MOBILITY PLAN 2045

Appendix J

Travel Demand Model Scenarios

J. TRAVEL DEMAND MODEL SCENARIOS

INTRODUCTION

Each update of the Knoxville Regional TPO's Mobility Plan includes the use of a travel demand model to predict travel patterns across the region. During the current update, Mobility Plan 2045, the COVID-19 pandemic has caused substantial shifts in travel behavior nationally and regionally. From telecommuting to online shopping, many of these shifts were already under way, but they have increased during the pandemic and could result in long-term travel behavior changes. Given that Mobility Plan 2045 analyzes travel patterns over a 25-year period, the travel demand model can be used to assess the outcomes of different scenarios on the transportation landscape in the Knoxville region. Modeling different scenarios can affect the prioritization of projects within different timeframes, expectations regarding future funding levels locally and statewide, and anticipated air quality improvements. This appendix briefly documents current research on travel trends and how they were incorporated into scenario testing using the regional travel demand model.

TRENDS IN TRAVEL BEHAVIOR

The characteristics of travel are constantly changing, and in recent decades, advances in technology have had significant impacts on travel behavior. While these changes have been occurring over many years, the COVID-19 pandemic accelerated the adoption of many technologies that inform people's travel choices.

Remote Work

The increased use of telecommuting or remote working arrangements has had a significant impact on roadway travel in 2020. In these situations, employees work at least a portion of the workweek outside the office or business location. Research confirms that the opportunity to telecommute is more commonly associated with white collar businesses, larger companies, and full-time employees with higher education and wages. Approximately 17% of U.S. employees were telecommuting full-time prior to the COVID-19 pandemic, a figure that has increased to 44% during the pandemic. While this dramatic increase in telecommuting occurred out of necessity in early 2020, it may have long-lasting impacts. Companies have invested significant resources to ensure continued productivity of a remote workforce, and many see additional benefits from reduced overhead costs, greater employee work-life balance, and expanded

labor markets. As a result, it is expected that commuting trips in the Knoxville region will continue to decrease over time with the continued adoption of telecommuting arrangements across all industries.

Distance Learning

The COVID-19 pandemic caused many elementary, middle, and high schools to incorporate distance learning options into their curriculum and colleges to move more courses to online formats. It is anticipated that in-person education will be reinstated as quickly as possible for most school-age children. Although little impact to travel is expected long-term, concerns about school transportation and cleanliness amid a pandemic will potentially affect short-term school trips. In the Knoxville region, vehicular trips to schools are expected to increase in the short-term (3-5 years) to account for parents who may have previously sent children to school on a bus but now prefer to drive them to school.

While universities across the country have increased the availability of online courses in recent years, this option is not necessarily the preferred alternative for students attending college. However, the increasing cost of a college education combined with economic impacts from COVID-19 could result in decreased enrollment overall and/or increased online enrollment, which can often be more cost-effective. In the Knoxville region, university trips are generally expected to decrease over time to account for these trends.

Freight

The U.S. economy was significantly impacted by the COVID-19 pandemic in 2020. Because of the economic slowdown, freight and logistics companies continue to feel the impacts of closing businesses, stay-at-home mandates, and increased demand for essential medical and food supplies. One of the most notable shifts in freight traffic during this time has been the tradeoff between demand for long-haul versus local truck trips. Long-haul truck trips (greater than 1,000 miles) decreased nationally by about 30% during the pandemic while local trips (less than 100 miles) increased by 130%. According to a report published by the American Transportation Research Institute (ATRI), “the anecdotal evidence is that long-haul movements of international containers decreased at the same time that fleet operations recalibrated to moving essential consumer goods from local and regional warehouses to retail establishments.” In the Knoxville region, it is expected that this pattern will prevail in the short-term as the economy continues to rebound. Long-term, both local and national truck travel are expected to eventually realign with the historic trend of increased truck volumes. This accounts for larger shifts to things like increased online consumer spending, or e-commerce.

Tourism

One of the most immediate impacts of COVID-19 was the decline in tourism spending and discretionary travel. Stay-at-home orders combined with concerns about large groups resulted in canceled car rentals, closed tourism attractions, and significant declines in air travel. While U.S. residents are gradually becoming more comfortable with travel, many tourist destinations are continuing to operate at reduced capacity. According to the U.S. Travel Association, domestic air and hotel bookings are down by 56% and vehicle trips over 50 miles are down 13% in 2020 compared to 2019. This reduced travel has resulted in a 44% decrease in travel spending in the U.S.

Local economies that rely on tourism for revenue generation have felt the impact of this reduced spending. However, the impact on different types of tourism attractions has varied. For example, theme parks have experienced a reduction in visitors, while other outdoor venues have seen dramatic increases in visitors during the pandemic. In the Knoxville region, it is expected that the tourism-related impacts of COVID-19 will be primarily felt in the short-term with reduced travel to attractions like Pigeon Forge or Dollywood, increased travel to the Great Smoky Mountain National Park, and increased auto travel on the interstates generated by concerns about air travel.

Other Trends

Other changes in travel choices may result from the trends documented above. For example, data shows that when employees are working remotely, they are less likely to stop by the grocery store after work, but more likely to pick up a child from school instead of having them ride the bus. While this example results in a net zero change in total daily trips, the timing of trips is changed, which ultimately results in a decrease in peak hour trips.

As mentioned, advances in technology are responsible for many changes in travel trends. One of these key changes is the continued increase in shared mobility and micromobility options available nationally and in the Knoxville region. Use of transportation apps for things like carpool matching and scooter renting can ultimately reduce the number of motor vehicles on the road. In addition, apps that make it easier to have doorstep delivery of groceries or takeout can also reduce the need for making trips. Trip reductions due to these technologies in the Knoxville region, particularly for non-home-based trips, is expected to continue in both the short- and long-term scenarios.

MODEL CONSTRUCT AND PARAMETERS

The Knoxville TPO's regional travel demand model predicts multiple trip types for both daily and peak period travel. The first model step, trip generation, estimates the number of trips by type that will be made from and to each traffic analysis zone (TAZ). Based on the trip types in the Knoxville model as well as the observed travel changes during the COVID-19 pandemic, the trip generation step was used to effectively reduce or increase the following trip types:

- Work Trips
- School Trips
- University Trips
- Other Non-Home-Based Trips
- Visitor Trips
- Auto trips through the region (known as External-External or XX trips)
- Truck trips through the region (External-External or XX trips)
- Truck trips with one end outside the region and one internal to the region (known as Internal-External or IX/XI trips)

These trip types were adjusted for two model scenarios – one short-term scenario and one long-term scenario – that estimate the effects of changing travel trends in the 2026 and 2045 horizon years. Based on a review of pertinent literature and recent research discussed in the previous section,
Table J-1 lists the range of adjustments used in the trip generation step of modeling these two scenarios. In general, the short-term trend is expected to increase over time with the exception of school, tourism-related, and long-haul truck trips.

Table J-1. Model Parameter Values

ADJUSTMENT	SHORT-TERM SCENARIO (2026)	LONG-TERM SCENARIO (2045)
WORK TRIPS	⇩ 5-10%	⇩ 15-20%
SCHOOL TRIPS	⇧ 0-5%	No Change
UNIVERSITY TRIPS	⇩ 0-5%	⇩ 5-10%
OTHER NHB TRIPS	⇩ 5-10%	⇩ 15-20%
VISITOR TRIPS	⇩ 0-5%	No Change
AUTO XX TRIPS	⇧ 5-10%	No Change
TRUCK XX TRIPS	⇩ 5-10%	⇧ 5-10%
TRUCK XI/IX TRIPS	⇧ 10-20%	⇧ 15-25%

MODEL RESULTS

Travel demand model outputs were used to compare existing + committed, or E+C, model runs for 2026 and 2045 for key metrics such as Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), and volume-to-capacity (v/c) ratios. These metrics were analyzed systemwide for the 10-county model area. In addition, corridor-specific metrics were analyzed for the most unreliable segments in the Knoxville Regional TPO area as detailed in the Congestion Management Process (CMP).

The adjustments detailed in

Table J-1 resulted in a 4% and 7% decrease in VMT and a 6% and 11% reduction in VHT in 2026 and 2045, respectively. Table J-2 illustrates this observed change across roadways of different functional classifications. In the short-term scenario, travel trend adjustments result in the largest VMT reductions on collectors and local roadways in both urban and rural areas. Long-term, these trends continue with interstates seeing the least impact on VMT. Conversely, the interstate system is expected to see a significant share of VHT reduction. When looking at changing travel trends by vehicle classification, passenger travel is expected to decrease while truck traffic increases in both scenarios as expected.

Table J-2. VMT and VHT by Functional Classification

	FUNCTIONAL CLASSIFICATION	2026 E+C	2026 COVID	2045 E+C	2045 COVID	2026 CHANGE	2045 CHANGE
VMT	Rural Interstates	4,345,629	4,364,730	5,135,680	5,258,982	0.4%	2.4%
	Other Rural Principal Arterials	1,135,714	1,108,917	1,324,466	1,262,573	-2.4%	-4.7%
	Rural Minor Arterials	1,851,785	1,790,325	2,166,553	2,014,594	-3.3%	-7.0%
	Rural Major Collectors	1,339,078	1,276,549	1,658,925	1,508,281	-4.7%	-9.1%
	Rural Minor Collectors	429,757	400,327	563,793	476,530	-6.8%	-15.5%
	Rural Local Roads	114,855	107,993	137,633	122,766	-6.0%	-10.8%
	Urban Interstates	8,315,036	8,107,906	9,309,055	8,843,036	-2.5%	-5.0%
	Other Urban Freeways	345,007	325,891	393,734	346,838	-5.5%	-11.9%
	Other Urban Principal Arterials	7,183,224	6,860,932	8,037,268	7,296,640	-4.5%	-9.2%
	Urban Minor Arterials	4,092,702	3,861,651	4,724,763	4,165,508	-5.6%	-11.8%
	Urban Collectors	2,169,940	2,020,776	2,600,789	2,219,540	-6.9%	-14.7%
	Urban Local Roads	380,890	351,727	464,660	390,942	-7.7%	-15.9%
VHT	Rural Interstates	66,359	66,922	90,977	101,402	0.8%	11.5%
	Other Rural Principal Arterials	23,078	22,293	27,576	25,829	-3.4%	-6.3%
	Rural Minor Arterials	39,779	38,162	48,319	44,129	-4.1%	-8.7%
	Rural Major Collectors	28,931	27,503	36,529	32,849	-4.9%	-10.1%
	Rural Minor Collectors	10,554	9,802	13,996	11,716	-7.1%	-16.3%
	Rural Local Roads	3,348	3,119	4,130	3,621	-6.8%	-12.3%
	Urban Interstates	140,529	133,643	165,972	148,810	-4.9%	-10.3%
	Other Urban Freeways	6,099	5,733	7,022	6,099	-6.0%	-13.1%
	Other Urban Principal Arterials	210,025	195,819	247,386	212,136	-6.8%	-14.2%
	Urban Minor Arterials	129,327	119,383	156,126	130,547	-7.7%	-16.4%
	Urban Collectors	72,158	66,275	87,776	72,421	-8.2%	-17.5%
	Urban Local Roads	12,841	11,699	15,655	12,793	-8.9%	-18.3%

Table J-3. VMT and VHT by Vehicle Classification

	VEHICLE CLASSIFICATION	2026 E+C	2026 COVID	2045 E+C	2045 COVID	2026 CHANGE	2045 CHANGE
VMT	Passenger Vehicles	28,790,937	27,433,821	32,923,656	29,595,924	-4.7%	-10.1%
	Commercial Trucks	3,620,337	3,817,831	4,366,467	4,998,865	5.5%	14.5%
VHT	Passenger Vehicles	701,315	654,113	842,678	726,943	-6.7%	-13.7%
	Commercial Trucks	65,823	68,928	85,610	98,542	4.7%	15.1%

Model outputs also allowed for analysis of those facilities currently at 50% capacity or more, measured with the v/c ratio. As shown in Table J-4, significant reductions in both VMT and VHT are expected in both the short-term and long-term scenarios for facilities with a v/c ratio above 0.84. In the short-term, miles driven on above-capacity facilities decreases by 27% with a long-term decrease of nearly 30%. Accompanying this change in travel mileage, both the short-term and long-term reduction in hours spent driving on these facilities decreased by nearly 40%. These changes in travel trends ultimately reduce the number of lane miles operating near or above capacity in the region despite projected growth.

Table J-4. VMT, VHT, and Lane Miles by V/C Ratio

	V/C RATIO GROUP	2026 E+C	2026 COVID	2045 E+C	2045 COVID	2026 CHANGE	2045 CHANGE
VMT	v/c > 0.50	7,214,988	6,816,753	10,757,303	9,865,371	-5.5%	-8.3%
	v/c > 0.70	2,048,913	1,817,570	4,191,344	3,900,302	-11.3%	-6.9%
	v/c > 0.84	484,117	370,865	1,337,310	1,145,473	-23.4%	-14.3%
	v/c > 0.99	128,329	93,551	231,960	163,221	-27.1%	-29.6%
VHT	v/c > 0.50	170,203	150,206	274,565	228,743	-11.7%	-16.7%
	v/c > 0.70	58,831	47,894	125,276	105,774	-18.6%	-15.6%
	v/c > 0.84	21,933	15,457	55,010	45,368	-29.5%	-17.5%
	v/c > 0.99	9,583	6,048	17,917	10,869	-36.9%	-39.3%
LANE MILES	v/c > 0.50	1,752	1,639	2,106	1,772	-6.4%	-15.9%
	v/c > 0.70	691	622	1,126	961	-10.0%	-14.7%
	v/c > 0.84	243	212	498	453	-12.8%	-9.0%
	v/c > 0.99	106	81	179	147	-23.6%	-17.9%

CONCLUSION

Scenario planning has often been used to assess and plan for the range of possibilities in the transportation landscape. However, the COVID-19 pandemic has created new challenges and opportunities for transportation planning that this exploratory exercise seeks to analyze. In the short-term, reduced travel has the potential to impact the need for various projects, change how projects are prioritized, and reduce local tax revenues and thereby funding available for projects. In the long-term, reduced travel could potentially negate or defer the need for high-cost capacity projects, improve air quality, and reduce federal funding stemming from fuel tax revenues. Providing the ability to routinely assess changes in travel behavior and demand using the regional travel demand model allows the TPO to consistently evaluate the need for and prioritization of projects in our region.

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