Commuter Rail Feasibility Study: Kings Mountain – Gastonia – Belmont Charlotte

Prepared For:

North Carolina State Legislature

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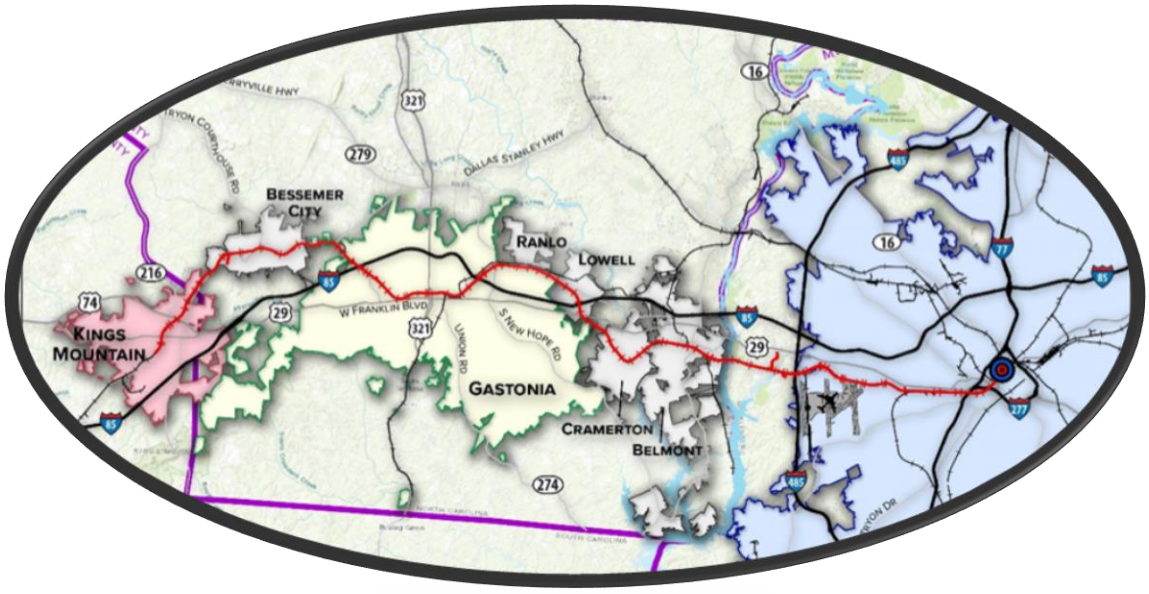

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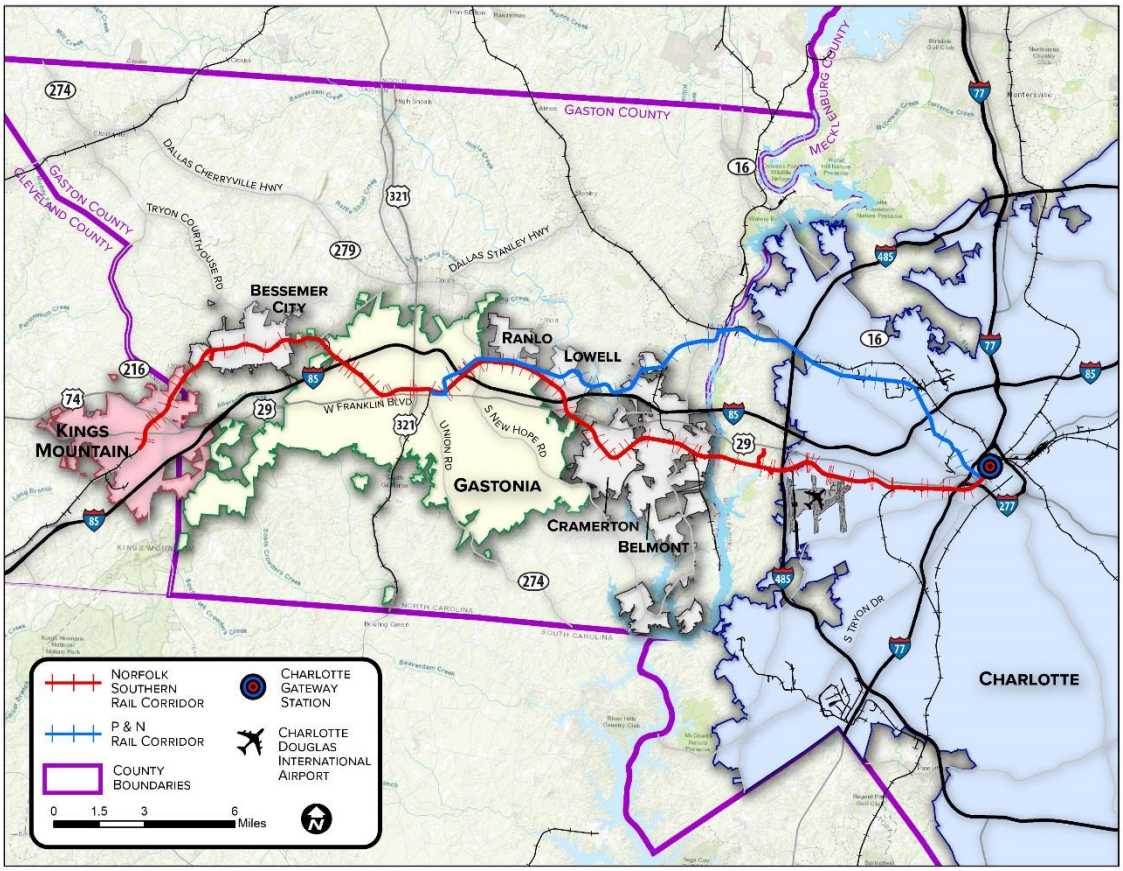
EXECUTIVE SUMMARY

Background

Kings Mountain and Gastonia requested a study to determine the feasibility of implementing a new commuter rail service to connect Kings Mountain, Gastonia, and Belmont with Charlotte-Douglas International Airport and terminate at the new Charlotte Gateway Station. In concept, the commuter rail service would begin in Kings Mountain, passing through Bessemer City, providing a station stop in Gastonia, passing through Lowell, providing a station stop in Belmont, providing a station stop at the Charlotte Douglas International Airport, and terminating at the new Charlotte Gateway Station. The new service would provide an additional transportation connection between the rural communities west of Charlotte to job centers.

Figure 1: Study Area



Existing Conditions

Two existing rail lines traverse east-west through the study area: the Norfolk Southern (NS) Main Line and the Piedmont and Northern Rail Line (P&N). Commuters utilize two main east-west thoroughfares; I-85 and US 74. While I-85 provides a direct connection from Kings Mountain to Charlotte, it is one of the most congested traffic corridors in the study area. In 2015, the portion of I-85 from Kings Mountain to Gastonia saw an Average Annual Daily Traffic (AADT) of 106,393 and the portion running from Gastonia to I-77 in

Charlotte had an AADT of 119,756. In 2040, the portion of I-85 from Kings Mountain to Gastonia is projected to carry 143,129 vehicles per day (vpd) and 160,156 vpd from Gastonia to I-77 in Charlotte.

The segment of I-85 between the Catawba River and I-485 in Charlotte has the highest traffic volumes in the study area, with a 2015 AADT of 146,181 vpd, projected to increase to 182,054 vpd by 2040.

The Charlotte Area Transit System (CATS) provides an express bus service (the 85X) from Uptown Charlotte to Gastonia - which operates Monday through Friday. CATS is also studying an extension of light rail service west of Uptown Charlotte to Charlotte-Douglas International Airport and beyond into Gaston County. Recent public engagement for this study has indicated strong support for a light rail corridor into Gaston County.

This study investigates implementing a new commuter rail service from Kings Mountain to Charlotte including ridership and revenue estimates, and railroad infrastructure needs. Also included in this report, are potential schedule and operating cost estimates for the proposed new service, and a consideration of vehicle and equipment types.

Summary of Study Findings

A kick-off meeting was held on July 12, 2018 to solicit stakeholder input on the study. The stakeholders identified preferred locations for stations, inquired about commuter rail operations, and how to engage with NS. A second stakeholder meeting was held on November 14, 2018 with stakeholders to summarize the study's findings.

While there are potential economic benefits to the region resulting from increased transportation choices within this corridor, this study highlights some challenges for implementation that most importantly include a need for an agreement with NS on access to their corridor for a new commuter rail service. Coordination with NS would be the most critical aspect in advancing any effort and would require significant additional analysis, including operations modeling, to determine project feasibility. In addition, other challenges include the expense of constructing the required infrastructure and identifying an agency with the legislative authority to operate this new type of service. Estimated infrastructure costs for implementing commuter rail included construction of independent single track within the NS ROW with two siding tracks for ability of commuter rail trains to pass. Due to adding the additional commuter track and sidings, 19 new bridges would need to be constructed adjacent to existing NS bridges. The new commuter rail track would also have to have signals to operate the commuter trains. Part of the negotiation with NS on access to their corridor would have to include whether the new signals would be tied into the existing NS signal system. Costs also include four new stations and three pedestrian overpass bridges to serve the stations, plus a vehicle maintenance facility to park and serve the commuter locomotives and cars. Any additional ROW costs or parking are not included in this study, as well as the cost by NS for use of their ROW. The estimated cost is $710M (in 2018 dollars). The four new stations that were identified along the 33.4-mile-long commuter rail service include Kings Mountain, Gastonia,

Belmont, and the Charlotte-Douglas International Airport, while terminating at the new Charlotte Gateway Station.

Ticket revenue was deducted from the total operating costs to ascertain the net cost to the operating service. Projected ticket revenue for this commuter rail service is estimated to be $900K. Total third party costs are estimated at $371K and route costs at $7.7M.

Either locomotive push-pull trains or Diesel Multiple Unit (DMU) trains could be implemented, since both vehicle types meet Federal Railroad Administration (FRA) regulations. Locomotives would be the preferred vehicle type. The proposed service would require four locomotives and 20 single-level passenger cars.

The estimated capital cost for constructing commuter rail and all the required infrastructure conceptually identified within this corridor is $710M. In addition, to implement commuter rail service, the cost for purchasing the required vehicles to operate the service would be approximately $100M. Total annual operating expenses are $8M, after deducting the annual ticket revenue, resulting in the new commuter rail service operating costs to be approximately $7.2M (in 2018 dollars) per year.

Table E1: Estimated Costs

Estimated Costs for Commuter Rail Service (in 2018 dollars)	
Infrastructure Costs	$710M
Purchase of Commuter Rail Vehicles (4 locomotives and 20 cars)	$100M
Total Costs for implementing service	**$810M**
Yearly Operations and Maintenance Costs	$8M
Yearly Revenue from Ticket Sales	$900k

1 STATION LOCATION ANALYSIS

1.1 Station Connectivity

Within any study for implementing commuter rail service, it is very important to consider how riders would connect to the proposed commuter rail stations. The terms 'first mile' and 'last mile' are phrases that describe the initial and final leg of a commuter trip. A primary goal of commuter rail is to ensure that all stations provide for a passenger's 'first mile' and 'last mile' connections. Stations need to account for connections relating to the following transportation modes:

Clearly visible connections to nearby sidewalk and bicycle facilities should be included within a station's site plan, and parking facilities should account for adequate capacity for park and ride facilities for commuters as well as designated spaces for private providers (taxis, Uber, Lyft, etc.). Any proposed vehicular, transit, bicycle, or pedestrian access to a commuter rail station would require grade separation from the NS mainline tracks. If there are existing transit routes near a new station, efforts should be taken for those fixed routes to serve the station to provide access to transit.

1.2 Background

An assessment of potential station locations for the proposed new service was performed. Stations were considered at the following locations: Kings Mountain, Bessemer City, Gastonia, Lowell, Belmont, Charlotte-Douglas International Airport, and Charlotte Gateway Station.

For each potential station location, consideration was given to:

- Proximity to the rail corridor
- Connections to existing and future transit corridors
- Roadway connectivity
- Environmental screening
- Land use/zoning

The results of this analysis are summarized in **Table 1**:

Table 1: Potential Commuter Rail Stations

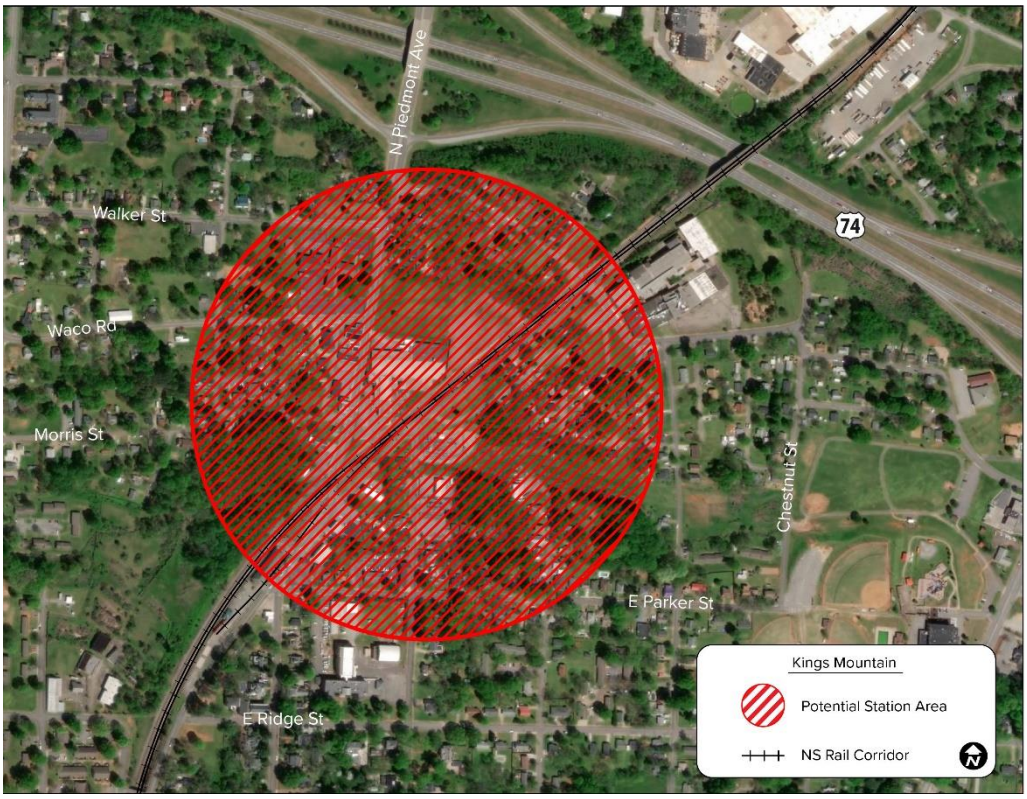
Potential Commuter Rail Stations	
Kings Mountain	Commuter Rail Station
Bessemer City	Analysis indicates low projected ridership, propose feeder bus connection to nearby station
Gastonia	Commuter Rail Station
Lowell	Analysis indicates low projected ridership, propose feeder bus connection to nearby station
Belmont	Commuter Rail Station. Coordination should occur with the CATS West Corridor study as that study is evaluating LRT to serve western Mecklenburg County and into Belmont and eastern Gaston Count.
Charlotte-Douglas International Airport	Commuter Rail Station
Charlotte Gateway Station	Commuter Rail Station

1.3 Kings Mountain

Three potential sites in Kings Mountain were considered for a commuter rail station. As there is no public transit service operating in Kings Mountain, consideration should be given to new transit connections that support commuter rail service. Kings Mountain may be suitable for a park and ride station for attracting riders from municipalities to the west. This would require additional footprint for either structured parking or a large surface parking lot.

Site 1 – Southern Arts Society at the intersection of N. Piedmont Avenue and E. Parker Street
Site 2 – Vacant, wooded lot north of the rail line and the Southern Arts Society property
Site 3 – Vacant lot directly north across the railroad tracks from N. Battleground Avenue and before the intersection of N. Battleground Ave and Baker Street

Figure 2: Kings Mountain Station Area



Site 1, on the South side of the rail line, is connected to Downtown Kings Mountain, and is currently home to the Southern Arts Society. The environmental constraints within ¼ mile of this potential site are a creek to the northeast and a historic district directly to the south of the site.

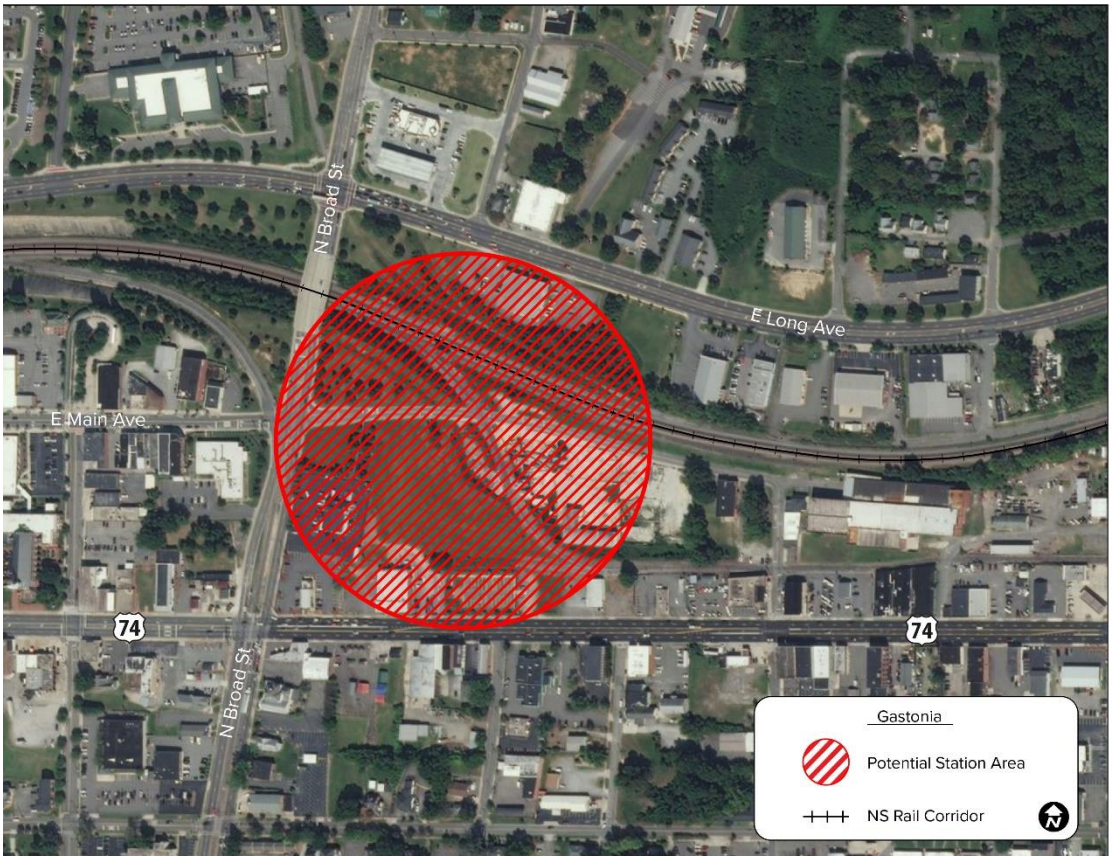
Sites 2 and 3, both on the north side of the rail line, benefit from proximity to Hwy 74 and are currently vacant, however are more removed from Downtown Kings Mountain. Site 2 is on curved track and Site 3 is on a straight section of track, more suited for constructing tracks to serve a commuter rail station. Both lots are currently vacant. Due to the proximity of all three potential sites, the environmental constraints associated with Site 1 are the same for Site 2 and Site 3. There is a creek to the northeast of both sites and a historic district to the south, but the historic property is separated from Site 2 and Site 3 by the railroad track.

1.4 Gastonia

Bus service to Gastonia is provided by Gastonia Transit at the downtown transfer terminal at the intersection of Oakland Street and Main Avenue. CATS operates an express service (the 85X) from Uptown Charlotte to Gastonia. Gaston County ACCESS also provides demand response transit services in the area. In 2005, the City of Gastonia completed a multi-modal study which resulted in a preferred location for a station, at East Main Avenue and Broad Street in Downtown Gastonia. The current Bradley Station location, while desirable in terms of location and existing transit services, was found to have significant potential for sinkholes and subsidence; shoring existing retaining walls would significantly increase the cost of a new facility. There are several environmental constraints within ¼ mile of this potential site location. Separated from the site by the railroad track there is a brownfield assessment site to the north

and a portion of the Carolina Thread Trail to the northwest. Directly east of the site is the Piedmont and Northern Railway Linear Historic district and west of the site is the Downtown Gastonia Historic district as well as two hazardous waste sites.

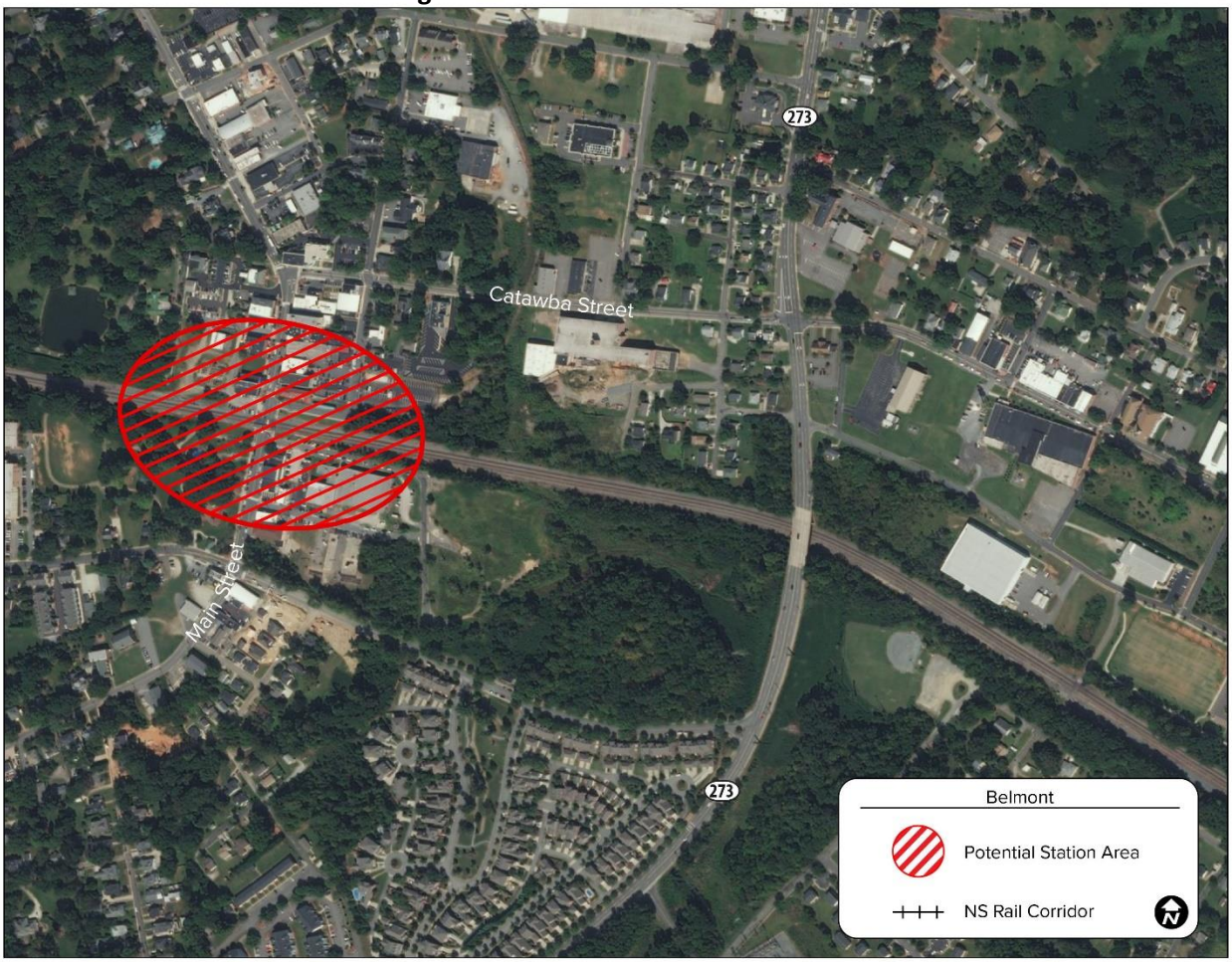
Figure 3: Gastonia Station Area



1.5 Belmont

Downtown Belmont continues to revitalize and become a destination. Locations near Main Street along the NS Main line provide abundant opportunities to build a station within downtown. As there is no public transit service operating in Belmont, consideration should be given to new transit connections that support commuter rail service. Belmont may be suitable for a park and ride station for attracting riders from municipalities to the north and south. This would require additional footprint for either structured parking or a large surface parking lot.

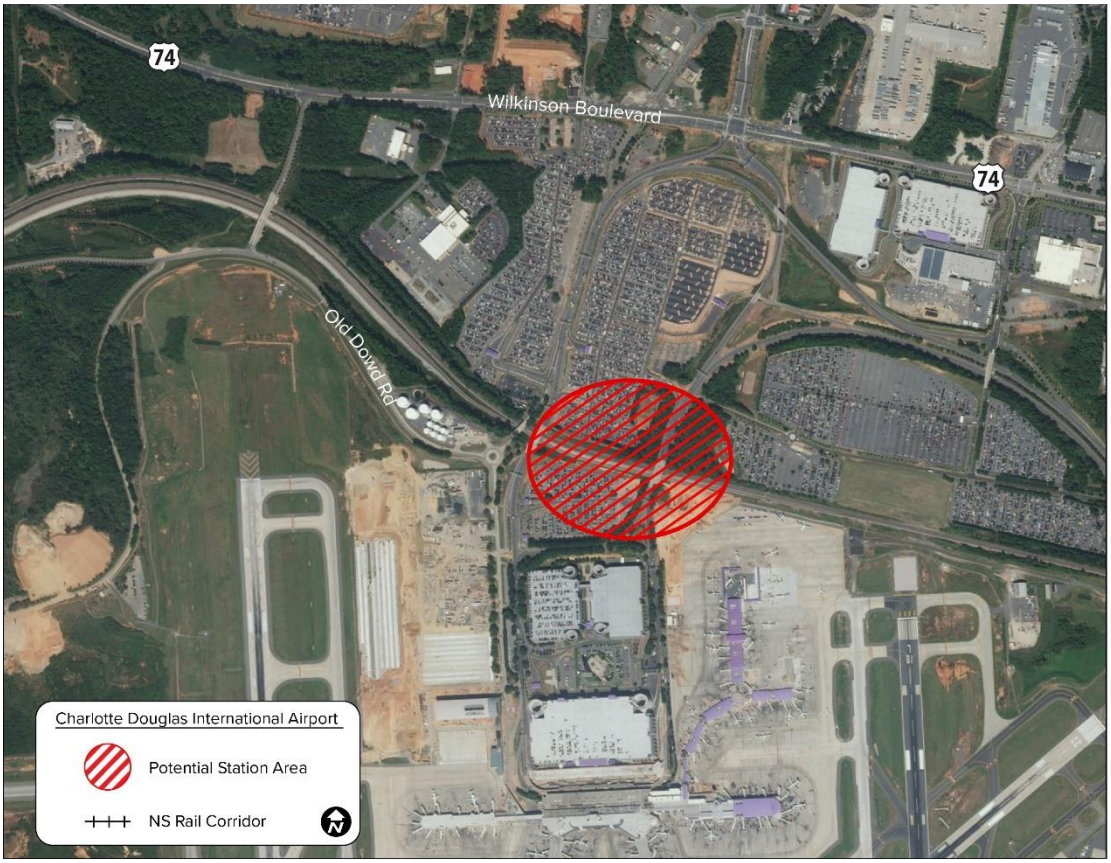
Figure 4: Belmont Station Area



1.6 Charlotte-Douglas International Airport

The NS mainline crosses a double-track railroad bridge and runs directly north of the Charlotte-Douglas International Airport (CDIA), connecting to a new major intermodal rail facility. A vacant lot north of the rail corridor to Old Dowd Road (adjacent to airport long-term parking lots) is a potential station location, although that area may be programmed for future development by the airport authority. The site location, although favorable for a north side commuter rail platform presents challenges of getting passengers from the platform to the airport which would have to be addressed by either a pedestrian overpass of the tracks, or by tunneling under the railroad, both of which options may be cost prohibitive. There is only one environmental constraint, a hazardous waste site, within ¼ mile of this potential site location. The hazardous waste site is separated from the site by the railroad track and is located on the CDIA property.

Figure 5: Charlotte-Douglas International Airport Station Area



An extension of the CATS Light Rail system from Uptown Charlotte to the airport is currently in the initial planning phases and the location of the Light Rail station has not yet been determined.

1.7 Charlotte Gateway Station

The proposed commuter rail service would terminate in Uptown Charlotte at the new Charlotte Gateway Station. Track and signal improvements for Charlotte Gateway Station are underway and will be ongoing for the next three to four years. The future commuter track identified in this study would have to be threaded into the current Charlotte Gateway Station track configuration without impacting the connectivity for inter-city passenger trains as well as the new NCDOT Charlotte Light Maintenance Facility which is south of Charlotte Gateway Station. The station building is planned to be developed as a public private partnership. Space has been reserved at the new station for future commuter rail services.

2 RAILROAD INFRASTRUCTURE NEEDS

2.1 Existing Conditions

NS owns the rail line from uptown Charlotte to points west, through Mecklenburg County, Gaston County, and Cleveland County. This line is heavily used by NS for their freight rail operations and provides a critical connection for freight movements from Atlanta through North Carolina to the Northeast Corridor. The NS corridor within the study area is generally double track with portions of single track from MP 385.8 - MP 390.6 and MP 402.3 - MP 408.6, particularly over the Catawba River. Within the study there are 19 rail bridges including one over the Catawba River, and 24 road bridges over the railroad. **Table 2** identifies the approximate length of track.

Table 2: Track Length for Commuter Rail Service

Kings Mountain to Bessemer City	5.2 miles
Bessemer City to Gastonia	6.7 miles
Gastonia to Lowell	5.0 miles
Lowell to Belmont	5.0 miles
Belmont to Charlotte-Douglas International Airport	5.9 miles
Charlotte-Douglas International Airport to Charlotte Gateway Station	5.6 miles
	33.4 miles

The stakeholders established a vision for implementing commuter rail service between Kings Mountain, Gastonia, Belmont, and CDIA. The goal was to identify how commuter rail could operate between these destinations by providing multiple headways during the AM and PM peak periods in order to provide additional options for commuters who travel to/from Uptown Charlotte and CDIA.

Taking into account the vision of this study, the P&N rail line was considered and disregarded as a potential alternative rail corridor for the possible introduction of commuter rail due to the circuitous route it takes to the north, along with the fact that the rail line does not connect to CDIA nor to Kings Mountain. By utilizing the P&N corridor, a transfer to a bus service from Gastonia to Kings Mountain and CDIA would be required; thus, adding an additional transfer point, travel time, and costs for operating two types of commuter service (rail and bus). Commuter rail service from Kings Mountain with a connection to CDIA was expressed by the project stakeholders to be an essential element of this proposed new service. In the future, if local stakeholders determine that access to CDIA is less critical, the P&N rail line could be further studied and included as a potential passenger route. However, either a transfer to a bus service would be needed or there would be the need for new commuter rail infrastructure within the NS right-of-way from Gastonia to Kings Mountain.

Currently the *Carolinian*, an Amtrak intercity passenger rail service that operates service from Charlotte to New York City, via Raleigh, NC, departs at 6:45am from Charlotte. By extending the *Carolinian* to Kings Mountain to begin the AM service, there would only be one AM headway serving commuters from Kings Mountain and other locations west of Mecklenburg County. With only one AM headway, the goal of a commuter rail service providing multiple headways would not be accomplished. In addition, the *Carolinian* arrives from New York City, via Raleigh, in Charlotte at approximately 8:42pm. The PM service would be

subject to delays en route as it originates in New York City. The ability to serve commuters heading back towards Kings Mountain would not meet the definition of a commuter rail service due to the late arrival to Charlotte. The Carolinian also provides intercity passenger rail baggage service and food services, which is not a common feature of a commuter rail service. Furthermore, extending the *Carolinian* would require:

- Additional train operating crews (due to the labor requirements established by Amtrak unions);
- Evening non-revenue operations from Kings Mountain back to the Charlotte maintenance yard for daily FRA mandated inspections, cleaning and re-stocking of café car;
- A possible additional Amtrak train set;
- Increased operating and maintenance costs; and
- New agreements between Amtrak, Norfolk Southern, and NCDOT Rail Division.

Since the *Carolinian* would not provide frequent service within the AM and PM peak periods, extending the *Carolinian* to Kings Mountain would not meet the vision and goals of the stakeholders to provide frequent commuter rail service.

2.2 Identification of Infrastructure Needs

Due to the high volume of freight transported on the NS rail line in the study area, and the fact that the rail line is privately owned, commuter rail operations in a shared track condition would present challenges. Commuter rail service on this line would present safety and liability concerns for NS which would create difficulties to the introduction of commuter rail services on this track, referred to as the NS Piedmont Division 'Main' line.

Due to the high volume of freight traffic on the existing NS track(s) and the need for both intercity passenger and freight traffic to continue to operate with no additional delay associated with the addition of commuter rail service in the corridor, this study made the conservative assumption to include costs for a new single track section separate from the existing NS main track(s) with two siding tracks for ability of commuter rail trains to pass. The concept is to construct new single track for commuter rail adjacent to the NS tracks to avoid interacting with freight. There would be two independent siding tracks from the freight tracks to allow the inbound and outbound commuter rail trains to pass. This provides free flow freight movement along the mainline, while allowing commuter rail free flow movements between stations.

There is approximately 200' of right-of-way along the corridor. Without coordination with NS, it is not known if new ROW would be required along the corridor for the additional commuter rail track. In addition to the possibility of costs for additional right of way along the railroad or crossing roadways, NS would likely also expect to be compensated for the use of NS ROW for the new commuter rail track(s).

Due to adding the additional commuter track and sidings, 19 new bridges would need to be constructed adjacent to existing NS bridges. The new commuter rail track would also have to have signals to operate the commuter trains. Part of the negotiation with NS on access to their corridor would have to include whether the new signals would be tied into the existing NS signal system. Costs also include four new stations and three pedestrian overpass bridges to serve the stations, plus a vehicle maintenance facility to park and serve the commuter locomotives and cars. Any additional ROW costs or parking are not included in this study, as well as the cost by NS for use of their ROW. The estimated infrastructure construction cost is **$710M (in 2018 dollars)**.

3 RIDERSHIP MODELING

3.1 Introduction

To estimate daily ridership for each station along the proposed commuter rail corridor a station catchment area was developed using Traffic Analysis Zones (TAZ) from the Metrolina Travel Demand Model (TDM). A 15-mile buffer was applied to each of the three proposed stations along the corridor to capture the TAZ's that each station would potentially serve. Station locations were derived during the stakeholder outreach efforts, and refined during the ridership analysis. The TAZs were then divided into Station Catchment Areas for each of the proposed stations along the proposed commuter rail corridor. TAZs were assigned to each area by analyzing the distance to a station, the direction of the traveler, travel time, and the underlying highway network. The Station Catchment Areas and their respective populations can be seen below.

Figure 6: Station Catchment Areas

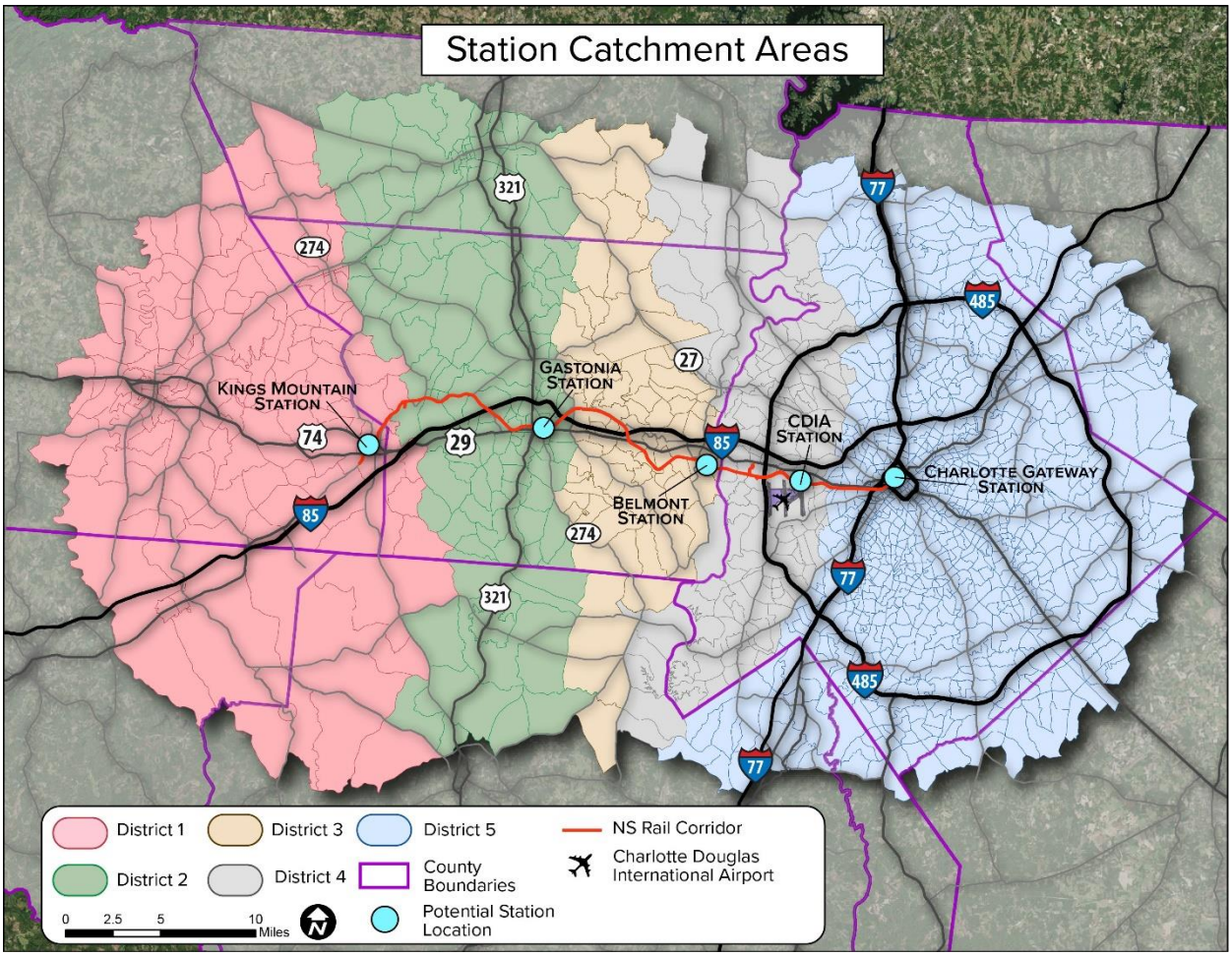


Table 3: Station Catchment Area Population

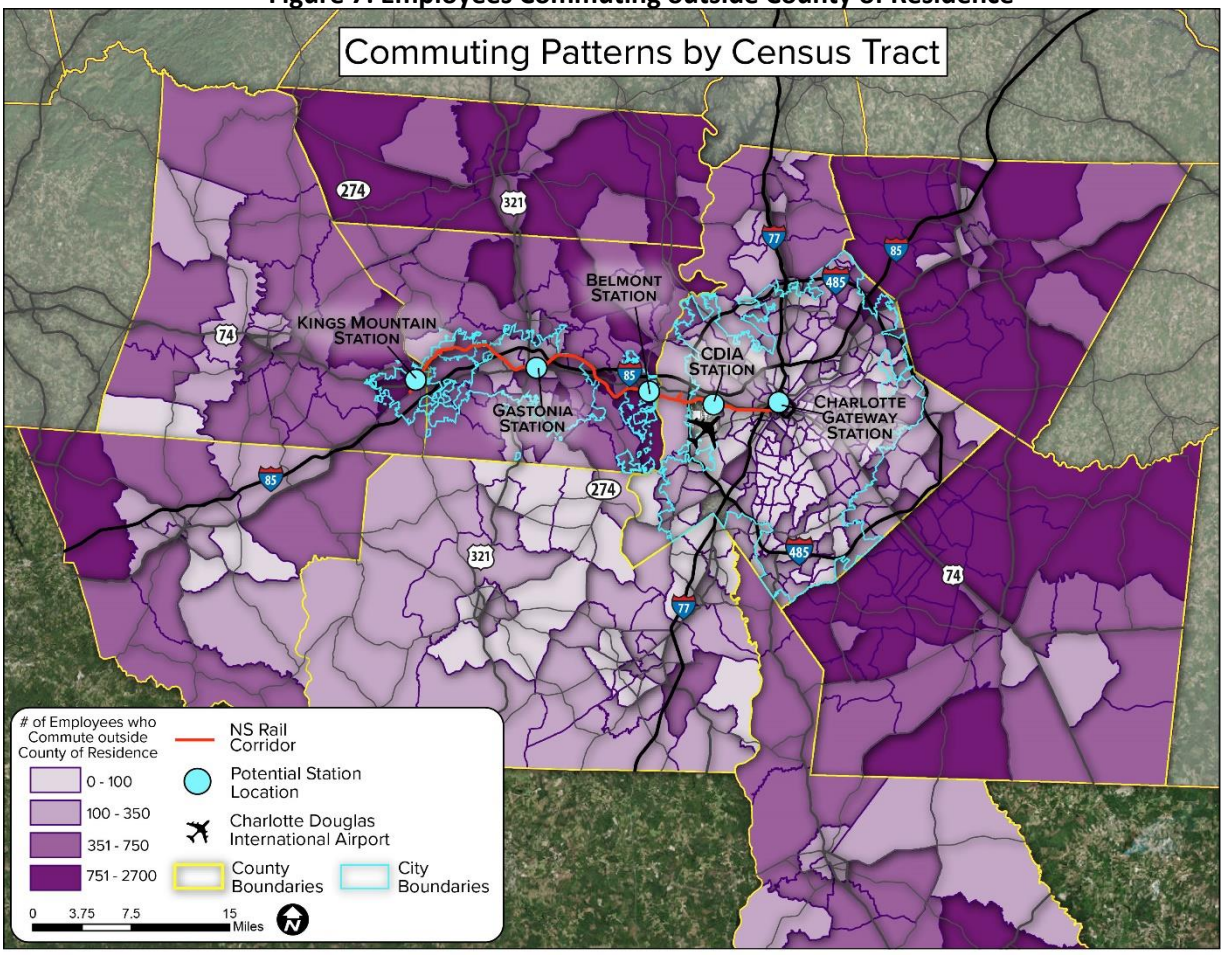
Population within Station Districts				
District	Station	2015 Population	2045 Population	Population Change
1	Kings Mountain	102,316	137,010	33.91%
2	Gastonia	145,204	176,403	21.49%
3	Belmont	109,248	161,192	47.55%
4	Charlotte Douglas International Airport	158,484	332,884	110.04%
5	Charlotte Gateway Station	1,011,502	1,591,065	57.30%

3.2 Commuting Patterns within the Study Area

After determining the areas that will be served by each of the potential stations, an analysis of general commuting patterns and major destinations in the study area was necessary to understand the potential demand for the proposed commuter rail service.

The map shown below in **Figure 7** represents the number of employees who commute outside of their county of residence for work.

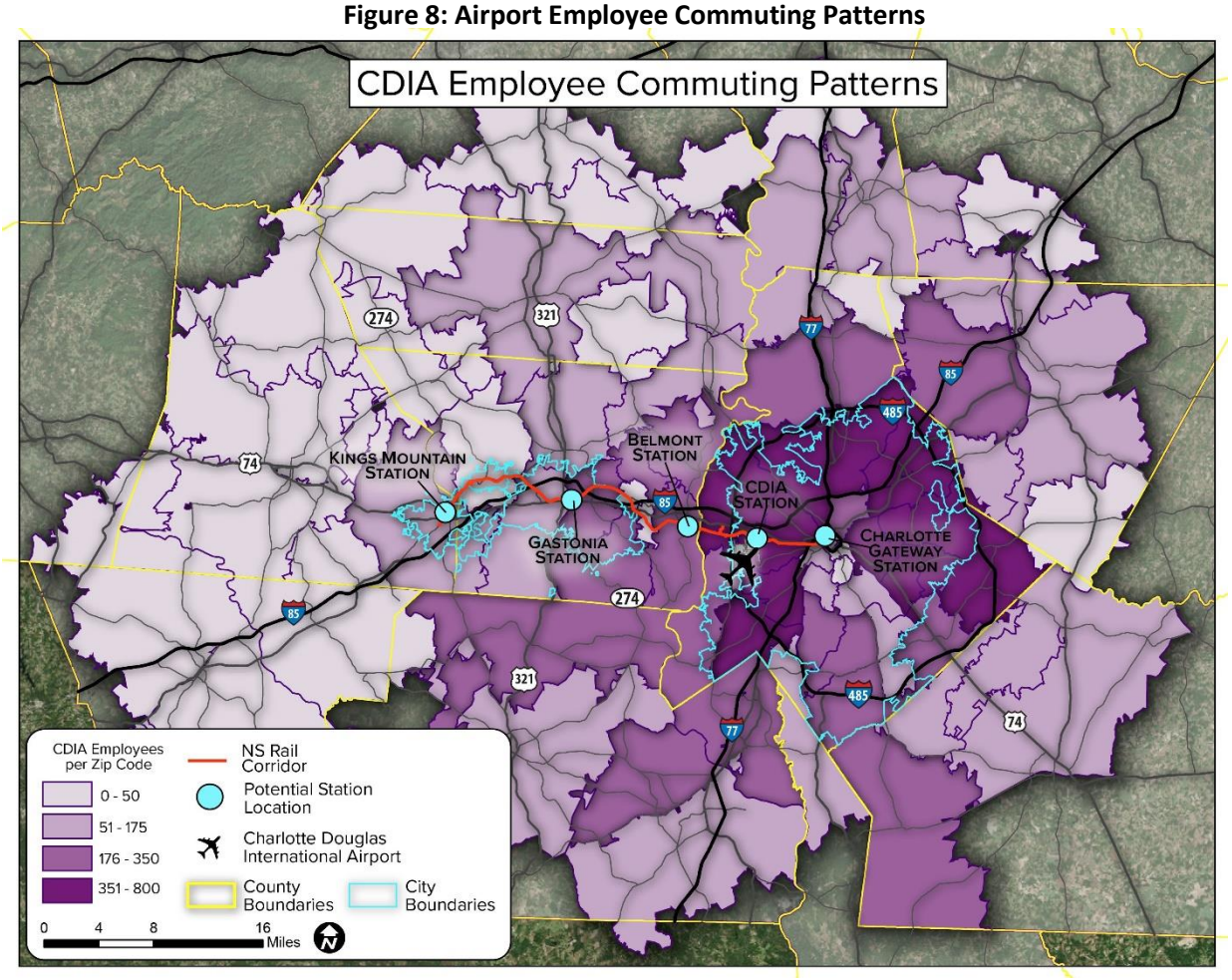
Figure 7: Employees Commuting outside County of Residence



From the map in **Figure 7**, it is evident that there is a relatively large number of employees who live west of Mecklenburg County in Gaston, Cleveland, Lincoln, and Cherokee counties that commute outside of their county of residence each day for work. Assuming that a majority of these commuters are ending their daily trips in Mecklenburg County, the largest employment area in the study area, a portion of these commuters are the target market for the proposed commuter rail service.

Along with Downtown Charlotte, the Charlotte-Douglas International Airport (CDIA) is one of the major employers in the area and should be considered as one of the main trip generators for potential riders on the commuter rail. While work schedules of CDIA employees may not always match up with the potential schedule of the commuter rail service, the existing commuting patterns of CDIA employees is still an important factor to consider when estimating daily ridership. The map shown below in **Figure 8** represents the areas where CDIA employees are commuting from.

Figure 8: Airport Employee Commuting Patterns



While most CDIA employees live within the CDIA and Charlotte Gateway Station catchment areas, there is still a fair number of employees who could potentially use the commuter rail as a viable option to commute to work, depending on their schedule. For further detail, **Table 4** shows the number of CDIA employees living within each station catchment district.

Table 4: Airport Employees living within Station Catchment Areas

District	Station	2015 Population	Airport Employees
1	Kings Mountain	102,316	192
2	Gastonia	145,204	1,049
3	Belmont	109,248	1,279
4	Charlotte Douglas International Airport	158,484	4,735
5	Charlotte Gateway Station	1,011,502	7,505

There is also an express bus service, the Gastonia Express – 85X, that runs from Gastonia to Charlotte on I-85 parallel to the proposed commuter rail corridor. This express bus service is a good example of the number of people who are willing to take public transit from the area surrounding Gastonia into Uptown Charlotte and other destinations along the route for work. **Table 5** below shows the yearly and average weekday ridership estimates for the Gastonia Express – 85X bus.

Table 5: Gastonia Express – 85X Bus Ridership

Gastonia Express Bus Ridership												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Estimated Yearly Ridership	58,056	66,486	75,511	60,404	57,107	52,953	49,894	48,613	41,609	41,552	38,715	35,590
Estimated Average Weekday Ridership	222	255	289	231	219	203	191	186	159	159	148	136

The Gastonia Express only runs from Gastonia to Charlotte. The proposed commuter rail would serve a larger area and would most likely provide a more reliable and efficient service.

3.3 Assessment of Comparable Commuter Rail Systems

The next step of the analysis was to assess other commuter rail systems in the U.S. and the ridership that they are able to generate. **Table 6** below shows annual and weekday average ridership estimates from the American Public Transportation Association (APTA) for the 30 commuter rail systems in the Country.

Table 6: Estimated Ridership on Commuter Rail Systems in the U.S.[1]

State	Primary City	System Name	2017 Annual Ridership	Estimated Weekday Ridership (Q4 2017)	Route Miles	Stations
AK	Anchorage	NA	192,400	2,000	NA	NA
CA	Los Angeles	Metrolink	10,625,800	37,800	534	62
CA	Oakland	Capitol Corridor	1,634,000	5,300	168	17
CA	Oceanside	Coaster	1,425,900	4,500	41	8
CA	San Carlos	Caltrain	18,819,600	59,700	77	32
CA	San Rafael	SMART	289,900	NA	43	10
CA	Stockton	Altamont Corridor Express	1,322,200	5,300	86	10
CO	Denver	FasTracks	7,105,900	20,500	29	NA
FL	Orlando	SunRail	851,800	2,334[2]	32[3]	12
FL	Pompano Beach	TriRail	4,287,400	14,600	71	18
IL	Chicago	Metra	70,923,300	285,400	488	242
IN	Chesterton	South Shore Line	3,455,800	11,200	90	19
MA	Boston	Massachusets Bay Transit Authority	33,784,200	123,100	398	137
MD	Baltimore	MARC	9,280,200	34,700	187	42
ME	Portland	Downeaster	545,900	1,400	148	12
MN	Minneapolis	Northstar Line	793,700	2,700	40	6
NJ	Newark	NJ Transit	85,478,900	NA	NA	165
NM	Albuquerque	New Mexico Rail Runner Express	811,500	2,600	97	13
NY	New York	LIRR	103,237,200	349,500	700	124
NY	New York	Metro North	86,367,700	306,900	787	124
OR	Portland	Westside Express Service	433,200	1,700	15	5
PA	Harris-Philadelphia	Keystone	1,508,200	5,000	195	19
PA	Philadelphia	NA	34,670,200	125,600	NA	150
TN	Nashville	Music City Star	287,800	1,100	32	6
TX	Austin	Capital MetroRail	825,700	2,800	32	9
TX	Dallas-Ft. Worth	Trinity Railway Express	2,103,500	7,700	34	10
TX	Lewisville	A-Train	481,500	1,600	21	6
UT	Salt Lake City	Front Runner	4,854,000	17,900	88	17
VA	Alexandria	VRE	4,683,000	NA	90	20
WA	Seattle	Sounder	4,431,100	17,700	83	12

1: Ridership data is from the Public Transportation Ridership Report published March 2018 by APTA.
2: Average Daily Ridership not Average Weekday Ridership as this service operates on weekends.
3: An additional 17-mile extension was completed earlier this year on the SunRail.

Of the commuter rail systems listed above, the Music City Star in Nashville, TN is the most similar to this proposed commuter rail system. The Music City Star is approximately 32 miles, approximately the same length as the proposed corridor, and it serves an area that has a similar population and follows the same general commuting pattern as the proposed commuter rail. The only exceptions are that the Music City Star operates on short line freight corridor with limited number of freight trains operating on a weekly basis and it includes six stations while this potential commuter rail system would only include four.

Both systems are also similar in that there is a major interstate and US Highway running parallel to the commuter rail routes. In Nashville, I-40 and US Highway 70 run parallel to the Music City Star while I-85 and US Highway 74/29 run parallel to the proposed commuter rail corridor. The traffic volumes from 2006 – 2016 for the routes mentioned above are shown in the tables below.

Table 7: Traffic Volume on Roads Running Parallel to Music City Star

AADT on Major Roads Parallel to Music City Star											
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I-40	90,970	95,043	86,304	85,558	88,839	91,572	93,892	96,909	100,440	103,878	106,523
US 70	21,643	21,110	20,305	19,930	20,197	19,737	19,852	20,110	20,284	21,163	21,514

Table 8: Traffic Volume on Roads Running Parallel to Proposed Commuter Rail

AADT on Major Roads Parallel to Proposed Commuter Rail											
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I-85	104,842	106,474	98,842	98,579	100,526	102,421	103,000	104,790	111,263	112,947	116,474
US 74/US 29	18,898	NA	19,031	NA	17,704	NA	17,717	NA	17,248	NA	19,256

As shown in **Tables 7 & 8**, the traffic volumes for the roads that parallel the two commuter rail routes are relatively similar. These two combinations of roads are both regarded as main corridors for commuters traveling into downtown Charlotte or Nashville. The Music City Star was implemented in 2007 to provide an alternative option for commuters. The average annual and weekday ridership estimates for the Music City Star since its inception are shown in **Table 9** below.

Table 9: Music City Star Ridership since Inception

Music City Star Estimated Ridership (APTA Quarterly Reports)											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Average Weekday Ridership	600	750	700	800	1,000	900	900	1,000	NA	1,200	1,100
Annual Ridership	142,000	191,000	182,000	210,000	279,000	261,000	246,000	257,000	274,000	281,000	288,000

3.4 Estimated Average Weekday Ridership

While considering the general commuting patterns in the study area, the station catchment areas and home-based work (HBW) automobile trips from the Metrolina TDM were used to produce average weekday ridership estimates. With CDIA and Downtown Charlotte representing the two main destinations for potential commuter rail riders, the average weekday ridership estimates were calculated based on the number of people who currently commute from within each station catchment area to those places.

Getting commuters in the study area to switch from driving their cars to taking the proposed commuter rail will be a challenge and as previously stated, the schedule of airport employees and whether it aligns with the commuter rail schedule will dictate the number of people that could use the commuter rail as a viable option to get to work at CDIA. Taking these factors into consideration, a 5% capture rate of HBW auto trips converting to commuter rail trips was used to produce the average weekday ridership estimates shown in **Table 10** below. This capture rate is representative of the existing commuting pattern in the study area and the challenge of converting automobile trips to commuter rail trips. The 5% capture rate also produces average weekday ridership estimates that are very similar to the Music City Star's average weekday ridership in its first year of operation.

Table 10: Estimated Average Weekday Ridership for Proposed Commuter Rail

District	Station	2015 Population	HBW Trips to Airport	HBW Trips to CGS	Total Auto Trips	Estimated Weekday Ridership (5% Capture of Total Auto Trips)
1	Kings Mountain	102,316	301	147	448	22.4
2	Gastonia	145,204	917	428	1,345	67.25
3	Belmont	109,438	1,669	884	2,553	127.65
4	Charlotte Douglas International Airport	158,484	N/A	1,573	1,573	78.65
5	Charlotte Gateway Station	1,011,502	6,658	N/A	6,658	332.9
					Total Estimated Weekday Riders	629

4 REVENUE PROJECTIONS

After analyzing the projected ridership for the new commuter rail service, a high-level estimate of operating costs of the new service was made, based on some Amtrak costs to operate the *Piedmont* and comparable commuter rail services, including the Music City Star in Tennessee, the Brightline in Florida, the A Train in Texas, and the Sprinter in California. To determine operating costs, service fees that included third party costs and credit for ticket revenue were considered, which resulted in a net operating cost.

Third party costs included in the model are all host railroad access fees including:

- Host railroad maintenance of way/performance payments
- Fuel and power charges

The route costs are operating costs associated with the commuter rail's route operations were considered. These costs include:

- Train and engine crew labor
- Car and locomotive maintenance
- Reservations and call centers
- Insurance

The proposed train schedules were analyzed to establish daily train frequency, train and engine crew labor, and equipment requirements for the new service to operate. Train consists were inserted to determine fuel and power and maintenance costs. A train and engine crew labor evaluation was developed that determined operations would require one engineer, one conductor, and one assistant conductor, regardless of patronage.

Ticket revenue was deducted from the total operating costs to ascertain the net cost to the operating service. Projected ticket revenue for this commuter rail service is estimated to be $900K. Total third party costs are estimated at $371K and route costs at $7.7M.

Total annual operating expenses are $8M, after deducting the annual ticket revenue, the new commuter rail service will cost the operator $7.2M (in 2018 dollars) per year.

5 COMMUTER RAIL SCHEDULE ANALYSIS

Ridership and revenue projections were analyzed to determine the appropriate frequency of the new proposed commuter rail service. Continuing to use the Music Star Service as an example, a peak-period only service would be operated between Kings Mountain and Charlotte. Ridership projections based upon this type of service would utilize the following representative schedule with a dwell time of 45 seconds, shown in **Table 11**:

Table 11: Proposed Commuter Rail Schedules

Eastbound AM Peak to Charlotte – 3 trips (40mph service)			
	Train #1	Train #2	Train #3
Kings Mountain	5:57am	6:32am	7:27am
Gastonia	6:17am	6:52am	7:47am
Belmont	6:35am	7:10am	8:05am
Charlotte-Douglas International Airport	6:45am	7:20am	8:15am
Charlotte Gateway	6:53am	7:28am	8:23am
Westbound PM Peak to Kings Mountain – 3 trips			
	Train #1	Train #2	Train #3
Charlotte Gateway	3:42pm	4:27pm	5:12pm
Charlotte-Douglas International Airport	3:50pm	4:35pm	5:20pm
Belmont	4:00pm	4:45pm	5:30pm
Gastonia	4:18pm	5:03pm	5:48pm
Kings Mountain	4:38pm	5:23pm	6:08pm

Implementing commuter rail service would consist of constructing Class 3 tracks with a maximum passenger operating speed of 60 mph. The route would be equipped with strategically located siding tracks at reasonable intervals to maintain reliability and passing opportunities between the inbound and outbound trains. Lines with similar characteristics, **Table 12**, may be found in other commuter systems and their average speeds can be calculated.

Table 12: Commuter Rail Lines with similar characteristics

Route	Territory Operated	Station Stops	Avg. MPH
New Haven Line (CT)	Stamford to GCT -33 mi	5	34.1 mph
Virginia Railway Express	Quantico to WAS, DC -35 mi	8	26.3
Tri-Rail (FL)	Ft. Lauderdale to Miami -27 mi	7	34.6
Music City Star (TN)	Lebanon to Nashville -33 mi	6	36.0

Using the above examples as guidance, a run time table (**Table 13**) was developed consistent with the average travel times of the other systems. Since this would be a new service, it is reasonable to consider a conservative average travel time estimate of 35 mph operations due to the corridor's existing topography and geometry, though further analysis would be needed to determine if a more aggressive average travel time of 40 mph could be operated.

Table 13: Commuter Rail Line Run Times

35 mph Travel Time Average		40 mph Travel Time Average	
Station	**Travel Time**	**Station**	**Travel Time**
Kings Mountain	63 min	Kings Mountain	56 min
Bessemer	53 min	Bessemer	47 min
Gastonia	41 min	Gastonia	36 min
Lowell	35 min	Lowell	27 min
Belmont	21 min	Belmont	18 min
CDIA	10 min	CDIA	8 min
Charlotte Gateway Station	0 min	Charlotte Gateway Station	0 min

Travel times on individual trains would likely be modified to account for the operational factors or to reflect potential future improvements to infrastructure or equipment.

6 PASSENGER RAIL VEHICLE ASSESSMENT

Passenger rail vehicles used for commuter rail operations in the nation present a wide range of designs and capabilities. Many of differences between the designs are attributable to the type of propulsion system used, railroad clearance limitations, passenger platform height and required maximum speed operated. Many commuter operators on the Northeast Corridor, for example, take advantage of the existing electric traction system to help achieve operating speeds of 100 mph or faster, but, due to restrictive overhead clearances, must use car designs with lower roof heights compared to equipment found on many commuter rail cars operating off the Corridor.

Passenger platform height is another major factor. Federal Railroad Administration regulations pertaining to Americans With Disabilities Act requirements call for commuter rail operations to comply with "level boarding" requirements that are approved for the type of rail line the service is operated on. A rail line with only limited or no freight service, for example, may achieve compliance through use of a vehicle with a car floor height, typically 48 inches above top of rail, the same as the station platform height and the platforms are located adjacent to the main tracks. It provides an optimal situation for passengers who may rely on wheelchairs or other forms of assistance to enter and exit the car. This type of operation is rarely found across much of the nation's rail lines due to the presence of freight traffic. Freight operators require additional side clearances than would be permissible for safely boarding / exiting passengers to a platform. Consequently, commuter operators may be forced to employ separate siding tracks with the station platform adjacent to them or to use a completely different rail car designed for low platform stations, typically eight inches above top of rail. Approval of the latter form of operation is granted only after it is demonstrated to the FRA's satisfaction that level boarding operations cannot be achieved under reasonable circumstances and that an approved alternate means (i.e., on-board lifts) to accommodate disabled passengers is established.

For purposes of this study, it is assumed trains would rely on diesel engine technology and operate to/from stations with platform heights consistent with the plans for the Charlotte Gateway Station. Host railroad NS has provided guidance that future stations, regardless of what corridor is involved, would be situated off their main line tracks and accessed with dedicated station tracks. It is also assumed the vehicle would comport with clearance and performance requirements for other NCDOT rail services to enable complete use of shared facilities such as the Charlotte Gateway Station. Given the highly-curved alignment, equipment capable of operating with a maximum speed of 80-90 mph is required.

6.1 Locomotive-Powered Vehicle

Locomotive-powered passenger equipment is the prevalent type of commuter rail equipment in the nation. Almost all of the vehicles are designed for "push-pull" operation, meaning the train can operate in either direction without requiring it to be physically repositioned with the locomotive always at the front of the train. The train is equipped with a special "cab car" which enables the Engineer to operate and control the train from it. Train control and communications cabling is installed in each of the passenger cars to provide a complete control capability from one end of the train to the other. Push pull train equipment may be found with multiple exterior dimensions, seat and door configurations and performance. Passenger car seating typically ranges from approximately 80 seats per car for single-level equipment to as many as 140 seats per car for multi-level equipment. The train type provides a very efficient design when passenger volume exceeds 200-300 passengers per train. Push pull trains routinely

achieve maximum speeds from 80mph to 125mph. **Figure 9** provides an example of a push-pull train operated by Virginia Railway Express.

Figure 9: Virginia Railway Express (VRE) Train 303 at Lorton, VA (author not known)

6.2 Diesel Multiple Unit

An alternative vehicle design would employ self-propelled "Diesel Multiple Unit" or DMU rail cars. These cars contain truck-sized diesel engines, either hung under the passenger car floor or mounted in a special compartment between passenger cabins. The engines provide power to propel the vehicle through mechanical or electric transmissions and generate electricity for car lighting, heating, air conditioning, etc. DMUs, once widely found across the nation, gradually were withdrawn from service until only a handful remained in operation. A new generation of DMU designs has emerged that offers potential to meet the market demand needs, especially for lighter volume operations. DMU cars typically seat from 70-90 passengers per car and operate with a maximum speed range from 60 mph to 90 mph, depending upon the design. Contemporaneous DMUs have been able to achieve "Tier IV" emissions standards more readily than larger locomotive engine designs have been able to do. The much larger population of engine applications for the smaller diesel engine has allowed manufacturers to invest R&D funds to develop a compliant technology. **Figure 10** illustrates a modern-day DMU vehicle.

Figure 10: Sonoma – Marin Area Rail Transit (SMART) rail vehicle (author not known)

There are advantages and disadvantages to each type of equipment. Locomotive-powered rolling stock can perform efficiently when measured on a passenger mile basis if passenger volume is sufficiently high to justify the fuel costs from using a large 3,000-4,000 hp diesel engine. DMUs can be considerably more fuel efficient in lower passenger volume operations. On the-other-hand, a single diesel locomotive concentrates the more time-consuming and expensive maintenance operations into just a single unit whereas each DMU operates, essentially, as its own locomotive and each is subject to the more rigorous inspection requirements. Diesel locomotives, while using a larger engine, typically operate for much longer intervals between overhauls than the smaller, higher speed DMU diesels can go. DMU engine replacements occur at higher rates than for locomotive engines.

6.3 Maintenance Facility

Factoring in maintenance requirements and facilities is an important element of the overall operations and financial analysis. If the new equipment can share facilities for maintenance with other operations, significant savings may be possible. With the new Light Maintenance Facility in west Charlotte, DMU could be maintained at the existing maintenance facility since the main facility equipment, such as; pit tracks, lifts/cranes, fueling facilities, warehousing, staff and work space exist. It would require the mechanical staff further training on the new equipment and require special tooling, assuming it has the capacity to

handle more equipment. Unfortunately, the current light maintenance facility does not have capacity for additional vehicles, therefore a separate facility to maintain this type of service has been identified and included in the capital cost estimate. Further analysis of refined ridership projections and equipment needs is necessary to guide which equipment type may be best suited for the service.

6.4 Vehicle Needs

6.4.1 Locomotive-powered passenger equipment

With the proposed ridership projections, four locomotives and 20 single-level passenger cars would provide adequate service for a proposed commuter rail service. This includes spare vehicles, which are generally calculated on the type of equipment involved. Coaches and Cab Car margins can be found ranging from as low as 10% (very unusual) to a more typical 15-20% of in service needs. Due to the typical complexity and more demanding maintenance requirements relating to commuter rail, locomotives tend to be in the 20-30% range of in service needs (rounding up to the nearest unit of course).

6.4.2 Diesel Multiple Unit

DMUs offer an advantage in that all units can be the same so each is interchangeable with the other. For a small fleet, such as identified for this potential commuter rail service, there would only be the need for one spare unit. This is due to the fact that DMU's are built as married pairs and are easily interchangeable. With the projected ridership, five DMU's would be needed for operating commuter rail service. DMU locomotives, such as the Stadler FLIRT DMUs, would be recommended since they meet FRA Alternative Compliance under 49 CFR 238. These are similar to the vehicles being utilized on the California's San Bernardino County Transportation Authority Arrow commuter service and the Fort Worth Transportation Authority's future TEX Rail commuter line. Each DMU costs approximately $12M per unit, with an overall cost of approximately $60M.

6.5 Vehicle Procurement Estimate

Locomotives would be the preferred vehicle types, which would equate to costs for the locomotives and cars at approximately $100M. The proposed service would require four locomotives and 20 single-level passenger cars.

Equipment			
Type	**Number**	**Cost per Unit**	**Total Cost**
Siemens "Charger" Locomotives	4	$6,500,000	$26,000,000
Single-Level Passenger Cars	20	$3,700,000	$74,000,000
Total Equipment Cost			$100,600,000

7 GOVERNANCE

For a project such as this, it will be important to navigate through the Federal Transit Administration's (FTA) New Starts program. Once the system is operating, FTA would continue to provide Project Management Oversight (PMO) and ensure the operating agency meets all FTA compliance regulations. FRA would provide jurisdiction over railway safety, Inspections, and other operating regulations.

Governance and organizational structure for an operating agency will not only depend on the source of funding, but also legislative authority. The two local transit agencies do not have legislative authority to operate commuter rail service since this proposed service crosses multiple county lines. Local transit agencies are prohibited from providing this type of transit service across county lines, without revising the legislative authority. The Metropolitan Transit Commission (MTC) as the policy board for the Charlotte Area Transit System (CATS) would need an organizational change to expand its oversight role to include Gaston and Cleveland County. It is important to note the Charlotte Council of Governments will be initiating a regional transit comprehensive study in 2019. Under this regional study, various transit modes will be evaluated within the region to identify how transit can be implemented to serve the greater Charlotte region, through investment of multiple transit modes to meet multiple needs. This corridor would most likely be considered within the regional transit study, along with determining how to implement a transit network with improved regional connections.

The other option for operating commuter rail service would be through procuring a private contractor to operate and maintain passenger rail service. There are a few private contractors throughout the United States that would be qualified to operate and maintain the service. The New Mexico Rail Runner Express, Trinity Railway Express, and the A-Train in Denton County, TX are just a few examples of passenger rail service operated by private contractors.

Over the past few years, this region has been involved in a number of regional studies evaluating passenger rail connecting Atlanta, GA with Raleigh, NC. Recently Georgia Department of Transportation (GDOT) submitted a Tier 1 Draft Environmental Impact Statement (EIS) to the FRA. This segment is part of a larger passenger rail initiative by FRA that extends north to Washington, DC, commonly referred to as the Southeast High Speed Rail (SEHSR) Corridor. There are currently three alternatives identified in the EIS. Two of the alternatives identify stations at CDIA and within Gastonia, and the third alternative only identifies a station at CDIA, with a greenfield station in south Gaston County. Further information can be found at http://www.dot.ga.gov/IS/Rail/AtlantatoCharlotte. If further analysis of potential commuter rail moves forward, it will be important to not only coordinate with the CATS LRT study, the upcoming regional transit study, but also the SEHSR study between Atlanta and Charlotte.

8 LOCAL OUTREACH

A kick-off meeting was held on July 12, 2018 to solicit stakeholder input on the study. Nearing the conclusion of the study, a second stakeholder meeting was held on November 14, 2018 with representatives of project stakeholders to summarize the study's findings and recommendations, and to gather input as the study report is finalized. Stakeholders discussed the need for a commuter rail station in Belmont, knowing that there could be a future light rail station and the importance between both transit modes to not compete between each other for ridership. The location of a potential station at CDIA would also need to take into account avoiding the FRA clear zone for runways.

9 NEXT STEPS

Following an update to study stakeholders on November 14. 2018, the below next steps were identified for further study of commuter rail to communities west of Charlotte:

- Continue engagement with Norfolk Southern as the owner of the rail corridor
- Investigate the possibility of commuter rail as a component of future highway expansion projects
- Explore potential funding options
- Further explore the use of other potential commuter rail corridors such as the P&N corridor
- The results of the study will be shared with the regional governing boards

APPENDIX A – REFERENCE LIST

Norfolk Southern Passenger Station Requirements, 2011
FRA Station Area Planning for Passenger Rail Stations, 2011
WSP First Mile/Last Mile connectivity studies for NC Passenger Rail Stations, 2017-2018
Comprehensive North Carolina State Rail Plan, 2015