MIAMI-DADE
METROPOLITAN
PLANNING
ORGANIZATION

Aerial Cable Transit Feasibility Study

WORK ORDER # GPC V-31
FEBRUARY 2016

PREPARED BY
JACOBS

THIS PAGE INTENTIONALLY LEFT BLANK

AERIAL CABLE TRANSIT FEASIBILITY STUDY

Final Report

Work Order #GPC V-31

MIAMI-DADE METROPOLITAN PLANNING ORGANIZATION

February 2016

Prepared by:

JACOBS™

RGConsultants, LLC ECO-Transit Technologies

C H Perez & Associates Consulting Engineers, Inc.

The preparation of this report has been financed in part from the U.S. Department of Transportation (USDOT) through the Federal Highway Administration (FHWA) and/or the Federal Transit Administration (FTA), the State Planning and Research Program (Section 505 of Title 23, U.S. Code) and Miami-Dade County, Florida. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix A: Engagement Activity and Agency Coordination Coordination Collateral Materials
Appendix B: Technical Memorandums
Appendix C: Conceptual Designs and Other Requested Materials

1. INTRODUCTION

This Aerial Cable Transit (ACT) Feasibility Study responds to the Miami-Dade Metropolitan Planning Organization (MPO) Work Order #GPC V-31, and is prepared by the consultant team of Jacobs Engineering Group, Eco-Transit Technologies and CH Perez and Associates. The MPO requested locational focus for this study is the transit corridor running east / west from South Miami Beach to the Florida's Turnpike Extension and Florida International University on the western end of Miami-Dade County.

The Miami-Dade MPO is interested in understanding the applicability and potential benefits of an ACT system being added to the local transit network. Specifically, previous studies conducted by the Miami-Dade MPO and others have identified new transit markets and corridors in Miami-Dade County but these potential transportation projects have been adversely impacted by either the high cost of right-of-way or the lack of available right-of-way. In many Latin American, Asian, North African and European cities, ACT systems have been implemented to extend transit service over geographical constraints such as water or mountains.

In other applications, this technology has been incorporated into the local transit network because ACT offers the potential for reduced right-of-way impacts. That is, ACT right-of-way is not a continuous corridor but, instead, is limited to the footprint of the cable support poles and station areas. This type of elevated operations allows ACT systems to bypass obstacles, avoid retrofitting streets, reduce high value right-of-way acquisitions and minimize potentially adverse impacts to valuable public and private assets. As such, some heavily-populated densely developed urban areas have implemented ACT over other traditional transit infrastructure.

Understanding the identified benefits and limitations, the study team evaluated the feasibility of implementing ACT systems in Miami-Dade County for short distances of from one to three miles as an extension of the existing rapid transit network. The objective of the study is to understand whether ACT systems could reasonably connect the transit network to various activity centers identified by the Miami-Dade MPO, which are: Florida International University (FIU), the Miami Intermodal Center (MIC), Marlins Park / Little Havana, the Health District, Downtown Miami, Port Miami and South Miami Beach. The study considers existing and planned ACT systems throughout the world, evaluating each for their unique characteristics. It also reviews the range of ACT technologies available for use, evaluating each technology for its feasibility within the context of the Miami-Dade Transit System.

Figure 1: Urban ACT System - Ankara, Turkey

From a system implementation standpoint, ACT systems are most appropriately implemented for short single segment lengths of from one half mile to two miles and for linked segment distances of up to five miles for a route. For the Miami-Dade County geography, this would suggest that an ACT system would serve as an extension of the existing and planned rapid transit network, providing first- and last-mile connectivity rather than extending for many miles along an east-west corridor, such as the Dolphin Expressway (SR 836) or Tamiami Trail (SR 41). Some ACT systems described in this technical memorandum have implemented multiple short segments and the resulting ACT system covers a broader area; this longer linking of transit oriented implementation is more prevalent in South America and "developing countries". In Europe, North America, and other developed nations, shorter single section routes that are a combination of transit function and attraction or resort function are more prevalent.

From an engineering standpoint, there are a few key considerations to be noted, such as:

- Alignments must be very linear or straight with direction changes occurring only at stations and / or special angle mechanisms;
- Stations are generally spaced widely at about a half-mile to a mile apart, so the transit service is express, rather than local, in nature and there are relatively few stations;
- Optimal passenger loading conditions are continuous with short headways and vehicles available at all times in the stations - "walk up and board";
- Cabin air conditioning is not currently incorporated in other ACT systems around the world; but
- All contemporary urban ACT systems are fully ADA compliant with level passenger platforms and level vehicle floors with no gap between platforms and floors; stations have ramps and / or elevators.

Strengths and Weaknesses of ACT

Aerial cable transit systems, particularly high frequency gondolas, are growing in popularity for urban applications. Originally developed to move skiers from the bottoms to the tops of steep slopes, the technology can fill a particular niche for city transport planners. Detachable grip gondolas offer very frequent service as the 8 to 15 passenger cabins arrive at the stations every 10 to 40 seconds allowing passengers to board and alight. Various combinations of cabin capacity and service frequency are made to yield service capacities in the typical range of 1000 to 3000 passengers per hour per direction.

In stations, the doors of the cabins automatically open and the cabins move at a very slow creeping speed as they are detached from the cable that carries them between stations. At the end of the boarding area, the doors automatically close and the cabin reattaches to the cable. The moving cable travels at 10 to 13 mph, making it faster than street systems like local buses or street cars operating on congested urban roadways. ACT does not offer service velocities or passenger capacities competitive with rail rapid transit and commuter rail technologies. But, because the ACT operates above urban streets, it avoids roadway congestion on the streets below. In contrast to bus rapid transit or light rail it does not require dedicated surface lanes to be carved from city streets. Because, the cabins are suspended from the cables, the construction costs, visual impacts and right-of-way requirements for ACT compare very favorably with other elevated transit modes such as automated guideway transit systems (like Miami's Metromover) or elevated rail transit systems (like Miami's Metrorail).) Services suspended from cables are much lighter than services that run atop rails. The lighter cables allow for a much lower density of support structures and much lighter overall structures than required to support rail cars. ACTs excel at spanning physical obstacles that would require a substantial bridge structure for other modes. Many urban applications cross waterways, highways and other transit mode structures. ACTs are also good for climbing steep grades, while steep grades are not a concern in Florida they are in other regions of the world.

However, the ACT mode also has significant limitations that restrict its utility to niche applications. Because the cabins are propelled by a highly tensioned moving cable, ACT system' flexibility in negotiating horizontal curves is limited. Most ACTs run in a generally straight alignment. Changes in direction can be made, and are usually made at stations, but the costs in terms of capital expense, operating cost, and service velocity are substantial. ACTs do not lend themselves to great station density. Every cabin needs to stop at every station whether the passengers on board want to visit that station or not. Each station needs attendants to oversee passenger loading and unloading. Stations are much longer than bus stops or streetcar stations, as the station must provide sufficient length for cars to decelerate to the surface (for surface stations), handle passengers at walking speed, and accelerate back into the air. If the station is built above the surface, space requirements are somewhat reduced but new additional travel time and financial costs are added for vertical circulation (e.g. elevators or escalators).

Funchal, Portugal

For these reasons, most systems are generally designed with widely spaced (generally 5,000 feet) passenger stations. Most lines have only two or three stations including the two end terminals. Most systems are less than two (2) miles long. The longest lines are generally three (3) miles long. The typical market urban ACT market corridor, point-to-point, is 5,000 to 7,500 feet long with a delivered service velocity of 13 mph or less.

ACT cabins generally have no onboard source of high voltage electrical power, only rechargeable batteries. Low voltage lighting, intercom, Wi-Fi and closed circuit video cameras are powered with these batteries but climate control systems for cooling or heating are limited at best. Cooling concerns limit the attractiveness of ACT for long trips in South Florida. For this reason the study team favors services of less than 6,000 feet and six minute travel times for initial trial applications in Miami.

As North American urban transport planners contemplate ACT systems for applications in their cities, few citizens are familiar and comfortable with the technology. Citizen concerns generally focus on visual impacts, safety, evacuation and reliability.

- Compared with higher capacity rail modes, the ACT's are slower with lower maximum capacities but cheaper to build and maintain. The ACTs also tend to be quieter and less visually intrusive than other elevated transit services.

- Compared with street transit services like local buses or streetcars that share the streets with automobiles, the ACT is faster but with a much lower stop density.
- Compared with semi-rapid transit services, like light rail or bus rapid transit, the stop density, passenger capacity and service velocity of the ACT is generally lower but the capital costs and right-of-way costs are also substantially lower.

ACT has a niche in urban transportation, but it like all other modes of public transportation, is not universally applicable for solving all transport problems.

1.1 AGENCY COORDINATION

Agency coordination is an essential component of any transportation planning activity; however, it is even more important for transit projects since they have historically generated more controversy than roadway projects. For this initial examination of ACT systems in Miami-Dade County, it was determined that the agency coordination for the study would involve the members of the Transportation Planning Technical Advisory Committee (known as TPTAC). The TPTAC along with a few other key stakeholders served as the SAC and study updates were presented at regular TPTAC meeting dates and locations.

Stakeholder and agency coordination was conducted throughout the study to identify key issues, acceptability of the technology, alignment opportunities, and future steps. Several feasible alignments were identified and recommended for further consideration as an outgrowth of engagement efforts described in this technical memorandum. Visual effects, evacuation procedures, and air conditioning remain key potential impediments to future implementation.

Community members who have ridden ACT in other locations remain excited about the potential applications in Miami-Dade County. Stakeholders recognize that ACT is an interesting alternative transportation mode because limited right-of-way is available in Miami-Dade County, dense traffic congestion creates significant delays along existing transportation corridors, and there are physical impediments to connectivity in key locations. Among other obstacles, ACT could potentially extend over the Dolphin Expressway (SR 836), SW 107th Avenue, the Miami River, Metrorail, Metromover, and I-95 to connect premium transit stations to key destinations and activity centers. ACT is also attractive because the vehicles move continuously through the stations so that passengers do not need to memorize schedules. Ultimately, additional studies along with stakeholder and community collaboration will be essential to advance alignments that address transportation needs and are acceptable to the community. During future studies, the community collaboration and engineering analysis need to be conducted simultaneously along with a detailed financial analysis.

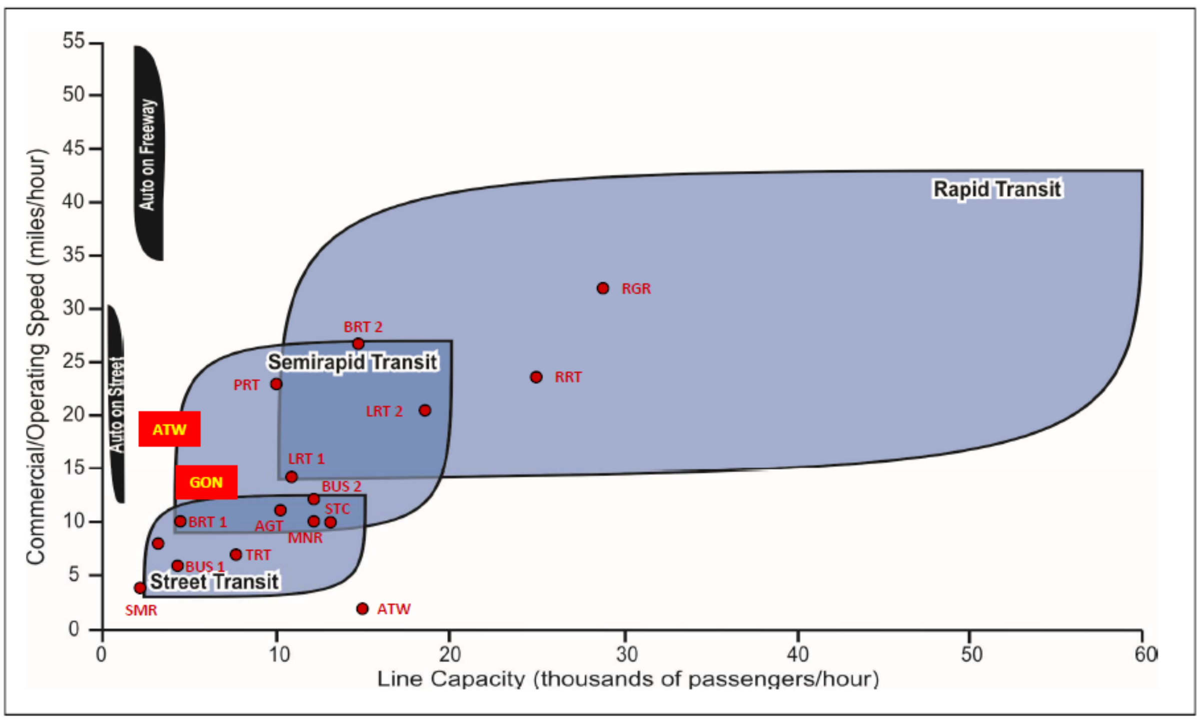
2. ACT TECHNOLGY

Historically, ACT systems have been associated with ski resorts, mountain transport, tourist areas and theme parks around the world. Eventually, ACT systems were considered for use as public transportation in resort villages to transport people between areas such as parking lots and hotels. More recently, municipalities and developers have begun to implement ACT systems in urban environments as a mode of mass transit. For the most part, these Aerial Cableway people movers have been constructed in metropolitan areas where there are geographic barrier and other challenges to utilizing surface public transit. These challenges and barriers include limited right-of-way, hilly terrain, waterways, under-developed infrastructure and roads and densely settled neighborhoods with narrow winding streets.

2.1 SYSTEM CHARACTERISTICS

ACT provides an interesting tool for urban transport planners and operators. In the overall speed / capacity / cost hierarchy of public transit modes the aerial cable technologies offer relatively fast service “semi-rapid” at the lower end of the semi-rapid capacity regime (See Figure 2 below). ACT modes can carry passenger volumes up to 5,000 passengers per hour at speeds in the range of 12 to 25 mph. The possible passenger volumes of ACT are in the range generally associated with local bus, enhanced bus, “BRT-Lite”, or streetcar systems but the speeds are generally comparable to that offered by semi-rapid transit modes such as light rail running in a reserved right-of-way.

Figure 2: Operating Speed and Capacity of Transit Modes



With respect to cost, the continuous operations and relatively low staffing levels required by ACT make it very attractive when traffic volumes are too low to warrant light rail. With a relatively low capital investment, ACT handles volumes generally assigned to bus operations but with much higher delivered service velocities and lower waiting times. The typical application in an urban setting heretofore has been to provide “first mile / last mile” feeder service to a higher volume, higher speed rapid transit line. ACT line lengths are generally limited, with most urban systems in the range of one to three miles in length. Longer systems are sometimes found but at 13 to 18 mph maximum service velocities for long applications, the trip durations are limiting factors. For example, at 10 mph a three-mile journey requires 18 minutes to complete).

2.1.1 CLIMATE CONTROL

Trip duration is a key consideration in contemplating ACT for subtropical climates like those found in Miami, since climate control mechanisms for cooling are not well developed for ACT. Systems to provide AC and heating for cabin have been developed but the duration of the cooling or heating is limited to by the life of the cabin’s rechargeable battery. Presently cooling can be sustained for about 2 1/2 minutes between stations. In Macau, one short ACT system is currently being constructed with all air conditioned vehicles, but other tropical ACT systems worldwide rely only on ventilation. In Latin America and North Africa, passengers accept longer journeys without air conditioning. It is not clear of Miamians will so readily tolerate the heat. For this reason, the study team recommends that if Miami is interested in testing and demonstrating ACT, that the initial application be limited to segments approximately one mile or less with a five- to six-minute maximum trip duration. Shorter segments are also less expensive to build, operate and maintain making the shorter options the lower risk and lower cost alternatives with fewer opportunities for adverse climatic impacts.

Recognizing these service characteristics the “perfect” demonstration application for Miami would be a last mile connection to the existing MDT Rapid Transit System across a natural or man-made barrier such as a waterway or highway. To maximize system usage, the ACT should be located to also serve off peak markets such as civic festivals, weekly markets, ball games, or tourism attractions. Scenic vistas along a route will also stimulate off peak and tourist ridership.

2.1.2 SUSTAINABILITY

Technologies that promote sustainable energy include renewable energy sources, such as hydroelectricity, solar energy, wind energy, geothermal energy, bioenergy, tidal power and also technologies designed to improve energy efficiency. ACT is a notable transportation technology that facilitates energy efficiency by virtue of its rapid transit application and its low consumption of clean electrical power.

Also, it is common for the ACT primary drive systems to use electrical power that is generated from renewable energy sources such as solar and wind power. Individual vehicle electric power for lighting, communications and HVAC is supplied by on-board batteries charged by solar panels on the vehicles and / or charging rails in the stations.

From this sustainability stand point aerial cable transit is far superior to internal combustion or hybrid transit systems such as enhanced bus, BRT and trolley, and ACT is one of the most energy efficient rapid transit technologies powered by electricity such as rail, streetcar and AGT. ACT's sustainability and energy efficiency, relative to these other electrical powered transit modes, derives from its centralized electric drive that propels the aerial cable that the vehicles are attached to versus other modes which the vehicles are propelled by individual, on-board electric drives.

Another aerial cable transit feature that promotes sustainability is its operation in an exclusive right-of-way above traffic with minimal obstructions to traffic, thus reducing traffic congestion and the resulting hydrocarbon emissions. Other electric transit modes are less effective in this aspect as their structures take away a greater amount of right-of-way from the streets, or their vehicles travel in the traffic lanes and add to roadway congestion.

A notable feature of ACT's energy efficiency is that to increase design or operating route capacity (adding vehicles) by 100%, 200%, etc. takes a small percentage of additional power consumption due to its centralized power source, whereas for other electrical transit modes to increase route capacity (adding vehicles) normally takes the corresponding percentage of additional power consumption, since each vehicle has a separate power source.

Table 1 illustrates the average power consumption per mile for typical passenger carrying capacities for ACT urban gondola systems:

Table 1: ACT Average Power Consumption

System Type Per Capacity	System Capacity (pphpd)	Avg Power Consumption (kwh / mile)	Operating Hours (year)	Power Consumption (kwh / year)	Power Cost ($ / kw Hour)	Annual Power Cost ($ / year)
Monocable Gondola	1,000	200	6,500	1,300,000	$0.08	$104,000
Monocable Gondola	2,000	220	6,500	1,430,000	$0.08	$114,400
Monocable Gondola	3,000	240	6,500	1,560,000	$0.08	$124,800
Tricable Gondola	4,000	300	6,500	1,950,000	$0.08	$156,000
Tricable Gondola	5,000	330	6,500	2,145,000	$0.08	$171,600

Assumptions:
1. *Urban Gondola on relatively flat terrain*
2. *Stations spaced at 1/2 mile intervals*

**pphpd=persons per hour per direction*

2.1.3 RELIABILITY / SAFETY

Modern day ACT systems are the result of over 100 years of research and development and operational experience from approximately 1,200 gondolas and aerial trams, and 25,000 ski lift cableways in service worldwide. Of course, there have been mishaps and breakdowns during this history of billions of hours of passenger service, but the safety record of Aerial Cableways appears to be one of the safest and most reliable of all public transportation, including airlines, railways, APM's, streetcars, elevators, buses, etc.

The U.S .Department of Transportation, Bureau of Transportation Statistics does not report injury and accident statistics for Aerial Cable Transit as a separate category; it is included in an "Other" category. Since ACT is a relatively new and widely dispersed urban transit technology, safety statistics are hard to come by. The National Ski Areas Association reports safety statistics for ski lifts in the United States, which include surface lifts, chairlifts and gondolas with similar, but far less sophisticated, aerial cable technology. The NSAA statistics show that in the last 40 years, as of 2012, there were 13 fatalities in 7.53 billion miles travelled on ski lifts and gondolas giving a fatality rate of 0.173 per 100 million miles travelled. Recent data from the US Bureau of Transportation Statistics shows that air transport experiences 0.1 fatalities per 100 million passenger miles, light rail experiences 1.1 fatalities per 100 million passenger miles and heavy rail rapid transit reports 0.3 fatalities per 100 million passenger miles[1].

Most of the NSAA 13 ski lift fatalities over 40 years were attributed to persons falling out of chairlifts and not to lift or gondola malfunctions, so the study team can infer that the fatality rate for urban transit gondolas, which are not chairlifts, do not operate in hostile environments, and have much more sophisticated automated safety systems, would be significantly less than 0.173 per million miles travelled. The study team is not aware of any passenger or worker fatalities on ACT systems in the last 50 years.

Contributing factors to this high level of ACT safety are 1) aerial rights of way – separated from pedestrians, bicycles, cars, trucks and surface modes of transit, 2) minimal human control element – no operators, drivers, pilots, and 3) centralized drive systems with fully automated operation.

The safety and control systems of ACT cableways are fully automated, redundant and fail-safe. When there is any failure or abnormal condition present, the ACT stops automatically and reverts to a safe state. Failures and abnormal conditions must be corrected before the gondola safeties can be reset to start the system. Double and triple redundant computers / programmable logic controllers monitor all the gondola configurations, performance and loads, constantly comparing these values with predetermined operational and safety standards. In such public transportation applications, it is common practice to provide added levels of redundancy for the gondola mechanical and electrical equipment to increase reliability to the highest level; this system redundancy assures virtually no down time due to equipment failures during operations. All of the tensioning systems, braking systems and electronic systems are backed up for normal operations, or can be bypassed to return passengers to the stations during a normal gondola evacuation.

In addition to high safety factors, ACT systems also appear to have high reliability factors in terms of electro-mechanical and weather related service interruption (downtime) versus the total available system operating hours. Generally the ACT industry refers to system reliability factors of over 99% (including weather downtime) for available operating hours, but specific gondola reliability data was hard to come by in the limited scope of the *Representative Urban Act Systems* section. However, two systems did report reliability / availability factors: the 2014 Mi Teleferico ACT gondola in La Paz, Bolivia, and the 1996 Mountain Village gondola in Telluride, Colorado. La Paz reported that in their first year of operation, overall reliability / availability factors for the three lines currently in

[1] *For more detail see: Bureau of Transportation Statistics. National Transportation Statistics 2010. U.S. Department of Transportation, Research and Innovative Technology Administration. http://www.bts.gov/publications/national_transportation_statistics. Accessed May 11, 2010.*

operation were: Red Line - 99.42% with 20,000 passengers riding per day; Yellow Line - 98.36% with 40,000 passengers riding per day; and Green Line - 99.11% with 14,000 passengers riding per day. The operations staff stated that these reliability factors will increase as the gondola system matures, the electronic bugs are worked out, and the staff becomes more familiar with the operations and maintenance of the system.

The Telluride ACT gondola reliability data is interesting in that the 20 year old system has been operating for over 100,000 hours in a harsh environment at 10,000 feet elevation, with ice and snow in the winter and lightning storms in the summer. The system has no storage facility for its cabins. Its technology is an older generation mono-cable gondola with no drive or control system redundancies; it has only two drives (one primary and one evacuation) and no backup drive, so if they lose electrical power they have to evacuate the gondola. Also there is no off-line storage for the gondola cabins. In contrast, current generation ACT gondolas, as studied for Miami-Dade, normally have three redundant drives (two primary, two backup and two evacuation) and redundant control systems. The urban gondolas studied for Miami-Dade also have off-line cabin storage which reduces the number of cycles on the cabins, grips and station mechanisms, as well as protecting the cabins from weather exposure.

It can be anticipated that the current generation gondola technology as proposed for Miami should outperform the Telluride era gondola technology in terms of reliability and service availability. The Telluride ACT gondola rides up to 20,000 passengers per day with reliability data reported as follows.

Table 2: Telluride Gondola Reliability / Availability

Telluride Gondola		Winter			Summer			Total	
	Total	G-Mtc	G-Ops	Total	G-Mtc	G-Ops	Total	G-Mtc	G-Ops
2010	99.77%	99.77%	99.76%	98.90%	99.81%	99.60%	99.33%	99.79%	99.68%
2011	98.64%	99.05%	99.76%	98.50%	99.70%	99.66%	98.57%	99.37%	99.71%
2012	99.58%	99.80%	99.84%	98.31%	99.35%	99.63%	98.95%	99.57%	99.74%
2013	99.61%	99.87%	99.86%	99.22%	99.88%	99.55%	99.41%	99.87%	99.70%
2014	99.69%	99.91%	99.84%	99.39%	99.91%	99.58%	99.54%	99.91%	99.71%
2015	99.55%	99.91%	99.81%	99.38%	99.82%	99.62%	99.47%	99.86%	99.71%

Notes: Availability factors for Operations (G-Ops); Maintenance (G-Mtc); and Total (weather downtime included)

For all ACT systems the principle causes for service interruption that affect reliability are:

- Weather related – winds over approximately 40 mph, or lightning in the immediate area
- Passenger related – boarding and de-boarding delays on the platforms
- Electrical power loss – switching over to backup generator – usually 1 or 2 minutes
- Control system – automatic stops for faults detected by sensors relating to electro-mechanical and safety faults
- Operators – manual stops related to passenger loading and operating irregularities

Jakarta, Indonesia

Most of the stops on modern ACT systems are nuisance type stops related to faults detected by the automatic tramway control (ATC) system. For automated transit systems there are hundreds of sensors for monitoring all electro-mechanical systems, cables, and vehicles for maintenance, performance and particularly safety. Most of these nuisance type stops are quickly reset within the automatic control system and are of short duration of one minute or less. Weather related service interruption occurs when the passengers are off of the line as high winds and lightning are predictable and the system is shut down for the duration of the weather event. As a note, lightning is not a direct threat to passengers as the entire ACT system is grounded. The threat is damage to the gondola equipment and electronic sensors which could cause an operating system to shut down; this is why ACT systems are shut down during lightning storms, as are airport operations some other automated guideway transit systems.

Another South Florida weather event to be discussed is hurricanes. An ACT gondola will be designed to current ASCE standards for hurricane events. All foundations and tower and terminal structures are designed to withstand hurricane force winds. At the onset of a hurricane the ACT system is shut down and all of the vehicles are automatically removed from the line and parked on rails in the maintenance / storage facility. The wire rope cable is then secured to each tower by special “hurricane clamps” on the cable rollers to keep the gondola cable in place during the storm. The ACT system would weather the hurricane much the same as other transit structures in the City.

2.1.4 EVACUATION

A normal gondola evacuation is defined as one where the cabins are able to be returned to the stations to remove the passengers from the line. A normal gondola evacuation is carried out when the installation loses electric power due to an interruption in electrical service, and if for some other reasons, it cannot be operated with generator power supplied to the primary drive or by utilization of the auxiliary diesel drive. Other reasons for a normal evacuation would be due to unsafe operating conditions such as severe weather, lightning, fire, or equipment malfunctions that cannot be cured through redundancy.

A normal gondola evacuation occurs only when the cabins can be safely returned to the stations with one of the gondola’s primary, auxiliary or evacuation drive systems and only if the cable is not derailed or obstructed and if no damage will result to the cables, gondola equipment, cabins or stations. A normal evacuation is usually carried out at slow speed with the evacuation drive, but if the primary or auxiliary drive is operational the evacuation can be done at normal speed also.

An emergency ACT gondola evacuation is defined as one where the cabins are not able to be returned to the stations to disembark passengers for whatever reasons and passengers must be removed from the cabins and lowered to the ground by fire trucks, cherry pickers, other specialized equipment, or ropes and harnesses in inaccessible areas. It is an event when the gondola’s redundant primary drives and / or secondary drives would not be able to return the passenger cabins to the stations due to an inability of the cable to rotate or where such rotation would cause damage to equipment or where such rotation would cause increased danger to the passengers. Such things as a derailment of the cable that causes major damage to the tower, major damage to a cabin, hanger or grip, or major damage to the station mechanisms, would be cause for an emergency evacuation. Therefore, provisions must be made for the emergency evacuation of the passengers out of the cabins, while they are still out on the cable and unable to return to the stations.

The gondola management and / or local authorities have complete responsibility for the evacuation of the cableway should it become impossible or inadvisable to operate. Efficient and orderly evacuations require advance planning, practice, trained and disciplined personnel, well maintained equipment, and constant communication and coordination. These guidelines are defined through the Gondola Evacuation Plan (GEP). The GEP is tailored to the specific gondola's installation, personnel, terrain, available equipment, and any environmental conditions that may be encountered. The gondola evacuation plan should clearly define the role of every department and team directly involved with the rescue.

2.1.5 ACCESSIBILITY / ADA

The stations, platforms and vehicles of ACT meet all applicable provisions of the "2010 American Disabilities Act (ADA) Standards for Accessible Design" and the Code of Federal Regulations Title 49, Subtitle A, Part 38.

Val Gardena, Italy

ACT stations are designed with handicap ramps, railings, elevators, restrooms and the proper equipment, clearances and safety measures in all public areas. The boarding platforms are level with the vehicles' floors and the gap between platform and floor does not exceed one inch. The clear opening width of the passenger doorways are at least 32 inches wide when open; when the doors close auditory and visual warning signals are provided to alert passengers of closing doors.

The passenger loading areas have a platform attendant or attendants who monitor and assist the boarding and de-boarding of all passengers, including the disabled and elderly. The platform attendants have nearby control pedestals where they are able to slow or stop the vehicles if there is a special passenger loading situation. In normal operation the gondola vehicles are constantly moving along the passenger platforms at a slow "creep speed" (approximately 50 feet per minute) for boarding and de-boarding. Operational experience indicates that many disabled passengers in self-propelled or motorized wheelchairs are able to enter and exit the cabins at the normal platform speed. However, for wheelchair, "walker", or elderly patrons who are unable to do so, the platform attendants can easily slow or momentarily stop the vehicles to aid in the boarding / de-boarding process.

2.2 ACT SYSTEM TYPES

There are basically five (5) types of aerial cableway systems that can be considered for Aerial Cable Transit in urban environments: Mono-cable Gondola, Bi-cable Gondola, Tri-cable Gondola, Pulse Gondola, and Jig-Back / Dual Line Tramway.

2.2.1 MONO-CABLE GONDOLA (1S)

The Mono-Cable Gondola (1S) is a single cable, detachable grip system where the vehicles (cabins) detach and attach to the moving haul cable (wire rope) in the stations. The tensioned haul cable itself provides the guideway for the vehicles and no support, a track cable is required. The cableway of circulating gondolas has multiple cabins spaced equally along the line. This 1S-ACT mode provides for the narrowest system pathway operating in an envelope as narrow as 40 feet with code mandated lateral clearances. Most urban ACT's are mono-cable systems.

Carrying Capacity:	1,000 to 4,000 passengers per hour, per direction
Vehicle Capacity:	8 to 15 passengers
Headways:	10 to 30 seconds
Max Speed:	13.6 mph
ROW Width:	40 to 45 feet

Lisbon, Portugal

2.2.2 BI-CABLE GONDOLA (2S)

The Bi-Cable Gondola (2S) system is the original lift technology used for gondola cabin-type cableways. Here too numerous gondola cabins that are equally spaced along the cable loop that circulate between the system's stations. To provide support between more widely spaced towers, the cabins travel on a highly tensioned stationary cable on each side of the cableway. Thus, there are two (2) cables per direction, a haul cable and a support track cable. The 2S system allows for higher speeds and larger cabins compared with monocable technology.

Carrying Capacity:	1,000 to 4,000 passengers per hour, per direction
Vehicle Capacity:	15 to 20 passengers
Headways:	12 to 30 seconds
Max Speed:	18 mph
ROW Width:	45 to 50 feet

Hong Kong, China

2.2.3 TRI-CABLE GONDOLA (3S)

The Tri-Cable Gondola (3S) system is a more specialized cableway technology used especially for long spans and high profile guideways. It is essentially a Bi-Cable Gondola (2S) system with a second fixed track cable on each side for more stability. Typically, the passenger cabins are larger with detachable grip cabins that circulate between the end and inline stations. Compared with the bi-cable the 3S provides for longer spans between towers and larger cabins. It is not faster than the bi-cable option.

Bolzano, Italy

Carrying Capacity:	2,000 to 5,000 passengers per hour, per direction
Vehicle Capacity:	20 to 35 passengers
Headways:	15 to 45 seconds
Max Speed:	18 mph
ROW Width:	60 to 65 feet

2.2.4 JIG-BACK AND DUAL-LINE AERIAL GONDOLA

The Jig-Back and Dual Line Aerial Tramway system is the original aerial cableway technology used for transit or general public transportation. There are several of these systems that have delivered passenger service continuously for over 100 years. Typically, there are two (2) large cabins on the same haul cable at opposite ends of the loop cable system that go back and forth; they “jig-back” between the stations. The cabins can also run on independent cable loops, a configuration called a “Dual Line,” on which they go back and forth between stations independently. New York City’s Roosevelt Island ACT is a Dual Line Aerial Tramway.

New York, USA

Carrying Capacity:	500 to 1,500 passengers per hour, per direction
Vehicle Capacity:	50 to 200 passengers
Headways:	4 to 15 minutes
Max Speed:	20 to 30 mph
ROW Width:	80 to 120 feet

2.2.5 PULSE GONDOLA

This type of system has limited application to ACT mass transit due to its relatively low passenger carrying capacities. This type of system is similar to the jig-back tramways, except that it is a circulating gondola with tramway type of movement. There can be only a haul cable and no track cables, or a single track cable and single haul cable. There are groups of two to four small cabins, rather than 2 large cabins; and the pulsed groups of cabins "circulate" between the stations on a continuous cable loop rather than jig-back between them. This is a fixed grip system where the cabins do not come to a complete stop in the stations, but move slowly through the stations for boarding, as do detachable gondolas, which helps to increase capacity. Istanbul Turkey uses a pulse gondola to span a gorge near Taxim Square on the north side of the city.

Grenoble, France

Carrying Capacity: 500 to 1,000 passengers per hour, per direction

Vehicle Capacity: 8 to 15 passengers

Headways: 2 to 5 minutes

Max Speed: 12 mph

ROW Width: 40 to 45 feet

Table 3: Comparison of ACT Technology Options

Variations in ACT Technologies	Max Passengers per Hour per Direction		Cabin Passenger Capacity		Minimum Headways (Seconds)	Maximum Speed (MPH)	Clearance Envelope (Feet)	
Technology	Low	High	Low	High			Low	High
Mono-cable Gondola	1,000	4,000	8	15	10	13	40	45
Bi-cable Gondola	1,000	4,000	15	20	12	18	45	50
Tri-cable Gondola	2,000	5,000	20	35	15	18	60	65
Aerial Tramway	500	1,500	50	200	240	30	80	120
Pulse Gondola	500	1,000	8	15	120	12	40	45

2.3 SELECTED ACT TECHNOLOGY TYPE

Due to the preliminary conceptual nature of this first Aerial Cable Transit Study for the Miami-Dade MPO, the Consultant Team decided focus on only one of the five ACT system types for application to the Miami route alignments. The ACT Mono-cable Gondola was selected for the following reasons:

- Ninety percent of all currently operating ACT systems are mono-cable gondolas, because they least expensive to build and operate.
- The transportation industry and ACT operators have the most experience with this type of ACT
- For high carrying capacities required in heavily congested urban areas, this ACT type is the most cost effective
- Requiring the narrowest ROW, it is the most appropriate ACT for built environments using existing roadways
- The mono-cable gondola is a standard product requiring the least amount of custom architecture and engineering

The guideway, or line, for a mono-cable gondola ACT system is an aerial rotating steel cable loop driven and tensioned at the end stations and supported and guided by sheave-train rollers mounted on cross arms supported by vertical, steel line towers along the route. The support towers can be constructed along the centerline of the alignment (middle of the roadway) or offset to one side or both sides of the alignment (on sidewalks or other right-of-way areas). The height of the towers and cables can range between 50 feet and 200 feet depending on numerous clearance factors such as pedestrians below, roadways and traffic below, other transit and stations below, buildings and structures below, obstacle clearance, crossing over waterways, highways and bridges, view corridors, privacy issues of commercial and residential buildings along the route, etc. In the case of Miami, the spacing of the towers along the alignment can range between 400 feet and 1,500 feet depending on factors, such as desirable / undesirable tower base locations, acceptable cable sag, suitability of ground for tower foundations, buildings and obstacles, crossing over waterways, highways and bridges.

For routes running along the right-of-way of city and county streets, the normal tower spacing distance is 400’ to 600’ depending upon required location in relation to traffic lanes and intersections, and the normal tower and cable heights are 50’ to 70’ depending upon the tower spacing and required clearance above the roadways. For routes running along highways and major roadways, the normal tower spacing distance is 600’ to 800’ depending upon location of traffic lanes, intersections and structures; and the normal tower and cable heights are 60’ to 80’ depending upon the tower spacing and required clearances. For routes running across waterways such as canals, rivers and bays the tower spacing and height will be engineered according to the specific circumstances and regulatory requirements; waterways may be crossed with no towers in the water by having long spans and tall towers on either side, or may be crossed with towers in the water by having more normal spans and tower heights.

The width of the mono-cable gondola clearance envelope, or pathway, is measured from cabin outer edge to cabin outer edge on each side of the gondola line; for a 10 to 15 passenger gondola system this measurement is approximately 26 feet. Added to the actual horizontal distances between the cabins are ANSI B.77 Code requirements of approximately 3 feet per side for possible horizontal cabin swing and 5 feet per side for clearance from vegetation or structures. Therefore the actual width of the system is approximately 26 feet, and the pathway required by Codes is approximately 42 feet. Roadway rights of way for the proposed route alignments in Miami range from 50 feet to 150 feet, so it is possible to consider Aerial Cable Transit for the studied route alignments. These required widths are at the height of the cabin. Requited widths on the surface below need only provide for the support towers. Motorized vehicles, pedestrians, parks, buildings, and natural features such waterways or ravines can all be accommodated at the surface level below the passenger cabins

Table 4: Study Area Mono-cable Gondola Right-of-Way Footprints

MONOCABLE GONDOLA	Station Platform Width	Station Platform Length	Station Accel/Decel Length	Cabin Climb Out Length	Total ROW Length	ROW Footprint On Ground	Tow er Heights	Tow er Spacing	DESCRIPTION
Ground Level Stations									
END STATION	40 - 50 ft	30 - 40 ft	50 - 60 ft	80 - 100 ft	160 - 200 ft	6,400 - 10,000 sf			Platforms can be at grade concrete, pavers, etc or elevated 2 ft to 4 ft w ith ramps, railings, etc - level platform loading for ADA.
IN-LINE STATION	40 - 50 ft	60 - 80 ft	100 - 120 ft	160 - 200 ft	320 - 400 ft	12,800 - 20,000 sf			Platforms same construction as end stations - passengers board / deboard in both directions - level platform ADA loading
ANGLE STATION	40 - 50 ft	80 - 100 ft	100 - 120 ft	160 - 200 ft	340 - 420 ft	13,600 - 21,000 sf			Platforms same construction and function as in-line stations - angles up to 90 degrees or greater can be realized.
ANGLE MECHANISM	NA	NA	80 - 100 ft	NA	80 - 100 ft	300 - 500 sf			Mechanisms required to make line angles greater than 5 degrees - mechanisms are normally elevated, not ground level
LINE TOWERS						25 - 75 sf	50 - 150 ft	400 - 800 ft	Tow er located out of ROW = 25 sf. Tow er located in ROW w ith traffic barrier = 50 to 75 sf. Foundations are 10 to 25 cu yds.
Elevated Stations									
END STATION	40 - 50 ft	30 - 40 ft	50 - 60 ft	NA	80 - 100 ft	3,200 - 6,000 sf			Platforms elevated 15' - 20' above ROW - if centerline pylons, 1 traffic lane not useable for 80 - 120 ft; if offset pylons - no traffic lane impact.
IN-LINE STATION	40 - 50 ft	60 - 80 ft	100 - 120 ft	NA	160 - 200 ft	6,400 - 9,500 sf			Same as end station. For centerline pylons, 1 traffic lane not useable for 210 feet - pylons and traffic barriers require 800 sf.
ANGLE STATION	40 - 50 ft	80 - 100 ft	100 - 120 ft	NA	180 - 220 ft	7,200 - 11,000 sf			Same as in-line station. Normally located over an intersection, so intersection design must be modified for traffic flow and turns.
ANGLE MECHANISM	NA	NA	80 - 100 ft	NA	80 - 100 ft	300 - 500 sf			Same as Angle Station. But less impact on intersection than an angle station.
LINE TOWERS						25 - 75 sf	50 - 150 ft	400 - 800 sf	Line tow er located out of ROW = 25 sf / Line tow er located in ROW w ith traffic barrier = 50 to 75 sf.
NOTES:	Station ROW lengths determined by terminal size, system capacity and speed, cabin size, load / unload speed, departure sheave trains, and platform elevation.								
	Total station ROW Length: Platform length + accel / decel length + climbout length, until bottom of cabin is 15 feet above ground in front of station								

The vehicles studied for Miami are 15 passenger cabins, which is the maximum size vehicle for an ACT gondola system using a single cable. The cabins are attached to the moving steel cable loop and hang down approximately 15 to 16 feet from the cable; additionally, the cable loop can sag approximately 5 feet to 20 feet between normally spaced towers. For vertical clearance the bottoms of the passenger cabins should be maintained 10 feet or more above the ground with pedestrians underneath, 25 feet or more above roadways with cars, trucks, buses, traffic signals and light poles underneath, and appropriate distances for clearance over bridges, buildings, vegetation and obstacles.

ACT stations and platforms can be constructed either at ground level or elevated above the ground, roadways or other transit structures depending on where the stations are located and what station amenities are desired. All elevated ACT station passenger platforms would be accessed by stairs, escalator and elevators, and both at grade and elevated stations are fully ADA accessible.

2.4 REPRESENTATIVE URBAN ACT SYSTEMS

The balance of this chapter provides overview of the characteristics and typical applications of ACT systems that have been implemented elsewhere, so that lessons could be derived from the experience of others. Information on ten current and proposed urban ACT systems was developed by the study team through research on the Internet, telephone interviews with some of the operations and maintenance managers, and site visits to several of the ACT systems (Roosevelt Island, Telluride, Medellin, La Paz, and Georgetown). More detailed information on the ten reviewed transit systems can be found in the "Literature Review Technical Memorandum" delivered to the MPO.

The study team assembled information concerning urban applications of ACT technologies as applied at ten representative ACT systems across the world. Five of the ten systems operate or are proposed in the United States, while the other five systems are located in South America, Central America, Europe and Africa. The primary filtering criteria for selection of the ten ACT systems are: 1) functionality as public transportation; and 2) applicability to the Miami-Dade Metro area geography.

There are approximately 1,500 ACT systems in operation worldwide. Of these systems, approximately 50 systems in resorts and urban environments can be classified as true "people movers," rather than ski lifts or tourist attractions. These aerial cableways collectively have a capacity of more than 20 million passengers per day. Several recent urban gondola people movers in South America (Medellin, Columbia; Caracas, Venezuela; Rio de Janeiro, Brazil; La Paz, Bolivia) are integrated into their respective cities' metro systems and each currently transports from ten to twenty-five million passengers per year.

The study team investigated seven ACT systems that are in daily operation and three ACT systems that are under study or construction:

2.4.1 ROOSEVELT ISLAND GONDOLA – NEW YORK CITY, NEW YORK

New York City's Roosevelt Island ACT system is an aerial tramway system that opened in 1976 to connect the community of Roosevelt Island to the Upper East Side of Manhattan with public transportation. It has transported approximately 35 million passengers to date. The Roosevelt Tramway was the first urban ACT installed in the United States and has a 40 year successful operating history. The tramway spans the East River for approximately 1,000 feet, and was constructed as a "temporary" connector to the MTA subway system, until the subway would be extended to Roosevelt in 1989. Prior to the completion of the Mississippi Aerial River Transit gondola in May 1984 for the New Orleans World's Fair, the 1996 ACT gondola in Telluride, CO and the Portland Aerial Tram in 2007, the Roosevelt tram was the only commuter ACT system in North America.

Prior to the construction of the ACT system, residents and workers on Roosevelt would have to commute to Manhattan by driving or taking a streetcar to the Queens side of the river and then backtracking across the Queensboro bridge to Manhattan, a trip taking 20 minutes. By taking the Tramway, the same trip now takes 3 to 5 minutes. An ACT system was selected as the most efficient transit solution for this application due to its 1) low capital cost and short construction time versus the subway, 2) limited footprint and civil works along the densely developed route, and 3) the ability to cross over the East River without building an expensive bridge for buses or rail.

The Roosevelt Island Aerial Tramway in New York City is applicable to this study in that the system: 1) is located in a densely populated urban area in a major United States city; 2) is located in a region with heavy traffic congestion particularly close to downtown, similar to the Miami- Dade Metropolitan area; 3) is primarily used for public transportation with a secondary use for tourism; and 4) is connected to other MTA / NYCT transportation services.

In 2010 the Tramway was completely retro-fitted with state of the art electro-mechanical equipment to convert it from a traditional Jig-back type aerial tramway to a Dual Line type Aerial Tramway. The operator replaced the passenger cabins with new units that independently move between the Roosevelt and Manhattan stations. Unlike the older jig-back style tramway that was replace, the new Roosevelt cabins now travel independently of one another and are not attached on the same haul cable, so during rush hour the cabins can maximize the one way commuter capacity. This type of system employs two fixed track cables and two separate moving haul cables on either side of the line. The cabins roll along the track cables on carriages pulled by the independently driven haul cables and accelerate and decelerate at the stations by movement of the individual haul cables. Each cabin accommodates 110 passengers (standing plus bench seats on ends) plus one cabin operator.

The maximum speed for the system is 18 mph, resulting in a one-way travel time of three minutes. The headways for passenger boarding are five to six minutes at peak and eight to nine minutes at off-peak periods. At full speed and frequent headways, the maximum passenger carrying capacity of the system is 1,200 riders per hour per direction.

Over 35 million passengers have used the tram since it began operation in 1976; ridership has steadily increased over the years and now registers close to 2.5 million riders annually. Each of the two cabins makes approximately 115 trips per day. During peak periods, the cabins make about 22 total trips per hour with an average of 90 persons aboard for a total maximum hourly capacity of 2,000 boardings. Off peak, the tram cars will run at either 7.5 minute or 15 minute intervals. The trams run 20 hours per weekday and 21.5 hours per weekend day from 6:00 a.m. to 2:00 a.m. (3:30 a.m. on weekends), seven days a week. The fare for a trip is the same as the subway system: $2.50 one-way and $4.00 roundtrip. There were 17,520 total annual operating hours in 2014 and 27,550 total maintenance hours.

The Aerial Tramway was funded publicly in 1975 by the State of New York to assist in the development of State-subsidized, affordable housing on Roosevelt Island. It was not a P3 project. The original tram was constructed by Von Roll Corp; the literature does not specify an original capital cost for the ACT system. Due to the older generation technology of the system, it was subject to breakdowns which led to decisions to upgrade the electrical systems and totally refurbish the tramway in 2006 and 2009, respectively. The 2010 refurbishment of the stations and equipment with a design change to an independent dual line system was accomplished by Leitner-Poma under contract for $25 million.

2.4.2 OREGON HEALTH SCIENCES TRAMWAY – PORTLAND, OREGON

The Oregon Health Sciences University (OHSU) ACT system is an aerial tramway constructed in 2006 and opened in 2007. The OHSU campus is comprised of 36 separate buildings located on 350 acres on Marquam Hill overlooking the Waterfront District. This Portland ACT system connects the OHSU campus to the Tri-Met Portland streetcar station and bus terminal located in the redeveloped Waterfront District adjacent to the river. The OHSU Tramway is the most recently constructed ACT system in a major United States city. It has carried over ten million passengers to date. Patient visits to the OHSU facilities total close to one million visits annually; many of these visits are facilitated by the ACT.

Prior to installation of the ACT aerial tramway, there was significant traffic congestion for employees, faculty, students and patients destined for the OHSU campus and hospitals. OHSU employs 15,000 persons and has 8,000 students and faculty. An ACT system was selected as the most appropriate transit solution due to its: 1) non-polluting ("green") operating characteristics; 2) limited guideway footprint; and 3) the ability to easily ascend the 500 foot elevation change between the OSHU Campus and transit services below.

During the planning and permitting phases there was localized NIMBY opposition to this public transportation project from residents who lived below the ACT pathway. But through the public involvement process, these concerns were eventually mitigated. Now the benefits to area residents in terms of less traffic and air pollution, also and to users of the system in terms of convenience and travel expense are being realized and promoted.

The OSHU Tramway is applicable to this study in that the system is: 1) located in a major urban area; 2) alleviating significant traffic congestion near a major employment center similar to the Miami-Dade County situation; 3) primarily used for public transportation with secondary appeal to tourists; 4) passing through and over commercial and residential neighborhoods; 5) extending the reach of other public transportation modes (streetcars and buses) of Tri-Met, Portland's transit authority; and 6) one of the most recent ACT systems constructed in the United States.

The OHSU ACT system is a Jig-Back Aerial Tramway with two specially designed cabins that alternate between the top and bottom stations; when one cabin is at the OHSU station, the other cabin is at the bottom and vice versa. This type of system employs two fixed-track cables and a moving haul cable on each side of the line. The cabins roll along the track cables on carriages pulled by the continuous loop haul cable and decelerate / accelerate in the stations by movement of the haul cable. Each cabin carries 78 passengers plus one operator.

Approximately 12 million passengers have used the tram since it began operation in 2007. Ridership has been consistent over the years and currently carries close to 1.2 million riders annually. The tramway is used regularly by students, faculty, employees and patients. It is also a key component of the City's public transportation network. Each of the two cabins makes approximately 90 trips per day. The tram's maximum speed is 22 mph and travels the 0.6 miles in three to four minutes.

At its peak, the ACT system climbs to 150 feet above Gibbs Street as it climbs Marquam Hill. The two cabins make the three minute one-way trip at six minute intervals during morning and evening peak periods. During the peak periods, passenger counts reflect both cabins making about 20 trips per hour with an average of 60 persons aboard. In the off-peak period, the ACT operates at 12 minute intervals six days per week. The trams are operated for a 16 hour service span on weekdays, nine hours on Saturdays and are closed on Sundays. The ACT cableway operates 52 weeks per year and approximately 4,600 hours per year.

The ACT system is owned and maintained by the City of Portland and operated under contract with OHSU. The fares and schedules are tied to Tri-Met's public transportation system. Monthly Tri-Met pass holders receive a discounted rate on the ACT system. Access to the tram platforms is automated with magnetic cards / turnstiles and the platforms are attended. The cabins have one operator who opens the cabin doors upon station arrival, allowing passengers to depart. The fare for a roundtrip is $4.35. OHSU employees, faculty, students and patients fares are pre-paid by OHSU, confirmed by display of an OHSU badge or patient ticket. The stations and vehicles of the OSHU ACT are fully ADA compliant.

The City of Portland owns the tram, which was set up as a P3 venture. OHSU provided $40 million of the $57 million construction costs for the ACT system. The City's share of construction costs ($8.5 million) will be collected over time from rising property values in the District. OHSU is responsible for and oversees operation of the tram. The City is responsible for maintenance and regulatory oversight. Tram personnel perform continuous rider counts to determine the mode split which is used to determine the share of operating costs split between OHSU and the City. Public fare is set and collected by the City and OHSU rides are paid by OHSU. Data for the annual Operation and Maintenance costs was not available.

2.4.3 MOUNTAIN VILLAGE GONDOLA – TELLURIDE, COLORADO

The Mountain Village Gondola in Telluride, Colorado is a mono-cable gondola style ACT system that was constructed in Colorado in 1996 by the Metropolitan District and the Resort to connect the Towns of Telluride and Mountain Village. Since its opening, the Mountain Village Gondola has served as a unique transportation system; the first gondola type ACT public transportation system of its kind in the United States. The gondola links Telluride and Mountain Village and serves as a people mover for skiers and public transportation for locals and visitors between towns, shopping malls and parking facilities. The unique 13 minute ride, between the elevations of 9,000 feet and 11,000 feet, offers views of the San Juan Mountains and is often referred to by local commuters as "the best commute in the country."

The Mountain Village Gondola has a 20 year history of successful operations over a three line, three mile route. Gondola type people movers, such as this ACT installation, are a significant investment and can have a useful operational life of 40 to 60 years with scheduled preventative maintenance, upgrades and refurbishment. The original construction time for the system in 1996 was 14 months; the complete refurbishing of the gondolas in 2006 was accomplished in four months.

The Mountain Village Gondola is relevant to the Miami-Dade County study since the system has the following characteristics: 1) its primary use is for public transit with a secondary use for tourism; 2) it passes through commercial and residential neighborhoods; 3) it extends the reach of other transit modes (buses and lifts); 4) it has multiple interconnected lines and stations; 5) it has a P3 funding structure; 6) it is owned and operated by a municipality; and 7) it is the first ACT system using gondola technology to be installed in the United States.

Currently, about 2.4 million passengers annually ride the gondola. More than 35 million riders have been transported since opening day. Since the ski resort has shoulder seasons in the spring and fall between winter season and summer season, the gondola operates roughly 287 days each year with routine maintenance scheduled during the off-season months. In total, the gondola system has approximately 97,000 hours of operating time over the years.

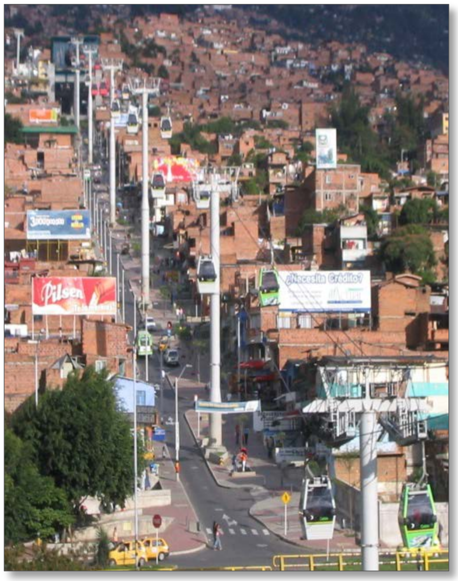
The operating hours are 7:00 a.m. to midnight. The staffing "per-shift" requirements for the Gondola's operations include between 15 and 17 persons with the following allocations: 1 supervisor, 1 operator, 8 attendants, 2 administrative persons, 1 - 2 mechanics, 1 to 2 electricians and 1 non-shift, salaried manager. There were 60,400 total operating hours per year in 2014 and 23,480 total maintenance hours. The stations and vehicles of the Mountain Village Gondola are ADA compliant. With older technology, the system must be stopped for about 30 seconds to position portable ramps for wheelchair loading and unloading.

The construction of the project was funded under a P3 structure on a 30% public / 70% private basis. A Metro District was set-up to issue bonds used to finance the system construction that are being repaid by both the public and private sectors. The Town of Mountain Village and the Town of Telluride are repaying the bonds on the public side. The Telluride Resort Company, along with local retail merchant associations, is repaying the bonds on the private side.

The original cost to build the Mountain Village gondola (equipment and installation) was $18 million in 1995 / 1996, not including the cost of station buildings, infrastructure or support facilities. Since that time, the capital costs for refurbishment, upgrading and major replacements have been approximately $8 million. The operation, maintenance and on-going capital improvements on the gondola are funded by a Mountain Village Real Estate Transfer Tax of three percent (3%), contributions from the Town of Telluride and San Miguel County and one percent (1%) of lift ticket sales from the Telluride Resort Company. Additionally, the system has obtained public sector grants from the Colorado Department of Transportation (CDOT) and the Federal Transit Administration (FTA) including Section 5304, 5309, 5311 and 5339 grants.

O&M costs average approximately $3.5 million annually including over 82,000 staff hours. All of the 59 cabins are original and have approximately 100,000 hours of operation on them.

2.4.4 METRO CABLE GONDOLA – MEDELLIN, COLUMBIA



Medellin is a metropolitan area with a population of approximately 2.2 million situated at 4,800 feet in the central part of Columbia. The City itself is located in a long valley with flat terrain, surrounded by hillside communities. As part of the national effort to rid the country and city of drug trafficking and related problems, Medellin began an aggressive campaign of public infrastructure and transportation projects in the late 1990's starting with the Medellin Metrorail and Bus Metro systems. The Metrorail and buses were effective for improving mobility in the more accessible valley areas of the City but certain communities surrounding the City, such as Santo Domingo, were on densely populated hillsides with inadequate roads and heavy traffic congestion, preventing them from conveniently accessing the Metro system.

The Medellin Metro Cable Gondola is now an integral component of the City's Metro Agency, with common routes, scheduling, fares and transfers. Since installation of the Gondola lines, crimes in the areas serviced by the ACT system have decreased ten-fold and the number of neighborhood businesses and jobs has increased 300%. The phased ACT system is comprised of gondola type aerial cableways, with three separate lines connected to the Metro system. The three lines were constructed starting in 2004 with Line K while Line J was added in 2008 and Line L in 2010.

The Medellin Metro Cable Gondola is applicable to this Miami-Dade MPO study in that the system is: 1) located in an densely developed and congested urban area of a major city; 2) experiencing heavy traffic congestion; 3) primarily used for public transportation; 4) elevated over commercial and residential neighborhoods; 5) used to extend the reach of interconnected Medellin Metro modes (Metrorail and bus); 6) the first major gondola technology in the world to integrate ACT into a citywide Metro transit system; 7) owned and operated by a Metro District; 8) towers are strategically located to minimize right-of-way impacts; and 9) attached to a system with more than one million boardings per month.

The Medellin Metro Cable System type is a mono-cable detachable grip gondola with ten passenger cabins that are evenly spaced on the lines and circulate through the ten stations along three lines. Unlike aerial tramways with two large cabins (e.g.: Roosevelt Island) that remain attached to the haul cable, gondolas have many smaller cabins that detach and attach to a constantly moving haul cable. This type of system employs a single continuously moving haul cable loop per line. The cabins attach to the haul cable loop in the stations and decelerate and accelerate in the stations via a separate conveyor in the stations. The maximum speed for the system is 11.4 mph resulting in a one- way travel time of 9 minutes for Line K, 12 minutes for Line J and 16 minutes for Line L. The headways for passenger boarding are 12 seconds at peak and 24 seconds at off-peak periods. The maximum capacity of the system is 3,000 riders per hour per direction.

The Medellin Metro Cable Gondola was constructed in order to address economic and social issues of the poorer and disconnected outlying neighborhoods. Key considerations were access to jobs, heavy traffic, congestion-based delay, traffic noise, commute time wasted and inadequate linkage to public transportation systems. Before Metro Cable was installed, commute times could be as high as two hours for Santo Domingo residents each way. With the Medellin Metro Cable Gondola System, commute times have been reduced to 20 or 30 minutes.

Line K has an annual ridership of approximately 14 million passengers, Line J approximately 6 million passengers and Line L approximately 4 million passengers for a total rider count on Medellin Metro Cable Gondola System-wide ridership of 24 million annual passengers. The Line K and Line J operate 20 hours per day and 355 days per year for a total of 7,100 annual operating hours each. The Line L operates 12 hours per day and 355 days per year. Reliability factors for the percentage of running time versus total available operating time have been reported at over 99.7% for all the lines. These calculations incorporate: weather-related stops; electro-mechanical stops; and passenger loading / unloading service interruptions. The average ridership per day on Line K is estimated at 35,000 to 40,000; Line J is estimated at 15,000 to 17,000 per day and Line L is estimated at 10,000 to 12,000 per day.

The first line constructed was Line K in 2004 at a reported capital cost of $26 million USD for the gondola equipment and installation. The second line constructed was the longer Line J in 2008 at a reported cost of $50 million for the gondola equipment and installation; the third line constructed was the more local tourist-oriented Line L at a reported cost of $25 million. The costs of the infrastructure, station buildings and support facilities for the three lines are not available. Specific staffing costs and operation and maintenance costs for the Medellin Metro are not available.

2.4.5 MI TELEFERICO GONDOLA – LA PAZ, BOLIVIA

Founded in 1548, City of La Paz, Bolivia has a metropolitan population of 2.3 million inhabitants. With an elevation greater than 12,000 feet above sea level, the city has the highest international airport in the world. Until the installation of the ACT system, it was one of the only major cities in the world with no public transportation system apart from local bus service. La Paz is one of the first public transportation networks in the world to use ACT as its primary transit mode.

The La Paz Mi Teleférico ACT system is a gondola type aerial cableway with two interconnected lines and one independent line that was constructed in 2013 and became operational in 2014. It connects downtown La Paz with the outlying community of El Alto on a plateau above the City. The La Paz installation is the most recent worldwide, multi-line ACT system constructed in a major metropolitan area. It has transported over 25 million passengers since opening, which could be extrapolated to more than 30 million annual passengers. With 11 stations and 6.2 miles in length, the first three lines in Phase One is the longest ACT cableway system in the world now that it's completed. Phase Two will extend the system by 23 more stations and an additional 12.1 miles.

The ACT system was constructed to address a number of problems, including an almost non-existent public transit system that could not cope with growing user demands, the high cost in time and money of traveling between La Paz and El Alto, heavy traffic with its subsequent environmental and noise pollution and a growing demand for gasoline and diesel fuel.

This urban gondola is applicable and relevant to our study in that the system 1) is located in an urban area in a major city, 2) has heavy traffic congestion that is similar to the Miami-Dade Metropolitan area condition, 3) is primarily used for public transit, 4) passes through and over commercial and residential neighborhoods, 5) is the most recent and longest Gondola ACT system worldwide, 6) is owned and operated by a Metro District and 7) has over two million passenger boardings per month.

Like Medellin and Telluride above, the La Paz ACT system uses a mono-cable detachable grip gondola with ten-passenger cabins that circulate through the ten stations along three lines. The maximum cabin speed is 11.4 mph. The headways for passenger boarding are 12 seconds at peak and 24 seconds at off-peak times. At full speed with frequent headways, the maximum passenger carrying capacity of the system is 3,000 riders per hour per direction, the same capacity as the Medellin, Caracas and Rio de Janeiro gondolas in South America. The maximum tower height along the lines is approximately 150 feet.

To date the reliability / availability factors for the system are: Red Line: 99.42%; Yellow Line: 98.36%; Green Line: 99.11%. The average number of riders per day: Red Line: 20,000; Yellow Line: 40,000; Green Line: 14,000. None of the lines are currently connected with bus / train stations but the 6 approved lines will have the capabilities to connect with bus routes and possibly a train station. The operating hours: 17 total hours per day (6:00 a.m. - 11:00 p.m.); the same for both weekdays and weekends.

Regarding obstacles along the lines; some lines cross over small rivers but haven't presented any real issues. All lines cross over heavily populated neighborhoods and commercial zones. The gondola was met with some resistance initially from residents in poorer neighborhoods but most residents now acknowledge the economic and travel-time benefits. The retail space per station is extensive and is still under construction and leasing. Retailers at stations currently include drug stores, cell phone providers, ATM's and tour kiosks. It is anticipated that future retail uses may also include restaurants, supermarkets and newsstands.

There are 443 cabins distributed throughout the network, each of which seats 10 passengers. Cars depart every 12 seconds and the network is open 17 hours a day. Six new interconnected lines will be built in the coming years. In January, 2015, the legislation permitting construction of Phase Two was passed, increasing the number of total stations to 33 and total lines to nine; Phase Two will extend the system by 12.6 miles.

In 2012, a legislative bill for the construction of Phase One of the ACT system at a cost of USD $238 million, to connect El Alto with the center and south of La Paz, was put in place. In early 2015 the Phase Two project extension was approved and legislated with six (6) gondola lines that will be implemented with a total cost of approximately USD $450 million. Both project phases are financed by the country's National Treasury with an internal loan from the National Bank of Bolivia. No data was provided for the annual Operation and Maintenance costs as all three lines had less than a year of operation on them.

2.4.6 CONSTANTINE / TLEMCEN / SKIKDA ACT SYSTEMS – ALGIERS, ALGERIA

Algiers in particular and Algeria in general is certainly the cradle of urban ACT systems. With 35 million inhabitants in Northern Africa, Algeria has been under the radar, but in the forefront of worldwide ACT technology. It is the worldwide leader in the adoption of such technology for transit use in many of its cities. The nation has 16 operating urban ACT systems and another 9 to 12 additional systems in either the planning or construction phases. The Algerian government has just allocated $675 million USD for the national refurbishment of its ACT systems and feasibility studies for future ACT systems.

The implementation of ACT technology, both in the form of jig-back aerial tramways and detachable grip gondolas dates back to1954 when the first aerial tramway was constructed in Algiers. This intensity of ACT implementation likely related to Algeria's history as a French colony since a major cableway manufacturer, Poma, is based in France. The early urban ACT systems were facilitated through foreign trade agreements. The hilly terrain of Algerian cities and different levels throughout urban areas also make ACT a highly applicable public transportation mode. Early on, relatively short aerial tramways were constructed to take the place of long sets of stairs used to access schools, shrines, markets and commercial areas. The numerous ACT tramway and gondola systems in the City of Algiers alone are:

1) Algiers Central, 2) Belouizdad, 3) Bouzareah Area, 4) El Madania, 5) Memorial des Martyres, 6) Riad el Feth, 7) Jardin d'Essais, 8) Notre Dame d'Afrique, 9) Bologhine, 10) Palais de la Culture, and 11) Oued Kniss.

The Algerian aerial tramways and gondolas are considered instructive and included in this review for the following reasons: 1) a significant number of installations; 2) long-term experience with aerial cableway technology for public transportation purposes; and 3) continued use of the ACT technology along with reinvestment through renovations and feasibility studies for future systems.

The ACT systems are critical to the movement of people in Algiers and they are all fully integrated with Algiers' other transit systems. These systems move millions of people per year; they are necessary components in the growing Algiers transit network. The Algerian ACT systems are generally owned by the city governments, renovated by the national government and operated by joint venture public / private operating companies.

Many of the 16 existing ACT routes in the cities address topographical challenges provide an alternative to traffic congestion along the steep and winding roadway network. In Algiers itself, the early aerial cableways were short (i.e.: less than 1,000 feet) and addressed specific local elevation changes. The newer ACT systems are one to five miles long with multiple lines and stations. These newer systems employ the current industry standard detachable grip, mono-cable gondola technology. The newer Constantine routes include two lines under construction in 2014 / 2015. They originate from the city center and will connect to Bekira and Sidi Mabrouk;

these Districts include parking and bus connections to the Mohamed-Boudiaf International Airport (1.6 miles), Ali-Mendjeli District (6.3 miles) and El Khroub (2 miles).

The gondola in Tlemcen, a city of 140,000 people, is situated on a limestone ridge. The stations in this system were inspired by traditional local styles, with both the design and construction assigned to local architects and contractors. The system not only connects the neighborhood to the city center but it is also incorporated into an amusement park, hotel and zoo. The Skikda line is 1.2 miles with three stations and provides a direct connection from two hillside communities to the city center in the valley below. The line passes over and through the two communities and then passes over greenbelts before arriving at the inline angle station in town.

In 2014, the Algerian Federal Government appropriated $675 million USD for the refurbishment of 15 existing ACT lines as well as feasibility studies for up to ten more cities that have proposed aerial cableway systems. Concurrently, EMA (Algiers Metro Company) and ETUSA (Enterprise Urban Transport and Suburban Algiers) announced the formation of a new countrywide operations and maintenance contract with one of the gondola manufacturers to operate the 15 ACT existing systems. Information regarding labor costs and operating and maintenance costs is not available online.

2.4.7 EMIRATES AIRWAY GONDOLA – LONDON, UNITED KINGDOM

London was the host city for the 2012 Olympic Games. Hosting the Olympics requires many new transportation and recreational sporting venues to be constructed in support of the Games. As part of the Olympic Games Master Plan, an ACT system was identified by Transport for London to carry patrons to indoor venues and connect with the City's Metro.

The Emirates Airway ACT system is a 0.7 mile gondola that crosses the River Thames. Construction began in August 2011 with a target completion date of July 2012. It is the first urban ACT system in the United Kingdom. In addition to transit across the River Thames, Transport for London advertises the spectacular views of London from heights of 300 feet as cabins travel between Greenwich Peninsula and the Royal Docks. Since the Olympic Games, ridership has declined and commuters are not using the system heavily as the gondola route duplicates other available rapid transit that charge lower fares. In the initial planning process, Transport for London indicated that the ACT system would be a valuable public transportation linkage within the Metro system. Since the stations are located in sparsely developed residential and commercial areas, there are few commuter destinations located at either end of the cableway. The destinations that are in those areas are already served by the London Underground rapid transit network.

The Emirates ACT system in London is applicable and relevant to the Miami-Dade MPO study in that the system incorporates the following characteristics: 1) location in a major city; 2) interconnection to rail and other transit modes; 3) flat urban terrain; 4) used to transport people over a water body; 5) location in an area with a significant tourist market; and 6) P3 type finance structure. It is instructive to understand that it should not be assumed that commuters will utilize ACT service that duplicate established faster and lower fare services using conventional technologies.

The London aerial cableway uses industry standard mono-cable detachable gondola technology, with a single cable for both propulsion and support. This type of gondola is cheaper and faster to install than a more complex 3S three-cable system which would allow for larger-capacity cars and a faster line speed. The gondola runs for a length of 0.7 mile over the River Thames with a vertical clearance of 177 feet above mean high tide. The three tower structures are located on the north side of the Thames with a 285-foot main tower at Clyde Wharf, a 217-foot intermediate tower located south of the Railway tracks and a 200-foot main support tower with a boarding station within the O2 Arena parking area.

The cableway service opened in 2012 and is operated and maintained by Mace Constructors, under contract with Transport for London. The Emirates Air Line ACT system is now illustrated on the London Tube maps as part of the Metro Transit system. Similar to the representation of the Light Rail, the cable car route is displayed as a triple red stripe rather than a solid line, to distinguish it from the London Underground lines. The one-way trip of the gondola cabins is referred to as a "flight" as the marketing literature borrows language from the airline industry, such as referring to tickets as "boarding passes." The fares are $6.50 for a single boarding pass or $4.75 when paid with the Oyster card. To encourage use of the service for commuting, further discounts are offered with a "frequent flyer" ticket which allows ten journeys within a 12-month period.

The government has called for full fare integration of the gondola into the Metro Transit system suggesting a lower fare. As of February 2013, there have been 1,815,212 passenger trips since July 2012. The average passenger trips for the period between September 2012 (after the Olympics) and February 2013 has been approximately 30,000 passengers per week. The highest weekly usage during that period was 70,000 in early November and the lowest usage was 15,000 in early February 2013. The ridership trend is declining due to lack of commuter ridership

When the project was announced, Transport for London's initial budget was $40 million USD. It was also announced that this would be entirely funded by private finance. This figure was first revised to $70 million USD and then to $90 million because soft costs associated with professional services, project management, land acquisition and other right-of-way costs had not been included. Transport for London planned to make up the shortfall by paying for the project out of the London Rail budget, applying for funding from the European Regional Development Fund and by seeking commercial sponsorship. In 2011, it was announced that the Dubai-based airline, Emirates Airways, would provide $55 million USD in a ten-year sponsorship deal which included branding of the cable car service with the airline's name. The balance of the project was funded by public funds, effectively categorizing the project as a P3 finance structure.

Construction on the gondola began in August 2011. The contractor, Mace, built the gondola (equipment and installation) for $67.5 million USD. Further construction costs were incurred for infrastructure and support facilities. The only data provided for the annual Operation and Maintenance costs is that the construction company, Mace, was contracted to operate and maintain the system for three years at a cost of $8.25 million USD, or $2.75 million per year (plus the cost of parts and supplies). The O&M costs are being paid for with a combination of the higher tourism fares as well as tax revenues.

2.4.8 THE WIRE GONDOLA – AUSTIN, TEXAS (PROPOSED)

Austin, Texas is a rapidly growing metropolitan area with a population of over two million and increasing traffic congestion daily. An ACT gondola system with an extensive network was proposed for Austin in 2012 by a design firm, Frog Design. Studies continue to date. The proposer / designer, Michael McDaniel proposed an idea for an urban cable car system to be called "The Wire." The team sees the aerial cableway system as a multi-modal component among numerous options within a greater transit network across the city. At this time, there are few details published regarding alignment and costs but it has been suggested that "the Wire" would traverse busy streets and other commercial areas to create connections to other transit modes, similar to the situation in Miami-Dade County.

According to McDaniel, a gondola cableway allows for the implementation of a public transportation system in a busy city at a lower cost than light rail and automated guideway transit with less required right-of-way. Their idea came from looking at photos from the early 1900's and noticing that all the major arteries in Austin were serviced by streetcars. Rebuilding those streetcar lines would require purchasing land for rights-of-way at high prices, negotiating with owners who may not want to sell and competing with other forms of traffic on the same roadways. The Wire is still in the feasibility phase of analysis. Some stakeholders have expressed a preference for commuter rail as an investment over gondolas.

The proposed "Wire" in Austin is applicable and relevant to the Miami-Dade MPO study relative to these characteristics: 1) location in a densely populated area of a major United States city; 2) heavy traffic congestion; 3) primary use for public transportation; 4) interconnection to rail and other transit modes of the Austin Metro Authority; 5) flat urban terrain; 6) potential river crossing; and 7) potential P3 finance structure.

Not all of the operating characteristics have been defined in Austin. The key considerations identified during the study include: 1) peak-period passenger capacity; 2) attractiveness of 12 to 18 mph speeds for choice riders; 3) integrating gondolas with the region's transit system; and 4) future viability of a network of gondolas as an Austin public transportation system.

Proponents have identified that a key advantage for gondolas is the ability to operate above the right-of-way rather than the guideway necessary for BRT lanes or rail tracks along or adjacent to streets. It is expected that the gondolas would operate at 15 to 30 second headways allowing people to use them without having to consult a schedule. Austin Mayor, Alan McGraw, who originally proposed the idea, said the ACT system would avoid a major impediment affecting the advancement of rail projects, which is acquiring right-of-ways. "Here's the problem when you start talking about alternatives in transportation; we continuously hear two options, which are buses and trains. Buses have limited ridership and trains are very expensive", McGraw said. The stations and vehicles proposed for the Austin Wire would be much less expensive and would be fully ADA compliant.

Austin had a light rail system voted down on ballot measures because residents and businesses didn't want to endure disruption for three to five years during construction. As such, proposed alignments would have to consider the length of time required for construction as well as potential economic impacts and disruption for neighborhoods and local businesses. McDaniel states, "When you start looking at the timing and cost of the infrastructure, gondolas are designed to be installed quickly." In Austin, the routes discussed would use existing right-of-way along road centerlines and adjacent to streets and waterways to avoid private property impacts and easement issues.

Over the years, the City of Austin has been studying whether to install approximately five miles of light rail at a cost of $550 to $750 million, or around $100 to $150 million per mile. Initial discussions of the gondola system have included estimates of $12 to $24 million per mile for construction but these costs do not appear to include the total cost of infrastructure and right-of-way. McDaniel estimates that a system of gondolas would cost about one-third as much as the $550 - $750 million urban rail project the city has planned. The ACT proponents suggest that the Federal Transportation Administration (FTA) may have grant funding available for a city-wide transit project.

2.4.9 GEORGETOWN GONDOLA – WASHINGTON, D.C. (PROPOSED)

The Georgetown ACT system is proposed by the Georgetown Business Improvement District (BID) as a mono-cable or tri-cable gondola that would cross the Potomac River and connect the Metro subway system located in Rosslyn, Virginia to the Georgetown central business core and Georgetown University. Currently the Georgetown district is not connected to the Washington DC Metro. Georgetown's businesses and residents are suffering from lack of a premium transit service. The Metro is not scheduled to be extended into Georgetown until 2040 or beyond and the business community is becoming proactive to find an alternative to fill the void until the subway is extended. This situation is very similar to Roosevelt Island, New York in the 1970's when the State constructed the ACT system as a "temporary" measure to meet community transit needs until subway construction was completed in 1989; the Roosevelt ACT continues to run today as a supplement to the completed subway.

In the case of Georgetown, the closest Washington Metro station is located just across the Potomac River, a short one mile away in Rosslyn, Virginia. To connect the Rosslyn Metro to Georgetown, a tunnel would be required under the river to reach Georgetown. The costs would be significant and the project is not funded. It is estimated that an ACT system could provide the same passenger capacity and service levels as the Metro at one-fourth of the subway capital cost. An ACT link to and from Rosslyn would benefit Georgetown commuters, students and shoppers, many of whom arrive at the Rosslyn Metro station and transfer to buses to cross the Key Bridge (SR 29) in heavy traffic.

The proposed Georgetown gondola is applicable and relevant to the Miami-Dade MPO study in that the system would incorporate the following characteristics: 1) location in a densely populated urban area in a major city; 2) heavy traffic congestion; 3) primary use as public transportation; 4) interconnection to rail and other transit modes; 5) flat urban terrain; 6) potential river crossing; and 7) likely P3 type finance structure.

The Georgetown ACT system is being proposed as a detachable grip circulating gondola employing either mono-cable (1S) technology or tri-cable (3S) technology. If mono-cable technology is selected, the vehicle size could range from 10 to 15 passenger cabins and if tri-cable is selected, the vehicle size could accommodate between 20 to 35 passengers. The technology assessment has not ruled out aerial tramways, like the Roosevelt Island and Portland systems, with up to 200 passengers per vehicle. However, the aerial tramway would result in a lower overall passenger capacity than 1S or 3S systems.

The system length ranges from 0.7 to 1.0 mile depending on whether the route terminates near M Street in downtown Georgetown or continues to Georgetown University. The maximum speed of the gondola could range from 12 mph to 18 mph, depending on technology with travel times ranging from four to seven minutes. Headways would be in the range of 12 to 30 seconds depending on the desired passenger carrying capacity per hour, which for these types of gondolas typically ranges from 2,000 to 5,000 passengers per hour per direction. Construction time for this system has been estimated at 12 to 18 months in the preliminary study documentation.

The proposed gondola system would serve the dual purposes as an urban people mover and a tourist attraction. Washington, D.C. is a major tourism market and Georgetown is a key component of the tourism base. In addition, the proposed gondola would extend over a scenic vista that includes the Potomac River and views of Theodore Roosevelt Island and the Washington Monument to the southeast and Georgetown University and Capital Crescent Parkway to the northwest. The gondola would operate as a connector to the Blue and Red lines of the Metro in Rosslyn. The ACT system would most likely operate the same hours as Metro (5:30 a.m. to 2:00 a.m.) and have the same fare structure to be fully integrated into the Metro system.

Informal studies, community analyses and public meetings have been undertaken during the past year by the Georgetown Business Improvement District to promote the proposed ACT system. To date, the BID has raised 90% of the estimated \$150,000 to \$200,000 funding required for the feasibility study to advance the project to the next level. A Request for Proposals for the study is scheduled to be released in the spring of 2016. Study funding has been secured through public and private sources: the Georgetown BID; Rosslyn BID; District of Columbia, Arlington County; Rosslyn, Virginia Planning Department; and commercial stakeholders who would benefit from the aerial people mover system. Estimates for the system's capital cost range from \$50 million to \$100 million depending on the ACT technology, route, and the stations' architecture / amenities.

2.4.10 MEXI-CABLE ACT SYSTEM – MEXICO CITY, MEXICO (UNDER CONSTRUCTION)

Mexico City (population of 22 million) and its northern outlying suburb of Ecatepec (3 million) are constructing the latest urban ACT cableway system. It is the first public transport ACT application in Mexico; other Mexican ACTs have served tourist areas. Legislated and approved in 2013, construction of the two line system commenced in the fall of 2014 and the system will be operational in March 2016.

Key aerial cableway system characteristics that led to the decision to build an ACT included: 1) local elevation changes; 2) serious traffic congestion; 3) inadequate and narrow roads; 4) budget constraints; 5) lack of available right-of-way; and 6) lack of an alternative transportation mode. For these reasons, light rail, bus rapid transit and automated guideway transit were not considered feasible solutions.

The Mexi-Cable ACT system that is now under construction is a gondola type aerial cableway with two lines to connect downtown Ecatepec and the outlying community of San Andreas Morelos to the regional bus terminal. This installation is now the most recent worldwide multi-line ACT system under construction in a major metropolitan area and is projected to transport up to 26,000 commuters per day or roughly ten million passengers annually. Phase One includes seven stations and three miles of guideway. These first two lines will connect several communities to the Ecatepec Mexi-Bus Terminal for continuing transport into Mexico City. Phases Two and Three may add five more lines and numerous interconnected stations. Like La Paz, Medellin, Caracas and Rio de Janeiro, this ACT system is being constructed to address a number of social problems including an almost non-existent public transit system which has adversely impacted the quality of life of workers and families in the metropolitan area.

The Ecatepec Mexi-Cable Gondola system is applicable and relevant to the Miami-Dade MPO study in that the system is: 1) located in a dense urban area adjacent to a major city; 2) experiencing heavy traffic congestion; 3) primarily used for public transportation; 4) extending over commercial and residential neighborhoods; 5) the most recent gondola ACT system. As such, the study reflects state of the art in ACT technology. The Ecatepec Mexi-Cable Gondola is also an example of a system installed to address severe air pollution and has a P3 finance structure.

The Phase One Ecatepec Mexi-Cable system type is a mono-cable detachable grip gondola with 190 cabins of ten passengers each that will circulate through the seven stations. All of the station platforms appear to be elevated above roads and plazas. This type of system employs a single continuously moving haul cable loop. As with the previous systems reviewed, the cabins attach / detach to the haul cable loop and decelerate / accelerate in the stations. The maximum system speed will be 13.6 mph for peak periods and headways are planned at 12 seconds during peak periods and 24 seconds during off-peak periods. At maximum capacity, it is capable of handling 3,000 passengers per hour, per direction.

The ACT equipment will be monitored by sensors for overheating and vibration, as it is the most current gondola technology. Diagnostics and troubleshooting for the ACT's systems will be done remotely from the gondola manufacturer's facility in Europe via installed modems. The electro-mechanical equipment and hydraulic tensioning systems are housed separately in the terminals for each line. The cable loops and cabins are supported by tubular towers, which carry the sheave trains, haul ropes, communications wires and fiber optic cables.

Mexico City is one of the largest and fastest growing metropolitan areas in the world. Because the infrastructure has not grown at the same pace as the population, there is a desire in the Mexican capital for alternative, space-saving traffic concepts. The solution: two gondola lifts running independently and connected at one middle station where passengers can change lines. This ACT system will connect Via Morelos with San Andrés De La Canada. The ropeways will operate 17 hours a day and seven days a week, or close to 6,000 hours annually. For the inhabitants of the Ecatepec de Morelos region, this connection will provide an easier commute and improved quality of life. Commuters, until now, have travelled 45 minutes along this route either via 'Peseros' minibuses or by car in traffic congestion. With the modern ACT system, the full journey will take approximately 19 minutes.

The system will be directly connected to the public transportation system. This new electric-powered gondola will reduce air pollution as well as commute times. Authorities have estimated that the system will result in a reduction of 17,000 tons of carbon dioxide annually as compared to auto and bus emissions. Mexi-Cable will also generate 300 direct construction jobs and about 50 permanent operations jobs. Information regarding staffing requirements and labor hours are not available online.

The new Ecatepec ACT project is a P3 venture that is estimated to cost $83 million USD. Mexiteleférico SA de CV, the construction company, will invest $33 million USD and the government will invest $50 million USD. The cost of a one-way trip is initially set at $0.60. The owner will be Mexico City and the system will be maintained and operated by Mexiteleférico. No data is available on projected labor costs or operating and maintenance costs.

Table 5: Operating / Proposed ACT Systems' Characteristics

ACT SYSTEMS IN OPERATION	YEAR	SYSTEM TYPE	PASS PER VEHICLE	VEHICLES	LINES / STATIONS	SYSTEM LENGTH (miles)	SYSTEM SPEED (mph)	ONE WAY TRIP TIME (minutes)	SYSTEM CAPACITY (pphpd)	SYSTEM HEADWAY	SYSTEM FUNCTION	MAX DAILY / ANNUAL BOARDINGS
NEW YORK, NY (Roosevelt Island)	1976	AERIAL TRAM	110 pass	2	1 line / 2 stations	0.6 mi	18 mph	3 min	1,200	5.5 min	Transit / Tourism	9,000 / 2,500,000
PORTLAND, OR (OHSU Center)	2007	AERIAL TRAM	78 pass	2	1 line / 2 stations	0.7 mi	22 mph	3 min	800	6 min	Transit / Tourism	7,000 / 1,500,000
TELLURIDE, CO (Mountain Village)	1996	GON - 1S	8 pass	59	3 lines / 6 stations	3.0 mi	11.4 mph	20 min	900	32 sec	Transit / Tourism	19,000 / 2,400,000
MEDELLIN, COL (Metro Cable)	2004 / 2010	GON - 1S	10 pass	300	3 lines / 10 stations	5.8 mi	11 mph	Various Lines	3,000	12 sec	Transit	57,000 / 20,000,000
LA PAZ, BOL (Mi Teleferico)	2014 / 2018	GON - 1S	10 pass	443	9 lines / 33 stations	18.2 mi	11 to 13 mph	Various Lines	3,000	12 sec	Transit	75,000 / 25,000,000
ALGIERS, ALG (Multiple Systems)	1954 / 2016	TRAMS + GON - 1S	8 pass to 35 pass	NA	Multiple lines / stations	0.1 to 6.2 mi	10 to 18 mph	Various Lines	500 to 3,000	Various Lines	Transit / Tourism	Various Lines
LONDON, UK (Emirates Airway)	2012	GON - 1S	10 pass	36	1 line / 2 stations	0.6mi	11 mph	5 min	2,500	14.4 sec	Transit / Tourism	6,000 / 1,000,000
ACT SYSTEMS PROPOSED												
WASHINGTON, DC (Georgetown)	Future	GON - 1S/ GON 3-S	TBD	TBD	1 line / 3 stations	1.0 mi	12 to 18 mph	TBD	TBD	TBD	Transit / Tourism	TBD
AUSTIN, TX (The Wire)	Future	GON - 1S/ GON 3-S	TBD	TBD	Multiple lines / stations	10 to 15 mi	12 to 18 mph	TBD	TBD	TBD	Transit	TBD
MEXICO CITY (Mexi-Cable)	2016	GON - 1S	10 pass	190	2 lines / 7 stations	2.9 mi	13 mph	18 min	3,000	12 sec	Transit	TBD
OTHER ACT SYSTEMS IN OPERATION	BRECKENRIDGE, CO / WINTER PARK, CO / PARK CITY, UT / MAMMOTH, CA / CARACAS, VEN / RIO DE JANIERO, BRA / MANIZALES, COL / SINGAPORE, IND / HONG KONG, CHI / TAIPEI, TAI / VINPEARL, VIE / KOBLENZ, GER / BOLZANO, ITA / NORSJO, SWE / BARCELONA, SPA / MADRID, SPA / LISBON, POR / FUNCHAL, POR / TIRI OUZOU, ALG / SKIKDA, ALG / ANKARA, TUR / ISTANBUL, TUR / CAIRNS, AUS / SIDNEY,AUS											
OTHER ACT SYSTEMS - PROPOSED	SEATTLE, WA / DENVER, CO / BOULDER, CO / ASPEN, CO / OGDEN , UT / KIRKLAND,WA / HOUSTON, TX / AUSTIN, TX / ST. LOUIS, MO / BRANSON,MO / ANN ARBOR, MI / PHILADELPHIA, PA / DETROIT, MI / TAMPA, FL / CLEARWATER,FL / FT MYERS, FL / ORLANDO, FL / FREDERICKSBURG, VA / ATLANTIC CITY, NJ / EAST RIVER, NY / BUFFALO, NY / TORONTO, CAN / TOKYO, JAP / CEBU, PHI / CHIANG MAI, THA / BANGKOK, THA / PORT AU PRINCE,HAI / GUADALAJARA, MEX / MAGDALENA, MEX / SANTIAGO, CHI / ROCINHA, BRA / POTOSI,BOL / ORURO, BOL / BOGOTA, COL / GOTHENBURG, SWE / GRONIGEN, NET / LYON, FRA / TOULOUSE, FRA / BREST, FRA / NANTES, FRA / GRENOBLE, FRA / BERLIN, GER / KONSTANZ, GER / HAMBURG, GER / BOCHUM, GER / KIEL, GER / GRAZ, AUT / SALZBURG, AUT / KRIENS, SWI / BADEN, SWI / GENOA, ITA / PALMERSTON, NZL / ORAN, ALG / LAGOS, NIG / KAMPALA, UGA / ISTANBUL, TUR / SINGAPORE, IND / BATUM, GRE / MUMBAI, IND / JERUSALEM, ISR / MAKKAH, SAU / SANTO DOMINGO, DR / SAN JUAN, PR											

2.5 ACT TECHNOLOGY CONCLUSIONS

As noted earlier, although 1,500 systems have been built worldwide, only 50 ACT systems serve as urban transit or "people movers." Collectively these 50 systems have a capacity of more than 20 million passengers per day. The study team reviewed ten existing or proposed systems to determine if key lessons, applicable and instructive for Miami-Dade County, could be derived.

Technology

- No air conditioning has been incorporated into existing ACT systems. The battery powered AC offered by cabin manufacturers is of short duration along a segment – approximately ½ mile.
- The engineering requirements of ACT technology necessitate single or multiple straight alignments connected at straight or angle stations to follow right-of-ways.
- Typical urban ACT route lengths are one mile with maximum routes seldom exceeding three miles.
- Stations are typically spaced widely with a minimum station spacing of 2,500 feet. Most systems have only two stations – one at each end.
- Slight alignment turns of 5 degrees or less can be made on line with towers; turns up to 90 degrees can be made on line with special detaching mechanisms and at stations.
- In many North American, Latin American and European cities ACT systems have been implemented to extend over geographical constraints such as water or steep inclines.
- Continuous strips of right-of-way or transit corridors are not needed but small parcels are required at regular intervals for support poles. Land is also required for stations and power systems.
- Land costs for right-of-way tend to be much lower for ACT systems than for rail corridors and dedicated lanes for bus or streetcar transit that operate on surface streets.
- Key operating considerations such as evacuation planning, ADA accessibility, security and comfort need to be considered when designing the urban ACT system.

Environment

- Visual impacts, privacy concerns and aerial property rights present notable concerns in the United States. Property owners have limited air rights above private property as it relates to privacy, noise and blocking of the sky.

Service Characteristics

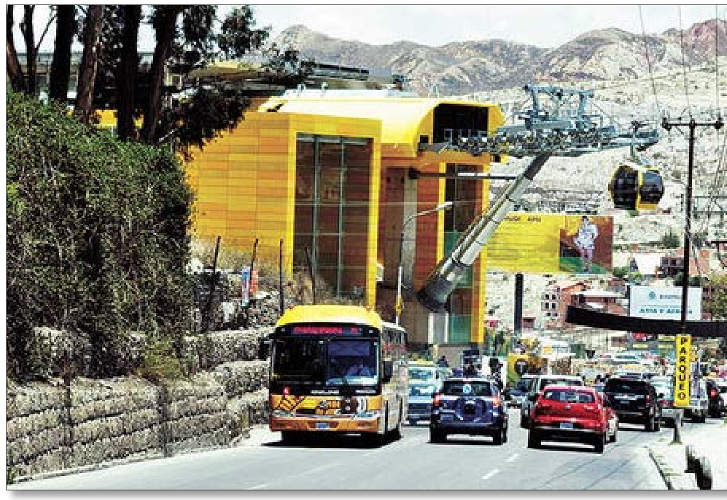
- Frequent cabins with short waiting times are very attractive to travelers when passenger traffic volumes are not heavily peaked.
- ACT does not have the same high top speed for rail rapid transit or regional rail service. Thus it is not a suitable substitute for rail transit for trips much more than two or three miles.

- ACT stations tend to be relatively expensive to build, staff, and operate. Slowing the line to serve an intermediate station adds to overall travel times and vehicle requirements. Consequently most urban ACT's tend to be built with station spacing in the neighborhood of 5,000 feet.
- Gondola systems operate continuously so that passengers do not need to memorize service schedules or wait for vehicles; however, surges exceeding 50 passengers per minute may require waiting times the same as any fixed guideway transit system of equal capacity.
- Maximum capacities are comparable street transit modes like bus, streetcar or light BRT serving 1,500 to 5,000 passengers per hour per direction.
- Stations need to be located proximate to densely developed areas or parking facilities, and connect key origins and destinations.
- In other applications, this elevated technology has been incorporated into the local transit network to avoid retrofitting streets, reduce high value acquisitions and minimize impacts to valuable public and private assets.
- ACT service can extend the reach of an existing transit network into heavily congested areas, areas difficult to serve due to geography, and to intermodal transit centers.

Markets

- Rigorous ridership analysis is needed to define the market for new ACT services.
- An ACT system may not attract commuters when an area is already well served by the existing transit network.
- In addition to their urban transport market, many ACT systems also draw a tourism market of persons interested in the views available from the elevated system and the novelty of the technology.

3. TRANSIT NEEDS IDENTIFICATION



La Paz, Bolivia

Evaluating the feasibility of new transit corridors is a complex, multi-step process. The identification of transportation needs is typically the result of multiple planning studies conducted by several partnering agencies. Early studies identify unmet travel demand that lead to subsequent feasibility studies to determine whether transit can serve these needs and, if so, which transit modes would be appropriate.

This ACT Feasibility Study serves to start a high-level discussion of the potential to add the ACT mode to Miami-Dade's transit network. Additional market analyses, planning studies, and engineering efforts will be required to examine any promising alignments in greater detail. Further travel demand analysis, outside the scope of this initial study would be required to develop more accurate ridership estimates and better understand market demand for any ACT service.

This chapter examines the existing and proposed connectivity between identified activity centers in the study area to determine where a potential ACT service would be most beneficial. This will be accomplished by reviewing previous and ongoing relevant studies, as well as existing and planned transit services. The goal is to identify a need for transit connections, or to find areas where ACT service could complement other transit modes without duplicating their service. As shown in the previous chapter, urban applications of ACT systems are usually for shorter distances, overcoming physical barriers or geographic impediments with point-to-point service. ACT is well-suited mode for making first / last-mile connections to institutions such as hospitals, universities, and isolated residential enclaves linking to premium line-haul general purpose transit services.

3.1 ACTIVITY CENTERS WITHIN THE STUDY AREA

This study was originally intended to review the feasibility of connecting some combination of six identified activities centers spread out in a general east-west direction across central Miami-Dade County. As the study process progressed, coordination with relevant stakeholders has led to the identification of two additional activity centers within close proximity that could potentially generate enough travel demand to warrant additional transit connectivity.

As a result, a total of eight major activity centers have been investigated during this study to determine the feasibility of potential connections using an ACT service. The final list of activity centers identified by the study steam in conjunction with the Study Advisory Committee (SAC) and other relevant stakeholders is as follows:

- Miami Beach;
- Port Miami;
- Downtown Miami / Government Center;
- Health District;
- Marlins Park;
- Miami Intermodal Center / Miami International Airport;
- Dolphin Station (Miami International Mall / Dolphin Mall/ CSX East-West Rail Station); and
- Florida International University's main and engineering campuses.

These identified activity centers are some of the largest trip generators in Miami-Dade County. These eight areas are well-established destinations for employment and recreational / tourism-related trips. Strong travel markets have been demonstrated between them. Congestion levels suggest that additional dedicated-guideway transit service could be beneficial. This ACT Feasibility Study examines unmet transit needs for connecting these activity centers and the potential to create new transit alignments consistent with ACT service design criteria.

Figure 3: Identified Activity Centers

3.2 PREVIOUS AND ONGOING RELEVANT STUDIES

A number of previous studies examined premium east-west transit options. The east-west movement in central Miami-Dade County is currently one of its heaviest travel markets. The east west spine is SR 836, supported by parallel arterial facilities such as Flagler Street, NW 12th Street and SW 8th Street. Several bus routes serve these east-west roadways. These transportation facilities, however, are heavily congested and failing to provide satisfactory service to and from Downtown Miami. Several premium transit services are currently in the planning phases or slated for implementation. As such, ACT alternative corridors examined during this study did not attempt to replicate or serve the same transit needs already studied or scheduled for implementation. The study team instead researched how an ACT system could serve other unique and well-defined transit needs.

The previous and ongoing transit studies are briefly described below. Any potential new transit services recommended by these studies are described. Some of these proposed services present opportunities for ACT service.

3.2.1 STATE ROAD 836 EXPRESS BUS SERVICE (2015)

The final draft Categorical Exclusion (CE) for the SR 836 / Dolphin Expressway Express Bus Service was released in March 2015. The CE documents the planned Express Bus Service, which will provide non-stop service, via SR 836 / Dolphin Expressway, to FIU, the Miami International Airport and Downtown's Government Center Metrorail Station. Three express services are planned. The first, the peak-only A-Line would run between the new "Tamiami Station" (SW 8th Street and SW 147th Avenue) and Government Center via US 41 / SR 90 / SW 8th Street / Tamiami Trail, SW 137th Avenue and SR 836. The peak-only B-Line would run between the new "Panther Station" (SW 8th Street and 109th Avenue) and the MIC, via SW 8th Street, SR 821 / Homestead Extension of Florida's Turnpike (HEFT), and SR 836. The full service C Line would run between the "Dolphin Station" (NW 12th Street at the HEFT) and Government Center. The new express bus services would operate on existing roadways; therefore, the general focus of the CE was on the infrastructure improvements (Tamiami Station and the Panther Station) and adjacent areas. C-Line service on the Dolphin Expressway would be able to leapfrog congestion in the general purpose travel lanes by operating on the shoulder of the limited access expressway.

3.2.2 ENHANCED BUS SERVICE ALONG FLAGLER / SW 8TH STREET (2014)

The Miami-Dade MPO recently studied transit service for the SR 968 / Flagler Street corridor, a key east-west transportation corridor serving Miami, Fontainebleau, and Sweetwater for 17 miles from Downtown Miami to the western end of the developed area west of SW 147th Avenue. The corridor is currently served by two MDT bus routes, Route 11, one of the highest ridership routes in the MDT system and the MDT Route 51 Max, which provides limited stop service to the corridor. Transit service on Flagler Street supports a large number of intermediate short distance trips, as well serving several strong trip generators, including Little Havana, Downtown Miami, Mall of the Americas, FIU, and the Fontainebleau-Sweetwater area.

The plan recommends that limited stop enhanced bus service (EBS) service be implemented along Flagler Street between Downtown Miami and a new (planned) FIU Transit Terminal known as Panther Station on SW 8th Street. Currently, about 80 percent of the ridership along the Flagler corridor travels between Downtown Miami and 79th Avenue, which supports a ridership level of more than 750 boardings per mile (bpm). Ridership west of 79th Avenue between the Mall of the Americas and FIU is lower at less than 225 bpm. Further west, ridership levels are even lower. West of 107th Street in the Coral Way area routes attract fewer than 80 bpm. Given this ridership pattern, implementation of EBS was not recommended west of FIU. The Flagler EBS would provide frequent and limited stop express service between FIU and the Government Center running along Flagler Street / SW 1st Street. Local bus service would continue to operate along Flagler Street / SW 1st Street to the Mall of the Americas. The Flagler EBS will improve travel times by serving only the most popular stops and connections within the Flagler Street corridor, and will improve and increase the volume of service on a number of segments. The service would be expected to increase attract new riders by reducing headways / increasing frequencies, thereby improving the quality of transit service throughout the corridor.

3.2.3 BEACH CORRIDOR TRANSIT CONNECTION STUDY (2014)

In 2013, the Miami-Dade MPO joined in a partnership with MDT, Miami Downtown Development Authority (MDDA), FDOT and the Cities of Miami and Miami Beach to conduct the Beach Corridor Transit Connection Study. This study updated and refined past studies (including the Bay Link Study) which examined possible premium connections between the cities of Miami and Miami Beach, and to evaluate how best to advance a rapid transit connection through the project development process. This is a high transit ridership corridor and has been identified as a candidate project and considered for premium transit over the last past two decades. In Downtown Miami, the proposed project would connect with the existing Metrorail, Metromover, and Metrobus systems. In Miami Beach, the proposed Light Rail Transit / Modern Street Car system would connect to the Convention Center and provide improved transit service to this densely settled area.

As of 2014, a new Miami Beach "hybrid" option is under consideration outside the corridors of South Beach. The study also considers an off-wire technology, as it could optimize routes, where there are aesthetic concerns and potential problems with clearance, narrow right-of-way, and utility conflicts. At the November 19, 2014 City of Miami Commission meeting, it was noted that "as a long term solution to improve transit connectivity", and the City Commission directed the administration to work with transportation partners, including the Miami-Dade MPO, FDOT, MDT, and the City of Miami, to advance the *Beach Corridor Transit Connection Project* to the next phase of FTA Project Development.

3.2.4 METROMOVER SYSTEM EXPANSION STUDY (2014)

The Miami-Dade MPO recently studied the potential expansion of the Metromover, automated people mover (APM) system. Currently the Metromover provides connections to the Metrorail network, at Government Center and Brickell stations. The MPO looked to provide greater system accessibility to Metromover users and improve system efficiency within Downtown Miami, Brickell, and the Arts / Entertainment areas. Preliminary concepts created at the initial study advisory committee included: Close Brickell Loop, Extend south along Brickell, Beach Connection, Close Omni Loop, Marlins Park Connection, North Connection, and Port of Miami Connection. Ultimately, the study focused on six concept alternatives: two north concepts, two south concepts, one east concept (Port of Miami) and one west concept (terminating at Marlins Park). The screening process, which included capital costs, population served, ridership, walkability, infrastructure constrains, geometric constraints, and constructability, led to the preferred *short-term* concept alternative, the South Brickell Loop. This concept alternative closes the current systems south loop to form a counter-clockwise loop that connects at the 8th Street Metromover Station. This concept also adds an inner loop that travels clockwise, providing additional circulation within the area. The South Loop concept alternative provides the most benefit with the least constraints, and was consequently selected for refinement. Therefore, while the Metromover Expansion is expected to increase connectivity in and around Downtown Miami, from the Arts District to Bayfront and to the Financial District, it is not expected to increase connectivity beyond Downtown Miami. It was not clearly stated in the Expansion Study if any of the other five alternatives would be considered for further study in the future.

3.2.5 ENHANCED BUS SERVICE ALONG BISCAYNE BOULEVARD – RAPID BISCAYNE (2013)

The Biscayne Boulevard Corridor, roughly defined as US1 from the Downtown Miami area to the Aventura Mall near the Miami-Dade / Broward County line, is one of Miami's busiest transit corridors. The 15-mile corridor extends through the historic county center, developed along the Florida East Coast (FEC) Railway linking Aventura, North Miami, North Miami Beach, and Miami Shores with the Downtown Miami area.

The Rapid Biscayne plan calls for EBS along Biscayne Boulevard to upgrade the existing MDT Route 93. This study was tasked with identifying transit infrastructure improvements, defining service characteristics, capital needs, and fleet requirements. Route 93 (Biscayne Max) travels from the Downtown bus terminal at Government Center to the Aventura Mall. Biscayne Max / Route 93 operates as a limited-stop service between NE 19th Street and NE 163rd Street with 16 stops. Rapid Biscayne envisions service with dedicated bus-only lanes along the entire, or portion of Biscayne Boulevard. The Biscayne EBS would truncate the existing Biscayne Max / Route 93 where it currently loops around the Omni Terminal. Because fixed and other premium modes of transit generally have a simplified route structure, which is a straightforward route alignment with little or no deviation connecting to or from a major trip generator / attractor, this Rapid Biscayne plan envisions that the Biscayne EBS be a line-haul, trunk service along Biscayne Boulevard supported by east-west local routes. The route deviation to Omni Terminal would be eliminated to reduce travel time by two to six percent.

3.2.6 BISCAYNE GREEN

The Miami Downtown Development Authority's Biscayne Green Plan recommends a landscaped open space urban park running along Biscayne Boulevard from SE 2nd Street to NE 5th Street. The park is intended to provide a pleasant and safe space for residents, workers, and visitors in Downtown Miami and to provide more pedestrian-friendly access from Downtown to Bayfront. A related Biscayne Boulevard Parking Reconfiguration Plan calls for additional Downtown parking development, both below grade and on-street.

3.2.7 METRORAIL-COCONUT GROVE CONNECTION STUDY (2007)

This report documented a preliminary planning study to examine the feasibility of establishing an exclusive right-of-way transit connection between the Metrorail line and Coconut Grove. The proposed transit corridor featured a direct link between the Coconut

Grove Metrorail Station and the Convention Center along SW 27th Avenue. Bus rapid transit (BRT), light rail transit (LRT), and ACT technologies were considered for this study. The ridership associated with the ACT showed to be higher than the forecasts for the BRT and LRT services due its short waiting times and ability to float above roadway congestion on 27th Avenue. *However, the public expressed skepticism regarding the viability and visual intrusion of the ACT development.* It was determined that, should the ACT mode move forward in future stages of the project, some effort would be required to remove public skepticism regarding the viability of the ACT service.

The study concluded that the ridership expectations for the Metrorail / Coconut Grove connector would be inadequate to support a conventional premium transit service. It was recommended that further studies of the Metrorail / Coconut Grove Connector should consider incorporating the Connector as an extension to the planned transit service for the Douglas Road Corridor. It was also noted that the attraction value of the ACT may be adequate to stimulate the necessary ridership to cover the development, operating, and maintenance cost for this technology; meaning "the success of this mode would be more dependent on its function as an attraction rather than a people mover."

3.2.8 INTERIM BRT SERVICE TO DOWNTOWN VIA THE MACARTHUR CAUSEWAY (ONGOING)

On January 14, 2015, the City Commission of Miami Beach discussed potential changes to the allocations of funding for transportation to increase the capacity of the free trolley system and provide additional funding for capital in North, Mid, and South Beach. The existing North Beach and Alton West trolley routes currently have a combined average daily ridership of about 3,100, running service every day from 8am until midnight. The newly planned Middle Beach route will increase the service area of the trolley system, and compliment other transit services to and from Miami Beach. Leaders in the Beach community opined:

> *"In an effort to reduce auto-dependency and improve mobility in our constrained and congested urban environment, the Administration is pursuing a series of transportation projects and transit initiatives that would improve traffic through-put, transit accessibility, and intermodal connectivity. Each of these initiatives will require additional transportation funding. One such initiative is the implementation of a citywide interconnected trolley system in conjunction with a series of park-and-ride facilities / transit hubs located at strategic junctions. The park-and-ride / transit hubs would serve as interceptor facilities for patrons to park, take transit, or transfer between modes. In addition to the recently implemented North Beach Loop, additions to the City's trolley system under consideration include a proposed Mid-Beach Loop, Collins Link, and South Beach Loop."*

At the November 19, 2014 meeting, the City Commission unanimously approved a resolution directing the Administration to explore the feasibility of implementing Bus Rapid Transit / Enhanced Bus Service connecting Downtown Miami and Miami Beach via the MacArthur Causeway. The City is working closely with FDOT and MDT to identify feasible options to implement the desired enhanced bus service within 24 months. It is anticipated that this bus service would feature technology enhancements, such as queue jumpers, transit signal priority, and real-time next bus information to improve the efficiency and reliability of the service. The annual operating cost of an interim Enhanced Bus Service / Bus Rapid Transit solution to improve connectivity between Miami and Miami Beach is preliminarily estimated at approximately $5 million.

3.2.9 CSX EAST-WEST RAIL FEASIBILITY STUDY (ONGOING)

The Miami-Dade MPO is studying the feasibility of passenger rail service on the existing CSX Lehigh Spur. The Spur runs from the MIC west to SW 137th Avenue, parallel to NW 12th Street and the Dolphin Expressway / SR 836. Three concepts have been developed: a Dolphin Diesel Light Rail service, a Dolphin Commuter Rail service, and a Dolphin / FIU Diesel Light Rail service. All three concepts would originate at the MIC. Possible western terminal stations include Krome Avenue, SW 137th Avenue, the HEFT, and FIU. Each concept has a different number of stations and headways. At this early stage, it is unclear who will operate the service, when operations would begin, or if, in fact, the project will move forward.

3.3 EXISTING AND PROPOSED TRANSIT SERVICES

To avoid duplicating other transit services in the study area, it is necessary to review their location and function. In addition to connecting the previously mentioned activity centers, an ACT system also has the potential to supplement one of these services by extending its service area and access, providing first / last-mile connections to areas of high activity, or facilitating transfers between two high-capacity or premium systems.

3.3.1 EXISTING TRANSIT

Transit services currently operated in the study area include rail rapid transit, regional rail service, local bus service, an automated people mover, and paratransit services. A list of these existing services can be found in Table 6 and their location is shown in Figure 4. They are described in greater detail below.

3.3.1.1 SOUTH FLORIDA REGIONAL TRANSPORTATION AUTHORITY - TRI-RAIL

Tri-Rail regional rail service is provided by SFRTA to connect Miami-Dade, Broward and Palm Beach counties. It runs 71 miles generally parallel to Interstate 95 with 18 stations, two of which provide connectivity to the MDT Metrorail. At the Metrorail Transfer Station in Hialeah passengers can transfer between Tri-Rail and MDT Metrorail service. The SFRTA Miami Airport Station is a part of the Miami Intermodal Center (MIC). At the MIC, passengers can connect to rapid transit, intercity rail, intercity bus, Miami International Airport, and the rental car center. Tri-Rail terminates southbound service at the Miami Airport Station before operating in a northbound direction toward Palm Beach County. The Miami Airport Station at the MIC is one of the activity centers identified for examination during this study.

3.3.1.2 MIAMI-DADE TRANSIT - METROBUS

MDT currently provides 47 Metrobus routes within a quarter-mile (comfortable walking distance) of the key activity centers identified by the Miami-Dade MPO. Of those 47 routes, 22 *directly* connect two of the activity centers identified for this project. The remaining 25 routes connect the activity centers to other parts of Miami-Dade County (as well as Broward County).

3.3.1.3 MIAMI-DADE TRANSIT - METRORAIL

MDT's Metrorail is a heavy rail rapid transit system with two lines in Miami-Dade County, the Green Line and the Orange Line. The Green Line starts in the Town of Medley at the Palmetto Station, traverses through Miami Springs and Hialeah, connects to the Hialeah Tri-Rail station, passes through the Health District, Downtown Miami, Bayside, Coconut Grove, and terminates in Dadeland. The Green Line connects the Health District and Downtown Miami activity centers. The Orange Lines starts at the MIC connecting to the Health District, Downtown Miami and Coconut Grove. It also terminates in Dadeland, providing connectivity to three of the identified activity centers for this project. The two MDT Metrorail branches service a total of 23 stations. Metrorail Government Center and Brickell stations provide for transfers to and from MDT's Metromover service.

3.3.1.4 MIAMI-DADE TRANSIT - METROMOVER

The MDT Metromover circulates through and around Downtown Miami with two lines: the inner loop serving the Omni and the outer loop serving Brickell. The Metromover network services 21 stations in Downtown Miami.

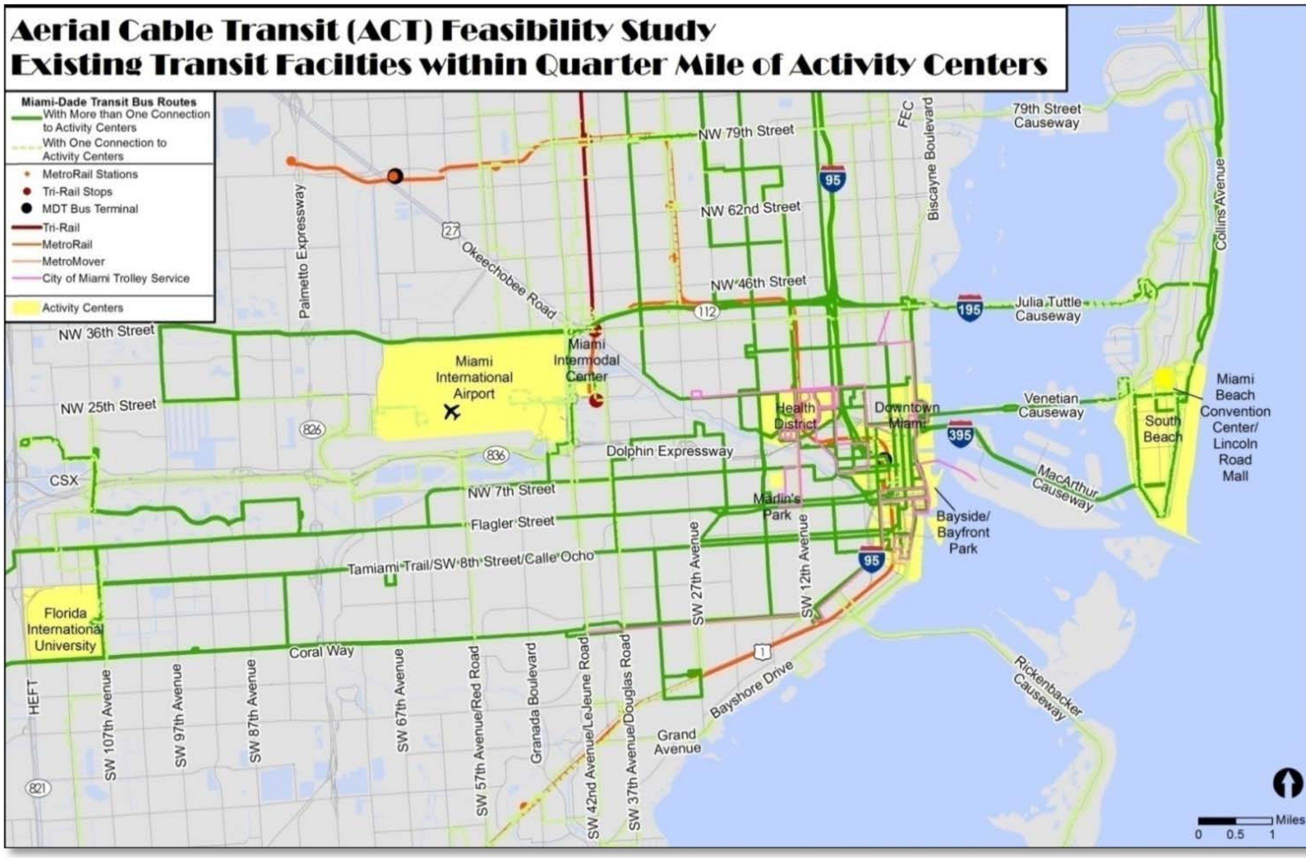
3.3.1.5 CITY OF MIAMI TROLLEY

The City of Miami provides a trolley service to supplement MDT public transportation services in their community. These are rubber tired trolleys operate with six routes all of which connect to at least one of the activity center identified by the MPO as key for this project: Allapattah, Biscayne, Coral Way, Overtown, Health District and Stadium Route. The Stadium route and the Allapattah route provide connectivity to more than one study activity centers.

Table 6: Existing Transit Services within a Quarter-Mile of Identified Activity Centers

Route Name		Study Area Connectivity	Connect Two+ Activity Centers
MDT Metrobus			
Route 24	WEST DADE TO BRICKELL VIA CORAL WAY	Bayside to FIU	Yes
Route 6	CENTER PLAZA-ROUND TOWERS VIA CBD	Downtown to Bayfront Park to Marlins Park	Yes
Route 8	CBD-107AV/WESTCHESTER VIA SW 8 ST	Downtown to FIU	Yes
Route 11	FIU TO CBD VIA FLAGLER ST	Downtown to FIU	Yes
Route 277	7 AVE MAX	Downtown to Health District	Yes
Route 32	MIAMI GRDNS-OMNI VIA NW 32 AVE-20ST	Downtown to Health District	Yes
Route 246	NIGHT OWL	Downtown to Health District	Yes
Route 21	NORTHSIDE - CBD	Downtown to Health District	Yes
Route 77	NORWOOD - CBD VIA NW 7 AVE	Downtown to Health District	Yes
Route 211	OVERTOWN CIRCULATOR	Downtown to Health District	Yes
Route 207	LITTLE HAVANA CONNECTION	Downtown to Marlins Park	Yes
Route 208	LITTLE HAVANA CONNECTION	Downtown to Marlins Park	Yes
Route 7	CBD-DOLPHIN MALL/MIA STA.VIA NW 7ST	Downtown to Marlins Park to MIC	Yes
Route 101	A-VIA VENETIAN CAUSEWAY	Downtown to South Beach	Yes
Route 120	BEACH MAX: CBD-AVENTURA MALL	Downtown to South Beach	Yes
Route 103	C-MT SINAI HOSP-CBD VIA WASH AVE	Downtown to South Beach	Yes
Route 51	FLAGLER MAX: WEST DADE TO CBD	FIU to Downtown	Yes
Route 95	I-95 GOLDEN GLADES EXPRESS	Health District to Downtown	Yes
Route 113	M-CIVIC CENTER-MIAMI BEACH	Health to Downtown to South Beach	Yes
Route 17	NORWOOD - VIZCAYA VIA NW-SW17AVE	Marlins Park to Health District	Yes
Route 119	S-AVENTURA-CBD VIA COLLINS & ALTON	South Beach to Downtown	Yes
Route 150	MIAMI BEACH AIRPORT FLYER	South Beach to MIC	Yes
MDT Metrorail			
Orange Line		Dadeland to Downtown to Health District to MIC	Yes
Green Line		Dadeland to Downtown to Health District to Hialeah	Yes
MDT Metromover			
-----		In and around Downtown	No
SFRTA Tri-Rail & Tri-Rail Shuttle Services			
Tri-Rail		MIC to North	No
City of Miami Trolley Service			
Allapattah Route		Downtown to Health District	Yes
Stadium		In and around Health District to Marlins Park	Yes
Biscayne Route		In and around Downtown	No
Coral Way Route		In and around Downtown, Port, Coconut Grove	No
Health District		In and around Health District	No
Overtown		In and around Health District to Overtown	No

Figure 4: Locations of Existing Transit Services within a Quarter-Mile of Identified Activity Centers



3.3.2 PLANNED OR PROPOSED TRANSIT

Potential future transit service within the study area could include additional passenger rail, enhanced or limited-stop bus service, and express bus service. Some future services were described in the previous review of related studies, and are included below as they are outlined in plans or programs such as the Miami-Dade MPO's 2040 Long Range Transportation Plan or Miami-Dade Transit's Transit Development Plan. A list of these planned or proposed services can be found in Table 7 and their location is shown in Figure 5. They are described in greater detail below.

3.3.2.1 MDT TRANSIT DEVELOPMENT PLAN

The annual TDP is a strategic plan presents current operational and capital improvement needs of MDT. It also serves as a planning mechanism to project future transit needs for implementation and operation over a 10 year horizon. The latest TDP (FY 2015-2024) represents planning efforts undertaken by MDT in 2013. The TDP provides a Recommended Service Plan (RSP) for all aspects of MDT, including new Metrobus routes, the expansion of Metromover service, the potential for expansion of the Metrorail service, and additional infrastructure. Eleven new Metrobus routes were proposed in this TDP. The preliminary programming of the routes was "conducted in a systematic and regional approach based on coordination with major capital projects". Of the 11 new bus routes, seven provide at least one direct connection to the defined activity centers, and of those seven routes serve multiple key activity centers identified by the MPO.

In addition to the RSP, there are 18 “2025 and Beyond RSP” Metrobus routes. Of those 18 noted, eight would serve at least one activity center, four would serve two or more activity centers. Two funded and two unfunded transit stations serving defined activity centers were also recommended in the TDP.

3.3.2.2 METROMOVER EXPANSION

In coordination with the Miami-Dade MPO, MDT studied the potential expansion of the Metromover. Six concept alternatives were identified. The preferred short-term concept alternative was the South Brickell Loop. Therefore, though the Metromover Expansion is expected to increase connectivity within Downtown Miami, it is not expected to increase connectivity beyond Downtown Miami. Anticipated service could begin as early as 2022.

3.3.2.3 MIAMI REGIONAL INTERMODAL PLAN

The Miami Regional Intermodal Plan (MRIP) was completed in January 2014. The MRIP studied a subarea of the City of Miami (bounded by the Miami River to the north, Brickell Avenue / SR 5 / US 1 to the east, SW 8th Street to the south, and NW 57th Avenue to the west), for potential transportation facility and service improvements. Three identified activity centers lie within the MRIP study area (Downtown, Marlins Park and the MIC). Two of the MRIP proposed transit projects are proximate to the defined activity centers: the Douglas Road Enhanced Bus, which would provide new premium limited stop and express transit service along NW / SW 37th Avenue from the MIC to the Douglas Metrorail Station, (now included in the TDP) and a limited stop, premium bus service from FIU to Downtown.

3.3.2.4 SOUTHEAST FLORIDA REGIONAL TRANSPORTATION PLAN

The Southeast Florida Transportation Council (SEFTC) includes representatives from the Miami-Dade, Broward, and the Palm Beach MPOs. Through this regional partnership, SEFTC works to advance transportation projects that will enhance mobility throughout Southeast Florida. In 2015, SEFTC completed its 2040 Regional Transportation Plan (RTP), which includes a variety of transit projects in Miami-Dade County. Of particular significance to the Downtown Miami activity center is SFRTA’s Tri-Rail Coastal Link (TRCL) Project.

The planned TRCL service will run on the Florida East Coast (FEC) railway, adding a new service between major markets, including Downtown Miami. The planned TRCL service is a strategic investment in South Florida’s transportation, quality of life and economic future. The project provides a convenient “one-seat” ride between major markets, notably West Palm Beach, Boca Raton, Fort Lauderdale and Downtown Miami. TRCL also adds entirely new service between Jupiter and Downtown Fort Lauderdale. The existing Tri-Rail service between Boca Raton and the Miami Intermodal Center will continue to provide the same convenient service to the Fort

Lauderdale and Miami International Airports. Service levels for both weekdays and weekends are expected to be similar to existing Tri-Rail passenger service.

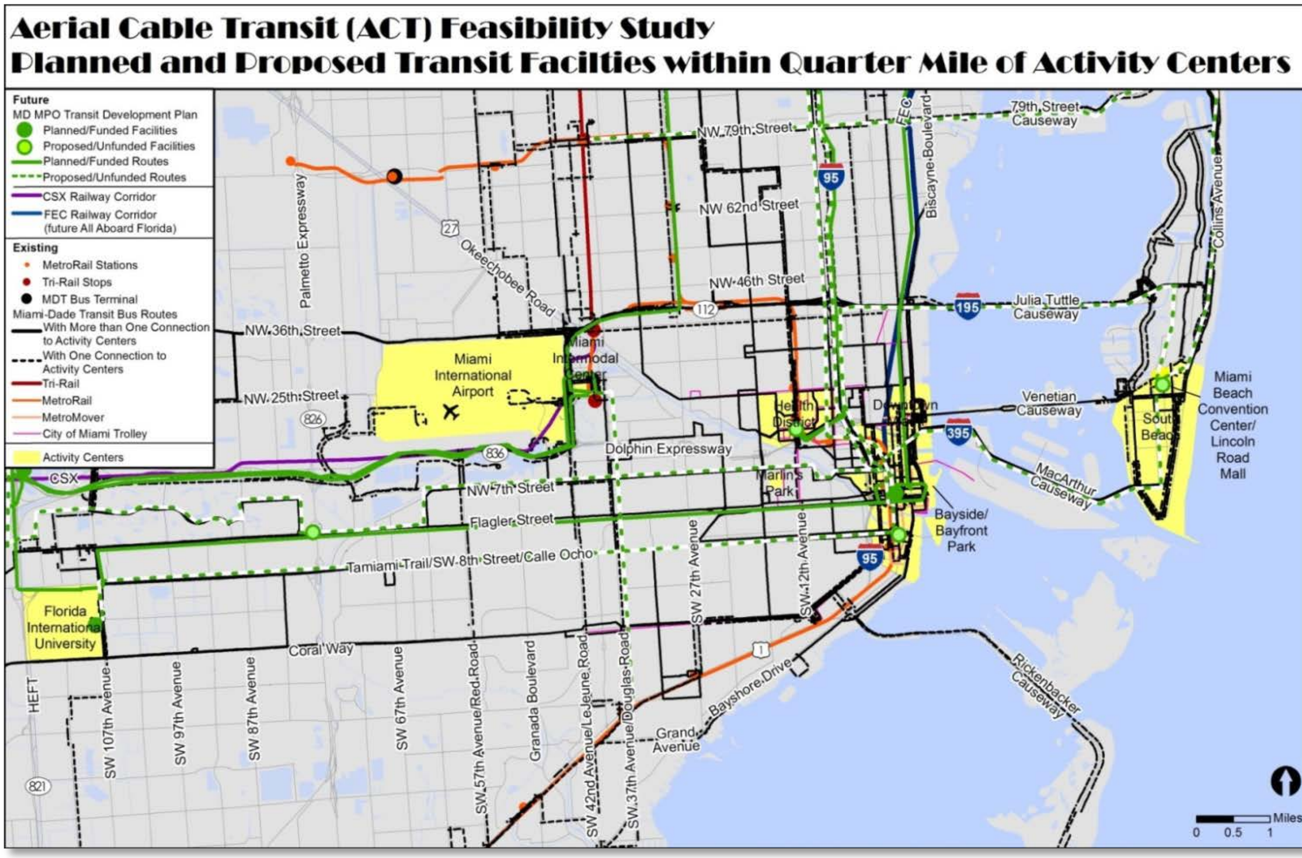
3.3.2.5 ALL ABOARD FLORIDA / BRIGHTLINE

All Aboard Florida will provide a new 240-mile “Brightline” express passenger rail service linking Downtown Miami to Fort Lauderdale, West Palm Beach, and Orlando. The one way end-to-end travel time for this service would be approximately three hours with speeds in undeveloped areas maxing out at 125 mph. Brightline will use upgrade existing Florida East Coast tracks between Cocoa and Miami. A new railway will be built between Cocoa and Orlando. Annual ridership is expected to be 3 million boardings per year. Of these trips approximately one-third would be confined to the South Florida market between Downtown Miami (Government Center), Fort Lauderdale and West Palm.

Table 7: Proposed Transit Services within a Quarter-Mile of Identified Activity Centers

Status	Route Name	Study Area Connectivity	ConnectTwo+ Activity Centers
MDT Transit Development Plan Metrobus Routes			
Proposed	Beach Connection LRT	Downtown to South Beach	Yes
Planned	Flagler Street EBS	FIU to Marlins Park to Downtown	Yes
Proposed	I-95 Express (South)	Downtown to South Beach	Yes
Proposed	NW 7 Avenue EBS	Downtown to Health District to north	Yes
Proposed	NW 7 Street EBS	Downtown to Marlins Park to west	Yes
Planned	SR 836 Express (via FIU)	FIU to MIC	Yes
Proposed	SW 8 Street EBS	Downtown to FIU	Yes
Proposed	295 Express Bus	Downtown to north	No
Planned	Biscayne Enhanced Bus Service (EBS)	Downtown to north	No
Proposed	Douglas Road EBS	MIC to south	No
Planned	I-95 BC Express Broward Boulevard to Civic Center	Health District to north	No
Planned	I-95 SC Express Sheridan Street to Civic Center	Health District to north	No
Planned	NW 27 Avenue EBS	MIC to north	No
Proposed	NW 79 Street EBS	South Beach to north then west	No
Planned	SR 836 Express (via SW 147Avenue)	MIC to west	No
MDT Transit Development Plan Capital Projects			
Planned	Downtown Intermodal Center		----
Planned	Panther Station (FIU-MMC) SW 8 Street and SW 109 Avenue		----
Proposed	Civic Center Station (NW 15 Street and NW 12 Avenue)		----
Proposed	Miami Beach Convention Center Intermodal Center		----
MDT Metromover Expansion			
Proposed	South Brickell Loop		No
Miami Regional Intermodal Plan			
Proposed	FIU to Downtown	Premium bus from FIU to Downtown	Yes
Proposed	*Douglas Road Enhanced Bus *Already included in MD MPO TDP	Premium limited stop and express transit service along NW/SW 37 Ave from the MIC to the Douglas Metrorail Station	No
Southeast Florida Regional Transportation Plan			
Planned	Tri-Coastal Link	Downtown Miami to north	No
All Aboard Florida			
Planned	Brightline	Downtown Miami to north	No

Figure 5: Locations of Proposed Transit Services within a Quarter-Mile of Identified Activity Centers



3.4 UNDERSERVED MARKETS AND TRANSIT NEEDS

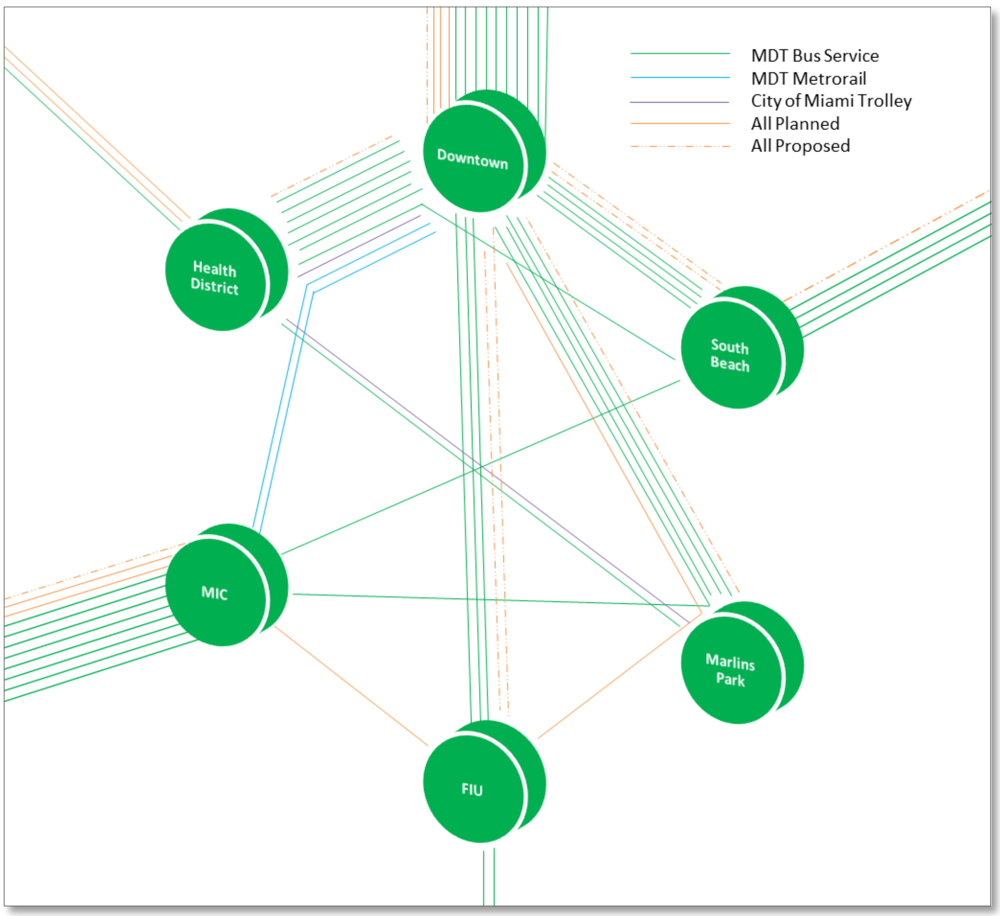
After reviewing existing conditions and potential future services as outlined in relevant plans and studies, it becomes possible to identify opportunities for making connections that serve unique travel markets. The study team focused on transit needs that could not otherwise be served by other modes, or would be better served by ACT technology. Additionally, the complete alignment length identified as feasible for an ACT service alignment was determined to be less than three miles long. This served as a limiting factor for several connections. As such, corridors of one to three miles that connect two or more activity centers, an existing or proposed transit service access point, or an intermodal center were keenly considered. One mile is generally the most common length for urban ACT systems. The longest systems are three miles in length. With limitations on climate control technology (cooling), systems of one (1) mile present less risk for customer acceptance. The ACT alternative development process and evaluation criteria used to evaluate the alignments that satisfy these market needs are described in the following chapter.

To simplify and illustrate the existing and planned connectivity between the identified activity centers, Figure 6 shows routes that connect two or more activity centers (those lines inside the circles) and routes that connect those activity centers to other areas of Miami-Dade County and the South Florida Region (those lines beyond the descriptors).

The diagram demonstrates the number of connections between Downtown Miami and every identified activity center, either directly or indirectly, particularly between Downtown and the Health District. Well-established connectivity also exists between several activity centers and other regional or county-wide transit services. These include Downtown Miami, the MIC, and Miami Beach. These connections to places outside of the study area would help to provide additional potential ridership for an ACT system at that location.

Many of the "holes" in connectivity (via direct connection) are beyond the maximum three-mile distance for ACT service. The travel time for connecting these locations via ACT would almost certainly preclude high levels of ridership. Transit needs between these activity center pairs, such as South Beach to Marlins Park or FIU to any of the activity centers other than Downtown, would therefore be better served by other modes.

Figure 6: Existing and Potential Future Connectivity between Major Activity Centers



In addition to potential connections between the originally identified activity centers, coordination with stakeholders also provided insight into unmet travel demands and other transit needs within the study area. The SAC and other stakeholders such as Florida International University, Port of Miami, and the City of Sweetwater provided valuable insight into local travel patterns. As a result of evaluating needed transit connections by using existing conditions, future plans, and stakeholder coordination, the following travel markets were identified as potentially viable location pairs for establishing an ACT starter service in Miami-Dade County:

- FIU (engineering or main campus) ◄ ► The Dolphin / International Malls;
- FIU (engineering or main campus) ◄ ► Future Dolphin Park & Ride / CSX Passenger Rail Station;
- The MIC ◄ ► Marlins Park;
- Marlins Park ◄ ► Miami Government Center;
- Bayfront Park ◄ ► Port Miami;
- Bayfront Park ◄ ► Watson Island; and
- Port Miami ◄ ► Miami Beach.

3.5 TRANSIT MARKET CONCLUSIONS

After reviewing ACT technology limitations and transit needs within the study area, it is apparent that several of the activity centers are either too far away from one another or have sufficient transit connections that are already established or being implemented in the coming years. It can therefore be determined that ACT would not be the best-suited transit technology for meeting travel demand between them. For example, FIU is too far from Marlins Park, and the Health District is too far away from Miami Beach for ACT to be a practical transit solution. The MIC and the Health District, for example, are already well connected by reliable Metrorail service. Similarly, Downtown Miami and Miami Beach could likely be connected by premium streetcar service in the near future, which would eliminate the need for reliable ACT service between the two.

As a result of these two factors: distance and the presence of duplicative transit service, many of the potential activity centers pairs were eliminated from further consideration, and will not be included in the development of alignment alternatives in the following chapter.

It should also be noted that ACT systems may generate a secondary tourism and resident ridership market beyond commuter uses due to the scenic views available from the cabins. Additional attraction ridership can vary depending on location, scenic view opportunities, and size of the tourist market. For example, the Metromover also generates an attraction ridership due to its novelty, location, and elevated views, whereas surface bus and rail enjoy little or no attraction ridership. This benefit can help supplement operating costs and subsidize the primary public transit function of ACT. It will be taken into consideration when developing, evaluating, and determining the feasibility of certain alternatives.

Potential tourism ridership, however, will not be solely used to justify an alignment location, as the purpose of this study is to assess the feasibility of ACT as an urban transit service for resident travelers. Each proposed alternative will therefore need to meet a local travel demand or serve a specific ridership market outside of any secondary tourism draw.

4. ALTERNATIVES DEVELOPMENT AND EVALUATION

Medellin, Colombia

In accordance with the previous study chapters, the study team, in discussions with the MPO and the Study Advisory Committee (SAC), identified multiple alignment alternatives within the assigned east-west corridor.

As noted, a number of previous studies explored east-west transit options for service across Miami-Dade. The east-west movement in the County is currently supported by numerous bus routes. Additional bus and rail transit services are under consideration. To identify transit needs, the study team has researched how, amidst these existing and emerging transit services, an ACT system could serve the existing and / or potential new transit markets. To develop and evaluate ACT options for Miami Dade, the study team developed a myriad of potential ACT alignments following the general guidelines and precepts listed below:

- Serve the transit corridor and activity centers specified by the MPO utilizing existing street and waterway rights-of-way.
- Avoid duplicating existing rapid transit lines, but work to connect and leverage existing fixed guideway services and intermodal centers.
- Connect communities or remote parking to employment centers, shopping / event centers, and transit services.
- Connect activity centers over route barriers such as waterways, major highways, traffic congestion and rail lines
- Service heavy traffic congestion areas where an ACT transit system would be faster than surface bus and streetcar options while also helping to reduce the numbers of cars and buses on the roadways.
- Design services to take advantage of ACT's high frequency, short wait loading regime – "walk up and board."
- Focus on optimal alignment lengths of approximately one mile with straight alignment sections.
- Rely on SAC advice, stakeholder input and current transit ridership in the corridor as rough guide to potential demand for new ACT service.

4.1 PRELIMINARY ACT ALIGNMENT ALTERNATIVES

Prior to review and input from the SAC meetings and stakeholders, the study team's aerial cableway experts reviewed the specified Miami-Dade, east-west transit corridor with the identified activity centers, and laid out a number of preliminary alignment alternatives for initial consideration. The alignments were considered as providing ACT short haul express service particularly as circulators, connectors and first / last-mile transit solutions.

4.1.1 MIAMI BEACH TO CONVENTION CENTER ALIGNMENT

Moving from east to west in Miami-Dade County, the first preliminary alignment considered was a circulator ACT system for Miami Beach and the Convention Center that could potentially connect at Alton and 5th Street to an ACT or other premium transit system to provide Baylink / Beach Corridor Service to downtown Miami. The primary function of this alignment would be mass transit with a secondary function and revenue stream as a tourist attraction due to its location in a major tourism zone.

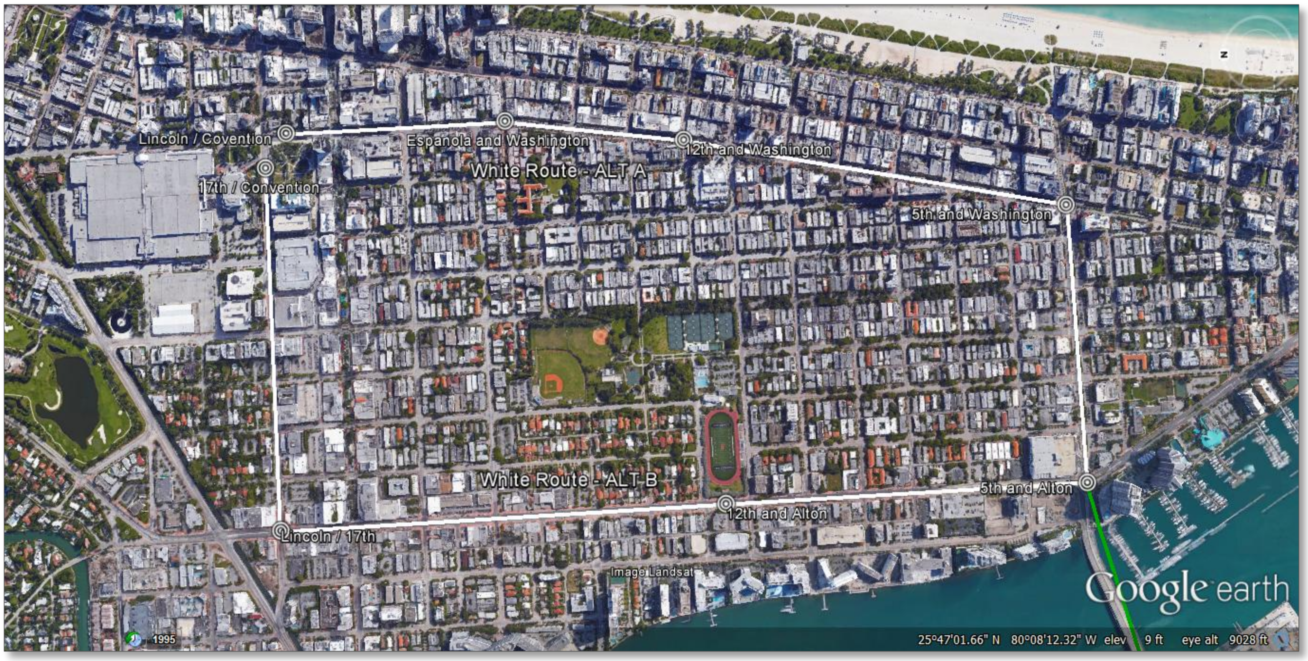
Two route options were mapped starting with a station at 5th Street and Alton Road, with the first option traveling east above the centerline of 5th Street and turning north on Washington Street to provide service to the South Beach blocks, the Lincoln Road retail mall and terminating at the Miami Beach Convention Center. The second alignment option would originate at 5th and Alton and travel north above the centerline of Alton Road providing service stops for the condos along this stretch of Biscayne Bay and also the west end of the Lincoln Road Mall. The route would then turn east on 17th Street and terminate at a station servicing the east end of Lincoln Road and the Convention Center.

Due to the Miami Beach built environment and relatively narrow right-of-way, the type of ACT system applicable to this route alignment would be a mono-cable, 15-passenger gondola with a 40 to 45-foot width pathway right-of-way. An aerial tram or tri-cable gondola would have a much wider pathway and large towers which would not be compatible with the character of the Miami Beach streets. The maximum speed of the mono-cable gondola along this 1.7 mile route alignment would be 13 mph. The system would typically be elevated 25 to 50 feet above the streets depending on span lengths, tower heights and visual concerns.

This alternative was identified within the east-west corridor, since it is not currently serviced by premium transit and Miami Beach has been studying transit modes that would serve as a beach circulator and connector to Baylink / Beach Corridor service. Other reasons for looking at this ACT alignment include 1) an exclusive aerial right-of-way to ease traffic congestion and avoid periodic flooding problems, 2) low capital cost and construction time and impact, and 3) additional attraction revenues could potentially pay for all or a portion of the system's operating and maintenance costs.

This preliminary alignment at Miami Beach was not selected for further study. Feedback at SAC meetings and further conversations with Miami Beach stakeholders and officials indicated a strong antipathy for aerial guideway structures and overhead wires, either from elevated people movers, aerial cableways, or even streetcar overhead power wires. Most of Miami Beach's guidelines for transit aim to retain the historical visual character of the community. This alignment was also seen as being duplicative of potential Baylink / Beach Corridor rail service that will likely circulate around Miami Beach in a similar fashion.

Figure 7: Miami Beach / Convention Center



4.1.2 MACARTHUR CAUSEWAY TO WATSON ISLAND ALIGNMENT

Another preliminary alignment was identified between Miami Beach and Watson Island as a phase of the Baylink / Beach Corridor concept to connect Miami Beach and Miami, which is being studied for light rail. The primary function of this alignment would be mass transit with a secondary function and revenue stream as a tourist attraction due to its scenic location along the cruise ship port and Biscayne Bay islands. Going east to west, this alignment would start at approximately 5th Street and Alton Road in Miami Beach and cross over the Miami Beach A1A Bridge and Intracoastal waterway to a station at the Fisher Island ferry; from there continuing west over the south edge of the MacArthur Causeway to a station to serve the attractions on Watson Island. The maximum ACT system speed along this 2.4 mile route alignment would be 13 mph with a mono-cable gondola or 18 mph with a tri-cable gondola. A gondola system could be elevated from 25 to100 feet above the Causeway depending on span lengths, tower heights and visual concerns.

This route was identified within the east-west corridor, since it is also not currently serviced by premium transit, although ongoing Baylink / Beach Corridor studies have identified light rail as the most appropriate mode for MacArthur Causeway. Other reasons for looking at this ACT alignment include 1) an exclusive aerial right-of-way that would not interfere with traffic lanes, 2) a significantly lower capital cost and construction time than light rail, and 3) additional attraction revenues could defray some or all of the system's operating and maintenance costs.

This preliminary alignment for the MacArthur Causeway was not selected for further study due to the alignment's length. The local preference for light rail service also weighed into the decision to not advance this option for further evaluation.

Figure 8: MacArthur Causeway / Watson Island

4.1.3 WATSON ISLAND TO BAYFRONT PARK ALIGNMENT

A continuation of the original Baylink / Beach Corridor route alignment was identified between Watson Island and over the I-395 bridge to the Miami Museum District and Bayfront Park as a phase of the Baylink / Beach Corridor transit concept, and also as a standalone system to connect Miami's Biscayne Blvd area and the existing Metromover system to the attractions on Watson Island. The primary transit function of this alignment would be to connect Baylink / Beach Corridor service at Watson Island, and with an equal function and significant revenue stream as a tourist attraction due to its scenic views and its location in Downtown Miami's tourism core which draws over 25 million annual visitors.

Going east to west, this alignment would start on Watson Island at a location near Parrot Jungle, and cross above the Island and the I-395 bridge over the Intracoastal Waterway to arrive at an interconnected station with Metromover in the Museum District, where the system would then turn south and travel above Biscayne Blvd to stations at American Airlines Arena and the Bayside Mall. The maximum ACT system speed along this approximate 2-mile route alignment would be 13 mph with a mono-cable gondola or 18 mph with a tri-cable gondola. A gondola system could be elevated from 25 to100 feet above the Island, the I-395 bridge / Intracoastal, and Biscayne Boulevard depending on water crossing requirements, span lengths, tower heights and visual concerns.

This route was identified as a preliminary alignment within the east-west corridor, since it is not currently serviced by premium transit and it could connect to future Baylink / Beach Corridor service from Miami Beach to Downtown Miami. Other reasons for looking at this ACT alignment include 1) an exclusive aerial right-of-way that would not interfere with traffic lanes, the bridge and the Intracoastal Waterway, 2) it would extend the reach of Metromover to Watson Island, and 3) significant additional attraction revenues with an ACT system.

This preliminary transit alignment for Watson Island and Biscayne Blvd was not selected for further study, specifications and cost analysis due to light rail currently being identified as the preferred mode for this section of the Baylink / Beach Corridor route, and no established ridership demand for an extension of Metromover to Watson Island.

Figure 9: Watson Island / Bayfront Park

4.1.4 GOVERNMENT CENTER TO HEALTH DISTRICT TO AIRPORT ALIGNMENT

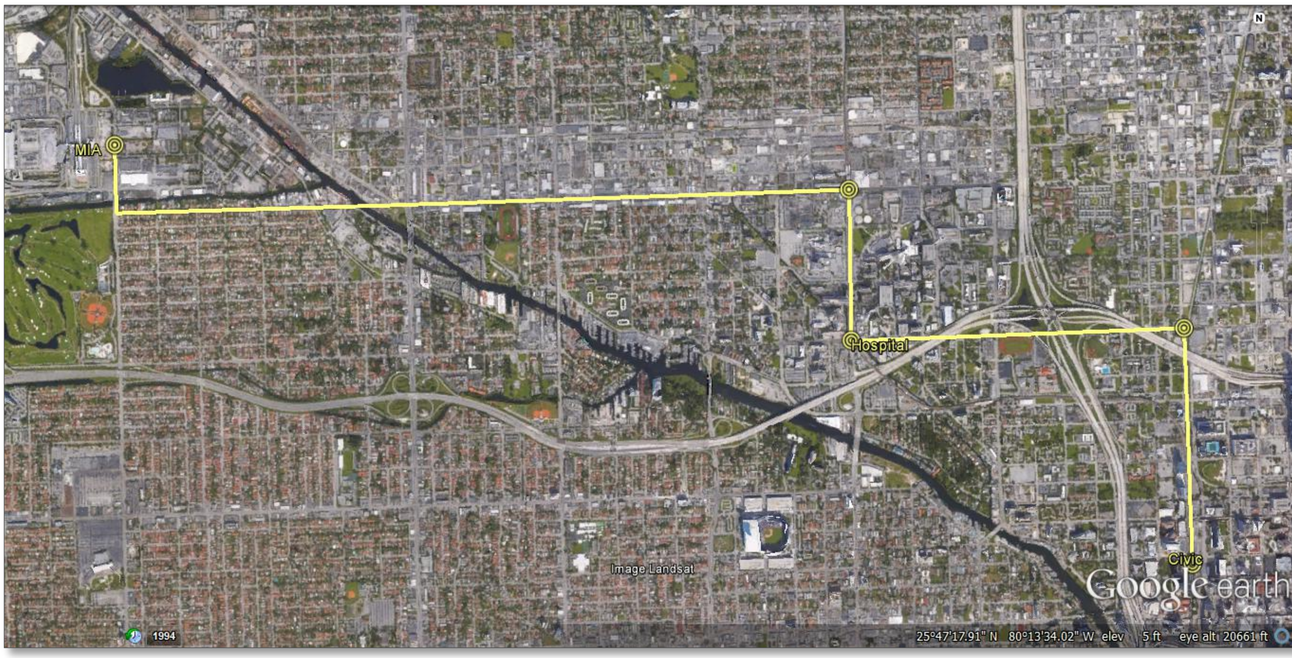
Early in the route investigations, another ACT alignment was considered to connect the Government Center in Downtown Miami, with the hospitals in the Health District and also the Miami Intermodal Center (MIC) at the Miami International Airport, since these were three of the identified activity centers. This ACT alignment would essentially duplicate and supplement existing Metrorail premium transit service to these three activity centers, although with a shorter and more direct series of route segments and a similar total travel time.

The alignment would start with a station that would be interconnected with the new Miami Central Station at Government Center and travel north sharing the Metrorail and All Aboard Florida (AAF) / Brightline rights-of-way to an angle station at NW 14th Street, and then travel west over the I-95 interchanges to NW 12th Avenue where it would turn north to a station to service the hospital complex area. From this Health District station the ACT would continue north and turn on NW 20th Street to travel west and cross the Miami River without a bridge, then continuing above NW 20th through a residential neighborhood to the intersection with NW 37th Avenue, making the northerly turn to complete the alignment with a station at the MIC. The maximum ACT system speed along this approximate five-mile route alignment would be 13 mph with a mono-cable gondola or 18 mph with a tri-cable gondola. The ACT system could be elevated from 25 to100 feet along the route depending on river crossing requirements, span lengths, tower heights and visual concerns. Preliminarily, there would be no conflicts with the ACT system height and airport flight paths or airport operations.

This route was identified as a preliminary ACT alignment within the east-west corridor as a possibility to supplement existing Metrorail service if in the future this became necessary. Other reasons for looking at this ACT alignment include its exclusive aerial right-of-way that would not interfere with traffic lanes and, its ability to cross over I-95 and the Florida River without constructing new bridges.

This preliminary transit alignment between Downtown, the Health District and the Airport was not selected for further study since it would duplicate existing Metrorail service. Moreover the overall system length of greater than five miles is well beyond the typical length of urban ACT systems.

Figure 10: Government Center / Health District / Airport



4.2 SELECTED ACT ALIGNMENT ALTERNATIVES

In addition to the preliminary alignments described above, three alignments survived preliminary screening after receiving input from SAC meetings, individual stakeholders and the MPO. These three alternatives were refined and subjected to further evaluation.

- FIU to Dolphin Station, with two route options, provides ACT service, within the east-west corridor, between the campuses of Florida International University, and the planned Dolphin Station with bus and potential rail service at the interchange between Florida's Turnpike and the Dolphin Expressway; Additional optional service could be provided along 107th Avenue and at the International and Dolphin Malls.

- **Marlins Park to Downtown** with two route options provides east-west ACT service from Marlins Park with its parking garages and Little Havana community to Miami Government Center with the Central Train Station and a possible future extension to Bayfront Park;

- **Downtown to Port Miami** with two route options provides an ACT connection between Government Center and the Miami Central Station to the Port Miami with an intermediate stop at Bayfront Park.

Table 8: Selected ACT Alignment Alternatives

Alignments	Route Options	Route Stations	Route Length	Capacity (pphpd)	System Speed	Cabin Interval	Ride Time
1. FIU to DOLHPIN PARK AND RIDE	2	3 to 7	2.4 mi to 3.2 mi	1,500	13 mph	36 sec	13 min to 19 min
2. MARLINS PARK to DOWNTOWN / BAYSIDE	2	2 to 4	1.2 mi to 2.6 mi	2,500	13 mph	22 sec	6 min to 14 min
3. DOWNTOWN to MIAMI PORT	2	3	1.3 mi to 1.4 mi	2,500	13 mph	22 sec	7 min

**pphpd=persons per hour per direction*

Urban ACT systems (versus surface transit modes) normally attract a secondary tourism and resident ridership, in addition to the primary transit ridership due to its novelty, attractiveness, and scenic views. With ACT this additional attraction ridership can range from 5 to 50% of the total ridership depending on an ACT system's location, scenic view opportunities and size of tourist market. ACT tourism / attraction ridership also tends to be off-peak and fills in system usage between the morning and evening peak commuter transit usage. Additional attraction revenues can help subsidize the primary public transit function of ACT, and in some cases, such as New York's Roosevelt Island Tramway, these additional revenues can cover all of the ACT system's annual operating costs.

4.2.1 FIU TO DOLPHIN STATION

This selected alignment alternative considered two possible route options for an ACT gondola to connect the FIU Main Campus and the FIU Engineering Campus with the proposed Dolphin Station transit facility with possible service to two nearby regional malls. Dolphin Station will be the western terminus for a new express bus service and is under consideration for a potential commuter rail service to the Miami Airport. The express bus service, focused on carrying commuters from the west to employments opportunities to the east has been permitted and funding is reportedly in hand. The commuter rail service is not as far advanced and is more questionable. No urban ACT found by the study team connects to an express bus route or commuter railroad as its primary source of riders[2], Primary ridership for this service would be FIU students and staff, the Malls' employees and patrons, area residents, and commuters connecting to the proposed Dolphin Station transit node. (It's not clear how an express bus or commuter rail service focused on serving eastbound commuter markets would also serve FIU students and staff at its western terminal.) There would be negligible attraction ridership on this alignment alternative due to the system's location away from Miami's tourist areas and lack of scenic views. Without a major express bus or commuter rail initiative at the Dolphin Station site, it's highly unlikely that this ACT service market would have sufficient size for the service to be viable.

Figure 11: FIU / Dolphin Station

4.2.1.1 FIU TO DOLPHIN STATION – OPTION 1 (107TH AVE ROUTE)

The FIU to Dolphin Station Option 1 ACT alignment along NW 107th Ave has been considered in two phases. Phase One begins with an end station serving the FIU Engineering Campus on NW 107th Ave north of the intersection with Flagler Street. The gondola line travels north along the centerline of 107th Ave from this FIU Engineering station to an inline angle station located at the intersection of NW 107th Ave and NW 7th Street, which would service the Fontainebleau community on the east and the residential communities and Lennar Industrial Park on the west. The gondola line continues north along the west side of 107th from the NW 7th Street station and then crosses over the 836 Dolphin Expressway and interchange before reaching a possible in-line station on the north side of the Dolphin Expressway adjacent to the CSX rail right-of-way where a future rapid transit rail station is proposed to be located. From this proposed CSX station the line continues north along the west side of 107th to an in-line station in front of and servicing the

[2] *All connect to higher capacity, more frequent and higher ridership rail rapid transit services when providing "first/last mile" connections.*

International Mall; at this station the line turns 90 degrees and continues west along the centerline of NW 14th Street to the parking lot of the Dolphin Mall where another in-line station can be located to service the Mall and make an angle. The line then re-directs further to the southwest and crosses over the Florida's Turnpike to a proposed end station if the planned Dolphin Station is developed at the property northwest of the Florida's Turnpike interchange.

Phase Two of the Option 1 alignment would connect the FIU Engineering Campus to the FIU Main Campus along the centerline of SW 107th Avenue. The Phase One end station at the Engineering Campus would be converted to an inline station, so that the gondola service would be continuous from the Dolphin Station all the way through to the FIU Main Campus. The new FIU end station for Phase Two could be constructed above SW 107th Avenue to the south of the SW 8th Street and SW 107th Avenue intersection.

The total length of the Option 1 Phase 1 alignment is 2.5 miles with 5 to 6 stations; the total length with the Phase 2 extension is 3.2 miles with 6 to 7 stations. The height of the Phase 1 and Phase 2 Gondola system ranges from 25 (roadways) to 60 feet (expressway crossings) along the alignment with line towers ranging from 50 to 80 feet in height.

The primary purpose of this Option 1 alignment from FIU to the proposed Dolphin Station is to provide north / south premium transit above traffic congestion for students and staff of FIU, employees and patrons of the International and Dolphin Malls, as well as local transit for Sweetwater and other area residents. This route would connect the two FIU campuses and encourage the use of the proposed Dolphin Station to access Dolphin and International Malls, FIU, and extend service to and from other transit services along the route, such as the proposed east-west rail service on the CSX corridor, the proposed east-west Enhanced Bus Service along Flagler and 836 Express Bus Service.

Advantages of the Option 1 alignment are: 1) connects both FIU campuses and both Malls, 2) potential to connect with future rapid transit along the CSX corridor, as well as other east-west transit, 3) primarily utilizes existing roadway rights-of-way, 4) reasonable permitting requirements, 5) has the initial support of FIU and the University City Transportation Management Association, 6) does not duplicate other rapid transit, 7) crosses over the 836 Expressway without a bridge, and 8) does not pass through any residential neighborhoods.

Disadvantages of the Option 1 alignment are: 1) utilizes some private right-of-way at the Dolphin Mall, 2) requires line towers and stations to be located in the 107th Avenue medians and roadway, and 3) the system is more expensive to construct and operate than Option 2 due to longer length and number of stations.

Future challenges for this FIU to Dolphin Station alignment would be the positioning of stations and line towers in the 107th Avenue right-of-way, obtaining necessary permits and easements, interfacing with existing infrastructure, and funding the project. But, at this early stage of analysis there seem to be no planning, permitting or construction issues that would be fatal flaws to the implementation of the project along the FIU to Dolphin Station Option 1 alignment.

Table 9: FIU / Dolphin Station – Option 1 (107th Ave Route)

Route Segments	ROW	ROW Width	ACT Length	ACT Height	ACT Stations	ROW Comments
PHASE 1 Engineering Campus to NW 7th Street	NW 107 Ave	95' to 125'	0.4 mi	25' to 40'	Engineering (Elevated)	Primary 6 lane collector road with medians. Medium density residential and light commercial corridor. 50' to 70' towers
NW 7th Street to Future CSX Station	NW 107 Ave / Hwy 836	125' to 150'	0.5 mi	25' to 60'	NW 7th (Elevated)	Primary 6 lane collector road. Low density residential and light commercial corridor. 50' to 80' towers.
Future CSX Station to International Mall	NW 107 Ave	125' to 150'	0.3 mi	25' to 40'	Future CSX (Elevated)	Primary 6 to 8 lane collector road. Medium density commercial mall corridor. 50' to 70' towers
International Mall to Dolphin Mall	NW 14 Street	70'	0.5 mi	25' to 40'	Int'l Mall (Elevated)	Primary 4 lane local road. Medium density light commercial / light industrial corridor. 50' to 70' towers
Dolphin Mall to Dolphin Park & Ride	Dolphin Parkin / FDOT	NA	0.8 mi	25' to 60'	Dolphin (Elev) P & R (Elev)	Dolphin Mall parking lot + FDOT right-of-way. 50' to 80' towers
PHASE 2 FIU Campus to Engineering Campus	SW 107th Ave	80' to 95'	0.7 mi	25' to 40'	FIU Main (Elevated)	Primary 4 lane collector road. Medium density, residential and light commercial corridor. 50' to 70' towers

4.2.1.2 FIU TO DOLPHIN STATION – OPTION 2 (FLORIDA'S TURNPIKE ROUTE)

The FIU to Dolphin Station Option 2 ACT alignment along SW 8th Street and Florida's Turnpike is proposed in a single phase. The FIU end station would be located along 8th Street on the north frontage of the FIU Main Campus. From this station the gondola line travels west along the south side of SW 8th Street crossing over Florida's Turnpike to an approximate 90 degree angle mechanism (angles require special line equipment), or a possible future Park and Ride station located on the west side of the Turnpike. From this point the line heads north along the Turnpike right-of-way, with no further stops, to an end station at the proposed Dolphin Station property. At this point, the Option 2 Alignment does not continue past the Park and Ride to connect to the Dolphin and International Malls and does not continue past the FIU Main Campus to connect to the FIU Engineering Campus.

The total length of the Option 2 alignment is 2.4 miles with 2 to 3 stations. The height of the gondola system ranges from 25 (roadways) to 60 feet (expressway crossings) along the alignment with line towers ranging from 50 to 80 feet in height.

The purpose of this Option 2 alignment from FIU to the proposed Dolphin Station is to provide express premium transit service between the proposed Park and Ride and FIU Main Campus to reduce on-campus parking and to connect to future Enhanced Bus Service from FIU to Downtown.

Advantages of the Option 2 alignment are: 1) less cost due to shorter route and less stations, 2) does not require station or tower structures in roadways, 3) primarily utilizes existing rights-of-way along and south of 8th Street and west of Florida's Turnpike, 4) could connect to a future Park and Ride at SW 8th Street and the Turnpike, and 5) does not pass through any residential neighborhoods.

Disadvantages of Option 2 are: 1) does not connect to the FIU Engineering Campus or to the Malls, 2) does not connect to future rapid transit passenger rail along the CSX corridor, and 3) does not service the Sweetwater community, and 4) has few stations.

Future challenges for this FIU to Dolphin Station alignment would be obtaining necessary permits and easements, interfacing with existing infrastructure, and funding the project. But, at this early stage of analysis there seem to be no planning, permitting or construction issues that would be fatal flaws to the implementation of the project along the FIU to Dolphin Station Option 2 alignment.

Table 10: FIU / Dolphin Station – Option 2 (Florida's Turnpike Route)

Route Segments	ROW	ROW Width	ACT Length	ACT Height	ACT Stations	ROW Comments
FIU Main Campus to Fla. Turnpike Angle	FIU and FDOT SW 8th St	100' to 150'	0.8 mi	25' to 60'	FIU Main (At Grade)	FIU property and FDOT ROW on the south side of SW 8th St Low density corridor. 50' to 80' towers
Fla. Turnpike Angle to Dolphin Station	FDOT / SW 118th Ave	75' to 150'	1.6 mi	25' to 60'	Dolphin P&R (Elevated)	FDOT and SW 108 Ave ROW. Low density highway and residential corridor. 50' to 80' towers

In general, the strongest advantage for developing an FIU-Dolphin Station service is keen interest and potential support from the University and City of Sweetwater. The biggest risks to developing this service are its long length and the status of developing the east-west transit services that would anchor this ACT investment. Typical passenger trip durations of 13 to 19 minutes could be very problematic on many days of the year in South Florida without an active means to cool the passenger cabins. Eventually the ACT industry will devise cabins with onboard cooling systems, but such systems are not available at this time making it difficult to recommend that the City and County invest in such a service. Also without a mature fixed guideway service on the north end of the proposed line to serve as an anchor, development of the ACT would be "putting the cart in front of the horse," since the ACT's largest likely market would be ferrying students and staff from Dolphin Station services to the campus.

4.2.2 MARLINS PARK TO DOWNTOWN AND BAYFRONT PARK

This alignment alternative looks at two possible route options for an ACT gondola to connect the Marlins Park, parking structures and Little Havana, with the Downtown Government Center area and Miami's Central Train Station. A possible Phase Two extension could be added linking Downtown to the Bayfront Park, Bayside Mall, American Airlines Arena, and Biscayne Boulevard area. This service would address several markets.

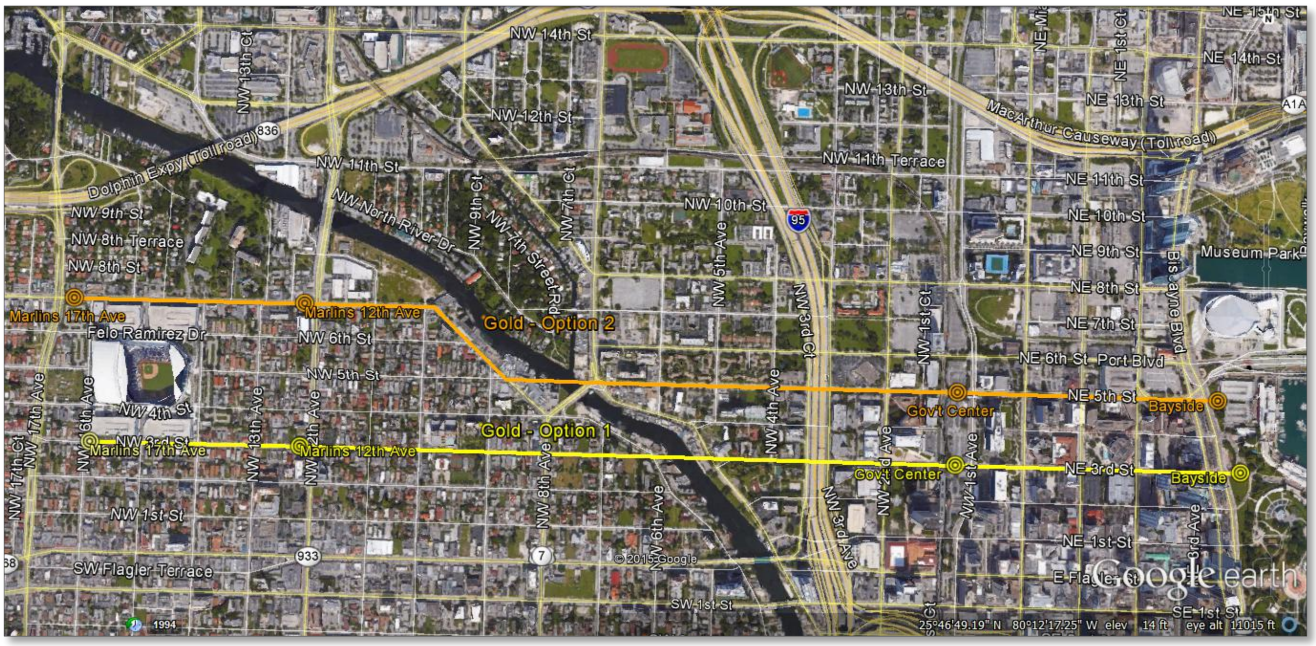
- First, the ball park has more than 5,000 structured and surface parking spaces that are vacant nearly every weekday. Building this ACT service would add these 5,000 spaces to Miami's Downtown parking inventory as ACT-serviced remote facilities.
- Second, the ball park does not enjoy any fixed guideway transit service to its venue. The ACT would allow fans to ride Metrorail, Tri-Rail and AAF / Brightline with the ACT to attend ballgames and other events at the stadium. Also during the

evenings and weekends, when most stadium events are held, the ample supply of Downtown parking available during these off peak hours would be available for fans to use when they ride the ACT to the ball park.

- Third, Little Havana is near Downtown Miami, but separated by the Miami River and I-95. The ACT would span the river and the highway to tie this vibrant district into Downtown. Neighborhood residents would have much improved access to Downtown while persons working or visiting Downtown or travelling by train from Orlando, Palm Beach, Fort Lauderdale, the Miami International Airport, Dadeland, or Coconut Grove would have direct access to the cultural attractions of Little Havana and the Stadium District.

In effect the ACT would function as a one-mile extension of the Metromover network west to the Stadium and Little Havana, which was proposed under the Metromover System Expansion Study (2014).

Figure 12: Marlins Park / Downtown / Bayfront Park



4.2.2.1 MARLINS PARK TO DOWNTOWN AND BAYFRONT PARK – OPTION 1 (3RD STREET ROUTE)

The Marlins Park to Downtown Option 1 ACT alignment along NW and NE 3rd Street has been considered in two phases. Phase One begins with an elevated end station serving Marlins Park at NW 3rd Street and NW 12th Avenue. This station is accessed by MDT bus stops and could also be accessed by a three-block long pedestrian / shopping / restaurant greenway corridor from the ball park along 3rd Street to help disperse event crowds between the ballpark and ACT station. From this Marlins station the gondola line then travels east along the centerline of 3rd Street through a residential neighborhood to a crossing of the Miami River at 3rd Street where 75 feet of clearance will have to be maintained between the vehicles and the high tide water level to match Miami River fixed bridge clearances for watercraft navigating on the River. This same 75 feet clearance will need to be maintained on the east side of the River to cross over the corner of the Scottish Rite building.

The line continues easterly along the centerline of NW 3rd Street crossing over I-95 and then continuing to an elevated end station that could be located on 3rd Street, one or two blocks west of the Government Center Metrorail station. Or, the gondola line could continue above the Metrorail station to the east side of Metrorail; in this case the ACT station could be integrated into the Miami Central Station development and interconnect with this planned Intermodal Center. The ACT gondola technology along 3rd Street would allow the Downtown ACT station to be located, if possible, at any level of the Miami Central Station or the Metrorail complex, but at this conceptual study level it is not possible to locate the 3rd Street Downtown ACT station exactly, as the Metrorail station is built out and the AAF / Brightline station is under final design and construction. The goal of this alignment would be to have the gondola system connect either directly into the Miami Central Station at one of the passenger levels or indirectly by a linked passenger sky-bridge from the ACT station location.

Phase Two of the Option 1 alignment would connect the Downtown station to the Bayside Shopping Mall eastward along the centerline of NE 3rd Street. The Phase One Downtown ACT end station would be designed so that it could be converted to an inline station in Phase Two, so that the gondola service would be continuous and seamless (no vehicle change) from Marlins Park all the way through Government Center and on to Bayside. The elevated Bayside end station for Phase Two would be constructed above the Bayside / Bayfront Park entrance and green area to the east of the 3rd Street and Biscayne Boulevard intersection.

The total length of the Option 1 Phase 1 alignment is 1.2 miles with 2 stations; the total length with the Phase 2 extension is 1.7 miles with 3 stations. The height of the Phase 1 and Phase 2 gondola system ranges from 25 (roadways) to 75 feet (waterway) along the alignment with line towers ranging from 50 to 110 feet in height.

The purpose of this Option 1 alignment from Marlins Park to Downtown and Bayside is to provide east-west premium transit service above traffic congestion for commuters who work Downtown and may park at Marlins Park, residents of Little Havana and Downtown, event attendees going to Marlins Park, Bayside Mall, Bayfront Park, and AA Arena, and tourists who will ride the gondola as an attraction.

This route would directly link to north-south MDT bus service at NW 12th Avenue; Metrorail, Metromover, AAF / Brightline rail and MDT bus service at Miami Central Station; and MDT bus and Miami Trolley service at Bayside and Bayfront Park. This route Option would also stimulate general economic and community development, as well as employment in the Little Havana neighborhoods and generate localized station area mixed-use development between Marlins Park and the NW 12th Avenue ACT station along the proposed pedestrian greenway.

Advantages of the Option 1 alignment are: 1) connects Marlins Park, Downtown and Bayside in a straight line, 2) primarily utilizes existing roadway rights-of-way, 3) creates station area development opportunities between Marlins Park and the NW 12th Avenue station, 4) does not duplicate other rapid transit routes, and 5) the Downtown station is adjacent to Government Center.

Disadvantages of the Option 1 alignment are: 1) only provides one station at Marlins Park to handle game and event crowds, 2) travels through a residential neighborhood, 3) the NW and NE 3rd Street right-of-way is only 50 feet wide, 4) route requires passing over the privately owned Scottish Rite building which may require an aerial easement.

Future challenges for this Marlins Park to Downtown and Bayside alignment would be the positioning of stations and line towers along the 3rd Street right-of-way (especially going through the residential neighborhood), interfacing of the Downtown station with the existing Metrorail station and the new Miami Central Station that would be required for Phase 2 expansion to Bayfront Park, obtaining necessary permits and easements, and interfacing with existing infrastructure. But, at this early stage of analysis there seem to be no planning, permitting or construction issues that would be fatal flaws to the implementation of the project along the Marlins Park to Downtown and Bayfront Park Option 1 alignment.

Table 11: Marlins Park / Downtown / Bayfront Park – Option 1 (3rd Street Route)

Route Segments	ROW	ROW Width	ACT Length	ACT Height	ACT Stations	ROW Comments
PHASE 1 – Marlins 12th Ave to South River Street	NW 3rd Street	50'	0.6 mi	25' to 40'	Marlins 12th (elevated)	Two lane local street - medium density, residential neighborhood corridor – 50' to 70' towers.
South River Street to North River Street	NW 3rd Street	NA	0.1 mi	75'	No station (tall tower)	Miami River crossing – low density commercial / marinas – approx. 110' towers needed for 75' clearance over river and clearance over Scottish Rite building.
North River Street to Gov't Center	NW 3rd Street	50'	0.5 mi	40' to 70'	Gov't Center (elevated)	Two lane downtown road - medium density residential / commercial corridor - cross over I-95 and Metrorail / Metromover – 70' to 100' towers.
PHASE 2 –Gov't Center to Bayside	NE 3rd Street	50'	0.5 mi	25' to 60'	Bayside (elevated)	Two lane downtown street - high density residential / commercial corridor -cross over Metromover and Biscayne Boulevard – 50' to 80' towers.

4.2.2.2 MARLINS PARK TO DOWNTOWN AND BAYFRONT PARK – OPTION 2 (7TH / 5TH STREET ROUTE)

The Marlins Park to Downtown and Bayside Option 2 ACT alignment has also been considered in two phases. Phase One begins with an elevated end station serving Marlins Park at NW 7th Street and NW 17th Avenue. This station is accessed by MDT bus stops, the Marlins parking lots, or a one block walk from the Park along 7th Street, which will help disperse event crowds between the Park and ACT station. From this station the gondola line travels east along the centerline of 7th Street adjacent to the ball park and arrives at a second Marlins Park in-line elevated station at NW 7th Street and NW 12th Avenue, which would be accessed by MDT bus stops or a three-block walk from the ball park along the existing sidewalks or a more commercially developed pedestrian greenway similar to Option 1, which would also act to disperse peak event passenger crowds.

The gondola line then resumes its eastward route along NW 7th Street and then slows to make an angle (angles require special line equipment) to travel south on South River Drive, resumes speed along South River and slows again to make another angle to continue its eastward travel and to cross over the Miami River at NW 5th Street. As in Option 1, the crossing of the Miami River requires 75 feet of clearance to be maintained between the vehicles and the high tide water level to match Miami River fixed bridge clearances for watercraft along the River.

After crossing the Miami River the line continues easterly along the centerline of 5th Street crossing over I-95 and then continuing to an elevated end station that could be located on 5th Street, one or two blocks west of the Metrorail tracks and Metromover Station. Or, the gondola line could continue above the Metrorail tracks to the Metromover station on the east side of Metrorail; in this case the ACT station could be integrated into the Miami Central Station development and interconnect with the planned Intermodal Center. The ACT technology would allow the Downtown station along 5th Street to be placed at any level of the Miami Central Station or constructed above the Metromover station, but at this conceptual study level it is not possible to locate the 5th Street Downtown ACT station exactly, as the Metrorail station is built out and the Miami Central Station is under final design and construction. The goal would be to have the gondola system connect either directly into the Metromover or Miami Central Station at one of the passenger levels or connect indirectly by a linked passenger sky-bridge.

Phase Two of the Option 2 alignment would connect the Downtown station to the Bayside Shopping Mall and Bayfront Park eastward along the centerline of NE 5th Street. The Phase One Downtown ACT end station would be designed so that it could be converted to an inline station in Phase Two, so that the gondola service would be continuous and seamless from Marlins Park all the way through Downtown and on to Bayside. The elevated Bayside end station for Phase Two could be constructed above and integrated into the Bayside parking structure to the east of the 5th Street and Biscayne Boulevard.

The total length of the Option 2 Phase 1 alignment is 1.7 miles with three stations; the total length with the Phase 2 extension is 2.2 miles with 4 stations. The height of the Phase One and Phase Two gondola system ranges from 25 (roadways) to 75 feet (waterway) along the alignment with line towers ranging from 50 to 110 feet in height.

As is the case for Option 1, the purpose of the Option 2 alignment from Marlins Park to Downtown and Bayside is to provide east-west premium transit service above traffic congestion for commuters who work Downtown and may park at Marlins Park, residents of Little Havana and Downtown, event attendees at Marlins Park, Bayside Mall, Bayfront Park and AA Arena, and tourists who will ride the gondola as an attraction.

This route would directly link to north-south bus service at NW 12th Avenue; Metrorail, Metromover, AAF / Brightline rail, and bus service at Miami Central Station; and MDT bus and Miami Trolley service at Bayside / Bayfront Park. This route would also stimulate general economic and community development in Little Havana and generate localized station area mixed-use development along the five-block corridor between the Marlins Park NW 17th Avenue ACT station and the NW 12th Avenue ACT station.

Advantages of the Option 2 alignment are: 1) provides two stations at Marlins Park to better disperse event crowds and connect to bus routes on both 12th and 17th Avenues, 2) does not pass through any residential neighborhoods, 3) primarily utilizes existing roadway rights-of-way, 4) creates more mixed-use station area development opportunities with two Marlins stations, 5) does not duplicate other rapid transit routes, 6) the 7th Street and 5th Street rights-of-way are 70 feet wide.

Disadvantages of the Option 2 alignment are: 1) two angles with special equipment are required to avoid a residential area on the east side of the Miami River and redirect the line from 7th Street to 5th Street, 2) crosses over private marina property at the River, 3) the Downtown station is two blocks further to Government Center, and 4) some of the NE 5th Street buildings' upper stories encroach into the 70-foot right-of-way.

Future challenges for this Marlins Park to Downtown and Bayfront Park alignment would be the positioning of stations, angles and line towers in the 7th Street and 5th Street rights-of-way, interfacing the Downtown station with the existing Metromover station and Miami Central Station, obtaining necessary permits and easements, interfacing with existing infrastructure, and funding the project. But, at this early stage of analysis there seem to be no planning, permitting or construction issues that would be fatal flaws to the implementation of the project along the Option 2 Marlins Park to Downtown and Bayfront Park alignment.

Table 12: Marlins / Downtown / Bayfront Park – Option 2 (7th / 5th Street Route)

Route Segments	ROW	ROW Width	ACT Length	ACT Height	ACT Stations	ROW Comments
Marlins NW 17th Ave to Marlins 12th Ave	NW 7th Street	70'	0.4 mi	25' to 40'	Marlins 17th (elevated)	Primary 4 lane collector road – Marlins Park access / commercial corridor – 50' to 70' towers.
Marlins NW 12th Ave to S River Drive	NW 7th Street	70'	0.2 mi	25' to 40'	Marlins 12th (elevated)	Secondary 4 lane collector road – low density residential and commercial corridor – 50' to 70' towers
S River Drive to NW 5th Street	S River Drive	50'	0.2 mi	25' to 40'	No station (angle in line)	Secondary 3 lane collector road – low to medium density residential and commercial corridor – 50' to 70' towers
NW 5th Street to N River Drive	Miami River	NA	0.2 mi	75''	No station (tall towers)	Miami River crossing – low density small marinas / storage yards – approx110' towers needed for 75' clearance over river.
N River Drive to Central Station	NW 5th Street	70'	0.7 mi	40' to 70'	Central Station (elevated)	Four lane downtown street – cross over I-95 and Metrorail / Metromover – connect to Central Station – 60' to 100' towers
Phase 2 – Central Station to Bayside	NE 5th Street	70'	0.5 mi	50' to 60'	Bayside Station (elevated)	3 lane downtown street – crosses Metromover for most of the 5th St. length – connect to Bayside parking

In general, the strongest advantages for the Stadium-Downtown ACT service would be developing connections and synergies between Downtown, the stadium and Little Havana. Downtown workers could park weekdays at the Stadium. Baseball fans would use the ACT to access the park by train or by parking during evenings and weekends in Downtown. Little Havana would be connected with fast, frequent fixed guideway transit to Downtown, Visitors and workers in Downtown would have much improved access to the cultural attractions of Little Havana. Unlike the long ACT ride required for the FIU alignments, the trip over the river and highway would take only 6 minutes. Because the line is short and the number of stations is limited the cost to develop and operate, the service would be more modest.

The biggest challenge for developing the ACT service would be finding a suitable station site in or near Government Center and carefully working with the visual sensitivities that all urban ACT systems face when they are built to service densely settled neighborhoods.

4.2.3 DOWNTOWN TO PORT MIAMI

Two potential alignments were developed to directly connect Downtown, Government Center, Metrorail, Metromover, Miami Central Station, Bayfront Park and the Bayside Mall with the Port Miami facilities and the proposed marina and commercial development on the southwest corner of the Port Island. The route would cross over the Intracoastal Waterway at Port Boulevard Primary transit ridership for this alignment would be cruise ship patrons and employees, Port and commercial activities employees, and future patrons and employees of the proposed southwest commercial development. An ACT gondola or other form of rapid transit linking Downtown to the Port could be a value added catalyst for the Port's proposed southwest commercial development.

There would be significant secondary attraction ridership due to the system's location in Miami's tourism core with a station at the Bayside Mall, and the scenic views would be excellent going over the water with a panorama of Biscayne Bay, the Intracoastal Waterway, Miami Beach, Downtown Miami and the cruise ships. According to Visitor Bureau statistics, Bayside Mall has over 20 million visitors per year and many of these visitors would ride the gondola for its attraction value. It is possible that the additional tourism revenues from this attraction ridership would pay for all of the ACT system's annual operating and maintenance costs and possibly generate an operating profit as well.

As this service was developed and vetted two significant challenges emerged. First, the Port is not interested in developing ACT service at this time. Second, the western leg of the alignment between Government Center and Bayside is already served by a frequent aerial fixed guideway service. Metromover vehicles already make the 7 minute trip between Government Center and Bayside in air-conditioned comfort. It might be difficult to get support and funding for a service that duplicates the already successful Metromover service for this leg of the trip.

Figure 13: Downtown / Port Miami

4.2.3.1 DOWNTOWN TO PORT MIAMI – OPTION 1 (6TH STREET ROUTE)

The Downtown to Port Miami Option 1 ACT alignment begins with an elevated end station (possibly integrated into the Miami Central Station complex) at the intersection of NE 1st Ave and NE 6th Street, and travels east along the centerline of 6th Street for 0.5 mile to an in-line angle station above Port Boulevard and adjacent to the Bayside Mall on the east side of the intersection of Port Boulevard and Biscayne Boulevard. From this Bayside station the line makes a small angle and continues east over the Intracoastal Waterway and over the new and old Port vehicle bridges and the FEC Rail bridge for 0.5 mile to the first Port parking structure. Crossing over the waterway and bridges, the gondola vehicles will have to maintain a minimum height of 100 feet above the water to clear the new bridge and its traffic. This will require approximately 150 to 175-foot towers on each side of the waterway, or 50 to 60-foot towers if located on the bridge structures. This route crossing over the bridges will insure that the gondola line will not infringe into the cruise ship turning basin to the north or interfere with ships docked at Terminal H.

The gondola line enters the Port property over the south end of terminal H and continues above the Terminal to the top of the adjacent parking structure for the purpose of redirecting at an angle eastward to an elevated or at-grade end station in the vicinity of the Seaport Administration Building. This Port ACT station would provide access to the cruise ship terminals, parking structures and proposed southwest corner commercial development.

The Miami Central ACT Station and passenger platforms can be elevated to match a platform level of the Miami Central Station and be integrated into the complex or located adjacent and connected to Central Station by a pedestrian sky bridge. The Bayside ACT Station would be elevated above Port Boulevard and connected to the Bayside Mall by a pedestrian sky bridge as well, and the Port Miami Station could be at ground level or elevated depending on location and amenities desired.

The total length of the Option 1 alignment is approximately 1.2 miles with 3 stations. The height of the Gondola system ranges from 50 (roadways) to 100 feet (bridge) along the alignment with line towers ranging from 70 to 175 feet in height.

The primary purpose of this Option 1 alignment from Downtown to the Port is to relieve Downtown traffic congestion by extending the reach of existing Metrorail and Metromover service by providing interconnected ACT rapid transit to the Port without constructing another bridge across the Intracoastal Waterway. There would be a broad range of ACT users including cruise ship patrons and employees, shore excursion operators, Port employees, future southwest commercial development patrons and employees, and tourists.

Advantages of the Option 1 alignment are: 1) connects into the new Miami Central Station, 2) connects parking structures at Central Station, Bayside and the Port, 3) avoids the proposed Sky Rise tower and Miamarina, 4) connects multiple popular activity centers, 5) does not duplicate other rapid transit, 6) extends the reach of existing Metrorail and Metromover rapid transit to Bayside and the Port, and 7) does not share right-of-way with the Metromover line.

Disadvantages of the Option 1 alignment are: 1) NE 6th Street right-of-way is only 50 feet 2) Bayside station needs to be located over Port Boulevard, 3) multiple transfers required to travel beyond the Miami Central Station.

Future challenges for this Downtown to Port Option 1 alignment would be the interface with the already designed Miami Central Station, the station placement above Port Boulevard, easements with FEC rail, and permitting to cross over the Intracoastal Waterway and Port Bridges. But, at this early stage of analysis there seem to be no planning, permitting or construction issues that would be fatal flaws to the implementation of the project along this alignment.

Table 13: Downtown / Port – Option 1 (6th Street Route)

Route Segments	ROW	ROW Width	ACT Length	ACT Height	ACT Stations	ROW Comments
Central Station to Bayside Station	NE 6th Street / Port Boulevard FEC	50'	0.5 mi	50' to 60'	Downtown Station (elev)	Three lane downtown street – crosses over Metromover line and Port Boulevard – 70' to 80' towers.
Bayside Station to Port parking angle	Port Boulevard FEC Intracoastal / Port	NA	0.5 mi	50' to 75'	Bayside Station (elev)	Crossing over Biscayne Bay, FEC rail, Port Bridges – ACOE, FDOT, Port and Coast Guard permits required – 70' to 150' towers.
Port parking angle to Port Station	Port	NA	0.2 mi	50' to 60'	Port Station (elev / grade)	Top level of parking garage – Port open space and ROW – 70' to 80' towers.

4.2.3.2 DOWNTOWN TO PORT MIAMI – OPTION 2 (5TH STREET ROUTE)

The Downtown to Port Miami Option 2 ACT alignment begins with an elevated end station (possibly integrated into the Miami Central Station complex) at the intersection of NE 1st Ave and NE 5th Street, and travels above the Metromover line east along the centerline of 5th Street for 0.5 mile to an in-line angle station at the Bayside Mall parking structure on the east side of the intersection of 5th Street and Biscayne Boulevard. From this Bayside in-line station the line diverts to the northwest across Port Boulevard to a location on the AA Arena property to make an angle (angles require special line equipment) to cross over the Intracoastal Waterway to the Port. The angle could also be made without going to the AA Arena property by locating the angle above Port Boulevard at the approximate location of the Option 1 Bayside station and then continuing east over the Port Bridge. The diversion around Miamarina is necessary due to the interference of the proposed Sky Rise Observation Tower with the straight line ACT route, and also the fact that sailboats with masts up to 200 feet tall have access to Miamarina and could interfere with the gondola operation.

From this AA Arena angle, the gondola line travels 0.2 mile east across the Intracoastal Waterway just north of and parallel to the Port Bridge with approximately 125 to 150-foot towers on each side of the waterway. This route crossing next to or over the bridge will insure that the gondola line will not infringe into the cruise ship turning basin to the north or interfere with ships docked at Port Terminal H. Again, the gondola vehicles will have to maintain a minimum crossing height of 75 feet above the water to match the 75-foot Port Bridge clearance over the waterway.

The gondola line enters the Port property at Port Boulevard and follows the roadway east to an elevated or at-grade end station in the vicinity of the Seaport Administration Building. This Port ACT station would provide access to the cruise ship terminals, parking structures and proposed southwest corner commercial development.

The Downtown ACT Station and passenger platforms can be elevated to match a platform level of Miami Central Station and be integrated into the complex or located adjacent and connected to Central Station by a pedestrian sky bridge. The Bayside ACT Station would be elevated above and connected to the Bayside parking structure, and the Port of Miami Station could be at ground level or elevated depending on location and amenities desired.

The total length of the Option 2 alignment is 1.3 miles with three stations. The height of the Gondola system ranges from 50 (roadways) to 75 feet (waterway) along the alignment with line towers ranging from 70 to 150 feet in height.

As is the case for Option 1, the primary purpose of this Option 2 alignment from Downtown to the Port is to relieve Downtown traffic congestion by extending the reach of existing Metrorail and Metromover service by providing interconnected ACT rapid transit to the Port at a reasonable cost and without constructing another bridge across the Intracoastal Waterway. There would be a broad range of ACT users including cruise ship patrons and employees, shore excursion operators, Port employees, future southwest development patrons and employees, and tourists.

Advantages of the Option 2 alignment are: 1) connects with the new Miami Central Station, 2) connects parking structures at Central Station, Bayside and the Port, 3) potential to interconnect directly with a NW 5th Street alignment Marlins Park to Downtown ACT gondola system if implemented, 4) avoids proposed Sky Rise tower and Miamarina, 5) connects multiple popular activity centers, 6) does not duplicate other rapid transit, 7) extends the reach of Metrorail and Metromover rapid transit to Bayside and the Port, and 8) the NE 5th Street right-of-way is 70'.

Disadvantages of the Option 2 alignment are: 1) utilizes some private right-of-way at Bayside and the AA Arena, 2) shares the NE 5th Street right-of-way with Metromover, 3) multiple transfers required to travel beyond the Miami Central Station.

Future challenges for this Downtown to Port Option 2 alignment would be the interface with the already designed Miami Central Station, the sharing of the 5th Street right-of-way with Metromover, the interface with the existing Bayside parking structure, easements on Bayside and the AA Arena property, and permitting to cross over the Intracoastal Waterway. But, at this early stage of analysis there seem to be no planning, permitting or construction issues that would be fatal flaws to the implementation of the project along this alignment.

Table 14: Downtown / Port – Option 2 (5th Street Route)

Route Segment	ROW	ROW Width	ACT Length	ACT Height	ACT Stations	ROW Comments
Central Station to Bayside Station	NE 5th Street	70'	0.5 mi	50' to 60'	Downtown Station (elev)	Three lane downtown street – crosses over Metromover for most of the 5th St. length – connect to Bayside parking
Bayside Station to AA Arena angle	Bayside / Port Boulevard / AA Arena	100'	0.2 mi	50' to 60'	Bayside Station (elev)	Crossing over parking structure, Port Boulevard and AA Arena property – medium density commercial – 70' to 80' towers.
AA Arena angle to Port Station	AA Arena / Intracoastal / FDO / Port	NA	0.6 mi	50' to 75'	Port Station (elev / grade)	Crossing over Biscayne Bay adjacent to Port Bridge – ACOE, Port and Coast Guard permits required – 70' to 150' towers.

In general, biggest attraction of the Downtown to Port Alignment is providing fixed guideway transit access between Downtown workers and residents, Bayside shoppers and tourists, and new development at the Port. The ACT would also be relatively short, helping to mitigate study team concerns about ACT climate control. The biggest drawbacks relate to duplication of service and stakeholder acceptance. As noted earlier, the western leg of the alignment between Government Center and Bayside is already served by a frequent aerial fixed guideway service. Metromover vehicles already make the 7-minute trip between Government Center and Bayside in air-conditioned comfort. It might be difficult to get support and funding for a service that duplicates the already successful Metromover service for this leg of the trip. Beyond concerns about duplication of service, the Port is not immediately interested in developing ACT service into the Port.

4.3 EVALUATION DIMENSIONS

The three final alignments and the sub-options were quantitatively and qualitatively evaluated on four principal dimensions:

1. Economic Characteristics – The team estimated costs for building and operating each of the nine options. Options that were less expensive to build and operate were favored over more expensive options. Any initial application of ACT as a transit mode in South Florida will present challenges relative to acceptance and support. Higher cost options will be harder to justify and fund.
2. Technological Risks – While ACT is a proven, safe and reliable transport mode, the lack of active climate control (cooling) technology for the cabins weighed heavily in the evaluation. Over time the industry will probably develop and demonstrate proven mechanisms for cooling (and heating) cabins, but at this time the tropical options for cooling are passive and relatively

rudimentary[3]. Until the cooling question is fully addressed, Options that would entail longer duration trips, greater than seven minutes, were considered to represent a significant technological risk.

3. Stakeholder Support – Any ACT innovation in Miami will require a project champion and stakeholder support. It will be difficult to weather strong opposition. Consequently the evidence of stakeholder support (or antipathy) was a key evaluation dimension for every option.

4. Market Characteristics – The study did not include any formal patronage forecasts but in planning and conceiving the services, the team did identify the nature and approximate sizes of markets to be targeted by the service. Options that offered clear travel advantages to well-developed markets were evaluated highly. Options that duplicated existing transit services or that did not link to well-established markets ranked lower.

4.3.1 ESTIMATED COSTS

Conceptual estimates of the capital and operating and maintenance (O&M) costs for each of the final service alignments were prepared. Capital costs were estimated using information from the ten ACT systems documented in Chapter 2 of this report. O&M costs were estimated using a detailed built-up cost model relying on standards developed over years of experience with the aerial cableway industry. A more detailed breakdown of estimated capital and O&M costs can be found in the Alternatives Development and Evaluation Technical Memorandum in Appendix B.

4.3.1.1 CAPITAL COST ESTIMATES

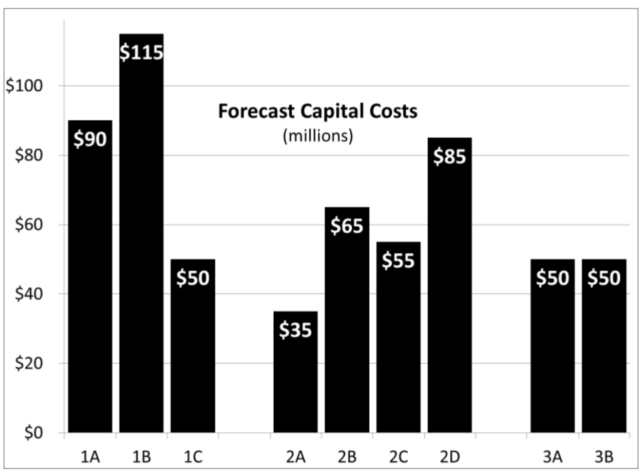
Capital costs are estimated for the three studied route alternatives considering the system pathway rights-of-way, passenger carrying capacities, the system lengths, number and type of stations, number of vehicles, and power requirements. The estimated capital costs include the gondola system equipment, stations, maintenance and storage, site infrastructure, construction and commissioning; capital costs do not include permitting or any right-of-way acquisition costs, if necessary. The principal capital cost drivers and final capital cost estimates are summarized in the table below.

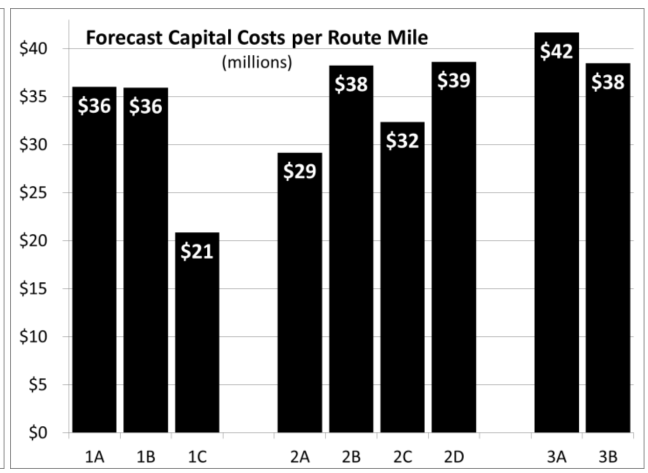
[3] *The industry has developed and offers AC and heating for vehicles, but the duration of the cooling or heating is limited to the vehicles' rechargeable battery life, which is currently about 2 1/2 minutes between stations. One short ACT system is currently being constructed in Macau with all air conditioned vehicles, but other ACT systems worldwide in tropical climates rely only on ventilation.*

Table 15: Capital Cost Estimates for Selected Final Alternatives

		Length (miles)	Number of Stations	Maximum Tower Height (feet)	Number of Passenger Cabins	Capital Cost (millions)	Average Capital Cost per Route Mile (millions)
FIU to Dolphin Station							
107th Avenue Engineering Campus	1A	2.5	6	60	71	$90	$36
107th Avenue Main Campus	1B	3.2	8	60	85	$115	$36
Turnpike to Main Campus	1C	2.4	3	60	47	$50	$21
Marlins Park to Downtown							
3rd Street to Govt Center	2A	1.2	2	75	35	$35	$29
3rd Street to Bayfront Park	2B	1.7	4	75	53	$65	$38
7th and 5th to Govt Center	2C	1.7	3	75	60	$55	$32
7th and 5th to Bayfront Park	2D	2.2	3	75	77	$85	$39
Downtown to Port Miami							
6th Street	3A	1.2	3	75	43	$50	$42
5th Street	3B	1.3	3	75	44	$50	$38

A more detailed cost estimate is available as part of the Alternatives Development and Evaluation Technical Memorandum in Appendix B.





Inspection of the table shows that the longer route options and those with more stations are projected to cost substantially more than the shorter options with fewer stations. The lowest cost option ($35M) would be the simple 1.2 mile, two-station route linking Government Center with the Stadium and Little Havana. The highest cost option ($115M) would be the 3.2 mile long eight-station network linking FIU with Dolphin Station via the Malls.

Simpler systems with fewer stations can clearly be built at a lower cost per mile than longer, more complex systems with multiple intermediate stations. For simple systems an average cost of around $20M per mile can achieved. More complex systems with high station densities can be expected to cost more than $40M per mile.

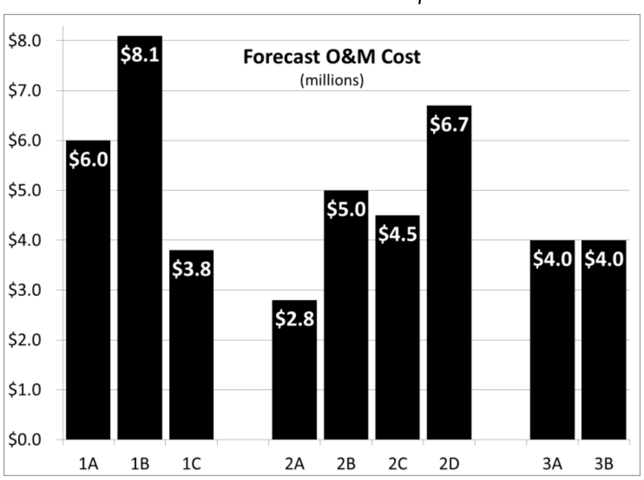
4.3.1.2 OPERATING AND MAINTENANCE (O&M) COST ESTIMATES

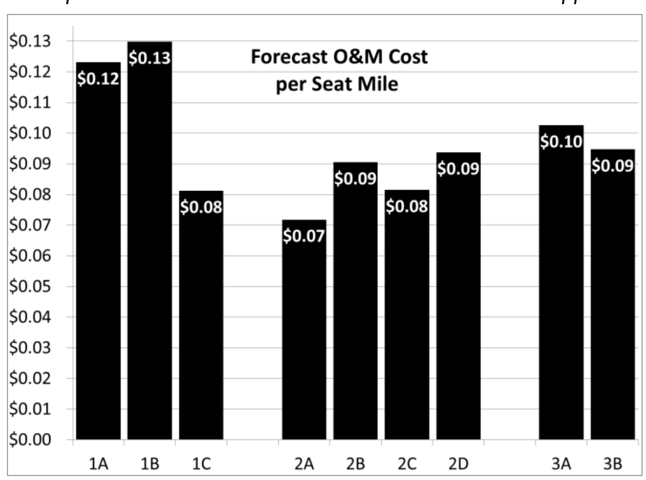
Operating and maintenance costs are estimated for all of the route options considering the number of gondola stations, towers and vehicles, and the power requirements. The length of service year was held constant across all alternatives with all systems forecast to operate 6,426 hours per year[4] The estimated O&M costs include the administrative, operating and maintenance staffing; office expenses and insurance; electricity, replacement parts, supplies, repairs and periodic equipment overhauls and upgrades. The principal capital cost drivers and final capital cost estimates are summarized in the table below.

Table 16: O&M Cost Estimates for Selected Final Alternatives

	Trip Duration (Minutes)	Length (Miles)	# of Stations	Capacity (Seats per Hour per Direction)	Cabin Headways (Seconds)	Energy Usage (kwh/h)	Annual Seat Miles of Capacity	Annual O&M (millions)	O&M Cost per Seat Mile
FIU to Dolphin Station									
107th Ave Engineering Campus	15	2.5	6	1,500	36	600	48,750,000	$6.0	$0.12
107th Ave Main Campus	19	3.2	8	1,500	36	750	62,400,000	$8.1	$0.13
Turnpike to Main Campus	13	2.4	3	1,500	36	225	46,800,000	$3.8	$0.08
Marlins Park to Downtown									
3rd Street to Govt Center	6	1.2	2	2,500	22	225	39,000,000	$2.8	$0.07
3rd Street to Bayfront Park	10	1.7	4	2,500	22	375	55,250,000	$5.0	$0.09
7th and 5th to Govt Center	11	1.7	3	2,500	22	475	55,250,000	$4.5	$0.08
7th and 5th to Bayfront Park	14	2.2	3	2,500	22	625	71,500,000	$6.7	$0.09
Downtown to Port Miami									
6th Street	7	1.2	3	2,500	22	350	39,000,000	$4.0	$0.10
5th Street	7	1.3	3	2,500	22	350	42,250,000	$4.0	$0.09

A more detailed cost estimate is available as part of the Alternatives Development and Evaluation Technical Memorandum in Appendix B.





[4] *18 hours per day, 7 days per week, 51 weeks per year*

Inspection of the table shows that the longer route options and those with more stations are projected to cost substantially more to operate than the shorter options with fewer stations. The lowest operating cost option ($2.8M) would be the simple 1.2 mile two-station route linking Government Center with the Stadium and Little Havana. The highest cost option ($8.1M) would be the 3.2 mile long eight-station network linking FIU with Dolphin Station via the Malls.

Simpler systems with fewer stations can clearly be operated at a lower cost per seat mile than longer, more complex systems with multiple intermediate stations. For simple short systems with two stations, an average cost of $0.07 per seat mile can achieved. More complex systems with high station densities can be expected to cost nearly twice as much to operate at $0.17 per seat mile.

4.4 FINAL EVALUATION

The study team made a thoughtful assessment of the economic characteristics, technological risks, stakeholder support and market characteristics of each of the alternatives in developing its final evaluation of the three alternatives.

- FIU-Dolphin Station: While this alternative has the greatest level of stakeholder interest and support, the service proposal suffers sorely on other evaluation dimensions. The long and complex options for this alignment add to capital and operating costs. Without a link to an established transit service at Dolphin Station the market risks for the service are also daunting. It seems to the study team that the prospect of up to 19 minutes suspended in the Florida sun without climate control is a wholly unacceptable technological risk. Given the apparently weak markets, high costs and technological risks the overall evaluation of this alternative is low.
- Marlins-Downtown: The study team did not fully plumb the depth of stakeholder interest and support for this investment option, but based on its economic characteristics, market opportunities, and technological risks, this alternative's overall evaluation is high. With its short length and two-station arrangement the Stadium-Downtown leg of this proposed service would be an economically attractive demonstration system with much lower capital and operating costs than other alternatives. Technological risks related to climate control would be mitigated by short trip lengths. From a markets perspective, this option linking a major parking facility with Downtown, linking Downtown with a major entertainment venue, and linking a vibrant resurgent cultural district with Downtown appears to tap several reliable and substantial sources of passenger demand. If City and County leaders are interested in further exploring ACT options for their jurisdiction this is the most attractive alternative identified by the study.
- Downtown-Port Miami: This alternative is lacking immediate support by a key stakeholder. But even if the option were supported by the Port, this service design suffers with respect to economics and markets. The short system with three stations would be relatively expensive to build and operate. Its western leg would essentially duplicate a parallel Metromover route, raising concerns about wasteful duplication of service and overserved markets. The short trip durations would minimize the technological risks related to cooling and climate control but the weak support, high costs and duplication of service work to lower the overall evaluation of this route option.

The feasibility of a potential ACT service following the Marlins Park to Downtown alignment, along with the likely next steps for implementation, will be assessed in the following chapter.

5. ACT FEASIBILITY ASSESSMENT

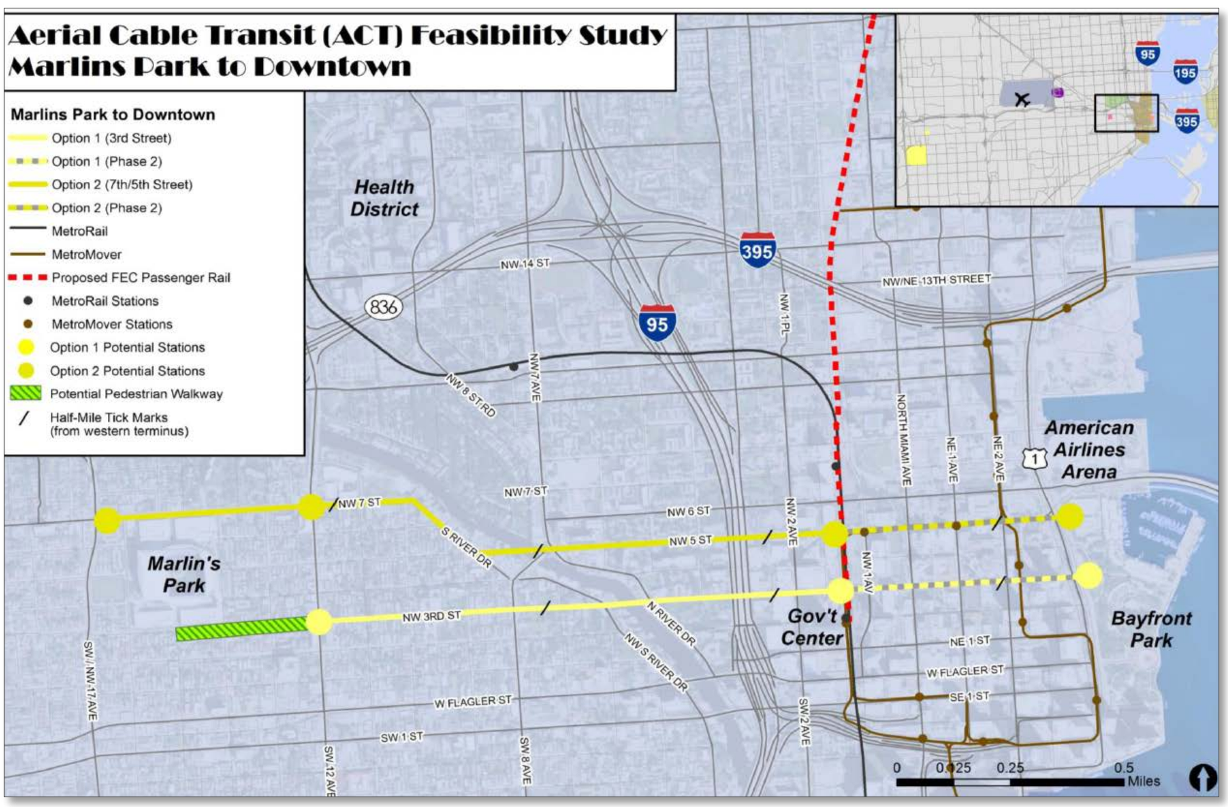
Having developed and evaluated several attractive potential ACT services for implementation in Miami, the question remains if such a service would be feasible and what steps would the City and County need to take to advance the development of an ACT system should it prove feasible and attractive.

5.1 RECOMMENDED ACT ALTERNATIVE

To test the question of feasibility, the study team chose the short 1.2 mile two-station Marlins Park (Little Havana) to Downtown alignment. This service was recommended by the study team for several reasons. Due to its short length and two-station arrangement the Stadium-Downtown leg of this proposed service would be an economically attractive demonstration system with relatively low capital and operating costs. Technological risks related to climate control would be mitigated by short trip lengths. From a markets perspective, this option serves clearly established markets related to parking demand, entertainment, and cultural activities tapping into several reliable and substantial sources of passenger demand.

Dimensions of feasibility include physical impacts, funding needs, and project delivery methods. Economic effectiveness will be evaluated by comparing likely performance of the Marlins Park ACT to other transit services offered in Miami.

Figure 14: Overview of Alignment Options for Marlins Park / Downtown Alternative



Aerial gondola transit systems are becoming popular in urban setting for their ability to overlay a developed district with minimum impacts on existing development below. Compared to light rail, bus rapid transit or streetcar systems, ACT's requirements for land and right-of-way are minimal. Rather than requiring the community to assemble new right-of-way or reassign general purpose road lanes to a specific transit service, the ACT floats above the community suspended by line towers that are normally 400 to 600 feet apart. Compared with an aerial installation of Metrorail or Metromover the density of support columns is much reduced and the aerial structure is much smaller and less intrusive. Compared to Metrorail or Metromover the impacts relative to visual amenity, shade, noise and vibration are almost negligible.

Aerial gondolas are not as fast as rapid transit, nor do they offer the high capacity of Metrorail. But for steady volumes of passengers in the range of 1,000 to 2,000 passengers per hour they offer shorter waiting times and faster travel times than other urban surface modes such as bus, streetcar, or light rail. ACT does not economically lend itself to the high stop density that characterizes local bus and streetcar service. Hence it is most commonly used for point-to-point express service with few, if any, intermediate stops. The Marlins Park service proposal offers this point-to-point service over a distance that is too far for most people to walk while avoiding the traffic, congestion, and geographic barriers that can make it relatively unattractive to drive or ride the bus. This alternative could provide limited pre- and post-event service to Marlins Park. It could also deliver reliable, regular transit service to/from Downtown Miami for residents of Little Havana and the surrounding neighborhoods within walking distance of the station(s). Additionally, weekday commuters from western Miami-Dade County could take advantage of this Downtown connection by using vacant spaces in the Marlins garages as a new Park-and-Ride location. This alternative is described in more detail in the following sections.

5.2 PHYSICAL IMPACTS

ACT stations require substantial land and investment. Some figures in this chapter illustrate some very preliminary concepts that were developed to illustrate options for station location and design. The towers that support the aerial cables are on the scale of large utility poles but are spaced much farther apart than the typical utility or light stanchion. Figure 17 illustrates how the line towers might look if it progressed up the median.

Similarly, the Little Havana community will need to be involved in project delivery as concerns about gentrification, historic preservation and environmental justice will all need to be addressed before the project would commence. One advantage of the ACT technology is that could focus development on less sensitive parcels in the vicinity of the stadium while silently flying over any sensitive blocks to the east. Obviously, the City would take the lead in the community relations elements of project delivery.

Figure 15: Potential Downtown Station Location

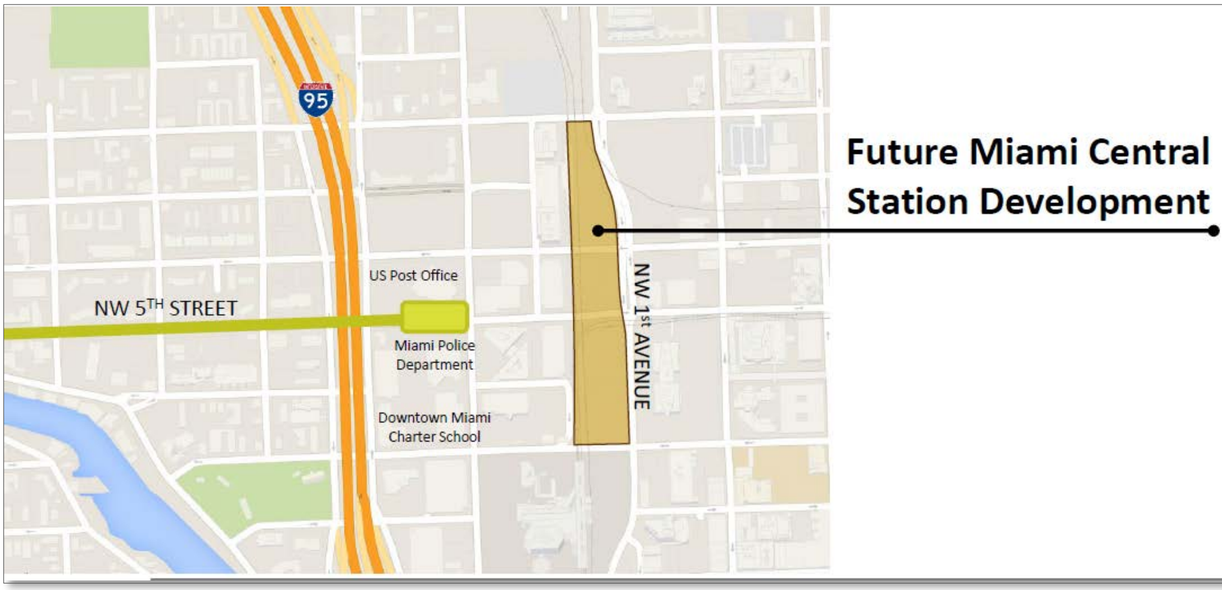
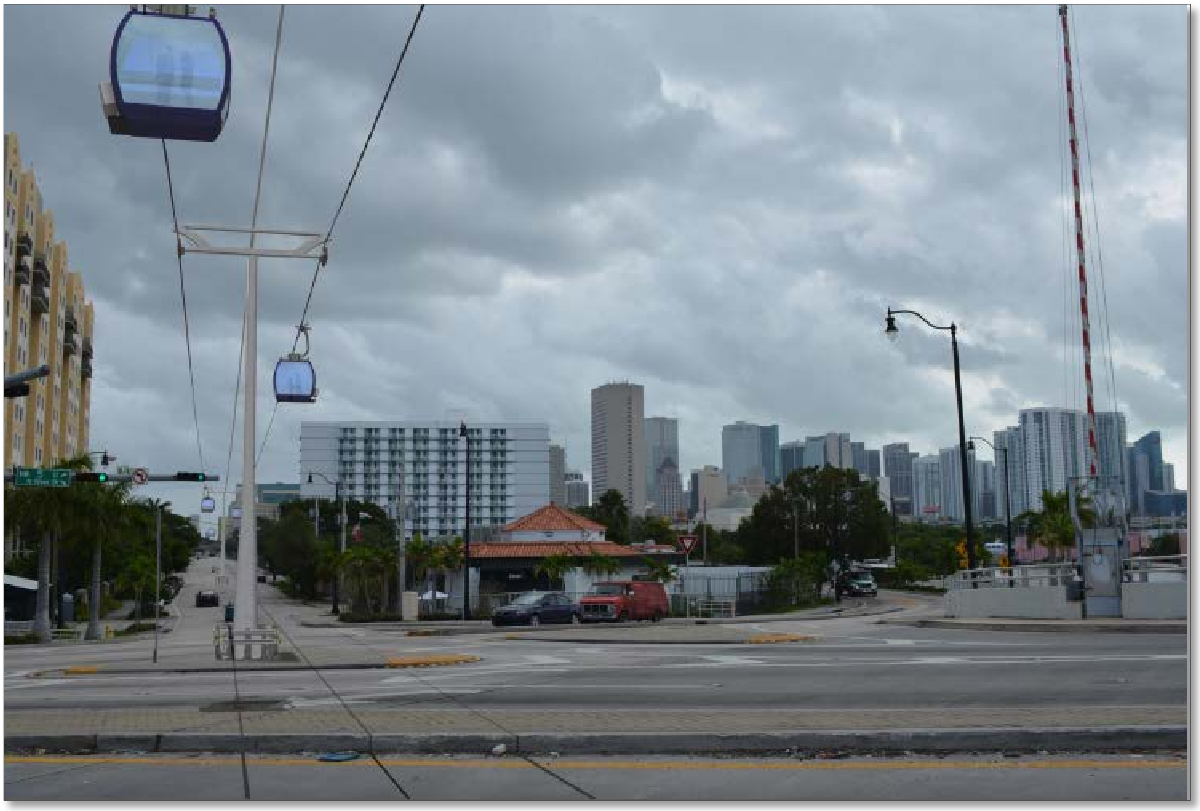


Figure 16: Potential Concepts for Design of Western Terminal near Ball Park

The elevated Station might be above 3rd and 7th Street.

The garage station would be adjacent to the Stadium.

Figure 17: Illustration of Possible ACT Line Towers Looking East toward Downtown Miami



5.3 ECONOMIC EFFECTIVENESS AND POTENTIAL MARKETS

Economic effectiveness is most commonly measured in terms of cost-per-boarding or cost-per-passenger mile. Whereas the study team prepared specific estimates of capital and operating costs, the team can confidently represent the likely costs of service. However, similarly specific estimates of potential ridership were beyond the scope of this limited feasibility study. Nonetheless for this particular route it is possible to make a rough markets-based forecast of potential patronage and revenue that would be derived from the Marlins Park / Little Havana ACT service to downtown.

The ACT would serve four specific markets of known magnitude. Using information on these markets it is possible to generate a conservative order of magnitude estimate of potential demand.

- Weekday Parkers – The Stadium has more than 5,000 structured and surface parking spaces that are generally vacant on weekdays during normal business hours. The ACT would be designed to provide a 6 minute shuttle trip between this supply of parking and downtown. It would seem reasonable that over time 1,000 to 2,000 downtown workers and visitors would use this new supply of parking.
- Stadium Traffic – The stadium hosts 81 regular season baseball games and perhaps nine other major events each year. With the ACT, fans would be able to directly access the event by fixed guideway transit to Government Center Station.

Services at this location include MDT Metrorail, Metromover, AAF / Brightline and Tri-Rail services. Fans would also be able to use readily available parking in the downtown during evenings and weekends and use the ACT to access the Park. It would be reasonable to expect that 1,000 to 2,000 fans per game would use the ACT

- Little Havana – Residents of the residential neighborhood south of the stadium could use the system to access downtown. If 0.5 percent of the approximately 87,000 residents of Little Havana used the system it would carry 870 daily passenger trips to and from downtown. If 1% used the system each day it would yield 1,640 daily trips.
- Downtown Visitors – According to the Greater Miami Convention & Visitors Bureau, downtown Miami hosts approximately 3,000,000 overnight visitors each year. If 1% of those visitors used the ACT to dine in Little Havana, or simply rode to experience the aerial gondola, it would attract 164 trips per day. At 5%, it would attract 822 daily trips.

Based on these market estimates it is possible to prepare a range of potential patronage levels for the proposed route as shown in the table below:

Table 17: Market-Based Projection of Possible Patronage of Marlins Park / Downtown Alternative

	Potential ACT Riders		Trips per		Days per	Annual Estimates of Boardings	
Market	Low	High	Rider	Frequency	Year	Low	High
Parkers	1,000	2,000	2	Weekdays	250	500,000	1,000,000
Baseball Fans	1,000	2,000	2	Stadium Events	90	180,000	360,000
Local Residents	435	820	2	Daily	358[5]	155,730	293,560
Out of Town Visitors	82	411	2	Daily	358	58,712	294,276
					Totals	894,442	1,947,836
					Say	*900,000*	*2,000,000*

Converting the market estimates to daily and annual patronage totals, it would be reasonable to assume that the route would carry roughly 900,000 to 2,000,000 annual trips.

How does this compare with other transit modes? Combining the rough estimates for patronage with the specific estimates of operating cost it is possible to compare this proposed Marlins Park service to other transit services offered in Miami on pro forma basis, as shown in the Table 18.

[5] *The ACT would be closed one week per year for heavy maintenance, refurbishment and overhaul.*

Table 18: Pro Forma Comparison of Costs and Revenues for Miami Transit Services

Mode	Vehicles Operated in Maximum Service	Annual Boardings	Annual Fare Revenues	Annual O&M Expenses	O&M Cost per Boarding	Fare Revenues per Boarding	Fare Revenues per Total Operating Expense (Recovery Ratio)
Metrorail	78	21,198,687	$22,845,276	$77,684,301	$3.66	$1.08	29%
Metrobus	692	78,500,785	$86,505,094	$302,261,718	$3.85	$1.10	29%
Metromover	21	9,643,713	$0	$22,487,177	$2.33	$0.00	0%
Marlin ACT	35	1,421,139	$1,610,984	$2,800,000	$1.97	$1.08	58%

The totals for Metrorail, Metrobus and Metromover shown above were reported by MDT to the FTA for 2013. The Marlin ACT boardings represent the average between the upper and lower bound patronage estimates derived above, The ACT O&M cost estimate was described in Chapter 4. The ACT average fare per boarding of $1.08 assumes that the ACT would have similar mix of full fare and discount fares as the Metrorail.

The projections for the Marlins Park ACT proposal compared with MDT services suggest that the Little Havana ACT could yield a lower cost per boarding and a higher cost recovery ratio than the typical performance of MDT bus and rail services. Information developed to date suggests that an ACT service linking Marlins Stadium and Little Havana with downtown would be an attractive transit investment for Miami. The ACT would function rather like a western extension of the Metromover at a relatively low capital cost.

5.4 FUNDING NEEDS

The Study estimates that the recommended 1.2 mile, two-station demonstration system would cost $35 million to construct including a 25% contingency factor. The cost estimate does not include the cost of land for stations, permitting or community / stakeholder coordination. With those considerations included a very conservative estimate of total cost would be $40 million. This total amount is small compared to other fixed guideway investments that have recently been completed or are under consideration in the region. For instance:

- The 2.4-mile extension of Metrorail that runs from Earlington Heights station to the Miami Intermodal Center (MIC), cost $506 million to complete[6].
- The latest Metromover expansion to be considered would add 0.8 miles and three stations to the system at a cost estimated cost of $260 million[7].

[6] *See "AirportLink Metrorail Extension Project". Miami-Dade County. November 2011. Retrieved 2011-12-29.*

[7] *See Metromover System Expansion study at http://miamidadempo.org/library/studies/metromover-system-expansion-study-executive-summary-2014-09.pdf*

- The local cost for the planned Tri-Rail Downtown Miami Link for limited direct regional rail service to Downtown Miami is approximately $70 million.
- The projected cost for 10-mile commuter rail service between the Miami Airport and the Florida's Turnpike under the Dolphin Expressway is $100 million exclusive of right-of-way cost.

Compared with other transit investments under consideration the overall capital cost of the potential route is comparatively modest. The project would probably be eligible for an FTA capital grant under its Small Starts or TIGER Grant programs. Small Starts would provide a grant of up to $75 million for a project of total cost less than $250 million. The federal share of overall project cost typically approaches but does not exceed 50% for successful grant applications. TIGER is a highly competitive multimodal grant program focused funding local transportation projects that promote five long-term outcomes related to safety, economic competitiveness, state of good repair, quality of life and environmental sustainability[8]. Once operating, the line would be eligible for ongoing financial assistance from the FTA under the Section 5307 program, and possible further assistance under Sections 5304 and 5311. For example the Mountain Village ACT gondola in Telluride, CO has received approximately $1.5 million under Section 5304 and 5311 grants in 2015 / 2016 for planning and system upgrades. The study team has not determined the potential value of that ongoing funding stream for this proposed project, but other potential sources of funding are described in the following section.

5.5 POTENTIAL FUNDING SOURCES

The objective of the section is to identify possible funding for the project and identify available revenues sources, both operating & maintenance and capital, to support construction, operation, and maintenance of this potential new transit service. Should this project be advanced for further study, a detailed financial analysis would need to be developed. A detailed financial analysis would focus on identifying potential sources of funding, estimating the relative level of funding likely to be available, and establishing the size of the resulting additional funding required for local funding sources.

Completion of a financial plan is a critical component of the requirements placed upon the project by the FTA, who could be a major participant in the funding of the project. The FTA's major source of funding is authorized within Section 5309 of 49 USC. Section 5309 Capital Investment Grant (CIG) projects are funded from the General Fund through annual appropriations. The amount of CIG program funding available is greatly exceeded by the combined total of grant applications from the many projects nationwide that are seeking this funding. FTA manages this intense competition through a technical oversight process that addresses many components of the project development process: design, environmental, project management, travel demand, land use, and financial.

[8] *DOT also evaluates TIGER applications on innovation, partnerships, project readiness, benefit cost analysis, and cost share.*

A key financial consideration in the FTA's oversight is the determination of the financial capacity of the implementing entity to continue its current transit operations (if any); maintain its transportation assets in a state of good repair; and successfully construct, operate, and maintain the proposed project. Identifying sufficient revenues to cover transit operating and capital expenditures is critical to the analysis. Potential revenue sources—described later in this section—may include fares, other operating revenues, dedicated revenues, state and federal grants, and participation by the private sector. The FTA's eventual commitment to participate in the funding of the project hinges on complementary commitments by state and local partners to fund the project.

Miami-Dade MPO is the agency currently conducting this ACT Feasibility Study; however, the implementing and operating entity for any proposed service is not yet known. There are a variety of potential options, including Miami-Dade Transit (MDT), the City of Miami, or another entity, such as a private company. In addition, the agency responsible for project delivery could differ from the entity that ultimately operates the transit services. Therefore, this report is general in describing "the project sponsor" which will be further defined as the Study advances. The following possible funding and revenue sources could potentially be used with any project sponsorship scenario.

5.5.1 FEDERAL CAPITAL INVESTMENT GRANT PROGRAM FUNDS

The FTA administers two types of Section 5309 CIG program discretionary funds for major new fixed-guideway transit investments:

- New Starts – the largest share of the program, aimed at projects with a total capital cost of greater than $250 million or that are seeking $75 million or more in Section 5309 CIG program funds; and,
- Small Starts – for projects with a total capital cost of $250 million or less and seeking total Small Starts funding of less than $75 million.

Of the two, only Small Starts is potentially relevant to this project due to the estimated implementation costs. In addition to the capital cost thresholds, there is a variety of other eligibility criteria for each program. These include such factors as mobility improvements, environmental benefits, congestion relief, cost-effectiveness, economic development, land use and local financial commitment.

On December 4, 2015, the Fixing America's Surface Transportation (FAST) Act was signed into law. This bill is the first long-term surface transportation authorization in ten years, since the passage of SAFETEALU in 2005. Under the FAST Act, the maximum Section 5309 federal share is maintained from SAFETEA-LU at 80 percent for Small Start projects. However, the FAST Act change the previously law for New Starts projects by reducing the maximum federal share allowed by law from 80 percent to 60 percent.

5.5.2 OTHER FEDERAL FUNDS

Other Federal funds include Section 5309 Fixed Guideway Modernization Grants, Section 5309 Bus and Bus Related grants, Section 5307 Urbanized Area Formula grants, Surface Transportation Program (STP) grants, Congestion Management/Air Quality (CMAQ) grants, and special Federal grant programs. Each of these programs is detailed on the following page:

- **Section 5309 Fixed Guideway Modernization grants –** These discretionary grants are derived by formula, a function of fixed guideway vehicle revenue miles and route miles operating, and can be requested seven years after opening of the fixed guideway segment.
- **Section 5307 Urbanized Area Formula grants –** These urbanized area formula grants are based on various demographic, level-of-service, and ridership variables. Under the FAST Act, the Urbanized Area Formula program grows at a more modest rate, starting at $4.539 billion in FY 2016 and rising to $4.929 in FY 2020. Urban formula grants increase by 1.8 percent in FY 2016 and 10.56 percent by FY 2020. The application of these grants is limited for capital purposes, but preventative maintenance expenses in the operating budget may be, in some instances, considered as "capital." One percent of these grants must be applied for "enhancements," which includes new initiative capital projects.
- **Surface Transportation Program (STP) grants –** STP is a block grant type program that may be used by states and localities for any roads that are not functionally classified as local or rural minor collector roads. Transit capital projects are also eligible under this program. MPO's must direct the use of these highway funds for use by transit.
- **Congestion Management / Air Quality (CMAQ) grants –** CMAQ directs funds toward transportation projects in Clean Air Act non-attainment areas for ozone and carbon monoxide. Projects must contribute to meeting attainment of National Ambient Air Quality Standards (NAAQS). In general, the capital costs of transit system expansions / improvements that are projected to increase ridership are eligible under the CMAQ program, as are up to three years of operating costs for new services. The likely availability of any CMAQ funds to support this project would be determined during development of the financial plan if the project is advanced for further study.
- **Special federal grant programs –** In recent years, the FTA and the U.S. Department of Transportation (USDOT) have administered special discretionary grant programs initially created by the American Recovery and Reinvestment Act (ARRA). These include the USDOT Transportation Investment Generating Economic Recovery (TIGER), FTA Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER), and FTA Urban Circulator capital grant programs.

5.5.3 LOCAL FUNDS

Local transit funding comes typically from local dedicated taxes. Their projections are a vital component of a project's financial analysis. A combination of new dedicated taxes or increments to existing taxes would be evaluated in detail in the financial plan analysis should the project be advanced for further study. The following is a list of potential local revenue sources that have been used in other parts of the Country to fund transit investments.

Dedicated taxes are widely used by transit agencies across the country to fund local capital and operating expenditures. Sales taxes generate over 50 percent of all local dedicated funding for all transit agencies across the US, and nearly 80 percent of local dedicated funding for new fixed-guideway systems. The following describes additional taxes or user fees that have been commonly applied to fund transit. The most common type of dedicated taxes used to support transit operations are:

- **Sales tax –** The sales tax is the most popular type of dedicated funding source used to support transit improvements and operations in the US. Sales tax revenue traditionally has been extremely reliable and relatively stable. This revenue source generally tracks well with inflation, but can be volatile as changes in local economic conditions tend to affect retail sales. Sales taxes tend to be labeled as regressive by opponents, but this characteristic can be eliminated by exempting food, clothing, and other necessities from sales taxes.

- **Payroll or income tax –** Revenue from payroll taxes is also used to support transit operations. This tax could be imposed on all employees within a transit district, or could be levied on all individuals who live or work within the district.

- **Real property tax –** Property taxes have also provided stable revenue streams to support transit capital and operations, as property taxes tend to track income levels more closely than local economic conditions. This type of tax could be levied on personal property and / or commercial property. Property taxes could also be used to structure benefit assessment districts whereby property owners within a specific geographic area pay a property tax surcharge to fund transit improvements within that area.

- **Motor fuels tax –** Tax collections on motor fuels usage can be applied on a per gallon or retail sales basis. The major difference between these two methods of collection is that changes in inflation are captured through the tax collected on retail sales of motor fuels.

5.5.4 OTHER / PRIVATE

Other transit-related revenues would be based on budget values for similar transit services, and can be adjusted annually to account for growth in inflation, level of service, ridership, and demographics. Additional operating revenues may include the following:

- **Farebox Revenues –** This represents the revenue derived from system riders from ticket sales. This revenue source represents a stable funding stream and could represent upwards of 30 percent of the annual operating costs.

- **Advertising –** This includes revenues generated from advertising on vehicles and in stations. Advertising revenues are generally based on contract rates negotiated with national advertising firms. Rates are based on "exposure," which is generally related to ridership and, thus, level of service. For exterior vehicle advertising, revenues can be based on the number of stations and peak-hour vehicles.

- **Concessions –** This includes income from automated teller machines, vending machines, and (potentially) retail operations within station space.

- **Station parking –** Parking revenues could be projected based on parking fees assumed in the travel demand analysis and the projected parking lot usage. Parking fees could be determined with the agreement of the jurisdiction in which the station is located, and fees could be based on historical parking lot usage and local government objectives regarding traffic volumes in station areas.

- **Lease income –** Including contracted rentals and private utilities (cellular towers, fiber optics, etc.). Lease revenues can be projected on any combination of growth in ridership, route-miles, vehicle-miles, and / or inflation.

It should be noted that while these sources can provide additional funding for projects, these revenues typically only yield only a small share of the total funds required.

Private revenues include potential revenue from value capture, such as air rights development above transit stations and line and connections to development on adjacent properties. Potential value-capture mechanisms include joint development, benefit assessment districts, developer contributions, and tax increment financing. Projection of these revenues would be based on development opportunities identified during the design process and in outreach with stakeholders.

- Joint Development – Partnership between a public entity and a private developer to develop certain assets. Their properties must have a physical and a functional relationship. It is applied most often by transit agencies that may be able to attract private developers to land adjacent to stations because of the superior access offered by high-quality transit service.
- Impact Fees – Charges assessed against developing property to offset the impact it has on existing infrastructure. These fees seek to recover the cost incurred by a local government in providing the public facilities required to serve the new or expanded development, and are generally one-time payments passed on to the purchasers of the developed property.
- Benefit Assessments – Districts formed to provide a specific service or benefit to lands contained within its boundaries. A district's charges are based on the benefit to property rather than value of the property. This method has relatively low revenue yield, with growth based on property values, which are not directly indexed to inflation.
- Tax Increment Financing – Allows jurisdictions to create special districts (tax increment areas) and to make public improvements that will generate private-sector development. The tax base is frozen at predevelopment level, and property taxes derived from increases in assessed values (the tax increment) either go into a special fund created to retire bonds issued to originate the development or leverage future growth in the district. There is a relatively low revenue yield initially that grows over time as property values escalate in value.

Other less common non-Federal dedicated sources of transit funding applied throughout the US are generated from the following economic activity: employer payroll, mortgage recordation, corporate income, vehicle emission fees, rental car fee, surface parking, luxury and amusement tax, hotel tax, and tobacco and alcohol taxes.

5.6 PROJECT DELIVERY AND FINANCING OPTIONS

This section describes potential financing tools as well as entities for financing. Should this project be advanced to construction, the specialized expertise of the aerial cable transport vendor community would be needed. A limited number of manufacturers engineer and install all of the world's aerial cable transport systems. All of the leading vendors are headquartered in Europe but have US subsidiaries. Since Miami would be building perhaps the first urban gondola system in North America, it is recommended that the eventual project sponsor minimize its risk by pursuing a Design, Build, Operate and Maintain approach to project delivery. Under this form of delivery the vendor would lend its expertise to designing and building the system and rely on its expertise to operate and maintain the service property.

MDT would be the logical agency to oversee the contractor. The City and County could minimize overall risk in the project by accepting responsibility for assembly of land for stations and right-of-way, obtaining permits, and leading in the area of stakeholder coordination. The Miami Marlins could obviously be a major beneficiary of the project. Consequently it would be expected that they may contribute to the financing or play a role in the management of the system. The study team has not contacted the Marlins regarding this proposal.

Funding the construction program effectively will require a careful balance of potential financing strategies, which can be evaluated using financial analysis models. The best single or combination of funding instruments that are appropriate for this project would be determined during development of the financing plan if the project is advanced for further study. A description of each strategy and the motivations for their application, however, are briefly described below.

5.6.1 CONVENTIONAL DEBT FINANCING

These bonds may be general obligation bonds or dedicated revenue bonds, and feature level, combined principal and interest payments. General obligation bonds are issued by a local, county, or state jurisdiction, which pledges its full faith and credit that the bonds will be repaid as promised. Dedicated revenue bonds are issued by the governmental jurisdiction against a projected revenue stream dedicated to bond repayment; if revenues are insufficient to cover debt service, bondholders have no recourse to repayment via other governmental revenue streams.

5.6.2 INNOVATIVE DEBT FINANCING

Innovative financing provides opportunities to increase capital revenues and reduce annual capital costs, thereby improving debt service coverage ratios and thus increasing financial capacity by taking advantage of Federal laws and regulations and current capital market conditions.Several types of innovative financing may be available:

- Tax-exempt commercial paper (TECP) for construction – The use of short-term debt is advantageous because debt instruments of shorter maturity generally have lower interest rates than longer-term debt.
- Construction bonds with capitalized interest – These are long-term bonds where the amount borrowed includes debt service payments during the construction period. During that period, only interest payments are made.
- Full-Funding Grant Agreement (FFGA) Bonds – The ability to borrow against Federal 5309 funds committed to the project could provide significant opportunities to stabilize the cash flows during construction, and may also provide for the construction of the project to be accelerated. The FFGA provided by the FTA is only a guarantee of the total dollars to be provided by the Federal government, and does not guarantee the timing of Federal payments.
- Transportation Infrastructure Finance and Innovation Act (TIFIA) Loan – TIFIA was established to provide federal assistance in the form of credit (direct loans, loan guarantees, and standby lines of credit) to major surface transportation projects of critical national importance. These projects include intermodal facilities, border crossing infrastructure, trade corridors, and other investments generating substantial regional and national economic and other benefits.

- **Public-Private Partnerships / Private Debt –** A Public-Private Partnership (P3) uses private financing as both a financing and a delivery mechanism. Under this approach, a public agency enters into a contract with a private developer who, depending on the contract type, can assume responsibility over the design, construction, financing, operations, and maintenance of a transportation facility. This approach can help reduce public funding shortfalls and accelerate overall project development time.

5.7 NEXT STEPS AND POSSIBLE ACT IMPLEMENTATIONS

This proposed Marlins Park to Downtown project was designed to provide an introduction to ACT for local transport officials and political leaders. It also surveyed opportunities for ACT to satisfy existing and potential travel demands in the east west markets across Miami. By and large, the study found that the mode is not a panacea for all east-west travel markets in the County, but it did find some niches were it could contribute to relieving pent up transport demand and also for potentially encouraging economic development. The niche markets for ACT in Miami are relatively short corridors less than 1.5 miles where a point-to-point service would attract several thousand passengers per day for a 6 to 10 minute trip generally linking a higher capacity faster transit mode with a remote attraction such as a stadium, hospital, university, or remote high-density residential enclave.

The study identified and explored several potentially attractive applications in the County. One application linking Marlins Stadium with downtown seems particularly attractive as a near-term demonstration system. If, after reviewing the findings of the study local leaders remain interested in ACT services for Miami, more work will need to be done.

For any service that might be of interest to local leaders, a more detailed corridor-specific study would be required. Engineering designs would more clearly define station locations, alignment and costs. Much more community and stakeholder involvement would be required. More detailed market analyses and ridership forecasts would be prepared. Funding from a mélange of government and private resources would need to be explored. Since ACT tends to be a targeted point to point type service, institutions and communities that benefit most from the improved access might contribute specifically to the project.

Presuming that engineering feasibility, community support, political will and funding coalesce around a particular service option the means and methods for implementation would be typical of any fixed guideway transit investment. A planning process following federal guidelines for funding and environmental permitting would make the project eligible for FTA support. Given the innovative nature of the service, a Design, Build, Operate and Maintain approach to project delivery would be wise. Federal support for DBOM projects is not uncommon. It is possible that some challenges would arise from the use of federal funding for the project as the cabins and mechanisms used to propel the cables and manage the cabins are all generally manufactured overseas. “Buy America” provisions associated with U.S. DOT funding would need to be addressed.

Once funding and permits are in place, actual construction of the system would be reasonably quick, typically in the range of 12 months or less The stations and terminals are the only substantial civil works required for the project. Erecting the towers and stringing the cables for a 5,000 to 7,500 foot system could be accomplished in a matter of weeks.

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK


12
Hello India
Emirates


22
Relax, refresh, and rejuvenate


SKYTRANS