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# Miami Urban Partnership Agreement (UPA) Pines Boulevard Transit Signal Priority Evaluation Report

SEPTEMBER 2011

FTA Report No. 0002
Federal Transit Administration

**PREPARED BY**
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U.S. Department of Transportation
**Federal Transit Administration**

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# Metric Conversion Table

| SYMBOL | WHEN YOU KNOW | MULTIPLY BY | TO FIND | SYMBOL |
|---|---|---|---|---|
| **LENGTH** | | | | |
| **in** | inches | 25.4 | millimeters | mm |
| **ft** | feet | 0.305 | meters | m |
| **yd** | yards | 0.914 | meters | m |
| **mi** | miles | 1.61 | kilometers | km |
| **VOLUME** | | | | |
| **fl oz** | fluid ounces | 29.57 | milliliters | mL |
| **gal** | gallons | 3.785 | liters | L |
| **$ft^3$** | cubic feet | 0.028 | cubic meters | $m^3$ |
| **$yd^3$** | cubic yards | 0.765 | cubic meters | $m^3$ |
| NOTE: volumes greater than 1000 L shall be shown in $m^3$ | | | | |
| **MASS** | | | | |
| **oz** | ounces | 28.35 | grams | g |
| **lb** | pounds | 0.454 | kilograms | kg |
| **T** | short tons (2000 lb) | 0.907 | megagrams (or "metric ton") | Mg (or "t") |
| **TEMPERATURE (exact degrees)** | | | | |
| **$^oF$** | Fahrenheit | 5 (F-32)/9 or (F-32)/1.8 | Celsius | $^oC$ |

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13. ABSTRACT

The Miami Urban Partnership Agreement included the conversion of high occupancy vehicle (HOV) lanes on I-95 to high occupancy toll (HOT) lanes and additional express bus service. It also included funding for the installation of transit signal prioritization (TSP) at 50 intersections on Pines/Hollywood and Broward Boulevards in Broward County. This report summarizes the findings of TSP data collection on Pines/Hollywood Blvd. from December 2010 to February 2011. The data showed an average time savings of 4 minutes in the AM peak period due to TSP, which amounted to a 12 percent reduction in travel times. On-time performance improved from 66.7 percent to 75 percent. In the PM peak period, the travel time and signal delay were similar with or without the TSP activated. This could be an indication that afternoon traffic volumes on westbound Pines/Hollywood Blvd. are so heavy that TSP is of only marginal benefit.

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# ABSTRACT

The Miami Urban Partnership Agreement included the conversion of high occupancy vehicle (HOV) lanes on I-95 to high occupancy toll (HOT) lanes and additional express bus service. It also included funding for the installation of transit signal prioritization (TSP) at 50 intersections on Pines/Hollywood and Broward Boulevards in Broward County. This report summarizes the findings of TSP data collection on Pines/Hollywood Blvd. from December 2010 to February 2011. The data showed an average time savings of 4 minutes in the AM peak period due to TSP, which amounted to a 12 percent reduction in travel times. On-time performance improved from 66.7 percent to 75 percent. In the PM peak period, the travel time and signal delay were similar with or without the TSP activated. This could be an indication that afternoon traffic volumes on westbound Pines/Hollywood Blvd. are so heavy that TSP is of only marginal benefit.

SECTION

1

# Introduction

## Background

Miami was one of six cities that were awarded funding from the United States Department of Transportation (USDOT) through the Urban Partnership Agreement/Congestion Reduction Demonstration (UPA/CRD) Program. USDOT sought applications from cities with congestion reduction programs that relied on what were called the 4T's: Tolling, Transit, Technology, and Telecommuting. The other cities that were awarded funds in addition to Miami included Atlanta, Los Angeles, Minneapolis, San Francisco, and Seattle.

The Miami Urban Partnership Agreement is being implemented by the Florida Department of Transportation (FDOT) and is supported by Florida's Turnpike Enterprise, Miami-Dade Transit (MDT), Broward County Transit (BCT), and South Florida Commuter Services (SFCS). The goal is to alleviate traffic congestion on the I-95 corridor between I-595 in Broward County and I-395 in Miami-Dade County. The project involved replacing high occupancy vehicle (HOV) lanes on a segment of I-95 with "95 Express Lanes" based on a high occupancy toll (HOT) lane concept and augmenting it with enhanced transit and travel demand management services.

An element of the Miami UPA was the installation of transit signal priority (TSP) at 50 intersections on SR 820 (Pines/Hollywood Blvd.) and SR 842 (Broward Blvd.) in Broward County. Both of these roads are east west arterials on which the 95 Express buses operate on their way to and from Interstate 95. This report summarizes the results of TSP data collection from December 2010 to February 2011 on Pines/Hollywood Blvd. Its purpose is to evaluate the impacts of TSP on transit travel times.

Both manual and automated data were collected for the evaluation. Automated passenger counter (APC) data were collected for all three months to determine average travel times. Manual data were collected for two weeks in December 2010 by SFCS staff who rode the buses and recorded the various components of travel time delay (e.g., dwell time, turn-out delay, signal delay, right-turn delay). During one week in December, the TSP was deactivated to determine baseline conditions.

# Evaluation Roles and Responsibilities

The National Bus Rapid Transit Institute (NBRTI) at the University of South Florida's Center for Urban Transportation Research (CUTR) is responsible for the evaluation of the transit elements of the Miami UPA project, with FDOT responsible for the other aspects of the evaluation. General NBRTI responsibilities are defined as follows:

- Provide technical assistance to Miami UPA local partners by providing input on the development of and review and comment on evaluation materials such as the evaluation plan, test plans, and surveys as applicable.
- Analyze data collected by local partners.
- Develop and submit transit evaluation reports to the Federal Transit Administration (FTA) and National UPA Evaluator (Battelle Memorial Institute), and assist FDOT with the transit-related sections of their evaluation reports.

# Transit Evaluation Objectives

A transit evaluation plan was developed for FTA to guide the transit evaluation process. A summary of this is provided as a matrix in Appendix C[1]. The TSP report focuses specifically on the TSP measures that were installed on Pines/Hollywood Blvd. (SR 820). The findings of the larger Miami UPA transit evaluation can be found in the Phase 1A and Phase 1 Transit Evaluation Reports.

[1] Some indicators shown in the Transit Evaluation Matrix have not been assessed within this report:
* Operating cost/farebox data are not available at the corridor level
* Safety data are not available at the corridor level
* ADA Compliance has not been assessed due to no infrastructure changes related to the project

SECTION

2

# Project Description

## Geographic Location

Pines/Hollywood Blvd. is located in Broward County approximately 2.6 miles north of the county line with Miami-Dade County. It is an east west arterial with seven lanes (three lanes eastbound, three lanes westbound, and a two-way left-turn lane). To the west of SW 72nd Ave. the roadway is called Pines Blvd. To the east of SW 72nd Ave. it is called Hollywood Blvd. A total of 24 intersections are equipped with TSP. Figure 2-1 shows the general limits of the TSP and the route of the Pines Blvd. Express Bus. Figure 2-2 shows the specific intersections where TSP is installed.

The only intersections not TSP-equipped are at the Florida Turnpike, U.S. 441, 52nd Ave., and the I-95 northbound off-ramp (not shown). U.S. 441 is not equipped with TSP because it is a major north/south arterial. The Turnpike intersection is not equipped with TSP because there was construction going on at the time of TSP installation. The northbound off-ramp from I-95 is not equipped with TSP because of its proximity to the Hollywood Tri-Rail Station. There are approximately 65 rail preemptions at this location per day. Also, Academy Circle is not equipped with TSP because it is a traffic circle with no traffic signals.

## TSP Equipment Details

The GPS-based signal preemption equipment at these intersections was installed previously under a countywide emergency signal preemption program and always had been capable of providing TSP. To complete the TSP system, in-vehicle equipment was installed on the buses, and an upgrade of the central traffic signal control platform and field controller firmware was made.

The TSP equipment used on Pines/Hollywood Blvd. is manufactured by Opticom and offers both extended green and early green (red truncation) signal priority.

GPS equipment on the buses determines location, speed, and heading of the bus. That information, along with the priority request, is transmitted via radio from the bus to the intersection equipment. The Opticom GPS intersection equipment reads the transmission and compares it to the parameters stored in memory to decide whether to grant the request.

**Figure 2-1**

*Pines/Hollywood Blvd. TSP Limits*


**Figure 2-2**

*Intersections with TSP*


The initial TSP goal was a 20-second reduction per intersection. During the December test, there was only one TSP restriction in place. The TSP controller would lock out (deny) a transit request for priority if it was within a 15-minute window of the last request that had been granted. That restriction is still in place.

Although more than one bus route operates on Pines Blvd., the only buses that could request priority were the 95 Express buses.

# Pines Blvd. Express Bus

The Pines Blvd. Express Bus is a peak period, peak direction service operated by BCT. It is one of five routes that make up the overall 95 Express Bus Service. It provides service between the C.B. Smith park-and-ride lot, located at the intersection of Pines Blvd. and Flamingo Rd. and downtown Miami. The bus makes intermediate stops at University Dr., U.S. 441, the Hollywood Tri-Rail Station and (at the time of the data collection) the Golden Glades park-and-ride lot. Since then, it no longer stops at the Golden Glades lot. The bus runs every 30 minutes during weekday rush hours.

SECTION

3

# Methodology

The general approach used in the evaluation was a "with and without" comparison. For one week in December 2010 (the week of December 6), the TSP was deactivated to measure baseline conditions. The following week, TSP was reactivated. The time frame of the evaluation was from December 2010 to February 2011. All data were collected on Tuesdays, Wednesdays, and Thursdays. Mondays and Fridays were deliberately excluded because of the different traffic patterns and volumes typically associated with these days. School was in session for all days of data collection.

Both manual and automated data were collected. APC data were collected from December 2010 to February 2011 to determine average travel times. Manual data were collected for two weeks in December 2010 to measure the components of delay. The manual data were only collected for two weeks instead of the full three months because of the labor intensity involved. SFCS staff rode the buses and recorded the various components of delay (e.g., dwell time, turn-out delay, signal delay, right turn delay). On December 7, 8, and 9, they rode the buses while the TSP was deactivated. On December 14, 15, and 16, they rode the buses again after the TSP had been reactivated.

The Pines Blvd. Express Bus runs every 30 minutes. Because the evaluation was focused on the peak periods and peak directions, data were collected for the scheduled departures shown in Table 3-1.

**Table 3-1**

*Trips Included in the Evaluation*

| AM | PM |
|---|---|
| Scheduled Departure C.B. Smith Park-and-Ride | Scheduled Departure Golden Glades Park-and-Ride |
| 7:00 AM | 4:38 PM |
| 7:30 AM | 5:08 PM |
| 8:00 AM | 5:38 PM |
| 8:30 AM | 6:08 PM |

In the morning, the Pines Blvd. Express begins its runs in the direction opposite of what it needs to travel and takes a detour. The bus leaves the C.B. Smith park-and-ride lot and travels westbound on Pines Blvd. until it gets to 129th Ave. At 129th Ave., it turns left and makes a turnaround through a strip mall parking lot so as to head east on Pines Blvd. This detour is shown in Figure 3-1.

Morning data were collected from the time the bus departed the C.B. Smith park-and-ride lot until it reached the intersection of Hollywood Blvd. and Calle Largo Dr. This is the last bus stop before the bus gets on I-95 South. The distance from the C.B. Smith park-and-ride lot (including the detour at 129th Ave.) to Hollywood Blvd. and Calle Largo Dr. is approximately 10 miles.

**Figure 3-1**

*Morning Detour for Pines Blvd. Express*


Afternoon data were collected between the Golden Glades park-and-ride lot and the C.B. Smith park-and-ride lot, a distance of approximately 16.5 miles. The reason for starting at Golden Glades in the afternoon was so that the signal delay at the northbound off-ramp from I-95 to Hollywood Blvd. could be measured. This off-ramp is located near the Hollywood Tri-Rail station and does not have TSP because of its proximity to the station. The only way to include the I-95 off-ramp in the evaluation was to have the data collectors board the bus at the Golden Glades lot. Because the PM test segment is longer than the AM test segment, the PM travel times are longer as well. Therefore, only AM to AM and PM to PM comparisons can be made. Figure 3-2 shows the morning and afternoon test segments.

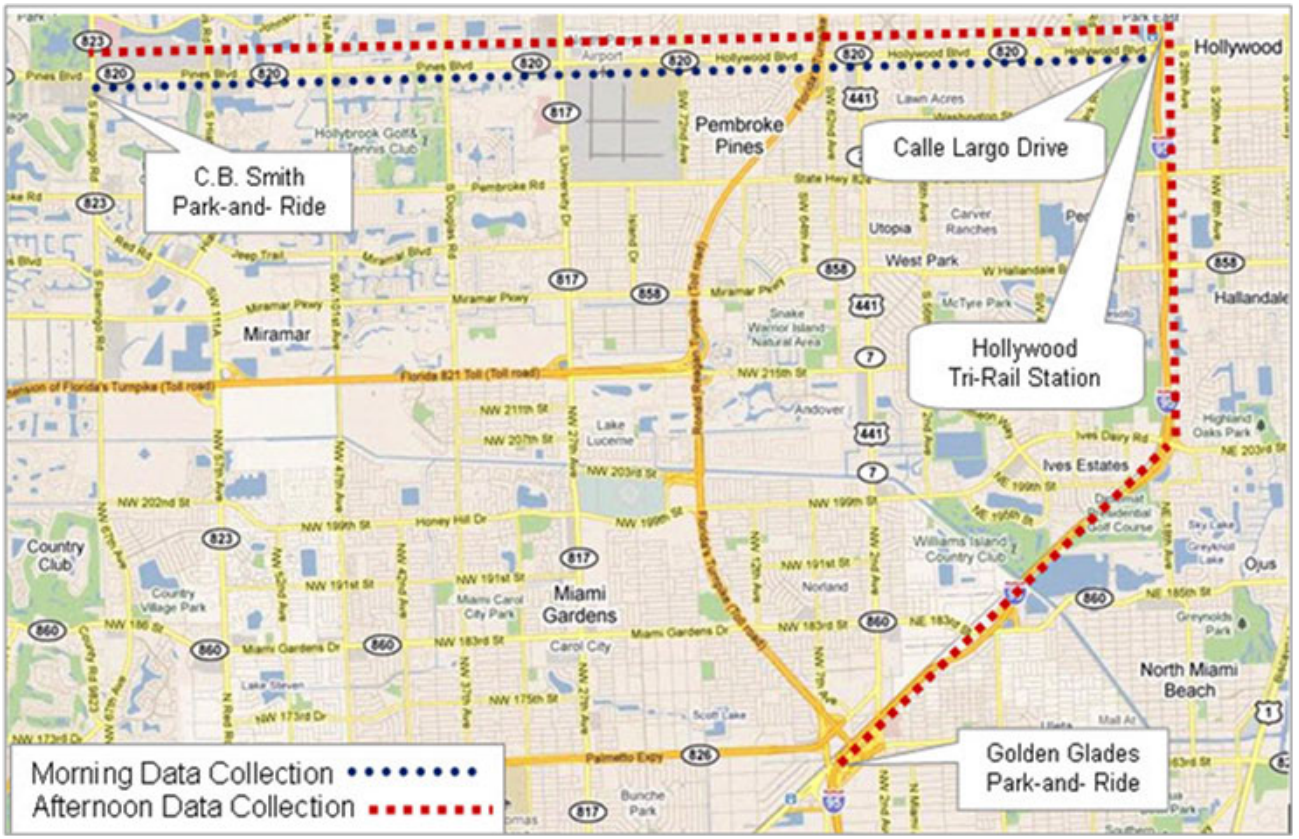
Data were collected both manually and automatically. The manual data were collected by staff from SFCS. Automatic data were compiled via the bus's APC system.

## Manual Data Collection

Staff from SFCS rode the buses on December 7, 8, and 9 when the TSP was deactivated, and again on December 14, 15, and 16 when the TSP was reactivated. Each time, they recorded the various components of travel delay, including the amount of time spent at traffic signals. Each data collector was equipped with a stopwatch, a clipboard, and a tracking sheet. After boarding the bus and after the doors closed, the SFCS recorders started their stopwatches and recorded the time of day shown on the bus's interior message display. As the bus crossed over the stop line of each intersection, they recorded the stopwatch time on the tracking sheet. If the bus stopped to pick up or drop off passengers, they recorded when the doors opened and closed. This was the dwell time. A sample of how these data were recorded on the tracking sheet is shown in Figure 5.

**Figure 3-2**

*Morning and Afternoon Test Segments*




On the tracking sheet, the stop watch times were recorded from bottom to top. In the example provided in Figure 3-3, the data collector began at the Golden Glades lot. The stop watch time was 00:00:00. At 00:14:46 (i.e., 14 minutes and 46 seconds into the run), the bus crossed the stop line at the I-95 off ramp to Pines/Hollywood Blvd. At the Hollywood Tri-Rail station, one of the designated bus stops, the doors opened at 00:15:18 and closed at 00:15:32 for a dwell time of 14 seconds. At the end of the run at Flamingo Road, the doors opened at 00:39:59 to end the trip.

**Figure 3-3**

*Sample Tracking Sheet*

Times entered are elapsed times (i.e., stopwatch times)

| Stop/Intersection | Check Point | Doors Open | Doors Close | Dwell Time |
|---|---|---|---|---|
| **Flamingo Rd.** | | 00:39:59 | | |
| 118th Ave. | 00:39:11 | | | |
| 114th Ave. | 00:38:55 | | | |
| Hiatus Rd. | 00:38:33 | | | |
| 107th Ave. | 00:37:00 | | | |
| 101st Ave/Palm Ave. | 00:36:43 | | | |
| 96th Ave. | 00:36:22 | | | |
| 89th Ave. | 00:35:11 | | | |
| 86th Ave. | 00:34:46 | | | |
| 83rd Ave. | 00:34:24 | | | |
| **University Dr.** | 00:33:36 | 00:33:41 | 00:34:18 | 00:37 |
| McArthur Pkwy. | 00:31:44 | | | |
| 72nd Ave. | 00:30:58 | | | |
| 68th Ave. | 00:30:26 | | | |
| 64th Way | 00:29:10 | | | |
| 64th Ave. | 00:28:44 | | | |
| 62nd Ave. | 00:28:26 | | | |
| **US 441** | 00:27:32 | 00:27:44 | 00:28:01 | 00:17 |
| 58th Ave. | 00:24:18 | | | |
| 56th Ave. | 00:23:44 | | | |
| 52nd Ave. | 00:20:11 | | | |
| 46th Ave. | 00:19:32 | | | |
| 35th Ave. | 00:18:01 | | | |
| Park Rd. | 00:17:03 | | | |
| Entrada Dr. | 00:16:10 | | | |
| **Hollywood Tri-Rail** | 00:15:15 | 00:15:18 | 00:15:32 | 00:14 |
| I-95 Off Ramp | 00:14:46 | | | |
| **(Start) Golden Glades** | | | 00:00:00 | |

Another portion of the tracking sheet was set aside for recording the different sources of travel delay. Table 3-2 shows the different delays that were taken into account and how they were defined.

**Table 3-2**

*Delay Codes and Definitions*

| Delay Code | Code Definition |
|---|---|
| S | Signal Delay: STARTS when bus stops at a traffic light or at end of queue. ENDS when bus crosses the stop line. |
| TO | Turn-out Delay: STARTS when door shuts at bus stop. ENDS as the bus moves into travel lane. |
| RT | Right Turn Delay: STARTS when bus comes to stop. ENDS when bus crosses the stop line or the driveway. |
| O | Other Delay (example: non signal delays associated with the turnaround point at 129th Ave.) |

Table 3-3 is a sample of delay data from one of the runs. As seen in Table 3-3, all of the delays were signal delays. The end time for signal delay was defined as the time the bus crossed the intersection stop line. Figure 3-4 shows an example of a stop line on Pines/Hollywood Blvd.

**Table 3-3**

*Sample Delay Data*

| Delay Type | Delay Start | Delay End | Total Delay |
|---|---|---|---|
| S | 0:12:11 | 0:14:46 | 2:35 |
| S | 0:16:30 | 0:17:03 | 0:33 |
| S | 0:20:41 | 0:23:44 | 3:03 |
| S | 0:25:15 | 0:27:32 | 2:17 |
| S | 0:29:54 | 0:30:26 | 0:32 |
| S | 0:32:01 | 0:33:36 | 1:35 |
| S | 0:35:41 | 0:36:22 | 0:41 |
| S | 0:37:19 | 0:38:33 | 1:14 |

Note: Times entered are stopwatch times.

**Figure 3-4**
*Example of a Stop Line*


In Table 3-3, the first signal delay began at 00:12:11 and ended at 00:14:46, a total delay of 2 minutes and 35 seconds. The 00:14:46 delay end time is also the time the bus crossed the stop line at the I-95 off-ramp, as shown in Figure 3-4. Putting these two pieces of information together (time tracking data and delay data), one can determine the locations for all of the signal delays.

The various components of delay then were summarized for each run. An example is shown in Table 3-4. For this particular run, total dwell time was 1 minute and 8 seconds. Total signal delay was 12 minutes and 30 seconds.

**Table 3-4**
*Example Summary of Delays*

| Example Summary of Delays | |
|---|---|
| Dwell Time | 01.08 |
| Signal Delay | 00.52 |
| Turn Out Delay | 00.00 |
| Other Delay | 00.00 |

# Automated Data Collection

Additional data were collected from the APCs. The APCs work in conjunction with a global positioning system (GPS). As a result, BCT is able to compare actual versus scheduled departure times, dwell times, and on/offs of passengers. In this evaluation, the APC data was used to calculate point-to-point travel times. APC data were collected from December 2010 to February 2011.

An example of the APC data is shown in Table 5. These data are taken from the same run that was described in a previous section. The 18:08 time shown under "Scheduled Time" indicates that this was the 18:08 scheduled departure from Golden Glades park and ride lot. It departed (i.e., the doors closed) at 18:10:32. It arrived (i.e., the doors opened) at Pines Blvd. and Flamingo Dr. at 18:50:38. Thus, the total running time from the Golden Glades lot to the end of the line was 40 minutes and 6 seconds.

**Table 3-5**

*Sample APC Data*

| Stop | Actual Time | Scheduled Time |
|---|---|---|
| Miami Downtown Terminal | 17:47:13 | 17:45:00 |
| Miami-Gov Center | 17:54:49 | 17:48:00 |
| Golden Glades Park-n-Ride | 18:10:32 | 18:08:00 |
| Hollywood Blvd./Tyler St. Tri-Rail | 18:25:18 | 18:22:00 |
| Hollywood Blvd./US 441 | 18:33:00 | 18:28:00 |
| Pines Blvd./University Dr. (W) | 18:40:19 | 18:35:00 |
| Pines Blvd./Flamingo Rd. | 18:50:38 | 18:46:00 |
| **Total Travel Time** | **0:40:06** | |

The summary delay data (Table 3-4) that was collected manually by staff from SFCS was then combined with the APC travel time data (Table 3-5) to create a comprehensive picture of that run. This is shown in Table 3-6. The data from the individual runs were then computed into weekly averages (Week 1: TSP Off; Week 2 TSP On).

**Table 3-6**

*Sample Run Summary*

| Sample Run Summary | |
|---|---|
| Total Running Time | 40:06 |
| In Transit Time | 26:28 |
| Dwell Time | 01:08 |
| Signal Delay | 12:30 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

Under ideal circumstances, there would have been 48 samples total over the two week test period (4 morning trips + 4 afternoon trips x 6 test days). However, one of the buses had technical problems with its APC and was not able to transmit data. As a result, there were 27 samples total instead. There were 11 samples during Week 1 (TSP Off) and 16 samples during Week 2 (TSP On).

SECTION

4

# TSP Test Results

When the TSP was activated, there was a 12.1 percent reduction in bus travel times during the AM peak period (7:00 to 9:00 AM). On average, it took 4 minutes less to travel the 10 miles from the C.B. Smith park-and-ride lot to Calle Largo Dr. In the PM peak period (4:30 to 6:00 PM), the travel times were similar with or without the TSP activated. This could be an indicator that afternoon traffic volumes are so heavy that TSP is only of marginal benefit. Table 4-1 compares the travel times derived from APC data in December, January, and February. All of the dates shown are a Tuesday, Wednesday, or Thursday. School was in session on all of these days.

Of note is a 10-minute difference between the AM and PM travel times. The reason is because different end points were used. For the PM time period, FDOT wanted to know the amount of signal delay at the I-95 northbound off-ramp to Pines/Hollywood Blvd. The signalized intersection at the end of this off-ramp is adjacent to the Hollywood Tri-Rail station. To capture this information, data collectors from SFCS had to board the bus further south at the Golden Glades lot. That accounts for the longer travel times.

**Table 4-1**

*Travel Time Comparison*

| | TSP OFF | TSP ON | TSP ON | TSP ON | %Change* |
|---|---|---|---|---|---|
| | (Baseline) Dec. 7, 8, 9 | Dec. 14, 15, 16 | Jan. 4, 5, 6 | Feb. 1, 2, 3 | |
| AM | 33:39:00 | 28:29:00 | 30:16:00 | 30:02:00 | -12.10% |
| PM | 42:21:00 | 41:22:00 | 42:08:00 | n/a | -1.40% |

*Percentage change was calculated using the average of the December, January, and February travel times with the TSP on.

For the AM peak period, on-time performance improved from 66.7 to 75.0 percent after the TSP was activated. However, there was a drop in on-time performance in February, which was due to changes made in the route schedule (see Table 4-2). During December and January, the buses were given 29 minutes to travel from the C.B. Smith park-and-ride lot to Calle Largo Dr., the last stop before getting onto I-95. In February, the schedule was changed, and the allotted time was reduced to 28 minutes. BCT adjusted the schedule again in May. The 7:00, 7:30, and 8:40 AM buses are still allotted 28 minutes to make the trip, but the 8:05 AM bus now is given 30 minutes.

**Table 4-2**

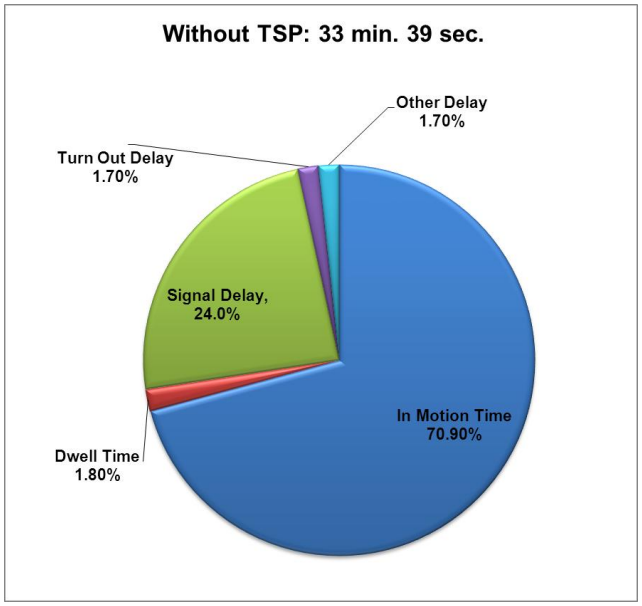
*On-Time Performance Comparison (AM)*

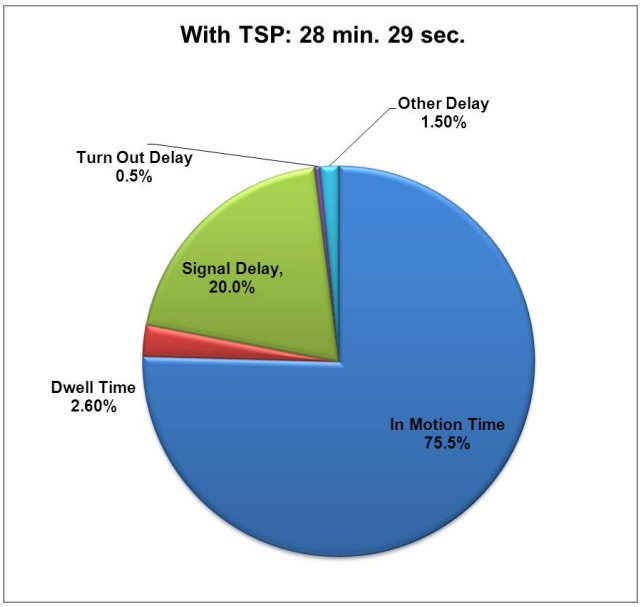
| TSP OFF | TSP ON | TSP ON | TSP ON |
|---|---|---|---|
| (Baseline) Dec. 7, 8, 9 | Dec. 14, 15, 16 | Jan. 4, 5, 6 | Feb. 1, 2, 3 |
| 66.7% | 75.0% | 75.0% | 58.3% |

The average percent of travel time spent stopped at traffic signals dropped 4 points in the AM period with the TSP activated, from 24 to 20 percent. For the PM period, the decrease was insignificant (see Figures 7 and 8.)

**Figure 4-1**

*Components of Delay (AM)*



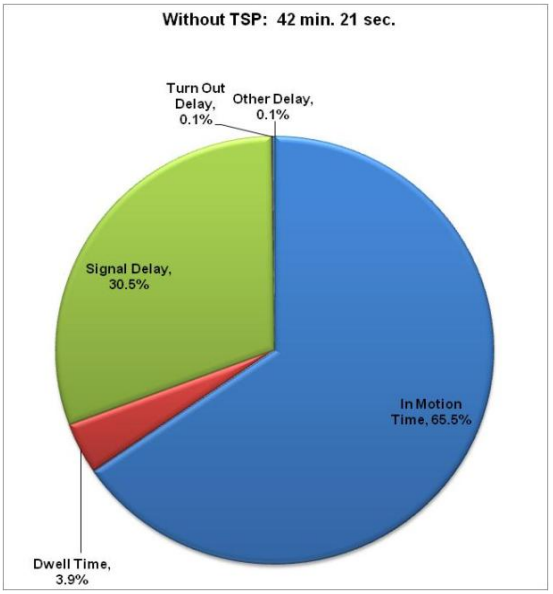

| Component | Time (mm:ss) | Percent* |
|---|---|---|
| **In Motion Time** | 23:51 | 70.9% |
| **Dwell Time** | 00:35 | 1.8% |
| **Signal Delay** | 08:05 | 24.0% |
| **Turn Out Delay** | 00:33 | 1.7% |
| **Other Delay** | 00:34 | 1.7% |
| **Total Travel Time** | 33:39 | 100.0% |

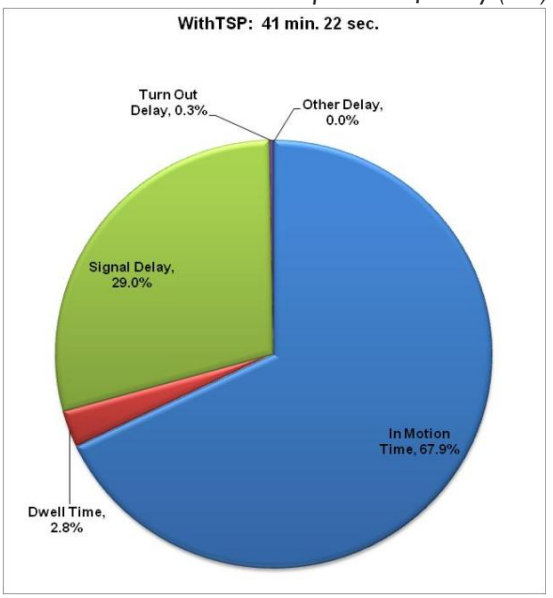
*Totals may not add to 100% due to rounding

| Component | Time (mm:ss) | Percent* |
|---|---|---|
| **In Motion Time** | 21:29 | 75.5% |
| **Dwell Time** | 00:44 | 2.6% |
| **Signal Delay** | 05:41 | 20.0% |
| **Turn Out Delay** | 00:08 | 0.5% |
| **Other Delay** | 00:26 | 1.5% |
| **Total Travel Time** | 28:29 | 100.0% |

## Figure 4-2

*Components of Delay (PM)*




| Component | Time (mm:ss) | Percent * |
|---|---|---|
| **In Motion Time** | 27:44 | 65.5% |
| **Dwell Time** | 01:38 | 3.9% |
| **Signal Delay** | 12:54 | 30.5% |
| **Turn Out Delay** | 00:01 | 0.1% |
| **Other Delay** | 00:03 | 0.1% |
| **Total Travel Time** | 42:21 | 100.0% |

*Totals may not add to 100% due to rounding

| Component | Time (mm:ss) | Percent* |
|---|---|---|
| **In Motion Time** | 28:05 | 67.9% |
| **Dwell Time** | 01:10 | 2.8% |
| **Signal Delay** | 12:01 | 29.0% |
| **Turn Out Delay** | 00:06 | 0.3% |
| **Other Delay** | 00:00 | 0.0% |
| **Total Travel Time** | 41:22 | 100.0% |

Figures 4-3 and 4-4 show the average signal delay by intersection. In general, almost every intersection that experienced delay with the TSP deactivated (shown in red) had less delay when the TSP was activated (shown in green). In the AM period, the intersection that benefitted most from the TSP was 129th Ave. This intersection is part of a detour for the morning buses. Although the morning buses travel eastbound on Pines Blvd. to I-95., initially they must travel westbound to 129th Ave., make a left turn, and then detour through a strip mall. The reason is because the starting point of the route, the C.B. Smith park-and-ride lot, is located on the north side of Pines Blvd., which is westbound. Figure 3-1 in the report graphically shows the detour. Average signal delay at 129th Avenue was reduced from 1 minute 37 seconds to 54 seconds.

Another intersection that showed a large drop in signal delay was the U.S. 441 intersection. Ironically, this intersection is not equipped with TSP. Nevertheless, average signal delay at the U.S. 441 intersection improved dramatically in both the a.m. and p.m. periods. For the a.m., it dropped from 1 minute 28 seconds to 6 seconds. For the p.m., it dropped from 3 minutes 20 seconds to 1 minute 7 seconds. A possible explanation for the improvement is that the TSP was part of a

larger county effort to synchronize the signals and improve overall traffic flow on Pines/Hollywood Blvd.

**Figure 4-3**

*Average Signal Delay by Intersection (AM)*

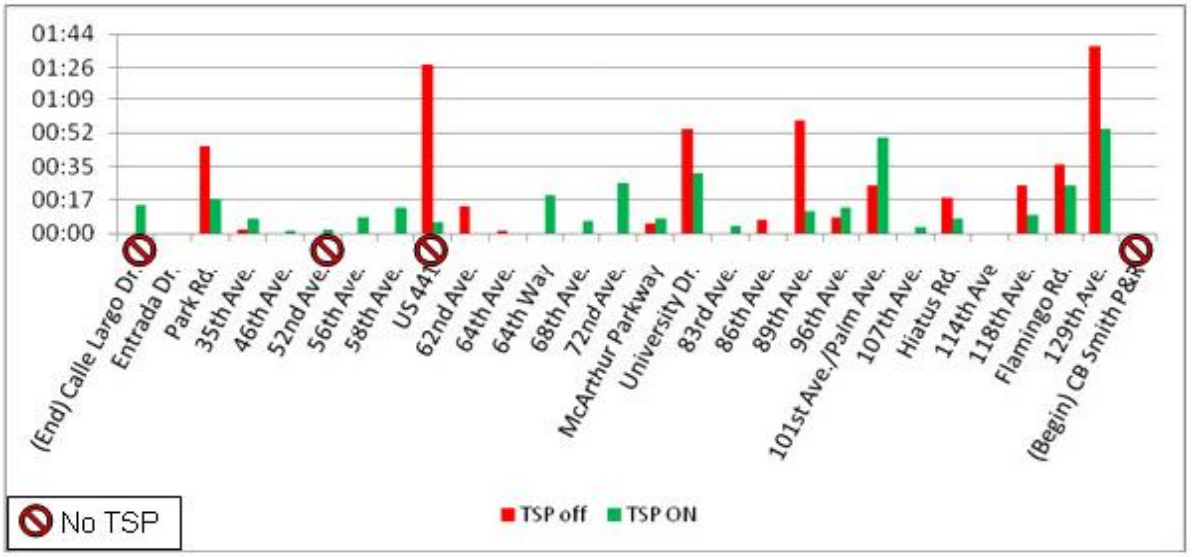
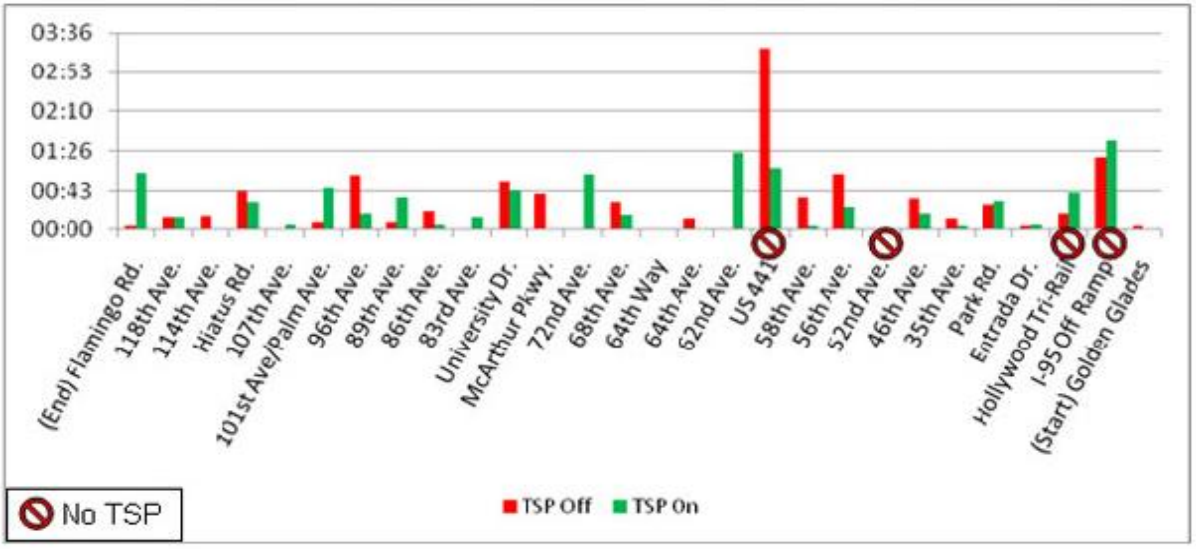



**Figure 4-4**

*Average Signal Delay by Intersection (PM)*




As stated earlier, FDOT was interested in knowing the amount of signal delay at the northbound off-ramp from I-95. According to Broward County staff, this intersection is not equipped with TSP because of its proximity to the Hollywood Tri-Rail Station. Furthermore if the crossing gate across Pines/Hollywood Blvd. is down, the traffic signal at the ramp intersection will stay red. This occurs both when a train is approaching the station and when it is stopped at the station

loading and offloading passengers. During Week 1, it had the second highest amount of signal delay (1 minute 19 seconds), and during Week 2, it had the highest amount of signal delay (1 minute 38 seconds).

SECTION

5

# Conclusions

TSP on Pines/Hollywood Blvd. has resulted in a 4 percent reduction in signal delay and an average travel time savings of 4 minutes in the AM peak period eastbound. These time savings are in line with another successful TSP project, the Fordham Rd. Route Bx12 operated by New York City Transit. In June 2008, New York City Transit unveiled what it called Select Bus Service (SBS), and the premier route was the Bx12 on Fordham Rd. in the Bronx. The Route Bx12 includes extra time saving features besides TSP, which the Pines Blvd. Express does not have--bus only lanes, bus queue jumps, and off-board fare collection. As would be expected, the overall time savings for the Route Bx12 were greater (11 minutes, 10 seconds). However, the percentage reduction in signal delay was about the same. The Route Bx12 experienced a 4.8 percent reduction in signal delay while the Pines Blvd. Express Bus experienced a 4.0 percent reduction. This is shown in Figure 5-1 and Figure 5-2.

In this light, the TSP on Pines/Hollywood Blvd. should be seen as a success. The main hindrance to better time savings for the Pines Blvd. Express Bus appears to be the detour at 129th Ave. Even with TSP at 129th Ave., the detour adds 6 to 8 minutes of travel time to the route.

**Figure 5-1**

*Pines Blvd. Express Before and After TSP Implementation (AM)*

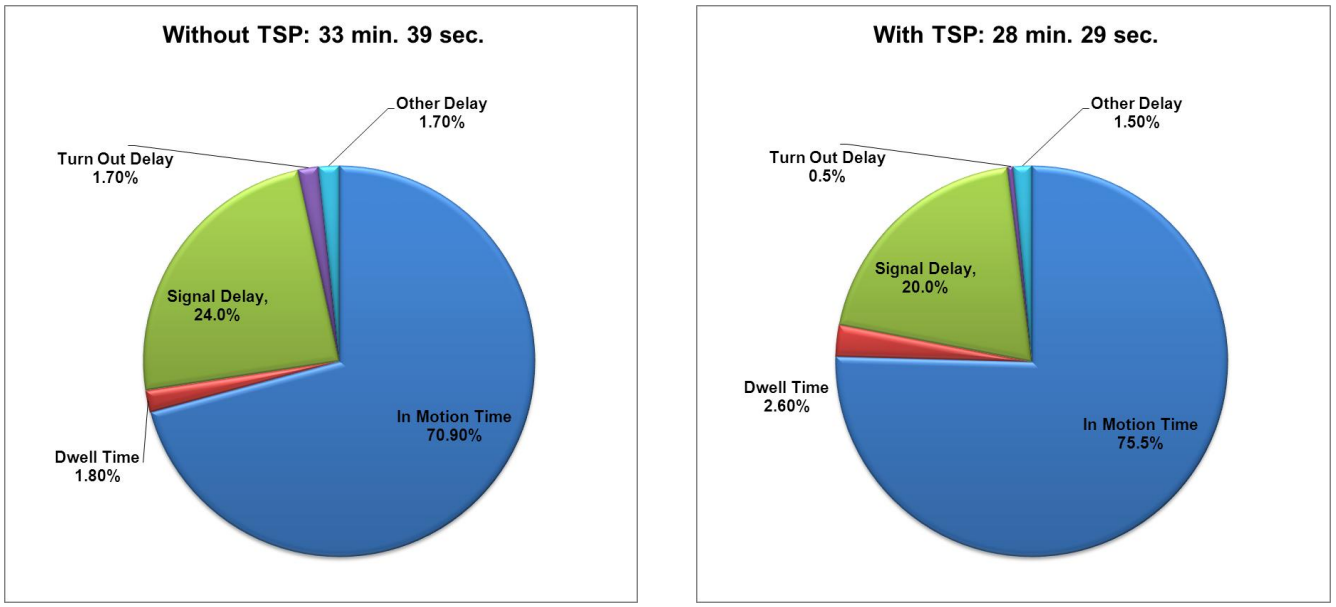
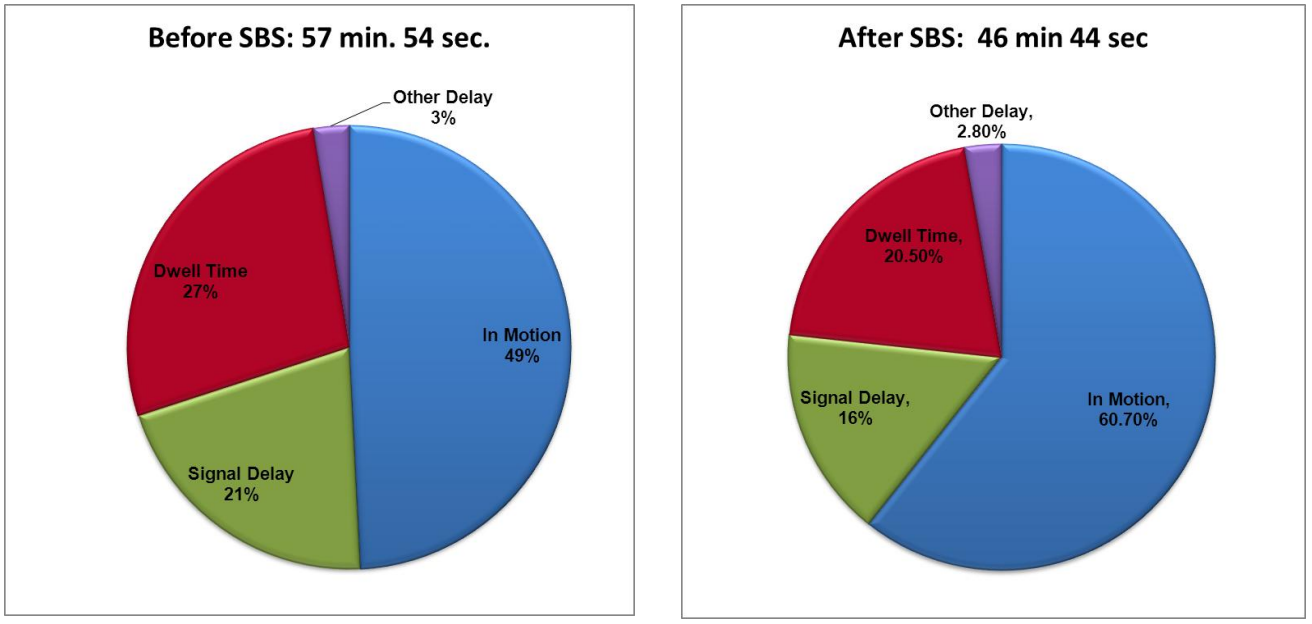



**Figure 5-2**

*NYC Transit Route Bx12 Before and After SBS Implementation (AM).*



APPENDIX

A

# Raw Data (AM)

The tables on the following pages are taken from two sources. The tables on the left side of the page are the APC data. The tables on the right are derived from the manual data collected by SFCS. Specifically, the SFCS data includes the dwell time, signal delay time, turn out delay time, and other delay time. The total delay time reported by SFCS then was subtracted from the APC travel time to calculate the in motion time.

For example, consider the 7:30 a.m. run for December 7 on the next page. According to the APC, the travel time from the intersection of Pines Blvd. and Flamingo Rd. to the intersection of Hollywood Blvd. and Calle Largo Dr. was 36 minutes and 12 seconds. According to the delay data collected by SFCS staff on that run, total delay was 14 minutes and 9 seconds. Subtracting total delay from total travel time yields a total in motion time of 22 minutes and 3 seconds.

**Dec. 7**

**7:30 AM run**

**Vehicle: 0905 Route: 107-South-9 Date: 2010-12-07(Tue) Block: 107-05_muwtf Trip: 107-05_muwtf_55288_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:33:18 | 7:30:00 | PINES B/FLAMINGO R |
| 7:40:43 | 7:33:18 | PINES BLVD & FLAMINGO RD |
| 7:52:21 | 7:44:00 | PINES B/UNIVERSITY D (E) |
| 8:01:38 | 7:52:00 | HOLLYWOOD B/US 441 (E) |
| 8:09:30 | 7:59:00 | HOLLYWOOD B/CALLE LARGO |
| 8:19:55 | 8:12:00 | GOLDEN GLADES Park & Ride |
| 8:47:45 | 8:32:00 | Miami-Gov Center |
| 8:51:29 | 8:35:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:36:12 |
| In Motion Time | 0:22:03 |
| Dwell Time | 00:35 |
| Signal Delay | 11:18 |
| Turn Out Delay | 01:29 |
| Other Delay | 00:47 |

0:36:12 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 8**

**7:30 AM run**

**Vehicle: 0905 Route: 107-South-9 Date: 2010-12-08(Wed) Block: 107-05_muwtf Trip: 107-05_muwtf_55288_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:31:49 | 7:30:00 | PINES B/FLAMINGO R |
| 7:37:28 | 7:33:18 | PINES BLVD & FLAMINGO RD |
| 7:46:59 | 7:44:00 | PINES B/UNIVERSITY D (E) |
| 7:55:49 | 7:52:00 | HOLLYWOOD B/US 441 (E) |
| 8:05:43 | 7:59:00 | HOLLYWOOD B/CALLE LARGO |
| 8:16:04 | 8:12:00 | GOLDEN GLADES Park & Ride |
| 8:31:14 | 8:32:00 | Miami-Gov Center |
| 8:34:42 | 8:35:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:33:54 |
| In Motion Time | 0:25:00 |
| Dwell Time | 00:13 |
| Signal Delay | 08:14 |
| Turn Out Delay | 00:27 |
| Other Delay | 00:00 |

0:33:54 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 9**

**7:00 AM run**

**Vehicle: 0904 Route: 107-South-9 Date: 2010-12-09(Thu) Block: 107-04_muwtf Trip: 107-04_muwtf_55287_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:00:55 | 7:00:00 | PINES B/FLAMINGO R |
| 7:05:17 | 7:03:18 | PINES BLVD & FLAMINGO RD |
| 7:15:06 | 7:14:00 | PINES B/UNIVERSITY D (E) |
| 7:23:35 | 7:22:00 | HOLLYWOOD B/US 441 (E) |
| 7:34:01 | 7:29:00 | HOLLYWOOD B/CALLE LARGO |
| 7:44:41 | 7:42:00 | GOLDEN GLADES Park & Ride |
| 8:01:08 | 8:02:00 | Miami-Gov Center |
| 8:03:50 | 8:05:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:33:06 |
| In Motion Time | 0:25:13 |
| Dwell Time | 00:56 |
| Signal Delay | 05:21 |
| Turn Out Delay | 00:18 |
| Other Delay | 01:18 |

0:33:06 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 9**

**7:30 AM run**

**Vehicle: 0905 Route: 107-South-9 Date: 2010-12-09(Thu) Block: 107-05_muwtf Trip: 107-05_muwtf_55288_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:31:53 | 7:30:00 | PINES B/FLAMINGO R |
| 7:37:58 | 7:33:18 | PINES BLVD & FLAMINGO RD |
| 7:47:24 | 7:44:00 | PINES B/UNIVERSITY D (E) |
| 7:56:21 | 7:52:00 | HOLLYWOOD B/US 441 (E) |
| 8:06:11 | 7:59:00 | HOLLYWOOD B/CALLE LARGO |
| 8:19:34 | 8:12:00 | GOLDEN GLADES Park & Ride |
| 8:37:46 | 8:32:00 | Miami-Gov Center |
| 8:40:57 | 8:35:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:34:18 |
| In Motion Time | 0:26:18 |
| Dwell Time | 00:51 |
| Signal Delay | 06:21 |
| Turn Out Delay | 00:33 |
| Other Delay | 00:15 |

0:34:18 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 9**

**8:00 AM run**

**Vehicle: 0901 Route: 107-South-9 Date: 2010-12-09(Thu) Block: 107-01_muwtf Trip: 107-01_muwtf_55289_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 8:00:44 | 8:00:00 | PINES B/FLAMINGO R |
| 8:04:36 | 8:03:18 | PINES BLVD & FLAMINGO RD |
| 8:17:02 | 8:14:00 | PINES B/UNIVERSITY D (E) |
| 8:24:50 | 8:22:00 | HOLLYWOOD B/US 441 (E) |
| 8:31:29 | 8:29:00 | HOLLYWOOD B/CALLE LARGO |
| 8:44:45 | 8:42:00 | GOLDEN GLADES Park & Ride |
| 9:02:41 | 9:02:00 | Miami-Gov Center |
| 9:05:46 | 9:05:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:30:45 |
| In Motion Time | 0:20:41 |
| Dwell Time | 00:22 |
| Signal Delay | 09:13 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:29 |

0:30:45 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Week 1 Average**

| | | |
|---|---|---|
| Total Running Time | 0:33:39 | 100.0% |
| In Motion Time | 0:23:51 | 70.9% |
| Dwell Time | 0:00:35 | 1.8% |
| Signal Delay | 0:08:05 | 24.0% |
| Turn Out Delay | 0:00:33 | 1.7% |
| Other Delay | 0:00:34 | 1.7% |

**Dec. 14**

**7:00 AM run**

**Vehicle: 0904 Route: 107-South-9 Date: 2010-12-14(Tue) Block: 107-04_muwtf Trip: 107-04_muwtf_55287_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:04:21 | 7:00:00 | PINES B/FLAMINGO R |
| 7:07:59 | 7:03:18 | PINES BLVD & FLAMINGO RD |
| 7:16:16 | 7:14:00 | PINES B/UNIVERSITY D (E) |
| 7:22:05 | 7:22:00 | HOLLYWOOD B/US 441 (E) |
| 7:29:24 | 7:29:00 | HOLLYWOOD B/CALLE LARGO |
| 7:39:46 | 7:42:00 | GOLDEN GLADES Park & Ride |
| 7:57:45 | 8:02:00 | Miami-Gov Center |
| 8:00:54 | 8:05:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:25:03 |
| In Motion Time | 0:17:36 |
| Dwell Time | 00:45 |
| Signal Delay | 03:12 |
| Turn Out Delay | 00:00 |
| Other Delay | 03:30 |

0:25:03 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 14**

**7:30 AM run**

**Vehicle: 0905 Route: 107-South-9 Date: 2010-12-14(Tue) Block: 107-05_muwtf Trip: 107-05_muwtf_55288_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:33:48 | 7:30:00 | PINES B/FLAMINGO R |
| 7:40:07 | 7:33:18 | PINES BLVD & FLAMINGO RD |
| 7:47:45 | 7:44:00 | PINES B/UNIVERSITY D (E) |
| 7:56:21 | 7:52:00 | HOLLYWOOD B/US 441 (E) |
| 8:04:43 | 7:59:00 | HOLLYWOOD B/CALLE LARGO |
| 8:17:01 | 8:12:00 | GOLDEN GLADES Park & Ride |
| 8:38:04 | 8:32:00 | Miami-Gov Center |
| 8:39:59 | 8:35:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:30:55 |
| In Motion Time | 0:22:42 |
| Dwell Time | 00:34 |
| Signal Delay | 07:27 |
| Turn Out Delay | 00:12 |
| Other Delay | 00:00 |

0:30:55 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 14**

**8:00 AM run**

**Vehicle: 0901 Route: 107-South-9 Date: 2010-12-14(Tue) Block: 107-01_muwtf Trip: 107-01_muwtf_55289_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 8:00:48 | 8:00:00 | PINES B/FLAMINGO R |
| 8:04:24 | 8:03:18 | PINES BLVD & FLAMINGO RD |
| 8:13:57 | 8:14:00 | PINES B/UNIVERSITY D (E) |
| 8:22:09 | 8:22:00 | HOLLYWOOD B/US 441 (E) |
| 8:29:32 | 8:29:00 | HOLLYWOOD B/CALLE LARGO |
| 8:41:47 | 8:42:00 | GOLDEN GLADES Park & Ride |
| 9:20:22 | 9:02:00 | Miami-Gov Center |
| 9:23:57 | 9:05:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:28:44 |
| In Motion Time | 0:21:43 |
| Dwell Time | 00:00 |
| Signal Delay | 07:01 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:28:44 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 15**

**7:00 AM run**

**Vehicle: 0904 Route: 107-South-9 Date: 2010-12-15(Wed) Block: 107-04_muwtf Trip: 107-04_muwtf_55287_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:02:30 | 7:00:00 | PINES B/FLAMINGO R |
| 7:10:16 | 7:03:18 | PINES BLVD & FLAMINGO RD |
| 7:17:28 | 7:14:00 | PINES B/UNIVERSITY D (E) |
| 7:24:15 | 7:22:00 | HOLLYWOOD B/US 441 (E) |
| 7:30:43 | 7:29:00 | HOLLYWOOD B/CALLE LARGO |
| 7:42:07 | 7:42:00 | GOLDEN GLADES Park & Ride |
| 7:57:27 | 8:02:00 | Miami-Gov Center |
| 8:00:30 | 8:05:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:28:13 |
| In Motion Time | 0:21:36 |
| Dwell Time | 01:17 |
| Signal Delay | 05:20 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:28:13 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 15**

**8:30 a.m. run**

**Vehicle: 0835 Route: 107-South-9 Date: 2010-12-15(Wed) Block: 107-02_muwtf Trip: 107-02_muwtf_55290_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 8:30:47 | 8:30:00 | PINES B/FLAMINGO R |
| 8:37:33 | 8:33:18 | PINES BLVD & FLAMINGO RD |
| 8:49:03 | 8:44:00 | PINES B/UNIVERSITY D (E) |
| 8:54:34 | 8:52:00 | HOLLYWOOD B/US 441 (E) |
| 8:58:56 | 8:59:00 | HOLLYWOOD B/CALLE LARGO |
| 9:09:17 | 9:11:00 | GOLDEN GLADES Park & Ride |
| 9:24:04 | 9:30:00 | Miami-Gov Center |
| 9:25:35 | 9:33:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:28:09 |
| In Motion Time | 0:18:40 |
| Dwell Time | 00:51 |
| Signal Delay | 08:38 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:28:09 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 16**

**7:00 AM run**

**Vehicle: 0904 Route: 107-South-9 Date: 2010-12-16(Thu) Block: 107-04_muwtf Trip: 107-04_muwtf_55287_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:08:26 | 7:00:00 | PINES B/FLAMINGO R |
| 7:14:11 | 7:03:18 | PINES BLVD & FLAMINGO RD |
| 7:22:57 | 7:14:00 | PINES B/UNIVERSITY D (E) |
| 7:29:25 | 7:22:00 | HOLLYWOOD B/US 441 (E) |
| 7:35:06 | 7:29:00 | HOLLYWOOD B/CALLE LARGO |
| 7:47:01 | 7:42:00 | GOLDEN GLADES Park & Ride |
| 8:02:51 | 8:02:00 | Miami-Gov Center |
| 8:05:31 | 8:05:00 | MIAMI DOWNTOWN TERM |

| | |
|---|---|
| Total Running Time | 0:26:40 |
| In Motion Time | 0:23:26 |
| Dwell Time | 00:35 |
| Signal Delay | 02:39 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:26:40 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

**Dec. 16**

**7:30 AM run**

**Vehicle: 0905 Route: 107-South-9 Date: 2010-12-16(Thu) Block: 107-05_muwtf Trip: 107-05_muwtf_55288_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 7:30:15 | 7:30:00 | PINES B/FLAMINGO R |
| 7:37:34 | 7:33:18 | PINES BLVD & FLAMINGO RD |
| 7:46:40 | 7:44:00 | PINES B/UNIVERSITY D (E) |
| 7:54:08 | 7:52:00 | HOLLYWOOD B/US 441 (E) |
| 8:03:51 | 7:59:00 | HOLLYWOOD B/CALLE LARGO |
| 8:14:26 | 8:12:00 | GOLDEN GLADES Park & Ride |
| 8:31:01 | 8:32:00 | Miami-Gov Center |
| 8:34:41 | 8:35:00 | MIAMI DOWNTOWN TERM |

0:33:36 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

| | |
|---|---|
| Total Running Time | 0:33:36 |
| In Motion Time | 0:24:53 |
| Dwell Time | 01:49 |
| Signal Delay | 06:04 |
| Turn Out Delay | 00:50 |
| Other Delay | 00:00 |

**Dec. 16**

**8:00 AM run**

**Vehicle: 0901 Route: 107-South-9 Date: 2010-12-16(Thu) Block: 107-01_muwtf Trip: 107-01_muwtf_55289_9**

| Act Time | Sch Time | Stop |
|---|---|---|
| 8:00:59 | 8:00:00 | PINES B /FLAMINGO R |
| 8:04:30 | 8:03:18 | PINES BLVD & FLAMINGO RD |
| 8:13:58 | 8:14:00 | PINES B/UNIVERSITY D (E) |
| 8:20:11 | 8:22:00 | HOLLYWOOD B/US 441 (E) |
| 8:27:27 | 8:29:00 | HOLLYWOOD B/CALLE LARGO |
| 8:39:09 | 8:42:00 | GOLDEN GLADES Park & Ride |
| 8:59:15 | 9:02:00 | Miami-Gov Center |
| 9:02:19 | 9:05:00 | MIAMI DOWNTOWN TERM |

0:26:28 Travel time from PINES B/FLAMINGO R to HOLLYWOOD B/CALLE LARGO

| | |
|---|---|
| Total Running Time | 0:26:28 |
| In Motion Time | 0:21:18 |
| Dwell Time | 00:00 |
| Signal Delay | 05:10 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

**Week 2 Average**

| | | |
|---|---|---|
| Total Running Time | 0:28:29 | 100.0% |
| In Motion Time | 0:21:29 | 75.5% |
| Dwell Time | 0:00:44 | 2.6% |
| Signal Delay | 0:05:41 | 20.0% |
| Turn Out Delay | 0:00:08 | 0.5% |
| Other Delay | 0:00:26 | 1.5% |

APPENDIX

# B

# Raw Data (PM)

**Dec. 7**

**6:08 PM run**
**Vehicle: 0905 Route: 107-North-7 Date: 2010-12-07(Tue) Block: 107-09_muwtf Trip: 107-09_muwtf_55305_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:47:13 | 17:45:00 | MIAMI DOWNTOWN TERM |
| 17:54:49 | 17:48:00 | Miami-Gov Center |
| 18:10:32 | 18:08:00 | GOLDEN GLADES Park & Ride |
| 18:25:18 | 18:22:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:33:00 | 18:28:00 | HOLLYWOOD B/US 441 |
| 18:40:19 | 18:35:00 | PINES B/UNIVERSITY D (W) |
| 18:50:38 | 18:46:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:40:06 |
| In Motion Time | 0:26:28 |
| Dwell Time | 01:08 |
| Signal Delay | 12:30 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:40:06 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 8**
**4:38 PM run**
**Vehicle: 0903 Route: 107-North-7 Date: 2010-12-08(Wed) Block: 107-08_muwtf Trip: 107-08_muwtf_55302_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 16:15:08 | 16:15:00 | MIAMI DOWNTOWN TERM |
| 16:19:47 | 16:18:00 | Miami-Gov Center |
| 16:38:00 | 16:38:00 | GOLDEN GLADES Park & Ride |
| 16:51:30 | 16:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 17:05:25 | 17:00:00 | HOLLYWOOD B/US 441 |
| 17:12:20 | 17:08:00 | PINES B/UNIVERSITY D (W) |
| 17:23:39 | 17:20:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:45:39 |
| In Motion Time | 0:27:20 |
| Dwell Time | 03:09 |
| Signal Delay | 14:51 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:19 |

0:45:39 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 8**

**5:38 PM run**

**Vehicle: 0901 Route: 107-North-7 Date: 2010-12-08(Wed) Block: 107-07_muwtf Trip: 107-07_muwtf_55304_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:14:30 | 17:15:00 | MIAMI DOWNTOWN TERM |
| 17:17:47 | 17:18:00 | Miami-Gov Center |
| 17:38:51 | 17:38:00 | GOLDEN GLADES Park & Ride |
| 17:53:07 | 17:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:09:21 | 18:00:00 | HOLLYWOOD B/US 441 |
| 18:16:20 | 18:07:00 | PINES B/UNIVERSITY D (W) |
| 18:26:27 | 18:18:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:47:36 |
| In Motion Time | 0:28:54 |
| Dwell Time | 00:29 |
| Signal Delay | 18:13 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:47:36 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 8**

**6:08 PM run**

**Vehicle: 0905 Route: 107-North-7 Date: 2010-12-08(Wed) Block: 107-09_muwtf Trip: 107-09_muwtf_55305_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:45:54 | 17:45:00 | MIAMI DOWNTOWN TERM |
| 17:48:54 | 17:48:00 | Miami-Gov Center |
| 18:07:21 | 18:08:00 | GOLDEN GLADES Park & Ride |
| 18:19:51 | 18:22:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:33:30 | 18:28:00 | HOLLYWOOD B/US 441 |
| 18:40:40 | 18:35:00 | PINES B/UNIVERSITY D (W) |
| 18:51:09 | 18:46:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:43:48 |
| In Motion Time | 0:32:20 |
| Dwell Time | 00:25 |
| Signal Delay | 11:03 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:43:48 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 9**

**4:38 PM run**

**Vehicle: 0903 Route: 107-North-7 Date: 2010-12-09(Thu) Block: 107-08_muwtf Trip: 107-08_muwtf_55302_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 16:15:40 | 16:15:00 | MIAMI DOWNTOWN TERM |
| 16:20:37 | 16:18:00 | Miami-Gov Center |
| 16:38:17 | 16:38:00 | GOLDEN GLADES Park & Ride |
| 16:52:42 | 16:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 16:59:37 | 17:00:00 | HOLLYWOOD B/US 441 |
| 17:07:00 | 17:08:00 | PINES B/UNIVERSITY D (W) |
| 17:17:38 | 17:20:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:39:21 |
| In Motion Time | 0:27:45 |
| Dwell Time | 2:46 |
| Signal Delay | 8:42 |
| Turn Out Delay | 0:08 |
| Other Delay | 0:00 |

0:39:21 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 9**

**6:08 PM run**

**Vehicle: 0905 Route: 107-North-7 Date: 2010-12-09(Thu) Block: 107-09_muwtf Trip: 107-09_muwtf_55305_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:46:41 | 17:45:00 | MIAMI DOWNTOWN TERM |
| 17:49:41 | 17:48:00 | Miami-Gov Center |
| 18:07:31 | 18:08:00 | GOLDEN GLADES Park & Ride |
| 18:22:16 | 18:22:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:28:00 | 18:28:00 | HOLLYWOOD B/US 441 |
| 18:35:07 | 18:35:00 | PINES B/UNIVERSITY D (W) |
| 18:45:06 | 18:46:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:37:35 |
| In Motion Time | 0:23:39 |
| Dwell Time | 1:50 |
| Signal Delay | 12:06 |
| Turn Out Delay | 0:00 |
| Other Delay | 0:00 |

0:37:35 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Week 1 Average**

| | | |
|---|---|---|
| Total Running Time | 0:42:21 | 100% |
| In Motion Time | 0:27:44 | 66% |
| Dwell Time | 0:01:38 | 4% |
| Signal Delay | 0:12:54 | 30% |
| Turn Out Delay | 0:00:01 | 0% |
| Other Delay | 0:00:03 | 0% |

**Dec. 14**

**5:38 PM run**

**Vehicle: 0901 Route: 107-North-7 Date: 2010-12-14(Tue) Block: 107-07_muwtf Trip: 107-07_muwtf_55304_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:16:31 | 17:15:00 | MIAMI DOWNTOWN TERM |
| 17:20:22 | 17:18:00 | Miami-Gov Center |
| 17:43:28 | 17:38:00 | GOLDEN GLADES Park & Ride |
| 17:56:26 | 17:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:03:49 | 18:00:00 | HOLLYWOOD B/US 441 |
| 18:11:28 | 18:07:00 | PINES B/UNIVERSITY D (W) |
| 18:20:46 | 18:18:00 | PINES B/FLAMINGO R |
| 0:37:18 | Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R. | |

| | |
|---|---|
| Total Running Time | 0:37:18 |
| In Motion Time | 0:28:22 |
| Dwell Time | 01:18 |
| Signal Delay | 07:38 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

**Dec. 14**

**6:08 PM run**

**Vehicle: 0905 Route: 107-North-7 Date: 2010-12-14(Tue) Block: 107-09_muwtf Trip: 107-09_muwtf_55305_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:46:51 | 17:45:00 | MIAMI DOWNTOWN TERM |
| 17:49:36 | 17:48:00 | Miami-Gov Center |
| 18:08:54 | 18:08:00 | GOLDEN GLADES Park & Ride |
| 18:23:31 | 18:22:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:30:52 | 18:28:00 | HOLLYWOOD B/US 441 |
| 18:40:02 | 18:35:00 | PINES B/UNIVERSITY D (W) |
| 18:48:25 | 18:46:00 | PINES B/FLAMINGO R |
| 0:39:31 | Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R. | |

| | |
|---|---|
| Total Running Time | 0:39:31 |
| In Motion Time | 0:29:14 |
| Dwell Time | 00:38 |
| Signal Delay | 08:48 |
| Turn Out Delay | 00:51 |
| Other Delay | 00:00 |

**Dec. 15**

**4:38 PM run**

**Vehicle: 0903 Route: 107-North-7 Date: 2010-12-15(Wed) Block: 107-08_muwtf Trip: 107-08_muwtf_55302_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 16:14:56 | 16:15:00 | MIAMI DOWNTOWN TERM |
| 16:18:04 | 16:18:00 | Miami-Gov Center |
| 16:38:27 | 16:38:00 | GOLDEN GLADES Park & Ride |
| 16:52:55 | 16:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 17:00:04 | 17:00:00 | HOLLYWOOD B/US 441 |
| 17:08:01 | 17:08:00 | PINES B/UNIVERSITY D (W) |
| 17:20:52 | 17:20:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:42:25 |
| In Motion Time | 0:29:11 |
| Dwell Time | 02:41 |
| Signal Delay | 10:33 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:42:25 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 15**

**5:38 PM run**

**Vehicle: 0901 Route: 107-North-7 Date: 2010-12-15(Wed) Block: 107-07_muwtf Trip: 107-07_muwtf_55304_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:14:32 | 17:15:00 | MIAMI DOWNTOWN TERM |
| 17:18:17 | 17:18:00 | Miami-Gov Center |
| 17:52:24 | 17:38:00 | GOLDEN GLADES Park & Ride |
| 18:06:44 | 17:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:14:38 | 18:00:00 | HOLLYWOOD B/US 441 |
| 18:22:02 | 18:07:00 | PINES B/UNIVERSITY D (W) |
| 18:30:07 | 18:18:00 | PINES B/FLAMINGO R |

| | |
|---|---|
| Total Running Time | 0:37:43 |
| In Motion Time | 0:23:59 |
| Dwell Time | 00:53 |
| Signal Delay | 12:51 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

0:37:43 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

**Dec. 15**

**6:08 PM run**

**Vehicle: 0905 Route: 107-North-7 Date: 2010-12-15(Wed) Block: 107-09_muwtf Trip: 107-09_muwtf_55305_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:46:11 | 17:45:00 | MIAMI DOWNTOWN TERM |
| 17:49:53 | 17:48:00 | Miami-Gov Center |
| 18:20:39 | 18:08:00 | GOLDEN GLADES Park & Ride |
| 18:35:45 | 18:22:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:43:20 | 18:28:00 | HOLLYWOOD B/US 441 |
| 18:49:15 | 18:35:00 | PINES B/UNIVERSITY D (W) |
| 18:57:09 | 18:46:00 | PINES B/FLAMINGO R |
| 0:36:30 | Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R. | |

| | |
|---|---|
| Total Running Time | 0:36:30 |
| In Motion Time | 0:22:14 |
| Dwell Time | 01:14 |
| Signal Delay | 13:02 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

**Dec. 16**

**4:38 PM run**

**Vehicle: 0903 Route: 107-North-7 Date: 2010-12-16(Thu) Block: 107-08_muwtf Trip: 107-08_muwtf_55302_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 16:26:11 | 16:15:00 | MIAMI DOWNTOWN TERM |
| 16:27:43 | 16:18:00 | Miami-Gov Center |
| 16:44:46 | 16:38:00 | GOLDEN GLADES Park & Ride |
| 17:01:27 | 16:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 17:11:07 | 17:00:00 | HOLLYWOOD B/US 441 |
| 17:21:04 | 17:08:00 | PINES B/UNIVERSITY D (W) |
| 17:32:46 | 17:20:00 | PINES B/FLAMINGO R |
| 0:48:00 | Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R. | |

| | |
|---|---|
| Total Running Time | 0:48:00 |
| In Motion Time | 0:32:16 |
| Dwell Time | 00:46 |
| Signal Delay | 14:58 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

**Dec. 16**

**5:38 PM run**

**Vehicle: 0901 Route: 107-North-7 Date: 2010-12-16(Thu) Block: 107-07_muwtf Trip: 107-07_muwtf_55304_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:15:04 | 17:15:00 | MIAMI DOWNTOWN TERM |
| 17:18:09 | 17:18:00 | Miami-Gov Center |
| 17:37:52 | 17:38:00 | GOLDEN GLADES Park & Ride |
| 17:52:29 | 17:53:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:01:11 | 18:00:00 | HOLLYWOOD B/US 441 |
| 18:09:11 | 18:07:00 | PINES B/UNIVERSITY D (W) |
| 18:20:33 | 18:18:00 | PINES B/FLAMINGO R |

0:42:41 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

| | |
|---|---|
| Total Running Time | 0:42:41 |
| In Motion Time | 0:28:57 |
| Dwell Time | 00:39 |
| Signal Delay | 13:05 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

**Dec. 16**

**6:08 p.m. run**

**Vehicle: 0905 Route: 107-North-7 Date: 2010-12-16(Thu) Block: 107-09_muwtf Trip: 107-09_muwtf_55305_7**

| Act Time | Sch Time | Stop |
|---|---|---|
| 17:51:12 | 17:45:00 | MIAMI DOWNTOWN TERM |
| 17:56:22 | 17:48:00 | Miami-Gov Center |
| 18:13:21 | 18:08:00 | GOLDEN GLADES Park & Ride |
| 18:33:02 | 18:22:00 | HOLLYWOOD B/TYLER S TRI-RAIL |
| 18:41:22 | 18:28:00 | HOLLYWOOD B/US 441 |
| 18:48:47 | 18:35:00 | PINES B/UNIVERSITY D (W) |
| 19:00:13 | 18:46:00 | PINES B/FLAMINGO R |

0:46:52 Travel time from GOLDEN GLADES Park & Ride to PINES B/FLAMINGO R.

| | |
|---|---|
| Total Running Time | 0:46:52 |
| In Transit Time | 0:30:31 |
| Dwell Time | 01:09 |
| Signal Delay | 15:12 |
| Turn Out Delay | 00:00 |
| Other Delay | 00:00 |

**Week 2 Average**

| | | |
|---|---|---|
| Total Running Time | 0:41:22 | 100% |
| In Motion Time | 0:28:05 | 68% |
| Dwell Time | 0:01:10 | 3% |
| Signal Delay | 0:12:01 | 29% |
| Turn Out Delay | 0:00:06 | 0% |
| Other Delay | 0:00:00 | 0% |

APPENDIX

C

# Average Signal Delay by Intersection

AM Eastbound

| | TSP Off | TSP On |
|---|---|---|
| Intersection Name | Average Signal Delay | Average Signal Delay |
| (End) Calle Largo Dr. | 00:00 | 00:15 |
| Entrada Dr. | 00:00 | 00:00 |
| Park Rd. | 00:45 | 00:18 |
| 35th Ave. | 00:02 | 00:07 |
| 46th Ave. | 00:00 | 00:02 |
| 52nd Ave. | 00:00 | 00:02 |
| 56th Ave. | 00:00 | 00:09 |
| 58th Ave. | 00:00 | 00:13 |
| US 441 | 01:28 | 00:06 |
| 62nd Ave. | 00:14 | 00:00 |
| 64th Ave. | 00:02 | 00:00 |
| 64th Way | 00:00 | 00:20 |
| 68th Ave. | 00:00 | 00:07 |
| 72nd Ave. | 00:00 | 00:26 |
| McArthur Parkway | 00:05 | 00:08 |
| University Dr. | 00:54 | 00:31 |
| 83rd Ave. | 00:00 | 00:04 |
| 86th Ave. | 00:07 | 00:00 |
| 89th Ave. | 00:58 | 00:11 |
| 96th Ave. | 00:09 | 00:14 |
| 101st Ave./Palm Ave. | 00:25 | 00:49 |
| 107th Ave. | 00:00 | 00:04 |
| Hiatus Rd. | 00:19 | 00:08 |
| 114th Ave | 00:00 | 00:00 |
| 118th Ave. | 00:25 | 00:10 |
| Flamingo Rd. | 00:36 | 00:25 |
| 129th Ave. | 01:37 | 00:54 |
| (Begin) CB Smith P&R | 00:00 | 00:00 |
| Total Average Signal Delay | 08:05 | 05:41 |

The signal delay times shown above are the same times reflected in Figure 4-3 of the report

PM Westbound

| | TSP Off | TSP On |
|---|---|---|
| Intersection Name | Average Signal Delay | Average Signal Delay |
| (End) Flamingo Rd. | 00:03 | 01:02 |
| 118th Ave. | 00:12 | 00:12 |
| 114th Ave. | 00:14 | 00:00 |
| Hiatus Rd. | 00:43 | 00:31 |
| 107th Ave. | 00:00 | 00:04 |
| 101st Ave/Palm Ave. | 00:07 | 00:46 |
| 96th Ave. | 01:00 | 00:16 |
| 89th Ave. | 00:07 | 00:36 |
| 86th Ave. | 00:19 | 00:04 |
| 83rd Ave. | 00:00 | 00:12 |
| University Dr. | 00:54 | 00:44 |
| McArthur Pkwy. | 00:40 | 00:00 |
| 72nd Ave. | 00:00 | 01:01 |
| 68th Ave. | 00:31 | 00:15 |
| 64th Way | 00:00 | 00:00 |
| 64th Ave. | 00:12 | 00:00 |
| 62nd Ave. | 00:00 | 01:24 |
| US 441 | 03:20 | 01:07 |
| 58th Ave. | 00:36 | 00:04 |
| 56th Ave. | 01:02 | 00:24 |
| 52nd Ave. | 00:00 | 00:00 |
| 46th Ave. | 00:35 | 00:16 |
| 35th Ave. | 00:11 | 00:04 |
| Park Rd. | 00:28 | 00:33 |
| Entrada Dr. | 00:04 | 00:05 |
| Hollywood Tri-Rail | 00:16 | 00:42 |
| I-95 Off Ramp | 01:19 | 01:38 |
| (Start) Golden Glades | 00:03 | 00:00 |
| Total Average Signal Delay | 12:54 | 12:01 |

The signal delay times shown above are the same times reflected in Figure 4-4 of the report.

APPENDIX

D

# Master Transit Evaluation Matrix

| Transit Improvement | Mechanisms for Congestion Reduction/ Hypotheses | Indicators | Measures | Data Source / Agency | NBRTI Action Items |
|---|---|---|---|---|---|
| **New transit services in HOT Lanes**<br><br>**New transit services in General Purpose lanes**<br><br>**Increases in existing transit service capacity /quality** | Transit in HOT lanes will create a virtual bus way, which increases transit travel speeds and improves reliability, thereby increasing passenger throughput on the facility.<br><br>Improved transit network coverage will enhance area-wide access to transit services and service connectivity. This is a service improvement, which ultimately will attract choice riders.<br><br>Increasing existing service can bring modal shifts, create operational impacts on associated transit corridors, and increase transit ridership during congested periods. | Travel Time | Max/Min Travel Time<br>Minutes per mile<br>Average Dwell time, signal delay time, Pull-out time<br>Door-to-Door Travel Time | Travel Time Comp. Analysis<br><br>or:<br><br>AVL data (MDT/BCT) | – Assist in developing data collection methodology<br>– Conduct data analysis and reporting<br><br>– Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting |
| | | Reliability/ Schedule Adherence | Running time reliability<br>On-time performance | | |
| | | Ridership | Ridership change over time<br>Boardings/deboardings by stop<br>Ridership by route segment<br>Passenger trip length<br>Linked and unlinked trips | Ridecheck (MDT/BCT)<br>APCs (MDT/BCT) | – Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting |
| | | Mode shift | Mode access (captive/choice)<br>Mode use history<br>Average vehicle occupancies and traffic volumes in HOT lanes and GP lanes | On-Board Survey<br><br>Traffic Man. Center (FDOT) | – Assist in developing data collection methodology<br>– Conduct data analysis and reporting<br><br>– Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting |
| | | Safety/security | Transit incidents / accidents<br>Perceptions of safety | Safety data (MDT/BCT)<br><br>On-Board Survey | – Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting<br><br>– Assist in developing data collection methodology<br>– Conduct data analysis and reporting |
| | | Capacity | Vehicle capacity<br>Corridor transit service capacity<br>Revenue hours/Revenue miles<br>Frequency/span/days of service<br>Level of Service information for HOT lanes and GP lanes | Ridecheck (MDT/BCT)<br><br>APCs (MDT/BCT)<br><br>AVL (MDT/BCT) | – Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting |
| | | Image/ Perception | Awareness<br>User perceptions<br>Demographics | On-Board Survey | – Assist in developing data collection methodology<br>– Conduct data analysis and reporting |
| | | Cost | Capital Cost<br>Operating cost<br>Farebox data<br>Cost effectiveness/efficiency | Transit cost and fare info (MDT/BCT)<br><br>HOT lane / P&R lot costs info (FDOT) | – Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting |

| Transit Improvement | Mechanisms for Congestion Reduction/ Hypotheses | Indicators | Measures | Data Source / Agency | NBRTI Action Items |
|---|---|---|---|---|---|
| **Park-and-Ride Capacity / Facility Improvements** | Increased park-and-ride capacity will attract more commuters to transit, thereby taking more vehicles off the road. | Lot Utilization | Lot usage/occupancy<br>Occupancy/loading by hour/day<br>Ridership<br>Awareness<br>User perceptions<br>demographics | Parking Lot Survey (FDOT)<br><br>On-Board Survey | – Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting<br><br>– Assist in developing data collection methodology<br>– Conduct data analysis and reporting |
| **Stationary transit infrastructure improvements (ADA enhancement, stations, shelters, depots, amenities)** | Depots and bus layup facilities will improve operational efficiencies. Customer amenities will improve comfort, accessibility, safety/security, and other intangible factors that are important to attracting choice riders. | ADA Compliance<br><br>Customer Impact | Station compliance (ADA)<br>Vehicle compliance (ADA)<br>Awareness<br>User perceptions<br>Demographics | Transit agency docs (MDT/BCT)<br><br>On-Board Survey | – Obtain and synthesize transit agency docs<br><br>– Assist in developing data collection methodology<br>– Conduct data analysis and reporting |
| **ITS – Bus arrival, Transit signal priority, etc.** | These technologies provide service quality enhancements and improve operational efficiencies, travel times, and reliability. | Operational Impact<br><br>Customer Impact | Service performance (reliability / schedule adherence)<br>Operating cost efficiency<br>Awareness<br>User perceptions<br>Demographics | Travel Time Comp. Analysis or:<br>AVL data (MDT/BCT)<br><br>Transit agency docs (MDT/BCT)<br><br>On-Board Survey | – Assist in developing data collection methodology<br>– Conduct data analysis and reporting<br><br>– Assist in data mining<br>– Check data for quality, quantity, and format.<br>– Conduct data analysis and reporting<br><br>– Obtain and synthesize transit agency docs<br><br>– Assist in developing data collection methodology<br>– Conduct data analysis and reporting |
| **Marketing / Branding** | Effective marketing and attractive branding schemes will increase awareness and improve the image of public transit, broadening the appeal to commuter markets. | Awareness and perception of service | Awareness<br>User perceptions<br>Demographics | On-Board Survey | – Assist in developing data collection methodology<br>– Conduct data analysis and reporting |

U.S. Department of Transportation

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