

Executive Summary
Preliminary Engineering Report
for the
Beach Corridor Rapid Transit Project
Project Development and Environment (PD&E)
Study

Prepared for:

**MIAMI-DADE DEPARTMENT OF TRANSPORTATION
AND PUBLIC WORKS**



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EXECUTIVE SUMMARY

ES-1.1. INTRODUCTION

In 2016, the Miami-Dade County Transportation Planning Organization (TPO) adopted the Strategic Miami Area Rapid Transit (SMART) plan as the blueprint for developing premium transit services throughout Miami-Dade County. The overall plan is illustrated in **Figure ES-1**. Subsequently the Miami-Dade County Department of Transportation and Public Works (DTPW) initiated the Beach Corridor Rapid Transit Project Development and Environment (PD&E) study in 2017, in collaboration with the Florida Department of Transportation (FDOT) and the cities of Miami and Miami Beach. This Preliminary Engineering Report (PER) summarizes the environmental analysis, engineering analysis, public outreach, and evaluation results of the PD&E study. The PER identifies DTPW’s Recommended Alternative and is intended to lead to the selection of a Locally Preferred Alternative (LPA) for the Beach Corridor by the Miami-Dade County TPO Governing Board. It may further support entry into the Federal Transit Administration (FTA) project development process and an application for a Capital Investment Grant, if DTPW elects to pursue the project as an FTA New Starts project.



Figure ES- 1: SMART Plan Map

ES-1.2. STUDY AREA

The Beach Corridor study area, shown in **Figure ES-2**, is located in the east central region of the SMART Plan and is generally bounded by:

- I-195/Julia Tuttle Causeway on the north,
- I-395/MacArthur Causeway on the south,
- I-95 on the west, and
- Washington Avenue on the east.

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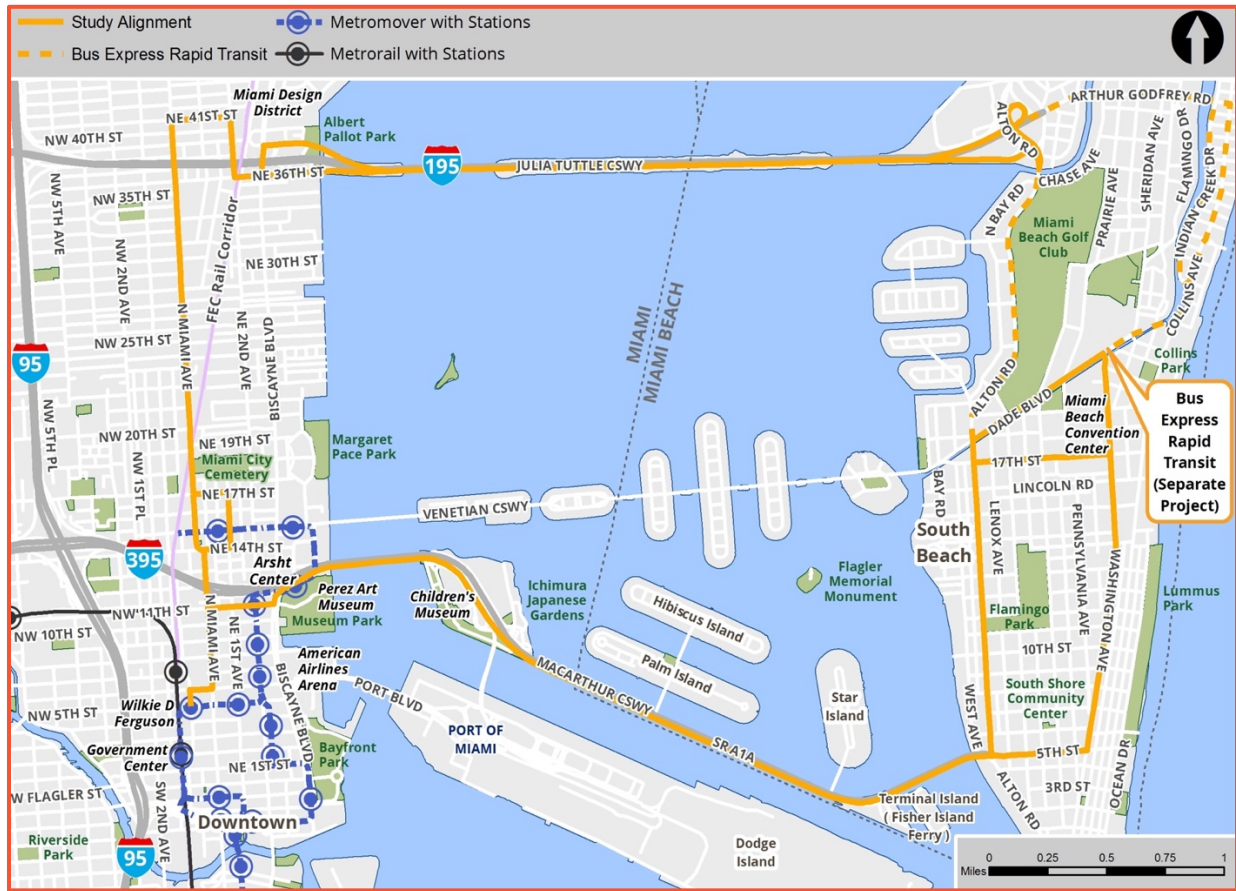


Figure ES- 2: Study Area

ES-1.3. PURPOSE & NEED

The purpose of this project is to increase the person-throughput to the Beach Corridor's major origins and destinations via a rapid transit technology. The need for the project is based upon the extensive population growth throughout the study area resulting in ever-increasing traffic congestion and the demand for enhanced access to the area's many facilities and services.

The Beach Corridor traverses an area that is at the epicenter of population and economic growth within Miami-Dade County. The City of Miami Central Business District (CBD) area and Miami Beach have undergone rapid population and employment increases over the past decade, a trend that is projected to continue over the next 20 years. The population densities in the study area are among the highest in the nation, with the Miami CBD at 17,800 persons per square mile and Miami Beach at 11,500 persons per square mile, per the 2010 U.S. Census. The Miami CBD saw a dramatic 172 percent increase in population density over the last decade.

Due to the region's appealing qualities, such as its temperate climate, attractive beaches, and convenient access to the Caribbean and Latin America, South Florida and Miami-Dade County have become an important tourist destination for both national and international visitors. The county hosts millions of annual visitors and seasonal residents. Visitors typically access the study area via tour bus, taxi, or rental car.

In 2018, Greater Miami and the Beaches attracted a record 16.5 million overnight visitors and an additional 6.8 million day trippers. Miami Beach and Downtown Miami are the two most popular locations for overnight stays, lodging nearly 50 percent of all 2018 area visitors with approximately 6.1 million and 1.6 million overnight guests, respectively. Additionally, four of the six most-visited attractions are in proximity to the Beach Corridor, including South Beach, the Beaches, Lincoln Road, Bayside Market Place, and Downtown Miami.

This high rate of tourism generates additional demand for travel, produces additional trips within the area, and contributes to traffic and subsequently roadway congestion. The Greater Miami Convention and Visitor's Bureau 2018 Visitor Industry Overview indicated that traffic congestion is the top negative aspect of trips to Greater Miami and Miami Beach. Traffic congestion has been the top-ranked problem in each of the last eight annual surveys.

In order to meet the project's purpose and need, goals were established that would accommodate the high travel demand throughout the study area and provide relief to the extreme traffic congestion along the surface streets. The project goals include the following:

- Connect to and provide direct, convenient, and comfortable rapid-transit service to serve existing and future planned land uses;
- Provide enhanced interconnections with Metrorail, Tri-Rail, Brightline, Metromover, and Metrobus routes; Broward County Transit (BCT) bus routes; Miami and Miami Beach circulators; jitneys; shuttles; taxis; Transportation Network Companies (TNCs); and/or other supporting transportation services; and
- Promote pedestrian- and bicycle-friendly solutions in the corridors of the study area.

ES-1.4. PROJECT CORRIDOR AND SUB-AREAS

The project corridor is characterized by:

- Mixed-use development, including areas of high residential and employment density;
- A diverse population with a higher-than-countywide minority percentage and a lower median household income than county and national levels;
- Limited transportation pathways, with high average daily traffic volumes and congestion on the expressways and major roadways;
- Historic, cultural, and recreational resources;

- Wetlands and critical habitats for protected species;
- Land uses sensitive to noise and vibration effects;
- Special Flood Hazard Area (SFHA) designation for nearly 50 percent of the corridor; and
- A navigable waterway (the Atlantic Intracoastal Waterway).

The study area is comprised of three sub-areas along this project corridor, featuring distinct segments of travel demand and origin/destination pairs that vary in their land use and environmental characteristics.

The Bay Crossing sub-area, an east–west corridor between Miami Beach and downtown Miami that would form the “trunk line” of the project. The travel demand in this corridor could be served directly via I-395/MacArthur Causeway, or less directly via I-95 and the Julia Tuttle Causeway (I-195).

The Midtown/Design District sub-area, a north–south corridor between the Design District/Midtown and downtown Miami.

The Miami Beach sub-area is a north-south corridor extending from Washington Avenue and 5th Street to the Miami Beach Convention Center.

Key distinguishing characteristics are described further in section ES-1.8.3, *Contextual Considerations for Alternatives Development*.

ES-1.5. PROJECT HISTORY

The Beach Corridor Rapid Transit (PD&E) study builds on prior studies dating back to 1988, as shown in Figure ES-3.

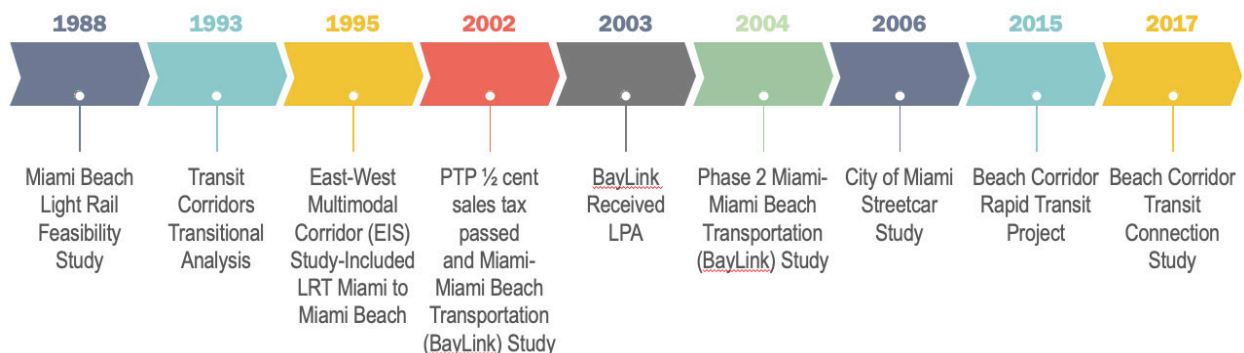


Figure ES- 3 Project History

ES-1.6. PUBLIC INVOLVEMENT

Public involvement was an important input to the PD&E Study. A Public Involvement Plan (PIP) was developed at the outset of the study to outline an engagement process that would help to ensure that the study reflects the values and needs of the communities it is designed to benefit. The public outreach process was designed to share information, obtain feedback and build consensus for a Locally Preferred Alternative (LPA) among all community stakeholders.

Public input was gathered at several project milestones (as shown in **Figure ES-4**), providing residents, business owners, elected officials and government agencies with the opportunity to inform the development and screening of the alternatives and the evaluation. The Tier One Screening public involvement activities included one agency/elected officials kick-off meeting, one public kick-off meeting (held in two locations) and more than 20 one-on-one meetings with elected officials and community stakeholders. Public and agency input during the Tier One screening process was important in shaping further analysis:

- As a result of stakeholder input and in response to a resolution adopted by the City of Miami Beach, DTPW expanded the study area to include both I-195 and I-395 as potential corridors for rapid transit to and from Miami Beach.
- To address requests for consideration of additional corridors within the City of Miami, a Corridor Analysis Report was completed in August 2018. The Corridor Analysis examined North Miami Avenue, NE 2nd Avenue and Biscayne Boulevard for potential transit improvements. The Corridor Analysis determined that due to various environmental, engineering and ridership factors, North Miami Avenue would be the recommended corridor for implementation of a rapid transit mode.

The public involvement opportunities during Tier Two screening process of the study included an additional agency/elected officials kick-off meeting, public-kick off meeting, and Alternatives Workshops held on the Miami side and Miami-Beach side to present initial alternatives. A Project Advisory Group (PAG) comprised of local stakeholders having an active role in the community was established during Tier Two. A second series of Alternatives Workshops was held to present the evaluation results and refinement of alternatives, in both Miami and Miami-Beach locations. Presentations to municipalities and a series of one-on-one briefings with elected officials were also conducted.



Figure ES- 4 Project Timeline with Public Involvement Milestones

ES-1.7. ALTERNATIVES CONSIDERED

ES-1.7.1. Phased Development of Alternatives – Tier One and Tier Two

Alternatives were developed in two project phases—Tier One, a transit technology screening, and Tier Two, Preliminary Engineering and Environmental Assessment.

The Tier One evaluation considered seven alternative technologies to provide rapid-transit connections between the Midtown Miami/Design District, Downtown Miami, and Miami Beach. Automated transit analysis was included with each technology assessment.

DTPW identified the following transit technologies (modes) for consideration in the Beach Corridor Rapid Transit Project Tier One Evaluation:

- Automated guideway transit (Metromover)
- Streetcar/light rail transit
- Heavy rail transit (Metrorail)
- Bus rapid transit
- Aerial cable transit
- Monorail
- Personal Rapid Transit

The Tier One Evaluation included a summary of these transit technologies and modes, the development of representative alignments, public involvement and the evaluation of the potential modes with respect to transit performance, economic and community development, environmental effects, and cost/feasibility. Based on the results of the evaluation, three transit modes were not recommended to advance for further analysis in the Tier Two Evaluation:

- Heavy Rail Transit – due to potential large right of way impacts in downtown
- Aerial Cable Transit – due to low capacity and speed
- Personal Rapid Transit – due to low capacity and speed

To support the Tier One Evaluation of transit technologies, representative alignments were developed for each mode to demonstrate how the general characteristics of the technology would be applied to the study area.

The purpose of the Tier One representative alignments was to provide enough specificity about the application of each mode to the corridor to allow for a comparative evaluation of the modes. Based on the results of the Tier One analysis, DTPW determined that the following technologies had the potential to meet the project purpose and need and would be advanced for further development in Tier Two.

- Automated People Mover (APM)
- Light Rail Transit/Streetcar (LRT)
- Monorail
- Bus Rapid Transit (BRT)

Figure ES-5 shows a comparison of the four transit modes advanced for further development.

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Automated People Mover (APM)



Light Rail Transit (LRT)/Streetcar



Monorail



Bus Rapid Transit (BRT)



Average Operating Speed	30 MPH	20 MPH (Semi-Exclusive)/ 30 MPH (Exclusive)	30 MPH	20 MPH (Semi-Exclusive)/ 30 MPH (Exclusive)
Passenger Capacity	210-300/Train	240 / Train	180-250/Train	100 / Bus
Right of Way	Exclusive	Semi-Exclusive & Exclusive	Exclusive	Semi-Exclusive & Exclusive
Typical Stop Spacing	 0.25 - 0.75 miles	 0.25 - 0.50 miles	 0.25 - 0.75 miles	 0.25 - 1.0 miles
Guideway	Elevated Guideway	Embedded Tracks at Street Level & Elevated Guideway	Elevated Guideway	Dedicated Lanes
Other Infrastructure	Elevated Stations	Stop Platforms at Street Level & Elevated Stations	Elevated Stations	Stop Platforms at Street Level & Freeway Median Stations
System Example	Miami-Dade Metromover Jacksonville Skyway	Houston METRO Nice, France Tramway	Seattle Monorail Las Vegas Monorail	Cleveland Healthline BRT Orlando LYNX LYMMO

Figure ES- 5 Transit Modes Comparison

ES-1.7.2. No-Build Alternative

The No-Build Alternative assumes that existing bus/trolley transit service continues to operate in the study area with no additional improvements to speed, reliability or capacity.

ES-1.7.3. Automated People Mover (APM) Alternative**a. *Technological features:***

Automated people mover (APM) is a fully-automated transportation system with driverless vehicles operating on fixed guideways and exclusive rights-of-way (elevated in urban areas or in tunnels at airports). APM trains operate on a two-rail guideway system with rubber tires on steel or concrete guideway. (Miami's existing Metromover is an example of this system, featuring concrete columns that support a steel guideway.) Typically, APMs, regardless of the technology or manufacturer, are defined by the following characteristics:

- Driverless/fully automated
- Operate on fixed guideway (usually elevated)
- Vehicles have rubber tires on concrete or steel surface

Miami currently has an APM system in place, which is known as the Metromover. The existing vehicles have an overall body length of 39 feet, 8 inches, and body width of 9 feet, 4 inches. The minimum turning radius of the CX100 vehicle is 75 feet, and the maximum grade is 10 percent. The maximum operating speed is 25 miles per hour (mph), but newer vehicles are expected to be able to achieve maximum operating speeds of 35 mph. While in Downtown Miami, curves and stop spacing limit the existing Metromover to average operating speeds of 10 mph, but the new APM would be able to travel at or near the maximum operating speed for the Bay Crossing trunk line.

b. Proposed Alignment:

The APM Alternative alignment is depicted on **Figure ES-6**. In the Bay Crossing trunk line, the APM would extend from the vicinity of the Herald Plaza and Museum Park Metromover station with a new Y-crossover to continue east on a new elevated guideway structure constructed approximately fifteen feet south of MacArthur Causeway. New stations would be provided at the Children's Museum and at 5th Street and Washington Avenue, with a potential additional station on 5th Street between Alton Road and Washington Avenue.

The APM Alternative would terminate at the 5th Street & Washington Avenue station, where passengers could transfer to bus/trolley service in a dedicated bus lane extending along Washington Avenue to the Miami Beach Convention Center. A bus transit hub facility will be provided. The guideway structure would be elevated with a minimum clearance of 16.5 feet above the roadway, supported on oblong-shaped columns with a typical spacing of 130 feet and typical

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diameter of four to six feet. The elevated stations would measure approximately 100 feet by 40 feet, typically supported by two columns.



Figure ES- 6 APM Alignment

In the Midtown/Design District sub-area, the APM Alternative would extend from the existing School Board Metromover Station on NE 15th Street to North Miami Avenue, with a two-track elevated alignment (mostly in the median) extending to a terminus at NW 41st Street. Stations would be required at North Miami Avenue and NW 16th, 22nd, 26th, 29th, 34th and 40th Streets. The guideway structure would be elevated with a minimum clearance of 16.5 feet above the roadway, supported on oblong-shaped columns with a typical spacing of 90 to 120 feet and typical diameter of four to six feet. The elevated stations would have approximate dimensions of 100 feet by 40 feet, typically supported by two columns. A new maintenance facility of approximately three acres would be provided in order to accommodate the additional vehicles for the trunk line and design district extension. Renderings of the APM guideway and station concepts are shown on ES-7 and ES-8, respectively. Typical sections are depicted on **Figures ES-9 and ES-10**.

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Figure ES- 7 APM Rendering



Figure ES- 8 APM Station Conceptual Design

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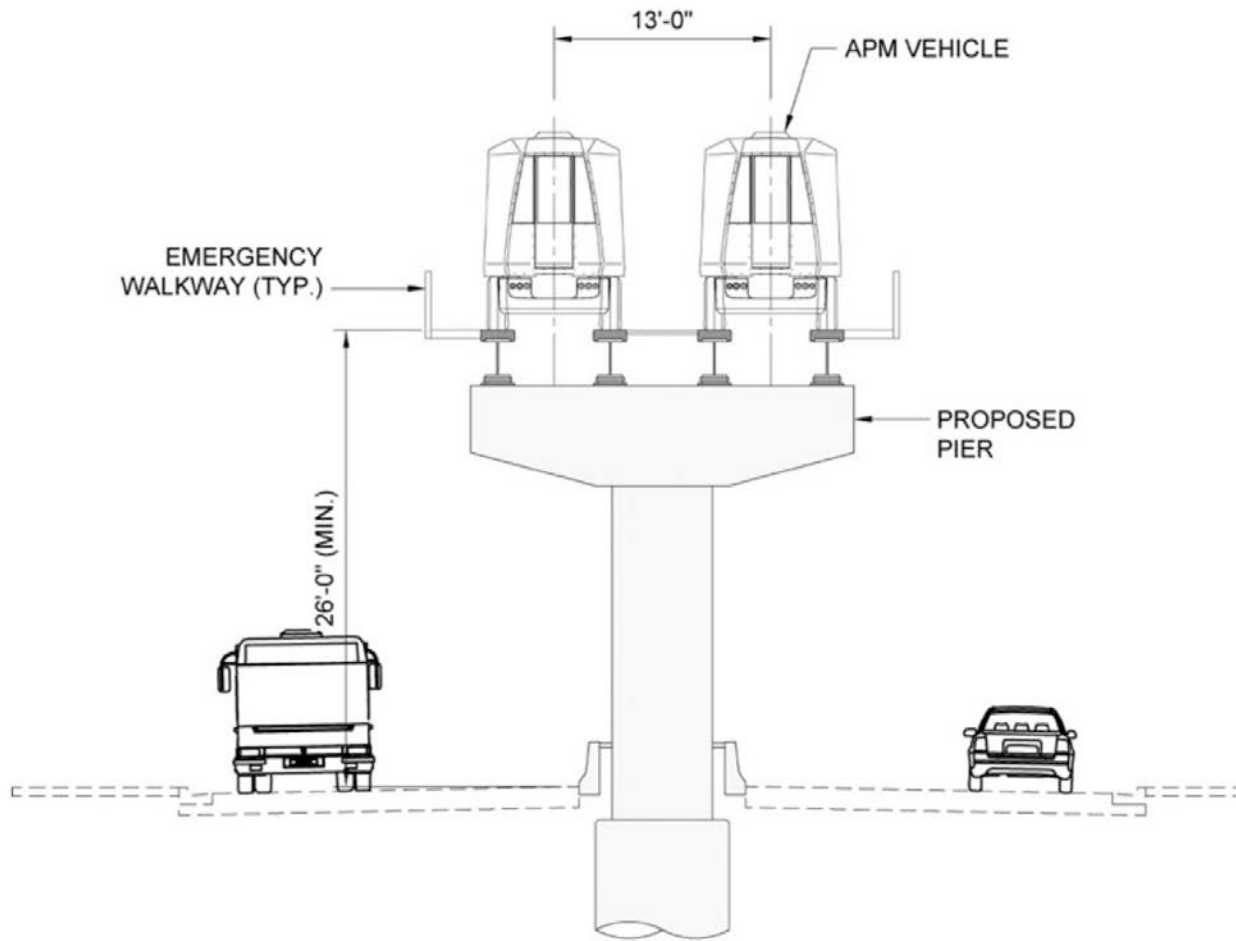


Figure ES- 9 North Miami Avenue and 5th Street sections

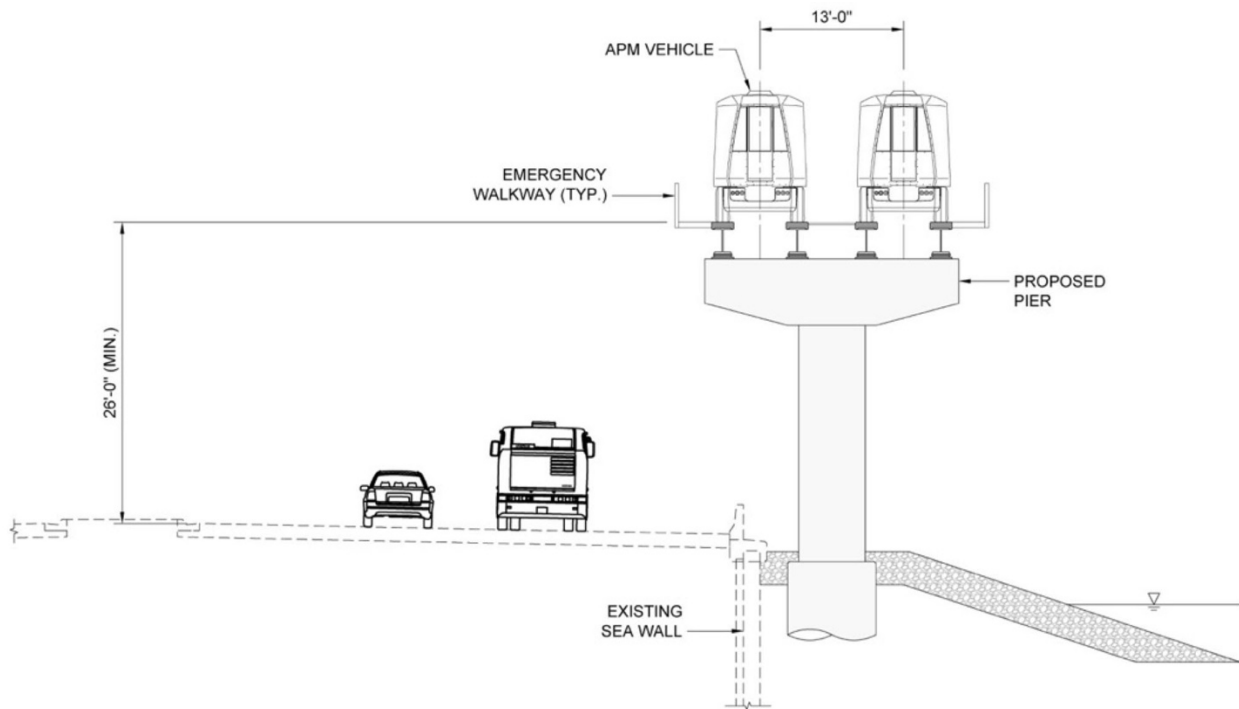


Figure ES- 10 APM – Trunk line

ES-1.7.4. Light Rail Transit (LRT)/Streetcar Alternative

a. Technological Features

Light rail vehicle (LRV) technology features rail cars that operate on steel wheels/rails with electric propulsion, level boarding, air-conditioning, passenger information systems, and double-leaf doors. LRVs range from 8–10 feet in width and from 66-foot, three-section, single-unit trains (modern streetcar) to 400-foot, four-car trainsets (light rail transit or LRT) in length. Trams, as implemented in Europe, are typically five- to seven-section, single-unit trains ranging from 98 to 155 feet in length. LRVs also vary in their minimum turning radius and maximum grade capabilities and can be powered via an overhead contact, battery power, or embedded third-rail power system (the latter limited to trams comprised of at least five sections because of requirements for the length of the train).

Streetcars and trams are now offered with a variety of off-wire technologies, allowing them to operate off-wire in some segments with power supplied via on-board rechargeable batteries or in-ground power systems. The off-wire capability can be applied to avoid overhead obstacles such as low-clearance bridges, or in areas where overhead wires are not locally acceptable for visual/aesthetic reasons. These vehicles offer “hybrid” operation, so they can operate with power from an overhead wire in segments where off-wire is not required. The battery-drive systems have significant range (for example, streetcars in Seattle travel off-wire for three miles on each round

trip). The in-ground systems have unlimited range but require a somewhat longer, tram-style vehicle to provide adequate spacing of the in-ground electrical relays. This allows the power system to be safely turned on while the train passes over the power source and off when the train is not present.

For the Beach Corridor Rapid Transit Project, a 40-meter (131-foot) vehicle that can be operated with an in-ground, off-wire power system on Washington Avenue and North Miami Avenue was assumed, consistent with previous Miami Beach streetcar proposals that assumed an off-wire system on Washington Avenue.

b. Proposed Alignment:

The LRT/Streetcar alignment would offer a one-seat ride from the Design District to the convention center area and is shown on **Figure ES-11**. The LRT/Streetcar Alternative would be comprised of a combination of at-grade and elevated segments. The alternative would extend from an at-grade station adjacent to the Museum Park Metromover station, continue east on a new elevated guideway structure on the south side of the MacArthur Causeway, with stations at the Children’s Museum and at 5th Street and Lenox Avenue, then transition to grade at the 5th Street and Washington Avenue intersection and travel at grade on Washington Avenue to the convention center area.

Westbound from the MacArthur Causeway, the alternative continues to the Midtown/Design District sub-area, operating at grade along 11th Street until reaching NE 2nd Avenue, where the tracks split. The westbound-to-northbound track turns at NE 2nd Avenue. The at-grade guideway would be comprised of steel-rail standard gauge track embedded in a concrete track slab at the roadway surface grade. Where the LRT alignment is elevated, the guideway structure would be at a minimum clearance of 16.5 feet above the roadway and would be supported on oblong-shaped columns with a typical spacing of 130 feet and typical diameter of four to six feet. The elevated stations would have approximate dimensions of 150 feet by 40 feet, typically supported by two columns.

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Figure ES- 11 LRT/Streetcar Alignment

In the Midtown/Design District sub-area, the LRT/Streetcar Alternative would replace the current outside travel lanes on North Miami Avenue north of NW 20th Street. Between NW 20th Street and NW 17th Street, the guideway will be elevated to cross over the existing Florida East Coast (FEC) Railway. The southbound tracks would then continue at-grade south along North Miami Avenue to NE 11th Terrace. The northbound tracks will turn east on 17th Street, and move back to at-grade level, turn south on NE 1st Avenue, turn east on NW 16th Street, and south on 2nd Avenue and meet the southbound tracks at 2nd Avenue and NE 11th Terrace. The LRT guideway will replace existing travel lanes on these local roads. A new maintenance facility of approximately 5.4 acres would be required to accommodate the entire alignment. The LRT/Streetcar guideway and station concepts are depicted on **Figures ES-12 and ES-13**. Typical sections are depicted on **Figures ES-14 and ES-15**.



Figure ES- 12 LRT/Streetcar Rendering Elevated

In the Miami Beach subarea, the LRT/Streetcar Alternative would be comprised of steel-rail standard gauge track embedded in a concrete track slab at the roadway surface grade. This LRT/Streetcar guideway would be located along the centerline of Washington Avenue and terminate at the Miami Beach Convention Center, with stations at 6th Street, 10th Street, and 14th Street, Lincoln Road, and 19th Street.



Figure ES- 13 LRT/Streetcar Station Conceptual Design Rendering - Street Running

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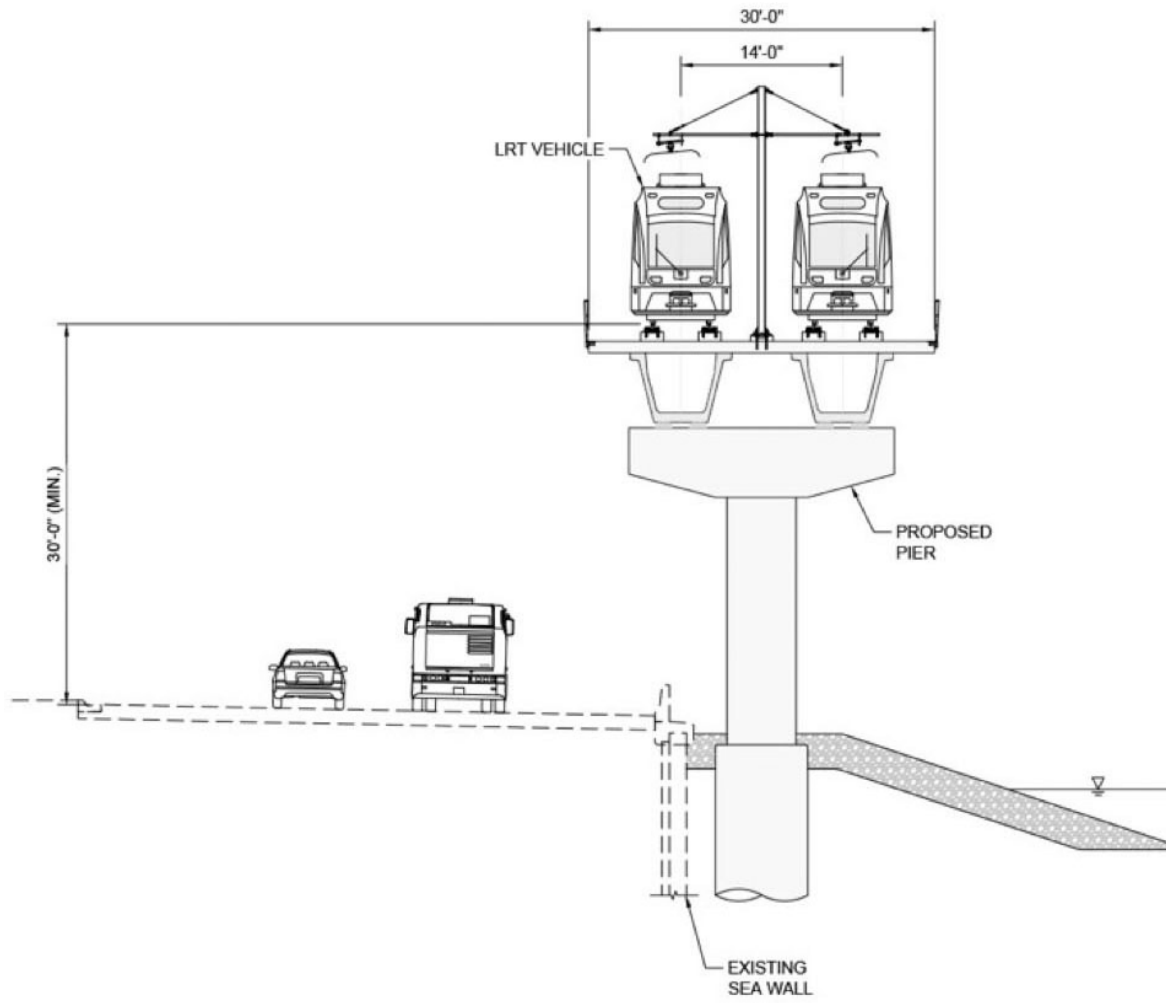


Figure ES- 14 LRT Section elevated

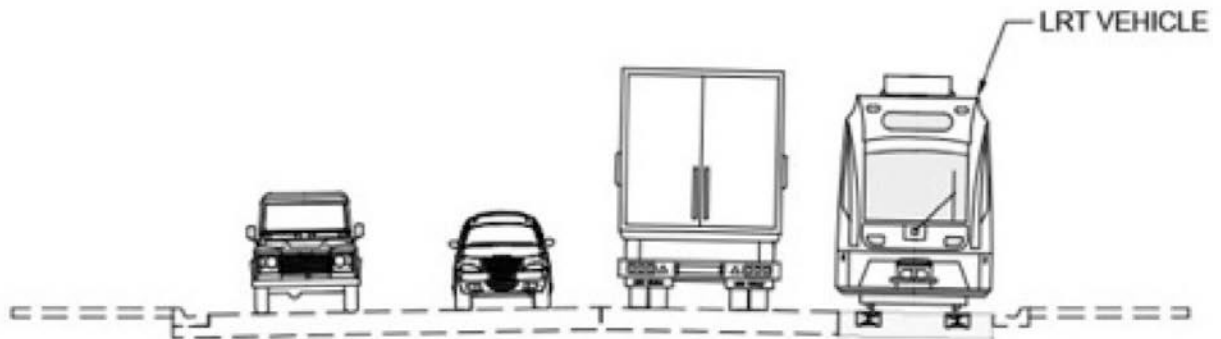


Figure ES- 15 LRT Section - North Miami Ave at grade

ES-1.7.5. Monorail Alternative**a. *Technological Features:***

Monorail technology features railcars that operate on concrete beam guideways, with rubber drive wheels that run on the top of the beam and guide wheels running along the two sides. Traction power is supplied by a trolley wire mounted on the sides of the guideway beam, and electricity is picked up by shoes on the vehicle.

Monorail vehicles are 10 feet wide and roughly 35–45 feet long (can vary by manufacturer) and may be operated in two- to eight-car trainsets. Monorails have a minimum turning radius of 130–150 feet and can handle grades as steep as 10 percent. Similar to APM, Monorail systems are driverless and fully automated. Although some older Monorail systems are comprised solely of columns, monorail beams, and power rails, new Monorail systems require additional structure to support a continuous emergency walkway along the alignment.

b. *Proposed Alignment:*

In the Bay Crossing sub-area, the Monorail Alternative would extend from a new station at Herald Plaza offering a direct seamless transfer to a Metromover platform within the same station house and continue east on a new elevated guideway structure along the south side of the MacArthur Causeway. The station at Herald Plaza has connectivity with the Omni Bus Terminal to facilitate transfers to and from existing and future bus routes. New stations would be provided at Herald Plaza, at the Children’s Museum and at 5th Street and Washington Avenue, with a potential additional station on 5th Street between Alton Road and Washington Avenue. A new maintenance facility, of approximately 2.3 acres, would be required at a potential Watson Island location.

The Monorail Alternative would terminate at 5th Street & Washington Avenue, where passengers could transfer to bus/trolley service extending along Washington Avenue to the Miami Beach Convention Center. A bus/trolley transfer facility would be provided at the termini location. The guideway structure would be elevated with a minimum clearance of 16.5 feet above the roadway and would be supported on oblong-shaped columns with a typical spacing of 130 feet and typical diameter of four to six feet. The elevated stations would have approximate dimensions of 100 feet by 40 feet, typically supported by two columns. The location of the Monorail alignment and proposed stations are shown on **Figure ES-16**. Renderings of the Monorail Alternative and center platform are shown on **Figures ES-17** and **ES-18**, respectively and typical sections are in **Figures ES-19** and **ES-20**.

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Figure ES- 16 Monorail Alignment

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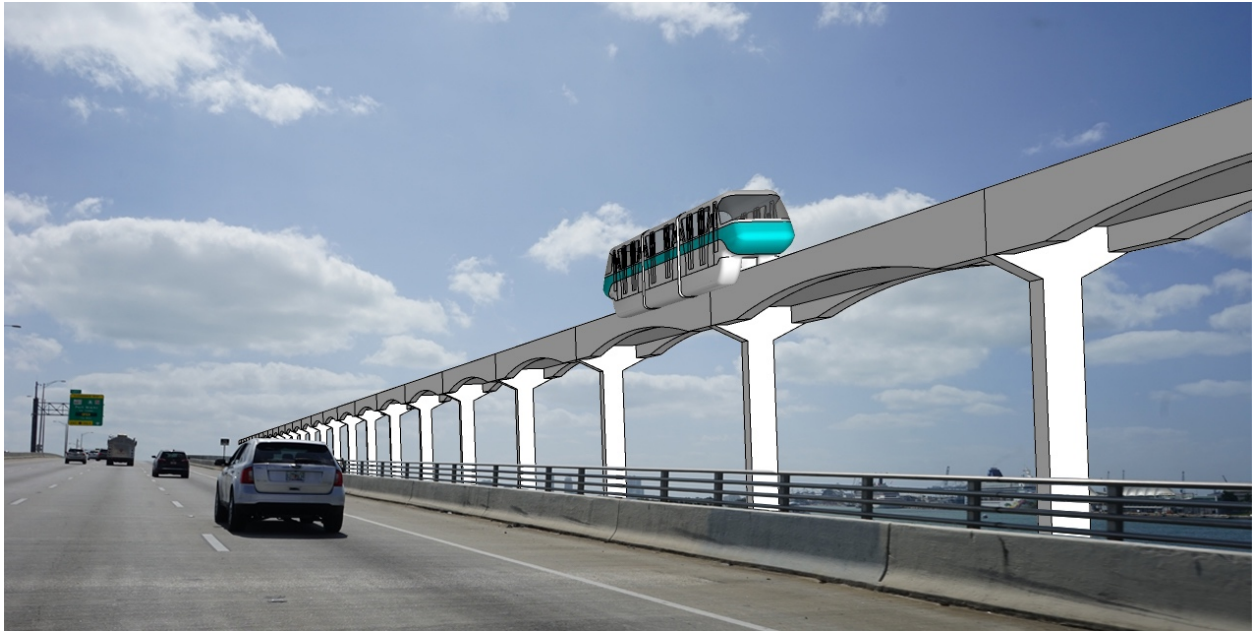


Figure ES- 17 Monorail Rendering



Figure ES- 18 Monorail Station Conceptual Design – Typical Station Plan

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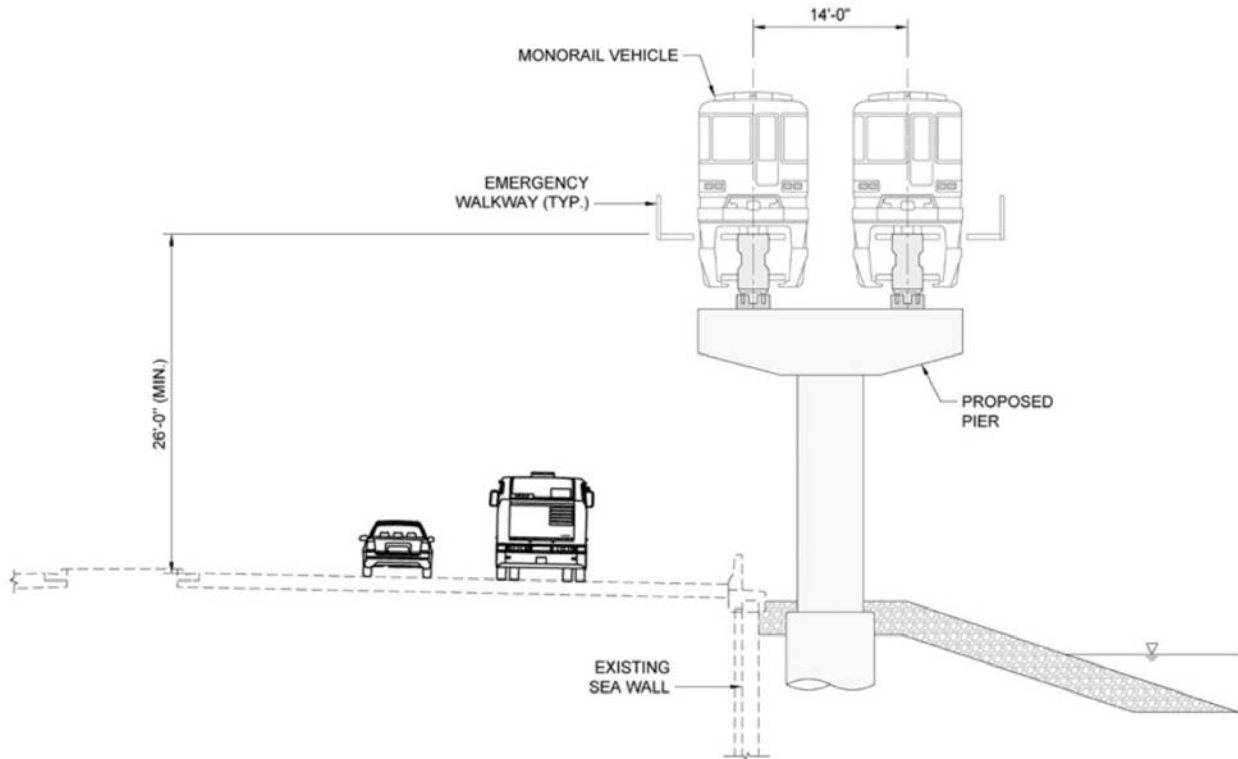


Figure ES- 19 Monorail- Trunk line

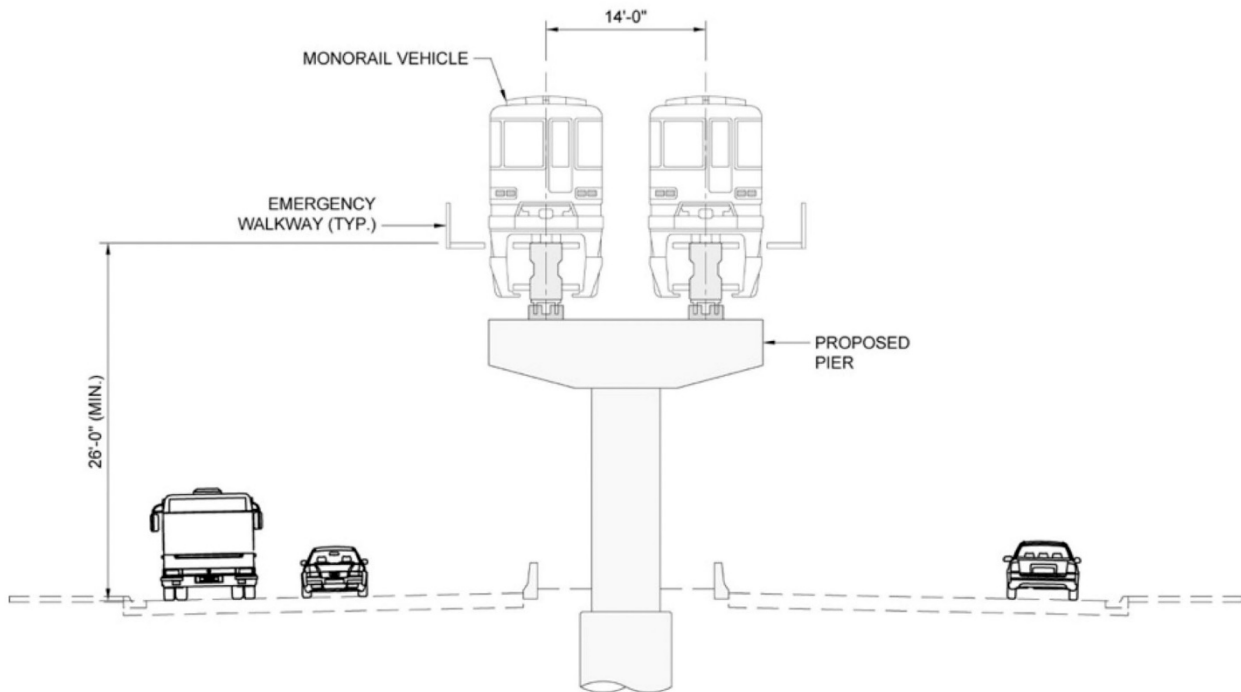


Figure ES- 20 Monorail - 5th Street section

ES-1.7.6. Bus Rapid Transit (BRT) Alternative**a. *Technological Features:***

Bus rapid transit (BRT) typically features 60-foot articulated buses, raised platforms at stations for near-level boarding, station amenities such as off-board fare payment and real-time arrival information, and provisions for operational priority, such as bus-only lanes and/or transit signal priority. Some BRT projects feature a “busway,” with exclusive, grade-separated operations. Some BRT vehicles feature left-sided doors to accommodate center-running alignments and center-platform stations. BRT vehicles may be traditional diesel-powered buses or may be powered with compressed natural gas (CNG), or battery-electric propulsion systems. The bus batteries can be charged during short station stops (station charging) or during longer layovers at terminus stations/maintenance facilities (depot charging).

b. *Proposed Alignments:****Bus Rapid Transit (BRT)/I-395 Alignment***

The I-395 BRT Alternative would begin at Overtown Transit Village Station, continuing east along NE/NW 8th Street to Biscayne Boulevard and turning north on Biscayne Boulevard and continuing on to I-395 and MacArthur Causeway, as shown in **Figure ES-21**. The BRT will operate in mixed flow in existing travel lanes from Overtown to Biscayne Boulevard.

The alternative would run east/west across Biscayne Bay on dedicated bus lanes across the bridges and MacArthur Causeway to Miami Beach. The proposed typical section will require the widening of the bridges and the Causeway. The characteristics of fixed guideway—including relatively closely spaced “track centers” and the dynamic loading characteristics—allow for the guideway deck to be supported on a series of single columns, resulting in a relatively small footprint at the waterway/ seawall level, whereas BRT would be subject to highway design requirements, resulting in a much wider deck that would require more columns. These issues would be exacerbated at each end of the trunk line where ramp structures would be necessary to connect the BRT guideway to the surface roadway system.

On the east side of the MacArthur Causeway the alternative continues east along 5th Street and north along Washington Avenue, utilizing dedicated bus lanes to the Miami Beach Convention Center (re-purposing an existing travel lane in each direction).

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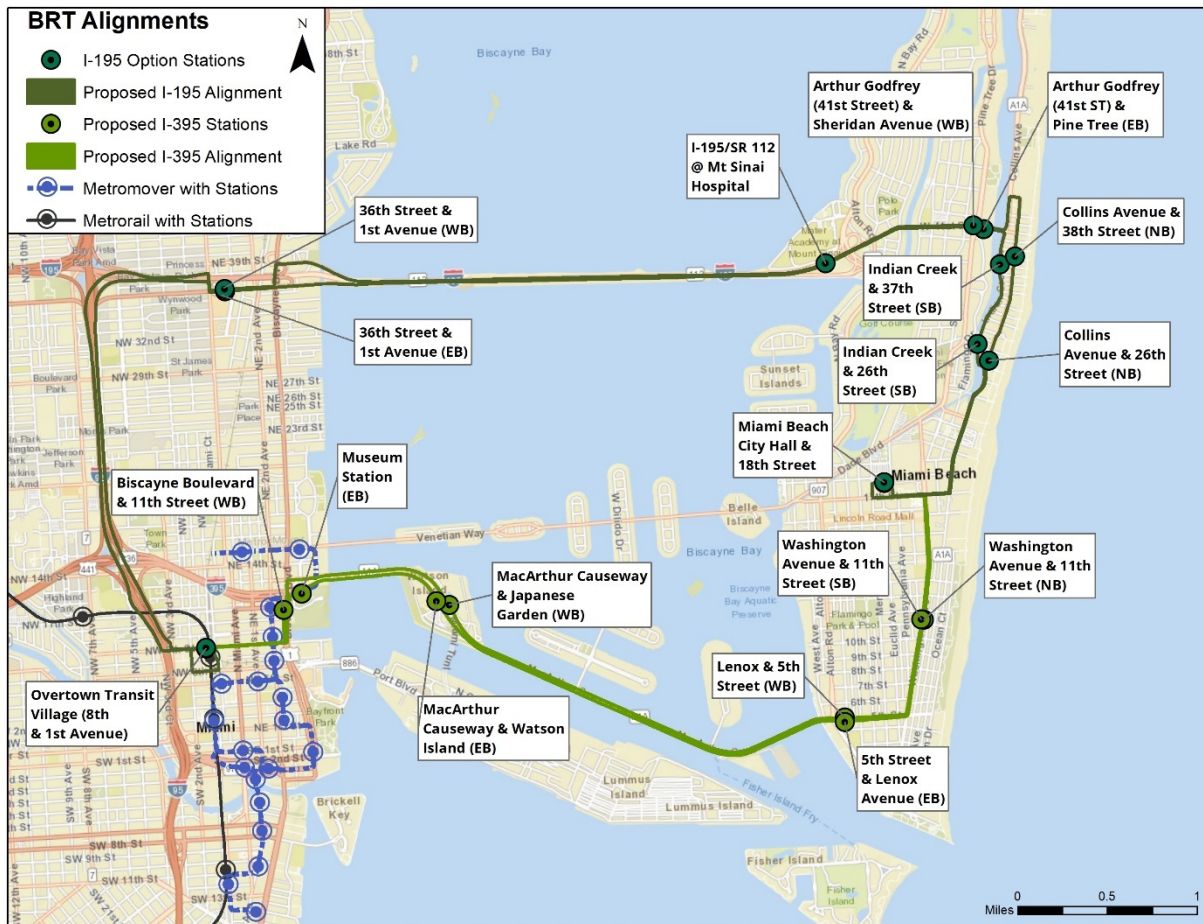


Figure ES- 21 BRT I-395 Alignment and BRT I-195 Alignment

Bus Rapid Transit (BRT)/I-195 Alignment

The BRT/I-195 Alignment is an alternative corridor that would utilize the Julia Tuttle Causeway as the connection between the City of Miami and Miami Beach.

Beginning at the Overtown Transit Village Station, the BRT would run west along NE/NW 8th Street to the I-95 on-ramp. The BRT would operate in mixed traffic (including travel in the express lanes) on I-95 north to I-195, continuing onto the Julia Tuttle Causeway. Along the Julia Tuttle Causeway, BRT would operate in dedicated bus lanes; the proposed typical section would require the widening of the bridges and the Causeway.

From the east side of the Julia Tuttle Causeway this alternative continues on 41st Street in dedicated lanes, east to Indian Creek Drive, and south on Indian Creek Drive to 17th Street and

loop around Miami Beach Convention Center, with the northbound return route in dedicated lanes on Collins Avenue.

A rendering of the BRT Typical Station Plan for both sub-alternative alignments is shown below on **Figure ES-22** and the typical section is depicted on **Figure ES-23**.

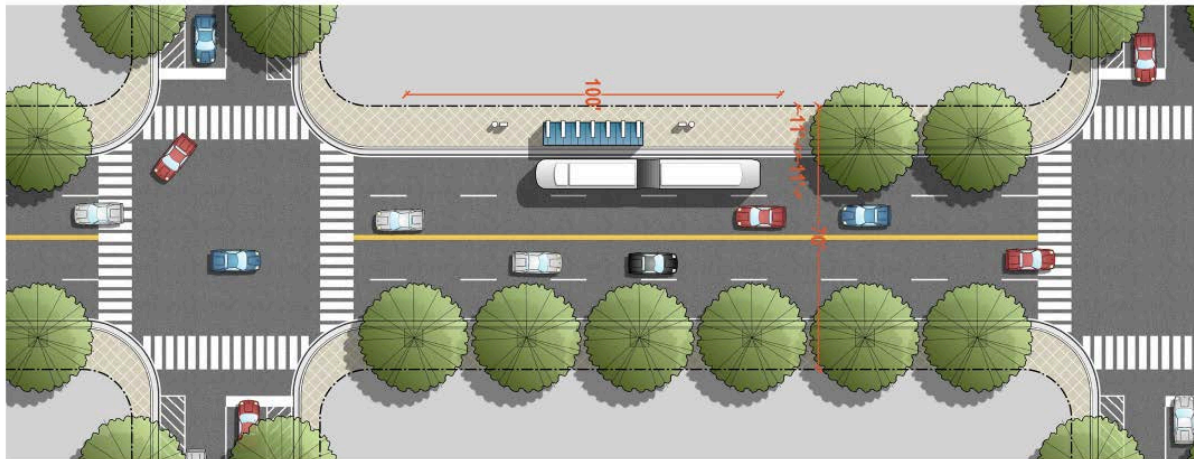


Figure ES- 22 BRT Rendering - Typical Station Plan

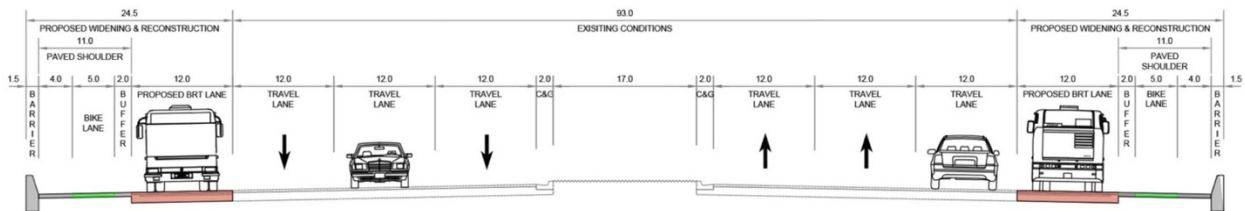


Figure ES- 23 BRT Typical Section

ES-1.8. APPROACH TO ALTERNATIVES DEVELOPMENT

ES-1.8.1. Trunk Line and Extensions

The Tier One evaluation demonstrated that the modes recommended for additional study differ in their suitability to sub-areas of the study area. Therefore, the comparative alternatives evaluation would benefit from the identification of distinct project sub-areas to allow for evaluation of the alternatives by project sub-area as well as by complete project sets that may be comprised of one or more sub-areas. As previously described, the Tier One report identified four distinct sub-areas based on the representative alignments which traversed the Design District, Downtown Miami (later eliminated), Bay Crossing and Miami Beach. The sub-areas were subsequently simplified as the “trunk line” and “extensions” during alternatives development. The extensions have their origins in projects that were initially studied as independent projects by the City of Miami and the City of Miami Beach. This PD&E study incorporates the extensions to allow for a full-corridor

evaluation of needs and opportunities in the study area. In addition, the BRT Alternatives were developed to serve the origins and destinations of all the subareas using the trunk line and serving the north-south travel on either side of the causeway via existing expressways.

a. *Bay Crossing Trunk Line:*

All project alternatives include a Bay Crossing (trunk line) which offers independent utility, as defined in the National Environmental Policy Act (NEPA) and described further below.

The Bay Crossing (trunk line) limits are from the vicinity of the existing Omni Bus Terminal, Herald Plaza site, and Museum Park Metromover station area in the City of Miami to a transit hub/stop at Washington Avenue and 5th Street in the City of Miami Beach. The logical termini for the project connects to major activity centers/destinations and existing transit. On the west end it connects to Miami's central business district and on the east end it connects to Miami Beach's entertainment and employment district. The City of Miami Beach has designated exclusive transit lanes along 5th Street and Washington Avenue in their Transportation Master Plan. The City of Miami Beach also operates an extensive trolley system that would distribute/circulate trips from the Bay Crossing project termini to other parts of the city. The Bay Crossing project is approximately four miles long and of sufficient length to address environmental impacts with viable mitigation options.

Assuming no additional transportation improvements in the area are made, this project has independent utility as it connects two major activity centers across a body of water which constrains cross-city travel. As indicated in the travel market analysis, the cities of Miami and Miami Beach have the largest share of population and employment within Miami-Dade County. The project is independently significant as it can provide seamless accessibility between these two vibrant cities. Moreover, a premium transit enhancement across the bay would be less impactful to the environment than any traditional roadway enhancement.

The project would not restrict consideration of transit expansion plans in either City. Extensions to Midtown in Miami and Mid Beach in Miami Beach could continue with context sensitive technology that may or may not be similar to that at the Bay Crossing.

b. *Design District/Midtown Miami Extension:*

The APM and LRT modes can also be extended through Midtown Miami to the Design District (in the vicinity of NW 41st Street and Miami Avenue). Project alternatives that consider the APM and LRT modes, comprised of both the Bay Crossing trunk line and Design District/Midtown Miami extension, were evaluated. An APM alternative that extends the existing Metromover system to the Design District/Midtown Miami, without an APM extension to serve the Bay Crossing, was also evaluated to allow for its consideration as a complement to a Bay Crossing trunk line alternative using the LRT or Monorail mode. BRT and Monorail technologies were not

considered in a Midtown only extension evaluation as the BRT was serving this market via an alternative north-south route, and an elevated rubber tire extension of an existing APM was more feasible from an operations perspective.

c. *Miami Beach Extension:*

The BRT and LRT modes can also be extended from 5th Street and Washington Avenue to the vicinity of the Miami Beach Convention Center at 19th Street and Washington Avenue. This sub-area is served by both of the BRT alternatives (I-395 and I-195 bay crossings) and in two LRT alternatives, one that includes the Bay Crossing and Miami Beach sub-areas and another that includes all three sub-areas. Elevated technologies were minimized in the Beach area due to its incompatibility with existing National Register of Historic Places District areas north of 5th Street.

ES-1.8.2. Corridor Alternatives

Alternatives that serve all three of the sub-areas along the project corridor were developed, with transfers between modes, to allow for evaluation of alternatives that could serve the travel demand of the entire corridor, recognizing that many desired trips have origins and destinations that span two or all three of the sub areas. The corridor alternatives were defined as follows:

a. *APM Corridor Alternative*

Extension of Omni Loop Metromover to Midtown/Design District and Bay Crossing (Trunk Line); bus/trolley connections via Washington Avenue to Miami Beach Convention Center.

b. *LRT/Streetcar Corridor Alternative*

Continuous LRT system from Midtown/Design District to Bay Crossing Trunk Line to Miami Beach Convention Center.

c. *Monorail Corridor Alternative*

Monorail Bay Crossing Trunk Line with APM extension to Midtown/Design District and bus/trolley connections via Washington Avenue to Miami Beach Convention Center

d. *BRT Corridor Alternatives*

Continuous BRT system from Downtown to Miami Beach Convention Center, via I-395/Washington Avenue or I-195/Collins Avenue.

ES-1.8.3. Contextual Considerations for Alternatives Development

The selection of transit modes and definition of the trunk line and extensions supported refinement and further development in Tier Two of the representative alignments that had been developed initially during Tier One. Contextual considerations—at the corridor, sub-area, alignment and station location level—were applied in the alternatives development process.

a. Corridor:

The project purpose—increasing person-throughput to the Beach Corridor’s major origins and destinations via rapid-transit technology - informed the identification of the most important areas to serve within the study area, including the establishment of the termini for each sub-area.

b. Sub-area:

Within the three sub-areas associated with the trunk line and extensions, major characteristics of the natural and built environment, such as views/aesthetics, natural resources, cultural resources, and major infrastructure, informed the determination of suitability of elevated or at-grade alternatives.

The Bay Crossing sub-area is characterized by view corridors, monumental scale, sensitive natural resources, and signature architecture. The built and natural environment in this sub-area can accommodate the introduction of an elevated transit guideway, but the guideway alignment and structural components must be sensitively located to minimize impacts.

The Midtown/Design District sub-area is characterized by a mix of warehouse and retail uses. Redevelopment featuring loft-style apartments and nightlife uses is beginning to occur. The current land use and redevelopment of the corridor make it suitable for the introduction of new transit infrastructure.

The Miami Beach sub-area includes the Collins/Washington Avenue Historic District, which is part of the District, extending from 6th Street to 23rd Street, listed on the U.S. Department of the Interior National Register of Historic Places. As such, federal, state and local regulations constrain the alternatives that would likely be considered “reasonable” and permissible under applicable environmental law; for this reason, elevated alternatives were not considered for the Miami Beach sub-area.

c. Alignment:

For both elevated and at-grade alternatives, compatibility with existing and planned infrastructure and road/highway operations was a key consideration.

In the Bay Crossing sub-area, the limits of the existing seawall on the south side of the MacArthur Causeway Bridge were an important consideration for both horizontal and vertical alignment. Locating guideway structural columns within the footprint of the existing seawall minimizes environmental impacts to the sensitive marine environment. To fit the guideway within this horizontal envelope, the structure is elevated to allow for the guideway to extend above the existing roadway.

An additional key consideration in the Bay Crossing sub-area is coordination with a pedestrian bridge that has been proposed as a public benefit feature of a residential tower at 5th Street and

Alton Road. The bridge constrains the vertical and horizontal envelope for the elevated transit alternatives, which also impacts the options for station locations. The preliminary design of the Beach Corridor Project alternatives has been coordinated with the design of the proposed pedestrian bridge. As a result of this coordination, the Beach Corridor Project rail alternatives are anticipated to be at an elevation of approximately 65 feet as they pass over the proposed pedestrian bridge.

In the Design District/Midtown Miami sub-area, an alignment on North Miami Avenue was identified following a comparative analysis of North Miami Avenue, NE 2nd Avenue and Biscayne Boulevard as potential alignments for the connection from the Bay Crossing sub-area to the Design District. The analysis addressed environmental impacts, ridership potential, and engineering feasibility. This analysis found that horizontal and vertical geometric constraints of the NE 2nd Avenue alignment presented significant challenges to engineering feasibility, while a Biscayne Boulevard alignment would result in the most significant environmental impacts. Additional detail is provided in the *Miami Corridor Analysis Report for the Beach Corridor Rapid Transit Project Development and Environment (PD&E) Study*.

Other key considerations in the Design District/Midtown Miami sub-area include coordination with the I-395/SR 836/I-95 Design-Build Project, featuring a reconstruction of the Midtown Interchange to the MacArthur Causeway with a signature bridge and community features beneath I-395, and the FEC Railway. For the BRT and LRT alignments, a feasible alignment envelope through the Midtown Interchange was identified through coordination with the design-build project team. Additionally, the LRT alignment incorporates grade separation over the FEC Railway to ensure safe operations and avoid impacts to freight and intercity passenger rail traffic.

In the Miami Beach sub-area, prior transit project development studies by the Miami-Dade Transportation Planning Organization recommended a light rail/modern streetcar system on Washington Avenue, featuring exclusive transit lanes accommodated by removal of the existing planted median. The LRT/Streetcar Alternative for this sub-area is based on the prior City and TPO studies.

d. Station Locations:

Stations are distributed at locations that are spaced at roughly even intervals between the termini of each sub-area, at a stop spacing appropriate to the transit mode. Ideally, stations are proposed at locations convenient to significant origins/destinations of trips within the corridor, based on adjacent land uses and/or transfer opportunities from existing transit services. Where significant trip generators may not be present, the opportunity for the station to support or serve as a catalyst for future development was considered.

The stop spacing and trip generation characteristics of potential station locations were balanced against site constraints on the ability to meet the geometric requirements of the station while minimizing impacts to traffic and bicycle/pedestrian facilities and maximizing the efficiency of the transit operation.

ES-1.9. EVALUATION CATEGORIES & CRITERIA

To comparatively evaluate the ability of each alternative to meet the project purpose and need, the following three evaluation categories were identified:

- Transit and Multimodal Performance
- Environmental Effects
- Cost and Feasibility

Within these categories, there are many potential measures of performance. As such, the evaluation focuses on those measures that were expected to best differentiate among the alternatives, based on preliminary results from the Tier One phase of evaluation and on draft findings of the environmental investigations and analysis undertaken to support Tier Two evaluation.

To further support the differentiation of alternatives, the evaluation criteria were categorized as either Primary or Secondary Measures, as shown in **Figure ES-25**. Secondary measures provide additional information within categories that are most differentiated by the primary measures.

Criteria were rated on scale ranging from lower performing to higher performing as illustrated in **Figure ES-24**, where higher performance is always represented by the preferred project outcomes (for example, higher ridership, or lower cost). A list of the measures of performance considered in each category is provided below.

EVALUATION MEASURE RATINGS				
Lower Performing	←—————→			Higher Performing
1	2	3	4	5

Figure ES- 24 Rating Scale for Evaluation Measures

ES-1.9.1. Transit & Multimodal Performance

a. Primary Measures

- Ridership (Average Weekday Riders) The ridership that each of the alternatives would attract was estimated to allow comparison of performance, as measured in average daily riders.
- Travel Time (Minutes)- Travel time (which includes transfer times) measured in minutes from end to end of each sub-area, was estimated based on the alignments, station locations,

and the technical capabilities of the transit modes (considering factors such as acceleration rates and operating speed in straight and curved sections of an alignment, as well as traffic conditions for at-grade sub-areas that interface with other traffic.

Interoperability/Modal Integration- The compatibility of the proposed mode with other existing and proposed transit modes, including the availability of one-seat rides between significant origins and destinations, the number of transfers required for trips between significant origins and destinations, and the horizontal and vertical separation between modes at significant transfer points.

b. Secondary Measure

- Passenger Capacity (Peak Hour Per Direction)

This is only a secondary measure because passenger capacity can vary based on manufacturer and project specifications. This measure is the capacity of each mode to serve passenger demand in the corridor measured in peak-hour, peak direction.

ES-1.9.2. Environmental Effects

a. Primary Measures

- Natural Resources- Potential impacts to natural resources
 - Wetland and other surface waters
 - Protected species and habitat
 - Coastal resources
 - Floodplains
- Cultural Resources- Potential impacts to historic resources
 - Historic/archaeological resources
- Aesthetics & Visual- Potential impacts to existing aesthetics and viewshed
- Noise & Vibration- The technical characteristics of the modes were used to model noise and vibration impact areas and determine the extent of impact to sensitive receptors within a modeled impact distance; the impacts are identified by type of use and severity of impact (using Federal criteria for assessing severity).
- Traffic Impacts- Impacts to level of service and delay for general purpose traffic and transit operating in existing traffic lanes and at existing intersections.

b. Secondary Measure

- Construction Impacts- Qualitative assessment of the magnitude and duration of traffic, noise and habitat impacts associated with the construction activities, as informed by the conceptual engineering of the alternatives.

ES-1.9.3. Cost & Feasibility

The cost and feasibility of the alternatives were evaluated using the following measures:

a. *Primary Measures*

- Capital Cost -The total capital cost in 2019 dollars
- Operations & Maintenance Cost- The annual cost in 2019 dollars to operate and maintain the alternative

b. *Secondary Measures*

- Lifecycle Cost (30-Year Present Value of Capital, O&M, and Major Maintenance Costs)
Lifecycle Cost Analysis considers the initial cost to design and build the project alternatives; the annual cost to operate and maintain the new transit system over a thirty-year period; and periodic major maintenance and capital replacement costs for both fleet (transit vehicles) and infrastructure during that thirty-year period. All of these cost are then discounted to a present value representing the total cost of ownership of the system.
- Resiliency (to Impacts of Sea Level Rise)- Considering the anticipated impacts of climate change on South Florida, the resilience of the proposed alternatives to flooding and sea-level rise were evaluated, based primarily on the vertical alignment of the infrastructure and the Southeast Florida Regional Climate Change Compact (SFRCCC) Unified Sea Level Rise projections (through the year 2100) and the United States Army Corps of Engineers (ACE) Sea-Level Change Curve Calculator (for years beyond 2100).
- Time to Construct- as measured in the estimated months assuming a convention (design-bid-build) project delivery method,

ES-1.10. EVALUATION METHODOLOGY

To support evaluation of the alternatives, conceptual architecture and engineering was developed for each mode and sub-area. Ridership forecasting was developed for each project alternative as defined by technology. This was used to refine alignments, station locations and STOPS model input parameters in a second round of ridership forecasting for individual segments by mode as well as combinations of segments by modes.

Conceptual engineering of the fixed facility components (guideway) and historical costs were used to define a preliminary cost estimates at the segment level for each of the transit modes, with the

total cost of corridor alternatives comprised of the component elements proposed for each sub-area of the corridor alternatives.

Following FTA requirements and general industry practice, a simplified cost allocation model was also developed to estimate operations and maintenance (O&M) costs for the Beach Corridor alternatives, considering characteristics, such as travel at the segment level and then incorporated into corridor alternative measures.

For estimating additional ridership options, express service links to the Beach and Design District were modeled for the APM/Monorail Alternatives. These express services would skip stations between the Government Center and new Herald Plaza stop. These express services would be possible once the ongoing upgrade to the Metromover systems and communications was completed. Refinement of these potential services would be completed after selection of a locally preferred alternative (LPA).

Further detail on the ridership forecasting and cost estimating methodologies is provided in the Travel Demand, Capital Cost and Operations & Maintenance Cost Technical Memoranda.

ES-1.11. EVALUATION RESULTS & RECOMMENDED ALTERNATIVE

As described in ES-1.8, *corridor alternatives* that serve all three of the sub-areas along the project corridor were developed in order to evaluate total project impacts. The complete project sets are:

APM Corridor Alternative

- Extension of Omni Loop Metromover to Midtown/Design District and Bay Crossing (Trunk Line); bus/trolley connections via Washington Avenue to Miami Beach Convention Center.

LRT/Streetcar Corridor Alternative

- Continuous LRT system from Midtown/Design District to Bay Crossing Trunk Line to Miami Beach Convention Center.

Monorail Corridor Alternative

- Monorail Bay Crossing Trunk Line with APM extension to Midtown/Design District and bus/trolley connections via Washington Avenue to Miami Beach Convention Center

BRT Corridor Alternatives

- Continuous BRT system from Downtown to Miami Beach Convention Center, via I-395/Washington Avenue or I-195/Collins Avenue.

These alternatives were evaluated, and the results are presented in **Figure ES-25**, “Detailed Evaluation Results-Corridor Alternatives.” A narrative summary of the results for each corridor alternative and the key differentiators between the alternatives follows below. Additionally, because it has been determined that the Bay Crossing Trunk Line would have independent utility, a summary comparison of the ridership, capital cost and O&M cost of the Trunk Line-only alternatives is presented in **Figure ES-26**, “Key Evaluation Factors-Trunk Line Alternatives.”

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Detailed Evaluation Results-Corridor Alternatives							
Project Elements:							
APM		Extension of Omni Loop Metromover to Midtown and Bay Crossing (Trunk Line); Premium Bus connections via Washington Avenue to Miami Beach Convention Center					
LRT		Continuous LRT system from Design District to Midtown to Bay Crossing Trunk Line to Miami Beach Convention Center					
Monorail		Monorail Bay Crossing Trunk Line with APM extension to Midtown/Design District and Premium Bus connections via Washington Avenue to Miami Beach Convention Center					
BRT		Continuous BRT system from Downtown to Miami Beach Convention Center, via I-395/Washington Avenue or I-195/Collins Avenue					
Evaluation Categories and Measures		APM	LRT/Streetcar	Monorail	BRT I-395	or	BRT I-195
							
		5.6 miles/10 stations	7.5 miles/17 stations	3.3 miles/4 stations	6.6 Miles/11 Stations		10.8 miles/12 stations
TRANSIT AND MULTIMODAL PERFORMANCE							
Primary Measures	Ridership 2040	Average Weekday Ridership	27,900 - 41,900	24,800 - 37,200	27,900 - 41,900	11,500-21,400	11,500-21,400
	Travel Time	Minutes-End to End	22	24	22	21	23
	Interoperability/ Modal Integration	One-Seat Rides	To/from Downtown	From Midtown to Beach	Most Trip Pairs Require Transfer	From Downtown to Beach	From Downtown to Beach
Secondary Measure	Passenger Capacity	Peak Hour Per Direction (5 Minute Peak Headways) <i>**Capacity varies based on manufacturer and specifications</i>	2,400	2,880	2,140	1,200	1,200
			2 car train	single articulated train	2 car train	Articulated bus	Articulated bus
ENVIRONMENTAL EFFECTS							
Primary Measures	Natural Resources	Water Resources, Habitat and Animals	Direct impacts to seagrass, coral and mangrove; small increase in impervious surface	Direct impacts to seagrass, coral and mangrove; additional indirect (shading) impacts; greater increase in impervious surface	Direct impacts to seagrass, coral and mangroves	Significant impacts to coral. Permitting and mitigation would be challenging-significant risk to cost & duration of project.	Bridge widening on I-195 would result in seagrass impacts that would require permitting and mitigation.
	Cultural Resources	# of Listed/Eligible Historic/Archaeological Resources	34	144	33	2	0
	Aesthetics and Visual	Views and Streetscape	Elevated guideway / stations impact views and streetscape	Elevated guideway / stations impact views in Bay Crossing segment; less impact in at-grade segments	Elevated guideway / stations impact views and streetscape	Buses/stops will have limited impact on view shed	Buses/stops will have limited impact on view shed
	Noise and Vibration	Number and Severity of Impacts by Type of Property/Use	2 Moderate Residential Impacts	5 Moderate/24 Severe Residential Impacts, 3 Moderate/3 Severe Institutional Impacts	No Impacts	9 Moderate/1 Severe Residential Impacts	No Impacts
	Traffic Impacts	Impact to Existing Traffic Lanes	No impacts to at-grade traffic due to elevated guideway	At-grade segments impact traffic by dedicating lanes to transit	No impacts to at-grade traffic due to elevated guideway	Arterial segments impact traffic by dedicating lanes to traffic	Arterial segments impact traffic by dedicating lanes to traffic
Secondary Measure	Construction Impacts	Traffic, Noise and Habitat Impacts	Some intermittent lane closures, navigational impacts, noise and habitat impacts.	Long-Duration Lane Closures for Utility Relocation, Roadway Excavation, Track Installation and Paving	Some intermittent lane closures, navigational impacts, noise and habitat impacts.	Short-duration lane closures for pavement striping, signage and stop platform installation	Short-duration lane closures for pavement striping, signage and stop platform installation
COST AND FEASIBILITY							
Primary Measures	Capital Cost	Total 2019 \$	\$1,022,250,000	\$1,136,900,000	\$1,079,300,000	\$366,800,000	\$244,200,000
			APM	LRT	Monorail	N/A	N/A
			Bus	LRT	Bus	N/A	N/A
			APM	LRT	APM	N/A	N/A
	Operations and Maintenance Cost	Annual Total (2019 \$)	\$19,100,000	\$17,600,000	\$16,500,000	\$5,500,000	\$6,100,000
Secondary Measures	Lifecycle Cost	30 Year Discounted Capital, O&M & Major Maintenance	\$1,444,000,000	\$1,506,000,000	\$1,440,000,000	\$499,000,000	\$392,000,000
	Resiliency	Mitigation of Sea Level Rise Impacts	Elevated guideway and stations provide mitigation of predicted sea level rise.	Limited opportunity to mitigate sea level rise outside of Bay Crossing	Elevated guideway and stations provide mitigation of predicted sea level rise.	No mitigation of sea level rise risks	No mitigation of sea level rise risks
	Time to Construct	Design-Bid-Build Delivery (Months)	48	54	48	33 - 36	33 - 36

Figure ES- 25 Detailed Evaluation Results-Corridor Alternatives

Alternative	Capital Cost (millions)	Operations and Maintenance Cost (annual/millions)	Average Daily Ridership (2040 baseline/ thousands)
APM (One-Seat Ride)	\$632	\$9.90	13.0 to 19.4
APM (Transfer)			10.2 to 15.4
Monorail	\$681	\$7.20	10.2 to 15.4
LRT*	\$732	\$9.10	8.0 to 12.0

*For comparison of the Trunk Line, capital cost of each alternative includes a MOF estimate for construction/row. However, for LRT there is no adequate MOF site within the Trunk Line sub-area only.

Figure ES- 26 Key Evaluation Factors-Trunk Line Alternatives

ES-1.11.1. APM Corridor Alternative Evaluation Summary

The APM Corridor Alternative is comprised of an extension of the Omni Loop Metromover to Midtown and Bay Crossing (Trunk Line); and Bus/Trolley connections via Washington Avenue to Miami Beach Convention Center. Key results of the evaluation of this alternative follow below by evaluation category.

a. Transit & Multimodal Performance:

- Highest ridership for trunk line & total project
- Possible “one-seat ride” opportunities from Midtown/Design District to Miami Beach
- Reduced connectivity to Omni Transit Center hub as compared with Monorail
- Sufficient Capacity for Future Growth

b. Environmental Effects:

- Similar for APM and Monorail
- More cultural resources and visual impacts in Miami/Midtown extension as compared with LRT

c. Cost & Feasibility:

- Lower Bay Crossing cost per rider
- Extension of existing system
- Higher O&M than Monorail

ES-1.11.2. LRT/Streetcar Corridor Alternative Evaluation Summary

The LRT/Streetcar Corridor Alternative is comprised of a continuous LRT system from the Design District to Midtown to the Bay Crossing Trunk Line to the Miami Beach Convention Center. Key results of the evaluation of this alternative follow below by evaluation category.

a. *Transit & Multimodal Performance:*

- Medium-high ridership for trunk line & total project
- Longer travel time than other alternatives for Miami extension
- “One-Seat Ride” opportunities for Midtown/Design District to Miami Beach
- Sufficient capacity for future growth

b. *Environmental Effects:*

- Most impact to traffic in Miami/Midtown and Miami Beach
- Most construction impacts
- More impact to cultural and natural resources than APM or Monorail

c. *Cost & Feasibility:*

- Highest Bay Crossing trunk line cost
- Longest construction duration

ES-1.11.3. Monorail Corridor Alternative Evaluation Summary

The Monorail Corridor Alternative is comprised of a Monorail Bay Crossing trunk line with an APM extension to Midtown/Design District and Bus/Trolley connections via Washington Avenue to Miami Beach Convention Center. Key results of the evaluation of this alternative follow below by evaluation category.

a. *Transit & Multimodal Performance:*

- High ridership for trunk line & total project
- Good connectivity to Omni Transit Center for bus transfers
- Sufficient capacity for future growth

b. *Environmental Effects:*

- Similar for Monorail and APM

c. *Cost & Feasibility:*

- Capital & operating cost of Bay Crossing trunk line similar to APM

ES-1.11.4. BRT Corridor Alternatives Evaluation Summary

The BRT Corridor Alternatives are comprised of a continuous BRT system from Downtown to Miami Beach Convention Center, via I-395/Washington Avenue or I-195/Collins Avenue. Key results of the evaluation of these alternatives follow below by evaluation category.

a. *Transit & Multimodal Performance:*

- Lowest capacity/lowest ridership
- May not meet purpose & need for project

b. Environmental Effects:

- Widening I-395 for BRT: Highest impact to natural resources; Significant permitting challenges

c. Cost & Feasibility:

- Lowest capital & operating cost
- No mitigation of vulnerability to sea level rise

ES-1.11.5. Evaluation Summary-Key Differentiators Between Modal Alternatives

The key differentiators between the modal alternatives are as follows:

a. Transit & Multimodal Performance:

- Rail options have similar ridership, capacity, speed and cost for Bay Crossing
- BRT options have lower ridership and capacity than the rail options
- LRT/Streetcar has the highest vehicle capacity and highest cost

b. Environmental Effects:

- Monorail and APM modes are similar for the Bay Crossing
- BRT on widened MacArthur Causeway has greatest impact to natural resources
- LRT/Streetcar has more traffic, noise and construction impacts in Miami/Midtown
- APM and Monorail have more visual and cultural impacts in Miami/Midtown

c. Cost & Feasibility:

- APM & Monorail costs approximately equal
- LRT cost higher but similar range
- BRT is significantly lower cost

ES-1.11.6. Evaluation Summary-Key Findings

Overall, the key findings of the evaluation of the alternatives are as follows:

- Rail modes are higher performing & have higher cost than BRT
- BRT capacity & ridership may not meet the purpose & need
- LRT impacts are higher than APM/Monorail
- APM/Monorail has similar Bay Crossing trunk line performance

ES-1.12. RECOMMENDED ALTERNATIVE & REASONS FOR SELECTION

The natural and built environment differ significantly by sub-area. These differences influenced the development of alternatives and the performance of the alternatives with respect to the evaluation criteria. Therefore, DTPW has identified recommended alternatives for each of the sub-areas as described below and summarized in **Figure ES-27**.

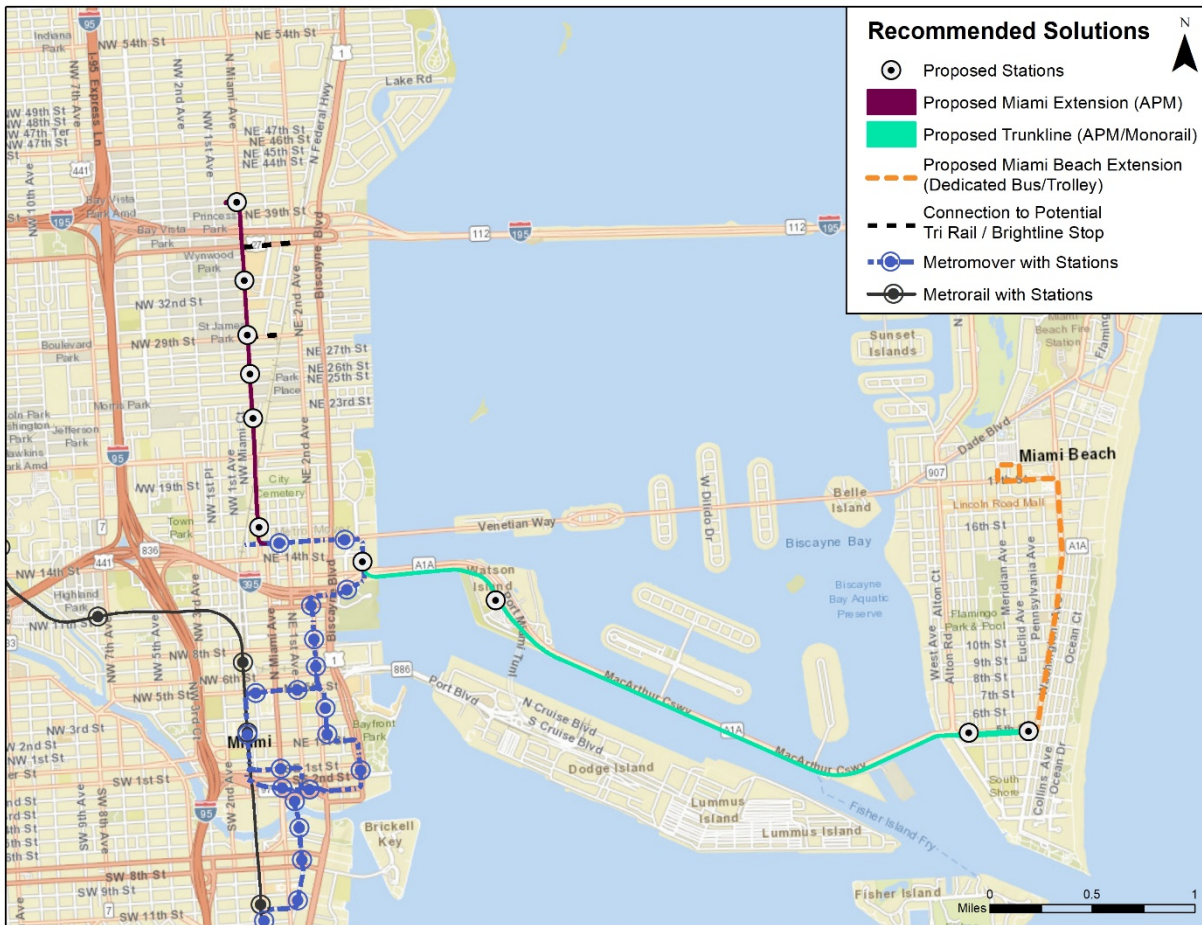


Figure ES- 27 Recommended Alternative

ES-1.12.1. Bay Crossing Sub-Area (Trunk Line): Elevated Automated Rail Transit (APM or Monorail)

The fixed-guideway modes offer similar transit performance for the Bay Crossing trunk line, with lower costs and impacts for the automated, rubber-tire modes (APM and Monorail) than for the LRT/Streetcar mode. The BRT alternatives, while lower cost, lack sufficient capacity to meet the project purpose and need, and present significant environmental impacts associated with the widening of the causeways. Therefore,

an elevated, automated rubber tire vehicle rail transit system (APM or Monorail) is the recommended alternative for the trunk line service in the Bay Crossing sub area.

If federal funds are pursued, funding analysis for the APM and Monorail technologies will be completed in the Engineering phase of the project.

ES-1.12.2. Midtown/Design District: Automated People Mover

In the Midtown/Design District sub-area, the APM is the Recommended Alternative because it provides better travel time and ridership than the LRT/Streetcar Alternative, with less impact to general traffic, more resilient infrastructure, and less construction impact.

ES-1.12.3. Miami Beach: Bus/Trolley in Dedicated Lanes

The Recommended Alternative in the Miami Beach sub-area is a connection to the existing (No Action Alternative) bus/trolley service in dedicated bus lanes in each direction. Some adjustments to routing and service plans of existing bus/trolley service may be implemented to enhance connections to the high-capacity rail system. The LRT/Streetcar Alternative is not recommended as a stand-alone project for the Miami Beach sub-area given its lack of resiliency to sea-level rise, high cost, and difficulty of siting an operations and maintenance facility in this sub-area.

ES-1.13. SERVICE PLAN AND OPERATIONS

Service plans, operating characteristics, and annual operations and maintenance costs estimates were developed for the two technologies advanced as technology options for the Preferred Alternative. The operation of the APM technology was developed as two operational alternatives, one that considers a shuttle service for the Bay Crossing sub-area and another that considers two extensions of the existing Metromover to serve both the Bay Crossing and Design District/Midtown sub-areas. The operation of the Monorail technology was developed only for the Bay Crossing sub-area.

It was determined that the weekday and weekend service plans for the Preferred Alternative are identical regardless of technology and sub-area.

The operating characteristics of the APM and Monorail technologies are very similar. A 15-second dwell time at stations was assumed for each APM and Monorail alternative, given that they will be able to take advantage of multi-door boarding, level boarding, and off-vehicle payment system.

Key operating characteristics of the APM and Monorail are summarized below in **Table ES-1**.

As mentioned previously, any express service options analyzed for ridership purposes will be further refined after the selection of the LPA. More detailed analysis will be required prior to recommending the express service feasibility.

Table ES- 1 Preferred Alternative-Operating Characteristics

	APM - Trunk line	APM Miami Extension	APM - Beach Express	Monorail
Length (mile)	3.8	4.0 (1.7 new)	5	3.8
Calculated Average Speed (mph)	35	13	23	35
One-way Travel Time (min)	6	19	14	6
Dwell Time (sec)	15	15	15	15
Layover / Recovery Time	10%	10%	10%	10%
Vehicle per Train	2	2	2	2

ES-1.14. SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PREFERRED ALTERNATIVE

ES-1.13.1 Land Use Changes

Based on the Future Land Use Plans for Miami, Miami Beach and Miami-Dade County, the land uses along the corridor and in the surrounding areas are anticipated to remain relatively unchanged. The project is not anticipated to affect land use patterns in the project corridor or the expected levels of development activity therein. Overall, land use changes as a result of the project are anticipated to be minimal.

ES-1.13.2 Social Impacts

The project will be conducted in accordance with Title VI of the Civil Rights Act and Executive Order 12898 regarding environmental justice to ensure that there are no disproportionate effects on low-income or minority populations. Overall, the project is not anticipated to negatively affect community cohesion and the social environment because the new rapid transit will occur on existing rights-of-way. The project will improve the ability of the resident and tourist populations to access important social, cultural and institutional facilities and community features. The project is intended to improve the people-carrying capacity with rapid transit along the project corridor and promote and support a multi-modal, multi-user transportation network that is pedestrian and bicycle friendly. The project will augment the ability of populations in the Beach Corridor, and from the greater metropolitan region, to access important social services and community facilities.

ES-1.13.3 Economic

The economic activities will continue to be supported in the area and the land use character will remain relatively unchanged. The project will provide an alternative mode of transportation to access commercial and employment hubs in Miami and Miami Beach, thereby boosting the economy.

ES-1.13.4 Mobility

The proposed project will enhance mobility by 1) increasing the person-throughput to the Beach Corridor's major origins and destinations via rapid transit technology; 2) connecting to and providing interconnections with Metrorail, Tri-Rail, Brightline, Metromover, Metrobus routes, Miami and Miami Beach circulators, jitneys, shuttles, taxis and Transportation Network Companies; and 3) promoting pedestrian- and bicycle-friendly solutions in the Beach Corridor.

ES-1.13.5 Aesthetic Effects

Median landscaping will remain undisturbed. It is anticipated that a rapid transit system on the Bay Crossing will affect the viewshed for both residents and tourists at PortMiami. The affect can be addressed through aesthetic bridge design and may not be considered adverse.

Downtown Miami already contains an elevated mode of transit, the Metromover. The area is characterized by skyscrapers and other commercial, institutional and light industrial land uses. An elevated mode of transit would not be incompatible with the existing downtown urban character of Miami.

Along the Miami Beach alignments, most of the buildings adjacent to the corridor are two or three stories high and the land uses are mainly residential and mixed use commercial and entertainment. In addition, the Beach Corridor traverses several historic districts on Miami Beach and there are numerous potentially historic structures. Furthermore, the streets are landscaped. Only at-grade modes of transit are proposed on Miami Beach to retain its aesthetic character.

The land use character in each segment is anticipated to remain relatively unchanged. The project appears to be consistent with the future land use vision of the area.

ES-1.13.6 Relocation Potential

Since the Beach Corridor rapid transitway is proposed on existing state and county rights-of-way, including highways and arterial roadways, no right-of-way acquisition or relocations are anticipated for the corridor alignment. Potential locations of other transit-related facilities, such as maintenance facilities, may require acquisition of commercial property.

ES-1.13.7 Historic and Archaeological Sites

No adverse impacts to historic and archaeological sites are anticipated as a result of the proposed project at this time. Following completion and submittal of the cultural resource assessment survey, a Section 106 Case Study will be prepared to evaluate project-related effects to NRHP-eligible cultural resources.

ES-1.13.8 Recreation Areas

No impacts to any of the local parks and recreational facilities are expected to occur as a result of the project. Additionally, none of the aquatic or land-based trails within the study area are expected to be impacted by the project.

ES-1.13.9 Section 4(f) Potential

No permanent use of any Section 4(f) resources is anticipated; however, an exception for temporary occupancy (use) of a Section 4(f) property during construction may be required.

ES-1.13.10 Coastal Wetlands and Surface Waters

Seagrass

Direct impacts to paddle grass from the transitway are estimated to result in 0.254 acres of impacts. However, if all of the seagrass is impacted due to construction methods, the total area of seagrass impacts will be 1.98 acres with a functional loss of 1.53 acres based on the Uniform Mitigation Assessment Method (UMAM) scores. Conceptual mitigation for seagrass impacts include filling of propeller scars from boating activities in Biscayne Bay.

Coral

It is anticipated that 0.55 acres of coral will be directly impacted by the project. The functional loss from the impact area is estimated at 0.42 acres based on the UMAM scores. Conceptual mitigation for coral impacts includes relocating coral out of the area of impact prior to construction and replacing coral habitat by installing riprap at the pier locations and along the causeway.

Mangroves

A total of 96 red mangrove (*Rhizophora mangle*), five black mangrove (*Avicennia germinans*) and 20 white mangrove (*Laguncularia racemosa*) were observed in the riprap south of MacArthur Causeway. The mangroves are above the water line except during high tide and, therefore, not considered wetland or Essential Fish Habitat (EFH). Mitigation for impacts to individual mangroves, however, is required by the County even if they are not wetlands. Conceptual mitigation includes planting mangroves at a recipient site in Biscayne Bay. There are also other species of trees along the causeway and in uplands that will require replacement canopy mitigation per County and City codes.

ES-1.13.11 Water Quality and Stormwater

The project will include drainage analyses and design of stormwater management systems that meet State of Florida water quality and stormwater discharge criteria for impaired waters and OFWs. Additionally, a Stormwater Pollution Prevention Program will be implemented to dictate the use of best management practices during construction to minimize impacts to Biscayne Bay.

ES-1.13.12 Floodplains

The Recommended Alternative is not expected to impact floodplains. Surface water that collects on the guideway will be conveyed and/or detained through an engineered drainage system.

ES-1.13.13 Protected Species and Habitat

Several protected species were identified with the potential to be present in the project area through desktop background research and comments issued by the applicable regulatory agencies. Effect determinations were based on observations of potential species habitats and the quality of those habitats relative to species requirements. It was determined that the project would have no effect or no adverse effect on coastal and wading birds and certain species of coral. The project may affect but is not likely to adversely affect the West Indian manatee, Florida bonneted bat, American crocodile, Eastern indigo snake, sea turtles, smalltooth sawfish, certain species of coral. The only species that the project may adversely affect is Johnson's seagrass. Consultation with National Marine Fisheries Service (NMFS) for this species will be required.

ES-1.13.14 Essential Fish Habitat

An Essential Fish Habitat (EFH) assessment was performed for the area of the bay crossing south. The identification of EFH in the project area was based on benthic surveys conducted during the seagrass growing season in 2018 and 2019. A list of managed species was developed in coordination with the NMFS. EFH in the project area include Submerged Aquatic Vegetation (Seagrasses), Live/Hardbottom (Sponges, Hard Coral and Soft Coral), Unconsolidated Bottom (Sand/Shell Bottom and Mud Bottom) and Estuarine Water Column. Habitat Areas of Particular Concern (HAPC) are subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially ecologically important or located in an environmentally sensitive area. The seagrass in the project area are HAPC for members of the snapper-grouper complex and hardbottom habitat are HAPC for members of the snapper-grouper complex and spiny lobster. Biscayne Bay is a geographically designated HAPC for spiny lobster and coral. The project has the potential to impact EFH, HAPC and managed species in the project area. Impacts to SAV, sand/shell bottoms and mud bottoms are anticipated to be minimal. Impacts to hardbottom communities are anticipated to be more than minimal but less than substantial. Mitigation will be conducted for impacts to the protected species that cannot be avoided will be conducted.

ES-1.13.15 Noise and Vibration

The Project is not expected to cause severe or moderate noise impacts for schools, public parks, or residential area. A noise study analysis was completed for the various alternatives.

ES-1.13.16 Air Quality

Since this project will result in decreased traffic congestion, air quality impacts are not expected to occur.

ES-1.13.16 Contamination

A Contamination Screening Evaluation Report (CSER) is being prepared to determine the risk potential for involvement with contaminated sites. Measures to avoid or minimize involvement with contaminated sites will be developed based on the findings of the CSER.