BENEFIT/COST ANALYSIS

IN SUPPORT OF THE TIGER VII APPLICATION

Intelligent Transportation Systems (ITS) for Traffic Monitoring, Traffic Management and Parking Management

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Prepared by:

MIAMIBEACH

Table of Contents

1 Executive Summary 1

2 Introduction 5

3 Project Costs 9

4 Project Benefits 10

4.1 State of Good Repair 10
4.2 Economic Competitiveness 11
4.3 Quality of Life 13
4.4 Environmental Sustainability 14
4.5 Safety 15

5 Cost Share 16

6 References 16

List of Tables

Table 1-1 Summary of Infrastructure Improvements and Associated Benefits of ITS Implementation 2
Table 1-2 Summary of Infrastructure Improvements and Associated Benefits of PMS Implementation .. 3
Table 1-3 Summary of Project Costs and Anticipated Funding Sources, in 2015 Dollars 4
Table 2-1 Benefits and Description by Evaluation Criteria 6
Table 2-2 Summary of Monetized Benefits and Costs, Non Discounted for ITS Implementation 7
Table 2-3 Summary of Monetized Benefits and Costs, Non Discounted for PMS Implementation 8
Table 2-4 Summary of Total Monetized Benefits and Costs, Non Discounted 9
Table 4-1 Idling Fuel Consumption 12
Table 4-2 Light Duty Gas Vehicle Emission Rates 14
Table 4-3 Value of Air Quality Improvements by Tons of Pollutants Reduced 14
Table 4-4 Light Duty Gas Vehicle Emission Rates 15
Table 4-5 Value of Air Quality Improvements by Tons of Pollutants Reduced 15

List of Appendices

Appendix A. Costs Calculations

1 Executive Summary

The TIGER VII funds being requested are for the implementation of an Intelligent Transportation System (ITS) and Parking Management Systems (PMS) within the City of Miami Beach. The project is intended to be implemented in three (3) phases. The first phase will consist of the ITS and PMS Implementation and Phase II will consist of the implementation of Adaptive Traffic Signal Control.

The implementation of the ITS will consist of:

Phase I

ITS

- Installation of travel time estimating Bluetooth/Wi-Fi readers on selected corridors throughout the City.
- Implementation of a Traveler Information System consisting of the installation of various Dynamic Message Signs (VMS) on selected areas throughout the City.
- Development of a Traffic Monitoring Center

PMS

- Installation of parking sensors for individual parking spots on 35 parking lots and two (2) corridors within the City.
- Installation of Interactive DMS or similar sign on entry point, to show real-time parking information, on 10 parking garages and 35 parking lots within the City
- Development of the Miami Beach Traffic and Parking Application which will provide information on traffic conditions, travel times, incidents, road closures and available parking for both garages and the lots

Phase II

- Installation of Adaptive Traffic Control Systems (ATCS) on various principal corridors throughout the City.

The implementation of this project will allow the City of Miami Beach to effectively monitor and manage traffic during times where the transportation network cannot meet traffic demand using the existing and innovative traffic control technologies. The Project will improve traffic conditions, travel times, safety, and transportation reliability with a sustainable approach by accommodating variable and unpredictable existing traffic demands typical of the City.

As per DOT guidance, although the implementation of ITS and PMS are intended toward the same objective within the City, the benefits and costs of each of the two components of the project were quantified separately to better determine the financial and economic feasibility of the project. The following table presents a summary of the changes that would be provided by the project and the benefits expected from them.

Table 1-1 Summary of Infrastructure Improvements and Associated Benefits of ITS Implementation

Current Status/Baseline & Problem to be Addressed	Changes to Baseline/ Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefits	Summary of Results	Page #
Heavy vehicular volumes on City's arterial and collector roadway network during regular travel days and special event days currently managed only by standard traffic control infrastructure	Installation of ATCSs, travel estimating sensors, Travel Time Data Collectors, Dynamic Message Signs, Mobile Phone Traffic Application	Decreased vehicular travel times and delays, reduced vehicle operation and thus reduced fuel consumption and emissions, decreased accident frequency	City residents, commuters, visitors, and tourists	Monetized value of reduced travel times, reduced fuel consumption, reduced emissions (GHG and Non-GHG), and reduced law enforcement wages for special events	The estimated monetized benefits for these components contribute to 51% of the overall benefit of $37,948,308 at a 7% discount rate and $53,799,056 at a 3% discount rate	7,9,10, 11

Table 1-2 Summary of Infrastructure Improvements and Associated Benefits of PMS Implementation

Current Status/Baseline & Problem to be Addressed	Changes to Baseline/ Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefits	Summary of Results	Page #
No current real-time parking availability information	Installation of parking spot presence sensors and Dynamic Message Signs. Upgrade of existing Park-Me Mobile Application to provide real time information	Reduced parking search times for everyday trips and for special event trips, and decreased accident frequency	City residents, commuters, visitors, and tourists	Monetized value of reduced travel times, reduced fuel consumption, and reduced emissions (GHG and Non-GHG)	The estimated monetized benefits for these components contribute to 49% of the overall benefit of $35,738,126 at a 7% discount rate and $51,006,582 at a 3% discount rate	8, 9, 10, 11

The period of analysis used in the estimation of benefits and costs corresponds to 21 years, 1 year of implementation and 20 years of operation. The total implementation cost of the project is **$14,578,830** and **$20,423,298** is needed for Operations and Maintenance over the 20 year operation period. The following table summarizes the total costs for the project and displays the distribution for the expected financing of the funds.

Table 1-3 Summary of Project Costs and Anticipated Funding Sources, in 2015 Dollars

	Funding Source	Percent of Total Cost Financed by Source	Total Capital Costs	Total O&M Costs (20 years)
ITS Implementation			$8,020,880	$17,875,280
PMS Implementation			$6,557,950	$2,548,018
ITS & PMS Implementation	Total ITS & PMS Capital Cost	100%	$14,578,830	
	Local	31%	$4,556,590	
	TIGER Request	69%	$10,022,240	

2 Introduction

This document presents a Benefit Cost Analysis (BCA) of the implementation of an Intelligent Transportation System (ITS) and a Parking Management System (PMS) in the City of Miami Beach. It quantitatively compares the benefits against the costs throughout the initial implementation and an operating life of twenty (20) years. The values for benefits and costs are monetized in 2015 dollars, and as per TIGER VII guidance, future dollar values were discounted using a real rate of seven (7) percent and an alternate of three (3) percent.

ITS Implementation:

Present Value of Total Benefits (at 7% discount rate):	$37,948,308
Present Value of Total Costs (at 7% discount rate):	$25,896,160
Benefit-Cost Ratio:	**1.47**

Present Value of Total Benefits (at 3% discount rate):	$53,799,056
Present Value of Total Costs (at 3% discount rate):	$33,123,643
Benefit-Cost Ratio:	**1.62**

PMS Implementation:

Present Value of Total Benefits (at 7% discount rate):	$35,738,126
Present Value of Total Costs (at 7% discount rate):	$9,105,967
Benefit-Cost Ratio:	**3.92**

Present Value of Total Benefits (at 3% discount rate):	$51,006,582
Present Value of Total Costs (at 3% discount rate):	$10,136,203
Benefit-Cost Ratio:	**5.03**

ITS & PMS Implementation:

Present Value of Total Benefits (at 7% discount rate):	$73,686,433
Present Value of Total Costs (at 7% discount rate):	$35,002,128
Benefit-Cost Ratio:	**2.11**

Present Value of Total Benefits (at 3% discount rate):	$104,805,638
Present Value of Total Costs (at 3% discount rate):	$43,259,846
Benefit-Cost Ratio:	**2.42**

The long-term outcomes as specified in TIGER VII selection criteria are presented in the following table along with the societal benefits expected from the implementation of the project.

Table 2-1 Benefits and Description by Evaluation Criteria

Long Term Outcome	Types of Societal Benefits
State of Good Repair	• Increase capacity of the existing roadway network. • Reduce VMT on existing roadway network and thus reduce the wear and tear on existing roadway facilities. • Increase City parking occupancy and potentially increase the reliability of City parking as a revenue source. • Improve local and regional transit.
Economic Competitiveness	• Travel time savings. • Vehicle operation savings. • Reduce need of hiring law enforcement during special events.
Quality of Life	• Increased accessibility through better vehicle routing. • Reduction in commute times and as a result, fuel savings. • Decrease stress levels through providing more convenient ways of finding parking within the City.
Environmental Sustainability	• Optimization of signal timing and traffic flow coordination can reduce vehicle delays and thus reduce emissions. • Reductions in VMT result in reduced emission and fuel consumption benefits.
Safety	• Fewer conflicts between major and minor streets due to better progression from better synchronization and coordination of traffic signals. • Reduction of vehicles “wandering” in search of parking within the network as result of improved guidance on parking availability.

From these criteria, the topics for which sufficient data was obtained, in order to make an "apples to apples" comparison, were economic competitiveness (travel time savings) and environmental sustainability (emissions and fuel consumption reduction). Additionally, the implementation of this project will reduce the need to contract law enforcement to direct the additional traffic demand during the numerous annual special events that take place in the City. Thus the annual cost savings were quantified in law enforcement wages. The following tables present the non-discounted monetized benefits as well as the costs of the project over an operating life of twenty (20) years.

Table 2-2 Summary of Monetized Benefits and Costs, Non Discounted for ITS Implementation

Calendar Year	Travel Time Reduction Benefits	Vehicle Operations (Fuel Consumption) Reduction Benefits	Air Pollution (GHG) Reduction Benefits (CO_2)	Air Pollution (Non-GHG) Reduction Benefits	Law Enforcement Wages Reduction Benefits	Total Benefits	Total Costs (Capital and O&M)
2015							$8,020,880
2016	$2,690,731	$180,613	$467	$4,681	$504,788	$3,381,281	$1,687,300
2017	$2,715,148	$182,252	$482	$4,723	$504,788	$3,407,394	$1,687,300
2018	$2,739,793	$183,906	$498	$4,766	$504,788	$3,433,752	$1,687,300
2019	$2,764,668	$185,576	$514	$4,810	$504,788	$3,460,355	$1,687,300
2020	$2,789,775	$187,261	$530	$4,853	$504,788	$3,487,208	$1,687,300
2021	$2,815,117	$188,963	$547	$4,897	$504,788	$3,514,312	$1,687,300
2022	$2,840,696	$190,679	$563	$4,942	$504,788	$3,541,669	$1,687,300
2023	$2,866,515	$192,413	$580	$4,987	$504,788	$3,569,283	$1,687,300
2024	$2,892,576	$194,162	$598	$5,032	$504,788	$3,597,155	$1,687,300
2025	$2,918,880	$195,928	$615	$5,078	$504,788	$3,625,289	$1,687,300
2026	$2,945,432	$197,710	$645	$5,124	$504,788	$3,653,699	$1,687,300
2027	$2,972,232	$199,509	$651	$5,171	$504,788	$3,682,351	$1,687,300
2028	$2,999,284	$201,325	$657	$5,218	$504,788	$3,711,271	$1,687,300
2029	$3,026,590	$203,157	$688	$5,265	$504,788	$3,740,489	$1,687,300
2030	$3,054,152	$205,008	$707	$5,313	$504,788	$3,769,968	$1,687,300
2031	$3,081,974	$206,875	$726	$5,362	$504,788	$3,799,725	$1,687,300
2032	$3,110,057	$208,760	$745	$5,410	$504,788	$3,829,761	$1,687,300
2033	$3,138,405	$210,663	$765	$5,460	$504,788	$3,860,080	$1,687,300
2034	$3,167,019	$212,584	$785	$5,510	$504,788	$3,890,685	$1,687,300
2035	$3,195,903	$214,522	$806	$5,560	$504,788	$3,921,579	$1,687,300
Totals	**$58,724,947**	**$3,941,866**	**$12,570**	**$102,163**	**$10,095,750**	**$72,877,305**	**$41,766,880**

Table 2-3 Summary of Monetized Benefits and Costs, Non Discounted for PMS Implementation

Calendar Year	Travel Time Reduction Benefits	Vehicle Operations (Fuel Consumption) Reduction Benefits	Air Pollution (GHG) Reduction Benefits	Air Pollution (Non-GHG) Reduction Benefits	Total Benefits	Total Costs (Capital and O&M)
2015						$6,557,950
2016	$2,935,513	$112,401	$547	$6,362	$3,054,823	$240,515
2017	$2,974,184	$113,882	$555	$6,446	$3,095,067	$240,515
2018	$3,013,425	$115,384	$562	$6,531	$3,135,902	$240,515
2019	$3,053,243	$116,909	$569	$6,617	$3,177,339	$240,515
2020	$3,093,649	$118,456	$577	$6,705	$3,219,387	$240,515
2021	$3,134,651	$120,026	$585	$6,793	$3,262,055	$240,515
2022	$3,176,259	$121,619	$592	$6,884	$3,305,355	$240,515
2023	$3,218,483	$123,236	$600	$6,975	$3,349,295	$240,515
2024	$3,261,333	$124,877	$608	$7,068	$3,393,886	$240,515
2025	$3,304,818	$126,542	$616	$7,162	$3,439,139	$240,515
2026	$3,348,949	$128,232	$625	$7,258	$3,485,063	$240,515
2027	$3,393,737	$129,947	$633	$7,355	$3,531,671	$240,515
2028	$3,439,191	$131,687	$641	$7,453	$3,578,973	$240,515
2029	$3,485,322	$133,453	$650	$7,553	$3,626,979	$240,515
2030	$3,532,142	$135,246	$659	$7,655	$3,675,702	$240,515
2031	$3,579,662	$137,066	$668	$7,758	$3,725,153	$240,515
2032	$3,627,892	$138,912	$677	$7,862	$3,775,343	$240,515
2033	$3,676,844	$140,787	$686	$7,969	$3,826,285	$240,515
2034	$3,726,531	$142,689	$695	$8,076	$3,877,991	$240,515
2035	$3,776,962	$144,620	$704	$8,185	$3,930,473	$240,515
Totals	**$66,752,792**	**$2,555,971**	**$12,448**	**$144,668**	**$69,465,879**	**$11,368,246**

Table 2-4 Summary of Total Monetized Benefits and Costs, Non Discounted

Calendar Year	Total Benefits ITS	Total Benefits PMS	Total Project Benefits	Total Costs (Capital and O&M)
2015	$0	$0	$0	$14,578,830
2016	$3,381,280	$3,054,823	$6,436,103	$1,927,815
2017	$3,407,394	$3,095,067	$6,502,460	$1,927,815
2018	$3,433,751	$3,135,902	$6,569,653	$1,927,815
2019	$3,460,355	$3,177,339	$6,637,694	$1,927,815
2020	$3,487,207	$3,219,387	$6,706,594	$1,927,815
2021	$3,514,311	$3,262,055	$6,776,367	$1,927,815
2022	$3,541,669	$3,305,355	$6,847,023	$1,927,815
2023	$3,569,282	$3,349,295	$6,918,577	$1,927,815
2024	$3,597,155	$3,393,886	$6,991,041	$1,927,815
2025	$3,625,288	$3,439,139	$7,064,427	$1,927,815
2026	$3,653,698	$3,485,063	$7,138,762	$1,927,815
2027	$3,682,350	$3,531,671	$7,214,021	$1,927,815
2028	$3,711,271	$3,578,973	$7,290,243	$1,927,815
2029	$3,740,488	$3,626,979	$7,367,467	$1,927,815
2030	$3,769,967	$3,675,702	$7,445,669	$1,927,815
2031	$3,799,724	$3,725,153	$7,524,877	$1,927,815
2032	$3,829,761	$3,775,343	$7,605,104	$1,927,815
2033	$3,860,080	$3,826,285	$7,686,365	$1,927,815
2034	$3,890,685	$3,877,991	$7,768,676	$1,927,815
2035	$3,921,578	$3,930,473	$7,852,051	$1,927,815
Totals	**$72,877,295**	**$69,465,879**	**$142,343,174**	**$53,135,126**

3 Project Costs

The costs portion of the BCA consists of all monetized expenditures that would be incurred in order to fully develop the project into a beneficial and sustainable system. Project costs consist of the total project budget for the implementation of an ITS and a PMS and future operation and maintenance required by such infrastructure. Appendix A presents detailed breakdowns for the cost of the project.

4 Project Benefits

The benefits associated with the implementation of this project were derived solely from the societal benefits expected for the selection criteria put forth by DOT. No transfer costs or economic impacts were considered in the derivation of this BCA. The following sections will discuss the expected benefits for each of the five (5) TIGER selection criteria and the methodology for their monetization, provided they could be quantified. It should be noted that although this project can provide societal benefits for all the criteria, some of the benefits are difficult to quantify, and while they have been presented in this document, they have not been monetized.

4.1 State of Good Repair

This project will allow effective management of the roadway network within the City of Miami Beach, thus improving the capacity of the existing roads without the need to perform major infrastructure reconstruction, as the latter would be unattainable due to existing right-of-way constraints. It would enhance the travel experience for commuters, visitors, and tourists from the main land to the island by providing real time traffic, incident, and parking availability information. This will ultimately increase the accessibility to the City by improving the performance of the four (4) causeways currently acting as the only regional network links and which are operating at sub-standard levels of service.

In addition to enhancing the management of large volumes of vehicles, the implementation of an Intelligent Transportation System (ITS) and Parking Management System (PMS) will be beneficial for the local as well as regional transit system. Currently, the Miami-Dade Transit (MDT) Authority and Metropolitan Planning Organization (MPO) have on-going plans for the implementation of Bus Rapid Transit and Light Rapid Transit routes between the main land and the City of Miami Beach, as well as internal routes within the City. Providing a more efficient management of the roadway network through adaptive signalization and dynamic messaging of real-time information will contribute to the counties effort of providing a reliable and efficient rapid transit infrastructure within the region. Moreover, local transit can benefit with the implementation of an application constantly providing updated traffic and parking information, as it would provide commuters and tourists a more reliable way to connect to the City's Circulator system. The improvement to the transit system will constitute an improvement to the *Ladders of Opportunity* for the residents of the City. Recent demographic data revealed that in some of the more dense areas in the City, as many as 650 to 1000 households do not have a car. Therefore, a reliable transit system will provide an opportunity for these residents to work and improve their economic condition. Having the certainty of knowing that parking will be available near specific stops would facilitate trip planning involving various modes within the city.

Since quantifying the above mentioned benefits will require too many assumptions, they have not been included in the benefit-cost analysis model.

4.2 Economic Competitiveness

4.2.1 Travel Time Savings

ITS Implementation

The data analyzed for the travel time savings analysis was provided by the City of Miami Beach. The data was gathered from a Pilot Project that the City conducted during major special events for access to the Miami Beach Convention Center in 2013. Ten (10) routes were developed for the study and monitored for each selected special event. Out of the ten (10) routes, six (6) critical routes mostly for internal and regional connectivity were identified. ITS technology was used to monitor and manage all routes but performance data for a baseline/no-build condition without ITS technology was only gathered for the six (6) critical routes in two (2) of the special events. These events served to define an average travel time along the routes. However, while performance data was collected only for the six (6) routes, significant improvements were observed by City staff on all ten (10) routes.

Travel time for the baseline/no-build conditions and monitored conditions were compared from routes to calculate average travel time savings. Annual Average Daily Traffic (AADT) and growth rates were gathered from the FDOT Traffic Online Website, information provided by the City and previous studies in the area. An average attendance of seventy (70) thousand attendees per event was assumed and a 1.2 vehicle occupancy factor was applied. Three (3) peak periods, morning, mid-day and evening peak hours were used to for the calculation of travel time savings. Only the City Commission approved high impact periods comprised of fifty 51 days were used to calculate travel time savings. Travel time was valued at $19 per hour.

The Net Present Value of the travel time benefits of implementing a ITS is calculated at
$30,494,371 (7%) and $43,298,309 (3%).

PMS Implementation

Research has indicated that a significant amount of traffic congestion is caused by people slowing down traffic while searching for parking. Studies suggest that one-third (1/3) of the volume of traffic in areas of high activity are cruising for parking at an average speed of 10 mph and spend an average of eight (8) minutes before they find a space to park.

The Average Daily Traffic volumes of the major arterial and collector roadways within the City of Miami Beach were used to estimate how many vehicles hold up traffic while looking for a place to park on a daily basis. It was estimated that an average of 7,500 vehicles per day cruise around the city while looking for parking. An average yearly growth rate was applied to the average annual number of vehicles for the life of the project, to reflect AADT growth. Driving at an average speed of 10 mph for an average of 8 minutes of searching time, vehicles in Miami Beach spend approximately 363,083 hours per year and drive approximately 3,630,828 miles per year while looking for a place to park.

According to companies currently providing smart parking, the implementation of a Parking Management System (PMS) reduces the time it normally takes to find parking by 42 percent and the total mileage travelled by 23 percent. These values were used to monetize the travel time savings benefits of implementing a PMS in the City of Miami Beach.
The Net Present Value of the travel time benefits of implementing a PMS is calculated at
$34,342,323 (7%) and $49,014,449 (3%).

4.2.2 Fuel Consumption Savings

ITS Implementation

The quantified benefits of fuel consumption savings from ITS implementation were calculated based on travel time reductions. The difference in travel times was considered to be the time that cars would otherwise remain delayed and therefore idling.

Rates for fuel consumption while a vehicle is idling were obtained from publications by the US Department of Energy. The following table presents average idling fuel consumption rates for different engine sizes.

Table 4-1 Idling Fuel Consumption

Engine Size (Liters)	Idling (grams/hour)
1	0.16
2	0.32
3	0.48
4	0.63
5	0.79

The idling fuel consumption rate used as an average was 0.48 g/hr, as the average engine size was assumed to be 3 liters. Finally, a current average gas price of $2.657/gallon was used to monetize the fuel consumption benefits of implementing ITS.

The Net Present Value of the fuel consumption benefits of implementing a ITS is calculated at
$2,046,911 (7%) and $2,906,365 (3%).

PMS Implementation

Fuel consumption savings benefits were estimated based on the vehicle miles traveled (VMT) annually while searching for parking, obtained using the methodology described in the previous section. An average rate of 20 mpg, obtained from the 2013 Fuel Economy Guide published by the EPA, was used to calculate the amount of fuel consumed annually while attempting to park within the City. Finally, a current average gas price of $2.657/gallon was used to monetize the fuel consumption benefits of implementing a PMS.

The Net Present Value of the fuel consumption benefits of implementing a PMS is calculated at
$1,314,971 (7%) and $1,876,768 (3%).

4.2.3 Law Enforcement Wages Savings

ITS Implementation

Law enforcement wages reduction savings were only quantified for the implementation of ITS. The City of Miami Beach hosts approximately fifteen (15) major events every year, for which they require strategic staffing of law enforcement officers. The City expects the implementation of ITS to considerably reduce the need for law enforcement to control intersections during special events. For purposes of quantifying the benefits of reducing the need for law enforcement, the wages are assumed to be reduced to zero by the implementation of the project.

The City provided staffing plans for various special events that have taken place in previous years. An average of $50,500 per special event was calculated from the data provided by the City and has been used to monetize the law enforcement wages savings benefits.

The Net Present Value of the law enforcement wages savings benefits of implementing a ITS is calculated at $5,347,726 (7%) and $7,509,963 (3%).

4.3 Quality of Life

Providing a more reliable infrastructure by implementing ITS and PMS within the City of Miami Beach will not only positively impact the local community but also the entire region. This implementation will create a more efficient and more accessible transportation network to better service the needs of residents, commuters, visitors, and tourists. The implementation of ITS and PMS will provide better transportation choices and more effective multimodal connections and therefore enhance connectivity between Miami Beach, the main land, Miami International Airport, Port of Miami, and other destinations surrounding the City.

Research shows that as congestion problems continue to worsen, more valuable hours are being spent behind the wheel and more dollars wasted on unnecessary fuel consumption; money that could be spent on activities to improve quality of life. Implementing ITS and PMS will improve the congestion problems that are currently experienced when accessing and driving through the City and thus reduce the travel time for residents, commuters, visitors, and tourists. This reduction in travel time will give locals the opportunities to engage in more leisure activities, and will give visitors more chances to explore the numerous attractions that currently exist within Miami Beach and the main land; all of which could translate into positive economic and social impacts to the region.

The benefits mentioned above are difficult to quantify, and therefore they have not been included in the benefit-cost analysis model.

4.4 Environmental Sustainability

4.4.1 Air Quality Benefits

ITS Implementation

The quantified benefits of emission savings from ITS implementation were calculated based on travel time reductions. The difference in travel times was considered to be the time that cars would otherwise remain delayed and therefore idling.

Average idling emission rates used, were obtained from literature published by the US EPA and are provided in the following table.

Table 4-2 Light Duty Gas Vehicle Emission Rates

Pollutant	Emission Rate (grams/hour)
VOC	2.683
CO	71.225
NOx	3.515

The yearly emission savings were obtained by multiplying the average travel time reduction (idling time) by the pollutant emission rates.

The monetized value of emission saving was estimated by using the US DOT guidance for TIGER VII. The following table provides the conversion values that were used.

Table 4-3 Value of Air Quality Improvements by Tons of Pollutants Reduced

Pollutant	Value (dollars/short ton) (2013 dollars)
VOC	$1,813
CO	Varies ($42 - $61)
NOx	$7,147

The Net Present Value of the air quality benefits is calculated at $59,300 (7%) and $84,418 (3%).

PMS Implementation

The quantified benefits of emission savings from PMS implementation were calculated based on VMT reductions. The vehicles miles were obtained from the estimation performed to obtain travel time savings.

Average emission rates used, were obtained from literature published by the US EPA and are provided in the following table.

Table 4-4 Light Duty Gas Vehicle Emission Rates

Pollutant	Emission Rate (grams/mile driven)
VOC	1.034
CO	9.400
NOx	0.693

The yearly emission savings were obtained by multiplying the saved VMT the pollutant emission rates.

The monetized value of emission saving was estimated by using the US DOT guidance for TIGER VII. The following table provides the conversion values that were used.

Table 4-5 Value of Air Quality Improvements by Tons of Pollutants Reduced

Pollutant	Value (dollars/short ton) (2013 dollars)
VOC	$1,813
CO	Varies ($42 - $61)
NOx	$7,147

The Net Present Value of the air quality benefits is calculated at $80,832 (7%) and $115,365 (3%).

4.5 Safety

As previously mentioned, the City of Miami Beach conducted a study which focused on traffic monitoring and management. Although crash data was obtained for the time period and year in which the study took place and for the same time period for the previous year, the data sample is not sufficient to provide concrete conclusions on how the implementation of this project will directly impact safety.

Having mentioned that, adaptive traffic control systems (ATCS) can produce safety benefits by reducing the conditions that lead to crashes. These ITS components can minimize opportunities for conflicts by decreasing the number of stops, queues and delay. ATCSs can optimize signalization as they adapt in real time to changing traffic demands. This way, they provide reductions in stop frequency, delay, and travel time. As a result, the system provides a decline in intersection related traffic crashes, primarily rear end type.

Additionally, traveler information systems could prove beneficial to safety. The implementation of a Parking Management System within the City of Miami Beach will provide travelers real-time information on parking availability and consequently lead them to making the appropriate route choices. This will reduce the amount of vehicles wandering within the City's roadway network looking for a place to park. As a result, traffic volumes on roadway segments and intersections will experience a decrease and so will crash numbers.

Since there is no available statistical data, the safety benefits discussed above cannot be monetized, and therefore will not be included in the benefit-cost analysis model.

6 Cost Share

The City allocated $4,556,590 as a match for this application. **If the grant is not awarded, the project cannot be readily and efficiently completed by the City.**

7 References

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5. *Cruising for Parking*, Donald Shoup, University of California, Los Angeles, Spring 2007
6. *Model Year 2003 Fuel Economy Guide*, EPA, 2014
7. *Adaptive Traffic Control Systems in the United States: A review of the cost, maintenance and reliability of popular adaptive traffic control technologies*, HDR Engineering, Inc., September 2009
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9. *Adaptive Traffic Control Systems: Domestic and Foreign State of Practice,* National Cooperative Highway Research Program, 2010
10. *Performance Evaluation of Intelligent Adaptive Traffic Control Systems: A Case Study,* Journal of Transportation Technologies, 2012
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13. *Adaptive Signal Control Technology: Current Practice and Comparison,* ITS- CT Student Research Project, Spring 2012
14. *Idling Fuel Consumption Calculation Worksheet,* Argonne National Laboratory, US Department of Energy
15. http://www.itsbenefits.its.dot.gov/
16. http://www.itscosts.its.dot.gov/
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19. Law enforcement staffing plan for special events information was provided by the City of Miami Beach

Appendix A

Costs Calculations

Intelligent Transportation System Capital Costs			
Subsystem/Unit Cost Element	**Quantity**	**Capital Cost**	**Total Capital Cost**
CCTV Video Camera *Includes color video camera with (PTZ), cabinet, electrical services, encoder/decoder, and installation.	18	$25,290.00	$455,220.00
CCTV Video Camera Tower (35 ft.) *Includes foundation, pole, conduit, and labor	16	$5,000.00	$80,000.00
CCTV Video Camera Tower (90 ft.) *Includes foundation, pole, conduit, and labor.	2	$20,000.00	$40,000.00
Camera Lowering Unit	2	$5,530.00	$11,060.00
Dynamic Message Sign *Smaller DMS installed on arterials	15	$50,000.00	$750,000.00
Dynamic Message Sign *Full matrix, LED, three-line, walk-in DMS installed on freeways	2	$125,000.00	$250,000.00
Dynamic Message Sign Tower *Small structure for arterials	15	$25,000.00	$375,000.00
Dynamic Message Sign Tower *Larger structure spanning three to four lanes	2	$135,000.00	$270,000.00
Real-time, Traffic Adaptive Signal Control System	93	$60,000.00	$5,580,000.00
Acyclica Bluetooth Travel Time Unit	32	$6,550.00	$209,600.00
TOTAL			**$8,020,880.00**

Intelligent Transportation System O&M Costs			
Subsystem/Unit Cost Element	**Quantity**	**O&M Cost (per year)**	**Total O&M Cost (per year)**
CCTV Video Camera *Includes color video camera with (PTZ), cabinet, electrical services, encoder/decoder, and installation.	18	$2,890.00	$52,020.00
Dynamic Message Sign *Smaller DMS installed on arterials	15	$2,400.00	$36,000.00
Dynamic Message Sign *Full matrix, LED, three-line, walk-in DMS installed on freeways	2	$6,500.00	$13,000.00
Real-time, Traffic Adaptive Signal Control System Maintainance	93	$1,000.00	$93,000.00
Real-time, Traffic Adaptive Signal Control System Operation Traffic Control Technician ($21/hr)	12	$514,080.00	$514,080.00
Real-time, Traffic Adaptive Signal Control System Operation Supporting Engineer ($60/hr)	8	$979,200.00	$979,200.00
TOTAL			**$1,687,300.00**

Parking Management System Capital Costs			
		(2014)	
Hardware Components	**Quantity**	**Unit Cost**	**Total Cost**
In-Ground Sensors	3465	$1,400.00	$4,851,000.00
Local Base Unit	35	$5,000.00	$175,000.00
Master Base Unit	1	$10,000.00	$10,000.00
Changeable Message Signs	60	$25,000.00	$1,500,000.00
DSL Line (installation)	35	$627	$21,949.90
TOTAL			**$6,557,950**

Parking Management System O&M Costs			
Hardware Components	**Months**		**Total O&M Cost**
DSL Line ($100/Line per Lot) (35 Parking Lots)	12	$3,900.00	$46,800.00
Communication			
Website	12	$1,100.00	$13,200.00
Secure Communication	12	$164.94	$1,979.22
Cellular Sign Connection (per sign)	12	$87.97	$1,055.58
Labor			
Supporting Engineer ($66/hr) (170 Hrs/Month)	12	$11,220.00	$134,640.00
Customer Support ($21/hr) (170 Hrs/Month)	12	$3,570.00	$42,840.00
TOTAL			**$240,514.81**