Fixed Guideway Transit: An Estimate of Probable Costs

Fixed Guideway transit includes services such as Bus Rapid Transit, Light Rail, and Modern Streetcar. The range of costs for the Fixed Guideway systems identified in the Comprehensive Mobility Proposal is referred to as “estimated probable cost” per industry standards. Each guideway system will have unique characteristics, opportunities, and constraints. For example, some guideway systems may be built through existing commercial or residential corridors, requiring extensive and complex right-of-way acquisitions. In other instances, transit may be accommodated on the managed or dedicated lanes on the Interstate system. Until further Systems Planning is conducted to determine feasible alignments, actual limits, and modes, the broad range of costs serves the purpose for high level planning.

Furthermore, operational and maintenance costs will depend on the selected mode, length of system, headways, ridership, and other requirements and features. These costs may change as systems mature, or if the modes change over time.

The tables below list the estimated ranges for the Fixed Guideway corridors and the associated assumptions. The estimated probable cost of Modern Streetcar was not calculated separately as it is typically within the range of costs for Bus Rapid Transit and Light Rail. These initial estimates are based on information in the following reports (attached):

- Transit Technology Costs, AECOM
- OPEX Comparisons, Information tabulated by AECOM, and
- Final review of estimates of probable costs, a letter from AECOM

In addition, the Hillsborough County Transit Options Assessment report (attached) was used as a guide for determining potential viable routes and modes. This report analyzed various Fixed Guideway transit alternatives through review of existing data at a planning level and the cost effectiveness of the different options. It also provided the necessary steps to positioning our community for federal and state grants in the future.

**Table 1 – Summary of Estimated Probable Cost of Fixed Guideway Transit Routes**

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Limits</th>
<th>Length (miles)</th>
<th>Total Capital (millions)</th>
<th>Total O&amp;M/year (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Downtown to Westshore</td>
<td>Marion Transit to Westshore Blvd.</td>
<td>4.7</td>
<td>$250</td>
<td>$800</td>
</tr>
<tr>
<td>Downtown to USF</td>
<td>Marion Transit to USF Campus</td>
<td>9.8</td>
<td>$515</td>
<td>$1,500</td>
</tr>
<tr>
<td>Downtown to Brandon</td>
<td>Marion Transit to Dover Road</td>
<td>15.9</td>
<td>$835</td>
<td>$1,500</td>
</tr>
<tr>
<td>Dale Mabry</td>
<td>I-4 to Van Dyke Road</td>
<td>12.0</td>
<td>$630</td>
<td>$1,100</td>
</tr>
</tbody>
</table>

Note: These numbers have been rounded and are consistent with those in the presentation.
Table 2 - Estimated Probable Cost Calculation for Fixed Guideway Transit Routes

**CAPITAL COSTS**

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Limits</th>
<th>Length (miles)</th>
<th>Capital Cost per mile (millions)*</th>
<th>Construction Cost (millions)</th>
<th>Right-of-Way (millions)</th>
<th>Total Capital (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BRT</td>
<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Downtown to Westshore</td>
<td>Marion Transit to Westshore Blvd.</td>
<td>4.7</td>
<td>$53</td>
<td>$88</td>
<td>$295</td>
<td>$409</td>
</tr>
<tr>
<td>Downtown to USF</td>
<td>Marion Transit to USF Campus</td>
<td>9.8</td>
<td>$53</td>
<td>$88</td>
<td>$517</td>
<td>$862</td>
</tr>
<tr>
<td>Downtown to Brandon</td>
<td>Marion Transit to Dover Road</td>
<td>15.9</td>
<td>$53</td>
<td>-</td>
<td>$834</td>
<td>-</td>
</tr>
<tr>
<td>Dale Mabry</td>
<td>I-4 to Van Dyke Road</td>
<td>12.0</td>
<td>$53</td>
<td>-</td>
<td>$631</td>
<td>-</td>
</tr>
</tbody>
</table>

*Based on figures from AECom (see attached)

**OPERATING AND MAINTENANCE (O&M) COSTS**

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Limits</th>
<th>Length (miles)</th>
<th>Maintenance Cost per mile/year (millions)**</th>
<th>Total Maintenance Cost per year (millions)</th>
<th>Operating Cost per mile/year (millions)</th>
<th>Total Operating Cost per year (millions)</th>
<th>Total O&amp;M/year (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BRT</td>
<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
<td>BRT*</td>
<td>LRT**</td>
<td>BRT</td>
</tr>
<tr>
<td>Downtown to Westshore</td>
<td>Marion Transit to Westshore Blvd.</td>
<td>4.7</td>
<td>$0.08</td>
<td>$0.38</td>
<td>$0.35</td>
<td>$1.75</td>
<td>$1.12</td>
</tr>
<tr>
<td>Downtown to USF</td>
<td>Marion Transit to USF Campus</td>
<td>9.8</td>
<td>$0.08</td>
<td>$0.38</td>
<td>$0.74</td>
<td>$3.68</td>
<td>$1.12</td>
</tr>
<tr>
<td>Downtown to Brandon</td>
<td>Marion Transit to Dover Road</td>
<td>15.9</td>
<td>$0.08</td>
<td>-</td>
<td>$1.19</td>
<td>-</td>
<td>$1.12</td>
</tr>
<tr>
<td>Dale Mabry</td>
<td>I-4 to Van Dyke Road</td>
<td>12.0</td>
<td>$0.08</td>
<td>-</td>
<td>$0.90</td>
<td>-</td>
<td>$1.12</td>
</tr>
</tbody>
</table>

*Operating cost based on average of Cleveland and LA total yearly cost divided by total length (see attached)

**Operating cost based on average of eight cities - total yearly cost divided by total length (see attached)**

***Based on averages from FTA National Transit Database (see email)
Attachment - 1

Transit Technology Costs
(Used to Determine Capital Costs)
Transit Technology Costs

Hillsborough County

July 18, 2014
Public Transport Alternatives

![Graph showing the relationship between average operating speed (MPH) and maximum line capacity (thousands of persons per hour) for different types of public transport options, including Exclusive Right-of-Way, Semi-Exclusive Right-of-Way, Street Transit, Express Bus, Local Bus, Bus Rapid Transit, Monorail, Light Rail Transit, and Heavy Rail. The graph also indicates the cost to construct, with Low and High levels.]
Bus Rapid Transit (BRT)

**Advantages**
- Lower capital costs
- Exclusive busway
- Traffic priority
- Flexible route design
- Substantial stations
- Attracts development

**Disadvantages**
- Local Emissions
- Perception: *It’s just a bus*
### Bus Rapid Transit (BRT) Cost Comparisons

<table>
<thead>
<tr>
<th>System</th>
<th>Year</th>
<th>Length (miles)</th>
<th>Total Cost (US$ millions)</th>
<th>Cost per mile (US$ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>2004</td>
<td>3.7</td>
<td>$625.0</td>
<td>$168.9</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>2000</td>
<td>4.2</td>
<td>$272.0</td>
<td>$64.8</td>
</tr>
<tr>
<td>Cleveland</td>
<td>2008</td>
<td>6.7</td>
<td>$199.8</td>
<td>$29.8</td>
</tr>
<tr>
<td>Eugene, OR</td>
<td>2007</td>
<td>4.0</td>
<td>$25.0</td>
<td>$6.25</td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>2014</td>
<td>9.6</td>
<td>$40.0</td>
<td>$4.2</td>
</tr>
</tbody>
</table>

Average cost per mile for BRT is $52.6 million in 2014$
## Light Rail Transit

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Higher capacity than BRT</td>
<td>• Higher capital cost than BRT</td>
</tr>
<tr>
<td>• Level platform loading</td>
<td>• No flexibility once built</td>
</tr>
<tr>
<td>• Attracts development</td>
<td>• Traffic impacts</td>
</tr>
</tbody>
</table>

![Light Rail Transit Images]
## Light Rail Transit (LRT) Cost Comparisons

<table>
<thead>
<tr>
<th>System</th>
<th>Year</th>
<th>Length (miles)</th>
<th>Total Cost (US$ millions)</th>
<th>Cost per mile (US$ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pittsburgh</td>
<td>2012</td>
<td>1.2</td>
<td>$523.4</td>
<td>$436.2 *</td>
</tr>
<tr>
<td>San Diego</td>
<td>2005</td>
<td>5.5</td>
<td>$504.0</td>
<td>$91.6</td>
</tr>
<tr>
<td>Phoenix</td>
<td>2008</td>
<td>20.0</td>
<td>$1,400.0</td>
<td>$70.00</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>2004</td>
<td>11.6</td>
<td>$672.5</td>
<td>$57.9</td>
</tr>
<tr>
<td>Salt Lake City</td>
<td>2013</td>
<td>6.0</td>
<td>$290.0</td>
<td>$48.3</td>
</tr>
</tbody>
</table>

Average cost per mile for LRT is $87.8 million in 2014$
Tram/Modern Streetcar

Advantages

• Medium capacity
• Downtown circulator
• Attracts development

Disadvantages

• Higher capital cost than BRT
• No flexibility once built
• Traffic impacts
# Streetcar/Tram Cost Comparisons

<table>
<thead>
<tr>
<th>System</th>
<th>Year</th>
<th>Length (miles)</th>
<th>Total Cost (US$ millions)</th>
<th>Cost per mile (US$ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas City</td>
<td>2016</td>
<td>2.0</td>
<td>$102.0</td>
<td>$51.00</td>
</tr>
<tr>
<td>Tucson</td>
<td>2014</td>
<td>3.9</td>
<td>$196.0</td>
<td>$50.3</td>
</tr>
<tr>
<td>Seattle</td>
<td>2007</td>
<td>1.3</td>
<td>$56.4</td>
<td>$43.4</td>
</tr>
<tr>
<td>Cincinnati</td>
<td>2015</td>
<td>3.6</td>
<td>$148.1</td>
<td>$41.1</td>
</tr>
<tr>
<td>Portland</td>
<td>2001</td>
<td>4.6</td>
<td>$57.0</td>
<td>$12.4</td>
</tr>
</tbody>
</table>

Average cost per mile for streetcar is $55 million in 2014.
## Cost Comparisons

<table>
<thead>
<tr>
<th>Technology</th>
<th>Cost per Mile ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Rapid Bus (BRT Lite)</td>
<td>$4.2</td>
</tr>
<tr>
<td>Diesel multiple unit (DMU)</td>
<td>$3.3</td>
</tr>
<tr>
<td>Bus Rapid Transit (BRT)</td>
<td>$30.0</td>
</tr>
<tr>
<td>Streetcar/tram</td>
<td>$12.4</td>
</tr>
<tr>
<td>Light Rail Transit (LRT)</td>
<td>$48.3</td>
</tr>
<tr>
<td>Metro Rail (HRT)</td>
<td>$172.4</td>
</tr>
</tbody>
</table>
Attachment - 2

OPEX Comparisons
(Operational Expenditure Comparison)
# Bus Rapid Transit (BRT) OPEX Comparisons

<table>
<thead>
<tr>
<th>System</th>
<th>Length (miles)</th>
<th>Total Cost</th>
<th>Cost per vehicle mile</th>
<th>Cost per Boarding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>3.7</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Cleveland</td>
<td>6.7</td>
<td>$6,514,207</td>
<td>$9.47</td>
<td>$1.41</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>17.7</td>
<td>$22,550,664</td>
<td>$14.30</td>
<td>$2.88</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>4.2</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Eugene, OR</td>
<td>4.0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>National BRT Average</strong></td>
<td></td>
<td><strong>$12.80</strong></td>
<td><strong>$2.30</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: FTA, National Transit Database 2012; published November 2013.
## Light Rail Transit (LRT) OPEX Comparisons

<table>
<thead>
<tr>
<th>System</th>
<th>Length (miles)</th>
<th>Total Cost</th>
<th>Cost per Vehicle Mile</th>
<th>Cost per Boarding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlotte</td>
<td>9.3</td>
<td>$17,537,021</td>
<td>$20.21</td>
<td>$3.59</td>
</tr>
<tr>
<td>Cleveland</td>
<td>15.2</td>
<td>$12,339,684</td>
<td>$17.65</td>
<td>$4.71</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>12.4</td>
<td>$27,886,232</td>
<td>$13.56</td>
<td>$2.66</td>
</tr>
<tr>
<td>Phoenix</td>
<td>19.6</td>
<td>$28,909,660</td>
<td>$11.87</td>
<td>$2.13</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>24.8</td>
<td>$52,043,343</td>
<td>$26.98</td>
<td>$7.30</td>
</tr>
<tr>
<td>Portland</td>
<td>52.1</td>
<td>$99,710,015</td>
<td>$12.88</td>
<td>$2.36</td>
</tr>
<tr>
<td>Salt Lake City</td>
<td>35.4</td>
<td>$42,177,868</td>
<td>$7.11</td>
<td>$2.42</td>
</tr>
<tr>
<td>San Diego</td>
<td>52.2</td>
<td>$63,309,242</td>
<td>$8.39</td>
<td>$1.94</td>
</tr>
<tr>
<td><strong>National LRT Average</strong></td>
<td></td>
<td><strong>$16.30</strong></td>
<td></td>
<td><strong>$3.30</strong></td>
</tr>
</tbody>
</table>

Source: FTA, National Transit Database 2012; published November 2013.
Attachment - 3

Final Review of Estimates of Probable Cost
July 30, 2014

Mr. Michael J. Williams, P.E.
Manager, Design and Engineering Support Section
Hillsborough County
601 E. Kennedy Blvd, 23rd Floor
Tampa, FL 33601

Subject: Review of Estimates of Probable Cost

Dear Mr. Williams:

AECOM has reviewed the estimated cost information you sent regarding potential transit alternatives. Overall we believe your estimates of probable cost to be reasonable and within the range of expected costs if built and operated using 2014 dollar values as the basis for comparison.

AECOM provided Hillsborough County with national averages for transit construction estimates of probable cost for CAPEX on a per mile basis developed as computed by our cost estimators. These costs are based on the Federal Transit Administration’s (FTA) Capital Cost Database of as-built costs for 35, federally-funded, light rail (LRT) and heavy rail transit (HRT) projects. The projects’ costs have been validated by the project sponsors. The database is used by AECOM to prepare conceptual, “ballpark” estimates for conceptual projects or for better understanding the unique characteristics of a cost estimate by comparing the costs to historical experiences. In addition, AECOM maintains a library of as-built capital costs used by our cost estimators in preparing cost estimates for highway, bridge and bus rapid transit projects. The average cost per mile for CAPEX provided in the “Hillsborough County Transit Technology Assessment” reflect these average CAPEX costs and are denominated in current 2014 dollars. Project costs are evaluated on year of expenditure values, which account for future costs.

The “Comparison of OPEX” prepared by AECOM highlights several BRT, streetcar and LRT systems as examples of the range of operating and maintenance expenditures (OPEX) incurred annually by the systems noted in the tables. The national averages are for total OPEX, which includes vehicle and non-vehicle maintenance and operating costs. These costs are based on the FTA National Transit Database and are averages for 2012, the last year published. Although your table slightly overstates the total OPEX, it is within a reasonable range for estimates of probable operating and maintenance costs valued in 2014 dollars.

Should you have any further questions or in need of additional clarification, please feel free to contact me.

Sincerely,

AECOM Technical Services, Inc.

Kenneth G. Sislak
Associate Vice President - Senior Project Manager
Attachment - 4

Hillsborough County Transit Options Assessment
Hillsborough County
Transit Options Assessment

May 2014
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Executive Summary

Travel demand in the Tampa Bay region has been growing, and is forecast to continue to grow. The rising roadway congestion will cause longer travel times, reduced reliability of arriving at destinations as planned, higher operating costs, and reduced competitiveness of the region when compared to other regions investing in integrated multimodal transportation systems. This report includes:

- Review of several transit studies completed for the Tampa region over the past 20 years;
- Review of transit technology options, looking at local applicability;
- Revised transit ridership forecasts;
- Revisions to capital, operating and maintenance costs to reflect current year costs; and

Findings: Based upon this review, it appears the Northeast Corridor linking downtown Tampa and the University of South Florida and the West Corridor linking downtown to the Westshore development and airport show the most promise; however, the analysis also determined that:

- Transit ridership in Hillsborough County has shown impressive growth but remains modest for a community considering rail transit investments. The vast majority of new rail projects implemented over the past few decades have occurred in communities where existing transit ridership levels are significantly higher than those currently observed in Hillsborough County.
- At this time, it appears that light rail transit in either corridor would not qualify for an FTA medium or higher rating, which is the usual threshold to be considered for federal funds.
- Bus rapid transit was found to be more cost effective for these corridors, with one option in the Northeast Corridor being just over the cost effectiveness threshold to qualify for a medium rating.

Recommendations: There is significant room for ridership growth in the area before a major investment in light rail transit would be viable. Hillsborough County should undertake steps to build patronage on the current bus transit system and develop a long-term transit and land use strategy that will support fixed-guideway transit, and that could allow a project to qualify for federal funds. Specific recommendations include:

- Continue investing in improvements to existing bus services, such as expansion of the MetroRapid enhanced bus system, which will help to increase transit use in key corridors. A full bus rapid transit option in some corridors might qualify for FTA funding once the projected ridership is higher and investment costs are lower.
- Develop a long-term transit/land-use plan that identifies travel corridors that could be developed to contain high capacity transit, and adopt specific land use policies that encourage transit-supportive development in these corridors.
- Include in the transit/land use plan a dedicated local funding source for transit investments, which will demonstrate a commitment to fund fixed-guideway transit.
- Invest in complete streets and other infrastructure that can create more walkable, transit supportive development in these key corridors, including Downtown circulator.
- Continue dialogue with CSX to determine if commuter rail options are operationally feasible and cost effective in their rights-of-way.
1. Introduction

Current travel demand in the Tampa Bay region generally exceeds roadway capacity, and according to the Hillsborough County Metropolitan Planning Organization (MPO), is forecast to increase. Even when accounting for planned roadway and transit improvements in the region, future travel demand will continue to overwhelm roadway capacity. In addition, rising roadway congestion will cause longer travel times, reduced reliability of arriving at destinations as planned, higher operating costs, and reduced competitiveness of the region when compared to other regions investing in integrated multimodal transportation systems.

SunRail, the new commuter rail service launched April 30 in Orlando and the planned referendum on light rail transit (LRT) in neighboring Pinellas County have heightened the sensitivity of Hillsborough County leaders to the prospect that they may fall further behind in providing quality transit options.

2. Purpose of this Report

The purpose of this report is to support Hillsborough County in analyzing various fixed guideway transit alternatives through review of existing data at a planning level and advising executive leadership on the cost effectiveness of the options under consideration. Hillsborough County’s immediate goal is to determine whether a viable starter line alternative exists, and if it does, the general parameters of such a starter line.

3. Prior Studies

Numerous planning studies have been conducted since 1988 with the Hillsborough County Mass Transit Corridor Alternatives Analysis Study, which looked at fixed-guideway options. Significant consideration for a transit system serving Hillsborough County began with the Tampa Bay Commuter Rail Authority’s Tampa Bay Regional Commuter Rail Feasibility Study (1993). Following this effort, several local, regional, and state agencies initiated studies looking at a wide range of alternatives for transit systems in the greater Tampa Bay region.

3.1. Review of Prior Studies

The following subsections briefly summarize the findings of the previous studies.

1993 Tampa Bay Regional Commuter Rail Feasibility Study (Wilbur Smith Associates).

The Tampa Bay Commuter Rail Authority examined the feasibility of operating commuter rail service between Downtown Tampa and Lakeland, Florida, which led to a wider study of other regional rail corridors utilizing the existing CSX right-of-way. The study concluded that diesel-multiple unit technology operating on several corridors serving MacDill Air Force Base and the University of South Florida through Downtown Tampa was technically feasible. The study found that the cost of acquiring trackage rights from CSX would require approval from corporate offices in Jacksonville.
1998 Alternatives for Mobility Enhancement Major Investment Study (BRW)

The study’s problem statement noted that the area’s growth in travel demand will exceed the capacity of the existing and committed transportation facilities, and that there are limited opportunities to provide new capacity in the existing transportation system due to physical and funding constraints. Moreover, there are incomplete connections between regional activity centers for those who are unable or who choose not to drive. The report noted that by 2015 many area highways would be over capacity or near capacity. The final plan recommended seven corridors:

1) Northeast Corridor (downtown to USF);
2) West Corridor (downtown to Westshore area and Airport);
3) Southwest Corridor (downtown to Interbay/Port Tampa);
4) Southeast Corridor (downtown to Brandon);
5) Northwest Corridor (Westshore to Carrollwood and Citrus Park);
6) North Corridor (downtown to Fowler Avenue to Bearss Avenue/I-275);
7) East Corridor (downtown to Lakeland).

The report recommended the Northeast and Southwest corridors be constructed first. Approximately $700 million in capital and $400 million in operating funding would be needed from a new local source such as a sales tax. No new transit organization or operational changes were included in the final plan. Figure 1 below shows the Locally Preferred Alternative for all improvements in the 1998 Study.

Figure 1 Locally Preferred Strategy from 1998 Mobility Study
It also noted need for bus, roadway, and pedestrian and bicycle improvements to allow for full range of multimodal connections. Diesel Multiple Unit (DMU) was recommended for all corridors, with commuter rail type equipment for the East Corridor to Lakeland. This study validated similar findings outlined in the *Tampa Bay Regional Commuter Rail Feasibility Study* that was completed in 1993.

Capital costs for all lines were $4.1 billion (1998-2015); the rail alternative would be $1.2 billion of that figure with the remainder would be pedestrian and bicycle improvements, street improvements, transportation system management and bus system improvements.

The gross operating costs for all projects (new roadways, bus, transportation system management and rail) were estimated to be $3.2 billion over that same time period. Of that total, the rail fixed guideway operating costs would be $255 million. The full preferred alternative would result in 121,000 daily transit boardings with $68.4 million dollars in travel time savings in the region. All figures are in 1997 dollars.

**2003 Tampa Rail Project (URS)**

Following up the 1998 Alternatives for Mobility Enhancement Major Investment Study, in 1999 the Federal Transit Administration (FTA) granted approval under the New Starts program to permit the preparation of an Alternatives Analysis and Environmental Impact Statement (AA/EIS), which was completed in 2002 with a Record of Decision (ROD) delivered in 2003. The AA/EIS was for a 30 mile corridor that connected downtown Tampa to USF, the Port Tampa area in the southwest, and the Tampa International Airport (TIA) in the west. The project was called the Tampa Rail Project. Development of the Tampa Rail Project continued until January 2005 when Hillsborough Area Regional Transit (HART) suspended further work on the project and withdrew it from the New Starts program due to lack of a local funding source.

**2005 Regional Transit Action Plan**

This short study considered long-term transit improvements in the West Central Florida region, which included Hillsborough County. The report recommended the development of a regional transit agency to improve transit coordination in the West Central Florida region and to develop a more detailed transit development plan that would recommend fixed guideway transit routes, a governing structure to manage it and a dedicated funding course to construct and maintain a regional transit system. The plan also recommends regional bus rapid transit corridors that parallel many of the same corridors identified for rail in the 1998 study. The study was limited in scope and recommended governance, operational and funding options for consideration in the region.

**2006 MPO Transit Study (Parsons Brinckerhoff)**

At the urging of the Citizens’ Advisory Committee, and the request from the Hillsborough County Metropolitan Planning Organization (MPO) Board, the MPO Transit Study commenced in November of 2006 to begin addressing pressing questions for Hillsborough County, which included how do to deal with growing population and resulting increases in congestion. The timing of the MPO Transit Study also coincides with the concurrent effort by the Tampa Bay Area Regional Transportation Authority (TBARTA) to develop a regional transit master plan for the eight county region.
The MPO Transit Study included the development of scenarios to illustrate the benefits and tradeoffs associated with different mobility strategies for the county. One scenario focused on creating a major transit system for the county, while the other no-build concept relied primarily on roadways to address long term mobility needs. The conclusion from this study is that a major transit investment in improved bus and possible rail service is a more desirable choice. The key findings illustrated the benefits associated with a transit rich future to address mobility needs that cannot be achieved through roadway capacity improvements alone. The 2050 Transit Vision can benefit citizens of Hillsborough County by:

- Accommodating future growth in a more efficient and sustainable manner
- Providing a fast and more reliable transportation choice for citizens over time

The Transit Concept for 2050 illustrated in more detail the key advantages of this transit future. The 2050 Transit Concept is set within the larger regional context that responds to local desires and opportunities concerning mobility, development patterns and the ability to accommodate future growth.

Recognizing that transit must work in concert with the existing roadway system and respond to community preferences concerning land use and development patterns, the study examines a wide range of transit technologies and complementary transit supportive development options. The process involved a significant public outreach and engagement campaign; the development of guiding principles; technical analysis of future travel demand; transit rail and bus technology assessments; and conceptual level fatal flaw analysis for various transit concepts.

2007 Tampa International Airport Conceptual Planning for Transit Station and Access

The Hillsborough County Aviation Authority (HCAA) studied potential transit options and alignments for a future transitway and two transit stations at TIA. This transitway alignment was part of the regional transit system identified by the Tampa Bay Area Regional Transportation Authority’s Master Plan.

Goals of the TIA study were to optimize transit connections at terminals, improve passenger convenience, and minimize impacts to airport operations in light of TIA’s long-range expansion plans. Two transit technologies were determined to be best suited for the purpose: Bus rapid transit (BRT) and light rail transit (LRT). As part of the study, TIA assumed the most restrictive criteria for both technologies so as not to preclude either option when the regional transit line is built. As a result, the study recommended:

- An at-grade alignment option at the south end of the airport by prohibiting any development along West Spruce Street airport property to the south service road.
- An aerial alignment along the George Bean Parkway to the terminal.
- An aerial alignment for connection to the future North Terminal.

As a result of a significant update to the Tampa International Airport Master Plan in 2012, the commitment to a northern terminal was eliminated and right-of-way previously envisioned for this potential transit corridor was committed to people mover connections to remote parking and future airport expansion. Previous plans called for a new terminal on this land, which planners believed was necessary once the airport served 25 million annual passengers. The 2012 Master
Plan update allows the existing facilities to accommodate 34.7 million annual passengers, preserving the north property for airport growth far into the future. Subsequent planning amended future potential rail alignments as skirting the Eastern Airport border area.

**2009 Tampa Bay Area Regional Transit Authority (TBARTA): Master Plan**

In 2007 the Governor signed into law legislation that created the Tampa Bay Area Regional Transportation Authority (TBARTA), a new governing body covering seven counties created to address the transportation needs for the West Central Florida region. TBARTA adopted its first Regional Transportation Master Plan in 2009. The inaugural master plan identified the vision for the regional transit network. The *2009 Regional Transportation Master Plan* noted that areas attracting the most trips in the region included the Tampa International Airport, University of Tampa, University of South Florida (USF), Ybor City and downtown Tampa. With this background, TBARTA studied alternatives for two corridors: downtown Tampa to the Tampa International Airport (West Corridor) and downtown to USF (Northeast). An update was completed in 2011 that introduced a regional freight and a regional roadway network to the plan. The *2013 Master Plan Update* is a minor update to refine all networks, and incorporate the progress made locally and regionally towards implementing the regional vision. The Master Plan is updated every two years to ensure that TBARTA continues to represent the changing needs for the mobility of passengers and freight throughout the region.

**2010 HART Alternatives Analysis (Parsons Brinckerhoff)**

This 2010 study builds upon the 2003 AA/EIS. The study also noted a 2007 Tampa International Airport Conceptual Planning for Transit Station and Access study which recommended an alignment to serve the airport. The HART AA work scope included examining and updating the previous Tampa Rail LPA, adopted by the HART Board in October 2001, and documented in the Final Environmental Impact Statement (FEIS) in December 2002, and approved by a Record of Decision (ROD) issued by the FTA on April 16, 2003. This Alternatives Analysis (AA) compared the Tampa Rail locally preferred alternative (LPA) to other potential alternatives, developing recommendations on an alternative that would best meet community needs.

The AA focused on two corridors: the Northeast and West Corridors. The Northeast Corridor spans from New Tampa, south to Downtown Tampa and is approximately 18 miles in length. (The Northeast Corridor spanned from downtown Tampa to the USF area initially and was extended to the new Tampa area in an attempt to serve additional markets. The West Corridor spans from Downtown Tampa, west to TIA and is approximately 7 miles in length. (This corridor was also extended through the airport to the northwest in an attempt to serve additional markets. The width of the Northeast Corridor is at most 5 miles. The width of the West Corridor is at most 4 miles. Work on the study commenced in July 2009 and was essentially completed in early 2011.

The study area’s population was projected to increase by 63 percent and employment was projected to increase by 59 percent from 2006 through 2035. The area has a high number of transportation-disadvantaged households (sometimes called transit-dependent). The area has buses with long headways and travel times that are not competitive with the automobile. By 2035, travel demand was predicted to exceed capacity by nearly 2 to 1 for the existing and planned facilities. Air quality for Hillsborough County was also noted as a concern. The study
area also has some of the highest densities in the area. For example, the study area has nearly 35 percent of the population and over 40 percent of the employment on only 10 percent of the land in Hillsborough County.

The study screened several alignments within the Northeast and West Corridors. After two rounds of screening, three alignments were still under consideration for the Northeast Corridor, along with two West Corridor alignments. For both corridors, the alignment options generally followed either I-275 or the CSX railroad. The alternative recommended included the I-275 alignment for both corridors for the following reasons:

- the greater capital expense of negotiating the use of the CSX right-of-way (on the Northeast corridor);
- the lower overall travel time for the I-275 route for both corridors; and
- the lower level of possible community impacts along I-275 route.

The report noted the need for further study on the routing within downtown Tampa. The report recommended LRT over BRT since it was reported that LRT was consistent with local and regional plans, had a better record for encouraging positive land use patterns, had greater air quality benefits, and had support from agencies and the public. The final screening table 4-3 noted that LRT costs were projected to be $78 million to $120 million per mile, with BRT costing between $37 million and $53 million per mile. LRT operating and maintenance costs were also projected to be higher than BRT. Figures 2 and Figure 3 below indicate the Locally Preferred Alternatives for the Northeast and West Corridors.

Figure 2 HART AA Northeast Corridor
HART staff recommended a 12 mile “starter” demonstration project from downtown to the Tampa Airport to Linebaugh Avenue, with a projected a $825 million capital cost and an average weekday ridership of 11,300 (by 2035). This starter project would include the West Corridor and then a Northwest Corridor that terminated north of the Airport. The project recommended designing the light rail line to be constructed simultaneously with the reconstruction of I-275. Moreover, since the West Corridor was included in the EIS completed in 2003, the West Corridor might take less time to receive environmental clearance than the Northeast Corridor. Finally, the West Corridor had a lower per-mile construction estimate, making it a more feasible starter project.

No cost effectiveness indices were calculated for any of the corridors evaluated.

Figure 4 below shows the general alignments for the demonstration project. However, the modified TIA Master Plan precludes this alignment through the airport.
The MPO and the Tampa Downtown Partnership initiated the Downtown Transit Assets & Opportunities Study in late 2013 to investigate potential opportunities for expansion and/or extension of the existing transit assets. The study is focused on downtown Tampa with potential connections to Tampa International Airport. The current Downtown Transit Assets & Opportunities Study builds upon many previous transit investment studies in Hillsborough County. The current transit assets and opportunities study is being guided by the City of Tampa, the MPO, HART, Florida Department of Transportation (FDOT) and the Tampa Historic Streetcar board.

The Final Report and recommendations are anticipated by the end of May 2014 and will feed into the MPO’s long range plan and HART’s Transit Development Plan. Figure 5 illustrates the current recommendation of the Steering Committee.
The estimate of probable capital cost of the recommended alternative is approximately $1.0 - $1.3 billion and is estimated to cost $14.1 to $16.9 million annually to operate and maintain. The estimated ridership is unreported at this time.

2014 Tampa Bay Express Lanes (TBX) and Intermodal System (Jacobs Engineering)

The purpose of this study is to determine the feasibility of operating a BRT service within proposed interstate tolled express lanes. This project evaluates the opportunity for BRT service with the goal of increasing the overall capacity of the interstate express lanes. This study also focuses on providing a regional transit service between Pasco, Hillsborough, and Pinellas Counties; making connections to beaches, business districts, and regional multi-modal centers. The study will not be completed until later this year.

3.2. Findings and Conclusions

All of the prior studies concentrate on a few major travel corridors radiating from downtown Tampa. Several of the studies recommend investments in:

- the Northeast Corridor linking Downtown Tampa with the University of South Florida, or
• the West Corridor linking downtown with the Tampa International Airport and the Westshore development.

Our review of the findings and recommendations from the prior studies suggests the initial transit investment should be in a travel corridor with the potential to generate very high transit ridership at a very low start-up cost to improve the project’s cost effectiveness and increasing the probability of obtaining federal funding support. This will be discussed in the following sections.

4. Review of Technology Options

A family of public transportation technologies appropriate to urban mass transit was evaluated during the prior studies. These technologies ranged from buses to rail rapid transit systems. Several of the technologies were eliminated from further evaluation and technical analysis. These technologies were deemed either inappropriate due to estimates of probable cost or higher capacity than required by the ridership estimates for the regional transit network contemplated. Technologies included in the final set of options were BRT, LRT, tram/modern streetcar and regional commuter rail using diesel multiple unit (DMU) trainsets.

4.1. Capacity of Transit Technologies

The capacity of a transit line is measured by calculating the number of persons per hour per direction (PHPD) the system is required to carry. This is achieved by multiplying vehicle capacity times the number of buses or trains operating per hour passing a given station. For example, assuming standard 40-foot buses seat 50 people and the public transport system maximum load factor is 120 percent of seated capacity, the peak capacity of the bus is approximately 60 passengers. With this load factor, a busway could theoretically serve up to 14,400 PHPD. This would be the equivalent of operating 4 buses per minute during the peak hour passing a station stop.

This capacity can be significantly increased by utilizing articulated or bi-articulated buses as is done in South America where some busways can carry up to 40,000 passengers per hour per direction. Although buses passing a given point on a busway can achieve this throughput, not all buses can stop unless fairly elaborate stations with multiple bus bays are provided. At such levels of development, the bus system is likely to exhibit capital and operating costs comparable to or higher than light rail transit.

However, the proposed Tampa Bay regional transit network does not require such high capacity technologies and the supporting infrastructure necessary to achieve such high loading capabilities. The preliminary ridership estimates for the priority corridors in the 2010 HART Alternatives Analysis ranged between 14,740 and 19,500 average total daily linked trips, depending upon alignment and technology alternative. Consequently, technologies with extremely high capacity capabilities are unnecessary. The following technologies are appropriate for the Hillsborough County area.
4.1.1. Local Bus

Local bus service is already provided by HART throughout the region. The slow travel speed and frequent stops makes this transit option less than ideal for providing the connectivity to large job centers like downtown Tampa, Westshore and the airport. Further, local bus improvements are unlikely to generate substantial ridership gains unless the service area coverage, span of service and frequency of service is substantially improved. Local bus will be an important feature of any transit improvement in the region. Local bus services provide a critical access linkage between neighborhoods and the potential rail and bus rapid transit services effectively increasing access and mobility.

4.1.2. Enhanced Bus/Rapid Bus

Limited-stop bus service could provide a faster trip to serve job destinations in downtown Tampa. Enhanced Bus/Rapid Bus service operating in mixed traffic could connect many neighborhoods with high frequency service at a low-to-medium cost. Station spacing would be flexible depending on the destinations in the extended route corridor. The characteristics of this service would include substantial stations, passenger information systems and transit signal priority but would operate in mixed-traffic similar to the MetroRapid service currently operating in Tampa. This system of express bus services currently operates successfully in Houston and Los Angeles using stations in the median of freeways with special access/exit ramps that avoid congested interchanges.

The HART MetroRapid operates north on Nebraska Avenue from downtown Tampa then east along Fletcher Avenue to the vicinity of Telecom Park (west of I-75). Hidden River Regional Park-n-Ride is the northern terminus. Enhanced Bus/Rapid Bus could also be operated on the Tampa Bay Express Lanes (TBX) on the regional freeway network. Buses could operate at higher speeds on the managed TBX lanes and act as their own collector/distributor system while operating on local roads.

4.1.3. Bus Rapid Transit (BRT)

Bus Rapid Transit (BRT) is a bus operation generally characterized by use of exclusive or reserved rights-of-way (busways) that permit higher speeds and avoidance of delays from general traffic flows. The HealthLine in Cleveland is the best example of full BRT in North America. Full BRT service operating in an exclusive lane could connect downtown Tampa to the Tampa International Airport with high frequency service and appropriate and flexible station spacing, at a cost similar to the HealthLine in Cleveland.
4.1.4. Regional Commuter Rail with Diesel-Multiple Unit (DMU)

The development of diesel-multiple unit (DMU) railcars capable of operating on the CSX freight railroad tracks makes this technology option a lower cost alternative than building LRT. It is considered a shared right-of-way light rail technology option. DMU have been successfully deployed in Austin, Camden/Trenton, Dallas, Miami, Portland, and San Diego. DMU operates on the South Florida Regional Transit Authority (Tri-Rail) commuter rail service between West Palm Beach and Miami sharing tracks with CSX freight trains. In New Jersey, the River Line operates DMU trains between Camden and Trenton. The DMU operate in city streets in Camden and then follow the Delaware River on the former Bordentown-Trenton Branch of the former Conrail freight railroad. New Jersey Transit purchased the branch line from Conrail in 1999 and today shares tracks with Norfolk-Southern under an FRA approved operating agreement.

The DMU could operate in downtown Tampa on city streets similar to the operation in Camden/Trenton or Austin and then utilize the existing CSX right-of-way and improved tracks. There are significant institutional and operational challenges that must be overcome to accomplish this. As the County understands, negotiations with the CSX railroad will be complex, lengthy and costly.

The DMU option was considered to be an appropriate technology according to the 1993 Tampa Bay Regional Commuter Rail Feasibility Study, the 1998 Mobility Study and the current Downtown Transit Assets and Opportunity Study.

4.1.5. Tram/Modern Streetcar

Modern streetcars are a form of urban rail public transportation operating entire routes predominantly on streets, often in mixed-traffic. The service typically operates with single-car trains with frequent stops powered by an overhead contact system. Portland operates a very large modern streetcar system. The cities of Atlanta, Cincinnati, Detroit, Kansas City, Los Angeles, Tucson and Washington, DC are building modern streetcar lines as downtown circulator systems. Tampa has a 2.4 mile heritage streetcar line (TECO) operating between Downtown, Channelside and Ybor City. There are aspirations and plans to extend the TECO streetcar line to serve more destinations in the Downtown area, specifically as part of the Downtown Transit Assets and Opportunities Study.

4.1.6. Light Rail Transit (LRT)

Light rail transit (LRT) is a rail transit technology capable of providing a broad range of passenger capacities. Modern electric rail vehicles operate singly or in short trains. Taking
power from an overhead wire, they can run on either exclusive or shared rights-of-way with or without grade crossings, or occasionally in mixed traffic lanes on city streets. Locational flexibility is the primary defining attribute separating LRT from other rail transit technology options. LRT has significant passenger capacity that requires substantial capital expenditures and operating and maintenance cost investment in corridors that have the population densities to support it. Such a major transit investment would require a local dedicated funding source to support an application for federal funding participation.

4.2. Findings and Conclusions

Each technology option has advantages and disadvantages associated with capacity and speeds. The higher speed and capacity transit options cost more than options operating at lower speed and with less carrying capacity. Generally, higher speeds and high capacity are required for longer trips, which require exclusive right-of-way. These longer distance commuter trips are best served by commuter rail (DMU), LRT and BRT operating on exclusive transitways or in managed lanes on freeways in the case of express buses. Convenient and highly accessible systems, such as streetcars and local buses, serve generally shorter trips but provide greater access to the transit system. These systems operate at slower commercial speeds and can operate in mixed-traffic. The balance must be found between near term and ultimate capacity for future population and travel patterns and select technologies that match travel market needs and capacities.

BRT is a viable technology alternative and should be a considered option. It is significantly lower in cost than LRT and has greater flexibility in terms of developing an operating plan that grows with the market. It can be implemented faster and sooner and provides the opportunity to provide quality curb to curb connections by providing one-seat trips by circulating on local streets to collect or distribute passengers. The shorter vehicle life, 12 versus 25-40 years provides the opportunity to update propulsion technology, amenities and features more frequently. BRTs land use impact is not as proven as LRT, but early results look promising as seen in Cleveland.

LRT is a viable technology that should be considered where high capacity is needed for (longer) line haul trips. Streetcar is a viable technology for a downtown circulator, but not for a line haul service requiring higher average commercial speeds. LRT and modern streetcar have attracted significant development around stations that are located within areas of the city that can support redevelopment.

Regional rail utilizing the infrastructure and facilities of the general railroad system make it an attractive option for achieving regional mobility improvements at a fraction of the cost of a light rail transit (LRT) system. This is the technology implemented in Austin and Denton County, Texas. Regional rail utilizing the CSX right-of-way is a viable technology alternative and should be a considered option, which was the recommendation of the 1993 Tampa Bay Regional Commuter Rail Feasibility Study.
Automated guideway transit (AGT) connecting the Tampa International Airport and a proposed Airport Intermodal Center is a viable transit option. The airport has already invested in a proprietary system that connects the main terminal building to departure/arrival gates.

Land use along the alignments influence potential transit oriented development and ridership. Alignments in the middle of freeways are more removed from convenient access to residential and mixed-use commercial development and are less likely to have direct walk access. Stations in the median of freeways are less likely to encourage transit oriented development and high land use impact.

5. Travel Market Analysis

The HART Alternatives Analysis (AA) ridership forecasts were updated to reflect changes in horizon year population and employment forecasts and most recent changes to FTA’s cost-effectiveness measure under MAP-21. This update was conducted at a planning level commensurate with project scope for an initial feasibility review. The HART AA study used the MPO’s 2035 population and employment forecasts, the most recent forecasts available at the time of the study. Recently the Hillsborough MPO developed 2040 forecasts, which differ substantially from the 2035 forecasts, as described further in this section. The Hillsborough MPO also recently developed population and employment estimates for 2010. The HART AA study calibrated the travel models using the then-latest 2006 estimates. The MPO’s 2010 estimates were used to develop sketch-planning 2010 project ridership for this analysis.

The 2010 population and employment estimates are modestly higher than their 2006 counterparts. These contribute to a 6 percent growth in unlinked trips between 2006 and 2010 according to HART’s National Transit Database summary reports for those years.

The 2040 West and Northeast Corridor population and employment estimates are all lower by 10 percent than their 2035 counterparts except for population in the West Corridor. Most notable is the decline in horizon year CBD employment: it was assumed to be 97,600 in 2035 but is 67,800 in 2040, a 30 percent reduction. Consequently the growth rates between base and horizon years are lower than in the HART AA (except for West Corridor population) but still strong compared to other urban areas around the country.

All of the above information indicates that the HART AA ridership forecasts are higher than what would be expected if the model were recalibrated and re-run with the 2010 Census and 2040 datasets, assuming the networks and project characteristics were identical.

The 2035 ridership forecasts were updated to 2040 by reflecting both the 6 percent increase in unlinked trips between 2006 and 2010 and the reduced growth between the 2035 2040 socio-demographic forecasts. An estimate of 2010 ridership was created by adjusting the newly developed 2040 ridership downwards using the 2010-2040 growth rates. No differences were assumed between LRT and BRT ridership for the HART Alternatives Analysis because the alignments were physically identical and the BRT and LRT would operate nearly identically. This assumption was maintained for this update, but a more rigorous update to the ridership forecasts would reflect modal differences.

The revised ridership forecasts are shown in Table 1.
Table 1: Revised Ridership Forecast

<table>
<thead>
<tr>
<th>Ridership</th>
<th>30th Street &amp; CSX</th>
<th>20th - 22nd &amp; CSX</th>
<th>I-275 Northeast</th>
<th>I-275 West</th>
<th>Cypress Street</th>
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</thead>
<tbody>
<tr>
<td>Average Daily Trips</td>
<td>14,325</td>
<td>12,343</td>
<td>12,123</td>
<td>4,473</td>
<td>5,709</td>
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<tr>
<td>Annual Trips</td>
<td>4,004,486</td>
<td>3,450,428</td>
<td>3,388,928</td>
<td>1,250,406</td>
<td>1,595,924</td>
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</table>

Source: AECOM, May 2014

6. Review of Capital Expenditure Estimates (CAPEX)

Capital cost development usually results from engineering analysis of alignment studies by defining infrastructure and rolling stock requirements. Cost estimates prepared during the early project development stage brings with it several challenges, including questions about whether the current economic conditions, construction industry configuration, and building technologies will apply to a project implemented many years in the future.

In general, the estimating process assumes future conditions will be predictably similar to historical trends. A recurring issue in estimating capital costs during a project’s conceptual phase is evaluating and treating uncertainty. Uncertainty can result in a difference between a project’s estimated cost as defined during the concept phase and the project’s actual cost, which is ultimately implemented. As cost estimates are built-up, explicit allowances for these risks must be accounted for. There risks are typically categorized as follows:

- Changes in project scope;
- Changes in design or operating standards;
- Incorrect unit cost / quantity assumptions; and
- Unforeseen issues in implementation.

As part of this review of prior studies, especially the 2010 HART Alternatives Analysis and the current Downtown Transit Assets and Opportunities Study, capital cost estimates were reviewed to determine whether they were still a valid estimate of probable cost to design and construct the alternatives under review. The HART Northeast and West Corridors Alternatives Analysis capital cost estimates were compared to an independent estimate of LRT and BRT alignments in other cities using the FTA Standardized Cost Category (SCC) format. The SCC includes the following categories as applicable:

- 10.00 Guideway & Track Elements;
- 20.00 Stations, Stops, Terminals, Intermodal;
- 30.00 Support Facilities: Yards, Shops, Administration Buildings;
The HART Alternatives Analysis did not provide cost estimating methodologies or appendices with detailed cost estimating calculations. The only specific information provided for the independent estimate were the capital cost totals, cost per mile, length in miles of the alignment divided into two types of guideway, the number of vehicles, and the number of stations.

A similar project from Austin converted to Tampa Bay area costs was used as the basis of the independent estimate. The 2010 HART estimates appear to be acceptable at this level of design. The independent estimate costs were then compared to the 2010 HART Alternatives Analysis capital cost estimates for the Northeast and West Corridors. There were not any significant differences that stood out. Therefore, the HART Alternatives Analysis capital cost estimates were converted to 2014 dollars. ENR CCI escalation data was used to determine the escalation from 2010 to 2014 (+5 percent escalation).

There may be a significant extra cost to access an acceptable yard site if only the downtown Tampa to Tampa International Airport line is considered as the starter line.

Table 2 on the following page illustrates the HART Alternatives Analysis 2010 capital cost estimates and the 2014 revisions including estimates of the annualized capital expenditures.
### Table 2 Capital Cost Estimate (2014$)

#### Features

<table>
<thead>
<tr>
<th>Features</th>
<th>30th Street &amp; CSX</th>
<th>20th-22nd &amp; CSX</th>
<th>I-275 Northeast</th>
<th>I-275 West</th>
<th>Cypress Street</th>
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<tr>
<td></td>
<td>LRT</td>
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<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
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<tr>
<td><strong>Operating Statistics</strong></td>
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<tr>
<td>Route Miles</td>
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<td>16.6</td>
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<td>% dedicated transit</td>
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<td><strong>Rolling Stock</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Vehicles to purchase</td>
<td>36</td>
<td>54</td>
<td>39</td>
<td>56</td>
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<td><strong>Capital Expenditures (CAPEX 2014 $000)</strong></td>
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<td></td>
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</tr>
<tr>
<td>CAPEX 2010 ($000)</td>
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<td>1,450,000</td>
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<td>1,650,000</td>
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<tr>
<td>CAPEX 2014 ($000)</td>
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<td>747,000</td>
<td>1,522,000</td>
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<tr>
<td>2014 cost/mile</td>
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<td>$39 M</td>
<td>$85 M</td>
<td>$42 M</td>
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<tr>
<td>Annualized CAPEX ($000)</td>
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<td>24,278</td>
<td>43,073</td>
<td>24,278</td>
<td>49,016</td>
</tr>
</tbody>
</table>

---

1 Red color indicates the BRT does not satisfy statutory requirement for a majority of the BRT route to be in dedicated transit ways.
7. Operating and Maintenance Expenditure Estimates (OPEX)

Operating and maintenance expenses (OPEX) include all expenditures required to provide daily service, including system administrative costs, wages and benefits for transit vehicle operators and maintenance workers, security, and the maintenance of the transit guideway, stations, facilities, buses and rolling stock.

The development of estimated annual operating and maintenance (OPEX) costs for the HART Alternatives Analysis could have been developed several different ways. One way is to base the estimates on the average unit costs derived from an examination of rail and bus operating costs in other cities. Another way is to use a cost build-up approach, which is a zero-base budgeting technique. It could be determined how the OPEX estimates were derived. For purposes of determining and testing operating cost assumptions in the review of cost effectiveness for the HART alternatives analysis, the average unit cost approach was used.

The data applied in the development of OPEX costs were accessed from the Florida Transit Information System – Integrated National Transit Database Analysis System (FTIS/INTDAS). This is a relational database operated by Florida International University, sponsored by the Florida Department of Transportation and FTA. The INTDAS user-friendly interface was applied to select either directly operated or contracted service, National Transit Database (NTD) reporting forms, and specific data elements. The data were retrieved from the FTIS/INTDAS website. A free user account is required to access this site.

Data for HART motor bus (MB) was assembled for fiscal years 2003 to 2012 (the latest published). The following data were downloaded:

- Agency identification: name, NTD number, year, mode, and service.

- Operating expenses: from NTD form F30, by function (vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration), by object classes (operator wages, other wages and salaries, fringes, fuel, power, services, etc.)

- Cost drivers: from NTD form S10 (vehicle operated in maximum service, annual vehicle revenue hours, annual vehicle revenue miles, exclusive fixed guideway directional route-miles)

The data were initially downloaded in the INTDAS format (transit agencies by year by mode are rows; data elements are columns). These data were then transposed for ease of use (data elements are rows; transit agencies by year by mode are columns). Each cost element, by function, by object class, was associated with a cost driver. The following cost drivers were considered:

- Vehicles operated in maximum service

- Annual vehicle revenue hours

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2 http://www.ftis.org/intdas.html
• Annual vehicle revenue miles (annual passenger car revenue miles for LRT)

• Fixed guideway directional route miles

Separate identification of cost drivers were prepared for the following functions:

• Vehicle operations: annual vehicle revenue hours (except for propulsion fuel and electricity, tires, which are driven by annual vehicle revenue miles).

• Vehicle maintenance: annual vehicle revenue miles (annual passenger car revenue miles for LRT).

• Non-Vehicle maintenance: vehicles operated in maximum service. This function is treated separately for demand response (DR), conventional motor bus (MB), and rapid bus (RB) modes (where costs are associated with vehicles in maximum service) and for LRT (where costs are associated with total directional route miles).

• General administrative (G&A) costs: Except for liability and insurance costs, were not associated with a cost driver and estimated as a percentage of other (direct) costs. Liability and insurance costs were associated with vehicle revenue hours.

Specific costs associated with cost drivers were segregated for the following object classes: operator wages, other wages and salaries, fringes, fuel, and electricity. These specific object classes are separately identified because the resulting unit OPEX costs will inflate at different rates:

• Vehicle Revenue Hours

• Vehicle Revenue Hours-Operator Wages

• Vehicle Revenue Hours-Wages

• Vehicle Revenue Hours-Fringe

• Vehicle Revenue Miles (car revenue miles for LRT)

• Vehicle Revenue Miles-Wages (car revenue miles for LRT)

• Vehicle Revenue Miles-Fringe (car revenue miles for LRT)

• Vehicle Revenue Miles-Fuel/Electricity (car revenue miles for LRT)

• Vehicles in Maximum Service

• Vehicles in Maximum Service-Wages

• Vehicles in Maximum Service-Fringe
Costs were aggregated (through a lookup function) by detailed cost driver. The model summarizes the aggregation by detailed cost driver (which distinguish the costs associated with operator wages, other wages and salaries, fringes, and fuel & electricity), the aggregated G&A costs, and confirm that the total aggregated costs total equal the Grand Total.

Direct unit OPEX costs were estimated by dividing aggregated costs by cost driver by the value of the associated cost driver. For example, aggregated costs for vehicle revenue hours-wage were divided by annual vehicle revenue hours.

The unit OPEX costs by detailed cost driver were further aggregated to total cost by driver (combining operator wages, other wages and salaries, fringes, fuel, and electricity into a single value) for the purposes of computing total cost by driver in 2012 dollars later in the analysis.

Direct unit OPEX costs were summed for each cost driver across all object classes. For example, unit OPEX costs per vehicle revenue hour for operator wages, other wages and salaries, fringes, and other were summed into a combined unit OPEX cost per vehicle revenue hour.

General Administration costs (except for liability and insurance) were estimated as a percentage of direct costs (the sum of vehicle operation, vehicle maintenance, non-vehicle maintenance, and liability & insurance. The general administration factor was then applied to the aggregated direct unit OPEX costs.

The loaded aggregated unit OPEX costs (including the general administration factor) were then applied to the cost drivers to compute OPEX cost by driver. The resulting overall total was compared to value reported in the NTD. No variances between the two values for each agency, mode, and reporting year were found.

Unit OPEX costs were converted from reported year to 2012 dollars by dividing the reported year dollar values by the change in the Tampa-St. Petersburg-Clearwater Consumer Price Index (CPI). The history of the CPI since 2003 is summarized along with the derivation of factors to convert reported year dollars to 2012 dollars within the cost model.

The stability of derived HART MB unit costs over time was evaluated and considered satisfactory. This included an examination of the trend in general administration costs as a percent of direct costs and aggregated unit OPEX costs in 2012 dollars by mode. Factors that might cause the volatility in unit OPEX costs that was observed are changes in operating efficiency, controlling health care costs (particularly in the beginning of the analysis period), aging assets, opportunities to control maintenance costs through the investment of capital funds for asset renewal and replacement, and the appropriateness of using the local CPI as the basis for the inflation adjustment (recognizing that many of the materials and supplies consumed by HART are purchased on a national market).
The Congressional Budget Office projection of 2013 and 2014 inflation was applied to the 2012 unit costs. These unit costs were applied to project costs for the alternatives.

Data were assembled for the following peer agencies (generally, in the Southwest and West, with no winter operations) for MB and LR in 2012:

- Tri-County Metropolitan Transportation District of Oregon;
- Metropolitan Transit Authority of Harris County, Texas;
- Dallas Area Rapid Transit;
- Santa Clara Valley Transportation Authority;
- Sacramento Regional Transit District;
- San Diego Metropolitan Transit System; and
- Los Angeles County Metropolitan Transportation Authority.

Unit costs in 2012 were derived in a manner similar to that applied for the MB data for HART. The resulting unit costs were then adjusted to reflect HART labor costs. The wage- and fringe-related MB unit costs for HART versus each of the peer agencies were compared. These factors were then applied to the wage- and fringe related LR unit costs for each of the peer agencies. Aggregated and adjusted unit costs were then computed in 2014 dollars. A simple average unit cost for each cost driver is derived in column BG. These unit costs were applied to projected cost drivers to project light rail OPEX costs.

Annual operating and maintenance costs (OPEX) costs for the alternatives under consideration were calculated based on the theoretical operating plans specified for the alternatives and are shown in Table 3 below.

Generally, the result of the review and revision indicate LRT operating costs increased and BRT operating costs are lower than the estimates in HART Alternatives Analysis, which reflects differing methodologies and assumptions.
### Table 3 Comparison of Operating and Maintenance Costs (2014$)

<table>
<thead>
<tr>
<th>Features</th>
<th>30&lt;sup&gt;th&lt;/sup&gt; Street &amp; CSX</th>
<th>20&lt;sup&gt;th&lt;/sup&gt; - 22&lt;sup&gt;nd&lt;/sup&gt; &amp; CSX</th>
<th>I-275 Northeast</th>
<th>I-275 West</th>
<th>Cypress Street</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
</tr>
<tr>
<td><strong>Operating Statistics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Route Miles</td>
<td>16.6</td>
<td>16.6</td>
<td>16.6</td>
<td>16.6</td>
<td>13.0</td>
</tr>
<tr>
<td>% dedicated transit</td>
<td>85.5%</td>
<td>85.5%</td>
<td>91.6%</td>
<td>91.6%</td>
<td>66.2%</td>
</tr>
<tr>
<td>Stations</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td><strong>Rolling Stock</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles to purchase</td>
<td>36</td>
<td>54</td>
<td>39</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td><strong>Average Daily Operating Vehicle Miles and Vehicle Hours</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual vehicle miles</td>
<td>6,424</td>
<td>7,744</td>
<td>6,075</td>
<td>7,322</td>
<td>5,776</td>
</tr>
<tr>
<td>Annual vehicle hours</td>
<td>360</td>
<td>438</td>
<td>361</td>
<td>440</td>
<td>329</td>
</tr>
<tr>
<td>Avg. speed (mph)</td>
<td>17.8</td>
<td>17.7</td>
<td>16.8</td>
<td>16.6</td>
<td>17.6</td>
</tr>
<tr>
<td><strong>Operating and Maintenance Cost Expenditures (OPEX – 2014 $000)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPEX 2010 $000</td>
<td>22,000</td>
<td>18,750</td>
<td>21,750</td>
<td>18,500</td>
<td>20,000</td>
</tr>
<tr>
<td>OPEX 2014 $000</td>
<td>31,314</td>
<td>15,966</td>
<td>30,597</td>
<td>15,611</td>
<td>28,497</td>
</tr>
</tbody>
</table>
8. Cost Effectiveness

The proposed transit alternatives were evaluated in accordance with the revised FTA New Starts project evaluation guidance published in August 2013. The cost effectiveness measure for New Starts projects is the annual capital and operating and maintenance cost per trip on the project. The FTA New Starts cost effectiveness measure is a significant factor to determine if a project will be awarded federal funds. For the purpose of evaluating the cost effectiveness of the proposed build alternatives in the HART Alternatives Analysis, the cost per trip on project criterion was used to determine whether the proposed investment was cost-effective. Cost effectiveness is derived as an absolute value and is not derived as a comparative value to any other alternative.

The evaluation of the cost effectiveness of an alternative requires that all evaluation measures (capital costs, operations and maintenance costs and ridership) be expressed in annual terms. Since capital costs are estimated as a total expenditure of constant (base year) dollars, an annual payment needs to be computed that is equivalent to what is in reality a one-time expenditure of capital funds. For each capital cost item, the annualized equivalent will be computed through application of the following annualization factor:

\[
Annulization\ Factor = \frac{i \times (1 + i)^n}{(1 + i)^n - 1}
\]

Where: \(i\) = discount rate; and \(n\) = economic life.

The annualized cost of the SCC category line item is the total cost of that line item multiplied by its annualization factor. Annualization factors have been determined based on FTA-prescribed guidance for economic life and discount rates. The method for calculating the annualized capital cost is embedded in the FTA New Starts SCC Workbook. Because the SCC workbook could not be used, an estimate of the annualization factors was computed based on other recent project cost estimates that had used the SCC workbook. It should also be pointed out that the discount rate for capital costs is now 2 percent rather than the 7 percent under prior legislation. This substantially reduces the annualized capital cost of each alternative.

The incremental cost per transit trip on the project is calculated by determining the annualized capital cost of the alternative and adding the annual net operating cost to obtain the sum of annualized costs. The annualized costs are divided by the annualized number of trips attracted to the alternative, for each alternative under consideration.

The number of transit trips attracted to the alternative is determined by calculating the number of linked transit trips using the project. The regional travel demand model is used to estimate the number of trips on the project. The annualization rate for trips on project is 300 per FTA guidance for the STOPS model. The FTA guidance requires the use of current year forecasts but allows the averaging of current and horizon year forecasts.

The objective is to develop a project definition that is “cost effective” by design that will fall within or above the medium rating category for cost effectiveness in the FTA New Starts project justification rating values. Table 4 below presents the breakpoint values FTA will use in FY
2015 for assigning a High, Medium-High, Medium, Medium-Low or Low cost effectiveness rating for each proposed project. FTA publishes updates to these breakpoints annually to reflect the impact of inflation. To qualify for a medium rating, a project must have a cost per trip between $6.00 and $9.99.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Breakpoint Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>&lt; $4.00</td>
</tr>
<tr>
<td>Medium-High</td>
<td>Between $4.00 and $5.99</td>
</tr>
<tr>
<td>Medium</td>
<td>Between $6.00 and $9.99</td>
</tr>
<tr>
<td>Medium-Low</td>
<td>Between $10.00 and $14.99</td>
</tr>
<tr>
<td>Low</td>
<td>&gt;$15.00</td>
</tr>
</tbody>
</table>


Table 5 shows the annualized costs and trips on project for the projects identified in the 2010 HART AA.

None of the alternatives considered in the HART AA would qualify for a medium rating under the current FTA guidance.

- Each and every one of the LRT options would be rated low as they all exceed $15.00 per trip.
- Most of the BRT options would be rated medium-low. The I-275 West BRT option would be rated low with a cost per trip of $15.77.
- The BRT option for the 30th Street & CSX alignment alternative is just slightly above the medium rating threshold at $10.06 instead of the $9.99 maximum.

The Downtown Transit Assets and Opportunities Study suggest several transit technologies for each of the recommended corridors for starter lines. For the West Corridor, LRT or modern streetcar is recommended; the Northeast Corridor uses DMU vehicles on the CSX alignment and the TECO streetcar line is extended to Downtown. The costs for these transit options are estimated to be $1.0 - $1.3 billion for capital expenditures and approximately $14.1 - $16.9 million annually to operate and maintain. These costs seem to be low when compared to the HART AA cost estimates even when considering modern streetcar and DMU technology options are somewhat less expensive to construct, operate and maintain.

The question remains, how many riders can be expected to use these high capacity services? As discussed, the 2040 horizon year population and employment forecasts have been revised downward. Only smaller scale transit investments seem to make economic sense when measured against the FTA New Starts cost effectiveness criterion.
### Table 5 Summary Evaluation Matrix and Cost Effectiveness Criterion

<table>
<thead>
<tr>
<th>Features</th>
<th>30th Street &amp; CSX</th>
<th>20th - 22nd &amp; CSX</th>
<th>I-275 Northeast</th>
<th>I-275 West</th>
<th>Cypress Street</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
<td>BRT</td>
<td>LRT</td>
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<tr>
<td><strong>Operating Statistics</strong></td>
<td></td>
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<tr>
<td>Route Miles</td>
<td>16.6</td>
<td>16.6</td>
<td>16.6</td>
<td>13.0</td>
<td>5.6</td>
</tr>
<tr>
<td>% dedicated transit</td>
<td>85.5%</td>
<td>85.5%</td>
<td>91.6%</td>
<td>66.2%</td>
<td>42.9%</td>
</tr>
<tr>
<td>Stations</td>
<td>19</td>
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<td>19</td>
<td>18</td>
<td>10</td>
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<td><strong>Rolling Stock</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles to purchase</td>
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<td>54</td>
<td>39</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td><strong>Operating and Maintenance Cost Expenditures (OPEX – 2014 $000)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPEX 2014 $000</td>
<td>31,314</td>
<td>15,966</td>
<td>30,597</td>
<td>15,611</td>
<td>28,497</td>
</tr>
<tr>
<td><strong>Capital Expenditures (CAPEX 2014 $000)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CAPEX 2014 $000</td>
<td>1,522,000</td>
<td>747,000</td>
<td>1,522,000</td>
<td>747,000</td>
<td>1,732,000</td>
</tr>
<tr>
<td>Annualized CAPEX</td>
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<td>24,278</td>
<td>43,073</td>
<td>24,278</td>
<td>49,016</td>
</tr>
<tr>
<td><strong>Ridership Estimates</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average daily trips</td>
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<td>14,325</td>
<td>12,343</td>
<td>12,343</td>
<td>12,123</td>
</tr>
<tr>
<td>on project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annualized trips</td>
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<td>4,004,486</td>
<td>3,450,428</td>
<td>3,450,428</td>
<td>3,388,928</td>
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<tr>
<td><strong>Cost Effectiveness Index (annualized cost per trip)</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annualized Cost $000</td>
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<td>$40,244</td>
<td>$73,760</td>
<td>$39,889</td>
<td>$77,513</td>
</tr>
<tr>
<td>Cost per trip (CEI)</td>
<td>$18.58</td>
<td>$10.05</td>
<td>$21.35</td>
<td>$11.56</td>
<td>$22.87</td>
</tr>
</tbody>
</table>
9. Land Use Impact

The ability of the proposed projects to influence land-use is a significant consideration in the FTA New Starts project evaluation process. While the cursory review makes it difficult to assess the land use influencing potential of various options, some observations can be made. The West Corridor alignment from downtown Tampa to Tampa International Airport, while in a capacity constrained corridor where new capacity could enhance development potential, is currently presumed to operate within the I-275 alignment. This location has limited stations and those stations are distant from attractive developable land. This alignment serves extremely limited residential areas and limits access to the stations to cars and feeder buses. The median of the I-275 freeway is not a pedestrian friendly realm. Station area space would be partially consumed by parking and/or bus transfer facilities in order to enable passengers to access this alignment. Consequently, the I-275 alignment options will not encourage dense, mixed-use transit oriented development necessary to build ridership and alter travel patterns in the region.

The Northeast Corridor traverses more real estate and has more areas where transit service would be accessible to adjacent land. However, unlike the West Corridor there is no obvious evidence of market potential for incurring the risks associated with redevelopment.

In both corridors the land-use potential will be influenced by the actual alignment decisions and policy and planning initiatives carried out to complement a guideway investment. More study is needed to find the alignment that best serves local travel markets and attracts transit oriented development.

10. Recommendations

Transit ridership in Hillsborough County has shown impressive growth but remains modest for a community considering fixed-guideway investments. The vast majority of new rail projects implemented in the United States over the past few decades have occurred in communities where existing transit ridership levels are significantly - often several times higher - than those currently observed in Hillsborough County. These higher ridership levels mitigate the risk and uncertainty associated with major capital investments as a significant share of the ridership market is already proven. They also enable a more credible proposal for federal funding.

Hillsborough County should approach making transit investments cautiously and prudently. HART currently carries approximately 50,000 riders on an average weekday. In comparison, the Pinellas Suncoast Transit Authority (PSTA) in Clearwater – St Petersburg carries only about 45,000 daily riders while the Central Florida Regional Transit Authority (LYNX) in Orlando carries over 96,000 daily riders and the Charlotte Area Transit System carries approximately 92,000 daily riders.

As the data shows, the 30th Street & CSX Corridor alternative generates the highest level of ridership at over 14,325 trips per day in 2040. This is nearly 30 percent of the current daily total system ridership for HART. There is significant room for ridership growth in the HART service area before a major investment in LRT would be viable.
However, if the BRT option was selected for this corridor and the alignment was modified to make it less expensive to build, operate and maintain, the alternative may become more cost effective and qualify for a *medium* rating.

The challenge in Hillsborough County is exacerbated by multiple objectives and lack of clarity on market priorities. Addressing regional commuting needs might favor one set of alignment locations and technologies whereas serving local transit markets and leveraging land-use benefits might suggest different alignments and technologies.

The prospect of a network of managed lanes within the Tampa Bay region provides an extremely attractive opportunity to provide high quality, higher speed Rapid Bus or Enhanced Bus on managed lane services to address regional travel and longer distance commuting markets. This strategy has the unique ability to provide the premium service attractive to choice travelers while still sharing the infrastructure and alignment right away cost with toll paying travelers using the managed Lane. Even this strategy would require far stronger commitments to feeder/distributors services, carefully sited park-and-ride facilities, and perhaps transit stations and transit exclusive entrance/exit ramps necessary to provide quality curb to curb service. Such a network could be implemented far faster, at much lower cost for public transportation, and provide far greater flexibility for serving the dispersed activity patterns in the Tampa Bay region.

If managed lanes are implemented with enhanced express bus services and if additional HART Metro Rapid or BRT corridors are implemented, new guideway alignments would need to be evaluated in the context of these sometimes competing service and facility investments. This type of analysis can only be carried out with more detailed planning and modeling efforts.

The Downtown to Tampa International Airport corridor is an important transportation and economic development focal point of Hillsborough County; however, the guideway transit options evaluated to date do not appear to provide cost-effective mobility investments. The high travel volumes through the corridor should not be confused with travel within the corridor potentially attracted to fixed-guideway transit. Uncertainty as to how collection and distribution would be handled at both ends of the corridor and how the prospect of transferring would impact ridership have not been fully explored. As currently planned, the West Corridor LRT option would be rated *low* for cost effectiveness. A BRT option that addresses access and mobility would be a better investment course for Hillsborough County to take.

Discussions with CSX are currently underway to determine if the DMU options are operationally feasible and cost effective once all costs and ridership estimates are known. This is extremely important to any serious consideration of rail transit in the region.

Hillsborough County should also look at adopting plans and policies that will advance land uses that will support transit use. This can start with an overall countywide or regional transportation and land use plan that will identify the major travel corridors and trip generators in the region. Once these corridors are identified, Hillsborough County can focus infrastructure investments (highways, complete streets and transit) to support growth in these corridors. Finally, and more importantly, the County can focus transit and transit supportive development within these corridors.