

E-470 Comprehensive Traffic and Revenue Study



Executive Summary
May 2020



**CDM
Smith**

Executive Summary

E-470 Traffic and Revenue Study

The E-470 Public Highway Authority (Authority) has requested CDM Smith to perform a comprehensive traffic and revenue study, culminating in the development of updated long-term traffic and revenue forecasts for the Authority. This study will serve to update prior forecasts including, those developed as part of the last investment-grade traffic and revenue study prepared in 2014, in addition to the latest forecasts developed in the study titled, E-470 Traffic and Revenue Forecasts, New Toll Structure dated January 5, 2018, and updated in the 2018 Traffic and Toll Revenue “Bring-Down” Letter dated December 20, 2018 (referred to in this report as the “2018 Update”). This current study and the associated forecasts of transactions and revenue include the collection of significant amounts of original traffic data, an independent review of the Region’s underlying socioeconomic forecasts by Economic & Planning Systems (EPS), and culminating in a detailed traffic and revenue evaluation. All standard due-diligence data review and analyses for this study were performed as noted in this report. The study was conducted at a level of detail to meet the typical requirements of an Investment Grade Traffic and Revenue Study for the financial community for major bond issues.

This Executive Summary provides a review of the traffic and revenue analysis and forecasts conducted for the E-470 system. The analysis and the associated forecasts of transactions and revenue relied upon traffic assignments conducted with an update of the Denver Regional Council of Governments (DRCOG) regional travel demand model, an assessment of the latest highway improvements, an independent review of the region’s underlying socioeconomic forecasts by Economic & Planning Systems (EPS), a detailed traffic and revenue evaluation, and the collection of significant amounts of traffic and revenue data.

E-470 System Description

As shown in **Figure ES-1**, E-470 is a 47-mile toll road running along the eastern perimeter of the Denver Metro area, forming the eastern half of the originally conceived I-470, the outer circumferential highway around Denver. E-470 extends from C-470 at I-25 in Douglas County south of Denver to the east and north through Aurora and then passes along the western edge of Denver International Airport (DIA). The road then turns westward, terminating at the Northwest Parkway at I-25 just south of 160th Avenue north of Denver in Thornton.

Roadway Configuration

A total of 24 interchanges exist along the E-470 alignment, as shown in **Figure ES-1**. In addition, four completely new interchanges have been programmed for construction. The currently planned chronological order of interchange construction follows. Two new full-access interchanges, one at 38th Avenue and the other at 88th Avenue are currently planned to open by 2024 and 2026, respectively. Additional new full-access interchanges at 112th Avenue and Potomac Avenue are scheduled to open by 2031 and 2036, respectively. New ramps are also planned at the I-70 and I-76 interchanges. At I-70, construction of an eastbound I-70 to southbound E-470 ramp is scheduled to open by 2023, while the remaining ramps, creating a full-

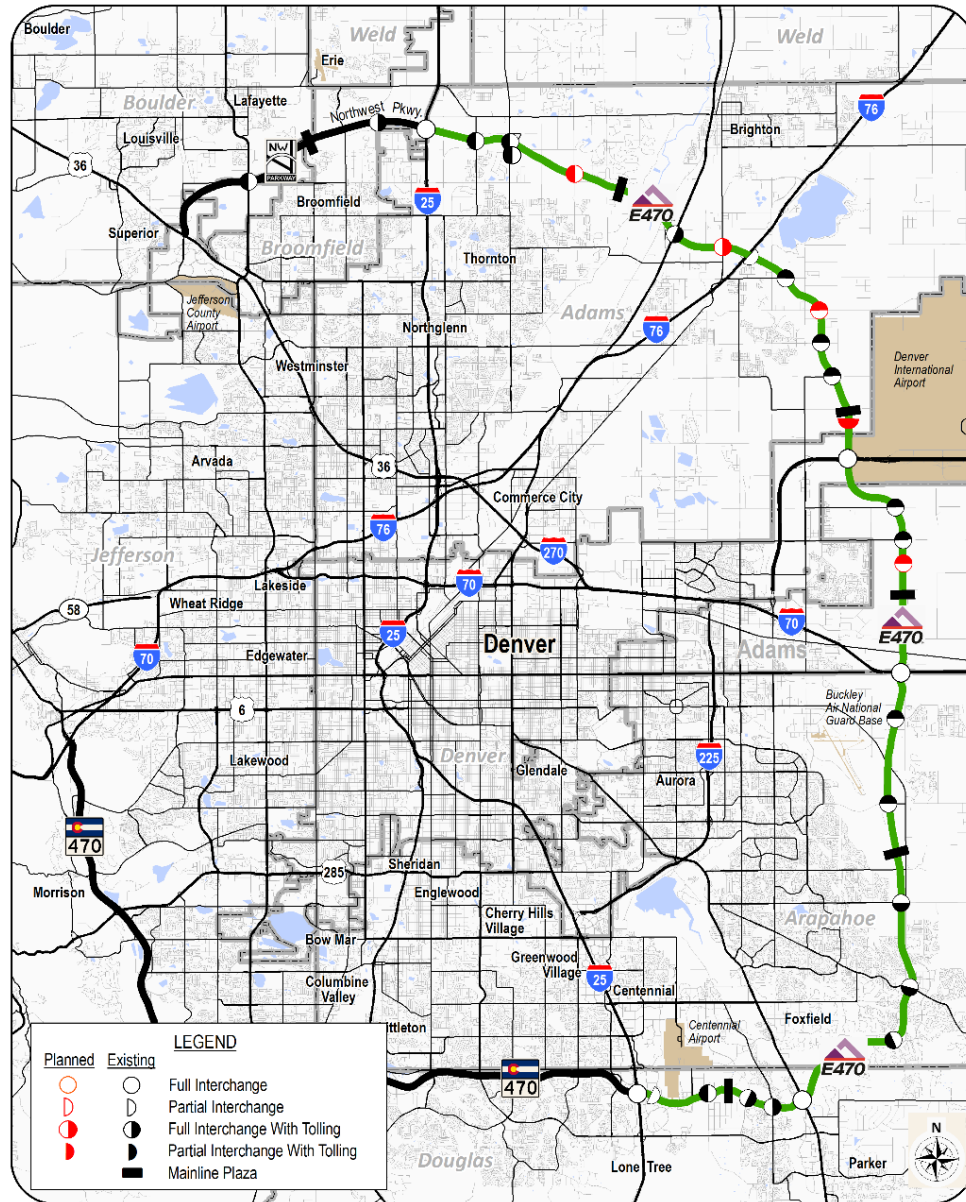


Figure ES-1
E-470 Alignment and Interchange Locations

access interchange with I-70, are scheduled to open to traffic by 2030. At I-76, ramps from northbound E-470 to westbound I-76 and westbound I-76 to northbound E-470 are scheduled to open to traffic by 2035 and 2040, respectively.

Toll Collection and Historically Planned/Programmed Tolls

E-470 operates an all-electronic, closed-barrier system of toll collection, wherein no toll-free passage is permitted. All motorists pass through at least one mainline or ramp toll plaza where tolls are paid either by the ExpressToll or License Plate Toll (LPT) methods of toll payment.

The current toll collection system consists of 5 mainline toll gantries and 34 ramp toll gantries, along with 8 additional planned ramp toll gantries. **Table ES-1** presents historical and previously

Table ES-1
Historical and Current Tolls
Passenger Car Tolls

Location	2018 ⁽¹⁾		2019 ⁽¹⁾		2020	
	ExpressToll	LPT	ExpressToll	LPT	ExpressToll	LPT
Toll Gantry A	2.70	4.15	2.70	4.30	2.70	4.30
Toll Gantry B	2.95	4.50	2.95	4.65	2.95	4.65
Toll Gantry C	2.70	4.15	2.70	4.30	2.70	4.30
Toll Gantry D	2.95	4.50	2.95	4.65	2.95	4.65
Toll Gantry E	2.95	4.50	2.95	4.65	2.95	4.65
Toll Ramps	1.25	1.95	1.25	2.05	1.25	2.05

(1) Toll increases implemented on January 1.

planned/programmed passenger car ExpressToll and LPT tolls from 2018 through 2020 Based on 2020 rates, an ExpressToll customer in a passenger car making a full-length trip pays \$14.25, or approximately \$0.30 per mile. However, as with any closed-barrier system of toll collection, motorists making relatively short trips will usually pay a higher per-mile toll because of the placement of the mainline and ramp toll gantries.

Under the All Electronic Tolling (AET) system, customers' vehicles not equipped with an ExpressToll transponder pay their toll via the LPT method. However, ExpressToll customers are charged a discounted toll compared to LPT customers. And, while neither the ExpressToll nor the LPT toll is the same at each of the five mainline gantries, the discount for an ExpressToll transaction of 37 percent is the same at each. In 2020 for example, passenger car ExpressToll customers pay a toll of \$14.25 for a full-length, 47-mile trip which is \$8.30, or 37 percent less than the \$22.55 toll made by LPT customers for a comparable trip. As shown in **Table ES-1**, mainline gantry tolls for ExpressToll customers remained unchanged, while LPT tolls increased by \$0.15 in 2019. A \$0.15 toll increase planned for LPT customers in 2020 was not made and tolls were retained at 2019 levels. Based on the ExpressToll versus LPT toll differential, the ExpressToll discount has risen modestly from 35 percent in 2018 to 37 percent in 2020. Prior to 2018, the ExpressToll discount was 20 percent.

Commercial vehicles are charged by the axle based on a modified "N-1" system. Beyond 2-axles, each additional axle is charged at roughly 90 percent of the 2-axle vehicle toll. After a 5 percent per axle discount implemented in 2020, an additional 20 percent discount is also provided as part of a two-year pilot program to 3-or-more axle ExpressToll vehicles from 9:00 AM to 12:00 PM.

Compared with 57 other AET toll roads in the U.S, E-470's ExpressToll toll rate is above the average of AET toll roads, with the ExpressToll rate ranking among the highest 25 percent. Although levying the largest toll for a full-length trip, the tolls on E-470 do fall well below the highest per-mile rate of those 57 AET facilities (\$0.50 per mile). However, while most toll facilities have increased toll rates, in November 2019, E-470's Board of Directors voted to reaffirm a freeze on the ExpressToll rate at 2017 levels through 2020. In addition to freezing ExpressToll rates, 2020 LPT tolls were also frozen at 2019 levels.

Traffic and Revenue Trends

Annual and monthly toll transaction and revenue trends from January 2007 through March 2020 were assembled and reviewed. These trends are important in understanding driver reactions to construction activities on and off E-470, toll rate changes, motor fuel price increases, recessions, and non-recurring, one-time events such as inclement weather, accidents, sporting events, etc. Average daily and weekday traffic volume trends, hourly traffic variations, trends in ExpressToll participation rates, and data related to customer trip characteristics were also reviewed.

Recent Transaction and Revenue Trends

Transaction and revenue growth rates over the past 10-year period from 2009 to 2019 are presented in **Table ES-2**. A short summary of these trends follows.

Since 2015, transaction growth has remained robust, although generally at slightly lower, single-digit rates than observed during prior years. Annual transaction growth in 2016 and 2017 was 7.2 percent and 4.0 percent respectively. Considering trends moving forward, growth rates began to slow in 2017, likely the result of gas price shocks resulting from the impacts of Hurricanes Harvey and Irma, both of which occurred in September 2017. As gas prices stabilized and employment levels grew between 2017 and 2019, strong transaction growth continued on E-470. Year-over-year growth rates in 2018 and 2019 were 5.0 percent and 3.4 percent, respectively, with year-over-year growth rates by month falling close to the annual average.

Comparing the gantries one against the other, transaction growth at Toll Gantry A has fallen significantly behind other E-470 toll locations, with several years of zero or negative transaction growth. This is due to the ongoing impacts related to construction of the C-470 Express Lanes. Prior to construction on C-470, Gantry A transactions were growing year-over-year at rates of 11.9 percent (2014), 10.3 percent (2015) and 3.2 percent (2016 thru beginning of C-470 construction in Oct.). C-470 construction began in late 2016, meaning 2017 was the first full “year over year” impact, with Gantry A transactions coming in 0.4 percent lower that year than in 2016. Based on historical growth trends, normal growth at Gantry A was likely about 3.5 percent in 2017, meaning that the negative impact of the C-470 Express Lane construction at Gantry A was likely around 4.0 percent. As the project continued into 2018, actual growth at Toll Gantry A was 0.0 percent, representing a level of normal growth constrained by the ongoing construction. In 2019, there was a ramp up in construction activity, leading to an increase in impacts at Toll Gantry A. Assuming a 1.0 percent normal growth rate under the constrained construction conditions, it is likely that the construction impacts increased at Gantry A in 2019 an additional 2.25 percent. Thus, the estimated total construction impact currently being experienced at Toll Gantry A is roughly 6.25 percent or 3,400 transactions per weekday. It is anticipated that when construction on C-470 ends in Spring 2020, the facility will experience a return of some of that traffic, plus an extra bump from the impacts of the project itself.

Lastly, it is worth noting a significant year-over-year decrease occurred in transactions in March 2020. This is due to the public space closures, event cancellations, stay-at-home orders, and reduced economic activity resulting from the COVID-19 outbreak, which began mid-month. CDM Smith continues to monitor these impacts on a daily basis to assess the short-term and potential long-term impacts. The effects of COVID-19 to E-470 traffic are discussed later in this Executive Summary as well as their potential impacts on future traffic and revenue.

**Table ES-2
Annual Systemwide Toll Transaction Trends
2009 - 2019**

Year	Toll Gantry A		Toll Gantry B		Toll Gantry C		Toll Gantry D		Toll Gantry E		Ramp Gantries		Total	
	Transactions	Percent of Total E-470	Transactions	Percent of Total E-470	Transactions	Percent of Total E-470	Transactions	Percent of Total E-470	Transactions	Percent of Total E-470	Transactions	Percent of Total E-470	Transactions	Percent of Total E-470
2009 (2)(3)	12,540,655	26.1	7,722,296	16.1	5,259,855	11.0	6,638,569	13.8	5,225,893	10.9	10,585,445	22.1	47,972,713	100.0
AAPC	6.3		8.7		10.2		7.5		8.0		3.9		6.9	
2010	13,331,374	26.0	8,394,057	16.4	5,797,063	11.3	7,136,412	13.9	5,644,401	11.0	10,994,634	21.4	51,297,941	100.0
AAPC	(3.5)		4.1		4.8		4.3		4.2		0.8		1.5	
2011 (4)	12,863,902	24.7	8,738,007	16.8	6,075,209	11.7	7,440,510	14.3	5,878,725	11.3	11,084,033	21.3	52,080,386	100.0
AAPC	1.4		5.0		5.3		5.3		5.3		2.1		3.6	
2012 (1)(5)	13,048,995	24.2	9,176,916	17.0	6,395,155	11.9	7,838,432	14.5	6,188,263	11.5	11,318,055	21.0	53,965,816	100.0
AAPC	5.2		9.9		11.1		10.5		9.2		6.6		8.2	
2013 (6)	13,722,771	23.5	10,084,744	17.3	7,104,817	12.2	8,665,141	14.8	6,759,547	11.6	12,065,712	20.7	58,402,732	100.0
AAPC	11.9		10.1		16.4		17.9		16.5		12.3		13.6	
2014 (7)	15,355,232	23.1	11,105,675	16.7	8,266,721	12.5	10,218,284	15.4	7,873,978	11.9	13,545,148	20.4	66,365,038	100.0
AAPC	10.3		8.4		10.2		17.5		14.8		14.3		12.4	
2015 (8)	16,935,141	22.7	12,034,972	16.1	9,109,646	12.2	12,007,555	16.1	9,039,236	12.1	15,482,497	20.8	74,609,047	100.0
AAPC	3.2		7.7		5.6		11.5		7.4		8.7		7.2	
2016 (1)(9)(10)	17,475,732	21.9	12,964,435	16.2	9,618,852	12.0	13,384,776	16.7	9,704,115	12.1	16,827,325	21.0	79,975,235	100.0
AAPC	(0.4)		1.4		3.4		12.6		8.3		1.6		4.0	
2017 (11)(12)(13)	17,401,797	20.9	13,147,947	15.8	9,941,687	12.0	15,071,870	18.1	10,512,371	12.6	17,099,498	20.6	83,175,170	100.0
AAPC	0.0		9.0		7.2		4.1		7.7		4.8		5.0	
2018 (14)	17,407,286	19.9	14,329,661	16.4	10,659,821	12.2	15,694,590	18.0	11,324,130	13.0	17,923,312	20.5	87,338,800	100.0
AAPC	(0.6)		4.0		6.1		3.4		7.3		2.6		3.4	
2019 (15)	17,304,686	19.2	14,898,208	16.5	11,311,613	12.5	16,224,973	18.0	12,149,520	13.5	18,390,570	20.4	90,279,570	100.0
AVERAGE ANNUAL PERCENT CHANGE (AAPC)														
2009 - 2014		4.1		7.5		9.5		9.0		8.5		5.1		6.7
2014 - 2019		2.4		6.1		6.5		9.7		9.1		6.3		6.3
2009 - 2019		3.3		6.8		8.0		9.3		8.8		5.7		6.5

Source: E-470 Public Highway Authority.

- (1) Leap Year.
- (2) On January 1, 2009, License Plate Tolling was introduced on the E-470 system, with a \$0.25 toll differential over ExpressToll tolls at mainline toll gantries and \$0.10 at ramp toll gantries. Cash toll collections continued until July 4, 2009, at which point the entire E-470 was converted to All-Electronic Tolling.
- (3) ExpressToll tolls increased at Toll Gantry A from \$1.75 to \$2.00 and at Toll Gantries B, C, D and E from \$2.00 to \$2.25 on January 1, 2009. Ramp toll gantries increased to \$0.90. Additionally, a toll differential of \$0.25 between ExpressToll and License Plate Toll was introduced at all mainline toll gantries.
- (4) Tolls increased at Toll Gantry A from \$2.00 to \$2.15 and at Toll Gantries B, C, D and E from \$2.25 to \$2.40 on January 1, 2011. Ramp toll gantries increased to \$0.95. Additionally, the toll differential between ExpressToll and License Plate Toll was increased from \$0.25 to 25 percent.
- (5) Tolls increased at Toll Gantry A from \$2.15 to \$2.25 and at Toll Gantries B, C, D and E from \$2.40 to \$2.50 on January 1, 2012. Ramp toll gantries increased to \$1.00.
- (6) Tolls increased at Toll Gantry A from \$2.25 to \$2.35 and at Toll Gantries B, C, D and E from \$2.50 to \$2.60 on January 1, 2013. Ramp toll gantries increased to \$1.05.
- (7) Tolls increased at Toll Gantry A from \$2.35 to \$2.45 and at Toll Gantries B, C, D and E from \$2.60 to \$2.70 on January 1, 2014. Ramp toll gantries increased to \$1.10.
- (8) Tolls increased at Toll Gantry A from \$2.45 to \$2.50 and at Toll Gantries B, C, D and E from \$2.70 to \$2.75 on January 1, 2015. Ramp toll gantries increased to \$1.15.
- (9) Tolls increased at Toll Gantry A from \$2.50 to \$2.60 and at Toll Gantries B, C, D and E from \$2.75 to \$2.85 on January 1, 2016. Ramp toll gantries increased to \$1.20.
- (10) Construction began in spring of 2016 to add a third lane in each direction along an eight-mile stretch from Parker Road and Quincey Avenue.
- (11) Tolls increased at Toll Gantry A from \$2.60 to \$2.70 and at Toll Gantries B, C, D and E from \$2.85 to \$2.95 on January 1, 2017. Ramp toll gantries increased to \$1.25.
- (12) Hurricane Harvey occurred in August 2017 and Hurricane Irma occurred in September 2017, leading to gasoline shortages and other national travel disruptions.
- (13) Construction on the C-470 Express Lanes began September 2017.
- (14) ExpressToll rates decreased at Toll Gantry C from \$2.85 to \$2.70 on January 1, 2018. Additionally, the toll differential between ExpressToll and License Plate Toll was increased to 53 percent.
- (15) The toll differential between ExpressToll and License Plate Toll was increased to 58 percent on January 1, 2019.

Annual system-wide revenue trends from 2009 through 2019 by method of payment are presented in **Table ES-3**. Coupled with annual toll increases and robust traffic growth, gross toll revenue increased by 16.8 percent, 15.0 percent, and 12.5 percent in 2014, 2015 and 2016, respectively. These systemwide increases were the product of comparable average revenue growth rates for both ExpressToll and LicensePlateToll between 2013 and 2016. ExpressToll revenue grew at an average rate of 13.7 percent over the three-year period, while License Plate Toll revenue grew by 16.7 percent.

While annual growth in gross ExpressToll revenue fell to 7.7 percent in 2018 and 3.2 percent in 2019, annual growth in gross LicensePlateToll revenue increased back to double digits (15.7 percent in 2018 and 13.1 percent in 2019). As a result, the share of ExpressToll revenue fell below 69 percent in 2019, for the first time in over 10 years. Likely, the increase in LicensePlateToll customers was due to new residents in the region using E-470 infrequently and who had not yet registered for an ExpressToll account. Total annual gross toll revenues grew in 2018 by 9.9 percent and in 2019 by 6.1 percent. Due to modest gains in toll collection rates, 2019 net toll revenues grew slightly more, by 6.8 percent.

Overall growth in systemwide gross toll revenues between 2009 and 2019 has averaged 11.0 percent per year, while net toll revenues have increased by 10.4 percent over the same 10-year period. During that time, system-wide gross toll revenue has more than doubled, from \$93.6 million to \$265.1 million. This is largely due to an average annual toll rate increase of 4.2 percent over that 10-year period. Total net toll revenue was \$249.0 million in 2019, representing a leakage rate of 6.1 percent.

2019 Average Weekday Traffic (AWDT) Volumes

A complete profile of 2019 AWDT mainline and ramp volumes is provided in **Figure ES-2**. Actual AWDT at the mainline and ramp toll gantries was obtained from count information provided by the Authority. In developing the profile, 48-hour machine traffic counts were taken at all non-tolled ramp locations in September 2019. These counts were then adjusted to 2019 AWDT levels based on monthly factors developed from data provided by the Authority. Together with control volumes at the mainline toll gantries, systemwide balanced AWDT volumes were estimated.

At the south end immediately north of I-25, the AWDT volume is estimated at 52,440. The peak load point is, however, one interchange north, between Jamaica Street and Peoria Street ramps, where the volume reached 57,030 vehicles on an average weekday. Volumes exceed 50,000 vehicles between I-25 and Gartrell Road. From Gartrell Road to I-70, weekday volumes gradually decline from just below 50,000 to just less than 45,000. Volumes continue to decrease and are generally in the range of 35,000 vehicles between I-70 and Pena Boulevard. North of Pena Boulevard to I-76, AWDT's increase to between 46,000 and 50,000 vehicles. North of I-76, AWDT's are in the range of 37,000 to 38,000. The heaviest interchange volumes occur at the Parker Road, Gartrell Road, Smoky Hill Road, Pena Boulevard and the I-25 and I-70 interchanges.

**Table ES-3
Annual Systemwide Toll Revenue Trends
2009 - 2019**

Year	ExpressToll			Cash / License Plate Toll			Total			Net Toll Revenues (2)	
	Revenue	Average Toll	Percent of Total E-470	Revenue	Average Toll	Percent of Total E-470	Revenue	Average Toll	Percent of Total E-470	Revenue	Average Toll
2009 (5)(6)	\$ 6,712,188	\$ 1.95	72.3	\$ 25,887,184	\$ 3.13	27.7	\$ 93,599,372	\$ 1.95	100.0	\$ 92,442,683	\$ 1.93
AAPC	8.9			(8.0)			4.2			2.0	
2010	\$ 73,708,570	\$ 1.98	75.6	\$ 23,815,212	\$ 1.69	24.4	\$ 97,523,782	\$ 1.90	100.0	\$ 94,309,891	\$ 1.84
AAPC	7.5			32.1			13.5			14.2	
2011 (7)	\$ 79,209,778	\$ 2.10	71.6	\$ 31,459,634	\$ 2.20	28.4	\$ 110,669,412	\$ 2.12	100.0	\$ 107,722,486	\$ 2.07
AAPC	8.2			9.9			8.7			8.4	
2012 (3)(8)	\$ 85,693,927	\$ 2.21	71.3	\$ 34,567,673	\$ 2.26	28.7	\$ 120,261,600	\$ 2.23	100.0	\$ 116,744,889	\$ 2.16
AAPC	11.3			14.1			12.1			10.7	
2013 (9)	\$ 95,367,587	\$ 2.32	70.8	\$ 39,425,861	\$ 2.28	29.2	\$ 134,793,448	\$ 2.31	100.0	\$ 129,181,918	\$ 2.21
AAPC	15.4			20.1			16.8			16.4	
2014 (10)	\$ 110,080,820	\$ 2.44	69.9	\$ 47,364,845	\$ 2.23	30.1	\$ 157,445,664	\$ 2.37	100.0	\$ 150,404,512	\$ 2.27
AAPC	14.5			16.0			15.0			15.0	
2015 (11)	\$ 126,058,057	\$ 2.51	69.6	\$ 54,933,992	\$ 2.26	30.4	\$ 180,992,049	\$ 2.43	100.0	\$ 173,039,512	\$ 2.32
AAPC	15.1			6.7			12.5			11.4	
2016 (3)(12)(13)	\$ 145,091,716	\$ 2.62	71.2	\$ 58,609,418	\$ 2.38	28.8	\$ 203,701,135	\$ 2.55	100.0	\$ 192,810,649	\$ 2.41
AAPC	12.5			9.0			11.5			10.9	
2017 (14)(15)(16)	\$ 163,299,992	\$ 2.75	71.9	\$ 63,896,754	\$ 2.70	28.1	\$ 227,196,746	\$ 2.73	100.0	\$ 213,765,649	\$ 2.57
AAPC	7.7			15.7			9.9			9.0	
2018 (17)	\$ 175,816,969	\$ 2.74	70.4	\$ 73,956,549	\$ 3.20	29.6	\$ 249,773,518	\$ 2.86	100.0	\$ 233,088,327	\$ 2.67
AAPC	3.2			13.1			6.1			6.8	
2019 (18)	\$ 181,436,249	\$ 2.76	68.4	\$ 83,634,020	\$ 3.42	31.6	\$ 265,070,269	\$ 2.94	100.0	\$ 249,013,096	\$ 2.76
AVERAGE ANNUAL PERCENT CHANGE (AAPC)											
2009 - 2014	10.2			12.8			11.0			10.2	
2014 - 2019	10.5			12.0			11.0			10.6	
2009 - 2019	10.4			12.4			11.0			10.4	

Source: E-470 Public Highway Authority, 2017.

(1) Gross Toll Revenues do not include adjustments for uncollectible revenues (non-revenue vehicles, bad license plate images, etc.) or unpaid transactions.

(2) Net Toll Revenues include adjustments for uncollectible revenues (non-revenue vehicles, bad license plate images, etc.) and unpaid transactions.

(3) Leap Year.

(4) Tolls increased at Toll Gantry A from \$1.50 to \$1.75 and at Toll Gantry B, C, D and E from \$1.75 to \$2.00 on January 1, 2006. Increases of \$0.25 at several ramp plazas.

(5) On January 1, 2009, License Plate Tolling was introduced on the E-470 system, with a \$0.25 toll differential over Express Toll tolls at mainline toll gantries and \$0.10 at ramp toll gantries.

Cash toll collections continued until July 4, 2009, at which point the entire E-470 was converted to All-Electronic Tolling.

(6) Express Toll tolls increased at Toll Gantry A from \$1.75 to \$2.00 and at Toll Gantries B, C, D and E from \$2.00 to \$2.25 on January 1, 2009. Ramp toll gantries increased to \$0.90.

Additionally, a toll differential of \$0.25 between ExpressToll and License Plate Toll was introduced.

(7) Tolls increased at Toll Gantry A from \$2.00 to \$2.15 and at Toll Gantries B, C, D and E from \$2.25 to \$2.40 on January 1, 2011. Ramp toll gantries increased to \$0.95.

Additionally, the toll differential between Express Toll and License Plate Toll was increased from \$0.25 to \$0.95.

(8) Tolls increased at Toll Gantry A from \$2.15 to \$2.25 and at Toll Gantries B, C, D and E from \$2.40 to \$2.50 on January 1, 2012. Ramp toll gantries increased to \$1.00.

(9) Tolls increased at Toll Gantry A from \$2.25 to \$2.35 and at Toll Gantries B, C, D and E from \$2.50 to \$2.60 on January 1, 2013. Ramp toll gantries increased to \$1.05.

(10) Tolls increased at Toll Gantry A from \$2.35 to \$2.45 and at Toll Gantries B, C, D and E from \$2.60 to \$2.70 on January 1, 2014. Ramp toll gantries increased to \$1.10.

(11) Tolls increased at Toll Gantry A from \$2.45 to \$2.50 and at Toll Gantries B, C, D and E from \$2.70 to \$2.75 on January 1, 2015. Ramp toll gantries increased to \$1.15.

(12) Tolls increased at Toll Gantry A from \$2.50 to \$2.60 and at Toll Gantries B, C, D and E from \$2.75 to \$2.85 on January 1, 2016. Ramp toll gantries increased to \$1.20.

(13) Construction began in spring of 2016 to add a third lane in each direction along an eight-mile stretch from Parker Road and Quincy Avenue.

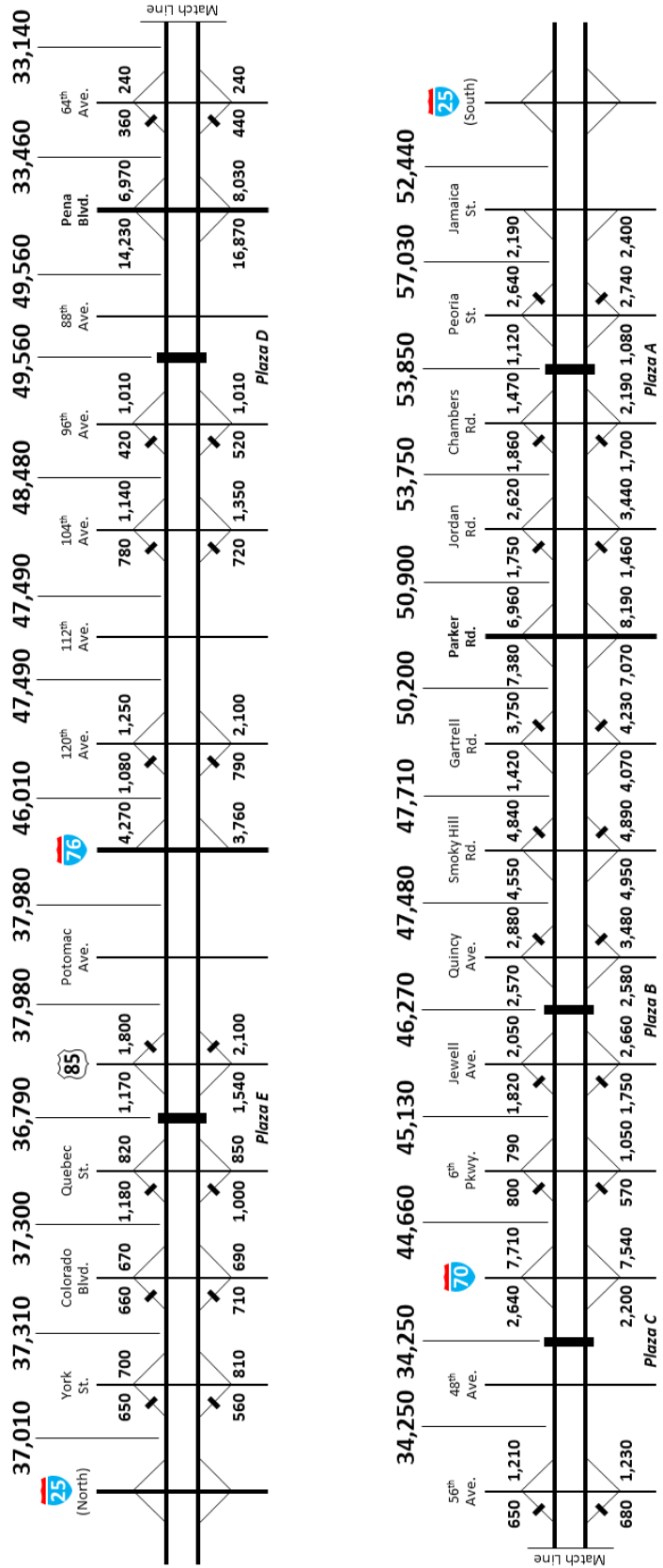
(14) Tolls increased at Toll Gantry A from \$2.60 to \$2.70 and at Toll Gantries B, C, D and E from \$2.85 to \$2.95 on January 1, 2017. Ramp toll gantries increased to \$1.25.

(15) Hurricane Harvey occurred in August 2017 and Hurricane Irma occurred in September 2017, leading to gasoline shortages and other national travel disruptions.

(16) Construction on the C-470 Express Lanes began September 2017.

(17) Express toll rates decreased at Toll Gantry C from \$2.85 to \$2.70 on January 1, 2018. Additionally, the toll differential between ExpressToll and License Plate Toll was increased to 53 percent.

(18) The toll differential between ExpressToll and License Plate Toll was increased to 58 percent on January 1, 2019.



LEGEND
 000 Mainline Volume ■ Mainline Toll Location
 000 Ramp Volume - Ramp Toll Location

Figure ES-2
 2019 Average Weekday Traffic Profile

Based on the actual ramp and mainline traffic volumes presented in **Figure ES-2**, it was estimated that on an average weekday in 2019, 155,390 trips were made. Dividing the 276,980 transactions, which occurred on an average weekday in 2019, the average number of transactions per trip was estimated at 1.8. The average number of transactions per trip on E-470 has historically remained relatively constant, with 1.8 transactions per trip observed during the prior 2017 and 2013 balanced profiles.

Monthly and Daily Traffic Variations

Monthly and daily traffic variations were also considered. These data were used to develop adjustment factors, as well as to consider the potential peak and seasonal variations.

In general, average December through April traffic volumes were below the average month, while May through November were above the average. For all toll locations, January represented the month with the lowest traffic volumes, about 17 percent below the average month, while July and August represented the highest months, with traffic approximately 12 percent above the average month.

As with most urban toll facilities, weekend traffic tends to be considerably lower than weekday volumes. All five weekdays have traffic volumes above the average at all mainline tolling locations, while Saturday and Sunday volumes are generally in the range of 60 to 75 percent of the average day, depending on tolling location. The peak days are Thursday and Friday, based on the sample data provided by the Authority. These patterns are consistent for all five mainline toll locations.

Hourly Traffic Variations

Figure ES-3 provides a graphical summary of typical hourly traffic volumes at the five mainline toll gantry locations. Considerable peaking occurred at Toll Gantries A and D, where peak hour, peak direction volumes come closest to reaching Level-of-Service (LOS) C capacity. At Toll Gantry A, the peak hour directional volume exceeded 4,000 vehicles in the morning and over 3,450 in the evening. This was substantially higher than midday and off-peak hours, most of which tended to average between 1,000 to 1,500 vehicles or less per direction per hour. Peak hour, peak direction volumes at Toll Gantry D approached 2,750 vehicles in the morning and 2,800 in the evening. Toll Gantry B exhibited similar peak hour volumes, ranging between 2,500 to 2,900 vehicles per hour per direction. Peak-hour volumes at Toll Gantries C and E were generally lower than at the other mainline gantries.

There is also a relatively significant directional distribution in both the AM and PM peak hours, generally in the range of 60/40 at Toll Gantries A, D and E. Toll Gantries B and C are atypical, having less pronounced peak hour directional distributions, ranging from 50/45 to 55/45, possibly related, to some extent, by demand patterns associated with DIA.

The potential for continued free-flow travel on E-470, at least in the near-term, based on current traffic volumes and mainline Level of Service C capacity is also shown. At each of the mainline toll locations, Level of Service C capacity per direction is indicated by the dashed horizontal line. Level of Service C indicates stable operation and relatively satisfactory operating speeds. As illustrated by the figure, 2019 volumes remain below LOS C capacity, although traffic growth

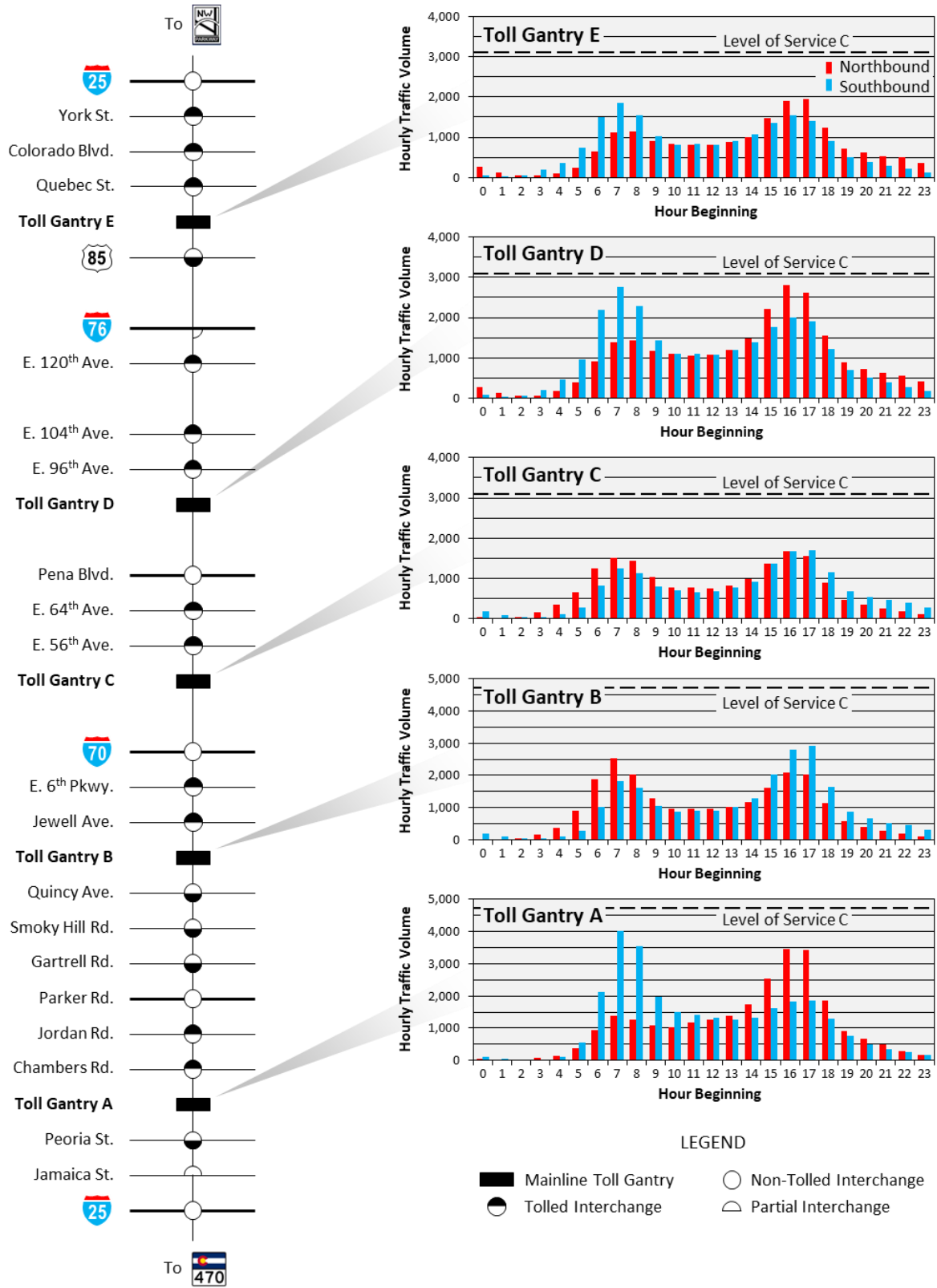


Figure ES-3
 2019 Average Hourly Traffic Variations by Mainline Toll Location

between 2016 and 2019 has been substantial, and has all but eroded the considerable excess capacity previously available at Toll Gantries A and D. This means that in the vicinity of these gantries E-470 will have less ability to absorb future increases in peak hour traffic volumes if LOS C travel conditions are to be retained.

Trends in Method of Toll Payment

Table ES-4 provides a summary of ExpressToll market share percentages by E-470 toll location for the last five years. ExpressToll transactions accounted for between 67.4 and 73.5 percent of all transactions between 2014 and 2019. The heaviest percentages are found at Toll Gantries A and B, which have the heaviest concentration of commuter traffic with higher trip frequencies.

ExpressToll percentages declined from 68 percent in 2014 to 67 percent in 2015. These declines, due to faster growth in LPT transactions, occurred despite an increase in the toll differential between ExpressToll and LPT and several overall toll increases. The faster growth in LPT transactions was speculated to be new system users coming from the developing areas in Aurora and Adams County who had yet to register for ExpressToll. ExpressToll market share then increased by 1.8 percent in 2016 to 69.2 percent, by 2.3 percent in 2017 to 71.5 percent and by 2.3 percent in 2017 to 73.5 percent. It is believed this was partly due to the opening of new managed lanes in the Denver region. During 2019, the ExpressToll market share decreased by 0.6 percent to 72.9 percent. Declines were relatively consistent at the mainline toll gantries averaging 0.4 percent, and ranging from 0.2 percent at Toll Gantry A to 0.5 percent at Toll Gantries B and E. The greatest percent declines of 1.2 percent occurred at the ramp toll gantries.

Table ES-4
ExpressToll Market Share Percentages
2014 – 2019

<u>Toll Gantry</u>	<u>2014</u>	<u>Change</u>	<u>2015</u>	<u>Change</u>	<u>2016</u>	<u>Change</u>	<u>2017</u>	<u>Change</u>	<u>2018</u>	<u>Change</u>	<u>2019</u>
A	64.7	(0.5)	64.2	1.5	65.7	8.4	74.1	1.8	75.9	(0.2)	75.7
B	62.1	(0.7)	61.4	2.8	64.2	8.0	72.2	1.9	74.1	(0.5)	73.6
C	65.0	(0.1)	64.9	2.8	67.7	0.4	68.1	2.1	70.2	(0.3)	69.9
D	66.7	(0.5)	66.2	1.8	68.0	(1.1)	66.9	2.4	69.3	(0.3)	69.0
E	72.0	0.2	72.2	0.8	73.0	(2.6)	70.4	2.2	72.6	(0.5)	72.1
All Mainline Gantries	66.7	(0.5)	66.2	1.8	68.0	2.6	70.6	2.0	72.6	(0.4)	72.2
Ramp Gantries	70.3	(0.4)	69.9	1.5	71.4	3.7	75.1	1.7	76.8	(1.2)	75.6
All Gantries	68.0	(0.6)	67.4	1.8	69.2	2.3	71.5	2.0	73.5	(0.6)	72.9

Source: E-470 Public Highway Authority.

Commercial Vehicle Traffic Distribution

Overall, two-axle vehicles, which include passenger cars, motorcycles, vans and SUVs, accounted for 96.3 percent of all transactions. Vehicles with three-or-more axles accounted for 3.7 percent of total transactions, consistent with historically observed percentages and were used in the forecasts of transactions and revenue presented in Chapter 4 of the full E-470 Traffic and Revenue Study Report.

In 2019, 72.9 percent of all transactions were ExpressToll. Disaggregating the ExpressToll market participation rates by vehicle type, a higher proportion of passenger vehicles transactions, 73.1

percent, were ExpressToll compared with 67.4 percent for vehicles with three-or-more-axes. Use of ExpressToll also varied within the three-or-more-axle vehicle category. ExpressToll was lowest among five-or-more-axle vehicles, which are generally 18-wheel tractor trailer trucks and other heavy commercial vehicles. ExpressToll participation by five-or-more-axle vehicles was 61.7 percent. Three-axle vehicles, which include delivery trucks, motor homes and other light commercial vehicles, had an ExpressToll participation rate of 78.0 percent.

E-470 Customer Trip Characteristics

CDM Smith also obtained and reviewed detailed E-470 transaction records. The purpose of this effort was to provide a better understanding of the E-470 customer base, their usage patterns, trip distributions, frequency of usage, geographical distribution, origins and destinations patterns, and demographic characteristics such as income, household size, or rates of car ownership. Towards those ends, a full year of 2018 transaction data (which was the most recent full year available at the time this analysis was conducted) by anonymous account numbers and actual ZIP codes including the toll gantry was obtained. As described in this section, the transaction data was analyzed and summarized at the individual toll gantry level to develop gantry-specific trip patterns and frequency of E-470 usage. Additionally, this information was combined with other readily available data sources such as Census, American Community Survey and Longitudinal Employer Household Dynamics (LEHD).

Trip Frequency

CDM Smith used trip chain information developed from the detailed dataset to analyze average trips per week for all weeks of the year in 2018 and averaged the results to develop an estimate of transaction frequency on E-470 for the “Typical Week”. The results of this analysis are presented in **Figure ES-4**. Customers making one trip per week represented 40.2 percent of total customers, while those making two trips per week represented 27.6 percent. Thus, roughly two-thirds of E-470 customers make 2 trips or less per week. Customers making 5 or more trips per week represented 16.0 percent of total customers. On average, E-470 customers made 2.77 trips per week in 2018.

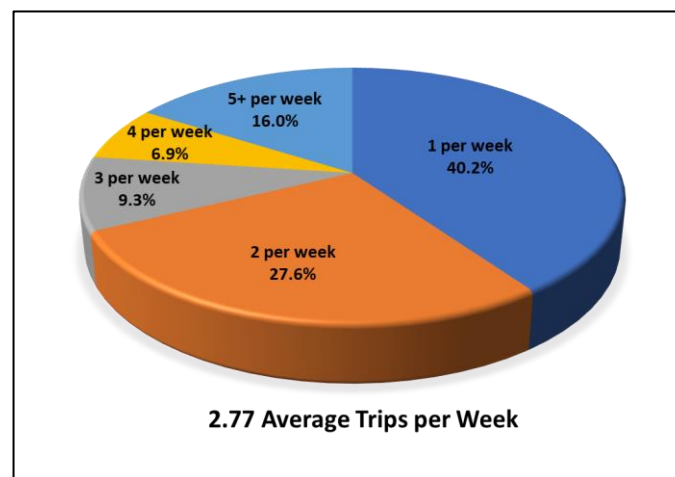


Figure ES-4
Trip Frequency Distribution for a Typical Week

Trip Movement Characteristics

The detailed transaction data and the trip identification process also allowed for the analysis of E-470 trips based on their movements across the system. In general, E-470 customers average 1.8 transactions per trip. This relationship between transactions and trips has historically been relatively consistent, as previously noted. ExpressToll customers made slightly less transactions per trip than LPT customers, which may be due in part to the differences in trip patterns between the two methods of payment.

The relationship between transactions and trips is primarily dependent on trip length. The longer the trip, the more toll transactions included in each trip. **Figure ES-5** illustrates the percent of E-470 trips traveling through the various E-470 “tolling segments,” which are based on the location of the major free interchanges on the E-470 system. For each tolling segment, a customer will pass through only one tolling point, whether it is a mainline or ramp toll gantry. The E-470 tolling segments are:

- Tolling Segment A: I-25 (South End) to Parker Road
- Tolling Segment B: Parker Road to I-70
- Tolling Segment C: I-70 to Pena Boulevard
- Tolling Segment D: Pena Boulevard to I-76
- Tolling Segment E: I-76 to I-25 (North End)

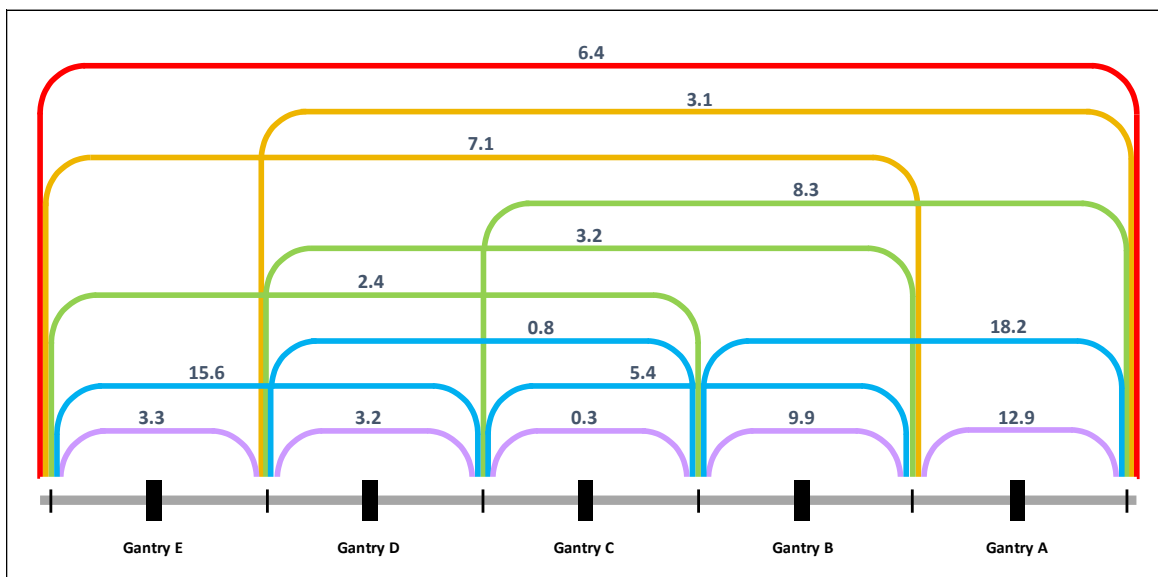


Figure ES-5
Distribution of 2018 Average Weekday Trips by Trip Tolling Segments
Percent of Total E-470 Trips

As previously indicated in **Figure ES-5**, 6.4 percent of E-470 trips pass through all five tolling segments. 18.2 percent of E-470 trips make a movement through (only) Segments A and B. A significant share of E-470 trips occur on the southern portion of the facility. In total, almost three quarters (74.6 percent) of E-470 trips pass through either Segment A or Segment B. Another significant movement passes through (only) Segments D and E. This movement represents trips between Broomfield, I-25, Brighton and DIA. It should be noted that 29.7 percent of E-470 trips are to or from the Pena Boulevard Interchange, and 21.8 percent of all E-470 trips are to or from the Denver International Airport. Trips through only segment C represent the smallest share of E-470 trips (0.3 percent), likely due to the number of parallel toll-free facilities in this area.

Customer Characteristics

The detailed transaction data, the trip identification process and ZIP code information associated with anonymized transponders was used to calculate trips by registered ZIP code. ZIP codes having at least one percent of total 2018 transactions are shown highlighted in **Figure ES-6**, with the lighter colors representing lower trips and the dark blue color representing higher number of trips. ZIP codes 80016, 80134 and 80015 in the southeast corner of the map in the city of Aurora, Douglas County and Arapahoe County, respectively, are the top three trip-generating ZIP codes based on E-470 customer data. These three ZIP codes account for 23.6 percent of all E-470 trips with the top ZIP code (80016) accounting for 10.6 percent of all the trips.

Average Age by ZIP Code

The detailed transaction data was used to also calculate the average age of E-470 users. While the weighted average age for the 8-county region is 37 years, the average age for major ZIP codes contributing most of the trips is higher at 46 years. This suggests that E-470 users are older compared to travelers on other facilities in the Denver region. ZIP code 80016, which accounts for 10.6 percent of all E-470 trips, has an average age of 42 years. The average age for the top three trip-generating zip codes is slightly higher at 43 years.

Education Level by ZIP Code

While the weighted average share of population with some college or higher for the 8-county was 71 percent, the average share for major ZIP codes contributing most of the trips was higher at 78 percent. It implies that E-470 users have a higher education level, as compared to all the roadway users in the Denver metropolitan area.

Median Household Income by ZIP Code

While the weighted average 2018 median household income for 8-county region was \$72,130, the average share for major ZIP codes contributing most of the E-470 trips is 43 percent higher at \$110,713 per year in 2018. ZIP code 80016, which accounts for 10.6 percent of all the trips, has median household income of \$116,940 while the top three trip-generating zip codes have average median household income of \$110,713. The data suggest that E-470 users on average have a higher median household income, as compared to general roadway users in the Denver metropolitan area. One reason this may be the case is that higher income households are better able to afford the cost of tolls and may even view their commute or other travel time as more valuable. This relationship between income and the willingness to pay tolls is generally reflected in the Value of Time assumption, discussed later in this Executive Summary.

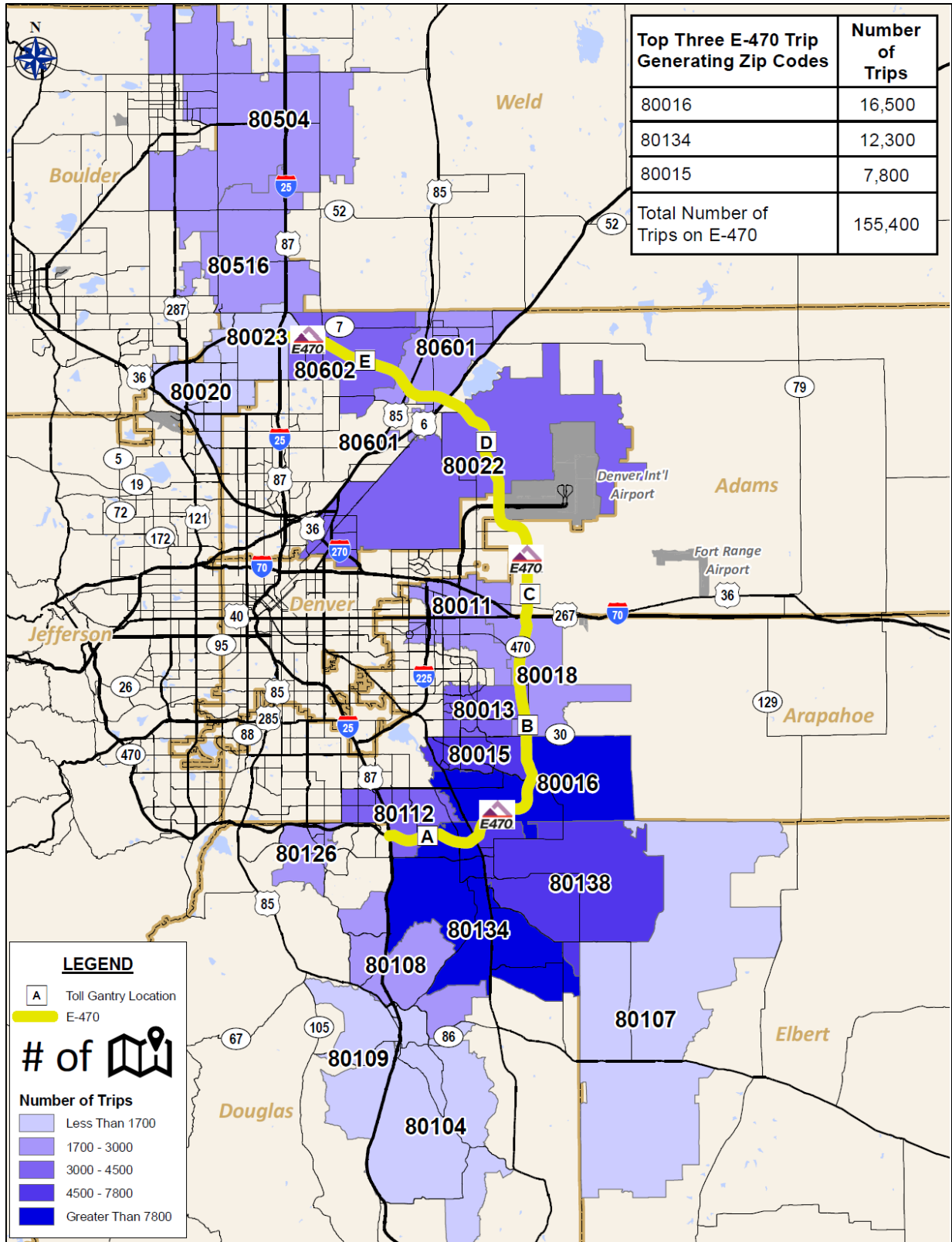


Figure ES-6
Distribution of 2018 Total Trips by ZIP Code

Average People per Household by ZIP Code

While the weighted average household size for 8-county region was 2.5 people in 2018, the average household size for major ZIP codes contributing most of the trips was 2.8 people. The top trip-generating ZIP code for E-470 (80016) has household size of 3.0 people, as compared to the top three trip-generating zip codes that have an average household size of 2.9 people. The data suggest that E-470 users have slightly larger household sizes, as compared to the general roadway users in Denver metropolitan area. This may be the result of the types of housing available along the E-470 corridor, which is generally single-family housing. As a result of these local development patterns, those living close to E-470 would more likely be families, as opposed to single individuals or couples without children.

Recent Trends Related to COVID-19

In March 2020, traffic impacts related to the Coronavirus (COVID-19) began as many states and localities began implanting stay-at-home orders, public space closures, social distancing orders and other restrictions in an effort to reduce the spread of the virus based on guidelines from the Center for Disease Control (CDC) and the Federal Government. On March 11, 2020, Governor Polis issued an emergency declaration due to COVID-19. This was followed by an order on March 18, 2020 to suspend in-person instruction at Colorado schools and a March 25, 2020 stay-at-home order. Following several prior extensions by the Governor, the current statewide stay-at-home order is set to expire on April 24, 2020. Denver Mayor Hancock issued a similar stay-at-home order on March 23, 2020, which has recently been extended to May 8, 2020. As of April 24, 2020, there have been over 10,400 confirmed cases of COVID-19 in Colorado, with almost 500 deaths. Within the 8-County Denver Metro area, there have been over 8,000 confirmed cases and almost 400 deaths, or roughly 80 percent of the total statewide impact.

These restrictions have significantly impacted regional traffic patterns. Moreover, since congestion on alternative roadways, such as I-25, I-70 and even local arterials, has been almost eliminated, E-470 no longer offers the same travel time savings to motorists as it did prior to the COVID-19 outbreak. As a result, E-470 has been particularly hard hit. Additionally, since more than 20 percent of E-470 traffic originates from or is destined for DIA, reductions in air travel and tourism related to the COVID-19 outbreak would also have impacted E-470 to a greater extent than other facilities in the region.

Figure ES-7 illustrates the reduction in total weekly E-470 transactions, as compared with the first week of March prior to the major COVID-19 impacts. As previously indicated, some impacts were observed during the second week of March, with transactions falling roughly 10 percent week-over-week. The major impacts to E-470 began on March 17th and 18th with the suspension of in-person instructions in Colorado schools. Transaction levels continued to fall until March 25th and 26th, when the Governor's stay-at-home order was implemented. Systemwide E-470 transactions have averaged less than 100,000 on an average weekday since late March, a reduction of over 60 percent compared to normal levels. There has been a slight increase in transactions during the first week of April, but it is unclear if this represents the beginning of a return to normal trends or simply fluctuations related to the Easter and Passover holidays.

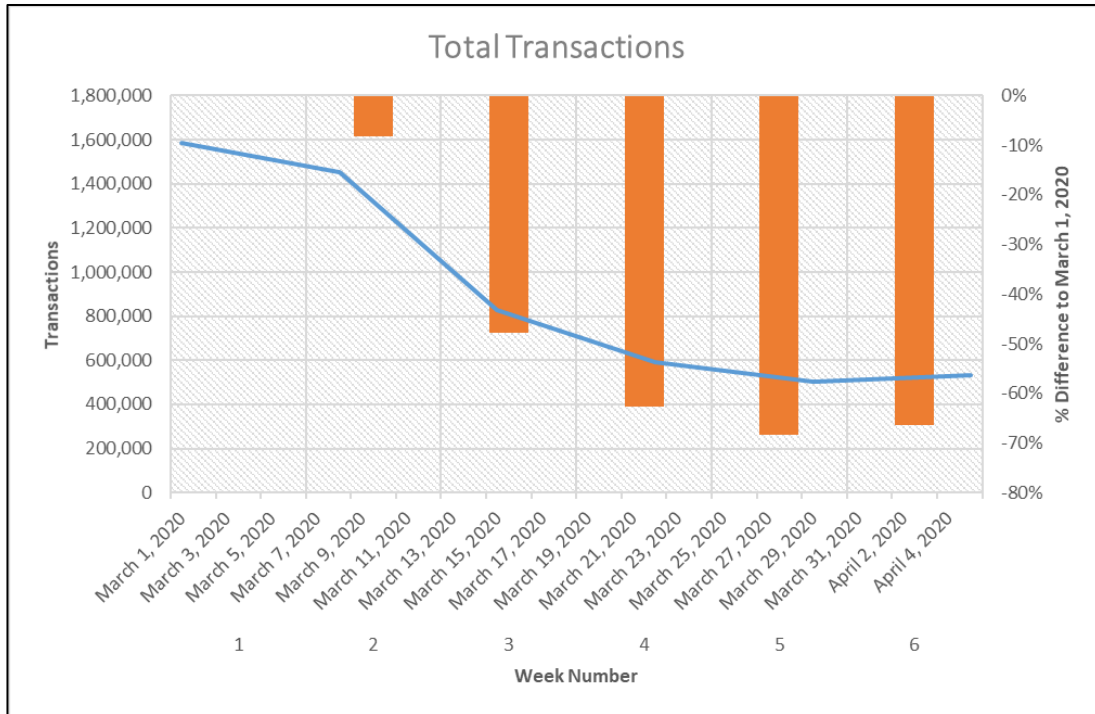


Figure ES-7
Week-over-Week Impacts of COVID-19 on E-470 Transactions
March 2020 to April 2020

Likely, continued traffic impacts will be related to the length of government stay-at-home orders, public space and school closures, and other travel restrictions. Estimates of the continued traffic impacts related to COVID-19 are discussed later in this Executive Summary.

One significant factor of the recent COVID-19 related traffic trends is the disparate impacts to E-470 transactions by vehicle class. Given the nature of the stay-at-home orders, daily commutes have largely stopped, while food and goods deliveries have continued. As a result, passenger car traffic has been affected much more than commercial vehicle traffic to date. **Figure ES-8** compares E-470 transactions week-over-week by vehicle class. While E-470 passenger car transactions are down by almost 70 percent compared to the first week of March, commercial vehicle transactions are down by just over 20 percent. This matches trends observed nationally on other toll facilities. It's clear that this reduction is contingent upon continued supply chain stability and by the ability of consumers to afford food and other basic supplies. Long-term unemployment or other supply chain disruptions could produce further decreases in commercial vehicle transactions.

Weekend transactions on E-470 have been slightly more impacted than the weekdays. This may be due to the closure of public spaces and recreational facilities, as well as a reduction in air travel and tourism within the region.

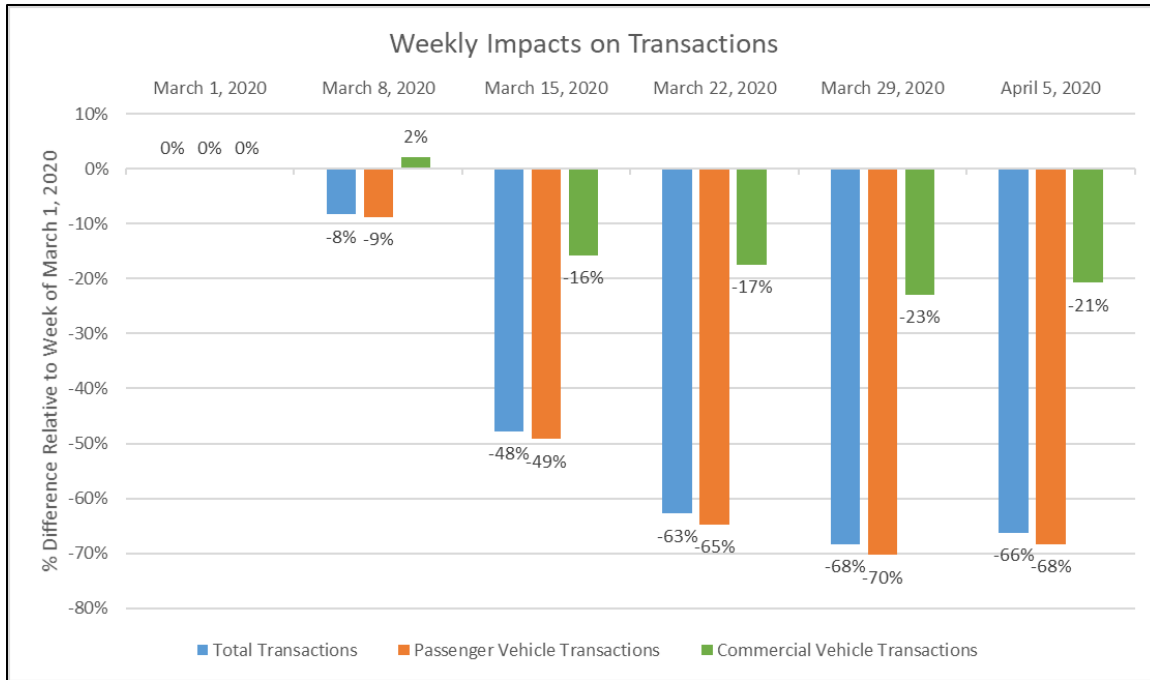


Figure ES-8
Week-over-Week Impacts of COVID-19 on E-470 Transactions by Vehicle Class
March 2020 to April 2020

Corridor Growth Assessment

Presented below is an overview of the work performed to make geospatial adjustments to the 2015 to 2040 employment, population, and household projections of the Denver Regional Council of Governments (DRCOG). The findings from this work were used as a basic input to the travel demand model which, in turn, aided in the forecasting of the traffic and revenue potential for E-470.

This work, performed by Economic & Planning Systems (EPS), provided independent economic growth projections throughout the Denver Metro Area. Growth forecasts are typically prepared by the metropolitan planning organization, DRCOG, but economic conditions and major development plans, which could influence traffic demand, have been meticulously reviewed and accounted for in this assessment. Motivation for this independent review was to account for economic and demographic conditions in a dynamic regional market that continues to change and expand.

Metro Area

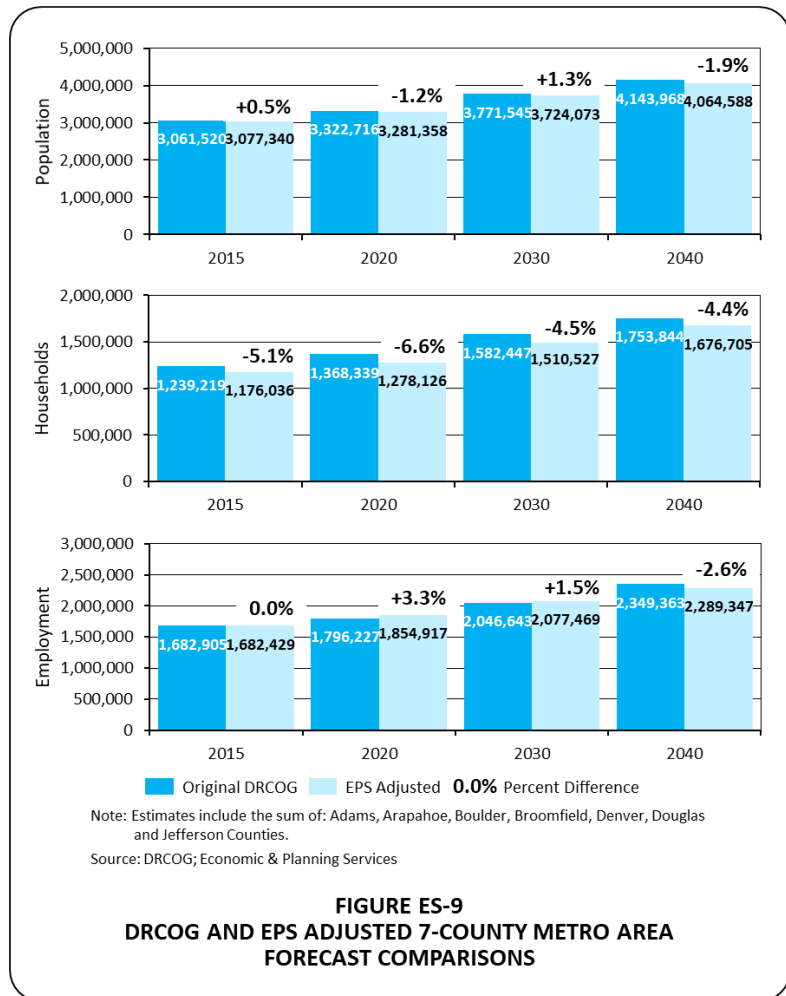
The original DRCOG forecasts and the EPS adjusted forecasts for the 7-county Metro Area are illustrated in **Figure ES-9**. The adjustments reflect extensive data and market analysis, research, and understanding of the original DRCOG model and forecasts. While the EPS forecasts in years 2015, 2020, 2030 and 2040 are generally lower than the original DRCOG forecasts for population and households and lower in 2040 for employment, it does not mean that growth is not occurring. In fact, just the opposite is true. In the DRCOG region, population between 2015-2020, 2020-2030 and 2030-2040 is forecasted by EPS to grow by 1.3 percent, 1.3 percent and 0.9 percent per annum, respectively. EPS has also forecasted households to grow by 1.7 percent, 1.7 percent and 1.1 percent per annum between 2015-2020, 2020-2030 and 2030-2040, respectively. Finally, regional employment

between 2015-2020, 2020-2030 and 2030-2040 is also forecasted by EPS to grow by 2.0 percent, 1.1 percent and 1.0 percent per annum, respectively. It should also be noted that EPS' forecasted growth rates presented in Chapter 3 of the full E-470 Traffic and Revenue Study Report reflect long-term rates, and that actual year-over-year growth rates may be higher or lower than these projections, as growth does not typically occur linearly.

Influence Area

The E-470 corridor influence area, as illustrated in **Figure ES-10**, is the primary focus, in which 199 major developments were evaluated, as well as the regional review of base year (2015) socioeconomic conditions and macro-level growth rate calibrations were performed.

E-470's member jurisdictions include Adams, Arapahoe, and Douglas counties, as well as the municipalities of Aurora, Brighton, Commerce City, Thornton, and Parker. There are also affiliate, non-voting members, including Arvada, Greeley, Lone Tree, Broomfield, and Weld County. As such, the influence area boundaries are drawn to reflect Board membership as well as the generally-accepted travel shed from which travel demand on E-470 is generated.



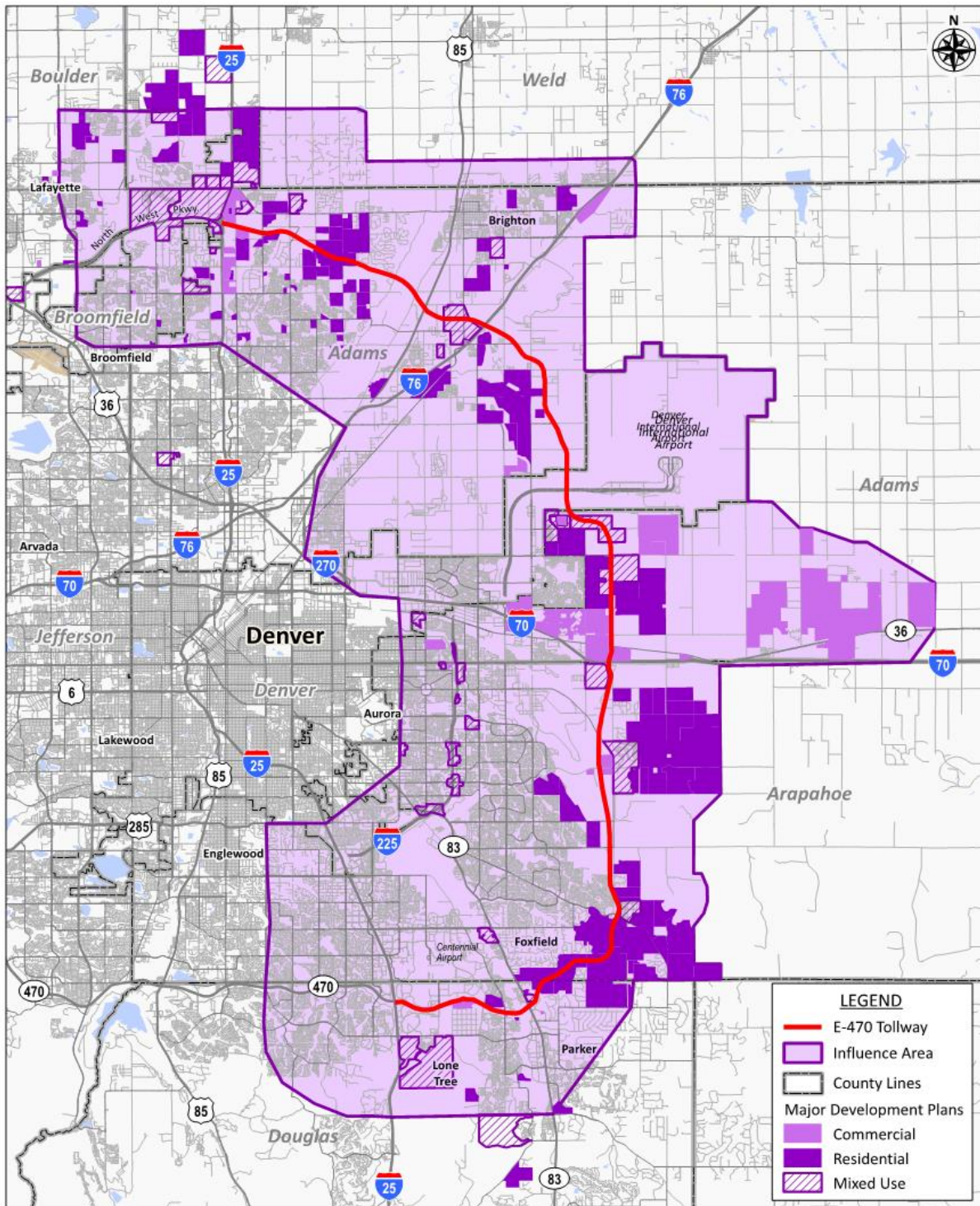


Figure ES-10
E-470 Influence Area

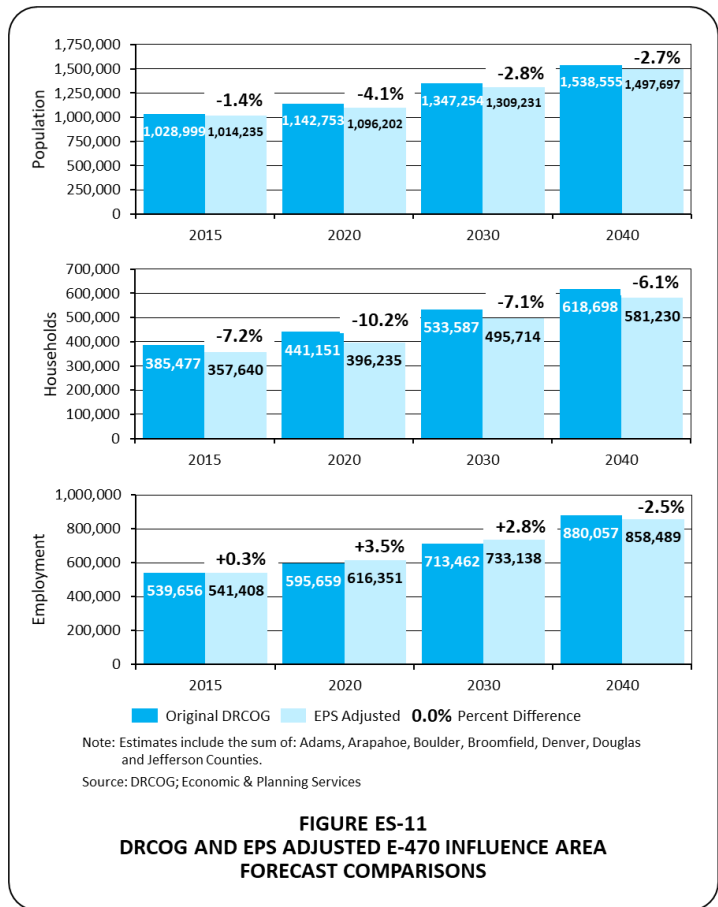
Differences between the original DRCOG forecasts and the EPS adjusted forecasts within the E-470 influence area are illustrated in **Figure ES-11**. They are provided to contrast the extent of the differences. Between 2015-2020, 2020-2030 and 2030-2040, population is forecasted to grow by 1.6 percent, 1.8 percent and 1.4 percent per annum, respectively. This translates into population growth between 2015-2040, within the E-470 influence area that is approximately 0.5 percent per annum higher than the forecasted growth in the Denver Metro area as a whole (1.6 percent per annum versus 1.1 percent per annum).

EPS has also forecast households to grow by 2.1 percent, 2.3 percent and 1.6 percent per annum between 2015-2020, 2020-2030 and 2030-2040, respectively. This means that within the E-470 influence area, households are forecasted to grow by approximately 0.6 percent per annum more than the forecasted Metro area growth between 2015 and 2040. Finally, study area employment between 2015-2020, 2020-2030 and 2030-2040 is forecasted by EPS to grow by 2.6 percent, 1.8 percent and 1.6 percent per annum, respectively. This translates into employment growth within the E-470 corridor that is 0.7 percent per annum greater than in the Metro area as a whole.

In general, while approximately one-third of the region’s population, households and employment reside within the E-470 influence area, EPS forecasts that approximately 40-60 percent of the growth in the demographics will occur there. These adjustments, as described briefly in earlier sections of this chapter, and in more detail in the full EPS report located in Appendix A, are based on extensive data and market analysis, research, as well as understanding of the original DRCOG forecasts, methodology and assumptions.

Traffic and Revenue Analyses

The following section presents the analytical methodology, study assumptions, steps taken to reflect the socioeconomic update, and results of an analysis of the sensitivity of usage and revenue to toll rates. The final products of the analysis are the estimates of annual traffic and toll revenue under the current toll rate assumptions, a comparison of these forecasts with the last CDM Smith forecasts from December 2018, and select sensitivity tests dealing with the potential traffic and revenue impacts associated with the COVID-19 pandemic, reduced regional growth forecasts and reduced value of time assumptions.



Analytical Methodology

The travel demand modeling undertaken for this study utilized, as the basic modeling platform, the DRCOG Focus 2.2 activity-based travel demand model. The model area covers eleven counties within the Denver metropolitan area and is divided into approximately 2,800 traffic analysis zones (TAZs). The DRCOG Focus 2.2 travel demand model used in this study included a 2015 base year model and three future year models: 2020, 2030 and 2040. The trip table matrices output by the modified DRCOG model, which incorporated the revised EPS socioeconomic forecasts and the latest highway improvements, served as inputs to the final traffic assignment step used to develop estimates of traffic volumes by roadway link across the model highway network.

Land Use and Demographic Assumptions

The independent economist provided input socioeconomic data for each of the model years, as previously summarized in this Executive Summary, utilizing the standard DRCOG household and employment categories. The development of the final socioeconomic files was completed by DRCOG staff using their UrbanSim model. This tool created the needed model input tables based on the total household and total employment numbers provided by the independent economist.

Roadway and Transit Network Review

A thorough review was completed of the roadway and transit networks included in the base DRCOG travel demand models for the base and three forecasts years by subconsultant Felsburg Holt & Ullevig (FHU). Beginning with the 2015 model, a detailed assessment of the road network, functional classifications, and number of lanes was completed to ensure consistency with the existing network. The forecast year networks included in the base DRCOG models were then reviewed and compared to the fiscally constrained roadway and rapid transit capital improvements described in the DRCOG 2040 Metro Vision Regional Transportation Plan (RTP) (Cycle Year 2019). The planning document identifies new roadways, additional lanes, and additions to the transit network consistent with the current FasTracks regional rapid transit expansion plans. Special attention was given to regional projects adjacent to the project corridor as well as those projects likely to affect the traffic forecasts on E-470. This review process, the specific projects considered, and their assumed years of construction are described in greater detail later in this chapter. A listing of the regional Metro Vision projects within the study area is shown graphically in **Figure ES-12**.

Toll Collection Percentages by Payment Type

Table ES-5 provides the traffic model assumptions for the percentage of ExpressToll and LPT customers used as part of the 2019 traffic model calibration based on the current toll rate structure. These were based on historic trends and anticipated future increases in ExpressToll participation. These assumptions were used as input to the traffic modeling process for each model year and represent the total ExpressToll market participation for the model area. As shown, estimated ExpressToll participation rates are assumed to remain relatively constant over the model forecast period based on recent trends, along with proposed changes to toll rate structure, which are discussed below.

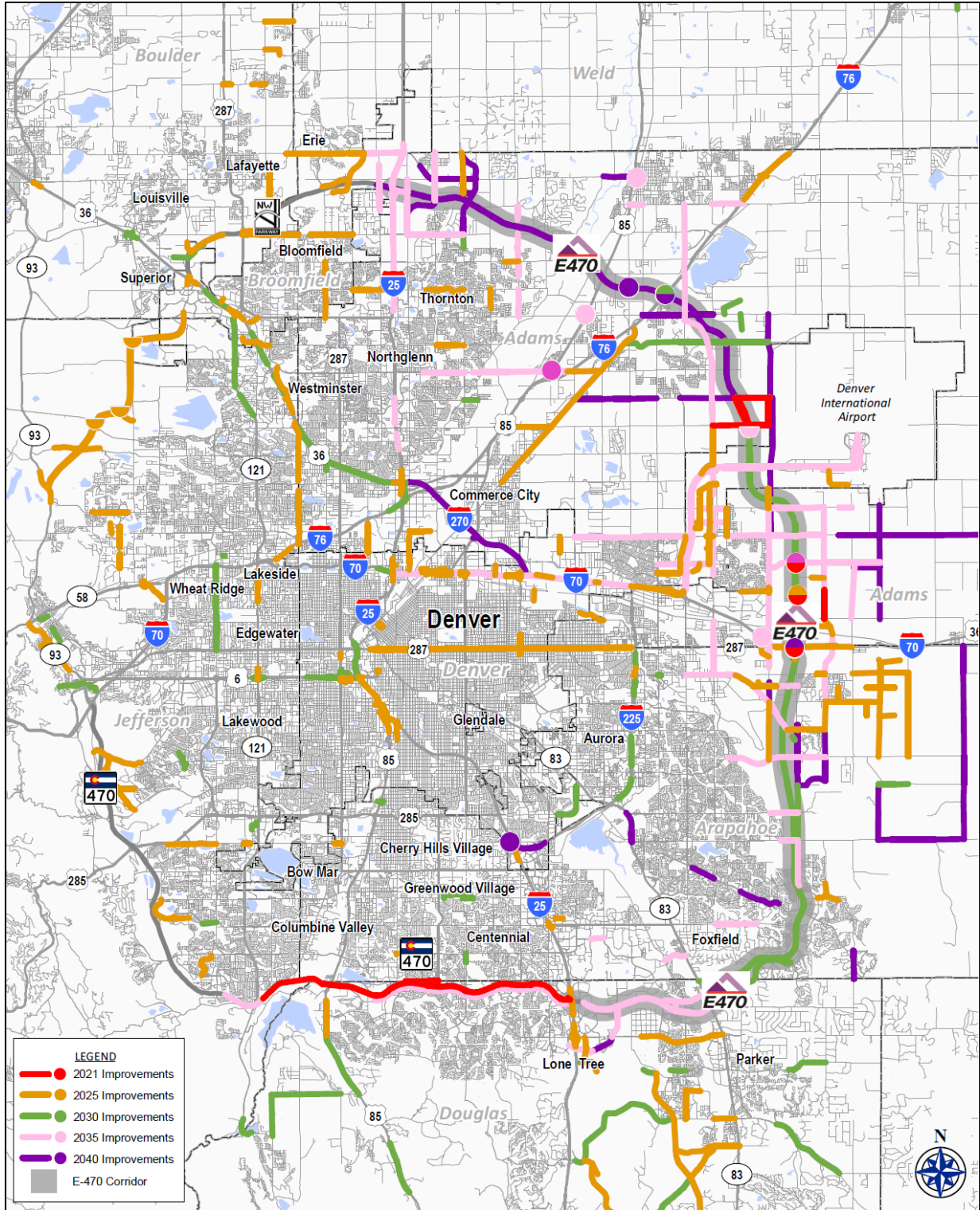


Figure ES-12
Programmed Regional Highway Improvements

**Table ES-5
ExpressToll Market Participation Rates**

Year	Percent of Total Transactions	
	Average Day	Average Weekday / Model Input
2019 ⁽¹⁾	72.9	73.4
2021	73.4	74.3
2025	74.3	74.6
2030	74.3	74.6
2035	74.5	74.8
2040	74.7	75.0

⁽¹⁾ Actual.

Toll Rates

Based on discussions with E-470 Staff, the future year toll rates were set to assume a 2 percent increase every five years. Additionally, current toll rate differentials between ExpressToll and LPT and between passenger cars and commercial vehicles are assumed to be maintained through the forecast period. It was also assumed that the current two-year Midday Commercial Vehicle Discount pilot program would be continued through the forecast period. As presented in **Table ES-6**, the toll rate at the mainline toll locations under these assumptions will be \$2.90 at Toll Gantries A and C, and \$3.15 at Toll Gantries B, D, and E by 2040 for ExpressToll passenger cars. These 2040 toll rates represent a cost of \$0.32 per mile for a 47-mile full-length trip on E-470. It was also assumed that passenger cars and commercial vehicles will continue to pay the same toll rate at the ramp toll locations through the forecast period, except during Midday discount hours.

**Table ES-6
Passenger Car Toll Rate Assumptions**

Year	Method of Payment	Toll Location					
		Gantry A	Gantry B	Gantry C	Gantry D	Gantry E	Toll Ramps
2019	ExpressToll	\$ 2.70	\$ 2.95	\$ 2.70	\$ 2.95	\$ 2.95	\$ 1.25
	LicensePlateToll	\$ 4.30	\$ 4.65	\$ 4.30	\$ 4.65	\$ 4.65	\$ 2.05
2020 ⁽¹⁾	ExpressToll	\$ 2.70	\$ 2.95	\$ 2.70	\$ 2.95	\$ 2.95	\$ 1.25
	LicensePlateToll	\$ 4.30	\$ 4.65	\$ 4.30	\$ 4.65	\$ 4.65	\$ 2.05
2021	ExpressToll	\$ 2.70	\$ 2.95	\$ 2.70	\$ 2.95	\$ 2.95	\$ 1.25
	LicensePlateToll	\$ 4.30	\$ 4.65	\$ 4.30	\$ 4.65	\$ 4.65	\$ 2.05
2025 ⁽²⁾	ExpressToll	\$ 2.75	\$ 3.00	\$ 2.75	\$ 3.00	\$ 3.00	\$ 1.30
	LicensePlateToll	\$ 4.40	\$ 4.80	\$ 4.40	\$ 4.80	\$ 4.80	\$ 2.05
2030 ⁽²⁾	ExpressToll	\$ 2.80	\$ 3.05	\$ 2.80	\$ 3.05	\$ 3.05	\$ 1.35
	LicensePlateToll	\$ 4.45	\$ 4.85	\$ 4.45	\$ 4.85	\$ 4.85	\$ 2.15
2035 ⁽²⁾	ExpressToll	\$ 2.85	\$ 3.10	\$ 2.85	\$ 3.10	\$ 3.10	\$ 1.40
	LicensePlateToll	\$ 4.55	\$ 4.95	\$ 4.55	\$ 4.95	\$ 4.95	\$ 2.25
2040 ⁽²⁾	ExpressToll	\$ 2.90	\$ 3.15	\$ 2.90	\$ 3.15	\$ 3.15	\$ 1.45
	LicensePlateToll	\$ 4.60	\$ 5.00	\$ 4.60	\$ 5.00	\$ 5.00	\$ 2.30

⁽¹⁾ Toll rates effective January 1, 2020.
⁽²⁾ Toll rate adjustments based on a 2 percent increase and assumed to be effective on January 1.

Vehicle Operating Cost and Value of Time Assumptions

In addition to tolls, two major costs were considered when calculating the total cost of a trip. Vehicle operating costs (VOC) take into account drivers' perception of the wear and tear on a vehicle as expressed in maintenance costs, tires, and variable costs such as fuel. The estimated 2019 vehicle operating cost of \$0.205 per mile for passenger cars was inflated at a rate of 2.0 percent per year through the forecast period. These inflation rates were based on an analysis of gas price forecasts from the Energy Information Administration (EIA) as well as fuel efficiency improvements based on current national CAFÉ standards. Operating costs of truck traffic were assumed at 3 times the operating cost of passenger cars.

Motorists' perception of their Value of Time (VOT) is another key component of the decision to use a toll facility or an alternative toll-free route. The estimated average values of time were \$0.320 per minute, or \$19.22 per hour at 2019 levels. DIA-specific VOTs were also used in the traffic assignments. A VOT of \$0.446 per minute was applied to all airport trips regardless of the zone of trip origin or destination. This value was estimated based on the trip-purpose level VOT obtained from SP surveys conducted under prior study efforts. As with VOC, the 2019 average values of time were inflated by 2.0 percent per annum through the forecast period. The estimated values of time in 2030 and 2040 were \$0.398 per minute and \$0.486 per minute, respectively.

Model Development and Calibration

The model calibration process, which was performed at 2019 levels, included a comparison of network speeds, non-toll road volumes and volumes on E-470, against the most recently available actual traffic counts. Model outputs were reviewed to ensure that E-470 volumes approximated, as closely as possible, the 2019 balanced traffic profile, specifically at the five mainline toll gantries. Moreover, model assignment outputs were reviewed to ensure that the E-470 market share across several screenlines, approximated the actual market share observed in the count data collected.

In general, the results of the traffic assignments indicated that, across the various screenlines and at the E-470 mainline toll locations, the updated travel demand model performed reasonably well. Specifically, total screenline model volumes ranged between -2.1 and 14.7 percent of actual screenline counts. At the E-470 mainline toll gantries, the adjusted model produced AWDT volumes ranging between -4.7 and 7.3 percent of actual 2019 volumes, well within acceptable ranges for calibration.

Basic Study Assumptions

Traffic and toll revenue estimates for E-470 are predicated upon the following assumptions, which are considered reasonable for purposes of the forecasts:

1. The toll collection concept and toll schedules as shown in this report will be adopted. Both ExpressToll and LPT will be employed.
2. The percentage of ExpressToll and LPT customers will be assumed as detailed earlier in this chapter.

3. Improvements to the present highway and local road system in the travel corridor will be limited to those described in this report. No other competing facilities, or capacity expansions, will occur in the forecast period.
4. Regional and corridor growth will be generally as forecast by DRCOG as reviewed and refined by Economic & Planning Systems for use in this study, as documented in Appendix A of the full E-470 Traffic and Revenue Study Report.
5. No major recession or significant economic restructuring will occur which would substantially reduce traffic in the region, other than the potential economic impacts described in this report related to the COVID-19 outbreak.
6. Over the long-term, motor fuel will remain in adequate supply, and future increases in fuel price will not significantly exceed the overall rate of inflation.
7. Inflation will average 2.0 percent per year through 2040.
8. Revenue leakage due to unreadable plates or uncollectable ExpressToll or LPT transactions or any transactions that cannot be processed and payment collected will occur. Leakage estimates have been estimated by CDM Smith in this analysis using actual historical data provided by the Authority.
9. The E-470 toll road will be well-maintained and effectively signed.
10. No natural disasters will occur that could significantly alter travel patterns through the area.
11. No local, regional, or national emergency will arise that would abnormally restrict the use of motor vehicles, other than those described in this report related to the COVID-19 outbreak.

Any significant departure from these basic assumptions could materially affect estimated traffic and toll revenue for the E-470.

Toll Rate Sensitivity

Toll sensitivity traffic assignments were run at 2021 and 2040 levels assuming mainline toll rates above or below the currently approved toll rates in increments of \$0.25. Toll sensitivity was considered on a gantry-by-gantry basis in order to understand the relative toll sensitivity of each segment of the E-470 system. The resulting toll sensitivity curves are presented by mainline toll gantry and for the total system in **Figures ES-13 and ES-14**. It should be noted that the toll sensitivity transactions, revenues and curves were developed without COVID-19 impacts so as to understand the toll sensitivity estimated by the raw model. This sensitivity was deemed to be acceptable for use in the forecasting process, since any toll rate increases would not occur under the Base Case until 2025, which is well after the anticipated recovery from the short-term COVID-19 impacts. The multi-year toll sensitivity analysis shows the approved tolls (\$0.30 per mile for through trips in 2021 and \$0.32 per mile for through trips in 2040) are relatively high, but still lie below the top of the toll revenue curve. As compared to estimates of toll sensitivity included in prior studies, this has generally been achieved through strong regional growth and toll reductions at Gantry C.

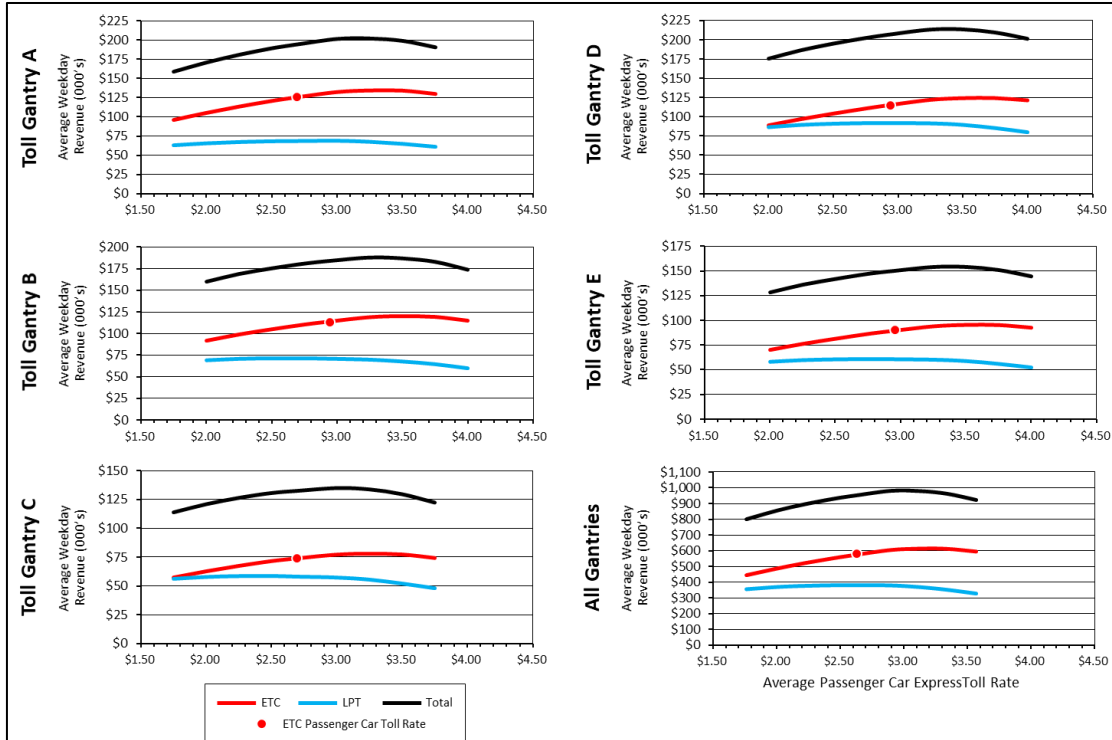


Figure ES-13
2021 Gross Toll Revenue Toll Sensitivity Curves

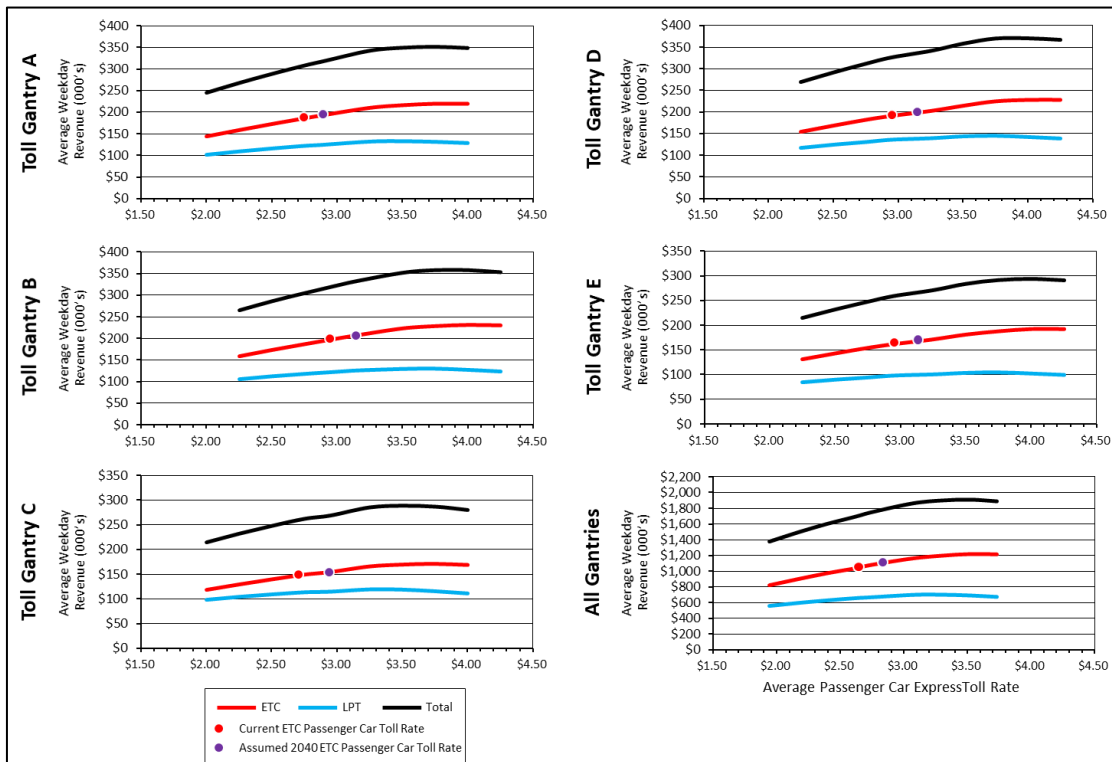


Figure ES-14
2040 Gross Toll Revenue Toll Sensitivity Curves

Estimated Base Case Traffic and Revenue

Following the year 2019 calibration process, future-year average weekday traffic assignments were run for years 2021, 2025, 2030, 2035, and 2040. Based on these assignments, an overall year-over-year “normal” growth rate of 3.6 percent was estimated, which is consistent with recent normal historical rates of growth. Beyond 2021, the growth rates forecasted by the travel demand model were reviewed and used as the basis for the traffic and revenue forecast through 2050.

Forecast Impacts Related to COVID-19

In addition to the “normal” growth rates developed based on historical trends and the updated DRCOG model, CDM Smith applied impacts related to the Coronavirus (COVID-19) outbreak. Observed E-470 transactions between March 1 and April 16, 2020 (the latest available data at the time of this report) indicated that the full impact of COVID-19 on E-470 has been a reduction in systemwide transactions of over 60 percent compared to normal levels. Additionally, while E-470 passenger car transactions are down by almost 70 percent compared to the first week of March, commercial vehicle transactions are down by just over 30 percent. These reduced traffic levels were assumed as the “bottom” of the COVID-19 impacts, which would generally continue through the end of the COVID-19 outbreak.

COVID-19 has impacted travel behavior in many ways some of these will be short-term in effect, while others will have more long-term consequences, including:

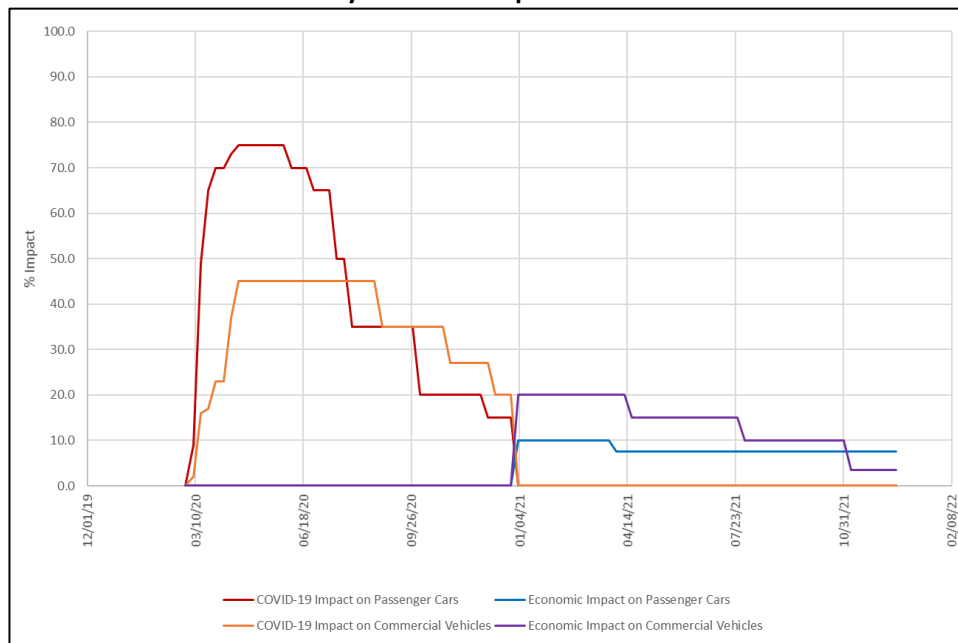
- Remote working;
- Remote learning at all levels;
- Reduced usage of shared modes of transportation;
- Retail Impacts;
- Change in housing and employment locations; and
- Reduced discretionary travel.

Based on this assessment, a review of regional and national trends, and a review of forecasts and estimates available from rating agencies and other financial institutions, annual impacts were applied to the forecast. These impacts, which are illustrated in **Figure ES-15**, were intended to account for both the short-term impacts of the COVID-19 stay-at-home orders and other closures, as well as the long-term structural economic impacts that would occur as a result of the crisis.

Varied impacts are assumed for passenger cars and commercial vehicles, based on actual observations through mid-April. In the short-term, a 36.1 percent reduction in 2020 transactions was assumed, based on the forecasts of the COVID-19 crisis duration. This impact would result in a 33.6 percent year-over-year transaction decrease compared to 2019. Moving forward, a slow recovery was assumed in 2020. However, an annual transaction impact of 8.1 percent was applied from 2022 through the remainder of the forecast period. This was done to account for the longer-term effects of the crisis, including potential recessionary impacts, increases in telecommuting, and reductions in tourism and recreational trips.

The estimated transaction and revenue forecasts presented in the remainder of this Executive Summary therefore recognize not only the forecast assumptions previously detailed in this chapter, but also the short- and long-term estimated impacts of COVID-19 crisis. There is significant uncertainty to both short-term and long-term travel impacts related to the COVID-19 Pandemic. CDM Smith has attempted to use the best available information at the time of developing these forecasts. These assumptions may be subject to change depending on the escalation or recovery from COVID-19, which may materially affect the resulting traffic and revenue estimates.

Figure ES-15
Estimated Weekly COVID-19 Impacts to E-470 Transactions



Estimated Annual Transactions and Revenue

Average weekday transaction estimates developed using the modified DRCOG model and the estimated COVID-19 impacts were then annualized by method of payment. Based on actual 2018 data provided by the Authority, annualization factors of 324.2 and 330.1 were calculated for ExpressToll and LPT transactions, respectively. This reflects the relationship between an average weekday and the annual totals. Annualization factors were also similarly calculated for toll revenue.

Based on the annualized transaction and revenue estimates, an annual transaction and revenue stream was developed. Beyond 2040, estimates were developed based on the average annual normal growth rates and toll increase impacts between 2030 and 2040. The annualized impacts of programmed widenings, interchange improvements and new toll ramps were added in the assumed year of opening. Additionally, a roughly 2 to 3 percent construction impact, consistent with observed historical impacts, was assumed in the area of a programmed widening during the two years prior to the scheduled completion.

The resulting annual transaction and revenue estimates through 2050 are provided for the total E-470 system in **Table ES-7**. These reflect the Base Case conditions, with the assumed toll increases, as well as adjustments for the short-term and long-term impacts of the COVID-19 crisis. Following strong historical growth trends, annual transactions are expected to decrease from an actual of 90.3 million in 2019 to 59.9 million in 2020 as a result of the COVID-19 impacts. A recovery is anticipated in 2021, with systemwide transactions increasing back to 88.0 million. Annual transactions are not estimated to return to 2019 levels until 2023, representing a four-year lag in growth as a result of the longer-term COVID-19 impacts outlined above. Transactions on E-470 are estimated to increase to 112.1 million in 2030 and 156.0 million in 2040. This represents an average systemwide growth rate of 3.1 percent between 2021 and 2040. The estimated share of ExpressToll transactions are estimated to increase slightly from 73.1 percent in 2019 to 75.2 percent by 2040.

Annual toll revenue estimates are also provided in **Table ES-7**. Adjustments for uncollectible and unpaid revenue were developed in order to estimate net toll revenues, which include revenue adjustments to account for non-revenue vehicles, unbillable license plate toll images and unpaid toll transactions. In consultation with E-470 staff and based on historical reductions in leakage rates, CDM Smith assumed the actual 2018 and 2019 leakage rates would be reduced slightly over the forecast period as toll collection technology and enforcement improve. In 2019, total actual leakage was 14.3 percent, which is a strong performance compared with that experienced by other AET facilities nationwide. This is in part due to the fact that collections were significantly improved in 2017 with the ability of the Authority to use automated processes to identify and bill customers with temporary license plates. Moving forward, slightly more conservative leakage rates, more in line with historically observed levels, were assumed (15.9 percent in 2020) and then reduced over the forecast period based on additional improvements in technology and collections. As shown previously in **Table ES-7**, leakage rates were estimated to be 14.8 percent by 2030 and 14.6 percent by 2035. As a result, net toll revenues on E-470 are estimated to increase to \$312.5 million in 2030 and \$443.5 million in 2040. This represents an average systemwide growth rate of 3.3 percent between 2021 and 2040, which incorporates the impacts of widenings, highway improvements and toll increases. Thus, despite the impacts of COVID-19 in 2020 and 2021, net toll revenues are still estimated to more than double over the course of the forecast period.

Table ES-7
Estimated Base Case Annual Transactions and Revenue (In Thousands)

Year	Annual Transactions (000s)			Annual Toll Revenue (\$000s)		
	ExpressToll	LPT	Total	Gross ⁽¹⁾	Uncollectible and Unpaid ⁽²⁾	Net ⁽³⁾
2019 (4)	65,910	24,370	90,280	\$ 290,393	\$ (41,380)	\$ 249,013
2020 (4)(5)(6)	44,153	15,752	59,905	193,459	(30,732)	162,727
2021 (6)(7)	65,398	22,605	88,003	282,645	(44,291)	238,354
2022	66,851	23,106	89,957	288,620	(44,889)	243,731
2023	68,521	23,627	92,148	295,331	(45,499)	249,832
2024 (5)(7)	71,545	24,510	96,055	306,862	(46,875)	259,987
2025 (8)	72,859	24,616	97,475	317,254	(47,948)	269,306
2026	74,752	25,117	99,869	321,899	(48,440)	273,459
2027 (7)	77,395	26,234	103,629	334,457	(50,350)	284,107
2028 (5)	79,497	27,072	106,569	343,834	(51,665)	292,169
2029 (7)	81,992	27,929	109,921	354,295	(53,116)	301,179
2030 (8)	83,786	28,347	112,133	367,004	(54,461)	312,543
2031 (7)	87,384	29,434	116,818	381,759	(56,560)	325,199
2032 (5)	90,618	30,543	121,161	395,173	(58,559)	336,614
2033 (7)	94,635	31,853	126,488	411,752	(60,961)	350,791
2034	98,168	33,021	131,189	425,963	(63,038)	362,925
2035 (7)(8)	103,380	34,431	137,811	456,286	(67,215)	389,071
2036 (5)	107,829	35,703	143,532	470,786	(69,206)	401,580
2037	110,038	36,495	146,533	480,398	(70,660)	409,738
2038 (7)	113,287	37,553	150,840	494,447	(72,679)	421,768
2039	115,828	38,614	154,442	506,257	(74,620)	431,637
2040 (5)(7)(8)	117,244	38,776	156,020	519,513	(76,012)	443,501
2041	119,729	39,612	159,341	529,886	(77,529)	452,357
2042	122,620	40,584	163,204	541,994	(79,300)	462,694
2043	125,604	41,585	167,189	554,428	(81,116)	473,312
2044 (5)	129,035	42,734	171,769	568,755	(83,209)	485,546
2045 (8)	130,674	42,787	173,461	582,613	(84,391)	498,222
2046	133,107	43,589	176,696	592,759	(85,855)	506,904
2047	135,600	44,412	180,012	603,116	(87,348)	515,768
2048 (5)	138,533	45,379	183,912	615,373	(89,116)	526,257
2049	140,774	46,117	186,891	624,489	(90,426)	534,063
2050 (8)	142,143	46,029	188,172	638,079	(91,465)	546,614

(1) Gross Revenue does not include adjustments for unbillable or uncollectable toll revenue.

(2) Uncollectible toll revenue represents non-revenue vehicles, bad or duplicate license plate images, or any other transactions for which revenue cannot be collected.

(3) Net Revenue includes adjustments for unbillable or uncollectable toll revenue.

(4) Includes actual data through March 2020.

(5) Leap Year.

(6) COVID-19 traffic impacts have been included in 2020 due to stay-at-home orders, public space closures and other travel restrictions. Some recovery is assumed in 2021, though longer-term traffic impacts of 8.1 percent have been included through the remainder of the forecast period.

(7) Assumed widening of various segments of the E-470 mainline.

(8) Assumed 2.0 percent Systemwide Toll Increase.

Estimated Sensitivity Test Traffic and Revenue

The Base Case traffic and revenue forecasts included in the report are based on certain assumptions and forecast of future economic growth and other events which are ultimately subject to some level of uncertainty. As such, it is typical in traffic and revenue studies of this nature to conduct sensitivity tests aimed at identifying the sensitivity of revenue forecasts to potential changes in certain basic assumptions or future forecasts of underlying variables. Sensitivity tests typically include hypothetical changes in future socioeconomic growth forecasts, value of time assumptions and so forth. For purposes of this study, traffic forecasts for the following three different sensitivity tests were developed:

1. Second Wave of COVID-19 Impacts in 2021
2. Long-Term Reduced Economic Growth (50 Percent Lower Trip Table Growth); and
3. Reduced Value of Time (25 Percent VOT Growth Reduction after 2024).

For each of the various sensitivity tests, the alternative transaction and revenue estimate were developed for each respective year of tests and considered in terms of the percent impact as compared with the Base Case estimates. The sensitivity tests were produced using all of the same socioeconomic inputs, highway improvements, values of time, vehicle operating costs, toll rates, and toll revenue leakage assumptions as the Base Case forecasts, except those being assessed in the particular sensitivity test. The results of these sensitivity tests are contained in Chapter 4 of the full E-470 Traffic and Revenue Study Report.

Disclaimer

CDM Smith used currently-accepted professional practices and procedures in the development of these traffic and revenue estimates. However, as with any forecast, 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 the E-470 Public Highway Authority. CDM Smith also relied upon the reasonable assurances of other 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; 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 the E-470 Public Highway Authority. 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.

CDM Smith is not, and has not been, a municipal advisor as defined in Federal law (the Dodd Frank Bill) to the E-470 Public Highway Authority and does not owe a fiduciary duty pursuant to Section 15B of the Exchange Act to the E-470 Public Highway Authority with respect to the information and material contained in this report. CDM Smith is not recommending and has not recommended any action to the E-470 Public Highway Authority. The E-470 Public Highway Authority should discuss the information and material contained in this report with any and all internal and external advisors that it deems appropriate before acting on this information.