



## B. Benefit-Cost Analysis



## MEMORANDUM

To: Jay Heikes, GoTriangle

From: David Samba, PE, PTOE, PTP, RSP1, Kimley-Horn and Associates, Inc.

Date: April 7, 2022

Subject: GoTriangle RTC Relocation RAISE Grant Application, Benefit-Cost Memorandum

## Contents

This memorandum is organized to complement the BCA spreadsheet and to provide a tab-by-tab walkthrough of the methodology and results. The memorandum is organized as follows:

<b>MEMORANDUM.....</b>	<b>1</b>
<b>Contents .....</b>	<b>1</b>
<b>Introduction.....</b>	<b>3</b>
<b>Project Overview.....</b>	<b>3</b>
Public Outreach.....	4
Site Selection Process .....	4
Conceptual Design.....	4
<b>BCA Summary.....</b>	<b>5</b>
<b>BCA Detailed Summary .....</b>	<b>6</b>
<b>Alternatives .....</b>	<b>8</b>
No-Build Alternative .....	8
Build Alternative .....	8
<b>BCA Methodology.....</b>	<b>9</b>
Analysis Period .....	9
Safety .....	10
Sustainability .....	10
Transit Vehicle Emissions .....	10
Passenger Vehicle Emissions .....	10
Fleet Electrification Emissions.....	11
Quality of Life .....	11

Vehicle Operating Costs..... 11

Mobility and Community Connectivity ..... 11

    Passenger Travel Time Savings ..... 11

    Park and Ride Drive Time Savings ..... 12

Economic Competitiveness..... 12

    RTC Operations Cost Savings ..... 12

    Transit Amenities..... 12

    Property Value and Development Potential ..... 13

State of Good Repair ..... 13

    External Highway Costs ..... 13

Residual Capital Value..... 13

Maintenance Costs ..... 14

Factors Not Quantified ..... 14

**BCA Results ..... 15**

## Introduction

This memorandum summarizes the assumptions, methodologies and results of the benefit-cost analysis (BCA) completed for the GoTriangle Regional Transit Center (RTC) Relocation grant application for the FY22 RAISE grant program. The BCA provides a means to measure the project's overall benefit by developing a uniform measurement of the impact the project has on society. This is accomplished by assigning a dollar value to benefits that can be compared to the construction costs and other related costs. In the BCA, the capital costs of constructing and maintaining the project are compared to the net benefit that the project provides to the region. The costs and benefits are discounted to compare all costs and benefit with a common measure such as using 2020 dollars.

## Project Overview

GoTriangle began the RTC Relocation Study in 2019 to evaluate opportunities for relocating the RTC to provide enhanced functionality, connectivity, and reliability. The new RTC location will optimally serve the regional transit network envisioned in the Wake, Durham, and Orange County transit plans. The relocation will create an improved bus network that is integrated with planned bus rapid transit (BRT), commuter rail, and multi-modal connections to connect residents to employment, education, and key regional destinations. In alignment with this purpose, the following goals guided the new site search process:

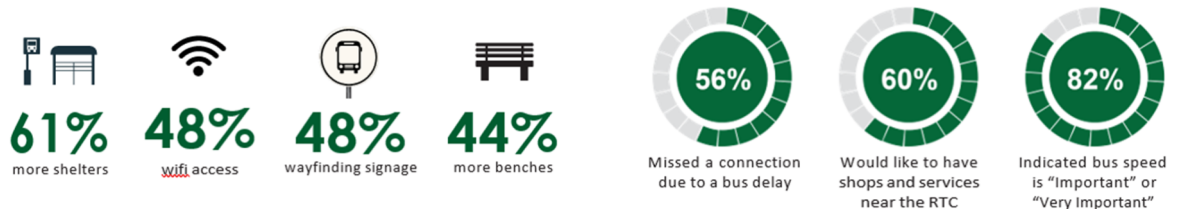
- **Safety & Accessibility:** Improve safety and accessibility for all users and vehicles
- **Access & Connectivity:** Increase transit access to regional destinations and multi-modal connections
- **Speed & Reliability:** Provide a better experience for riders and increase operational efficiency

The current RTC locations has operational and access challenges, including insufficient amenities, and limited opportunity for expansion. The current site also has a shared entrance/exit and circulation paths for buses and cars, and 1.5-mile average distance through several signalized intersections from the current transit center site to the nearest I-40 interchanges, all of which contribute to service reliability challenges for passengers and GoTriangle operations.

The RTC relocation will address limitations of the current facility by enhancing safety and functionality, improving bus speed and reliability, and expanding multimodal connections. Additionally, it will allow for improved mobility access for both areas of persistent poverty and historically disadvantaged communities along routes that serve the proposed new location by increasing the speed and reliability of trips to and from the transit center. Future planned connections to both bus rapid transit (BRT) and commuter rail (CRT) at the new site location, in addition to the proposed multi-use, live/work/play site design of the surrounding land uses, make the RTC relocation project operationally beneficial as well as environmentally sustainable.

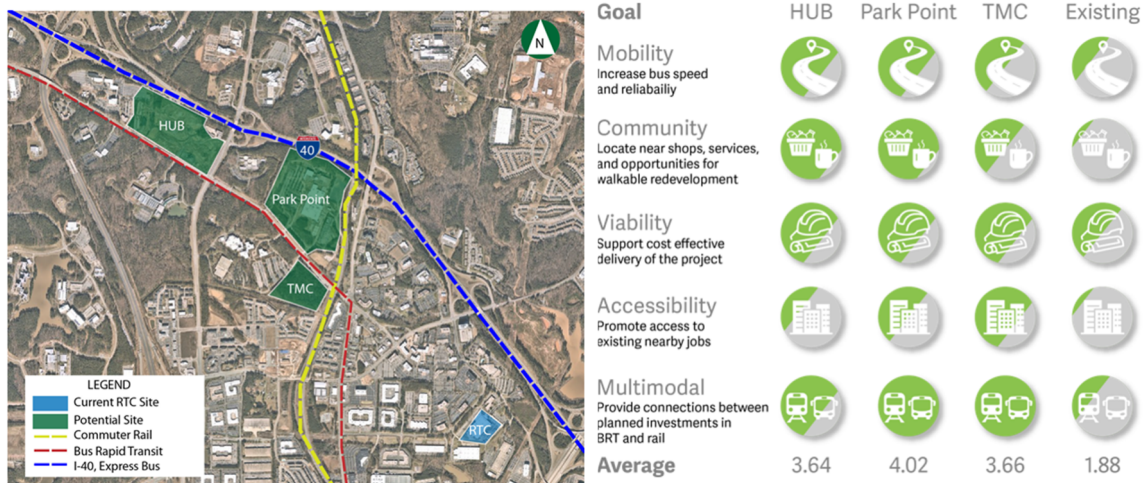
## PUBLIC OUTREACH

GoTriangle conducted several virtual public outreach events in the Spring of 2020 as a result of the COVID-19 pandemic. The feedback gathered on rider experience and amenity improvements was used to inform the evaluation criteria for the site selection and conceptual design process of the preferred site.



## SITE SELECTION PROCESS

To assess possible locations, a parcel search was conducted resulting in initial list of 113 sites. Using an iterative and criteria-driven search process, including proximity to the highway network, ease of access, and size of site, the list was reduced to three preliminary sites for further detailed evaluation. The sites were evaluated on a scorecard to identify the preferred site based on five primary criteria – mobility, community access, site viability, site accessibility, and proximity to multimodal connections.



## CONCEPTUAL DESIGN

A conceptual facility program and a conceptual design were developed for the preferred site location. The proposed project includes real estate acquisition, design, and construction for a transit center on the Park Point site as well as roadway and intersection improvements in the vicinity of the site including a signalized entrance and exit. The conceptual program includes ten bus boarding bays, with the potential for two additional bays, plus two bays for buses that are out-of-service. On-site amenities include an enclosed building with a waiting area, five additional bays for paratransit riders, microtransit (providing connections to nearby local systems), taxis, and a central boarding platform.

with a pass sales booth and comfort stations. The preferred site location is more easily accessible from I-40, NC-54, NC-147, and I-540; will be co-located with a proposed commuter rail station and future bus rapid transit (BRT) stop, both of which are in the planning stages.

The relocation will provide similar transit services and programming as the current location but will address several operational challenges posed by the current site and provide for additional future capacity. The project will contribute quantifiable benefits for all merit criteria, improving safety for passengers and providing travel-time efficiencies.

### **BCA Results Summary**

The cumulative benefits of the project are monetized at \$29.2M in discounted benefits, compared to a discounted project cost of \$19.3M. As a result, the project has a benefit-cost ratio (BCR) of 1.52 (assuming a 3% discount rate for CO2 emissions, and 7% discount for all other benefits), which represents a favorable investment of federal funds and a significant benefit to the region.

## BCA Detailed Summary

Table 1: Benefit Cost Analysis Summary

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits (Undiscounted)	Present Value (Discounted at 7 Percent)
<b>Safety</b>			
Crash Savings	Reduction in injury and PDO crashes related to personal vehicle VMT reductions and improvements in safety at the local intersections near the new RTC location	\$2,128,031	\$644,958
<b>Environmental Sustainability</b>			
Transit Emissions Saved - Bus	Reduction in criteria emissions by bus based on reduced transit miles travelled	\$844,044	\$507,452
Passenger Vehicle Emissions Saved	Reduction in passenger vehicle emission due to mode shift to transit. Rate of mode shift is accelerated in the Build Condition.	\$728,554	\$418,790
Fleet Electrification	Additional Reduction in bus emissions due to the RTC enabling a quicker conversion of the fleet to electric vehicles as a result of additional charging infrastructure	\$2,878,241	\$1,626,111
<b>Quality of Life</b>			
Vehicle Operating Cost	Reduction in personal vehicle operating costs per personal VMT due to mode shift to transit. Rate of mode shift is accelerated in the Build Condition.	\$3,307,644	\$502,380
<b>Mobility and Community Connectivity</b>			
Passenger Travel Time Savings	Reduction in personal travel delays due to mode shift to transit. Rate of mode shift is accelerated in the Build Condition.	\$12,137,133	\$3,589,148
Park and Ride User Travel Time Savings	Reduction in personal travel delays due to travel time saving between park and ride lot location and future RTC Location	\$601,077	\$177,748
<b>Economic Competitiveness and Opportunity</b>			
Operations Costs (RTC)	Reduction in operations costs based on reduction in vehicle revenue hours assuming greater route efficiencies resulting in reduced average travel distance and increased averaged travel speeds	\$40,098,240	\$12,152,875
Transit Amenities	Revealed/Stated Transit Preference Benefit of Transit Facility Amenities. Assumes a higher value of amenities in the new Facility due to a newness factor.	\$12,882,629	\$3,890,482
Property Value	Assumed increase in property value in the surrounding 1/4 mile due to increased access to increase transit access and complementing TOD	\$7,343,625	\$4,573,241
<b>State of Good Repair</b>			
External Highway Costs (Noise, Congestion, Pavement Maintenance)	Reduction in external highway mitigation costs due to personal VMT-related Noise, Congestion, and Pavement Impacts	\$3,030,133	\$583,625

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits (Undiscounted)	Present Value (Discounted at 7 Percent)
<b>Other</b>			
Residual Value	Residual value of assets at the end of the analysis period	\$8,383,572	\$961,941
Operations & Maintenance Costs	Cost of regular maintenance and inspection of assets	-\$1,470,982	-\$407,284
<b>Total Benefit</b>		<b>\$92,891,941</b>	<b>\$29,221,467</b>
<b>Total Costs</b>		<b>-\$27,991,214</b>	<b>-\$19,258,881</b>
<b>Benefit / Cost Ratio</b>		<b>3.32</b>	<b>1.52</b>
<b>NPV</b>		<b>\$ 64,900,727</b>	<b>\$ 9,962,585</b>



## **Alternatives**

Consistent with the direction provided by the US Department of Transportation (USDOT), the BCA compares a No-Build Alternative and a Build Alternative. These alternatives compare the benefits and costs of doing nothing at the project location to completing the improvements.

### **NO-BUILD ALTERNATIVE**

The No-Build Alternative maintains the existing facility at the current location and assumes the service increases included in the regional transit plan including increased peak hour frequency on existing routes. This assumes no major improvements will be made to the existing facility, and that current operational challenges will continue unabated. Ridership will continue to grow at 2 percent per year consistent with historic ridership increases as reported by GoTriangle. These assumptions develop a baseline to compare with the benefits from constructing the project. The No-Build Alternative is consistent with USDOT BCA guidance.

### **BUILD ALTERNATIVE**

The Regional Transit Center (RTC) Relocation project will relocate the existing RTC operations to a site more easily accessible from I-40, NC-54, NC-147, and I-540. The proposed location will also provide operational efficiencies by being co-located with a proposed commuter rail station and future bus rapid transit (BRT) stop, both of which are in the planning stages. The relocation will provide similar services and programming as the current location but will alleviate several operational challenges posed by the current site, provide additional future capacity, as well as provide travel-time efficiencies and improvements for transit riders.

The new facility will consist of the same number of fixed route bus bays as the current site but will include a more efficient site design to improve operations, five additional bays for smaller transit and ride-share vehicles, as well as include key rider comfort improvements, such as covered waiting areas and indoor ticket vending among many other amenities. The site will also include safety improvements, including a signalized intersection at the facility entrance, and will be co-located with planned commuter rail and BRT service. The facility is located closer to major regional transportation arterial roadways, reducing overall drive time for transit vehicles and those accessing the park-and-ride facility. The facility is also located closer to major regional employers, as well as planned future developments, increasing long-term ridership potential.

The Build Alternative further improves upon the No-Build Alternative by accelerating the rate of new ridership from the 2 percent historic average to 4 percent in the first five years of the facilities operation. (For the purposes of a conservative analysis it was assumed that after the first five years the rate of ridership increase would be reduced such that the 2040 model forecasted ridership would be the same in the No-Build and Build Alternative).

Other improvements of the Build Alternative include the ability to accommodate an expanded electric fleet due to a greater investment in electric charging infrastructure.

## BCA Methodology

The BCA was developed using the updated 2022 guidance provided by the USDOT. Analysis was completed as necessary to develop the benefits and costs of the No-Build and Build alternatives. Major components of the analysis include:

- Costs and Disbenefits
  - Initial capital costs
  - Facility maintenance costs
- Benefits
  - GoTriangle operating savings due to reduced revenue hours
  - Personal vehicle operating costs savings due to mode shift
  - Safety benefits associated with access improvements at the site's entrance
  - Environmental benefits of improved air quality due to reduced bus and passenger vehicle VMT as well as accelerated fleet electrification
  - Personal vehicle travel time savings due to mode shift and related to improved transit facility location synergy with park and ride lot
  - Value of transit amenities related to user adoption and experience.
  - Local property value increases associated with the relocation and complementary TOD
  - Residual capital value at the end of the BCA period

In addition to the main benefits, unquantified benefits were also identified. These benefits were not developed into monetized results but describe additional value of constructing the project beyond the quantified results of the BCA. These broader benefits are generally discussed in the project narrative.

The BCA spreadsheet included in this application begins with an Inputs tab containing key information about the project. This tab also includes many of the inputs and assumptions discussed below and provides source information, as appropriate. The next tab is the Summary which includes all the annualized costs and benefits and calculates the BCA results. The following tabs calculate the individual costs and benefits including construction costs and residuals, safety impacts, travel time, and others. These individual tabs reference information from the main Inputs tab and include additional inputs and sources as necessary.

## ANALYSIS PERIOD

The BCA analysis was completed for a 30-year period starting in 2023 and covering the two-year construction of the project which begins in 2025. This results in a 26-year operating period of benefits following completion of the project. This analysis period was used to capture the benefits of the project while staying within USDOT guidance. The present value of all benefits aligns with the design year forecasting for transit facilities.

The analysis uses the current project schedule and construction duration assumptions. This assumes construction will begin in 2025 and be completed by late 2026. Any temporary net benefits or indirect costs caused by the construction of the project, including jobs created by the construction or travel time delays due to construction are assumed to be minimal and were excluded from the analysis.

Based on this schedule, the project costs will be \$28.0M in 2020 dollars undiscounted and \$19.3M using a 7% discount rate. 2027 is the first full year that benefits from the project will begin.

## **SAFETY**

The current access point for the RTC facility is currently stop-controlled. The Build Alternative will improve safety by providing a signalized intersection at the facility's access point, thereby reducing the propensity for all types of crashes for vehicles entering and exiting the facility.

Crash reports for the six-year period of 2016-2022 were calculated at the existing facility driveway and nearby area intersections. These were compared to crash rates at intersection nearby the proposed location. The proposed location has 3.5 less annual crashes than the current location (for a similar area around the site). Generally it appears as though the new location will have an inherently lower safety risk which will be a benefit to all users. Additionally, the proposed location will include a signalized intersection at the facility entrance whereas the current entrance is unsignalized. This will serve to further improve the direct safety entering and exiting the site. A crash modification factor of 0.56 was applied to the existing crash rates at the facility entrance and the annual monetized value of crashes was calculated for each year of the project based on 2022 USDOT BCA standard values. The change in the monetized value of crashes was then calculated over the analysis period.

Over the analysis period, the annual monetized value of the predicted reduction in crashes was approximately \$1.9M. The total safety benefit of the project in terms of the monetized value of decreased crashes was \$2.1M or \$645K discounted at 7%.

## **SUSTAINABILITY**

The project is assumed to result in an overall reduction in emissions based on three factors: a decrease in bus revenue miles traveled due to operational efficiencies, the ability to electrify the existing transit fleet, and a reduction in overall passenger VMT based on an assumed ridership increase.

### **Transit Vehicle Emissions**

According to GoTriangle modeling results, relocating the facility is anticipated to result in an annual reduction of approximately 59,812 vehicle revenue miles beginning in 2027. Bus emissions estimates were taken from the parameters of the Cal-B/C model (2022 update). This results in an assumption of over 8,255 metric tons of CO<sub>2</sub> emissions saved over the analysis period, among other pollutant savings. This result was monetized based on standard 2022 USDOT BCA values for the value of emissions, to reach a total benefit of \$844K over 30 years, or \$507K at a 7% discount rate (but assuming a 3% discount for CO<sub>2</sub>)

### **Passenger Vehicle Emissions**

The project is also anticipated to result in a modest decrease in regional VMT based on the assumed increased transit ridership associated with the project. For the purposes of this analysis, it was assumed that new transit riders would have driven single-occupancy passenger vehicles if the facility was not built, reflecting the predominance of auto-oriented development patterns in the region. Therefore, each additional transit rider will result in a decrease in passenger vehicle miles traveled. 9

percent of trips are unlinked and assumed to have a one-way distance of 11.7 miles per GoTriangle projections. The remaining trips have lengths that are assumed to be equal to the average round trip transit mileage for the routes that serve the RTC, assumed to be 34 and 32 miles for No-Build and Build alternatives respectively. This results in a benefit of 12.6 million VMT avoided throughout the analysis period, beginning in 2026.

The reduction in emissions based on reduced vehicle miles was calculated according to 2022 USDOT BCA standard values and monetized based on standard values. This results in a total benefit of \$729K over the analysis period, or \$419K discounted (with CO2 emissions discounted at 3%, and all other emissions discounted at 7%.)

### **Fleet Electrification Emissions**

The project is also anticipated to result in an acceleration of fleet electrification due to additional charging infrastructure and capacity. Based on staff projections and the project scope, the RTC will allow for six additional electric vehicles to be brought online much earlier than otherwise would be feasible. The savings associated with this was monetized by comparing the proportional zero emissions savings per VMT that would be realized with more electric vehicles.

The reduction in emissions based additional fleet electrification was calculated according to 2022 USDOT BCA standard values and monetized based on standard values. This results in a total benefit of \$2.9M over the analysis period, or \$1.6M discounted (with CO2 emissions discounted at 3%, and all other emissions discounted at 7%.)

## **QUALITY OF LIFE**

### **Vehicle Operating Costs**

Similar to the calculations for Travel Time Savings, the VMT savings for passenger vehicles that no longer travel on the roadways due to mode split were monetized. This calculation reflects savings in reduced user operating costs associated with less personal vehicle travel as prescribed in the 2022 USDOT BCA Guidance. Compared to no operating cost savings in the No-Build alternative, the Build alternative costs savings represent the total vehicle operating costs benefit of the project.

Over the analysis period, the BCA resulted in a vehicle operating costs benefit of \$3.3M undiscounted, or \$502K at a 7% discount rate.

## **MOBILITY AND COMMUNITY CONNECTIVITY**

### **Passenger Travel Time Savings**

The GoTriangle modeling exercise also predicted the change in one-way travel times for each route that currently serves the RTC. This analysis showed a weighted average travel time savings of 7 minutes per round trip.

Passenger travel time savings were calculated based on 2019 ridership numbers presented in the relocation study's existing conditions analysis, showing an average of 1027 boardings per weekday and the 2040 model forecast of 1550 boardings per weekday. In the No-Build alternative, ridership



was increased at an average rate between 2019 and 2040 of 2%. In the Build analysis, ridership was increased at an average rate of 4 percent for the first five years of the RTC's opening in the new location, then reduced such that the 2040 the ridership values for the No-build and Build scenarios were the same.

Travel time savings of 7 minutes per round-way trip were then annualized to 300 round trips per year, accounting for 260 weekdays and reduced weekend ridership. Travel time savings were monetized using standard 2022 USDOT BCA values of \$17.90 per hour for all vehicle travel, to amount to total benefit of \$12.1M over the course of the analysis, or \$3.6M at a 7% discount rate.

### **Park and Ride Drive Time Savings**

The relocated facility is also anticipated to result in travel time savings for park-and-ride users due to the location closer to I-40. A traffic analysis showed that drivers could anticipate an average savings of one minute per one-way trip when accessing the park-and-ride facility via I-40. GoTriangle estimates show that approximately 10% of riders use the park-and-ride facility, so this additional travel time benefit was applied to 10% of total ridership estimates. Travel time savings of one minute per one-way trip were then annualized based on the assumed ridership. Travel time savings were monetized using standard 2022 USDOT BCA values of \$17.90 per hour for all vehicle travel, to amount to total benefit of \$601K over the course of the analysis, or \$178K at a 7% discount rate.

## **ECONOMIC COMPETITIVENESS**

### **RTC Operations Cost Savings**

The project is assumed to result in operational efficiencies for GoTriangle, which will reduce the total annual revenue service hours for the routes serving the RTC, resulting in decreased operational costs for the agency. The operations cost savings of the relocation were calculated based on information provided by GoTriangle (see attached modeling results). A GoTriangle modeling exercise estimated that travel time efficiencies created by the new location closer to major transportation arteries, as well as the new signalized entrance, will result in a reduction of 10,710 annual revenue service hours during the peak period. This savings was assumed to begin in 2027 and to remain static throughout the analysis period. GoTriangle's 2022 per-revenue-hour operations cost of \$144 also remain static throughout the analysis period. This cost was applied to the annual revenue hour savings to develop a total operations cost benefit of \$40.1M, or \$12.2M at a 7% discount rate. This saving underestimates the true GoTriangle operations costs savings because it does not consider savings outside of the peak period.

### **Transit Amenities**

The 2022 USDOT BCA Guidance provides a valuation for transit facilities amenities. While both the current and proposed RTC have transit amenities it is recognized that amenities in the new facility will be of higher perceived quality to the user based on their newness. As such the transit amenity benefit was calculated for both the No-Build and Build conditions, but the value of the no-build benefit was scaled at 90%.

Over the analysis period, the BCA resulted in a transit facility benefit of \$12.9M undiscounted, or \$3.9M at a 7% discount rate.

### **Property Value and Development Potential**

Based on previous research, including a 2008 study prepared for the FTA and USDOT by the Center for Transit-Oriented Development,<sup>1</sup> it is assumed that the relocated facility will result in a modest increase in property values in the area immediately surrounding the facility, based on the benefits of providing new access to transit. This study shows wide variety of property value increases due to multimodal transit centers. A one-time 2.8% increase for the properties within 1/4 mile of the new facility south of the interstate was assumed as a conservative assumption (it was assumed that the facility would have no impact on property values on the other side of the interstate.) This one-time property value increase represents one-quarter of the anticipated benefits for a transit station with TOD elements (11%).

The current assessed property value within 1/4 mile of the new facility location was calculated at approximately \$267M based on local GIS datasets. A property value premium of 2.8% was applied to the assessed values. This results in a total benefit of over \$7.3M in 2027, or \$4.6M at a 7% discount rate.

## **STATE OF GOOD REPAIR**

### **External Highway Costs**

Similar to the calculations for Travel Time Savings, the VMT savings for buses and passenger vehicles that no longer travel due to mode split (or travel with reduced VMT in the case of buses) were monetized. This calculation reflects savings in reduced mitigation and maintenance costs associated with noise, congestion, and pavement as a function of VMT as prescribed in the 2022 USDOT BCA Guidance. Compared to external cost savings in the No-Build alternative, the Build alternative costs savings represent the total vehicle operating costs benefit of the project.

Over the analysis period, the BCA resulted in a vehicle operating costs benefit of \$3.0M undiscounted, or \$584K at a 7% discount rate.

## **RESIDUAL CAPITAL VALUE**

Many of the components of the project have service lives beyond the analysis period, so the residual capital value is calculated for the Build alternative. This residual value is applied as a benefit in the BCA. Major structural components were assumed to have a 75-year design life, while most roadway components were assumed to have a 40-year design life. The total benefit associated with the residual values was \$8.4M undiscounted, or \$962K at a 7% discount.

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<sup>1</sup> <http://www.reconnectingamerica.org/assets/Uploads/ctodvalcapture110508v2.pdf>  
<https://digital.lib.washington.edu/researchworks/handle/1773/34203>

To be conservative, soft costs associated with construction such as engineering costs and mobilization are given no residual values.

## MAINTENANCE COSTS

There will be additional maintenance costs associated with maintaining the newly constructed facility in a state of good repair. Average annual maintenance costs for the existing GoTriangle facility include a \$36,000 lease (assumed to continue throughout the analysis period as part of the No-Build scenario), approximately \$66,000 in total annual maintenance dedicated to the transit facility, and an additional \$110,000 per year in small capital costs. Since the current transit facility occupies the GoTriangle “Plaza,” which includes the agency’s office building, the analysis included assumptions to define the total annual maintenance costs that might reasonably be assumed to support the transit facility, including lawn maintenance, utilities, and general repairs. The new facility is anticipated to be more costly to maintain due to the increase in amenities, however the relocation will allow GoTriangle to discontinue the lease on the current site. An estimate of \$250,000 annually for the Build scenario was established based on a review of similar facilities, including the downtown Raleigh RUS Bus facility currently under construction. All maintenance costs were escalated at a rate of 2.5% per year.

The total increased cost of maintenance over the analysis period was valued at approximately \$1.5M, or \$407K at a 7% discount. In the BCA, the maintenance and inspection costs are treated as a negative benefit (a disbenefit).

## FACTORS NOT QUANTIFIED

Several factors were not quantified as part of the analysis but provide additional benefits beyond those quantified above. Some unquantified factors are:

- **Economic Output:** Construction of the project and an injection of new federal money to the region is anticipated to create short-term spending, earning, and employment gains. To quantify these benefits, the aggregate Region Input-Output Modeling System (RIMS II), Type II multipliers for the construction industry were obtained from the Bureau of Economic Analysis. These multipliers provide an estimate of the total economic gains in all industries in the region per dollar of expenditure for specific industries. These multipliers were applied to the total anticipated federal expenditure anticipated and proportioned across each of the two years of project construction based on the anticipated constructions schedule. These benefits are anticipated to amount to an increased total economic output of \$28M, increased earnings of \$12M, and an increase of 259 jobs associated with the investment.
- **Regional Safety Benefits and Long-Term Mode Shift** to the larger roadway system associated with increased ridership. As ridership increases and vehicles are removed from the roadway system, it is likely to decrease the total number of crashes throughout the region.
- **Improved Access to Jobs.** The new facility will be located closer to major existing regional employers within the Research Triangle Park, as well as in an area anticipated to see increased development over the coming decade. This increased location efficiency will provide increased transit access to employment compared to the existing facility, which relies

on a partnership with transportation network companies, or app-based ride-hailing services, to access many regional employers.

## BCA Results

The results of the BCA conducted for the RTC relocation project are presented in terms of a benefit-cost ratio (BCR) and a net present value (NPV). A BCR greater than 1.0 and NPV greater than 0 mean that the project benefits outweigh the project costs. The larger the BCR and NPV, the greater the expected benefits of the project. The BCR provides the amount of benefit per unit cost, which can be useful for determining the highest dollar for dollar benefit when comparing projects.

The results of the BCA for the project, calculated using the methodology described above, are presented in the table below. The results are shown without any discount applied and with the appropriate discount value applied (3% discounted rate for CO2 emissions, 7% for all other benefits). As can be seen in the table, there are substantial benefits associated with the RTC relocation.

	<i>Undiscounted</i>	<i>Discounted</i>
<i>Benefits</i>	<b>\$92,891,941</b>	<b>\$29,221,467</b>
<i>Costs</i>	<b>-\$27,991,214</b>	<b>-\$19,258,881</b>
<i>BCR</i>	<b>3.32</b>	<b>1.52</b>
<i>NPV</i>	<b>\$ 64,900,727</b>	<b>\$ 9,962,585</b>



Project Information

Project RTC Benefit-Cost Analysis  
Grant RAISE 2022

Spreadsheet Color Coding

## Input  
## Calculated value  
## Monetization factor or rate  
## Benefits result

Project Schedule

Base Year 2020 \*as per BCA guidance  
Project Start 2023  
Construction Start 2025  
Construction Years 2 did not change  
Project Use Start 2027  
Total Analysis Period 30 years \*30 years of operation + 2 years of construction  
Days / year 365

Guidance Source

Primary Guidance Source USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2022

Costs and Other Inputs

	Value	Note	Source
In-Vehicle Travel Time: All	\$17.80	per hour	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2022

Time Savings

Model Revenue Hours No-Build	115,348		GoTriangle Calculated Values (see Model Tabs)
Model Revenue Hours Build	104,638		GoTriangle Calculated Values (see Model Tabs)
Operating Cost	\$ 144.00	per revenue	GoTriangle Calculated Values (see Model Tabs)
Current Center Maintenance Costs	\$4,000	annual	GoTriangle historic values
Future Maintenance Costs	\$250,000	annual	GoTriangle anticipated values
Average Weekday boardings (2019)	1027	passengers	2019 Existing Conditions Study
Average Weekday boardings (2040)	1550	passengers	GoTriangle Calculated Values (see Model Tabs)
Annual Ridership Increase Rate	2%		

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits (Undiscounted)	Present Value (Discounted at 7 Percent)	Spreadsheet Tab
<b>Safety</b>				
Crash Savings	Reduction in injury and PDO crashes related to personal vehicle VMT reductions and improvements in safety at the local intersections near the new RTC location	\$2,128,031	\$644,958	TAB C
<b>Environmental Sustainability</b>				
Transit Emissions Saved - Bus	Reduction in criteria emissions by bus based on reduced transit miles travelled	\$844,044	\$507,452	TAB D
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Fleet Electrification	Additional Reduction in bus emissions due to the RTC enabling a quicker conversion of the fleet to electric vehicles as a result of additional charging infrastructure	\$2,878,241	\$1,626,111	TAB F
<b>Quality of Life</b>				
Vehicle Operating Cost	Reduction in personal vehicle operating costs per personal VMT due to mode shift to transit. Rate of mode shift is accelerated in the Build Condition.	\$3,307,644	\$502,380	TAB G
<b>Mobility and Community Connectivity</b>				
Passenger Travel Time Savings	Reduction in personal travel delays due to mode shift to transit. Rate of mode shift is accelerated in the Build Condition.	\$12,137,133	\$3,589,148	TAB H
Park and Ride User Travel Time Savings	Reduction in personal travel delays due to travel time saving between park and ride lot location and future RTC Location	\$601,077	\$177,748	TAB I
<b>Economic Competitiveness and Opportunity</b>				
Operations Costs (RTC)	Reduction in operations costs based on reduction in vehicle revenue hours assuming greater route efficiencies resulting in reduced average travel distance and increased averaged travel speeds	\$40,098,240	\$12,152,875	TAB J
Transit Amenities	Revealed/Stated Transit Preference Benefit of Transit Facility Amenities. Assumes a higher value of amenities in the new Facility due to a newness factor.	\$12,882,629	\$3,890,482	TAB K
Property Value	Assumed increase in property value in the surrounding 1/4 mile due to increased access to increase transit access and complementing TOD	\$7,343,625	\$4,573,241	TAB L
<b>State of Good Repair</b>				
External Highway Costs (Noise, Congestion, Pavement Maintenance)	Reduction in external highway mitigation costs due to personal VMT-related Noise, Congestion, and Pavement Impacts	\$3,030,133	\$583,625	TAB M
<b>Other</b>				
Residual Value	Residual value of assets at the end of the analysis period	\$8,383,572	\$961,941	TAB N
Operations & Maintenance Costs	Cost of regular maintenance and inspection of assets	-\$1,470,982	-\$407,284	TAB O
Total Benefit		\$92,891,941	\$29,221,467	
Total Costs		-\$27,991,214	-\$19,258,881	TAB P
Benefit / Cost Ratio		3.32	1.52	
NPV		\$ 64,900,727	\$ 9,962,585	

#	At-Grade Crossing	Years	Average Annual Total Crashes from 2016-2020 (No-Build)				
			Number of Crashes	K – Killed	A – Incapacitating	B – Non-incapacitating	C – Possible Injury
1	Current Driveway	6	0.8	0.0	0.0	0.3	0.0
	Current Location Total		26.2	0.0	0.0	4.3	0.0
	Proposed Location		22.7	0.0	0.0	6.0	0.0
	Proposed Location Minus Crash improvements		19.9	0.0	0.0	4.9	0.0
	Monetized value (\$2019)		\$12,837,400	\$302,600	\$302,600	\$302,600	\$3,900

			Number of Crashes	K – Killed	A – Incapacitating	B – Non-incapacitating	C – Possible Injury
							O – No Injury
	Slater at Parliament		5.0	0.0	0.0	2.0	0.0
	Slater at Emperor		15.0	0.0	0.0	3.0	0.0
	I-40 EB at Page		83.0	0.0	0.0	13.0	0.0
Current	I-40 WB at Page		54.0	0.0	0.0	8.0	0.0
	NC 54 at Wilkson		0.0	0.0	0.0	0.0	0.0
	Miami at NC 54		80.0	0.0	0.0	20.0	0.0
	Miami at I-40 EB		15.0	0.0	0.0	5.0	0.0
New	Miami at I-40 WB		41.0	0.0	0.0	11.0	0.0

KABCO		Monetized value (\$2019)
KABCO Level	Level	
O – No Injury	O	\$3,900
C – Possible Injury	C	\$77,200
B – Non-incapacitati	B	\$151,100
A – Incapacitating	A	\$554,800
K – Killed	K	\$11,600,000
# accidents reported	# Accidents Reported (Unknown if Injure	\$159,800
U	U - Injured (Severity Unknown)	\$210,300
Injury Crash		\$302,600
Fatal Crash		\$12,837,400

Total Avg monetized value (\$2020) - no-build **\$186,017**  
 Total Avg monetized value (\$2020) - build **\$104,169**  
 Signalized Intersection CMF **0.56** <http://www.cmfclearinghouse.org/detail.cfm?facid=7981#commentanchor>

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Calendar Year	Project Year	Project Use Year	NO BUILD Monetized value	BUILD Monetized Value	Total	Total Benefit	Present Value (7% Discount Rate)
2023	1	0	\$0	\$0	\$0	\$0	\$0
2024	2	0	\$0	\$0	\$0	\$0	\$0
2025	3	0	\$0	\$0	\$0	\$0	\$0
2026	4	0	\$0	\$0	\$0	\$0	\$0
2027	5	1	\$186,017	\$104,169	\$81,847	\$81,847	\$50,970
2028	6	2	\$186,017	\$104,169	\$81,847	\$81,847	\$47,636
2029	7	3	\$186,017	\$104,169	\$81,847	\$81,847	\$44,520
2030	8	4	\$186,017	\$104,169	\$81,847	\$81,847	\$41,607
2031	9	5	\$186,017	\$104,169	\$81,847	\$81,847	\$38,885
2032	10	6	\$186,017	\$104,169	\$81,847	\$81,847	\$36,341
2033	11	7	\$186,017	\$104,169	\$81,847	\$81,847	\$33,964
2034	12	8	\$186,017	\$104,169	\$81,847	\$81,847	\$31,742
2035	13	9	\$186,017	\$104,169	\$81,847	\$81,847	\$29,665
2036	14	10	\$186,017	\$104,169	\$81,847	\$81,847	\$27,725
2037	15	11	\$186,017	\$104,169	\$81,847	\$81,847	\$25,911
2038	16	12	\$186,017	\$104,169	\$81,847	\$81,847	\$24,216
2039	17	13	\$186,017	\$104,169	\$81,847	\$81,847	\$22,631
2040	18	14	\$186,017	\$104,169	\$81,847	\$81,847	\$21,151
2041	19	15	\$186,017	\$104,169	\$81,847	\$81,847	\$19,767
2042	20	16	\$186,017	\$104,169	\$81,847	\$81,847	\$18,474
2043	21	17	\$186,017	\$104,169	\$81,847	\$81,847	\$17,265
2044	22	18	\$186,017	\$104,169	\$81,847	\$81,847	\$16,136
2045	23	19	\$186,017	\$104,169	\$81,847	\$81,847	\$15,080
2046	24	20	\$186,017	\$104,169	\$81,847	\$81,847	\$14,094
2047	25	21	\$186,017	\$104,169	\$81,847	\$81,847	\$13,172
2048	26	22	\$186,017	\$104,169	\$81,847	\$81,847	\$12,310
2049	27	23	\$186,017	\$104,169	\$81,847	\$81,847	\$11,505
2050	28	24	\$186,017	\$104,169	\$81,847	\$81,847	\$10,752
2051	29	25	\$186,017	\$104,169	\$81,847	\$81,847	\$10,049
2052	30	26	\$186,017	\$104,169	\$81,847	\$81,847	\$9,391
Total			\$4,836,433	\$2,708,403	\$2,128,031	\$2,128,031	\$644,958



Annual NoBuild Transit VMT	2,328,478	GoTriangle model results
Annual Build Transit VMT	2,268,665	GoTriangle model results
Annual Transit VMT saved	59,812	GoTriangle model results
Increased ridership		See Travel Time tab
Average Speed No Build	24.83333333	GoTriangle model results
Average Speed Build	27.16666667	
Average NB transit round trip mileage	33.92833333	
Average BUILD transit round trip mileage	32.39166667	

Assumed No-Build Speed	25 MPH
Build Speed	28 MPH

Grams to Metric Tons	1,000,000
1 metric ton is equal to 1,000,000 grams	

Calendar Year	Project Year	No-Build Transit VMT	Build Transit VMT	Metric Tons Emitted - Bus - No Build						Metric Tons Emitted - Bus - No Build					
				CO	CO2	NOX	PM2.5	SOX	VOC	CO	CO2	NOX	PM2.5	SOX	VOC
2023	1														
2024	2														
2025	3														
2026	4														
2027	5	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2028	6	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2029	7	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2030	8	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2031	9	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2032	10	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2033	11	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2034	12	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2035	13	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2036	14	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2037	15	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2038	16	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2039	17	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2040	18	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2041	19	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2042	20	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2043	21	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2044	22	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2045	23	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2046	24	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2047	25	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2048	26	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2049	27	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2050	28	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2051	29	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
2052	30	2,328,478	2,268,665	16.9	3,292.2	3.4	0.0	0.2	0.0	15.9	2,974.7	3.0	0.0	0.1	0.0
Total		60,540,418	58,985,301	439.3	85,596.8	87.7	0.6	4.3	0.7	414.5	77,341.7	78.3	0.6	3.7	0.6

Emission Savings						Damage Costs for Emissions per metric ton						Build Savings	
CO	CO2	NOX	PM2.5	SOX	VOC	CO	CO2	NOX	PM2.5	SOX	VOC	Total Non CO2 Savings	Total CO2 Savings
						\$101	\$54	\$16,000	\$774,700	\$43,100	\$1,415	\$0	\$0
						\$103	\$55	\$16,200	\$788,100	\$44,000	\$1,415	\$0	\$0
						\$105	\$56	\$16,500	\$801,700	\$44,900	\$1,415	\$0	\$0
						\$107	\$57	\$16,800	\$814,500	\$45,700	\$1,415	\$0	\$0
1.0	317.5	0.4	0.0	0.0	0.0	\$109	\$58	\$17,100	\$827,400	\$46,500	\$1,415	\$8,856	\$18,519
1.0	317.5	0.4	0.0	0.0	0.0	\$113	\$60	\$17,400	\$840,600	\$47,300	\$1,415	\$9,008	\$19,157
1.0	317.5	0.4	0.0	0.0	0.0	\$114	\$61	\$17,700	\$854,000	\$48,200	\$1,415	\$9,272	\$19,368
1.0	317.5	0.4	0.0	0.0	0.0	\$116	\$62	\$18,100	\$867,600	\$49,100	\$1,415	\$9,465	\$19,685
1.0	317.5	0.4	0.0	0.0	0.0	\$118	\$63	\$18,100	\$867,600	\$49,100	\$1,415	\$9,467	\$20,003
1.0	317.5	0.4	0.0	0.0	0.0	\$120	\$64	\$18,100	\$867,600	\$49,100	\$1,415	\$9,469	\$20,320
1.0	317.5	0.4	0.0	0.0	0.0	\$122	\$65	\$18,100	\$867,600	\$49,100	\$1,415	\$9,471	\$20,638
1.0	317.5	0.4	0.0	0.0	0.0	\$124	\$66	\$18,100	\$867,600	\$49,100	\$1,415	\$9,472	\$20,955
1.0	317.5	0.4	0.0	0.0	0.0	\$126	\$67	\$18,100	\$867,600	\$49,100	\$1,415	\$9,474	\$21,273
1.0	317.5	0.4	0.0	0.0	0.0	\$129	\$69	\$18,100	\$867,600	\$49,100	\$1,415	\$9,478	\$21,908
1.0	317.5	0.4	0.0	0.0	0.0	\$131	\$70	\$18,100	\$867,600	\$49,100	\$1,415	\$9,480	\$22,225
1.0	317.5	0.4	0.0	0.0	0.0	\$133	\$71	\$18,100	\$867,600	\$49,100	\$1,415	\$9,481	\$22,543
1.0	317.5	0.4	0.0	0.0	0.0	\$135	\$72	\$18,100	\$867,600	\$49,100	\$1,415	\$9,483	\$22,860
1.0	317.5	0.4	0.0	0.0	0.0	\$137	\$73	\$18,100	\$867,600	\$49,100	\$1,415	\$9,485	\$23,178
1.0	317.5	0.4	0.0	0.0	0.0	\$139	\$74	\$18,100	\$867,600	\$49,100	\$1,415	\$9,487	\$23,495
1.0	317.5	0.4	0.0	0.0	0.0	\$141	\$75	\$18,100	\$867,600	\$49,100	\$1,415	\$9,489	\$23,813
1.0	317.5	0.4	0.0	0.0	0.0	\$144	\$77	\$18,100	\$867,600	\$49,100	\$1,415	\$9,492	\$24,448
1.0	317.5	0.4	0.0	0.0	0.0	\$146	\$78	\$18,100	\$867,600	\$49,100	\$1,415	\$9,494	\$24,765
1.0	317.5	0.4	0.0	0.0	0.0	\$148	\$79	\$18,100	\$867,600	\$49,100	\$1,415	\$9,496	\$25,083
1.0	317.5	0.4	0.0	0.0	0.0	\$150	\$80	\$18,100	\$867,600	\$49,100	\$1,415	\$9,497	\$25,400
1.0	317.5	0.4	0.0	0.0	0.0	\$152	\$81	\$18,100	\$867,600	\$49,100	\$1,415	\$9,499	\$25,718
1.0	317.5	0.4	0.0	0.0	0.0	\$154	\$82	\$18,100	\$867,600	\$49,100	\$1,415	\$9,501	\$26,035
1.0	317.5	0.4	0.0	0.0	0.0	\$156	\$83	\$18,100	\$867,600	\$49,100	\$1,415	\$9,503	\$26,353
1.0	317.5	0.4	0.0	0.0	0.0	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415	\$9,506	\$26,988
1.0	317.5	0.4	0.0	0.0	0.0	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415	\$9,506	\$26,988
1.0	317.5	0.4	0.0	0.0	0.0	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415	\$9,506	\$26,988
24.8	8,255.1	9.4	0.1	0.6	0.1							\$245,338	\$598,706

Total (Benefit) *			
Total	Present Value (3% Discount Rate)*	Present Value (7% Discount Rate)*	Discounted Total
\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0
\$27,374	\$15,057	\$11,533	\$26,590
\$28,165	\$15,123	\$11,150	\$26,273
\$28,640	\$14,844	\$10,535	\$25,379
\$29,151	\$14,648	\$10,007	\$24,655
\$29,470	\$14,450	\$9,503	\$23,954
\$29,789	\$14,252	\$9,022	\$23,275
\$30,108	\$14,053	\$8,564	\$22,617
\$30,428	\$13,854	\$8,127	\$21,981
\$30,747	\$13,654	\$7,710	\$21,364
\$31,386	\$13,652	\$7,421	\$21,073
\$31,705	\$13,447	\$7,036	\$20,483
\$32,024	\$13,242	\$6,670	\$19,911
\$32,343	\$13,037	\$6,321	\$19,358
\$32,663	\$12,833	\$5,990	\$18,823
\$32,982	\$12,630	\$5,674	\$18,304
\$33,301	\$12,428	\$5,375	\$17,803
\$33,940	\$12,388	\$5,157	\$17,545
\$34,259	\$12,183	\$4,882	\$17,065
\$34,579	\$11,980	\$4,621	\$16,601
\$34,898	\$11,778	\$4,374	\$16,152
\$35,217	\$11,578	\$4,139	\$15,717
\$35,536	\$11,379	\$3,916	\$15,295
\$35,856	\$11,183	\$3,704	\$14,887
\$36,494	\$11,119	\$3,545	\$14,664
\$36,494	\$10,795	\$3,313	\$14,108
\$36,494	\$10,480	\$3,097	\$13,577
\$844,044	\$336,066	\$171,386	\$507,452

Damage Costs for Emissions per metric ton*						
Year	NOX	SO2	PM2.5	VOCs	CO2	CO
2021	\$15,600	\$41,500	\$748,600	\$1,415	\$52	\$98
2022	\$15,800	\$42,300	\$761,600	\$1,415	\$53	\$99
2023	\$16,000	\$43,100	\$774,700	\$1,415	\$54	\$101
2024	\$16,200	\$44,000	\$788,100	\$1,415	\$55	\$103
2025	\$16,500	\$44,900	\$801,700	\$1,415	\$56	\$105
2026	\$16,800	\$45,700	\$814,500	\$1,415	\$57	\$107
2027	\$17,100	\$46,500	\$827,400	\$1,415	\$58	\$109
2028	\$17,400	\$47,300	\$840,600	\$1,415	\$60	\$113
2029	\$17,700	\$48,200	\$854,000	\$1,415	\$61	\$114
2030	\$18,100	\$49,100	\$867,600	\$1,415	\$62	\$116
2031	\$18,100	\$49,100	\$867,600	\$1,415	\$63	\$118
2032	\$18,100	\$49,100	\$867,600	\$1,415	\$64	\$120
2033	\$18,100	\$49,100	\$867,600	\$1,415	\$65	\$122
2034	\$18,100	\$49,100	\$867,600	\$1,415	\$66	\$124
2035	\$18,100	\$49,100	\$867,600	\$1,415	\$67	\$126
2036	\$18,100	\$49,100	\$867,600	\$1,415	\$69	\$129
2037	\$18,100	\$49,100	\$867,600	\$1,415	\$70	\$131
2038	\$18,100	\$49,100	\$867,600	\$1,415	\$71	\$133
2039	\$18,100	\$49,100	\$867,600	\$1,415	\$72	\$135
2040	\$18,100	\$49,100	\$867,600	\$1,415	\$73	\$137
2041	\$18,100	\$49,100	\$867,600	\$1,415	\$74	\$139
2042	\$18,100	\$49,100	\$867,600	\$1,415	\$75	\$141
2043	\$18,100	\$49,100	\$867,600	\$1,415	\$77	\$144
2044	\$18,100	\$49,100	\$867,600	\$1,415	\$78	\$146
2045	\$18,100	\$49,100	\$867,600	\$1,415	\$79	\$148
2046	\$18,100	\$49,100	\$867,600	\$1,415	\$80	\$150
2047	\$18,100	\$49,100	\$867,600	\$1,415	\$81	\$152
2048	\$18,100	\$49,100	\$867,600	\$1,415	\$82	\$154
2049	\$18,100	\$49,100	\$867,600	\$1,415	\$83	\$156
2050	\$18,100	\$49,100	\$867,600	\$1,415	\$85	\$159

Sources  
NOX, SO2, PM2.5 [USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2022](#)  
VOC Sources: [McCubbin and Delucchi, 1996 for emissions other than CO2e](#)  
CO [Interagency Working Group on Social Cost of Carbon, United States Government, 2021 for CO2e](#)



Annual NoBuild Transit VMT	2,328,478
Annual Build Transit VMT	2,268,665
Annual Transit VMT saved	59,812
Increased ridership	
Average Speed No Build	24.833333
Average Speed Build	27.166667
Average NB transit round trip mileage	33.928333
Average BUILD transit round trip mileage	32.391667
Unlinked Trip Mileage	11.68
Unlinked Trip Percentage	9%

GoTriangle model results  
GoTriangle model results  
GoTriangle model results  
See Travel Time tab  
GoTriangle model results

Assumed No-Build Speed	25 MPH	Grams to Metric Tons	1,000,000
Build Speed	28 MPH	1 metric ton is equal to 1,000,000 grams	

Calendar Year	Project Year	No-Build Passenger Car VMT	Build Passenger Car VMT	Metric Tons Emitted -Car- No Build						Metric Tons Emitted - car - Build					
				2	3	4	6	7	8	2	3	4	6	7	8
				CO	CO2	NOX	PM2.5	SOX	VOC	CO	CO2	NOX	PM2.5	SOX	VOC
2023	1														
2024	2														
2025	3														
2026	4														
2027	5	11,545,241	11,038,560	13.2	3,832.9	0.8	0.04	0.3	0.02	12.2	3,510.8	0.8	0.03	0.2	0.02
2028	6	11,784,571	11,480,102	13.4	3,912.3	0.8	0.04	0.3	0.02	12.7	3,651.2	0.8	0.04	0.2	0.02
2029	7	12,023,933	11,939,306	13.7	3,991.8	0.9	0.04	0.3	0.02	13.2	3,797.3	0.8	0.04	0.3	0.02
2030	8	12,263,263	12,416,878	14.0	4,071.2	0.9	0.04	0.3	0.02	13.7	3,949.2	0.9	0.04	0.3	0.02
2031	9	12,502,625	12,913,553	14.3	4,150.7	0.9	0.04	0.3	0.02	14.3	4,107.2	0.9	0.04	0.3	0.02
2032	10	12,741,955	13,430,096	14.5	4,230.2	0.9	0.04	0.3	0.02	14.8	4,271.4	0.9	0.04	0.3	0.02
2033	11	12,981,317	13,520,336	14.8	4,309.6	0.9	0.04	0.3	0.02	14.9	4,300.1	0.9	0.04	0.3	0.02
2034	12	13,220,646	13,610,599	15.1	4,389.1	0.9	0.04	0.3	0.02	15.0	4,328.8	0.9	0.04	0.3	0.02
2035	13	13,459,976	13,700,831	15.4	4,468.5	1.0	0.04	0.3	0.02	15.1	4,357.5	1.0	0.04	0.3	0.02
2036	14	13,699,338	13,791,094	15.6	4,548.0	1.0	0.05	0.3	0.02	15.2	4,386.3	1.0	0.04	0.3	0.02
2037	15	13,938,668	13,881,326	15.9	4,627.4	1.0	0.05	0.3	0.03	15.3	4,415.0	1.0	0.04	0.3	0.02
2038	16	14,178,030	13,971,588	16.2	4,706.9	1.0	0.05	0.3	0.03	15.4	4,443.7	1.0	0.04	0.3	0.02
2039	17	14,417,360	14,061,820	16.5	4,786.4	1.0	0.05	0.3	0.03	15.5	4,472.4	1.0	0.04	0.3	0.02
2040	18	14,656,722	14,152,083	16.7	4,865.8	1.1	0.05	0.4	0.03	15.6	4,501.1	1.0	0.04	0.3	0.02
2041	19	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2042	20	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2043	21	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2044	22	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2045	23	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2046	24	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2047	25	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2048	26	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2049	27	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2050	28	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2051	29	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
2052	30	14,896,052	14,242,315	17.0	4,945.3	1.1	0.05	0.4	0.03	15.7	4,529.8	1.0	0.04	0.3	0.02
Total		362,166,268	354,815,947	413.2	120,234.2	26.0	1.20	8.8	0.65	391.8	112,849.1	24.70	1.1	7.6	0.57

Emission Savings						Damage Costs for Emissions per metric ton					
						7	6	2	4	3	5
CO	CO2	NOX	PM2.5	SOX	VOC	CO	CO2	NOX	PM2.5	SOX	VOC
						\$101	\$54	\$16,000	\$774,700	\$43,100	\$1,415
						\$103	\$55	\$16,200	\$788,100	\$44,000	\$1,415
						\$105	\$56	\$16,500	\$801,700	\$44,900	\$1,415
						\$107	\$57	\$16,800	\$814,500	\$45,700	\$1,415
1.0	322.0	0.1	0.0	0.0	0.0	\$109	\$58	\$17,100	\$827,400	\$46,500	\$1,415
0.8	261.1	0.0	0.0	0.0	0.0	\$113	\$60	\$17,400	\$840,600	\$47,300	\$1,415
0.5	194.5	0.0	0.0	0.0	0.0	\$114	\$61	\$17,700	\$854,000	\$48,200	\$1,415
0.3	122.0	0.0	0.0	0.0	0.0	\$116	\$62	\$18,100	\$867,600	\$49,100	\$1,415
0.0	43.5	0.0	0.0	0.0	0.0	\$118	\$63	\$18,100	\$867,600	\$49,100	\$1,415
-0.3	-41.3	0.0	0.0	0.0	0.0	\$120	\$64	\$18,100	\$867,600	\$49,100	\$1,415
-0.1	9.5	0.0	0.0	0.0	0.0	\$122	\$65	\$18,100	\$867,600	\$49,100	\$1,415
0.1	60.2	0.0	0.0	0.0	0.0	\$124	\$66	\$18,100	\$867,600	\$49,100	\$1,415
0.2	111.0	0.0	0.0	0.0	0.0	\$126	\$67	\$18,100	\$867,600	\$49,100	\$1,415
0.4	161.7	0.0	0.0	0.0	0.0	\$129	\$69	\$18,100	\$867,600	\$49,100	\$1,415
0.6	212.5	0.0	0.0	0.0	0.0	\$131	\$70	\$18,100	\$867,600	\$49,100	\$1,415
0.7	263.2	0.0	0.0	0.0	0.0	\$133	\$71	\$18,100	\$867,600	\$49,100	\$1,415
0.9	314.0	0.1	0.0	0.0	0.0	\$135	\$72	\$18,100	\$867,600	\$49,100	\$1,415
1.1	364.8	0.1	0.0	0.1	0.0	\$137	\$73	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$139	\$74	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$141	\$75	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$144	\$77	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$146	\$78	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$148	\$79	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$150	\$80	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$152	\$81	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$154	\$82	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$156	\$83	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415
1.3	415.5	0.1	0.0	0.1	0.0	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415
\$21	\$7,385	\$1	\$0	\$1	\$0						

Build Savings		Total (Benefit) *			Discounted Total
Total Non CO2 Savings	Total CO2 Savings	Total	Present Value (3% Discount Rate)*	Present Value (7% Discount Rate)*	
\$0	\$0	\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0	\$0	\$0
\$6,311	\$18,786	\$25,097	\$15,275	\$11,699	\$26,974
\$5,522	\$15,751	\$21,273	\$12,434	\$9,167	\$21,601
\$4,683	\$11,864	\$16,546	\$9,092	\$6,453	\$15,546
\$3,631	\$7,567	\$11,198	\$5,631	\$3,847	\$9,477
\$2,398	\$2,743	\$5,142	\$1,982	\$1,303	\$3,285
\$1,062	-\$2,642	-\$1,580	-\$1,853	-\$1,173	-\$3,026
\$1,913	\$616	\$2,530	\$420	\$256	\$675
\$2,765	\$3,975	\$6,740	\$2,628	\$1,541	\$4,169
\$3,617	\$7,436	\$11,053	\$4,773	\$2,695	\$7,468
\$4,471	\$11,160	\$15,631	\$6,954	\$3,780	\$10,735
\$5,325	\$14,874	\$20,199	\$8,999	\$4,709	\$13,708
\$6,179	\$18,691	\$24,870	\$10,979	\$5,530	\$16,509
\$7,034	\$22,608	\$29,643	\$12,893	\$6,251	\$19,145
\$7,890	\$26,628	\$34,518	\$14,743	\$6,881	\$21,624
\$8,746	\$30,748	\$39,495	\$16,529	\$7,426	\$23,955
\$8,749	\$31,164	\$39,913	\$16,264	\$7,034	\$23,298
\$8,754	\$31,995	\$40,748	\$16,212	\$6,749	\$22,961
\$8,756	\$32,410	\$41,166	\$15,944	\$6,390	\$22,333
\$8,758	\$32,826	\$41,584	\$15,678	\$6,048	\$21,726
\$8,761	\$33,241	\$42,002	\$15,414	\$5,724	\$21,138
\$8,763	\$33,657	\$42,420	\$15,152	\$5,416	\$20,568
\$8,765	\$34,072	\$42,838	\$14,892	\$5,125	\$20,017
\$8,768	\$34,488	\$43,256	\$14,635	\$4,848	\$19,483
\$8,773	\$35,319	\$44,092	\$14,551	\$4,640	\$19,191
\$8,773	\$35,319	\$44,092	\$14,127	\$4,336	\$18,463
\$8,773	\$35,319	\$44,092	\$13,716	\$4,053	\$17,768
<b>\$167,938</b>	<b>\$560,616</b>	<b>\$728,554</b>	<b>\$288,062</b>	<b>\$130,728</b>	<b>\$418,790</b>

	Damage Costs for Emissions per metric ton*					
	2	3	4	5	6	7
Year	NOX	SO2	PM2.5	VOCs	CO2	CO
2021	\$15,600	\$41,500	\$748,600	\$1,415	\$52	\$98
2022	\$15,800	\$42,300	\$761,600	\$1,415	\$53	\$99
2023	\$16,000	\$43,100	\$774,700	\$1,415	\$54	\$101
2024	\$16,200	\$44,000	\$788,100	\$1,415	\$55	\$103
2025	\$16,500	\$44,900	\$801,700	\$1,415	\$56	\$105
2026	\$16,800	\$45,700	\$814,500	\$1,415	\$57	\$107
2027	\$17,100	\$46,500	\$827,400	\$1,415	\$58	\$109
2028	\$17,400	\$47,300	\$840,600	\$1,415	\$60	\$113
2029	\$17,700	\$48,200	\$854,000	\$1,415	\$61	\$114
2030	\$18,100	\$49,100	\$867,600	\$1,415	\$62	\$116
2031	\$18,100	\$49,100	\$867,600	\$1,415	\$63	\$118
2032	\$18,100	\$49,100	\$867,600	\$1,415	\$64	\$120
2033	\$18,100	\$49,100	\$867,600	\$1,415	\$65	\$122
2034	\$18,100	\$49,100	\$867,600	\$1,415	\$66	\$124
2035	\$18,100	\$49,100	\$867,600	\$1,415	\$67	\$126
2036	\$18,100	\$49,100	\$867,600	\$1,415	\$69	\$129
2037	\$18,100	\$49,100	\$867,600	\$1,415	\$70	\$131
2038	\$18,100	\$49,100	\$867,600	\$1,415	\$71	\$133
2039	\$18,100	\$49,100	\$867,600	\$1,415	\$72	\$135
2040	\$18,100	\$49,100	\$867,600	\$1,415	\$73	\$137
2041	\$18,100	\$49,100	\$867,600	\$1,415	\$74	\$139
2042	\$18,100	\$49,100	\$867,600	\$1,415	\$75	\$141
2043	\$18,100	\$49,100	\$867,600	\$1,415	\$77	\$144
2044	\$18,100	\$49,100	\$867,600	\$1,415	\$78	\$146
2045	\$18,100	\$49,100	\$867,600	\$1,415	\$79	\$148
2046	\$18,100	\$49,100	\$867,600	\$1,415	\$80	\$150
2047	\$18,100	\$49,100	\$867,600	\$1,415	\$81	\$152
2048	\$18,100	\$49,100	\$867,600	\$1,415	\$82	\$154
2049	\$18,100	\$49,100	\$867,600	\$1,415	\$83	\$156
2050	\$18,100	\$49,100	\$867,600	\$1,415	\$85	\$159

Sources

NOX, SO2, PM: USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2022

VOC Sources: McCubbin and Delucchi, 1996 for emissions other than CO2e

CO Interagency Working Group on Social Cost of Carbon, United States Government, 2021 for CO2e

Annual NoBuild Transit VMT	2,328,478	GoTriangle model results
Annual Build Transit VMT	2,268,665	GoTriangle model results
Daily Transit VMT saved	59,812	GoTriangle model results
Increased ridership		See Travel Time tab
Average Speed No Build	24.833333	GoTriangle model results
Average Speed Build	27.166667	
Average NB transit round trip mileage	33.928333	
Average BUILD transit round trip mileage	32.391667	

Assuming 2 electric veh in fleet (no build)	9% % electric			
Assuming 8 electric veh in fleet (build)	36% % Electric	Assumed No-Build Speed	25 MPH	Grams to Metric Tons 1,000,000
		Build Speed	28 MPH	1 metric ton is equal to 1,000,000 grams

		No Build Emissions															
		No-Build Transit VMT	Build Transit VMT	Metric Tons Emitted - Bus - No Build						Metric Tons Emitted - Bus - No Build							
				2	3	4	6	7	8	2	3	4	6	7	8		
Calendar Year	Project Year			CO	CO2	NOX	PM2.5	SOX	VOC	CO	CO2	NOX	PM2.5	SOX	VOC		
2023	1																
2024	2																
2025	3																
2026	4																
2027	5	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2028	6	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2029	7	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2030	8	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2031	9	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2032	10	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2033	11	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2034	12	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2035	13	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2036	14	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2037	15	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2038	16	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2039	17	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2040	18	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2041	19	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2042	20	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2043	21	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2044	22	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2045	23	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2046	24	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2047	25	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2048	26	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2049	27	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2050	28	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2051	29	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
2052	30	2,116,798	1,443,696	15.4	2,992.9	3.1	0.021	0.15	0.023	10.1	1,893.0	1.92	0.014	0.09	0.014		
Total		55,036,744	37,536,101	399.34	77,815.24	79.75	0.56	3.87	0.60	264	49,217	50	0.357	2	0.375		



Build Emissions

Emission Savings						Damage Costs for Emissions per metric ton					
Bus						7	6	2	4	3	5
CO	CO2	NOX	PM2.5	SOX	VOC	CO	CO2	NOX	PM2.5	SOX	VOC
						\$101	\$54	\$16,000	\$774,700	\$43,100	\$1,415
						\$103	\$55	\$16,200	\$788,100	\$44,000	\$1,415
						\$105	\$56	\$16,500	\$801,700	\$44,900	\$1,415
						\$107	\$57	\$16,800	\$814,500	\$45,700	\$1,415
5.2	1099.9	1.2	0.008	0.06	0.01	\$109	\$58	\$17,100	\$827,400	\$46,500	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$113	\$60	\$17,400	\$840,600	\$47,300	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$114	\$61	\$17,700	\$854,000	\$48,200	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$116	\$62	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$118	\$63	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$120	\$64	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$122	\$65	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$124	\$66	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$126	\$67	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$129	\$69	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$131	\$70	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$133	\$71	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$135	\$72	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$137	\$73	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$139	\$74	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$141	\$75	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$144	\$77	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$146	\$78	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$148	\$79	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$150	\$80	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$152	\$81	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$154	\$82	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$156	\$83	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415
5.2	1099.9	1.2	0.0	0.06	0.01	\$159	\$85	\$18,100	\$867,600	\$49,100	\$1,415
135.56	28,597.82	29.93	0.20	1.52	0.22	3,951	2,107	534,000	25,655,800	1,449,000	42,450

Build Savings		Total (Benefit) *			Discounted Total
Total Non CO2 Savings	Total CO2 Savings	Total	Present Value (3% Discount Rate)*	Present Value (7% Discount Rate)*	
\$0	\$0	\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0	\$0	\$0
\$0	\$0	\$0	\$0	\$0	\$0
\$28,766	\$64,362	\$93,128	\$52,332	\$23,389	\$75,722
\$29,259	\$66,582	\$95,841	\$52,560	\$23,098	\$75,658
\$30,356	\$67,095	\$97,451	\$51,423	\$23,266	\$74,688
\$30,984	\$68,195	\$99,179	\$50,743	\$23,055	\$73,798
\$30,994	\$69,295	\$100,288	\$50,060	\$22,390	\$72,450
\$31,003	\$70,395	\$101,398	\$49,373	\$21,745	\$71,118
\$31,013	\$71,495	\$102,508	\$48,684	\$21,118	\$69,803
\$31,023	\$72,594	\$103,617	\$47,993	\$20,510	\$68,503
\$31,033	\$73,694	\$104,727	\$47,302	\$19,919	\$67,220
\$31,052	\$75,894	\$106,946	\$47,295	\$19,351	\$66,645
\$31,062	\$76,994	\$108,056	\$46,583	\$18,793	\$65,376
\$31,072	\$78,094	\$109,166	\$45,872	\$18,251	\$64,123
\$31,082	\$79,194	\$110,275	\$45,163	\$17,725	\$62,889
\$31,091	\$80,294	\$111,385	\$44,457	\$17,214	\$61,671
\$31,101	\$81,394	\$112,495	\$43,753	\$16,718	\$60,472
\$31,111	\$82,494	\$113,605	\$43,053	\$16,237	\$59,289
\$31,130	\$84,694	\$115,824	\$42,914	\$15,774	\$58,687
\$31,140	\$85,793	\$116,934	\$42,205	\$15,319	\$57,524
\$31,150	\$86,893	\$118,043	\$41,501	\$14,877	\$56,378
\$31,160	\$87,993	\$119,153	\$40,802	\$14,449	\$55,251
\$31,169	\$89,093	\$120,263	\$40,109	\$14,032	\$54,141
\$31,179	\$90,193	\$121,372	\$39,421	\$13,628	\$53,049
\$31,189	\$91,293	\$122,482	\$38,740	\$13,235	\$51,975
\$31,209	\$93,493	\$124,701	\$38,518	\$12,858	\$51,375
\$31,209	\$93,493	\$124,701	\$37,396	\$12,483	\$49,879
\$31,209	\$93,493	\$124,701	\$36,307	\$12,119	\$48,426
\$803,745	\$2,074,495	\$2,878,241	\$1,164,558	\$461,553	\$1,626,111

Year	Damage Costs for Emissions per metric ton*					
	2	3	4	5	6	7
	NOX	SO2	PM2.5	VOCs	CO2	CO
2021	\$15,600	\$41,500	\$748,600	\$1,415	\$52	\$98
2022	\$15,800	\$42,300	\$761,600	\$1,415	\$53	\$99
2023	\$16,000	\$43,100	\$774,700	\$1,415	\$54	\$101
2024	\$16,200	\$44,000	\$788,100	\$1,415	\$55	\$103
2025	\$16,500	\$44,900	\$801,700	\$1,415	\$56	\$105
2026	\$16,800	\$45,700	\$814,500	\$1,415	\$57	\$107
2027	\$17,100	\$46,500	\$827,400	\$1,415	\$58	\$109
2028	\$17,400	\$47,300	\$840,600	\$1,415	\$60	\$113
2029	\$17,700	\$48,200	\$854,000	\$1,415	\$61	\$114
2030	\$18,100	\$49,100	\$867,600	\$1,415	\$62	\$116
2031	\$18,100	\$49,100	\$867,600	\$1,415	\$63	\$118
2032	\$18,100	\$49,100	\$867,600	\$1,415	\$64	\$120
2033	\$18,100	\$49,100	\$867,600	\$1,415	\$65	\$122
2034	\$18,100	\$49,100	\$867,600	\$1,415	\$66	\$124
2035	\$18,100	\$49,100	\$867,600	\$1,415	\$67	\$126
2036	\$18,100	\$49,100	\$867,600	\$1,415	\$69	\$129
2037	\$18,100	\$49,100	\$867,600	\$1,415	\$70	\$131
2038	\$18,100	\$49,100	\$867,600	\$1,415	\$71	\$133
2039	\$18,100	\$49,100	\$867,600	\$1,415	\$72	\$135
2040	\$18,100	\$49,100	\$867,600	\$1,415	\$73	\$137
2041	\$18,100	\$49,100	\$867,600	\$1,415	\$74	\$139
2042	\$18,100	\$49,100	\$867,600	\$1,415	\$75	\$141
2043	\$18,100	\$49,100	\$867,600	\$1,415	\$77	\$144
2044	\$18,100	\$49,100	\$867,600	\$1,415	\$78	\$146
2045	\$18,100	\$49,100	\$867,600	\$1,415	\$79	\$148
2046	\$18,100	\$49,100	\$867,600	\$1,415	\$80	\$150
2047	\$18,100	\$49,100	\$867,600	\$1,415	\$81	\$152
2048	\$18,100	\$49,100	\$867,600	\$1,415	\$82	\$154
2049	\$18,100	\$49,100	\$867,600	\$1,415	\$83	\$156
2050	\$18,100	\$49,100	\$867,600	\$1,415	\$85	\$159

Sources

NOX, SO2, PM2 [USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2022](#)

VOC [Sources: McCubbin and Delucchi, 1996 for emissions other than CO2e](#)

CO [Interagency Working Group on Social Cost of Carbon, United States Government, 2021 for CO2e](#)

Light Duty Vehicles \$ 0.45 per mile USDOT BENEFIT COST GUIDANCE

Calendar Year	Project Year	No-Build		Vehicle Operating Costs		Vehicle Operating Cost Savings	
		Passenger Car VMT	Build Passenger Car VMT	No-Build	Build	Total Benefit	Present Value (7% Discount Rate)
2023	1	0	0	\$0	\$0	\$0	\$0
2024	2	0	0	\$0	\$0	\$0	\$0
2025	3	0	0	\$0	\$0	\$0	\$0
2026	4	0	0	\$0	\$0	\$0	\$0
2027	5	11,545,241	11,038,560	\$5,195,358	\$4,967,352	\$228,007	\$141,991
2028	6	11,784,571	11,480,102	\$5,303,057	\$5,166,046	\$137,011	\$79,742
2029	7	12,023,933	11,939,306	\$5,410,770	\$5,372,688	\$38,082	\$20,714
2030	8	12,263,263	12,416,878	\$5,518,468	\$5,587,595	-\$69,127	-\$35,141
2031	9	12,502,625	12,913,553	\$5,626,181	\$5,811,099	-\$184,918	-\$87,853
2032	10	12,741,955	13,430,096	\$5,733,880	\$6,043,543	-\$309,663	-\$137,494
2033	11	12,981,317	13,520,336	\$5,841,592	\$6,084,151	-\$242,559	-\$100,653
2034	12	13,220,646	13,610,599	\$5,949,291	\$6,124,770	-\$175,479	-\$68,054
2035	13	13,459,976	13,700,831	\$6,056,989	\$6,165,374	-\$108,385	-\$39,284
2036	14	13,699,338	13,791,094	\$6,164,702	\$6,205,992	-\$41,290	-\$13,986
2037	15	13,938,668	13,881,326	\$6,272,401	\$6,246,597	\$25,804	\$8,169
2038	16	14,178,030	13,971,588	\$6,380,114	\$6,287,215	\$92,899	\$27,485
2039	17	14,417,360	14,061,820	\$6,487,812	\$6,327,819	\$159,993	\$44,239
2040	18	14,656,722	14,152,083	\$6,595,525	\$6,368,437	\$227,088	\$58,684
2041	19	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$71,049
2042	20	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$66,401
2043	21	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$62,057
2044	22	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$57,997
2045	23	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$54,203
2046	24	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$50,657
2047	25	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$47,343
2048	26	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$44,246
2049	27	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$41,351
2050	28	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$38,646
2051	29	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$36,118
2052	30	14,896,052	14,242,315	\$6,703,223	\$6,409,042	\$294,182	\$33,755
Total		362,166,268	354,815,947	\$162,974,821	\$159,667,176	\$3,307,644	\$502,380

	Value	unit	Source
In-Vehicle Travel Time: All	\$17.80	per hour	BCA Standard Values
Operations Costs (per revenue hour)	144.00	per revenue hour	GoTriangle 2022 data
Average Weekday boardings (2019)	1027	passengers	2019 Existing Conditions Study
Average Weekday Boardings (2040)	1550		GoTriangle 2022 data
Average transit time saved per one-way trip	3.50	minutes	GoTriangle service model results
Annual Ridership Increase	2%	annually	Average annual increase in boardings from 2010-2019 (GoTriangle historic data)
Initial Ridership Bump	4%		Assumes Double annual ridership for the first 5 years of the new transit
Assumed rides per year, per passenger	300	annually	260 weekdays, plus 0.92 X 52 to account for Sat/Sun decreased ridership (Sat+Sunday equals 92% of weekday ridership, according to GoTriangle Data), minus 5 days of no service (260+45-4=300)
Estimated drive time saved per one-way trip	1	minutes	GoTriangle service model results
Assumed share of Park-and-Ride users	10%		GoTriangle data

Calendar Year	Project Year	No-Build Passenger Trips	Build Passenger Trips	Annual Hourly Savings	Passenger Travel Time Savings	
					Total Benefit	7% Discount
2023	1	337986	337986	0.0	\$ -	\$ -
2024	2	345457	345457	0.0	\$ -	\$ -
2025	3	352929	352929	0.0	\$ -	\$ -
2026	4	360400	360400	0.0	\$ -	\$ -
2027	5	367871	374816	17.5	\$ 389,184	\$ 242,364
2028	6	375343	389809	17.5	\$ 404,751	\$ 235,569
2029	7	382814	405401	17.5	\$ 420,941	\$ 228,964
2030	8	390286	421617	17.5	\$ 437,779	\$ 222,545
2031	9	397757	438482	17.5	\$ 455,290	\$ 216,305
2032	10	405229	441428	17.5	\$ 458,349	\$ 203,513
2033	11	412700	444375	17.5	\$ 461,409	\$ 191,468
2034	12	420171	447321	17.5	\$ 464,468	\$ 180,129
2035	13	427643	450268	17.5	\$ 467,528	\$ 169,454
2036	14	435114	453214	17.5	\$ 470,587	\$ 159,404
2037	15	442586	456161	17.5	\$ 473,647	\$ 149,945
2038	16	450057	459107	17.5	\$ 476,706	\$ 141,040
2039	17	457529	462054	17.5	\$ 479,766	\$ 132,659
2040	18	465000	465000	17.5	\$ 482,825	\$ 124,771
2041	19	465000	465000	17.5	\$ 482,825	\$ 116,609
2042	20	465000	465000	17.5	\$ 482,825	\$ 108,980
2043	21	465000	465000	17.5	\$ 482,825	\$ 101,850
2044	22	465000	465000	17.5	\$ 482,825	\$ 95,187
2045	23	465000	465000	17.5	\$ 482,825	\$ 88,960
2046	24	465000	465000	17.5	\$ 482,825	\$ 83,140
2047	25	465000	465000	17.5	\$ 482,825	\$ 77,701
2048	26	465000	465000	17.5	\$ 482,825	\$ 72,618
2049	27	465000	465000	17.5	\$ 482,825	\$ 67,867
2050	28	465000	465000	17.5	\$ 482,825	\$ 63,427
2051	29	465000	465000	17.5	\$ 482,825	\$ 59,278
2052	30	465000	465000	17.5	\$ 482,825	\$ 55,400
Total		12806872	13,085,824	455	12,137,133	3,589,148

	Value	unit	Source
In-Vehicle Travel Time: All	\$17.80	per hour	BCA Standard Values
Operations Costs (per revenue hour)	144.00	per revenue hour	GoTriangle 2022 data
Average Weekday boardings (2019)	1027	passengers	2019 Existing Conditions Study
Average Weekday Boardings (2040)	1550		GoTriangle 2022 data
Average transit time saved per one-way trip	3.50	minutes	GoTriangle service model results
Annual Ridership Increase	2%	annually	Average annual increase in boardings from 2010-2019 (GoTriangle historic data)
Initial Ridership Bump	4%		Assumes Double annual ridership for the first 5 years of the new transit
Assumed rides per year, per park and ride passenger	260	annually	260 weekdays,
Estimated drive time saved per one-way trip	1	minutes	GoTriangle service model results
Assumed share of Park-and-Ride users	10%		GoTriangle data



Calendar Year    Project Year		No-Build Passenger Trips	Build Passenger Trips	Drive time saved per passenger			
				Annual Park- and-Ride Users	Drive Time Savings per round trip	Total Benefit	7% Discount
2023	1	292921	292921	29292	0	\$0.00	\$0.00
2024	2	299396	299396	29940	0	\$0.00	\$0.00
2025	3	305871	305871	30587	0	\$0.00	\$0.00
2026	4	312347	312347	31235	0	\$0.00	\$0.00
2027	5	318822	324841	32484	0.0333	\$19,274	\$12,003
2028	6	325297	337835	33783	0.0333	\$20,045	\$11,666
2029	7	331772	351348	35135	0.0333	\$20,847	\$11,339
2030	8	338248	365402	36540	0.0333	\$21,681	\$11,021
2031	9	344723	380018	38002	0.0333	\$22,548	\$10,712
2032	10	351198	382571	38257	0.0333	\$22,699	\$10,079
2033	11	357673	385125	38513	0.0333	\$22,851	\$9,482
2034	12	364149	387679	38768	0.0333	\$23,002	\$8,921
2035	13	370624	390232	39023	0.0333	\$23,154	\$8,392
2036	14	377099	392786	39279	0.0333	\$23,305	\$7,894
2037	15	383574	395339	39534	0.0333	\$23,457	\$7,426
2038	16	390050	397893	39789	0.0333	\$23,608	\$6,985
2039	17	396525	400446	40045	0.0333	\$23,760	\$6,570
2040	18	403000	403000	40300	0.0333	\$23,911	\$6,179
2041	19	403000	403000	40300	0.0333	\$23,911	\$5,775
2042	20	403000	403000	40300	0.0333	\$23,911	\$5,397
2043	21	403000	403000	40300	0.0333	\$23,911	\$5,044
2044	22	403000	403000	40300	0.0333	\$23,911	\$4,714
2045	23	403000	403000	40300	0.0333	\$23,911	\$4,406
2046	24	403000	403000	40300	0.0333	\$23,911	\$4,117
2047	25	403000	403000	40300	0.0333	\$23,911	\$3,848
2048	26	403000	403000	40300	0.0333	\$23,911	\$3,596
2049	27	403000	403000	40300	0.0333	\$23,911	\$3,361
2050	28	403000	403000	40300	0.0333	\$23,911	\$3,141
2051	29	403000	403000	40300	0.0333	\$23,911	\$2,936
2052	30	403000	403000	40300	0.0333	\$23,911	\$2,744
Total		11,099,289	11,341,049	1,134,105	0.867	601,077	177,748

	Value	unit	Source
In-Vehicle Travel Time: All	\$17.80	per hour	BCA Standard Values
Operations Costs (per revenue hour)	144.00	per revenue hour	GoTriangle 2022 data
Average Weekday boardings (2019)	1027	passengers	2019 Existing Conditions Study
Average Weekday Boardings (2040)	1550		GoTriangle 2022 data
Average transit time saved per one-way trip	3.50	minutes	GoTriangle service model results
Annual Ridership Increase	2%	annually	Average annual increase in boardings from 2010-2019 (GoTriangle historic data)
Initial Ridership Bump	4%		Assumes Double rate of annual ridership growth for the first 5 years of the new transit facility
Assumed rides per year, per passenger	300	annually	260 weekdays, plus 0.92 X 52 to account for Sat/Sun decreased ridership (Sat+Sunday equals 92% of weekday ridership, according to GoTriangle Data), minus 5 days of no service (260+45-4=300)
Estimated drive time saved per one-way trip	1	minutes	GoTriangle service model results
Assumed share of Park-and-Ride users	10%		GoTriangle data

Annual Transit Revenue Service Hours					Operations Costs Per Revenue Hour				
Calendar Year	Project Year	No Build	Build	Benefit	Operations Costs (per revenue hour)	No Build	Build	Total Benefit	7% Discount
2023	1	115,348	104,638	10,710					
2024	2	115,348	104,638	10,710					
2025	3	115,348	104,638	10,710					
2026	4	115,348	104,638	10,710					
2027	5	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 960,430
2028	6	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 897,598
2029	7	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 838,876
2030	8	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 783,997
2031	9	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 732,707
2032	10	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 684,773
2033	11	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 639,975
2034	12	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 598,107
2035	13	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 558,979
2036	14	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 522,410
2037	15	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 488,234
2038	16	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 456,293
2039	17	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 426,442
2040	18	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 398,544
2041	19	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 372,471
2042	20	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 348,104
2043	21	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 325,331
2044	22	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 304,047
2045	23	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 284,156
2046	24	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 265,567
2047	25	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 248,193
2048	26	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 231,956
2049	27	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 216,782
2050	28	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 202,600
2051	29	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 189,345
2052	30	115,348	104,638	10,710	\$144.00	#####	\$ 15,067,872	\$ 1,542,240	\$ 176,958
Total		3,460,440	3,139,140	321,300	3,744	431,862,912	391,764,672	40,098,240	12,152,875

Calendar Year	Project Year	Annual User Trips		Transit Amenity Benefits		Present Value (7% Discount Rate)	
		No-Build	Build	No-Build	Build	Total Benefit	
2023	1	337,986	337,986	\$681,379	\$681,379	\$0	\$0
2024	2	345,457	345,457	\$696,441	\$696,441	\$0	\$0
2025	3	352,929	352,929	\$711,505	\$711,505	\$0	\$0
2026	4	360,400	360,400	\$726,566	\$726,566	\$0	\$0
2027	5	367,871	374,816	\$741,628	\$1,150,685	\$409,057	\$254,740
2028	6	375,343	389,809	\$756,691	\$1,196,713	\$440,021	\$256,096
2029	7	382,814	405,401	\$771,753	\$1,244,581	\$472,828	\$257,187
2030	8	390,286	421,617	\$786,817	\$1,294,364	\$507,548	\$258,012
2031	9	397,757	438,482	\$801,878	\$1,346,139	\$544,261	\$258,574
2032	10	405,229	441,428	\$816,942	\$1,355,184	\$538,242	\$238,986
2033	11	412,700	444,375	\$832,003	\$1,364,231	\$532,228	\$220,856
2034	12	420,171	447,321	\$847,065	\$1,373,275	\$526,211	\$204,074
2035	13	427,643	450,268	\$862,128	\$1,382,323	\$520,194	\$188,542
2036	14	435,114	453,214	\$877,190	\$1,391,367	\$514,177	\$174,170
2037	15	442,586	456,161	\$892,253	\$1,400,414	\$508,161	\$160,871
2038	16	450,057	459,107	\$907,315	\$1,409,458	\$502,144	\$148,566
2039	17	457,529	462,054	\$922,378	\$1,418,506	\$496,127	\$137,183
2040	18	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$126,654
2041	19	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$118,368
2042	20	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$110,624
2043	21	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$103,387
2044	22	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$96,624
2045	23	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$90,302
2046	24	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$84,395
2047	25	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$78,874
2048	26	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$73,714
2049	27	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$68,891
2050	28	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$64,384
2051	29	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$60,172
2052	30	465,000	465,000	\$937,440	\$1,427,550	\$490,110	\$56,236
Total		12,806,872	13,085,824	#####	\$38,701,283	\$12,882,629	\$3,890,482

Included Scenario	Amenity	Value
NB B	Electric Real-Time Info Dis	\$0.29
NB B	Platform Seating	\$0.18
NB B	Platform Weather Protecti	\$0.24
NB B	Restroom Availability	\$0.10
NB B	Timetables	\$0.22
B	Surveillance Cameras	\$0.29
NB B	Ticket Machines	\$0.10
NB B	Information / Emergency E	\$0.22
B	PA System	\$0.29
NB B	Temperature Controlled Er	\$0.59
NB B	Step-Free Access to Statio	\$0.30
B	Bike Facilities	\$0.09
B	Car Access Facilities	\$0.11
B	Taxi Pickup/Dropoff	\$0.05
Assumed Existing Amenity Benefit		90%

Estimated value within 1/4 mile     \$     267,040,924

Local GIS data  
<http://www.reconnectingamerica.org/assets/Uploads/ctodvalcapture110508v2.pdf>  
<https://digital.lib.washington.edu/researchworks/handle/1773/34203>  
Based on TOD/Transit Center Premimu increase of 11% (conservatively reduced to a one-time benefit of 1/4 of this value)

Property Value Premium Range  
10.6% within 1500 ft     Rail  
17% within 500 ft     Rapid Transit  
11% within 1890 ft     Transit Center

One-time increase w/in 1/4 mile     2.8%

Calendar Year	Project Year	No-BUILD Estimated property Value 1/4 mile	BUILD Estimated Property Value	Benefit	Present Value (7% Discount Rate)
2023	1				
2024	2				
2025	3				
2026	4				
2027	5	\$267,040,924	\$274,384,549	\$7,343,625	\$4,573,241
Total			\$274,384,549	\$7,343,625	\$4,573,241

Cost per VMT			
Light Duty Vehicles - Congestion	\$ 0.12	per mile	USDOT BENEFIT COST GUIDANCE
Light Duty Vehicles - Noise	\$ 0.00	per mile	USDOT BENEFIT COST GUIDANCE
Bus - Congestion	\$ 0.31	per mile	USDOT BENEFIT COST GUIDANCE
Bus Noise	\$ 0.04	per mile	USDOT BENEFIT COST GUIDANCE
Pavement costs	\$ 0.18	per mile	USDOT BENEFIT COST GUIDANCE (Hihgway Allocation Study, scaled with CPI to 2020 costs)

Calendar Year	Project Year	Annual User VMT				External Costs		Present Value (7% Discount Rate)	
		No-Build Car	No-Build Bus	Build Car	Build Bus	No-Build	Build	Total Benefit	
2023	1	0			0	\$0	\$0	\$0	\$0
2024	2	0			0	\$0	\$0	\$0	\$0
2025	3	0			0	\$0	\$0	\$0	\$0
2026	4	0			0	\$0	\$0	\$0	\$0
2027	5	11,545,241	2,328,478	11,038,560	2,268,665	#####	\$4,515,546	\$184,008	\$114,591
2028	6	11,784,571	2,328,478	11,480,102	2,268,665	#####	\$4,648,543	\$123,099	\$71,645
2029	7	12,023,933	2,328,478	11,939,306	2,268,665	#####	\$4,786,860	\$56,881	\$30,939
2030	8	12,263,263	2,328,478	12,416,878	2,268,665	#####	\$4,930,709	-\$14,880	-\$7,564
2031	9	12,502,625	2,328,478	12,913,553	2,268,665	#####	\$5,080,313	-\$92,386	-\$43,892
2032	10	12,741,955	2,328,478	13,430,096	2,268,665	#####	\$5,235,901	-\$175,885	-\$78,095
2033	11	12,981,317	2,328,478	13,520,336	2,268,665	#####	\$5,263,082	-\$130,968	-\$54,347
2034	12	13,220,646	2,328,478	13,610,599	2,268,665	#####	\$5,290,270	-\$86,068	-\$33,379
2035	13	13,459,976	2,328,478	13,700,831	2,268,665	#####	\$5,317,449	-\$41,158	-\$14,917
2036	14	13,699,338	2,328,478	13,791,094	2,268,665	#####	\$5,344,637	\$3,752	\$1,271
2037	15	13,938,668	2,328,478	13,881,326	2,268,665	#####	\$5,371,816	\$48,662	\$15,405
2038	16	14,178,030	2,328,478	13,971,588	2,268,665	#####	\$5,399,004	\$93,572	\$27,685
2039	17	14,417,360	2,328,478	14,061,820	2,268,665	#####	\$5,426,182	\$138,482	\$38,292
2040	18	14,656,722	2,328,478	14,152,083	2,268,665	#####	\$5,453,370	\$183,393	\$47,392
2041	19	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$55,138
2042	20	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$51,531
2043	21	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$48,160
2044	22	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$45,009
2045	23	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$42,065
2046	24	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$39,313
2047	25	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$36,741
2048	26	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$34,337
2049	27	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$32,091
2050	28	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$29,991
2051	29	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$28,029
2052	30	14,896,052	2,328,478	14,242,315	2,268,665	#####	\$5,480,549	\$228,302	\$26,196
Total		#####	60,540,418	#####	58,985,301	#####	\$137,830,272	\$3,030,133	\$583,625



	Residual	40 Year	75 year	
	Calculation	lifespan	lifespan	ROW
	Construction Cost	\$4,735,741	\$6,832,433	\$3,057,036
	Design Service Life (years)	40	75	100
	Age (years)	26	26	26
	Residual ratio at end of analysis (linear depreciation)	0.350	0.653	0.740
	Residual Value at end of analysis	\$1,657,509	\$4,463,856	\$2,262,206

Construction Costs (Cost)			
Calendar Year	Project Year	Project Cost	Present Value (7% Discount Rate)
2023	1	\$0	\$0
2024	2	\$0	\$0
2025	3	\$13,962,506	\$9,955,074
2026	4	\$13,962,506	\$9,303,807
2027	5	\$0	\$0
2028	6	\$0	\$0
2029	7	\$0	\$0
2030	8	\$0	\$0
2031	9	\$0	\$0
2032	10	\$0	\$0
2033	11	\$0	\$0
2034	12	\$0	\$0
2035	13	\$0	\$0
2036	14	\$0	\$0
2037	15	\$0	\$0
2038	16	\$0	\$0
2039	17	\$0	\$0
2040	18	\$0	\$0
2041	19	\$0	\$0
2042	20	\$0	\$0
2043	21	\$0	\$0
2044	22	\$0	\$0
2045	23	\$0	\$0
2046	24	\$0	\$0
2047	25	\$0	\$0
2048	26	\$0	\$0
2049	27	\$0	\$0
2050	28	\$0	\$0
2051	29	\$0	\$0
2052	30	\$0	\$0
Total		\$27,925,012	\$19,258,881

Residual Value (Benefit)						
Calendar Year	Project Year	30 Year Lifespan	75 Year Lifespan	ROW	Total Benefit	Present Value (7% Discount Rate)
2023	1	\$0	\$0	\$0	\$0	\$0
2024	2	\$0	\$0	\$0	\$0	\$0
2025	3	\$0	\$0	\$0	\$0	\$0
2026	4	\$0	\$0	\$0	\$0	\$0
2027	5	\$0	\$0	\$0	\$0	\$0
2028	6	\$0	\$0	\$0	\$0	\$0
2029	7	\$0	\$0	\$0	\$0	\$0
2030	8	\$0	\$0	\$0	\$0	\$0
2031	9	\$0	\$0	\$0	\$0	\$0
2032	10	\$0	\$0	\$0	\$0	\$0
2033	11	\$0	\$0	\$0	\$0	\$0
2034	12	\$0	\$0	\$0	\$0	\$0
2035	13	\$0	\$0	\$0	\$0	\$0
2036	14	\$0	\$0	\$0	\$0	\$0
2037	15	\$0	\$0	\$0	\$0	\$0
2038	16	\$0	\$0	\$0	\$0	\$0
2039	17	\$0	\$0	\$0	\$0	\$0
2040	18	\$0	\$0	\$0	\$0	\$0
2041	19	\$0	\$0	\$0	\$0	\$0
2042	20	\$0	\$0	\$0	\$0	\$0
2043	21	\$0	\$0	\$0	\$0	\$0
2044	22	\$0	\$0	\$0	\$0	\$0
2045	23	\$0	\$0	\$0	\$0	\$0
2046	24	\$0	\$0	\$0	\$0	\$0
2047	25	\$0	\$0	\$0	\$0	\$0
2048	26	\$0	\$0	\$0	\$0	\$0
2049	27	\$0	\$0	\$0	\$0	\$0
2050	28	\$0	\$0	\$0	\$0	\$0
2051	29	\$0	\$0	\$0	\$0	\$0
2052	30	\$1,657,509	\$4,463,856	\$2,262,206	\$8,383,572	\$961,941
		\$1,657,509	\$4,463,856	\$2,262,206	\$8,383,572	\$961,941

Annual Maintenance	Cost	Frequency (years)	Start year	
No-Build Annual Maintenance	\$66,310	1	2021	Data from Go Triangle
No-Build Small Capital Costs	\$110,000	1	2021	Email from Go Triangle
No-Build Annual Site Lease	\$36,710	1		Data from Go Triangle
Build Annual Maintenance	\$250,000	1	2026	Review of similar facilities, including RUS Bus
Annual Escalation	2.5%			Data from Go Triangle

\*Maintenance of No-Build does not start until 2026 because the No Build maintenance costs would have to incur in previous years regardless.

Calendar Year	Project Year	Project Use Year - No Build	Project Use Year - Build	No Build Lease	No Build Maintenance	Build Maintenance	No-Build Cost (Base Year)	Build Cost (Base Year)	No-Build Cost (Escalated)	Build Cost (Escalated)	Total Benefit	Present Value (7% Discount Rate)
2023	1	1	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2024	2	2	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2025	3	3	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2026	4	4	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2027	5	5	1	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$241,013	\$282,852	-\$41,839	-\$26,056
2028	6	6	2	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$241,013	\$282,852	-\$41,839	-\$24,351
2029	7	7	3	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$247,038	\$289,923	-\$42,885	-\$23,327
2030	8	8	4	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$253,214	\$297,171	-\$43,958	-\$22,346
2031	9	9	5	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$259,544	\$304,601	-\$45,057	-\$21,406
2032	10	10	6	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$266,033	\$312,216	-\$46,183	-\$20,506
2033	11	11	7	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$272,684	\$320,021	-\$47,338	-\$19,643
2034	12	12	8	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$279,501	\$328,022	-\$48,521	-\$18,817
2035	13	13	9	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$286,488	\$336,222	-\$49,734	-\$18,026
2036	14	14	10	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$293,650	\$344,628	-\$50,977	-\$17,268
2037	15	15	11	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$300,992	\$353,243	-\$52,252	-\$16,542
2038	16	16	12	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$308,516	\$362,075	-\$53,558	-\$15,846
2039	17	17	13	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$316,229	\$371,126	-\$54,897	-\$15,179
2040	18	18	14	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$324,135	\$380,405	-\$56,269	-\$14,541
2041	19	19	15	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$332,239	\$389,915	-\$57,676	-\$13,930
2042	20	20	16	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$340,544	\$399,663	-\$59,118	-\$13,344
2043	21	21	17	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$349,058	\$409,654	-\$60,596	-\$12,783
2044	22	22	18	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$357,785	\$419,895	-\$62,111	-\$12,245
2045	23	23	19	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$366,729	\$430,393	-\$63,664	-\$11,730
2046	24	24	20	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$375,897	\$441,153	-\$65,255	-\$11,237
2047	25	25	21	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$385,295	\$452,181	-\$66,887	-\$10,764
2048	26	26	22	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$394,927	\$463,486	-\$68,559	-\$10,311
2049	27	27	23	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$404,800	\$475,073	-\$70,273	-\$9,878
2050	28	28	24	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$414,920	\$486,950	-\$72,030	-\$9,462
2051	29	29	25	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$425,293	\$499,124	-\$73,830	-\$9,064
2052	30	30	26	\$36,710	\$176,310	\$250,000	\$213,020	\$250,000	\$435,926	\$511,602	-\$75,676	-\$8,683
				\$954,460	\$4,584,060	\$6,500,000	\$5,538,520	\$6,500,000	\$8,473,463	\$9,944,446	-\$1,470,982	-\$407,284

## Sources and Notes:

Average maintenance and operation costs based on total RTC maintenance costs for the prior year as shown below. The Transit center is assumed to be a portion of the total maintenance costs, as most costs support the GoTriangle offices on the site.

Category	Total Budget (2018)	RTC Assumption	RTC Total
Other Professional Services	150,000	0%	\$0
Meeting Expense - Materials		0%	\$0
Recycling		10%	\$0
Miscellaneous Supplies	20,000	10%	\$2,000
Telephone/WAN Services	2,500	30%	\$750
Postage		0%	\$0
Electrical utilities	150,000	10%	\$15,000
Water and Sewer	14,200	30%	\$4,260
Outside Repairs - Building	26,000	30%	\$7,800
Building Repairs	38,500	0%	\$0
Office Equipment (NonCap)		0%	\$0
Lawn Maintenance	120,000	30%	\$36,000
Waste Removal	5,000	10%	\$500
Rental of Office Space	37,000	0%	\$0
Fixed Assets/Capital Outlay		0%	\$0
Property Management	70,000	0%	\$0
<b>TOTAL EXPENSES</b>	<b>633,200</b>		<b>\$66,310</b>

RTC Relocation Study		Park Point			
Park Point Site without Building		Address	4001-4135 E NC 54 Hwy		
Opinion of Probable Cost Estimate		Owner	PP Office Owner 1 LP		
ITEM DESCRIPTION	UNIT COST	QUANTITY	COST (2022)	COST (2020)	RESIDUAL VALUE
Mobilization 10%		1	\$ 1,472,845	\$ 1,286,440	No residual
Miscellaneous (30% of Civil Construction)		1	\$ 1,218,533	\$ 1,064,314	No residual
Clearing and Grubbing	\$ 10,000.00	7.1	\$ 71,000	\$ 62,014	No residual
Borrow Excavation	\$ 25.00	8,000	\$ 200,000	\$ 174,688	No residual
Comprehensive Grading	\$ 300,000.00	1	\$ 300,000	\$ 262,032	No residual
Removal of Exist. Asphalt Paving	\$ 12.00	2,700	\$ 32,400	\$ 28,299	No residual
				\$ -	
Fine Grading	\$ 4.00	23,800	\$ 95,200	\$ 83,151	No residual
Heavy Duty Concrete Pavement (Bus Facility)	\$ 75.00	7,740	\$ 580,500	\$ 507,031	75 Year Life Span
Asphalt Pavement (Parking Lot)	\$ 45.00	12,693	\$ 571,185	\$ 498,895	No residual
Concrete Sidewalk	\$ 50.00	3,320	\$ 166,006	\$ 144,996	75 Year Life Span
Landscaped Islands	\$ 5.25	14,437	\$ 75,794	\$ 66,202	
Curb and Gutter	\$ 35.00	9,549	\$ 334,215	\$ 291,916	No residual
Erosion Control	\$ 20,000.00	7.1	\$ 142,000	\$ 124,028	No residual
Site Lighting	\$ 75,000.00	1	\$ 75,000	\$ 65,508	No residual
Landscaping	\$ 50,000.00	1	\$ 50,000	\$ 43,672	No residual
Storm Sewer	\$ 60.00	3,000	\$ 180,000	\$ 157,219	40 Year Useful Life
Storm Structures	\$ 3,000.00	20	\$ 60,000	\$ 52,406	40 Year Useful Life
Underground Storm BMP	\$ 100,000.00	7.1	\$ 710,000	\$ 620,141	40 Year Useful Life
Development Fees	\$ 200,000.00	1.0	\$ 200,000	\$ 174,688	No residual
				\$ -	
Bus Shelter/Canopy	\$ 150.00	29,813	\$ 4,471,950	\$ 3,905,974	Life
Station Amenities & CCTV	\$ 500,000.00	1	\$ 500,000	\$ 436,719	No residual
500kW Overhead Fast Charging Station	\$ 350,000.00	6	\$ 2,100,000	\$ 1,834,221	No residual
Backup Generator	\$ 500,000.00	1	\$ 500,000	\$ 436,719	No residual
TVMs	\$ 20,000.00	4	\$ 80,000	\$ 69,875	No residual
				\$ -	
Pass Sales Building	\$ 250.00	5,000	\$ 1,250,000	\$ 1,091,798	75 Year Life Span
Ticket Counter and Restroom on Island	\$ 250.00	540	\$ 135,000	\$ 117,914	No residual
Additional Canopy Cover Outside Bus Loop	\$ 75.00	19,063	\$ 1,429,725	\$ 1,248,777	No residual
				\$ -	
NC54 ROADWAY IMPROVEMENTS				\$ -	
Signalized Intersection	\$ 250,000.00	1	\$ 250,000	\$ 218,360	No residual
Pavement Widening	\$ 65.00	1,247	\$ 81,084	\$ 70,822	No residual
Curb and Gutter	\$ 35.00	965	\$ 33,775	\$ 29,500	No residual
Sidewalk	\$ 50.00	1,072	\$ 53,611	\$ 46,826	No residual
				\$ -	
BRT on NC 54			\$ 2,000,000	\$ 1,746,877	No residual
				\$ -	
Subtotal			\$ 19,419,824	\$ 16,962,026	
Other Costs				\$ -	
Contingency		30%	\$ 5,825,947	\$ 5,088,608	75 Year Life Span
Engineering		10%	\$ 1,941,982	\$ 1,696,203	No residual
Construction Administration		7%	\$ 1,359,388	\$ 1,187,342	No residual
Land Acquisition			\$ 3,500,000	\$ 3,057,036	
				\$ -	
Total			\$ 32,047,141	\$ 27,991,214	

\*2021 to 2019 baseline cost estimation  
based on BLS.Gov CPI Inflation Calculator

No residual	\$13,299,802
40 Year Useful Life	\$4,735,741
75 Year Life Span	\$6,832,433
ROW/Land	\$3,057,036
Total	\$27,925,012

Annual Construction Costs		% complete
2023	\$0	0%
2024	\$0	0%
2025	\$13,962,506	50%
2026	\$13,962,506	50%
2027	\$0	0%
Total	\$27,925,012	100%
Check	TRUE	

# FY 2019

Weekday												Operating Weekdays		249
Service	Route	Passenger Trips	Daily Revenue Hours	Annual Revenue Hours	Daily Vehicle Hours	Annual Vehicle Hours	Daily Revenue Miles	Annual Revenue Miles	Daily Vehicle Miles	Annual Vehicle Miles	Average Trip Length	Passenger Miles Traveled		
DO	100	130492		12708.62		13713.29		250023		283069	13.45	1754592		
DO	300	135468		11020.16		12495.08		197486		245362		1306575		
DO	400	179715		14730.22		16418.80		218278		282963		1743359		
DO	700	111141		7165.49		7478.99		165011		176976	10.76	1195970		
DO	800	205105		14935.89		16337.64		266436		314858	9.67	1982689		
DO	105	54189		4638.00		5774.58		92373		133050	12.11	656093		
DO	201	13853		2034.00		3270.75		45242		89370	16.92	234365		
DO	301	29639		4258.56		5445.06		71835		113810		261236		
DO	305	23993		2933.84		3889.76		53910		81803		238014		
DO	311	21252		3675.36		4795.86		84019		105012	9.56	203068		
DO	405	122833		6009.28		7615.18		98603		151552		1272919		
DO	805	87726		6810.32		7769.99		108941		139565	9.28	813919		
DO	ODX	27436		2687.76		3298.26		73463		103258		544396		
DO	CRX	92010		7653.36		10267.86		205996		296738		2459025		
DO	DRX	131119		8868.16		11858.83		228220		329354		3184331		
DO Route Total		1365971	442.29	110129.02	523.81	130429.93	8674	2159836	11433	2846740	11.68	17850550		
PT	420	45784		3403.83		5166.75		76941		94122		671392		
PT	102	17982		1494.00		1909.83		29131		35206		135398		
PT	WRX	13684		2447.67		3261.90		49713		61503		185945		
PT	KRX	7689		1399.38		1967.10		30507		41832		76876		
PT	ZWX	20096		1785.33		2504.94		47325		76194		404099		
PT	FRX	14702		1805.25		2574.66		44571		53286		182174		
PT	RSX					4047.52		88111		94513		308520		
PT Route Total		119937	49.54	12335.46	86.08	21432.70	1471	366299	1834	456656	16.38	1964405		
Weekday Total		1485908	491.83	122464.48	609.89	151862.63	10145	2526134	13267	3303396	13.34	19814955		
Saturday												Operating Saturdays		52
DO	100	23466		2608.24		2768.12		47380		53812	13.76	322940		
DO	400	19224		2717.00		2877.16		41521		47897		192711		
DO	700	13934		1312.04		1376.00		30527		33122	10.94	152496		
DO	800	13366		2496.88		2657.12		41070		47404	10.50	140320		
											11.73	0		
DO Route Total		69990	36.68	9134.16	38.87	9678.40	645	160499	732	182234	11.55	808467		
PT	300	12657	25.83	1343.16	26.67	1386.84	238	12365	493	25620	7.42	93915		
PT	RSX	2313				350.16		7462		8008		25374		
Saturday Total		84960	62.51	10477.32	65.54	11415.40	882	180326	1225	215863	10.92	927755		
Sunday												Operating Sundays		58
DO	100	16395		1606.08		1684.92		29099		32580	13.27	217541		
DO	400	12436		1535.86		1622.86		23157		26634		114766		
DO	700	9700		788.64		827.50		18328		19892	10.97	106382		
DO	800	7076		1522.48		1618.81		24920		28746	10.52	74432		
											11.58	0		
DO Route Total		45607	21.90	5453.06	23.11	5754.09	384	95503	433	107852	11.25	513120		
PT	300	8046	11.92	688.36	12.33	712.14	238	13715	242	13959	7.42	59701		
PT	RSX	1342				344.09		7320		7950		14722		
Sunday Total		54995	33.82	6141.42	35.44	6810.32	621	116538	675	129761	10.68	587543		
Annual Total		1625863	588.16	139083.22	710.87	170088.35	11649	2822999	15166	3649020	13.12	21330253		

Same RTC

Same RTC

							Weekday										
							Frequency			Vehicles			Span				
New Route	Round Trip Mileage	Estimated Average Speed	Round Trip Running Time (mins)	Minimum Recovery Time (min)	Minimum Cycle Time (min)	One Way Trip Time	Peak	Base	Eve	Peak	Base	Eve	Peak	Base	Eve	RVH	
310	22.1	20	66	6.6	73	33	30	60	60	3	2	2	6	4	2	30.0	
800	33.6	21	96	9.6	106	48	30	30	60	4	4	2	6	7	5.5	63.0	
805	32	20	96	9.6	106	48	30	0	0	4	0	0	6	7	5.5	24.0	
12/12B	31.77	23	83	8.3	91	41	30	30	60	4	4	2	6	7	5.5	63.0	
311	34.5	25	83	8.3	91	41	30	0	0	4	0	0	6	7	5.5	24.0	
NRX	49.6	40	74	7.4	82	37	30	0	0	3	0	0	6	7	5.5	18.0	
33.9283 24.83333333										22	10	6					
										0.272727							

New RTC - travel time savings with new driveway + improved location

New RTC - travel time savings with new driveway + improved location

							Weekday										
							Frequency			Vehicles			Span				
New Route	Round Trip Mileage	Estimated Average Speed	Round Trip Running Time (mins)	Minimum Recovery Time (min)	Minimum Cycle Time (min)	One Way Trip Time	Peak	Base	Eve	Peak	Base	Eve	Peak	Base	Eve	RVH	
310	23.5	22	64	6.4	71	32	30	60	60	3	2	2	6	4	2	30.0	
800	32.15	25	77	7.7	85	39	30	30	60	3	3	2	6	7	5.5	50.0	
805	29.4	22	80	8.0	88	40	30	0	0	3	0	0	6	7	5.5	18.0	
12/12B	29.2	25	70	7.0	77	35	30	30	60	3	3	2	6	7	5.5	50.0	
311	32.2	27	72	7.2	79	36	30	0	0	3	0	0	6	7	5.5	18.0	
NRX	47.9	42	68	6.8	75	34	30	0	0	3	0	0	6	7	5.5	18.0	
32.3917 27.1666667										18	8	6					

	Same RTC								Same RTC							
	Saturday								Sunday							
	Frequency	Vehicles		Span					Frequency	Vehicles		Span				
lew Route	Base	Eve	Base	Eve	Base	Eve	RVH		Base	Eve	Base	Eve	Base	Eve	RVH	
310	0	0	0	0	10	5	0.0		0	0	0	0	0	0	0.0	
800	30	60	4	2	10	5	50.0		60	60	2	2	12	2	28.0	
805	0	0	0	0	10	5	0.0		0	0	0	0	12	2	0.0	
12/12B	30	60	4	2	10	5	50.0		60	60	2	2	12	2	28.0	
311	0	0	0	0	10	5	0.0		0	0	0	0	12	2	0.0	
NRX	30	30	3	3	10	5	45.0		30	30	3	3	12	2	42.0	

	New RTC - travel time savings with new driveway + improved location							New RTC - travel time savings with new driveway + improved location							
	Saturday							Sunday							
	Frequency		Vehicles		Span				Frequency		Vehicles		Span		
lew Route	Base	Eve	Base	Eve	Base	Eve	RVH	Base	Eve	Base	Eve	Base	Eve	RVH	
310	0	0	0	0	10	5	0.0	0	0	0	0	0	0	0.0	
800	30	60	3	2	10	5	40.0	60	60	2	2	12	2	28.0	
805	0	0	0	0	10	5	0.0	0	0	0	0	12	2	0.0	
12/12B	30	60	3	2	10	5	40.0	60	60	2	2	12	2	28.0	
311	0	0	0	0	10	5	0.0	0	0	0	0	12	2	0.0	
NRX	30	30	3	3	10	5	45.0	30	30	3	3	12	2	42.0	



## Same RTC

				Annual				
RVH		Net	FY25	FY26	FY27	FY28	FY29	FY30
lew Route		Annual VMT	wk vehicles	sat vehicles	sun vehicles			
310	7,650	101,439		18	0	0		
800	20,239	340,015		31.5	25	14		
805	6,120	97,920		12	0	0		
12/12B	20,239	321,497		31.5	25	14		
311	6,120	105,570		12	0	0		
NRX	9,321	308,214		12	30	28		
69,689		1,274,655		117	80	56		

## New RTC - travel time savings with new driveway + improved location

				Annual				
RVH			FY25	FY26	FY27	FY28	FY29	FY30
lew Route		Annual VMT	wk vehicles	sat vehicles	sun vehicles			
310	7,650	107,865		18	0	0		
800	16,414	325,342		31.5	25	14		
805	4,590	89,964		12	0	0		
12/12B	16,414	295,489		31.5	25	14		
311	4,590	98,532		12	0	0		
NRX	9,321	297,651		12	30	28		
	58,979	1,214,843		117	80	56		

## RDU Shuttle Model

Description	Route Name	Round Trip Mileage	RTC	Current Freq	Add'l Peak Freq	All day freq	Reduce DRX	Elim 105	Estimated Average Speed	Round Trip Running Time (mins)	Minimum Recovery Time (min)	Minimum Cycle Time (min)	One Way Trip Time
Additional all day frequency at Park Point	DRX	45.3	New	No	No	Yes	Yes	Yes	30	91	9.1	100	45
	100	33.9							25	81	8.1	89	41
	RDU	11.0							25	26	2.6	29	13
	105	32.6							23	85	8.5	94	43
	700	21.7							28	47	4.7	51	23
Additional all day frequency	DRX	45.3	Same	No	No	Yes	Yes	Yes	30	91	9.1	100	45
	100	28.8							23	75	7.5	83	38
	RDU	8.3							23	22	2.2	24	11
	105	28.8							23	75	7.5	83	38
	700	23.2							28	50	5.0	55	25
Additional peak frequency at Park Point	DRX	45.3	New	No	Yes	No	Yes	Yes	30	91	9.1	100	45
	100	33.9							25	81	8.1	89	41
	RDU	11.0							25	26	2.6	29	13
	105	32.6							23	85	8.5	94	43
	700	21.7							30	43	4.3	48	22
Additional peak frequency	DRX	45.3	Same	No	Yes	No	Yes	Yes	30	91	9.1	100	45
	100	28.8							23	75	7.5	83	38
	RDU	8.3							23	22	2.2	24	11
	105	28.8							23	75	7.5	83	38
	700	23.2							28	50	5.0	55	25
Current service at Park Point	DRX	54.2	New	Yes	No	No	No	No	25	130	13.0	143	65
	100	40.8							25	98	9.8	108	49
	105	32.6							23	85	8.5	94	43
	700	21.7							28	47	4.7	51	23
Current service	DRX	54.2	Same	Yes	No	No	No	Yes	25	130	13.0	143	65
	100	28.8							23	75	7.5	83	38
	RDU	8.3							23	22	2.2	24	11
	105	28.8							23	75	7.5	83	38
	700	23.2							28	50	5.0	55	25

RDU Shuttle Model			Weekday												Saturday											
Description	Route Name	Round Trip Mileage	Frequency			Vehicles			Span			Frequency			Vehicles			Span								
			Peak	Base	Eve	Peak	Base	Eve	Peak	Base	Eve	RVH	Base	Eve	Base	Eve	Base	Eve	RVH							
Additional all day frequency at Park Point	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0						
	100	33.9	15	15	30	6	6	3	6	7	5.5	94.5	30	30	3	3	10	5	45.0	30						
	RDU	11.0	30	30	30	1	1	1	6	7	5.5	18.5	30	30	1	1	10	5	15.0	30						
	105	32.6	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0	0						
	700	21.7	15	15	30	4	4	2	6	7	5.5	63.0	30	30	2	2	10	5	30.0	30						
Additional all day frequency	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0						
	100	28.8	15	15	30	6	6	3	6	7	5.5	94.5	30	30	3	3	10	5	45.0	30						
	RDU	8.3	30	30	30	1	1	1	6	7	5.5	18.5	30	30	1	1	10	5	15.0	30						
	105	28.8	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0	0						
	700	23.2	15	15	30	4	4	2	6	7	5.5	63.0	30	30	2	2	10	5	30.0	30						
Additional peak frequency at Park Point	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0						
	100	33.9	15	30	60	6	3	2	6	7	5.5	68.0	30	60	3	2	10	5	40.0	30						
	RDU	11.0	30	30	0	1	1	0	6	7	5.5	13.0	30	0	1	0	10	5	10.0	30						
	105	32.6	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0	0						
	700	21.7	15	30	60	4	2	1	6	7	5.5	43.5	30	60	2	1	10	5	25.0	30						
Additional peak frequency	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0						
	100	28.8	15	30	60	6	3	2	6	7	5.5	68.0	30	60	3	2	10	5	40.0	30						
	RDU	8.3	30	30	0	1	1	0	6	7	5.5	13.0	30	0	1	0	10	5	10.0	30						
	105	28.8	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0	0						
	700	23.2	15	30	60	4	2	1	6	7	5.5	43.5	30	60	2	1	10	5	25.0	30						
Current service at Park Point	DRX	54.2	22	0	0	7	0	0	6	7	5.5	42.0	0	0	0	0	0	0	0	0						
	100	40.8	30	30	60	4	4	2	6	7	5.5	63.0	30	60	4	2	10	5	50.0	30						
	105	32.6	30	0	0	4	0	0	6	7	5.5	24.0	0	0	0	0	13	5.5	0.0	0						
	700	21.7	30	30	60	2	2	1	6	7	5.5	31.5	30	60	2	1	10	5	25.0	30						
Current service	DRX	54.2	22	0	0	7	0	0	6	7	5.5	42.0	0	0	0	0	0	0	0	0						
	100	28.8	30	30	60	3	3	2	6	7	5.5	50.0	30	60	3	2	10	5	40.0	30						
	RDU	8.3	30	30	0	1	1	0	6	7	5.5	13.0	30	0	1	0	10	5	10.0	30						
	105	28.8	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0	0						
	700	23.2	30	30	60	2	2	1	6	7	5.5	31.5	30	60	2	1	10	5	25.0	30						

RDU Shuttle Model			Sunday								Annual						
Description	Route Name	Round Trip Mileage	Frequency		Vehicles		Span		RVH	Annual	FY25	FY26	FY27	FY28	FY29	FY30	
			Base	Eve	Base	Eve	Base	Eve									
Additional all day frequency at Park Point	DRX	45.3	0	0	0	0	0	0	0.0	7,650	61,992						
	100	33.9	30	30	3	3	12	2	42.0	28,829							
	RDU	11.0	30	30	1	1	12	2	14.0	6,295							
	105	32.6	0	0	0	0	12	2	0.0	0							
	700	21.7	30	30	2	2	12	2	28.0	19,219							
Additional all day frequency	DRX	45.3	0	0	0	0	0	0	0.0	7,650	61,992						
	100	28.8	30	30	3	3	12	2	42.0	28,829							
	RDU	8.3	30	30	1	1	12	2	14.0	6,295							
	105	28.8	0	0	0	0	12	2	0.0	0							
	700	23.2	30	30	2	2	12	2	28.0	19,219							
Additional peak frequency at Park Point	DRX	45.3	0	0	0	0	0	0	0.0	7,650	45,659	137,700	18	0	0		
	100	33.9	60	60	2	2	12	2	28.0	21,004		329,488	43.5	25	14		
	RDU	11.0	0	0	0	0	12	2	0.0	3,825		191,250	26	20	0		
	105	32.6	0	0	0	0	12	2	0.0	0		0	0	0	0		
	700	21.7	60	60	1	1	12	2	14.0	13,180		395,385	43.5	25	14		
Additional peak frequency	DRX	45.3	0	0	0	0	0	0	0.0	7,650	45,659						
	100	28.8	60	60	2	2	12	2	28.0	21,004							
	RDU	8.3	0	0	0	0	12	2	0.0	3,825							
	105	28.8	0	0	0	0	12	2	0.0	0							
	700	23.2	60	60	1	1	12	2	14.0	13,180							
Current service at Park Point	DRX	54.2	0	0	0	0	0	0	0.0	10,710	47,189						
	100	40.8	60	60	2	2	12	2	28.0	20,239							
	105	32.6	0	0	0	0	12	2	0.0	6,120							
	700	21.7	60	60	1	1	12	2	14.0	10,120							
Current service	DRX	54.2	0	0	0	0	0	0	0.0	10,710	41,069						
	100	28.8	60	60	2	2	12	2	28.0	16,414							
	RDU	8.3	0	0	0	0	12	2	0.0	3,825							
	105	28.8	0	0	0	0	12	2	0.0	0							
	700	23.2	60	60	1	1	12	2	14.0	10,120							
											FY25	FY26	FY27	FY28	FY29	FY30	

Current Route Structure Model

Description	Route Name	Round Trip Mileage	RTC	Current Freq	Add'l Peak Freq	All day freq	Reduce DRX	Elim 105	Estimated Average Speed	Round Trip Running Time (mins)	Minimum Recovery Time (min)	Minimum Cycle Time (min)	One Way Trip Time
Additional all day frequency at Park Point	DRX	45.3	New	No	No	Yes	Yes	Yes	30	91	9.1	100	45
	100	40.8							25	98	9.8	108	49
	105	32.6							23	85	8.5	94	43
	700	21.7							28	47	4.7	51	23
Additional all day frequency	DRX	45.3	Same	No	No	Yes	Yes	Yes	30	91	9.1	100	45
	100	35.7							23	93	9.3	102	47
	105	28.8							23	75	7.5	83	38
	700	23.2							28	50	5.0	55	25
Additional peak frequency at Park Point	DRX	45.3	New	No	Yes	No	Yes	Yes	30	91	9.1	100	45
	100	40.8							25	98	9.8	108	49
	105	32.6							23	85	8.5	94	43
	700	21.7							28	47	4.7	51	23
Additional peak frequency	DRX	45.3	Same	No	Yes	No	Yes	Yes	30	91	9.1	100	45
	100	35.7							23	93	9.3	102	47
	105	28.8							23	75	7.5	83	38
	700	23.2							28	50	5.0	55	25
Current service at Park Point	DRX	54.2	New	Yes	No	No	No	No	25	130	13.0	143	65
	100	40.8							25	98	9.8	108	49
	105	32.6							23	85	8.5	94	43
	700	21.7							28	47	4.7	51	23
Current service	DRX	54.2	Same	Yes	No	No	No	No	25	130	13.0	143	65
	100	35.7							23	93	9.3	102	47
	105	28.8							23	75	7.5	83	38
	700	23.2							28	50	5.0	55	25

Current Route Structure Model			Weekday												Saturday																							
Description	Route Name	Round Trip Mileage	Frequency						Vehicles						Span						Frequency						Vehicles						Span					
			Peak	Base	Eve	Peak	Base	Eve	Peak	Base	Eve	Peak	Base	Eve	RVH	Base	Eve	Base	Eve	Base	Eve	Base	Eve	Base	Eve	RVH												
Additional all day frequency at Park Point	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0												
	100	40.8	15	15	30	8	8	4	6	7	5.5	126.0	30	30	4	4	10	5	60.0							60.0												
	105	32.6	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0							0.0												
	700	21.7	15	15	30	4	4	2	6	7	5.5	63.0	30	30	2	2	10	5	30.0							30.0												
Additional all day frequency	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0												
	100	35.7	15	15	30	7	7	4	6	7	5.5	113.0	30	30	4	4	10	5	60.0							60.0												
	105	28.8	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0							0.0												
	700	23.2	15	15	30	4	4	2	6	7	5.5	63.0	30	30	2	2	10	5	30.0							30.0												
Additional peak frequency at Park Point	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0												
	100	40.8	15	30	60	8	4	2	6	7	5.5	87.0	30	60	4	2	10	5	50.0							50.0												
	105	32.6	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0							0.0												
	700	21.7	15	30	60	4	2	1	6	7	5.5	43.5	30	60	2	1	10	5	25.0							25.0												
Additional peak frequency	DRX	45.3	20	0	0	5	0	0	6	7	5.5	30.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0												
	100	35.7	15	30	60	7	4	2	6	7	5.5	81.0	30	60	4	2	10	5	50.0							50.0												
	105	28.8	0	0	0	0	0	0	6	7	5.5	0.0	0	0	0	0	10	5	0.0							0.0												
	700	23.2	15	30	60	4	2	1	6	7	5.5	43.5	30	60	2	1	10	5	25.0							25.0												
Current service at Park Point	DRX	54.2	22	0	0	7	0	0	6	7	5.5	42.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0												
	100	40.8	30	30	60	4	4	2	6	7	5.5	63.0	30	60	4	2	10	5	50.0							50.0												
	105	32.6	30	0	0	4	0	0	6	7	5.5	24.0	0	0	0	0	13	5.5	0.0							0.0												
	700	21.7	30	30	60	2	2	1	6	7	5.5	31.5	30	60	2	1	10	5	25.0							25.0												
Current service	DRX	54.2	22	0	0	7	0	0	6	7	5.5	42.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0												
	100	35.7	30	30	60	4	4	2	6	7	5.5	63.0	30	60	4	2	10	5	50.0							50.0												
	105	28.8	30	0	0	3	0	0	6	7	5.5	18.0	0	0	0	0	10	5	0.0							0.0												
	700	23.2	30	30	60	2	2	1	6	7	5.5	31.5	30	60	2	1	10	5	25.0							25.0												

Current Route Structure Model			Sunday								Annual						
Description	Route Name	Round Trip Mileage	Frequency		Vehicles		Span		RVH	Annual	FY25	FY26	FY27	FY28	FY29	FY30	
			Base	Eve	Base	Eve	Base	Eve									
Additional all day frequency at Park Point	DRX	45.3	0	0	0	0	0	0	0.0	7,650	65,307						
	100	40.8	30	30	4	4	12	2	56.0	38,438							
	105	32.6	0	0	0	0	12	2	0.0	0							
	700	21.7	30	30	2	2	12	2	28.0	19,219							
Additional all day frequency	DRX	45.3	0	0	0	0	0	0	0.0	7,650	61,992						
	100	35.7	30	30	4	4	12	2	56.0	35,123							
	105	28.8	0	0	0	0	12	2	0.0	0							
	700	23.2	30	30	2	2	12	2	28.0	19,219							
Additional peak frequency at Park Point	DRX	45.3	0	0	0	0	0	0	0.0	7,650	47,189						
	100	40.8	60	60	2	2	12	2	28.0	26,359							
	105	32.6	0	0	0	0	12	2	0.0	0							
	700	21.7	60	60	1	1	12	2	14.0	13,180							
Additional peak frequency	DRX	45.3	0	0	0	0	0	0	0.0	7,650	45,659						
	100	35.7	60	60	2	2	12	2	28.0	24,829							
	105	28.8	0	0	0	0	12	2	0.0	0							
	700	23.2	60	60	1	1	12	2	14.0	13,180							
Current service at Park Point	DRX	54.2	0	0	0	0	0	0	0.0	10,710	47,189						
	100	40.8	60	60	2	2	12	2	28.0	20,239							
	105	32.6	0	0	0	0	12	2	0.0	6,120							
	700	21.7	60	60	1	1	12	2	14.0	10,120							
Current service	DRX	54.2	0	0	0	0	0	0	0.0	10,710	45,659	FY25	FY26	FY27	FY28	FY29	FY30
	100	35.7	60	60	2	2	12	2	28.0	20,239							
	105	28.8	0	0	0	0	12	2	0.0	4,590							
	700	23.2	60	60	1	1	12	2	14.0	10,120							

# Route 100-105-DRX Annual Revenue Service Hours

Annual Hours	Current Service and Frequency 30-min M-S; 60-min night/Sun		Additional Peak Frequency 15-min peak; 30-min M-S; 60-min night/Sun		Additional Frequency All Day 15-min M-S; 30-min night/Sun		Other Services
	100-105	100-RDU Shuttle	100-105	100-RDU Shuttle	100-105	100-RDU Shuttle	
Slater Rd RTC	45,659	41,069	45,659	45,659	61,992	61,992	69,689
Park Point RTC			47,189	45,659	65,307	61,992	58,979
Assume DRX changes too							
Always run RDU shuttle							

## With other services (310, 311, NRX, 12/12B, 805, 800)

Annual Hours	Current Service and Frequency 30-min M-S; 60-min night/Sun		Additional Peak Frequency 15-min peak; 30-min M-S; 60-min night/Sun		Additional Frequency All Day 15-min M-S; 30-min night/Sun	
	100-105	100-RDU Shuttle	100-105	100-RDU Shuttle	100-105	100-RDU Shuttle
Slater Rd RTC	115,348	110,758	115,348	115,348	131,681	131,681
Park Point RTC			106,168	104,638	124,286	120,971
FY23				10,710 \$144.00 \$1,542,240.00		

## Peak Vehicle Needs (Raleigh-Durham Corridor only)

Annual Hours	Current Service and Frequency 30-min M-S; 60-min night/Sun		Additional Peak Frequency 15-min peak; 30-min M-S; 60-min night/Sun		Additional Frequency All Day 15-min M-S; 30-min night/Sun	
	100-105	100-RDU Shuttle	100-105	100-RDU Shuttle	100-105	100-RDU Shuttle
Slater Rd RTC	16	13	16	16	16	16
Park Point RTC			17	16	17	16
Assume DRX changes too						
				Always run RDU shuttle		

179 Highlighted cells are the best option

Pax Travel Time savings

(see sheet " model")

Route	Time savings per trip
100	-6
RDU	-5
700	6
310	2
800	19
805	16
12/12B	13
311	11
NRX	6
Average pax time savings	7