CONNECT400

GA 400 TRANSIT INITIATIVE

Alternatives Analysis

Evaluation Framework Report

Prepared for:
Metropolitan Atlanta Rapid Transit Authority

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Atlanta, GA

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marta

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Executive Summary

The Metropolitan Atlanta Rapid Transit Authority (MARTA) has undertaken the Georgia 400 Corridor Alternatives Analysis (AA) in an effort to identify potential transit improvements for portions of northern Fulton County. The AA will result in the identification of a transit alternative (or alternatives) that best addresses the transportation needs in this study area. To this end, this GA 400 Corridor Evaluation Framework Report documents the process by which potential transit alternatives are developed and evaluated as part of the AA. As shown in **Figure ES-1**, the evaluation framework reflects the purpose and needs of the project which led to the development of the goals and objectives, followed by the development of evaluation criteria and related performance measures to be used in the screening of alternatives.

The following three levels of evaluation are used to define and screen alternatives to identify a Locally Preferred Alternative (LPA) for the GA 400 corridor:

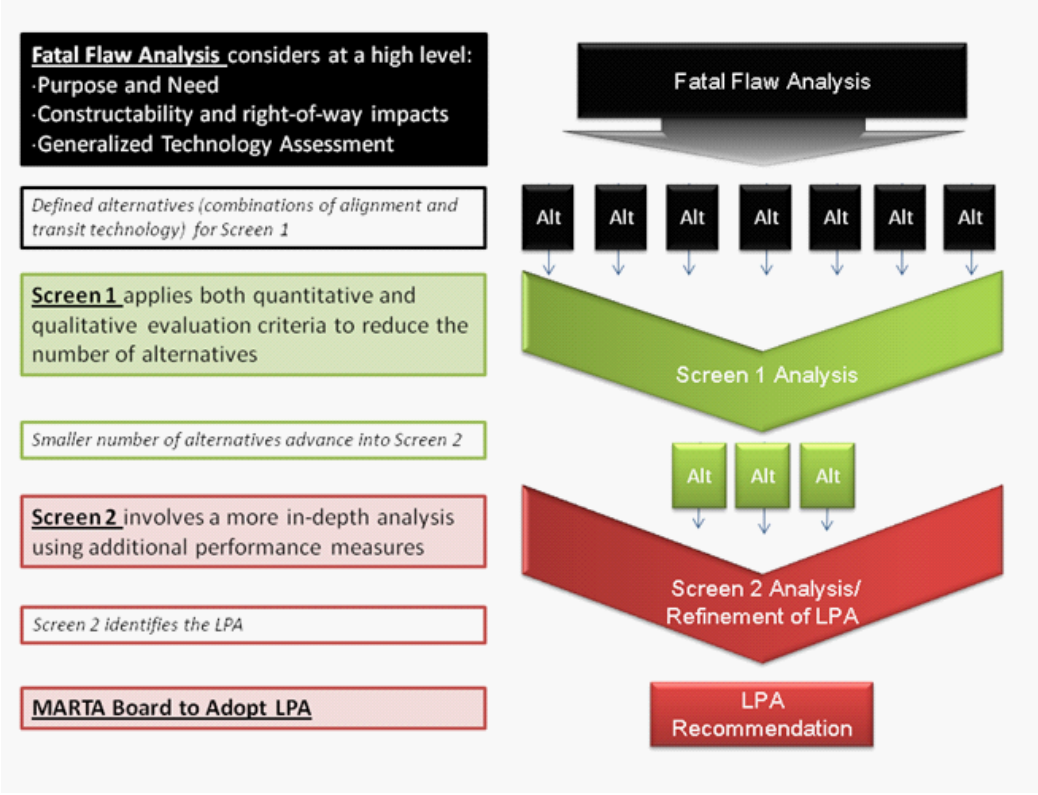
- **Fatal Flaw Analysis** – to identify Build Alternatives to advance into Screen 1
- **Screen 1** – to identify Build Alternatives to advance into Screen 2
- **Screen 2**– to identify the LPA

As presented in **Figure ES-2**, the three-step evaluation process is generally characterized by the application of an increasingly detailed and comprehensive set of performance measures to a decreasing number of alternatives. Each step in the evaluation process is designed to focus the analysis on progressively fewer alternatives with higher levels of scrutiny. In addition, the Build Alternatives are not only compared to each other but also to the No-Build Alternative, which provides the benchmark for establishing the travel benefits, environmental impacts and the cost-effectiveness.

The Fatal Flaw Analysis requires a primarily qualitative assessment of the initial set of alternatives with regard to meeting the Purpose and Need for the project and constructability using existing information, field reconnaissance, and aerial photography. **Table ES-1** shows the evaluation criteria and associated performance measures organized by the project goals and objectives they are intended to address. These measures have been refined based on input received from the Technical Advisory Committee (TAC). **Table ES-1** also presents the evaluation criteria and performance measures to be applied in the Screen 1 and Screen 2 analyses. Due to the number of alternatives being evaluated in Screen 1, the evaluation criteria selected consist of factors that utilize simplified analytical methods and require relatively lower levels of analysis. The result of Screen 1 is a smaller set of Build Alternatives subject to undergo Screen 2.

Figure ES-1: Evaluation Framework Overview

Figure ES-2: Three Step Evaluation Process



Note: The graphic above is illustrative in nature and the actual number of alternatives to be carried forward through each stage of screening is dependent on analysis results

TABLE ES-1: GOALS, OBJECTIVES, EVALUATION CRITERIA AND PERFORMANCE MEASURES

Transportation Challenges	Evaluation Framework				
	Goals and Objectives	Evaluation Criteria	Performance Measures	Screen 1	Screen 2
	Goal 1: Improve Mobility and Access				
Levels of roadway congestion are forecasted to increase along the corridor. Transit mobility options are limited. Transit travel times are not competitive with auto travel times in the corridor. Travel demands are increasing.	Increase north-south and east-west transportation capacity	Mobility	Total daily project transit boardings		X
			New transit riders		X
			Number of transfers per linked trip		X
	Increase transit ridership		Total passengers miles		X
			Potential impacts to roadway capacity	X	X
			Annual corridor crash reductions		X
	Improve transit travel times and reliability for all trip purposes	Travel Times	Transit travel time savings		X
			Differences in transit and auto travel times between various origins and destinations in the study area		X
	Improve transit access and connectivity to employment, education, residential, and activity centers within the study area and the region	Accessibility and Connectivity	Projected population, household, and employment within a 10 minute walk and drive of stations	X	X
			Major trip generators/activity centers within a 10 minute walk and drive of stations	X	X
	Improve multimodal connections and access to the existing transit systems		Low-income, minority, elderly and zero-car populations/households within a 10 minute walk of stations	X	X
			Interface with existing transit and future Concept 3 rapid transit service	X	X
			Maximize walking and bicycling accessibility to stations		X
	Goal 2: Support Land Use and Economic Development Planning				
Economic development is constrained.	Ensure consistency with land use plans of study area jurisdictions	Land Use and Development	Consistency with adopted local and regional plans	X	X
	Support planned and potential economic development		Acres of land with economic development incentives within 1/2 mile of stations		X
	Provide opportunities for compact land development that supports transit ridership	Potential for TOD	Projected population and employment densities within 1/2 mile of stations	X	X
			Acres of transit-supportive future land uses and zoning within 1/2 mile of stations	X	X
			Acres of vacant or under utilized land within 1/2 mile of stations		X

TABLE ES-1: GOALS, OBJECTIVES, EVALUATION CRITERIA (CONTINUED)

Transportation Challenges	Evaluation Framework				
	Goals and Objectives	Evaluation Criteria	Performance Measures	Screen 1	Screen 2
	Goal 3: Provide Cost-Effective Transit Services				
There is a funding shortfall to construct transportation improvements.	Maximize operating and cost-efficiency	Costs	Annual Operations and Maintenance (O&M) Costs	X	X
	Match the transportation investment to the study area's level of travel demand		Construction Capital Costs	X	X
			RIght of Way Costs		X
	Provide a cost-effective transit system	Cost Effectiveness	Cost Effectiveness Index (incremental costs divided by transportation system user benefit)		X
			Incremental cost per new rider		X
	Goal 4: Minimize Environmental Impacts				
Continued growth of vehicular travel will negatively affect the study area's environment.	Avoid, minimize, and mitigate impact to cultural, historic, and environmentally sensitive areas	Environmental Quality	Acres of potentially impacted wetlands and water bodies within 500 feet of alignments and 1/2 mile of stations	X	X
			Number of potentially impacted historic resources within 500 feet of alignments and and 1/2 mile of stations	X	X
			Acres of noise sensitive land uses within 700 (HRT), 350 (LRT), or 200 (BRT) feet alignments		X
			Number of contaminated and hazardous materials sites within 1/4 mile of alignments		
		Air Quality	Change in Vehicle Miles Traveled (VMT)		X
			Change in daily emissions of air quality pollutants (CO, NOx, PM2.5, PM10)		X
	Avoid, minimize, and mitigate negative impacts on the surrounding community including parks	Community Impact	Low-income, minority, elderly and zero-car populations/households within 500 feet of alignments		X
			Estimated community impacts/ disruptions and number of displacements	X	X

1.0 Introduction

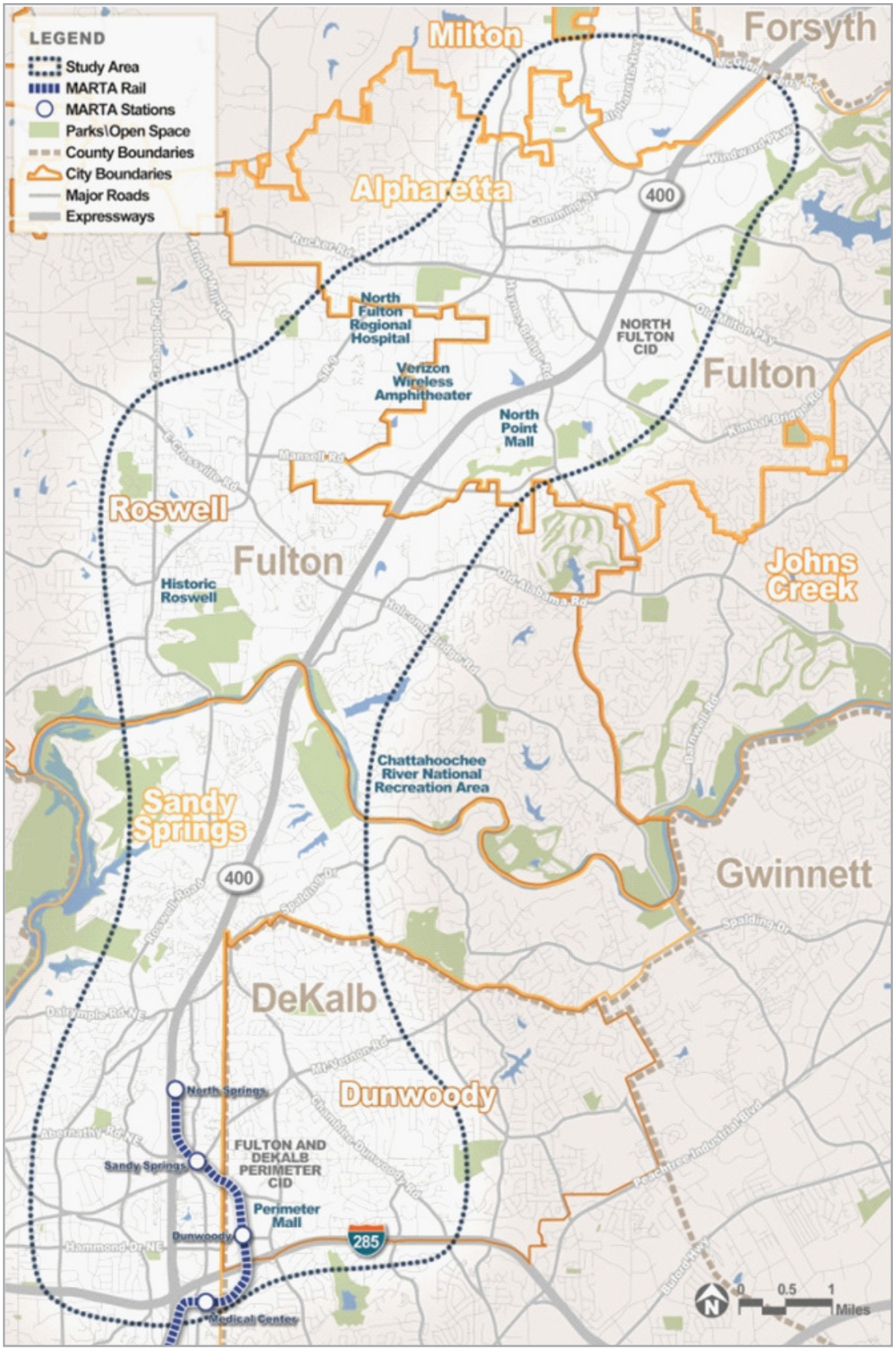
The Metropolitan Atlanta Rapid Transit Authority (MARTA) has undertaken the Georgia 400 Corridor Alternatives Analysis (AA) in an effort to identify potential transit improvements for portions of northern Fulton County. The study area, shown in **Figure 1-1**, includes the Georgia State Route 400 (GA 400) expressway between I-285 and the county line separating Fulton and Forsyth. The AA will result in the identification of a transit alternative (or alternatives) that best addresses the transportation needs in this study area.

The Federal Transit Administration(FTA) requires a "rigorous and objective" evaluation. Alternatives must follow its guidance and procedures as a first step in the Federal project development (New Starts[1]) program, (49 USC 5309(e)(1)(A)). FTA also requires that a No-Build Alternative be considered in addition to Build Alternatives as a benchmark for establishing the travel benefits, environmental impacts of the alternatives and the cost-effectiveness of the Build Alternatives. The Evaluation Framework Report documents the process by which potential transit alternatives are developed and evaluated. This report also provides detail on performance measures and associated analysis methodologies used to screen conceptual alternatives and ultimately select a solution called a Locally Preferred Alternative (LPA) that best meets the purpose and need of the AA.

Several previous planning studies have helped guide the development of the Evaluation Framework Report. A complete listing and summary of each study can be found in the *GA 400 Corridor Existing Conditions and Future Trends Report (November 2012).*

1 FTA funds the development of transit fixed guideway projects through the Section 5309 grant program which is commonly known as the New Starts program. This discretionary program includes a detailed federal evaluation process that is intended to (1) determine the justification for federal investment in a project and (2) confirm that a project sponsor has the financial capacity to undertake the project.

FIGURE 1-1: Connect 400 Study Area



Source:
AECOM/JJG Joint Venture

2.0 Relationship to Purpose and Need

As illustrated in **Figure 2-1**, the evaluation framework documents the process by which potential transit alternatives are developed and evaluated. The evaluation framework reflects the purpose and need of the project which led to the development of the goals and objectives, followed by the development of evaluation criteria and related performance measures to be used in the screening of alternatives. The following sections provide a summary of the key factors identified in the Existing Conditions and Future Trends Report (November 2012) and documented in the Purpose and Need Report (November 2012) which represent the basis of the evaluation framework.

2.1 Problem Statement

The GA 400 study area is challenged by low-density, single use land use patterns, a fragmented and discontinuous roadway network, and a lack of transportation options in the corridor. Area land use results in increased automobile use. Further, as a result of few transportation options, a high proportion of trips are made on GA 400 and State Route 9, the only available north-south routes. In addition to roadways, a majority of the transit routes follow a similar north-south pattern. Therefore, mobility for citizens that require east-west movement to and through the study area is limited.

Transportation-related problems caused by these conditions include:

- Increasing levels of roadway congestion within the corridor.
- Limited mobility options.
- Longer transit travel times compared to auto.
- Increasing travel demands.

These problems may also contribute to:

- Constrained economic development.
- Delayed construction of transportation improvements due to funding shortfalls.
- Continued growth of vehicular traffic negatively affects the study area's air quality.

2.2 Project Purpose

The purpose of the project is to provide reliable, convenient, efficient, and sustainable transit service in the GA 400 corridor by:

- Providing high capacity transit (bus and/or rail) through the GA 400 corridor study area,
- Improving transit linkages and coverage to communities within the study area, and
- Enhancing mobility and accessibility to and within the study area by providing a more robust transit network that offers an alternative to automobile travel.

2.3 Need for the Project

During evaluation of the mobility problem and travel conditions within the GA 400 corridor study area and through the public involvement process, the following themes emerged that reinforce the need for transportation improvements:

- Travel demand - Increased travel demand and traffic congestion is expected to result from:
  - Population, employment, and household growth,
  - Increases in the elderly population, and
  - High percentage of minority, low-income, and transit dependent populations in the study area.
- Transit mobility - There is inadequate transit connectivity between northern Fulton, DeKalb, Gwinnett, and Cobb Counties, including east-west travel; and limited north-south roadway connectivity across the Chattahoochee River.
- Transit travel times - Transit travel times are not competitive with auto travel times for trips within the study area or for trips with origins and destinations outside the study area.
- Economic development - Traffic congestion caused by insufficient transportation system capacity affects both personal travel and goods movement, which constrains economic development opportunities.
- Air quality - The continued growth of vehicular travel will negatively affect air quality in the study area and the region.

2.4 Goals and Objectives

The FTA New Starts process prescribes that an AA identify a series of goals and related objectives that potential transit investments would fulfill. The goals and objectives of the GA 400 Corridor AA were developed to address the mobility and accessibility challenges identified in the problem statement and the associated Purpose and Need statement. These goals and objectives also reflect input received from the general public and the Project Steering Committee (PSC), which is the advisory committee established to guide the study process. The PSC is made up of the Stakeholder Advisory Committee (SAC) and Technical Advisory Committee (TAC). The SAC includes key members of the community, elected officials, residents and area employers to provide community insight and input on major project themes. The TAC is made up of representatives from state, local, and federal agencies who are responsible for providing input on technical and policy framework. The goals and objectives of the GA 400 Corridor AA are presented in **Table 2-1.**

2.5 Evaluation Criteria

Evaluation criteria are quantitative and qualitative factors or standards related to the specific goals and objectives used to identify the LPA. Performance measures are based upon evaluation criteria and intended to serve as:

- Measurable indicators of the degree to which alternatives meet the project goals and objectives
- Basis for comparing and highlighting distinctions between alternatives.

Section 4 provides a detailed description of the evaluation criteria and associated performance measures applied during the evaluation processes.

2.6 Public and Stakeholder Input

The Purpose and Need and associated goals and objectives underwent a number of revisions and refinements to reflect input from the public and stakeholders. A series of project advisory committee and public meetings were held in winter and spring of 2012 to present major findings from the assessment of existing conditions and to solicit input. The study team explained the importance of developing these statements that clearly reflect the mobility challenges in the corridor and to set the basis for the definition alternatives.

The TAC and PSC met in February and May 2012 to review and further refine the statements to better address the Purpose and Need. Additionally, the TAC and PSC participated in exercises to review and help determine the performance measures to be used in the screening of alternatives. The following bullets highlight the input from the public and stakeholders that were incorporated into the evaluation framework process.

- Focus on moving people rather than vehicles
- Ensure transit ridership includes new riders, transit dependent riders, and choice riders
- Consider improvements to safety such as the potential reduction in crashes
- Consider some of the performance measures (e.g., VMT reductions, ARC's multimodal measure, transit and Equitable Target Area Index) used in Atlanta Regional Commission's Plan 2040
- Mitigate environmental impacts such as noise
- Reduce the number of transfers is important
- Consider the potential for interoperability and/or the use of existing facilities (park and rides)

Figure 2-1: Evaluation Framework Overview

Table 2-1: GA 400 Corridor AA Goals and Objectives

Goal 1: Improve Mobility and Access:	
Problems	Goals and Objectives
• Levels of roadway congestion are forecast to increase along the corridor. • Transit mobility options are limited. • Transit travel times are not competitive with auto travel times in the corridor. • Travel demands are increasing.	Improve transit access and connectivity to employment, education, residential, and activity centers within the study area and the region
	Increase transit ridership and capacity
	Improve transit travel times and reliability for all trip purposes
	Improve multimodal connections and access to the existing transit systems
Goal 2: Support Land Use and Economic Development Planning:	
Problem	Goals and Objectives
• Economic development is constrained	Ensure consistency with land use plans of study area jurisdictions
	Support planned and potential economic development
	Provide opportunities for compact land development that supports transit ridership
Goal 3: Provide Cost-Effective Transit Service:	
Problem	Goals and Objectives
• A funding shortfall slows the construction of transportation improvements.	Maximize operating cost-efficiency [2]
	Match the transportation investment to the study area's level of travel demand
	Provide a cost-effective transit system
Goal 4: Minimize Environmental Impacts:	
Problem	Goals and Objectives
• Continued growth of vehicular traffic will negatively affect the study area's environment.	Avoid, minimize, and mitigate impacts to cultural, historic, and environmentally sensitive areas
	Avoid, minimize, and mitigate negative impacts on the surrounding community including parks

2 Maximize in this Objective refers to the optimization of operating and maintenance costs.

3.0 Evaluation Process

The alternatives development process employs the following three levels of evaluation to define the LPA for the GA 400 corridor:

- **Fatal Flaw Analysis** – to identify Build Alternatives to advance into Screen 1
- **Screen 1** – to identify Build Alternatives to advance into Screen 2
- **Screen 2** – to identify the LPA

As presented in **Figure 3-1**, the three-step evaluation process is generally characterized by the application of an increasingly detailed and comprehensive set of evaluation criteria and performance measures to a decreasing number of alternatives. As the process advances, more quantitative and less qualitative measures are applied. To accommodate the more detailed evaluation of the alternatives during each successive step in the evaluation process, the alternatives are also defined in progressively greater detail.

In addition to the Build Alternatives that undergo evaluation, the No-Build Alternative is also developed and assessed against the criteria noted in this report. The No-Build Alternative provides the benchmark for establishing the travel benefits, environmental impacts of the alternatives and the cost-effectiveness of the alternatives. It also establishes much of the information needed for the purpose and need since it examines the horizon year travel demand and its impact on the transportation facilities and services that are likely to exist in the year 2040.

3.1 Fatal Flaw Analysis

The fatal flaw analysis is a three-part process: Step 1 identifies potential transit technologies and recommends those to advance; Step 2 pairs those transit technologies with proposed geographic alignments to form the universe of alternatives; and Step 3 evaluates the alternatives to identify those to advance to the Screen 1 analysis.

Step 1: Conduct an independent transit technology assessment in order to identify the most promising technologies for consideration in the fatal flaw analysis. The technologies include, but are not limited to, the following:

- Bus
- Bus Rapid Transit (BRT)
- Light Rail transit/Streetcar (LRT/SC)
- Heavy Rail transit (HRT)
- Diesel Multiple Unit (DMU)
- Automated Guideway Transit (AGT)

Step 2: Based on the results of Step 1, apply the technologies that rate best to a universe of geographic alignments identified through previous studies, baseline conditions,

and public and stakeholder input to develop the universe of alternatives.

Step 3: Based upon the alternatives generated from Step 2, conduct the fatal flaw analysis using existing information and field reconnaissance, and aerial photography. The fatal flaw analysis is a primarily qualitative assessment of the initial alternatives with regard to meeting the purpose and need for the project and constructability. The fatal flaw analysis considers the following evaluation criteria:

- Capacity;
- Transit accessibility and connectivity;
- Engineering constraints/costs; and
- Community impact.

Qualitative scoring is incorporated based on comparative analysis. The goal of the fatal flaw analysis is to reduce the universe of alternatives to a manageable number of Build Alternatives to move forward to the Screen 1 analysis. Those alternatives determined to be non-supportive of the above criteria are eliminated from further consideration.

3.2 Screen 1 Analysis

The objective of Screen 1 is to further reduce the set of alternatives to the most promising alternative(s), and to eliminate others from consideration. The alternatives subject to Screen 1 are defined in greater detail than they were during the fatal flaw analysis using additional information such as typical cross-sections, general station locations and estimated capital, operating and maintenance coststo provide the basis for a higher level of technical analysis. Further, the No-Build Alternative isdeveloped and evaluated as part of Screen 1 for comparisons to the Build Alternatives.

Screen 1 employs a single-step process of evaluating, scoring, and ranking the alternatives using a set of quantitative and qualitative performance measures (see **Table 4-1**), but a relatively less comprehensive level of analysis than the subsequent Screen 2 analysis. Further information on each performance measure, including their application,is provided in Section 4. Screen 1 will consider the following evaluation criteria:Mobility;

- Mobility;
- Travel times;
- Accessibility and connectivity;
- Land use and development;
- Potential for transit oriented development (TOD);
- Costs;
- Environmental quality; and
- Community impact.

The result of Screen 1 is a subset of the Build Alternatives identified during the fatal flaw analysis and subject to undergo Screen 2.

3.3 Screen 2 Analysis

Screen 2 is similar to Screen 1 in terms of the approach, in that it is a single-step process of evaluating, scoring, and ranking the alternatives. However, the shorter list of alternatives subject to Screen 2 permits a more in-depth analysis using the entire list of performance measures identified in Table 4-1. Many of the criteria used in Screen 2 include technical analyses using the Travel Demand Model (TDM) to generate the mobility and cost-effective metrics required in the FTA New Starts project rating process. Screen 2 will consider the following evaluation criteria:

- Mobility;
- Travel times;
- Accessibility and connectivity;
- Land use and development;
- Potential for TOD;
- Costs;
- Cost effectiveness;
- Environmental quality;
- Air quality; and
- Community impact.

To accommodate Screen 2, conceptual engineering of the alternatives is developed at a greater level of detail sufficient to establish the physical requirements of the alternatives, and the associated costs, benefits, and impacts. This requires a greater level of definition of how the alternatives would function - including the operational and design characteristics, and more precise alignment footprints. In addition, information regarding potential alignment challenges, particularly grade and turning radii, for these technologies are incorporated. For fixed guideway transit alternatives, this entails a level of detail sufficient to identify right-of-way requirements, geometrics, and operating requirements for alignment, maintenance center(s) stations and parking sites. Screen 2 concludes with a recommendation for an LPA.

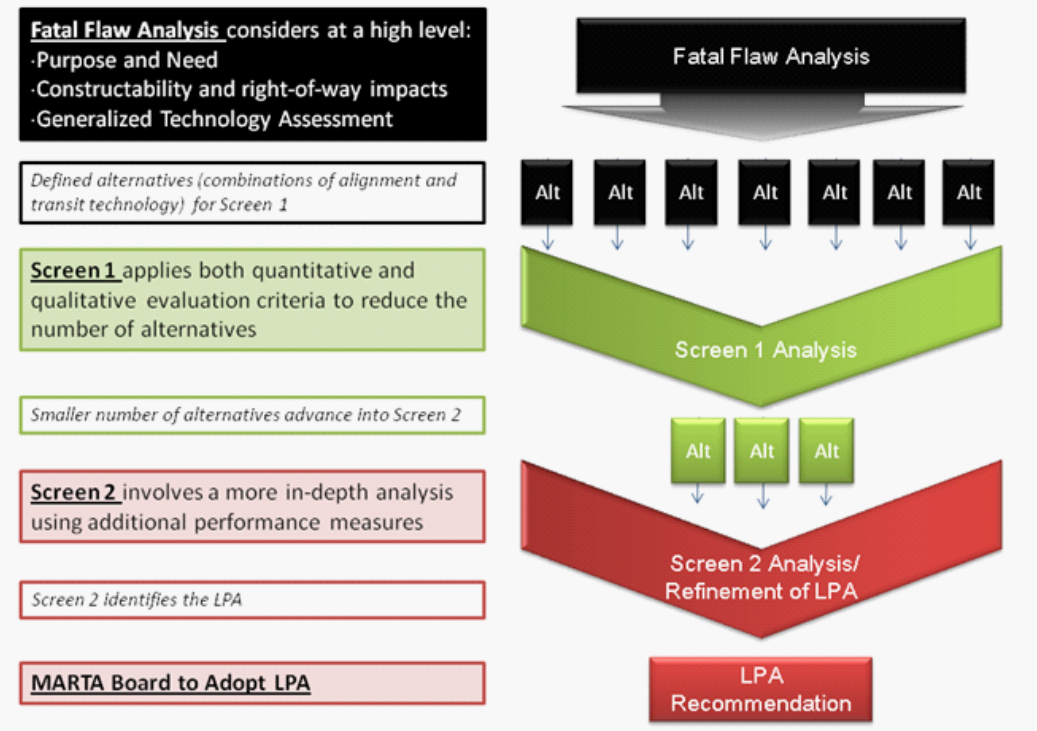
3.4 Rating Methodology

The comparison of alternatives, depending on available and relevant data, is based on a quantitative assessment of data results in combination with a qualitative evaluation of each criterion. Each alternative is assigned a rating of High, Medium, or Low relative to its performance. These rating terms are a means of qualitatively comparing the alternatives to one another, and the No-Build Alternative. The ratings are shown as a numeric value. The following equivalencies are applied in the rating of alternatives:

- 2 points = High
- 1 point = Medium
- 0 point = Low

The quantitative analysis results are grouped into three equal ranges from highest to lowest to arrive at the ratings for the alternatives. If the data can be grouped based on three equal intervals, the ratings of 'High,' 'Medium,' and 'Low' are assigned to the alternatives accordingly. However, the ranges may be adjusted based on the data to establish more logical differentiation among the alternatives. In cases where the variance is very small among the values, a medium rating, or one point is used as appropriate.

Figure 3-1: Three Step Evaluation Process



Note: The graphic above is illustrative in nature and the actual number of alternatives to be carried forward through each stage of screening is dependent on analysis results

4.0 Evaluation Criteria and Performance Measures

The evaluation criteria and performance measures used in the evaluation of alternatives were developed based on the purpose, needs, goals and objectives presented in Section 2. These measures are both quantitative and qualitative to allow for a comparison of the order of magnitude benefits and detriments of the proposed alternatives. In certain cases, one performance measure (PM) correlates to multiple project objectives, and certain objectives have been defined by more than one PM. It is important to note that care has been taken to include measures that would be effective in demonstrating the relative differences in alternatives.

The evaluation framework applied in the GA 400 Corridor AA was tailored to reflect the current New Starts criteria. The evaluation framework also considers the proposed recommended changes documented in the Notice of Proposed Rulemaking (NPRM)[3].

4.1 Evaluation Criteria

Table 4-1 shows the evaluation criteria and associated performance measures organized by the project goals and objectives they are intended to address. **Table 4-1** also presents how the evaluation criteria and performance measures were applied in the screen analyses. The following discussions provide details on each PM grouped by evaluation criteria and include the methodology, data sources and assumptions.

4.1.1 Mobility and Access

The evaluation criteria identified under this category were developed to address travel conditions and limited mobility options within the corridor. Major roadways in the corridor are consistently congested with lengthy delays during peak periods and this is expected to worsen in the next 30 years. The ARC TDM is used to perform analysis of alternatives in determining their potential benefits in ridership and travel times. The travel demand estimates are based on the future year 2040 Regional Transportation Plan (RTP) transportation system and the adopted Plan 2040 socio-economic forecasts for the Atlanta metropolitan area.

The performance measures under this category are intended to capture effectiveness of the given alternative in allowing more people to travel in the corridor and in providing travel time savings during congested conditions. Furthermore, these measures were developed under the premise that transit works most effectively when it provides access to jobs and housing.

3 A Notices of Proposed Rulemaking (NPRM) is a public notice issued by law when a Federal agency wants to change a regulation as part of the rulemaking process and is required to provide a 60-day public comment period. FTA recently issued the NPRM to make a number of changes in the evaluation process for New Starts and Small Starts projects. The NPRM is intended to streamline the process and to capture a wider range of potential transit benefits.

Evaluation Criterion: Mobility

Forecast ridership is one of the important measures in characterizing the efficiency and utility of a transit alternative. A transit alternative that attracts more new riders would have a dual benefit as it would yield high total ridership in addition to potentially reduce roadway congestion. Forecast ridership generated by the alternatives is bench marked against the No-Build to measure the incremental benefits.

PM: Total daily project transit boardings

This measure provides the sum of the number of daily boardings or riders on the potential alternatives using the TDM. Higher ratings are assigned to those alternatives with higher number of boardings.

PM: New transit riders

This measure reflects the relative performance of the alternatives in attracting new riders to the transit system. The term transit rider refers to a linked trip between and origin and destination, regardless of the number of transfers. Higher ratings are assigned to those alternatives with a higher number of new riders.

PM: Number of transfers per linked trip

This PM reflects the directness and convenience of travel as expressed by the average number of transfers required per trip. An entire journey, from origin to destination is a "linked" trip; this includes all aspects such as foot, car bus, or other mode between the origin and the ultimate destination. The measure is computed by contrasting the number or boardings to the number of linked trips to yield the number of transfers. Higher ratings are assigned to those alternatives with the least number of transfers.

PM: Total passengers miles

This measure is used to assess magnitude of trips in a region. Passenger miles traveled is evaluated by multiplying the project boardings by the distance of the route. Since transit vehicles generally produce less pollution and allow for a more space-efficient passage of people through a region, if all other variables are held equal, the greater societal benefit is often derived from moving people a greater distance. As such, higher ratings are assigned to those alternatives that yield higher passenger miles.

PM: Potential impacts to roadway capacity

This measure reflects the relative impact of the transit alignment on roadway capacity. Fewer impacts are associated with an increasing degree of separation between transit facilities and general travel lanes. The analysis is based on various alignment types, including exclusive at-grade, grade separated (tunnel or aerial), or in mixed traffic. As such, higher ratings are assigned to those alternatives with longer lengths of grade separated operation or exclusive guideway, potential operational impacts on the existing roadways as a result of implementing transit.

PM: Annual corridor crash reductions

Transportation safety statistics have consistently shown that transit is safer than driving based on collisions per passenger mile. In order to address safety concerns in the corridor, this measure evaluates the effective reduction in crashes, which can be used as an indicator of how well a transit alternative mitigates roadway congestion resulting from crashes.

This measure provides a comparative assessment of the potential safety benefits resulting from each transit alternatives. Data required to compute the estimated reduction in crashes are daily passenger miles computed from the travel demand model, average crash rate for private vehicle travel and average crash rate for transit travel. To calculate the number of incidents, average crash rates based on travel mode are multiplied by the change in passenger miles traveled to determine the net change in incidents. For private vehicles, the change in passenger miles considers the travel distance matrix for both single-occupancy vehicle (SOV) and high-occupancy vehicle (HOV) trips. For public transportation, the transit assignment output passenger miles are summarized by mode for the baseline scenario and alternative scenarios; these are then used to compute the difference.

The proposed crash rates are derived from the ARC Plan 2040 methodology for transit incident congestion. A positive value represents a reduction in net crashes and a negative value represents an increase in net crashes resulting from the project. As such, higher ratings are assigned to those alternatives that yield higher reductions in net crashes.

Evaluation Criterion: Travel Times

PM: Transit travel time savings

This measure evaluates the impact the Build Alternatives would have on transit travel time. This measure compiles travel time spent on transit, whether on a transit vehicle, time spent transferring from one transit technology to another, and wait times associated with the given trip. Travel time savings are estimated for both existing riders and forecast new transit riders. Trip tables from the modal choice model and transit travel times are used in this calculation. Higher ratings are assigned to those alternatives with a higher level of travel time savings.

PM: Differences in transit and auto travel times between origins and destinations in the study area

This measure shows the difference in transit travel time and automobile travel time for various origins and destinations in the study area. A number of origins and destinations are selected and the average travel times by mode are determined. This measure gauges the overall competitiveness of transit compared to automobile travel. Higher ratings are assigned to those alternatives with shorter average travel times.

Evaluation Criterion: Accessibility and Connectivity

PM: Projected population and employment within a 10-minute walk and drive of stations

This measure identifies 2040 population and employment within a 10 minute walk and drive of proposed stations using the GIS Network Analyst tool. This network-based spatial analysis allows users to dynamically model realistic network conditions, including turn restrictions, speed limits and traffic conditions at different times of the day. A 10 minute walk time was chosen as a standard equivalence to walking ½ mile. Drive time calculation takes into consideration congested roadway conditions. The 2040 population and jobs allocated at the traffic analysis zone (TAZ) level are used as the basis for this calculation. Higher ratings are assigned to alternatives that provide access to higher population and employment areas.

PM: Major trip generators/activity centers within a 10-minute walk anddrive of stations

Similar to the previous measure, GIS Network Analyst is used to identify activity centers and trip generators within a 10 minute walk or drive of proposed stations. As there are varying degrees of trip generating potential associated with various types of activity centers, each activity center is qualitatively ranked as Minor (1 point), Moderate (10 points), or Major (100 points). Under this performance measure, a minor activity center (i.e. day-care center) would have one-tenth the trip generating potential of a moderate activity center (i.e. small shopping center), while a major activity center (i.e. a university or regional mall) would have ten times the trip-generating potential of the moderate activity center. Higher ratings are assigned to those alternatives that yield higher trip generating scores.

PM: Low-income, minority, elderly, and zero-car populations/ households within a 10-minute walk of stations

This measure gauges the degree to which alternatives provide access to transit dependent populations, which are defined as low-income, minority, elderly populations and zero-car households. This measure captures the potential benefits by measuring how many transit dependant persons live within walking distance of a proposed transit station. This measure is consistent with the NPRM's greater focus on estimating the transit benefits to these populations. Using U.S. Census 2010 data, GIS Network Analyst is used to calculate the total number of low-income, minority, elderly and zero-car populations or households within a 10 minute walk to proposed stations. Drive time is not considered in this analysis since many of these populations may not own vehicles. Higher ratings are assigned to those alternatives that provide access to the greatest number of transit dependent populations.

PM: Interface with existing transit and future Concept 3 rapid transit service

This measure considers potential access to existing and proposed transit as described in Concept 3, the Atlanta region's transit vision. GIS is utilized to spatially assess the potential for the alternatives to interface with existing and potential rapid transit envisioned in Concept 3. Furthermore, this analysis also includes the degree to which a proposed transit project can interface with and/or utilize existing transit infrastructure such as park and ride lots, vehicle fleets and maintenance facilities. Higher ratings are assigned to those alternatives that provide a higher level of interface with existing and proposed transit.

PM: Maximize walking and bicycling accessibility to stations

This measure considers the accessibility of proposed stations for pedestrians and bicyclists based on the surrounding transportation network. Improved pedestrian and bicycle access allows short-distance trips to access a greater number of potential destinations. The roadway networks within a ½ mile radius of stations are qualitatively assessed for their potential to provide a safe environment for pedestrians and bicyclists. Factors to consider include existing and planned sidewalks and bike lanes, presence of higher density land uses and general road characteristics such as average vehicle speeds, accident data, and daily volumes. Higher scores are given to those alternatives with stations which have a higher potential for improved accommodations for safe pedestrian and bicycle access.

4.1.2 Land Use and Economic Development

Station areas that provide access to high capacity transit have the opportunity to become destinations within the region provided that appropriate zoning and incentives exist to support new developments. As such, the analysis of land use and economic development potential is focused on station

areas. This evaluation is a two-step process that involves an analysis at the station area level in which the results are aggregated and assigned to alternatives to determine their performance. A ½ mile radius of transit stations is used as the geographic unit of analysis. The following sections will more clearly describe the process.

Evaluation Criterion: Land Use and Development

PM: Consistency with adopted local and regional plans

The degree to which an alternative is consistent with land use policies is evaluated based on a review of the adopted local and regional plans; these include comprehensive land use plans, Livable Centers Initiative (LCI), corridor studies and Concept 3. The assessment relies upon a qualitative evaluation comparing the plans with the alternatives. Relevant plans identified in the Existing Conditions and Future Trends Report (May 2012) are reviewed for their support of, opposition to, or exclusion of the following five factors: transit-supportive nodal development, multimodal transportation, general and explicit support of fixed-guideway transit, and accommodation of transit-oriented land uses at specific station areas. Higher ratings are assigned to those alternatives that show greater support of the local and regional plans.

PM: Acres of land with economic development incentives within ½ mile of stations

This measure considers the degree to which the proposed stations of alternatives are served by economic development incentives that traditionally focus on tax incentives and infrastructure improvements to encourage growth. This measure requires the identification of areas with economic development incentives within the ½ mile station area boundaries. Higher ratings are assigned to those alternatives within proximity to a higher number of economic development incentives.

Evaluation Criterion: Potential for Transit-Oriented Development (TOD)

PM: Projected population and employment densities within ½ mile of stations

This measure serves to identify those alternatives that would provide transit access to the areas with high concentrations of residents and employment in the corridor. This measure is quantifiable by calculating the average residential and employment densities within a ½ mile of proposed stations using the GIS spatial analysis tool. For each alternative, the 2040 population and the number of households allocated at the TAZ level is used to derive residential and employment densities surrounding the stations. Once the population, households, and employment within the buffered areas have been calculated and summed up for each alternative, they are normalized by the cumulative buffered area to determine the average residential and employment densities in proximity to each alternative. Higher ratings are assigned to those alternatives that provide access to the areas with greater population and employment densities.

PM: Acres of transit-supportive future land uses within ½ mile of stations

This measure is intended to identify the alternatives that serve the areas planned for transit-supportive future land uses. The GIS spatial analysis tool is used to calculate the acreages of transit supportive future land uses within ½ mile of proposed stations. The residential density threshold of 9 units per acre is considered supportive of fixed guideway transit according to frequently cited research by the Transportation Research Board (TRB).Other categories considered to be transit-supportive include office-institutional, commercial and mixed-use, which permit a mixture of high-density residential, office, and retail. Higher ratings are assigned to those alternatives that are in proximity to the greatest acres of transit-supportive land uses.

PM: Acres of vacant or underutilized land within ½ mile of stations

Available land for development or redevelopment is quantified in terms of the acres of vacant or underutilized land located within ½ mile of proposed stations. This analysis utilizes aerial photography supplemented by tax assessor's data, where available. Using qualitative criteria, which include age and condition of buildings and property, land use, site layout, surface parking and economic obsolescence, underutilized properties are designated on a parcel-by-parcel basis within each station area. Higher ratings are assigned to those alternatives with proximity to greater acres of vacant or underutilized lands.

4.1.3 Costs and Cost-Effectiveness

The performance measures under the costs and cost-effectiveness category are intended to ensure project costs are commensurate with measurable benefits and ensure financial feasibility.

Evaluation Criterion: Costs

PM: Annual Operations and Maintenance (O&M) Costs

Annual O&M costs are estimated for each alternative and the incremental costs above the No-Build are calculated or rail service, peak rail cars, annual revenue car-miles, annual

revenue train-hours, number of stations, miles of track, and number of rail storage and maintenance facilities are the typical parameters used to estimate operating and maintenance cost. For bus service, peak buses, annual revenue bus-miles, annual revenue bus-hours and number of bus garages are the parameters used to estimate operating and maintenance cost. Additionally, the average roadway O&M costs from GDOT and industry average transit O&M costs are taken into account in the O&M cost estimates of the alternatives.

O&M costs for Screen 1 are based on the operating requirements necessary to meet MARTA service standards, and thus, vehicle operating capacity and potential ridership are not taken into consideration. O&M costs for Screen 2 builds on vehicle requirements calculated in Screen 1 relative to modeled ridership demand. Higher ratings are assigned to those alternatives associated with lower annual O&M costs.

PM: Construction Capital Costs

Project costs for each alternative are developed based on the FTA Standard Cost Categories established for New Starts with consideration of acceptable industry practices for the given transit technology. Specifically, capital costs for Screen 1 are developed based on unit costs for similar national and local transit investments and cost estimates used by the Georgia Regional Transportation Authority (GRTA) and ARC. Furthermore, the costing methodology is consistent with FTA guidelines as well as the unit costs associated with the transit projects under the Georgia's Transportation Investment Act of 2010. A range of high and low capital unit costs are applied to obtain a range of potential capital costs for a given alternative. Capital costs are refined during Screen 2 as detailed cost worksheets associated with conceptual engineering are developed. Higher ratings are assigned to those alternatives associated with lower construction capital costs.

PM: Right of Way Costs

A preliminary estimate of right of way acquisition costs is prepared by estimating the total areas required for alignment and station construction, then applying average land values determined from general land use types and parcel-level tax data. Higher ratings are assigned to those alternatives associated with lower right of way costs.

Evaluation Criterion: Cost-Effectiveness

PM: Cost Effectiveness Index (incremental costs divided by transportation system user benefit)

Cost Effectiveness Index (CEI) is a key measure used by FTA to evaluate projects for Federal funding. It is calculated using the incremental cost divided by transportation system user benefits (TSUB). Incremental cost is the sum of annualized incremental capital cost and annualized incremental O&M cost in current dollars.

TSUB is a system-wide measure of the benefits that are derived by travelers related to the implementation of the project. This statistic is expressed as person-hours of equivalent in-vehicle time savings when the project is compared to the No-Build Alternative. An expected key benefit of a new fixed guideway project is faster travel times (i.e., in-vehicle time), fixed guideway projects may also include improved access, egress, frequencies and costs; all of these elements are embedded in the TSUB measure. However, faster travel time may not be realized for every origin-destination pair. The TSUB calculation includes disbenefits and allows identification of affected zones. This is an important consideration for evaluation social and community benefits of a transportation project. The user benefits measure is sensitive to changes in both travel times and travel costs, and recognizes benefits for both existing transit users and new users diverted from other modes. The measure is computed using the FTA SUMMIT program which utilizes the regional model's mode choice data. User benefits are a direct output of the SUMMIT model. Higher ratings are assigned to those alternatives associated with lower CEI values.

PM: Incremental cost per new rider

The purpose of this measure is to identify the incremental cost for each new rider attracting to the transit system. The ARC regional TDM output is utilized to determine the number of new transit users. Capital costs and operating and maintenance costs are annualized and then divided by the new transit users to compute the value. Higher ratings are assigned to those alternatives associated with lower incremental costs per new rider.

4.1.4 Environmental Impacts

Potential transit investments should be implemented in a manner that minimizes effects to the natural and man-made environment. Potential negative impacts can include noise, displacement, physical barriers to traffic circulation and neighborhood severance. Consistent with the goals and objectives, care should be taken to ensure that potential impacts to the environment are avoided, minimized and mitigated. Furthermore, as a federally-designated non-attainment area, maintaining and/or improving air quality is an important issue in the Atlanta region. As such, the potential for transit projects to improve air quality directly relates to reduction of auto emissions.

Many of the environmental data used in this analysis are derived from the ARC GIS database or other widely accepted sources such as the U.S. Census Bureau, Georgia Department of Natural Resources or U.S. Fish and Wildlife Service. Specific data sources are sited under each performance measure.

Evaluation Criterion: Environmental Quality

The following performance measures offer a cursory review of the potentially sensitive resources that could be affected by the implementation of transit in the study area. GIS spatial analysis using the specified buffered distances is applied to the following measures to assess the potential impacts on the natural and built environment:

PM: Acres of potentially impacted wetlands and water bodies within 500 feet of alignments and ½ mile of stations

Acres of wetlands and water bodies are calculated using the National Wetlands Inventory (NWI) GIS database, and GDOT's DLG-F Polygonal Hierarchy and/or linear feet of ARC's Rivers and Streams GIS database. Higher ratings are assigned to those alternatives with proximity to smaller acres of potentially impacted wetlands and water bodies.

PM: Number of potentially impacted historic resources within 500 feet of alignments and ½ mile of stations

The number of historic resources is calculated using the GIS layer developed by Historic Preservation Division of Georgia Department of Natural Resources. Higher ratings are assigned to those alternatives with proximity to a lower number of potentially impacted historic resources.

PM: Acres of noise sensitive land uses within 700 (HRT), 350(LRT), or 200(BRT) feet of alignments

Using FTA guidance on transit noise assessment, this analysis considers the potential impacts of noise associated with the project alternatives. Construction and operation of new transit facilities poses a potential noise problem for residents and businesses near an alignment. Noise-sensitive land uses are defined as single- and multi-family residential, low-density commercial and institutional uses (e.g., schools and churches).This measure requires application of GIS to identify and calculate the acres of the noise-sensitive land uses within 700 feet of heavy rail, 350 feet of light rail and within 200 feet of BRT alternatives. Higher ratings are assigned to those alternatives with proximity to smaller acres of noise sensitive land uses.

PM: Number of contaminated and hazardous material sites within ¼ mile of alignments

The EPA's Geospatial Data Access Project GIS shapefile and the Multisystem Envirofacts Query Form are used to identify the number of contaminated hazardous material sites within ¼ mile of alignments.This buffer area would capture all direct physical impacts and allow for a broader view of potential effects. Higher ratings are assigned to those alternatives with proximity to smaller number of contaminated and hazardous material sites.

Evaluation Criterion: Air Quality

PM: Change in VMT

This measure is intended to show the potential for a reduction in the total VMT for all corridor trips from the various alternatives. The estimated change in VMT resulting from mode shift is considered in accordance with the proposed NPRM. The TDM performs separate highway assignments by four time periods. These time periods are split into AM (6AM to 10AM), Midday (10AM to 3PM), PM (3PM to 7PM), and Night (7PM to 6AM). The total VMT calculation for each scenario is a summation of these four time periods. Higher ratings are assigned to those alternatives with higher reductions in VMT.

PM: Change in daily emissions of air quality pollutants (CO, NOx, PM2.5, PM10)

This measure takes into account the importance of air quality benefits of transit by estimating the change in mobile emissions associated with each alternative. The emission factors specific for the Atlanta region are calculated using the EPA model MOBILE6.1. These factors are used in conjunction with output of the highway assignment (calculated from the previous VMT measure) to generate daily emissions of air quality pollutants. Higher ratings are assigned to those alternatives with higher reductions in pollutants.

Evaluation Criterion: Community Impact

The performance measures under the community impacts criteria consider the potential burdens, displacements, and disruptions associated with constructing a major transit investment.

PM: Low-income, minority, elderly, and zero-car populations/ households within 500 feet of alignments

This measure considers potential negative impacts on transit dependent populations located in proximity to proposed alignments. As aforementioned, transit dependent populations are defined as those who are low-income, minority, elderly and do not have vehicle ownership. GIS spatial analysis is used to evaluate the project's impact areas by identifying the defined 2010 Census block groups within 500 feet of an alignment. Furthermore, this analysis may be supplemented with the use of the ARC Equitable Target Area

(ETA) Index which identifies a regional distribution of transit dependent communities and considers age, education, median housing values, poverty and race. Higher ratings are assigned to those alternatives that result in a lower number of potentially impacted transit dependent individuals or households.

PM: Estimated community impacts/disruptions and number of displacements

Potential impacts on neighborhoods, residences, and businesses located along the alignments or near the proposed stations are assessed. A count of the parcels in addition to acres of park lands located within 500 feet of an alignments or 1,000 feet of potential stations is used for comparison in Screen 1. The parcel data is overlaid on the ARC existing land use (LandPro) data to cumulate the affected residential, commercial and institutional parcels.

During Screen 2, a preliminary assessment of potential acquisitions is conducted using aerial photography and field surveys. This supplements the parcel-level analysis. An offset distance consistent with the design criteria for each technology is applied to estimate the number of potential acquisitions.

TABLE 4-1: GOALS, OBJECTIVES, EVALUATION CRITERIA AND PERFORMANCE MEASURES

Transportation Challenges	Evaluation Framework				
	Goals and Objectives	Evaluation Criteria	Performance Measures	Screen 1	Screen 2
	Goal 1: Improve Mobility and Access				
Levels of roadway congestion are forecasted to increase along the corridor. Transit mobility options are limited. Transit travel times are not competitive with auto travel times in the corridor. Travel demands are increasing.	Increase north-south and east-west transportation capacity	Mobility	Total daily project transit boardings		X
			New transit riders		X
			Number of transfers per linked trip		X
	Increase transit ridership		Total passengers miles		X
			Potential impacts to roadway capacity	X	X
			Annual corridor crash reductions		X
	Improve transit travel times and reliability for all trip purposes	Travel Times	Transit travel time savings		X
			Differences in transit and auto travel times between various origins and destinations in the study area		X
	Improve transit access and connectivity to employment, education, residential, and activity centers within the study area and the region	Accessibility and Connectivity	Projected population, household, and employment within a 10 minute walk and drive of stations	X	X
			Major trip generators/activity centers within a 10 minute walk and drive of stations	X	X
	Improve multimodal connections and access to the existing transit systems		Low-income, minority, elderly and zero-car populations/households within a 10 minute walk of stations	X	X
			Interface with existing transit and future Concept 3 rapid transit service	X	X
			Maximize walking and bicycling accessibility to stations		X
	Goal 2: Support Land Use and Economic Development Planning				
Economic development is constrained.	Ensure consistency with land use plans of study area jurisdictions	Land Use and Development	Consistency with adopted local and regional plans	X	X
	Support planned and potential economic development		Acres of land with economic development incentives with in 1/2 mile of stations		X
	Provide opportunities for compact land development that supports transit ridership	Potential for TOD	Projected population and employment densities within 1/2 mile of stations	X	X
			Acres of transit-supportive future land uses and zoning within 1/2 mile of stations	X	X
			Acres of vacant or under utilized land within 1/2 mile of stations		X

TABLE 4-1: GOALS, OBJECTIVES, EVALUATION CRITERIA (CONTINUED)

Transportation Challenges	Evaluation Framework				
	Goals and Objectives	Evaluation Criteria	Performance Measures	Screen 1	Screen 2
	Goal 3: Provide Cost-Effective Transit Services				
There is a funding shortfall to construct transportation improvements	Maximize operating and cost-efficiency	Costs	Annual Operations and Maintenance (O&M) Costs	X	X
	Match the transportation investment to the study area's level of travel demand		Construction Capital Costs	X	X
			RIght of Way Costs		X
	Provide a cost-effective transit system	Cost Effectiveness	Cost Effectiveness Index (incremental costs divided by transportation system user benefit)		X
			Incremental cost per new rider		X
	Goal 4: Minimize Environmental Impacts				
Continued growth of vehicular travel will negatively affect the study area's environment.	Avoid, minimize, and mitigate impact to cultural, historic, and environmentally sensitive areas	Environmental Quality	Acres of potentially impacted wetlands and water bodies within 500 feet of alignments and 1/2 mile of stations	X	X
			Number of potentially impacted historic resources within 500 feet of alignments and and 1/2 mile of stations	X	X
			Acres of noise sensitive land uses within 700 (HRT), 350(LRT), or 200 (BRT) feet of alignments		
			Number of contaminated and hazardous material sites within 1/4 mile of alignments		X
		Air Quality	Change in Vehicle Miles Traveled (VMT)		X
			Change in daily emissions of air quality pollutants (CO, NOx, PM2.5, PM10)		X
	Avoid, minimize, and mitigate negative impacts on the surrounding community including parks	Community Impact	Low-income, minority, elderly and zero-car population/households within 500 feet of alignments		X
			Estimated community impacts/ disruptions and number of displacements	X	X

5.0 Next Steps

The next step in the AA process is to identify the universe of conceptual alternatives for the fatal flaw analysis. These alternatives consist of various alignments in combination with transit technologies. Additionally, No-Build and Build Alternatives must be defined for consideration in Screen 1 and Screen 2. The evaluation criteria and performance measures outlined in this report will then provide the basis for a comparison of the alternatives relative to the purpose and need and corresponding goals and objectives. The evaluation results are subject to review and comment by the TAC, PSC and public. Comments received from these groups will be used to refine the evaluation results. The revised results then will serve as the basis for identifying a preferred alternative(s) to advance in the AA process.