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TECHNICAL REPORTS

A. Project Initiation Package
B. Detailed Definition of Alternatives Report
C. Operations Plan
D. Transit Ridership Report
E. Conceptual Engineering Report
F. Stop Location Memorandum
G. Vehicle Technical Alternatives Report
H. Public Involvement Report
I. Traffic Operations Impacts Technical Memorandum
J. On-Street Parking Impacts Technical Memorandum
K. Environmental Screening Technical Memorandum
L. Vehicle Maintenance Facility Site Selection and Evaluation Memorandum
M. Development Potential Memorandum
N. Capital Cost Report
O. Finance Strategy Report
1 INTRODUCTION

1.1 Why was this document prepared?
Federally-funded projects, such as the proposed Urban Circulator project, are subject to review under a number of environmental statutes, regulations, and executive orders. This document provides detailed information on the project and the selection of the Locally Preferred Alternative (LPA) as required by the Federal Transit Administration's (FTA) Alternatives Analysis (AA) process. The AA requires a comprehensive assessment of various mobility options for any potential major transit investment.

Additionally, this document summarizes information from an environmental screening process that will be included in a future Environmental Assessment (EA) in compliance with National Environmental Policy Act (NEPA).

1.2 Who is the project sponsor?
The FTA is the lead agency for the proposed Urban Circulator project. As the grant recipient, the City of Winston-Salem is the primary sponsor of this project. The City partnered with Winston-Salem Transit Authority (WSTA) and Piedmont Authority for Regional Transportation (PART) to conduct previous preliminary feasibility studies and this study.

1.3 Is more detailed information available about the project?
A series of technical reports was completed that provides supporting information about the elements summarized in this document. "For more information" boxes on the following pages guide the reader to the appropriate supplemental reports, which are published as appendices to this document. All reports are available on the study website at www.winstonsalemcirculator.com.

1.4 What opportunities for public comment will be available?
As described later in this document, public and stakeholder input was sought throughout the study and, it informed all project decisions leading to the identification of the LPA. As part of the NEPA documentation to be submitted at a future date, the public will have additional opportunities to comment on the proposed Urban Circulator project prior to the completion of the environmental review.

1.5 What decisions remain to be made?
An environmental screening was prepared as part of this project. However, future work will involve the preparation of NEPA documents that will be submitted to the FTA in compliance with NEPA regulations.

A conceptual level of design was completed through this study; and detailed design decisions will be made as part of the future preliminary engineering and final design processes. Coordination with the public and stakeholders will continue throughout the design process.

A general funding strategy for the proposed Urban Circulator project is included as part of this study. However, a more detailed funding plan will be established through continuing discussions with potential project partners. Additionally, in recognition of limited funding resources, the proposed project may be implemented in phases. Details regarding the potential phased implementation will be determined based on continuing technical analysis and stakeholder input.

1.6 Study Area
The study area (Figure 1) is bounded by 6th Street and 5th Street through the Wake Forest Innovation Quarter (formerly known as Piedmont Triad Research Park or PTRP) to the north, Martin Luther King Jr. Drive to the east, Rams Drive and Interstate 40 to the south and Hawthorne Road to the west. The area extends from Wake Forest Baptist Medical Center (WFBMC) through downtown Winston-Salem, Wake Forest Innovation Quarter, Winston-Salem State University (WSSU), and on to the East Winston area.
Figure 1: Study Area

Source: HDR Engineering, 2013
2 PURPOSE AND NEED

2.1 Why is this project needed?

The Urban Circulator is needed to help Winston-Salem achieve its vision as described in the 2030 Legacy Comprehensive Plan to grow smarter and better by managing future development. The Urban Circulator can support this vision by enhancing economic competitiveness and providing more mobility options in the urban core.

An Urban Circulator could be a viable transit service connecting:

- More than 11,000 Baptist Medical Center employees;
- BB&T Ballpark with 300,000 game-day and 50,000 non-game day visitors annually,
- 6.1 million gross square feet of planned redevelopment space and an estimated 20,000 additional employees at the Wake Forest Innovation Quarter;
- A vibrant Downtown – regional business and arts center, home to special events venues;
- An additional 20,000 employees and over 2,000 residents throughout greater downtown;
- Nearly 6,500 students attending Winston-Salem State University;
- The Transportation Center, serving nearly 11,000 passengers per day; Union Station, which is the planned destination for future commuter and intercity rail; and
- The commercial center of the “East Winston” community.

The west to east corridor connects the greatest combination of activity centers and underutilized areas where development can be spurred. Beyond economic growth, transit can help the downtown and the surrounding neighborhoods flourish by giving citizens a non-automobile alternative. Neighborhoods with transit preserve mobility, encourage walking, support higher property values, and promote overall public health.

2.2 What other efforts support the proposed project?

A multi-modal transportation system is a key part of the community vision for economic growth and environmental sustainability building upon the Winston-Salem Streetcar Feasibility Study (completed in 2006) and recommendations developed as part of the Regional Transit Development Plan, Forsyth and Guilford Counties Transit Vision for 2025 (completed in 2010), the 2030 Legacy Comprehensive Plan Update (2012) and the Winston-Salem Downtown Plan (completed in 2013).

2.2.1 2006 Streetcar Feasibility Study

The 2006 Streetcar Feasibility Study established the concept for a streetcar route through the urban core of Winston-Salem. The Study recommended a plan that encourages new residential development, establishes better transportation linkages and stimulates other parts of the city and surrounding areas.

2.2.2 2013 Downtown Plan

Streetcars were specifically identified in the City’s 2013 Downtown Plan as a desired part of Winston-Salem’s transportation network. The plan identifies the need for access by Downtown residents, shoppers and visitors to a modern streetcar system. The Plan was supported by extensive public involvement.

2.2.3 Forsyth and Guilford Counties Transit Vision 2025

The joint vision by Forsyth and Guilford Counties recommends the creation of an enhanced circulation system in downtown Winston-Salem and downtown Greensboro. The Vision identifies Winston-Salem State University (WSSU), Piedmont Triad Research Park (PTRP), Wake Forest Baptist Medical Center, Wake Forest University, and University of North Carolina School of the Arts as key destinations to be served by an Urban Circulator.
2.2.4 Legacy 2030 Comprehensive Plan Update

The Legacy 2030 Comprehensive Plan is a guide for shaping the future of Winston-Salem and Forsyth County. Originally adopted in 2001, it was updated in 2012. It emphasizes the promotion of a modern rail streetcar system to connect destinations in the larger Center City area and serve as a catalyst for development. It encourages transit connections between Downtown Winston-Salem and suburban areas to increase ridership. The Legacy Plan was supported by extensive public involvement.
3 CONCEPTUAL ROUTE ALTERNATIVES

3.1 What route options were considered?

Various transit route options were identified based on the earlier feasibility studies and stakeholder feedback to connect Wake Forest University Baptist Medical Center (WFBMC) to WSSU and Union Station. The “spaghetti map” shown on Figure 2 illustrates the initial set of candidate alignments. The route options are color-coded based on geographic areas (Figure 3 further illustrates the route descriptions):

- Hospital area is shown in brown;
- Downtown Winston-Salem is shown in red;
- The area that parallels the rail corridor is shown in purple;
- PTRP is shown in blue; and
- The route through the East Winston community along Martin Luther King Jr. Drive is shown in green.

This set of options illustrates the array of streets that were considered for possible Urban Circulator service. Many routing options are possible through the identification of various street segments that can be combined to form a logical route.

3.2 Development of specific route options

To organize the candidate alignments into specific route options, a decision-making framework was established that allowed for the systematic consideration of various segments within the overall study area. The flowchart shown in Figure 3 was used during the screening process to select a general route. Screening data were developed for each of the segments (boxes) shown in the flowchart. The colors correspond to the segment colors on the map, showing the initial set of candidate alignments.
A general route was selected by connecting the segments along a viable route (as illustrated by the lines connecting the boxes in the flowchart). Further detailed analysis on the general route will enable any necessary route refinements.

Figure 3: Route Analysis Flow Chart

Source: HDR Engineering, 2013
3.3 What technology options were considered?

The transit vehicle (technology) and the type of service considered focused on those best suited to provide local access to activity centers within the study area. These included streetcars, rubber-tired buses or options that are well-suited to travel short distances and make frequent stops. Other types of rail-based technologies, such as light rail and heavy rail, were not considered because they are better suited for larger communities for longer-distance, or regional travel where a dedicated right-of-way is available.

Through this process, the City of Winston-Salem compared the merits of streetcars and buses to identify the best way to enhance economic competitiveness, provide more mobility options in downtown Winston-Salem and surrounding neighborhoods, to advance the Legacy vision to grow smarter and better by managing future development.

In recognition of the desire to compare the merits of the Urban Circulator project, three alternative transit technologies, as shown in Figure 4, were defined for detailed evaluation.

3.4 How were the route and technology options evaluated?

A two-phased process was used to assess the various transit route and technology. This process means that Winston-Salem carefully weighed its choices for what will be a significant community investment. This evaluation process also conforms to requirements of the federal government before it considers participating in funding such an investment. An "initial screening" analysis examined the relative strengths, weaknesses, benefits, costs, and impacts of conceptual route options. Based on the screening, a primary route was selected and advanced for additional study.

The primary route went through a more rigorous analysis in a "detailed evaluation" phase. This includes developing a ridership model for the comparison of a streetcar "build" alternative and an enhanced bus service option ("Transportation Systems Management" alternative). This phase featured a greater level of detail and more focused quantitative data that enabled the selection of LPA for both route and technology.
With regard to the selection of a primary route in the initial screening phase, the various route options were quite similar. The specific route options and the reasons for the similarities between them are discussed in more depth in the Technical Report, “Final Definition and Evaluation of Alternatives Report.” For this reason, the initial screening criteria focused on the relative differences between the options to determine which route is the “best” in meeting the goals of the study. For the subsequent detailed evaluation of technology options, an in-depth analysis of the absolute characteristics determined how a streetcar “build” alternative compares to the no-build and bus Transportation System Management (TSM) options.

*Table 1* lists goals of the study linked to specific performance measures. During the initial screening phase, the performance measures were analyzed broadly. For the detailed evaluation process, the same general performance measures will be used, but the analysis will be more rigorous.

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<th>Goals</th>
<th>Performance Measures</th>
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<td>Enhance Economic Competitiveness</td>
<td>Focus development and coordinate investments to maximize economic return • Development and revenue generation potential along route • Development and revenue generation potential with transit technology</td>
</tr>
<tr>
<td>Protect and enhance the City’s distinct character</td>
<td>• Enhance the traditional downtown form and walkable grid • Consistency with adopted plans • Positive passenger experience • Minimize potential environmental impacts</td>
</tr>
<tr>
<td>Connect key destinations in urban core</td>
<td>• Service to key activity centers and development sites • Ridership potential • System capacity • Travel time • Design constraints</td>
</tr>
<tr>
<td>Connect to local and regional transit to provide the “last mile” of service</td>
<td>• Integrate with other transit service: — Access to Transportation Center — Link to future commuter rail at Union Station • Connect to potential extensions</td>
</tr>
<tr>
<td>Support existing communities and infrastructure</td>
<td>• Minimize of conflict with existing utility and street infrastructure • Traffic and on-street parking impacts</td>
</tr>
<tr>
<td>Extend pedestrian connectivity</td>
<td>• Ability to support enhanced pedestrian connectivity and infrastructure</td>
</tr>
</tbody>
</table>
3.5 What role did the public and stakeholders have in the decision-making process?

As a key element of the AA process, the public involvement program was an effective tool in documenting the outcomes and implementation. The program utilized a variety of consensus-building tools to engage the public. The overall emphasis of the program was to:

- Educate interested stakeholders in all aspects of the project;
- Encourage public participation by providing multiple opportunities and a variety of tools/techniques for public input; and
- Build consensus that best meets the needs of a diverse public.

There were many benefits of involving the public in an engaging and participatory way. First, the process heightened the potential for agreement of a solution or - at a minimum - reach informed consent. This allows for a greater chance the project can be implemented. Second, public involvement also facilitated the identification of community issues early in the process so they could be acknowledged and addressed, while reducing the potential for project delays. Third, the public involvement program was committed to involving the public and taking action on the input from the public, with the end result yielding a widely supported outcome. Last, federal requirements necessitate meaningful citizen participation as a significant element in projects such as this AA.

The public involvement program was built on the following guiding principles:

- To provide early and continuous public involvement opportunities throughout the planning process, particularly at project milestones, technical activity and decision-making points.
- To offer adequate opportunities for public input and provide timely information to citizens, private sector transportation entities and other interested parties.
- To advance requirements of Environmental Justice by engaging those traditionally underserved by existing transportation systems, including but not limited to, low-income and minority households and populations covered under the Americans with Disabilities Act (ADA).
- To provide adequate public notice of participation activities and allow sufficient time for public review and comment at key decision points.
- To allow periodic review of public involvement efforts by the City to provide full and open access to all.
- To use easy-to-understand collateral materials and website content.
- To facilitate convenient and accessible locations for public forums.

Public involvement activities were compliant with Title VI of the Civil Rights Act of 1964 and related regulations. This means that no person shall, on the grounds of race, color, sex, national origin, (including limited English proficiency), religion, age, income, family status, or physical handicap, be excluded from participation in, be denied benefits of, or be otherwise subjected to discrimination under any program receiving federal assistance from the United States Department of Transportation (USDOT).

These public involvement efforts included ongoing outreach and input activities, as well as meetings and activities held at major project milestones. The four major milestones, anticipated events associated with each and projected timeframes are illustrated in Figure 5. As shown, meetings with the project’s Technical and Policy committees, as well as public open houses were held during the four key milestones.
The study team coordinated with several committees and numerous stakeholders over the course of the project. Major stakeholder groups are:

- **The Technical Committee (TC)** – An advisory committee that provided technical-level input into the various work items throughout the study. TC members provided unique perspectives that combined ongoing, detailed knowledge of the project with respect to partner agencies, residents, businesses and organizations within the study area.

- **The Policy Committee (PC)** – A broader-based policy-level group that focused on key implementation challenges such as the development of a feasible financial plan. The Committee was made up of key organizational and institutional leaders such as City Council members, Winston-Salem State University, Piedmont Triad Research Park, Transit Agencies (PART and WSTA), North Carolina Department of Transportation Board, Winston-Salem Chamber of Commerce, Wake Forest University, among others.

- **Associated Agencies** – Appropriate federal, state, regional, and local agencies participated in reviewing project issues and alternatives considered, and discussing agency concerns about the project.

Recognizing the extent and diversity of opinions on the potential service design for the Urban Circulator, a series of activities was held to engage the Policy and Technical Committees, the public and interested stakeholders to discuss the alternatives routes and modes. These activities include the following:

**Routing Workshop** - A day-long workshop was held on August 29, 2012 at Wake Forest Biotech Place. The workshop was attended by the Policy and Technical Committee members and community stakeholders. The goal for the workshop was to get stakeholders involved in selecting an Urban Circulator route based on the established goals and objectives. The workshop consisted of a presentation of the initial screening performed by the study team, a walking tour, and a routing exercise. Groups of participants, during the routing exercise, were able to map out their own routes with pre-cut ribbon and pins. Costs for routes were incorporated to add a financial dimension. The exercise helped the study team advance route segments for further analysis.

**Public Open Houses** - Three open houses were held during the study process - March 2012, January 2013, and June 2013. The intent of these forums was to provide two-way interaction with the public, informing them about the project and gaining their thoughts on viable solutions. These open houses, in general, were efficient ways to provide information and accommodate large groups of participants.

**Elected Official Briefings** - During major milestones, elected officials were given the opportunity to be briefed individually about the project status, concerns and outstanding issues and public reaction. Elected officials also were invited to attend public open houses. For this plan, City Council will be the governmental agency responsible for formally adopting the Locally Preferred Alternative (LPA) at the conclusion of the study.
Other Outreach activities – More than 10 presentations were made to businesses, neighborhoods, civic, and other organizations throughout the planning process to inform them and receive their input on the different routes and modes considered.

Project website and e-mail – The website provided a valuable means of distributing project information and soliciting input throughout the study process. The study team established a project website - www.winstonsalemcirculator.com - dedicated to the study. The site includes: project history; project goals and schedule; fact sheets; meeting notices; documents, presentations and reports; information contacts; and relevant links. Emails were also sent out to groups and individuals to notify them of upcoming meetings and other key project information.

Social Media – Through coordination with the City, the study team posted information on the City’s Facebook page for public outreach purposes such as open house notices and survey requests.

Web-based survey – An online survey was developed to provide data for the ridership forecasting process and the evaluation of service options. Approximately 200 people completed the survey during the one month period the survey was active.

Fact sheets – Five fact sheets were developed at key study milestones and were posted on the study website and made available at public and stakeholder meetings.

For More Information:
- Final Definition and Evaluation of Alternatives Report
- Public Involvement Report
4  MOBILITY IMPACTS

The Urban Circulator will operate in mixed traffic, and both modal options would serve premium stop locations and connect with existing transit services. This section analyzes possible impacts on traffic, on-street parking and transit services of the Urban Circulator alternatives.

4.1  How will traffic be impacted?

The Circulator will operate with a ten minute frequency, which equates to six westbound trips and six eastbound trips during the peak hours. The traffic analysis concludes that its implementation will not adversely affect traffic flow and intersection delay within the study area intersections. The necessary intersection modifications are indicated in the Capacity Analysis section.

Traffic data collection and analysis were conducted at 10 intersections in the study area. Analysis of these intersections was important to understanding the impacts associated with the implementation of the Circulator and to compare the traffic conditions along the proposed route. The intersections are:

- 5th St. & Patterson Ave.;
- 5th St. & Church St.;
- 5th St. & Liberty St.;
- 5th St. & Trade St.;
- 5th St. & Spruce St.;
- 4th St. & Spruce St.;
- 4th St. & Broad St.;
- 4th St. & Burke St.;
- 1st St. & Burke St.; and
- 1st St. & Hawthorne Rd.

The intersection of 1st St. & Hawthorne Rd. is projected to have a poor level of service with the implementation of the Circulator service. To mitigate the traffic impacts, a signal phasing change is recommended at this intersection to improve the overall intersection flow and to maintain the existing level of service. Modifications are also planned for the Martin Luther King Jr. Drive corridor that includes construction of a four-lane, median-divided facility. As the project continues through the design process, additional coordination with the North Carolina Department of Transportation (NCDOT) and more detailed traffic analyses may be necessary to ease potential concerns in this area.

4.2  How will on-street parking be impacted?

A total of 267 on-street parking spaces are available along the proposed route. Currently, there are no designated on-street parking spaces on Hawthorne Street, 1st Street, 2nd Street, Research Park Boulevard, Rams Drive or Martin Luther King Boulevard. Field inspections were performed during the morning and afternoon peak hours to determine the number of occupied spaces. During the morning peak hour, 41% of all spaces were utilized while during the evening peak hour, 47% of all spaces were utilized. However, utilization varies along the route. To accommodate the proposed route, 45 on-street parking spaces are projected to be eliminated, representing a 17% loss. Of these 45 total on-street parking spaces, approximately nine are metered.

4.3  How will existing transit services be impacted?

With the introduction of a Circulator system, adjustments to the existing WSTA bus services will be needed to allow an efficient operation and integration with bus services. As a result of the implementation of the Circulator service, the existing 40 West End Trolley will be discontinued, reducing annual operating costs.

For More Information:

- Traffic Impacts Technical Memorandum
- On-Street Parking Impacts Technical Memorandum
- Operations Plan Report
There are two alternatives to integrate local bus service with the Circulator.

- **Conservative approach**: Eliminate or restructure the minimum number of bus routes to minimize the duplication of service. This approach heavily favors the current transit operations that have the majority of WSTA services connecting at the downtown transportation center (Clark Campbell Multimodal Transportation Center). Most riders will continue to have a one-seat ride to downtown.

- **Aggressive approach**: Terminates routes where they connect with the Circulator service, reducing the number of buses entering downtown. This approach significantly reduces operating costs but will require more riders to transfer from buses to the Urban Circulator to reach downtown. Bus congestion at the downtown transportation center will be reduced, but additional Urban Circulator vehicles may be required to accommodate expected passenger loads.

The conservative approach is generally used in the operations plan, while the aggressive approach is recommended where greater cost savings are desired. However, this will require more public input to develop the final recommendations. Detailed operational plans for existing bus service modifications are on-going by the City of Winston-Salem. The areas for greatest potential efficiencies are connections between downtown and the Wake Forest University (WFU) Baptist Medical Center and between downtown and WSSU.

**WFU Baptist Medical Center to Downtown**

Three routes -12, 19, and 20 - connect downtown with WFU Baptist Medical Center. Under the aggressive approach, all three routes would be terminated at the medical center, but such an aggressive action is likely to generate considerable opposition. Route 20 in particular is one of the more heavily used routes in the WSTA system, so its termination could result in overloads on the Circulator. Route 19, however, is a less-used route that only offers five inbound and five outbound trips per day using one bus. This route is an ideal candidate to terminate at the medical center circulator station. This termination will not result in any cost savings, since only one bus is used on the route, but it would allow WSTA to double the number of trips west of the medical center at no additional cost.

**Downtown to WSSU**

Between downtown and WSSU, three routes provide connection - 3, 26 (shown in turquoise), and 30 (shown in maroon). The 26 and 30 follow the same route from downtown along Salem and Stadium Drive, roughly following the planned circulator route. Under the aggressive approach, both of these routes would terminate at the WSSU station, as well as the Route 3. The latter change could remove stops from a portion of MLK.

Of the three routes, Route 30 carries the fewest riders and offers the least frequent service. One bus is used to provide hourly service. Terminating this route at WSSU would save about 15 minutes on a round trip. Such a reduction will not save any costs since only one bus is used on the route, but it could allow for more frequent service east of WSSU. Likewise, it could be used to extend the route farther east.

**MLK & 5th Street**

Two routes - 1 and 25 - would connect with the Urban Circulator at the MLK & 5th terminus. Both routes offer the potential for costs savings or improved headways should they terminate at the Urban Circulator station instead of continuing into downtown. These potentials need further examination to determine their feasibility.

Both routes appear to have high layovers in order to provide regular 30 minute headways throughout the day on Route 1 and hourly throughout the day on Route 25. The travel time saving on Route 1 is about 16 minutes, resulting in an overall round trip running time of 37 minutes if the route were shortened. With this shortened running time, three buses could provide 15 minute headways on Route 1. This change does not save any operating costs but would allow more frequent service at a lower cost. Route 1 is the second heaviest route in the system, so the more frequent service would be a benefit, but a forced transfer is likely to be unpopular. On Route 25, about 10 minutes of round-trip running time could be saved, which is not sufficient to save a bus or improve the headways to 30 minutes on the shorter route.
4.3.1 Transit Operations

Conceptual operations plans include service from 5:30am to 7:30pm on Monday through Wednesday, 5:30am to 11:00pm on Thursday and Friday, and 7:00am to 11:00pm on Saturday. The frequency of service will be approximately 10 minutes during the weekdays and 15 minutes during early morning, evenings and Saturday. Sunday services could be added if future demands were to be demonstrated for such based on further analysis. A final operations plan is being developed as part of the detailed analysis phase of a separate study.

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Figure 6: Proposed Hours of Service and Frequency (in minutes)

A yet-to-be-determined flat fare would be charged to passengers; the specifications of the fare structure are being developed. The following traffic flow changes, as indicated earlier, are necessary to accommodate a Circulator operating along the proposed alignment:

- Traffic signal at 4th St. and Burke St. to facilitate the westbound left-turn;
- Modifying 5th St. between Church St. and Patterson Ave. to accommodate single-track that allows two-way operations;
- Replacing the two-way left-turn lane on Rams Dr. between Research Park Blvd. and Martin Luther King Jr. Dr. with a single-track that allows two-way operations; and
- Modifications to the roundabout at Research Park Blvd. and 3rd St. to accommodate rails.

The need for a traffic signal priority system will be examined as part of the detailed analysis of alternatives. Such a system would allow a traffic signal to remain green for an extended period of time when a transit vehicle approaches.
5 IDENTIFICATION OF LOCALLY PREFERRED ALTERNATIVE

5.1 What is the locally preferred alternative?

The FTA, under a previous legislation (enacted in 2005) known as Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), emphasizes that the New Starts planning and project development process is simply an approach to problem solving, and should answer questions like:

- What is the problem in need of solving?
- What are potential solutions?
- What are their benefits?
- What do they cost? and,
- Which alternative is the best solution, given available resources, to address the problem?

The early stages of the New Starts project development process are the Alternatives Analysis (AA) and Preliminary Engineering (PE) that are carried out within the metropolitan planning process and the environmental review processes as required by NEPA. As such, planning and project development activities for New Starts projects – with only a few exceptions – are intended to be consistent with the analyses and decision-making process expected for the adequate study and subsequent development of any major capital transportation (such as for this Urban Circulator) project in a given corridor.

AA studies are corridor-level analyses of a range of alternatives designed to address locally-identified mobility and other problems in a specific transportation corridor. The AA is considered complete with the selection of a LPA to advance into PE. In PE, the LPA is further developed to the point where environmental impacts are known and mitigation is provided; the project scope is final; its cost estimate is relatively firm; and its financial plan is set, with the majority of local funding committed. Final Design is the last phase of New Starts project development during which the project sponsor prepares for construction. Final design is also the stage during which FTA may enter into a multi-year commitment to fund a proposed New Starts project called the Full Funding Grant Agreement (FFGA).

In October 2012, the Moving Ahead for Progress in the 21st Century (MAP-21) legislation was enacted replacing SAFETEA-LU. MAP-21 eliminates the requirement for a stand-alone AA and relies on the evaluation of options that may occur during the metropolitan planning process and the review of alternatives that occurs to meet the requirements of NEPA. Although project sponsors may still conduct a stand-alone AA separate from the NEPA review because it may ultimately streamline the environmental review process and because the results of prior planning work evaluating alternatives may be incorporated into the NEPA review, FTA’s involvement would be minimal. FTA suggests that as general planning practice, the project sponsors look at a range of alternatives and consider carefully the evaluation criteria that will be used to choose among alternatives.

The City of Winston-Salem briefed the FTA at different times during the AA process leading up to the identification of a “selected” route. The “selected” route was subsequently presented to the Public Works Committee – a Committee of the Winston-Salem City Council for review and approval.

The primary objective of this Alternatives Analysis is to evaluate the various alternatives for the Winston-Salem Urban Circulator project and determine the most preferred route and mode. Various route
alternatives and three modal options were assessed using quantitative and qualitative measures. Analysis included ridership forecasts, capital, operating and maintenance costs, economic development impact, mobility impacts and input from the general public, City Council, Technical and Policy Committees, other stakeholders and the project development team. This AA Report and associated Technical Reports document the process and analysis to select a Streetcar as opposed to an Enhanced Bus as the Locally Preferred Alternative (LPA) along the selected 4-mile corridor connecting Wake Forest Baptist Medical Center through Downtown Winston-Salem, Wake Forest Innovation Quarter (formerly known as PTRP) and Winston-Salem State University to the intersection of Martin King Jr. Drive and 5th Street in East Winston. The figure here shows this evaluation process.

The report will be provided to the City Council for consideration in their process to approve the LPA and forward it to the FTA and NCDOT.

5.1.1 Preferred Technology (Mode)

After both qualitative and quantitative analyses of the three different modes of service being considered (Standard Bus, Enhanced Bus and Streetcar), the results determined that compared with the two alternatives, service along the corridor would be better provided by modern, low-floor streetcar vehicles operating within existing streets in lanes shared with general traffic, as shown in Figure 7.

A typical 66’ streetcar vehicle has seating for roughly 30 passengers and can accommodate a total of 140 passengers seated and standing. The vehicle is equipped with a bridge plate that quickly deploys to aid mobility-impaired passengers. Power likely would be supplied via overhead electric lines, although emerging “wireless” technologies will also be considered. Eight electrical substations along the route are needed to distribute the electrical power to the vehicles. Each is located every half mile along the route.

Streetcar is being selected as the LPA primarily because of its unique ability to attract more economic development opportunities in Winston-Salem. Analysis of projected economic impact provided in Chapter 6 of this report indicates that the proposed Streetcar will attract more intense commercial and denser residential development - approximately $2.8 billion - along the preferred route, much better than the existing regular bus or enhanced bus alternatives will attract. In the last 10 years, other cities that have implemented streetcar, as opposed to enhanced bus, experienced an increase in land values, intensities and densities and mixed-use developments along streetcar routes. The same results are anticipated for Winston-Salem. Figure 8 below indicates that overall development impacts and level of infrastructure developments associated with Streetcar exceed Local and Enhanced Bus systems nationally.

Further, Winston-Salem’s tax base studies (as indicated in the Legacy Update and the Winston-Salem Downtown Plan 2013) show higher beneficial impacts on the local tax base, thereby producing real economic benefits for everyone. Furthermore, Streetcar supports the project’s two primary goals – enhancing economic competitiveness and providing more mobility options – envisioned for the urban core.
5.1.2 Alignment (Route)

The proposed route, as shown in Figure 8, is approximately 4 miles long. It will provide two-way service along Hawthorne Road from Wake Forest Baptist Medical Center to 1st Street. A one-way couplet is used in the West End area: on the eastbound approach, the alignment follows 4th Street to 2nd Street to Broad Street and turning right onto 4th Street; on the return trip, the alignment travels west on 4th Street and turns left onto Burke Street and continues along to 1st Street. From 4th Street, the alignment turns north onto Spruce Street and continues eastbound on 5th Street. The alignment turns south at Patterson Street to 4th Street to Research Park Boulevard. To the east, service would continue along Rams Drive to Winston-Salem State University. To the north, service would continue along Martin Luther King Jr. Drive to Union Station to 5th Street to serve East Winston. The vehicle will operate within the existing street right-of-way along with mixed traffic.

5.1.3 Traffic Operations

This traffic analysis concludes that the Urban Circulator will not adversely affect traffic flow and intersection delay within the study area, intersections with the necessary modifications indicated in the Capacity Analysis section. The following traffic flow changes are proposed to accommodate the streetcar project:

- Install a new traffic signal at the intersection of 4th St. and Burke St. to reduce turning movement conflicts; and
- Modify the phasing at 1st St. & Hawthorne Rd. intersection to improve the overall delay.

To accommodate the proposed median station at the Transportation Center, as discussed further in Section 8.3, the following modifications would be needed:

- Convert the westbound shared through/left-turn lane on 5th St. at Liberty St. to a left-turn lane; and
- Remove the westbound shared through/left-turn lane on 5th St. at Trade St.

The following lanes will be modified to accommodate a streetcar-only lane on 5th St. between Patterson Ave. and Church St., which is needed to achieve the minimum vertical clearance under the railroad bridge:

- Convert Chestnut St. to a right-in, right-out access;
- Remove the eastbound left-turn lane on 5th St. at Patterson St.; and
- Remove the westbound left-turn lane on 5th St. and Church St.

5.1.4 Station/Stop Characteristics

Station amenities would include shelters, benches, lighting, trash receptacles, and real-time information to let waiting passengers know when the next vehicle will arrive. Ticket vending machines would be available at each stop, so that passengers pay their fares station prior to boarding the vehicle. The height of station platforms is planned to be 10 inches above the street surface, enabling nearly-level boarding for passengers.

5.1.5 Vehicle Maintenance Facility

To accommodate new streetcar vehicles, a vehicle maintenance facility (VMF) is required. A 1.6-acre site at Union Station, owned by the City of Winston-Salem, is identified as the preferred location. In Section 11, various options are proposed for the initial phase of implementation. Not all route options will connect with the Union Station. Depending on which option is implemented in the initial phase, other alternative sites for a VMF will be further evaluated.
Figure 9: Proposed Streetcar Route

Source: HDR Engineering, 2013
6 ECONOMIC DEVELOPMENT IMPACTS

6.1 What is the projected economic impact of the proposed streetcar project?

The City of Winston-Salem views the proposed streetcar project as a component of a larger development strategy - an opportunity for enhancing the City’s economic competitiveness. Streetcars in and of themselves do not generate growth. However, given underlying market conditions for development and supportive zoning and land use policies, they help to accelerate and shape growth to create denser, mixed-use environments. These higher intensities, densities and mixed-use environments have a higher positive effect on land values and the resulting tax base, benefitting the entire city over the long run. Such a growth pattern matches the City’s vision for Winston-Salem’s urban core.

The total additional build-out capacity along the proposed route, and within 600 to 700 feet of it, is estimated at 5,000 to 11,000 residential units and 11 to 12 million square feet of commercial development.

Of the 11-12 million square feet of commercial development, an estimated 6.2 million square feet is designated as biotechnology and related special space in the PTRP plan area. That leaves approximately 4.6 to 5.5 million square feet in the area west of the PTRP and 0.1 to 0.4 million square feet in the area to the east of the PTRP.

In the 2007 Feasibility Study, an initial value of future development was prepared. In that prior study, values employed for residential and commercial uses were $100/SF and $120/SF, respectively. For this AA study, these estimates were updated for the LPA looking at potential residential and commercial uses applying a similar methodology that was based on a forecast of multifamily residential units (average of 1,200 SF/unit) and square footage (SF) of commercial uses. These were then multiplied by a $/SF for each category.

As indicated above, this Study estimates 5,000 to 11,000 residential units for an area proximate to the proposed Streetcar corridor. Using the mid-range of 8,000 residential units x 1,200 SF x $120/SF = $1.15 billion in development potential. Additionally, for commercial uses, the AA/LPA Study estimates 11M-12M SF. Using the low end of 11 M SF x $150/SF = $1.65 billion development potential.

This totals $2.8 billion in potential new development for an area 600 to 700 feet of the proposed streetcar line.

The potentially developable sites were grouped into 16 districts, as shown in Figure 10, to reflect their location in different market subareas, localized variations in overall density controls per the zoning rules, and the likelihood that different economic forces would be at work in the different areas. Areas West of PTRP, PTRP and East of PTRP were included in the analysis.
6.2 What funding opportunities are created by the projected development?

The positive impacts of the proposed streetcar project in catalyzing development would be manifested in numerous ways. One such way is the additional financial resources that would be made available to the City and the region through increased revenues from property taxes, business taxes, and other sources. Additional revenue resulting from a streetcar investment could not only be used to support a wide variety of critical needs, it could also help finance the project. Using value capture strategies, a portion of the revenues resulting from a new development could be dedicated to help pay for the streetcar investment.
7 ENVIRONMENTAL IMPACTS AND CONSEQUENCES

An Environmental Screening was prepared for the corridor and vehicle maintenance facility sites. The intent was to review readily-available environmental (physical, natural, socio-economic, and regulatory) data to determine potential issues associated with streetcar in the study area. This environmental review considers the proposed infrastructure (in-street tracks, boarding locations, and vehicle maintenance facility) associated with the alternatives analysis. These analyses did not include any on-site reconnaissance or detailed regulatory investigation. The goal is to determine feasibility and broad constraints.

7.1 What resource topics may be impacted by the proposed streetcar project?

The study team determined the following resources will not be substantially affected by the implementation of the project:

- Air quality;
- Community disruption;
- Consistency with state and local plans;
- Ecologically sensitive areas and threatened and endangered species;
- Energy requirements;
- Environmental justice;
- Floodplains;
- Land use and zoning;
- Noise and vibration; parklands;
- Water resources and water quality;
- Wetlands; and wild and scenic rivers; and
- Navigable waterways and coastal resources.

The associated technical reports include existing conditions, resource mapping and impact assessments for these resource categories.

7.2 Physical Environment

The physical environment includes historic resources, public lands, zoning, noise, and hazardous materials.

7.2.1 Historic Resources

The proposed route passes through three National Register Historic Districts (West End, Downtown North, and Winston-Salem Tobacco). Additionally, there are likely to be a number of structures eligible for the National Register along the route, and at least one known National Register-listed property at Union Station on S. Martin Luther King Jr. Drive. Consultation with the State Historic Preservation Office (SHPO) will be required during the NEPA process to further ascertain any potential impacts.

7.2.2 Zoning

The proposed route passes through an array of zoning districts (residential neighborhoods, light industrial, commercial, downtown business, government, institutional, campus). As the planning of the project moves forward, designers will need to be cognizant of the more sensitive districts (residential, downtown business, campus) in order to involve them as stakeholders in the process.

For More Information:
- Environmental Screening Technical Memorandum
7.2.3 Public Lands and Prime Farmlands
The proposed route would not “use” public lands (parks, recreational open space) other than existing road rights-of-way. No Prime or Unique Farmlands occur within the proposed route.

7.2.4 Noise
Noise concerns will be analyzed at a later stage in the design process. The residential neighborhoods could potentially contain sensitive receptors that require detailed analysis. Additionally, some of the light industrial uses on the east side of downtown in/near the Wake Forest Innovation Quarter (formerly known as Piedmont Triad Research Park or PTRP) may be sensitive to noise and/or vibration due to the presence of certain types of laboratories.

7.2.5 Hazardous Materials
The proposed route would use existing rights-of-way and minimize soil disturbance, thus avoiding the potential for encountering hazardous conditions. The most likely issue would involve soils that may contain dry-cleaning or petroleum contamination, and there are a number of known or potential sites along the proposed route that may be of concern. Sites of concern may include:

- Former Modern Chevrolet, corner of Broad and Fourth Streets
- Trade Street Cleaners, 426 North Trade Street
- North Liberty Street properties (Brownfields Assessment)
- R.J. Reynolds Tobacco properties
- Piedmont Triad Research Park properties (Brownfields Assessment)
- Stadium Drive properties north of City Yard (former landfill, City Fleet Services adjacent)

This screening did not uncover any definitive knowledge of contamination directly affecting the route, but a more detailed NEPA process will address this comprehensively.

7.3 Natural Environment
The natural environment includes wetlands, streams, floodplains, water quality, and protected species.

7.3.1 Wetlands & Streams
The proposed route would follow existing streets, with no new alignment or road widening necessary. No wetland or stream impacts (fill, pipes, and culverts) are anticipated.

7.3.2 Floodplains
As with wetlands and streams, floodplains are not likely to be affected since there would be no additional development footprint due to the proposed route. The primary flooding concern along the route is at the intersection of Hawthorne Road and First Street, which lies in the 100-year floodplain of Peters Creek.

7.3.3 Water Quality
The project could potentially affect water quality and stormwater runoff within and around the project area. However, water quality will not be negatively affected because the proposed route will follow existing streets. Further detailed environmental analysis will be conducted as part of next steps to determine the impact of increased paving on stormwater runoff within the project area.

7.3.4 Protected Species
No protected species (federally-endangered and federally-threatened) have potential habitat in the study area vicinity of any of the potential improvements. Additionally, no state-protected natural areas occur in the study area.
The proposed route will receive further analysis as the project planning progresses. This screening did not uncover any fatal flaws with the proposed route.

7.4 Vehicle Maintenance Facility (VMF)

Six candidate sites were identified for review (Figure 11). Each one is in close proximity to the proposed route and in locations that were previously disturbed by various types of development. The six primary sites are identified as follows:

- Site under I-40 Business near WFBMC;
- Hawthorne Rd. site;
- 1st St. site near BB&T Park;
- 3rd St. site;
- PTRP site; and
- Union Station site.

The VMF must be large enough to store and maintain a minimum of eight streetcars (including one spare vehicle). The VMF would also provide spaces for office and storage to support streetcar activities. A range of factors was considered to find the preferred VMF, including:

- Size;
- Site configuration;
- Land use compatibility;
- Environmental impacts;
- Property ownership and potential acquisition costs;
- Constructability;

For More Information:
- Environmental Screening Technical Memorandum
- Vehicle Maintenance Facility Site Selection and Evaluation Technical Memorandum

Figure 11: Potential Vehicle Maintenance Facility Sites
- Topography and drainage;
- Property easements and restrictions on use;
- Joint use potential; and
- System connectivity.

Each of the six sites was analyzed based on the various factors. Table 2 shows a comparison of the different sites.

<table>
<thead>
<tr>
<th>Site under I-40 Business</th>
<th>Property size and configuration</th>
<th>Likely Environmental impacts</th>
<th>Property ownership</th>
<th>Constructability</th>
<th>Topography</th>
<th>Joint use potential</th>
<th>System connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.52 acres Rectangular</td>
<td>Moderate (hospital upgradient, former dry cleaners adjacent)</td>
<td>Owned by WFU Health Services</td>
<td>I-40 Business columns and height restrictions present challenges</td>
<td>Some grade change</td>
<td>Low</td>
<td>Adjacent to proposed route</td>
<td></td>
</tr>
</tbody>
</table>

| Hawthorne Rd. Site       | 1.15 acres Irregular            | Moderate (hospital upgradient) | Owned by NCDOT | Some access restrictions for construction equipment & materials storage space | Relatively level, away from the I-40 Business berm | Low | Adjacent to proposed route |

| 1st St. Site             | 1.5 acres Irregular             | Low (former auto dealer and repair shops adjacent) | Owned by Brookstown Development Partners | Good access for construction equipment & materials storage space | Some grade change | High | Adjacent to proposed route |

| 3rd St. Site             | 0.7 acres Irregular             | Low (previous industrial uses) | Owned by Forsyth County | Ceiling height restrictions present challenges | Relatively level | Good example of joint development | 1,350 feet south of proposed route |

| PTRP Site                | 1.25 acres with potentially more space available Rectangular | High (unlined former landfill on-site or adjacent) | Owned by PTRP Holdings LLC | Depending on timing, other constructability impacts are likely at this site | Some grade change | High | Adjacent to proposed route |

| Union Station Site       | 1.6 acres Irregular             | High (former train station/yard and auto repair facility) | Owned by the City of Winston-Salem | Good access for construction equipment & materials storage space | Some grade change | High | Adjacent to proposed route |

The Union Station Site favorably satisfies most of the site selection criteria; therefore it is identified as the preferred location. Additional investigations and coordination with the State would be needed to gain closure on the soil and groundwater investigations conducted during the Phase II Environmental Site Assessments. If additional analysis identifies new constraints, the other five sites should be evaluated further.
With the section of Locally Preferred Alternative, the VMF will undergo design in the future project development process. That may result in a design framework that varies significantly from the preliminary layout shown in this AA (Figure 9).
8 CONCEPTUAL ENGINEERING

Streetcar-oriented conceptual design elements were reviewed as part of the AA study including track alignment, stop locations, systems aspects, and the location of a Vehicle Maintenance Facility as discussed in Section 7 (Environmental Screening). Additionally, this report summarizes the findings of more specific reviews of key design challenges along the proposed route. The observations and conclusions in this section are based on conceptual level analyses only, and these elements will be examined in more detail as part of preliminary and final engineering tasks.

8.1 Track/Guideway Element

Streetcar systems generally operate in the street. The benefit of an in-street placement is limited right-of-way acquisition, challenging designers to “fit” the system into the existing roadway. The conceptual design focused on the horizontal alignment, station stop locations, VMF layout, and potential property impacts. Future design phases will consider the vertical profile, which generally follows the existing roadway profile. The following criteria were used to develop a conceptual level track design:

- Track gauge = 4’-8 ½” (distance between inside edge of each rail);
- Track slab width = 8 feet;
- Rail type: 115lb rail encapsulated within a rubber boot
- Horizontal tangents shall be used in areas of special trackwork (turnouts, crossovers, etc.) and stop platforms:
  - Minimum horizontal tangent beyond stop platform = 15 feet;
  - Minimum horizontal tangent between curves = 40 feet;
  - Minimum horizontal tangent between switches = 60 feet;
- Offset distance from centerline of track to edge of platform = 4.2 feet;
- Minimum horizontal turning radius = 65 feet; and
- Maximum vertical grade = 9.0% for short distances.

8.2 Roadway

The streetcar integrates into the existing roadway infrastructure. Track design considers the existing roadway configuration (curves, intersections, vertical grades, travel lanes, traffic signals, pedestrian crosswalks, property impacts and roadway cross section). By following the existing physical features of the roadway, streetcar trackways avoid major reconstruction of the remaining lanes. This method of avoiding reconstruction also allows existing drainage patterns to be maintained. In general, the following conceptual design criteria were used:

- Minimum shared travel lane width = 11 feet, 10.5 feet absolute minimum
- Minimum adjacent parking lane width = 9 feet; and
- Minimum sidewalk width = 5 feet (wider sidewalks needed at platform sites).

8.3 Stops

Stops for this project were identified as at-grade platforms on the sides of the street for most stops; with two median platforms in the center of the street at the WFBMC end-of-line and Transportation Center. In general, the following conceptual design criteria were used:

- Platform length = 66 feet (minimum of 45 feet);
- Platform height = ramp up to a height of 10 inches above the top of street pavement. Typically, sidewalks have a height of approximately 6 inches above the top of street pavement);
• Platform width = 8 feet; and
• Shelter width = 5 feet.
• ADA accessibility requirements

Stops generally are intended to include the following furnishings:

• Simple shelter at back of platform;
• Electronic message board on shelter;
• Benches
• One ticket vending machine;
• ADA tactile warning strip along platform edge; and
• Simple signage (like WSTA sign).

More detailed platform-specific design will be conducted in the future preliminary engineering effort.

Figure 13 shows the potential stop locations. The following stops and platform configurations were identified for the Streetcar project:

Table 3: Stops/Platform Configurations

<table>
<thead>
<tr>
<th>Proposed Stop Location</th>
<th>Potential Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFBMC / Hawthorne Rd.</td>
<td>Center boarding</td>
</tr>
<tr>
<td>1st St. / Hawthorne Rd.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>1st St. / Burke St. (EB only)</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>2nd St. / BBT Ballpark (EB only)</td>
<td>Left-side boarding</td>
</tr>
<tr>
<td>Burke St. / Brookstown Ave. (WB only)</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Burke St. / 1st St. (WB only)</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>4th St. / Spring St.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>4th St. / Spruce St.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>5th St. / Marshall St.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>5th St. / Trade St.</td>
<td>Center boarding</td>
</tr>
<tr>
<td>Patterson Ave. / 5th St.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>4th St. / Research Park Blvd.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Research Park Blvd. / 2nd St.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Research Park Blvd. at railroad</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Rams Dr. / Research Park Blvd.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Martin Luther King Jr. Blvd. near Rams Dr.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Union Station</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>Martin Luther King Jr. Dr. / 2nd St.</td>
<td>Right-side boarding</td>
</tr>
<tr>
<td>5th St. / Martin Luther King Jr. Dr.</td>
<td>Right-side boarding</td>
</tr>
</tbody>
</table>
Figure 9: Potential Stop Locations

Source: HDR Engineering, 2013
8.4 Systems

Systems include the streetcar power supply and distribution systems, traffic signals with streetcar only signal, corrosion control and communications. Streetcar traction power supply and distribution system requirement highlights are presented as follows.

8.4.1 Low Power Substations

Electrical substations are small buildings that contain the equipment necessary to supply the vehicles with operating power. Low power substations are defined as having a rated power of 500 Kw or less. Smaller “low-power” substations are recommended rather than larger “high-power” substations, given the potential cost savings resulting from the following:

- No underground or overhead parallel feeder wires;
- Utility service from common distribution circuits;
- Lower return rail voltages and lower stray current levels reducing utility relocations;
- Smaller land acquisition requirements; and
- Greater flexibility in the siting of substations.

Typical spacing is approximately one unit per one-half mile, and eight low-power substations are estimated along the proposed route. A standard low-power substation is approximately 25 feet by 18 feet in size. They can be designed as pre-fabricated enclosures or as stand-alone buildings. Installations are available as pre-fabricated units ready to set in place or as individual assemblies of equipment. The latter can be installed in a specially built enclosure in locations such as building basements and parking garages. A typical pre-fabricated substation is shown in Figure 14.

Architecturally treated low power substations can be integrated into areas with high design standards or historic districts. Figure 15 shows an application where two parking spaces of an existing parking area were modified to accommodate a low power substation.

8.4.2 Traction Power Supply and Distribution

Traction power is distributed from the substations to the vehicles via an overhead contact system (OCS). See Figures 16 and 17. Poles are spaced at regular intervals along the entire alignment with a resulting design standard of two or three poles per block depending on the maximum span length of the OCS and the length of the blocks. Generally, for a trolley wire system, the maximum distance between poles is 100-120 feet. The distance actually used in the design is 10 feet less than the maximum span length to permit
flexibility in siting the poles and foundations. This avoids underground structures and utilities found during construction of the line. The proposed trolley wire system relies on a single contact wire to distribute power to the vehicles, limiting visual impacts.

8.4.3 Traffic Signals

Traffic signals would be needed to accommodate some of the traffic flow changes to facilitate streetcar movements, including bi-directional transit operation. Streetcar through and left-turning movements can create conflicts with opposing traffic if left unsignalized. The conceptual design identified new traffic signals at Burke Street and 4th Street.

Some intersections through the proposed route are currently signalized, but modifications are needed to accommodate the streetcar and facilitate vehicle preemption/priority. Potential signal modifications were identified at:

- Hawthorne Rd. and 1st St.;
- 5th St. and Church St.;
- 5th St. and Patterson Ave.;
- Research Park Blvd. and Rams Dr. (assumes Research Park Blvd. will be constructed, completed and signalized in the future build year); and
- Martin Luther King Jr. Dr. and 5th St.

Streetcar movements in the existing traffic lanes will be controlled by normal traffic signal operations. At locations where sight distance is limited or the streetcar must make a left-turn movement, transition into or out of special lanes, or transition into semi-exclusive operations, special transit-only signals will be provided. These transit signals will be physically separated from the traffic signals and will use transit-only display indications consistent with the Manual on Uniform Traffic Control Devices (MUTCD).

8.5 Vehicle Maintenance Facility

A Vehicle Maintenance Facility (VMF) is needed to provide vehicle storage and maintenance services, including vehicle inspection, exterior washing, interior cleaning, repair activities, and spare parts storage. Space for operations and administrative functions would also be included. The facility must accommodate a minimum of eight streetcar vehicles (seven active vehicles and one spare), based on a preliminary assessment of vehicle requirements for the project. A general guideline for property sizing requirements is 0.20 – 0.25 acres per stored vehicle, based on typical sizes of other functioning streetcar facilities and local environmental and topographic conditions. Thus, a site with a minimum size of 1.6 – 2.0 acres is
needed to support proposed streetcar operations. The option to acquire additional acreage would be beneficial to accommodate more vehicles if the fleet size grows.

The Union Station site favorably satisfies most of the site selection criteria and is identified as the preferred location.

8.5.1 Conceptual Layout of Preferred Site

At the Union Station Site, consideration was given to constructing a new stand-alone VMF or retrofitting the basement level of existing train station. Constructing a storage yard at street level and utilizing the basement level of the existing structure was deemed not feasible based on the following:

- The vertical difference between street level and the basement level of Union Station and orientation of the building would require a streetcar to make a tight turn on a 9% grade; and
- A streetcar vehicle is too long to fit within the basement level of Union Station which would require the building to be extended.

*Figure 18* shows a feasible configuration for the conceptual stand-alone VMF at Union Station.

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8.6 Evaluation of Route Design Challenges

There were several areas throughout the corridor that could constrain the streetcar. Investigations of these areas were performed to review the existing conditions, explore options for use with modern streetcars, summarize modifications required for streetcar applications, and provide conceptual level cost estimates for the anticipated work. *Figure 19* illustrates some of the locations with design issues.
Figure 15: Route Design Challenges

5th Street 12’ – 4”

4th Street 13’ – 4”

Roundabout at 3rd St. and Research Park Blvd.

15’-7” vertical clearance under railroad bridge

9% grade along Research Park Blvd north of Rams Drive

Rams Drive 13’ – 9”

Possible Future Extension

Union Station

Bridge over I-40 Business

Bridge over US 52

Bridge over Railroad

Transportation Center
9 RIDERSHIP FORECAST

A data-driven ridership forecasting approach was developed in coordination with the FTA for the Streetcar project. This forecasting method utilized for the project considered the following:

- The TransCAD travel demand model, Piedmont Triad Regional Model (PTRM), is not adequately robust to support a FTA Small Starts application.
- PTRM does not adequately understand the travel markets to be served by a premium transit circulator in Winston-Salem.
- Substantial effort will need to be undertaken to enhance PTRM, if the project proceeds into a New/Small Starts funding application.
- Travel markets of interest, necessary to support a data-driven approach, already exist in the project corridor.
- A data-driven approach will allow the project sponsors to conduct the analysis cost effectively and expeditiously.

The data-driven forecasting approach involved:

- Development of trip tables of the existing transit riders (year 2012) in the corridor based on stop-level origin-destination survey and on-off counts;
- Assigning the existing trip table to the current transit network for reasonableness check;
- Growing the trip tables to opening year (year 2017) based on ridership trends and projected socioeconomic growth in the corridor;
- Estimating the number of short walk trips that may potentially use premium transit based on stated preference survey;
- Assigning the opening year trip table to the corresponding transit networks; and
- Extracting the transit and premium transit trips from the assignment results.

The “unmeasured attributes” (visibility, reliability, flexibility, safety, comfort, and so forth) were accounted for in the assignment process by considering mode specific credits per FTA’s recent guidance on unmeasured attributes for transit services.

Table 4 shows the 2017 daily ridership forecast for the streetcar. This table compares the results of the Low, Moderate, and Aggressive growth scenarios. Based on this table, the streetcar system will generate a low of 1,915 riders and a high of 2,256 riders in opening year 2017.

Only the opening year forecasts were developed for the project as opposed to horizon year forecasts per FTA Small Starts guidelines. While FTA requires project sponsors to report horizon year ridership forecasts for New Starts projects (2035 or 2040), only opening year ridership forecasts are required by FTA for Small Starts projects. The rationale lies in relatively less capital investment involved with Small Starts projects compared to New Starts and streamlined project evaluation and rating process.

The next steps involve discussing the detailed definition of the alternatives with the FTA, finalizing the mode specific credits associated with the unmeasured attributes, securing FTA concurrence on the baseline alternative, discussing the Small Starts reporting requirements with FTA given the data-driven forecasting methodology, and estimating the cost-effectiveness of the Locally Preferred Alternative.
### Table 4: 2017 Opening Year Streetcar Ridership

<table>
<thead>
<tr>
<th>Stops</th>
<th>Directions</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. WFU Medical Center</td>
<td>EB</td>
<td>191</td>
<td>198</td>
<td>204</td>
</tr>
<tr>
<td>2</td>
<td>EB</td>
<td>53</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>EB</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>4</td>
<td>EB</td>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>EB</td>
<td>81</td>
<td>88</td>
<td>93</td>
</tr>
<tr>
<td>6</td>
<td>EB</td>
<td>106</td>
<td>110</td>
<td>114</td>
</tr>
<tr>
<td>7. Convention Center</td>
<td>EB</td>
<td>24</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>8. Transportation Center</td>
<td>EB</td>
<td>323</td>
<td>376</td>
<td>438</td>
</tr>
<tr>
<td>9</td>
<td>EB</td>
<td>15</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>10. 4th Street@Research Park</td>
<td>EB</td>
<td>12</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>11</td>
<td>EB</td>
<td>8</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>EB</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>EB</td>
<td>12</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>14. WSSU</td>
<td>EB</td>
<td>8</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>15. WSSU North</td>
<td>EB</td>
<td>3</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>16</td>
<td>EB</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>17</td>
<td>EB</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18. MLK Dr @ 5th Street</td>
<td>EB</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18. MLK Dr @ 5th Street</td>
<td>WB</td>
<td>130</td>
<td>136</td>
<td>140</td>
</tr>
<tr>
<td>17</td>
<td>WB</td>
<td>124</td>
<td>141</td>
<td>156</td>
</tr>
<tr>
<td>16</td>
<td>WB</td>
<td>11</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>15. WSSU North</td>
<td>WB</td>
<td>101</td>
<td>102</td>
<td>102</td>
</tr>
<tr>
<td>14. WSSU</td>
<td>WB</td>
<td>21</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>13</td>
<td>WB</td>
<td>21</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>12</td>
<td>WB</td>
<td>15</td>
<td>21</td>
<td>40</td>
</tr>
<tr>
<td>11</td>
<td>WB</td>
<td>7</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>10. 4th Street @ Research Park</td>
<td>WB</td>
<td>83</td>
<td>90</td>
<td>91</td>
</tr>
<tr>
<td>9</td>
<td>WB</td>
<td>16</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>8. Transportation Center</td>
<td>WB</td>
<td>475</td>
<td>477</td>
<td>479</td>
</tr>
<tr>
<td>7. Convention Center</td>
<td>WB</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>WB</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>WB</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>WB</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>WB</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. 1st Street</td>
<td>WB</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>1. WFU Medical Center</td>
<td>WB</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| Total                                      | 1,915      | 2,053 | 2,256   |
10 COST AND FUNDING PLAN

10.1 How much will the proposed streetcar project cost?

The proposed streetcar project extending from Queens Avenue (near WFBMC) to 5th Street (near Winston Mutual) has an estimated capital cost of $179 million (in 2017 dollars). The cost estimate is based on conceptual engineering plans that were developed to the 5-10% level of design. As the project moves to advanced stages of engineering, the cost estimates will be refined. Annual operating costs are estimated as $4.3 million, based on the proposed hours and frequency of service and unit cost assumptions.

The capital cost estimate is presented in Table 5 using FTA’s Standard Cost Categories, which is used by all major transit investment projects seeking FTA funding. Contingencies varying from 10-50% of each item are included; the additional unallocated contingency shown as a separate item represents other elements that are yet-to-be defined at this conceptual stage.

### Table 5: Conceptual Cost Estimate of Proposed Streetcar Project

<table>
<thead>
<tr>
<th>Project Component (FTA Standard Cost Categories)</th>
<th>Description</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>010 Guideway and Track Elements</td>
<td>Track installed at-grade in mixed traffic and in reserved right-of-way on 5th St. and Rams Dr.</td>
<td>$29,120,390</td>
</tr>
<tr>
<td>020 Stations, Stops, Terminals, Intermodal</td>
<td>30 platforms along the alignment typically placed every 1,000 feet</td>
<td>$8,473,169</td>
</tr>
<tr>
<td>030 Support Facilities: Yards, Shops, Admin. Bldgs</td>
<td>A Vehicle Maintenance Facility is needed to provide vehicle storage and maintenance services, including inspection, exterior washing, interior cleaning, repair activities, and spare parts storage</td>
<td>$3,049,444</td>
</tr>
<tr>
<td>040 Sitework &amp; Special Conditions</td>
<td>Modifying the existing cross-sections in some locations along the alignment to accommodate the streetcar and pedestrian traffic. Also includes in-street utility conflict mitigation.</td>
<td>$6,102,238</td>
</tr>
<tr>
<td>050 Systems</td>
<td>Includes new and modified traffic signals, eight traction power substations, and the overhead catenary power distribution system</td>
<td>$29,047,080</td>
</tr>
<tr>
<td>060 ROW, Land, Existing Improvements</td>
<td>Property needed for maintenance facility, to accommodate streetcar turning radius in several locations, and streetcar end-of-line at 5th St.</td>
<td>$787,500</td>
</tr>
<tr>
<td>070 Vehicles</td>
<td>Seven active streetcar vehicles and one spare streetcar vehicle</td>
<td>$41,280,000</td>
</tr>
<tr>
<td>080 Professional Services</td>
<td>Preliminary engineering, final design, project management, construction management, insurance, permitting and fees, and survey (estimated to be 27% of SCC 010 though 050)</td>
<td>$20,463,927</td>
</tr>
<tr>
<td>090 Unallocated Contingency</td>
<td>Standard unallocated contingency to account for any items or issues potentially not considered (10% of SCC 010 though 080)</td>
<td>$13,832,375</td>
</tr>
<tr>
<td>100 Finance Charges</td>
<td>Finance charges expected to be paid by the project sponsor/grantee prior to either the completion of the project</td>
<td>$3,000,000</td>
</tr>
</tbody>
</table>

**Total construction items** $75,792,321

**Total (includes allocated contingencies)** $76,579,821

**Total Base Cost for Proposed Streetcar Project (2013 dollars)** $155,156,123

**Total Cost for Proposed Streetcar Project (escalated to 2017 dollars)** $179,868,471
10.2 How will the proposed streetcar project be funded?

This AA Report did not include the preparation of a detailed financial plan on how the Streetcar system will be built and operated. However, a funding strategy was developed that assesses different scenarios for the implementation and operations of the Streetcar system. Future steps in the project development process will provide a detailed financial plan based on the strategy discussed in this report.

From the initial financial planning analysis, preliminary conclusions and next steps reflect the following:

- At the current level of planning, conceptual capital costs for the streetcar are approximately $179 million (2017 dollars).
- There is a reasonable list of potential federal, State and local capital funding sources that could support the implementation of the streetcar line and should be carried forward for further evaluation. The primary capital sources would likely include a combination of the following:
  - FTA Small Starts Program will be targeted to provide up to $88 million (49 percent) in funding. In order to pursue Small Starts funding, the City and its partners will need to determine which agency or agencies will implement and operate the streetcar line in order to address FTA’s technical and financial evaluation criteria for a Construction Grant Agreement (CGA).
  - Other federal funding sources including flexible federal highway funds, which could be used for specific elements of the project.
  - Based on the precedent of Charlotte’s LYNX Light Rail System, NCDOT’s State Full Funding Grant Agreement (SFFGA) program could fund 50 percent of the Non-Small Starts share of costs.
  - A potential local funding share could be provided through the proceeds of a larger transportation infrastructure bond program in which the streetcar project is one of multiple transportation improvement projects.
  - As a potential alternative to the infrastructure bond program, and if an existing repayment source is available, the City may want to consider the federal government’s Transportation Infrastructure Finance & Innovation Act (TIFIA) loan program which is described in detail in Appendix B of the Funding Strategy Technical Report.
  - Other potential capital funding sources could reflect: public or private donation of property at potential station and/or maintenance facility locations; partnering with private property owners to establish a benefit assessment district; or considering the potential of a voter approved dedicated transportation sales tax.
- Potential conceptual capital funding strategies could reflect the following:
  - If the decision is made to not pursue FTA Small Starts funds, local funding on the order of $130 million combined with $49 million in other federal funding programs and match would be required.
  - Under scenarios where FTA Small Starts funding is pursued, Federal funding could provide between 50 percent to 80 percent of total project costs or between $88 million to $144 million (2013 dollars), while State and local funding could each provide between 10 percent and 25 percent of total project costs or between $18 million and $46 million (2013 dollars).
- Based on the current level of planning, conceptual operating costs for the streetcar line is approximately $4.3 million (2013 dollars). Fare revenues will be one of the critical operating funding sources to assist in covering these costs. Detailed ridership and fare revenue projections will be developed in future phases of this study to determine the projected fare box recovery ratio.
- Discussions should be initiated among the potential public and private partners to identify which of the following sources have the most political support and revenue potential to carry forward for further evaluation as the streetcar project continues through the project development process.

For More Information:
- Streetcar Development Impact Summary
- Streetcar Funding Strategy Report
- Programming Congestion Mitigation & Air Quality (CMAQ) Improvement Program funds through the Metropolitan Planning Organization (MPO) for the first three years of operations;
- Identifying the potential impact to the existing bus route network with the implementation of the streetcar line and determine if any cost savings could be transferred to support the streetcar operations;
- Evaluate the potential for the City and private partners served by the streetcar to provide annual operating assistance;
- Assess the interest from the private sector to purchase naming rights (the entire streetcar line, stations, and/or vehicles);
- Estimate potential revenue from on-board and at-station advertising;
- Determine if the implementation of a dedicated transportation sales tax or increased parking fees are politically and publicly reasonable options; and
- Once station locations are identified, determine if there are opportunities for partnerships with the private sector or major activity centers and evaluate the potential funding stream that could be generated through the implementation of a benefit assessment district or tax increment finance district.

Tax Increment Financing (TIF) and TIFIA loan programs are additional funding strategy options for implementing the Streetcar project.

- TIF is a public financing technique used to encourage economic development by capturing the future tax benefits stemming from an infrastructure investment to pay for the cost of those improvements as well as other activities within a specific area. Voters in the State approved constitutional changes to allow TIF and in 2004, local leaders pushed for the program to be used as an economic development tool.

- The Transportation Infrastructure Finance and Innovation Act (TIFIA) Program, provides Federal credit assistance (financing) for eligible projects of regional and national significance. The TIFIA program is designed to fill market gaps and leverage substantial private and other non-federal co-investment by providing supplemental and subordinate capital to projects. Entities that are eligible to apply for TIFIA assistance include state and local governments, transit agencies, railroad companies, special authorities, special districts, and private entities. TIFIA assistance is available for a variety of surface transportation projects including highway, transit, intercity passenger rail, some types of freight rail, and intermodal freight transfer facilities.

### 10.2.1 Conceptual Funding Scenarios

*Table 6, Table 7 and Table 8* provide three conceptual strategies to initiate the discussion on potential realistic approaches to fund implementation of the streetcar project.

*Table 6* represents the minimal federal participation scenario in which the streetcar project does not pursue FTA Small Starts funding because the project does not rate high enough on the Project Justification measures and criteria (mobility improvements, economic development effects, environmental benefits, cost-effectiveness, transit supportive land use, and congestion relief). Key assumptions for this scenario include:

- The City would work with its partners on the MPO to program $20 million in Flexible FHWA funds for the project;
- The State will provide the 20 percent non-federal match for the FHWA funds ($4 million);
- The City will be successful in obtaining a $25 million competitive USDOT grant in the future (assuming the programs are restarted); and
- Local funds from a combination of the sources described above would provide $130 million.
Table 6: Scenario 1: Minimal Federal Participation  
(2013 dollars in millions)

<table>
<thead>
<tr>
<th>Proposed Streetcar Line</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$179</td>
</tr>
</tbody>
</table>

Conceptual Funding Approach

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FHWA Funds</td>
<td>$20</td>
</tr>
<tr>
<td>Future Competitive Grant</td>
<td>$25</td>
</tr>
<tr>
<td>State Match - FHWA Funds</td>
<td>$4</td>
</tr>
<tr>
<td>Local Sources</td>
<td>$130</td>
</tr>
</tbody>
</table>

Table 7 represents the moderate federal participation scenario in which the City successfully pursues Small Starts funding. Small Starts provides funding for 49 percent of the capital costs ($88 million) and the non-Small Starts share is split 25 percent from NCDOT’s SFFGA Program, and 25 percent from local funding sources. Under this scenario, the State and City would each be responsible for providing $46 million (2013$).

Table 7: Conceptual Funding Strategy – Scenario 2: Moderate Federal Participation  
(2013$, in millions)

<table>
<thead>
<tr>
<th>Proposed Streetcar Line</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$179</td>
</tr>
</tbody>
</table>

Conceptual Funding Approach

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FTA Small Starts</td>
<td>$88</td>
</tr>
<tr>
<td>NCDOT SFFGA</td>
<td>$46</td>
</tr>
<tr>
<td>Local Sources</td>
<td>$46</td>
</tr>
</tbody>
</table>

Table 8 represents a scenario in which the streetcar project is funded 80 percent through multiple federal funding programs including the FTA Small Starts Program (49 percent) and some combination of FHWA funding programs and USDOT Competitive Grants (31 percent). The remaining 20 percent would be split evenly between NCDOT’s SFFGA Program and local funding sources. Under this scenario, the State and City would each be responsible for providing $18 million (2013$).

Table 8: Conceptual Funding Strategy – Scenario 3: Maximum Federal Participation  
(2013$, in millions)

<table>
<thead>
<tr>
<th>Proposed Streetcar Line</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$179</td>
</tr>
</tbody>
</table>

Conceptual Funding Approach

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FTA New Starts</td>
<td>$88</td>
</tr>
<tr>
<td>Other Federal Funding</td>
<td>$56</td>
</tr>
<tr>
<td>NCDOT SFFGA</td>
<td>$18</td>
</tr>
<tr>
<td>Local Sources</td>
<td>$18</td>
</tr>
</tbody>
</table>

Note: Revenue levels may not match total costs due to rounding
10.2.2 Potential Operations & Maintenance Funding Sources

Implementation of streetcar line will result in an increase in the transit operating costs for the Winston-Salem area. As discussed previously, the conceptual annual O&M costs for the streetcar line are $4.3 million (2013 dollars). Similar to capital costs, long-term operating funding will likely reflect a combination of multiple sources. At this stage of project development, operating funding sources are typically less defined compared to capital revenue sources. As such, a preliminary operating funding strategy is not provided at this time. However, it is critical to initiate the discussions among the public and private partners that would benefit from the proposed service to identify which potential sources have the most political support to carry forward for further evaluation.

Additionally, if operating funding will be sought from multiple agencies, institutions, and/or the private sector, the City will need to define an approach to ensure the commitment of funds is received between the Project Development and Construction Grant Agreement steps of the Small Starts process. A potential issue is the “last one in” scenario. On fixed guideway projects with several funding partners, there have been situations where multiple agencies/institutions/businesses would not fully commit their proposed level of annual funding until all other partners had executed their commitments and the FTA had indicated the project would receive the CGA. Unfortunately, the FTA will not indicate the receipt of a CGA until all operating funds are committed. Prior to applying to enter Project Development, the City and its partners should identify the most realistic sources and annual funding contributions. While these sources will not need to committed as part of the application to enter Project Development, the City should define the process that will be used to finalize the sources and annual contributions (including all required approvals by governing bodies) to ensure the operating funds are committed during the Construction Grant Agreement step.

To initiate this process, the following is a long list of potential operating revenue sources that can be narrowed down as the project implementation process moves forward.

- **Fare Revenue:** Passenger fares will be one of the key sources of operating revenue for the streetcar line. The preliminary ridership projections estimates daily ridership in FY 2017 will be 1,500 passenger trips. Based on the Operations Plan, service will be provided 304 days per year, which would result in an annual ridership estimate of 456,000 passenger trips. Based on the 2011 National Transit Database, the Winston-Salem Transit Authority’s (WSTA) average fare is $0.59. Combining the average fare and the estimated annual ridership estimate results in an annual fare revenue estimate of approximately $270,000 (2013 $).

- **Reallocation of Existing Fixed Route Bus Service Costs within the Corridor:** A key planning component of the project implementation process is the development of an integrated service plan that reflects the incorporation of the proposed streetcar line into the existing bus route network. As discussed in the Operations Plan Technical Memorandum, the proposed integrated service plan would eliminate the existing Route 40 West End Trolley. The elimination of this route would result in a savings of $195,000 annually and could be reallocated to pay for a portion of the streetcar’s O&M costs.

- **Congestion Mitigation and Air Quality Improvement (CMAQ) Program:** In addition to supporting implementation of capital projects, based on recent MAP 21 guidance, CMAQ funding is also eligible to support the first five years of operation of a new transit service. The City would have to work with the regional partners on the MPO to identify realistic annual levels of CMAQ funding that could assist with the first five years of streetcar service.

- **City General Funds:** Once the streetcar operating plan and annual O&M costs are finalized, the City could provide an annual operating subsidy for the project. This could be a specified annual amount or annual percent share of O&M costs.

- **Contributions from Private Partners:** For major employers and/or other activity centers served directly by the streetcar line, a revenue structure could be established where the employer/ activity center purchases a set number of tickets per year or pays an agreed upon share of operating costs relative to the benefits the streetcar line provides.

For More Information:
- Cost Estimation Methodology and Results Report
- Operations Plan
- Finance Strategy Report
- **Naming Rights/Sponsorships**: This potential source reflects a form of revenue participation provided through the provision of equity investments for a project. In return, sponsors receive a combination of advertising, promotion of image, and/or a commitment that their products will be used by the entity they are sponsoring. Sponsorships are an increasingly important mechanism for funding large public projects. Stadiums, aquariums, and rail transit projects are examples that attract large attendance and/or provide high visibility. Sponsors could potentially be attracted from the many organizations and companies located along the streetcar line or at specific station areas. Such sponsorships could demonstrate the commitment and sense of identity the organization has with the City. Revenue collection from sponsorships would be governed by policies established by the City regarding the charges it would require for different levels of sponsorship.

An example of a streetcar line with naming rights is the TECO Trolley Line in Tampa, FL, with the naming rights provided by TECO Energy for $1.0 million. Tampa also sought revenue from vehicle naming rights ($225,000 per car) and station naming rights (between $75,000 and $150,000 per station). Station names include: Tampa Bay Federal Credit Union; The Tampa Tribune Station, and the HSBC Station. Vehicle sponsorship includes the Vigo Importing Company Breezer Car (open air streetcar).

- **Advertising Revenue**: This could include revenues derived from advertisements placed inside and/or outside the vehicles; at stations; and/or in schedules, maps, flyers, and other promotional materials. Additionally, a potential emerging source of advertising revenue is from smart phone apps that provide passengers with real time travel information. The Charlotte Area Transit System (CATS) will be issuing a request for proposal (RFP) to implement an approach to monetize smart phone apps technology in the near future.

- **Benefit Assessment Districts/Tax Increment Financing Districts**: These Districts provide a funding mechanism whereby benefits accruing to privately owned land from a public capital improvement, such as station areas, are recouped in order to assist in paying for the on-going maintenance of the improvement. As such, these districts provide a form of value capture finance whereby a portion of the privately accruing monetary value is captured to support long-term operating costs.

In addition to being a potential capital revenue source, a Benefit Assessment could also be established to assist in paying a portion of the operating costs for the capital improvements made within and specifically benefiting that area. Examples of private property owners establishing benefit assessment districts to support on-going operations can be found in San Diego and Denver.

A TIF District uses property tax revenues generated beyond an established baseline that are then pledged specifically for infrastructure-related improvements within an area or district. The ability of a TIF district to generate revenue for the streetcar will depend in large part on the development potential along the streetcar corridor. Results from the land use/development potential analysis completed in another task will assist in the viability of these districts as an operating funding option.

- **Future Voter Approved Local Funding Source**: In addition to potentially supporting construction of the streetcar line, a future voter-approved dedicated transportation funding source could also provide a long-term operating funding source for the streetcar.

- **Parking Fees**: A parking fee is a tax or surcharge levied on paid parking. The fee could be applied within LPA corridor or within the City limits for the use of off-street commercial or employer provided parking spaces. If applied within the streetcar corridor, there would be some degree of relationship between traffic and parking within the corridor relative to parking requirements and parking tax. If applied City-wide, the relationship between the parking fee and operating costs within the corridor would be less direct. More likely, a City-wide parking fee would be used to fund a variety of improvements, and would not be used solely to fund operating costs for the streetcar.
11 PROJECT STARTER-LINE ALTERNATIVES

As defined in Section 2.1.3 and shown in Figure 2, the proposed route is approximately 4 miles in length and will provide a two-way service along Hawthorne Road from Wake Forest Baptist Medical Center to 1st Street. A one-way couplet is used in the West End area: on the eastbound approach, the alignment follows 1st Street to 2nd Street to Broad Street and turning right onto 4th Street; on the return trip, the alignment travels west on 4th Street and turns left onto Burke Street and continues along to 1st Street. From 4th Street, the alignment turns north onto Spruce Street and continues eastbound on 5th Street. The alignment turns south at Patterson Street to 4th Street to Research Park Boulevard. To the east, service would continue along Rams Drive to Winston-Salem State University. To the north, service would continue along Martin Luther King Jr. Drive to Union Station to 5th Street to serve East Winston.

The projected capital cost for this alignment at full-build is $179 million while the operating costs are projected to be $4.3 million annually in opening year 2017.

This AA already provides a description of conceptual alternatives that were studied during the process and includes transit technologies, route alignment options and general service characteristics of each alternative.

For projects submitted for funding under the New Starts/Small Starts program, FTA urges consideration of one or more minimum operable segments (MOS). These are separate alternatives to provide flexibility in any future funding discussions. A MOS is a subset of an entire proposed project build- option that can be built prior to construction of the full project. The MOS represents reduced-scope initial service implementation that would address the project’s vision of enhancing economic competitiveness and providing more mobility options. Each phase or MOS can be built independently and its usefulness as a transportation investment does not depend upon the implementation of subsequent phases. These options would go through the public involvement process during the next phase of project development.

The purpose of this section is to present potential subsets of the proposed route that would allow the project to begin with a starter-line. At a future time the entire proposed route could be built out in one or more phases after the construction of the starter-line. Four potential options were identified:

<table>
<thead>
<tr>
<th>Option I</th>
<th>Option II</th>
<th>Option III</th>
<th>Option IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1.6 mile segment that extends from the Burke St. / BB&amp;T Ballpark area east connecting the core of downtown and the Transportation Center to northern PTRP.</td>
<td>• 2.2 mile segment that extends from WFBMC east connecting the Burke St. / BB&amp;T Ballpark area, the core of downtown, and the Transportation Center to northern PTRP.</td>
<td>• 2.7 mile segment that extends from 4th St. / Broad St. east connecting downtown, the Transportation Center, PTRP and WSSU to Union Station.</td>
<td>• 3.3 mile segment that extends from WFBMC east connecting the Burke St. / BB&amp;T Ballpark area, the core of downtown, the Transportation Center, PTRP and WSSU to Union Station.</td>
</tr>
</tbody>
</table>

The segments of the alignment were evaluated based on the following criteria:

- **Mobility**
  - Connect activity centers, transit hub, or pedestrian-oriented areas in close proximity to each other;
  - Total average weekday ridership (2017); and
  - Number of stops.

- **Financial**
  - Develop a “starter line” (at least 1.25 to 3.3 miles) that is affordable and manageable, offers opportunities for future expansion, and long enough to justify investment;
  - Capital cost/mile;
  - Operating cost/mile; and
- Costs/rider.
- **Land Use and Economic Development**
  - Potential economic development and redevelopment opportunities.
- **Design and Operational Constraints**
  - Design Challenges; and
  - Logical terminus for end stop (anchor to prominent destinations).

Based on these criteria, the four starter-line options performed as follows:

### Table 9: Starter Line Segments

<table>
<thead>
<tr>
<th>LPA Segment (MOS)</th>
<th>Option I</th>
<th>Option II</th>
<th>Option III</th>
<th>Option IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (Route Mile)</td>
<td>Burke St./Westdale Ave. to northern PTRP</td>
<td>WFBMC to northern PTRP</td>
<td>Broad St. to Martin Luther King Jr. Dr./5th St.</td>
<td>WFBMC to Union Station</td>
</tr>
<tr>
<td>Number of Stops</td>
<td>1.6</td>
<td>2.2</td>
<td>2.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Ridership (2017)</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>$87.9 Million</td>
<td>$109.8 Million</td>
<td>$131.9 Million</td>
<td>$146.4 Million</td>
</tr>
<tr>
<td>Operating Cost</td>
<td>$2.14 Million</td>
<td>$2.96 Million</td>
<td>$3.45 Million</td>
<td>$4.27 Million</td>
</tr>
<tr>
<td>Potential Development</td>
<td>15 Million Square Feet</td>
<td>15.9 Million Square Feet</td>
<td>12.2 Million Square Feet</td>
<td>16.9 Million Square Feet</td>
</tr>
<tr>
<td>Challenges</td>
<td>• No connection to WFBMC, southern PTRP, WSSU and East Winston • Transfers at the Transportation Center</td>
<td>• No connection to southern PTRP, WSSU and East Winston • Transfers at the Transportation Center</td>
<td>• Design constraints No connection to WFBMC</td>
<td>• Major design constraints • No connection to East Winston</td>
</tr>
<tr>
<td>Key destinations</td>
<td>• BB&amp;T Ballpark • Library • Convention Center • Transportation Center • Downtown • Northern PTRP</td>
<td>• WFBMC • BB&amp;T Ballpark • Library • Convention Center • Transportation Center • Downtown • Northern PTRP</td>
<td>• Downtown • Transportation Center • PTRP • WSSU • Union Station • East Winston</td>
<td>With the exception of East Winston, captures every key destination along corridor</td>
</tr>
<tr>
<td>Benefits</td>
<td>• No major design challenges • Connects to Transportation Center and regional transit system • Connects to northern PTRP</td>
<td>• No major design challenges • Connects to Transportation Center and regional transit system • Connects to northern PTRP</td>
<td>• Connects to Transportation Center and regional transit system • Accessibility of East Winston residents and businesses to system • Connects WSSU with PTRP</td>
<td>With the exception of East Winston, captures every key destination along corridor</td>
</tr>
<tr>
<td>Capital Cost per Route Mile</td>
<td>$54.9 Million</td>
<td>$49.9 Million</td>
<td>$48.8 Million</td>
<td>$44.4 Million</td>
</tr>
<tr>
<td>Operating Cost per Rider</td>
<td>$1,500</td>
<td>$1,800</td>
<td>$1,800</td>
<td>$2,200</td>
</tr>
</tbody>
</table>
Table 9 presents the potential development based on the gross square footage development for the high build-out scenario, without PTRP, defined in the Development Potential Memorandum. Figure 20 shows the potential development sites in yellow in the vicinity of Option I, which extends from Burke Street/Westdale Avenue to northern PTRP.

Figure 16: Starter Line Option I

Figure 21 shows the potential development sites in yellow in the vicinity of Option II, which extends from WFBMC to northern PTRP.

Figure 17: Starter Line Option II
Figure 22 shows the potential development sites in yellow in the vicinity of Option III, which extends from Broad Street to 5th Street to Martin Luther King Jr. Drive.

Figure 18: Starter Line Option III

Figure 23 shows the potential development sites in yellow in the vicinity of Option IV, which extends from WFBMC to Union Station.

Figure 19: Starter Line Option IV

These segments will be presented to the City Council in February, 2014 for consideration in their process to approve the Locally Preferred Alternative (LPA) and to identify the segments for the initial phase of project implementation.