

ALIGNMENT DEFINITION REPORT

CATS CENTER CITY STREETCAR



Charlotte Area Transit System
600 East Fourth Street
Charlotte, NC 28202

April 2006

Draft Revision: 1



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CENTER CITY STREET CAR CORRIDOR ALIGNMENT DEFINITION REPORT

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Document Revision Policy

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Summary of Changes to the Alignment Definition Report
Revision _____

Location	Change	Explanation

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1 INTRODUCTION

This report summarizes the analysis of various alignment options for the Charlotte Area Transit System (CATS) Center City Streetcar. A series of alignment alternatives was examined in consideration of specific performance criteria to ensure that the selected alignment operates efficiently, minimizes negative impacts, and provides effective service to the Center City.

The following pages contain background information on the Center City Streetcar, including a description of the project, the purpose and need for the Streetcar, and the relationship of this project to other relevant planning efforts. In addition, this report describes the detailed analysis of options for the Center City segment, including specific alternatives, evaluation methodology, examination of impacts, and recommendations.



1.1 Project Background

The Center City Streetcar is conceived as a “Portland” type streetcar system utilizing modern vehicle technology based on the European “tram”. This type of vehicle is smaller and more lightweight than traditional light rail transit vehicles, and is capable of operating within shared traffic lanes. The Center City Streetcar is an important component of CATS’ overall system plan, providing a critical link between other major transit corridors while also enhancing service currently provided on heavily-used bus routes.

1.2 Study Area Description

The Center City Streetcar ultimately is planned to extend from Beatties Ford Road at I-85, through the Center City, to Eastland Mall via Central Ave (see Figure 1-1). This corridor enables service to a number of major attractions, including Johnson C. Smith University, Johnson & Wales University, the Center City business and government districts including the new Charlotte Arena, Central Piedmont Community College, Presbyterian Hospital, the Plaza-Midwood neighborhood, and Eastland Mall.

Large housing concentrations in West Charlotte and along Central Avenue are also served, and connections throughout the CATS system are enabled through direct service to the Charlotte Transportation Center and the planned multimodal center (Charlotte Gateway Station) on West Trade Street.

Beatties Ford Road, Trade Street / Elizabeth Avenue, Hawthorne Lane, and Central Avenue were identified by the *2025 Transit Corridor System Plan* to comprise the primary corridor. However, this planning process was initiated to investigate possible alternatives and to confirm the preferred alignment.

Figure 1-1: Proposed System Map



2 PURPOSE AND NEED

A preliminary Purpose and Need statement is provided below; however, the Team will be further developing and expanding this statement based upon data received from the demand modeling analysis and other sources including the Working Session Group established for this project. The Working Session Group was created as a group of staff members from CATS and other City departments to provide technical review and feedback, meeting bi-weekly over the course of the project to discuss specific study issues.

The Center City Streetcar project is being developed as a key element of the CATS System Plan to address three critical purposes:

1. To provide an effective, high-capacity transportation link between the Charlotte Transportation Center on East Trade Street and the planned Charlotte Gateway Station on West Trade Street. The Streetcar will enable access to both transportation hubs from all major Center City destinations, and will link multiple rapid transit services as identified in the 2025 Transit System Corridor Plan.
2. To enhance transit service along two of the most heavily-utilized bus routes (Routes 7 and 9) in the CATS system. The Streetcar will improve service along high-demand transit routes on Beatties Ford Road and Central Avenue.
3. To promote usage of the five major corridors by providing needed Center City circulation and supporting economic development opportunities. The Streetcar represents a cost-effective transit investment with minimized disruption.

3 RELATIONSHIPS TO OTHER PLANS

The Center City Streetcar is closely linked to other recent and on-going planning efforts in the Charlotte region, including the CATS System Plan, other Center City planning projects such as the 2010 Vision Plan and the Center City Transportation Study, planned streetscape improvements along Elizabeth Avenue, and the regional long-range transportation plan.

CATS Corridor System Plan (September 2002)

The Center City Streetcar originates from the CATS Corridor System Plan, which includes provision of streetcars in its “Center City” element: “New circulation services connecting Center City districts not only with each other but also with areas just outside of I-277, including streetcars along Trade Street extending east to Presbyterian Hospital and west to Johnson C. Smith University and the Center City Streetcar Loop” (Staff Recommendations – p. 9).

In addition, “streetcar service to the Eastland Mall area” is included in the Southeast Corridor element, and the Beatties Ford streetcar from Johnson C. Smith University to I-85 is recommended “for study”.

Center City 2010 Vision Plan (May 2000)

Even though the Center City Vision Plan was adopted well before the CATS Corridor System Plan, the Center City Plan recognizes the importance of transit and an east-west transit corridor through the Center City. The Plan includes the following recommendation: “Study the development and technical implications of creating an East-West Transit Corridor within a zone bounded by Fourth and Sixth Streets, with continued vehicular operations” (p. 63).

Center City Transportation Study (Draft) (March 2005)

The Center City Transportation Study (CCTS) acknowledges the role of the Center City Streetcar. This report references both the CATS Corridor System Plan as well as the Center City 2010 Vision Plan, and reports that CATS is currently in the conceptual design phase of planning for modern streetcar operations along the Trade Street corridor as well as along a Center City loop. Extensions along Beatties Ford Road and Central Avenue are also discussed (p. 5:18). Policy recommendations from the Draft Report are scheduled to be adopted in Spring 2006.

2030 Long Range Transportation Plan (April 2005)

The 2030 Long Range Transportation Plan includes streetcar services in its “public transportation” component. The following statement is included under the heading for “2020 Transit Improvements”: “A ‘Portland’-type streetcar service is proposed eastward along Central Avenue to Eastland Mall, westward to Johnson C. Smith University and then north along Beatties Ford Road to I-85. The proposed streetcar route would extend along Trade Street through the center of Uptown Charlotte and will provide another transit link between the Multimodal Center and the Charlotte Transportation Center in Uptown Charlotte” (p. 6-25).

In addition, the 2030 Long Range Transportation Plan also includes streetcar service under “2030 Transit Improvements”: “A Streetcar loop of Uptown Charlotte is proposed to complement the expansion of rapid transit and provide a link with Uptown’s four historic residential wards” (p. 6-26).

Elizabeth Avenue Business Corridor Project (Draft) (August 2005)

A major streetscape project is planned for Elizabeth Avenue between Kings Drive and Hawthorne Lane. The streetscape design was developed to incorporate the track for future streetcar use, to avoid heavy construction on the street for track installation soon after the construction associated with the streetscape project is completed. Although track will be installed several years prior to the initiation of service in this corridor, construction impacts will be minimized.

4 ALIGNMENT ALTERNATIVES

4.1 Phased Implementation Approach

Although the proposed full Streetcar corridor extends from Beatties Ford Road at I-85 to Eastland Mall, it will be implemented in several phases. The first phase extends from Johnson C. Smith University, through Center City, to Presbyterian Hospital via the Trade Street / Elizabeth Avenue corridor. Alternatively, the first phase may be extended to The Plaza, via Hawthorne Lane and Central Avenue, as adopted in the 2025 Transit System Corridor Plan. Future phases will extend the streetcar along Central Avenue to Eastland Mall, and along Beatties Ford Road to I-85. Also, future streetcar “spokes” (radiating away from the primary east-west line) are proposed to provide an additional circulation element in Center City. These phased services are illustrated in the system map shown on Page 1-2.

4.2 Description of Alternatives

This Section describes the various alignment options for the Center City segment of the proposed Streetcar, extending from the vicinity of Gateway Village to McDowell Street (generally within the I-77 / I-277 freeway loop). It is important to note that the first phase of service to be implemented is more extensive in length, stretching from Johnson C. Smith University to Presbyterian Hospital (or The Plaza). However, the primary consideration of alignment options relates to the section within the Center City as defined above, because of the limited number of options available outside of the freeway loop. The purpose of this evaluation is to define the recommended east-west corridor for the streetcar through the Center City.

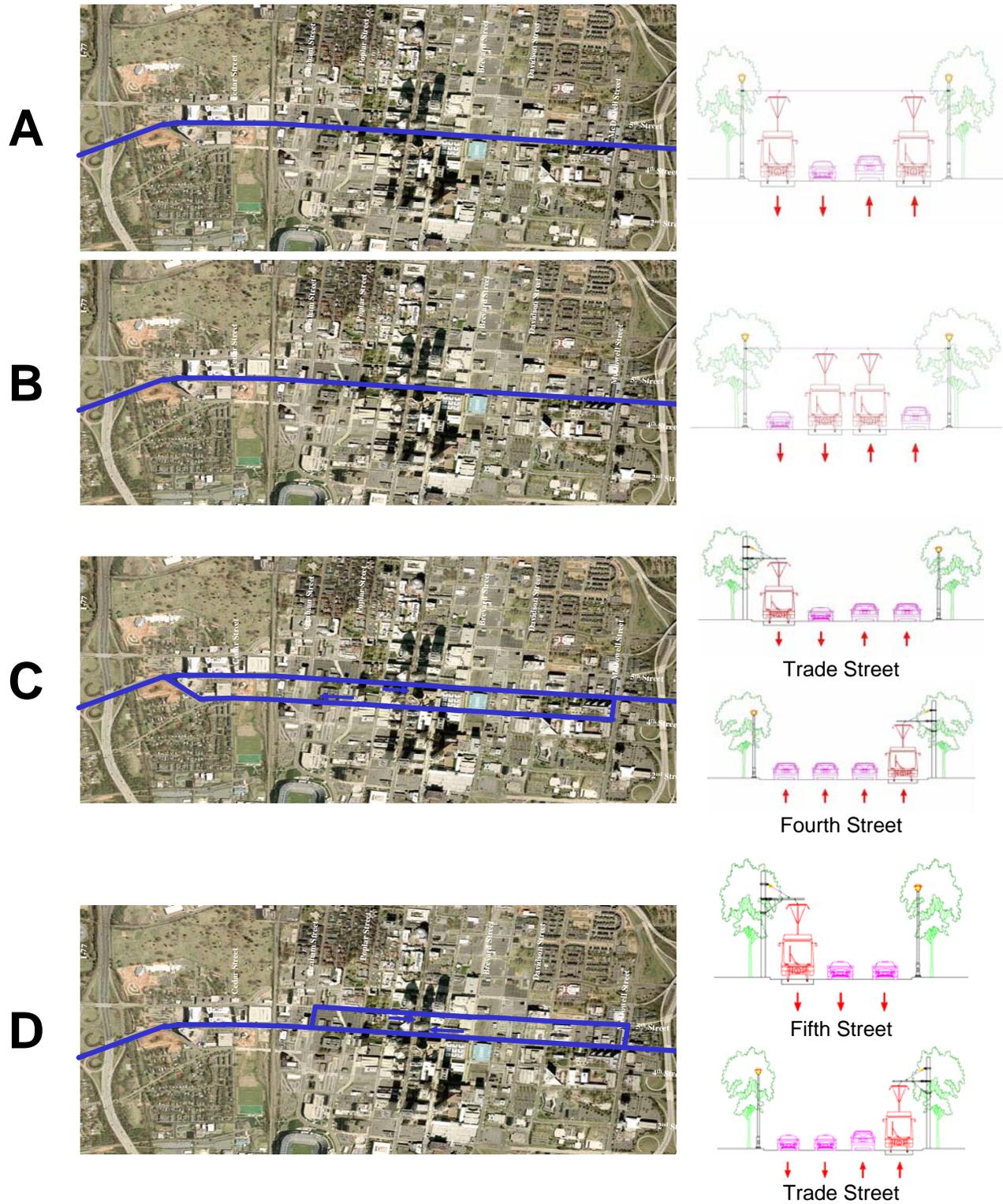
An initial feasibility assessment (described under “Tier 1 Analysis” in Section 7) was performed on five east-west thoroughfares through Center City between Third Street and Sixth Street:

- Third Street;
- Fourth Street;
- Trade Street;
- Fifth Street; and
- Sixth Street.

A series of alternatives was defined using these streets. Because all of the candidate streets (except Trade Street) operate one-way, several “couplet” options were developed, in which eastbound streetcars would operate on a different street than westbound streetcars. The initial alignment options included the following:

- Trade Street (bi-directional / curb-running);
- Trade Street (bi-directional / median-running);
- Third Street / Fourth Street couplet;
- Fourth Street / Fifth Street couplet;
- Fourth Street / Trade Street couplet;
- Trade Street / Fifth Street couplet; and
- Fifth Street / Sixth Street couplet.

Figure 4-1: Tier 2 Alternatives



The intent of the initial feasibility assessment was to eliminate those streets that are least conducive to streetcar service, based on objective evaluation criteria addressing key aspects of streetcar implementation. Through this process, the alternatives that operate on the eliminated streets would then be removed from further consideration.

The initial feasibility assessment resulted in the following three alternatives being advanced for further consideration in Tier 2:

- A. Trade Street (bi-directional / curb-running);
- B. Trade Street (bi-directional / median-running); and
- C. Fourth Street / Trade Street couplet (curb-running).

Following stakeholder input received at the Center City Transit Workshop held in February 2005, a fourth option was reinstated for additional analysis:

- D. Trade Street / Fifth Street couplet (curb-running).

These four alternatives, and representative cross-sections (looking westward), are illustrated in Figure 4-1 on the following page.

5 ALTERNATIVES EVALUATION

5.1 Overview of Evaluation Methodology

The various alternatives were evaluated using a three-tiered approach:

Tier 1: “Basic screening” process to identify street segments with the highest propensity to support the streetcar system;

Tier 2: More detailed evaluation on specific candidate alternatives to select preferred alignment; and

Tier 3: Confirmation of the preferred alignment through analysis of specific stop locations.

The methodology and criteria used to conduct each of these analyses are discussed in the following sections.

5.2 Tier 1 Analysis

Tire 1 analysis was the first step in the tiered process and was designed to screen and identify street segments with the highest propensity to support the streetcar system. The best ranking streets were advanced to Tire 2 for more detailed evaluation.

5.2.1 Methodology and Criteria

The Tier 1 analysis was intended to identify alternatives for more detailed examination, using the following four objectives as the basis for comparison:

1. Provides the most benefits to surrounding land uses and development;
2. Provides the best fit within the framework of the streetcar system;
3. Minimizes negative transportation / environmental impacts; and
4. Presents the fewest problems in terms of constructability.

This evaluation was conducted on the five east-west thoroughfares between Third Street and Sixth Street. Specific performance measures were developed for each of the objectives, and were reviewed by the Working Session Group. Scores relative to “high”, “medium”, and “low” rankings were established for each measure, and equal weighting was used for all criteria.

At this level of analysis, it is not possible to conduct detailed ridership and cost modeling evaluations on each alternative. Therefore, many of these performance measures also serve as proxies for an assessment of potential ridership and cost. The projected population and employment data, the number of major trip generators and activity centers, and the expansion of the five-minute walkable catchment area are indicators of potential ridership. Likely traffic operations impacts and utility conflicts serve as indicators of the relative cost difference of streetcar implementation on the streets being examined.

Objective #1: Provides the most benefit to surrounding land uses and development

- *Performance Measure #1: 2010 segment area population and employment*

The potential of each segment to attract transit riders from both within and outside the study area was evaluated by estimating the future population and employment located within each of the Mecklenburg Union Metropolitan Planning Organization's (MUMPO) Traffic Analysis Zones (TAZ) on or adjacent to the roadway segment. Segments with higher population and employment values received higher ratings for this measure. Projected population and employment data for 2010 were used for this assessment to coincide with the approximate opening date for the first phase of the streetcar through Center City.

- *Performance Measure #2: Number of major trip generators, activity centers, and significant parking facilities*

A major trip generator and/or activity center is defined as any hospital, shopping center/mall, convention center, government center/building, sports arena, major employer, school, and any other location that is expected to attract or generate significant transit ridership. Public parking facilities with more than 200 spaces are also considered to be major trip generators. An area with multiple adjacent surface lots was considered as one parking area. To evaluate each segment, a simple count of trip generators, activity centers, and parking areas was used. Segments with higher numbers of generators and activity centers received higher ratings.

Objective #2: Fits the best within the framework of the streetcar system

- *Performance Measure #3: Existing bus / Gold Rush bus routes*

This is a quantitative assessment of the potential transit ridership along each segment being analyzed by examining the number of routes that currently operate on each street. Streets with a higher number of transit routes received a higher rating.

- *Performance Measure #4: Expands Center City five-minute walk catchment area*

One of the objectives of the *Center City Transportation Study (Draft)* is to maximize the number of residents/employees who can access transit from within a five-minute walking distance to a transit station/stop. This criterion was used to identify segments that will add new households and employment centers that can access transit within a five-minute walk. This performance measure was defined as the percentage increase in employment and population that each segment adds to the five-minute walking catchment area (illustrated in Figure 5-1 below). Higher percentages resulted in higher ratings.

Figure 5-1: Center City Five-Minute Walk Catchment Area



Objective #3: Minimizes negative transportation / environmental impacts

- *Performance Measure #5: Traffic operations impact*

The implementation of streetcar services is not expected to have a significant impact on traffic operations. However, segments with lower traffic volumes are more conducive to streetcar operations and construction. This measure was used to evaluate the impact of automobile traffic on streetcar operations by examining the traffic volumes on the segment, parking loss or displacement along the segment, loss of access and/or access restrictions, bridge clearance conflicts, and turning restrictions.



Bridge clearance concerns are especially critical because electrical power is supplied to the streetcar system by suspending a wire above the trackway. This wire and the mechanism that supports it, is referred to as the Overhead Catenary System (OCS). The streetcar draws power from the OCS by extending a variable height pantograph or trolley pole. The streetcar pantograph is essentially the same system that is utilized for light rail systems, including the South

Corridor. The pantograph for the Portland-style vehicle has the ability to extend and retract to allow for a maximum wire height around 21 feet and a minimum wire height around 13.5 feet. For the purposes of this report, it is assumed that the same pantograph system will be used for the Center City Streetcar project.

When operating in mixed traffic, the height of the OCS wire not only has to fit within the operating range for the pantograph; it also must be situated to avoid conflicts with vehicular traffic. If a vehicle (e.g. truck, bus, or emergency vehicle) were to make contact with the OCS wire, electricity may discharge and create a potentially life threatening condition. The required clearance between an existing bridge structure and the proposed top of rail is 18 feet. If a bridge clearance is less than 18 feet, avoidance measures or waivers will be necessary.

- *Performance Measure #6: Sidewalk / pedestrian ratings*

With regard to pedestrian operations, the *Center City Transportation Study (Draft)* is recommending a hierarchy of sidewalks on Center City streets, including “signature”, “primary”, and “secondary” streets. Signature and primary streets will have sidewalk widths needed to create a viable streetcar environment, with signature sidewalks having more available space for streetcar stop amenities, such as shelters, benches, and displays. Therefore, a street that is recommended as a signature or primary street would receive a higher rating.

Objective #4: Presents the fewest problems with regard to constructability

- *Performance Measure #7: Utility avoidance*

The presence of utilities in segments can increase the expense of construction of the streetcar. This measure incorporated the number and type of utility conflicts that may need to be addressed to construct the streetcar line. The data were obtained from a visual survey and a review of underground utility maps. The analysis (at this stage) does not consider the type of utility or its specific underground location; however, these aspects were evaluated as part of the Tier 2 analysis. Manholes, overhead utilities, and traffic signals were visually surveyed, and the number and type of utility conflicts were used to establish a rating for each segment.

5.2.2 Evaluation and Results

Data for each candidate street were collected and evaluated in relation to the seven performance measures. Based on the data, thresholds were established for each performance measure using “high”, “medium”, and “low” categories, and a preliminary rating was assigned to each street for each criterion. The rating system assigned a value of zero to each item rated “low,” a value of one to each item classified as “medium”, and a value of two to items categorized as “high”. Equal weighting was used for all of the criteria. Ratings were totaled for each option across all seven performance measures, with higher composite scores indicative of streets that are more consistent with the four major objectives.

Results of the Tier 1 analysis are illustrated as follows. Trade Street and Fourth Street received the highest rankings, based largely on the significant number of

activity centers along these streets, the considerable number of bus routes that already use these thoroughfares (as an indicator of potential ridership), their connections to the existing and planned transportation centers, and the role of both of these streets as planned “signature” and “primary” streets for sidewalks.

Table 5-1: Tier 1 Analysis Summary Table

Evaluation Criteria		Performance Measure	3rd Street	4th Street	Trade Street	5th Street	6th Street	Thresholds
Surrounding Land Use and Development	Number of People who Live/Work along Street Segments (per 1,000 feet) (2010 PROJECTIONS)	Value	1234	1094	986	830	732	(High = 1000 or greater) (Med = 850 to 999) (Low = 849 or less)
		Rating	High	High	Med	Low	Low	
	Number of Major Trip Generators, Activity Centers and Significant Parking Facilities	Value	7	15	18	6	3	(High = 10 or greater) (Med = 5 to 9) (Low = 4 or less)
		Rating	Med	High	High	Med	Low	
Streetcar/Transportation System	Number of bus routes on Street Segment	Value	1	10	23	0	1	(High = 20 or greater) (Med = 10 to 19) (Low = 9 or less)
		Rating	Low	Med	High	Low	Low	
	Percentage of street segment that will expand Center City 5-Minute Walk Catchment Area	Value	0.0	0.0	0.0	0.0	0.0	
		Rating	Low	Low	Low	Low	Low	
Utility Conflicts along Street Segments	Manholes (per 1,000 ft segment/per traffic lane)	Value	5	7	7	5	4	(High = 7.0 or less) (Med = 7.1 to 9.0) (Low = 9.1 or greater)
	Overhead utilities (per 1,000 ft segment)	Value	0.0	0.1	0.0	3.0	1.5	
	Traffic signals (per 1,000 ft segment)	Value	1.6	1.4	4.1	2.0	1.4	
	Magnitude of Utility Conflicts in Each Segment	Value	6.6	8.6	11.1	10.0	6.9	
Transportation System/Environment	Traffic Operations Impact - 2002 CDOT Traffic Volumes (Average ADT)/(per traffic lane) ⁽¹⁾	Value	4139	3884	3672	3465	1657	(High = 1500 or less) (Med = 1501 to 3750) (Low = 3751 or greater)
		Rating	Low	Low	Med	Med	Med	
	Other Traffic Operations Impact/Bridge Clearance Conflicts	Value	Low	Low	Med	Med	Med	
	Overall	Rating	Low	Low	Med	Med	Med	
	Proposed Sidewalk/Pedestrian Ratings	Value	2	3	3	3	2	(High = 3-signature, primary) (Medium = 2-secondary) (Low = 1-no prop. changes)
		Rating	Med	High	High	High	Med	
Overall Score			6	8	8	4	4	

⁽¹⁾ ADT = Annual Daily Traffic

5.2.2.1 Third Street (McDowell Street to Graham Street)

Third Street received an overall score of six, ranking it third-highest of the five streets examined. Third Street scored highly in the population / employment density category, but does not have as many significant trip generators as other candidate streets. It also currently has a minor transit role, with only one bus route operating along it. The street has a low number of utility conflicts, but is only being planned as a “secondary” street for sidewalks. A number of traffic operations challenges are apparent along Third Street and would conflict with streetcar operations. These issues include the following:

- Two bridge clearance conflicts occur at the South Corridor LRT bridge and the pedestrian bridge located between Tryon Street and Church Street.
- Restriping of the existing bicycle lanes is possible, but curb-running streetcar (on the north side of the street) would be in direct conflict.
- The traffic lane split between Third and Fourth Streets on the west side of Center City creates an alignment issue.
- Streetcar operations on the north side of the street could impact vehicles making left turns off of Third Street.
- Parking garage exit ramps are located near College Street. These ramps also run directly underneath Third Street, which potentially could create a structural problem if the streetcar were added to Third Street, due to weight of the streetcar and the construction depth.

5.2.2.2 Fourth Street (McDowell Street to Trade Street via Johnson & Wales Way)

Of the five streets examined, Fourth Street and Trade Street tied with the highest overall score of eight. Fourth Street ranked highly with regard to population / employment density, and has a number of significant trip generators. Fourth Street has a notable transit / pedestrian focus, with ten bus routes currently in operation and plans in place to designate it as a “primary” street for sidewalks. However, Fourth Street has the highest traffic volume of the streets examined, and a number of traffic operations impacts along Fourth Street would conflict with streetcar operations:

- Parking garage entrance ramps are located near College Street.
- Four bridge clearance conflicts occur at the South Corridor LRT Bridge, the pedestrian bridge between Tryon Street and Church Street, the pedestrian bridge between College Street and Tryon Street, and the Norfolk Southern Railroad bridge.
- Restriping of the existing bicycle lanes is possible, but curb-running streetcar (on the north side of the street) would be in direct conflict.
- The traffic lane split between Third and Fourth Streets on the west side of Center City creates an alignment issue.
- Fourth Street has a large number of curb cuts.
- Streetcar operations on the north side of the street could be impacted by vehicles making right turns off of Fourth Street.

5.2.2.3 Trade Street (McDowell Street to Johnson & Wales Way)

Trade Street tied with Fourth Street, sharing the highest overall score of eight. Trade Street has the greatest number of significant trip generators compared to the other streets, and plays a major transit role with 23 bus routes currently operating along the corridor. Additionally, Trade Street is being planned as a “signature” street for sidewalks. Trade Street has the highest number of potential utility conflicts, as indicated by the frequency of manholes along the corridor, but has relatively modest traffic volumes (note that a more detailed examination of utility conflicts is performed as part of the Tier 2 analysis). One key traffic operation issue along Trade Street would conflict with streetcar operations:

- Three bridge clearance conflicts occur at the South Corridor LRT Bridge, the pedestrian bridge between College Street and Tryon Street, and the Norfolk Southern Railroad Bridge.

5.2.2.4 Fifth Street (McDowell to Graham Street)

Fifth Street ranked very low compared to the other streets, with an overall score of four. Fifth Street has a relatively low population / employment density, and few major trip generators. There are currently no bus routes operating along the street, and significant utility conflicts are apparent. However, Fifth Street is being planned as a “primary” street for sidewalks. Several traffic operations issues along Fifth Street would conflict with streetcar operations. These challenges include the following:

- The traffic lane split between Fifth and Sixth Streets on the west side of Center City creates an alignment issue.
- Two bridge clearance conflicts occur at the pedestrian bridge between College Street and Tryon Street and the Norfolk Southern Railroad Bridge.
- An at-grade crossing with the South Corridor Light Rail line results in higher costs for special trackwork and train signaling, as well as operational challenges.

5.2.2.5 Sixth Street (McDowell Street to Graham Street)

Sixth Street ranked very low compared to the other streets, with an overall score of four. Sixth Street has the lowest number of significant trip generators of the candidate streets, and currently has only one bus route operating in the corridor. Sixth Street also has the lowest density of people living or working along it, and is being planned only as a “secondary” street for sidewalks. However, Sixth Street has the fewest utility conflicts, the lowest traffic volumes, and no bridge clearance concerns (in the section between McDowell and Graham). Nevertheless, certain traffic operations issues along Sixth Street would conflict with streetcar operations:

- The traffic lane split between Fifth and Sixth Streets on the west side of Center City creates an alignment issue.
- One bridge clearance conflict occurs at the Norfolk Southern Railroad Bridge.
- Sixth Street is planned as a vehicular circulator in the Center City Transportation Study (CCTS).
- An at-grade crossing with the South Corridor Light Rail line results in higher costs for special trackwork and train signaling, as well as operational challenges.

5.2.2.6 Connections to the Charlotte Transportation Center and Proposed Charlotte Gateway Station

Physical constraints in the Center City have forced CATS to explore the development of two transfer centers at the hub of its system rather than one. The existing Charlotte Transportation Center (CTC) between East Trade Street and East Fourth Street would be complemented by the proposed Charlotte Gateway Station on West Trade Street. Proposed right-of-way alignments for the regional transit corridors are too far apart to cost-effectively bring them together into a single transfer station. A configuration using two transfer stations does not facilitate transfers between the regional corridors as well as a single station, but there are other advantages.

By splitting the regional services between the two stations, CATS will be able to avoid concentrating bus services at one location and reducing potential congestion at the CTC. This configuration also provides more transit-oriented development opportunities by operating transit services into two locations. However, it is critical that a seamless connection between the two transit centers be implemented so that passengers have access to all regional corridors and to the development at each location. This need has been cited as a primary purpose of the Center City Streetcar.

For the operation of the Streetcar to provide a seamless connection between the transit centers, streetcar stops will be required at both centers in each direction. The most efficient alignment for providing access to these two sites would be directly along Trade Street or Fourth Street. The alignments along Third, Fifth, and Sixth Streets are possible but their alignments present challenges with the connections to the CTC. Generally, all of the options can access the planned Multimodal Center on West Trade Street, because Graham Street can be used to connect between Trade Street and Third, Fourth, Fifth, or Sixth Streets.

- There is some difficulty in providing a connection between the Third Street (eastbound) leg and the CTC. A possible solution here would be a contra-flow lane connection on Brevard Street (currently one-way southbound) to serve the CTC, but then the alignment would require the use of Trade Street to continue east toward Presbyterian Hospital.
- A Fifth Street alignment would have connection problems at the CTC in the eastbound direction. Patrons at the CTC would have to walk one block to get to the eastbound streetcar service. Also, many of the buildings on the south side of 5th Street are oriented to Trade Street, requiring many passengers being discharged on Fifth Street to walk one block to Trade Street to access their building.
- A Sixth Street alignment would require a complex connection to the CTC. The use of Brevard Street with a weave to Caldwell Street provides the first opportunity to access Trade Street, and it is a block past the CTC on Trade Street. The required backtracking for this alignment to make the connection at the CTC also would result in a complex connection to the South Line at its station at Sixth Street. A connection between the Streetcar and the regional corridors would be enabled, but it is unlikely that many commuter bus patrons at the CTC would make a double transfer to access the Streetcar at Sixth Street.

It should be noted that for all options utilizing Fourth Street, a few opportunities exist for redevelopment along the street; however, near Tryon Street the only accessible structures are parking decks, especially on the north side of the street. Most of the primary destinations are oriented toward Trade Street, requiring streetcar passengers to walk around the buildings to access them. Redevelopment opportunities were addressed in more detail as part of the Tier 2 analysis, discussed later in this report.

5.2.3 Summary of Analysis

Based on the Tier 1 rating system described earlier, the following streets (and any alignment options utilizing these streets) were eliminated from further analysis:

- Third Street;
- Fifth Street; and
- Sixth Street.

Therefore, the following three alternatives were advanced for further consideration under Tier 2 examination:

- A. Trade Street (bi-directional / curb-running);**
- B. Trade Street (bi-directional / median-running); and**
- C. Fourth Street / Trade Street couplet (curb-running).**

Following stakeholder input received at the Center City Transit Workshop, a fourth option was reinstated for Tier 2 analysis:

- D. Trade Street / Fifth Street couplet (curb-running).**

5.3 Tier 2 Analysis

The Tier 2 evaluation was more detailed and focused on those alignment options advanced from Tier 1. The results of Tier 2 identified a recommended alignment option for the streetcar through Center City.

5.3.1 Methodology and Criteria

After the Tier 1 (“Basic Screening”) analysis was conducted to determine the streets in Center City most favorable to streetcar service, a more detailed assessment was performed on the four alternatives (described earlier) that advanced to this next stage of evaluation.

A series of objective criteria was developed, and a relative ranking (1st, 2nd, 3rd, 4th) was assigned to each alternative under each performance measure. All criteria were weighted equally to determine a final ranking of alternatives.

The Tier 2 analysis addressed many of the same impacts studied as part of the Tier 1 analysis, but provides a more in-depth examination of these impacts and also evaluates several additional aspects of the proposed streetcar service. For example, a more detailed assessment of on-street parking impacts and redevelopment opportunities is given in the Tier 2 analysis.

Like the Tier 1 analysis, several of these performance measures serve as proxies for an evaluation of potential ridership. Such criteria include *redevelopment opportunities* (providing access to new ridership markets associated with emerging trip generators and destinations), and *streetcar operations* (more reliable, faster, convenient service encourages more ridership). A qualitative assessment of relative capital costs was explicitly included in the Tier 2 examination.

The following eleven evaluation criteria were used:

- Access and traffic impacts;
- Existing on-street parking;
- Redevelopment opportunities;
- **Platforms and pedestrian environment;**
- **Streetcar operations;**
- Bridge clearances;
- **Potential utilities impacts;**
- **Relative capital costs;**
- **Ease of construction;**
- Flexibility of streetcar; and
- Compatibility with Light Rail Transit.

Based on feedback received from the Working Session Group and the Program Steering Team during this analysis, five of the eleven evaluation criteria were identified as “highly critical”. These specific criteria, shown in bold in the list above, indicate the most important considerations when comparing the attributes of various alignment options. The six remaining criteria are not as critical due to conclusions reached during the Tier 2 analysis:

- Access and traffic impacts are relatively minor, as indicated by a VISSIM traffic analysis conducted to simulate future traffic flow in conjunction with streetcar service;
- Existing on-street parking is addressed through a variety of strategies in the Center City Transportation Study;
- Streetcar service is supportive of redevelopment opportunities regardless of the particular alignment that is chosen;
- Bridge clearance conflicts can be resolved through unique design solutions;
- Streetcar operations can be enhanced in the future in a variety of ways using any of the alternative alignment options; and
- Compatibility with Light Rail Transit was deferred as a major consideration due to preliminary study findings associated with the Southeast Corridor transit project, suggesting that Southeast Corridor service likely would not operate on the same streets in the Center City as the streetcar.

5.3.2 Evaluation and Results

The Tier 2 analysis was conducted on the four specific alignment alternatives that were identified as a result of the Tier 1 analysis. For this examination, a relative ranking from “best” to “worst” (1st, 2nd, 3rd, 4th) was established for each alternative under each of the eleven Tier 2 performance measures. Points were then assigned across each criterion, with the “best” alternative receiving four points, the 2nd best option receiving three points, the 3rd best option receiving two points, and the 4th best alternative receiving one point. The number of points was then totaled for each alternative, with a higher number of points indicative of an alternative that more effectively meets the established performance criteria. A final relative ranking was then assigned. Equal weighting was used for all of the criteria; however, different results could emerge if specific criteria were weighted more heavily.

5.3.3 Access and Traffic Impacts

Three elements comprise this performance measure:

1. The number of curb cuts / conflict points (where vehicles turning into or out of driveways may impede streetcars);
2. The number of parking garages with entrances or exits affected by the alignment (which may negatively impact garage access); and
3. The potential impact on traffic capacity, due to the presence of the streetcar.

A Synchro traffic analysis conducted along the Trade Street corridor indicates that intersections along the corridor function at an acceptable volume / capacity ratio under existing conditions and future growth scenarios. A VISSIM analysis, which explicitly models traffic flow in conjunction with the proposed streetcar service, was conducted by the City and further substantiated the findings predicting satisfactory traffic and streetcar operations along Trade Street.

A composite ranking was established accounting for all three of these elements. Alternatives with fewer curb cuts, parking garage conflicts, and minimal traffic impacts received a higher ranking.

The numbers of curb cuts and parking garages for each alternative are illustrated in Table 5-2.

Table 5-2: Curb Cuts and Parking Garages

Alternative	Number of Curb Cuts	Number of Parking Garages
A. Trade Street (curbside)	32	3
B. Trade Street (median)	0	0
C. Fourth / Trade Street couplet	48	4
D. Trade / Fifth Street couplet	21	5

The Fourth Street / Trade Street couplet has the highest number of curb cuts, and all curbside alternatives impact several parking garages.

With regard to traffic capacity impacts, the two “couplet alternatives” minimize impacts to Trade Street (because service on Trade Street is provided in one direction only), and result in a slight reduction in capacity due to the presence of streetcars in the curbside lanes on these streets. The Trade Street (curbside) option also results in a reduction in capacity, due to conflicts with vehicles turning into garages, driveways, and at intersections. A stopped streetcar also impedes vehicular traffic. Compared to the curbside alternative, the Trade Street (median) option produces a slightly increased level of capacity reduction, due to the fact that streetcars would operate in the median lanes which primarily serve through vehicle movements and therefore have a higher vehicle throughput.

- Relative Ranking (based on a composite assessment of all three components):
 - 1st – B. Trade Street (median)
 - 2nd – A. Trade Street (curbside)
 - 3rd – D. Trade / Fifth Street couplet
 - 4th – C. Fourth / Trade Street couplet

5.3.4 Existing On-Street Parking

The Center City Transportation Study (Draft) is recommending a policy to “Expand the on-street parking system program”, not only in terms of the number of spaces available, but also with regard to hours of operation. In several cases, the CCTS is recommending the reuse of underutilized traffic lanes in the Center City for on-street parking and/or bicycle lanes. The displacement of on-street parking spaces for streetcar operation reduces the availability of parking along the candidate corridors, which contradicts the desired expansion of on-street parking. Therefore, alternatives requiring the removal of fewer parking spaces received a higher ranking.

The number of on-street parking spaces displaced as a result of each alternative is denoted in Table 5-3.

Table 5-3: Parking Spaces Displaced

Alternative	Number of Parking Spaces Displaced
A. Trade Street (curbside)	135
B. Trade Street (median)	0
C. Fourth / Trade Street couplet	64
D. Trade / Fifth Street couplet	112

The Trade Street (curbside) option requires the removal of the highest number of on-street parking spaces, followed closely by the Trade / Fifth Street couplet.

- Relative Ranking:
 - 1st – B. Trade Street (median)
 - 2nd – C. Fourth / Trade Street couplet
 - 3rd – D. Trade / Fifth Street couplet
 - 4th – A. Trade Street (curbside)

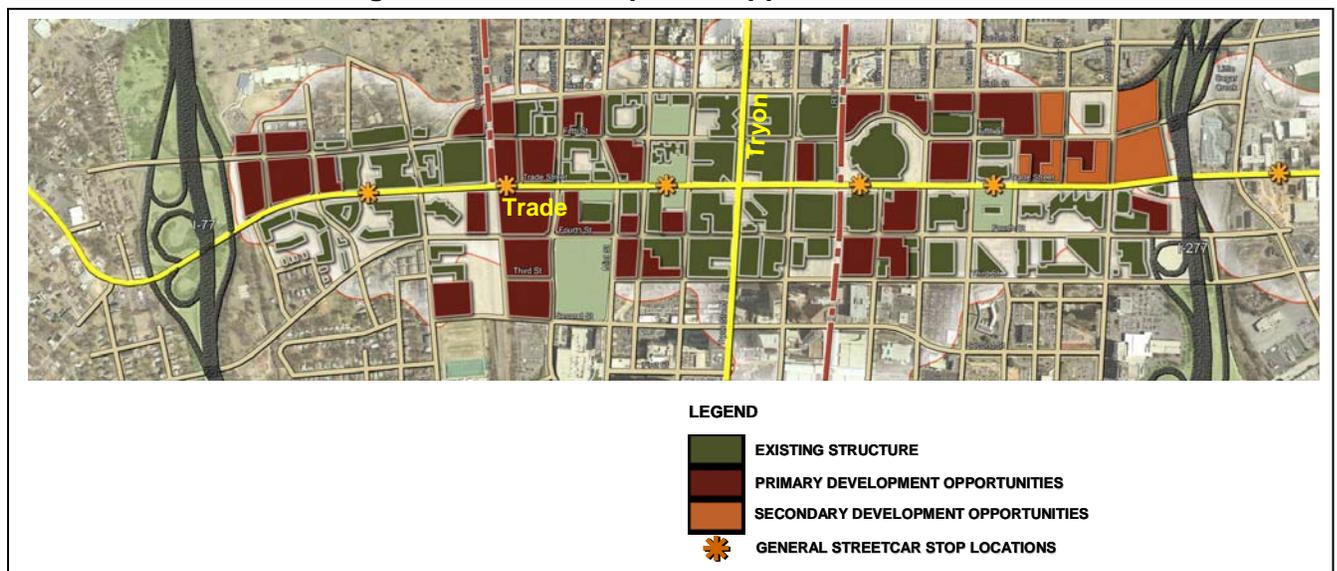
5.3.5 Redevelopment Opportunities

Streetcar service will boost current and future redevelopment activities within the Center City. An assessment of on-going and potential redevelopment sites was conducted (illustrated in Figure 5-2), and alternatives enabling streetcar access to a higher number of redevelopment sites received a higher ranking. Greater access to redevelopment sites results in higher potential ridership to and from these locations.

Center City redevelopment activities are surging, with new residential development at the forefront of these plans. Almost 1,700 new condominium units have been announced in the past year, housed within seven planned residential towers. Six of these seven towers are located between Third Street and Sixth Street, and all of these planned buildings are within walking distance of all candidate streetcar corridors. Several of these planned towers also include mixed-use components, with office, retail, and entertainment space that will serve as regional destinations.

Other significant developments are also taking shape in Center City, including the new Charlotte Arena, new Mecklenburg County Courthouse, new Federal Courthouse, and continuing expansion at Johnson and Wales University. All of these destinations are located within close proximity of the candidate streetcar corridors, and will serve as major ridership generators for streetcar service.

Figure 5-2: Redevelopment Opportunities



The “couplet alternatives” are more supportive of redevelopment opportunities than the alternatives operating only along Trade Street, because streetcar exposure is enabled along two streets rather than one. However, all alternatives are generally supportive of current redevelopment efforts such as the new Arena, EpiCentre, and new residential towers. The couplet alternatives provide additional support for increased ridership associated with redevelopment opportunities at surface parking lots located along Fourth and Fifth Streets.

- Relative Ranking:
 - 1st (tied) – C. Fourth / Trade Street couplet
 - 1st (tied) – D. Trade / Fifth Street couplet
 - 3rd (tied) – B. Trade Street (median)
 - 3rd (tied) – A. Trade Street (curbside)

5.3.6 Platforms and Pedestrian Environment

The provision of streetcar stop platforms has a significant impact on the surrounding pedestrian environment. Streetcar stops along the sidewalk (as is required by all “curbside” options) will likely result in the narrowing of adjacent walkways, and will create a barrier between the sidewalk and the street. With a typical stop size of 60 feet long and 12 feet wide, these impacts can be considerable. These impacts are more severe on some streets than others, due to the differences in existing sidewalk widths. Furthermore, placement of streetcar platforms may negatively impact access to existing driveways. Alternatively, locating the platforms to minimize sidewalk and driveway conflicts may result in a platform location that is less intuitive to passengers. Each of the alternatives was examined to determine the likely obstacles related to the pedestrian environment surrounding the stops, and options with fewer negative impacts received a higher ranking.

As discussed earlier, a variety of issues must be addressed with regard to the impact of streetcar platforms on the surrounding pedestrian environment. Sidewalk conflicts, driveway conflicts, and locations of passenger waiting areas must be considered.

Each of the four alternatives has unique characteristics relative to the pedestrian environment, but all have approximately the same level of impact. The Trade Street (curbside) alternative has sidewalk conflicts to some degree in the vicinity of all stops, and in some areas may require reconstruction of the sidewalk due to placement of the platforms (with the requisite height differential from the sidewalk). The Trade Street (median) alternative will likely result in sidewalk conflicts at the CTC and at Alexander Street, in order to widen the street to accommodate a center platform. The two “couplet alternatives” may have fewer sidewalk conflicts, but are less intuitive to passengers, who must walk to different streets depending on their desired direction of travel.

- Relative Ranking:
 - 1st (tied) – B. Trade Street (median)
 - 2nd (tied) – A. Trade Street (curbside)
 - 2nd (tied) – C. Fourth / Trade Street couplet
 - 2nd (tied) – D. Trade / Fifth Street couplet

5.3.7 Streetcar Operations

This evaluation criterion includes several elements:

1. Running time and operational costs - alternatives resulting in higher streetcar travel times will result in higher operational costs and potentially less ridership;
2. Reliability - alternatives with a higher number of potential conflict points, such as traffic lights, rail crossings, and turning movements, are subject to more variation in travel time; and
3. Passenger convenience and comprehension – curbside operations are generally perceived as more convenient to passengers, but median

operations are more intuitive because service is enabled in both directions from the same platform. Furthermore, bi-directional operations on the same street is more passenger-friendly than service on two different streets.

A composite ranking was developed addressing these three elements. Alternatives producing minimized running times, high levels of reliability, and convenient and easily-understood operations received a higher ranking.

Because the length of the alignment and the number of turns is minimized, the two "Trade Street only" alternatives have shorter running times and lower operating costs than the two couplet options.

In terms of reliability, the Trade Street (median) alternative will produce the most consistent travel times, because the alignment requires no turns, and there is no turning automobile traffic to impede the streetcar. The Trade Street (curbside) option is subject to more interruption, due to right-turning traffic entering and exiting the curbside lanes. The two couplet alternatives have higher levels of interruption, because of the additional turns involved between Trade Street and Fourth Street and Trade Street and Fifth Street, respectively.

The Trade Street (curbside) alternative is perceived as the most convenient, with stops located along the sidewalks. However, the Trade Street (median) option is more intuitive, with travel in both directions provided from the same platforms. The Fourth / Trade Street couplet is less convenient and intuitive for passengers because different streets are used for eastbound and westbound travel; however, the Trade / Fifth Street couplet is the least convenient and intuitive, because in addition to using two streets, Fifth Street is a block away from the CTC.

Trade Street Bi-Directional Option as compared to Couplet Alternatives.

There are several specific operational considerations that must be addressed when comparing the "couplet" alternatives to the bi-directional options on Trade Street. The same concepts apply to when comparing the bi-directional options to both the Trade Street / Fourth Street couplet and the Trade Street / Fifth Street couplet. Specific differences between the Trade Street / Fourth Street couplet and the bi-directional options are highlighted below.

The most significant difference between the Trade Street / Fourth Street couplet and the Trade Street bi-directional option is the streetcar running time along these alignments. Preliminary travel time runs have shown that transitioning the rail alignment from Trade Street (westbound) via McDowell or Davidson Streets and back to Trade Street via Johnson & Wales Way will add approximately 2.5 minutes at each end, including time needed to traverse the added distance as well as delay resulting from additional traffic lights. In addition to the added distance (travel time of 25 to 35 seconds), the streetcar will be delayed on average 20-40 seconds at each of the intersections (four total) while the traffic signals cycle through their respective phases. It is assumed that the streetcar system will require its own phase in the signal timings in order to traverse each intersection. At present, the traffic pattern from Fourth Street to Johnson & Wales Way works very much like a ramp and is not signalized. However, plans from the Center City Transportation Study have identified this intersection for

reconfiguration into a traditional "T" intersection, indicating an alteration of the travel pattern to a normal right turn at a signalized intersection.

A five-minute increase in total running time required for the couplet could have a significant impact on the operational cost of the streetcar system. If CATS provides service at five-minute frequency, the initial segment between Presbyterian Hospital and Johnson C. Smith University would require an additional peak hour streetcar. As the system matures and future extensions afford CATS the opportunity to supplement service along the trunk line on Trade/Fourth, increased frequency will require two or more vehicles to provide a sufficient level of service. The Trade Street bi-directional alignment minimizes running time and thus would require fewer vehicles to maintain the preferred frequency between the transit centers.

The transition to and from Fourth Street via McDowell or Davidson Streets will also complicate an intersection on Trade Street. Assuming a center-running alignment westbound from Presbyterian Hospital, the streetcar will be turning left via a protected phase in the traffic signal and crossing over the eastbound track at grade. The crossing is feasible but will add to the construction costs of the streetcar because the crossing will require custom-made tracking (at a cost of approximately \$200,000). The transition is also a significant factor in the increase in running time since streetcars will be delayed at the intersection while waiting for its protected phase.

Fourth Street operations must also be curb-running to avoid conflicts with the BB&T parking ramp at Tryon Street, which places the streetcar alignment in direct conflict with the bike lane on the north side of the street. Stops along Fourth Street will also negatively impact traffic flow on the street, which has been designated by the CCTS as a primary travel corridor in Center City.

All of the couplets examined as a part of this analysis have been evaluated as if they were curb-running. One drawback that also must be considered is that using curb-running operations on Fourth and Trade Streets (as well as curb-running operations on Trade Street only) will be in direct conflict with curbside deliveries and parking. Generally, curb-running streetcar systems are facilitated through a prohibition of deliveries at the curbside because a stopped delivery truck could significantly increase the running time required for the streetcar to serve the corridor.

The couplet system using Fourth and Trade Streets also presents some concerns from a customer service standpoint. Given the configuration and direction of the two streets, the couplet will require the streetcar rails to cross over each other to make the transition to and from Fourth Street. Most one-way pair streetcar couplets are operated on corresponding one-way paired streets, so the direction of transit service is intuitive to the user because it mirrors traffic flow. The fact that traffic operates two-way on Trade Street will beg the question regarding the direction of streetcar operations on Trade Street. Consistent daily riders likely will not have difficulty with this configuration, but it could cause customer service problems for visitors and less frequent riders trying to return to one of the transit centers to access regional services.

- Relative Ranking (based on a composite assessment of all three components):
 - 1st – B. Trade Street (median)
 - 2nd – A. Trade Street (curbside)
 - 3rd – C. Fourth / Trade Street couplet
 - 4th – D. Trade / Fifth Street couplet

5.3.8 Bridge Clearances

As stated earlier, bridge clearances typically must be at least 18 feet for the streetcar to share a lane with automobile traffic, due to proximity to the streetcar's overhead catenary system and other traffic using the same lane. For bridge clearances less than 18 feet, a streetcar using a pantograph will require unique solutions to ensure safety. Alternatively, streetcars may be able to use a trolley pole instead of a pantograph to maintain contact with an overhead catenary system located above an adjacent median or sidewalk. For the purposes of this evaluation, those alignments with fewer bridge clearance restrictions received a higher ranking; however, the potential use of a trolley pole would eliminate this restriction on all of the alternatives.

The following bridge clearance conflicts (with a clearance of less than 18 feet) were observed along Fourth, Trade and Fifth Streets:

Fourth Street

- Norfolk Southern railroad (14.5')
- Bank of America pedestrian bridge (17')
- First Citizens pedestrian bridge (16.8')
- South Line LRT / Trolley bridge (14.5')

Trade Street

- Norfolk Southern railroad (15.1')
- Bank of America pedestrian bridge (16.7')
- South Line LRT / Trolley bridge (14.9')

Fifth Street

- Bank of America pedestrian bridge (<18')

(The Fifth Street alignment would cross under the Norfolk Southern railroad on Trade Street.)

No ranking was created due to the possible use of a trolley pole and other unique solutions to address bridge clearance conflicts.

5.3.9 Potential Utilities Impacts

As a follow-up to the Tier 1 utilities assessment, the following utilities were addressed in more detail:

- Water lines;
- Stormwater lines;
- Sanitary sewer lines; and
- Overhead wires.

The magnitude of conflict for each type of utility was assessed using locational data and assumed criteria for relocation / replacement. For Trade Street, a detailed utilities survey provided information on type, size and location of pipes and overhead wires. For Fourth Street and Fifth Street, information was gathered from data provided by Charlotte-Mecklenburg Utilities as well as through a field inspection of manhole locations.

Minimum distances between the streetcar track and the utility pipes are necessary to enable utility maintenance without impacting the streetcar slab. A “conflict” was assumed if one of the following conditions was met:

- For water lines, a conflict occurs if the center line of the proposed streetcar track is less than nine feet from the center line of the water pipe.
- For stormwater and sanitary sewer lines, a conflict occurs if the center line of the proposed streetcar track is less than nine feet from a terracotta pipe (TCP), or less than six feet from a reinforced concrete pipe (RCP).

Options with a lower extent of utility conflicts received a higher ranking. The length of utilities conflicts associated with each alternative is shown in Table 5-4 below.

Table 5-4: Utilities Conflicts

Alternative	Water Conflicts	Sewer / Stormwater Conflicts	Overhead Conflicts
A. Trade Street (curbside)	6,800 linear ft	9,100 linear ft	Minimal
B. Trade Street (median)	4,400 linear ft	7,600 linear ft	Minimal
C. Fourth / Trade Street couplet	7,400 linear ft	12,000 linear ft	Minimal
D. Trade / Fifth Street couplet	4,800 linear ft	9,600 linear ft	Significant

The Trade Street (median) alternative has minimal overhead utility conflicts and the fewest underground utility conflicts. In comparison, the Trade Street (curbside) option has a higher number of underground utility conflicts. The Trade / Fifth Street couplet has fewer underground utility conflicts than the Trade Street (curbside) alignment, but significantly more overhead utilities are present on Fifth Street (as indicated in the Tier 1 assessment). The Fourth / Trade Street couplet has significantly more underground utility conflicts than the other alternatives.

- Relative Ranking:
 - 1st – B. Trade Street (median)
 - 2nd – A. Trade Street (curbside)
 - 3rd – D. Trade / Fifth Street couplet
 - 4th – C. Fourth / Trade Street couplet

5.3.10 Relative Capital Costs

Although a full cost estimate was not developed for each alternative, the relative levels of investment required for each alternative were analyzed qualitatively by examining the features of each option that contribute to changes in capital or operational costs. Based on this comparison, alternatives with lower relative costs were assigned a higher ranking. Elements that contribute to relative differences in costs include the following:

- Utility work (more utility conflicts result in higher costs);
- Location of tracks in street (tracks located toward the middle of the street are easier and less costly to construct than tracks near the sidewalk);
- Sidewalk reconstruction (capital costs increase as the amount of required sidewalk reconstruction increases);
- Length of alignment (longer alignments require higher levels of investment and operational costs);
- Special rail crossings (alignments that force streetcar tracks to cross require special trackwork, at an additional cost); and
- Traffic signals (alignments impacting more traffic signals have a higher capital cost – and potentially operational costs as well - associated with the modification of the signals).

The relative capital costs were included in this analysis through comparing each alternative with respect to elements that impact the overall capital cost, including the amount of needed utility work and sidewalk reconstruction, the length of the alignment, the need for special trackwork, and the number of traffic signals that must be modified.

The Trade / Fifth Street couplet is estimated to have the highest relative capital costs, due to its longer alignment as well as the need for special rail crossings and train signaling at the grade crossing with the South Corridor LRT line on Fifth Street. There would also be special trackwork costs at the locations where the streetcar tracks cross each other. In addition, this alternative involves more traffic signal modifications and a substantial amount of sidewalk reconstruction and utility work.

The Fourth / Trade Street couplet has a similar capital cost requirement in comparison to the Trade / Fifth Street couplet, but does not have the expense associated with an at-grade crossing of the South Corridor LRT line. Also, fewer traffic signals must be modified for streetcar operation.

The Trade Street (curbside) option has a shorter alignment than the “couplet alternatives”, and also requires no special rail crossings. However, there is a need for substantial sidewalk reconstruction and utility work.

Like the Trade Street (curbside) option, the Trade Street (median) alternative also has a shorter alignment and requires no special rail crossings. Furthermore, less sidewalk reconstruction, street reconstruction, and utility work is necessary in comparison to the Trade Street (curbside) option. Due to the crown of the

street, constructing tracks near the median is more economical and less intrusive than along the curbside.

- Relative Ranking:
 - 1st – B. Trade Street (median)
 - 2nd – A. Trade Street (curbside)
 - 3rd – C. Fourth / Trade Street couplet
 - 4th – D. Trade / Fifth Street couplet

5.3.11 Ease of Construction

The ease of construction of each alternative was assessed qualitatively by determining the relative levels of impacts to businesses and activity centers, as well as the relative requirements for sidewalk reconstruction and utility work. Those alternatives affecting fewer activity centers, as well as involving lower levels of reconstruction and / or utility work, are more favorable and rank higher under this criterion.

The Trade Street (median) and Fourth / Trade Street couplet alternatives were judged to have the fewest negative construction impacts, due primarily to the fact that these two alternatives directly impact fewer existing businesses. The Trade Street (median) option is within a concentration of activity, but construction will have less of a direct impact on accessibility to businesses because most construction activities will occur in the median of the roadway and not at the front doors of the businesses. The median option also requires less roadway construction in general.

The Trade / Fifth Street couplet impacts even fewer businesses, but requires more sidewalk and roadway reconstruction and also involves a significant amount of utility work (primarily overhead utilities on Fifth Street).

The Trade Street (curbside) option was deemed to be the most intrusive, due to the direct construction impacts on the businesses along the corridor and the need for significant roadway and sidewalk reconstruction.

- Relative Ranking:
 - 1st (tied) – B. Trade Street (median)
 - 1st (tied) – C. Fourth / Trade Street couplet
 - 3rd – C. Trade / Fifth Street couplet
 - 4th – A. Trade Street (curbside)

5.3.12 Flexibility to Improve Future Streetcar Operations

In the future it may be desirable to enhance streetcar operations along Trade Street as the Center City continues to develop. Phased strategies such as the prohibition of turning movements for automobile traffic, the conversion of shared travel lanes to transit-only lanes, and the implementation of signal prioritization could be means to further enhance streetcar operations. Alternatives more conducive to these improvements received a higher ranking.

The Trade Street (median) alternative is most conducive to these types of improvements, particularly through a ban on left turns and the potential creation of an exclusive lane that could be accommodated with relatively few adverse impacts. The two “couplet alternatives” could also benefit from these types of enhancement strategies, but would have significant impacts to traffic operations and would be costly to implement. However, the negative impacts would be spread across two streets, rather than concentrated on one. The Trade Street (curbside) option is the least conducive to these enhancements, because of the need to maintain access to driveways and parking garages (thus making the implementation of an exclusive lane or the prohibition of right turns more difficult).

- Relative Ranking:

1st – B. Trade Street (median)
2nd (tied) – C. Fourth / Trade Street couplet
2nd (tied) – D. Trade / Fifth Street couplet
4th – A. Trade Street (curbside)

5.3.13 Compatibility with Light Rail Transit

On-going planning activities for CATS' Southeast Corridor are examining whether light rail transit (LRT) or bus rapid transit (BRT) will be selected as the preferred mode in that corridor. Because the Southeast Corridor may share the same alignment as the Streetcar in Center City, there are several unique considerations that must be addressed if LRT is selected as the preferred mode and if it is to operate along the same alignment as the streetcar. Among these considerations are the following:

- Use of an exclusive lane, which is likely necessary to support LRT operations;
- Impacts on access, driveways, and traffic operations related to longer LRT vehicles, and the need to run in an exclusive lane;
- Safety concerns associated with the use of a contraflow lane on a one-way street (the tracks should be on the side of the street that is consistent with driver expectation);
- Safety concerns associated with LRT running parallel in the same direction;
- More stringent track infrastructure requirements to serve both LRT and streetcar (e.g. longer tangent track segments at stops);
- Changes to stop locations and platform extensions needed to accommodate both types of vehicles;
- Infrastructure costs related to the passenger facilities that would serve both operations.

Options that have a higher level of compatibility with light rail transit were assigned a higher ranking.

The Trade Street (median) option has the highest level of compatibility with light rail transit. This alignment would enable an exclusive lane to be designated if necessary, would minimize impacts on driveways and access points through

placement of the longer platforms in the median of the roadway, and would eliminate safety concerns associated with one-way operation on couplets. In addition, prohibition of left turns would eliminate many traffic conflicts. None of the three other alternatives address these issues as well, primarily due to the difficulty in establishing an exclusive lane described previously, and the significant impacts on sidewalks and access that would be created as a result of the much longer and higher LRT platforms.

- Relative Ranking:

- 1st – B. Trade Street (median)
- 2nd (tied) – A. Trade Street (curbside)
- 2nd (tied) – C. Fourth / Trade Street couplet
- 2nd (tied) – D. Trade / Fifth Street couplet

5.3.14 Summary of Analysis

Results of the Tier 2 analysis are presented in Table 5-5 (rankings are shown for each performance measure, along with a composite ranking). The Trade Street (bi-directional / median-running) alternative received the highest score by a wide margin, ranking 1st in almost every category.

Table 5-5: Summary of Tier 2 Analysis (All Criteria)

	Trade Curbside Alt A	Trade Median Alt B	Trade/4 th Couplet Alt C	Trade/5 th Couplet Alt D
On-street parking	4 th	1 st	2 nd	3 rd
Access	2 nd	1 st	4 th	3 rd
Streetcar operations	2 nd	1 st	3 rd	4 th
Platforms & Ped environment	2 nd	1 st	2 nd	2 nd
Redevelopment	3 rd	3 rd	1 st	1 st
Bridge clearances	n/a	n/a	n/a	n/a
Utility impacts	2 nd	1 st	4 th	3 rd
Capital costs	2 nd	1 st	3 rd	4 th
Ease of construction	4 th	1 st	1 st	3 rd
Flexibility	4 th	1 st	2 nd	2 nd
LRT consideration	2 nd	1 st	2 nd	2 nd
OVERALL POINTS	23	38	26	23

Based on evaluation using eleven specific performance measures, the **Trade Street (median)** alternative ranked the highest among the four options studied. Although this evaluation weighted all criteria equally, a separate scoring compilation was created using only five highly critical criteria, as determined by the Team with guidance from the Working Session Group and Program Steering Team:

- Capital costs;
- Utility impacts;
- Streetcar operations;
- Ease of construction; and
- Platforms and pedestrian environment.

The scoring summary using only these critical criteria is shown in Table 5-6. The **Trade Street (median)** alternative ranked the highest in this scenario as well, followed by the Trade Street (curbside) option and the Trade Street / Fourth Street couplet.

Table 5-6: Summary of Tier 2 Analysis (Highly-Critical Criteria)

	Trade Curbside Alt A	Trade Median Alt B	Trade/4 th Couplet Alt C	Trade/5 th Couplet Alt D
Capital costs	2 nd	1 st	3 rd	4 th
Utility impacts	2 nd	1 st	4 th	3 rd
Streetcar operations	2 nd	1 st	3 rd	4 th
Ease of construction	4 th	1 st	1 st	3 rd
Platforms & Ped Env	2 nd	1 st	2 nd	2 nd
OVERALL POINTS	13	20	12	9

The Tier 2 analysis concluded that the Trade Street (median) option best meets the stated evaluation criteria; however, the next highest-ranking alternative (Trade Street (curbside)) was also advanced to the Tier 3 analysis to confirm the preferred alignment based on detailed stop-level evaluations.

5.4 Tier 3 Analysis

As noted earlier, Tier 3 was conducted to confirm the recommended streetcar alignment through Center City and examine further the specific potential impacts of the proposed streetcar stops might have on the urban environment.

5.4.1 Methodology and Criteria

Results from the Tier 2 investigation illustrate that a median alignment on Trade Street convincingly outranks the other alternatives when considering the stated performance measures; nevertheless, issues associated with this alignment must still be addressed. Though operating the streetcar primarily on a median alignment through Center City is preferred, alternative platform locations might better address the unique challenges and concerns at specific stops. Combining

a median alignment with some of the best qualities of the curbside alternative on Trade Street may optimize a preferred alignment.

The purpose of the Tier 3 analysis was to confirm the Trade Street (median) option as the preferred alignment, by conducting a detailed analysis to compare the impacts of median and curbside platforms at individual stop locations. Special attention was given to widening requirements, parking displacement, tree displacement, and sidewalk impacts. This assessment resulted in stop-by-stop recommendations for each of the potential stop locations.

For each alternative station design concept, the following impacts were considered:

- Is Widening Required. If street widening is required to implement the proposed station stop, the amount of necessary widening is illustrated. Alternatives that minimize roadway widening are favored.
- Number of Parking Spaces Displaced. The number of on-street parking spaces that would be displaced as a result of the proposed station stop is illustrated. There are significant differences between the parking impacts associated with median and curbside platform alternatives.

No permanent parking spaces would be displaced as a result of median stops, but “Cinderella” spaces may be affected (a “Cinderella” space is designated for curbside parking during off-peak times, but parking is prohibited during peak periods to provide an additional travel lane). A concern has been raised regarding the provision of “Cinderella” parking spaces alongside median streetcar platform locations. The apprehension is due to the potential temporary blockage of traffic if a streetcar is stopped at a platform and vehicles are also parked in “Cinderella” spaces next to the stopped streetcar. However, this condition would only occur for short periods of time in off-peak periods, and would have only minor impacts to traffic flow. It is not necessary to remove these spaces, but removal may be favored by the Charlotte Department of Transportation.

A related issue is the location of bus stops on the curbside relative to proposed streetcar stops in the median. Attention must be paid to ensuring that these stops are not located adjacent to each other, which potentially could result in traffic bottlenecks (if a stopped streetcar and stopped bus are side by side).

It is important to note that if “Cinderella” spaces are removed due to the provision of median streetcar platforms, they would be removed only in the immediate vicinity of the stops. However, if curbside streetcar platforms are implemented, all curbside parking (“Cinderella” or permanent spaces) must be removed to enable the streetcar to have full use of the curbside travel lane.

- Are Trees Displaced? The number of trees that would likely be displaced due to construction of the streetcar platform areas is noted. The removal of the fewest trees is preferred.

- Remaining Sidewalk Width (Beyond Platform). The construction of streetcar platforms may reduce the existing sidewalk width, with more significant impacts typically occurring with regard to curbside platforms. The amount of sidewalk width that would be available after construction of the streetcar platforms is estimated, with alternatives that maintain greater sidewalk widths being favored.

It should be noted that although curbside platform alternatives typically result in reduced sidewalk widths, platform design modifications can be made to integrate the stop with the sidewalk. These design treatments reduce the degree of impact on the sidewalk; however, if such a treatment is used, pedestrians have to share the walking area with streetcar passengers who are waiting at the stop. Also, if the projected ridership at a specific stop(s) is projected to be comparatively low, the platform width may be able to be reduced slightly to enable additional sidewalk width.

Another consideration for curbside platforms is the location of the passenger shelter(s). It is undesirable to locate shelters adjacent to the front doors of businesses, due to the reduction in visibility and access to the affected businesses. For curbside platforms, these impacts would need to be mitigated.

For each alternative, the overall impacts in each of these categories were compared to determine the preferred platform location. Comments from the Working Session Group were included in the process of selecting preferred alternatives.

5.4.2 Evaluation and Results

Six proposed stop locations along Trade Street in Center City were evaluated for potential median or curbside impacts. At each location, the proposed footprint of the platform was marked and photographed to show the impact that the platform could generate. Alternatives were generated to mitigate the unwanted affects that the alignment might present. The proposed stop locations and the alternatives are listed below:

Johnson & Wales

- Alternative A – Median
- Alternative B – Curbside

Charlotte Gateway Station

- Alternative A – Median
- Alternative B – Curbside

Mint Street/Pine Street

- Alternative A – Median
- Alternative B – Curbside

Tryon Street

- Alternative A – Median between Church and Poplar
- Alternative B – *Road Diet* between Church and College
- Alternative C1 – *Take a Lane* eastbound between Church and College

- Alternative C2 – *Take a Lane* westbound between Church and College
- Alternative D – Median to curbside shift

Arena/Transportation Center

- Alternative A1 – Wide median platform
- Alternative A2 – Narrow Median Platform
- Alternative B – *Take a Lane* eastbound between Church and College

Government Center

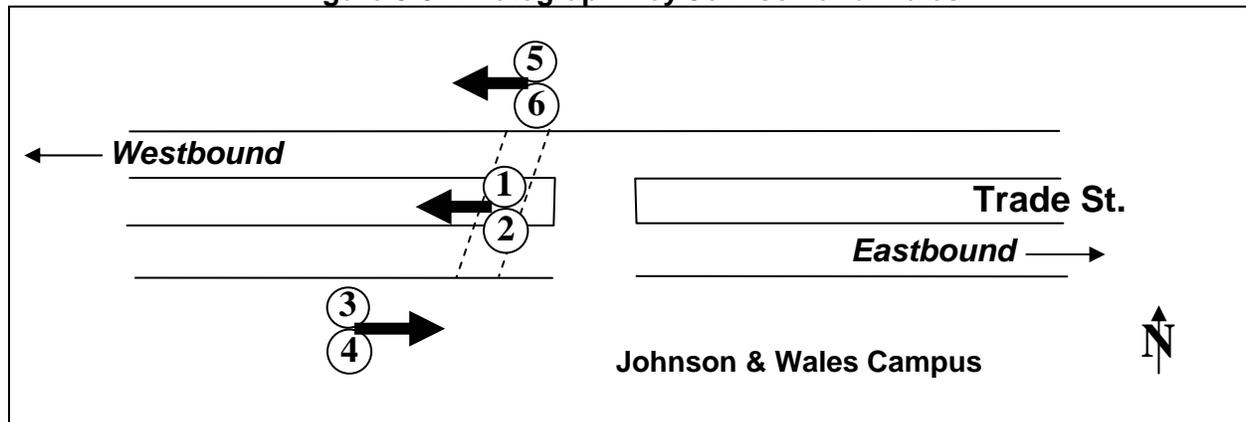
- Alternative A – Narrow Median Platform
- Alternative B – Curbside stops
- Alternative C – Wide median platform

For each stop location, a description of alternatives, “before and after” illustrations, a comparison of alternatives, and a recommendation are given.

5.4.2.1 Johnson and Wales

This stop will serve Gateway Village, Gateway Center, the Doubletree Hotel, residential areas of Third Ward, and Johnson and Wales University. This stop will be located in the heart of Gateway Village at a signalized crosswalk. The existing median width in this area is eighteen feet. Two different alternatives are considered for this stop, a median platform or a curbside platform on each side of Trade Street.

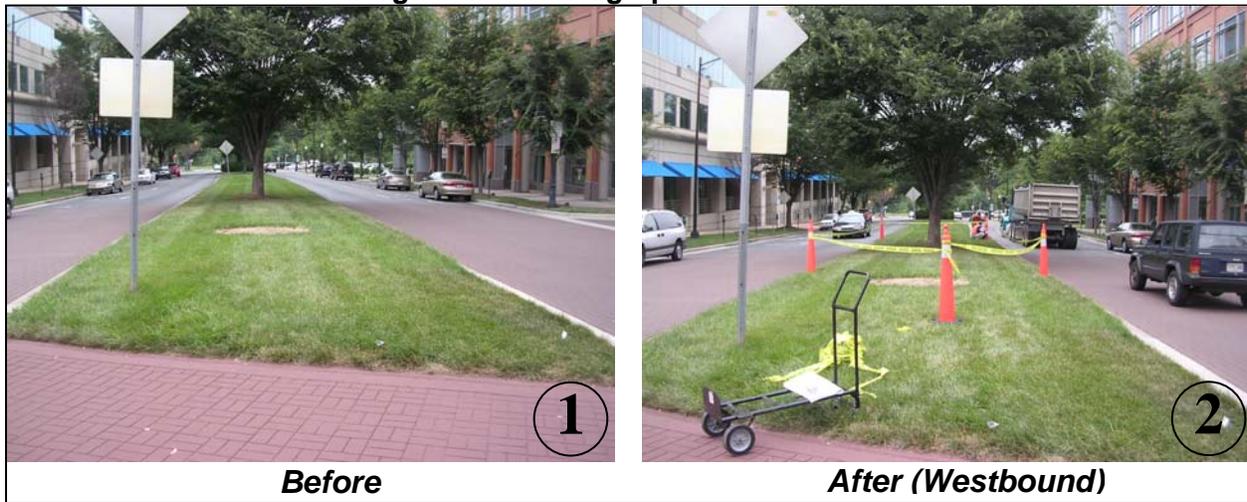
Figure 5-3: Photograph Key Johnson and Wales



Alternative A - Median

This alternative calls for a median platform in a space that is currently 18 feet wide, so widening is not necessary. No permanent on-street parking would be affected. However, four or five eastbound and seven or eight westbound “Cinderella” spaces would be displaced, if on-street parking is removed parallel to platforms to address concerns regarding potential traffic impacts when a streetcar is stopped for passenger loading and unloading. One large tree in the median would have to be removed, but the current sidewalk widths would be maintained.

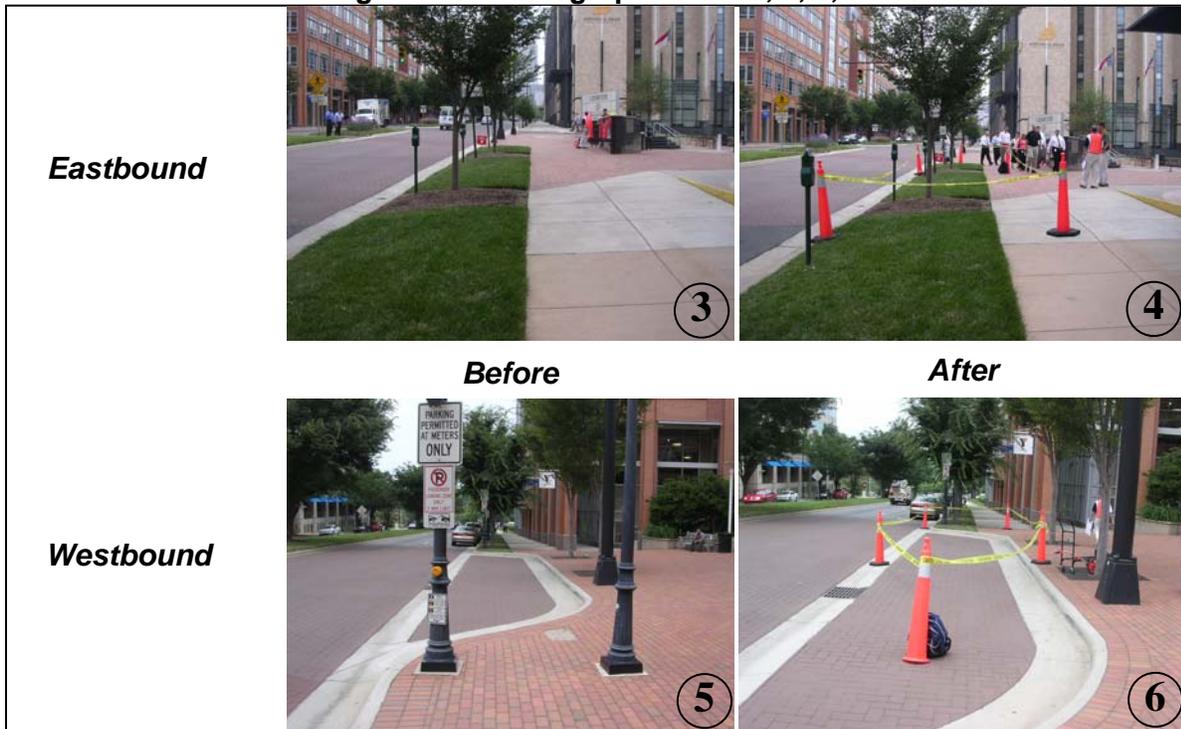
Figure 5-4: Photograph Views 1 and 2



Alternative B – Curbside

This option would place curbside stops adjacent to the signalized crosswalk. It would not require any widening, but three to five eastbound parking spots would be eliminated and an existing pullout on the westbound side would be removed. Two small trees on the eastbound side will have to be removed; and one to three medium-sized trees on the westbound side will be affected. The planting strip on the eastbound side would be removed, and the sidewalk width would be reduced to six feet. No changes would be necessary for the westbound sidewalk.

Figure 5-5: Photograph Views 3, 4, 5, and 6



Comparison of Alternatives

Table 5-7: Comparison of Alternatives (Johnson and Wales)

Alternative	Description	Widening Required?	# of Parking Spaces Displaced	Trees Displaced?	Remaining Sidewalk Width (Beyond Platform)
A	Median	No	0 (11-13 <i>Cinderella</i>)	1	Current widths maintained
B	Curbside	No	3-5	3-5	Approx. 6 ft. on eastbound side, no change for westbound.

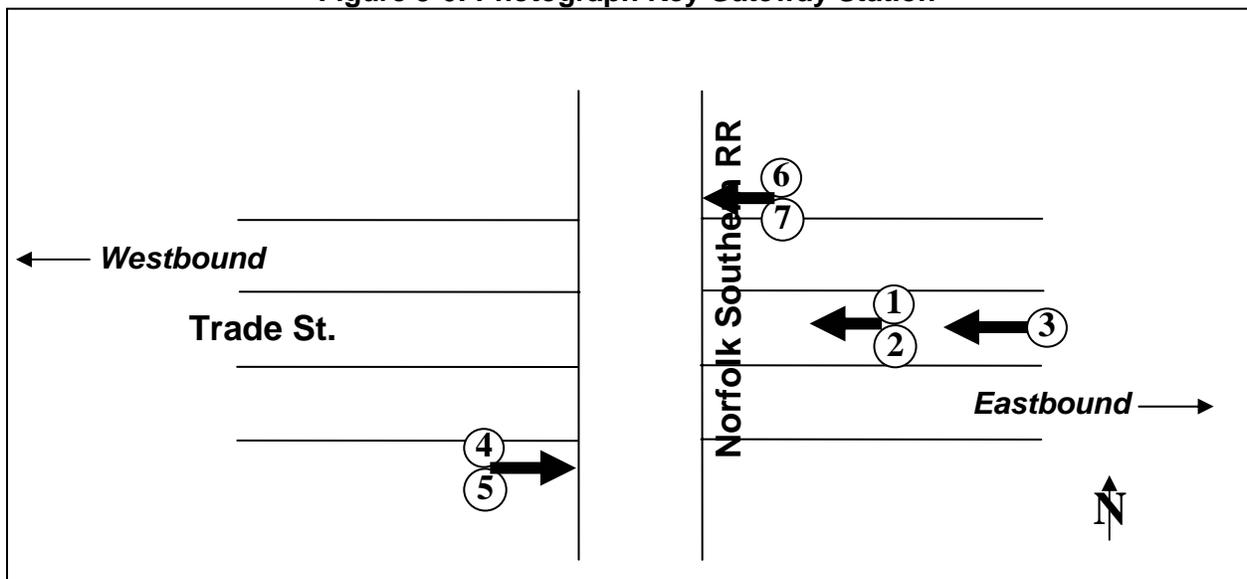
Recommendation

The preferred median alignment is optimal at this location, primarily because all existing sidewalk width can be maintained.

5.4.2.2 Charlotte Gateway Station

The future multimodal hub will be a key transfer point for streetcar passengers at Gateway Station. Stop locations are located adjacent to or under the Norfolk Southern Railroad overpass. The existing median width in this area is approximately eighteen feet. Two different alternatives are considered for this stop, a 60' or 110' median platform or a curbside platform on each side of Trade Street.

Figure 5-6: Photograph Key Gateway Station



Alternative A – Median

This alternative provides an 18 foot-wide median platform east of the existing Norfolk Southern Railroad overpass. No widening would be required, no parking or trees would be displaced, and the current sidewalk widths would be maintained. Both of the median options would use a platform extending the full width of the median; however, the 110' foot option includes ramps and a crosswalk between platforms that would serve each direction of travel. A more

precise projection of the size of platform that would be necessary can be obtained after travel demand modeling and ridership data become available.

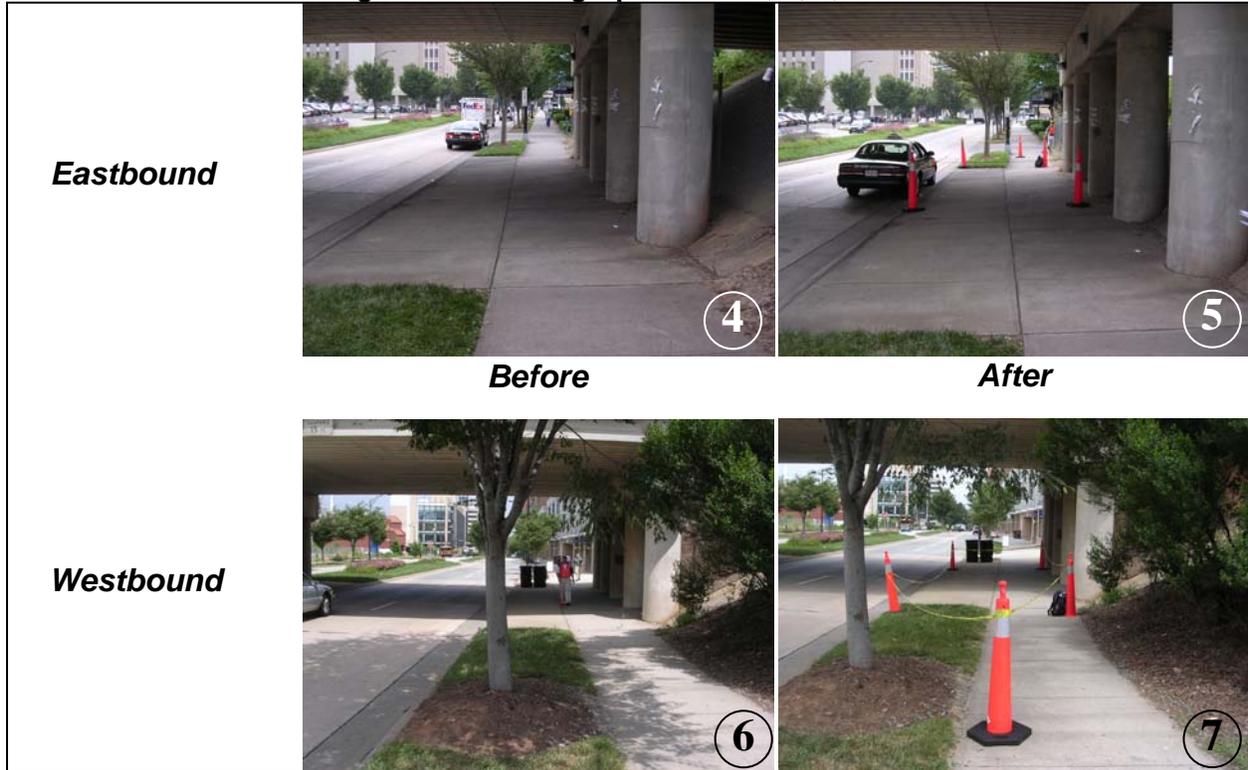
Figure 5-7: Photograph Views 1, 2 and 3



Alternative B - Curbside

These curbside stops will be located underneath the Norfolk Southern Railroad Bridge. No roadway widening would be required and no parking spaces would be impacted. However, the sidewalk width beyond the platform would be totally eliminated and one medium-sized tree would be affected.

Figure 5-8: Photograph Views 4, 5, 6, and 7



Comparison of Alternatives

Table 5-8: Comparison of Alternatives (Charlotte Gateway Station)

Alternative	Description	Widening Required?	# of Parking Spaces Displaced	Trees Displaced?	Remaining Sidewalk Width (Beyond Platform)
A	Median platform	No	0	0	Current widths maintained
B	Curbside stops	No	0	1	None (EB and WB)

Recommendation

The preferred median alignment is optimal at this location, because all existing sidewalk width can be maintained.

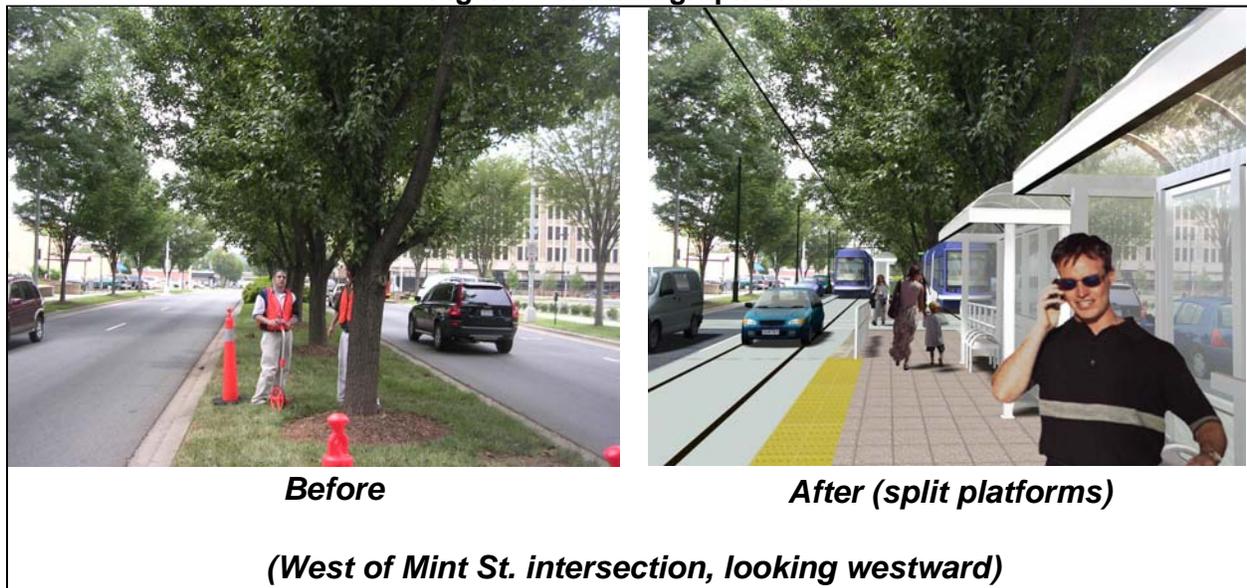
5.4.2.3 Mint/Pine Street

This stop serves nearby businesses, residential areas and the Federal Courthouse (potentially to be converted to the law school for Queens College). In addition, this stop provides access to the proposed Third Ward Park and two new proposed residential towers. Potential stop locations are west of the Trade Street/Mint Street intersection. Two different alternatives are considered for this stop, a median platform or a curbside platform on each side of Trade Street.

Alternative A – Split Median

The median width at this portion of the street would support a “split median platform” with a width of approximately thirteen feet. This platform configuration includes two individual platforms, connected by ramps and a crosswalk to each sidewalk. Each platform would serve one direction of travel. This split platform will allow the current widths on the sidewalks to be maintained and would not require any widening. No conventional parking spaces will be displaced, but seven or eight *Cinderella* spaces would be affected on both the eastbound and westbound sides, if on-street parking is removed parallel to platforms to address concerns regarding potential traffic impacts when a streetcar is stopped for passenger loading and unloading. Six medium to large-sized trees in the median would have to be removed.

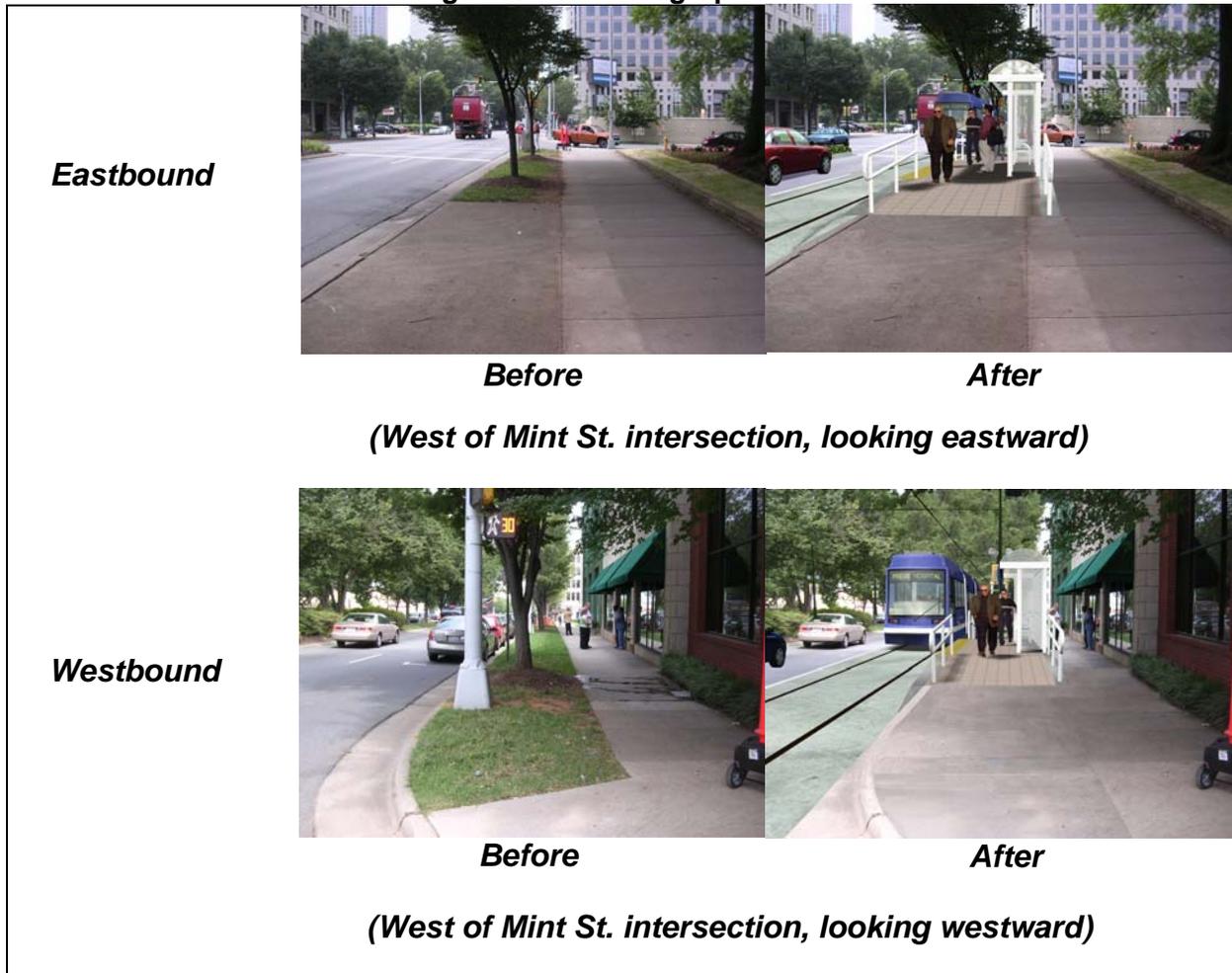
Figure 5-9: Photograph View



Alternative B - Curbside

This alternative will have curbside stops at the west side of the intersection of Trade and Mint Street. No widening would be required and no conventional parking would be affected except for four or five *Cinderella* spaces on the westbound side. Two medium-sized trees on the eastbound side and one medium-sized tree on the westbound side would be removed, and the sidewalk will be reduced to six feet on the eastbound side and to two feet on the westbound side.

Figure 5-10: Photograph View



Comparison of Alternatives

Table 5-9 Comparison of Alternatives (Mint/Pine Street)

Alternative	Description	Widening Required?	# of Parking Spaces Displaced	Trees Displaced?	Remaining Sidewalk Width (Beyond Platform)
A	Split Median	No	0 (7-16 Cinderella)	6	Current widths maintained
B	Curbside	No	0 (4-5 Cinderella)	3	Approx. 6 ft. (EB) approx. 4 feet (WB)

Recommendation

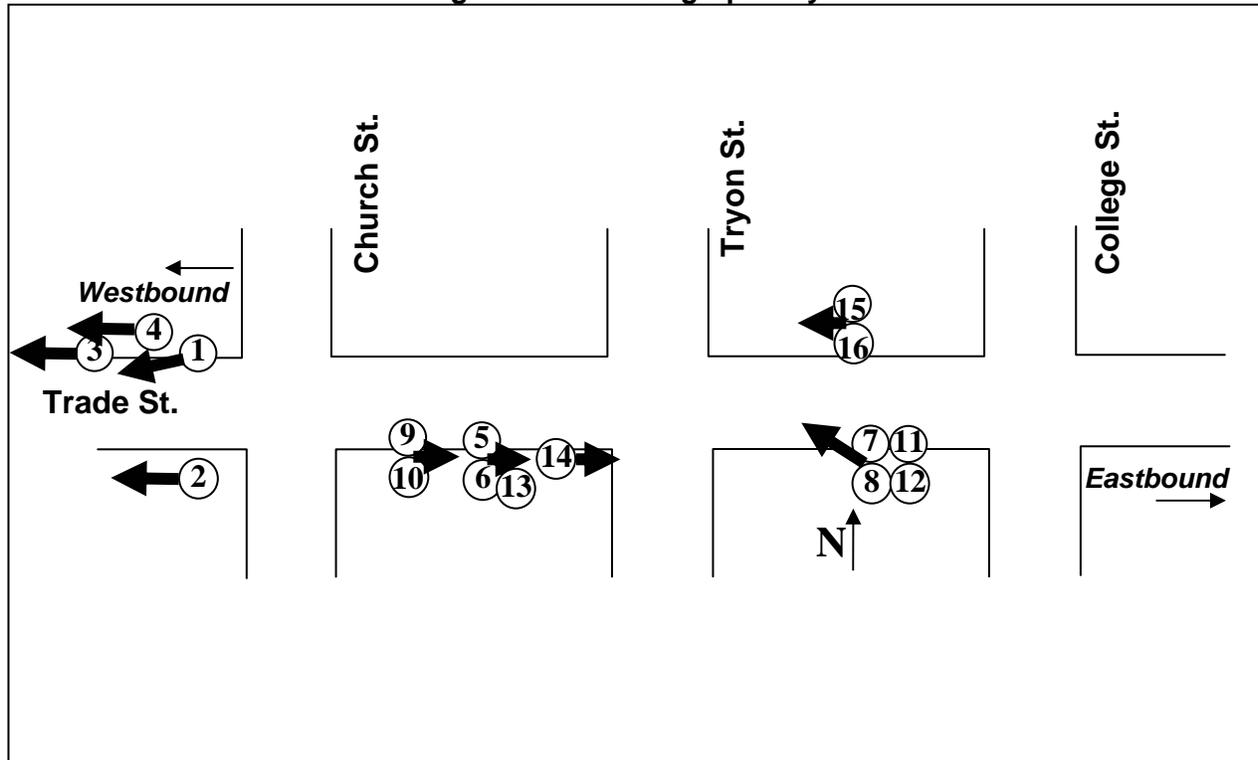
Although the impacts to trees associated with a median alternative are more than desired, the reduction of sidewalk width makes the curbside option impractical. Thus, a median stop is recommended.

5.4.2.4 Tryon Street

This stop will serve the historical and economic center of the city at the intersection of Trade Street and Tryon Street. Bank of America Corporate Center, Bank of America Plaza, First Citizens Bank Plaza and Independence

Center surround the “Square”, while the performing arts center, Hearst Tower, the main county library, and Discovery Place are also located nearby. Notable concerns exist with regard to this intersection and impacts related to traffic congestion, sidewalk impacts, and conserving the characteristics of the Square. Several stop alternatives deviate were developed in response to these concerns.

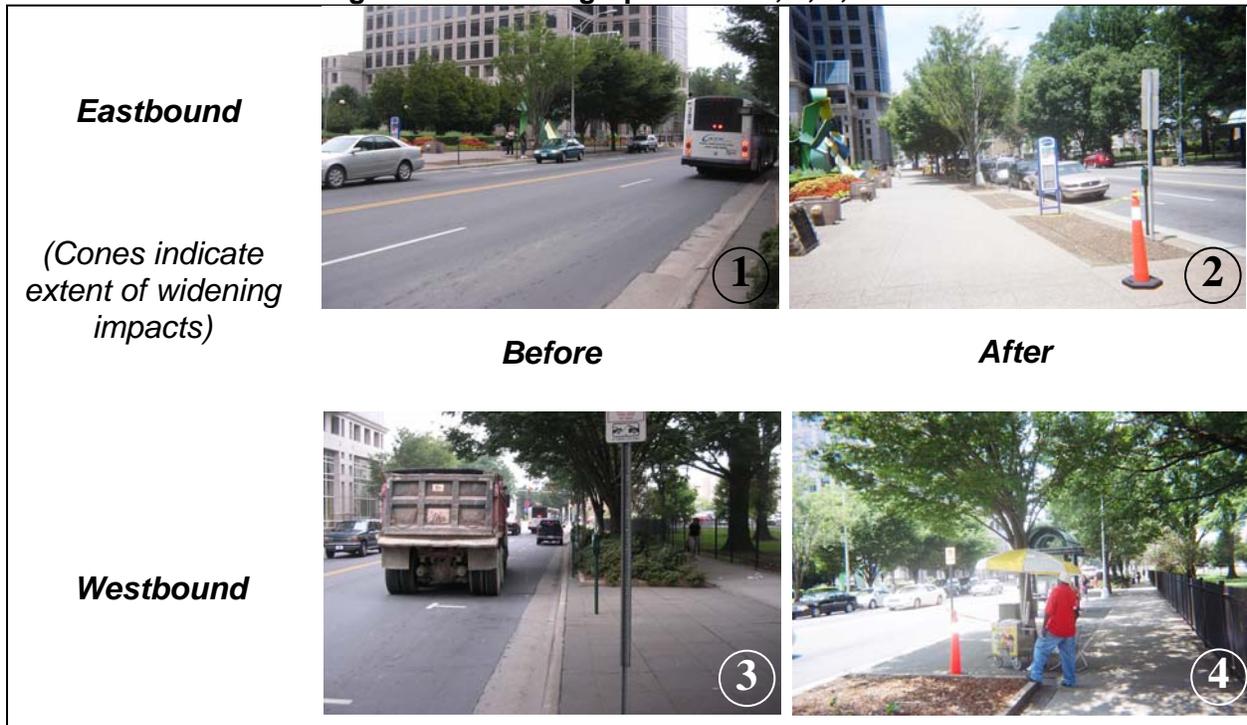
Figure 5-11: Photograph Key



Alternative A – Median between Church and Poplar

A median platform would be placed west of Tryon and Trade Streets between Church and Poplar to ease the impacts on the Tryon/Trade Square. Widening of three to five feet on the north side of the street and five to seven feet on the south side of the street would be necessary to accommodate the platform. No permanent parking spaces would be affected, but seven *Cinderella* spaces on each side would be displaced (if on-street parking is removed parallel to platforms to address concerns regarding potential traffic impacts when a streetcar is stopped for passenger loading and unloading). Approximately five medium-sized trees on the eastbound side and four to five medium and large-sized trees and shrubs would be displaced on the westbound side. The remaining sidewalk width beyond the platform would be approximately 18 feet on the eastbound side and 15 to 18 feet on the westbound side.

Figure 5-12: Photograph Views 1, 2, 3, and 4



Alternative B – Road Diet between Church and College

A *Road Diet* option, illustrated in Figure 5-12, would provide a narrower roadway with platforms on the curb. This alternative reduces traffic to one lane in each direction between College and Church, and establishes curbside platforms located on the near sides of Tryon (platforms are located on the east side of Tryon for westbound streetcars, and on the west side of Tryon for eastbound streetcars.) No widening would be required, no parking would be removed, and no trees should be displaced with this option. The current widths of the sidewalks would be maintained in the platform areas, and would be increased by approximately ten feet outside of the platform areas.

This alternative also enables continued streetcar service to the area of the Trade / Tryon intersection from both directions during special events, even when the intersection itself is closed to vehicular traffic. Westbound streetcars could approach the Square from the east, then return eastbound. Conversely, eastbound streetcars would approach from the west, then return westbound. Maintaining access to the Square from both directions would play a major role of transporting people to and from special events.

Figure 5-13: Alternative B

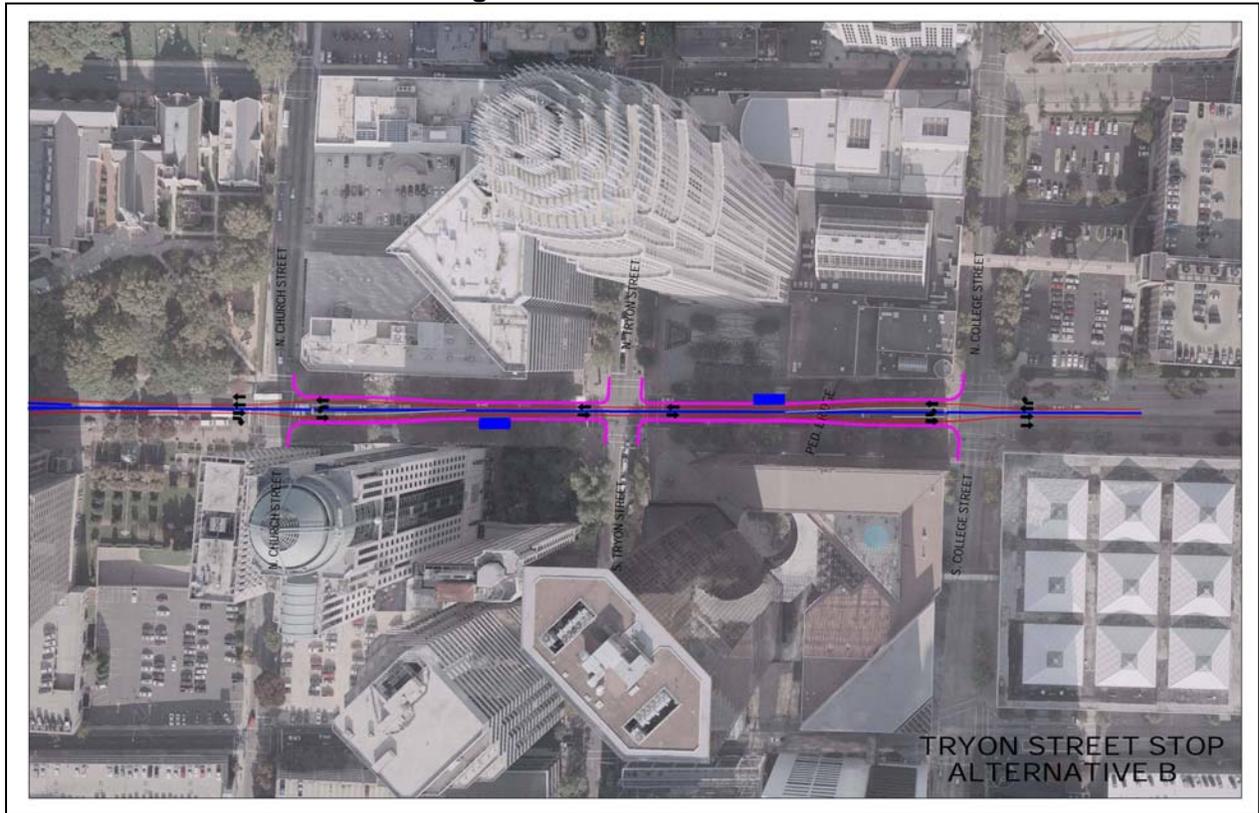
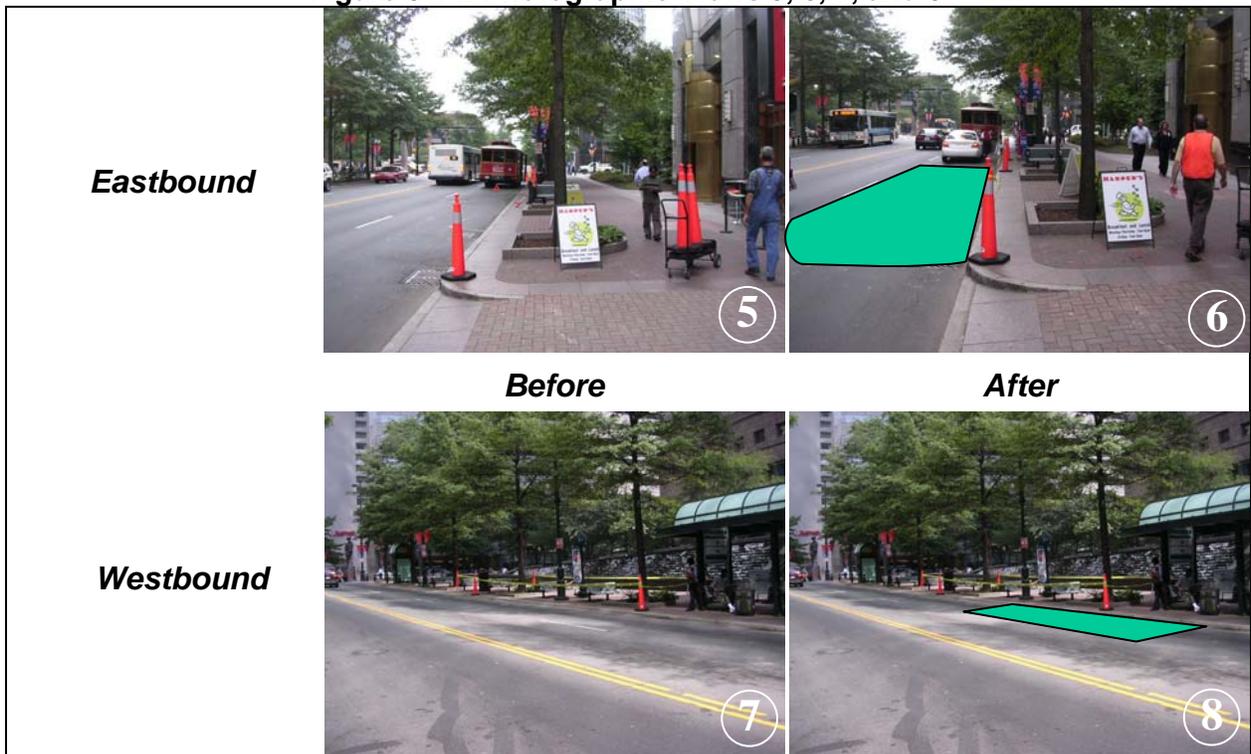


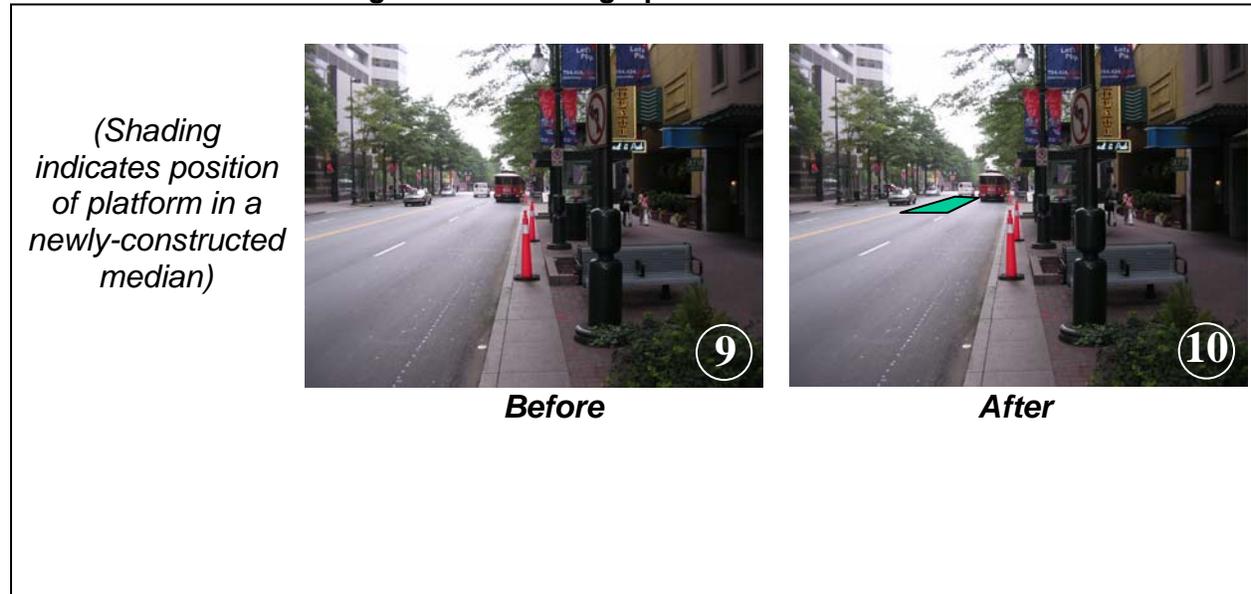
Figure 5-14: Photographic Views 5, 6, 7, and 8



Alternative C1 - Take a Lane EB between Church and College

This option calls for the removal of one eastbound lane of traffic and locating a median platform between Church Street and Tryon Street. Two westbound travel lanes and one eastbound travel lane would be available after implementation of this alternative. This option would not require any widening, affect street-side parking, or require the removal of any trees. The existing sidewalk widths would also be maintained.

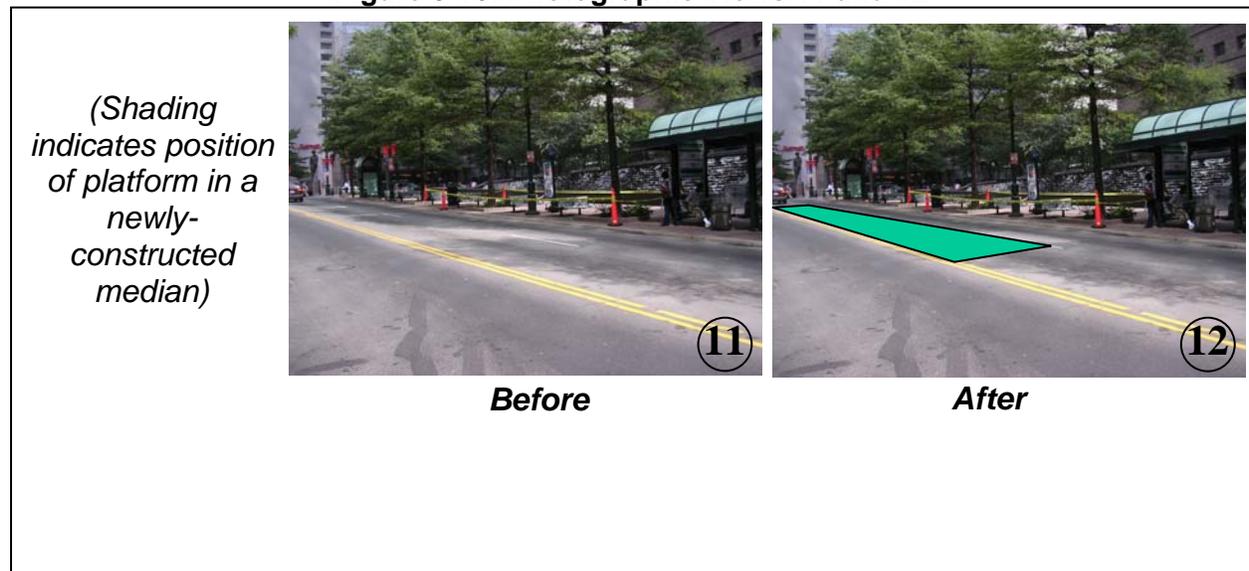
Figure 5-15: Photographic Views 9 and 10



Alternative C2 - Take a Lane WB between Church and College

This alternative removes one westbound travel lane and locates a median platform between College Street and Tryon Street. Two eastbound travel lanes and one westbound travel lane would be available after implementation of this alternative. This option would not require any widening, affect street-side parking, or require the removal of any trees. The current sidewalk widths would also be maintained.

Figure 5-16: Photographic Views 11 and 12



Alternative D - Median to curbside shift

Transitioning the track from a median-running alignment to a curb-running one is another option. This alternative would locate curbside platforms on the near sides of the Tryon Street intersection. This option would not require any widening or displace any parking spaces, and would maintain two travel lanes. In addition, streetcar stops would be placed at existing bus / transit shelter locations. However, it would require the removal of two or three medium-sized trees on each side of the road. It would also require a reduction in sidewalk width to nine to ten feet wide on the eastbound side and eleven to twelve feet on the westbound side beyond the platforms. Because stops are located on the near sides of the Tryon Street intersection, streetcar service could be maintained to the Square during special events in which vehicular traffic is prohibited (streetcars would approach the Square from each direction, then return in the opposite direction without crossing the Square itself).

To accomplish the shift from median-running to curbside-running and back again, two concepts can be employed. The first (Alternative D) illustrated below in Figure 5-17, is the creation of a “lane trap” (see illustration below). As median-running streetcars approach the Square, eastbound vehicles in the curb lane are forced to turn right onto Church Street (southbound) and westbound vehicles in the curb lane must turn right onto College Street (northbound). These forced turns enable streetcars to transition from the median lane into the curb lane as they pass through these intersections. After passing through the Square, eastbound vehicles in the median lane must turn left onto College Street (northbound), and westbound vehicles in the median lane are forced to turn left onto Church Street (southbound). These forced turns enable streetcars to transition back into the median lane as they pass through these intersections.

The second (Alternative D1) would include modifying the traffic signals at the Tryon Street intersections with Church and College streets to include streetcar-only phases that would provide a protected streetcar phase where the streetcar could transition from the median lane to the curb lane and back again. Under

this concept, the streetcar would call the signal phase as it approaches the intersection. All other traffic would remain stopped until the streetcar proceeds through the intersection.

Figure 5-17: Alternate D



Figure 5-18: Photographic Views 13, 14, 15, and 16



Comparison of Alternatives

Table 5-10: Comparison of Alternatives (Tryon Street)

Alternative	Description	Widening Required?	# of Parking Spaces Displaced	Trees Displaced?	Remaining Sidewalk Width (Beyond Platform)
A	Median Between Church and Poplar	Yes	0 (14 <i>Cinderella</i>)	9-10	Approx. 18 ft. (EB); 15-18 ft. (WB)
B	<i>Road Diet</i> between Church and College	No	0	0	Current widths maintained; approx. 10 ft. extra sidewalk width outside of platform area.
C1	Take a lane EB between Church and College	No	0	0	Current widths maintained.
C2	Drop 1 WB lane & locate median platform between College & Tryon.	No	0	0	Current widths maintained.
D & D1	Median to curbside shift	No	0	4-6	Approx. 9-10 feet (EB); approx. 11-12 ft. (WB)

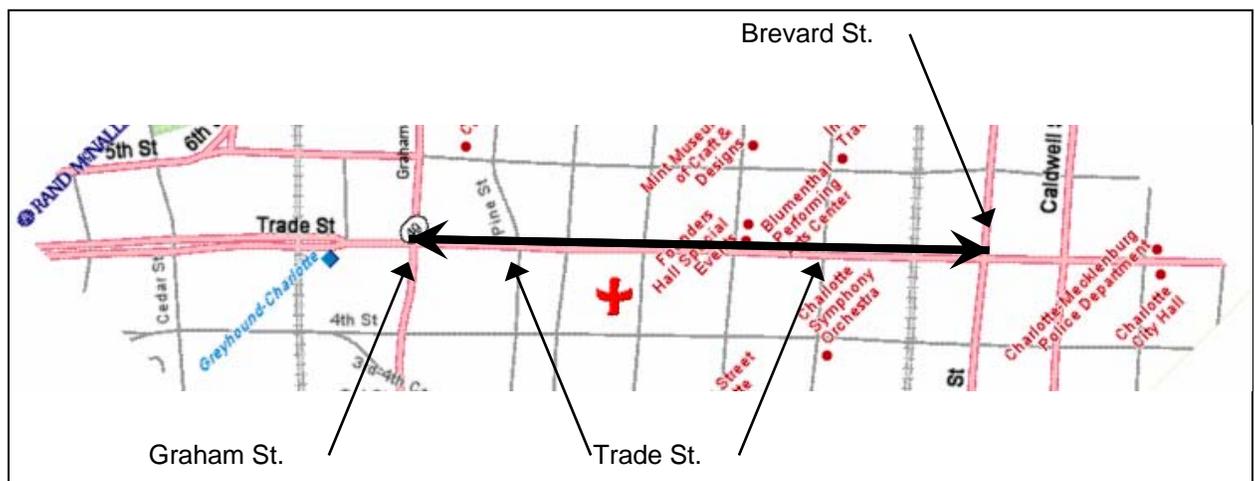
CDOT Traffic Assessment

The Charlotte Department of Transportation conducted a traffic assessment of the potential alternatives developed for the Tryon Street streetcar stops to answer the following questions:

- What will the impact on vehicular/bus operation be with streetcar?
- Does a curb or median running streetcar have more or less of an impact on motor vehicles?
- Will potential roadway widening for streetcar significantly impact pedestrian space at key locations?
- What station configuration will “fit” at Trade and Tryon to maximize the benefits of streetcar and minimize the costs for all users, or achieve the Center City vision?

The assessment methodology used VISSIM to simulate existing and proposed conditions. VISSIM is a traffic operations model that permits microscopic simulation of conditions as well as transit modeling capabilities. Each aforementioned scenario was assessed for the morning peak two-hour period, with detailed statistics compiled in 15-minute intervals. The study area limits is graphically depicted in Figure 5-19.

Figure 5-19: VISSIM Traffic Assessment Study Area Limits



Results of the VISSIM traffic analyses are tabulated in Table 5-9. The following summarizes the results:

- Reduction in eastbound travel lanes on Trade Street has significant impact on travel speeds.
- Reduction in westbound travel lanes on Trade Street has little to no significant impact on travel speeds.

Table 5-11: Summary of VISSIM Traffic Analyses

Alternative	Future Traffic No Streetcar		Future Traffic With Streetcar Alt. A1		Future Traffic With Streetcar Alt. A2		Future Traffic With Streetcar Alt. B		Future Traffic With Streetcar Alt. C1		Future Traffic With Streetcar Alt. C2		Future Traffic With Streetcar Alt. D1	
	Total	Ave	Total	Ave	Total	Ave	Total	Ave	Total	Ave	Total	Ave	Total	Ave
WB Trade														
Time Period (sec.)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)
Min	189	11.2	184	11.5	190	11.1	183	11.6	162	13.1	183	11.5	192	11.0
Max	198	10.7	200	10.5	215	9.8	212	9.9	182	11.6	206	10.2	207	10.2
Difference	9	0.5	16	0.9	25	1.3	30	1.6	20	1.4	23	1.3	15	0.8
Average	194	10.9	194	10.9	204	10.4	196	10.8	172	12.3	196	10.8	199	10

Alternative	Future Traffic No Streetcar		Future Traffic With Streetcar Alt. A1		Future Traffic With Streetcar Alt. A2		Future Traffic With Streetcar Alt. B		Future Traffic With Streetcar Alt. C1		Future Traffic With Streetcar Alt. C2		Future Traffic With Streetcar Alt. D1	
	Total	Ave	Total	Ave	Total	Ave	Total	Ave	Total	Ave	Total	Ave	Total	Ave
EB Trade														
Time Period (sec.)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)	Travel Time (sec.)	Speed (mph)
Min	160	13.1	171	12.3	173	12.2	184	11.5	201	10.5	162	13.0	166	12.7
Max	182	11.6	191	11.1	196	10.8	393	5.4	401	5.3	181	11.6	192	11.0
Difference	22	1.6	19	1.2	23	1.4	209	6.1	200	5.2	19	1.4	26	1.7
Average	175	12.0	183	11.5	188	11.2	314	6.7	322	6.6	175	12.0	180	11.7

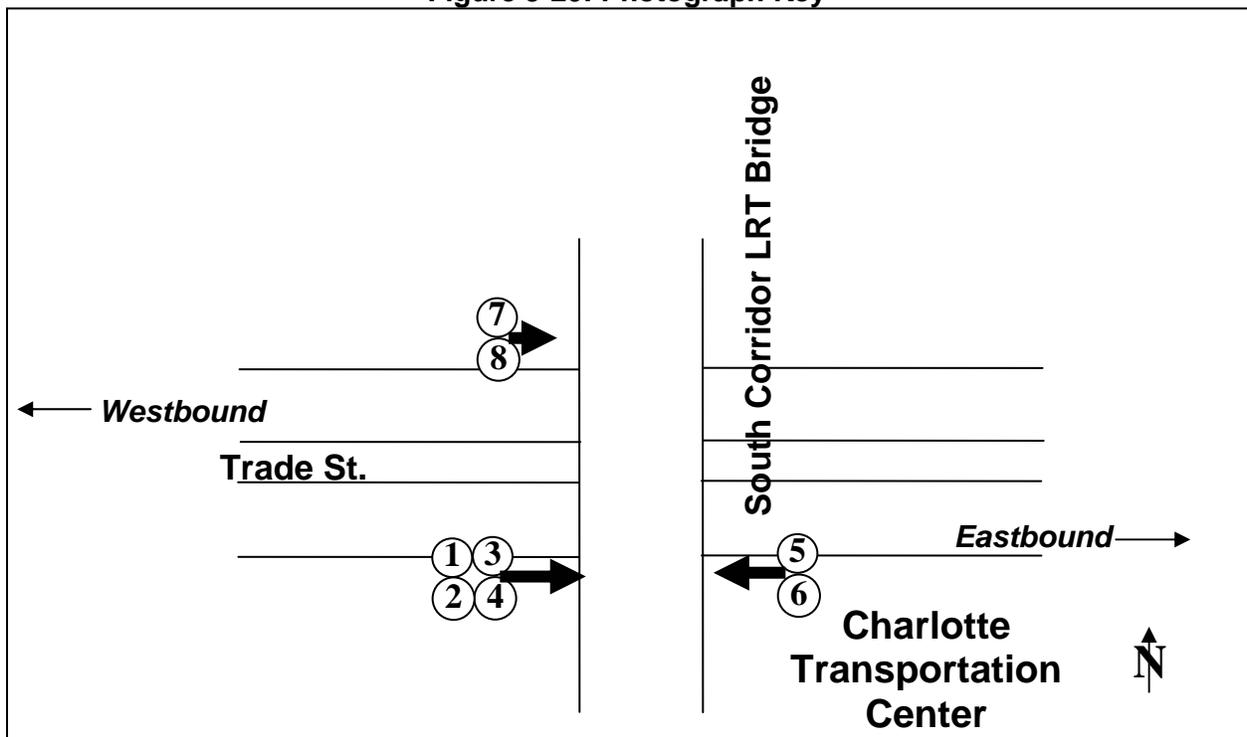
Recommendation

To mesh with the urban design of the area, reduce impacts at the Square, and to alleviate concerns over future events along Tryon Street and potential traffic impacts, Alternative D1 (median-to-curb side shift with new streetcar-only traffic signal phases) is recommended, in conjunction with median platform locations at the next stop in each direction.

5.4.2.5 Arena/Transportation Center

This stop would serve the Charlotte Transportation Center as well as a key entertainment and shopping hub once the Charlotte Arena, proposed EpiCentre mixed-use development, and proposed Ritz Carlton are complete. Two median options are presented, along with a curbside option.

Figure 5-20: Photograph Key



Alternative A1 – Wide Median Platform

This alternative provides median platforms that are approximately 24 feet wide. The actual platform width will be determined based on modeling ridership data that are not yet available. The existing median is not wide enough for a streetcar platform, so either the north, south, or a combination of the curblines would have to be moved to accommodate the needed widening. This widening will reduce the sidewalk width to 21 feet to the EpiCentre right-of-way line in the eastbound lane. No widening would be necessary in the westbound direction; the curb line will remain unchanged. No parking spaces will be removed, but four or five small trees and shrubs in the median and along the eastbound curb will be displaced.

Figure 5-21: Alternative A1

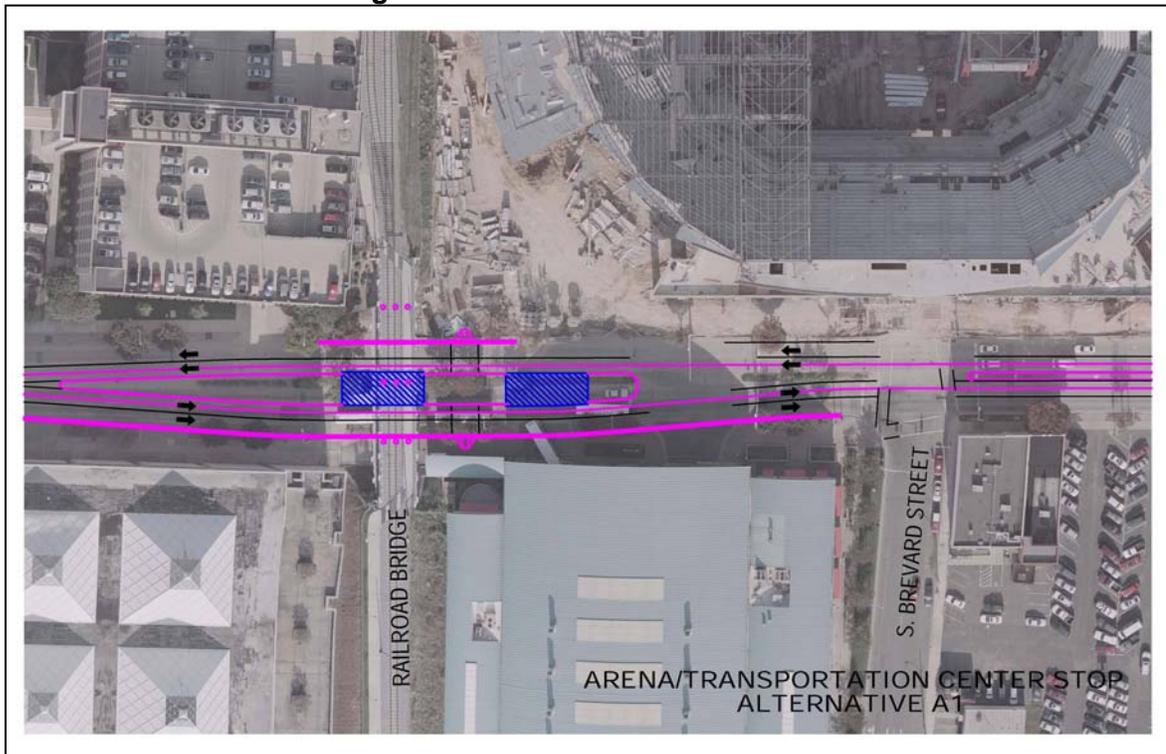


Figure 5-22: Photographic View



Alternative A2 – Narrow Median Platform

This alternative will have a median platform of approximately half the width (about 12 feet wide) of the previous alternative. The existing median would be widened slightly for the station platform. No roadway widening would be necessary, but the lane widths would be reduced to create sufficient space for the platform. Both westbound travel lanes would be reduced from approximately 11.5 feet in width to 10.5 feet, and the eastbound median travel lane width would be reduced from approximately 11 feet to 10.5 feet (there would be no change in width to the eastbound curb lane). This option maintains the current sidewalk widths, and will not affect any current parking spaces. It will require the removal

of the same trees that were affected in the prior alternative. It is important to emphasize that ridership modeling data are needed to determine if this platform size can effectively handle projected ridership demands; needed data are not yet available.

Figure 5-23: Alternative A2

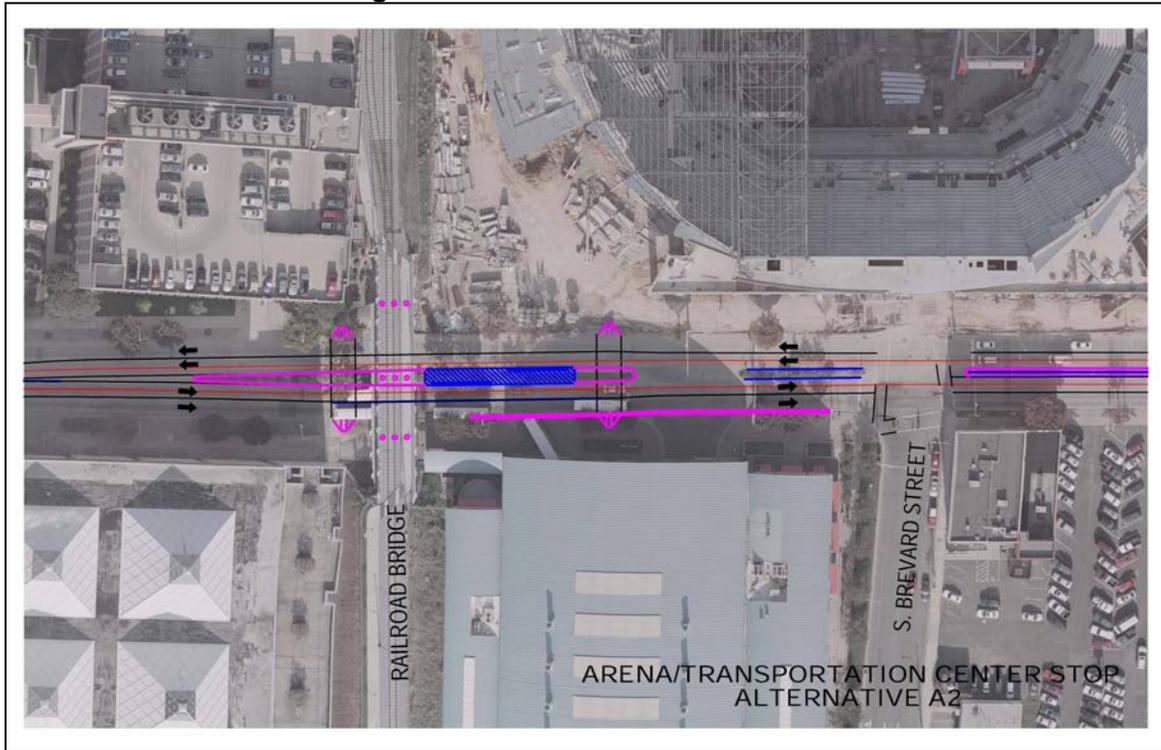


Figure 5-24: Photographic View



Before

After (Eastbound)

Alternative B – Curbside Platforms

The platforms would be located curbside under the light rail overpass in this alternative. No roadway widening is needed, and two travel lanes are maintained in each direction. However, the sidewalk width would be reduced to 22 feet in the eastbound direction and 27 feet on the westbound side (though the platform

would extend close to the existing bridge supports). No parking spaces will be affected, but three small trees on the eastbound side and one on the westbound side may need to be removed.

In addition, with curb-running streetcars, there is a potential conflict between the overhead catenary system and delivery trucks turning into the proposed EpiCentre service driveway on the south side of Trade Street. The OCS will be transitioning to a lower (non-standard) height to pass under the South Corridor LRT bridge, and large delivery trucks could potentially come into contact with the OCS. This situation is an extreme safety hazard and must be avoided. However, this situation is less of a concern if the OCS is situated over the median lane, while delivery trucks are turning out of the curbside lane.

Figure 5-25: Photographic View



Comparison of Alternatives

Table 5-12: Comparison of Alternatives (Arena / Transportation Center)

Alternative	Description	Widening Required?	# of Parking Spaces Displaced	Trees Displaced?	Remaining Sidewalk Width (Beyond Platform)
A1	Wide Median Platform	Yes	0	4-8	21' to EpiCentre ROW line (EB); No change (WB)
A2	Narrow Median Platform	No	0	4-8	No change
B	Curbside platforms	No	0	4	22' to EpiCentre Row line (EB); 27' (WB)

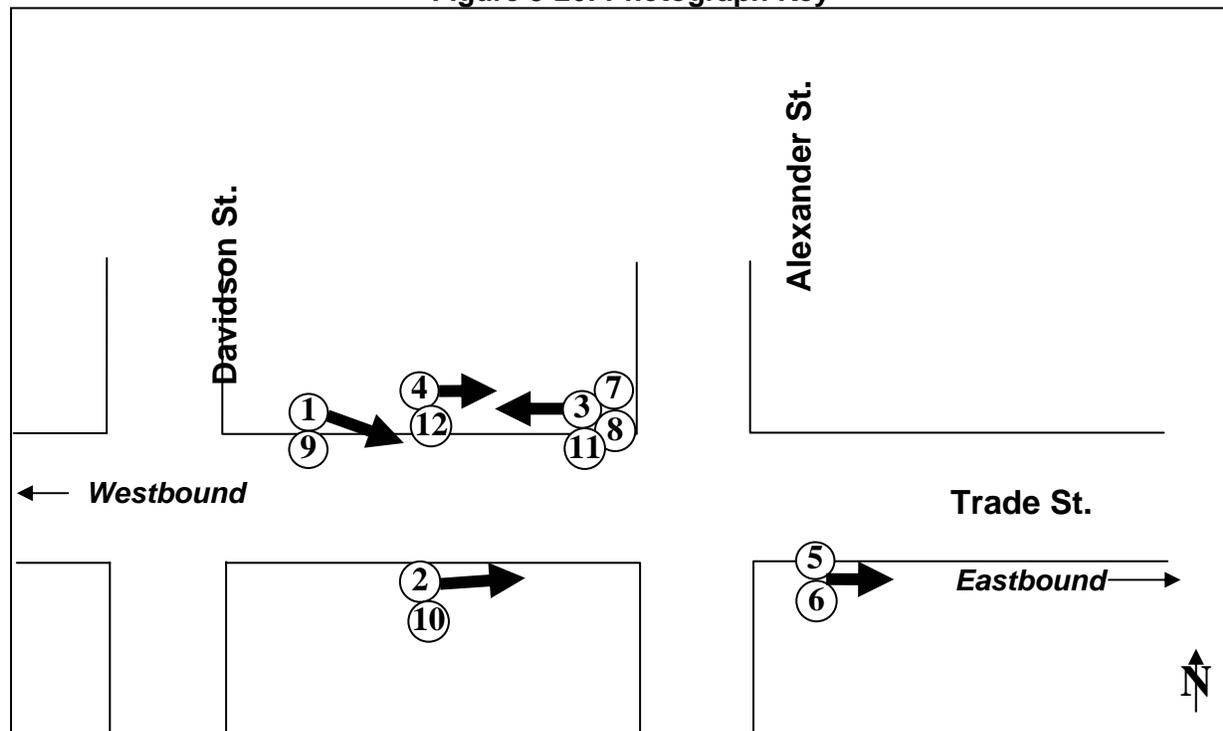
Recommendation

The *Narrow Median* option (A2) minimizes negative impacts to the sidewalk. However, modeling data are needed to determine the appropriate platform size at this location.

5.4.2.6 Government Center

This stop in the vicinity of Davidson Street and North Alexander Street serves City Hall, Charlotte-Mecklenburg Police Department, the judicial buildings, the post office, and the Charlotte-Mecklenburg Government Center on Fourth Street. Both narrow and wide median platforms are offered as alternatives here, in addition to an option to operate along the curb.

Figure 5-26: Photograph Key



Alternative A – Narrow Median Platform

Widening will be required of five to seven feet on the north side only to accommodate a median platform of 12' wide by 110' long near the Davidson Street intersection (between Davidson Street and Alexander Street). No parking spaces will be affected, and no trees on the south side of the street will have to be removed. However, four to six smaller trees in the planting strip on the north side may be affected, and the planting strip will be reduced from approximately 14 feet to 7 feet in the westbound direction. The current sidewalk and planting strip width of 6-8 feet will be maintained in the eastbound direction. Placing the stop closer to the Davidson Street intersection also places it closer to the Arena, serving as an alternate stop for the Arena during special events.

Figure 5-27: Alternative A

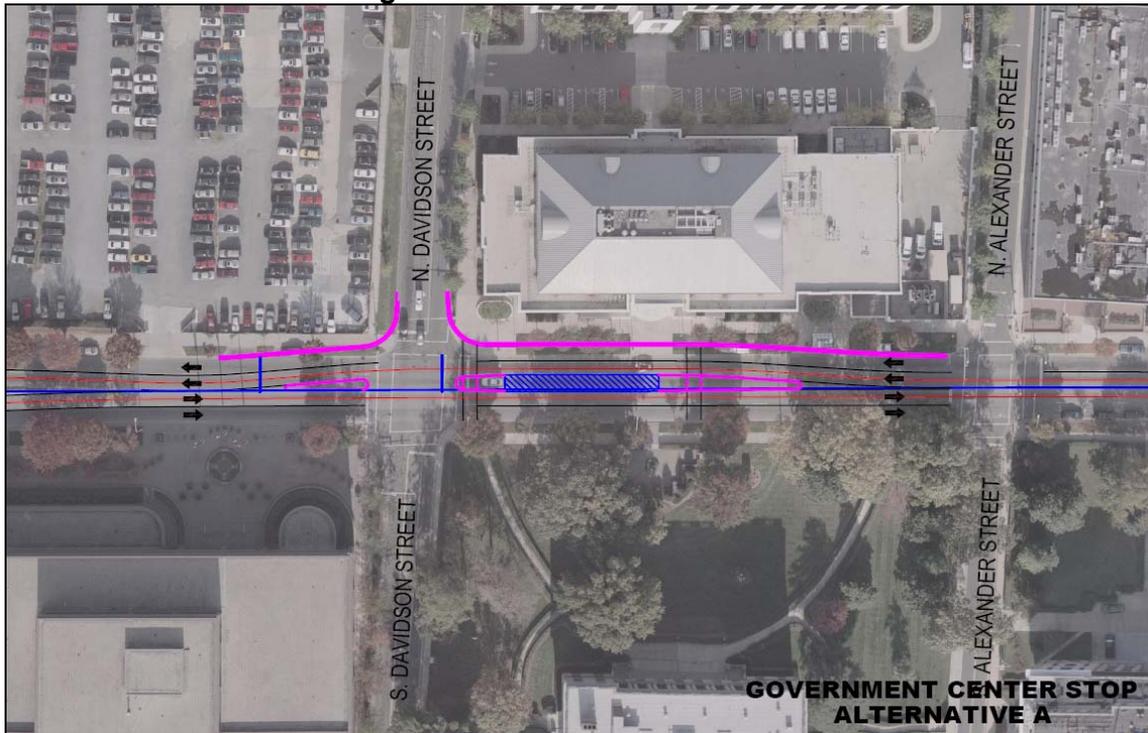


Figure 5-28: Photographic Views 1, 2, 3, and 4



Alternative B – Curbside Stops

This alternative provides far-side stops at Alexander Street. No widening will be required and no westbound parking will be affected, but six to eight *Cinderella* spaces on the eastbound side of the road may be displaced. One small tree on the eastbound curb and three medium-sized trees on the westbound side will be affected. This option does not require any change to the sidewalk in the westbound direction, but the sidewalk will be reduced significantly and the planting strip will be eliminated in the eastbound direction.

Figure 5-29: Photographic Views 5, 6, 7, and 8



Alternative C – Wide Median Platform

Widening of five to seven feet on both sides of the street would be needed to accommodate a median platform of 19 feet wide by 44 feet long between Davidson Street and Alexander Street. No parking would be affected, but several medium-sized trees on south side of street and west of Alexander in the planting strip might need to be removed along with two to four smaller trees in planting strip on the north side. The eastbound sidewalk would lose its planting strip, and the westbound sidewalk would have its planting strip reduced from approximately 14 to seven feet.

Figure 5-30: Photographic Views, 9, 10, 11, and 12



Comparison of Alternatives

Table 5-13 Comparison of Alternatives (Government Center)

Alternative	Description	Widening Required?	# of Parking Spaces Displaced	Trees Displaced	Remaining Sidewalk Width (Beyond Platform)
A	Narrow Median Platform	Yes	0	4-6	No change EB; planting strip reduced to 7 feet on WB.
B	Curbside	No	0 (6-8 Cinderella)	4	6 ft. (EB – no planting strip); current width maintained (WB)
C	Wide Median Platform	Yes	0	6-8	EB: 6-8 feet (no planting strip); WB: 6-8 feet (planting strip reduced to 7 feet.

Recommendation

The narrow median platform described in *Alternative A* produces the least overall impact on the surrounding parking, trees, sidewalk, and planting strip.

5.4.3 Summary of Analysis

The examination of potential streetcar stop alternatives in the Tier 3 analysis indicates that in most cases, median platforms are preferred primarily due to the ability to maintain existing sidewalk widths. However, the unique conditions and the urban design surrounding the Trade Street/Tryon Street intersection provide strong support for a curbside alternative in this area.

The proposed alternatives for each stop location are as follows:

- **Johnson & Wales:** Median
- **Charlotte Gateway Station:** Median
- **Mint/Pine Street:** Split Median
- **Tryon Street:** Median to Curbside Shift
- **Arena/Transportation Center:** Narrow Median
- **Government Center:** Narrow Median

(A median stop at McDowell Street is also proposed, but this stop location was not examined in detail as part of this analysis due to its proximity to the Elizabeth Avenue section, where the alignment previously has been defined.)

It should be noted that three of these locations (Mint Street, Arena, and the Government Center) have narrow median platforms specified as the preferred alternatives. Analysis of ridership modeling data is needed to determine if these platform widths are sufficient for the anticipated demand.

6 DEFINITION OF ALIGNMENT AND OVERALL SUMMARY

This Section provides an overall summary of the analyses performed to develop a definition for the preferred streetcar alignment through Center City. The preferred alignment was developed in three phases of study, each at an increasing level of detail. The results of these three stages are summarized below, along with a description of the preferred streetcar alignment.

6.1 Tier 1 Analysis

The Tier 1 analysis identified alternatives for more detailed examination, using the following four objectives as the basis for comparison:

1. Provides the most benefits to surrounding land uses and development;
2. Provides the best fit within the framework of the streetcar system;
3. Minimizes negative transportation / environmental impacts; and
4. Presents the fewest problems in terms of constructability.

This evaluation was conducted on the five east-west thoroughfares between Third Street and Sixth Street. Specific performance measures were developed for each of the objectives, and were reviewed by the Working Session Group. Scores relative to “high”, “medium”, and “low” rankings were established for each measure, and equal weighting was used for all criteria.

Based on the Tier 1 rating system described earlier, the following streets (and any alignment options utilizing these streets) were eliminated from further analysis:

- Third Street;
- Fifth Street; and
- Sixth Street.

Therefore, the following three alternatives were advanced for further consideration under Tier 2 examination:

- A. Trade Street (bi-directional / curb-running);**
- B. Trade Street (bi-directional / median-running); and**
- C. Fourth Street / Trade Street couplet (curb-running).**

Following stakeholder input received at the Center City Transit Workshop, a fourth option was reinstated for Tier 2 analysis:

- D. Trade Street / Fifth Street couplet (curb-running).**

6.2 Tier 2 Analysis

After the Tier 1 (“Basic Screening”) analysis was conducted to determine the streets in Center City most favorable to streetcar service, a more detailed assessment was performed on the four alternatives (described earlier) that advanced to this next stage of evaluation.

A series of objective criteria was developed, and a relative ranking (1st, 2nd, 3rd, 4th) was assigned to each alternative under each performance measure. All criteria were weighted equally to determine a final ranking of alternatives. However, it is important to note that the relative ranking determined through this analysis could change if CATS elects to prioritize the performance measures.

The Tier 2 analysis addressed many of the same impacts studied as part of the Tier 1 analysis, but provides a more in-depth examination of these impacts and also evaluates several additional aspects of the proposed streetcar service. The following eleven evaluation criteria were used:

- Access and traffic impacts;
- Existing on-street parking;
- Redevelopment opportunities;
- Platforms and pedestrian environment;
- Streetcar operations;
- Bridge clearances;
- Potential utilities impacts;
- Relative capital costs;
- Ease of construction;
- Flexibility of streetcar; and
- Compatibility with Light Rail Transit.

Based on evaluation using these eleven specific performance measures, the **Trade Street (median-running)** alternative ranked the highest among the four options studied. Although this evaluation weighted all criteria equally, a separate scoring compilation was created using only five highly critical criteria, as determined by the Team:

- Capital costs;
- Utility impacts;
- Streetcar operations;
- Ease of construction; and
- Platforms and pedestrian environment.

The **Trade Street (median-running)** alternative ranked the highest in this scenario as well, followed by the Trade Street (curbside) option and the Trade Street / Fourth Street couplet.

6.3 Tier 3 Analysis

Results from the Tier 2 investigation illustrate that a median alignment on Trade Street convincingly outranks the other alternatives when considering the stated performance measures; nevertheless, issues associated with this alignment must still be addressed. Though operating the streetcar primarily on a median alignment through Center City is preferred, alternative platform locations might better address the unique challenges and concerns at specific stops. Combining a median alignment with some of the best qualities of the curbside alternative on Trade Street may optimize a preferred alignment.

The purpose of the Tier 3 analysis was to confirm the Trade Street (median) option as the preferred alignment, by conducting a detailed analysis to compare the impacts of median and curbside platforms at individual stop locations. Special attention was given to widening requirements, parking displacement, tree displacement, and sidewalk impacts. This assessment resulted in stop-by-stop recommendations for each of the potential stop locations.

The examination of potential streetcar stop alternatives in the Tier 3 analysis indicates that in most cases, median platforms are preferred primarily due to the ability to maintain

existing sidewalk widths. However, the unique conditions and the urban design surrounding the Trade Street/Tryon Street intersection provide strong support for a curbside alternative in this area.

The proposed alternatives for each stop location are as follows:

- **Johnson & Wales:** Median
- **Charlotte Gateway Station:** Median
- **Mint/Pine Street:** Split Median
- **Tryon Street:** Median to Curbside Shift
- **Arena/Transportation Center:** Narrow Median
- **Government Center:** Narrow Median

(A median stop at McDowell Street is also proposed, but this stop location was not examined in detail as part of this analysis due to its proximity to the Elizabeth Avenue section, where the alignment previously has been defined.)

6.4 Preferred Streetcar Alignment

Ultimately, a streetcar alignment was selected that would operate on Trade Street through Center City. Streetcars would operate in the median travel lanes through most of Center City, except for the area near The Square (Trade Street and Tryon Street), where unique design features would be utilized to shift to a curb-running alignment to take advantage of the distinctive urban design opportunities associated with curbside stops in this area. Graphic depictions of the overall alignment and each recommended stop location are provided on the following pages.

Figure 6-1: Preferred Streetcar Alignment

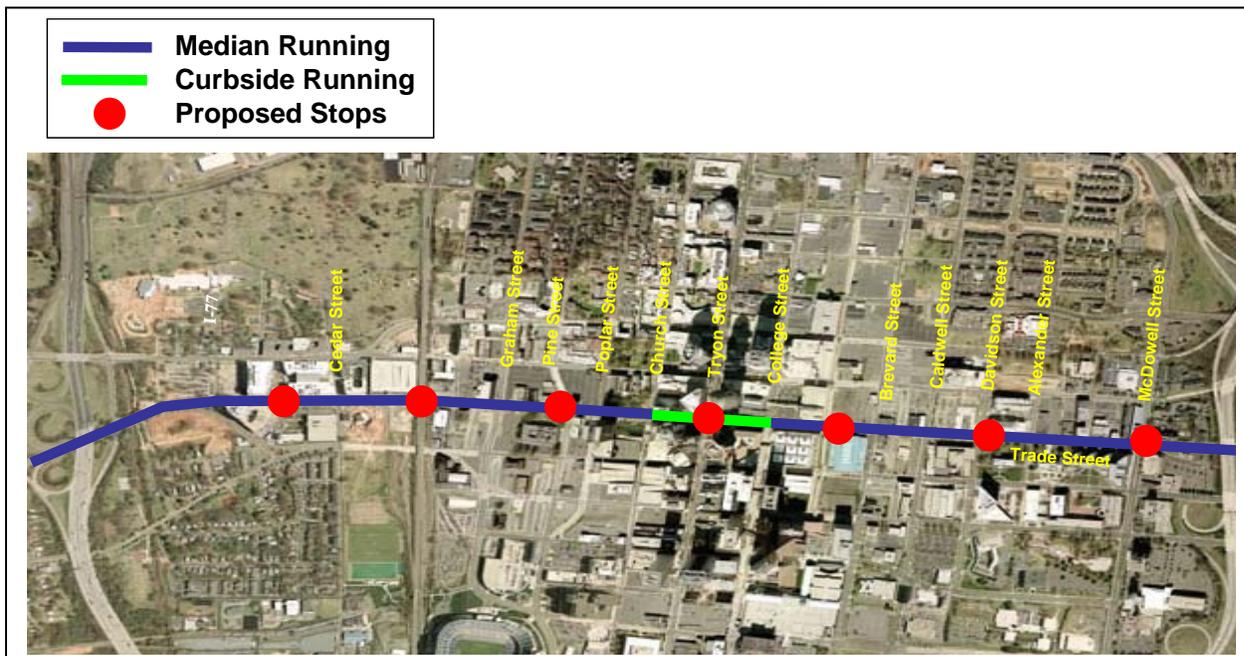


Figure 6-2: Johnson and Wales (Existing Conditions)



(existing plan view)

Figure 6-3: Johnson and Wales (Proposed Conditions)



(proposed plan view)



(proposed aerial view)



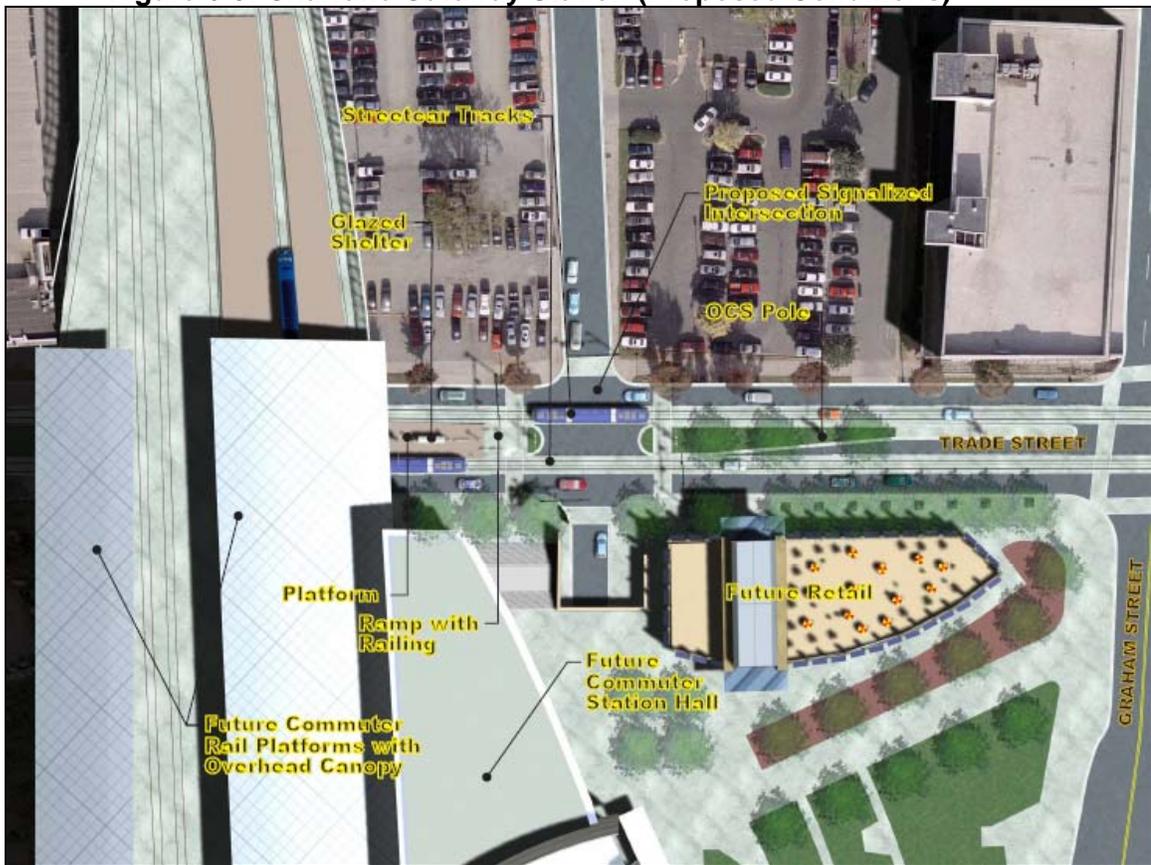
(proposed ground view)

Figure 6-4: Charlotte Gateway Station (Existing Conditions)



(existing plan view)

Figure 6-5: Charlotte Gateway Station (Proposed Conditions)



(proposed plan view)



(proposed aerial view)



(proposed ground view)

Figure 6-6: Mint/Pine Street (Existing Conditions)



(existing plan view)

Figure 6-7: Mint/Pine Street (Proposed Conditions)



(proposed plan view)



(proposed aerial view)



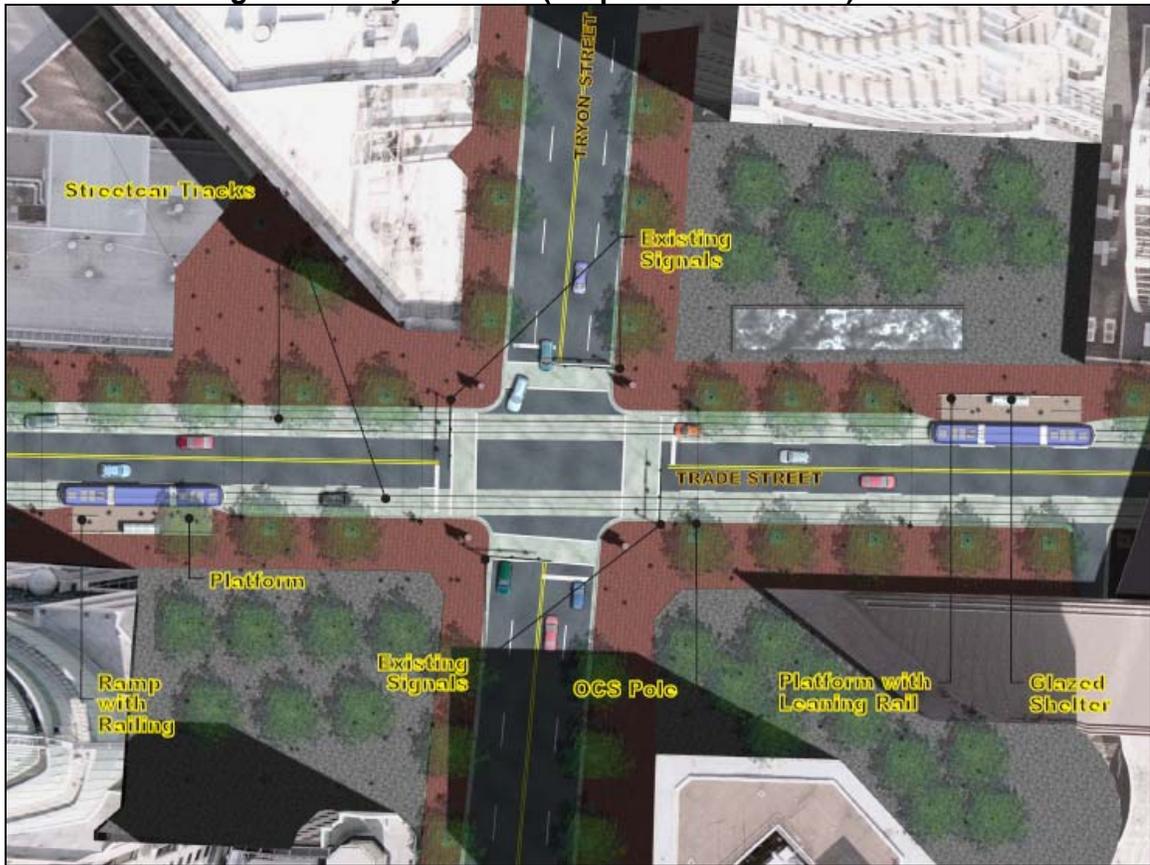
(proposed ground view)

Figure 6-8: Tryon Street (Existing Conditions)



(existing plan view)

Figure 6-9: Tryon Street (Proposed Conditions)



(proposed plan view)



(proposed aerial view)



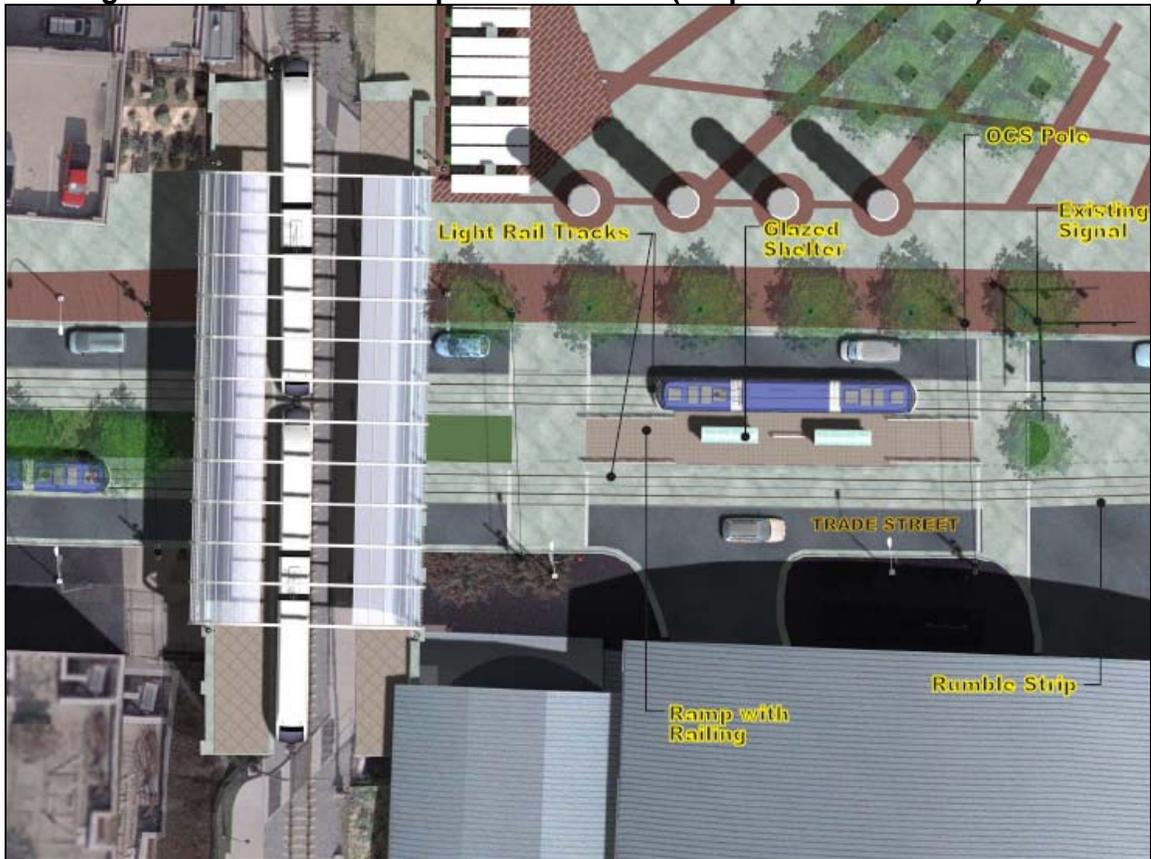
(proposed ground view)

Figure 6-10: Arena / Transportation Center (Existing Conditions)



(existing plan view)

Figure 6-11: Arena / Transportation Center (Proposed Conditions)



(proposed plan view)



(proposed aerial view)



(proposed ground view)

Figure 6-12: Government Center (Existing Conditions)



(existing plan view)

Figure 6-13: Government Center (Proposed Conditions)



(proposed plan view)



(proposed aerial view)



(proposed ground view)