 31 | 30 | 33 | 0 | 2 |
| 17:30 | 5 | 15 | 6 | 23 | 12 | 9 | 33 | 17 | 18 | 26 | 0 | 4 |
| 17:35 | 1 | 24 | 13 | 20 | 18 | 17 | 5 | 8 | 13 | 12 | 2 | 5 |
| 17:40 | 3 | 19 | 12 | 10 | 9 | 8 | 31 | 8 | 35 | 25 | 0 | 3 |
| 17:45 | 5 | 8 | 2 | 30 | 13 | 15 | 19 | 6 | 12 | 13 | 0 | 0 |
| 17:50 | 3 | 13 | 4 | 26 | 21 | 11 | 23 | 31 | 16 | 13 | 1 | 5 |
| 17:55 | 1 | 25 | 9 | 19 | 20 | 11 | 18 | 18 | 31 | 9 | 1 | 6 |
| 18:00 | 1 | 22 | 13 | 3 | 15 | 7 | 30 | 35 | 29 | 19 | 1 | 2 |

Sion Farm Intersection AM

| TIME | NBR | SBR | NBT | SBT | NBL | SBL | EBR | WBR | EBT | WBT | EBL | WBL |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 6:05 | 0 | 7 | 0 | 1 | 1 | 1 | 0 | 0 | 7 | 15 | 0 | 1 |
| 6:10 | 0 | 2 | 1 | 2 | 3 | 1 | 2 | 0 | 9 | 14 | 1 | 1 |
| 6:15 | 0 | 15 | 2 | 0 | 3 | 2 | 0 | 3 | 13 | 15 | 0 | 2 |
| 6:20 | 0 | 7 | 1 | 2 | 7 | 1 | 0 | 0 | 16 | 18 | 0 | 6 |
| 6:25 | 0 | 5 | 1 | 3 | 6 | 3 | 1 | 3 | 14 | 18 | 1 | 3 |
| 6:30 | 1 | 10 | 0 | 4 | 6 | 1 | 0 | 1 | 20 | 19 | 0 | 1 |
| 6:35 | 0 | 9 | 2 | 2 | 7 | 1 | 0 | 0 | 22 | 13 | 1 | 3 |
| 6:40 | 1 | 13 | 3 | 3 | 8 | 2 | 2 | 1 | 25 | 35 | 0 | 2 |
| 6:45 | 1 | 15 | 0 | 6 | 7 | 2 | 1 | 3 | 23 | 49 | 0 | 7 |
| 6:50 | 0 | 21 | 1 | 5 | 8 | 5 | 2 | 2 | 16 | 29 | 0 | 8 |
| 6:55 | 1 | 6 | 5 | 4 | 3 | 1 | 2 | 4 | 22 | 49 | 0 | 5 |
| 7:00 | 1 | 13 | 0 | 5 | 2 | 9 | 3 | 2 | 21 | 28 | 0 | 4 |
| 7:05 | 0 | 11 | 4 | 3 | 8 | 3 | 1 | 1 | 15 | 44 | 0 | 12 |
| 7:10 | 1 | 12 | 2 | 4 | 5 | 7 | 4 | 3 | 32 | 43 | 2 | 8 |
| 7:15 | 1 | 14 | 3 | 2 | 9 | 6 | 1 | 1 | 36 | 48 | 0 | 8 |
| 7:20 | 2 | 26 | 5 | 9 | 12 | 13 | 4 | 1 | 26 | 42 | 3 | 10 |
| 7:25 | 2 | 22 | 3 | 2 | 9 | 8 | 5 | 3 | 41 | 41 | 1 | 13 |
| 7:30 | 3 | 27 | 2 | 5 | 15 | 6 | 3 | 0 | 48 | 53 | 1 | 2 |
| 7:35 | 2 | 28 | 7 | 8 | 4 | 18 | 6 | 0 | 36 | 40 | 1 | 7 |
| 7:40 | 1 | 24 | 8 | 13 | 15 | 11 | 4 | 1 | 18 | 45 | 2 | 8 |
| 7:45 | 1 | 30 | 8 | 10 | 13 | 15 | 4 | 1 | 30 | 45 | 1 | 6 |
| 7:50 | 3 | 15 | 3 | 6 | 4 | 19 | 6 | 0 | 45 | 65 | 3 | 8 |
| 7:55 | 2 | 18 | 4 | 1 | 14 | 10 | 8 | 0 | 42 | 45 | 3 | 10 |
| 8:00 | 6 | 12 | 11 | 11 | 13 | 18 | 12 | 5 | 30 | 41 | 0 | 6 |
| 8:05 | 5 | 13 | 11 | 6 | 8 | 13 | 14 | 3 | 27 | 22 | 6 | 2 |
| 8:10 | 4 | 23 | 12 | 7 | 11 | 10 | 8 | 0 | 39 | 41 | 1 | 6 |
| 8:15 | 11 | 20 | 5 | 2 | 9 | 11 | 14 | 0 | 33 | 45 | 2 | 4 |
| 8:20 | 4 | 15 | 4 | 5 | 12 | 21 | 7 | 3 | 29 | 46 | 0 | 9 |
| 8:25 | 5 | 15 | 7 | 2 | 5 | 9 | 5 | 4 | 48 | 64 | 1 | 6 |
| 8:30 | 1 | 13 | 4 | 2 | 10 | 7 | 4 | 4 | 38 | 48 | 3 | 12 |
| 8:35 | 1 | 8 | 2 | 4 | 4 | 4 | 2 | 2 | 20 | 22 | 2 | 3 |
| 8:40 | 0 | 7 | 2 | 2 | 7 | 1 | 5 | 0 | 25 | 35 | 0 | 6 |
| 8:45 | 0 | 9 | 1 | 3 | 6 | 3 | 3 | 3 | 22 | 18 | 1 | 3 |
| 8:50 | 1 | 10 | 3 | 4 | 6 | 1 | 0 | 1 | 20 | 19 | 0 | 1 |
| 8:55 | 0 | 9 | 2 | 2 | 7 | 1 | 1 | 0 | 14 | 13 | 1 | 3 |
| 9:00 | 1 | 8 | 3 | 3 | 8 | 2 | 2 | 1 | 16 | 17 | 0 | 2 |

Sion Farm Intersection PM

| TIME | NBR | SBR | NBT | SBT | NBL | SBL | EBR | WBR | EBT | WBT | EBL | WBL |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 15:05 | 0 | 11 | 10 | 4 | 10 | 11 | 10 | 4 | 52 | 38 | 2 | 14 |
| 15:10 | 5 | 21 | 4 | 5 | 8 | 13 | 7 | 3 | 43 | 38 | 3 | 9 |
| 15:15 | 3 | 11 | 4 | 7 | 8 | 18 | 4 | 2 | 45 | 52 | 3 | 7 |
| 15:20 | 9 | 20 | 10 | 5 | 12 | 16 | 13 | 2 | 41 | 32 | 0 | 14 |
| 15:25 | 4 | 26 | 7 | 7 | 11 | 16 | 7 | 6 | 38 | 42 | 2 | 4 |
| 15:30 | 4 | 15 | 5 | 5 | 10 | 18 | 7 | 0 | 44 | 49 | 1 | 15 |
| 15:35 | 5 | 20 | 5 | 6 | 10 | 10 | 25 | 4 | 21 | 44 | 4 | 14 |
| 15:40 | 5 | 21 | 5 | 3 | 16 | 6 | 8 | 6 | 36 | 44 | 4 | 6 |
| 15:45 | 9 | 5 | 11 | 3 | 24 | 10 | 6 | 3 | 40 | 43 | 1 | 7 |
| 15:50 | 9 | 11 | 9 | 1 | 19 | 13 | 8 | 2 | 39 | 45 | 2 | 6 |
| 15:55 | 3 | 7 | 12 | 8 | 23 | 11 | 6 | 4 | 39 | 39 | 2 | 11 |
| 16:00 | 2 | 9 | 8 | 5 | 11 | 3 | 13 | 5 | 39 | 38 | 4 | 16 |
| 16:05 | 1 | 6 | 4 | 2 | 12 | 5 | 5 | 1 | 58 | 55 | 1 | 9 |
| 16:10 | 3 | 7 | 11 | 6 | 14 | 15 | 6 | 3 | 45 | 46 | 2 | 6 |
| 16:15 | 9 | 11 | 6 | 2 | 18 | 5 | 9 | 7 | 40 | 41 | 2 | 10 |
| 16:20 | 7 | 8 | 6 | 2 | 11 | 3 | 3 | 4 | 32 | 41 | 3 | 13 |
| 16:25 | 10 | 17 | 3 | 2 | 15 | 15 | 9 | 4 | 38 | 41 | 3 | 7 |
| 16:30 | 4 | 9 | 11 | 3 | 15 | 7 | 3 | 4 | 31 | 41 | 5 | 8 |
| 16:35 | 2 | 9 | 2 | 4 | 8 | 11 | 5 | 5 | 34 | 40 | 2 | 6 |
| 16:40 | 8 | 11 | 6 | 4 | 6 | 3 | 13 | 4 | 27 | 53 | 1 | 14 |
| 16:45 | 7 | 7 | 6 | 2 | 16 | 3 | 8 | 6 | 34 | 33 | 2 | 13 |
| 16:50 | 3 | 4 | 3 | 1 | 13 | 1 | 6 | 3 | 47 | 53 | 3 | 8 |
| 16:55 | 9 | 9 | 5 | 4 | 15 | 5 | 8 | 3 | 34 | 50 | 4 | 13 |
| 17:00 | 3 | 8 | 7 | 4 | 23 | 7 | 3 | 2 | 40 | 37 | 2 | 11 |
| 17:05 | 3 | 5 | 7 | 5 | 15 | 12 | 10 | 9 | 30 | 46 | 1 | 8 |
| 17:10 | 6 | 9 | 8 | 2 | 19 | 4 | 5 | 3 | 45 | 41 | 0 | 16 |
| 17:15 | 7 | 17 | 9 | 3 | 11 | 4 | 4 | 6 | 32 | 45 | 1 | 18 |
| 17:20 | 7 | 8 | 9 | 7 | 21 | 10 | 5 | 6 | 40 | 38 | 2 | 10 |
| 17:25 | 2 | 11 | 10 | 5 | 16 | 5 | 8 | 4 | 51 | 53 | 4 | 10 |
| 17:30 | 2 | 13 | 5 | 5 | 7 | 2 | 6 | 2 | 39 | 42 | 1 | 15 |
| 17:35 | 4 | 11 | 11 | 7 | 18 | 11 | 0 | 10 | 26 | 49 | 5 | 5 |
| 17:40 | 4 | 11 | 9 | 3 | 19 | 7 | 4 | 4 | 31 | 38 | 1 | 7 |
| 17:45 | 2 | 10 | 5 | 3 | 19 | 10 | 7 | 2 | 35 | 42 | 2 | 18 |
| 17:50 | 2 | 10 | 5 | 0 | 12 | 10 | 8 | 3 | 37 | 45 | 1 | 10 |
| 17:55 | 7 | 8 | 9 | 7 | 21 | 10 | 5 | 6 | 40 | 38 | 2 | 10 |
| 18:00 | 2 | 11 | 10 | 5 | 16 | 5 | 8 | 4 | 51 | 53 | 4 | 10 |

Appendix B

Peak Hour Count and PHF calculation

Sunny Isle Peak Hour Count Morning

| TIME | NBR | NBT | NBL | SBL | SBT | SBR | EBR | WBR | EBT | WBT | EBL | WBL |
|--------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|
| 7:25 | 1 | 10 | 10 | 17 | 22 | 13 | 24 | 23 | 36 | 37 | 0 | 1 |
| 7:30 | 0 | 7 | 13 | 29 | 16 | 13 | 17 | 27 | 18 | 18 | 1 | 3 |
| 7:35 | 0 | 12 | 23 | 22 | 20 | 21 | 19 | 22 | 26 | 18 | 0 | 2 |
| 7:40 | 3 | 8 | 8 | 13 | 9 | 10 | 14 | 32 | 28 | 34 | 4 | 0 |
| 7:45 | 2 | 13 | 15 | 24 | 13 | 19 | 20 | 33 | 20 | 23 | 1 | 4 |
| 7:50 | 0 | 9 | 17 | 19 | 17 | 13 | 7 | 18 | 25 | 11 | 2 | 5 |
| 7:55 | 3 | 10 | 10 | 9 | 10 | 5 | 30 | 36 | 15 | 10 | 2 | 4 |
| 8:00 | 0 | 22 | 17 | 20 | 22 | 17 | 19 | 19 | 28 | 19 | 1 | 2 |
| 8:05 | 2 | 24 | 11 | 15 | 7 | 23 | 15 | 16 | 33 | 32 | 1 | 4 |
| 8:10 | 4 | 17 | 9 | 21 | 12 | 7 | 24 | 32 | 32 | 21 | 0 | 9 |
| 8:15 | 0 | 9 | 9 | 10 | 5 | 5 | 24 | 30 | 37 | 25 | 1 | 4 |
| 8:20 | 5 | 17 | 7 | 25 | 14 | 9 | 8 | 14 | 14 | 21 | 2 | 1 |
| Total | 20 | 158 | 149 | 224 | 167 | 155 | 221 | 302 | 312 | 269 | 15 | 39 |

2031

To obtain the PHF, the hourly volume is divided by the maximum rate of flow in the fifteen minutes period.

$$PHF = \frac{\text{Hourly Volume}}{\text{Maximum Rate of Flow}}$$

Sunny Isle Peak Hour Count Morning

| TIME | 5 Min Sum | 15 Min Sum | 1 Hr Sum |
|------|-----------|------------|----------|
| 7:25 | 194 | 493 | 1585 |
| 7:30 | 162 | 490 | 1654 |
| 7:35 | 185 | 541 | 1730 |
| 7:40 | 163 | 510 | 1783 |
| 7:45 | 187 | 535 | 1823 |
| 7:50 | 143 | 493 | 1825 |
| 7:55 | 144 | 474 | 1826 |
| 8:00 | 186 | 473 | 1901 |
| 8:05 | 183 | 513 | 1955 |
| 8:10 | 188 | 557 | 2034 |
| 8:15 | 159 | 530 | 2028 |
| 8:20 | 137 | 484 | 2031 |

PHF - PHF = 2031/(4*557) = 0.91158
 Peak Hour 7:20 AM- 8:20 AM

Sunny Isle Peak Hour Count Afternoon

| TIME | NBR | NBT | NBL | SBL | SBT | SBR | EBR | WBR | EBT | WBT | EBL | WBL |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 16:30 | 4 | 21 | 9 | 20 | 14 | 12 | 28 | 25 | 26 | 20 | 0 | 5 |
| 16:35 | 4 | 20 | 12 | 14 | 7 | 7 | 13 | 12 | 31 | 19 | 0 | 3 |
| 16:40 | 2 | 14 | 5 | 11 | 11 | 11 | 31 | 15 | 29 | 16 | 3 | 1 |
| 16:45 | 4 | 21 | 9 | 27 | 12 | 12 | 28 | 24 | 18 | 5 | 0 | 2 |
| 16:50 | 5 | 23 | 10 | 26 | 15 | 12 | 11 | 12 | 30 | 24 | 1 | 7 |
| 16:55 | 5 | 9 | 3 | 16 | 10 | 7 | 20 | 21 | 27 | 28 | 0 | 2 |
| 17:00 | 4 | 24 | 10 | 28 | 21 | 13 | 31 | 19 | 12 | 5 | 1 | 4 |
| 17:05 | 2 | 29 | 6 | 23 | 6 | 24 | 12 | 12 | 32 | 22 | 0 | 2 |
| 17:10 | 3 | 27 | 4 | 9 | 7 | 12 | 29 | 30 | 23 | 31 | 0 | 6 |
| 17:15 | 2 | 15 | 4 | 13 | 12 | 27 | 21 | 27 | 27 | 31 | 0 | 4 |
| 17:20 | 5 | 22 | 8 | 11 | 19 | 16 | 15 | 14 | 20 | 17 | 1 | 3 |
| 17:25 | 2 | 16 | 14 | 14 | 10 | 10 | 32 | 31 | 30 | 33 | 0 | 2 |

Total 42 241 94 212 144 163 271 242 305 251 6 41 2012

Sunny Isle Peak Hour Count Morning

| TIME | 5 Min Sum | 15 Min Sum | 1 Hr Sum |
|-------|-----------|------------|----------|
| 16:30 | 184 | 495 | 2004 |
| 16:35 | 142 | 460 | 1979 |
| 16:40 | 149 | 475 | 1948 |
| 16:45 | 162 | 453 | 1971 |
| 16:50 | 176 | 487 | 1956 |
| 16:55 | 148 | 486 | 1938 |
| 17:00 | 172 | 496 | 1973 |
| 17:05 | 170 | 490 | 1949 |
| 17:10 | 181 | 523 | 1963 |
| 17:15 | 183 | 534 | 1978 |
| 17:20 | 151 | 515 | 1952 |
| 17:25 | 194 | 528 | 2012 |

PHF = 2012/(4*534) = 0.941948

Peak Hour 4:25 PM-5:25 PM

Sion Farm Peak Hour Count Morning

| TIME | NBR | SBR | NBT | SBT | NBL | SBL | EBR | WBR | EBT | WBT | EBL | WBL |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 7:30 | 3 | 27 | 2 | 5 | 15 | 6 | 3 | 0 | 48 | 53 | 1 | 2 |
| 7:35 | 2 | 28 | 7 | 8 | 4 | 18 | 6 | 0 | 36 | 40 | 1 | 7 |
| 7:40 | 1 | 24 | 8 | 13 | 15 | 11 | 4 | 1 | 18 | 45 | 2 | 8 |
| 7:45 | 1 | 30 | 8 | 10 | 13 | 15 | 4 | 1 | 30 | 45 | 1 | 6 |
| 7:50 | 3 | 15 | 3 | 6 | 4 | 19 | 6 | 0 | 45 | 65 | 3 | 8 |
| 7:55 | 2 | 18 | 4 | 1 | 14 | 10 | 8 | 0 | 42 | 45 | 3 | 10 |
| 8:00 | 6 | 12 | 11 | 11 | 13 | 18 | 12 | 5 | 30 | 41 | 0 | 6 |
| 8:05 | 5 | 13 | 11 | 6 | 8 | 13 | 14 | 3 | 27 | 22 | 6 | 2 |
| 8:10 | 4 | 23 | 12 | 7 | 11 | 10 | 8 | 0 | 39 | 41 | 1 | 6 |
| 8:15 | 11 | 20 | 5 | 2 | 9 | 11 | 14 | 0 | 33 | 45 | 2 | 4 |
| 8:20 | 4 | 15 | 4 | 5 | 12 | 21 | 7 | 3 | 29 | 46 | 0 | 9 |
| 8:25 | 5 | 15 | 7 | 2 | 5 | 9 | 5 | 4 | 48 | 64 | 1 | 6 |

Total 47 240 82 76 123 161 91 17 425 552 21 74 1909

Sion Farm Peak Hour Count Morning

| TIME | 5 Min Sum | 15 Min Sum | 1 Hr Sum |
|------|--------------|---------------|-------------|
| 7:30 | 165 | 468 | 1378 |
| 7:35 | 157 | 472 | 1475 |
| 7:40 | 150 | 472 | 1530 |
| 7:45 | 164 | 471 | 1580 |
| 7:50 | 177 | 491 | 1660 |
| 7:55 | 157 | 498 | 1715 |
| 8:00 | 165 | 499 | 1792 |
| 8:05 | 130 | 452 | 1820 |
| 8:10 | 162 | 457 | 1859 |
| 8:15 | 156 | 448 | 1886 |
| 8:20 | 155 | 473 | 1888 |
| 8:25 | 171 | 482 | 1909 |

PHF = 1909/(4*499) = 0.956413

Peak Hour 7:25 AM-8:25 AM

Sion Farm Peak Hour Count Afternoon

| TIME | NBR | SBR | NBT | SBT | NBL | SBL | EBR | WBR | EBT | WBT | EBL | WBL |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 15:05 | 0 | 11 | 10 | 4 | 10 | 11 | 10 | 4 | 52 | 38 | 2 | 14 |
| 15:10 | 5 | 21 | 4 | 5 | 8 | 13 | 7 | 3 | 43 | 38 | 3 | 9 |
| 15:15 | 3 | 11 | 4 | 7 | 8 | 18 | 4 | 2 | 45 | 52 | 3 | 7 |
| 15:20 | 9 | 20 | 10 | 5 | 12 | 16 | 13 | 2 | 41 | 32 | 0 | 14 |
| 15:25 | 4 | 26 | 7 | 7 | 11 | 16 | 7 | 6 | 38 | 42 | 2 | 4 |
| 15:30 | 4 | 15 | 5 | 5 | 10 | 18 | 7 | 0 | 44 | 49 | 1 | 15 |
| 15:35 | 5 | 20 | 5 | 6 | 10 | 10 | 25 | 4 | 21 | 44 | 4 | 14 |
| 15:40 | 5 | 21 | 5 | 3 | 16 | 6 | 8 | 6 | 36 | 44 | 4 | 6 |
| 15:45 | 9 | 5 | 11 | 3 | 24 | 10 | 6 | 3 | 40 | 43 | 1 | 7 |
| 15:50 | 9 | 11 | 9 | 1 | 19 | 13 | 8 | 2 | 39 | 45 | 2 | 6 |
| 15:55 | 3 | 7 | 12 | 8 | 23 | 11 | 6 | 4 | 39 | 39 | 2 | 11 |
| 16:00 | 2 | 9 | 8 | 5 | 11 | 3 | 13 | 5 | 39 | 38 | 4 | 16 |

Total 58 177 90 59 162 145 114 41 477 504 28 123 1978

Sion Farm Peak Hour Count Morning

| TIME | 5 Min Sum | 15 Min Sum | 1 Hr Sum |
|-------|-----------|------------|----------|
| 15:05 | 166 | | |
| 15:10 | 159 | | |
| 15:15 | 164 | 489 | |
| 15:20 | 174 | 497 | |
| 15:25 | 170 | 508 | |
| 15:30 | 173 | 517 | |
| 15:35 | 168 | 511 | |
| 15:40 | 160 | 501 | |
| 15:45 | 162 | 490 | |
| 15:50 | 164 | 486 | |
| 15:55 | 165 | 491 | |
| 16:00 | 153 | 482 | 1978 |

PHF = 1978/(4*517) = 0.95648
Peak Hour o 3:00 PM- 4:00 PM

Sunny Isle PHF per Approach

| TIME | Northbound | Southbound | Westbound | Eastbound |
|-------------|------------|------------|-----------|-----------|
| AM | 0.77 | 0.79 | 0.82 | 0.88 |

Sunny Isle PHF per Approach

| TIME | Northbound | Southbound | Westbound | Eastbound |
|-------------|------------|------------|-----------|-----------|
| PM | 0.86 | 0.88 | 0.90 | 0.81 |

Sion Farm PHF per Approach

| TIME | Northbound | Southbound | Westbound | Eastbound |
|-------------|------------|------------|-----------|-----------|
| AM | 0.78 | 0.76 | 0.90 | 0.89 |

Sion Farm PHF per Approach

| TIME | Northbound | Southbound | Westbound | Eastbound |
|-------------|------------|------------|-----------|-----------|
| PM | 0.65 | 0.74 | 0.92 | 0.92 |

Appendix C

Report of Computer Software Current Conditions AASIDRA

Intersection Summary

SUNNY ISLE MORNING CURRENT SITUATION

| Performance Measure | Vehicles |
|-----------------------------------|-----------------|
| Demand Flow | 2392 veh/h |
| Degree of Saturation | 1.105 |
| Capacity (Total) | 3397 veh/h |
| 95% Back of Queue (m) | 403 m |
| 95% Back of Queue (veh) | 57.6 veh |
| Control Delay (Total) | 66.18 veh-h/h |
| Control Delay (Average) | 99.6 s/veh |
| Level of Service | LOS F |
| Level of Service (Worst Movement) | LOS F |
| Total Effective Stops | 2521 veh/h |
| Effective Stop Rate | 1.05 per veh |
| Travel Distance (Total) | 1322.1 veh-km/h |
| Travel Distance (Average) | 553 m |
| Travel Time (Total) | 96.3 veh-h/h |
| Travel Time (Average) | 144.9 secs |
| Travel Speed | 13.7 km/h |
| Operating Cost (Total) | 2278 \$/h |
| Fuel Consumption (Total) | 220.2 L/h |
| Carbon Dioxide (Total) | 550.5 kg/h |
| Hydrocarbons (Total) | 1.089 kg/h |
| Carbon Monoxide (Total) | 28.07 kg/h |
| NOX (Total) | 0.824 kg/h |

Movement Summary

SUNNY ISLE MORNING CURRENT SITUATION

Signalised - Fixed time
Cycle Time = 174 seconds

Vehicle Movements

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|---------------------|------|---------------------|----------------|-------------------------|------------------------|---------------------|--------------------------------|
| ROUTE 681 | | | | | | | |
| 1 | L | 194 | 211 | 0.918 | 90.2 | LOS F | 263 |
| 2 | T | 205 | 252 | 0.918 | 85.9 | LOS F | 263 |
| 2 | R | 26 | 252 | 0.918 | 85.9 | LOS F | 263 |
| Approach | | 425 | 463 | 0.918 | 87.9 | LOS F | 263 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 18 | 18 | 0.990 | 116.9 | LOS F | 306 |
| 5 | T | 328 | 427 | 0.981 | 113.5 | LOS F | 306 |
| 6 | R | 270 | 179 | 1.000 | 75.8 | LOS E | 107 |
| Approach | | 616 | 624 | 1.000 | 102.6 | LOS F | 306 |
| ROUTE 70 W | | | | | | | |
| 7 | L | 284 | 163 | 1.001 | 70.6 | LOS E | 92 |
| 8 | T | 211 | 300 | 1.105 | 144.8 | LOS F | 403 |
| 9 | R | 163 | 148 | 1.104 | 152.8 | LOS F | 403 |
| Approach | | 658 | 611 | 1.105 | 128.3 | LOS F | 403 |
| ROUTE 66 | | | | | | | |
| 10 | L | 44 | 995 | 0.044 | 10.3 | LOS B | 9 |
| 11 | T | 306 | 448 | 0.879 | 80.7 | LOS F | 241 |
| 12 | R | 343 | 256 | 1.000 | 82.4 | LOS F | 151 |
| Approach | | 693 | 1698 | 1.000 | 76.9 | LOS E | 241 |
| All Vehicles | | 2392 | 3397 | 1.105 | 99.6 | LOS F | 403 |

Intersection Summary

SUNNY ISLE AFTERNOON CURRENT SITUATION

| Performance Measure | Vehicles |
|-----------------------------------|-----------------|
| Demand Flow | 2335 veh/h |
| Degree of Saturation | 1.050 |
| Capacity (Total) | 3344 veh/h |
| 95% Back of Queue (m) | 294 m |
| 95% Back of Queue (veh) | 42.0 veh |
| Control Delay (Total) | 57.00 veh-h/h |
| Control Delay (Average) | 87.9 s/veh |
| Level of Service | LOS F |
| Level of Service (Worst Movement) | LOS F |
| Total Effective Stops | 2374 veh/h |
| Effective Stop Rate | 1.02 per veh |
| Travel Distance (Total) | 1287.5 veh-km/h |
| Travel Distance (Average) | 551 m |
| Travel Time (Total) | 90.5 veh-h/h |
| Travel Time (Average) | 139.6 secs |
| Travel Speed | 14.2 km/h |
| Operating Cost (Total) | 2139 \$/h |
| Fuel Consumption (Total) | 207.0 L/h |
| Carbon Dioxide (Total) | 517.5 kg/h |
| Hydrocarbons (Total) | 1.014 kg/h |
| Carbon Monoxide (Total) | 26.58 kg/h |
| NOX (Total) | 0.757 kg/h |

Movement Summary

SUNNY ISLE AFTERNOON CURRENT SITUATION

Signalised - Fixed time
Cycle Time = 174 seconds

Vehicle Movements

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|---------------------|------|---------------------|----------------|-------------------------|------------------------|---------------------|--------------------------------|
| ROUTE 681 | | | | | | | |
| 1 | L | 109 | 114 | 0.960 | 105.5 | LOS F | 294 |
| 2 | T | 280 | 343 | 0.961 | 101.3 | LOS F | 294 |
| 2 | R | 49 | 343 | 0.961 | 101.3 | LOS F | 294 |
| Approach | | 438 | 456 | 0.961 | 102.3 | LOS F | 294 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 7 | 7 | 1.045 | 106.1 | LOS F | 292 |
| 5 | T | 339 | 439 | 1.050 | 101.2 | LOS F | 292 |
| 6 | R | 301 | 179 | 1.000 | 75.8 | LOS E | 107 |
| Approach | | 647 | 624 | 1.051 | 94.2 | LOS F | 292 |
| ROUTE 70 W | | | | | | | |
| 7 | L | 241 | 163 | 1.001 | 70.6 | LOS E | 92 |
| 8 | T | 164 | 252 | 0.957 | 94.0 | LOS F | 288 |
| 9 | R | 185 | 193 | 0.958 | 98.5 | LOS F | 288 |
| Approach | | 590 | 609 | 1.000 | 88.9 | LOS F | 288 |
| ROUTE 66 | | | | | | | |
| 10 | L | 51 | 950 | 0.054 | 12.1 | LOS B | 12 |
| 11 | T | 310 | 450 | 0.786 | 71.6 | LOS E | 200 |
| 12 | R | 299 | 256 | 1.000 | 82.4 | LOS F | 151 |
| Approach | | 660 | 1655 | 1.000 | 71.2 | LOS E | 200 |
| All Vehicles | | 2335 | 3344 | 1.050 | 87.9 | LOS F | 294 |

Intersection Summary

Sion Farm Morning Current Situation

| Performance Measure | Vehicles |
|-----------------------------------|-----------------|
| Demand Flow | 2269 veh/h |
| Degree of Saturation | 1.076 |
| Capacity (Total) | 4221 veh/h |
| 95% Back of Queue (m) | 460 m |
| 95% Back of Queue (veh) | 65.7 veh |
| Control Delay (Total) | 53.15 veh-h/h |
| Control Delay (Average) | 84.3 s/veh |
| Level of Service | LOS F |
| Level of Service (Worst Movement) | LOS F |
| Total Effective Stops | 2330 veh/h |
| Effective Stop Rate | 1.03 per veh |
| Travel Distance (Total) | 1208.5 veh-km/h |
| Travel Distance (Average) | 533 m |
| Travel Time (Total) | 84.8 veh-h/h |
| Travel Time (Average) | 134.6 secs |
| Travel Speed | 14.2 km/h |
| Operating Cost (Total) | 1990 \$/h |
| Fuel Consumption (Total) | 183.0 L/h |
| Carbon Dioxide (Total) | 457.4 kg/h |
| Hydrocarbons (Total) | 0.891 kg/h |
| Carbon Monoxide (Total) | 19.81 kg/h |
| NOX (Total) | 0.613 kg/h |

Movement Summary

Sion Farm Morning Current Situation

Signalised - Fixed time
Cycle Time = 165 seconds

Vehicle Movements

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|-------------------------|------|---------------------|----------------|-------------------------|------------------------|---------------------|--------------------------------|
| ROUTE 81 | | | | | | | |
| 1 | L | 158 | 225 | 0.702 | 62.9 | LOS E | 127 |
| 2 | T | 105 | 150 | 0.702 | 64.1 | LOS E | 127 |
| 3 | R | 60 | 199 | 0.302 | 60.3 | LOS E | 37 |
| Approach | | 323 | 573 | 0.702 | 62.8 | LOS E | 127 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 23 | 27 | 0.842 | 66.3 | LOS E | 268 |
| 5 | T | 472 | 559 | 0.844 | 67.5 | LOS E | 268 |
| 6 | R | 101 | 161 | 0.626 | 67.1 | LOS E | 61 |
| Approach | | 596 | 748 | 0.844 | 67.4 | LOS E | 268 |
| ROUTE 811 | | | | | | | |
| 7 | L | 212 | 197 | 1.076 | 102.8 | LOS F | 227 |
| 8 | T | 100 | 190 | 1.076 | 104.0 | LOS F | 227 |
| 9 | R | 316 | 211 | 1.000 | 68.3 | LOS E | 114 |
| Approach | | 628 | 599 | 1.076 | 91.6 | LOS F | 227 |
| ROUTE 70 W | | | | | | | |
| 10 | L | 83 | 1551 | 0.054 | 1.7 | LOS A | 2 |
| 11 | T | 620 | 587 | 1.056 | 116.2 | LOS F | 460 |
| 12 | R | 19 | 163 | 0.116 | 63.2 | LOS E | 13 |
| Approach | | 722 | 2301 | 1.056 | 101.7 | LOS F | 460 |
| All Vehicles | | 2269 | 4221 | 1.076 | 84.3 | LOS F | 460 |

Intersection Summary

Sion Farm Afternoon Current Situation

| Performance Measure | Vehicles |
|-----------------------------------|-----------------|
| Demand Flow | 2313 veh/h |
| Degree of Saturation | 1.000 |
| Capacity (Total) | 4266 veh/h |
| 95% Back of Queue (m) | 337 m |
| 95% Back of Queue (veh) | 48.2 veh |
| Control Delay (Total) | 42.46 veh-h/h |
| Control Delay (Average) | 66.1 s/veh |
| Level of Service | LOS E |
| Level of Service (Worst Movement) | LOS E |
| Total Effective Stops | 2173 veh/h |
| Effective Stop Rate | 0.94 per veh |
| Travel Distance (Total) | 1233.4 veh-km/h |
| Travel Distance (Average) | 533 m |
| Travel Time (Total) | 75.6 veh-h/h |
| Travel Time (Average) | 117.7 secs |
| Travel Speed | 16.3 km/h |
| Operating Cost (Total) | 1785 \$/h |
| Fuel Consumption (Total) | 170.8 L/h |
| Carbon Dioxide (Total) | 427.1 kg/h |
| Hydrocarbons (Total) | 0.815 kg/h |
| Carbon Monoxide (Total) | 19.30 kg/h |
| NOX (Total) | 0.591 kg/h |

Movement Summary

Sion Farm Afternoon Current Situation

Signalised - Fixed time
Cycle Time = 165 seconds

Vehicle Movements

| Mov No | Turn | Dem Flow (veh/h) | Cap (veh/h) | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|---------------------|------|---------------------|----------------|-------------------------|------------------------|---------------------|--------------------------------|
| ROUTE 81 | | | | | | | |
| 1 | L | 249 | 294 | 0.848 | 68.6 | LOS E | 171 |
| 2 | T | 95 | 112 | 0.847 | 69.8 | LOS E | 171 |
| 3 | R | 89 | 198 | 0.449 | 61.3 | LOS E | 53 |
| Approach | | 433 | 604 | 0.847 | 67.3 | LOS E | 171 |
| ROUTE 70 E | | | | | | | |
| 4 | L | 30 | 33 | 0.910 | 75.6 | LOS E | 314 |
| 5 | T | 502 | 553 | 0.907 | 76.8 | LOS E | 314 |
| 6 | R | 124 | 204 | 0.607 | 67.6 | LOS E | 73 |
| Approach | | 656 | 791 | 0.907 | 75.0 | LOS E | 314 |
| ROUTE 811 | | | | | | | |
| 7 | L | 196 | 280 | 0.700 | 51.4 | LOS D | 118 |
| 8 | T | 62 | 128 | 0.700 | 52.6 | LOS D | 118 |
| 9 | R | 239 | 211 | 1.000 | 68.3 | LOS E | 114 |
| Approach | | 497 | 620 | 1.000 | 58.8 | LOS E | 118 |
| ROUTE 70 W | | | | | | | |
| 10 | L | 134 | 1502 | 0.089 | 1.8 | LOS A | 5 |
| 11 | T | 548 | 587 | 0.933 | 76.9 | LOS E | 337 |
| 12 | R | 45 | 162 | 0.277 | 64.4 | LOS E | 30 |
| Approach | | 727 | 2252 | 0.933 | 62.3 | LOS E | 337 |
| All Vehicles | | 2313 | 4266 | 1.000 | 66.1 | LOS E | 337 |

Appendix D

Report of Alternatives AASIDRA

SUNNY ISLE MORNING
OPTIMUM SITUATION

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 90

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases | Adjusted ----- Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Time | Required Movement |
|-------------------|--------------|---------|-----------------------------|---------------------|-------------------------|---------------|-------------------|
| 12 | W_R | J I | 5 | 0.173 | 0.192 | 22.3 | |
| 4 | E_L | 1st I E | 5 | 0.205 | 0.228 | 25.5 | |
| 7 | N_L | 1st E C | 5 | 0.210 | 0.233 | 26.0 | |
| 1 | S_L | 2nd C J | 5 | 0.202 | 0.224 | 25.2 | |
| ----- | | | | | | | |
| Total: | | | 20 | 0.789 | 0.877 | 98.9 | |

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 44 | 200 | 162 | 90 |

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | E |
| Worst movement Level of Service | = | F |
| Average intersection delay (s) | = | 56.8 |
| Largest average movement delay (s) | = | 90.3 |
| Largest back of queue, 95% (m) | = | 175 |
| Performance Index | = | 164.51 |
| Degree of saturation (highest) | = | 1.036 |
| Practical Spare Capacity (lowest) | = | -13 % |
| Total vehicle capacity, all lanes (veh/h) | = | 3725 |
| Total vehicle flow (veh/h) | = | 2477 |
| Total person flow (pers/h) | = | 3716 |
| Total vehicle delay (veh-h/h) | = | 39.08 |
| Total person delay (pers-h/h) | = | 58.62 |
| Total effective vehicle stops (veh/h) | = | 2859 |
| Total effective person stops (pers/h) | = | 4288 |
| Total vehicle travel (veh-km/h) | = | 1366.0 |
| Total cost (\$/h) | = | 1802.60 |
| Total fuel (L/h) | = | 193.2 |
| Total CO2 (kg/h) | = | 482.90 |

SUNNY ISLE MORNING
OPTIMUM SITUATION

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 90

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| J | 0 | 5 | 15 | 20 | 0.222 |
| I | 20 | 25 | 18 | 23 | 0.256 |
| E | 43 | 48 | 19 | 24 | 0.267 |
| C | 67 | 72 | 18 | 23 | 0.256 |

Current Phase Sequence No.: 1
Input phase sequence: J I E C
Output phase sequence: J I E C

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 3.39 | 5.09 | 63.0 | 1.00 | 1.18 | 20.5 | 144 | 12.50 | 19.4 |
| 2 TR | 3.76 | 5.64 | 58.6 | 1.00 | 1.18 | 20.5 | 144 | 14.42 | 19.3 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.34 | 0.51 | 68.6 | 1.00 | 1.34 | 21.1 | 148 | 1.36 | 15.6 |
| 5 T | 6.72 | 10.09 | 63.7 | 1.00 | 1.34 | 21.1 | 148 | 28.28 | 16.3 |
| 6 R | 4.00 | 5.99 | 53.3 | 1.00 | 1.13 | 14.9 | 104 | 18.52 | 17.0 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.53 | 0.79 | 6.7 | 0.36 | 0.62 | 4.9 | 34 | 8.43 | 28.8 |
| 8 T | 3.99 | 5.99 | 68.1 | 1.00 | 1.40 | 25.0 | 175 | 17.25 | 15.8 |
| 9 R | 3.96 | 5.94 | 72.7 | 1.00 | 1.40 | 25.0 | 175 | 16.29 | 15.2 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.12 | 0.18 | 9.9 | 0.36 | 0.67 | 0.9 | 6 | 1.12 | 38.0 |
| 11 TR | 4.27 | 6.41 | 46.6 | 1.00 | 1.00 | 16.9 | 118 | 19.42 | 22.0 |
| 12 R | 7.99 | 11.99 | 90.3 | 1.00 | 1.31 | 21.5 | 151 | 26.91 | 15.4 |

SUNNY ISLE MORNING

Two Turn Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 65

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases | Adjusted Fr | Adjusted To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|-------------------|--------------|---------|-------------|-------------|--------------------|---------------------|-------------------------|------------------------|
| 12 | W_R | J I | 5 | 0.093 | 0.103 | 11.7 | | |
| 4 | E_L | 1st I E | 5 | 0.205 | 0.227 | 19.8 | | |
| 9 | N_R | E C | 5 | 0.210 | 0.233 | 20.1 | | |
| 2 | S_TR | C J | 5 | 0.107 | 0.119 | 12.7 | | |
| Total: | | | 20 | 0.614 | 0.683 | 64.4 | | |

Cycle Time:

Minimum Maximum Practical Chosen

44 200 63 65

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 32.8 |
| Largest average movement delay (s) | = | 46.1 |
| Largest back of queue, 95% (m) | = | 120 |
| Performance Index | = | 119.56 |
| Degree of saturation (highest) | = | 0.908 |
| Practical Spare Capacity (lowest) | = | -1 % |
| Total vehicle capacity, all lanes (veh/h) | = | 4494 |
| Total vehicle flow (veh/h) | = | 2477 |
| Total person flow (pers/h) | = | 3716 |
| Total vehicle delay (veh-h/h) | = | 22.59 |
| Total person delay (pers-h/h) | = | 33.88 |
| Total effective vehicle stops (veh/h) | = | 2447 |
| Total effective person stops (pers/h) | = | 3670 |
| Total vehicle travel (veh-km/h) | = | 1367.9 |
| Total cost (\$/h) | = | 1428.00 |
| Total fuel (L/h) | = | 167.8 |
| Total CO2 (kg/h) | = | 419.44 |

SUNNY ISLE MORNING

Two Turn Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 65

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| J | 0 | 5 | 7 | 12 | 0.185 |
| I | 12 | 17 | 15 | 20 | 0.308 |
| E | 32 | 37 | 15 | 20 | 0.308 |
| C | 52 | 57 | 8 | 13 | 0.200 |

Current Phase Sequence No.: 1

Input phase sequence: J I E C

Output phase sequence: J I E C

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 0.86 | 1.29 | 15.9 | 0.77 | 0.79 | 4.5 | 32 | 5.78 | 34.9 |
| 2 TR | 2.45 | 3.68 | 38.2 | 0.97 | 1.00 | 9.4 | 66 | 11.26 | 24.3 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.23 | 0.34 | 45.0 | 1.00 | 1.22 | 16.3 | 114 | 1.09 | 19.1 |
| 5 T | 4.23 | 6.35 | 40.1 | 1.00 | 1.22 | 16.3 | 114 | 22.42 | 20.2 |
| 6 R | 2.79 | 4.19 | 37.2 | 1.00 | 0.89 | 6.1 | 42 | 14.23 | 19.8 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.51 | 0.77 | 6.5 | 0.43 | 0.65 | 4.0 | 28 | 8.04 | 28.8 |
| 8 T | 2.27 | 3.40 | 38.7 | 1.00 | 1.25 | 17.1 | 120 | 12.58 | 20.4 |
| 9 R | 2.32 | 3.48 | 42.7 | 1.00 | 1.25 | 17.1 | 120 | 11.93 | 19.6 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.09 | 0.14 | 7.8 | 0.31 | 0.66 | 0.5 | 3 | 0.94 | 39.6 |
| 11 T | 2.44 | 3.66 | 28.7 | 0.96 | 0.86 | 11.1 | 77 | 13.06 | 27.7 |
| 12 R | 4.39 | 6.59 | 46.1 | 1.00 | 1.02 | 8.1 | 56 | 18.23 | 23.0 |

SUNNY ISLE MORNING

Jug Handle Two Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Phases & Turn | Adjusted Period Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|---------------------|-----------------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 5 | E_T | I E | 12 | - | - | 12.0Min | |
| 8 | N_T | E C | 5 | 0.377 | 0.419 | 30.1 | |
| 2 | S_T | C I | 5 | 0.227 | 0.252 | 20.1 | |
| Total: | | | 22 | 0.604 | 0.671 | 62.2 | |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 34 | 200 | 67 | 60 |

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 32.3 |
| Largest average movement delay (s) | = | 54.1 |
| Largest back of queue, 95% (m) | = | 206 |
| Performance Index | = | 121.20 |
| Degree of saturation (highest) | = | 0.971 |
| Practical Spare Capacity (lowest) | = | -7 % |
| Total vehicle capacity, all lanes (veh/h) | = | 6668 |
| Total vehicle flow (veh/h) | = | 2471 |
| Total person flow (pers/h) | = | 3707 |
| Total vehicle delay (veh-h/h) | = | 22.14 |
| Total person delay (pers-h/h) | = | 33.22 |
| Total effective vehicle stops (veh/h) | = | 2667 |
| Total effective person stops (pers/h) | = | 4000 |
| Total vehicle travel (veh-km/h) | = | 1364.0 |
| Total cost (\$/h) | = | 1441.64 |
| Total fuel (L/h) | = | 181.4 |
| Total CO2 (kg/h) | = | 453.44 |

SUNNY ISLE MORNING

Jug Handle Two Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| I | 0 | 5 | 7 | 12 | 0.200 |
| E | 12 | 18 | 23 | 29 | 0.483 |
| C | 41 | 46 | 14 | 19 | 0.317 |

Current Phase Sequence No.: 1

Input phase sequence: I E C

Output phase sequence: I E C

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 0.80 | 1.20 | 14.8 | 0.79 | 0.80 | 4.4 | 31 | 5.40 | 35.6 |
| 2 T | 6.07 | 9.10 | 44.4 | 0.97 | 1.21 | 19.8 | 139 | 26.41 | 22.6 |
| 3 R | 0.32 | 0.47 | 54.1 | 1.00 | 1.22 | 19.8 | 139 | 1.19 | 22.4 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.00 | 0.00 | 5.6 | 0.20 | 0.57 | 0.0 | 0 | 0.02 | 30.2 |
| 5 T | 3.65 | 5.47 | 34.6 | 1.00 | 1.08 | 8.1 | 57 | 20.55 | 21.3 |
| 6 R | 0.01 | 0.01 | 33.8 | 0.96 | 0.57 | 0.0 | 0 | 0.05 | 20.5 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.59 | 0.89 | 7.5 | 0.57 | 0.70 | 4.3 | 30 | 8.03 | 28.5 |
| 8 T | 5.65 | 8.48 | 34.3 | 0.95 | 1.26 | 29.5 | 206 | 33.96 | 21.4 |
| 9 R | 2.26 | 3.39 | 41.5 | 1.00 | 1.35 | 29.5 | 206 | 12.08 | 19.8 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.00 | 0.00 | 6.5 | 0.20 | 0.60 | 0.0 | 0 | 0.02 | 40.7 |
| 11 T | 2.79 | 4.18 | 32.8 | 1.00 | 0.86 | 6.3 | 44 | 13.44 | 26.2 |
| 12 R | 0.01 | 0.02 | 37.5 | 0.96 | 0.57 | 0.0 | 0 | 0.04 | 25.5 |

SUNNY ISLE MORNING

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Phases & Turn | Adjusted Period Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|-------------------|---------------------|-----------------------|--------------------|---------------------|-------------------------|------------------------|
| 12 | W_R | A C | 5 | 0.186 | 0.207 | 17.4 |
| 2 | S_T | C E | 5 | 0.117 | 0.130 | 12.8 |
| 9 | N_R | E A | 5 | 0.210 | 0.233 | 19.0 |
| Total: | | | 15 | 0.512 | 0.569 | 49.2 |

Cycle Time:

Minimum Maximum Practical Chosen

33 200 35 60

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | B |
| Worst movement Level of Service | = | C |
| Average intersection delay (s) | = | 15.2 |
| Largest average movement delay (s) | = | 33.5 |
| Largest back of queue, 95% (m) | = | 89 |
| Performance Index | = | 77.75 |
| Degree of saturation (highest) | = | 0.701 |
| Practical Spare Capacity (lowest) | = | 28 % |
| Total vehicle capacity, all lanes (veh/h) | = | 8908 |
| Total vehicle flow (veh/h) | = | 2477 |
| Total person flow (pers/h) | = | 3716 |
| Total vehicle delay (veh-h/h) | = | 10.44 |
| Total person delay (pers-h/h) | = | 15.65 |
| Total effective vehicle stops (veh/h) | = | 1529 |
| Total effective person stops (pers/h) | = | 2294 |
| Total vehicle travel (veh-km/h) | = | 1364.8 |
| Total cost (\$/h) | = | 1142.83 |
| Total fuel (L/h) | = | 143.0 |
| Total CO2 (kg/h) | = | 357.47 |

SUNNY ISLE MORNING

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| A | 0 | 5 | 17 | 22 | 0.367 |
| C | 22 | 27 | 10 | 15 | 0.250 |
| E | 37 | 42 | 18 | 23 | 0.383 |

Current Phase Sequence No.: 1

Input phase sequence: A C E

Output phase sequence: A C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (m) | Perf. Index (km/h) | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|--------------|--------------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 0.46 | 0.69 | 8.6 | 0.31 | 0.71 | 1.8 | 12 | 4.24 | 39.9 |
| 2 T | 1.73 | 2.60 | 30.4 | 0.99 | 0.89 | 8.6 | 61 | 8.79 | 27.0 |
| 3 R | 0.24 | 0.36 | 33.5 | 0.99 | 0.89 | 8.6 | 61 | 1.14 | 25.9 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.04 | 0.06 | 8.5 | 0.42 | 0.63 | 0.3 | 2 | 0.53 | 28.9 |
| 5 T | 0.00 | 0.00 | 0.0 | 0.00 | 11.9# | | 6.30 | 32.0 | |
| 6 R | 1.79 | 2.68 | 23.9 | 0.88 | 0.80 | 8.5 | 60 | 11.71 | 22.9 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.33 | 0.50 | 4.2 | 0.22 | 0.56 | 1.4 | 10 | 6.56 | 29.8 |
| 8 T | 1.26 | 1.89 | 21.5 | 0.94 | 0.86 | 12.7 | 89 | 9.58 | 24.7 |
| 9 R | 1.43 | 2.14 | 26.2 | 0.94 | 0.90 | 12.7 | 89 | 9.19 | 23.2 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.11 | 0.16 | 8.9 | 0.40 | 0.67 | 0.6 | 4 | 1.01 | 38.7 |
| 11 T | 0.30 | 0.46 | 3.6 | 0.38 | 6.4# | | 4.58 | 44.3 | |
| 12 R | 2.74 | 4.11 | 28.7 | 0.93 | 0.86 | 10.9 | 76 | 14.12 | 28.7 |

Largest density (passenger cars per km or mile) for any lane

SUNNY ISLE AFTERNOON

Optimum

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 75

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Turn | Phases | Adjusted Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|-------------------|------------|---------|----------------|--------------------|---------------------|-------------------------|------------------------|
| 6 | E_R | J I | 5 | 0.163 | 0.181 | 18.6 | |
| 4 | E_L | 1st I E | 5 | 0.178 | 0.198 | 19.9 | |
| 8 | N_T | E C | 5 | 0.180 | 0.200 | 20.0 | |
| 1 | S_L | 2nd C J | 5 | 0.216 | 0.240 | 23.0 | |
| Total: | | | 20 | 0.738 | 0.820 | 81.5 | |

Cycle Time:

Minimum Maximum Practical Chosen

44 200 111 75

(Variable cycle times: Program-determined)

Intersection Level of Service = D
 Worst movement Level of Service = F
 Average intersection delay (s) = 52.8
 Largest average movement delay (s) = 80.0
 Largest back of queue, 95% (m) = 146
 Performance Index = 145.04
 Degree of saturation (highest) = 1.040
 Practical Spare Capacity (lowest) = -13 %
 Total vehicle capacity, all lanes (veh/h) = 3538
 Total vehicle flow (veh/h) = 2335
 Total person flow (pers/h) = 3503
 Total vehicle delay (veh-h/h) = 34.24
 Total person delay (pers-h/h) = 51.37
 Total effective vehicle stops (veh/h) = 2801
 Total effective person stops (pers/h) = 4201
 Total vehicle travel (veh-km/h) = 1282.7
 Total cost (\$/h) = 1634.11
 Total fuel (L/h) = 176.6
 Total CO2 (kg/h) = 441.57

SUNNY ISLE AFTERNOON

Optimum

Intersection ID: 1 *** UNREGISTERED VERSION ***
 Fixed-Time Signals, Cycle Time = 75

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| J | 0 | 5 | 13 | 18 | 0.240 |
| I | 18 | 23 | 13 | 18 | 0.240 |
| E | 36 | 41 | 13 | 18 | 0.240 |
| C | 54 | 59 | 16 | 21 | 0.280 |

Current Phase Sequence No.: 1
 Input phase sequence: J I E C
 Output phase sequence: J I E C

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 1.84 | 2.77 | 60.9 | 1.00 | 1.22 | 19.8 | 139 | 6.77 | 19.7 |
| 2 TR | 5.18 | 7.77 | 56.7 | 1.00 | 1.22 | 19.8 | 139 | 19.81 | 19.7 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.13 | 0.19 | 66.0 | 1.00 | 1.38 | 17.1 | 120 | 0.51 | 16.0 |
| 5 T | 5.75 | 8.63 | 61.1 | 1.00 | 1.38 | 17.1 | 120 | 24.00 | 16.7 |
| 6 R | 4.42 | 6.63 | 52.8 | 1.00 | 1.25 | 15.3 | 107 | 20.11 | 17.0 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.41 | 0.62 | 6.2 | 0.36 | 0.62 | 3.5 | 24 | 6.76 | 29.0 |
| 8 T | 3.44 | 5.15 | 75.4 | 1.00 | 1.56 | 20.9 | 146 | 13.59 | 14.9 |
| 9 R | 4.11 | 6.17 | 80.0 | 1.00 | 1.56 | 20.9 | 146 | 15.58 | 14.4 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.15 | 0.23 | 10.8 | 0.43 | 0.68 | 1.0 | 7 | 1.32 | 37.3 |
| 11 T | 4.09 | 6.14 | 47.5 | 1.00 | 1.10 | 15.1 | 105 | 17.86 | 21.8 |
| 12 R | 4.72 | 7.08 | 56.8 | 1.00 | 1.15 | 15.2 | 107 | 18.72 | 20.5 |

SUNNY ISLE AFTERNOON

Two Turn Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|--------------|--------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 6 | E_R | J I | 11 | - | - | 11.0Min | |
| 4 | E_L | 1st I C | 5 | 0.178 | 0.198 | 16.9 | |
| 2 | S_TR | C E | 5 | 0.149 | 0.166 | 14.9 | |
| 8 | N_T | E J | 5 | 0.171 | 0.190 | 16.4 | |
| Total: | | | 26 | 0.498 | 0.553 | 59.2 | |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

Minimum Maximum Practical Chosen

45 200 58 60

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 34.1 |
| Largest average movement delay (s) | = | 44.4 |
| Largest back of queue, 95% (m) | = | 97 |
| Performance Index | = | 101.95 |
| Degree of saturation (highest) | = | 0.894 |
| Practical Spare Capacity (lowest) | = | 1 % |
| Total vehicle capacity, all lanes (veh/h) | = | 4105 |
| Total vehicle flow (veh/h) | = | 2335 |
| Total person flow (pers/h) | = | 3503 |
| Total vehicle delay (veh-h/h) | = | 22.14 |
| Total person delay (pers-h/h) | = | 33.20 |
| Total effective vehicle stops (veh/h) | = | 2225 |
| Total effective person stops (pers/h) | = | 3337 |
| Total vehicle travel (veh-km/h) | = | 1283.7 |
| Total cost (\$/h) | = | 1166.83 |
| Total fuel (L/h) | = | 146.1 |
| Total CO2 (kg/h) | = | 365.33 |

SUNNY ISLE AFTERNOON
 Two Turn Lanes
 Intersection ID: 1 *** UNREGISTERED VERSION ***
 Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| J | 0 | 5 | 6 | 11 | 0.183 |
| I | 11 | 16 | 12 | 17 | 0.283 |
| C | 28 | 33 | 10 | 15 | 0.250 |
| E | 43 | 49 | 11 | 17 | 0.283 |

Current Phase Sequence No.: 1
 Input phase sequence: J I C E
 Output phase sequence: J I C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 0.52 | 0.79 | 17.3 | 0.84 | 0.79 | 3.1 | 21 | 3.22 | 34.1 |
| 2 TR | 3.51 | 5.26 | 38.4 | 0.98 | 1.02 | 11.9 | 83 | 14.93 | 27.3 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.09 | 0.13 | 44.4 | 1.00 | 1.23 | 13.9 | 97 | 0.41 | 19.2 |
| 5 T | 3.86 | 5.79 | 41.0 | 1.00 | 1.07 | 13.9 | 97 | 16.57 | 27.0 |
| 6 R | 3.55 | 5.32 | 42.4 | 1.00 | 0.94 | 6.6 | 46 | 13.99 | 25.9 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.63 | 0.95 | 9.4 | 0.69 | 0.73 | 4.0 | 28 | 7.23 | 27.7 |
| 8 T | 1.33 | 1.99 | 29.2 | 0.96 | 1.07 | 12.7 | 89 | 8.34 | 22.6 |
| 9 R | 2.05 | 3.08 | 39.9 | 1.00 | 1.01 | 12.7 | 89 | 8.70 | 27.5 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.12 | 0.17 | 8.2 | 0.36 | 0.67 | 0.6 | 4 | 1.12 | 39.2 |
| 11 T | 2.94 | 4.41 | 34.2 | 1.00 | 0.96 | 11.5 | 80 | 13.39 | 29.1 |
| 12 R | 3.54 | 5.31 | 42.6 | 1.00 | 0.93 | 6.6 | 46 | 14.05 | 26.4 |

SUNNY ISLE AFTERNOON

Jug Handle Two Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Phases & Turn | Adjusted Period Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|-------------------|---------------------|-----------------------|--------------------|---------------------|-------------------------|------------------------|
| 5 | E_T | I E | 12 | - | - | 12.0Min |
| 8 | N_T | E C | 5 | 0.292 | 0.324 | 24.5 |
| 2 | S_TR | C I | 5 | 0.266 | 0.296 | 22.7 |
| Total: | | | 22 | 0.558 | 0.620 | 59.2 |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 34 | 200 | 58 | 60 |

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 27.4 |
| Largest average movement delay (s) | = | 37.5 |
| Largest back of queue, 95% (m) | = | 142 |
| Performance Index | = | 101.59 |
| Degree of saturation (highest) | = | 0.887 |
| Practical Spare Capacity (lowest) | = | 1 % |
| Total vehicle capacity, all lanes (veh/h) | = | 6552 |
| Total vehicle flow (veh/h) | = | 2245 |
| Total person flow (pers/h) | = | 3368 |
| Total vehicle delay (veh-h/h) | = | 17.11 |
| Total person delay (pers-h/h) | = | 25.67 |
| Total effective vehicle stops (veh/h) | = | 2205 |
| Total effective person stops (pers/h) | = | 3308 |
| Total vehicle travel (veh-km/h) | = | 1232.9 |
| Total cost (\$/h) | = | 1208.31 |
| Total fuel (L/h) | = | 145.5 |
| Total CO2 (kg/h) | = | 363.65 |

SUNNY ISLE AFTERNOON

Jug Handle Two Lanes

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| I | 0 | 5 | 7 | 12 | 0.200 |
| E | 12 | 18 | 19 | 25 | 0.417 |
| C | 37 | 42 | 18 | 23 | 0.383 |

Current Phase Sequence No.: 1

Input phase sequence: I E C

Output phase sequence: I E C

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 0.51 | 0.77 | 16.9 | 0.79 | 0.80 | 4.1 | 29 | 3.21 | 34.4 |
| 2 TR | 5.25 | 7.88 | 30.6 | 0.96 | 1.05 | 19.0 | 133 | 27.72 | 27.0 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.00 | 0.00 | 5.6 | 0.20 | 0.57 | 0.0 | 0 | 0.02 | 30.2 |
| 5 T | 2.98 | 4.47 | 31.7 | 1.00 | 0.96 | 7.0 | 49 | 17.44 | 22.0 |
| 6 R | 0.01 | 0.01 | 33.8 | 0.96 | 0.57 | 0.0 | 0 | 0.05 | 20.5 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.57 | 0.85 | 8.5 | 0.61 | 0.71 | 4.4 | 31 | 7.12 | 28.1 |
| 8 T | 3.23 | 4.84 | 26.5 | 0.95 | 1.10 | 20.3 | 142 | 22.17 | 23.3 |
| 9 R | 1.72 | 2.57 | 33.4 | 1.00 | 1.18 | 20.3 | 142 | 10.14 | 21.5 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.00 | 0.00 | 6.5 | 0.20 | 0.60 | 0.0 | 0 | 0.02 | 40.7 |
| 11 T | 2.83 | 4.25 | 32.9 | 1.00 | 0.87 | 6.4 | 45 | 13.66 | 26.1 |
| 12 R | 0.01 | 0.02 | 37.5 | 0.96 | 0.57 | 0.0 | 0 | 0.04 | 25.5 |

SUNNY ISLE MORNING

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|--------------|--------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 6 | E_R | A C | 5 | 0.163 | 0.181 | 15.9 | |
| 2 | S_T | C E | 5 | 0.167 | 0.185 | 16.1 | |
| 8 | N_T | E A | 5 | 0.180 | 0.200 | 17.0 | |
| Total: | | | 15 | 0.510 | 0.567 | 49.0 | |

Cycle Time:

Minimum Maximum Practical Chosen

33 200 35 60

(Variable cycle times: Program-determined)

Intersection Level of Service = B
 Worst movement Level of Service = C
 Average intersection delay (s) = 16.8
 Largest average movement delay (s) = 32.0
 Largest back of queue, 95% (m) = 79
 Performance Index = 76.38
 Degree of saturation (highest) = 0.699
 Practical Spare Capacity (lowest) = 29 %
 Total vehicle capacity, all lanes (veh/h) = 8692
 Total vehicle flow (veh/h) = 2335
 Total person flow (pers/h) = 3503
 Total vehicle delay (veh-h/h) = 10.87
 Total person delay (pers-h/h) = 16.30
 Total effective vehicle stops (veh/h) = 1493
 Total effective person stops (pers/h) = 2240
 Total vehicle travel (veh-km/h) = 1282.3
 Total cost (\$/h) = 1092.10
 Total fuel (L/h) = 134.6
 Total CO2 (kg/h) = 336.43

SUNNY ISLE MORNING

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***
 Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs Prop. |
|-----------|-------------|-------------|-----------------|-----------------------|
| A | 0 | 5 | 14 | 19 0.317 |
| C | 19 | 24 | 15 | 20 0.333 |
| E | 39 | 44 | 16 | 21 0.350 |

Current Phase Sequence No.: 1
 Input phase sequence: A C E
 Output phase sequence: A C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Rate (vehs) | Longest Queue (m) | 95% Back | Perf. Index (km/h) | Aver. Speed (km/h) |
|-------------------|-----------------------|------------------------|-------------------|--------------|------------------|-------------------|----------|--------------------|--------------------|
| South: ROUTE 681 | | | | | | | | | |
| 1 L | 0.26 | 0.38 | 8.4 | 0.28 | 0.70 | 0.9 | 7 | 2.34 | 40.0 |
| 2 T | 1.99 | 2.98 | 25.6 | 0.95 | 0.85 | 10.8 | 76 | 11.18 | 29.0 |
| 3 R | 0.39 | 0.59 | 28.7 | 0.95 | 0.86 | 10.8 | 76 | 2.01 | 27.7 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.02 | 0.02 | 7.8 | 0.38 | 0.61 | 0.1 | 1 | 0.20 | 29.2 |
| 5 T | 0.00 | 0.00 | 0.0 | 0.00 | 10.6# | | | 5.62 | 32.0 |
| 6 R | 2.39 | 3.59 | 28.6 | 0.97 | 0.91 | 10.4 | 73 | 14.31 | 21.7 |
| North: ROUTE 70 W | | | | | | | | | |
| 7 L | 0.29 | 0.43 | 4.3 | 0.23 | 0.57 | 1.4 | 10 | 5.65 | 29.8 |
| 8 T | 1.03 | 1.54 | 22.6 | 0.95 | 0.85 | 11.3 | 79 | 7.50 | 24.3 |
| 9 R | 1.40 | 2.10 | 27.2 | 0.95 | 0.88 | 11.3 | 79 | 8.73 | 22.9 |
| West: ROUTE 66 | | | | | | | | | |
| 10 L | 0.14 | 0.21 | 10.1 | 0.45 | 0.68 | 0.9 | 6 | 1.25 | 37.8 |
| 11 T | 0.31 | 0.46 | 3.6 | 0.38 | 6.5# | | | 4.64 | 44.3 |
| 12 R | 2.66 | 3.98 | 32.0 | 0.96 | 0.89 | 10.3 | 72 | 12.97 | 27.4 |

Largest density (passenger cars per km or mile) for any lane

Sion Farm Morning
Optimum

Intersection ID: 2 *** UNREGISTERED VERSION ***
Fixed-Time Signals, Cycle Time = 85

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|--------------|--------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 1 | S_L | 1st C E | 5 | 0.085 | 0.094 | 13.0 | |
| 7 | N_L | 1st E I | 5 | 0.171 | 0.190 | 21.2 | |
| 6 | E_R | I J | 11 | - | - | 11.0Min | |
| 11 | W_T | J C | 5 | 0.320 | 0.355 | 35.2 | |
| Total: | | | 26 | 0.576 | 0.640 | 80.4 | |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 44 | 200 | 72 | 85 |

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | E |
| Average intersection delay (s) | = | 30.3 |
| Largest average movement delay (s) | = | 55.8 |
| Largest back of queue, 95% (m) | = | 180 |
| Performance Index | = | 118.12 |
| Degree of saturation (highest) | = | 0.898 |
| Practical Spare Capacity (lowest) | = | 0 % |
| Total vehicle capacity, all lanes (veh/h) | = | 4758 |
| Total vehicle flow (veh/h) | = | 2269 |
| Total person flow (pers/h) | = | 3404 |
| Total vehicle delay (veh-h/h) | = | 19.13 |
| Total person delay (pers-h/h) | = | 28.69 |
| Total effective vehicle stops (veh/h) | = | 2025 |
| Total effective person stops (pers/h) | = | 3037 |
| Total vehicle travel (veh-km/h) | = | 1209.2 |
| Total cost (\$/h) | = | 1361.27 |
| Total fuel (L/h) | = | 142.7 |
| Total CO2 (kg/h) | = | 356.74 |

Sion Farm Morning
Optimum

Intersection ID: 2 *** UNREGISTERED VERSION ***
Fixed-Time Signals, Cycle Time = 85

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| C | 0 | 5 | 8 | 13 | 0.153 |
| E | 13 | 18 | 18 | 23 | 0.271 |
| I | 36 | 41 | 6 | 11 | 0.129 |
| J | 47 | 52 | 33 | 38 | 0.447 |

Current Phase Sequence No.: 1
Input phase sequence: C E I J
Output phase sequence: C E I J

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.57 | 0.85 | 13.0 | 0.58 | 0.69 | 4.6 | 32 | 5.83 | 26.3 |
| 2 T | 1.52 | 2.28 | 52.0 | 1.00 | 1.12 | 9.7 | 68 | 7.05 | 17.1 |
| 3 R | 0.93 | 1.39 | 55.8 | 1.00 | 1.12 | 9.7 | 68 | 4.10 | 16.6 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.17 | 0.26 | 27.2 | 0.87 | 0.84 | 17.8 | 125 | 1.15 | 22.0 |
| 5 T | 3.09 | 4.64 | 23.6 | 0.87 | 0.78 | 17.8 | 125 | 22.82 | 22.9 |
| 6 R | 1.45 | 2.17 | 51.6 | 1.00 | 0.95 | 6.2 | 43 | 6.51 | 17.2 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 1.57 | 2.36 | 26.7 | 0.94 | 0.92 | 9.9 | 69 | 9.63 | 22.2 |
| 8 T | 0.64 | 0.96 | 23.1 | 0.94 | 0.90 | 9.9 | 69 | 4.41 | 23.1 |
| 9 R | 3.76 | 5.64 | 42.9 | 1.00 | 1.02 | 15.2 | 106 | 19.37 | 18.7 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.04 | 0.07 | 1.9 | 0.12 | 0.29 | 0.3 | 2 | 1.72 | 30.9 |
| 11 T | 5.13 | 7.70 | 29.8 | 0.96 | 0.97 | 25.8 | 180 | 34.41 | 21.3 |
| 12 R | 0.24 | 0.37 | 46.2 | 0.96 | 0.69 | 1.2 | 8 | 1.12 | 18.1 |

Sion Farm Morning

Two Thru Lanes

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 55

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Turn | Period | Adjusted Fr | Adjusted To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|-------------------|------------|--------|-------------|-------------|--------------------|---------------------|-------------------------|------------------------|
| 1 | S_L | 1st | C | E | 11 | - | - | 11.0Min |
| 9 | N_R | | E | I | 5 | 0.171 | 0.190 | 15.5 |
| 6 | E_R | | I | J | 11 | - | - | 11.0Min |
| 10 | W_L | 2nd | J | C | 5 | 0.176 | 0.196 | 15.8 |
| Total: | | | | | 32 | 0.347 | 0.386 | 53.2 |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 45 | 200 | 52 | 55 |

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | C |
| Average intersection delay (s) | = | 23.9 |
| Largest average movement delay (s) | = | 33.7 |
| Largest back of queue, 95% (m) | = | 82 |
| Performance Index | = | 99.55 |
| Degree of saturation (highest) | = | 0.856 |
| Practical Spare Capacity (lowest) | = | 5 % |
| Total vehicle capacity, all lanes (veh/h) | = | 3760 |
| Total vehicle flow (veh/h) | = | 2269 |
| Total person flow (pers/h) | = | 3404 |
| Total vehicle delay (veh-h/h) | = | 15.04 |
| Total person delay (pers-h/h) | = | 22.56 |
| Total effective vehicle stops (veh/h) | = | 2128 |
| Total effective person stops (pers/h) | = | 3191 |
| Total vehicle travel (veh-km/h) | = | 1209.0 |
| Total cost (\$/h) | = | 1271.27 |
| Total fuel (L/h) | = | 138.0 |
| Total CO2 (kg/h) | = | 345.11 |

Sion Farm Morning
 Two Thru Lanes
 Intersection ID: 2 *** UNREGISTERED VERSION ***
 Fixed-Time Signals, Cycle Time = 55

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| C | 0 | 5 | 6 | 11 | 0.200 |
| E | 11 | 16 | 11 | 16 | 0.291 |
| I | 27 | 32 | 6 | 11 | 0.200 |
| J | 38 | 44 | 11 | 17 | 0.309 |

Current Phase Sequence No.: 1
 Input phase sequence: C E I J
 Output phase sequence: C E I J

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.38 | 0.57 | 8.7 | 0.55 | 0.67 | 2.8 | 19 | 4.77 | 27.9 |
| 2 T | 0.88 | 1.32 | 30.2 | 1.00 | 0.99 | 6.5 | 46 | 5.13 | 21.2 |
| 3 R | 0.56 | 0.84 | 33.4 | 1.00 | 0.99 | 6.5 | 46 | 3.00 | 20.6 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.16 | 0.24 | 24.6 | 0.94 | 0.82 | 7.7 | 54 | 0.99 | 22.7 |
| 5 T | 2.80 | 4.20 | 21.4 | 0.94 | 0.79 | 7.9 | 55 | 19.87 | 23.6 |
| 6 R | 0.85 | 1.28 | 30.4 | 0.98 | 0.77 | 3.9 | 28 | 4.68 | 21.3 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 0.85 | 1.28 | 14.5 | 0.93 | 0.85 | 5.8 | 41 | 7.23 | 25.8 |
| 8 T | 0.30 | 0.45 | 10.9 | 0.93 | 0.82 | 5.8 | 41 | 3.27 | 27.1 |
| 9 R | 2.96 | 4.44 | 33.7 | 1.00 | 1.15 | 11.6 | 81 | 16.40 | 20.5 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.66 | 0.99 | 28.7 | 1.00 | 1.07 | 11.7 | 82 | 3.97 | 21.7 |
| 11 T | 4.48 | 6.73 | 26.0 | 1.00 | 1.07 | 11.7 | 82 | 29.39 | 22.3 |
| 12 R | 0.15 | 0.23 | 28.6 | 0.92 | 0.68 | 0.8 | 5 | 0.84 | 21.7 |

Sion Farm Morning

Jug Handle

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 55

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Period | Phases Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|--------------|--------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 11 | W_T | B C | 5 | 0.320 | 0.355 | 24.6 | |
| 2 | S_T | C E | 5 | 0.145 | 0.161 | 13.9 | |
| 7 | N_L | 2nd E B | 6 | 0.155 | 0.172 | 15.5 | |
| Total: | | | 16 | 0.620 | 0.689 | 53.9 | |

Cycle Time:

Minimum Maximum Practical Chosen

34 200 51 55

Intersection Level of Service = C
 Worst movement Level of Service = D
 Average intersection delay (s) = 24.7
 Largest average movement delay (s) = 36.8
 Largest back of queue, 95% (m) = 144
 Performance Index = 100.75
 Degree of saturation (highest) = 0.888
 Practical Spare Capacity (lowest) = 1 %
 Total vehicle capacity, all lanes (veh/h) = 6109
 Total vehicle flow (veh/h) = 2190
 Total person flow (pers/h) = 3285
 Total vehicle delay (veh-h/h) = 15.05
 Total person delay (pers-h/h) = 22.57
 Total effective vehicle stops (veh/h) = 2288
 Total effective person stops (pers/h) = 3433
 Total vehicle travel (veh-km/h) = 1165.7
 Total cost (\$/h) = 1239.23
 Total fuel (L/h) = 135.0
 Total CO2 (kg/h) = 337.51

Sion Farm Morning

Jug Handle

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 55

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| B | 0 | 5 | 20 | 25 | 0.455 |
| C | 25 | 30 | 9 | 14 | 0.255 |
| E | 39 | 45 | 10 | 16 | 0.291 |

Current Phase Sequence No.: 1

Input phase sequence: B C E

Output phase sequence: B C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.54 | 0.81 | 12.3 | 0.70 | 0.73 | 3.8 | 26 | 5.46 | 26.5 |
| 2 T | 2.11 | 3.16 | 33.6 | 1.00 | 1.20 | 11.0 | 77 | 11.91 | 20.5 |
| 3 R | 0.61 | 0.92 | 36.8 | 1.00 | 1.20 | 11.0 | 77 | 3.23 | 19.9 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.00 | 0.00 | 4.5 | 0.24 | 0.52 | 0.0 | 0 | 0.02 | 29.7 |
| 5 T | 2.18 | 3.27 | 16.6 | 0.89 | 0.80 | 12.6 | 88 | 18.89 | 25.0 |
| 6 R | 0.01 | 0.01 | 30.3 | 0.94 | 0.57 | 0.0 | 0 | 0.04 | 21.3 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 1.31 | 1.97 | 22.3 | 0.97 | 1.03 | 8.2 | 57 | 8.61 | 23.4 |
| 8 T | 0.63 | 0.95 | 18.7 | 0.97 | 1.01 | 8.2 | 57 | 4.80 | 24.4 |
| 9 R | 2.96 | 4.44 | 33.7 | 1.00 | 1.15 | 11.6 | 81 | 16.40 | 20.5 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.00 | 0.00 | 4.1 | 0.18 | 0.51 | 0.0 | 0 | 0.02 | 29.9 |
| 11 T | 4.68 | 7.02 | 27.2 | 1.00 | 1.20 | 20.6 | 144 | 31.32 | 22.0 |
| 12 R | 0.01 | 0.01 | 25.0 | 0.85 | 0.58 | 0.0 | 0 | 0.04 | 22.6 |

SION FARM MORNING

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Phases & Turn | Adjusted Period Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|---------------------|-----------------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 6 | E_R | A C | 11 | - | - | 11.0Min | |
| 1 | S_L | 1st C E | 11 | - | - | 11.0Min | |
| 9 | N_R | E A | 5 | 0.217 | 0.241 | 19.5 | |
| Total: | | | 27 | 0.217 | 0.241 | 41.5 | |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 33 | 200 | 36 | 60 |

(Variable cycle times: Program-determined)

| | | |
|---|---|--------|
| Intersection Level of Service | = | A |
| Worst movement Level of Service | = | C |
| Average intersection delay (s) | = | 9.1 |
| Largest average movement delay (s) | = | 34.0 |
| Largest back of queue, 95% (m) | = | 72 |
| Performance Index | = | 56.41 |
| Degree of saturation (highest) | = | 0.483 |
| Practical Spare Capacity (lowest) | = | 86 % |
| Total vehicle capacity, all lanes (veh/h) | = | 8816 |
| Total vehicle flow (veh/h) | = | 2269 |
| Total person flow (pers/h) | = | 3404 |
| Total vehicle delay (veh-h/h) | = | 5.71 |
| Total person delay (pers-h/h) | = | 8.57 |
| Total effective vehicle stops (veh/h) | = | 1070 |
| Total effective person stops (pers/h) | = | 1604 |
| Total vehicle travel (veh-km/h) | = | 1253.1 |
| Total cost (\$/h) | = | 955.19 |
| Total fuel (L/h) | = | 122.6 |
| Total CO2 (kg/h) | = | 306.62 |

SION FARM MORNING

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| A | 0 | 5 | 7 | 12 | 0.200 |
| C | 12 | 17 | 11 | 16 | 0.267 |
| E | 28 | 33 | 27 | 32 | 0.533 |

Current Phase Sequence No.: 1

Input phase sequence: A C E

Output phase sequence: A C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back | Perf. Index (km/h) | Aver. Speed |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|----------|--------------------|-------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.39 | 0.58 | 8.8 | 0.33 | 0.71 | 1.6 | 11 | 3.53 | 39.7 |
| 2 T | 0.79 | 1.18 | 27.0 | 0.93 | 0.77 | 6.0 | 42 | 4.16 | 28.4 |
| 3 R | 0.50 | 0.75 | 30.2 | 0.93 | 0.79 | 6.0 | 42 | 2.44 | 27.2 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.04 | 0.05 | 5.6 | 0.21 | 0.60 | 0.1 | 1 | 0.57 | 30.1 |
| 5 T | 0.00 | 0.01 | 0.0 | 0.00 | 14.8# | | | 7.82 | 32.0 |
| 6 R | 0.91 | 1.37 | 32.5 | 0.97 | 0.77 | 4.2 | 29 | 4.85 | 20.8 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 0.25 | 0.38 | 4.3 | 0.23 | 0.57 | 1.2 | 9 | 4.96 | 29.8 |
| 8 T | 0.35 | 0.53 | 12.6 | 0.75 | 0.65 | 10.3 | 72 | 3.76 | 27.6 |
| 9 R | 1.52 | 2.28 | 17.3 | 0.75 | 0.78 | 10.3 | 72 | 12.55 | 25.8 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.16 | 0.24 | 7.1 | 0.28 | 0.66 | 0.7 | 5 | 1.68 | 40.2 |
| 11 T | 0.62 | 0.93 | 3.6 | 0.38 | 12.9# | | | 9.28 | 44.3 |
| 12 R | 0.18 | 0.27 | 34.0 | 0.92 | 0.70 | 0.8 | 6 | 0.80 | 26.7 |

Largest density (passenger cars per km or mile) for any lane

Sion Farm Afternoon

Optimum Phases

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 65

Table S.3 - INTERSECTION PARAMETERS

| Mov No. | & Turn | Period | Adjusted Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|---------|--------|--------|----------------|--------------------|---------------------|-------------------------|------------------------|
| 2 | S_T | | C E | 5 | 0.116 | 0.129 | 13.4 |
| 7 | N_L | 1st | E I | 5 | 0.130 | 0.144 | 14.4 |
| 6 | E_R | | I J | 11 | - | - | 11.0Min |
| 4 | E_L | 2nd | J C | 5 | 0.283 | 0.314 | 25.4 |
| Total: | | | | 26 | 0.529 | 0.587 | 64.2 |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 45 | 150 | 63 | 65 |

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 29.4 |
| Largest average movement delay (s) | = | 50.3 |
| Largest back of queue, 95% (m) | = | 146 |
| Performance Index | = | 118.62 |
| Degree of saturation (highest) | = | 0.945 |
| Practical Spare Capacity (lowest) | = | -5 % |
| Total vehicle capacity, all lanes (veh/h) | = | 4612 |
| Total vehicle flow (veh/h) | = | 2390 |
| Total person flow (pers/h) | = | 3585 |
| Total vehicle delay (veh-h/h) | = | 19.51 |
| Total person delay (pers-h/h) | = | 29.26 |
| Total effective vehicle stops (veh/h) | = | 2449 |
| Total effective person stops (pers/h) | = | 3673 |
| Total vehicle travel (veh-km/h) | = | 1274.4 |
| Total cost (\$/h) | = | 1423.08 |
| Total fuel (L/h) | = | 151.6 |
| Total CO2 (kg/h) | = | 378.99 |

Sion Farm Afternoon

Optimum Phases

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 65

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| C | 0 | 5 | 8 | 13 | 0.200 |
| E | 13 | 18 | 10 | 15 | 0.231 |
| I | 28 | 33 | 6 | 11 | 0.169 |
| J | 39 | 44 | 21 | 26 | 0.400 |

Current Phase Sequence No.: 1

Input phase sequence: C E I J

Output phase sequence: C E I J

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.92 | 1.38 | 13.3 | 0.70 | 0.74 | 6.3 | 44 | 9.05 | 26.2 |
| 2 T | 1.78 | 2.68 | 46.5 | 1.00 | 1.28 | 11.1 | 77 | 8.57 | 18.0 |
| 3 R | 1.24 | 1.87 | 50.3 | 1.00 | 1.28 | 11.1 | 77 | 5.63 | 17.4 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.30 | 0.45 | 35.9 | 1.00 | 1.17 | 20.8 | 146 | 1.67 | 20.1 |
| 5 T | 4.64 | 6.96 | 32.3 | 1.00 | 1.17 | 20.8 | 146 | 28.25 | 20.8 |
| 6 R | 1.34 | 2.01 | 39.0 | 1.00 | 0.93 | 5.8 | 40 | 6.70 | 19.4 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 1.01 | 1.52 | 18.6 | 0.96 | 0.89 | 6.7 | 47 | 7.50 | 24.5 |
| 8 T | 0.33 | 0.50 | 15.0 | 0.96 | 0.87 | 6.7 | 47 | 2.96 | 25.6 |
| 9 R | 2.59 | 3.89 | 39.1 | 1.00 | 1.09 | 10.3 | 72 | 13.37 | 19.4 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.08 | 0.12 | 2.2 | 0.21 | 0.34 | 0.7 | 5 | 2.87 | 30.7 |
| 11 T | 4.81 | 7.21 | 31.6 | 1.00 | 1.16 | 20.9 | 146 | 29.80 | 20.9 |
| 12 R | 0.44 | 0.67 | 35.5 | 0.96 | 0.73 | 2.1 | 15 | 2.25 | 20.1 |

Sion Farm Afternoon

Two Thru Lanes

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 50

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases | Adjusted ----- Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|--------------|---------|--------------------------|---------------------|--------------------|---------------|-------------------|
| 2 | S_T | C E | 5 | 0.116 | 0.129 | 11.5 | |
| 9 | N_R | E I | 5 | 0.130 | 0.144 | 12.2 | |
| 6 | E_R | I J | 11 | - | - | 11.0Min | |
| 10 | W_L | 2nd J C | 5 | 0.166 | 0.185 | 14.2 | |
| Total: | | | 26 | 0.412 | 0.458 | 48.9 | |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 44 | 200 | 48 | 50 |

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 25.1 |
| Largest average movement delay (s) | = | 47.2 |
| Largest back of queue, 95% (m) | = | 75 |
| Performance Index | = | 98.34 |
| Degree of saturation (highest) | = | 0.970 |
| Practical Spare Capacity (lowest) | = | -7 % |
| Total vehicle capacity, all lanes (veh/h) | = | 3741 |
| Total vehicle flow (veh/h) | = | 2390 |
| Total person flow (pers/h) | = | 3585 |
| Total vehicle delay (veh-h/h) | = | 16.67 |
| Total person delay (pers-h/h) | = | 25.01 |
| Total effective vehicle stops (veh/h) | = | 2318 |
| Total effective person stops (pers/h) | = | 3477 |
| Total vehicle travel (veh-km/h) | = | 1273.9 |
| Total cost (\$/h) | = | 1229.98 |
| Total fuel (L/h) | = | 139.1 |
| Total CO2 (kg/h) | = | 347.66 |

Sion Farm Afternoon

Two Thru Lanes

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 50

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| C | 0 | 5 | 6 | 11 | 0.220 |
| E | 11 | 16 | 8 | 13 | 0.260 |
| I | 24 | 29 | 6 | 11 | 0.220 |
| J | 35 | 40 | 10 | 15 | 0.300 |

Current Phase Sequence No.: 1

Input phase sequence: C E I J

Output phase sequence: C E I J

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (km/h) | Perf. Index | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|-----------------|-------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.56 | 0.85 | 8.2 | 0.58 | 0.70 | 4.0 | 28 | 7.41 | 28.1 |
| 2 T | 1.81 | 2.71 | 47.2 | 1.00 | 1.15 | 9.7 | 68 | 6.89 | 24.3 |
| 3 R | 1.13 | 1.69 | 45.6 | 1.00 | 1.38 | 9.7 | 68 | 5.23 | 18.2 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.21 | 0.32 | 25.2 | 0.98 | 0.94 | 8.4 | 59 | 1.32 | 22.6 |
| 5 T | 3.87 | 5.80 | 26.9 | 0.98 | 0.89 | 8.5 | 59 | 18.83 | 32.7 |
| 6 R | 0.96 | 1.44 | 28.0 | 0.98 | 0.81 | 4.4 | 31 | 5.52 | 21.9 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 0.68 | 1.01 | 12.4 | 0.90 | 0.82 | 4.6 | 32 | 6.30 | 26.5 |
| 8 T | 0.30 | 0.45 | 13.6 | 0.90 | 0.81 | 4.6 | 32 | 1.96 | 42.3 |
| 9 R | 2.01 | 3.02 | 30.3 | 1.00 | 1.06 | 8.3 | 58 | 11.51 | 21.3 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.99 | 1.49 | 26.7 | 1.00 | 1.12 | 10.7 | 75 | 6.14 | 22.2 |
| 11 T | 3.82 | 5.73 | 25.1 | 1.00 | 1.11 | 10.7 | 75 | 25.30 | 22.5 |
| 12 R | 0.33 | 0.49 | 26.4 | 0.93 | 0.72 | 1.6 | 11 | 1.92 | 22.3 |

Sion Farm Afternoon

Jug Handle

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 55

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green Phases & Turn | Adjusted Period Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Time Ratio | Required Movement Time |
|-------------------|---------------------|-----------------------|--------------------|---------------------|-------------------------|------------------------|
| 11 | W_T | B C | 5 | 0.283 | 0.314 | 22.3 |
| 3 | S_R | C E | 5 | 0.205 | 0.228 | 17.5 |
| 7 | N_L | 2nd E B | 5 | 0.136 | 0.151 | 13.3 |
| Total: | | | 15 | 0.624 | 0.693 | 53.1 |

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 33 | 200 | 49 | 55 |

| | | |
|---|---|---------|
| Intersection Level of Service | = | C |
| Worst movement Level of Service | = | C |
| Average intersection delay (s) | = | 24.8 |
| Largest average movement delay (s) | = | 33.0 |
| Largest back of queue, 95% (m) | = | 127 |
| Performance Index | = | 103.27 |
| Degree of saturation (highest) | = | 0.868 |
| Practical Spare Capacity (lowest) | = | 4 % |
| Total vehicle capacity, all lanes (veh/h) | = | 5533 |
| Total vehicle flow (veh/h) | = | 2236 |
| Total person flow (pers/h) | = | 3354 |
| Total vehicle delay (veh-h/h) | = | 15.40 |
| Total person delay (pers-h/h) | = | 23.11 |
| Total effective vehicle stops (veh/h) | = | 2353 |
| Total effective person stops (pers/h) | = | 3530 |
| Total vehicle travel (veh-km/h) | = | 1190.1 |
| Total cost (\$/h) | = | 1268.24 |
| Total fuel (L/h) | = | 138.2 |
| Total CO2 (kg/h) | = | 345.51 |

Sion Farm Afternoon

Jug Handle

Intersection ID: 2 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 55

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| B | 0 | 5 | 18 | 23 | 0.418 |
| C | 23 | 28 | 13 | 18 | 0.327 |
| E | 41 | 46 | 9 | 14 | 0.255 |

Current Phase Sequence No.: 1

Input phase sequence: B C E

Output phase sequence: B C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back | Queue Perf. Index | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|----------|-------------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.80 | 1.20 | 11.6 | 0.72 | 0.76 | 5.8 | 41 | 8.66 | 26.8 |
| 2 T | 2.60 | 3.89 | 29.8 | 1.00 | 1.17 | 14.2 | 99 | 15.96 | 21.3 |
| 3 R | 0.82 | 1.22 | 33.0 | 1.00 | 1.17 | 14.2 | 99 | 4.62 | 20.7 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.00 | 0.00 | 4.3 | 0.22 | 0.51 | 0.0 | 0 | 0.02 | 29.8 |
| 5 T | 2.52 | 3.78 | 19.6 | 0.94 | 0.90 | 13.4 | 94 | 19.78 | 24.1 |
| 6 R | 0.01 | 0.01 | 30.4 | 0.94 | 0.57 | 0.0 | 0 | 0.04 | 21.3 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 1.54 | 2.31 | 28.3 | 1.00 | 1.16 | 9.7 | 68 | 8.98 | 21.8 |
| 8 T | 0.93 | 1.39 | 24.7 | 1.00 | 1.16 | 9.7 | 68 | 6.03 | 22.6 |
| 9 R | 2.11 | 3.17 | 31.8 | 1.00 | 1.03 | 8.8 | 62 | 11.86 | 21.0 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.00 | 0.00 | 5.5 | 0.33 | 0.53 | 0.0 | 0 | 0.03 | 29.3 |
| 11 T | 4.08 | 6.11 | 26.8 | 1.00 | 1.18 | 18.1 | 127 | 27.25 | 22.1 |
| 12 R | 0.01 | 0.01 | 27.1 | 0.88 | 0.58 | 0.0 | 0 | 0.04 | 22.1 |

SION FARM AFTERNOON

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.3 - INTERSECTION PARAMETERS

| Crit App. Mov No. | Green & Turn | Phases Fr To | Adjusted Lost Time | Adjusted Flow Ratio | Adjusted Grn Ratio | Required Time | Required Movement |
|-------------------|--------------|--------------|--------------------|---------------------|--------------------|---------------|-------------------|
| 6 | E_R | A C | 11 | - | - | 11.0Min | |
| 2 | S_T | C E | 5 | 0.116 | 0.129 | 12.8 | |
| 9 | N_R | E A | 5 | 0.166 | 0.185 | 16.1 | |
| Total: | | | 21 | 0.283 | 0.314 | 39.9 | |

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

| | | | |
|---------|---------|-----------|--------|
| Minimum | Maximum | Practical | Chosen |
| 33 | 200 | 33 | 60 |

(Variable cycle times: Program-determined)

| | | |
|---|---|---------|
| Intersection Level of Service | = | A |
| Worst movement Level of Service | = | D |
| Average intersection delay (s) | = | 9.4 |
| Largest average movement delay (s) | = | 32.3 |
| Largest back of queue, 95% (m) | = | 64 |
| Performance Index | = | 62.58 |
| Degree of saturation (highest) | = | 0.476 |
| Practical Spare Capacity (lowest) | = | 89 % |
| Total vehicle capacity, all lanes (veh/h) | = | 8706 |
| Total vehicle flow (veh/h) | = | 2390 |
| Total person flow (pers/h) | = | 3585 |
| Total vehicle delay (veh-h/h) | = | 6.22 |
| Total person delay (pers-h/h) | = | 9.33 |
| Total effective vehicle stops (veh/h) | = | 1141 |
| Total effective person stops (pers/h) | = | 1712 |
| Total vehicle travel (veh-km/h) | = | 1315.9 |
| Total cost (\$/h) | = | 1053.97 |
| Total fuel (L/h) | = | 131.7 |
| Total CO2 (kg/h) | = | 329.19 |

SION FARM AFTERNOON

Single Point

Intersection ID: 1 *** UNREGISTERED VERSION ***

Fixed-Time Signals, Cycle Time = 60

Table S.4 - PHASE INFORMATION

| Phase No. | Change Time | Green Start | Displayed Green | Grn+Intgrn Secs | Prop. |
|-----------|-------------|-------------|-----------------|-----------------|-------|
| A | 0 | 5 | 9 | 14 | 0.233 |
| C | 14 | 19 | 15 | 20 | 0.333 |
| E | 34 | 39 | 21 | 26 | 0.433 |

Current Phase Sequence No.: 1

Input phase sequence: A C E

Output phase sequence: A C E

Table S.5 - MOVEMENT PERFORMANCE

| Mov No. | Total Delay (veh-h/h) | Total Delay (pers-h/h) | Aver. Delay (sec) | Prop. Queued | Eff. Stop Rate (vehs) | Longest Queue (m) | 95% Back (m) | Perf. Index (km/h) | Aver. Speed (km/h) |
|------------------|-----------------------|------------------------|-------------------|--------------|-----------------------|-------------------|--------------|--------------------|--------------------|
| South: ROUTE 81 | | | | | | | | | |
| 1 L | 0.45 | 0.67 | 6.4 | 0.33 | 0.66 | 2.5 | 17 | 6.81 | 29.8 |
| 2 T | 0.81 | 1.22 | 21.3 | 0.89 | 0.74 | 7.5 | 52 | 5.84 | 23.6 |
| 3 R | 0.61 | 0.91 | 24.5 | 0.89 | 0.79 | 7.5 | 52 | 3.89 | 22.8 |
| East: ROUTE 70 E | | | | | | | | | |
| 4 L | 0.05 | 0.07 | 5.6 | 0.21 | 0.60 | 0.2 | 1 | 0.74 | 30.1 |
| 5 T | 0.00 | 0.01 | 0.0 | 0.00 | 16.2# | | 8.58 | 32.0 | |
| 6 R | 1.04 | 1.57 | 30.3 | 0.95 | 0.78 | 4.8 | 34 | 5.80 | 21.3 |
| North: ROUTE 811 | | | | | | | | | |
| 7 L | 0.24 | 0.36 | 4.4 | 0.24 | 0.57 | 1.3 | 9 | 4.66 | 29.7 |
| 8 T | 0.37 | 0.56 | 16.7 | 0.82 | 0.70 | 9.1 | 64 | 3.25 | 26.1 |
| 9 R | 1.42 | 2.13 | 21.4 | 0.82 | 0.79 | 9.1 | 64 | 10.14 | 24.5 |
| West: ROUTE 70 W | | | | | | | | | |
| 10 L | 0.27 | 0.41 | 7.4 | 0.31 | 0.67 | 1.3 | 9 | 2.80 | 39.9 |
| 11 T | 0.55 | 0.82 | 3.6 | 0.38 | 11.4# | | 8.20 | 44.3 | |
| 12 R | 0.40 | 0.61 | 32.3 | 0.90 | 0.73 | 1.8 | 13 | 1.86 | 27.3 |

Largest density (passenger cars per km or mile) for any lane

Appendix E

Report on Selected Alternatives SYNCHRO

Lanes, Volumes, Timings
2: ROUTE 66 & ROUTE 681

4/29/2008



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|------------------------|-------|-------|------|------|-------|------|-------|------|------|--------|------|------|
| Lane Configurations | ↑↑ | ↑ | ↑ | ↑↑ | ↑ | | | ↑↑ | | | ↑↑ | |
| Volume (vph) | 302 | 269 | 39 | 221 | 312 | 15 | 155 | 167 | 224 | 20 | 158 | 149 |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.82 | 0.82 | 0.82 | 0.79 | 0.79 | 0.79 | 0.77 | 0.77 | 0.77 |
| Lane Group Flow (vph) | 343 | 306 | 44 | 270 | 398 | 0 | 0 | 691 | 0 | 0 | 425 | 0 |
| Turn Type | Prot | | Perm | Prot | | | Split | | | custom | | |
| Protected Phases | 1 | 2 | | 1 | 2 | | 6 | 6 | | 4 | 4 | |
| Permitted Phases | | | 2 | | | | | | | 4 | | |
| Minimum Split (s) | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | | 22.0 | 22.0 | | 22.0 | 22.0 | |
| Total Split (s) | 12.0 | 20.0 | 20.0 | 12.0 | 20.0 | 0.0 | 20.0 | 20.0 | 0.0 | 8.0 | 8.0 | 0.0 |
| Total Split (%) | 20% | 33% | 33% | 20% | 33% | 0% | 33% | 33% | 0% | 13% | 13% | 0% |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 2.0 | |
| Lead/Lag | Lead | Lag | Lag | Lead | Lag | | | | | | | |
| Lead-Lag Optimize? | Yes | Yes | Yes | Yes | Yes | | | | | | | |
| Act Effct Green (s) | 8.0 | 16.0 | 16.0 | 8.0 | 16.0 | | 16.0 | | | 4.0 | | |
| Actuated g/C Ratio | 0.13 | 0.27 | 0.27 | 0.13 | 0.27 | | 0.27 | | | 0.07 | | |
| w/c Ratio | 0.73 | 0.58 | 0.09 | 0.57 | 0.78 | | 0.62 | | | 1.04 | | |
| Uniform Delay, d1 | 24.9 | 19.1 | 0.0 | 24.4 | 20.1 | | 10.9 | | | 14.6 | | |
| Delay | 28.9 | 19.7 | 6.4 | 24.7 | 26.0 | | 11.3 | | | 62.3 | | |
| LOS | C | B | A | C | C | | B | | | E | | |
| Approach Delay | | 23.4 | | | 25.5 | | 11.3 | | | 62.3 | | |
| Approach LOS | | C | | | C | | B | | | E | | |
| Queue Length 50th (m) | 19.0 | 29.1 | 0.0 | 14.8 | 39.8 | | 19.5 | | | ~15.5 | | |
| Queue Length 95th (m) | #33.4 | 48.9 | 5.5 | 22.1 | #65.9 | | 26.7 | | | #29.1 | | |
| Internal Link Dist (m) | | 307.7 | | | 590.6 | | 166.2 | | | 127.3 | | |
| 50th Up Block Time (%) | | | | | | | | | | | | |
| 95th Up Block Time (%) | | | | | | | | | | | | |
| Turn Bay Length (m) | 91.5 | | | 57.9 | | | | | | | | |
| 50th Bay Block Time % | | | | | | | | | | | | |
| 95th Bay Block Time % | | | | | 16% | | | | | | | |
| Queuing Penalty (veh) | | | | | 21 | | | | | | | |

Intersection Summary

Cycle Length: 60
 Offset: 27 (45%), Referenced to phase 2:EBWB, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum w/c Ratio: 1.04
 Intersection Signal Delay: 27.3 Intersection LOS: C
 Intersection Capacity Utilization 77.5% ICU Level of Service C
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: ROUTE 66 & ROUTE 681



Lanes, Volumes, Timings
3: ROUTE 811 &

4/29/2008



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|------------------------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| Lane Configurations | ↑ | ↑ | ↑ | ↑ | ↑ | | ↑ | ↑ | | | ↓ | ↑ |
| Volume (vph) | 17 | 552 | 74 | 94 | 425 | 21 | 240 | 76 | 161 | 47 | 82 | 123 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.90 | 0.90 | 0.90 | 0.76 | 0.76 | 0.76 | 0.78 | 0.78 | 0.78 |
| Lane Group Flow (vph) | 19 | 620 | 83 | 104 | 495 | 0 | 316 | 312 | 0 | 0 | 165 | 158 |
| Turn Type | pm+pt | | Perm | Prot | | | Split | | | Split | | Perm |
| Protected Phases | 3 | 4 | | 3 | 4 | | 7 | 7 | | 6 | 6 | |
| Permitted Phases | 4 | | 4 | | | | | | | | | 6 |
| Minimum Split (s) | 40.0 | 55.0 | 55.0 | 40.0 | 55.0 | | 35.0 | 35.0 | | 35.0 | 35.0 | 35.0 |
| Total Split (s) | 11.0 | 38.0 | 38.0 | 11.0 | 38.0 | 0.0 | 23.0 | 23.0 | 0.0 | 13.0 | 13.0 | 13.0 |
| Total Split (%) | 13% | 45% | 45% | 13% | 45% | 0% | 27% | 27% | 0% | 15% | 15% | 15% |
| Yellow Time (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 2.0 | 2.0 |
| Lead/Lag | Lead | Lag | Lag | Lead | Lag | | | | | | | |
| Lead-Lag Optimize? | Yes | Yes | Yes | Yes | Yes | | | | | | | |
| Act Effct Green (s) | 41.0 | 34.0 | 34.0 | 7.0 | 34.0 | | 19.0 | 19.0 | | 9.0 | 9.0 | 9.0 |
| Actuated g/C Ratio | 0.48 | 0.40 | 0.40 | 0.08 | 0.40 | | 0.22 | 0.22 | | 0.11 | 0.11 | 0.11 |
| w/c Ratio | 0.06 | 0.87 | 0.13 | 0.75 | 0.67 | | 0.84 | 0.70 | | 0.90 | 0.50 | 0.50 |
| Uniform Delay, d1 | 9.6 | 23.5 | 0.0 | 38.1 | 20.7 | | 31.5 | 18.6 | | 37.5 | 0.0 | 0.0 |
| Delay | 9.7 | 31.0 | 4.1 | 55.8 | 21.4 | | 42.1 | 20.5 | | 70.5 | 6.8 | 6.8 |
| LOS | A | C | A | E | C | | D | C | | E | A | A |
| Approach Delay | | 27.4 | | | 27.4 | | | 31.3 | | | 39.3 | |
| Approach LOS | | C | | | C | | | C | | | D | |
| Queue Length 50th (m) | 1.4 | 90.6 | 0.0 | 16.9 | 63.8 | | 49.3 | 29.1 | | 26.9 | 0.0 | 0.0 |
| Queue Length 95th (m) | 4.4# | 148.7 | 7.3 | #42.0 | 97.2 | | #65.1 | 42.2 | | #49.2 | 10.4 | 10.4 |
| Internal Link Dist (m) | | 590.6 | | | 278.5 | | | 127.2 | | | 127.4 | |
| 50th Up Block Time (%) | | | | | | | | | | | | |
| 95th Up Block Time (%) | | | | | | | | | | | | |
| Turn Bay Length (m) | 38.1 | | 61.0 | 51.8 | | | 51.8 | | | | | 44.2 |
| 50th Bay Block Time % | | 38% | | | 16% | | 3% | | | | | |
| 95th Bay Block Time % | | 48% | | | 24% | | 21% | | | | 17% | |
| Queuing Penalty (veh) | | 8 | | | 21 | | 33 | | | | 13 | |

Intersection Summary

| | |
|---|------------------------|
| Cycle Length: 85 | |
| Offset: 1 (1%), Referenced to phase 6:SBTL, Start of Green | |
| Natural Cycle: 165 | |
| Control Type: Pretimed | |
| Maximum w/c Ratio: 0.90 | |
| Intersection Signal Delay: 30.2 | Intersection LOS: C |
| Intersection Capacity Utilization 78.9% | ICU Level of Service C |
| # 95th percentile volume exceeds capacity, queue may be longer. | |
| Queue shown is maximum after two cycles. | |

Splits and Phases: 3: ROUTE 811 &



Lanes, Volumes, Timings
2: ROUTE 66 & ROUTE 681

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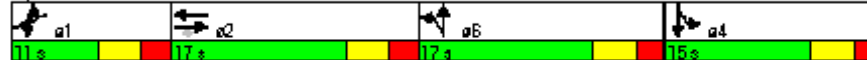


| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|------------------------|-------|-------|------|-------|-------|------|-------|------|--------|-------|------|------|
| Lane Configurations | ↖↗ | ↑ | ↖ | ↖↗ | ↖ | ↖ | | ↖↗ | | | ↖↗ | |
| Volume (vph) | 242 | 251 | 41 | 271 | 305 | 6 | 163 | 144 | 212 | 42 | 241 | 94 |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.82 | 0.82 | 0.82 | 0.79 | 0.79 | 0.79 | 0.77 | 0.77 | 0.77 |
| Lane Group Flow (vph) | 275 | 285 | 47 | 330 | 379 | 0 | 0 | 656 | 0 | 0 | 490 | 0 |
| Turn Type | Prot | | Perm | Prot | | | Split | | custom | | | |
| Protected Phases | 1 | 2 | | 1 | 2 | | 6 | 6 | | 4 | 4 | |
| Permitted Phases | | | 2 | | | | | | | 4 | | |
| Minimum Split (s) | 22.0 | 11.0 | 11.0 | 22.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Total Split (s) | 11.0 | 17.0 | 17.0 | 11.0 | 17.0 | 0.0 | 17.0 | 17.0 | 0.0 | 15.0 | 15.0 | 0.0 |
| Total Split (%) | 18% | 28% | 28% | 18% | 28% | 0% | 28% | 28% | 0% | 25% | 25% | 0% |
| Yellow Time (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 2.0 | |
| Lead/Lag | Lead | Lag | Lag | Lead | Lag | | | | | | | |
| Lead-Lag Optimize? | Yes | Yes | Yes | Yes | Yes | | | | | | | |
| Act Effct Green (s) | 7.0 | 13.0 | 13.0 | 7.0 | 13.0 | | 13.0 | | | 11.0 | | |
| Actuated g/C Ratio | 0.12 | 0.22 | 0.22 | 0.12 | 0.22 | | 0.22 | | | 0.18 | | |
| w/c Ratio | 0.67 | 0.66 | 0.12 | 0.80 | 0.91 | | 0.70 | | | 0.71 | | |
| Uniform Delay, d1 | 25.4 | 21.5 | 0.0 | 25.8 | 22.9 | | 12.5 | | | 19.8 | | |
| Delay | 27.8 | 23.9 | 7.1 | 34.3 | 42.5 | | 12.9 | | | 20.8 | | |
| LOS | C | C | A | C | D | | B | | | C | | |
| Approach Delay | | 24.4 | | | 38.7 | | 12.9 | | | 20.8 | | |
| Approach LOS | | C | | | D | | B | | | C | | |
| Queue Length 50th (m) | 15.2 | 28.8 | 0.0 | 18.6 | 40.8 | | 20.0 | | | 22.9 | | |
| Queue Length 95th (m) | #25.9 | #50.5 | 6.2 | #30.9 | #73.2 | | 27.8 | | | 29.8 | | |
| Internal Link Dist (m) | | 307.7 | | | 590.6 | | 166.2 | | | 127.3 | | |
| 50th Up Block Time (%) | | | | | | | | | | | | |
| 95th Up Block Time (%) | | | | | | | | | | | | |
| Turn Bay Length (m) | 91.5 | | | 57.9 | | | | | | | | |
| 50th Bay Block Time % | | | | | | | | | | | | |
| 95th Bay Block Time % | | | | | 30% | | | | | | | |
| Queuing Penalty (veh) | | | | | 49 | | | | | | | |

Intersection Summary

Cycle Length: 60
 Offset: 32 (53%), Referenced to phase 2:EBWB, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum w/c Ratio: 0.91
 Intersection Signal Delay: 24.7 Intersection LOS: C
 Intersection Capacity Utilization 75.0% ICU Level of Service C
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: ROUTE 66 & ROUTE 681



Lanes, Volumes, Timings
3: ROUTE 811 &

4/29/2008



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|------------------------|------|--------|------|-------|--------|------|-------|-------|------|-------|-------|------|
| Lane Configurations | ↖ | ↖ | ↖ | ↖ | ↖ | ↖ | ↖ | ↖ | ↖ | | ↖ | ↖ |
| Volume (vph) | 41 | 504 | 123 | 114 | 477 | 28 | 177 | 59 | 145 | 58 | 90 | 162 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.90 | 0.90 | 0.90 | 0.76 | 0.76 | 0.76 | 0.78 | 0.78 | 0.78 |
| Lane Group Flow (vph) | 46 | 566 | 138 | 127 | 561 | 0 | 233 | 269 | 0 | 0 | 189 | 208 |
| Turn Type | Prot | | Perm | Prot | | | Split | | | Split | | Perm |
| Protected Phases | 3 | 4 | | 3 | 4 | | 7 | 7 | | 6 | 6 | |
| Permitted Phases | | | 4 | | | | | | | | | 6 |
| Minimum Split (s) | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | | 15.0 | 15.0 | | 11.0 | 11.0 | 11.0 |
| Total Split (s) | 11.0 | 26.0 | 26.0 | 11.0 | 26.0 | 0.0 | 15.0 | 15.0 | 0.0 | 13.0 | 13.0 | 13.0 |
| Total Split (%) | 17% | 40% | 40% | 17% | 40% | 0% | 23% | 23% | 0% | 20% | 20% | 20% |
| Yellow Time (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 2.0 | 2.0 |
| Lead/Lag | Lead | Lag | Lag | Lead | Lag | | | | | | | |
| Lead-Lag Optimize? | Yes | Yes | Yes | Yes | Yes | | | | | | | |
| Act Effct Green (s) | 7.0 | 22.0 | 22.0 | 7.0 | 22.0 | | 11.0 | 11.0 | | 9.0 | 9.0 | 9.0 |
| Actuated g/C Ratio | 0.11 | 0.34 | 0.34 | 0.11 | 0.34 | | 0.17 | 0.17 | | 0.14 | 0.14 | 0.14 |
| w/c Ratio | 0.25 | 0.94 | 0.23 | 0.70 | 0.89 | | 0.82 | 0.67 | | 0.78 | 0.51 | 0.51 |
| Uniform Delay, d1 | 26.6 | 20.9 | 0.0 | 28.0 | 20.2 | | 26.0 | 9.5 | | 27.1 | 0.0 | 0.0 |
| Delay | 27.1 | 39.9 | 3.5 | 40.3 | 32.1 | | 40.6 | 12.9 | | 40.9 | 4.9 | 4.9 |
| LOS | C | D | A | D | C | | D | B | | D | A | A |
| Approach Delay | | 32.4 | | | 33.7 | | | 25.8 | | | 22.0 | |
| Approach LOS | | C | | | C | | | C | | | C | |
| Queue Length 50th (m) | 5.2 | 64.9 | 0.0 | 15.1 | 62.4 | | 27.4 | 8.5 | | 22.4 | 0.0 | 0.0 |
| Queue Length 95th (m) | 13.6 | #119.3 | 9.6 | #38.2 | #117.3 | | #45.5 | 22.8 | | #40.6 | 9.5 | 9.5 |
| Internal Link Dist (m) | | 590.6 | | | 278.5 | | | 127.2 | | | 127.4 | |
| 50th Up Block Time (%) | | | | | | | | | | | | |
| 95th Up Block Time (%) | | | | | | | | | | | | |
| Turn Bay Length (m) | 38.1 | | 61.0 | 51.8 | | | 51.8 | | | | | 44.2 |
| 50th Bay Block Time % | | 33% | | | 19% | | | | | | | |
| 95th Bay Block Time % | | 52% | | | 48% | | | | | | | |
| Queuing Penalty (veh) | | 19 | | | 42 | | | | | | | |

Intersection Summary

| | |
|---|------------------------|
| Cycle Length: 65 | |
| Offset: 24 (37%), Referenced to phase 6:SBTL, Start of Green | |
| Natural Cycle: 70 | |
| Control Type: Pretimed | |
| Maximum w/c Ratio: 0.94 | |
| Intersection Signal Delay: 29.6 | Intersection LOS: C |
| Intersection Capacity Utilization 76.2% | ICU Level of Service C |
| # 95th percentile volume exceeds capacity, queue may be longer. | |
| Queue shown is maximum after two cycles. | |

Splits and Phases: 3: ROUTE 811 &



Appendix F

Queue Study

Right Turn From Route 70 to Hovensa

| TIME | 0 | 15 | 30 | 45 |
|-------|---|----|----|----|
| 15:00 | 0 | 1 | 1 | 1 |
| 15:01 | 0 | 0 | 0 | 0 |
| 15:02 | 0 | 0 | 0 | 3 |
| 15:03 | 4 | 0 | 0 | 0 |
| 15:04 | 1 | 1 | 1 | 1 |
| 15:05 | 1 | 1 | 1 | 0 |
| 15:06 | 0 | 1 | 1 | 2 |
| 15:07 | 2 | 2 | 2 | 2 |
| 15:08 | 2 | 0 | 0 | 0 |
| 15:09 | 0 | 0 | 1 | 3 |
| 15:10 | 6 | 5 | 9 | 10 |
| 15:11 | 2 | 0 | 0 | 0 |
| 15:12 | 1 | 1 | 1 | 1 |
| 15:13 | 3 | 3 | 0 | 2 |
| 15:14 | 2 | 3 | 3 | 3 |
| 15:15 | 4 | 5 | 5 | 5 |
| 15:16 | 0 | 1 | 1 | 1 |
| 15:17 | 1 | 1 | 3 | 3 |
| 15:18 | 4 | 0 | 0 | 0 |
| 15:19 | 0 | 0 | 0 | 0 |
| 15:20 | 0 | 0 | 0 | 0 |
| 15:21 | 0 | 0 | 0 | 1 |
| 15:22 | 2 | 2 | 2 | 1 |
| 15:23 | 0 | 0 | 1 | 1 |
| 15:24 | 1 | 1 | 1 | 1 |
| 15:25 | 2 | 0 | 0 | 0 |
| 15:26 | 0 | 0 | 0 | 0 |
| 15:27 | 0 | 2 | 3 | 0 |
| 15:28 | 0 | 1 | 1 | 2 |

| | | | | |
|-------|---|---|---|---|
| 15:29 | 2 | 2 | 2 | 3 |
| 15:30 | 1 | 0 | 0 | 0 |
| 15:31 | 1 | 2 | 2 | 2 |
| 15:32 | 2 | 0 | 0 | 0 |
| 15:33 | 0 | 0 | 0 | 1 |
| 15:34 | 2 | 2 | 2 | 0 |
| 15:35 | 0 | 1 | 1 | 2 |
| 15:36 | 1 | 1 | 1 | 1 |
| 15:37 | 0 | 0 | 0 | 1 |
| 15:38 | 1 | 2 | 4 | 4 |
| 15:39 | 2 | 0 | 1 | 0 |
| 15:40 | 0 | 0 | 1 | 1 |
| 15:41 | 1 | 3 | 4 | 0 |
| 15:42 | 0 | 0 | 0 | 0 |
| 15:43 | 1 | 1 | 2 | 2 |
| 15:44 | 2 | 0 | 0 | 0 |
| 15:45 | 0 | 0 | 0 | 0 |
| 15:46 | 1 | 1 | 1 | 0 |
| 15:47 | 0 | 1 | 3 | 3 |
| 15:48 | 3 | 5 | 5 | 1 |
| 15:49 | 0 | 0 | 0 | 0 |
| 15:50 | 0 | 0 | 0 | 0 |
| 15:51 | 0 | 1 | 0 | 0 |
| 15:52 | 0 | 1 | 1 | 1 |
| 15:53 | 2 | 2 | 2 | 2 |
| 15:54 | 0 | 1 | 1 | 3 |
| 15:55 | 3 | 3 | 5 | 5 |
| 15:56 | 5 | 3 | 2 | 0 |
| 15:57 | 1 | 1 | 1 | 1 |
| 15:58 | 2 | 2 | 3 | 3 |
| 15:59 | 3 | 3 | 0 | 0 |

Right Turn From Route 70 to Sion Farm

| TIME | 0 | 15 | 30 | 45 |
|-------|---|----|----|----|
| 15:00 | 0 | 1 | 2 | 2 |
| 15:01 | 1 | 0 | 0 | 0 |
| 15:02 | 0 | 0 | 0 | 0 |
| 15:03 | 0 | 0 | 0 | 0 |
| 15:04 | 0 | 1 | 1 | 2 |
| 15:05 | 2 | 2 | 2 | 0 |
| 15:06 | 0 | 0 | 0 | 1 |
| 15:07 | 1 | 0 | 0 | 0 |
| 15:08 | 0 | 0 | 0 | 0 |
| 15:09 | 0 | 0 | 0 | 0 |
| 15:10 | 0 | 0 | 1 | 1 |
| 15:11 | 0 | 0 | 0 | 0 |
| 15:12 | 0 | 0 | 1 | 1 |
| 15:13 | 3 | 3 | 0 | 0 |
| 15:14 | 0 | 0 | 1 | 1 |
| 15:15 | 1 | 2 | 2 | 3 |
| 15:16 | 0 | 0 | 0 | 0 |
| 15:17 | 0 | 0 | 1 | 1 |
| 15:18 | 1 | 0 | 0 | 0 |
| 15:19 | 0 | 0 | 1 | 2 |
| 15:20 | 2 | 2 | 0 | 0 |
| 15:21 | 0 | 1 | 1 | 1 |
| 15:22 | 2 | 2 | 2 | 1 |
| 15:23 | 0 | 0 | 0 | 0 |
| 15:24 | 0 | 0 | 1 | 2 |
| 15:25 | 2 | 0 | 0 | 0 |
| 15:26 | 0 | 0 | 0 | 0 |
| 15:27 | 0 | 0 | 0 | 0 |
| 15:28 | 0 | 0 | 0 | 0 |

| | | | | |
|-------|---|---|---|---|
| 15:29 | 1 | 1 | 1 | 1 |
| 15:30 | 0 | 0 | 1 | 1 |
| 15:31 | 1 | 1 | 2 | 2 |
| 15:32 | 0 | 0 | 0 | 0 |
| 15:33 | 0 | 0 | 1 | 1 |
| 15:34 | 2 | 4 | 4 | 1 |
| 15:35 | 0 | 0 | 0 | 0 |
| 15:36 | 0 | 0 | 0 | 0 |
| 15:37 | 1 | 1 | 1 | 1 |
| 15:38 | 2 | 2 | 2 | 4 |
| 15:39 | 5 | 1 | 1 | 0 |
| 15:40 | 0 | 0 | 0 | 0 |
| 15:41 | 1 | 2 | 2 | 1 |
| 15:42 | 0 | 0 | 0 | 1 |
| 15:43 | 1 | 1 | 1 | 2 |
| 15:44 | 1 | 0 | 0 | 2 |
| 15:45 | 2 | 2 | 2 | 2 |
| 15:46 | 2 | 2 | 2 | 0 |
| 15:47 | 0 | 0 | 0 | 1 |
| 15:48 | 1 | 1 | 1 | 0 |
| 15:49 | 0 | 0 | 0 | 0 |
| 15:50 | 0 | 0 | 0 | 1 |
| 15:51 | 1 | 0 | 0 | 0 |
| 15:52 | 0 | 0 | 0 | 0 |
| 15:53 | 0 | 0 | 0 | 0 |
| 15:54 | 0 | 0 | 0 | 0 |
| 15:55 | 0 | 0 | 0 | 0 |
| 15:56 | 0 | 0 | 0 | 0 |
| 15:57 | 0 | 0 | 0 | 0 |
| 15:58 | 0 | 0 | 0 | 0 |
| 15:59 | 0 | 0 | 0 | 0 |

| TIME | Route 81 Left - Through | | | | 15:29 | 0 | 2 | 2 | 3 |
|-------|-------------------------|----|----|----|-------|----|----|----|----|
| | 0 | 15 | 30 | 45 | | | | | |
| 15:00 | 0 | 0 | 0 | 1 | 15:30 | 7 | 9 | 9 | 10 |
| 15:01 | 2 | 1 | 2 | 4 | 15:31 | 5 | 0 | 1 | 2 |
| 15:02 | 2 | 2 | 3 | 5 | 15:32 | 3 | 4 | 5 | 5 |
| 15:03 | 5 | 6 | 6 | 6 | 15:33 | 6 | 7 | 1 | 0 |
| 15:04 | 3 | 0 | 0 | 0 | 15:34 | 1 | 0 | 1 | 3 |
| 15:05 | 0 | 1 | 2 | 2 | 15:35 | 3 | 5 | 6 | 2 |
| 15:06 | 3 | 0 | 0 | 1 | 15:36 | 2 | 0 | 0 | 1 |
| 15:07 | 4 | 4 | 4 | 9 | 15:37 | 2 | 5 | 6 | 6 |
| 15:08 | 9 | 9 | 10 | 10 | 15:38 | 6 | 6 | 3 | 0 |
| 15:09 | 4 | 0 | 0 | 2 | 15:39 | 1 | 2 | 2 | 2 |
| 15:10 | 2 | 5 | 5 | 5 | 15:40 | 4 | 7 | 7 | 5 |
| 15:11 | 6 | 7 | 3 | 0 | 15:41 | 1 | 2 | 3 | 3 |
| 15:12 | 0 | 1 | 1 | 1 | 15:42 | 4 | 7 | 8 | 10 |
| 15:13 | 0 | 0 | 0 | 0 | 15:43 | 7 | 6 | 0 | 1 |
| 15:14 | 1 | 0 | 1 | 0 | 15:44 | 3 | 4 | 5 | 8 |
| 15:15 | 0 | 0 | 1 | 1 | 15:45 | 9 | 4 | 2 | 0 |
| 15:16 | 1 | 2 | 3 | 0 | 15:46 | 1 | 1 | 2 | 6 |
| 15:17 | 1 | 0 | 0 | 0 | 15:47 | 7 | 7 | 10 | 10 |
| 15:18 | 1 | 1 | 2 | 4 | 15:48 | 8 | 7 | 7 | 2 |
| 15:19 | 0 | 0 | 0 | 0 | 15:49 | 4 | 5 | 6 | 8 |
| 15:20 | 3 | 3 | 3 | 4 | 15:50 | 10 | 12 | 8 | 6 |
| 15:21 | 4 | 6 | 3 | 0 | 15:51 | 0 | 0 | 2 | 6 |
| 15:22 | 0 | 2 | 2 | 4 | 15:52 | 8 | 8 | 9 | 5 |
| 15:23 | 5 | 6 | 7 | 7 | 15:53 | 0 | 0 | 0 | 1 |
| 15:24 | 4 | 0 | 0 | 3 | 15:54 | 4 | 5 | 7 | 7 |
| 15:25 | 5 | 5 | 3 | 2 | 15:55 | 0 | 0 | 1 | 4 |
| 15:26 | 3 | 0 | 1 | 3 | 15:56 | 6 | 8 | 9 | 9 |
| 15:27 | 4 | 4 | 5 | 6 | 15:57 | 9 | 10 | 6 | 3 |
| 15:28 | 6 | 2 | 0 | 0 | 15:58 | 2 | 0 | 2 | 3 |
| | | | | | 15:59 | 4 | 8 | 9 | 9 |

| TIME | Route 81 Right | | | | 15:29 | 2 | 2 | 2 | 2 |
|-------|----------------|----|----|----|-------|---|---|---|---|
| | 0 | 15 | 30 | 45 | | | | | |
| 15:00 | 1 | 1 | 1 | 2 | 15:30 | 2 | 0 | 0 | 1 |
| 15:01 | 2 | 2 | 0 | 0 | 15:31 | 3 | 3 | 4 | 5 |
| 15:02 | 0 | 0 | 1 | 1 | 15:32 | 5 | 5 | 5 | 2 |
| 15:03 | 1 | 1 | 2 | 0 | 15:33 | 0 | 0 | 1 | 2 |
| 15:04 | 0 | 0 | 0 | 0 | 15:34 | 2 | 4 | 4 | 5 |
| 15:05 | 0 | 0 | 0 | 0 | 15:35 | 6 | 7 | 0 | 0 |
| 15:06 | 0 | 0 | 0 | 0 | 15:36 | 1 | 1 | 1 | 1 |
| 15:07 | 0 | 0 | 0 | 0 | 15:37 | 1 | 2 | 2 | 2 |
| 15:08 | 0 | 0 | 0 | 0 | 15:38 | 0 | 0 | 1 | 1 |
| 15:09 | 0 | 0 | 0 | 0 | 15:39 | 2 | 2 | 2 | 2 |
| 15:10 | 0 | 0 | 0 | 0 | 15:40 | 5 | 2 | 0 | 1 |
| 15:11 | 0 | 1 | 1 | 1 | 15:41 | 2 | 2 | 2 | 2 |
| 15:12 | 2 | 2 | 2 | 2 | 15:42 | 2 | 3 | 4 | 0 |
| 15:13 | 2 | 2 | 0 | 0 | 15:43 | 0 | 0 | 1 | 1 |
| 15:14 | 0 | 0 | 1 | 2 | 15:44 | 2 | 2 | 3 | 3 |
| 15:15 | 2 | 2 | 2 | 0 | 15:45 | 0 | 0 | 0 | 1 |
| 15:16 | 0 | 0 | 0 | 0 | 15:46 | 0 | 1 | 1 | 2 |
| 15:17 | 0 | 0 | 0 | 0 | 15:47 | 2 | 2 | 0 | 0 |
| 15:18 | 0 | 0 | 0 | 0 | 15:48 | 1 | 1 | 1 | 2 |
| 15:19 | 0 | 0 | 0 | 0 | 15:49 | 2 | 2 | 3 | 3 |
| 15:20 | 1 | 1 | 2 | 2 | 15:50 | 0 | 0 | 0 | 1 |
| 15:21 | 0 | 0 | 0 | 0 | 15:51 | 2 | 2 | 2 | 4 |
| 15:22 | 0 | 0 | 0 | 0 | 15:52 | 4 | 4 | 0 | 0 |
| 15:23 | 0 | 0 | 1 | 1 | 15:53 | 1 | 2 | 3 | 4 |
| 15:24 | 1 | 1 | 2 | 2 | 15:54 | 4 | 4 | 5 | 0 |
| 15:25 | 2 | 0 | 0 | 0 | 15:55 | 0 | 1 | 1 | 1 |
| 15:26 | 0 | 2 | 2 | 3 | 15:56 | 1 | 2 | 3 | 5 |
| 15:27 | 3 | 3 | 3 | 0 | 15:57 | 5 | 0 | 0 | 0 |
| 15:28 | 1 | 1 | 1 | 2 | 15:58 | 0 | 0 | 1 | 2 |
| | | | | | 15:59 | 2 | 2 | 2 | 3 |

Maximum queues observed and queues from simulation programs.

| | MAXIMUM QUEUE OBSERVED (Same day) | AASIDRA QUEUE 95TH | SYNCHRO QUEUE 95TH |
|------------------------------|--|--------------------------|--------------------------|
| ROUTE 70 W RIGHT | 10 | 10.4 | 9.45 |
| ROUTE 70 E RIGHT | 5 | 4.2 | 4.1 |
| ROUTE 81 LEFT AND THROUGH | 12* | 25.0 | 18.0 |
| ROUTE 81 RIGHT | 7 | 7.5 | 4.8 |

*Higher queues have been observed other days

Estimated delays based in traffic counts+

| | AASIDRA DELAY | SYNCHRO DELAY | COMPUTED DELAY |
|------------------------------|------------------|------------------|-------------------|
| ROUTE 70 E RIGHT | 67.6 | 59.4 | 55.4 |
| ROUTE 70 W RIGHT | 64.4 | 56.5 | 63.8 |
| ROUTE 81 LEFT AND THROUGH | N/A | N/A | N/A |
| ROUTE 81 RIGHT | 61.3 | 53.8 | 63.5 |

+ Traffic count to estimate delays performed in a different day after original traffic count

$$d = \frac{\sum D * 15}{q}$$

Where,

D = Σ vehicles in queue

q = traffic flow during peak hour