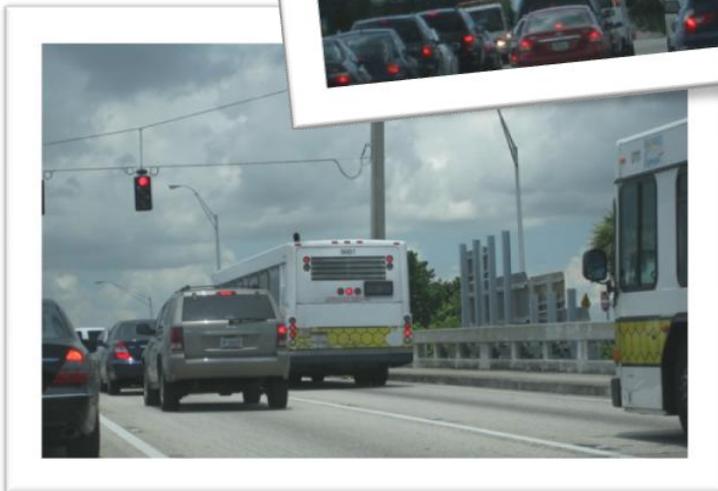


# Quarterly TSM&O Performance Measurement Report



Broward County  
*October 2010*



Florida DOT District 4  
Transportation System  
Management & Operations  
Program



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# Introduction

As congestion continues to increase disproportionately to funding resources, the current practice of roadway expansion is becoming obsolete. It is clear that a paradigm shift is needed, and the Florida Department of Transportation (FDOT) is responding by developing a statewide Transportation System Management and Operations (TSM&O) program that is expected to address the growing congestion problem within the state. TSM&O will shift the focus of FDOT's strategies to ones that provide mobility outcomes, such as travel time reliability, that maximize the efficiency of the transportation system. TSM&O improves mobility for all users through an emphasis on real-time active management and operations of the existing transportation system. TSM&O is a performance driven program that requires inter-agency coordination and collaboration among the agencies that currently manage and/or operate the transportation system.

The Broward County TSM&O program began with the formation of the Broward County TSM&O Task Team. The Task Team is comprised of the agencies that manage and/or operate the Broward County transportation system, which include Broward County Traffic Engineering Division (BCTED), Broward County Transit (BCT), Broward County Metropolitan Planning Organization (MPO), FDOT Planning, FDOT Traffic Operations, and FDOT Modal Development. The Team has been meeting regularly since its formation in January 2009. Activities to date include defining the Broward County TSM&O Initial Deployment Network and targeted user groups; defining performance measures to begin tracking; and establishing a quarterly performance reporting schedule.

The performance measurement reports will be used to identify trends and assist FDOT and Broward County in understanding the casual relationship between resources allocated to specific TSM&O activities and the resulting outcomes. It is expected that TSM&O program activities in Broward County will continue to be refined based in part on what is learned through the performance measurement process.

For purposes of comparison, this report references the results of the previous quarterly report for Broward County, published in April 2010.

## **TSM&O PERFORMANCE MEASURES**

The TSM&O performance measures addressed in this report include the following:

- Mobility Performance Measures
  - Travel Time Index
  - Arterial Travel Time Delay
  - Throughput (Vehicle)
  - Throughput (Person)
- Transit Performance Measures

- Transit Schedule Adherence
- Safety Performance Measures
  - Number of Incidents
  - Incident Duration
- Other Performance Measures
  - Signal System Health
  - Work Zone Characteristics
  - Air Quality
  - Resources Spent

## **TSM&O NETWORK**

Arterial roadways included in Broward County TSM&O Initial Deployment Network include the following:

1. Oakland Park Boulevard (West) from SR 817/ University Drive to NW 31<sup>st</sup> Avenue (3.7 mi)
2. Oakland Park Boulevard (East) from NW 31<sup>st</sup> Avenue to US 1/SR 5 (3.7 mi)
3. Sunrise Boulevard from SR 7/US 441 to US 1/SR 5 (4.1 mi)
4. Broward Boulevard from SR 7/US 441 to US 1/SR 5/Federal Highway (4.0 mi)
5. SR 7/US 441 from Broward Boulevard to Oakland Park Boulevard (3.1 mi)
6. US 1/SR 5 from Broward Boulevard to Oakland Park Boulevard (4.1 mi)

School zones are located along portions of Sunrise Boulevard and Broward Boulevard.

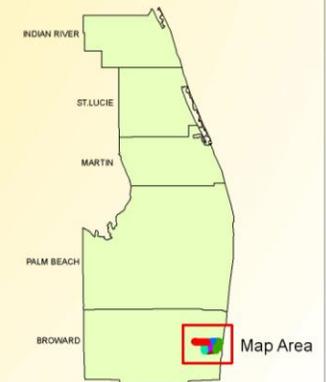
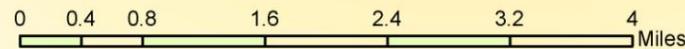
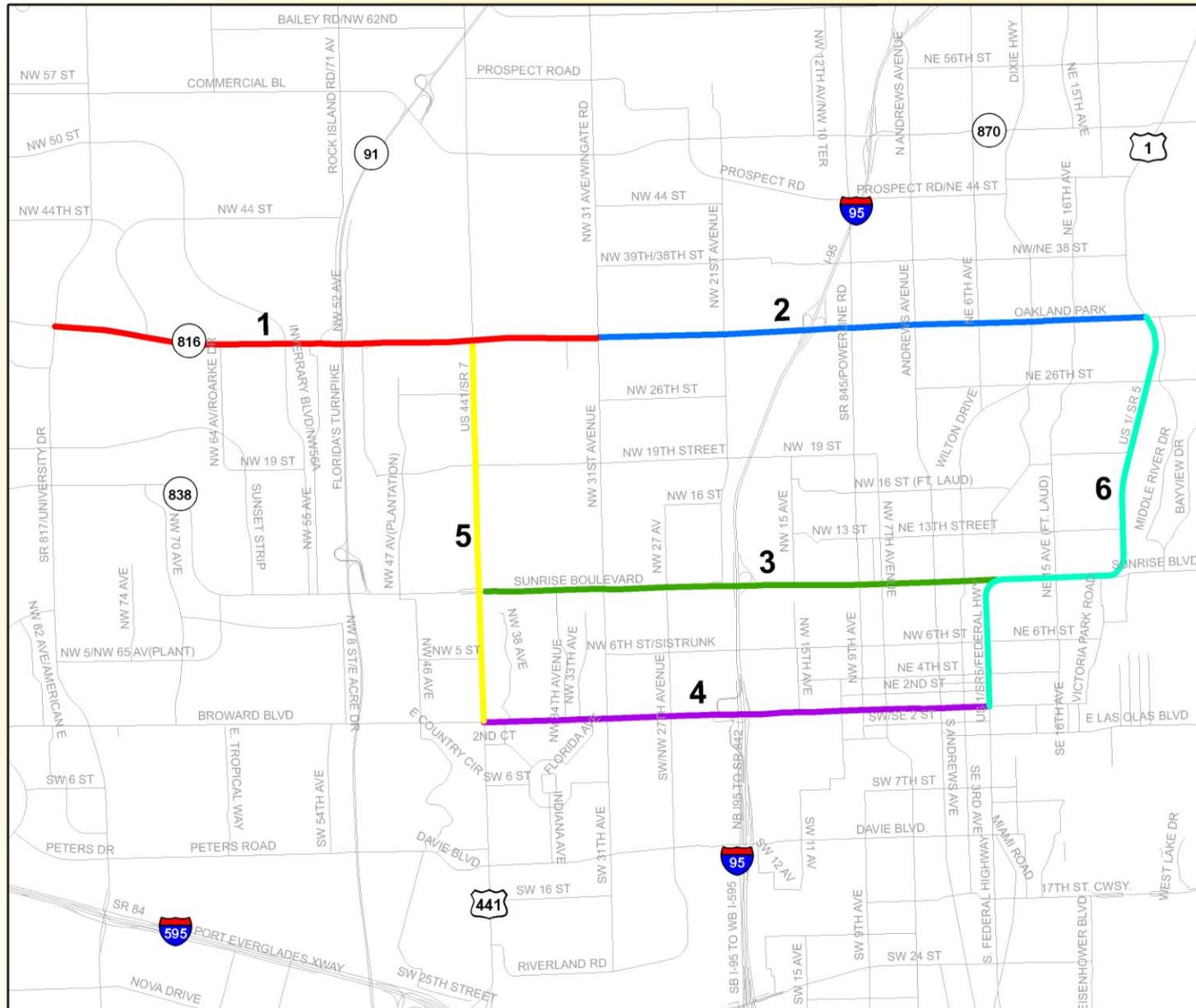
Maps depicting the Broward County TSM&O arterial network and locations of school zones are shown on the following two pages.

# TSM&O Performance Measurement Report

## Broward County TSM&O Network

### Legend

- TSM&O Arterial Corridors**
- 1 - Oakland Park Blvd. (West)
  - 2 - Oakland Park Blvd. (East)
  - 3 - Sunrise Blvd.
  - 4 - Broward Blvd.
  - 5 - SR-7
  - 6 - US-1
  - Major Roads

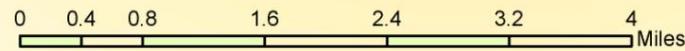
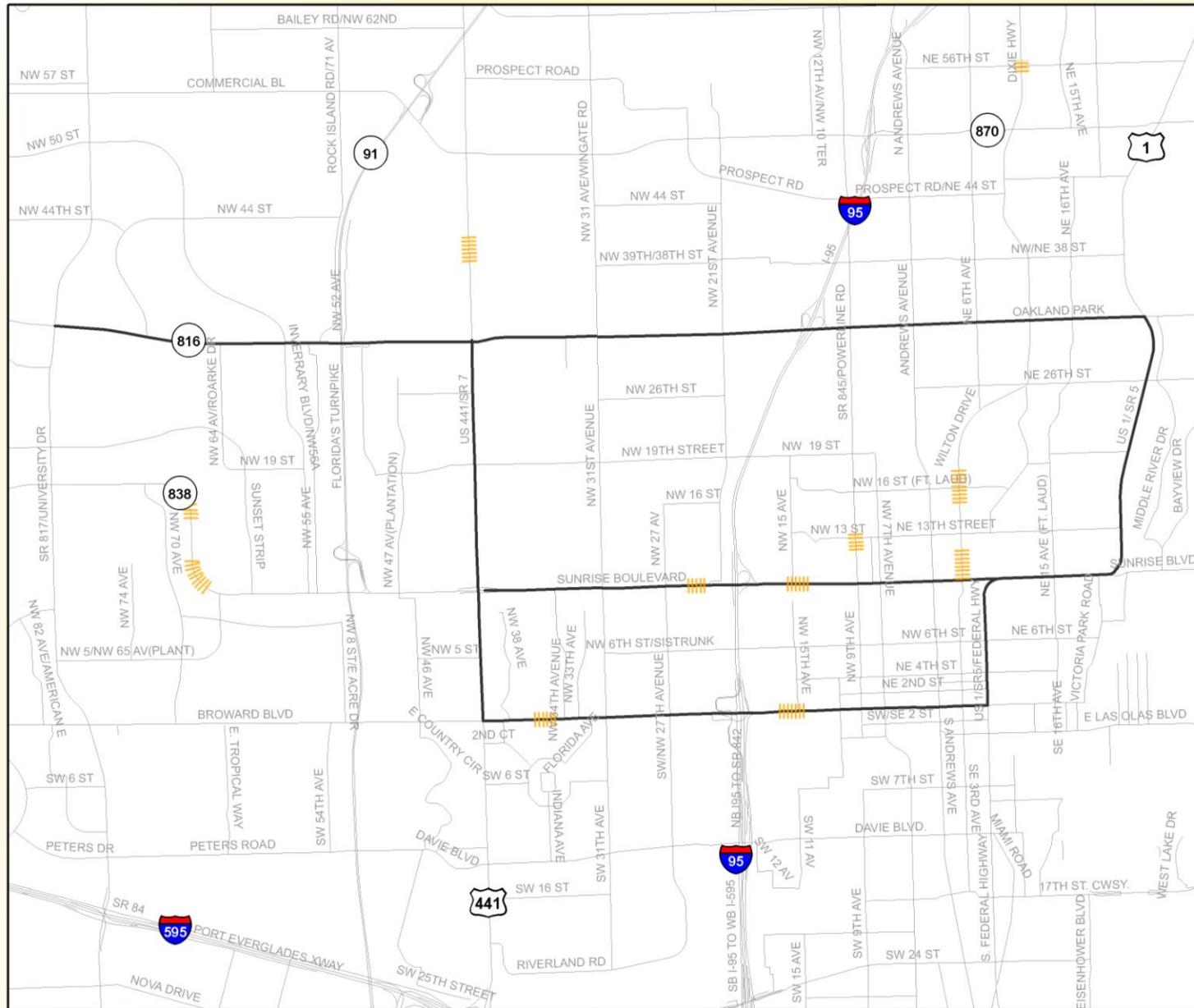


# TSM&O Performance Measurement Report

## Broward County School Zones

### Legend

-  School Zones
-  TSM&O Arterials
-  Major Roads



# Travel Time Index

## DEFINITION

The Travel Time Index (TTI) is a measure of congestion that describes the average time it takes to travel during peak hours compared to free flow conditions.

## PURPOSE

Report a qualitative measure of the variability or uncertainty in the performance of the TSM&O network over time.

## OBJECTIVE

Achieve peak period travel time reliability on critical arterial segments in the TSM&O network.

## METHODOLOGY

The TTI is calculated as the ratio of average peak travel time to an off-peak (free-flow) standard, as shown in the following equation:

$$\text{Travel Time Index} = \frac{\text{Average Travel Time}}{\text{Free Flow Travel Time}}$$

TTI is reported as an index value. For example, a TTI value of 1.20 means that average peak travel times are 20 percent longer than off-peak travel times. A TTI value equal to or slightly greater than 1 is desired, but may not be realistic for the traffic demands.

TTI is calculated based on travel time data, which are collected by probe vehicles equipped with QSTARZ GPS loggers that record travel time directly while conducting travel time runs along each arterial in the TSM&O network. Travel time runs were conducted on October 5-6, 2010 during the following time periods:

AM peak: from 7 a.m. to 9 a.m.

Midday peak: from 11:30 a.m. to 1:30 p.m.

PM peak: 4 p.m. to 6 p.m.

For purposes of TSM&O performance reporting, the free flow travel time is assumed to be equal to the lowest recorded travel time on the segment of interest from all travel time runs conducted to date (presumed to be the free flow travel time during the off peak period).

## RESULTS & TRENDS

Table 1 summarizes the travel time and travel time index results for Broward County TSM&O network. The table indicates the free flow travel time, average peak period travel time, travel

time index, and change compared to previous quarter values. The TTI values highlighted in red indicate the worst congested arterials for each peak period, as well as the arterials experiencing the greatest increase and decrease compared to last quarter. Figure 1 shows the average travel time for each peak period compared to the free flow travel time, while Figure 2 shows the change in travel time index compared to last quarter.

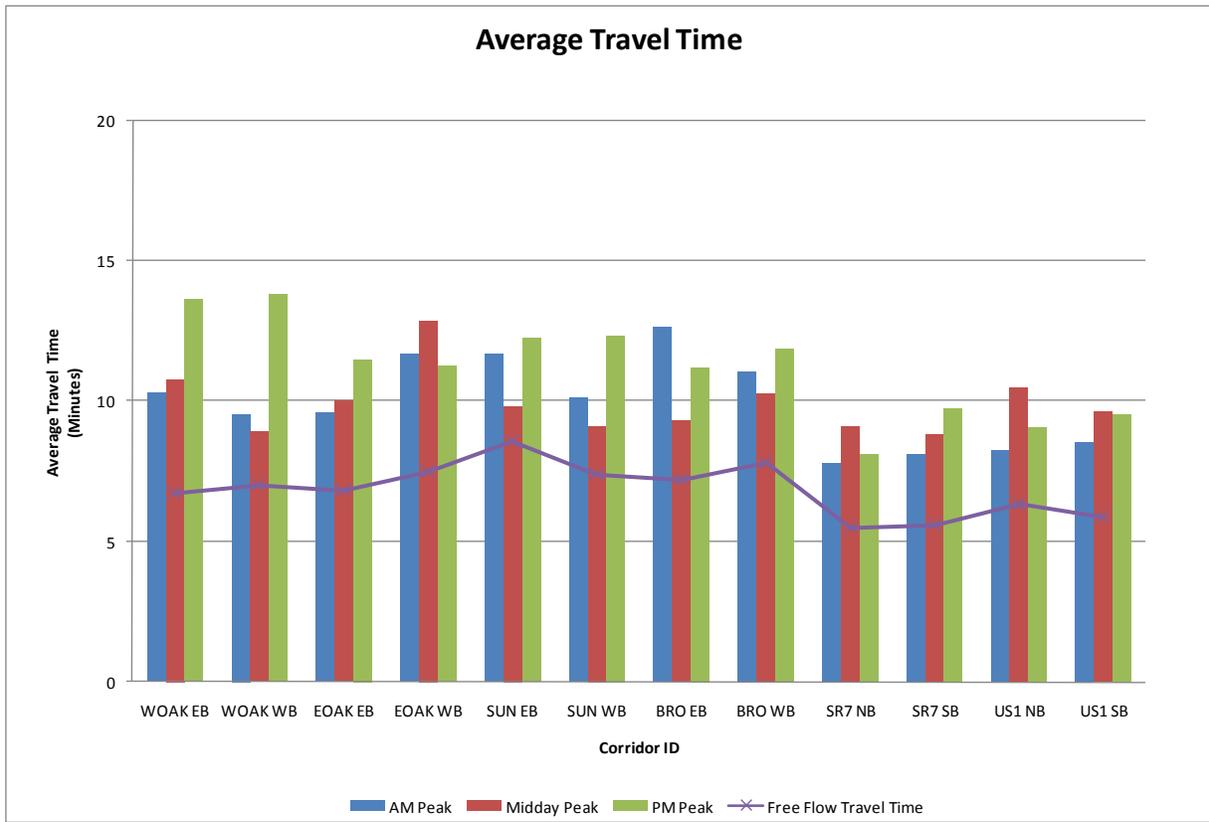
During the AM peak, the eastbound direction of Broward Boulevard experienced the most congestion, with a travel time index of 1.76. This is less than 1 percent decrease compared to last quarter. For the AM peak period, the westbound direction of Sunrise Boulevard experienced the greatest increase (20 percent) compared to last quarter, while the eastbound direction of Oakland Park Boulevard (East) experienced the greatest decrease (8 percent). During the midday peak, the westbound direction of Oakland Park Boulevard (East) experienced the most congestion, with a travel time index of 1.72. This is a 10 percent increase, which is also the greatest increase in TTI compared to last quarter. The greatest decrease occurred at eastbound Oakland Park Boulevard (East) (34 percent). During the PM peak, the eastbound direction of Oakland Park Boulevard (West) experienced the most congestion, with a travel time index of 2.03. The westbound direction of this corridor experienced the greatest increase in TTI compared to the previous quarter (19 percent). Westbound Oakland Park Boulevard (East) experienced the greatest decrease (21 percent).

**Table 1. Travel Time Index for the TSM&O Network**

ID	Arterial Corridor	Dir	Free Flow TT	AM Peak Period			Midday Peak Period			PM Peak Period		
				Average TT	TTI	Change from Last Quarter	Average TT	TTI	Change from Last Quarter	Average TT	TTI	Change from Last Quarter
1	Oakland Park Blvd (West)	EB	6.7	10.31	1.53	-1%	10.8	1.60	9%	13.65	<b>2.03</b>	17%
		WB	7.0	9.54	1.36	2%	8.92	1.27	-7%	13.82	1.97	<b>19%</b>
2	Oakland Park Blvd (East)	EB	6.8	9.59	1.41	<b>-8%</b>	10	1.47	<b>-34%</b>	11.52	1.69	-1%
		WB	7.5	11.68	1.56	12%	12.87	<b>1.72</b>	<b>10%</b>	11.24	1.50	<b>-21%</b>
3	Sunrise Blvd	EB	8.6	11.68	1.36	2%	9.83	1.15	0%	12.26	1.43	12%
		WB	7.4	10.13	1.37	<b>20%</b>	9.12	1.23	2%	12.36	1.67	-11%
4	Broward Blvd	EB	7.2	12.66	<b>1.76</b>	-0.2%	9.31	1.29	-5%	11.19	1.55	3%
		WB	7.8	11.07	1.42	17%	10.28	1.32	5%	11.87	1.52	-7%
5	SR 7	NB	5.5	7.78	1.41	-6%	9.1	1.65	-4%	8.14	1.48	-13%
		SB	5.6	8.11	1.45	-3%	8.84	1.58	9%	9.75	1.75	-1%
6	US 1	NB	6.3	8.28	1.31	-6%	10.49	1.66	-3%	9.07	1.43	0%
		SB	5.9	8.56	1.46	8%	9.63	1.64	-10%	9.53	1.62	-4%

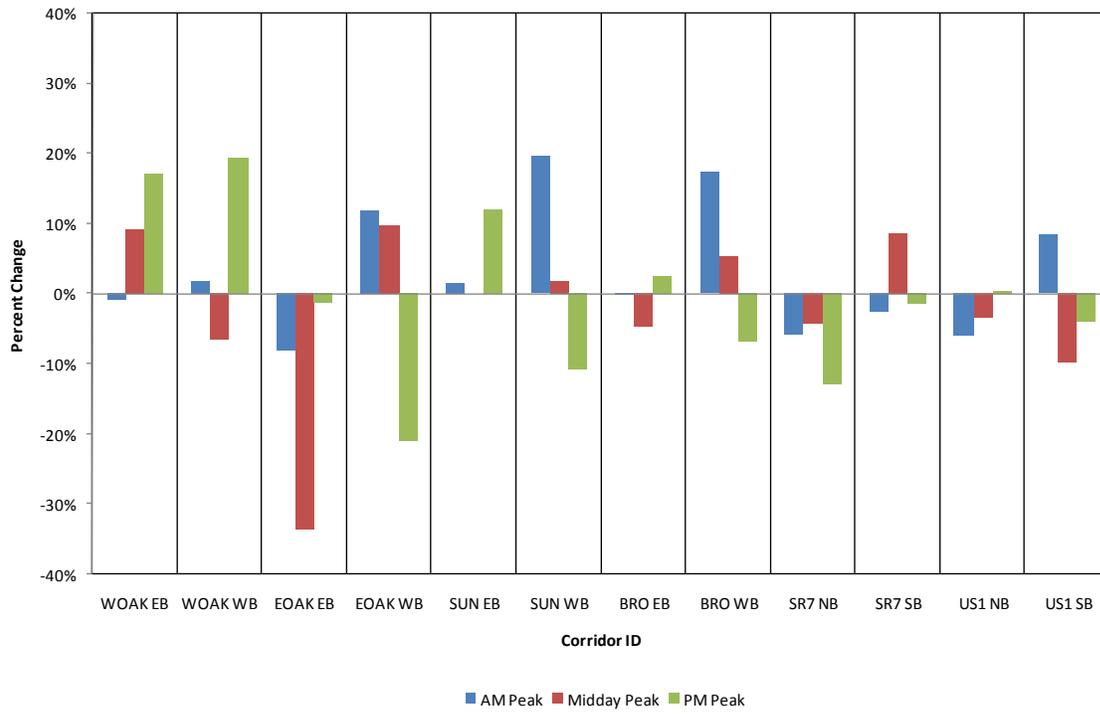
\*The raw data sheets are showing the times as being off by an hour. The cause of this timing issue is due daylight savings not being accounted for.

**Figure 1. Average Travel Time on the TSM&O Network**



**Figure 2. Travel Time Index - Change from Last Quarter**

### Travel Time Index Change from Last Quarter



# TSM&O Performance Measurement Report

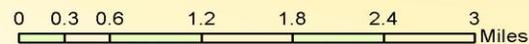
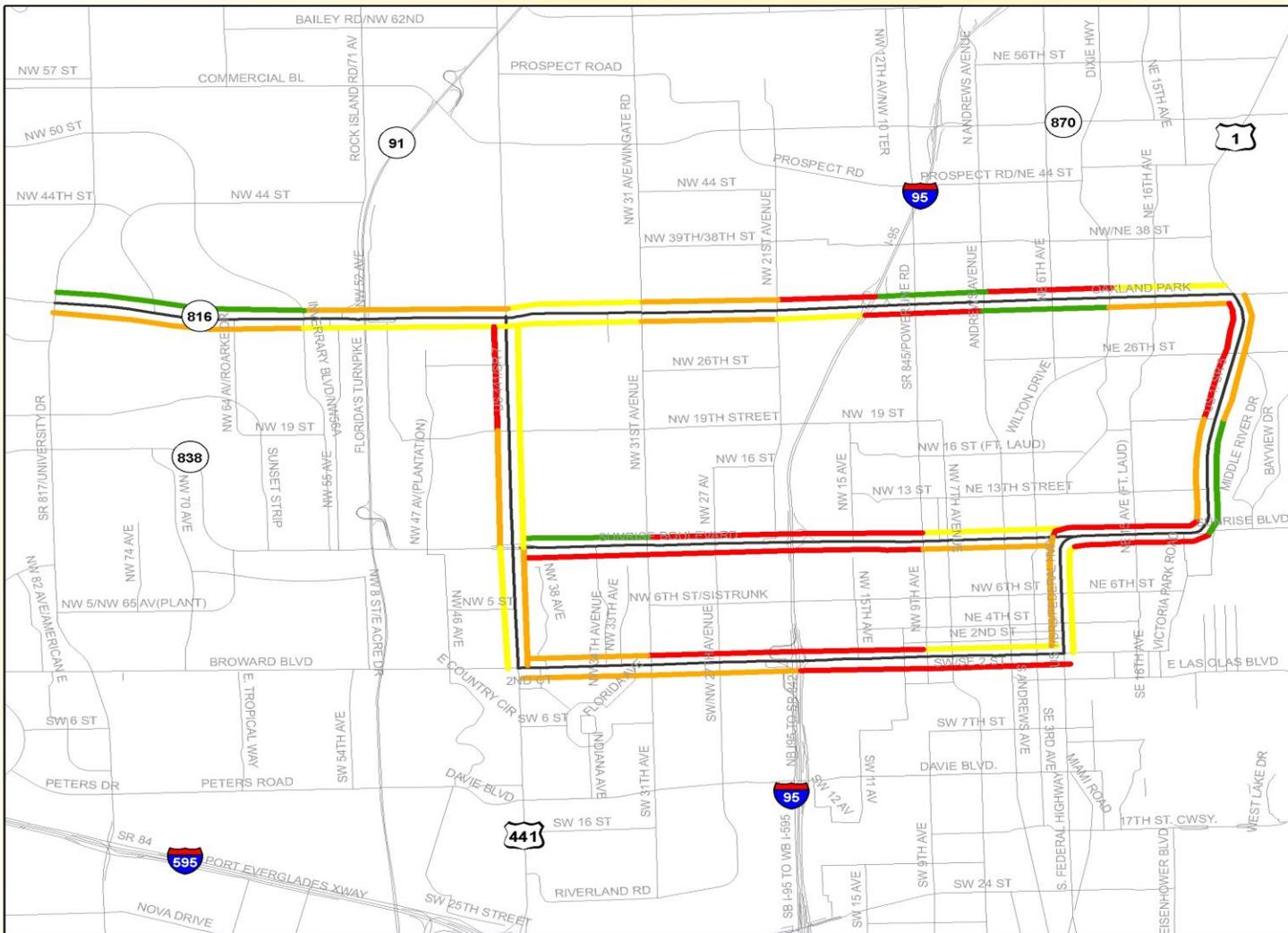
## Broward County Travel Time Index AM Peak

October 2010

### Legend

#### Travel Time Index AM Peak

- 1.13 - 1.25
- 1.26 - 1.50
- 1.51 - 1.75
- > 1.75
- TSM&O Arterials
- Major Roads



# TSM&O Performance Measurement Report

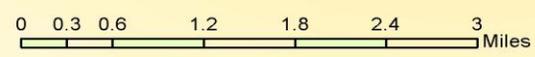
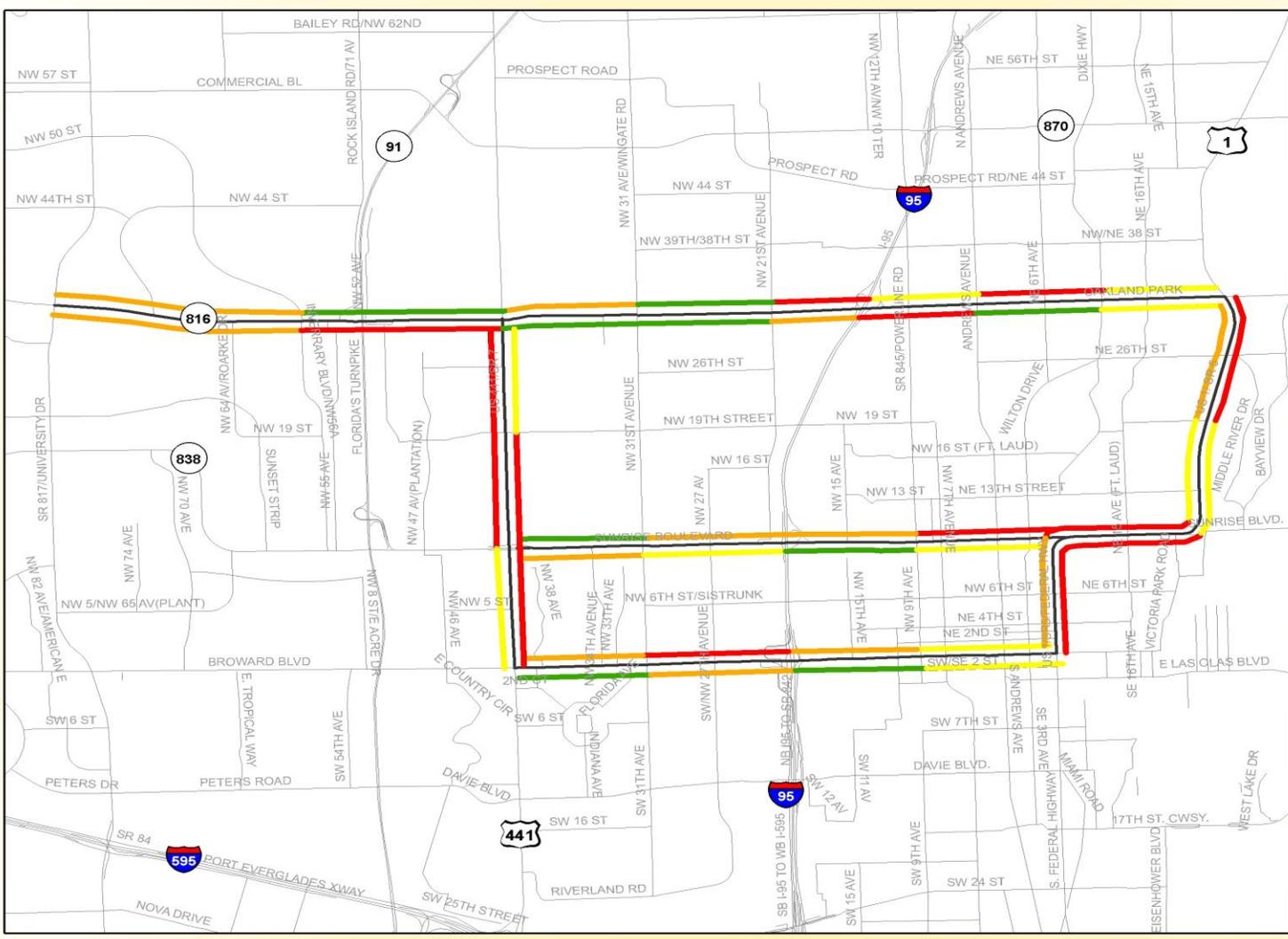
## Broward County Travel Time Index Midday Peak

October 2010

**Legend**

**Travel Time Index Midday Peak**

- 1.0 - 1.3
- 1.4 - 1.5
- 1.6 - 1.8
- > 1.75
- TSM&O Arterials
- Major Roads



# TSM&O Performance Measurement Report

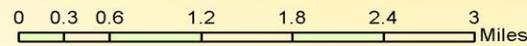
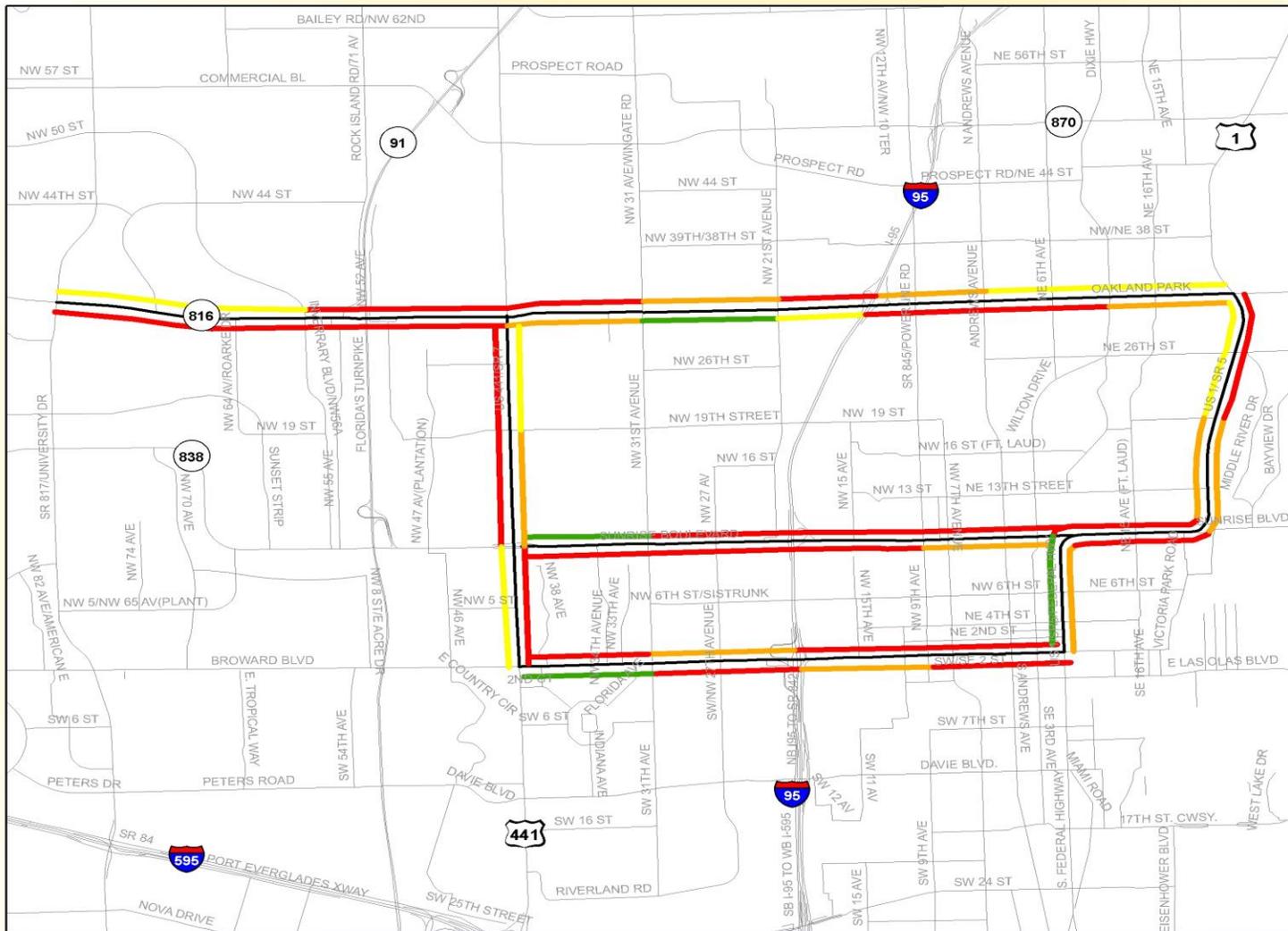
## Broward County Travel Time Index PM Peak

October 2010

### Legend

#### Travel Time Index PM Peak

- 1.1 - 1.3
- 1.4 - 1.5
- 1.6 - 1.8
- > 1.75
- TSM&O Arterials
- Major Roads



# Arterial Travel Time Delay

## DEFINITION

Arterial travel time delay is the additional travel time beyond the “ideal” (or free flow) travel time experienced by a driver along a corridor. Stopped and control delay are inherently included as part of this measure, since its calculation is based on cumulative travel time runs conducted between the begin and end points of the corridor.

## PURPOSE

Report a qualitative measure of arterial travel time delay on the TSM&O network over time.

## OBJECTIVE

Reduce delay on critical arterial segments in the TSM&O network.

## METHODOLOGY

Average travel time delay is calculated as the difference between the average travel time measured during the peak period, and the free flow travel time, as shown in the following equation:

$$\text{Average Arterial Travel Time Delay} = \text{Average Travel Time} - \text{Free Flow Travel Time}$$

Average travel time delay is calculated based on travel time data obtained from the travel time runs conducted along each arterial in the TSM&O network, as described in the previous section. The average travel time was computed by direction for each corridor and peak period. For purposes of TSM&O performance reporting, the free flow travel time is equal to the lowest recorded travel time for each direction of the corridor across all peak periods (presumed to be the free flow travel time during the off peak period).

## RESULTS & TRENDS

Table 2 summarizes the arterial travel time delay results for each arterial in the City of Port St. Lucie TSM&O network. The values highlighted in red indicate the arterial with the highest average arterial travel time delay for each time period, as well as the arterials experiencing the greatest increase and decrease compared to last quarter. Figure 3 shows the average arterial travel time delay for each peak period, while Figure 4 shows the change in arterial travel time delay compared to last quarter.

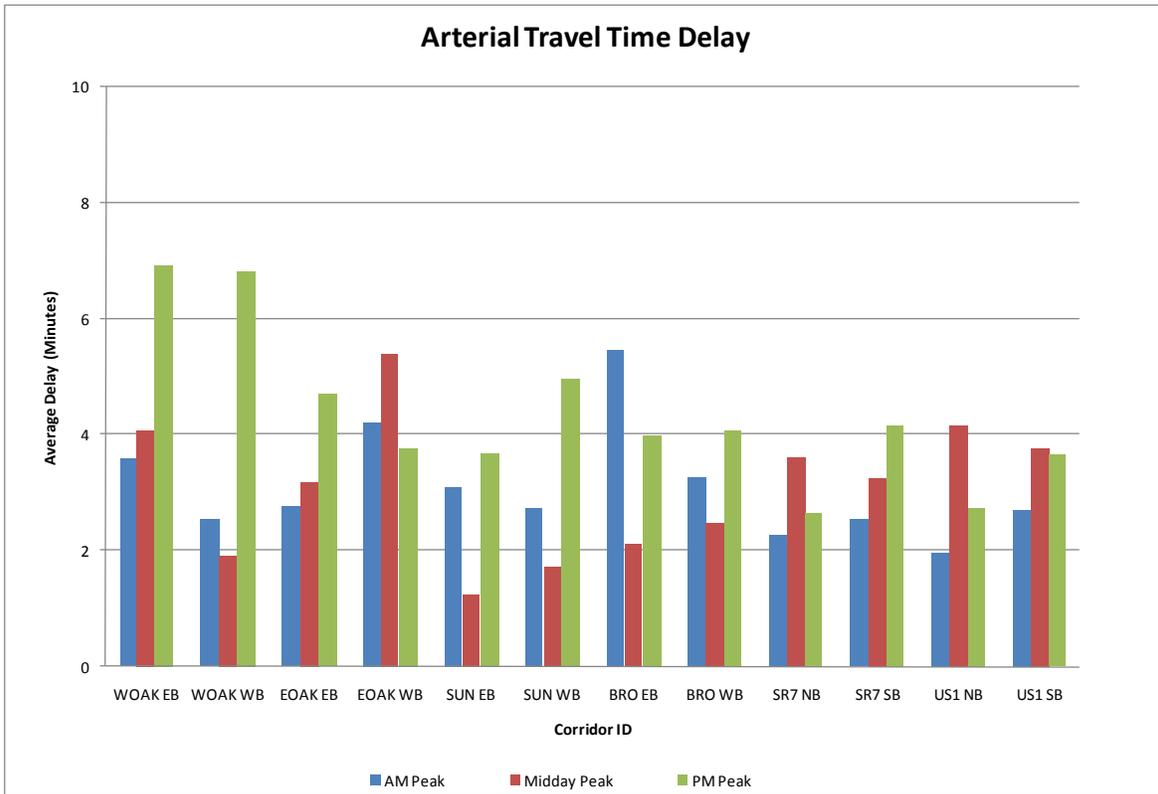
During the AM peak, the eastbound direction of Broward Boulevard experiences the highest delay, with an average of 5.5 minutes. The greatest increase in travel time delay occurred at westbound Sunrise Boulevard (69 percent), whereas the greatest decrease for the AM peak period occurred at northbound US 1 (31 percent). The westbound direction of Oakland Park Boulevard (East) experiences the highest delay during the midday peak, with an average delay

of 5.4 minutes. The greatest increase during the midday peak occurred at eastbound Oakland Park Boulevard (West) (24 percent), and the greatest decrease occurred at eastbound Oakland Park Boulevard (East) (105 percent). For the PM peak period, eastbound Oakland Park Boulevard (West) experienced the greatest delay at 6.9 minutes. Eastbound Sunrise Boulevard experienced the greatest increase in delay (40 percent), while westbound Oakland Park Boulevard (East) experienced the greatest decrease (63 percent).

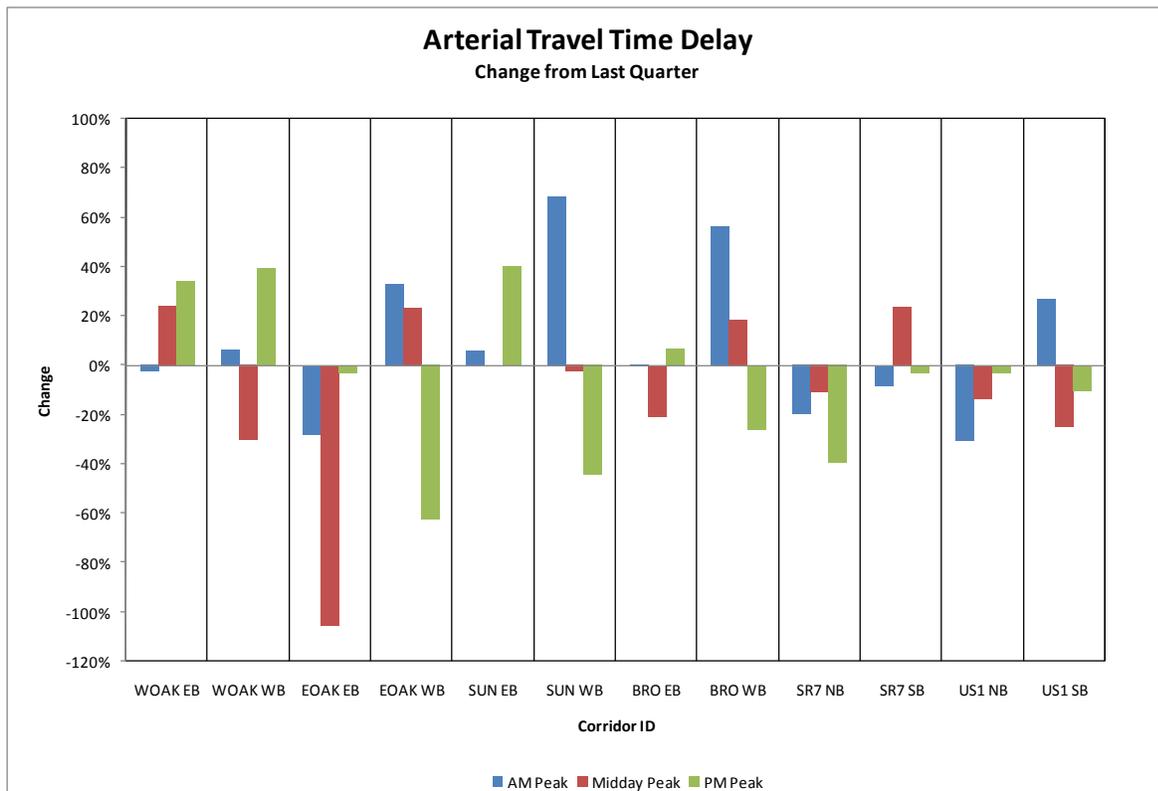
**Table 2. Arterial Travel Time Delay for the TSM&O Network**

ID	Arterial Corridor	Dir	AM Peak Period		Midday Peak Period		PM Peak Period	
			Average Delay	Change from Last Quarter	Average Delay	Change from Last Quarter	Average Delay	Change from Last Quarter
1	Oakland Park Blvd (West)	EB	3.6	-2%	4.1	24%	6.9	34%
		WB	2.5	7%	1.9	-30%	6.8	39%
2	Oakland Park Blvd (East)	EB	2.8	-28%	3.2	-105%	4.7	-3%
		WB	4.2	33%	5.4	23%	3.8	-63%
3	Sunrise Blvd	EB	3.1	6%	1.3	0%	3.7	40%
		WB	2.7	69%	1.7	-2%	5.0	-44%
4	Broward Blvd	EB	5.5	-0.4%	2.1	-21%	4.0	7%
		WB	3.3	57%	2.5	18%	4.1	-26%
5	SR 7	NB	2.3	-20%	3.6	-11%	2.6	-39%
		SB	2.5	-8%	3.3	24%	4.2	-3%
6	US 1	NB	2.0	-31%	4.2	-13%	2.7	-3%
		SB	2.7	27%	3.8	-25%	3.7	-10%

**Figure 3. Arterial Travel Time Delay for the TSM&O Network**



**Figure 4. Arterial Travel Time Delay - Change from Last Quarter**





# TSM&O Performance Measurement Report

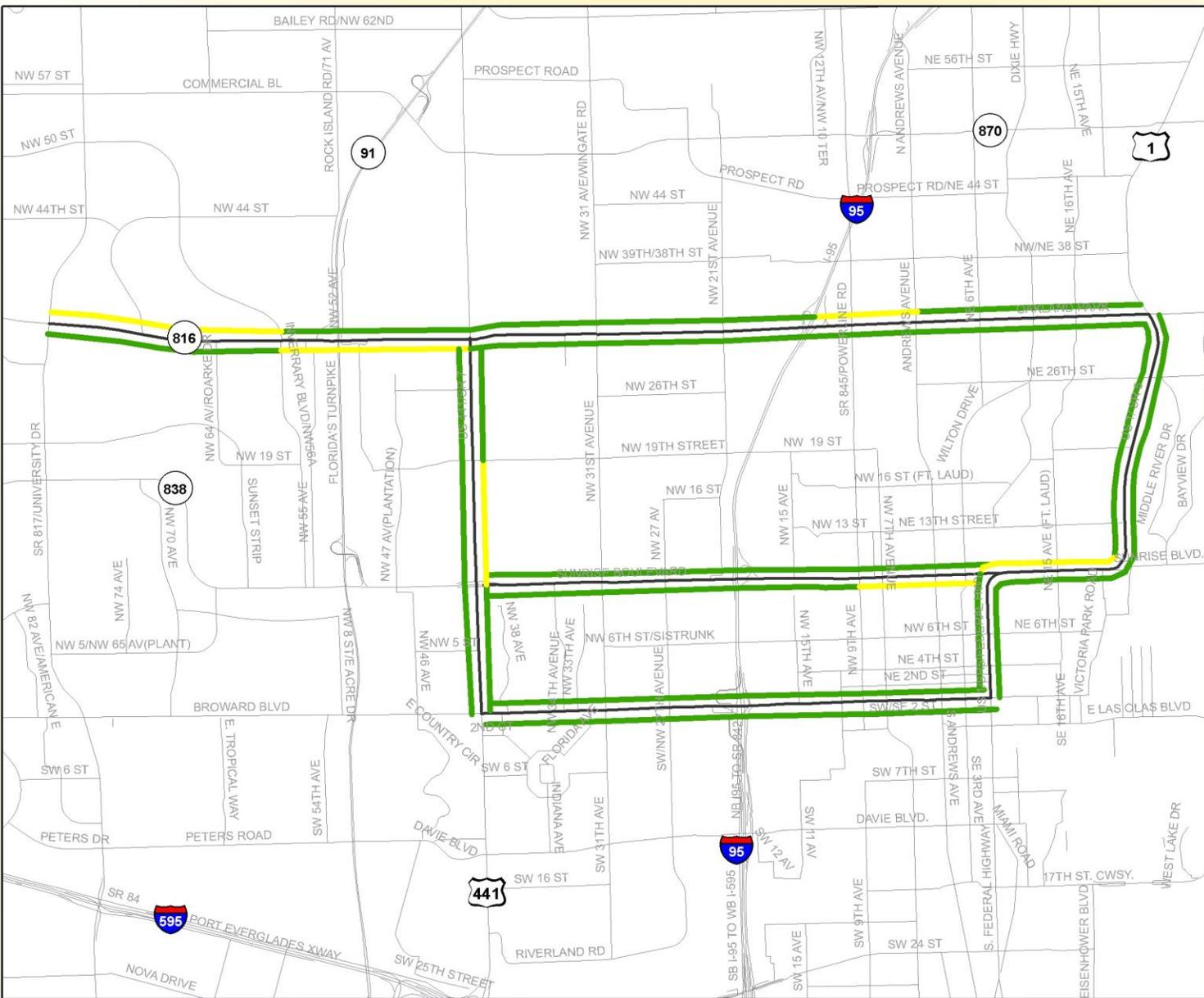
## Broward County Arterial Travel Time Delay Middy Peak

October 2010

### Legend

#### Number of Stops Middy Peak

- 0.0 - 2.0
- 2.1 - 4.0
- > 4.0
- TSM&O Arterials
- Major Roads





# Throughput (Vehicle)

## DEFINITION

Vehicle throughput is defined as the number of vehicles traversing an arterial during a given peak period.

## PURPOSE

Vehicle throughput provides information on how effective the TSM&O network is in moving people and goods through the network.

## OBJECTIVE

Increase vehicle volume throughput on the TSM&O network.

## METHODOLOGY

Vehicle throughput is calculated based on 24-hour traffic volume counts conducted at 20 Portable Traffic Monitoring Sites (PTMS) located within the TSM&O network, as shown on the map on the following page. The locations in blue depict sites that are maintained by Florida DOT, while the locations in green depict those maintained by the local jurisdiction. Each PTMS location is equipped with in-pavement sensors (loops and/or piezoelectric traffic sensors) and a traffic cabinet. A traffic counter is placed in the cabinet and attached to the in-pavement sensors to collect vehicle volume data for the duration of the data collection period.

Traffic volume data were collected at each PTMS location in 15-minute increments by lane for the period from October 5-6, 2010. The volumes across all lanes was computed for each hour of each day of data collection. An average hourly volume was then computed for each peak period, defined as follows:

AM peak: from 7 a.m. to 9 a.m.

Midday peak: from 11:30 a.m. to 1:30 p.m.

PM peak: 4 p.m. to 6 p.m.

The average hourly volume was then computed across all PTMS locations for each arterial corridor.

## RESULTS & TRENDS

Table 3 summarizes the vehicle throughput results for the Broward County TSM&O network. The values highlighted in red indicate the arterial corridors with the greatest change in vehicle throughput compared to the previous quarter for each time period. Figure 5 shows the average hourly vehicle throughput for each peak period, while Figure 6 shows the change in vehicle throughput compared to last quarter.



During the AM peak, the eastbound direction of Broward Boulevard had an average vehicle throughput of 1781 vehicles per hour, which is an 62.2 percent decrease compared to last quarter. This corridor also had the greatest change during the midday peak period, with an average of 1383 vehicles per hour and 67 percent decrease compared to last quarter. During the PM peak, the westbound direction of Broward Boulevard had an average vehicle throughput of 1798 vehicles per hour, which is a decrease of 80.5 percent compared to last quarter.

In comparison to October 2009, the eastbound direction of Broward Boulevard had a 13.1 decrease during the AM peak. This corridor also had the greatest change during the midday peak period, with a 14.9 percent decrease compared to last year. Moreover, the westbound direction of Broward Boulevard had a decrease of 18.1 percent from last year.

**Table 3. Vehicle Throughput for the TSM&O Network**

ID	Arterial Corridor	Dir	AM Peak Period			Midday Peak Period			PM Peak Period		
			Average Hourly Volume	Change from Last Quarter	Change from Last Year	Average Hourly Volume	Change from Last Quarter	Change from Last Year	Average Hourly Volume	Change from Last Quarter	Change from Last Year
1	Oakland Park Boulevard (West)	EB	2169	-6.7%	2.2%	1591	-10.8%	4.4%	1818	-3.5%	0.6%
		WB	1475	-4.8%	-1.0%	1604	-9.4%	5.9%	2198	-4.7%	<b>6.9%</b>
2	Oakland Park Boulevard (East)	EB	1866	<b>10.0%</b>	3.3%	1601	-6.4%	-3.4%	1720	-1.8%	2.1%
		WB	1341	4.4%	-4.9%	1606	-4.6%	-2.8%	2010	1.2%	6.4%
3	Sunrise Boulevard	EB	1800	-6.8%	-7.1%	1393	<b>-18.8%</b>	-8.3%	1614	-6.7%	-4.6%
		WB	1176	-2.4%	0.6%	1533	-3.6%	-2.5%	2066	6.5%	4.3%
4	Broward Boulevard *	EB	1781	<b>-62.2%</b>	<b>-13.1%</b>	1383	<b>-67.0%</b>	<b>-14.9%</b>	1445	<b>-49.1%</b>	-7.5%
		WB	1253	<b>-42.5%</b>	7.0%	1358	<b>-63.6%</b>	-6.7%	1798	<b>-80.5%</b>	<b>-18.1%</b>
5	SR 7 / US 441	NB	1447	-0.7%	0.1%	1489	-5.9%	3.3%	1767	-1.9%	-0.1%
		SB	1399	-1.6%	-4.5%	1555	-7.2%	1.0%	1751	-7.5%	-3.7%
6	US 1 / SR 5	NB	1233	3.9%	<b>12.4%</b>	1724	-14.7%	6.2%	1925	-11.0%	-1.6%
		SB	1605	5.3%	4.5%	1755	-2.6%	<b>10.0%</b>	1799	-5.3%	5.0%

\*The traffic volumes for the PTMS site located on Broward Boulevard – West of W of SE 3<sup>rd</sup> Avenue was attained during the dates of October 12<sup>th</sup> and 13<sup>th</sup>. Differences in traffic volumes are not assumed.

Figure 5. Vehicle Throughput for the TSM&O Network

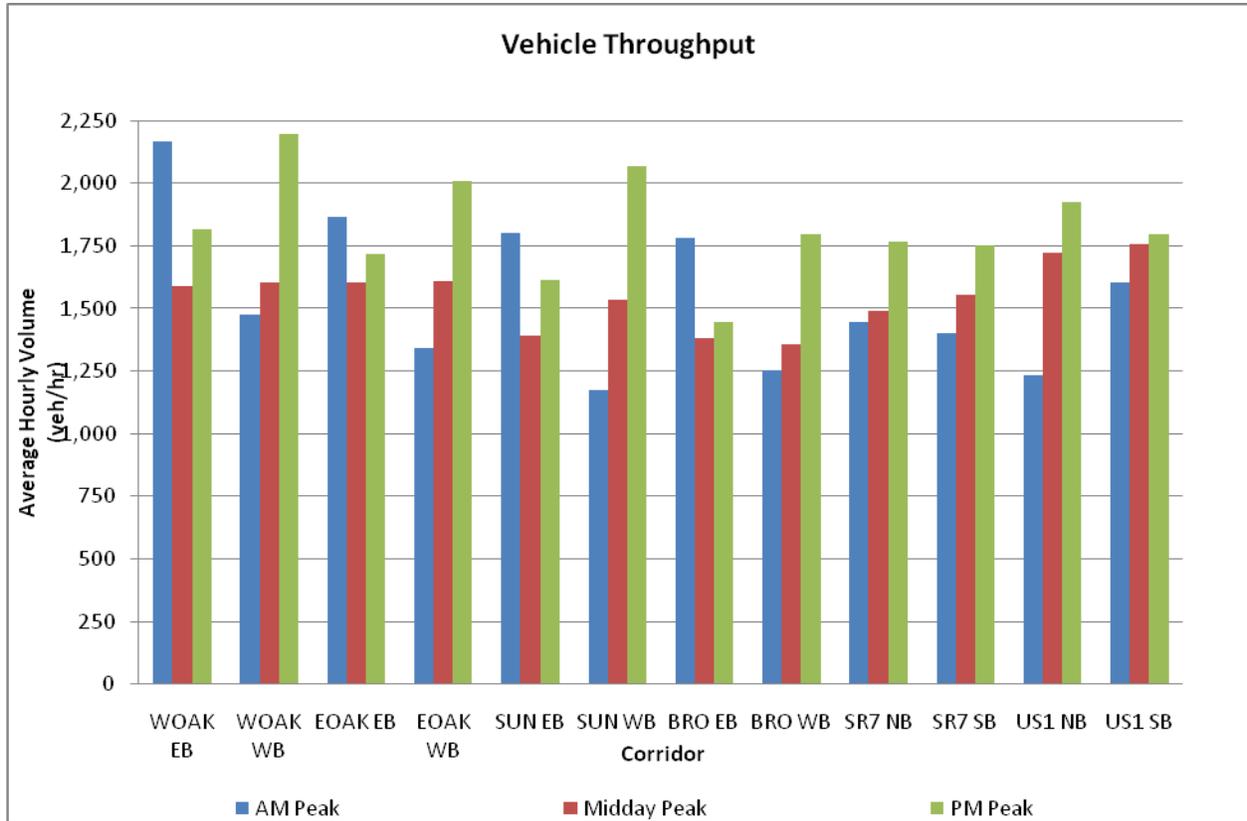
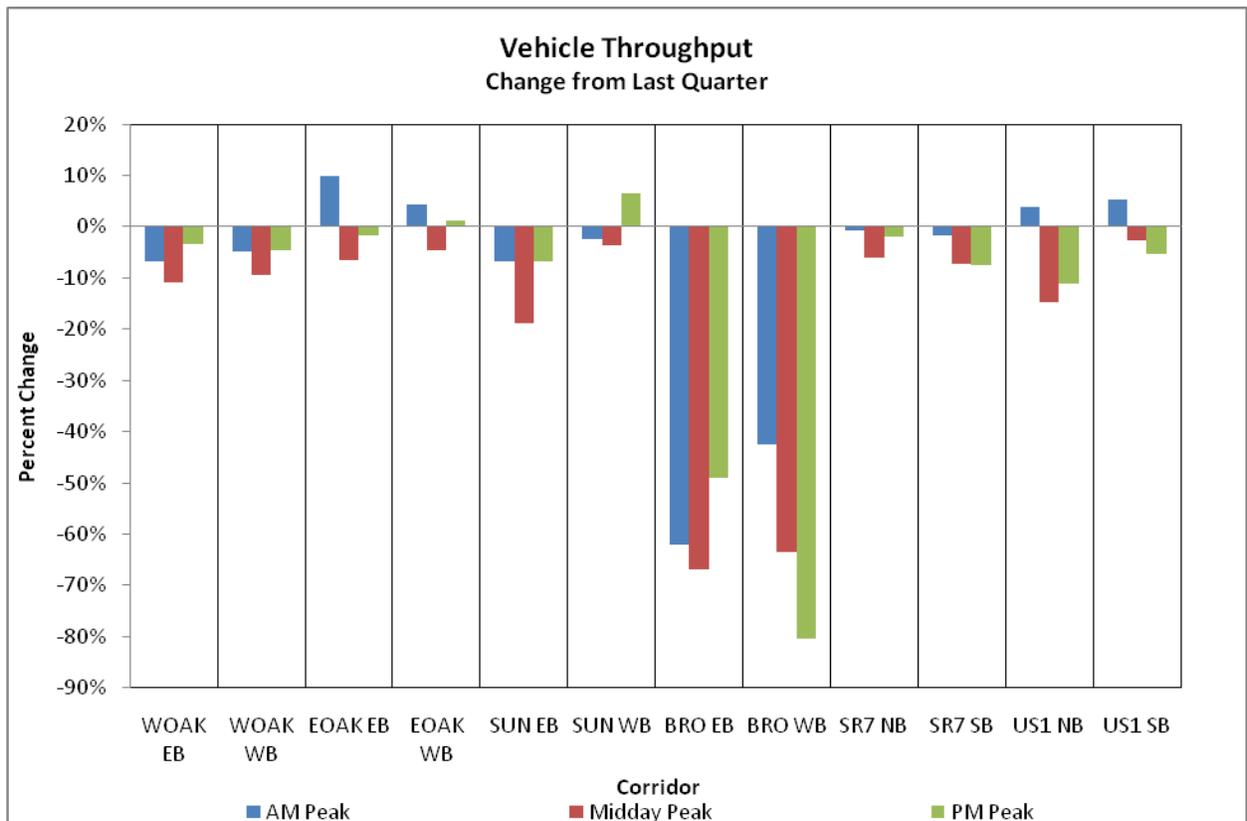


Figure 6. Vehicle Throughput - Change from Last Quarter



# TSM&O Performance Measurement Report

## Broward County Vehicle Throughput AM Peak

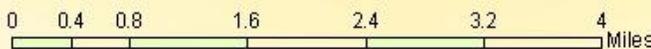
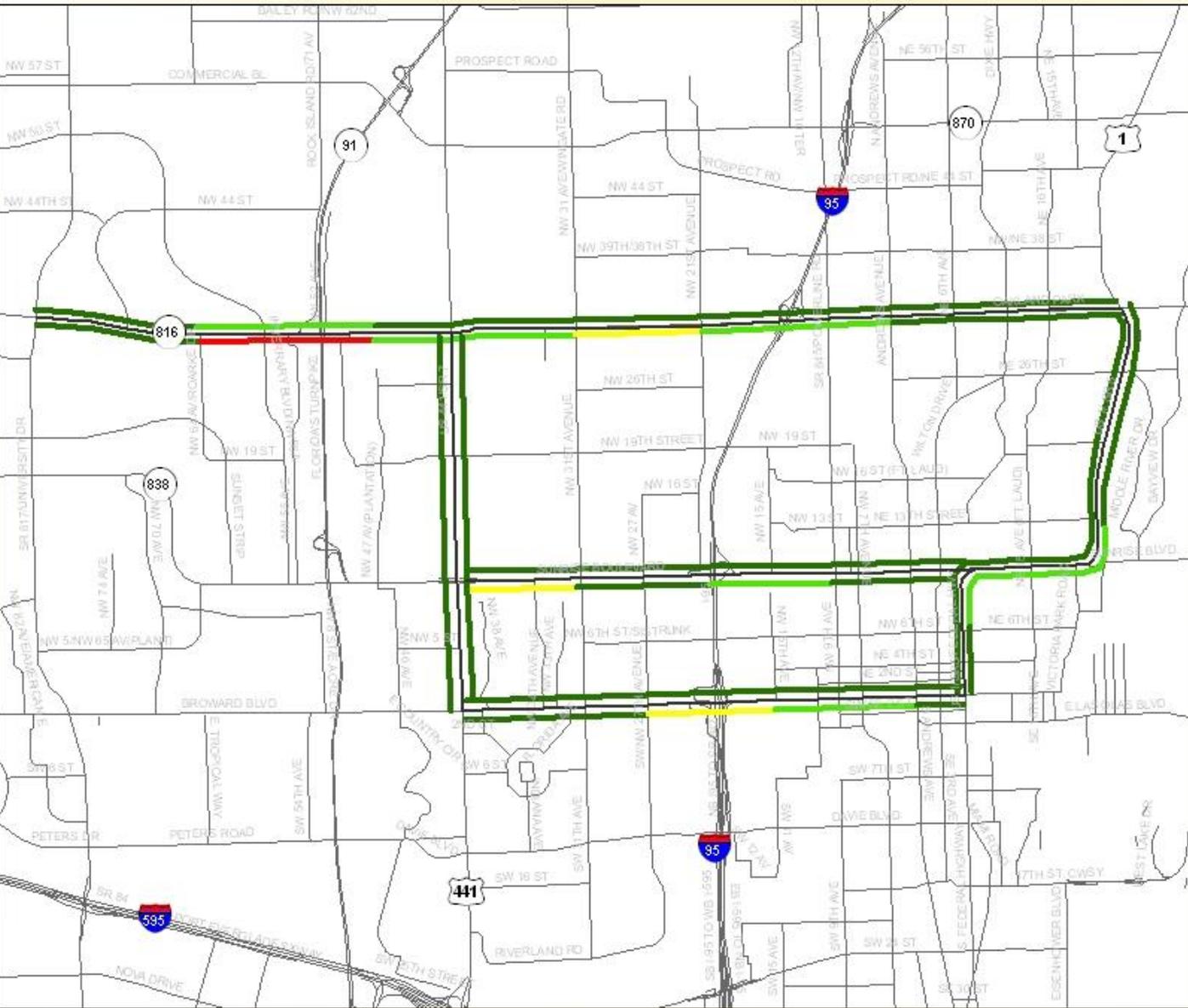
**Legend**

**PTMS Volume AM Peak HOURLY\_AVE**

- █ < 1800
- █ 1801 - 2199
- █ 2200 - 2599
- █ > 2600

— Major Roads

— TSM&O Arterials



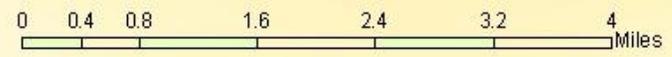
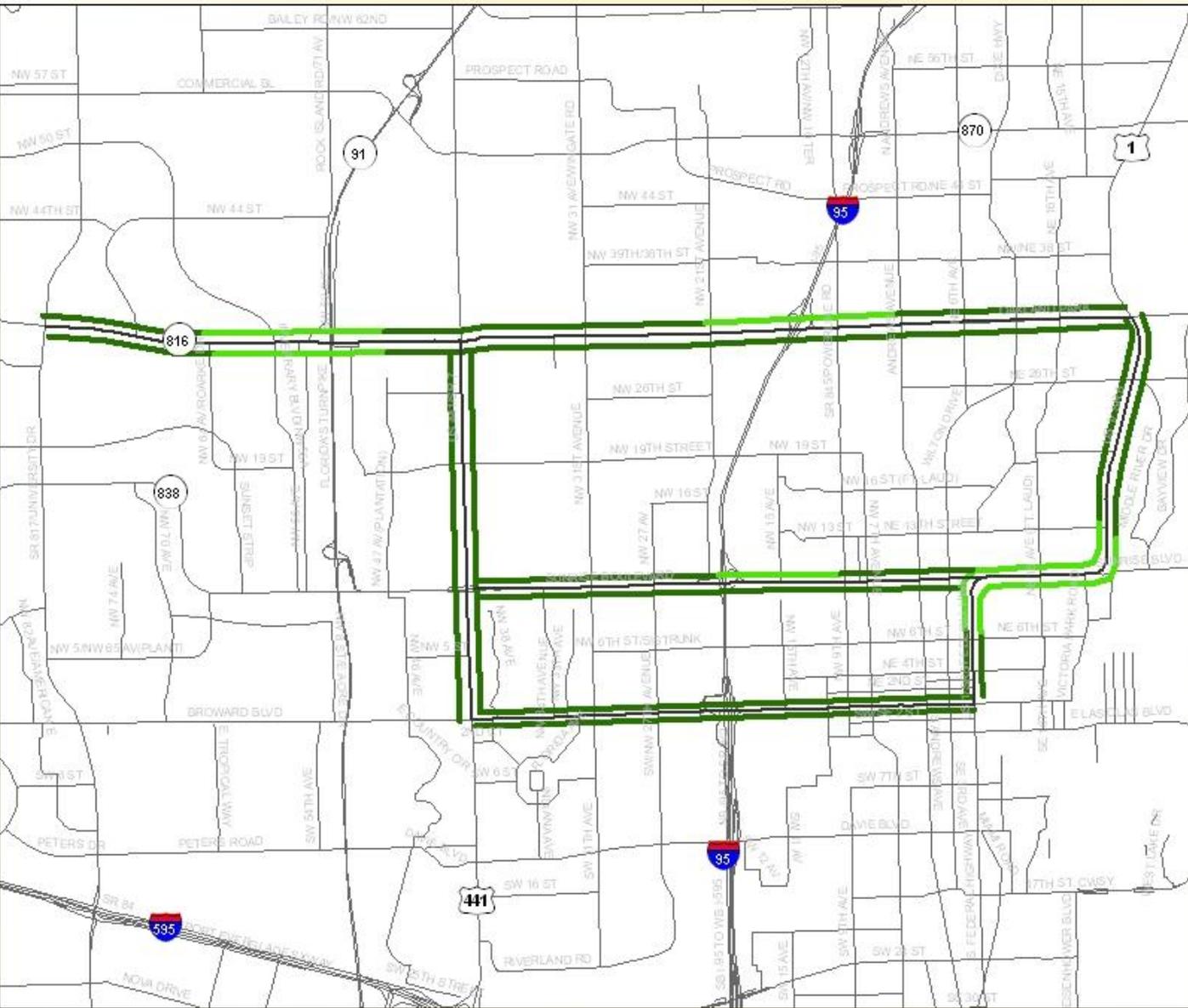
# TSM&O Performance Measurement Report

## Broward County Vehicle Throughput Middy Peak

**Legend**

**PTMS Volume MD Peak HOURLY\_AVE**

- < 1800
- 1801 - 2199
- 2200 - 2599
- > 2600
- Major Roads
- TSM&O Arterials

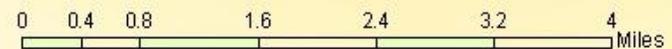
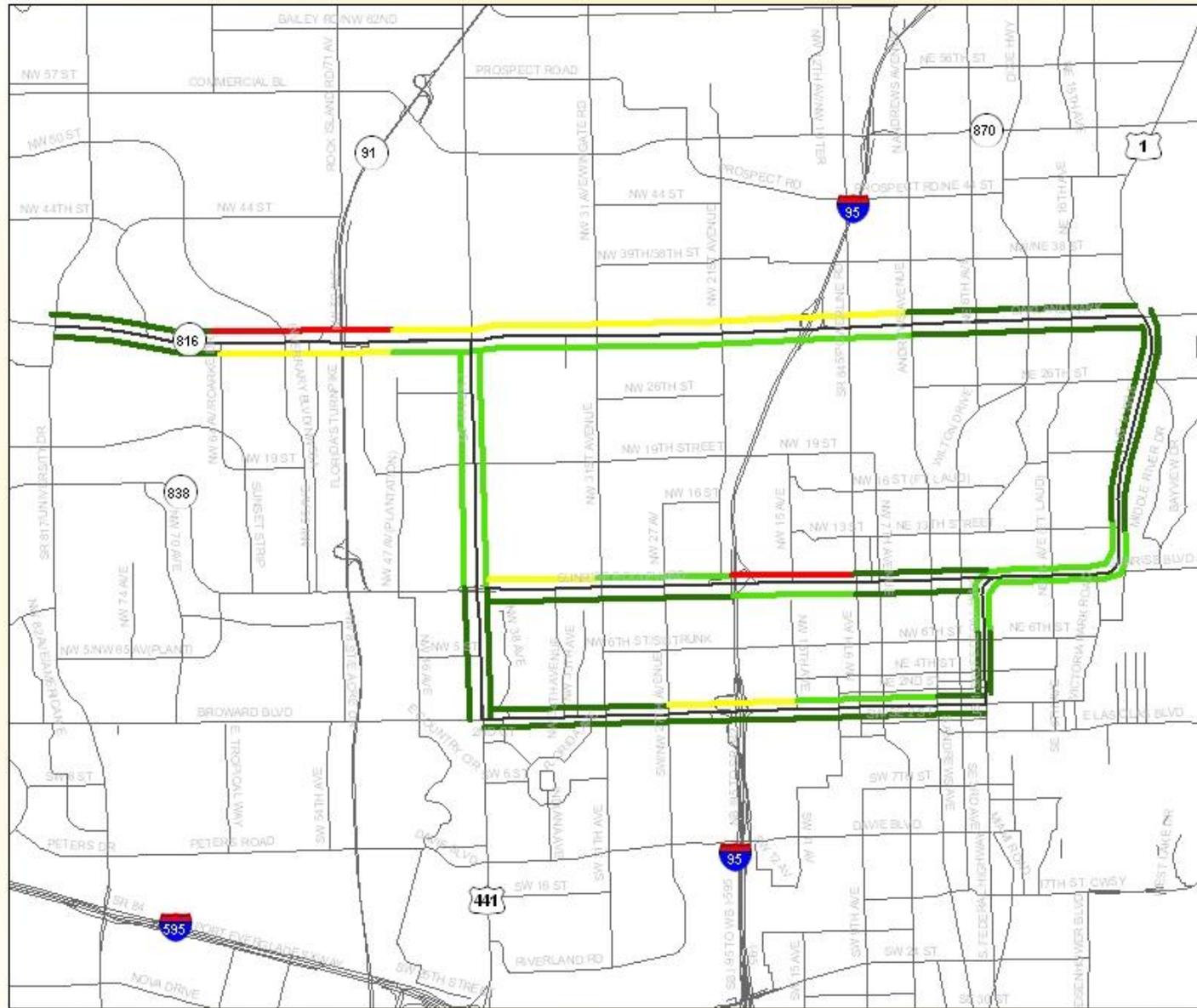


# TSM&O Performance Measurement Report

## Broward County Vehicle Throughput PM Peak

### Legend PTMS Volume PM Peak HOURLY\_AVE

- < 1800
- 1801 - 2199
- 2200 - 2599
- > 2600
- Major Roads
- TSM&O Arterials



# Throughput (Person)

## DEFINITION

Person throughput is defined as the average number of persons traversing an arterial during a given peak period.

## PURPOSE

Person throughput provides information on how effective the TSM&O network is in moving people and goods through the network.

## OBJECTIVE

Increase person throughput on the TSM&O network.

## METHODOLOGY

Person throughput data is based on two data sources: 1) Transit passenger counts provided by Broward County Transit (BCT) on routes within the TSM&O network; and 2) average vehicle occupancy rates provided by the Broward County MPO. Transit passenger counts were taken from October 4<sup>th</sup> through October 8<sup>th</sup>. Transit passenger counts were not available for prior quarters. The person throughput was computed by applying an average vehicle occupancy rate of 1.3773 persons per vehicle to the vehicle throughput results reported in the previous section. The transit passenger counts and the vehicle occupancy volumes were then calculated, and added to obtain the average hourly throughput.

## RESULTS & TRENDS

Table 4 summarizes the person throughput results for the TSM&O network. The values highlighted in red indicate the arterial corridors with the greatest change in person throughput compared to the previous quarter. Figure 7 shows the average hourly person throughput for each peak period, while Figure's 8, 9, and 10 show the differences between average hourly person throughput based on vehicle occupancy and transit passenger counts for the AM peak, midday peak, and PM peak, respectively.

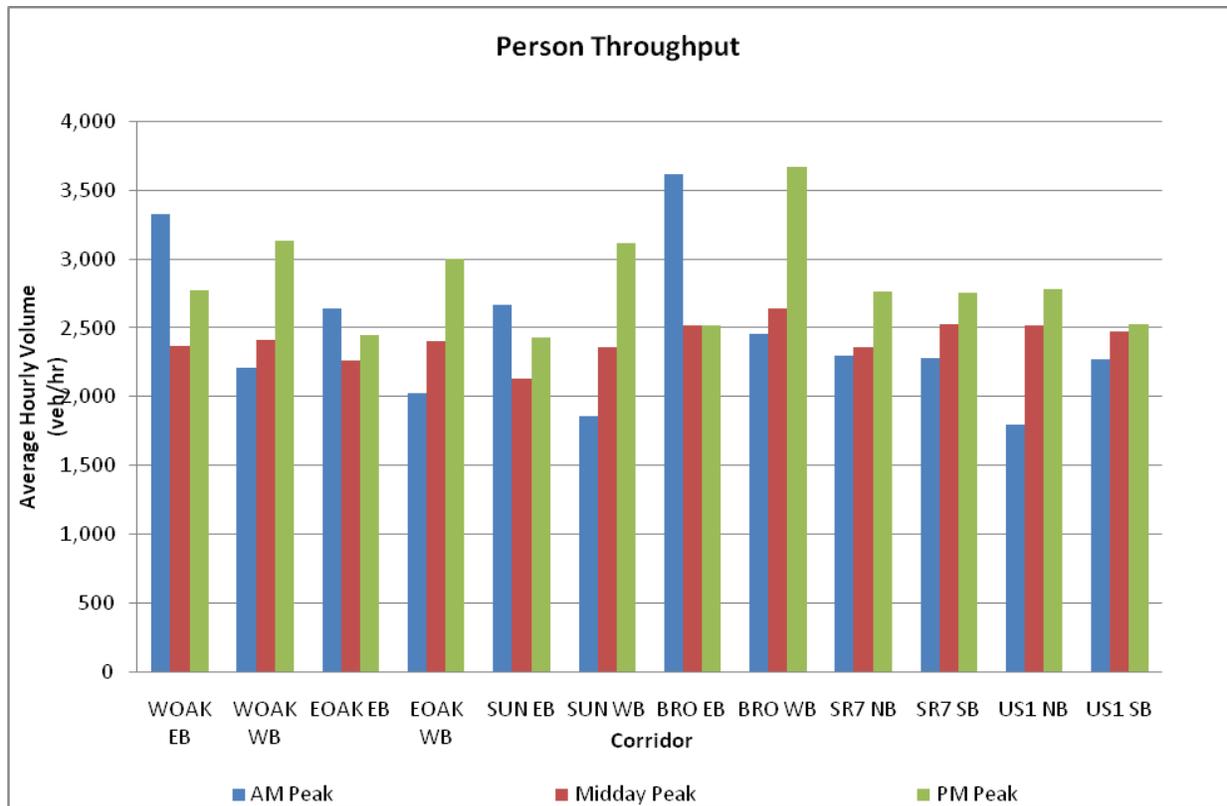
Comparisons between previous quarters was not computed because person throughput for this quarter was based on both the transit counts and the vehicle occupancy counts, while the previous quarters only based the person throughput on vehicle occupancy counts.

The eastbound direction of Broward Boulevard had the greatest AM peak person throughput with 3614. The westbound direction on Broward Boulevard had the greatest throughput during both the midday peak and PM peak with 2638 and 3665, respectively.

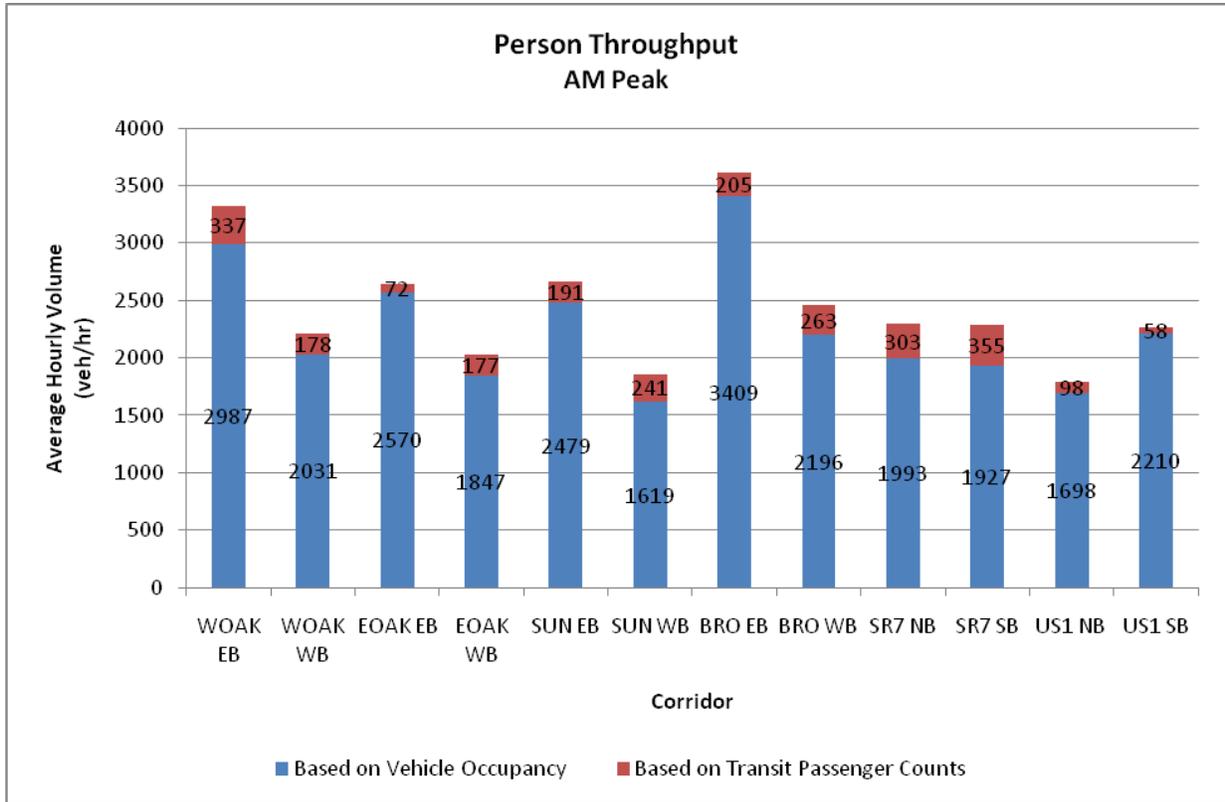
**Table 4. Person Throughput for the TSM&O Network**

ID	Arterial Corridor	Dir	AM Peak Period		Midday Peak Period		PM Peak Period	
			Average Hourly Throughput	Change from Last Quarter	Average Hourly Throughput	Change from Last Quarter	Average Hourly Throughput	Change from Last Quarter
1	Oakland Park Boulevard (West)	EB	3324	N/A	2370	N/A	2770	N/A
		WB	2209	N/A	2415	N/A	3132	N/A
2	Oakland Park Boulevard (East)	EB	2642	N/A	2258	N/A	2448	N/A
		WB	2024	N/A	2401	N/A	2999	N/A
3	Sunrise Boulevard	EB	2670	N/A	2130	N/A	2426	N/A
		WB	1860	N/A	2359	N/A	3112	N/A
4	Broward Boulevard	EB	3614	N/A	2514	N/A	2521	N/A
		WB	2459	N/A	2638	N/A	3665	N/A
5	SR 7 / US 441	NB	2296	N/A	2363	N/A	2761	N/A
		SB	2282	N/A	2522	N/A	2752	N/A
6	US 1 / SR 5	NB	1796	N/A	2519	N/A	2784	N/A
		SB	2268	N/A	2476	N/A	2524	N/A

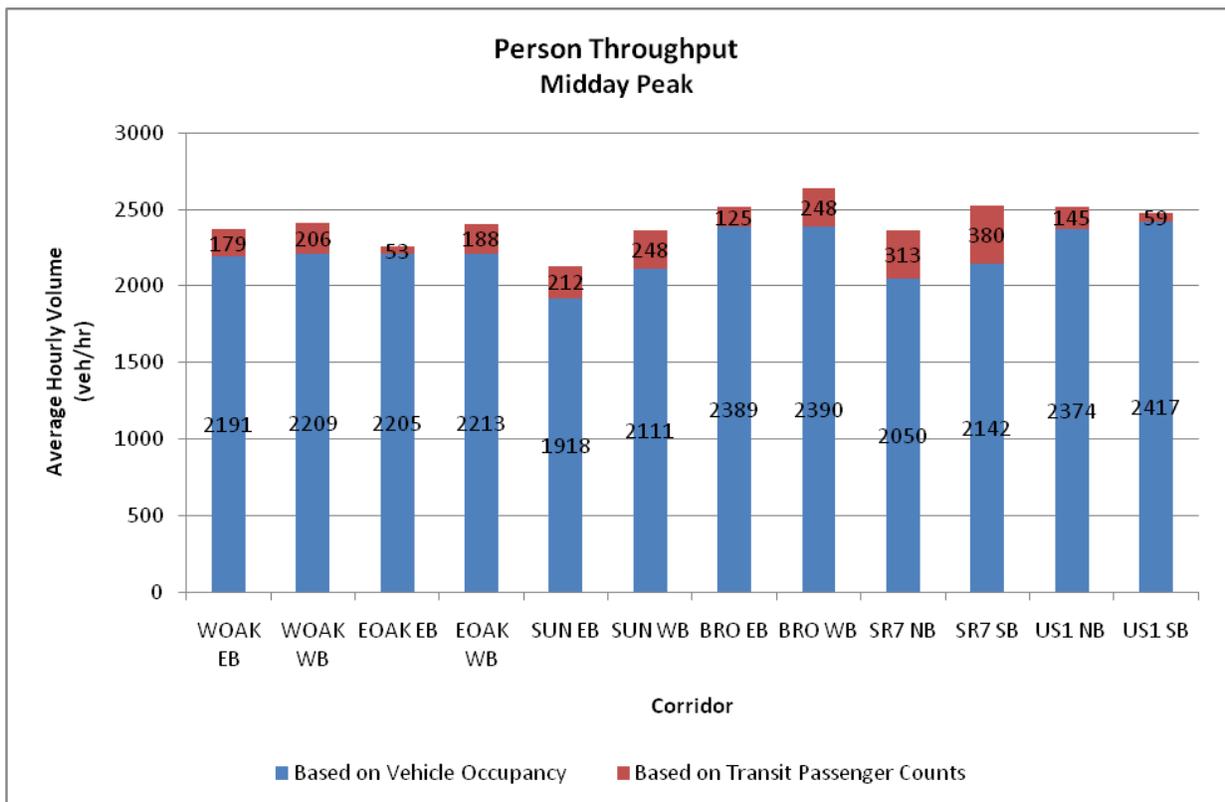
**Figure 7. Person Throughput for the TSM&O Network**



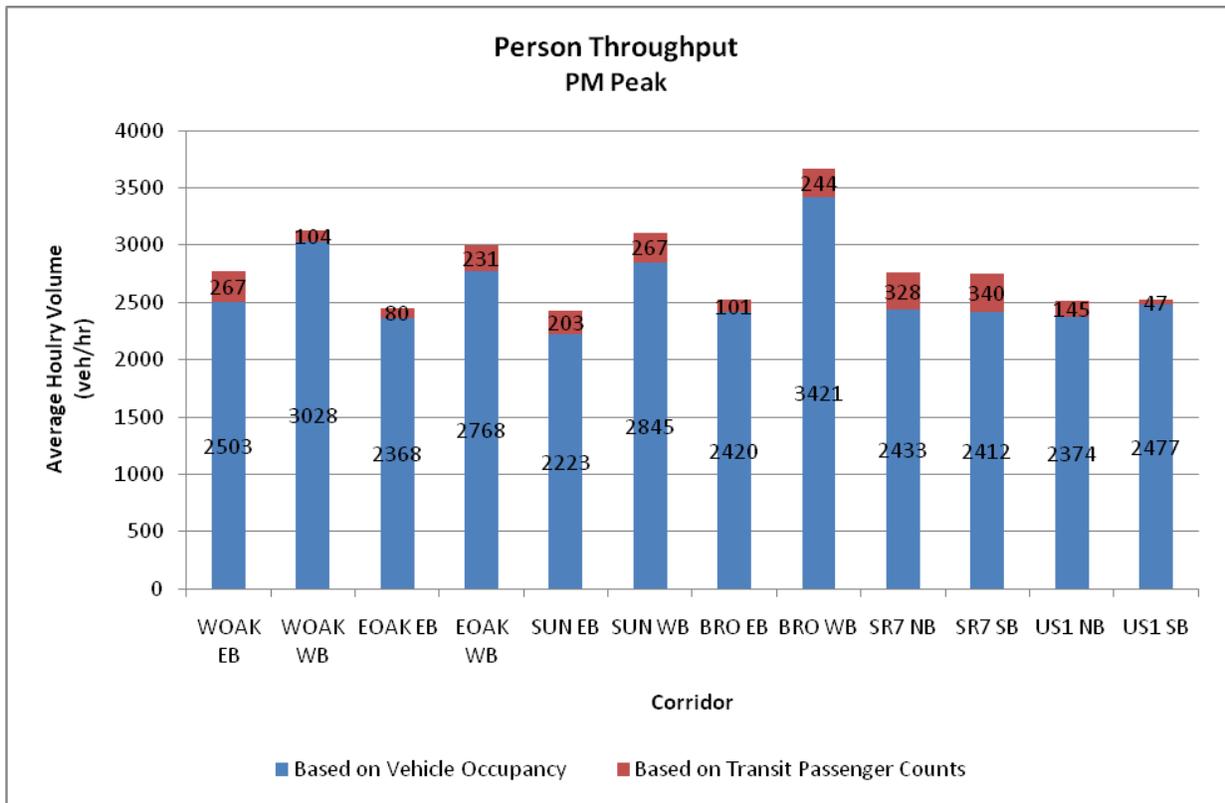
**Figure 8. Person Throughput – AM Peak**



**Figure 9. Person Throughput – Midday Peak**



**Figure 10. Person Throughput – PM Peak**



# Transit Schedule Adherence

## DEFINITION

Transit schedule adherence (or on-time performance) is a measure of a bus' ability to adhere to a published schedule. A transit vehicle operating along a fixed route is considered "on-time" if it departs from its scheduled location no more than five (5) minutes early or late.

## PURPOSE

Report a qualitative measure of the impact that the TSM&O network has on transit schedule adherence over time.

## OBJECTIVE

To track the extent to which fixed route transit vehicles adhere to their pre-determined schedules.

## METHODOLOGY

Broward County Transit operates the following local bus routes along the arterials included in the Broward County TSM&O network:

- Route 10 serving US 1
- Route 18 serving SR 7/US 441
- Route 22 serving Broward Boulevard
- Route 36 serving Sunrise Boulevard
- Route 72 serving Oakland Park Boulevard
- Route 441 Breeze serving SR 7/US 441

Transit schedule adherence data for these routes is collected by Broward County Transit (BCT), who runs the report through their Automated Passenger Count (APC) system. BCT is in process of installing an Automatic Vehicle Location (AVL) system, which will be used to report transit schedule adherence when it is operational. FDOT coordinated with BCT to ensure that buses equipped with APC were assigned to the routes within the TSM&O network for the duration of the data collection period.

Data collected includes the number and percent of Very Early Departures (more than 5 minutes early), Early Departures (0 to 5 minutes early), On-time Departures (0 to 5 minutes late), Late Departures (5 to 10 minutes late), and Very Late Departures (more than 10 minutes late). Transit schedule adherence is calculated based on the percent of early and on-time departures (i.e., no more than five minutes early or late). Currently, Broward County Transit has targets

aimed at eliminating *all* early departures. A target for eliminating late departures should be established by the TSM&O Task Team.

## RESULTS & TRENDS

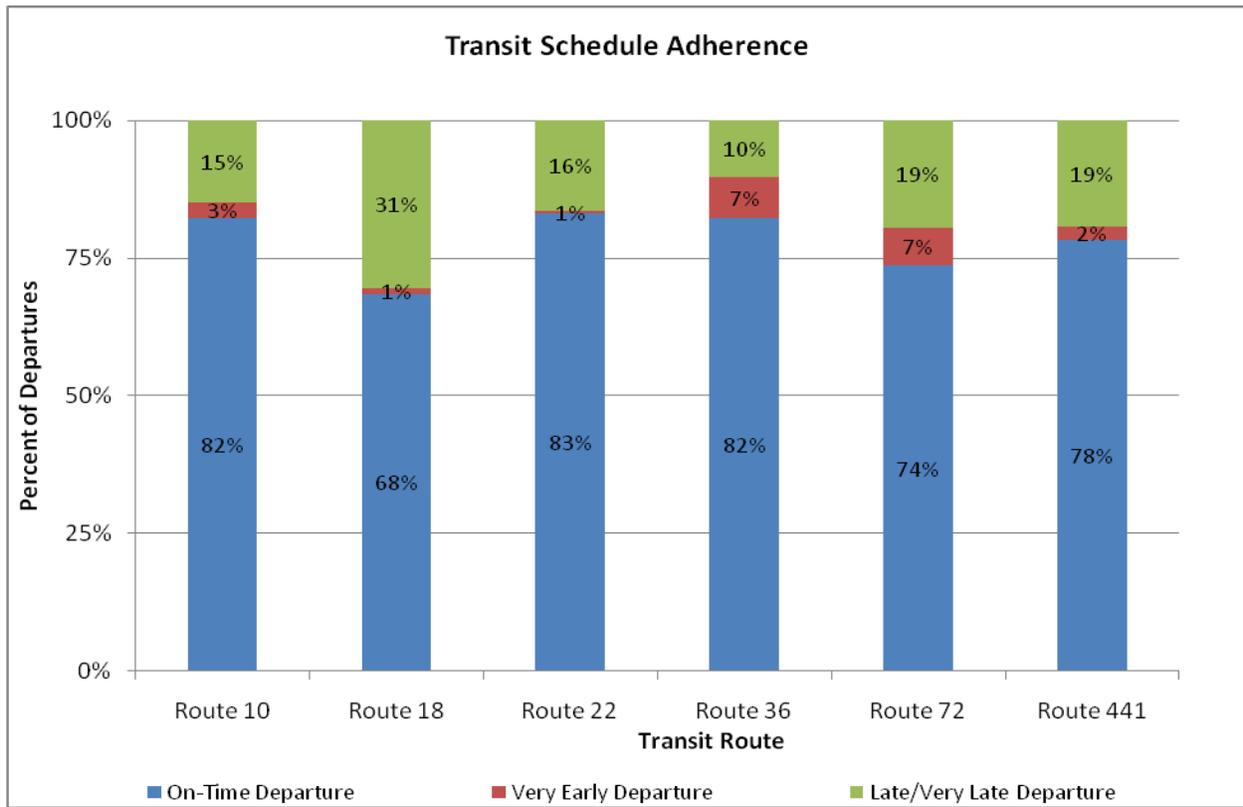
Broward County Transit reported ongoing problems with their APC system; therefore, the transit schedule adherence data was not available prior to October 2010. Table 5 summarizes the transit schedule adherence results for last quarter. The values highlighted in red indicate the routes with the worst performance in terms of on-time departure, very early departure, and late/very late departure (for last quarter). Figure 11 shows the transit schedule adherence results graphically for each route.

Route 22 had the best on-time departure performance, with 83 percent of departures occurring within 5 minutes of the scheduled departure time. Route 18 operating on SR 7 had the worst on-time performance, with 68.5 percent. BCT asks that patrons arrive at their bus stop 5 minutes prior to the bus' scheduled arrival; therefore, the very early departures (more than 5 minutes early) should be avoided. However, some routes continue to have very early departures, particularly Route 36 on Sunrise Boulevard, with 7.4 percent of departures occurring more than 5 minutes early. Route 18 on SR 7 had the most late or very late departures, with 30.5 percent of departures occurring more than 5 minutes late.

**Table 5. Transit Schedule Adherence for the TSM&O Network**

Route	Local Road Served	Percent On Time Departure (Within 5 minutes)		Percent Very Early Departure (More than 5 min early)		Percent Late/Very Late Departure (More than 5 min late)	
		This Quarter	Last Quarter	This Quarter	Last Quarter	This Quarter	Last Quarter
10	US-1: Broward Blvd. to Oakland Park Blvd.	82.2%	N/A	2.9%	N/A	15.0%	N/A
18	SR 7: Broward Blvd. to Oakland Park Blvd.	68.5%	N/A	1.0%	N/A	30.5%	N/A
22	Broward Blvd.: SR 7 to Andrews Ave.	83.0%	N/A	0.5%	N/A	16.4%	N/A
36	Sunrise Blvd.: SR 7 to US-1	82.2%	N/A	7.4%	N/A	10.4%	N/A
72	Oakland Park Blvd.: University Dr. to US-1	73.6%	N/A	6.9%	N/A	19.5%	N/A
441	SR 7: Broward Blvd. to Oakland Park Blvd.	78.2%	N/A	2.4%	N/A	19.4%	N/A
<b>Average</b>		<b>83.0%</b>	N/A	<b>4.9%</b>	N/A	<b>12.1%</b>	N/A

Figure 11. Transit Schedule Adherence for the TSM&O Network



# Number of Incidents and Incident Duration

## DEFINITION

Incident duration is defined as the period of time from when the agency is first notified or observes an incident to the time when the incident is resolved and the arterial travel lanes are cleared.

## PURPOSE

Incident duration is included as a performance measure to help identify possible causes of delay on arterials.

## OBJECTIVE

Reduce the number and duration of incidents on critical arterial segments in the TSM&O network.

## METHODOLOGY

Incident duration data is obtained from the Broward County Sheriff's Office and the City of Fort Lauderdale, as well as travel time run volunteers as they conduct travel time runs along the corridors. Data is also obtained from the SunGuide Transportation Management Center incident logs, as Road Ranger Service Patrol provides service on a portion of Oakland Park Boulevard from University Drive to US 1. This area is monitored during the peak hours of 6 a.m. to 9 a.m. and 4 p.m. to 7 p.m., Monday through Friday.

As part of the travel time data collection effort, volunteers keep a log of incidents observed while they are conducting travel time runs. The start time is recorded as the time they pass by the incident, while the clearance time is recorded as the time they observe the incident has cleared. Incident duration is calculated as the difference between the incident start time and the time the incident is cleared, as shown in the following equation:

$$\text{Incident Duration} = \text{Incident Clearance Time} - \text{Incident Start Time}$$

## RESULTS & TRENDS

Table 6 summarizes the incident duration results for the Broward County TSM&O network. The values highlighted in red indicate the arterial corridors with the highest incident duration. The location and type of incident are also depicted on the map on the following page.

There were 6 incidents that occurred on the Broward County TSM&O network, with an average incident duration of 8 minutes. The average incident duration has increased from last quarter's incident duration of 3 minutes and 7 seconds. The incident with the highest duration occurred

during the PM peak period on westbound Oakland Park Boulevard (West), near SR 7. The incident lasted for 13 minutes and was a crash involving 2 vehicles.

**Table 6. Incident Duration for the TSM&O Network**

Corridor ID	Corridor	Location	Date	Type of Incident	Incident Start Time (hr:min)	Incident Clearance Time (hr:min)	Incident Duration (hr:min)	No. of Incidents	Incident Duration	Last Quarter	Change from Last Quarter (min:sec)
1	Oakland Park Blvd (West)	NW 31st Avenue	10/5/10	Disabled Vehicle	6:41	6:48	0:06	3	0:07:25	0:10:00	0:10:00
1	Oakland Park Blvd (West)	NW 31st Avenue	10/5/10	Disabled Vehicle	17:23	17:26	0:02				
1	Oakland Park Blvd (West)	SR 7	10/5/10	Crash	18:18	18:31	0:13				
2	Oakland Park Blvd (East)	I-95	10/5/10	Disabled vehicle	16:41	16:44	0:03	2	0:06:55	0:00:30	0:00:30
2	Oakland Park Blvd (East)	US-1	10/5/10	Disabled Vehicle	18:48	18:58	0:10				
3	Sunrise Blvd				0:00	0:00	0:00	0			0
4	Broward Blvd	1900 W Broward Blvd	5-Oct	Crash	17:06	17:16	0:10	1	0:10:00	0:01:00	0:09:00
5	SR 7				0:00	0:00	0:00	0			0
6	US-1				0:00	0:00	0:00	0		0:01:00	0:01:00
							<b>0:05:07</b>	<b>6</b>	<b>0:08:07</b>	<b>0:03:07</b>	<b>0:04:59</b>

# TSM&O Performance Measurement Report

## Broward County Incident Locations

**Legend**

**Incident Locations**

Type of Incident

-  Crash
-  Disabled Vehicle
-  Other

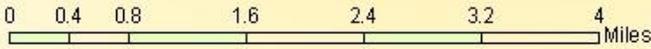
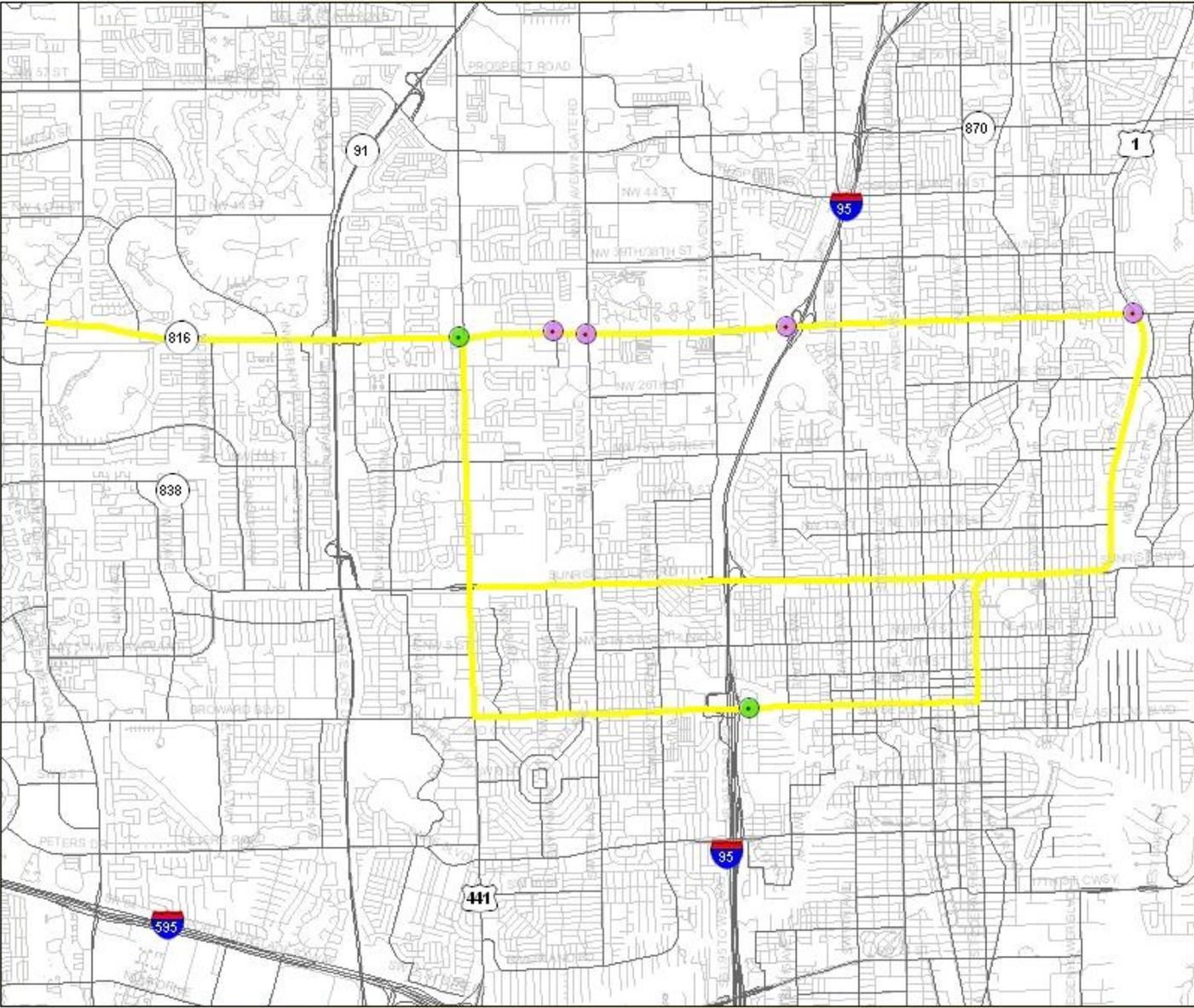
 TSM&O Aerial Corridor

 Major Road

 Road



 Map Area



# Signal System Health

## DEFINITION

Signal system health is defined as the number of signals that went offline or lost communication with the central computer located in the Broward County Traffic Management Center. When a signal falls offline, it essentially loses coordination with adjacent signals on the arterial network, which causes user delay.

## PURPOSE

Signal system health provides information on the effectiveness of active signal system operation/management strategies.

## OBJECTIVE

Reduce the impact of signal system failures on traffic operations on critical arterial segments in the TSM&O network.

## METHODOLOGY

Signal system health is based on traffic signal failure data collected by Broward County Traffic Engineering. This data is routinely collected for all signalized intersections in the county, and includes the date and time of the failure, as well as the type of failure (see Table 7). For all Failure IDs except 0, 10 and 15, it is assumed that communications is lost. For Failure IDs 0, 10 and 15, if the failure is chronic, it could lead to communications failure.

Traffic signal failure data were obtained from Broward County for signalized intersections located along the Broward County TSM&O network. The data were obtained for the period from October 5-6, 2010, then parsed to isolate those signal failures occurring during the peak periods for the network, defined as follows:

AM peak: from 7 a.m. to 9 a.m.

Midday peak: from 11:30 a.m. to 1:30 p.m.

PM peak: 4 p.m. to 6 p.m.

The total number of signal system failures was then computed by peak period for each arterial corridor. These include all signal system failures (failure IDs 0, 1, 10, 13, 15, 18, 50 and 51). Controller preemption failures (failure ID 60 and 61) are reported separately.

**Table 7. Signal System Failure Codes**

Failure ID	Description/Cause	Description/Cause
0	Automatic Repair	Every 15 minutes the central computer checks to see if the signals are online and if they are not, it automatically brings them back online.
1	No Communication Response	Central computer sent a command to the signal and the signal did not respond.
10	Controller Stuck	
13	Offset Synchronization Failure	Signal was unable to reach the predefined offset in the allotted amount of time. This can happen when the signal is transitioning between timing patterns.
15	Excessive Clearance Time	
18	Flash	Signal is flashing yellow. Signals are sensitive to changes in voltage, making them vulnerable to lightening and power surges.
50	Maintenance Preemption Finished	Police officer may be manually operating the signal or a technician may be working on the signal.
51	Maintenance Preemption in Progress	
60	Controller Preemption Finished	An emergency vehicle or a train is passing through an intersection causing the signal to turn red for the opposing movements.
61	Controller Preemption In Progress	An emergency vehicle or a train is passing through an intersection causing the signal to turn red for the opposing movements.

## RESULTS & TRENDS

Table 8 summarizes the signal system health performance for the TSM&O Network. The values highlighted in red indicate the arterial corridors with the highest number of signal failures during each peak period. The location and number of signal system failures are also shown on maps for each peak period.

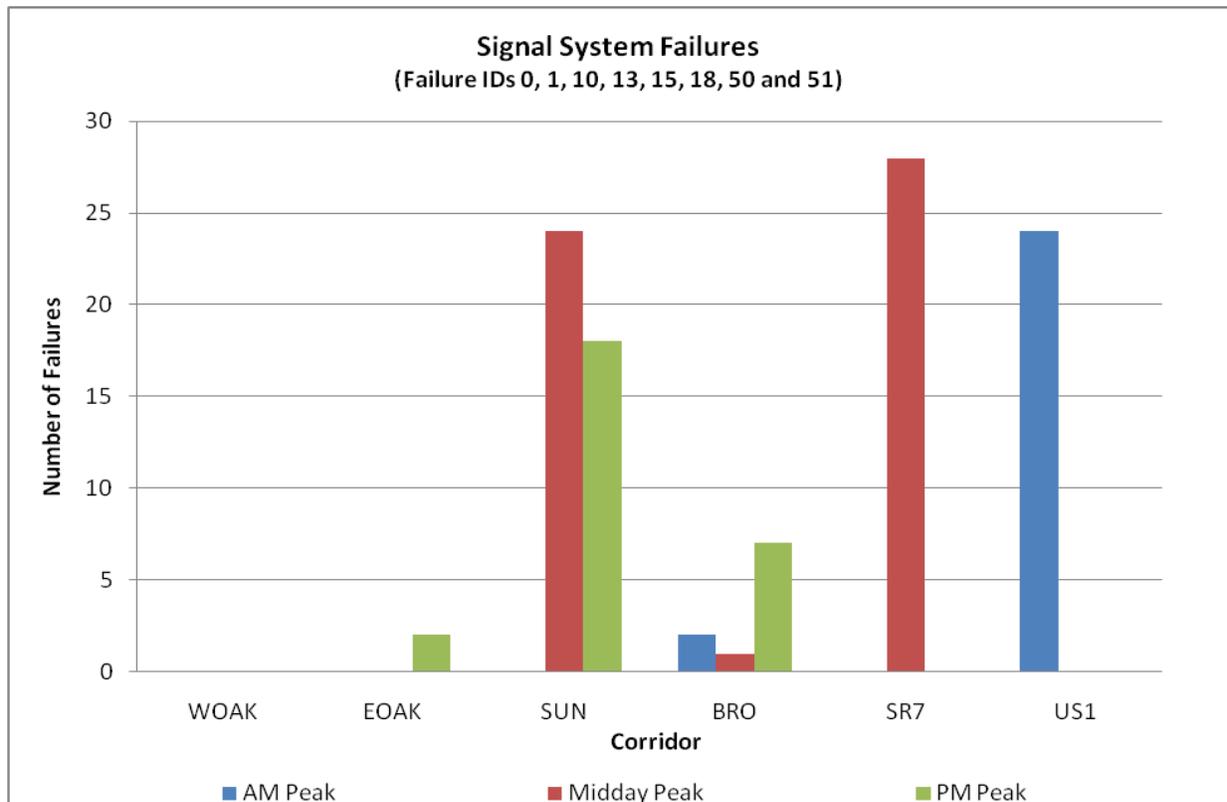
There were 26 signal failures during the AM peak period, with US 1/SR 5 experiencing the highest number of failures at 24. During the midday peak, there were 53 total signal failures, with SR 7/US 441 experiencing the highest number of failures at 28. During the PM peak, there were 27 total signal failures, with Sunrise Boulevard experiencing the highest number of failures at 18.

There were a total of 106 traffic signal failures for the entire duration of the data collection period, which is an increase of 58 from last quarter.

**Table 8. Signal System Health for the TSM&O Network**

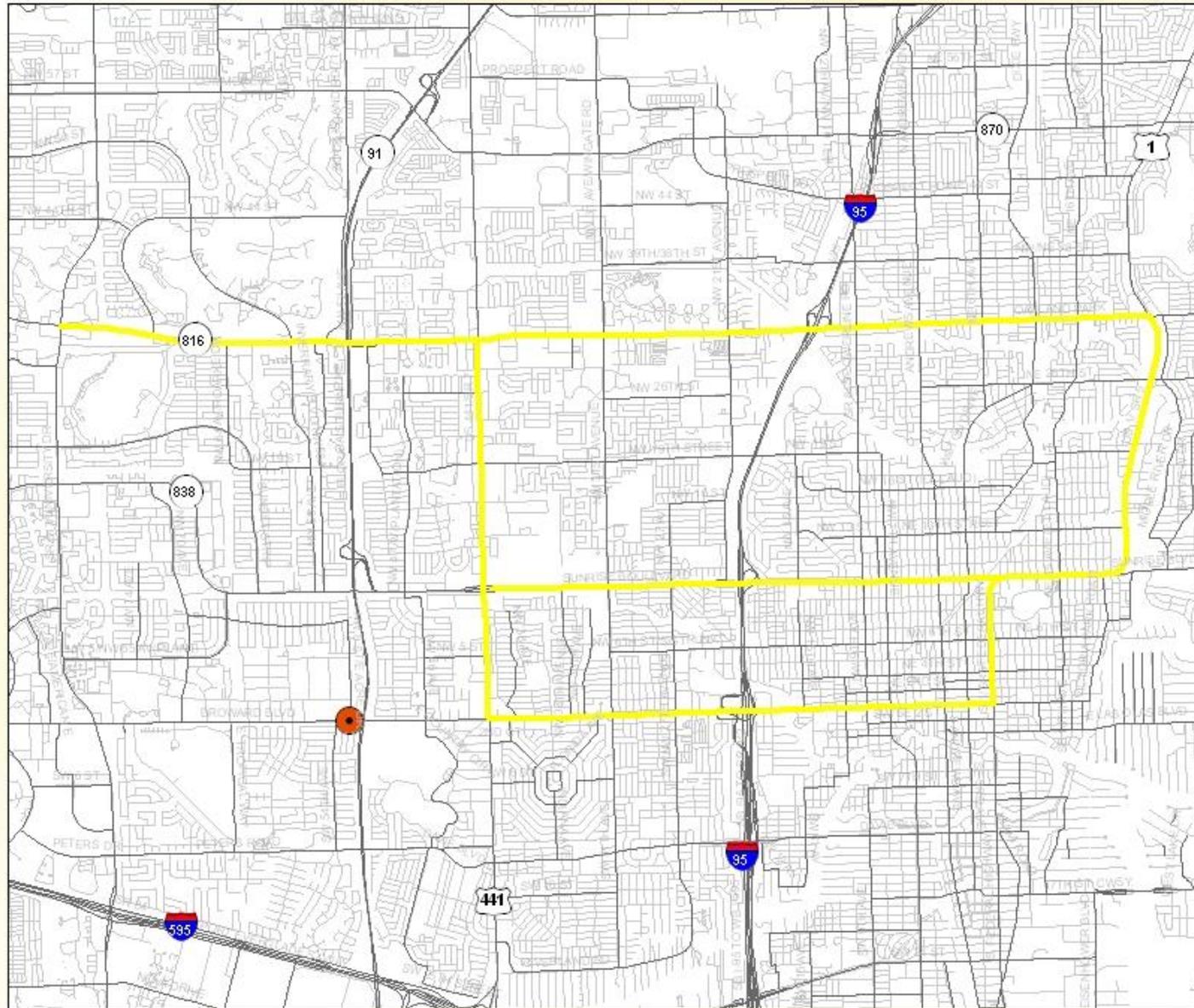
ID	Corridor	AM Peak			Midday Peak			PM Peak		
		Number of Pre-emptions	Number of Failures	Change from Last Quarter	Number of Pre-emptions	Number of Failures	Change from Last Quarter	Number of Pre-emptions	Number of Failures	Change from Last Quarter
1	Oakland Park Boulevard (West)	6	0	0	14	0	0	14	0	0
2	Oakland Park Boulevard (East)	34	0	-22	50	0	-4	46	2	-2
3	Sunrise Boulevard	46	0	0	67	24	24	30	18	14
4	Broward Boulevard	18	2	-10	120	1	-1	28	7	7
5	SR 7 / US 441	34	0	0	16	28	28	12	0	0
6	US 1 / SR 5	0	24	24	0	0	0	0	0	0
<b>Total</b>		<b>138</b>	<b>26</b>	<b>-8</b>	<b>267</b>	<b>53</b>	<b>47</b>	<b>130</b>	<b>27</b>	<b>19</b>

**Figure 12. Signal System Failures for the TSM&O Network**



# TSM&O Performance Measurement Report

## Broward County AM Peak Signal System Health



**Legend**

**Signal Health**

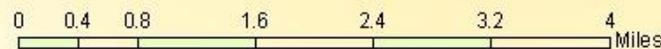
**Fall Rate**

- 1
- 7

— TSM&O Arterial Corridor

— Major Roads

— Roads



# TSM&O Performance Measurement Report

## Broward County Midday Peak Signal System Health

**Legend**

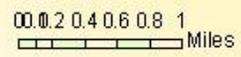
**Signal Health**  
Fail Rate

- 1 - 4
- 5 - 9

— TSM&O Arterial Corridor

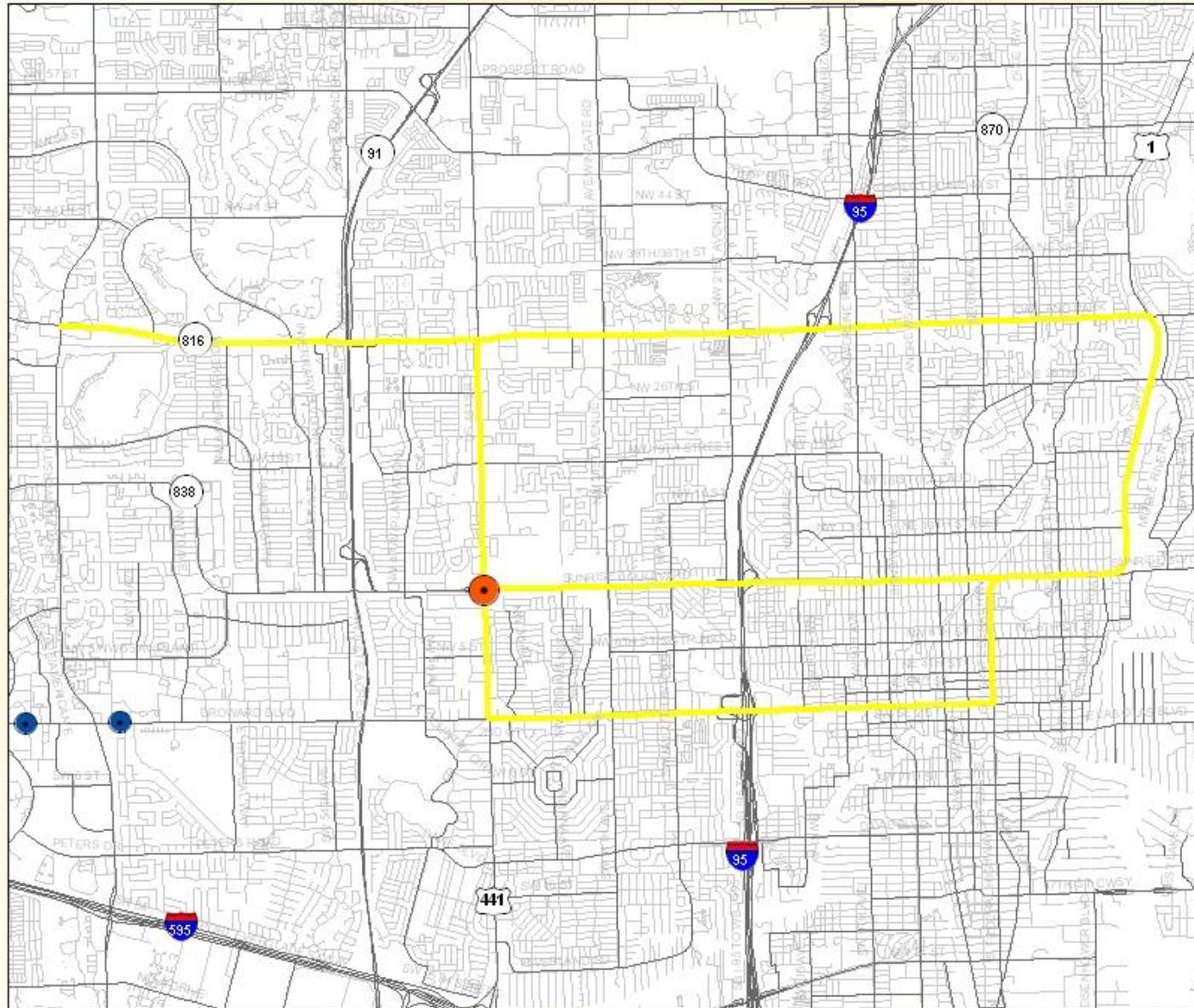
— Major Roads

— Roads



# TSM&O Performance Measurement Report

## Broward County PM Peak Signal System Health



**Legend**

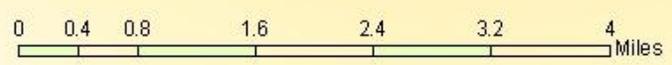
**Signal Health**  
Fail Rate

- Blue circle: 1-2
- Red circle: 3-9

Yellow line: TSM&O Aerial Corridor

Thick grey line: Major Roads

Thin grey line: Roads



# Work Zone Characteristics

## **DEFINITION**

Work zone characteristics describe the planned construction projects and other maintenance activities occurring on the TSM&O network during the data collection time period.

## **PURPOSE**

Work zone characteristics is included as a performance measure to help identify possible causes of delay on arterials.

## **OBJECTIVE**

Reduce the impact of work zones on traffic operations on critical arterial segments in the TSM&O network.

## **METHODOLOGY**

FDOT is aware of major construction projects, and travel time volunteers also observe maintenance activities while they are conducting travel time runs.

## **RESULTS & TRENDS**

There were no construction or work zone activities observed or ongoing during the data collection time period for the Broward TSM&O Network.

# Air Quality

## DEFINITION

This measure describes the quality of the air at a given location on the TSM&O network.

## PURPOSE

Air quality is a measure of the effectiveness of TSM&O strategies in reducing greenhouse gas emissions.

## OBJECTIVE

Reduce greenhouse gas emissions on critical arterial segments in the TSM&O network.

## METHODOLOGY

Air quality data is obtained from Broward County's Pollution Prevention, Remediation and Air Quality Division, which manages several air quality measurement stations throughout the county, as shown in Figure 13. For purposes of TSM&O performance reporting, air quality data is obtained for Station 28, which is located on Sunrise Boulevard within the limits of the Broward County TSM&O network. This station collects Carbon Monoxide (CO), Sulfur Dioxide (SO<sub>2</sub>), and Particulate Matter (PM-10). Broward County currently measures air quality every 6 days at Station 28, but will eventually implement continuous data collection.

Air quality data was obtained from Station 28 for the data collection period, October 14-15, 2009.

## RESULTS & TRENDS

Table 9 summarizes air quality results for the TSM&O network during the data collection period, along with the change compared to last quarter. The maximum allowable guidelines for emissions are as follows:

- CO Max Allowed: 9 ppm
- SO<sub>2</sub> Max Allowed: 0.14.ppm
- PM-10 Max Allowed: 150 µg/m<sup>3</sup>

<<Insert observations regarding air quality results and trends compared to last quarter. Example as follows.> CO, SO<sub>2</sub>, and PM-10 emissions for the Broward County TSM&O network were all within the maximum allowable guidelines.

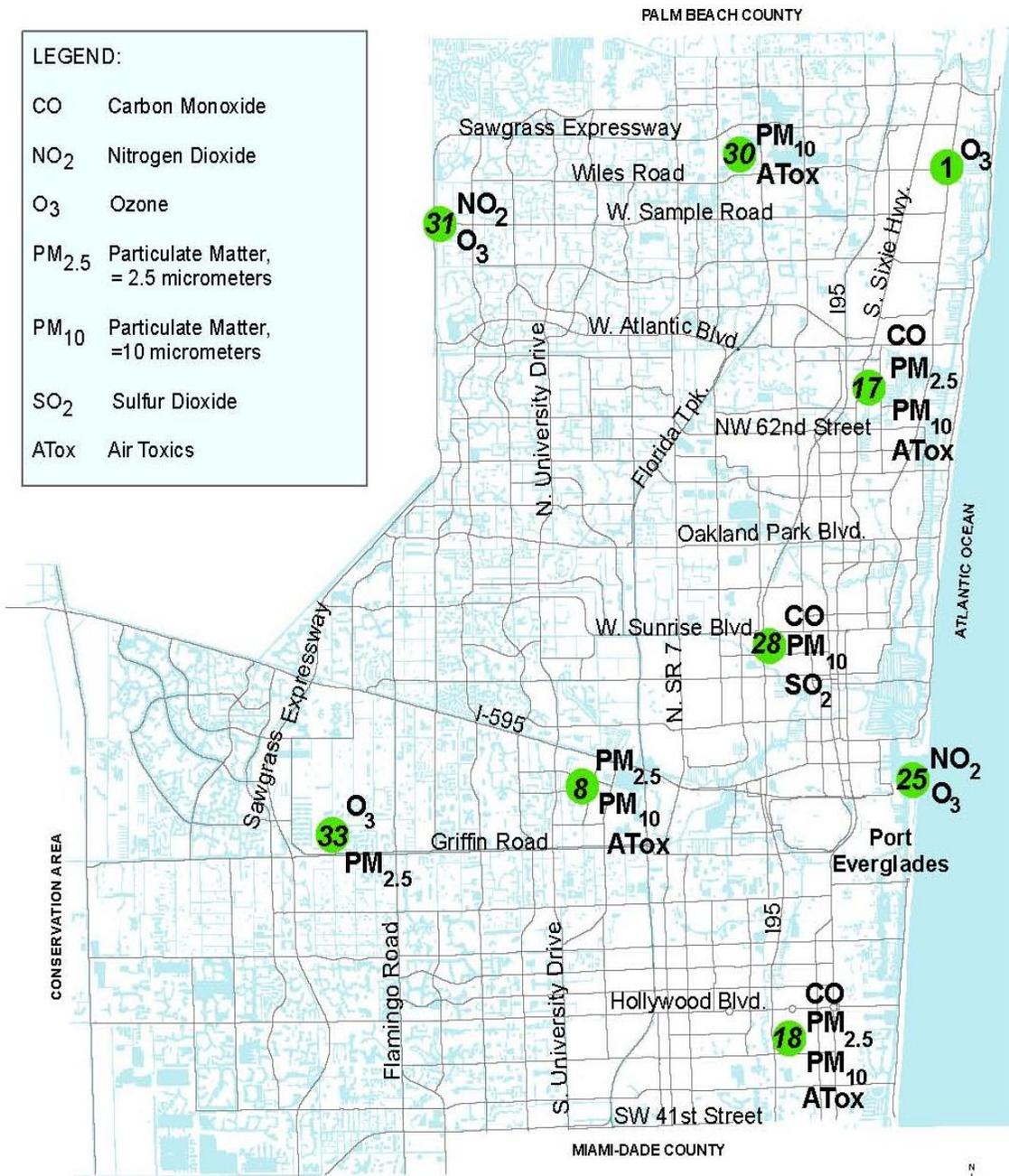
**Table 9. Air Quality for the TSM&O Network**

	Carbon Monoxide (CO) Ppm		Sulfur Dioxide (SO <sub>2</sub> ) ppm		Particulate Matter (PM-10) µg/m <sup>3</sup>	
	This Quarter	Change from Last Quarter	This Quarter	Change from Last Quarter	This Quarter	Change from Last Quarter
Minimum Observed						
Mean Observed						
Maximum Observed						
<b>Maximum Allowed</b>	<b>9</b>		<b>0.14</b>		<b>150</b>	

# Broward County Air Quality Monitoring Network

**LEGEND:**

CO	Carbon Monoxide
NO <sub>2</sub>	Nitrogen Dioxide
O <sub>3</sub>	Ozone
PM <sub>2.5</sub>	Particulate Matter, = 2.5 micrometers
PM <sub>10</sub>	Particulate Matter, =10 micrometers
SO <sub>2</sub>	Sulfur Dioxide
ATox	Air Toxics



Updated: May 2008



Environmental Protection & Growth Management Department

Figure 9. Broward County Air Quality Monitoring Site Locations

# Resources Spent

## DEFINITION

This measure describes the additional funding required to support data collection for quarterly TSM&O performance measure reporting for the jurisdiction, including labor, equipment, annual expenditures, etc. This measure excludes data that is currently collected/reported by other agencies (e.g., transit schedule adherence, transit passenger count data for person throughput, traffic signal system health, air quality, and work zone characteristics), or that is collected by travel time run volunteers (e.g., travel time index, arterial travel time delay, number of incidents, and incident duration).

## PURPOSE

Resources spent tracks the additional funding required to support data collection for quarterly TSM&O performance reporting.

## OBJECTIVE

Minimize resources spent to support data collection for quarterly TSM&O performance reporting.

## METHODOLOGY

For the October data collection period, the Department reported on the additional funding required to collect traffic volume data at 20 PTMS locations for purposes of calculating vehicle throughput. Resources spent is calculated as the average cost for data collection per site multiplied by the number of sites, as shown in the following equation:

$$\text{Resources Spent} = \text{Average Cost per Site for Data Collection} \times \text{Number of PTMS Locations}$$

## RESULTS & TRENDS

Table 10 summarizes the Resources Spent to collect the data for Vehicle Throughput. The total cost was \$7,119.87. This amount is unchanged compared to last quarter.

**Table 10. Resources Spent for the TSM&O Network**

	Average Cost per Site for Data Collection	Number of PTMS Locations	Total Cost
<Jurisdiction>	\$355.99	20	\$7,119.87

A task work order was also used to obtain the required travel time information for October 2010. The total amount for the task work order was **\$13,061.14**.