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November 2020

Mr. David Roy
Chief Financial Officer
North Carolina Turnpike Authority
1 South Wilmington Street
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Raleigh, NC 27601

Subject: Monroe Expressway Planning Level T&R Forecast Update

Dear Mr. Roy:

This letter summarizes the work efforts and updated inputs and assumptions used to develop planning-level traffic and toll revenue estimates for the Monroe Expressway. To produce this updated forecast, CDM Smith relied primarily on actual traffic and revenue data on the facility, and updated the models originally developed for the ***North Carolina Monroe Expressway Traffic and Toll Revenue Study***, dated November 2016 (2016 T&R Study). The following key inputs and assumptions were updated:

- Calibration and validation of the traffic and revenue model to a base year of 2019, reflecting:
  - Observed transactions and revenue data on the Monroe Expressway, which opened in November 2018
  - Observed travel times and speeds on US 74 parallel to the Monroe Expressway
  - Observed 2019 traffic counts on many parallel roads within the study area
- Updates to current and projected socioeconomic data in Union and Mecklenburg Counties, provided by Dr. Stephen Appold, independent economist
- Updates to future travel demand model networks based on the NCDOT STIP as of June 2020
- Updates to inflation forecasts and other variables affecting travelers' values of time and vehicle operating costs
- Short term impacts to traffic and revenue from the COVID-19 pandemic

The intent of this letter report is to review and revise, as warranted, the forecasts developed for the 2016 T&R Study. Updated fiscal year forecasts are provided for the base case as well as a hypothetical no-COVID case for comparison purposes.

1. Project Overview

1.1 Project Description

The Monroe Expressway, shown in **Figure 1**, is a controlled-access toll road, extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 19.7 miles. The Monroe Expressway is generally parallel with US 74 and provides a high-speed alternative to US 74 for area motorists. The road opened to toll-paying traffic on November 27, 2018.

Figure 1 shows the general alignment of the Monroe Expressway and the toll concept. Six full intermediate interchanges are located at Indian Trail Fairview Road (SR 1520), Unionville Indian Trail Road (SR 1367), North Rocky River Road (SR 1514), US 601, NC 200 (Morgan Mill Road), and Austin Chaney Road (SR 1758). Partial interchanges are located between US 74 and the Monroe Expressway at the east and west termini of the tolled portion of the project. Tolls are collected electronically via overhead mainline gantries using both electronic toll collection (ETC) and video toll collection (Bill by Mail or BBM). If a motorist does not have a transponder, high-speed cameras mounted on gantries record a license plate image and an invoice is mailed to the registered owner of the vehicle through the BBM program. ETC transactions receive a 35 percent discount from the BBM toll. Toll gantries are located within a toll zone that are placed on each mainline section between interchanges. Toll rates are based on the distance covered on each mainline section. The toll zones are numbered 1 through 7 and are depicted in Figure 1 along with the distance covered for each toll zone.

Figure 2 shows 2020 toll rates on Monroe Expressway for each toll location by class and method of payment. These toll rates are in effect throughout the day. Class 2 rates are double Class 1 rates, and Class 3 rates are four times Class 1 rates. ETC toll rates reflect a 35 percent discount from BBM toll rates.

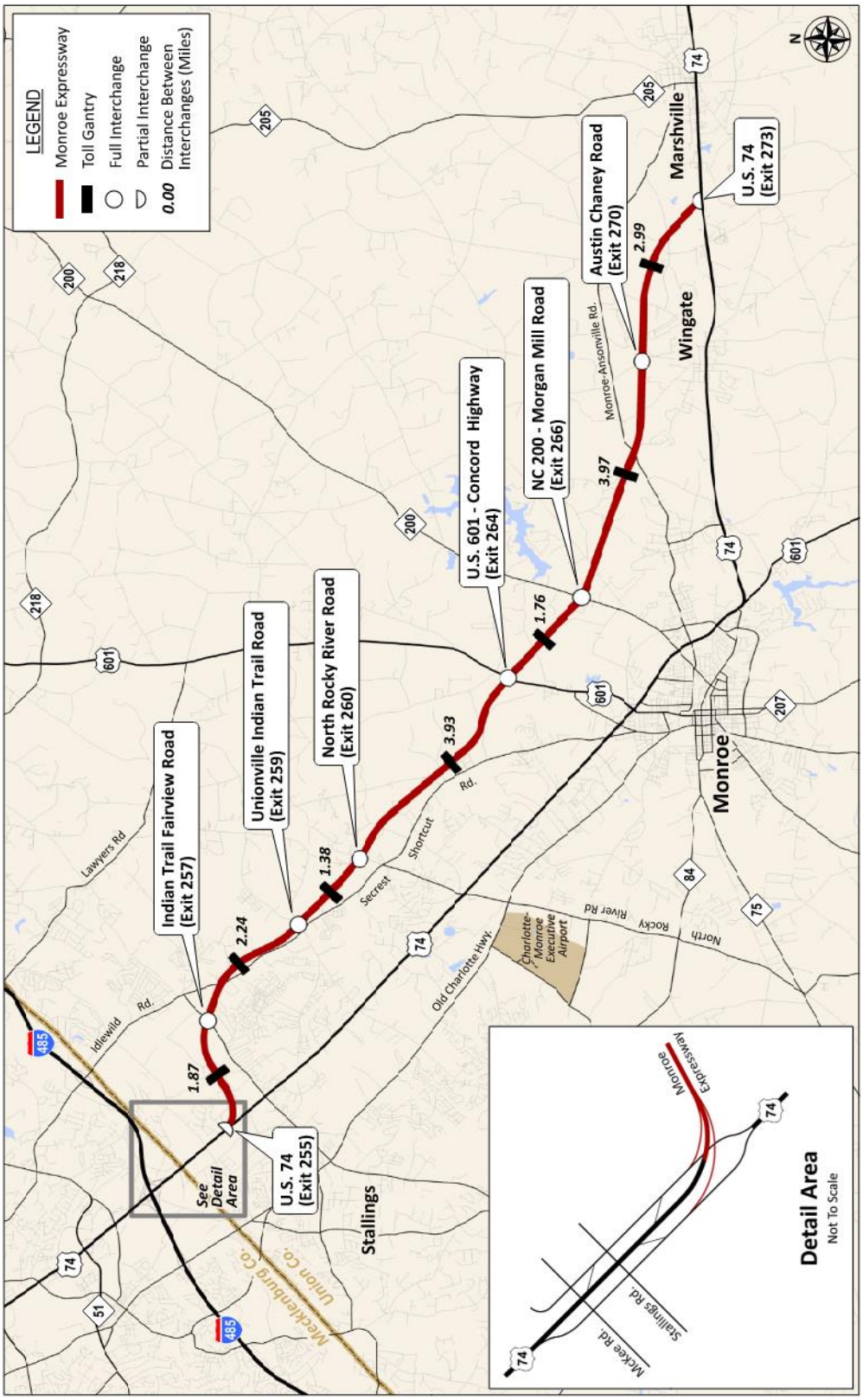
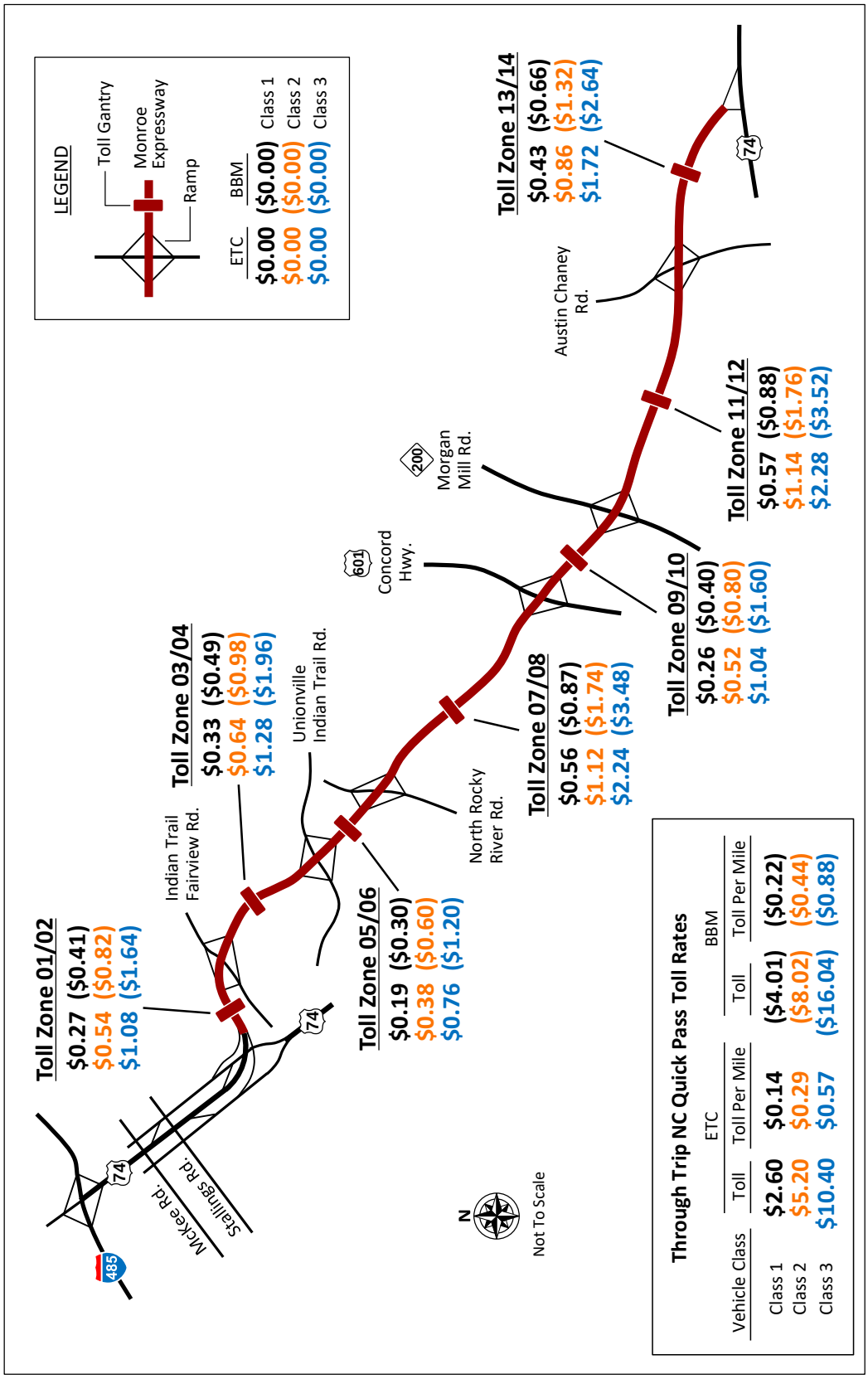


Figure 1 - Project Location Map

Figure 2 - 2020 Toll Rates by Class and Method of Payment



Through Trip NC Quick Pass Toll Rates

Vehicle Class	ETC Toll	ETC Toll Per Mile	BBM Toll	BBM Toll Per Mile
Class 1	$2.60	$0.14	($4.01)	($0.22)
Class 2	$5.20	$0.29	($8.02)	($0.44)
Class 3	$10.40	$0.57	($16.04)	($0.88)

2. Monroe Expressway Transaction and Toll Revenue

This section presents an overview of historical transactions and revenue on the Monroe Expressway from its opening in November 2018 to Fall 2020. A particular emphasis is given to evaluating the impact of the COVID-19 pandemic on the performance of the facility.

2.1 Historical Transaction and Toll Revenue Growth

Monthly transactions and collected toll revenue from opening day through October 2020, are shown in **Table 1**. The table also shows the truck share of transactions, and the average per-transaction toll rate.

Strong growth occurred from opening through Fall 2019 for both passenger cars (Class 1) and trucks (Classes 2 and 3 combined). Historical transaction trends reflect ramp-up effects on this new facility, as well as seasonal variations with passenger car transactions peaking in August 2019 when recreational traffic is high. The impacts of the COVID-19 pandemic started in March 2020 and were most severe in April 2020 when Class 1 transactions were down 44 percent compared to April 2019. Traffic recovered fairly quickly after April on the Monroe Expressway; in fact, Class 1 transactions as well as total transactions in June 2020 were higher than in June 2019. Truck traffic was less impacted by COVID, with a decline of approximately 10 percent in April 2020 followed by a rebound to pre-COVID levels in June 2020. Truck transactions continued to grow, peaking in October 2020.

Table 1 shows similar monthly trends for collected revenue. Revenue peaked in October 2019, both for Class 1 and overall revenue. In June 2020, the total revenue was higher than in June 2019. indicating that the Monroe Expressway was more resilient to the pandemic impacts than many other tolled facilities.

Transaction breakout by class generally shows a gradual increase in truck share, from about 10 percent in December 2019 to 13.6 percent in October 2020. However, there was a spike in April 2020 due to COVID, when passenger car traffic dropped significantly due to travel restrictions while truck traffic was less severely impacted.

Pre-COVID, the average per-transaction toll rate increased gradually primarily due to the truck share increase, and the annual toll rate increase on January 1, 2020. In April 2020, the average toll rate peaked with the very high truck share of traffic resulting from the COVID impacts. Between May 2020 and October 2020, average toll rates returned to similar levels and mirrored seasonal trends observed in the same months in 2019.

Table 1 - Monthly T&R by Class

			Toll Transactions (000s)			Collected Toll Revenue (000s)			Classes 2 & 3	Average
				Classes			Classes		Percent of	Weighted
CY	Month		Class 1	2 & 3	Total	Class 1	2 & 3	Total	Transactions	Toll
2018	November	(1)	76	12	88	$10	$3	$13	13.1%	$0.15
	December		1,048	118	1,166	78	73	151	10.1%	0.13
2019	January	(2)	1,658	179	1,838	267	116	383	9.8%	0.21
	February		1,481	193	1,674	599	49	648	11.5%	0.39
	March		2,299	286	2,585	656	311	967	11.1%	0.37
	April		2,256	281	2,537	973	206	1,179	11.1%	0.46
	May		2,495	335	2,830	1,137	175	1,312	11.8%	0.46
	June		2,437	311	2,748	883	339	1,222	11.3%	0.44
	July		3,042	356	3,397	1,385	288	1,673	10.5%	0.49
	August		3,284	406	3,691	1,409	263	1,671	11.0%	0.45
	September		2,997	368	3,365	1,468	314	1,781	10.9%	0.53
	October		3,086	400	3,486	1,648	271	1,918	11.5%	0.55
	November		2,769	360	3,129	1,412	281	1,693	11.5%	0.54
	December		2,732	339	3,071	1,402	253	1,655	11.0%	0.54
2020	January	(2)	2,460	357	2,817	1,539	240	1,778	12.7%	0.63
	February		2,378	330	2,708	1,380	236	1,615	12.2%	0.60
	March	(3)	2,098	381	2,479	1,245	272	1,517	15.4%	0.61
	April		1,265	344	1,609	1,065	251	1,316	21.4%	0.82
	May		2,112	358	2,470	901	269	1,169	14.5%	0.47
	June		2,630	388	3,018	1,044	285	1,329	12.9%	0.44
	July		2,803	420	3,223	1,212	323	1,535	13.0%	0.48
	August		2,710	402	3,113	1,224	407	1,631	12.9%	0.52
	September		2,766	407	3,173	1,281	309	1,589	12.8%	0.50
	October		2,748	431	3,179	1,267	342	1,609	13.6%	0.51
Total CY18 (Nov-Dec)			**1,124**	**129**	**1,254**	**89**	**75**	**164**	**10.3%**	**0.13**
Total CY19 (Jan-Dec)			**30,537**	**3,815**	**34,352**	**13,237**	**2,864**	**16,102**	**11.1%**	**0.47**
Total CY20 (Jan-Oct)			**23,969**	**3,820**	**27,789**	**12,156**	**2,932**	**15,088**	**13.7%**	**0.54**

1) Facility opened to toll-paying traffic on November 27, 2018
2) Programmed toll increases occurred every year on January 1st
3) COVID-19 related transaction and toll revenue impacts began in March 2020

Source: NCTA

Table 2 shows the ETC market share of Monroe Expressway transactions by vehicle class through September 2020. The data in Table 2 represents ETC market share after image-based tolls are processed and those that can be associated with a valid pre-paid transponder account (either in-state or out-of-state) are identified and charged the appropriate ETC toll rate. The ETC market share of transactions shown in Table 2 was used to benchmark transaction forecasts in this study.

Among passenger cars, ETC transaction market share grew from about 34 percent in December 2018 to about 44 percent in calendar year (CY) 2020 (through September). Truck ETC market share grew from about 57 percent in December 2018 to about 65 percent in CY 2020.

Table 2 - ETC Market Share by Toll Class

		ETC Market Share		
			Classes	
CY	Month	Class 1	2 & 3	Total
2018	November (1)	40.5%	55.5%	42.2%
	December	33.5%	57.1%	35.8%
2019	January	40.0%	59.8%	42.4%
	February	43.5%	60.9%	45.6%
	March	41.8%	61.0%	44.0%
	April	41.4%	61.8%	43.9%
	May	41.5%	62.3%	44.1%
	June	39.5%	62.7%	42.3%
	July	37.8%	61.8%	40.6%
	August	39.3%	61.8%	41.9%
	September	42.5%	61.8%	44.9%
	October	44.7%	63.7%	47.2%
	November	45.2%	65.7%	47.7%
	December	45.0%	67.3%	47.7%
2020	January	49.4%	68.6%	52.0%
	February	49.0%	67.9%	51.4%
	March	47.5%	66.4%	50.6%
	April	46.8%	65.9%	51.0%
	May	41.2%	63.3%	44.6%
	June	40.6%	63.5%	43.8%
	July	40.2%	62.9%	43.4%
	August	41.8%	62.0%	44.7%
	September	42.1%	61.9%	44.9%
Total CY18 (Nov-Dec)		**34.1%**	**56.9%**	**36.4%**
Total CY19 (Jan-Dec)		**41.9%**	**62.8%**	**44.3%**
Total CY20 (Jan-Sep)		**44.0%**	**64.5%**	**47.0%**

1) Facility opened to toll-paying traffic on November 27, 2018
Source: NCTA

ETC market share tends to be lower in the summer due to higher recreational traffic. In the first part of 2020 (pre-COVID), overall ETC market share was about five percent higher than in early 2019. Following the pandemic, the ETC market share decreased by about five percent.

2.2 Timeline of COVID-19 Events Impacting Monroe Expressway

The COVID-19 pandemic is impacting nearly all aspects of society and the economy, including travel. Beginning in March of 2020, the pandemic caused significant reductions in transactions and revenue on toll facilities around the U.S., including on the Monroe Expressway. **Table 3** provides the timeline of events, mandates, and other announcements related to COVID-19 affecting travel in the Monroe Expressway region.

Table 3 - National, North Carolina, Local and NCTA Mandates Related to COVID-19

Date	Location	Description
March 3	NC	- First case of COVID-19 in NC identified in Wake County.
March 10	NC	- Gov. Roy Cooper declares state of emergency due to COVID-19 cases.
March 12	Mecklenburg/ Cabarrus County	- Mecklenburg County reports its first two confirmed cases of COVID-19 and Cabarrus County reports one.
March 13	USA	- National Emergency declared
March 16	NC	- Executive Order 117: No mass gatherings. K-12 public schools closed
March 17	NC	- Executive Order 118: Close sit-down service at restaurants
March 18	NC	- NC Quick Pass Customer Service Centers have been closed since March 18 to customers. Call center staff operating at reduced levels to maintain social distancing.
March 18-20	USA	- U.S./Canada and U.S./Mexico borders closed for non-essential travel
March 25	NC	- Executive Order 120: Limit gatherings to less than 50 people. Close gyms, movie theaters, parlors, and other similar facilities by 3/25.
March 30	NC/ NCTA	- Executive Order 121: Stay At Home order until April 29, 2020. Only essential business to remain open. Bans gatherings of more than 10 people and directs everyone to physically stay at least 6 feet apart from others. - NCTA Relief Effort: NCTA suspends third-party collection efforts for past due accounts and placement of new DMV vehicle registration hold for past due accounts.
April 3	NCTA	- NCTA Relief Effort: NCTA suspends all processing fees and civil penalties on Bill-by-Mail Invoices.
April 9	NC	- Executive Order 131: Retail stores still operating to implement new social distancing policies. Earlier COVID-19 guidelines mandatory for nursing facilities, and recommends other long-term care facilities to do the same. Issues changes to unemployment benefits that will speed up certain benefit payments to those who are out of work.
April 23	NC	- Executive Order 135: Extends North Carolina's Stay At Home order until May 8.
May 9	NC	- Executive Order 138: Transition to Phase 1 recovery. Stay at home order remains in place. Nonessential businesses allowed to open at 50 percent capacity. Parks, outdoor worship services, and childcare facilities allowed to reopen.
May 23	NC	- Phase 2 Announcement: Transition to Phase 2 recovery. Social gatherings allowed for less than 10 people indoors and less than 25 people outdoors. Indoor sit-down dining reopens.
June 24	NC	- Executive Order 147: North Carolina will remain in Safe at Home Phase 2 for three more weeks (July 17). Face coverings must be worn when people are in public places as officials seek to stabilize concerning trends of increasing viral spread.
July 16	NC	- Executive Order 151: North Carolina extends Safe at Home Phase 2 measures until at least August 7, 2020.
July 28	NC	- Executive Order 153: Restaurants, breweries, wineries, distilleries, shall cease the sale and service of alcoholic beverages for onsite consumption between 11:00 pm and 7:00 am.
August 12	NC	- NCTA reopens Monroe and Charlotte Customer Service Centers.
August 17	Charlotte-Mecklenburg	- Charlotte-Mecklenburg students will follow a full-remote learning plan
October 12	Charlotte-Mecklenburg	- Charlotte-Mecklenburg students will move to in-person instruction in a phased plan that would begin Oct. 12. Under the plan, all pre-K students will return first on Oct. 12. Next, groups of K-5 students will return to classrooms on a rotational basis, starting on Nov. 2. Groups of middle school students will return to classrooms on a rotational basis starting on Nov. 23. Groups of high school students will return to classrooms for testing the weeks of Dec. 14 and Dec. 21, and then return to classrooms on a rotational basis for instruction on Jan. 5.
October 26	NCTA	- NCTA resumes processing fees and civil penalties on Bill-by-Mail invoices

Regionwide travel announcements that resulted in reduced travel on the Monroe Expressway include: the closure of schools beginning on March 16, 2020; the gradual limitation of gatherings in public and closure of specific businesses initiated between March 16 and March 25; and the closure of non-essential businesses on March 30. On March 30, NCTA announced suspension of third-party

collection efforts and all processing fees and penalties; this suspension has since been rescinded as of October 26, 2020.

2.3 Estimated Impacts of COVID-19 Pandemic on Monroe Expressway

CDM Smith conducted an analysis on total system transactions from the existing Monroe Expressway to estimate the impacts due to the COVID-19 pandemic on passenger cars and commercial vehicles traffic and to develop a trend analysis toward a gradual recovery. The analysis methodology used is described below:

1. Daily transaction data for each Monroe Expressway toll zone was obtained for the period from January 2019 through August 2020.

2. Since the facility was still in early stages of ramp-up through most of 2019, actual weekday transaction totals for cars and trucks were adjusted to estimate conditions without ramp-up.

3. Baseline (without COVID impact) growth rates from 2019 to 2020 were estimated based on the 2016 Traffic and Revenue Study as well as comparison of growth for January and February 2020 against the same period in 2019 (by passenger cars versus commercial vehicles).

4. Baseline growth rates were applied to 2019 average weekday daily transactions from Step 2 to estimate baseline 2020 transactions without COVID impacts and without ramp-up.

5. Actual traffic from March through August was compared to the baseline 2020 (no COVID impact) estimates developed in Step 3 to identify impacts on a weekly basis for passenger cars and commercial vehicles. Ultimately, a seven-day rolling average was used for passenger cars and a 21-day rolling average for commercial vehicles to illustrate the impacts due to COVID-19 and the related stay-at-home orders on passenger cars and commercial vehicles.

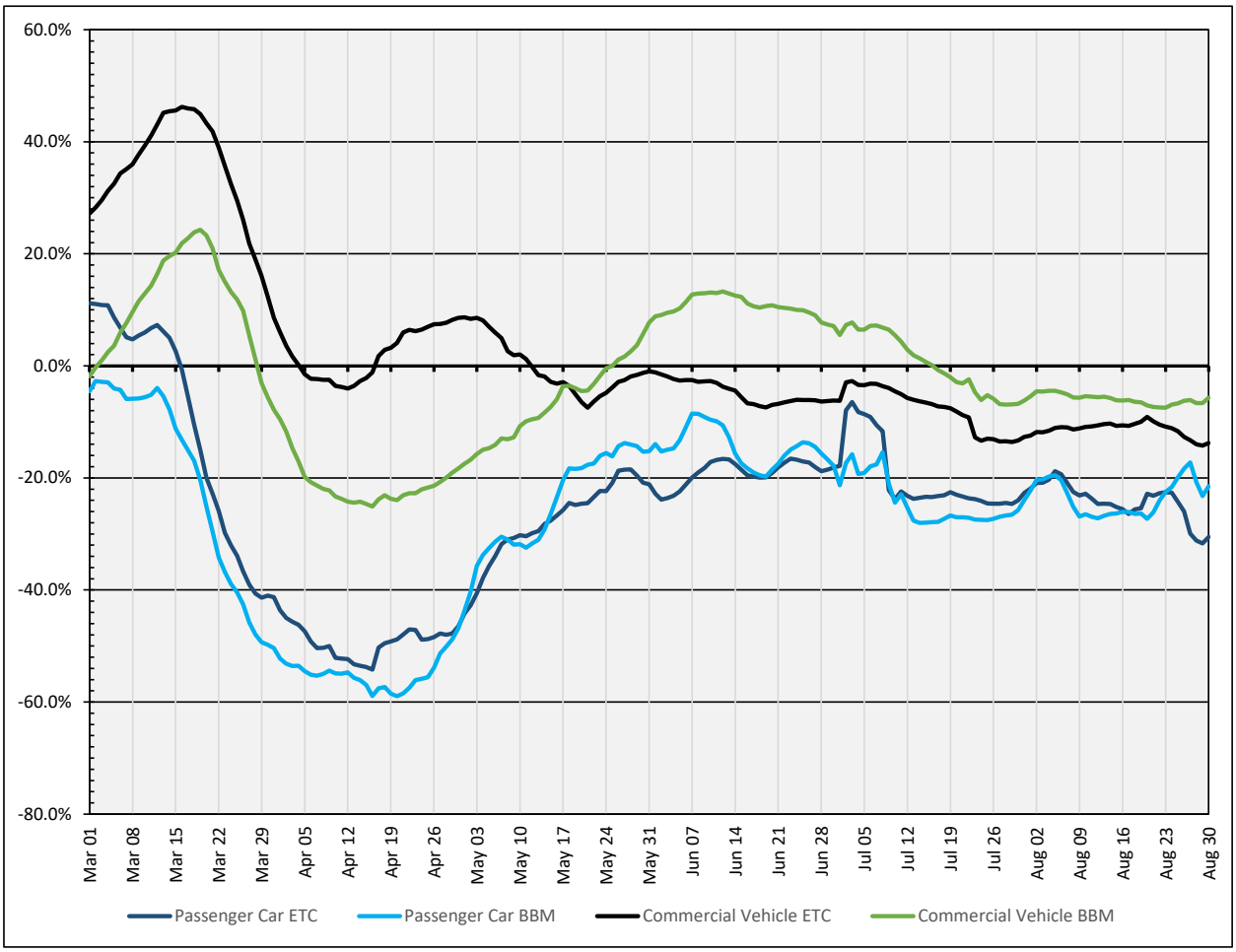
The impact of the COVID-19 pandemic on passenger car and commercial vehicle transactions on the Monroe Expressway are shown in **Figure 3** by ETC and BBM.

The largest drop in passenger car traffic versus expected no-COVID 2020 traffic occurred the week immediately following the closure of K-12 schools, from – 5.1 percent week ending March 15 to -30.5 percent week ending March 22. After non-essential businesses were closed on March 30, transactions dropped by an additional 20 percent (–31 to –51 percent in the week ending April 5).

Total system passenger car impacts are estimated to have bottomed out in mid-April at about –55 percent, meaning that about 45 percent of normal passenger car traffic was retained on the system. The state transitioned through Phase 1 in early May and entered into Phase 2 recovery on May 23, resulting in traffic recovering to about 80 percent of expected levels (-20 percent), where it has hovered through the end of August. Traffic in July and August appear to be slightly lower, but that is

based on estimated "normal" traffic conditions that were influenced by both strong seasonal summer traffic and traffic ramp-up during first year of operation in 2019.

Figure 3 - Monroe Expressway Estimated COVID-19 Transaction Impacts by Vehicle Class and Payment Method



The impact of COVID-19 on commercial vehicle traffic on the Monroe Expressway, shown on a 21-day rolling average, is also shown in Figure 3. As observed on other toll facilities around the U.S., the impact of COVID-19 has been lower on commercial vehicle traffic overall, resulting in a maximum impact of -11 percent in the week ending April 4, which would be the first 21-day period using data entirely after the beginning of closures in March. Following the Phase 2 reopening of the region on May 23, commercial vehicle traffic recovered to expected levels by the last week in May. While the graphs for commercial vehicles appear to have dipped in June, July, and August, the expected 2020 levels against which these are compared were estimated using one year of operating experience, which could be slightly overestimated. Revenue impacts of COVID-19 on the Monroe Expressway have generally followed the traffic patterns.

3. Model Update and Calibration

For this update, CDM Smith focused on collecting data and updating model inputs which were most likely to significantly influence the traffic and revenue estimates on the Monroe Expressway. CDM Smith used the Metrolina Regional Model 15 version 1.1 (MRM) for the 2016 T&R Study and again as the basis for this update. Various elements of the model were updated or adjusted for the 2016 T&R Study based on information available to the project team at the time the work was performed. The following key inputs and assumptions were further updated for this study:

- Socioeconomic forecasts including population and employment
- Corridor traffic counts and travel time data (2019)
- Current adopted long-range highway improvement program
- Inflation forecasts and vehicle operating cost estimates
- Model calibration to reflect actual experience over the first 16 months of operation (pre-pandemic conditions)

Traffic counts around the Monroe Expressway were collected for NCTA in April and May of 2019 as part of the ***Monroe Expressway Impacts on the U.S. 74 Corridor Study,*** dated September 2019. This, along with average travel speed data gathered from HERE, provided operating conditions for purposes of model calibration and validation, and to update conditions for future years in which model runs were conducted: 2025, 2030 and 2040.

3.1 Socioeconomic Forecasts

CDM Smith engaged an independent economist, Dr. Stephen J. Appold, to provide a review and update of the land use and socioeconomic growth forecasts used in the 2016 T&R Study. Dr. Appold's review focused on overall population and employment in Union and Mecklenburg Counties. Dr. Appold had developed the socioeconomic forecasts used in the 2016 T&R Study. Similar, but more rudimentary, methods were used in generating the updated baseline estimates and projections for Mecklenburg and Union Counties in this planning-level T&R forecast update. While the earlier study used 2015 as the baseline year, this update uses 2019-based population and employment estimates generated from Census 2019 population estimates and the latest NC Office of State Budget and Management's (OSBM's) population projections.

There are some slight differences in methodology with the original study. Most notably, Census county-level estimates were used as population control totals because 2019 NC OSBM estimates were not yet available. Both organizations have access to the same data and use essentially the same methodology. However, the OSBM and Census population estimates have drifted apart over the course of the decade. It is not uncommon for inter-Census population estimates to be corrected in the light of information from a complete count. Clarification will not likely be available for a year

or more. A newer vintage of the Census American Community Survey has been used in creating aspects of this version of the socioeconomic data, which could result in minor changes.

The same sources of small area (sub-county) information on employment were used in both versions of the data. Regional planners have not mounted a comprehensive update to their estimates of employment location since the previous study. The main impact of the baseline update is likely to be related to recent developments that may or may not have been accurately foreseen at the time of the earlier survey.

Due to the timing of this update report, the impacts of the COVID-19 pandemic were not taken into account in generating either the (pre-pandemic) 2019 baseline nor in the growth projections presented in this section. These impacts are applied in subsequent steps of the traffic and revenue analysis as described later in this report.

3.1.1 Adjustments to Population Forecast

Table 4 presents the updated population forecasts for Mecklenburg and Union Counties. The regional model spans 12 counties but the project corridor is located entirely within Union County and ends near the Mecklenburg County border to the north. Actual total regional growth from 2015 to 2019 for these two counties has generally fallen in line with the growth rate originally forecasted, with a total change of 9.0 percent. Total population in the updated forecast for the two counties is higher than that used in the previous study by 3.9 percent in 2025, increasing to a difference of 7.3 percent by 2040.

Table 4 - Total Population Forecasts for Mecklenburg and Union Counties (population in thousands)

County	Actual				2025				2030				2040			
	2015	2019	Growth	% Growth	2016 Study	Update Study	Diff.	% Diff.	2016 Study	Update Study	Diff.	% Diff.	2016 Study	Update Study	Diff.	% Diff.
Mecklenburg	1,018.5	1,112.1	93.5	9.2%	1,204.0	1,249.1	45.0	3.7%	1,291.6	1,353.1	61.4	4.8%	1,473.1	1,565.8	92.7	6.3%
Union	220.2	238.6	18.4	8.4%	260.9	273.0	12.1	4.6%	281.8	302.4	20.6	7.3%	323.5	361.9	38.4	11.9%
Total	**1,238.7**	**1,350.7**	**112.0**	**9.0%**	**1,464.9**	**1,522.0**	**57.1**	**3.9%**	**1,573.5**	**1,655.5**	**82.0**	**5.2%**	**1,796.6**	**1,927.7**	**131.1**	**7.3%**

The socioeconomic data was aggregated into 19 superzones adjacent to the Monroe Expressway and US 74 to summarize data within the immediate study area (see **Figure 4 and Table 5**). The total forecast for population within the 19 superzones has increased by 3.7 percent over the previous study for 2025 and 10.1 percent for 2045. In the near term (2025), the revised forecasts show higher growth at two superzones at the south/east end of the project area (superzones 19 and 7) and near the north/west end (superzone 15).

Figure 4 - Superzone Boundaries

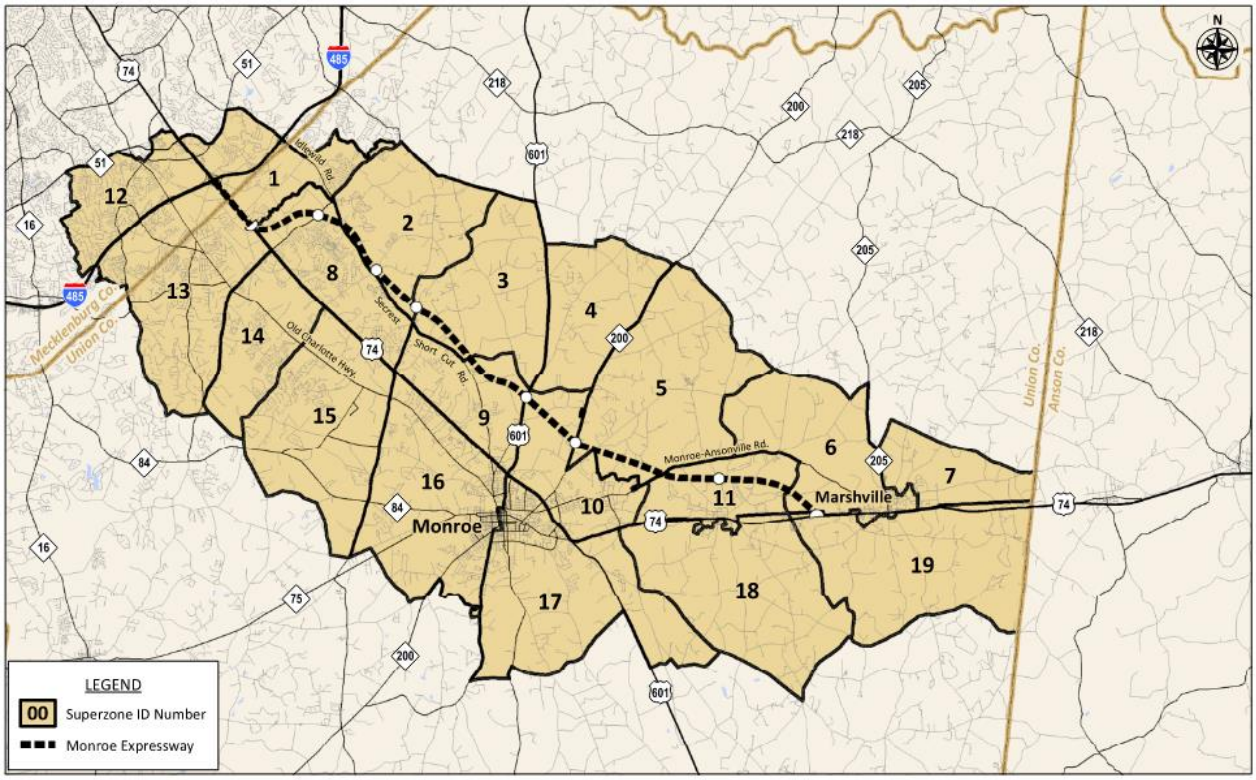


Table 5 - Study Area Total Population Forecasts by Superzone (population in thousands)

Super zone	Actual				2025				2030				2040			
	2015	2019	Growth	% Growth	2016 Study	Update Study	Diff.	% Diff.	2016 Study	Update Study	Diff.	% Diff.	2016 Study	Update Study	Diff.	% Diff.
1	11,243	13,001	1,758	15.6%	13,198	13,734	536	4.1%	14,207	14,800	593	4.2%	16,158	16,888	730	4.5%
2	7,061	8,129	1,068	15.1%	11,393	9,502	-1,891	-16.6%	12,238	11,027	-1,211	-9.9%	13,966	13,947	-19	-0.1%
3	2,468	2,819	351	14.2%	3,343	3,409	66	2.0%	3,664	3,879	215	5.9%	4,289	4,903	614	14.3%
4	2,276	2,350	74	3.3%	2,585	2,669	84	3.2%	2,761	2,920	159	5.8%	3,105	3,393	288	9.3%
5	2,840	3,136	296	10.4%	3,333	3,662	329	9.9%	3,619	4,048	429	11.9%	4,172	4,786	614	14.7%
6	2,381	2,449	68	2.9%	2,701	2,889	188	7.0%	2,854	3,207	353	12.4%	3,148	3,816	668	21.2%
7	634	653	19	3.0%	753	856	103	13.7%	804	994	190	23.6%	900	1,259	359	39.9%
8	13,394	14,182	788	5.9%	14,890	15,674	784	5.3%	15,838	16,839	1,001	6.3%	17,756	19,402	1,646	9.3%
9	5,141	5,401	260	5.1%	5,969	6,281	312	5.2%	6,444	6,979	535	8.3%	7,366	8,337	971	13.2%
10	4,460	4,579	119	2.7%	4,924	5,068	144	2.9%	5,192	5,455	263	5.1%	5,713	6,197	484	8.5%
11	4,593	5,018	425	9.3%	5,126	5,569	443	8.6%	5,472	5,980	508	9.3%	6,160	6,832	672	10.9%
12	15,582	16,505	923	5.9%	16,976	17,794	818	4.8%	17,765	18,633	868	4.9%	19,159	20,486	1,327	6.9%
13	23,098	23,987	889	3.8%	26,161	27,494	1,333	5.1%	28,220	30,182	1,962	7.0%	31,742	35,305	3,563	11.2%
14	11,723	12,246	523	4.5%	14,296	14,682	386	2.7%	15,432	16,438	1,006	6.5%	17,703	19,920	2,217	12.5%
15	11,987	12,938	951	7.9%	13,126	14,570	1,444	11.0%	14,291	15,871	1,580	11.1%	16,650	18,535	1,885	11.3%
16	15,868	16,415	547	3.4%	17,717	18,300	583	3.3%	18,725	19,700	975	5.2%	20,660	22,434	1,774	8.6%
17	9,519	9,651	132	1.4%	10,940	11,248	308	2.8%	11,519	12,314	795	6.9%	12,634	14,359	1,725	13.7%
18	2,546	2,709	163	6.4%	3,012	3,261	249	8.3%	3,272	3,711	439	13.4%	3,781	4,569	788	20.8%
19	1,441	1,458	17	1.2%	1,679	1,874	195	11.6%	1,787	2,143	356	19.9%	1,990	2,663	673	33.8%
Total	**148,255**	**157,626**	**9,371**	**6.3%**	**172,122**	**178,536**	**6,414**	**3.7%**	**184,104**	**195,120**	**11,016**	**6.0%**	**207,052**	**228,031**	**20,979**	**10.1%**

3.1.2 Employment Forecasts

Dr. Appold determined that the current (2019) levels of employment were consistent with the projections assumed in the 2016 T&R Study, and that there was no reason to adjust them or to change the forecasts for future years (see **Table 6**).

Table 6 - Total Employment Forecasts for Mecklenburg and Union Counties (jobs in thousands)

	Actual				2025				2030				2040			
County	2015	2019	Growth	% Growth	2016 Study	Update Study	Diff.	% Diff.	2016 Study	Update Study	Diff.	% Diff.	2016 Study	Update Study	Diff.	% Diff.
Mecklenburg	768.3	828.3	60.0	7.8%	899.1	899.1	0.0	0.0%	951.4	951.4	0.0	0.0%	1,080.2	1,080.2	0.0	0.0%
Union	86.0	91.0	5.0	5.8%	97.8	97.8	0.0	0.0%	103.3	103.3	0.0	0.0%	116.6	116.7	0.0	0.0%
Total	**854.3**	**919.3**	**65.0**	**7.6%**	**996.9**	**996.9**	**0.0**	**0.0%**	**1,054.6**	**1,054.7**	**0.0**	**0.0%**	**1,196.9**	**1,196.9**	**0.0**	**0.0%**

3.1.3 Forecasting in the Age of a Pandemic

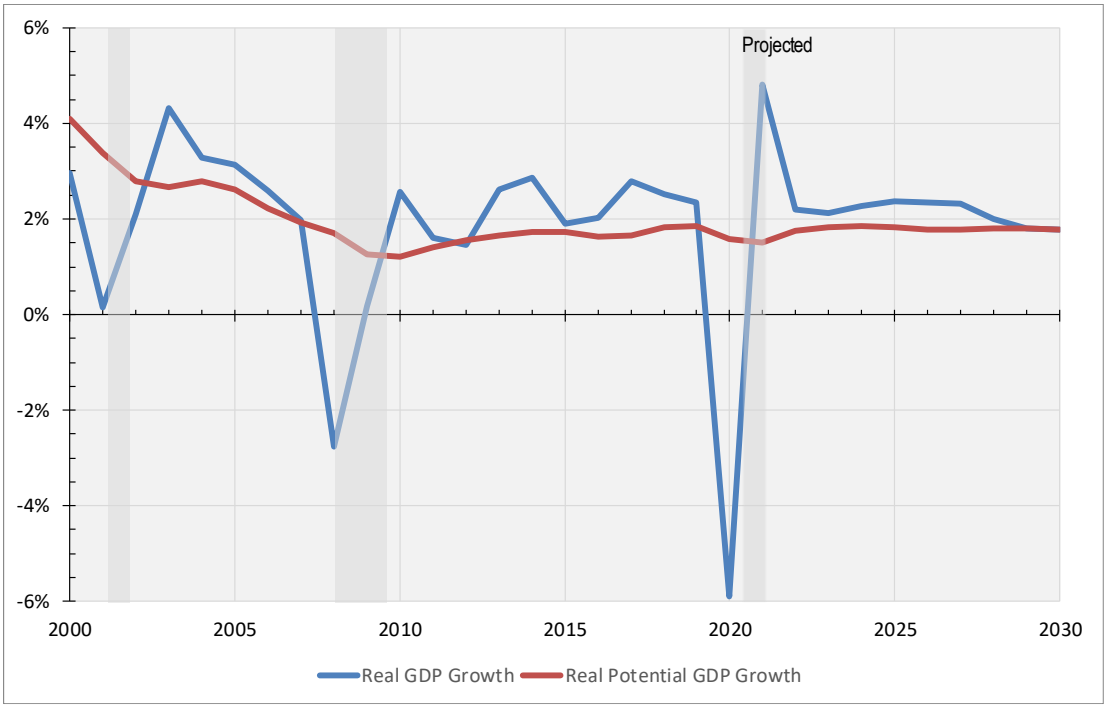
The ongoing COVID-19 pandemic has upset traffic forecasting in two fundamental ways. First, the pandemic has brought on significant employment loss and a serious economic contraction of unknown duration, partly because many businesses were either forced to close due to governmental restrictions, while others reduced operations in response to diminished demand. Second, many of those who are still employed are working from home. Both factors have impacted the number of journeys to work.

Any projection of the course of either indicator, the number of people employed and the proportion of the employed working remotely, must be seen as speculative at this point. Those speculations, however, are not without basis. The following paragraphs address the first concern, employment trends.

Figure 5 shows the past and projected growth of real Gross Domestic Product (GDP) for the U.S. economy according to the latest available Congressional Budget Office (CBO) analysis which is based on data available as of June 26, 2020.[1] The sharp contraction in economic activity can be seen. In these revisions of its estimates generated in May 2020, CBO has revised downward its estimate of growth in the second half of 2020. Nevertheless, the CBO expects real GDP to recover to its pre-pandemic level by the middle of 2022. Unemployment will likely remain above pre-pandemic levels for several years.

[1] As of October 28, 2020, no update had been issued.

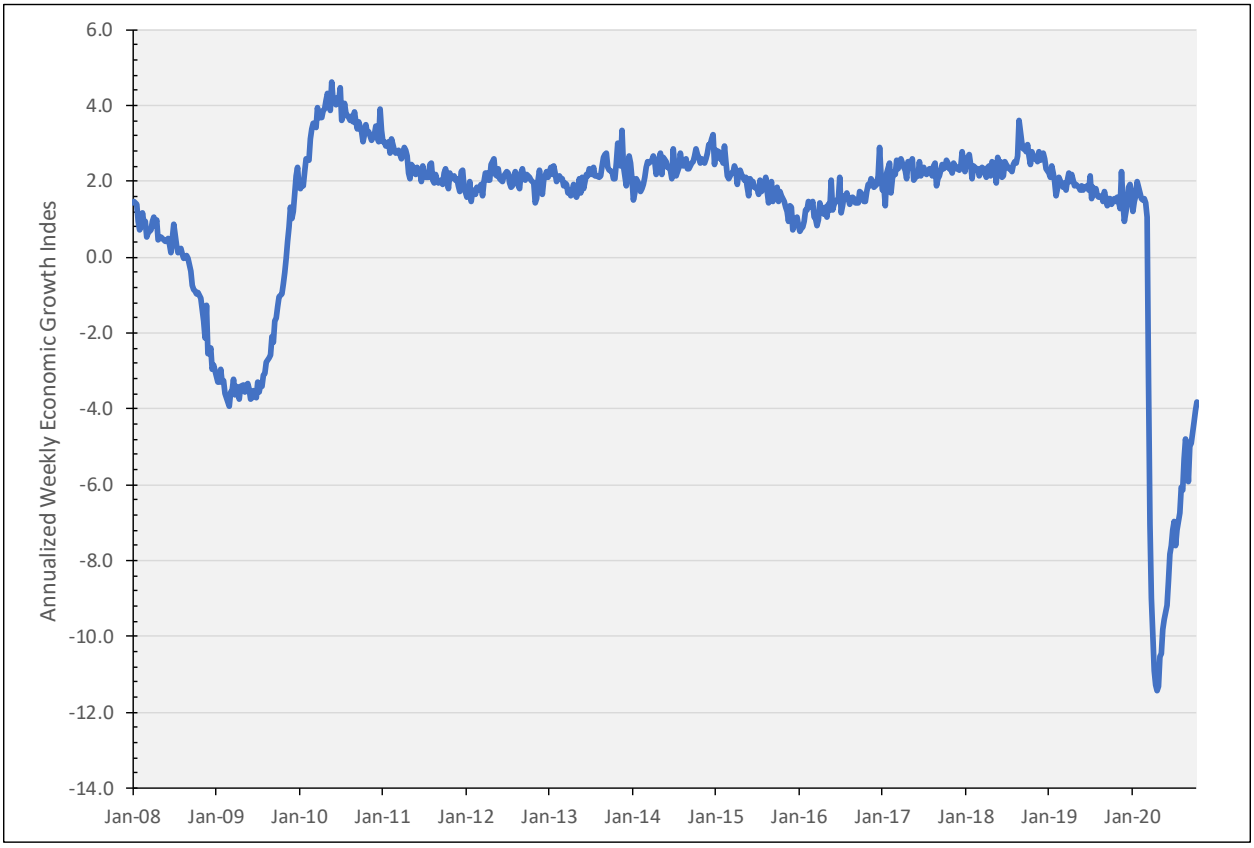
Figure 5 - Growth of Real GDP and Real Potential GDP, CBO July 2020



Source: CBO, An Update to the Economic Outlook: 2020 to 2030, *https://www.cbo.gov/publication/56465*

The Federal Reserve Bank has been compiling a weekly index of U.S. economic activity based on 10 series of consumer behavior and industrial production data sources. These are national data but are fairly representative of the North Carolina economy as well. The advantage of these data is that they provide a more up-to-date profile of the state of the U.S. economy than the CBO publication. As shown in **Figure 6**, annualized economic growth rates are charted so that a reading of, say, 2.00 would imply that the economy was growing at rate which would be equivalent to two percent annually, even though that rate was measured for just one week.

Figure 6 - Annualized Weekly Economic Index for U.S.



Source: Lewis, Daniel J., Mertens, Karel, and Stock, James H., Weekly Economic Index, *https://www.newyorkfed.org/research/policy/weekly-economic-index*

The trends in Figure 6 over time are complex. The graphic includes the contractions of the Great Recession, the subsequent rapid initial recovery, the return to an underlying long-term economic growth rate followed by a slowing of growth in 2015 and a subsequent recovery in 2016. There is evidence of a general slowdown in 2019 even before the pandemic impacts begin in March and April 2020. The initial period after the COVID-19 nadir suggested a rapid V-shaped recovery. Other evidence, including the CBO projections, suggests that despite the sharp partial rebound, full recovery will likely take years to be manifested.

The Federal Reserve also maintains an on-going daily Mobility and Engagement Index (MEI) using cell phone location data from Safegraph.[2] The MEI is based on a weighted combination of:

1. Fraction of devices leaving home in a day.
2. Fraction of devices away from home for three to six hours at a fixed location.
3. Fraction of devices away from home longer than six hours at a fixed location.

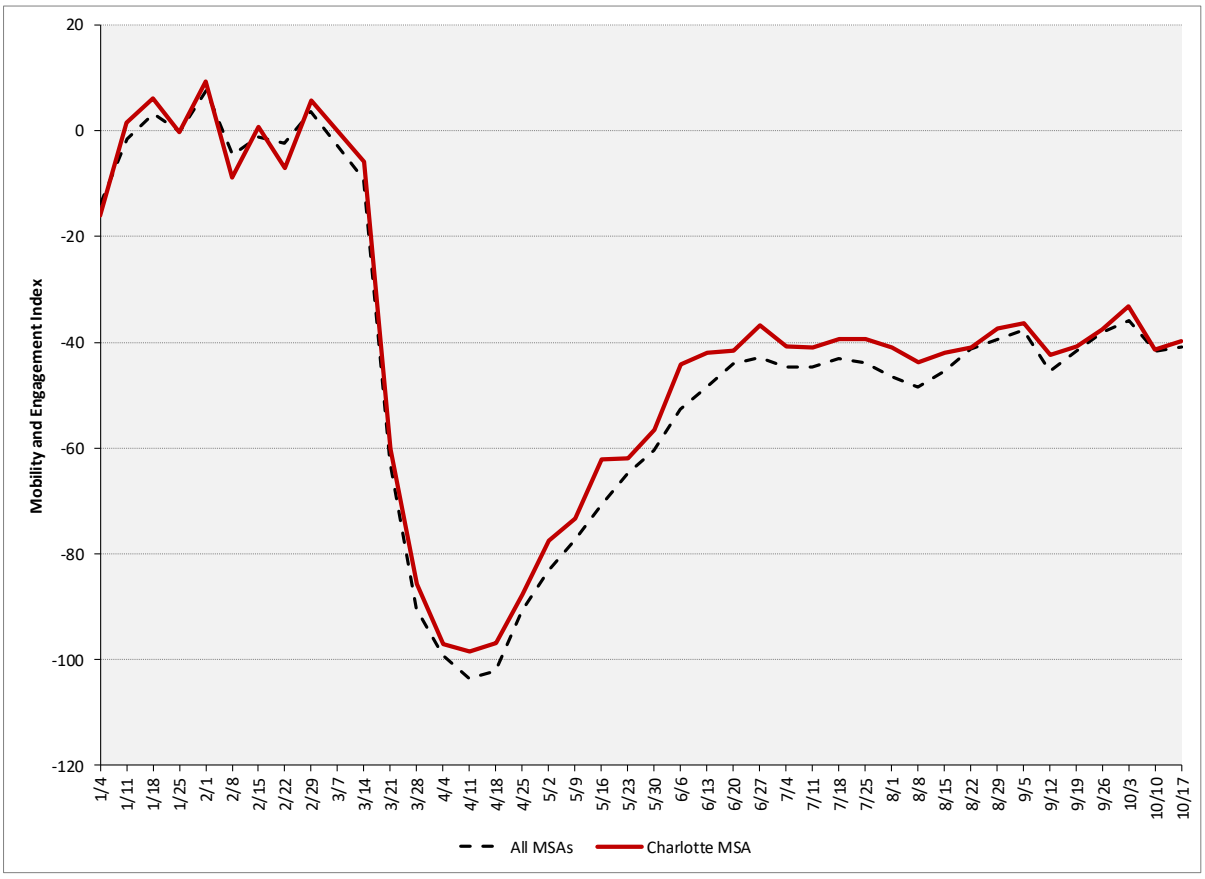
[2] https://www.dallasfed.org/research/~/media/documents/research/papers/2020/wp2014.pdf

4. An adjusted average of daytime hours spent at home.
5. Fraction of devices taking trips longer than 16 kilometers (10 miles).
6. Fraction of devices taking trips less than 2 kilometers (1.2 miles).
7. Average time spent at locations far from home.

The data are scaled so that the daily average measurements for January and February of this year average zero.[3] Data for the Charlotte MSA and all MSAs nation-wide are shown in **Figure 7**.

The two data series are roughly consistent. Four time periods can be seen: the period of normal mobility in January and February, the rapid drop off during March and the first half of April, the fairly rapid partial resumption of movement in late April and May, and a plateauing of movement beginning in early June and lasting through the present. Those same patterns are repeated, with some variation, for each of the North Carolina metropolitan areas.

Figure 7 - Average Mobility and Engagement Index for Charlotte MSA and All MSA, January to October 2020

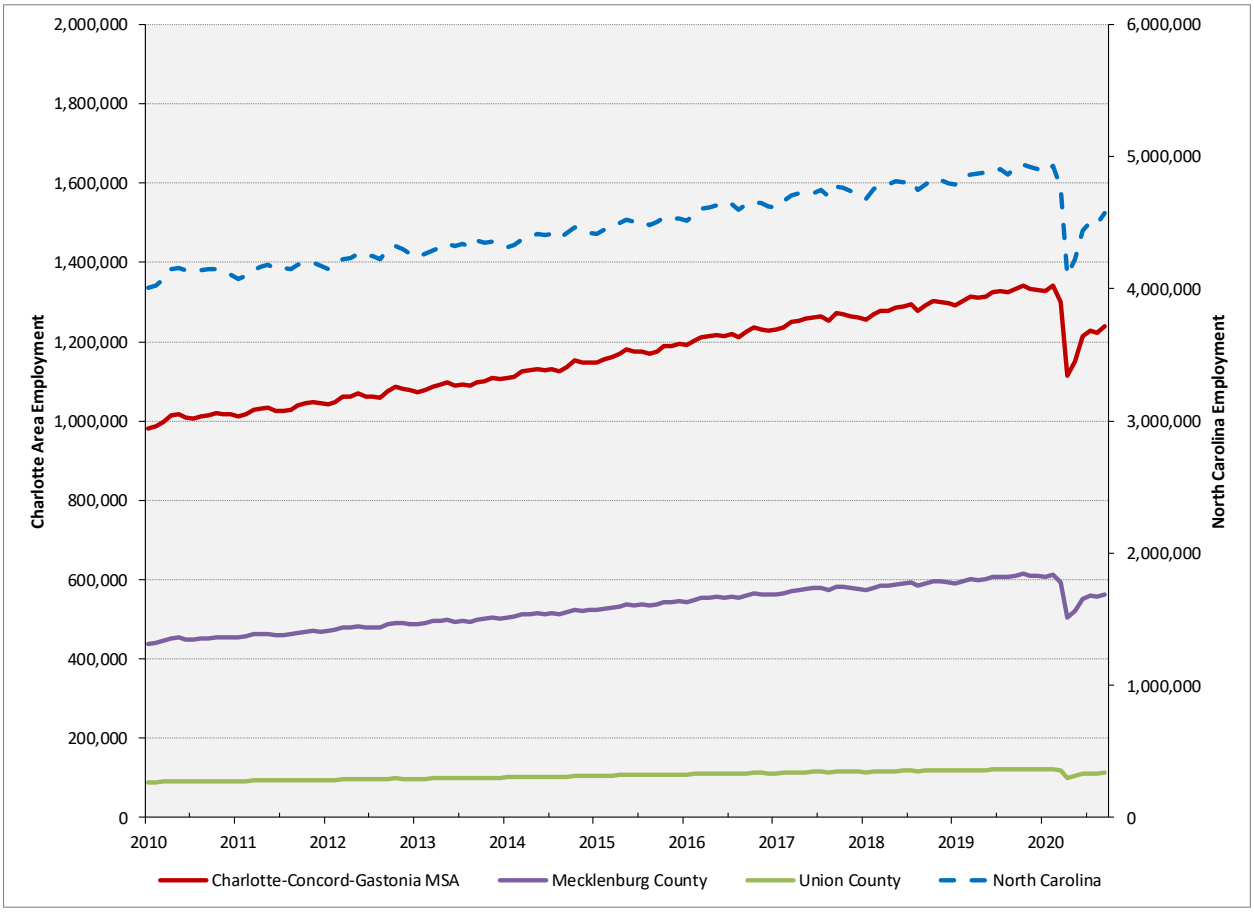


Source: Federal Reserve Bank, Dallas

[3] https://www.dallasfed.org/research/mei

The employment trends for North Carolina, the Charlotte-Concord-Gastonia metropolitan area, and the two most relevant counties of the Metrolina region (Mecklenburg and Union Counties) (see **Figure 8**) provides provisional corroborative support for the CBO and Federal Reserve analysis. Statewide employment, illustrated by the dashed line using the right scale, grew throughout the last decade, as did employment in the metropolitan area and each of the two selected counties. U.S. employment grew by 16.3 percent between January 2010 and October 2019 (not shown) and North Carolina employment grew by 23.2 percent over that same period while employment in the Charlotte metropolitan area, Mecklenburg, and Union Counties increased by 36.9 percent, 40.7 percent, and 38.1 percent, respectively. Employment then dropped marginally, 0.6 percent for the U.S. and 0.1 percent in North Carolina, to the pre-pandemic level measured in February. The Charlotte metropolitan area then lost 226,027 jobs (130,271 in Mecklenburg and Union Counties) – approximately 17 percent – then bottoming out at 1,114,258 (605,035 for Mecklenburg and Union Counties) in April.

Figure 8 - Monthly Employment, January 2010 to September 2020

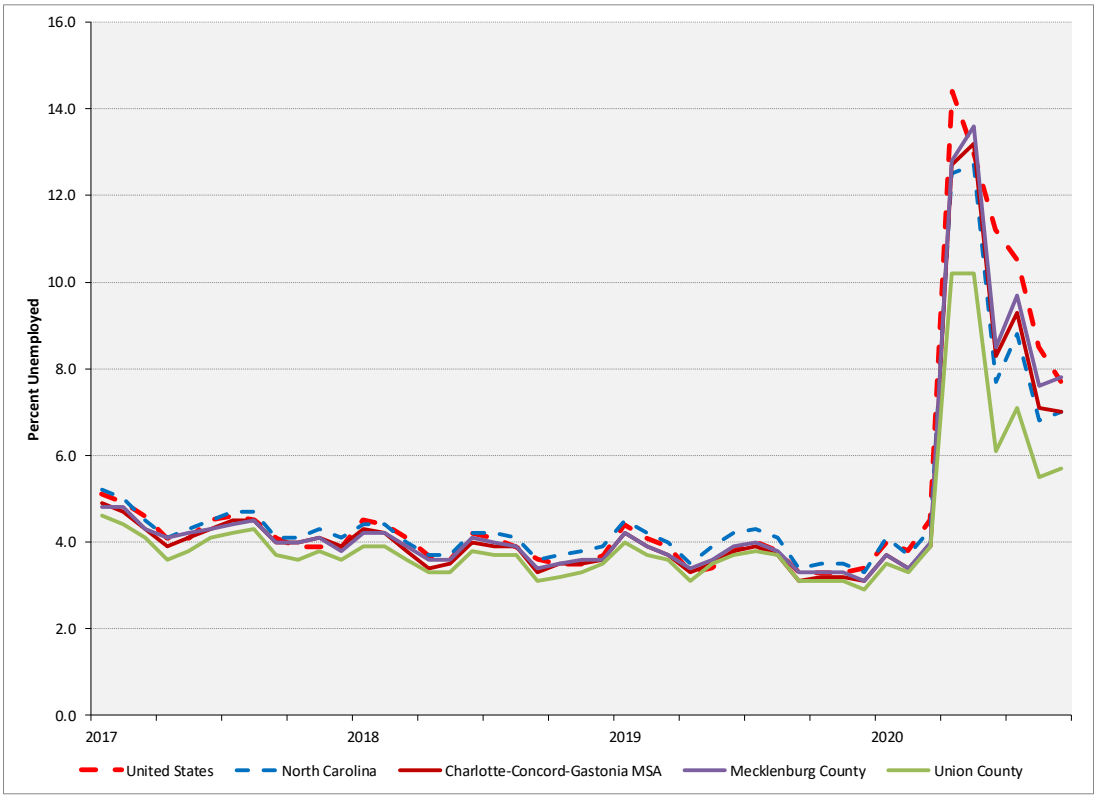


Source: North Carolina Department of Commerce

Employment rebounded decisively in May 2020, then decisively in June, but only modestly in July. By July, the Charlotte metropolitan area and the two selected counties had recovered 53 percent of their February pre-pandemic peak and had risen modestly to approximately 55 percent by September. Regional employment growth varies from the national pattern, alternatively falling behind and then surging ahead of national growth rates. Using the average weekly employment growth in May through September as a rough and arbitrary recovery guide, the Charlotte metropolitan area, including Mecklenburg and Union Counties, is projected to recover its pre-pandemic employment peak by July or August of 2021. The state of North Carolina is projected to reach that milestone at the same time and the U.S., as a whole, a month before that. These calculations suggest a more rapid recovery than that projected by the CBO, but they are less rapid than expected earlier. These are, of course, simple extrapolations from a short trend and the coming months will provide critical information in refining these calculations.

Figure 9, which charts unemployment rates in the U.S., North Carolina, the Charlotte metropolitan area, and the two selected counties, suggests that the pandemic-induced downturn may not have been as severe in Union County as elsewhere. The drop in unemployment rates in the Charlotte region generally corroborates the analysis above.

Figure 9 - Monthly Unemployment Rate January 2017 to September 2020



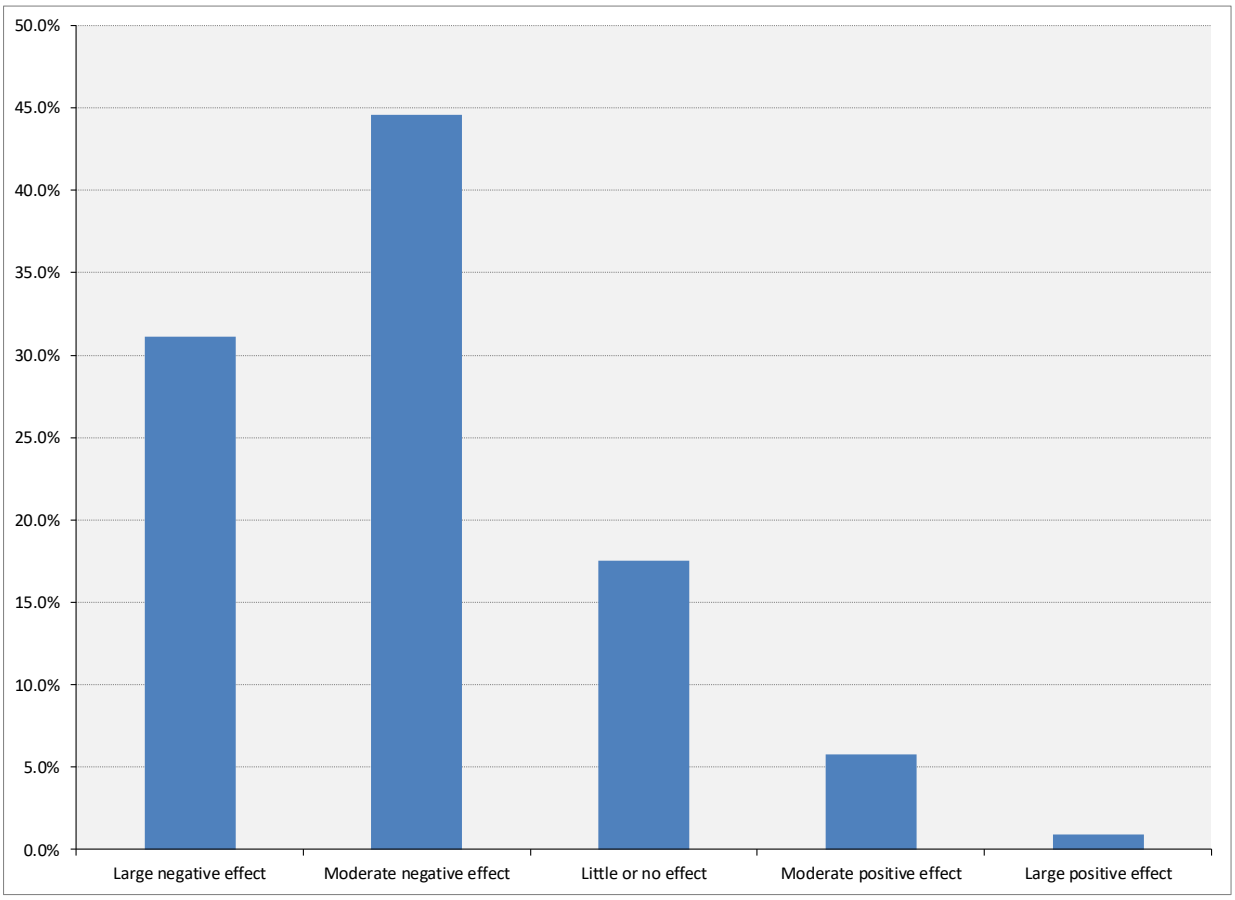
Source: North Carolina Department of Commerce

3.1.4 Results from a Recent Small-Business Survey

This section presents a selection of results from the Census Bureau's Small Business "Pulse" Survey series for the Charlotte-Concord-Gastonia, NC Metropolitan Statistical Area (MSA) for the week of October 2 to October 10, 2020. The respondents are small businesses, and therefore do not directly reflect the situation of large businesses and government. However, since most small businesses are directly or indirectly dependent upon large businesses, the responses are likely good indications of regional conditions.

Figure 10 shows the responses to a question about the pandemic's impact on business operations. Not surprisingly, three-fourths of the respondents claim negative impacts. This is almost exactly as many a had claimed a negative impact at the end of August. A large negative impact was reported by 30 percent of respondents.

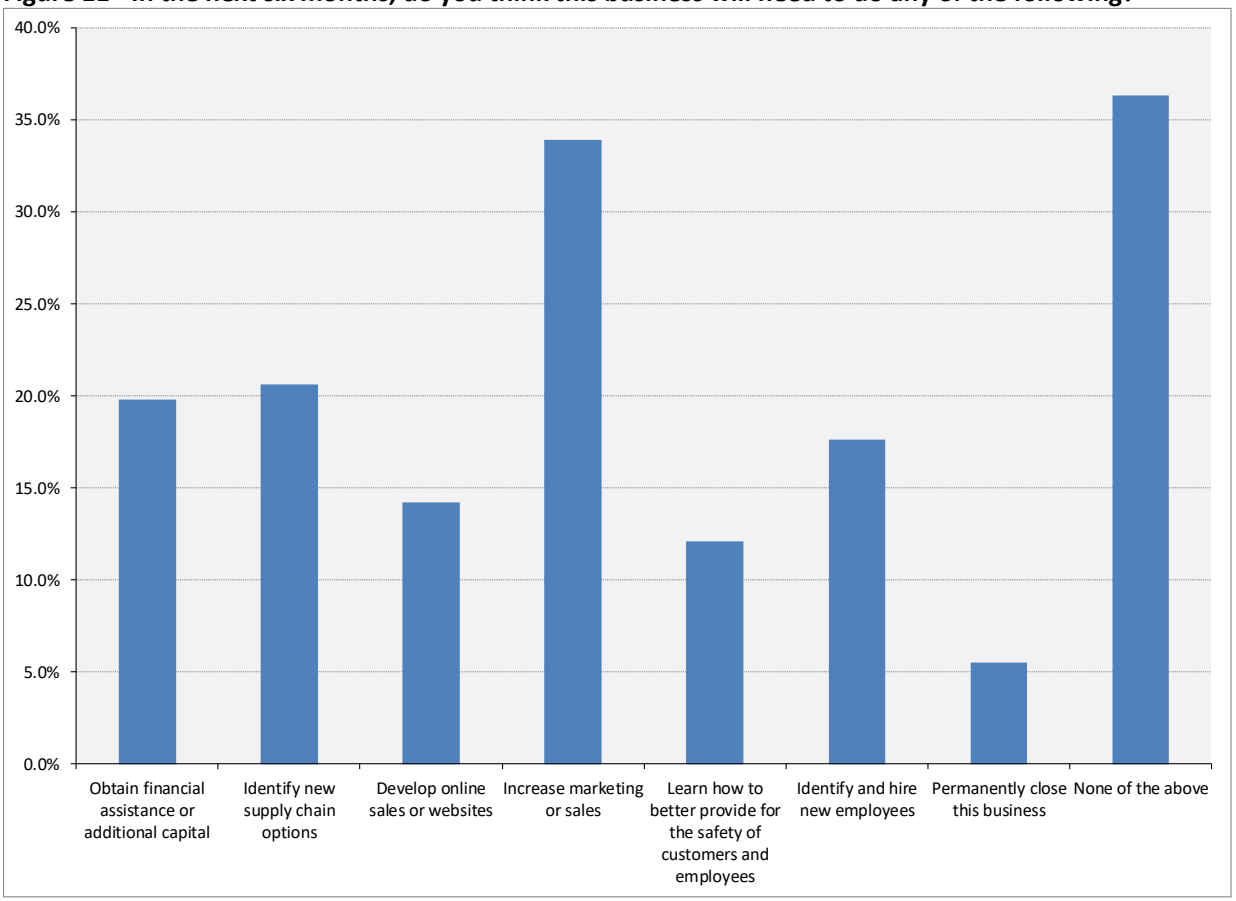
Figure 10 - Overall how has this business been affected by the Coronavirus pandemic?



Source: Census Bureau Small Business Pulse Survey, October 2020

Figure 11 shows the responses to a question about future strategic business actions (respondents could select multiple choices so the bars may not sum to 100 percent). The good news is that comparatively few businesses foresaw closing. However, nearly 20 percent saw the need for a cash infusion. Compared to August, fewer businesses expected to need to hire new employees. Many businesses were actively strategizing for the future, suggesting acknowledgement of difficult times for the coming months, but with optimistic anticipation.

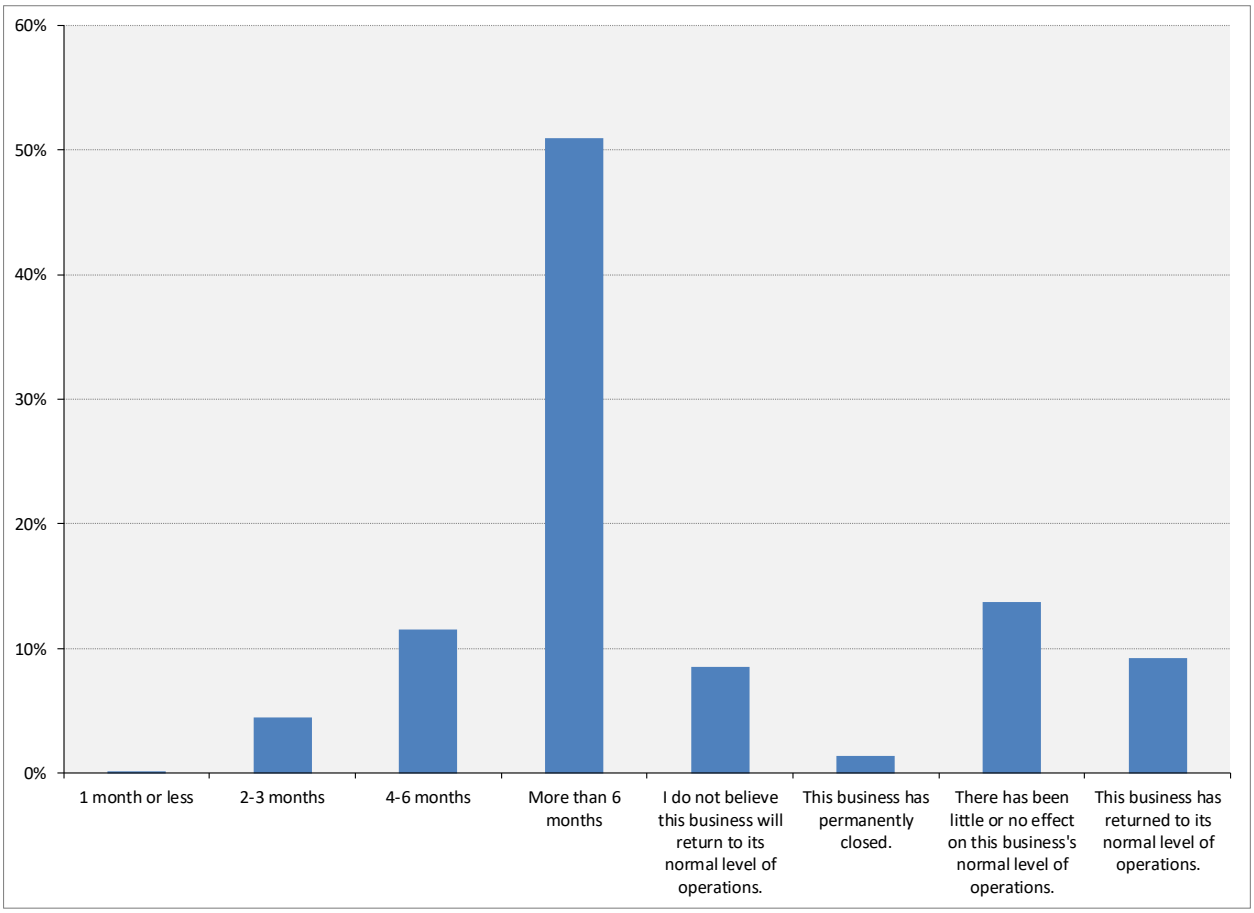
Figure 11 - In the next six months, do you think this business will need to do any of the following?



Source: Census Bureau Small Business Pulse Survey, October 2020

Figure 12 most directly shows the range of anticipated business trajectories from the survey respondents. Nearly half the respondents predicted recovery times of six months or more. By now, it is possible to compare responses over time, and the pattern of responses has been fairly constant over time. Taken together, these responses show significant impacts of the pandemic on business operations but also suggest strong optimism about the future – even if significant challenges are anticipated.

Figure 12 - In your opinion, how much time do you think will pass before this business returns to its normal level of operations relative to one year ago?



Source: Census Bureau Small Business Pulse Survey, October 2020

These are survey responses. The respondents can claim no special insight into the economy but can report on what they observe in their businesses' day to day. The series is relatively new, and subsequent waves of the survey will allow for more careful tracing of the path towards economic recovery.

3.1.5 Adjustments to Future Year Trip Tables

The updated socioeconomic forecasts were used to inform adjustments to the trip tables developed from the regional travel demand model, Metrolina Regional Model (MRM), used in the 2016 T&R Study. For the purposes of this study, the full MRM model was not rerun; the trip tables from the previous study were adjusted considering the changes in population and employment in each zone. First, CDM Smith used the total trip ends in a zone from the MRM trip tables used in the 2016 T&R Study and the population and employment in each zone to estimate a regression model. Then, the changes in population and employment from this update study were applied using the relationships from that regression model to estimate adjustments to total daily vehicle trips for each zone. The output of this process is a series of baseline trip tables that do not reflect the impacts of the COVID-19 pandemic.

As noted earlier, the updated socioeconomic forecasts developed by Dr. Appold did not take into account any impacts of the ongoing COVID-19 pandemic since there was very limited actual data available on changes at the small area level at the time of this analysis and the situation continues to evolve.

In light of this, COVID-19 impacts have been applied to the traffic and revenue forecast in this study in two ways. First, actual experience from March through August 2020 was used to estimate an assumed recovery pattern in the region for the next several years. Second, it is assumed that the pandemic will have resulted in a slowdown in growth over the short-term. To reflect this impact in these forecasts, the total growth previously assumed to take place between 2019 and 2025 has been assumed to be delayed three years to 2028. Assuming that the 2025 trip tables reflecting Dr. Appold's changes will occur by 2028, an adjusted 2025 trip table was developed by interpolation from 2019. The net difference between the 2025 and 2028 trip tables was also subtracted from the baseline 2030 and 2040 trip tables to recognize this delayed growth.

3.2 Changes to Roadway Improvements Assumptions

The 2016 T&R Study used the roadway improvement program contained in the NCDOT 2015 State Transportation Improvement Program (STIP) as the basis for the networks used in the model. The STIP has since been updated. CDM Smith reviewed the current NCDOT 2020-2029 STIP (as of July 2020) and consulted with NCDOT/NCTA staff to determine if any revisions were needed to the 2019, 2025, 2030 and 2040 roadway networks used in the model. **Table 7** presents a list of roadway improvement projects with the greatest potential to influence travel on the Monroe expressway corridor that have been added, removed, or for which completion years have shifted in the current STIP. The table indicates the original year of completion used in the 2016 T&R Study, and the updated year of completion used in this study.

Table 7 - Changes to Roadway Improvement Assumptions

STIP ID	Roadway	Location	Description	Completion Year in 2016 T&R Study	Updated Completion Year
U-5804	SR 3448	Fullwood Lane to Weddington Road	Add 1 lane per direction	2019	2021
R-0211EC	I-485	Weddington Road overpass	Construct new interchange between I-485 and Weddington Road	2019	2022
I-5507	I-485	I-77 South of Charlotte to US 74 (Independence Boulevard)	Add 1 express lane per direction	2019	2023
U-4713	McKee Rd Ext	New 2 lane roadway	New 2-lane roadway	2019	2023
U-4713A	New road	SR 3448 (Pleasant Plains Road) to SR 1009 (E. John Street)	Add 1 lane per direction on new location	n/a	2024
U-6103	US 74	I-277 to W of Idelwild Rd	Widen roadway to allow for two-way express lanes. Coordinate with U-2509	2019	2025
U-4913	Idlewild Rd	I-485 to SR 1524 (Stevens Mill Road)	Add 1 general purpose lane per direction	2023	2026
U-5763	NC 51	SR 3356 (Sardis Road) to SR 1009 (Monroe Road)	Add 1 general purpose lane per direction	2024	2026
U-4714	SR 1009	SR 3448 (Trade Street) to SR 1377 (Wesley Chapel-Stouts Road)	Add 1 general purpose lane per direction and convert to supershtreet	2025	2026
U-3467	New road	NC 16 (Providence Road) to SR 84 (Weddington Road)	Extend SR 1316 (Rea Road) from NC 16 (Providence Road) to SR 84 (Weldington Road)	2025	2027
U-5764	US 74	Hanover Drive to SR 1007 (Rocky River Road)	Add 1 general purpose lane per direction	2025	2028
U-6109	US 521	SC State line to SR 4979	Widen to multi-lanes	n/a	2029
U-2549	Monroe northern loop	US 74 TO SR 1751 (Walkup Avenue) at SR 1763 (Bivens Road)	Add 2 lanes per direction on new location	2030	Remove

3.3 Other Model Inputs

This section summarizes the updates made to other key model inputs: inflation, value of time, vehicle operating cost, future toll rates and future ETC market share.

3.3.1 Inflation Rates

For this study, estimated future rates of inflation were updated using the latest CPI forecasts available from Moody's Analytics for the Charlotte MSA, which show 1.7 percent inflation for 2019 and -0.3 percent for 2020. **Table 8** shows a comparison of the prior and updated estimated inflation rates.

Table 8 - Estimated Annual Inflation Rate

	2016 T&R Study	Current Study
2019 to 2025	2.3%	2.2%
2025 to 2030	2.1%	2.3%
2030 to 2040	2.1%	2.2%
2040 to 2045	2.0%	2.0%
2045 to 2058	2.0%	2.0%

3.3.2 Value of Time

The values of time used for the 2016 T&R Study were calculated based on median household income data by traffic analysis zone in the MRM model. For this update study, the values of time were adjusted using changes in income in the region and updated inflation forecasts. The resulting values of time are lower than the previous study by 0.2 percent in 2025 on a net basis, and higher by 1.3 percent in 2040. **Table 9** shows the aggregate values of time for each model year in the 2016 T&R Study and the current study.

Table 9 - Estimated Values of Time

	Average Value of Time ($ per minute)			
	2019	**2025**	**2030**	**2040**
2016 T&R Study				
Passenger Cars	$ 0.178	$ 0.204	$ 0.227	$ 0.279
Commercial Vehicles	$ 0.309	$ 0.355	$ 0.395	$ 0.540
Current Study				
Passenger Cars	$ 0.177	$ 0.202	$ 0.226	$ 0.282
Commercial Vehicles	$ 0.305	$ 0.348	$ 0.391	$ 0.542

3.3.3 Vehicle Operating Costs

The vehicle operating costs were updated to reflect changes in forecasted inflation rates, updated forecasts of fuel prices, changes in fuel efficiency standards adopted by the Environmental Protection Agency (EPA) in April 2019, and the 2019 information on average vehicle maintenance costs from the Automobile Association of America. **Table 10** shows the vehicle operating costs used for each model year in the 2016 T&R Study and the current study.

Table 10 - Estimated Vehicle Operating Costs

	Vehicle Operating Cost ($ per mile)			
	2019	**2025**	**2030**	**2040**
2016 T&R Study				
Passenger Cars	$0.180	$0.190	$0.209	$0.276
Commercial Vehicles	$0.616	$0.730	$0.846	$1.188
Current Study				
Passenger Cars	$0.198	$0.212	$0.239	$0.306
Commercial Vehicles	$0.643	$0.727	$0.844	$1.110

3.3.4 ETC Market Share

Table 11 shows the assumed percent of travelers who have ETC transponders, by vehicle type and by model year in the 2016 T&R Study and the current study. The 2019 and 2025 percentages are lower than assumed in the 2016 T&R Study, reflecting actual transaction experience on the Monroe Expressway after it opened. As in the 2016 T&R Study, it is assumed that over time, more travelers would acquire ETC transponders in order to pay lower toll rates. The 2030 and 2040 ETC percentages are similar to those assumed in the 2016 T&R Study.

Table 11 - Average Weekday ETC Market Share Model Input Splits

	2019	2025	2030	2040
2016 T&R Study				
Passenger Cars	55%	57%	60%	65%
Commercial Vehicles	68%	70%	72%	74%
Current Study				
Passenger Cars	42%	55%	60%	65%
Commercial Vehicles	62%	70%	75%	78%

Note that these percentages of travelers do not necessarily translate to exact percentages of transactions on the Monroe Expressway itself; rather they correspond to the percent of travelers for whom the assumed toll charge on the Expressway would be the ETC charge, were they to choose a travel route that includes the expressway. Since the tolls for ETC traffic is lower than BBM, the ETC shares from model outputs tend to be about five percent higher than the values in Table 11 for passenger cars, better matching observations on Monroe Expressway.

3.4 Model Inputs Calibration and Validation

The 2016 T&R Study included an extensive model calibration effort to 2015 conditions. The calibration year for this study was 2019.

The Monroe Expressway was open for all of 2019, so a major component of the model calibration was to accurately represent average daily transactions on the Monroe Expressway for that year. Other key elements of calibration and validation involved comparisons between modeled and observed traffic volumes across screenlines and speeds on US 74.

3.4.1 Daily Transactions

Table 12 shows the comparison of average daily transactions for calendar year 2019 between actual observations and modeled transactions after calibration.

Table 12 - Comparison of Observed and Modeled Daily Transactions

Gantry	Location	Direction	Observed	Model	% Diff
M01	US 74 -	WB	8,639	9,473	10%
M02	Indian Trail Fairview	EB	8,512	9,249	9%
M03	Indian Trail Fairview -	WB	8,448	8,630	2%
M04	Unionville Indian Trail	EB	8,436	8,663	3%
M05	Unionville Indian Trail -	WB	8,012	7,647	-5%
M06	Rocky River Rd	EB	7,665	7,800	2%
M07	Rocky River Rd -	WB	7,706	7,138	-7%
M08	US 601	EB	7,583	6,953	-8%
M09	US 601 -	WB	6,639	6,025	-9%
M10	Morgan Mill Rd	EB	6,812	5,824	-14%
M11	Morgan Mill Rd -	WB	5,317	4,852	-9%
M12	Austin Chaney Rd	EB	5,507	4,442	-19%
M13	Austin Chaney Rd -	WB	4,310	3,643	-15%
M14	US 74	EB	4,493	3,394	-24%

In addition to improving the consistency between the model and observed daily transactions, the model calibration increased the truck share on the Monroe Expressway from four to 12 percent, more closely matching the observed truck share of 15 percent. The model calibration also decreased the ETC market share on the Monroe Expressway from 54 to 49 percent, matching the observed market share in 2019.

As part of forecasting the transaction and revenue streams presented later in this memo, future year model outputs (2025, 2030 and 2040) were adjusted to account for the remaining differences between 2019 modeled and observed transactions by time of day, direction, ETC share, and truck shares.

3.4.2 Screenline Traffic Volumes

Figure 13 shows the location of the traffic volume screenlines within the study area. As shown on the figure, six screenlines were developed for this study. All screenlines are perpendicular to US 74, and therefore capture traffic on roads parallel to the Monroe Expressway.

Figure 13 - Location of Traffic Volume Screenlines

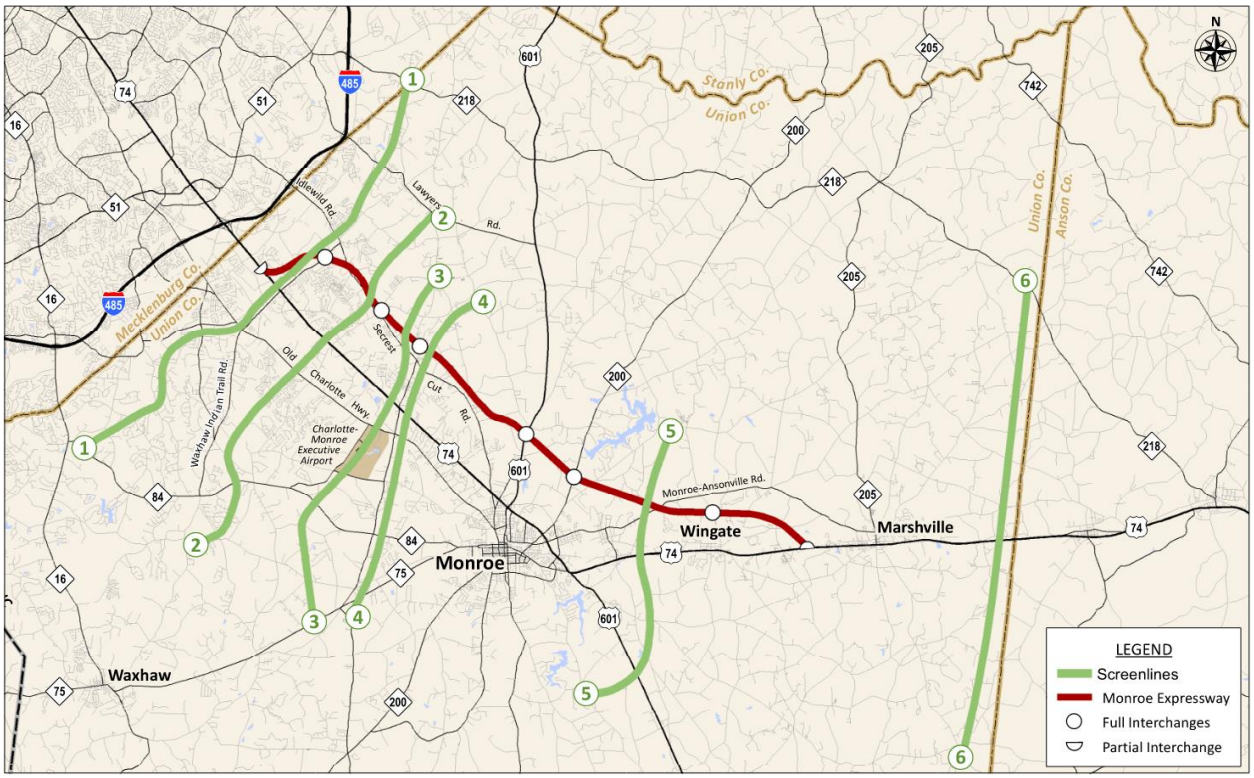


Table 13 shows the comparison of 2019 traffic volumes at each screenline between actual counts and model values, after calibration.

Table 13 - Comparison of Observed and Modeled 2019 Screenline Daily Traffic Volumes

Screenline	Description	Observed	Model	% Diff
1	West of Indian Trail-Fairview Rd	211,427	208,024	-2%
2	West of Sardis Church/Unionville	171,414	159,445	-7%
3	West of Rocky River Rd	127,749	126,162	-1%
4	East of Rocky River Rd	123,829	123,972	0%
5	East of Bivens Rd	69,839	69,633	0%
6	Union/Anson County Line	40,884	43,115	5%

3.4.3 Travel Speeds along US 74

Table 14 shows the comparison of actual vs calibrated model speeds along US 74. This 22-mile section of US 74 between I-485 and NC-205 in Marshville is the main toll-free alternative route to the Monroe Expressway. The observed speeds by segment were obtained from HERE[4] and represent average conditions by for each model period on non-holiday weekdays in CY 2019.

The calibration effort resulted in model speeds closer to observations, particularly at both ends of the corridor, to the point where none of the travel segments had differences exceeding 10 mph. Speed differences of five mph or higher are highlighted on the table.

4. Traffic and Revenue Forecasts

Estimated annual traffic and revenue forecasts are presented in this section. First, some of key assumptions not already covered in the prior section are summarized. Also included in this section is a comparison with the 2016 T&R study forecast and with a hypothetical no-COVID case, as well as T&R estimates at the monthly level for the period July 2020 through December 2021.

4.1 T&R Forecast Assumptions

In general, the forecasting approach used for this study is the same as the 2016 T&R Study with the incorporation of several adjustments in the model and post-processing techniques. The model adjustments were described in Section 3. Post processing adjustments included incorporation of the COVID-19 pandemic impacts, and revised factors for ramp-up, annualization, and leakage.

4.1.1 Basic Modeling Assumptions

Basic modeling assumptions and adjustments applied in this study are listed below.

- The model was calibrated against 2019 conditions based on actual transactions on the Monroe Expressway, traffic counts and travel speeds in the corridor of influence, and revised 2019 population estimates from the independent economist
- Economic growth in the study area will generally occur as forecasted by the independent economist
- Planned roadway improvements within the study area will be implemented within the time frames assumed in the June 2020 version of NCDOT's STIP (State Transportation Improvement Program).
- Model inputs related to value of time, vehicle operating cost, and inflation were reviewed and revised as needed.
- ETC market share assumptions by vehicle type and by model year were reviewed and updated.

[4] HERE speed data is built on a database derived from vast amounts of GPS probes.

Table 14 - Comparison of Observed and Modeled Speeds on US 74

Eastbound		Distance	HERE Observed Speeds				Model Speeds				Difference			
From	To	(mi)	AM	MD	PM	NT	AM	MD	PM	NT	AM	MD	PM	NT
I-485/JAMES G MARTIN FWY	STALLINGS RD	0.89	58	57	57	56	53	53	52	54	-4	-4	-4	-2
STALLINGS RD	INDIAN TRAIL-FAIRVIEW RD	1.23	44	42	32	46	40	41	39	43	-3	-2	8	-3
INDIAN TRAIL-FAIRVIEW RD	WESLEY CHAPEL STOUTS RD	2.12	43	41	38	43	36	37	34	39	-8	-4	-4	-4
WESLEY CHAPEL STOUTS RD	ROCKY RIVER RD	2.54	45	34	41	49	43	44	41	46	-2	10	0	-3
ROCKY RIVER RD	ROLAND DR	2.24	43	40	36	44	40	41	40	43	-3	1	4	-1
ROLAND DR	DICKERSON BLVD	0.92	34	32	28	34	35	35	33	38	1	3	5	4
DICKERSON BLVD	US-601/NC-200/CONCORD HWY	0.72	37	33	33	37	36	36	34	38	0	3	1	2
US-601/NC-200/CONCORD HWY	US-601/NC-200/CONCORD HWY	0.28	37	33	33	37	37	37	37	39	1	4	4	3
US-601/NC-200/CONCORD HWY	NC-200/MORGAN MILL RD	1.15	35	35	34	38	38	38	37	39	2	3	3	1
NC-200/MORGAN MILL RD	E FRANKLIN ST	1.22	29	26	26	36	32	32	32	34	3	7	6	-3
E FRANKLIN ST	US-601/PAGELAND HWY	0.14	34	28	28	37	30	30	29	32	-4	2	1	-5
US-601/PAGELAND HWY	NC-205/ELM ST	8.56	46	45	45	46	43	42	42	43	-3	-4	-3	-4
TOTAL Eastbound		22.01	42	39	38	44	40	40	39	42	-2	1	1	-2

Westbound		Distance	HERE Observed Speeds				Model Speeds				Difference			
From	To	(mi)	AM	MD	PM	NT	AM	MD	PM	NT	AM	MD	PM	NT
NC-205/ELM ST	US-601/PAGELAND HWY	8.58	46	45	45	46	41	41	41	41	-5	-4	-4	-5
US-601/PAGELAND HWY	E FRANKLIN ST	0.14	19	22	18	29	26	26	25	28	7	4	8	-1
E FRANKLIN ST	NC-200/MORGAN MILL RD	1.22	26	28	27	32	28	28	28	29	2	0	1	-2
NC-200/MORGAN MILL RD	US-601/US-74/NC-200	1.15	37	33	34	37	38	38	38	39	1	5	4	2
US-601/US-74/NC-200	US-601/NC-200	0.28	39	35	37	39	38	38	38	39	-1	3	1	0
US-601/NC-200	DICKERSON BLVD	0.72	36	30	32	37	35	36	36	38	-1	7	4	1
DICKERSON BLVD	ROLAND DR	0.92	33	32	31	36	34	35	34	38	1	4	3	2
ROLAND DR	ROCKY RIVER RD	2.24	39	34	38	44	41	41	40	43	1	7	1	-1
ROCKY RIVER RD	WESLEY CHAPEL STOUTS RD	2.53	42	41	41	48	41	43	42	46	-1	2	1	-2
WESLEY CHAPEL STOUTS RD	INDIAN TRAIL-FAIRVIEW RD	2.30	36	38	36	41	34	37	35	40	-2	-1	-1	-1
INDIAN TRAIL-FAIRVIEW RD	STALLINGS RD	1.06	47	48	47	47	46	49	46	50	-1	1	-1	3
STALLINGS RD	I-485/JAMES G MARTIN FWY	0.86	43	52	54	54	53	54	54	55	9	2	0	1
TOTAL Westbound		22.00	40	39	39	43	39	40	39	41	-1	1	0	-2

4.1.2 Toll Schedule

Table 15 shows Class 1 ETC and BBM rates, by tolling zone, for all years from 2019 through 2040. In all years, Class 2 rates are double Class 1 rates, and Class 3 rates are four times Class 1 rates. ETC toll rates receive a 35 percent discount from BBM toll rates. Annual rate adjustments are assumed to take place each year on January 1.

4.1.3 COVID-19 Impacts

COVID-19 impacts on traffic and revenue were described in Section 2 and accounted for in the updated forecast in two ways. First, as described in Section 3.1.5, it is assumed that the pandemic will have resulted in a slowdown in growth over the short-term. To reflect this impact, the growth previously assumed to occur between 2019 and 2025 is assumed to be delayed by three years to 2028. Assuming that the 2025 trip tables reflecting Dr. Appold's changes will occur by 2028, an adjusted 2025 trip table was developed by interpolation from 2019. The net difference between 2025 and 2028 was also subtracted from the baseline 2030 and 2040 trip tables to recognize this delayed growth effect.

Second, near-term impacts due to the COVID-19 pandemic were incorporated into the forecast using a series of negative monthly impact factors by vehicle class and payment method. Transaction and revenue impacts for the second half of CY 2020 were estimated to be –19.5 percent and –16.2 percent, respectively. This reflects the observed pace of recovery on the Monroe Expressway and the potential for continued cautiousness from policy makers regarding school and business re-opening. Transaction and revenue impacts for the first half of CY 2021 were estimated to be –18.1 percent and –14.8 percent, respectively, reflecting a gradual recovery accelerating into the summer months. Continued recovery was assumed resulting in an estimated impact to Fiscal Year (FY) 2022 transactions and revenue of –10.0 percent and –7.9 percent, respectively. Estimated FY 2023 and FY 2024 transactions were developed by interpolation using the compound annual growth rate between FY 2022 and FY 2025. A return to long-term modeled growth rates was assumed beginning in January 2025.

4.1.4 Updated Ramp-Up Factors

The Monroe Expressway opened to traffic in November 2018; ramp up effects are expected to last for three years. Based on observed traffic volumes on Monroe Expressway, updated ramp-up factors, reflecting a lag between project opening and full utilization, were estimated to be 0.75 in calendar year 2019, 0.85 in 2020, and 0.95 in 2021. These factors were derived from prior experience on other similar facilities, and actual data on the Monroe Expressway through July 2020 reflective of typical ramp-up combined with COVID-19 impacts. The initial year ramp-up factor was also incorporated into the estimated impacts of the pandemic on 2020 traffic and revenue.

Table 15 - Monroe Expressway Annual Toll Rates by Tolling Zone – Class 1 ETC and BBM

	Zone 01/02 (1.87 mi.) Indian Trail Fairview Rd. - US 74		Zone 03/04 (2.24 mi.) Unionville Indian Trail Rd. - Indian Trail Fairview Rd.		Zone 05/06 (1.38 mi.) N. Rocky River Rd. - Unionville Indian Trail Rd.		Zone 07/08 (3.93 mi.) US 601 - N. Rocky River Rd.		Zone 09/10 (1.76 mi.) NC 200 - US 601		Zone 11/12 (3.97 mi.) Austin Chaney Rd - NC 200		Zone 13/14 (2.99 mi.) US 74 - Austin Chaney Rd		Through Trip Toll (Passes through All Zones)	
Calendar Year (1)	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM	ETC	BBM
2019	$ 0.26	$ 0.40	$ 0.31	$ 0.48	$ 0.19	$ 0.29	$ 0.55	$ 0.85	$ 0.25	$ 0.39	$ 0.56	$ 0.86	$ 0.42	$ 0.65	$ 2.54	$ 3.92
2020	0.27	0.41	0.32	0.49	0.19	0.30	0.56	0.87	0.26	0.40	0.57	0.88	0.43	0.66	2.60	4.01
2021	0.27	0.42	0.32	0.50	0.20	0.30	0.58	0.89	0.26	0.41	0.59	0.90	0.44	0.68	2.66	4.10
2022	0.28	0.43	0.33	0.51	0.20	0.31	0.59	0.91	0.27	0.42	0.60	0.92	0.45	0.70	2.72	4.20
2023	0.28	0.44	0.34	0.53	0.21	0.32	0.60	0.93	0.27	0.43	0.61	0.94	0.46	0.71	2.77	4.30
2024	0.29	0.45	0.35	0.54	0.21	0.32	0.62	0.95	0.28	0.44	0.63	0.96	0.47	0.73	2.85	4.39
2025	0.30	0.46	0.36	0.55	0.22	0.33	0.63	0.97	0.29	0.45	0.64	0.99	0.48	0.74	2.92	4.49
2026	0.30	0.47	0.36	0.56	0.22	0.34	0.64	0.99	0.29	0.46	0.66	1.01	0.49	0.76	2.96	4.59
2027	0.31	0.48	0.37	0.57	0.23	0.35	0.66	1.02	0.30	0.47	0.67	1.03	0.50	0.78	3.04	4.70
2028	0.32	0.49	0.38	0.59	0.23	0.35	0.67	1.04	0.31	0.48	0.68	1.05	0.51	0.79	3.10	4.79
2029	0.32	0.50	0.39	0.60	0.24	0.36	0.69	1.06	0.31	0.49	0.70	1.07	0.52	0.81	3.17	4.89
2030	0.33	0.51	0.39	0.61	0.24	0.37	0.70	1.08	0.32	0.50	0.71	1.09	0.53	0.83	3.22	4.99
2031	0.34	0.52	0.40	0.62	0.25	0.38	0.71	1.10	0.32	0.51	0.73	1.12	0.55	0.84	3.30	5.09
2032	0.34	0.53	0.41	0.64	0.25	0.38	0.73	1.13	0.33	0.52	0.74	1.14	0.56	0.86	3.36	5.20
2033	0.35	0.54	0.42	0.65	0.26	0.39	0.74	1.15	0.34	0.53	0.76	1.16	0.57	0.88	3.44	5.30
2034	0.36	0.55	0.43	0.66	0.26	0.40	0.76	1.17	0.35	0.54	0.77	1.19	0.58	0.90	3.51	5.41
2035	0.37	0.56	0.44	0.68	0.27	0.41	0.78	1.20	0.35	0.55	0.79	1.21	0.59	0.92	3.59	5.53
2036	0.37	0.58	0.45	0.69	0.27	0.42	0.79	1.22	0.36	0.56	0.81	1.24	0.60	0.94	3.65	5.65
2037	0.38	0.59	0.46	0.71	0.28	0.43	0.81	1.25	0.37	0.57	0.82	1.26	0.62	0.96	3.74	5.77
2038	0.39	0.60	0.47	0.72	0.29	0.44	0.83	1.28	0.38	0.59	0.84	1.29	0.63	0.98	3.83	5.90
2039	0.40	0.61	0.47	0.74	0.29	0.44	0.84	1.30	0.38	0.60	0.86	1.32	0.64	1.00	3.88	6.01
2040	0.41	0.63	0.49	0.75	0.30	0.45	0.86	1.33	0.39	0.61	0.88	1.35	0.66	1.02	3.99	6.14

1) Toll rates are assumed to increase annually on January 1.

Note: Class 2 toll rates are two times Class 1 rates and Class 3 toll rates are four times Class 1 rates.

4.1.5 Annualization Factors

Annualization factors are used to derive annual transactions and revenue based on average Monday-Thursday transactions (excluding holidays) estimated from the model. The 2016 T&R Study used an annualization factor of 327 for all vehicle classes and for all years; this reflected the assumptions that Fridays would have similar volumes to other weekdays, and that weekends and holidays would have 68 percent as many transactions as average weekdays. However, the use of the Monroe Expressway on Fridays and weekends during the first year of operation has been higher than predicted, particularly during summer months.

Actual traffic and revenue collected from the Monroe Expressway was used to estimate actual annualization factors in 2019. In 2019, Fridays had 26 percent higher passenger car volumes than other weekdays, while weekends had 2 percent higher passenger car volumes. Conversely, truck volumes were similar on Fridays to other weekdays, but were only 39 percent as high on weekends. This translates to annualization factors of 380 for passenger cars and 295 for trucks in 2019; these values are significantly higher than those assumed in the 2016 T&R Study.

These factors are expected to decrease significantly in the future. Based on the socioeconomic growth anticipated in the area, the share of commuter traffic on Monroe Expressway is expected to grow more rapidly than recreational traffic. In addition, it appears that the weekend usage of the facility has ramped up more quickly than weekday traffic. These two factors are anticipated to result in an increasing proportion of overall transactions occurring on weekdays over time. **Table 16** shows the revised annualization factors for 2019 and for the forecast years. For passenger cars (Class 1), the assumed annualization factor decreases gradually from 2019 to 2040. The decrease between 2019 and 2025 is based on projected differences in the rate of growth, including ramp up, in weekday versus weekend-day traffic. This trend is expected to continue beyond 2025, albeit at a slower rate, resulting in a decrease from a factor of 350 in 2025 to 333 in 2040. The progression between 2025 and 2040 was developed via straight-line interpolation. This trend is expected to stabilize for Class 2 and Class 3 vehicles by 2025 resulting in a factor of 284 and stays at that level for the remaining forecast horizon. The resulting overall annualization factor of 327 in 2040 is equal to the value used in the 2016 T&R Study which was derived from observed traffic counts in the US 74 corridor prior to the opening of the Monroe Expressway.

Table 16 - Annualization Factors (Ratio of annual to average weekday transactions)

	Annualization Factor		
Year(s)	Class 1	Classes 2 & 3	Overall
2019	380	295	369
2025	350	284	343
2030	346	284	339
2040	333	284	327

4.1.6 Collected Revenue

Collected revenue reflects leakage due to unbillable and uncollectible BBM transactions and also includes processing fee revenue from late BBM payments. The following assumptions were used in the process of converting gross revenue into collected revenue.

Leakage estimates in this study assumed 8.2 percent of BBM transactions (and revenue) to be unbillable, due to reasons such as missing, blocked or damaged license plates, or insufficient vehicle owner address information. Of the remaining 91.8 percent of transactions and revenue that is invoiced, 12.1 percent was assumed to remain unpaid after all invoicing and collections steps. This results in a combined leakage rate of approximately 22 percent which was applied to BBM toll revenue estimates in all forecast years. For comparison, the 2016 T&R Study assumed a leakage rate of approximately 21 percent in all forecast years.

Processing fee revenue projections in this study were estimated based on the relationship between observed BBM transactions on the Monroe Expressway and collected processing fee revenue. This relationship results in a factor of 0.117 which was applied to projected BBM transactions to estimate processing fee revenue in each forecast year. This process was used due to the limited period of operating history on Monroe Expressway for metrics such as invoice payment rates and transactions per invoice to stabilize prior to the onset of COVID-related impacts. For comparison, processing fee revenue estimates in the 2016 T&R study were based on the assumption that 56.9 percent of BBM invoices would be paid on the first invoice, 15.3 percent on the second invoice with a $6 late fee, and 15.6 percent on the third or later invoice with an additional $6 late fee. These assumptions were based on actual invoice payment rates on the Triangle Expressway in 2014 and 2015. An average of 16 transactions were assumed per invoice. These assumptions resulted in a factor of 0.193. The factor of 0.117 used in this study represents a reduction of 39 percent from the factor used in the 2016 T&R Study.

4.2 Updated T&R Forecast

4.2.1 Annual Transactions

Estimated annual toll transactions by class and by payment type are presented in **Table 17**. Annual transactions are expected to increase from 36.8 million in FY 2021, to 53.9 million in FY 2025, 59.2 million in FY 2030, and 67.0 million in FY 2040. Traffic estimates for FY 2021 and FY 2022 were adjusted downward to reflect the assumed three-year ramp-up period following project opening.

Over the entire forecast period between FY 2021 and FY 2058, annual transactions are expected to increase by 2.1 percent on average. The growth rate is higher in the earlier years, with transactions increasing by 10 percent per year on average between FY 2021 and FY 2025. This strong transaction growth through FY 2025 is due to the combination of recovery from COVID-19 impacts, the end of the ramp up effects, and strong economic growth anticipated in the study area.

After FY 2025, the transaction growth is primarily reflective of projected socioeconomic trends. The annual growth rate is expected to gradually taper down from 1.9 percent on average between 2025 and 2030, to 1.2 percent between 2030 and 2040, and 0.9 percent between 2040 and 2058.

Table 17 - Estimated Annual Transactions FY 2021 – FY 2058 (in thousands)

Fiscal	Class 1			Classes 2 and 3			All Vehicles		
Year	BBM	ETC	Total	BBM	ETC	Total	BBM	ETC	Total
2021 (1)	17,232	14,781	32,013	1,808	3,008	4,816	19,040	17,790	36,830
2022 (1)	19,687	18,288	37,974	1,951	3,329	5,280	21,638	21,616	43,255
2023	20,774	21,415	42,188	1,975	3,772	5,746	22,748	25,187	47,935
2024	20,965	24,035	45,000	1,887	4,048	5,935	22,852	28,083	50,935
2025	21,000	26,765	47,765	1,791	4,311	6,102	22,791	31,076	53,867
2026	20,671	28,733	49,404	1,721	4,482	6,203	22,392	33,215	55,607
2027	20,140	29,975	50,115	1,690	4,581	6,271	21,830	34,555	56,385
2028	19,629	31,272	50,900	1,660	4,682	6,342	21,288	35,954	57,242
2029	19,135	32,628	51,763	1,630	4,787	6,416	20,765	37,414	58,180
2030	18,660	34,045	52,705	1,601	4,893	6,494	20,261	38,939	59,199
2031	18,406	35,089	53,495	1,591	4,993	6,584	19,997	40,082	60,079
2032	18,366	35,734	54,100	1,599	5,085	6,684	19,965	40,819	60,784
2033	18,325	36,391	54,716	1,607	5,179	6,787	19,933	41,570	61,503
2034	18,285	37,060	55,346	1,616	5,275	6,891	19,901	42,335	62,236
2035	18,245	37,742	55,987	1,624	5,373	6,997	19,870	43,115	62,984
2036	18,206	38,437	56,642	1,633	5,472	7,105	19,838	43,909	63,747
2037	18,166	39,144	57,310	1,641	5,574	7,215	19,808	44,718	64,525
2038	18,127	39,865	57,992	1,650	5,677	7,327	19,777	45,542	65,319
2039	18,088	40,599	58,687	1,659	5,782	7,441	19,747	46,382	66,128
2040	18,049	41,347	59,396	1,668	5,890	7,557	19,716	47,237	66,953
2041	18,049	42,032	60,081	1,673	5,984	7,658	19,722	48,017	67,738
2042	18,087	42,652	60,739	1,676	6,066	7,742	19,763	48,718	68,480
2043	18,125	43,280	61,406	1,678	6,148	7,827	19,804	49,429	69,232
2044	18,164	43,918	62,082	1,681	6,232	7,913	19,845	50,150	69,995
2045	18,203	44,565	62,768	1,683	6,317	8,000	19,886	50,882	70,769
2046	18,211	45,153	63,364	1,683	6,393	8,076	19,894	51,546	71,440
2047	18,188	45,680	63,868	1,680	6,460	8,140	19,868	52,140	72,008
2048	18,165	46,212	64,378	1,677	6,529	8,205	19,842	52,741	72,583
2049	18,143	46,751	64,894	1,674	6,597	8,271	19,816	53,348	73,165
2050	18,120	47,296	65,416	1,671	6,667	8,338	19,791	53,963	73,754
2051	18,091	47,847	65,937	1,667	6,738	8,404	19,758	54,584	74,342
2052	18,056	48,402	66,458	1,661	6,809	8,471	19,717	55,211	74,928
2053	18,021	48,964	66,985	1,656	6,882	8,538	19,677	55,846	75,523
2054	17,986	49,532	67,518	1,651	6,955	8,606	19,637	56,487	76,124
2055	17,951	50,107	68,058	1,645	7,029	8,675	19,597	57,137	76,733
2056	17,916	50,689	68,605	1,640	7,104	8,744	19,557	57,793	77,350
2057	17,882	51,277	69,159	1,635	7,180	8,815	19,517	58,457	77,974
2058	17,847	51,873	69,720	1,630	7,256	8,886	19,477	59,129	78,606

1) Ramp up was applied to the first 36-month period after opening.

The share of ETC transactions is anticipated to increase from 48.3 percent in FY 2021 to 65.8 percent by FY 2030; after 2030, the ETC penetration rate continues to increase gradually to reach 75.2 percent by 2058.

The share of truck transactions (Classes 2 and 3) is anticipated to decline from 13.1 percent in FY 2021 to 11.0 percent by FY 2030; after 2030, the truck share remains stable between 11 and 11.5 percent. This reflects the observation that truck traffic has ramped up faster than passenger car traffic on the Monroe Expressway.

4.2.2 Gross Toll Revenue

In this section, gross toll revenue represents expected revenue prior to accounting for BBM leakage and processing fee revenue. Estimated annual gross toll revenue by class (Classes 2-3 combined) and by payment type are presented in **Table 18**. Annual gross toll revenue is expected to increase from $22.9 million in FY 2021 to $85.5 million in FY 2058.

Over the entire forecast period from FY 2021 to FY 2058, annual gross revenue is expected to grow at an average rate of 3.6 percent. This is higher than the average annual transaction growth rate (2.1 percent) because adopted future toll rates are scheduled to increase annually. In the short term (through FY 2025), the average revenue per transaction stays fairly flat due to the increasing ETC market share and Class 1 vehicles are expected to grow more rapidly than Classes 2 and 3 as they recover from greater negative impacts due to COVID-19.

Consistent with transaction trends, the share of gross revenue generated by ETC transactions increases from 40.3 percent in FY 2021 to 67.3 percent in FY 2058.

The share of gross revenue generated by trucks declines from 35 percent in FY 2021 to 29.5 percent in FY 2058. This is also consistent with the increasing share of Class 1 transactions over time.

4.2.3 Collected Revenue

Estimates of collected revenue include adjustments for leakage associated with BBM and anticipated processing fee revenue. Estimated annual collected toll revenue by class and by payment type are presented in **Table 19**. Annual collected toll revenue is expected to increase from $20.9 million in FY 2021 to $81.5 million in FY 2058. Collected revenue ranges from 3.0 percent to 4.6 percent lower than gross toll revenue throughout the forecast, as leakage is expected to exceed processing fee revenues in all years. Collected revenue growth trends are consistent with the trends previously described for gross revenue projections.

Table 18 - Estimated Annual Gross Toll Revenue FY 2021 – FY 2058 (1) (in thousands of $)

Fiscal	Class 1			Classes 2 and 3			All Vehicles		
Year	BBM	ETC	Total	BBM	ETC	Total	BBM	ETC	Total
2021 (2)	$9,690	$5,191	$14,881	$3,990	$4,027	$8,016	$13,680	$9,217	$22,898
2022 (2)	11,280	6,547	17,827	4,354	4,515	8,869	15,634	11,063	26,697
2023	12,175	7,849	20,024	4,326	5,074	9,400	16,501	12,923	29,424
2024	12,571	9,021	21,593	4,065	5,410	9,476	16,637	14,432	31,068
2025	12,883	10,287	23,170	3,793	5,725	9,518	16,676	16,012	32,688
2026	12,957	11,236	24,193	3,655	5,971	9,626	16,612	17,207	33,819
2027	12,893	11,969	24,862	3,678	6,229	9,907	16,571	18,198	34,769
2028	12,820	12,809	25,628	3,698	6,520	10,217	16,517	19,328	35,846
2029	12,728	13,665	26,393	3,712	6,816	10,528	16,440	20,482	36,921
2030	12,643	14,539	27,182	3,726	7,110	10,836	16,368	21,649	38,017
2031	12,710	15,284	27,993	3,780	7,400	11,180	16,490	22,684	39,174
2032	12,942	15,882	28,824	3,879	7,691	11,570	16,821	23,573	40,394
2033	13,171	16,509	29,680	3,978	7,997	11,974	17,149	24,505	41,654
2034	13,394	17,190	30,584	4,078	8,327	12,405	17,472	25,517	42,989
2035	13,646	17,896	31,542	4,185	8,663	12,847	17,831	26,559	44,389
2036	13,913	18,572	32,485	4,297	8,991	13,288	18,210	27,563	45,773
2037	14,178	19,285	33,463	4,412	9,338	13,749	18,590	28,623	47,213
2038	14,451	20,121	34,572	4,530	9,740	14,270	18,981	29,861	48,842
2039	14,705	20,859	35,563	4,644	10,100	14,744	19,348	30,959	50,308
2040	14,962	21,674	36,635	4,763	10,496	15,259	19,725	32,170	51,894
2041	15,283	22,604	37,888	4,877	10,918	15,795	20,160	33,523	53,683
2042	15,619	23,414	39,033	4,979	11,287	16,266	20,598	34,701	55,299
2043	15,968	24,195	40,164	5,092	11,678	16,770	21,060	35,873	56,933
2044	16,326	24,966	41,292	5,206	12,067	17,273	21,532	37,033	58,565
2045	16,698	25,818	42,516	5,319	12,469	17,787	22,017	38,287	60,304
2046	17,054	26,733	43,787	5,426	12,874	18,300	22,481	39,607	62,088
2047	17,358	27,588	44,946	5,527	13,276	18,802	22,885	40,863	63,748
2048	17,690	28,459	46,149	5,629	13,690	19,319	23,319	42,149	65,468
2049	18,033	29,433	47,466	5,732	14,106	19,838	23,765	43,539	67,304
2050	18,362	30,425	48,787	5,837	14,539	20,376	24,199	44,964	69,162
2051	18,691	31,319	50,011	5,943	14,988	20,930	24,634	46,307	70,941
2052	19,033	32,269	51,302	6,047	15,451	21,498	25,079	47,721	72,800
2053	19,384	33,291	52,675	6,149	15,927	22,076	25,532	49,219	74,751
2054	19,728	34,358	54,086	6,255	16,416	22,671	25,982	50,774	76,757
2055	20,107	35,453	55,560	6,365	16,925	23,290	26,472	52,379	78,850
2056	20,493	36,576	57,069	6,475	17,456	23,931	26,968	54,031	80,999
2057	20,847	37,759	58,607	6,586	17,990	24,576	27,433	55,749	83,183
2058	21,226	39,028	60,254	6,699	18,534	25,233	27,925	57,562	85,487

1) Gross toll revenue is the expected revenue prior to accounting for BBM leakage and processing fee revenue.
2) Ramp up was applied to the first 36-month period after opening.

Table 19 - Estimated Annual Collected Toll Revenue FY 2021 – FY 2058 (1) (in thousands of $)

Fiscal Year	Collected Toll Revenue									Processing Fee Revenue	Total Collected Revenue
	Class 1			Classes 2 and 3			All Vehicles				
	BBM	ETC	Total	BBM	ETC	Total	BBM	ETC	Total		
2021 (2)	$7,969	$5,191	$13,160	$2,531	$4,027	$6,558	$10,501	$9,217	$19,718	$1,222	$20,940
2022 (2)	9,277	6,547	15,824	2,762	4,515	7,278	12,039	11,063	23,102	2,532	25,633
2023	10,012	7,849	17,861	2,744	5,074	7,819	12,757	12,923	25,680	2,662	28,342
2024	10,339	9,021	19,360	2,579	5,410	7,989	12,918	14,432	27,350	2,674	30,023
2025	10,595	10,287	20,882	2,406	5,725	8,131	13,002	16,012	29,013	2,667	31,680
2026	10,656	11,236	21,891	2,319	5,971	8,290	12,974	17,207	30,182	2,620	32,802
2027	10,603	11,969	22,572	2,333	6,229	8,562	12,936	18,198	31,134	2,554	33,689
2028	10,543	12,809	23,352	2,346	6,520	8,866	12,889	19,328	32,217	2,491	34,708
2029	10,468	13,665	24,133	2,355	6,816	9,171	12,822	20,482	33,304	2,430	35,733
2030	10,397	14,539	24,936	2,364	7,110	9,474	12,761	21,649	34,410	2,371	36,780
2031	10,452	15,284	25,736	2,398	7,400	9,798	12,851	22,684	35,535	2,340	37,874
2032	10,644	15,882	26,526	2,461	7,691	10,152	13,104	23,573	36,678	2,336	39,014
2033	10,832	16,509	27,341	2,524	7,997	10,520	13,356	24,505	37,861	2,332	40,193
2034	11,015	17,190	28,205	2,587	8,327	10,914	13,602	25,517	39,120	2,328	41,448
2035	11,222	17,896	29,118	2,655	8,663	11,317	13,877	26,559	40,436	2,325	42,760
2036	11,442	18,572	30,014	2,726	8,991	11,717	14,168	27,563	41,731	2,321	44,052
2037	11,660	19,285	30,945	2,799	9,338	12,137	14,459	28,623	43,082	2,317	45,399
2038	11,884	20,121	32,005	2,874	9,740	12,614	14,758	29,861	44,619	2,314	46,933
2039	12,093	20,859	32,952	2,946	10,100	13,047	15,039	30,959	45,998	2,310	48,309
2040	12,304	21,674	33,978	3,022	10,496	13,518	15,326	32,170	47,496	2,307	49,803
2041	12,569	22,604	35,173	3,094	10,918	14,012	15,663	33,523	49,185	2,307	51,493
2042	12,845	23,414	36,259	3,159	11,287	14,446	16,004	34,701	50,704	2,312	53,017
2043	13,132	24,195	37,328	3,231	11,678	14,908	16,363	35,873	52,236	2,317	54,553
2044	13,426	24,966	38,393	3,303	12,067	15,370	16,729	37,033	53,762	2,322	56,084
2045	13,732	25,818	39,550	3,374	12,469	15,843	17,107	38,287	55,394	2,327	57,720
2046	14,026	26,733	40,759	3,443	12,874	16,317	17,468	39,607	57,075	2,328	59,403
2047	14,275	27,588	41,863	3,506	13,276	16,782	17,781	40,863	58,645	2,325	60,969
2048	14,548	28,459	43,008	3,571	13,690	17,261	18,119	42,149	60,268	2,322	62,590
2049	14,830	29,433	44,263	3,636	14,106	17,742	18,467	43,539	62,006	2,319	64,324
2050	15,101	30,425	45,526	3,703	14,539	18,242	18,804	44,964	63,767	2,316	66,083
2051	15,372	31,319	46,691	3,770	14,988	18,758	19,142	46,307	65,449	2,312	67,760
2052	15,652	32,269	47,922	3,836	15,451	19,288	19,489	47,721	67,209	2,307	69,516
2053	15,941	33,291	49,232	3,901	15,927	19,828	19,842	49,219	69,060	2,302	71,363
2054	16,224	34,358	50,582	3,968	16,416	20,385	20,192	50,774	70,966	2,297	73,264
2055	16,536	35,453	51,989	4,038	16,925	20,963	20,574	52,379	72,953	2,293	75,245
2056	16,854	36,576	53,429	4,108	17,456	21,564	20,961	54,031	74,993	2,288	77,281
2057	17,145	37,759	54,904	4,178	17,990	22,168	21,323	55,749	77,072	2,283	79,356
2058	17,456	39,028	56,484	4,250	18,534	22,784	21,707	57,562	79,268	2,279	81,547

1) Collected revenue is the expected revenue after accounting for BBM leakage and processing fee revenue.
2) Ramp up was applied to the first 36-month period after opening.

4.3 T&R Forecast Comparison

Table 20 shows a forecast comparison between the 2016 T&R Study, a hypothetical no-COVID scenario and the base case.

Prior to making any COVID-related adjustments, the updated forecast has higher transaction and revenue estimates than the 2016 T&R Study, particularly in FY 2025 and beyond. Starting in FY 2025, the no-COVID scenario shows transactions higher by 3.5 to 4.4 percent. This is due to a combination of re-benchmarking to recent actual traffic and revenue, revised truck market share estimates, increased annualization factors, and increased population growth forecasts. Following the transaction trend, after 2025, collected revenue in the no-COVID scenario exceeds the 2016 T&R Study forecast by 3.3 percent to 6.6 percent.

Comparing the base case forecast to the no-COVID scenario, the collected revenue is estimated to be 20.2 percent lower in FY 2021 and 12.6 percent lower in FY 2022. By FY 2025, collected revenue for the base case is expected to recover to 7.9 percent lower than the no-Covid case. This difference gradually decreases to 5.4 percent by FY 2041 and remains unchanged thereafter.

Comparing the base case forecast to the 2016 T&R Study forecast, collected revenue is lower in the short term, by 11.5 percent in FY 2021, 7.3 percent in FY 2022, and 4.8 percent in FY 2023. This difference decreases over time as the increased population estimates gradually overcome the COVID-related negative adjustments to the trip tables. Eventually, by FY 2050, collected revenue estimates for the base case exceed the forecasts from the 2016 T&R Study but the difference is never greater than 1 percent. This comparison is illustrated in **Figure 14**.

Table 20 - Transaction and Revenue Forecast Comparison (FY 2021 – FY 2058) (in thousands)

	Total Transactions						Gross Toll Revenue						Total Collected Revenue					
		2020 T&R Update Study						2020 T&R Update Study						2020 T&R Update Study				
Fiscal Year	2016 T&R Study	No COVID	Percent Diff. (1)	Base Case	Percent Diff. (2)	Percent Diff. (3)	2016 T&R Study	No COVID	Percent Diff. (1)	Base Case	Percent Diff. (2)	Percent Diff. (3)	2016 T&R Study	No COVID	Percent Diff. (1)	Base Case	Percent Diff. (2)	Percent Diff. (3)
2021	44,034	45,358	3.0	36,830	(18.8)	(16.4)	$22,568	$27,095	20.1	$22,898	(15.5)	1.5	$23,659	$26,242	10.9	$20,940	(20.2)	(11.5)
2022	50,717	50,523	(0.4)	43,255	(14.4)	(14.7)	26,449	30,274	14.5	26,697	(11.8)	0.9	27,644	29,328	6.1	25,633	(12.6)	(7.3)
2023	53,804	54,440	1.2	47,935	(11.9)	(10.9)	28,572	32,594	14.1	29,424	(9.7)	3.0	29,767	31,597	6.1	28,342	(10.3)	(4.8)
2024	55,682	57,215	2.8	50,935	(11.0)	(8.5)	30,126	34,210	13.6	31,068	(9.2)	3.1	31,292	33,197	6.1	30,023	(9.6)	(4.1)
2025	57,251	59,233	3.5	53,867	(9.1)	(5.9)	31,625	35,412	12.0	32,688	(7.7)	3.4	32,750	34,405	5.1	31,680	(7.9)	(3.3)
2026	58,261	60,464	3.8	55,607	(8.0)	(4.6)	32,796	36,323	10.8	33,819	(6.9)	3.1	33,856	35,287	4.2	32,802	(7.0)	(3.1)
2027	59,065	61,253	3.7	56,385	(7.9)	(4.5)	33,903	37,325	10.1	34,769	(6.8)	2.6	34,890	36,222	3.8	33,689	(7.0)	(3.4)
2028	59,889	62,120	3.7	57,242	(7.9)	(4.4)	35,107	38,462	9.6	35,846	(6.8)	2.1	36,020	37,296	3.5	34,708	(6.9)	(3.6)
2029	60,732	63,066	3.8	58,180	(7.7)	(4.2)	36,296	39,592	9.1	36,921	(6.7)	1.7	37,137	38,372	3.3	35,733	(6.9)	(3.8)
2030	61,507	64,095	4.2	59,199	(7.6)	(3.8)	37,236	40,739	9.4	38,017	(6.7)	2.1	38,020	39,466	3.8	36,780	(6.8)	(3.3)
2031	62,193	64,959	4.4	60,079	(7.5)	(3.4)	38,173	41,933	9.8	39,174	(6.6)	2.6	38,898	40,593	4.4	37,874	(6.7)	(2.6)
2032	62,878	65,625	4.4	60,784	(7.4)	(3.3)	39,368	43,177	9.7	40,394	(6.4)	2.6	40,013	41,753	4.3	39,014	(6.6)	(2.5)
2033	63,574	66,303	4.3	61,503	(7.2)	(3.3)	40,591	44,460	9.5	41,654	(6.3)	2.6	41,157	42,952	4.4	40,193	(6.4)	(2.3)
2034	64,283	66,995	4.2	62,236	(7.1)	(3.2)	41,877	45,819	9.4	42,989	(6.2)	2.7	42,365	44,229	4.4	41,448	(6.3)	(2.2)
2035	65,003	67,700	4.1	62,984	(7.0)	(3.1)	43,242	47,244	9.3	44,389	(6.0)	2.7	43,645	45,563	4.4	42,760	(6.2)	(2.0)
2036	65,737	68,419	4.1	63,747	(6.8)	(3.0)	44,599	48,647	9.1	45,773	(5.9)	2.6	44,910	46,871	4.4	44,052	(6.0)	(1.9)
2037	66,483	69,151	4.0	64,525	(6.7)	(2.9)	46,009	50,105	8.9	47,213	(5.8)	2.6	46,228	48,233	4.3	45,399	(5.9)	(1.8)
2038	67,242	69,898	4.0	65,319	(6.6)	(2.9)	47,580	51,760	8.8	48,842	(5.6)	2.7	47,706	49,790	4.4	46,933	(5.7)	(1.6)
2039	68,014	70,659	3.9	66,128	(6.4)	(2.8)	49,017	53,236	8.6	50,308	(5.5)	2.6	49,054	51,173	4.3	48,309	(5.6)	(1.5)
2040	68,799	71,435	3.8	66,953	(6.3)	(2.7)	50,556	54,835	8.5	51,894	(5.4)	2.6	50,501	52,678	4.3	49,803	(5.5)	(1.4)
2041	69,570	72,219	3.8	67,738	(6.2)	(2.6)	52,159	56,686	8.7	53,683	(5.3)	2.9	52,009	54,427	4.6	51,493	(5.4)	(1.0)
2042	70,327	73,010	3.8	68,480	(6.2)	(2.6)	53,611	58,393	8.9	55,299	(5.3)	3.1	53,373	56,037	5.0	53,017	(5.4)	(0.7)
2043	71,098	73,812	3.8	69,232	(6.2)	(2.6)	55,177	60,118	9.0	56,933	(5.3)	3.2	54,849	57,659	5.1	54,553	(5.4)	(0.5)
2044	71,883	74,625	3.8	69,995	(6.2)	(2.6)	56,829	61,840	8.8	58,565	(5.3)	3.1	56,405	59,276	5.1	56,084	(5.4)	(0.6)
2045	72,683	75,449	3.8	70,769	(6.2)	(2.6)	58,549	63,675	8.8	60,304	(5.3)	3.0	58,029	61,003	5.1	57,720	(5.4)	(0.5)
2046	73,375	76,166	3.8	71,440	(6.2)	(2.6)	60,241	65,560	8.8	62,088	(5.3)	3.1	59,620	62,781	5.3	59,403	(5.4)	(0.4)
2047	73,957	76,771	3.8	72,008	(6.2)	(2.6)	61,857	67,312	8.8	63,748	(5.3)	3.1	61,140	64,435	5.4	60,969	(5.4)	(0.3)
2048	74,548	77,384	3.8	72,583	(6.2)	(2.6)	63,521	69,128	8.8	65,468	(5.3)	3.1	62,714	66,146	5.5	62,590	(5.4)	(0.2)
2049	75,146	78,004	3.8	73,165	(6.2)	(2.6)	65,265	71,068	8.9	67,304	(5.3)	3.1	64,358	67,980	5.6	64,324	(5.4)	(0.1)
2050	75,751	78,632	3.8	73,754	(6.2)	(2.6)	66,973	73,031	9.0	69,162	(5.3)	3.3	65,967	69,838	5.9	66,083	(5.4)	0.2
2051	76,355	79,259	3.8	74,342	(6.2)	(2.6)	68,697	74,907	9.0	70,941	(5.3)	3.3	67,595	71,608	5.9	67,760	(5.4)	0.2
2052	76,956	79,885	3.8	74,928	(6.2)	(2.6)	70,574	76,869	8.9	72,800	(5.3)	3.2	69,368	73,461	5.9	69,516	(5.4)	0.2
2053	77,564	80,518	3.8	75,523	(6.2)	(2.6)	72,464	78,929	8.9	74,751	(5.3)	3.2	71,150	75,411	6.0	71,363	(5.4)	0.3
2054	78,182	81,159	3.8	76,124	(6.2)	(2.6)	74,420	81,047	8.9	76,757	(5.3)	3.1	72,995	77,419	6.1	73,264	(5.4)	0.4
2055	78,807	81,809	3.8	76,733	(6.2)	(2.6)	76,402	83,258	9.0	78,850	(5.3)	3.2	74,872	79,513	6.2	75,245	(5.4)	0.5
2056	79,441	82,466	3.8	77,350	(6.2)	(2.6)	78,415	85,526	9.1	80,999	(5.3)	3.3	76,780	81,661	6.4	77,281	(5.4)	0.7
2057	80,084	83,132	3.8	77,974	(6.2)	(2.6)	80,590	87,831	9.0	83,183	(5.3)	3.2	78,840	83,853	6.4	79,356	(5.4)	0.7
2058	80,735	83,806	3.8	78,606	(6.2)	(2.6)	82,676	90,266	9.2	85,487	(5.3)	3.4	80,818	86,169	6.6	81,547	(5.4)	0.9

1) Percent difference between the No-COVID Case and the 2016 T&R Study.
2) Percent difference between the Base Case and No-COVID Case.
3) Percent difference between the 2020 Base Case and the 2016 T&R Study.

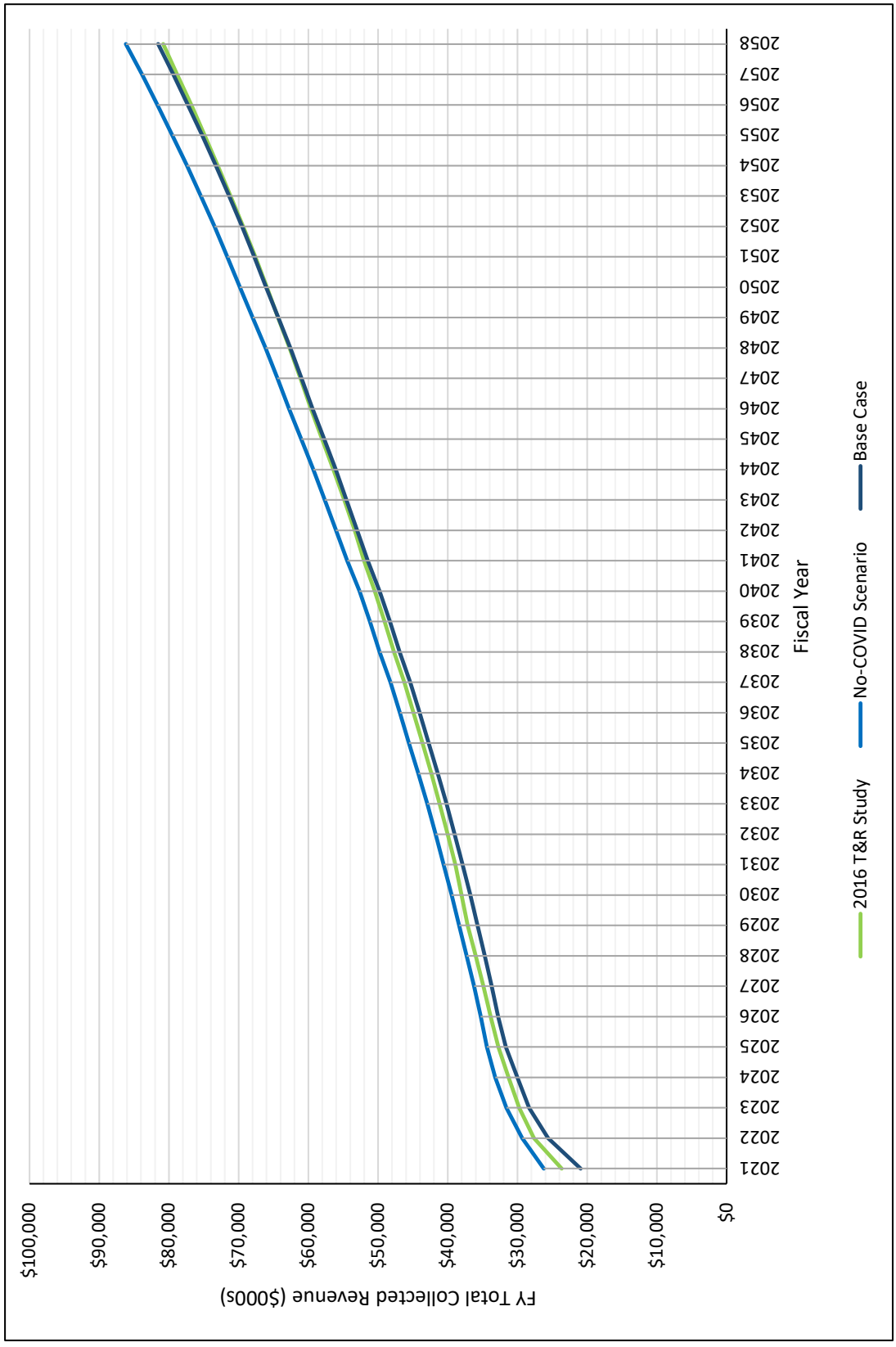


Figure 14 – Total Collected Revenue Forecast Comparison

Disclaimer

CDM Smith used currently-accepted professional practices and procedures in the development of the traffic and revenue estimates in this report. However, as with any forecast, it should be understood that differences between forecasted and actual results may occur, as caused by events and circumstances beyond the control of the forecasters. In formulating the estimates, CDM Smith reasonably relied upon the accuracy and completeness of information provided (both written and oral) by NCTA. CDM Smith also relied upon the reasonable assurances of independent parties and is not aware of any material facts that would make such information misleading.

CDM Smith made qualitative judgments related to several key variables in the development and analysis of the traffic and revenue estimates that must be considered as a whole; therefore, selecting portions of any individual result without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underlying methodologies used to obtain the results. CDM Smith gives no opinion as to the value or merit of partial information extracted from this report

All estimates and projections reported herein are based on CDM Smith's experience and judgment and on a review of information obtained from multiple agencies, including NCTA. These estimates and projections may not be indicative of actual or future values and are therefore subject to substantial uncertainty. Certain variables such as future developments, economic cycles, global pandemics and impacts related to advances in automotive technology etc. cannot be predicted with certainty and may affect the estimates or projections expressed in this report, such that CDM Smith does not specifically guarantee or warrant any estimate or projection contained within this report.

While CDM Smith believes that the projections and other forward-looking statements contained within the report are based on reasonable assumptions as of the date of the report, such forward looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted. Therefore, following the date of this report, CDM Smith will take no responsibility or assume any obligation to advise of changes that may affect its assumptions contained within the report, as they pertain to socioeconomic and demographic forecasts, proposed residential or commercial land use development projects and/or potential improvements to the regional transportation network.

The report and its contents are intended solely for use by the NCTA and designated parties approved by NCTA and CDM Smith. Any use by third-parties, other than as noted above, is expressly prohibited. In addition, any publication of the report without the express written consent of CDM Smith is prohibited.

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Sincerely,

Adam Aceto
Planner
CDM Smith Inc.

cc: Scott Allaire