Greater Triangle Commuter Rail (GTCR)
Phase II Feasibility Study

Client: GoTriangle

STV Project Number: 4020151

Downtown Durham Feasibility Report

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Executive Summary

This report documents the evaluation of thirteen concepts for establishing commuter rail through Downtown Durham. The conceptual engineering analysis included functional level track, roadway, stormwater, utility, and structural designs to adequately evaluate risks, confirm costs, and make recommendations. Two conceptual designs with the lowest risk and most conservative cost estimates are recommended for consideration in the next phase of the project: one utilizing low-level station platforms (Concept 2) and one with high-level station platforms (Concept D). Two additional approaches (Concept E and Gauntlet Concept) could also be evaluated should the commuter rail project move forward to implementation. These concepts are feasible but are higher risk in terms of acceptability to Norfolk Southern.

Figure 1. Visualization of Downtown Durham Concept 2 w/ Low-Level Platforms

Figure 2 Visualization of Downtown Durham Concept D w/ High-Level Platforms

1 Introduction

The potential operation of 40 daily commuter rail trains in the rail corridor between West Durham and Auburn will require construction of a second track to provide capacity for all commuter rail, intercity, and freight trains to operate reliably. In Downtown Durham, existing conditions pose challenges to a second track. The City was built up around the railroad corridor in the mid-1800s; therefore, today many historic properties, as well as, roadways and utilities, around the corridor. The infrastructure was primarily built according to standards that have long since been changed and updated. The roads are steep and change grade quickly. The at-grade crossings between the roads and track do not meet current standards meant to prevent modern trucks from getting stuck on the rails. The 100-year-old bridges also do not meet current vertical clearance standards to accommodate modern trucks, nor do they have wide spans to accommodate increased pedestrian and bicycle use. A history of infrastructure projects impacting disadvantaged neighborhoods has created a rift in Downtown Durham, split along both the railroad corridor and Highway 147.

The scope of work for Phase II of the feasibility study included conceptual engineering for Downtown Durham to evaluate concepts and understand their associated risks. This technical memorandum summarizes the development and evaluation of concepts that could deliver the required capacity with limited negative implications for the downtown area.

2 Description of Functional Concepts

With these challenges in mind, STV developed and evaluated 13 potential concepts to determine their feasibility. The concepts were discussed with stakeholders (e.g., representatives from the City of Durham, Durham County, NCDOT, NCRR) as they were being developed and variants emerged from those discussions. Below are descriptions and schematics of the 9 most promising concepts that were considered for functional level preliminary engineering design. Each schematic is oriented in the same direction and the **Figure 3** is representative of the line styles for each schematic. More detailed depictions of these concepts are in **Appendix (Functional Concepts)**.

Two groups of concepts were developed to address different approaches to achieving system accessibility between the trains and station platform in compliance with Federal standards: low-level platform concepts with assisted boarding, and high-level platform concepts with level (unassisted) boarding. As a programmatic determination of the approach to accessibility for the project as a whole has not yet been made, the project team ensured that feasible concepts would exist for both approaches.

Federal standards for passenger accessibility on commuter rail systems require level boarding at stations where the tracks are used only by passenger trains. For stations where tracks are shared between passenger and freight trains, Federal standards allow for assisted boarding methods such as mini-high platforms, ramps, and wheelchair lifts. Additionally, NS design standards require that station platforms constructed on tracks shared between freight and passenger

service be limited to a "low-level" height of only 8 inches; for stations with this platform height, level boarding would be impossible and one of the assisted boarding methods would need to be employed. Therefore, the project team has pursued two general approaches: low-level station platforms with assisted boarding on shared tracks, or high-level station platforms with level boarding on dedicated passenger tracks.

Concepts 1 and 2 include low-level station platforms located alongside two tracks shared between passenger and freight trains. These concepts would require passengers to climb steps to access the train; passengers using mobility devices, or otherwise needing assistance, would access the train via passenger lifts built into the train or via short, raised platforms known as "mini-high" platforms.

Concept 3E through G include high-level station platforms located alongside two dedicated station tracks for passenger trains, separated from the freight track(s). These concepts, with the additional infrastructure, are the only Concepts that would provide level boarding between the train and station platform; that is, passengers would be able to move seamlessly from train to platform at the same level, regardless of mobility constraints.

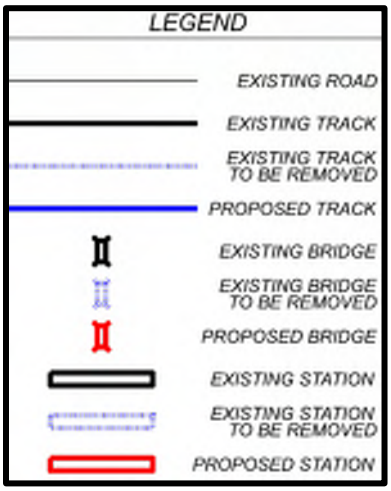


Figure 3. Legend for Schematic Drawings

2.1 Concept 1

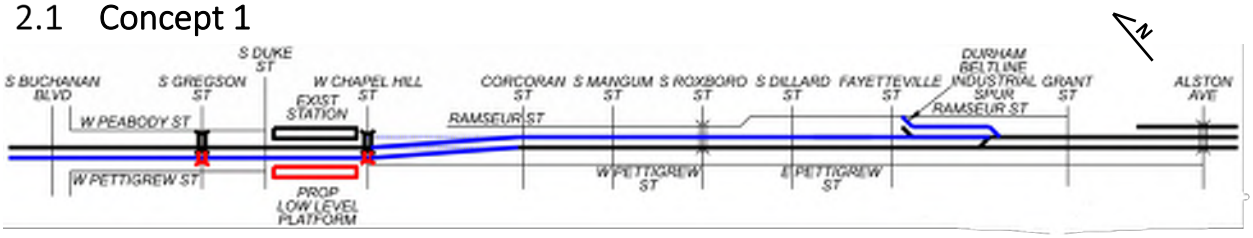


Figure 4. Schematic of Concept 1

Concept 1 is the simplest of the options, where a new track is added to the South side of the existing tracks east of Chapel Hill Street, then transitioning to the North side of the existing tracks between Chapel Hill Street and Blackwell Street, and remaining on the north side throughout the remainder of the Downtown Durham study limits. A new or widened rail bridge is required over

S Gregson St and Chapel Hill Street on the South side of the existing tracks to accommodate the second track. The additional track ties back into the existing configuration near Grant Street. Concept 1 utilizes low-level platforms at the station and maintains the existing track profile/elevation.

2.2 Concept 2

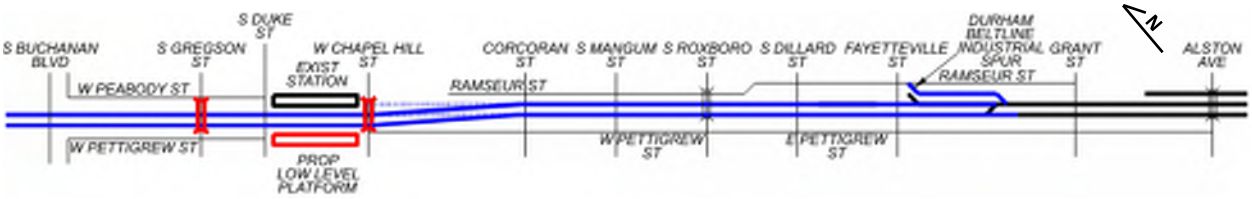
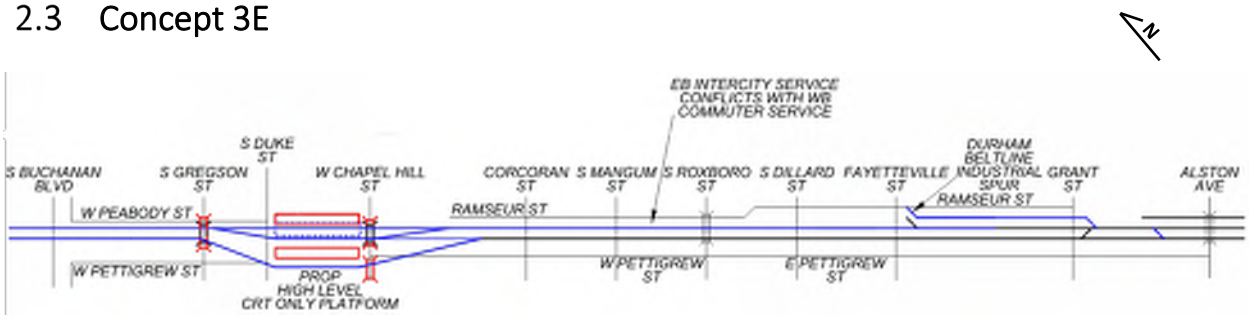


Figure 5. Schematic of Concept 2

Concept 2 mimics Concept 1 horizontally, however this concept explores raising the existing and proposed tracks to create additional vertical clearance under the rail bridges. Entirely new, double track rail bridges are required over Gregson Street and Chapel Hill Street. Concept 2 utilizes low-level platforms at the station.

2.3 Concept 3E



Concept 3E explores separating the Intercity station platform from the Commuter Rail platform with a high-level, center loaded Commuter platform. NCDOT Rail has expressed concerns with the operational function and flexibility of this concept. NCRR has expressed concerns with limiting freight traffic to a single track with new tracks only for commuter trains.

2.4 Concept A

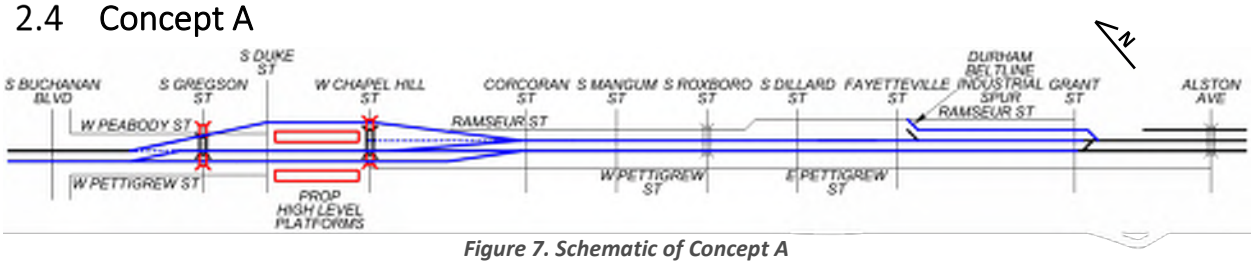


Figure 7. Schematic of Concept A

Concept A begins to explore how high-level platforms might be implemented in Downtown Durham. High-level platforms require the use of station tracks which must be spaced 26’ from freight tracks, per Norfolk Southern policy, thereby creating a larger footprint, more infrastructure, and higher cost, to obtain the benefit of level boarding. This Concept arranges the freight track on the North side of a proposed side loaded platform. New or widened bridges are

needed at Gregson and Chapel Hill Streets on both the North and South sides of the existing track. The track profile/elevation remains as existing.

2.5 Concept B

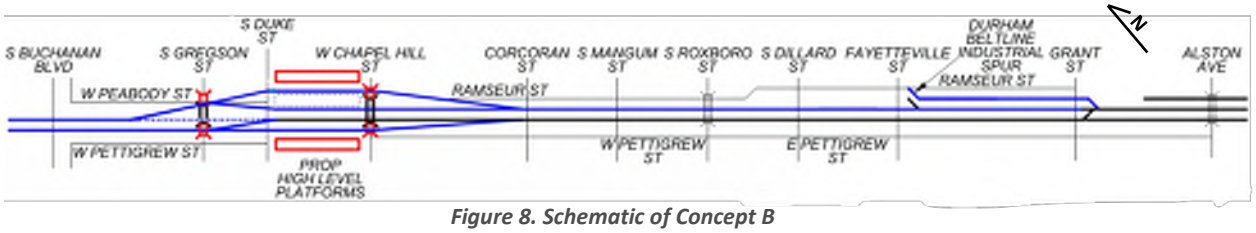


Figure 8. Schematic of Concept B

Concept B also utilizes high-level, side loaded platforms; however, this layout has the freight track between the station tracks. To accommodate future capacity for the NCRR corridor, sufficient space is provided for two freight tracks to reduce future reconstruction. This Concept allows pedestrians to access platforms directly from either side without needing to cross a track. The track profile/elevation remains as existing.

2.6 Concept C

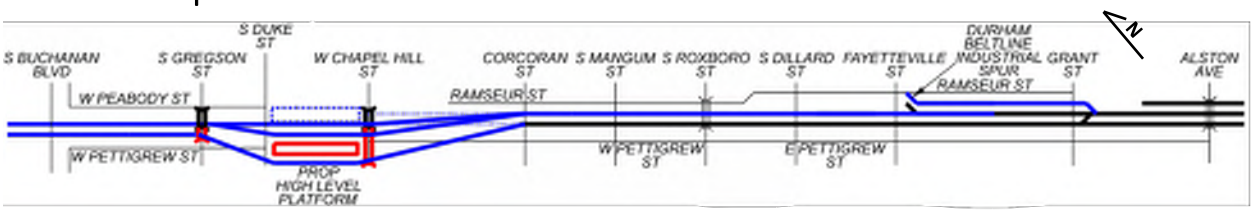


Figure 9. Schematic of Concept C

Concept C investigates a high-level, center loaded platform. The freight track is located on the north side in this concept, and it mimics the 2016 NCRR Infrastructure Planning Study, on which this phase of the GTCR Study is based. The track profile/elevation remains as existing.

2.7 Concept D

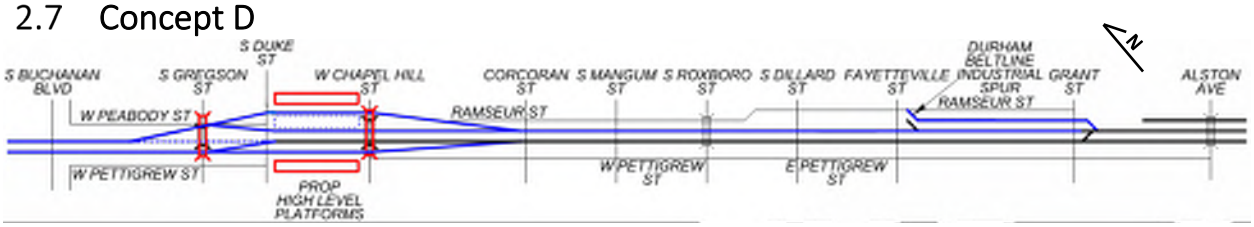


Figure 10. Schematic of Concept D

Concept D matches Concept B horizontally; however, this concept raises the track from existing to allow more vertical clearance under the bridges. The freight track is located between the station tracks. To accommodate future capacity for the NCRR corridor, sufficient space is provided for two freight tracks to reduce future reconstruction. This Concept allows pedestrians to access platforms directly from either side without needing to cross a track.

2.8 Concept E

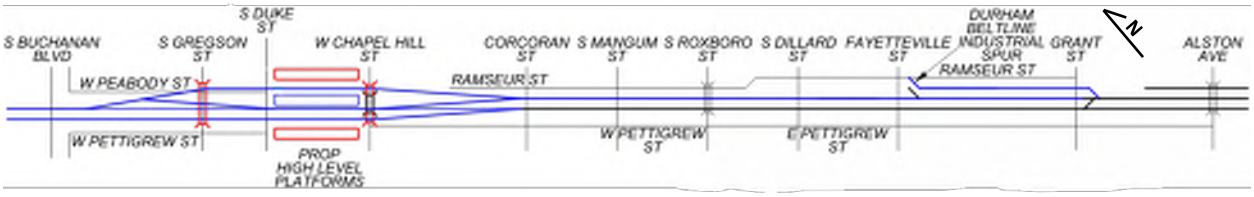


Figure 11. Schematic of Concept E

Concept E is a high-level, side loaded platform layout that attempts to reduce the impacts seen in Concept D. This concept explores potential design exceptions to the NS policy of maintaining 26' between station and freight tracks. This layout has 30' between the westbound station track and the freight track and 15' between the eastbound station track and the freight track.

2.9 Concept G

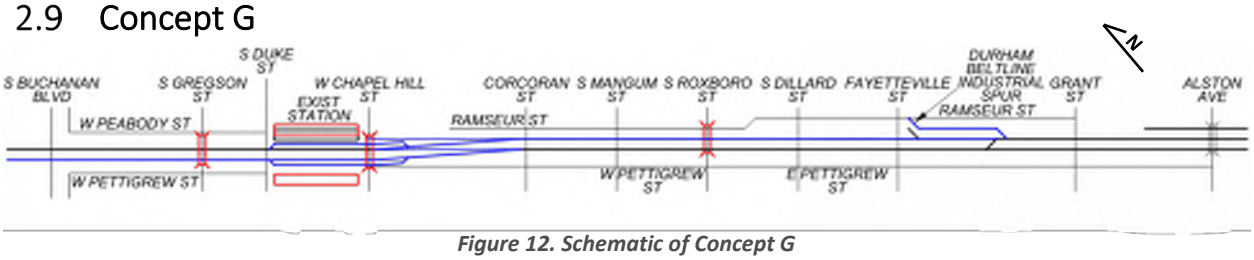


Figure 12. Schematic of Concept G

Concept G is a high-level, side loaded platform layout that attempts to reduce the impacts further from those seen in Concept D and E. This concept explores potential design exceptions to the NS policy by using gauntlet tracks. NS highly discourages the use of gauntlet tracks on their corridors.

3 Evaluation Process

3.1 Stage 1: Initial Screening of Concepts

The purpose of the initial screening of concepts was to eliminate concepts that did not meet basic requirements for feasibility in order to focus more detailed design, risk, and cost evaluation of a smaller subset of concepts. The concepts, described above, were evaluated in Stage 1 by developing a GIS Constraint/SHPO map, and track and roadway functional level preliminary engineering designs. Stakeholder engagement was performed to help identify preferred concepts and to ensure the City of Durham, and others, were able to provide feedback and comments, as well as aid in decision making.

3.1.1 Constraint Mapping and Data Collection

Within the study area in Downtown Durham (NCRR Mile Post NC-H53.5 to NC-H56), various public databases were referenced to provide an overview of sensitive and historic boundaries. The map, which can be found in the **Appendix (Constraint Mapping),** included streams, floodplains, greenways/bike routes, NC SHPO sites/boundaries, National Register sites/boundaries, gas stations, parks, and other points of interest. This map aided in the

development of functional level preliminary engineering designs and was a critical reference for decisions on concept progression into Stage II.

Survey information was obtained for the study area, using a compilation of DOLRT survey data and new ground and top of rail shots obtained specifically for the GTCR project.

3.1.2 Track

Conceptual track designs were conducted with the purpose of adding a second track to the existing rail corridor, to meet the needs of the GTCR project. Horizontal and vertical geometry were designed by utilizing AREMA, NCRR, and NS standards and considered an area in Downtown Durham encompassed by NCRR Mile Post (MP) H53.5 to H56. Functional level preliminary engineering drawings for each track concept can be found in the Appendix**.**

3.1.3 Roadway

Conceptual roadway designs were developed that would accommodate the additional track and utilize NCDOT and City of Durham standards. Roadway infrastructure was replaced-in-kind for all roadways that required design (roadway configurations remained the same), but future City of Durham projects and initiatives were also considered as warranted (i.e. the Move Durham Initiative, American Tobacco Trail, etc.). Roadway designs were considered for the following roadways in the Downtown Durham study area, as needed to accommodate the railroad infrastructure:

- Buchanan Street
- Gregson Street
- Peabody Street
- Pettigrew Street
- Duke Street
- Chapel Hill Street
- Corcoran/Blackwell Street
- Mangum Street
- Roxboro Street

Roadways were designed and analyzed to detail sufficient to determine potential impacts for each track concept layout. Utilities were examined at a high-level in this stage to determine whether relocations were feasible and the maximum cut that was possible at each roadway.

3.1.4 Initial Screening

Nine concepts were identified, analyzed, and screened to identify the best options to carry forward for further evaluation. Impacts to City of Durham streets, private property, historic sites, and railroad operations were heavily weighted in the decision-making process.

Table 1 summarizes Stage 1 analyses describing which concepts were selected to move into Stage 2 for further investigation in the roadway, stormwater, utilities, and structural disciplines. Through extensive stakeholder engagement, Concepts E and G were preferred from an impact perspective, however they carry significant risk because they do not meet NS policy and require additional discussions and design exceptions to determine their viability.

Table 1 Initial Concept Screening

Conceptual Design	Recommended for Stage 2	Reason for Recommendation
Concept 1	No	Does not accommodate increased vertical clearance under Gregson or Chapel Hill Streets
		Low-level platform option
Concept 2	**Yes**	**Accommodates increased vertical clearance under Gregson and Chapel Hill Streets with minimal impact to roadways, utilities, and historic properties**
		Best of the low-level platform options
Concept 3E	No	Significant operational concerns
		NCDOT Rail Concerns with reconstructing the Durham station as low-level with high-level commuter platform nearby.
Concept A	No	Impacts to private property
		Impacts to roadways and utilities
		Does not accommodate increased vertical clearance under Gregson or Chapel Hill Streets
Concept B	No	Impacts to private property
		Impacts to roadways and utilities
		Does not accommodate increased vertical clearance under Gregson or Chapel Hill Streets
Concept C	No	Impacts to private property
		Impacts to roadways and utilities
		Impacts to the Pettigrew/Chapel Hill Street intersection, impacting bus operations
		Does not accommodate increased vertical clearance under Gregson or Chapel Hill Streets
Concept D	**Yes**	**Best of the high-level platform options**
		Accommodates increased vertical clearance under Gregson and Chapel Hill Streets
Concept E	No*	Does not meet NS policy
Concept G	No*	Does not meet NS policy

* While this concept was not evaluated further at this time, this phase of GTCR Study does not preclude it from being pursued at a later phase of the project. Further discussions with Norfolk Southern could allow Concept D to evolve into Concept E, and Concept 2 could evolve into Concept G.

It was originally anticipated that Stage 2 of this feasibility study would only include one conceptual design for further evaluation. However, given the complex analysis of impacts versus high-level platform cost and benefits, and a desire for flexibility and better understanding of the alternatives for the GTCR project, it was determined that both a low-level platform (Concept 2) and high-level platform (Concept D) option should be analyzed further. Concepts 2 and D were selected because they represent the best concepts with the lowest risk and most conservative costs. Concepts E and G are not precluded with this study, nor any other evolution of these concepts as design progresses and coordination with stakeholders continues.

3.2 Stage 2: Additional Analysis

After the Initial Screening of Concepts, two concepts were selected for more detailed design, risk, and cost evaluation. In Stage 2, functional level preliminary engineering designs were developed for Concepts 2 & D in roadway, stormwater, structures, and utilities, as well as development of a traffic analysis and capital cost estimates. Extensive stakeholder engagement was also performed, to help refine the preferred concepts and to ensure the City of Durham, and others, were able to provide feedback and comments, as well as aid in decision making.

3.2.1 Roadway

Roadways were refined further from design completed in Stage 1 with additional coordination with structural, utility, and stormwater disciplines. Functional Plan sets were developed for Concepts 2 and D and can be found in **Appendix (Roadway)**.

3.2.2 Stormwater

A high-level drainage evaluation was completed for the GTCR project in Downtown Durham. Most of the proposed rail improvements are located directly in the highly developed downtown area of Durham. The project is served by a series of sideline pipe and ditch systems and cross pipes no greater than 36” in diameter.

Based on current data and proposed designs, most of the stormwater management for this project will be handled by simple rail side base ditches and closed systems. Based on field investigations, most cross drains along the rail corridor currently operate within desirable limits. However, in later phases of design all cross drains will be analyzed for compliance to local and State requirements. Those with HW/D ratios greater than 1.2 will need to be either determined as sufficient in place or designed with upgrades as necessary to meet requirements. Current upstream water surface profiles along the corridor will also need to be ascertained and documented.

The rail currently is situated on a major ridge through Durham and acts as basin boundary for drainage areas to either side. Proposed new rail alignments are to be located to the south of the existing mainline predominantly. This new construction will require substantial ditch work along

both sides of the alignment and will necessitate a thorough existing closed systems evaluation near the outfalls to determine if adequate downstream capacity exists outside the rail right-of-way. If capacity issues are found, rail runoff may either need to be attenuated or reallocated to other outfalls with capacity.

Post construction water quality may be required for the new impervious areas along the corridor. Confirming which portion of the rail is located within the Jordan and Falls River basins will also be important since their regulations differ. As noted with City of Durham stormwater personnel, water quality credit may be available for either repurposed or removed existing impervious areas along the corridor.

Further survey of existing hydrologic and hydraulic components along the rail corridor is highly recommended to better determine how the existing closed systems, ditches and cross drains are currently operating. Proposed designs will most likely show several cross drains need to be upsized and closed systems added to offset the proposed new rail line's impacts. New cross drains may require a jack & bore approach to construct and may necessitate right of way purchase. Downstream analyses are needed to ensure any new flows added to these systems operate without adverse impact. Survey will be needed along these routes as well. Depending on the amount of water quality and quantity controls needed, additional right-of-way may be required.

Functional level preliminary engineering stormwater drawings for Concept 2 and Concept D, as well as calculations and a more detailed summary can be found in the **Appendix (Stormwater).**

3.2.3 Structures

Functional level preliminary engineering structural drawings for the Gregson Street and Chapel Hill Street rail bridges were developed for Concept 2 and Concept D and can be found in the **Appendix (Structures).** General plan view, elevation, and typical sections are included in the plans.

3.2.4 Utility Design

Water and sewer utility relocation plans were prepared for both Concept 2 and Concept D, utilizing NC Department of Environmental Quality, City of Durham, and North Carolina Railroad standard practices and procedures. Said plans include analysis of both existing utilities and proposed utilities that the City of Durham intends to install within the near future. As part of the GTCR project, utilities within the railroad right-of-way and in conflict with the proposed improvements will be required to be relocated to accommodate the additional track. There are also utility relocations within roadway right-of-way to accommodate roadway and drainage modifications. Water line relocations range in diameter from 6 inches to 24 inches, and sewer lines from 8 inches to 10 inches. Railroad utility crossings were designed with steel casings that extend the full width of the railroad right-of-way, where possible, to ensure compliance with

NCRR and NS standard requirements. For Concept D, the high-level station platforms require relocation of additional parallel water and sewer lines inside the railroad right-of-way that were not impacted in Concept 2. Where possible, parallel utilities are relocated outside of the railroad right-of-way. In total, for Concept 2 there are approximately 9,360 linear feet of water line relocations and approximately 4,110 linear feet of sewer relocations, and for Concept D there are approximately 10,640 linear feet of water line relocations and approximately 5,560 linear feet of sewer relocations, required within the limits of the Downtown Durham study area. Functional level preliminary engineering utility (water/sewer) relocation drawings for Concept 2 and Concept D can be found in the **Appendix (Utility Design).**

3.2.5 Utility Coordination

To help inform the functional level preliminary designs and decision-making, private utility information was obtained and analyzed. Utility information for known encroachments within the North Carolina Railroad (NCRR) right-of-way was provided by NCRR. The project team also analyzed utilities along the adjacent roadways to determine the prior rights status of utilities outside of the railroad right-of-way. Once all data was obtained, potential impacts to utilities for the functional level preliminary engineering design Concept 2 & Concept D were compared and analyzed. While impacts to utilities are to be expected, it was determined there were no “critical” impacts for either Concept 2 or Concept D. Critical impacts are defined as impacts that require extensive relocations and have significant cost and lengthy relocation timelines. A list of utility owners and their contact information can be found in the **Appendix (Utility Coordination).**

3.2.6 Traffic Analysis

The workplan for the Downtown Durham analysis has several components, including analysis of traffic operations and the potential impacts that the future commuter rail service levels could have on vehicular traffic. A separate report assessed the potential impacts that the future commuter rail service levels could have on vehicular traffic in the future year by comparing capacity analysis results from microsimulation models for the following scenarios:

- 2019 Base Year No-Build (2019 BY-NB)
- 2019 Base Year Build (2019 BY-B)
- 2045 Future Year No-Build (2045 FY-NB)
- 2045 Future Year Build (2045 FY-B)
- 2045 Future Year Build + Improvements (2045 FY-B+I)

The capacity analysis was completed using TransModeler (Version 5.0 Build 7245 64-bit) for the full study area. TransModeler is a microscopic behavior-based multi-purpose traffic simulation program that takes into consideration vehicle interaction and driver behaviors, as well as the operational impacts, such as at-grade rail crossings, for both the upstream and downstream conditions. For this reason, TransModeler was used to assess the impacts of gate downtime within the study area.

As a result of projected future year volume, most signalized and unsignalized intersections in the 2045 FY-NB network experience increased congestion and delay in addition to heavy queuing, specifically along Fayetteville Street, S Mangum Street, W Chapel Hill Street, W Pettigrew Street, S Duke Street and Corcoran Street. During both the AM and PM peak hours, the most substantial increase in delay (up to 170 second increases) is along US 15-501. The major increases in delays along Fayetteville Street is a result of the reduction in lanes as part of the bicycle improvements projects planned by the City of Durham.

With the additional commuter rail services extending gate closure down time under the 2045 FY--B conditions compared to the 2045 FY-NB conditions, the following results were observed:

- There is a general increase in delay and degradation in levels of service (LOS) in already congested locations within the study area compared to 2045 FY-NB conditions.
- During both the AM and PM peak hours, the most substantial increases in delay (up to 50 second increases) is among the Fayetteville Street signalized intersections. While increased delay would be expected due to additional gate down time, it is compounded due to the reduction in lanes as part of the bicycle improvements project.
- Main Street, Swift Avenue, and N Buchanan Boulevard see overall increased delays of up to 70 seconds.
- During the PM peak hour, maximum queue increases by approximately 500 feet in the northbound direction at the Blackwell Street rail crossing and by 900 feet in the northbound direction at the Duke Street rail crossing.
- The maximum queue increases by approximately 400 feet in the north- and southbound directions at Swift Avenue rail crossing during the PM peak hour.

The 2045 FY-B+I scenario tested the potential for additional improvements to mitigate delay. Improvements such as extending/adding turn bays and restriping approach lanes along Pettigrew Street, Swift Street and Main Street generally decreased delay, in some cases even below 2045 FY-NB levels, and have the potential to improve safety throughout the study area. However, these improvements do not completely mitigate the congestion and delay that is anticipated in the future with and without commuter rail. In the downtown area, opportunities for physical improvements are very limited, as most roadways have sidewalks at the back of the curb and buildings directly behind the sidewalks.

A supplemental analysis was performed in response to the City of Durham's request for analysis that would shed light on the potential impacts of new commuter rail service on bus riders, recognizing that bus delays affect multiple passengers. The analysis included two key elements:

- Compare 2019 BY-NB to 2019 BY-B to eliminate the challenge of future year volumes. (Future year conditions both with and without commuter rail had rendered networks reaching or exceeding capacity in multiple locations.)
- Use Fall 2019 automated passenger count (APC) data to derive a person-hours of delay metric.

Most bus routes would generally experience an increase in total movement delay during both the AM and PM peak hours due to additional gate down time in the downtown area. However, an increase in delay under 2019 BY-B conditions does not adversely affect route on-time performance. GoDurham Routes carrying the highest ridership would be most sensitive to any increase in delay from the commuter rail. As an example, the Route 2 and Route 3 series generally carry the most ridership both inbound and outbound, with the highest ridership during the PM peak hour, outbound. While movement delays for those specific routes generally increase by no more than 45 seconds, the net change in aggregate person-hours of trip time is approximately two percent.

GoTriangle also provided the 2019 average amount of time between the bus arriving and the next bank of scheduled departures from the Durham Station. The inbound buffer time target is five minutes for each route. The general increase in delay under 2019 BY-B conditions does not adversely affect route on-time performance as additional delay generally fits within the time available.

It should be noted that this analysis does not include recommendations from the City of Durham's ongoing Durham Station Transit Emphasis Zone (TEZ) or Bus Speed and Reliability (BSR) studies, which would be expected to improve bus speed and reliability in this area.

Development and detailed analysis of each scenario is summarized in a separate traffic memo that can be found in the **Appendix (Traffic).**

3.2.7 Capital Costs

Cost Estimate Methodology
Due to the early stage of project design, two methods were used in preparing the cost estimates:

1. Historical/Unit Price Method as a basis for establishing unit prices for a proposed project
2. Detailed Activity Cost Estimate Method to develop activity costs and unit prices by making an analysis of production rates, labor and equipment rates and material costs for each construction activity that makes up the total cost of constructing specific project elements. This method can also be used to develop Detailed Unit Prices.

Historical/Unit Price Method
Historical bid prices were used for the Station and Systems Elements of the estimate and are based on the costs developed for the Phase I estimate as well as multiple similar projects including the CATS Blue Line Light Rail, CATS Blue Extension and the estimators experience on various similar projects. These prices are typically adjusted to reflect conditions of the project, such as type of terrain, geographical location, soil, traffic, and other related factors. These

adjustments are typically based on the experience and judgment of the estimator and for location factor adjustments, the City Cost Index published by RS Means would be applied.

Detailed Activity Cost Estimate, Detailed Unit Price Methods
Detailed activity pricing for the Guideway, Trackwork, Bridges, Utilities and Highway/Roadway items. Advantages of using the Detailed Activity Cost approach is that the input and analysis of the data necessary to calculate the costs for any given construction activity can be quickly adjusted to reflect changes in material costs, labor rates and related burdens, productivity factors, market conditions that may have a direct impact on construction activities. To the extent possible, the following steps are followed when preparing costs for this type of method:

- analyze the proposed construction (location, access, difficulty factor etc.)
- select the appropriate labor crew and apply expected productivity rates
- calculate what materials and quantities are required to construct work
- obtain current material prices from vendors/suppliers to extent possible
- determine labor and burden based on Davis-Bacon wage rates, local market rates etc.
- obtain equipment rates and operation/maintenance costs
- obtain local sub-contractor quotes for specialty items if possible
- calculate direct unit price using the above factors
- add contractor overhead, profit, insurance, bond etc. for the total cost

Capital Cost Estimates
Detailed capital cost estimates were prepared for Concept 2, Concept D, and a comparison estimate was also completed utilizing the capital cost estimates from the Phase 1 Study. The comparison estimate is representative of the Phase I cost estimate within similar limits in the Downtown Durham study area. **Table 2** below shows the total cost for each scenario, and a more detailed cost breakdown can be found in the **Appendix (Capital Costs).**

Table 2 Capital Cost Estimates, $2020

Conceptual Design	Total Estimated Cost
Concept 2	$46,850,000
Concept D	$66,250,000
Phase I Comparison	$31,400,000

3.2.8 Visualizations

A drone was utilized to capture photos of the existing infrastructure, from multiple perspectives, in the Downtown Durham area of the GTCR project. Select photos, from key vantage points, were then selected for modification using digital rendering technology. Each selected photo was overlayed with renderings of the functional level preliminary engineering designs for both Concept 2 and Concept D. The visualizations can be found in the **Appendix (Visualizations)**.

4 Conclusion

The chief insight from the Downtown Durham Feasibility Study is that Concept 2 and Concept D are both feasible alternatives for implementation, and until a platform height recommendation is made, both concepts warrant further study in later stages of the Greater Triangle Commuter Rail (GTCR) project. It is worth noting that because of the high-level platforms and Norfolk Southern (NS) Design Requirements, Concept D requires separate station tracks to separate the passenger and freight train traffic, resulting in higher costs and a wider railroad cross section at the station.

4.1 Next Steps

Platform Heights
To understand opportunities and risks more accurately in the Downtown Durham study area, a selection between low-level or high-level platforms at the Durham Station should be prioritized. This will require further coordination and clear information sharing between Durham stakeholders and GoTriangle's Greater Triangle Commuter Rail (GTCR) team.

Project and Stakeholder Coordination

NCDOT/NCRR/Norfolk Southern/CSX/Amtrak – NCDOT and NCRR have been involved during all phases of GTCR study, and their continued involvement and coordination is paramount. In the next phase of the project, more extensive engagement with Amtrak and Norfolk Southern is anticipated, to introduce them to the preferred concepts and obtain their feedback. Norfolk Southern engagement is key to understanding the feasibility of Concepts E and G.

Move Durham Transportation Study – As GTCR moves forward continued coordination will be needed as different aspects of the Move Durham Study move into design and implementation.

2-Way Conversion of Downtown Durham Streets – During this phase of GTCR, the City of Durham has indicated interest in converting several downtown streets to 2-way and are coordinating with NCDOT regarding the feasibility of the conversion. If this interest moves forward into design and implementation, continued coordination with the GTCR project will be required for roadways that cross the NCRR corridor.