REGIONAL FREIGHT TRANSPORTATION PLAN UPDATE

FREIGHT NETWORK CONGESTION, BOTTLENECK, SAFETY AND SECURITY ISSUES

DECEMBER 29, 2022

CORE
COASTAL REGION MPO

Regional Freight Transportation Plan Update

Freight Network Congestion, Bottleneck, Safety and Security Issues

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1 INTRODUCTION

The Coastal Region Metropolitan Planning Organization (CORE MPO) region serves a gateway for global trade and for freight movement in the Southeast, due in large part to the Port of Savannah – the nation's 4th largest container port. In addition to the Port of Savannah, the region contains a comprehensive multimodal network of freight railroads and railyards, major highways, cargo-serving airports, as well as a substantial warehousing/distribution/logistics industry to manage freight movements over that network. Overall, goods movement in the Savannah region has a major impact on the regional and state economy.

In support of the region's multimodal freight network and the people and businesses that rely on it, the CORE MPO is conducting an update of its Regional Freight Transportation Plan. This technical memorandum identifies system deficiencies related to congestion, travel time reliability, and safety across the region's multimodal freight network. Its purpose is to provide the foundation for identifying needs related to bottlenecks and safety so that the region may develop effective strategies to address those needs. The following are key focus areas included in this memorandum:

- **Congestion and Reliability.** This focus area assesses and analyzes existing and future congestion and reliability challenges on the CORE MPO's highway network. It identifies "hot spots" on the region's network where freight congestion or reliability issues are a concern.
- **Safety Performance.** The safety performance component identifies locations with high truck- or rail-involved incidents in the region. Specific focus was given to at-grade rail crossings as these locations are potential safety hazards given the opportunity for trains to collide with vehicles and vulnerable roadway users. For locations that were determined to have a relatively high rate of incidents involving freight vehicles, a high-level assessment of the potential conditions that contribute to truck- or rail-related crashes was performed.
- **System Gaps, Restrictions, and Other Bottlenecks.** This focus area identifies the physical constraints that may be underlying factors in observed congestion, reliability, and safety performance challenges. Turning radii at intersections, vertical clearances along highway and rail corridors, and weight-limited bridges are examples of physical impediments to freight movements that can impact travel time, routing decisions, and safety.

2 CONGESTION AND RELIABILITY

Traffic congestion and route reliability are critical components affecting the freight network. The following section highlights those critical trucking corridors where congestion-related delays are being experienced by trucks navigating to and from the Port of Savannah. The assessment methodology details are summarized below, however; the overall approach to this assessment focused primarily on identifying the base year (2020) and future year (2050) levels of delay experienced (or would be anticipated to experience) by trucks along each the available main routes accessing the Port.

Current performance was evaluated using travel time data from the National Performance Management Research Data Set (NPMRDS). Future performance was estimated using a combination of the NPMRDS data and the CORE MPO region's travel demand model results. The travel demand model reports vehicle hours of delay for all vehicle classes, not just trucks. Therefore, the NPMRDS data, which is truck specific, was combined with the travel demand model results to develop a truck-specific forecast. Specifically, the total delay from the model for both the years 2020 and 2050 was extracted and delay difference is computed. The difference in the delay was then added to the base year delay estimated from the NPMRDS data to develop a 2050 truck delay forecast.

2.1 Base Year Performance

Performance in the base year is characterized using multiple measures including truck delay, truck travel time index, and truck buffer time index. Multiple measures were used in order to provide a comprehensive view of truck travel conditions throughout the region. While truck delay and the truck travel time index provide indicators of congestion, the truck buffer time index indicates the magnitude of unreliability on the region's highway freight network. These measures are discussed in detail in the subsections that follow.

Base Year Congestion Performance

Truck congestion on the region's highway network was captured by examining three measures: (1) Annual Truck Hours of Delay per Mile, (2) Average Daily Delay per Truck, and the Truck Travel Time Index. Each measure provides a different perspective on how trucks experience the region's highway network and where they encounter challenges.

Annual Truck Hours of Delay per Mile

Annual Truck Hours of Delay per Mile was calculated using the 2021 NPMRDS travel time data as follows:

- Delay was calculated for each 15-minute time period as the difference between actual truck travel time and reference travel time. Reference travel time is based on 85th percentile speed during off-peak and overnight time periods.
- Delay for each 15-minute time period was multiplied by 15-minute truck volumes. The 15-minute truck volumes were calculated by multiplying the Annual Average Daily Truck Traffic (AADTT) reported in the NPMRDS data by the percent of trucks estimated to be traveling during that 15-minute time period. This percentage is based on the time-of-day truck traffic volume profile indicated by the INRIX origin-

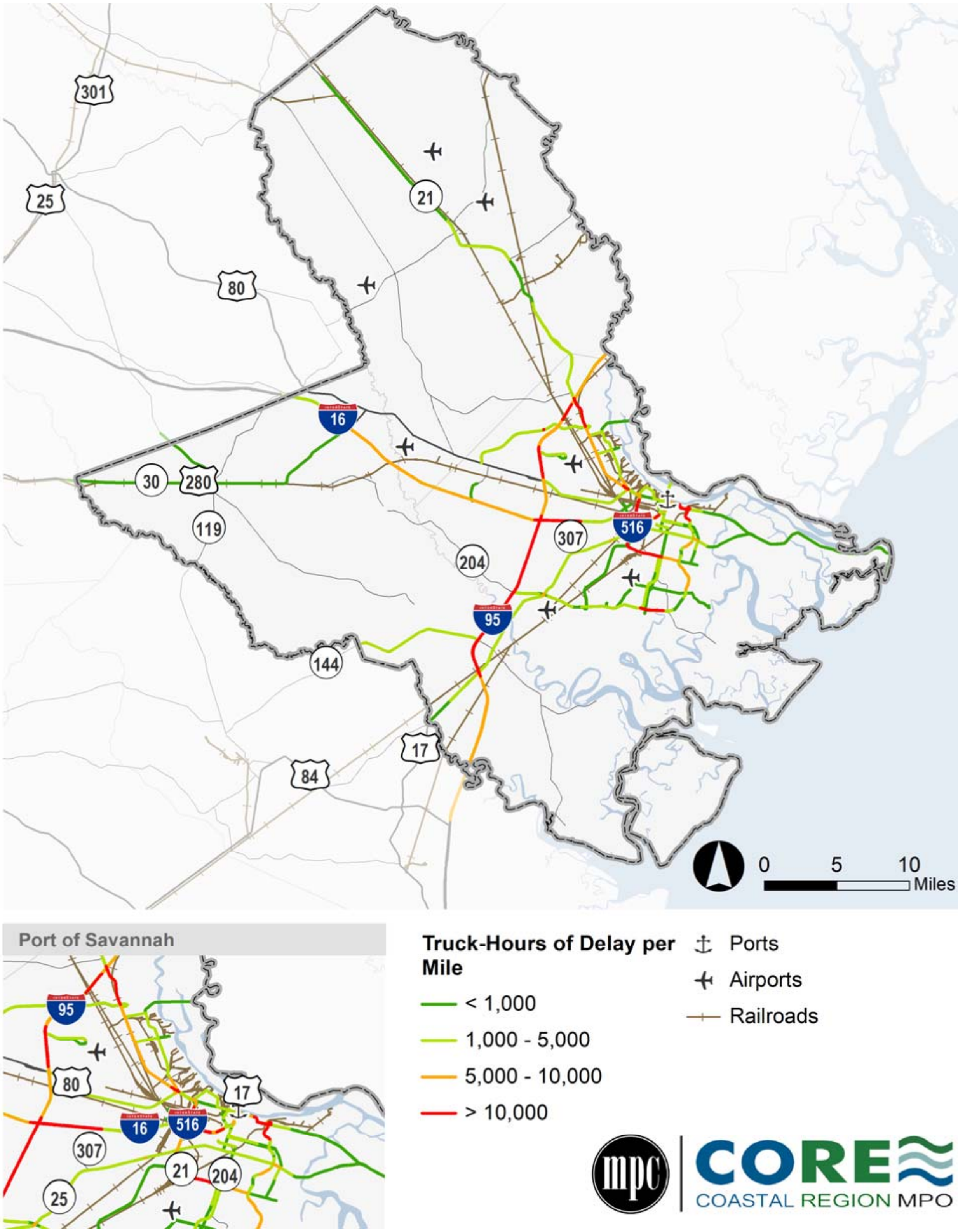
destination data for the region.[1] Delay for each 15-minute time period was aggregated to get annual truck hours of delay.

- The total truck hours of delay is then divided by the segment length to get total truck hours of delay per mile.

As calculated, Annual Truck Hours of Delay per Mile emphasizes corridors with both a substantial difference between actual and reference travel times as well as those that carry high volumes of trucks. The results of the analysis are shown in Figure 2.1. Overall, they indicate that truck delay is largely concentrated on a handful of the region's major freight corridors. These include I-95, I-16, I-516, and SR 21.

[1] Refer to the Task 2.1 technical memorandum for more details on this data.

FIGURE 2.1 TRUCK-HOURS OF DELAY PER MILE

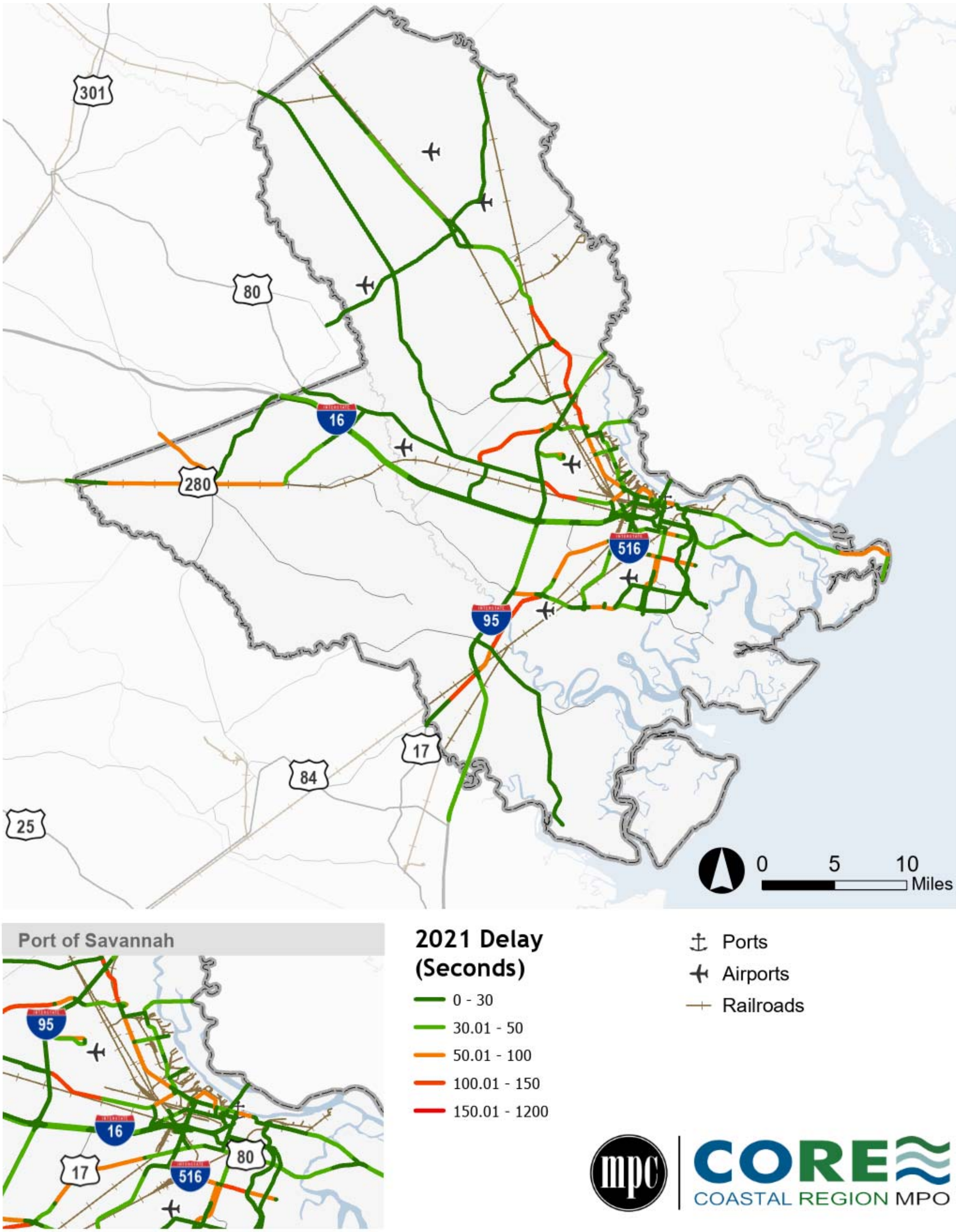


Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

Average Daily Delay per Truck

Congestion on the highway freight network was also evaluated using Average Daily Delay per Truck (measured in seconds). Unlike the Annual Truck Hours of Delay per Mile, this measure is not weighted by truck volumes. Instead, it focuses in on corridors with substantial differences between actual and reference travel times. It is useful for highlighting corridors that may have modest truck volumes but are nonetheless important as last-mile connectors or local freight routes. As shown in Figure 2.2, corridors such as SR 21, Jimmy Deloach Pkwy. between U.S. 80 and I-95, and U.S. 17 experience average daily peak period link delays of 50 to 150 seconds (about one to two-and-a-half minutes) and as high as 1,090 seconds (up to 18 minutes of delay).

FIGURE 2.2 AVERAGE DAILY TRUCK DELAY, 2021



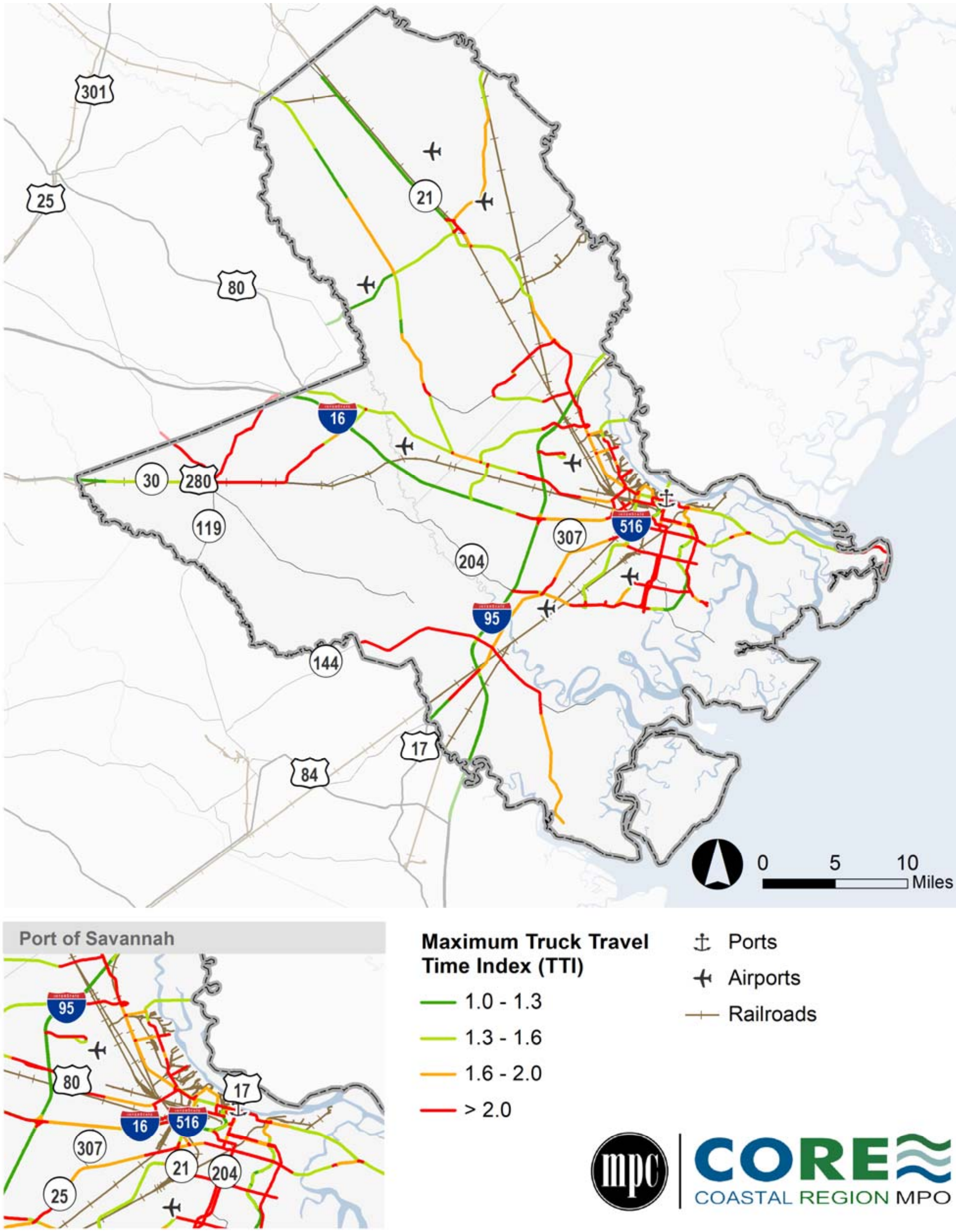
Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

Truck Travel Time Index

Truck-related congestion on the CORE MPO region's network is also captured by calculating the Truck Travel Time Index (TTI). TTI is a commonly used measure of congestion intensity on a roadway network. It is calculated as the ratio of the average truck travel time to the reference travel time: TTI = Mean Truck Travel Time / Reference Travel Time. Thus, TTI reflects the degree to which speeds decline during peak periods. A low truck TTI indicates that that the peak and off-peak travel periods have generally the same level of intensity. Conversely, a high TTI indicates that peak period performance is much worse relative to its off-peak performance. For instance, a TTI equal to 1.6 indicates that travel times during peak periods are 60 percent longer than during free flow conditions.

The NPMRDS data indicate that I-516 experiences the greatest Truck Travel Time Index (TTTI) throughout a whole week. The AM, midday, and PM peak periods all have higher total TTTIs, indicating larger volumes and consistent truck use of this corridor for travel. I-16 and I-95 are lower and more comparable to one another and follow a similar trend of higher TTI values at midday and PM peak times compared to the AM peak. This is the inverse of I-516 which exhibits higher TTTI in the AM peak compared to midday and PM peak times.

FIGURE 2.3 TRUCK TRAVEL TIME INDEX, 2021



Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

TABLE 2.1 TRUCK TRAVEL TIME INDEX ON INTERSTATE CORRIDORS, 2021

Interstate	AM Peak	Midday	PM Peak	Overnight	Weekend
I-16	1.22	1.27	1.24	1.17	1.15
I-95	1.08	1.13	1.12	1.09	1.13
I-516	1.61	1.58	1.62	1.39	1.40

Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

Table 2.2 highlights the distribution of truck TTI on interstate highways. The majority of interstate highway miles, approximately 81 to 88 percent across analysis periods, exhibit less than a 1.3X higher travel time during all peak periods. Generally, the evening period is the most challenging for truck travel according to the data. About 12 percent of the region’s interstate highway system experiences truck travel times that are 1.6X higher (or more) than average.

TABLE 2.2 TRUCK TRAVEL TIME INDEX ON INTERSTATE CORRIDORS – DIRECTIONAL MILES, 2021

Time Period	1.0 – 1.3	1.3 – 1.6	1.6 – 2.0	> 2.0	Total
	Directional Miles of Interstate Highway				
AM Period	85.34%	8.37%	3.28%	3.00%	100%
Midday Period	81.56%	10.37%	6.42%	1.65%	100%
Evening Period	87.86%	5.80%	1.99%	4.35%	100%

Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

Base Year Reliability Performance

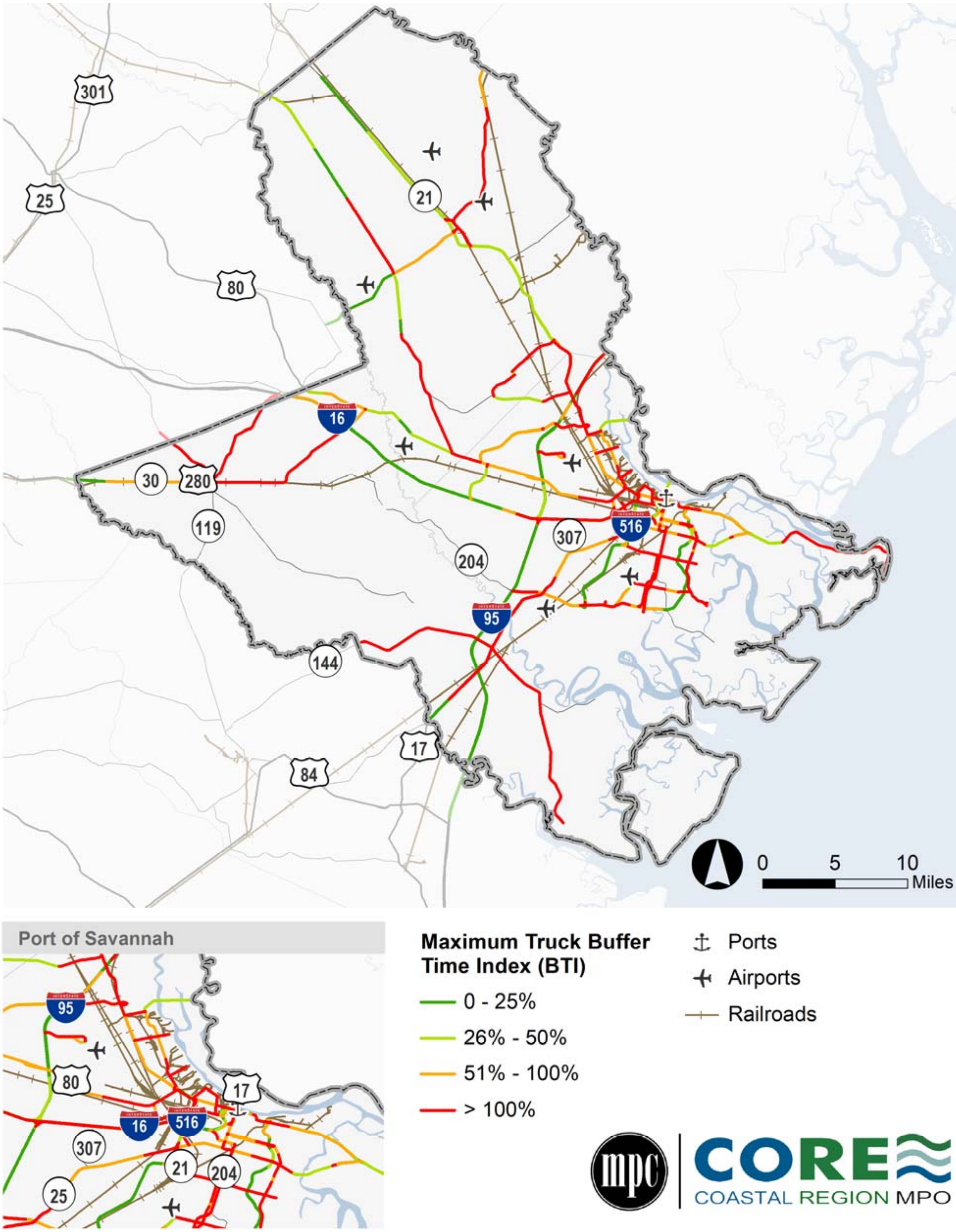
An analysis was also done to gauge truck travel time reliability in the CORE MPO region. In general, measures of reliability gauge the variability of travel times between peak and non-peak periods. Roadway segments with highly variable travel times are deemed less reliable than those with more consistent travel times. Reliability is a particularly useful freight performance measure because it is directly related to a motor carrier’s operating cost. Truck travel on less reliable routes compels carriers to build into their schedules extra time because they are unsure of the actual travel time any given trip on that route will require. This results in higher costs in the form of labor and forgone opportunities to use a truck to carry an additional shipment.

Buffer Time Index

This analysis measures reliability via the buffer time index (BTI). The BTI is the ratio of the difference between the 95th percentile truck travel time and average travel time to the average travel time: [(95th Percentile Travel Time – Average Travel Time) / Average Travel Time] x 100%. Thus, buffer time index is expressed as a percentage. For example, if BTI and average travel time are 20% and 10 minutes, then the buffer time would be 2 minutes. Since it is calculated by 95th percentile travel time, it represents almost all worst-case delay scenarios and assures travelers to be on-time 95 percent of all trips. A higher BTI indicates the opposite, that extra travel time is needed to traverse a corridor.

For I-516, truck travel is most unreliable during the PM peak with a weighted average BTI of 34%, following with similar values for the overnight and weekend peak periods. The BTI gives an additional time for unexpected delays that commuters should consider along with average travel time to be on-time 95 percent of the time. In this case, the commuter would experience a travel time which is 34 times more than the average travel time on this corridor. I-95 experiences the least, or lowest, BTI during the week which would be attributed to a less congested road network. Furthermore, on weekends, both I-95 and I-16 BTI ramps up owing to greater congestion and volume of traffic.

FIGURE 2.4 TRUCK BUFFER TIME INDEX, 2021



Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

TABLE 2.3 TRUCK BUFFER TIME INDEX ON INTERSTATE CORRIDORS, 2021

Interstate	AM Peak	Midday	PM Peak	Overnight	Weekend
I-16	26.1%	45.7%	25.2%	16.3%	12.4%
I-95	3.8%	7.0%	11.8%	6.1%	12.6%
I-516	26.6%	24.8%	34.0%	31.5%	31.6%

Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

Table 2.4 shows the distribution of BTI on the region's interstate highways. It indicates that the majority of interstate highway miles, about 80 to 91 percent, experience a BTI between 0-25 for the AM, midday, and PM periods. The greatest BTI (50-100 and > 100) mostly occurs during the midday periods.

TABLE 2.4 TRUCK TRAVEL TIME INDEX ON INTERSTATE CORRIDORS – DIRECTIONAL MILES, 2021

Time Period	0-25	25-50	50-100	>100	Total
		Directional Miles of Interstate Highway			
AM Period	90.74%	2.02%	4.51%	2.73%	100%
Midday Period	80.28%	3.37%	7.74%	8.60%	100%
Evening Period	85.75%	6.72%	2.80%	4.73%	100%

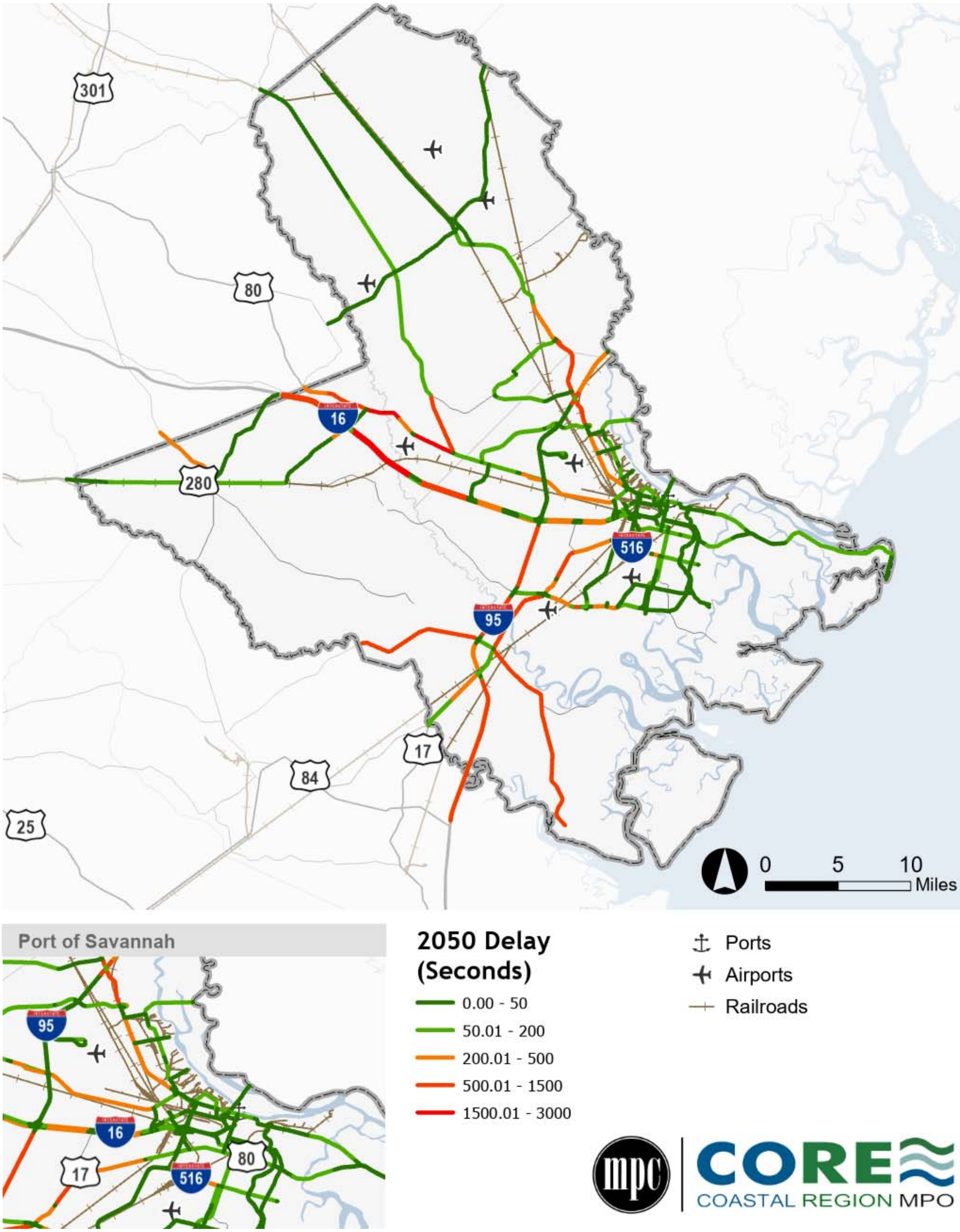
Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

2.2 Future Year Performance

While base year performance was characterized using multiple measures, the analysis of future year performance focuses on Average Daily Delay per Truck. The reason for this is to take advantage of the region's travel demand model which estimates changes in travel times based on population growth, changes in land use, and other factors that impact travel behavior. Specifically, the total delay from the model for both the years 2020 and 2050 was extracted and the difference in between the two years was computed. The difference in the delay was then added to the base year delay estimated from the NPMRDS data to develop a 2050 truck delay forecast. The future performance assessment is for the existing plus committed condition, which assumes no improvements beyond what has already been programmed for construction and included by the MPO as part of its transportation improvement program.

The results of the analysis are shown in Figure 2.5. Note the overall increases in anticipated future delay across the network as more links are forecasted to experience delays in excess of 200 seconds and up to nearly 12,500 seconds.

FIGURE 2.5 2050 TRUCK DELAY



Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

In addition to the region-wide analysis, three primary freight routes providing access to the Port of Savannah were isolated and examined in detail for future travel time performance. Specifically, for these routes comparisons were made between base year and anticipated future year travel times to examine how delay is predicted to change over the long term. Figure 2.6 shows the results of this analysis while Figures 2.7 to 2.9 depict the freight routes. Overall, the results imply substantial increases in truck delay.

FIGURE 2.6 2050 TRUCK DELAY ON PRIMARY FREIGHT ROUTES

Route A: I-16

Delay in Minutes

	2020	2050
To Port	**15.35**	**131.96**
From Port	**15.5**	**122.49**

Route B: I-516, Veterans Pkwy., and I-95

Delay in Minutes

	2020	2050
To Port	**14.61**	**68.51**
From Port	**15.25**	**73.92**

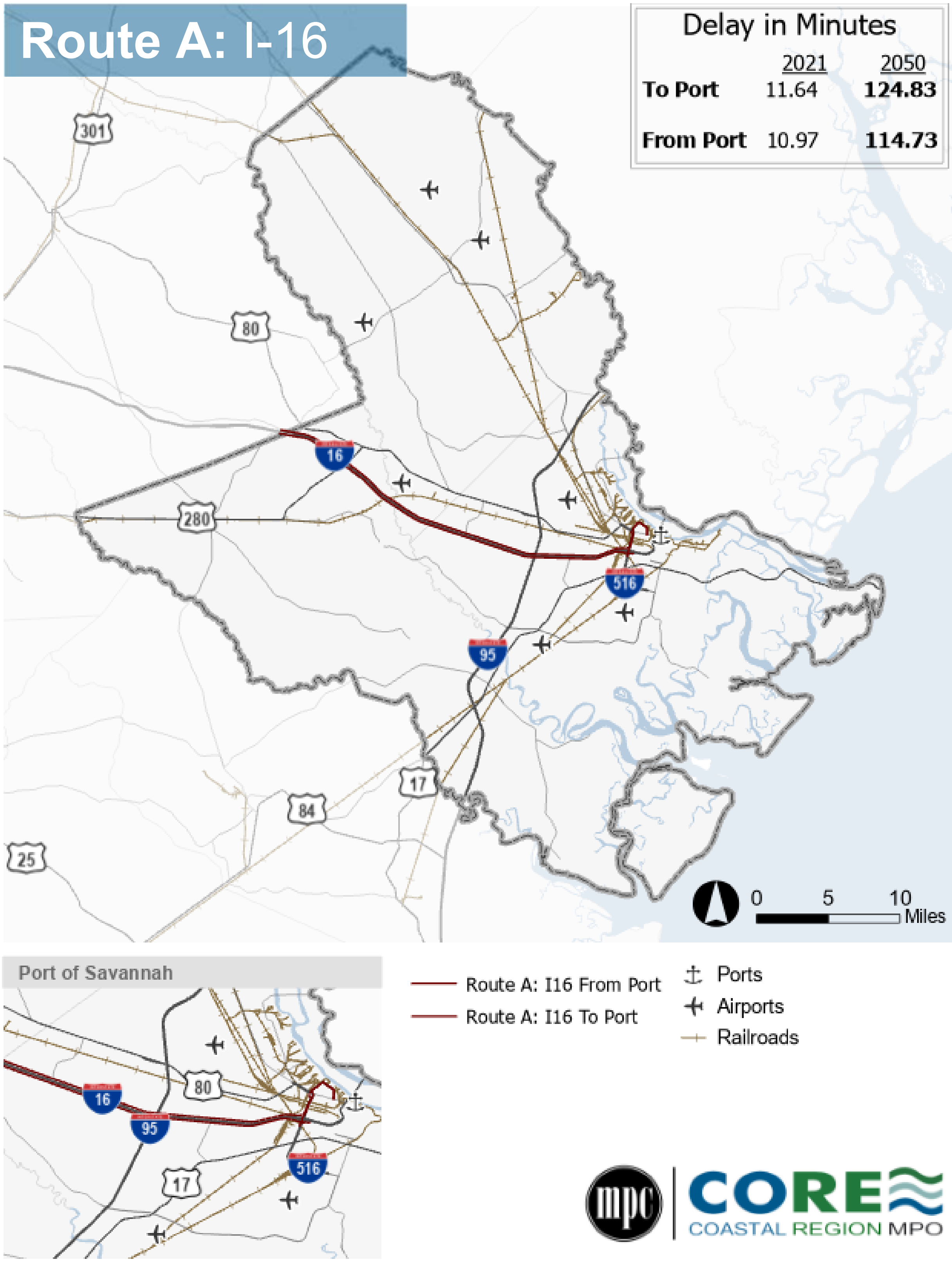
Route C: SR 21 and SR 25

Delay in Minutes

	2020	2050
To Port	**24.26**	**78.98**
From Port	**23.93**	**68.58**

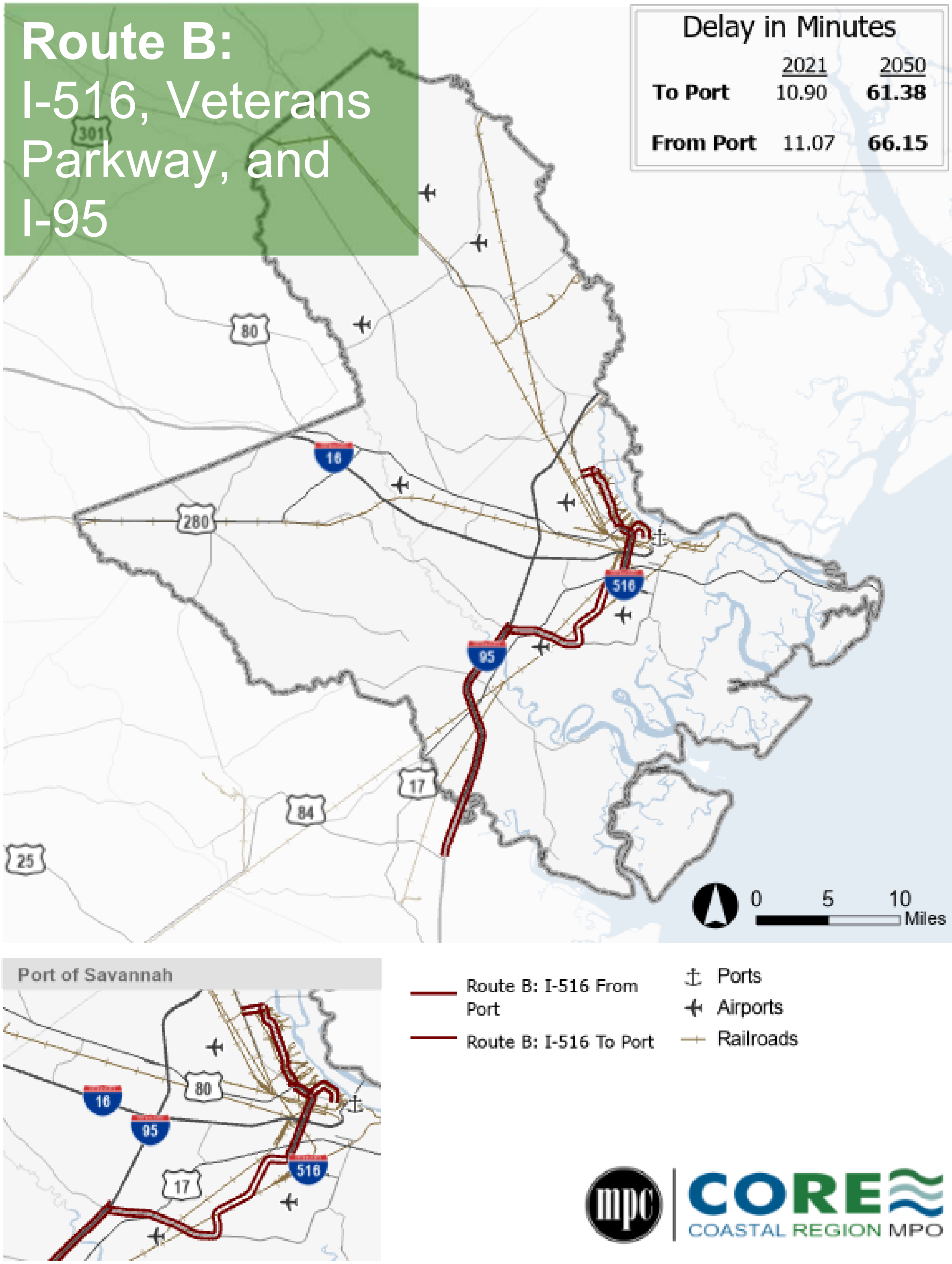
Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

FIGURE 2.7 2050 TRUCK DELAY – I-16 CORRIDOR



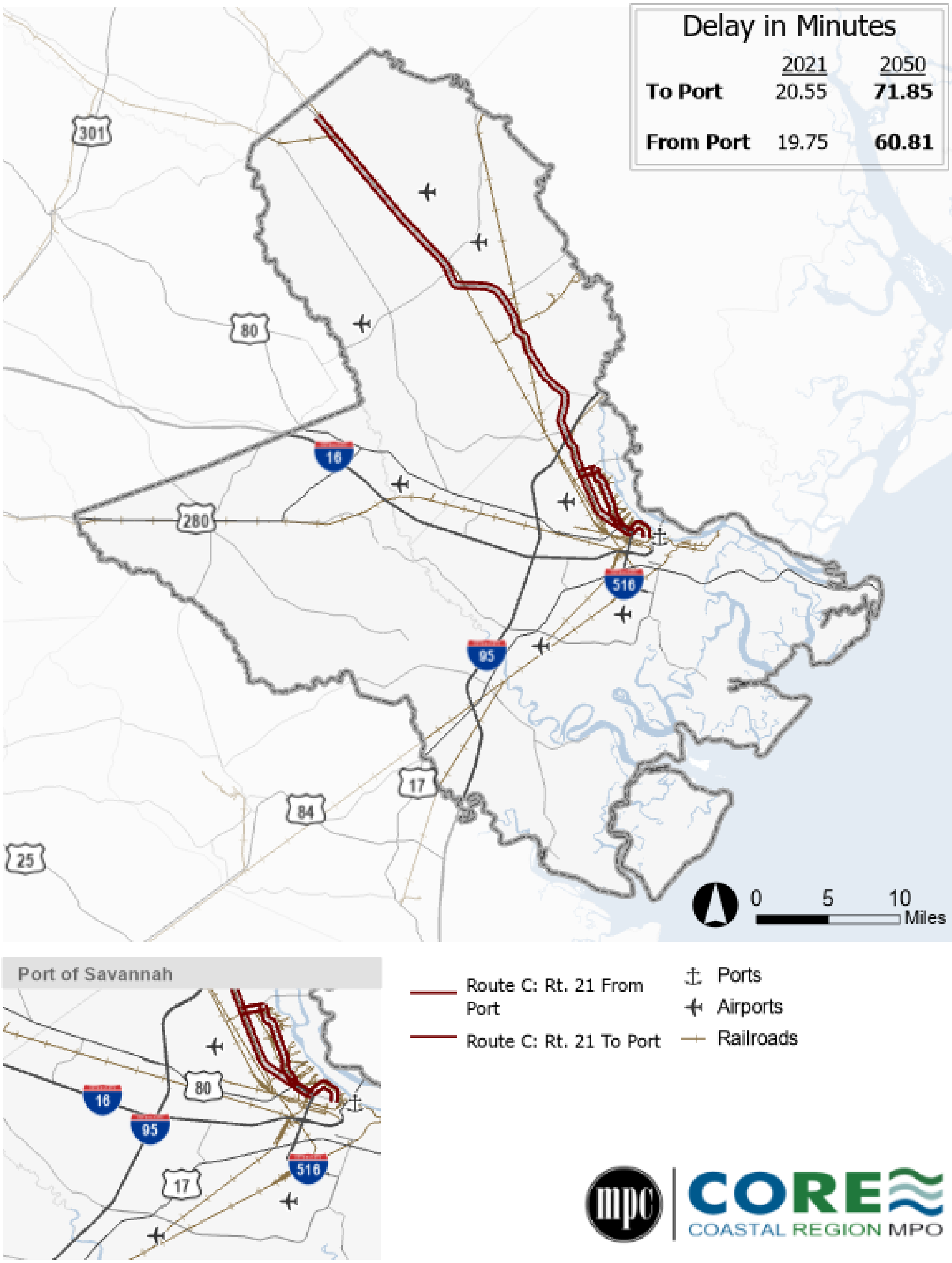
Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

FIGURE 2.8 2050 TRUCK DELAY – I-516, VETERANS PKWY., AND I-95 CORRIDOR



Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

FIGURE 2.9 2050 TRUCK DELAY - SR 21 CORRIDOR



Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

3 SAFETY PERFORMANCE

Vehicular safety is a paramount concern for all roadway network users. Understanding truck safety and related performance is a critical component necessary for addressing frequency and severity of incidences and the overall impact they have on congestions and delays within the overall roadway network.

3.1 Truck-Involved Crashes

Crash data for Bryan, Chatham, and Effingham Counties were collected for the years 2016 through 2020 from the GDOT Numetrics database. Table 3.1 shows the data by county and year. For total truck-related crashes, Chatham County had the highest share of crashes at 83 percent. However, Chatham County also contains a larger share of the region's roadway network and vehicle-miles traveled. Bryan and Effingham Counites accounted for 9 percent and 8 percent of truck-involved crashes, respectively.

TABLE 3.1 TOTAL TRUCK-INVOLVED CRASHES BY COUNTY AND YEAR

Total Crash Counts by County and Year							
	2016	**2017**	**2018**	**2019**	**2020**	**2016 - 2020 Total**	**% Share**
Chatham	596	569	531	706	692	3094	83%
Effingham	67	57	57	66	52	299	8%
Bryan	49	56	65	67	86	323	9%
Total Incidents	**712**	**682**	**653**	**839**	**830**	**3,716**	**100%**

The severity of a crash is categorized according to the KABCO severity scale, as follows:

- A – Suspected Serious Injury
- B – Suspected Minor/Visible injury
- C – Possible Injury/Complaint
- K – Fatal Injury
- O – No Injury

The severity of crashes by year for the region is summarized Table 3.2. Crashes involving fatalities or serious injury accounted for 82 incidents or just over 2 percent of the total crashes. No injuries were reported in 75 percent of truck-involved crashes. The severity of crashes by county, shown in Table 3.3, indicate that Chatham County experienced the most fatal truck crashes with 13 over the analysis period. Effingham and Bryan Counties experienced 6 and 3 fatal truck crashes, respectively. The majority of truck-involved crashes for each county resulted in no injuries.

TABLE 3.2 TOTAL TRUCK-INVOLVED CRASHES BY YEAR AND SEVERITY

Crash (KABCO) Severity Counts by Year							
	2016	2017	2018	2019	2020	2016 - 2020 Total	% Share
(A) Suspected Serious Injury	10	7	11	16	16	60	1.6%
(B) Suspected Minor/Visible Injury	37	44	47	43	56	227	6.1%
(C) Possible Injury / Complaint	137	117	92	129	129	604	16.3%
(K) Fatal Injury	7	2	3	4	6	22	0.6%
(O) No Injury	519	512	499	645	615	2,790	75.1%
Unknown						13	0.3%
Year Total	**710**	**682**	**652**	**837**	**822**	**3,716**	**100%**

Source: GDOT Numetrics Database; AECOM.

TABLE 3.3 TOTAL TRUCK-INVOLVED CRASHES BY COUNTY, YEAR, AND SEVERITY

KABCO Severity of Crashes in Chatham							
	2016	2017	2018	2019	2020	2016 - 2020 Total	% Share
(A) Suspected Serious Injury	7	3	4	11	9	34	1%
(B) Suspected Minor/Visible Injury	22	24	33	35	44	158	5%
(C) Possible Injury / Complaint	112	101	71	111	103	498	16%
(K) Fatal Injury	3	1	2	3	4	13	0.004%
(O) No Injury	450	440	420	544	526	2380	77%
Year Total	**594**	**569**	**530**	**704**	**686**	**3,083**	**100%**

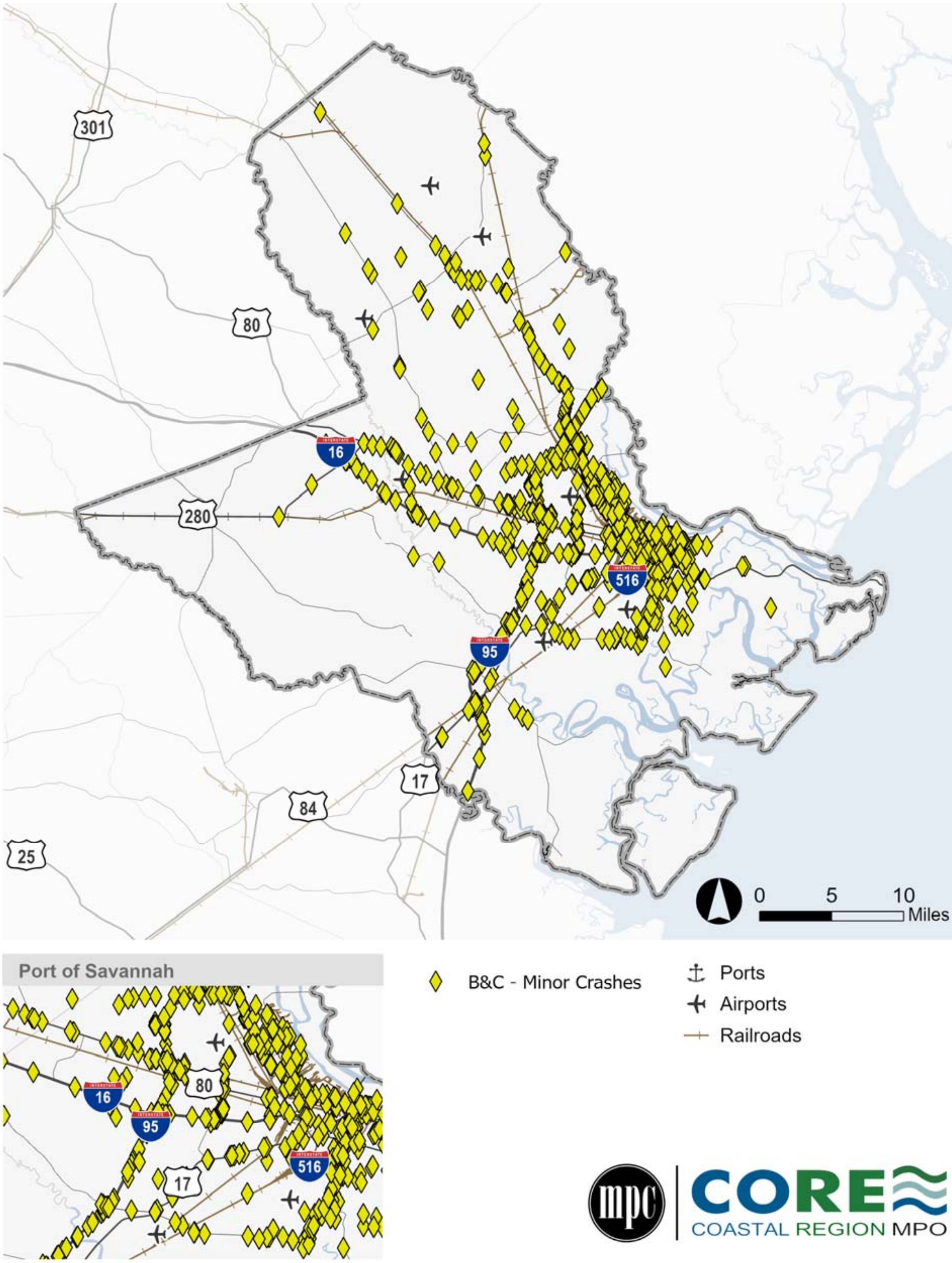
KABCO Severity of Crashes in Effingham							
	2016	2017	2018	2019	2020	2016 - 2020 Total	% Share
(A) Suspected Serious Injury	2	1	5	2	5	15	5%
(B) Suspected Minor/Visible Injury	7	13	12	7	5	44	15%
(C) Possible Injury / Complaint	16	10	11	8	11	56	19%
(K) Fatal Injury	3	1	0	0	2	6	2%
(O) No Injury	39	32	29	49	27	176	59%
Year Total	**67**	**57**	**57**	**66**	**50**	**297**	**100%**

KABCO Severity of Crashes in Bryan							
	2016	2017	2018	2019	2020	2016 - 2020 Total	% Share
(A) Suspected Serious Injury	1	3	2	3	2	11	3%
(B) Suspected Minor/Visible Injury	8	7	2	1	7	25	8%
(C) Possible Injury / Complaint	9	6	10	10	15	50	15%
(K) Fatal Injury	1	0	1	1	0	3	1%
(O) No Injury	30	40	50	52	62	234	72%
Year Total	**49**	**56**	**65**	**67**	**86**	**323**	**100%**

Source: GDOT Numetrics Database; AECOM.

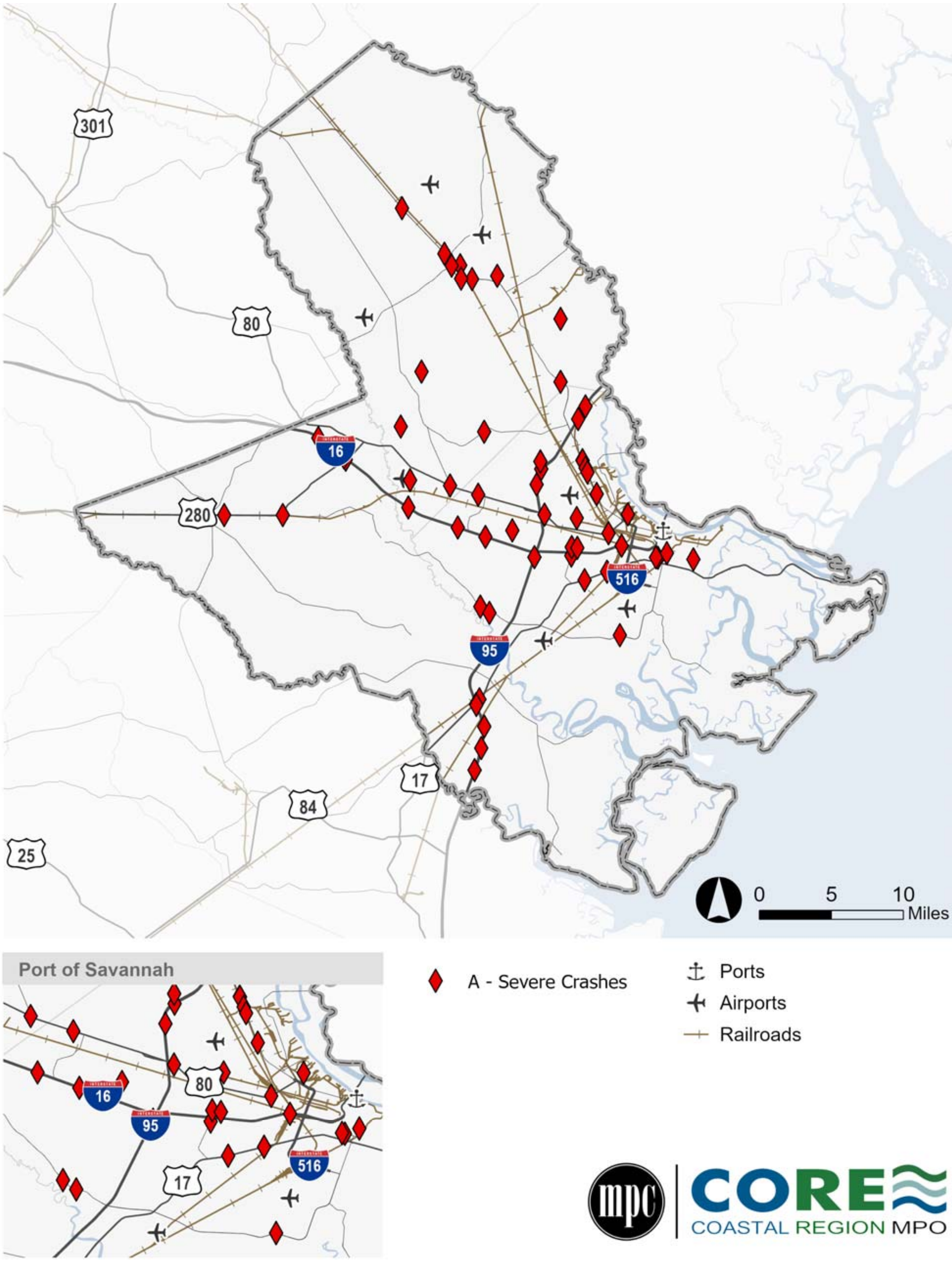
Figures 3.1 to 3.3 show the locations of minor injury (B and C), severe injury (A), and fatal injury (K) truck-involved crashes. While minor and (to a lesser extent) severe injury truck-involved crashes are broadly distributed across the region's highway network, fatal injury crashes appear to have primarily occurred on a few key freight routes. These include I-16, I-95, SR 21, SR 17/SR 30, and U.S. 17.

FIGURE 3.1 MINOR INJURY TRUCK-INVOLVED CRASHES, 2016 - 2020



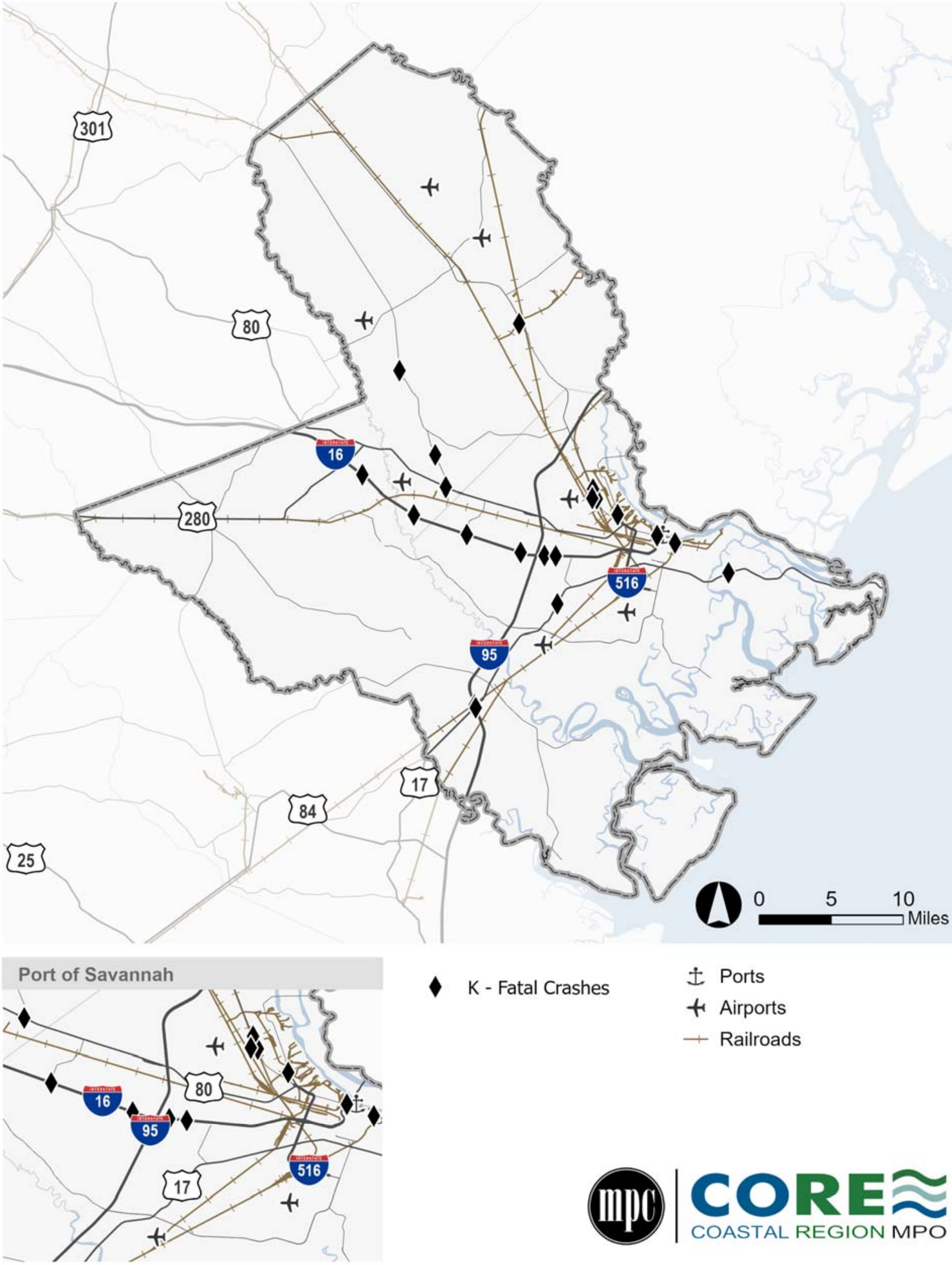
Source: GDOT Numetrics Database; AECOM.

FIGURE 3.2 SEVERE INJURY TRUCK-INVOLVED CRASHES, 2016 - 2020



Source: GDOT Numetrics Database; AECOM.

FIGURE 3.3 FATAL INJURY TRUCK-INVOLVED CRASHES, 2016 - 2020

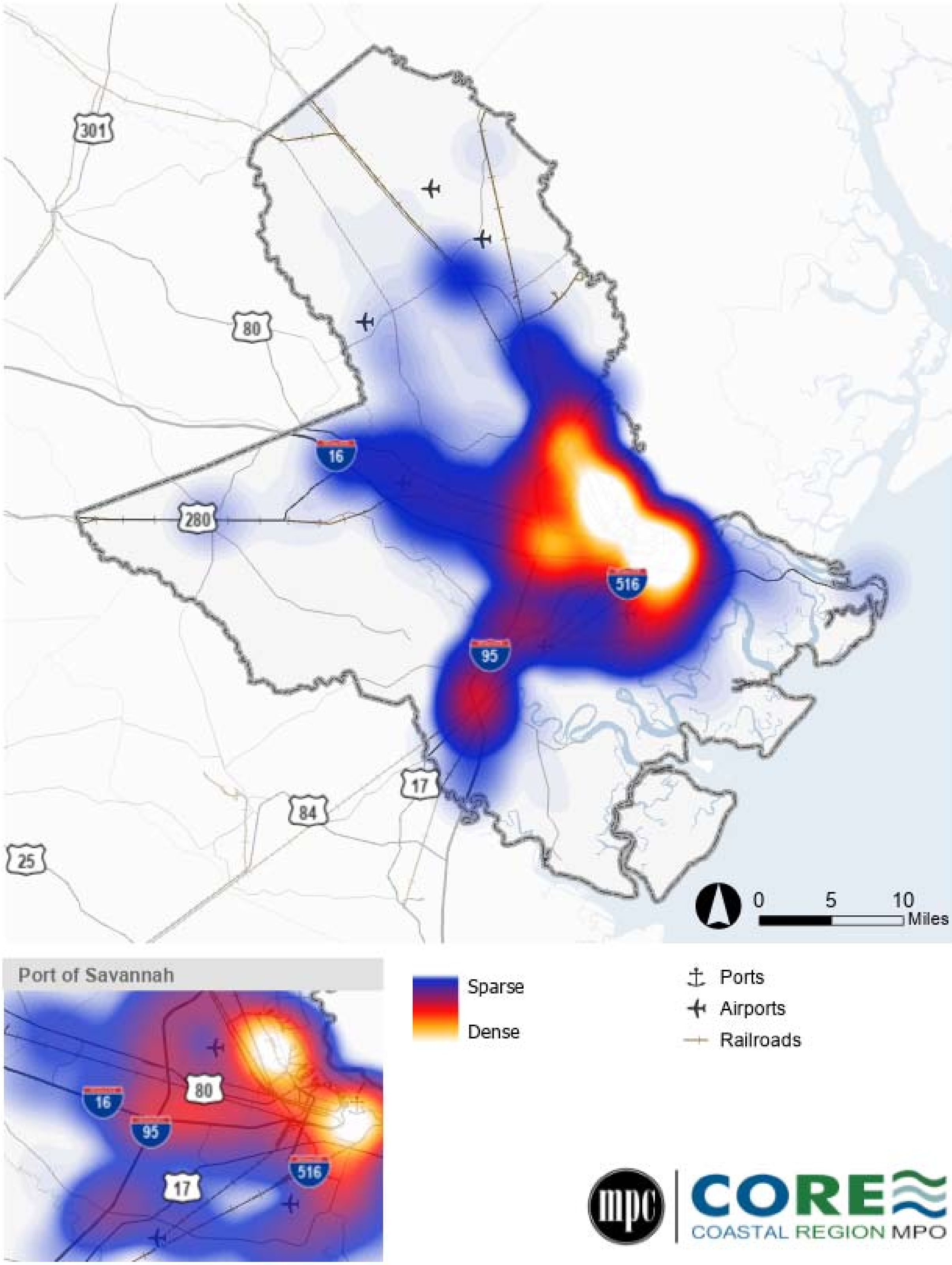


Source: GDOT Numetrics Database; AECOM.

Figure 3.4 shows the concentration of truck-involved crashes throughout the CORE MPO region. It reveals that there are about 5 areas that appear to have higher concentrations of truck-involved crashes. They include:

- Ocean Terminal and West Savannah area – the area near the Port of Savannah Ocean Terminal as well as the West Savannah area (west of U.S. 17, east of I-516, north of I-16, and south of the Savannah River);
- Garden City Terminal area – the area surrounding the Port of Savannah Garden City Terminal;
- I-95/SR 21 interchange area – the area surrounding the I-95/SR 21 interchange;
- I-16/I-95 interchange to I-16/SR 307 interchange area – the areas between the interchanges of I-16 with I-95 and SR 307; and
- I-95/U.S. 17 interchange to I-95/SR 144 interchange area – the areas between the interchanges of I-95 with U.S. 17 and SR 144 near the City of Richmond Hill.

FIGURE 3.4 HEAT MAP OF TRUCK-INVOLVED CRASHES, 2016 - 2020

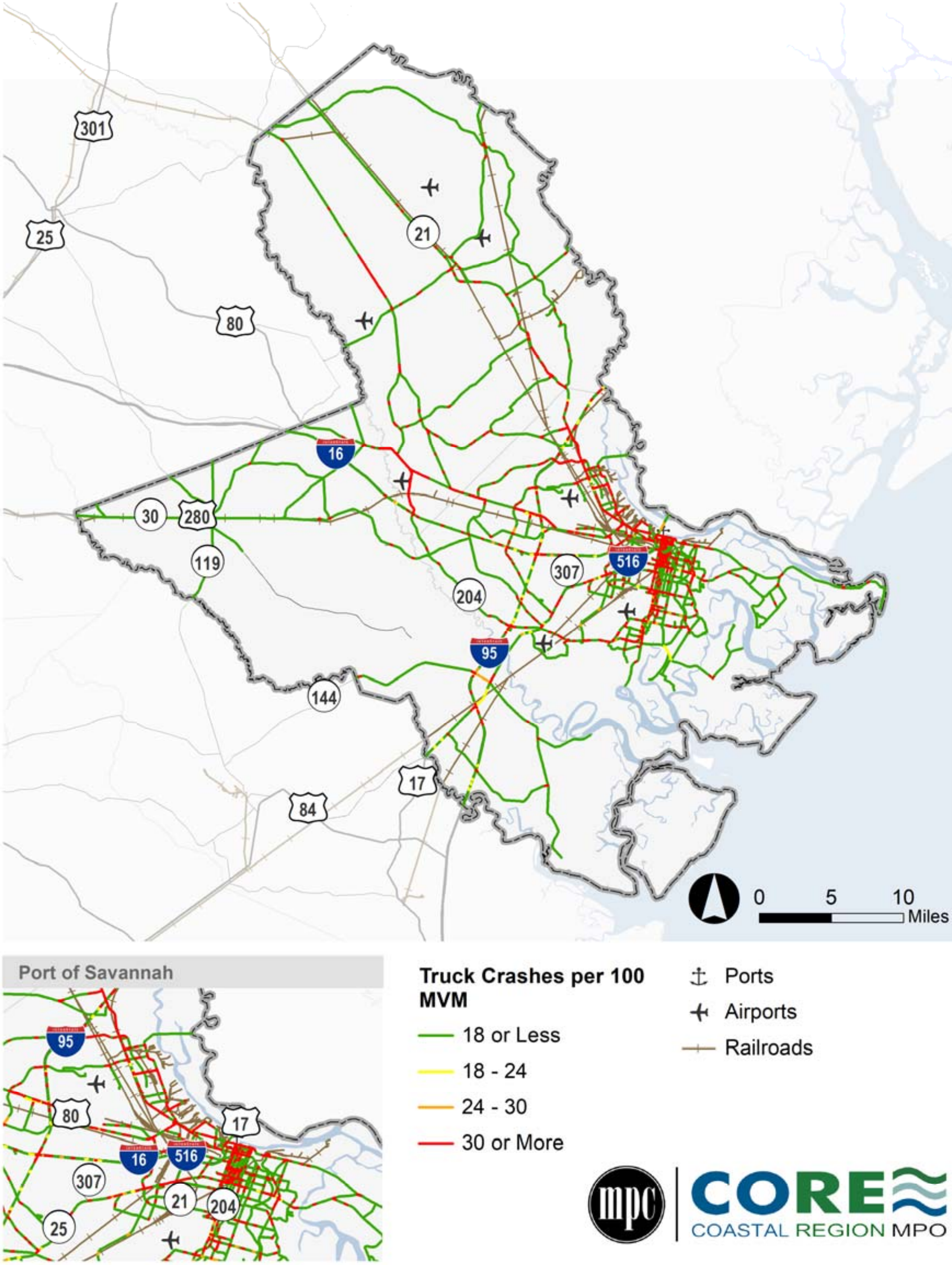


Source: GDOT Numetrics Database; AECOM.

Figure 3.5 and Figure 3.6 show the annual average rates of all truck-involved crashes and fatal or severe truck-involved crashes, respectively, for roadways functionally classified as major collectors and above. The crash rates are calculated as the 2016-2020 average crashes divided by 100 million vehicle-miles traveled (100 MVM) based on estimates from 2020 Highway Performance Monitoring System (HPMS) data. The regional average rate for all truck-involved crashes is about 18 crashes per 100 MVM. For fatal or severe truck-involved crashes, the regional average rate is 0.5 crashes per 100 MVM. Both single unit and combination unit trucks are included in the analysis.

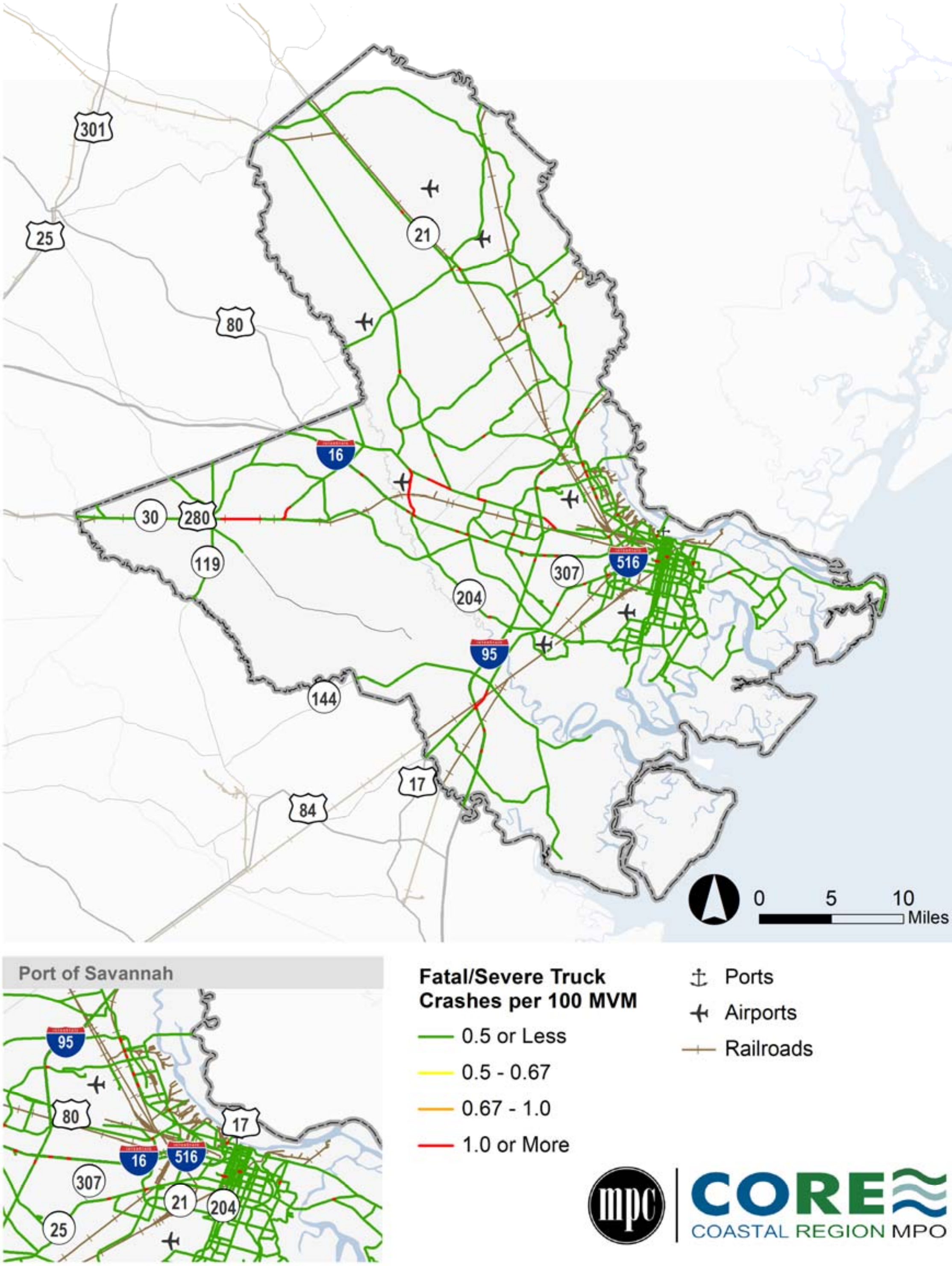
Overall, the results indicate that corridors that exceed the regional average truck crash rate are concentrated in the urban core of the region and along the Savannah River. For corridors in downtown Savannah, the truck-involved crash rates are likely being driven by box trucks and smaller delivery vehicles serving the region's substantial restaurant and hospitality industry. Examples include Bay Street and SR 204/Abercorn Street. Along the Savannah River, portions of corridors such as SR 21 and SR 25 exhibit higher crash rates. This is likely associated with freight traffic serving the Port of Savannah and nearby warehousing/distribution center developments.

FIGURE 3.5 ANNUAL AVERAGE TRUCK-INVOLVED CRASH RATE, 2016 - 2020



Source: GDOT Numetrics Database; AECOM; Cambridge Systematics.

FIGURE 3.6 ANNUAL AVERAGE FATAL OR SEVERE TRUCK-INVOLVED CRASH RATE, 2016 - 2020

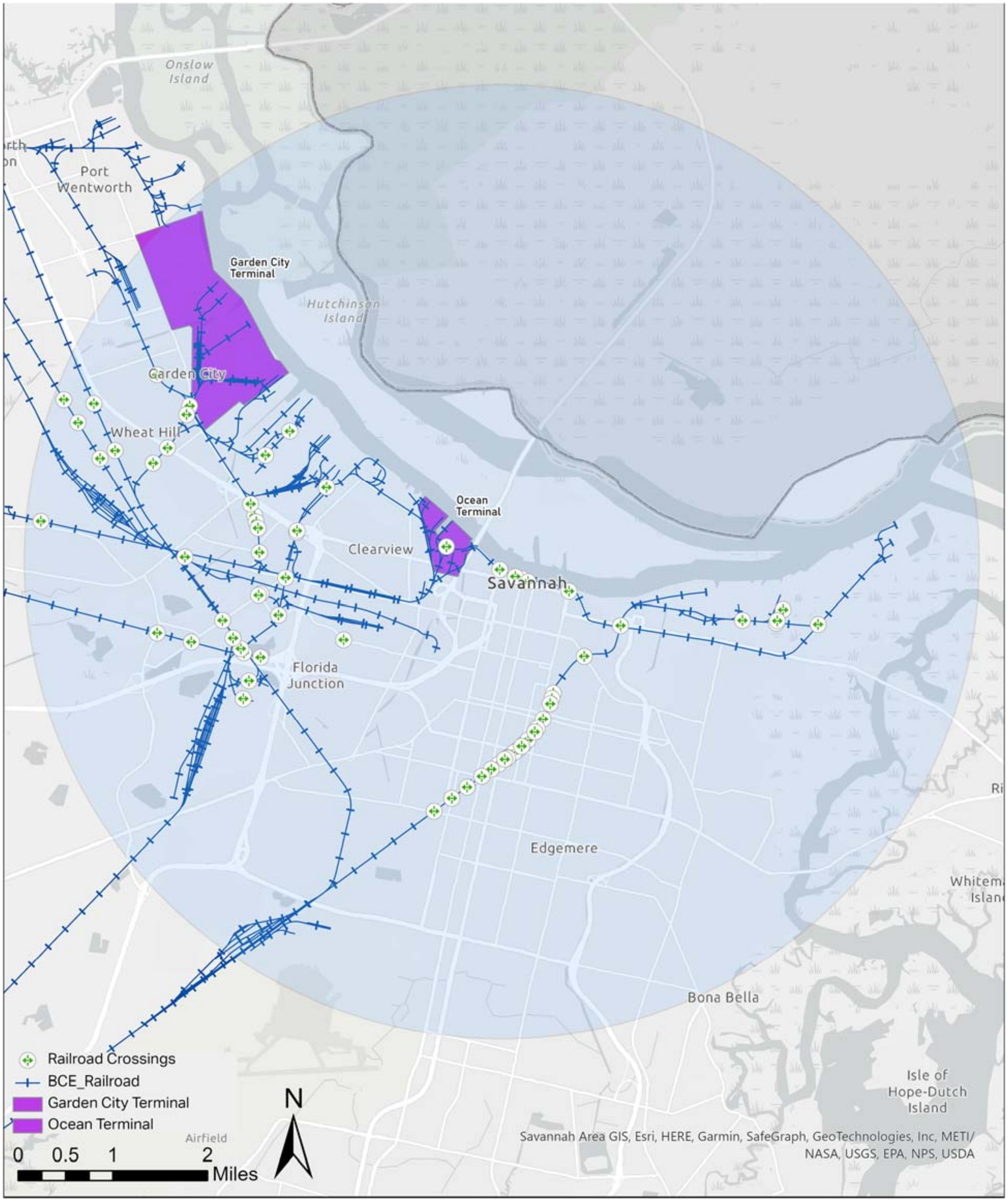


Source: GDOT Numetrics Database; AECOM; Cambridge Systematics.

3.2 At-Grade Crossing Safety

Using data available from the Federal Railroad Administration's (FRA) Highway-Rail Crossing Inventory database for Georgia, a safety analysis was performed for active at-grade public crossings for the region. This included examining the incident history of the crossings as well as performing an evaluation of the types of crossing equipment that are present as this can impact safety. In addition to the analysis performed at the regional level, an analysis was also performed for a 5-mile focus area around the Port of Savannah. The 5-mile focus area, with 86 active at-grade public crossing locations, is shown in Figure 3.7. The reason for honing in on this particular area, is that it contains nearly 45 percent of the region's public at-grade crossings and historically it has been a challenged area in regard to transportation network performance and quality-of-life issues surrounding rail crossings.

FIGURE 3.7 ACTIVE AT-GRADE CROSSINGS WITHIN THE 5-MILE FOCUS AREA



Source: Federal Railroad Administration, Highway-Rail Crossing Inventory.

Regional At-Grade Crossing Equipment Analysis

The FRA Highway-Rail Crossing Inventory database contains field codes corresponding to various types of equipment that are present at each crossing location. The equipment was categorized as "passive equipment" or "active equipment" and the number of crossings (out of the 192 total active public crossing locations for the full study area) with the equipment in-place was tabulated, as shown in Table 3.4. For the purpose of this evaluation, passive equipment relates predominantly to static signage or pavement markings and active equipment includes bells, flashing lights, and other features that can be dynamically managed and controlled. In general, crossings with active equipment are found at higher risk locations with significant volumes of trains and roadway vehicles. It should be noted that there were 267 total active at-grade crossing locations in the study area, 75 were private at-grade crossings and 192 were public at-grade crossings. In general, most private crossings have passive signalization given the low crossing volume. For this equipment analysis, only at-grade public crossings were considered.

TABLE 3.4 REGION-WIDE AT-GRADE CROSSING EQUIPMENT ANALYSIS

Equipment Type	Description	# Crossings with Equipment Present	% of Total Crossings with Equipment Present
Passive Equipment	Advance Warning Signs	95	49%
	ENS (Emergency Notification System) Sign	178	93%
	Pavement Markings (for Railroad Crossing)	145	76%
	Private Crossing Signs	0	0%
	STOP Signs	46	24%
	YIELD Signs	24	13%
Active Equipment	Wayside Horn	0	0%
	Bells	112	58%
	Mast Mounted Flashing Lights	108	56%
	Gate Configuration: 2-Quad	104	54%
	Gate Configuration: 3-Quad	1	1%
	Gate Configuration: 4-Quad	0	0%
	Pedestrian Gate Arms	0	0%
	Roadway Gate Arms	109	57%
	Highway Traffic Pre-Signals	2	1%
	Nearby Highway Intersection Traffic Signals	15	8%
	Highway Traffic Signals Controlling Crossing	4	2%
	Highway Monitoring Devices	2	1%
	Highway Traffic Signal Preemption	11	6%

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

In the full study area, active equipment is present in fewer locations than passive equipment. Four types of active equipment (bells, flashing lights, two-quad gates, and roadway gate arms) are present at over half of the crossing locations, with low percentages associated with the presence of all other active equipment. In comparison, there are two forms of passive equipment (ENS signs and pavement markings for the railroad crossing) that are present at 75 percent or more of the crossing locations, with the remaining forms of passive equipment generally being present at approximately 10-50 percent of locations. It should be noted that none of these locations have private crossing signs present. This is to be expected since the data represents only public crossings.

This analysis was taken a step further by relating the in-use crossing equipment to the specific railroad owners, as shown in Table 3.5. The following five owners are presented in this analysis, as identified in the FRA crossing data:

- CSX Transportation (CSX)
- Norfolk Southern (NS)
- Riceboro Southern Railroad (RSOR)
- Savannah and Old Fort Railroad (SVHO)
- Ogeechee Railroad Co. (ORC)

As shown in Table 3.5, the majority of the crossing locations in the full study area are owned by CSX (93 crossings), NS (67 crossings), and SVHO (27 crossings). In terms of these three owners, SVHO generally has a higher percentage of locations with passive equipment present. CSX and NS are comparable with the percent of locations having some sort of active equipment present, with some features being located at well over 50 percent of locations.

The number of crossings owned by the remaining two owners represents only three percent of the total – RSOR (3 crossings) and ORC (2 crossings). With this small sample size, the percentages do not compare directly to the other three owners discussed above. In general, RSOR has the highest percentage of locations with both passive and active equipment in this group.

TABLE 3.5 REGION-WIDE AT-GRADE CROSSING EQUIPMENT ANALYSIS BY OWNER

Equipment Type	Description	% of Total Owned Crossings with Equipment Present				
		CSX (93 Crossings)	NS (67 Crossings)	RSOR (3 Crossings)	SVHO (27 Crossings)	ORC (2 Crossings)
Passive Equipment	Advance Warning Signs	48%	36%	67%	89%	0%
	ENS (Emergency Notification System) Sign	99%	87%	100%	93%	0%
	Pavement Markings (for Railroad Crossing)	88%	55%	100%	81%	50%
	Private Crossing Signs	0%	0%	0%	0%	0%
	STOP Signs	12%	31%	0%	48%	50%
	YIELD Signs	19%	9%	0%	0%	0%
Active Equipment	Wayside Horn	0%	0%	0%	0%	0%
	Bells	67%	45%	100%	63%	0%
	Mast Mounted Flashing Lights	67%	45%	100%	48%	0%
	Gate Configuration: 2-Quad	65%	39%	100%	56%	0%
	Gate Configuration: 3-Quad	0%	1%	0%	0%	0%
	Gate Configuration: 4-Quad	0%	0%	0%	0%	0%
	Pedestrian Gate Arms	0%	0%	0%	0%	0%
	Roadway Gate Arms	66%	45%	100%	56%	0%
	Highway Traffic Pre-Signals	0%	0%	0%	7%	0%
	Nearby Highway Intersection Traffic Signals	4%	7%	0%	22%	0%
	Highway Traffic Signals Controlling Crossing	0%	3%	0%	7%	0%
	Highway Monitoring Devices	1%	0%	0%	4%	0%
	Highway Traffic Signal Preemption	3%	6%	0%	15%	0%

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

Focus Area At-Grade Crossing Equipment Analysis

Table 3.6 shows the results of the equipment analysis for the 5-mile focus area around the Port of Savannah. It shows that active equipment is present in fewer locations than passive equipment overall. Four types of active equipment (bells, flashing lights, two-quad gates, and roadway gate arms) are present at approximately half of the crossing locations, with low percentages associated with the presence of all other active equipment. In comparison, there are three forms of passive equipment (advance warning signs, ENS signs, and pavement markings for the railroad crossing) that are present at 60 percent or more of the crossing locations.

TABLE 3.6 FOCUS AREA AT-GRADE CROSSING EQUIPMENT ANALYSIS

Equipment Type	Description	# Crossings with Equipment Present	% of Total Crossings with Equipment Present
Passive Equipment	Advance Warning Signs	55	64%
	ENS (Emergency Notification System) Sign	74	86%
	Pavement Markings (for Railroad Crossing)	65	76%
	Private Crossing Signs	0	0%
	STOP Signs	24	28%
	YIELD Signs	7	8%
Active Equipment	Wayside Horn	0	0%
	Bells	49	57%
	Mast Mounted Flashing Lights	46	53%
	Gate Configuration: 2-Quad	43	50%
	Gate Configuration: 3-Quad	1	1%
	Gate Configuration: 4-Quad	0	0%
	Pedestrian Gate Arms	0	0%
	Roadway Gate Arms	46	53%
	Highway Traffic Pre-Signals	2	2%
	Nearby Highway Intersection Traffic Signals	10	12%
	Highway Traffic Signals Controlling Crossing	3	3%
	Highway Monitoring Devices	1	1%
	Highway Traffic Signal Preemption	5	6%

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

As shown in Table 3.7, the majority of the crossing locations within five miles of the Port are owned by CSX (23 crossings), NS (36 crossings), and SVHO (27 crossings). CSX and SVHO are comparable and generally have a higher percentage of locations with passive equipment present, with some features being located at approximately 65-95 percent of locations. RSOR or ORC do not have any crossings within the focus area.

TABLE 3.7 FOCUS AREA AT-GRADE CROSSING EQUIPMENT ANALYSIS BY OWNER

Equipment Type	Description	% of Total Owned Crossings with Equipment Present				
		CSX (23 Crossings)	NS (36 Crossings)	RSOR (0 Crossings)	SVHO (27 Crossings)	ORC (0 Crossings)
Passive Equipment	Advance Warning Signs	65%	44%	N/A	89%	N/A
	ENS (Emergency Notification System) Sign	96%	75%	N/A	93%	N/A
	Pavement Markings (for Railroad Crossing)	87%	64%	N/A	81%	N/A
	Private Crossing Signs	0%	0%	N/A	0%	N/A
	STOP Signs	17%	19%	N/A	48%	N/A
	YIELD Signs	9%	14%	N/A	0%	N/A
Active Equipment	Wayside Horn	0%	0%	N/A	0%	N/A
	Bells	74%	42%	N/A	63%	N/A
	Mast Mounted Flashing Lights	78%	42%	N/A	48%	N/A
	Gate Configuration: 2-Quad	65%	36%	N/A	56%	N/A
	Gate Configuration: 3-Quad	0%	3%	N/A	0%	N/A
	Gate Configuration: 4-Quad	0%	0%	N/A	0%	N/A
	Pedestrian Gate Arms	0%	0%	N/A	0%	N/A
	Roadway Gate Arms	70%	42%	N/A	56%	N/A
	Highway Traffic Pre-Signals	0%	0%	N/A	7%	N/A
	Nearby Highway Intersection Traffic Signals	4%	8%	N/A	22%	N/A
	Highway Traffic Signals Controlling Crossing	0%	3%	N/A	7%	N/A
	Highway Monitoring Devices	0%	0%	N/A	4%	N/A
	Highway Traffic Signal Preemption	0%	3%	N/A	15%	N/A

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

When comparing the full study area (Bryan County, Chatham County, and Effingham County) to the 5-mile focus area, the percentages of various active equipment that are present are all comparable (within four percent or less, relative to the total number of crossings). In terms of passive equipment, 14 percent more locations within five miles of the Port have advance warning signs than in the full study area and seven percent more locations in the full study area have Emergency Notification System signs than in the area within five miles of the Port. The presence of other passive equipment is comparable for both areas (within four percent or less, relative to the total number of crossings). Overall, the condensed area closer to the Port is representative of the entire study area in terms of the presence of both active and passive equipment.

Regional At-Grade Rail Crossing Safety Analysis

Between 2012 and 2021, there were 62 highway-rail incidents involving freight railroads (excluding passenger rail) as shown in Table 3.8. In addition to the total number of crossing and incidents, the data shows 24 incidents (or 39 percent) occurred at crossings with passive equipment and 38 incidents (61 percent) occurred at crossings featuring active equipment. Further, when track miles per operator are considered, SAPT represents the highest percentage of incidents per track mile at 111 percent followed by SVHO at 29 percent, as highlighted in Figure 3.8. However, when incidents per crossing are considered, SAPT remains highest at 283 percent followed by CSXT at 15 percent. Figure 3.9 depicts the locations of the 62 highway-rail incidents that occurred between 2012 and 2021 within the region and Figure 3.10 shows the severity of these incidents.

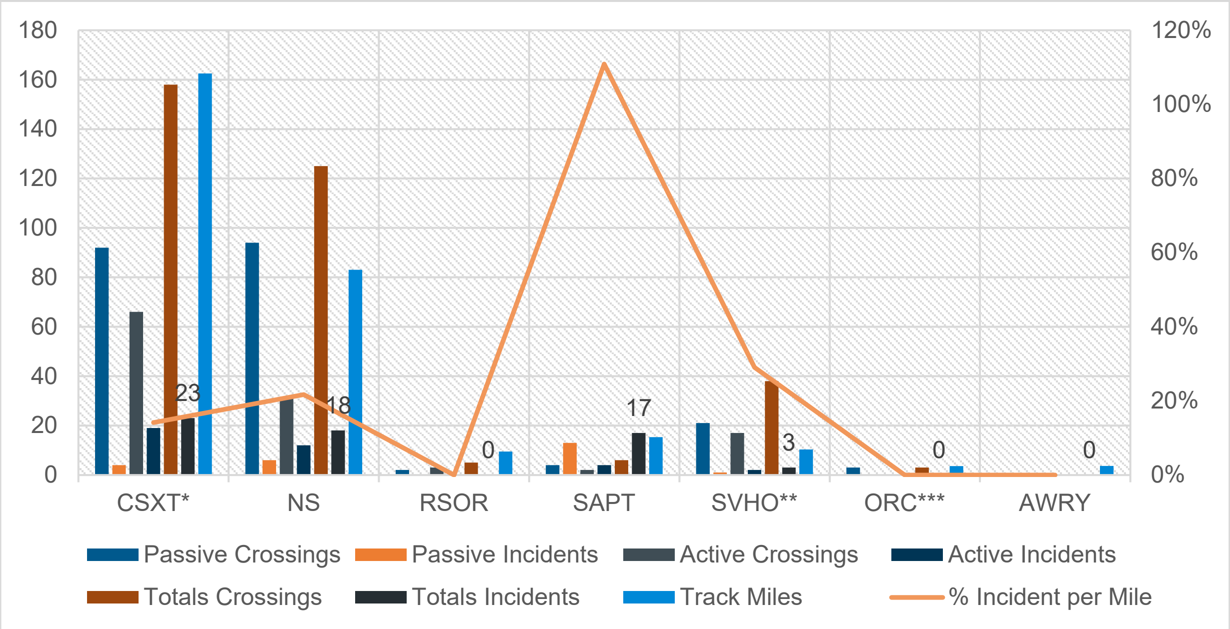
TABLE 3.8 REGION-WIDE HIGHWAY RAIL CROSSING INCIDENTS BY OPERATOR, 2012-2021

Railroad Owner	Passive		Active		Totals		Track Miles	% Incident per Mile	% Incident per Crossing
	Crossings	Incidents	Crossings	Incidents	Crossings	Incidents			
CSXT*	92	4	66	19	158	23	162.5	14%	15%
NS	94	6	31	12	125	18	83.1	22%	14%
RSOR	2	0	3	0	5	0	9.5	0%	0%
SAPT	4	13	2	4	6	17	15.3	111%	283%
SVHO**	21	1	17	2	38	3	10.3	29%	8%
ORC***	3	0	0	0	3	0	3.6	0%	0%
AWRY	0	0	0	0	0	0	3.6	0%	0%
Totals	216	24	119	37	335	61	288		
% of Total	64%	39%	36%	61%					

* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

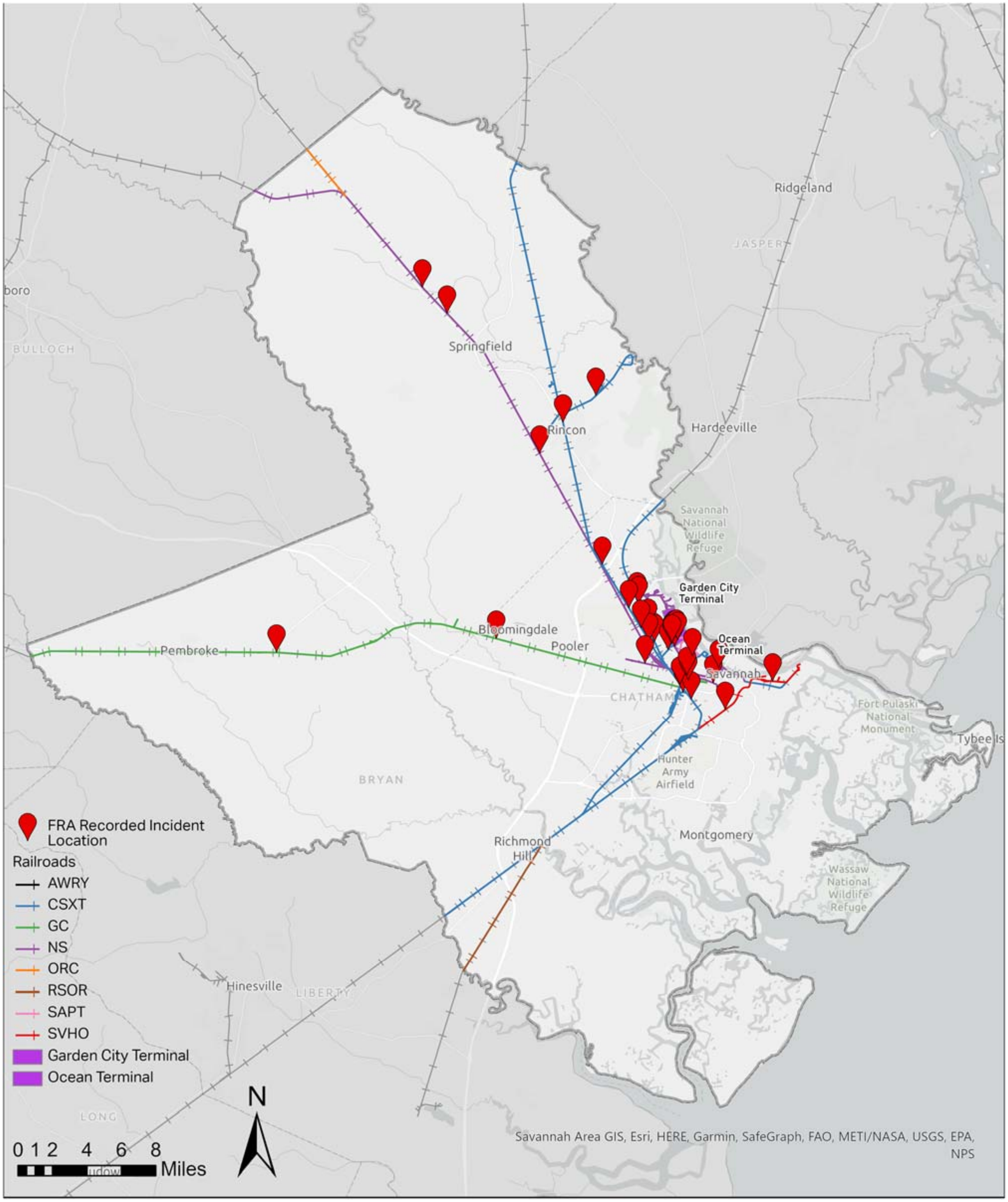
FIGURE 3.8 REGION-WIDE HIGHWAY-RAIL CROSSING INCIDENTS BY OPERATOR, 2012 - 2021



* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

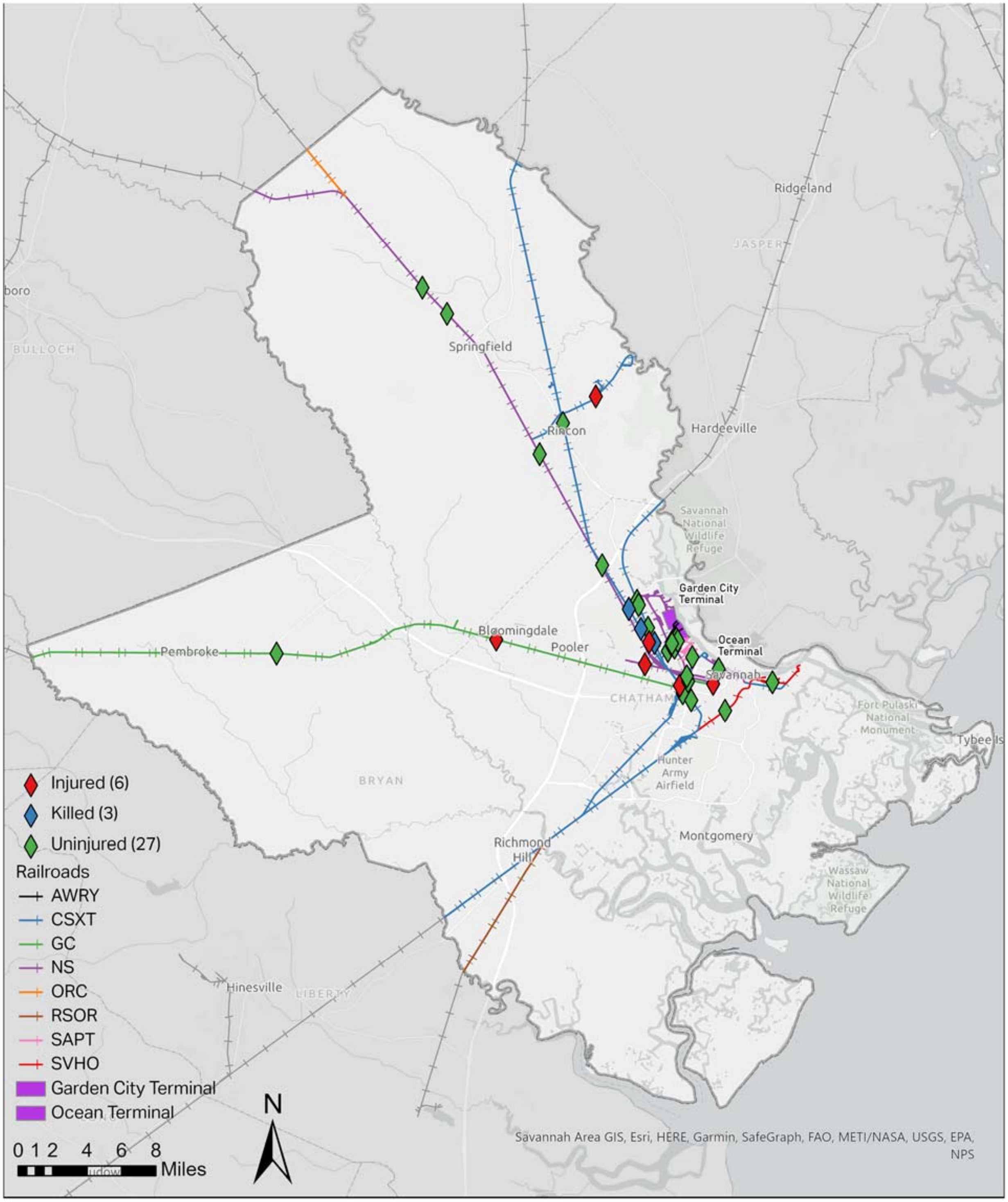
Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.9 REGION-WIDE HIGHWAY-RAIL CROSSING INCIDENTS, 2012 - 2021



Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.10 HIGHWAY-RAIL CROSSING INCIDENTS WITHIN STUDY AREA BY SEVERITY, 2012 - 2021



Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

Regional Rail Incidents Per Year

The highway-rail incidents by year for each operating entity between 2012 and 22 and within the study area is summarized in Table 3.9 and depicted graphically in Figure 3.11. This data shows an increasing trend in the occurrence of incidents, particularly between 2017 and 2021. According to FRA, between 2012 and 2016 there were 24 recorded incidents. Between 2017 and 2021 there were 36 reported incidents, a 54 percent increase over the previous five-year period.

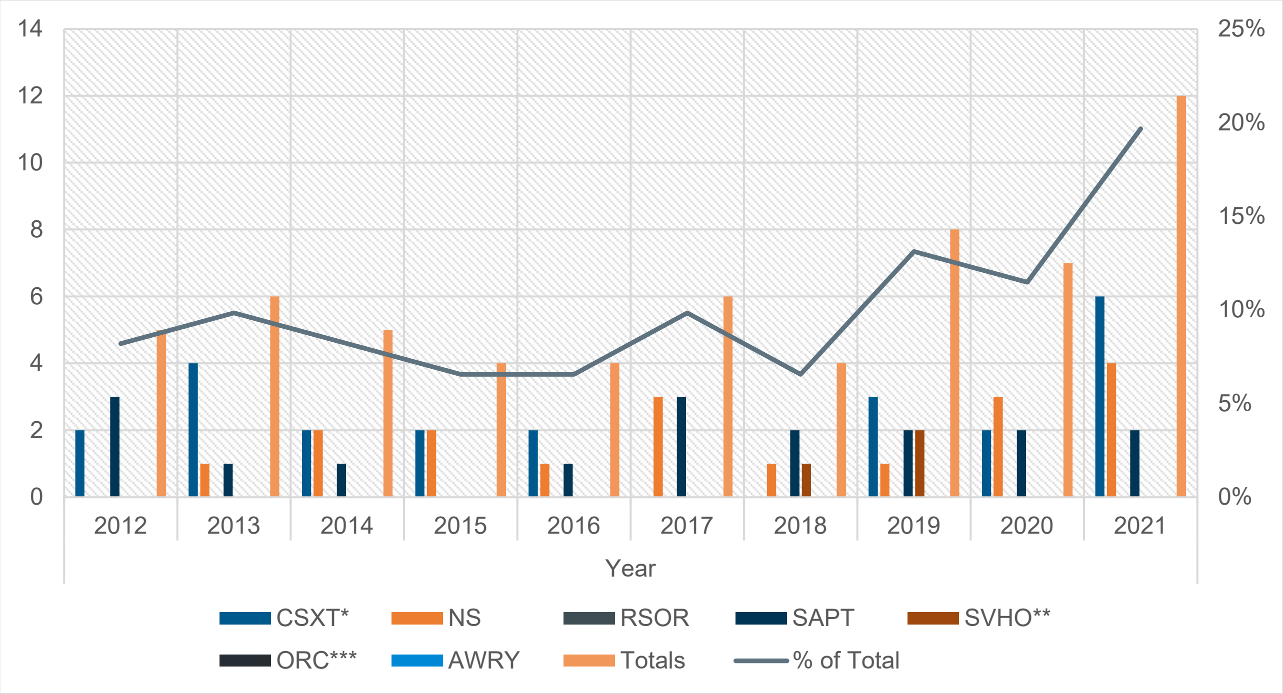
TABLE 3.9 REGION-WIDE HIGHWAY-RAIL CROSSING INCIDENTS BY YEAR, 2012-2021

Railroad Owner	Year										Total	% Total
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021		
CSXT*	2	4	2	2	2	0	0	3	2	6	23	38%
NS	0	1	2	2	1	3	1	1	3	4	18	30%
RSOR	0	0	0	0	0	0	0	0	0	0	0	0%
SAPT	3	1	1	0	1	3	2	2	2	2	17	28%
SVHO**	0	0	0	0	0	0	1	2	0	0	3	5%
ORC***	0	0	0	0	0	0	0	0	0	0	0	0%
AWRY	0	0	0	0	0	0	0	0	0	0	0	0%
Totals	5	6	5	4	4	6	4	8	7	12	61	100%
% of Total	8%	10%	8%	7%	7%	10%	7%	13%	11%	20%	100%	

* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.11 REGION-WIDE HIGHWAY-RAIL INCIDENTS BY YEAR, 2012 - 2021



* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

Crossing with Multiple Rail Incidents in the Study Area

The numbers of multiple incidents at study area crossings for the data period by type of warning device are detailed in Table 3.10. Multiple incident crossing locations are more likely to occur at passive warning device crossings than active crossings. Locations with multiple reported incidents between 2012 and 2021 within the study area are shown in Figure 3.12. Nearly 26 percent of locations with multiple incidents occur at passive crossings occur at locations. While 36 percent of multiple incident locations are active warning device crossings. Of the 11 locations where multiple incidents occurred, SAPT had the highest rate of 14 incidents occurring at two crossing locations. The next highest rate was NS, which reported 13 incidents at 5 locations.

TABLE 3.10 REGION-WIDE HIGHWAY-RAIL CROSSING LOCATIONS WITH MULTIPLE INCIDENTS, 2012 – 2021

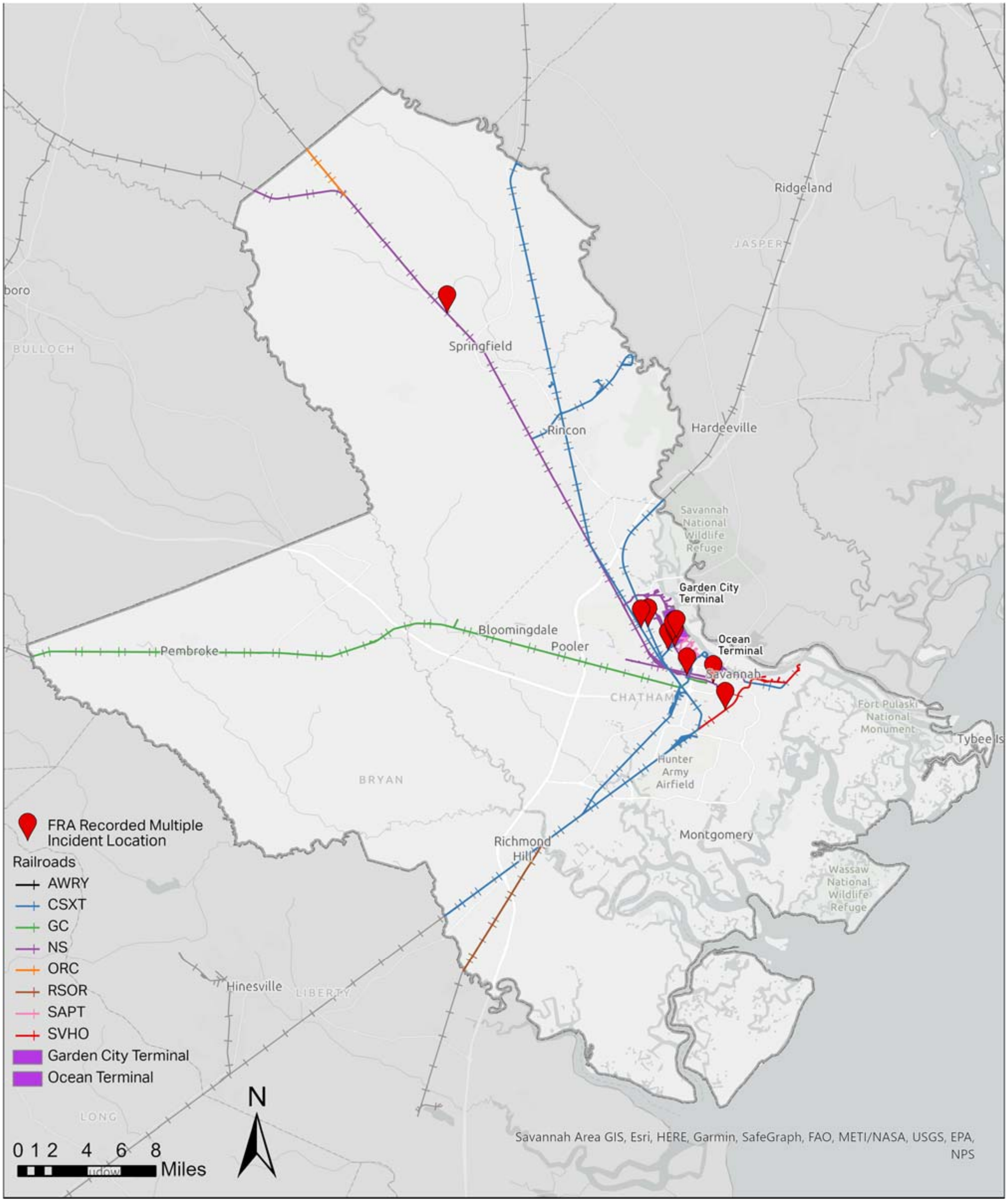
Railroad Owner	Passive		Active	
	Crossings	Incidents	Crossings	Incidents
CSXT*	0	0	3	9
NS	1	2	4	11
RSOR	0	0	0	0
SAPT	2	14	0	0
SVHO**	0	0	1	2

Railroad Owner	Passive		Active	
	Crossings	Incidents	Crossings	Incidents
ORC***	0	0	0	0
AWRY	0	0	0	0
Totals	3	16	8	22
% of Total	1.4%	26.2%	6.7%	36.1%

* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.12 HIGHWAY-RAIL CROSSING LOCATIONS WITH MULTIPLE INCIDENTS WITHIN THE STUDY AREA, 2012 - 2021



Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

Focus Area At-Grade Rail Crossing Safety Analysis

According to a subset of the FRA Office of Safety Analysis database; within the 5-mile focused study area around the Port of Savanah within Chatham County there are 155 at-grade crossings. Between 2012 and 2021, there were 44 highway-rail incidents involving Class I, II, and III Freight Railroads at these crossings as shown in Table 3.11. The data shows 18 incidents (41 percent) occurred at crossings with passive equipment and 26 incidents (59 percent) occurred at crossings featuring active equipment. Further, when track miles per operator are considered, SAPT represents the highest percentage of incidents per track mile at nearly 104 percent followed by NS at 45 percent, as highlighted in Figure 3.13. When incidents per crossing are considered, SAPT is highest at 267 percent followed by NS at 26 percent. Figure 3.14 depicts the locations of all 44 highway-rail incidents that occurred between 2012 and 2021 within the focus area.

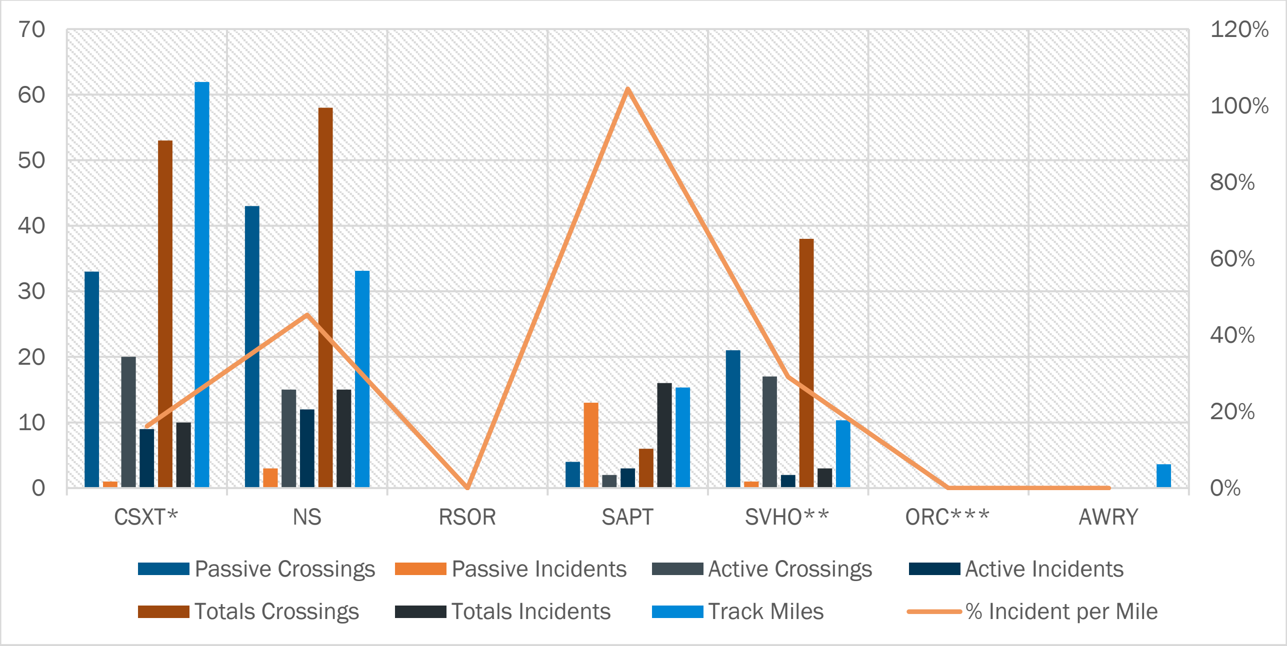
TABLE 3.11 FOCUS AREA HIGHWAY-RAIL CROSSING INCIDENTS BY OPERATOR, 2012 – 2021

Railroad Owner	Passive		Active		Totals		Track Miles	% Incident per Mile	% Incident per Crossing
	Crossings	Incidents	Crossings	Incidents	Crossings	Incidents			
CSXT*	33	1	20	9	53	10	61.93	16%	19%
NS	43	3	15	12	58	15	33.14	45%	26%
RSOR	0	0	0	0	0	0	0	0%	0%
SAPT	4	13	2	3	6	16	15.33	104%	267%
SVHO**	21	1	17	2	38	3	10.33	29%	8%
ORC***	0	0	0	0	0	0	0	0%	0%
AWRY	0	0	0	0	0	0	3.63	0%	0%
Totals	101	18	54	26	155	44	124.36		
% of Total	65%	41%	35%	59%					

* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

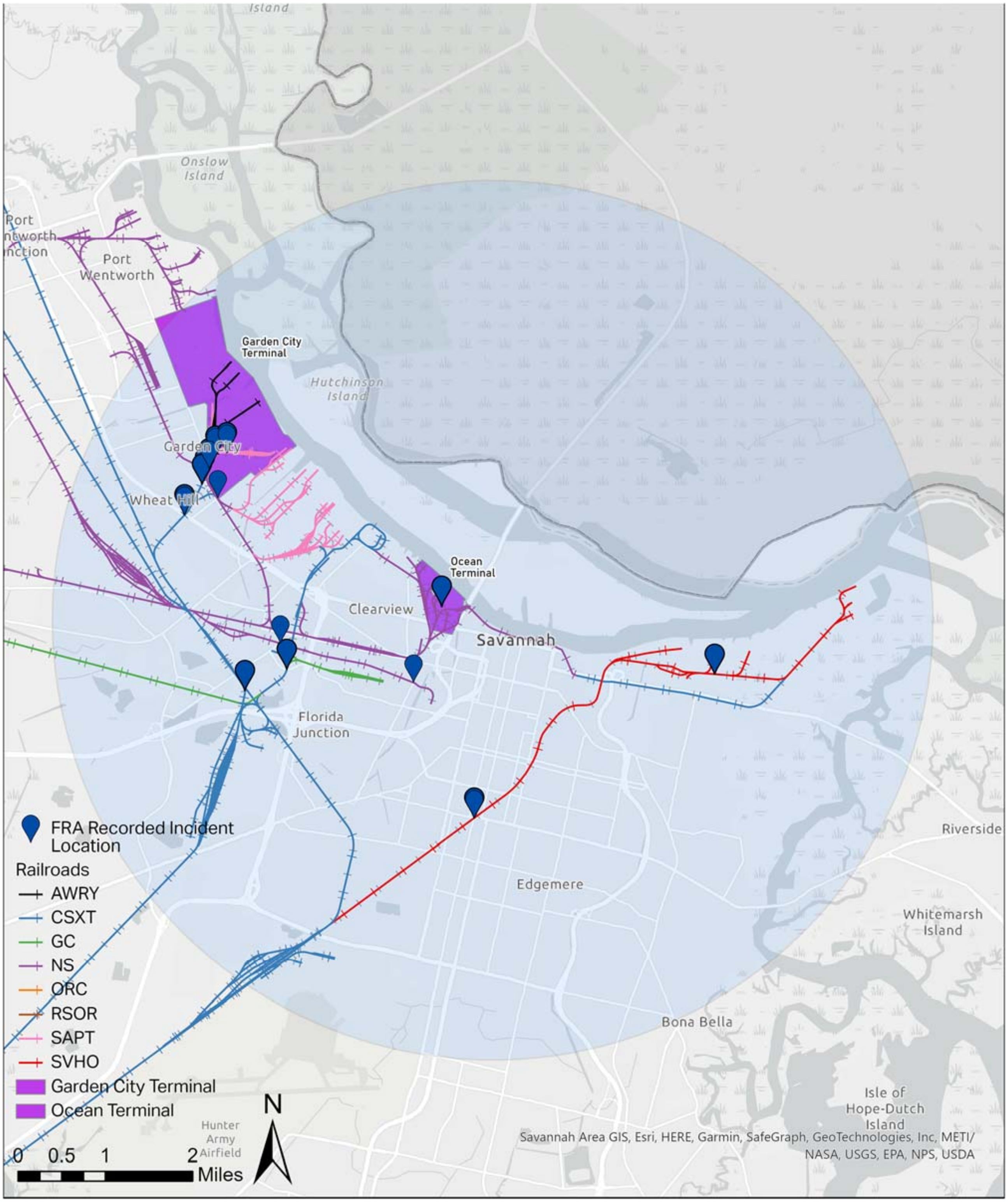
FIGURE 3.13 HIGHWAY-RAIL CROSSING INCIDENTS BY OPERATOR WITHIN FOCUS AREA, 2012 - 2021



*GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.14 HIGHWAY-RAIL CROSSING INCIDENTS WITHIN FOCUS AREA, 2012 - 2021



Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

Rail Incidents Per Year Within Focus Area

The highway-rail incidents by year for each operating entity withing the data capture timeframe and within the 5-mile study area is summarized in Table 3.12 and depicted graphically in Figure 3.15. Though a relatively small sample size, the data does indicate a potential trend of an increase in the occurrence of incidents. Between 2012 and 2016 there were 18 reported incidents. Between 2017 and 2021 there were 26 reported

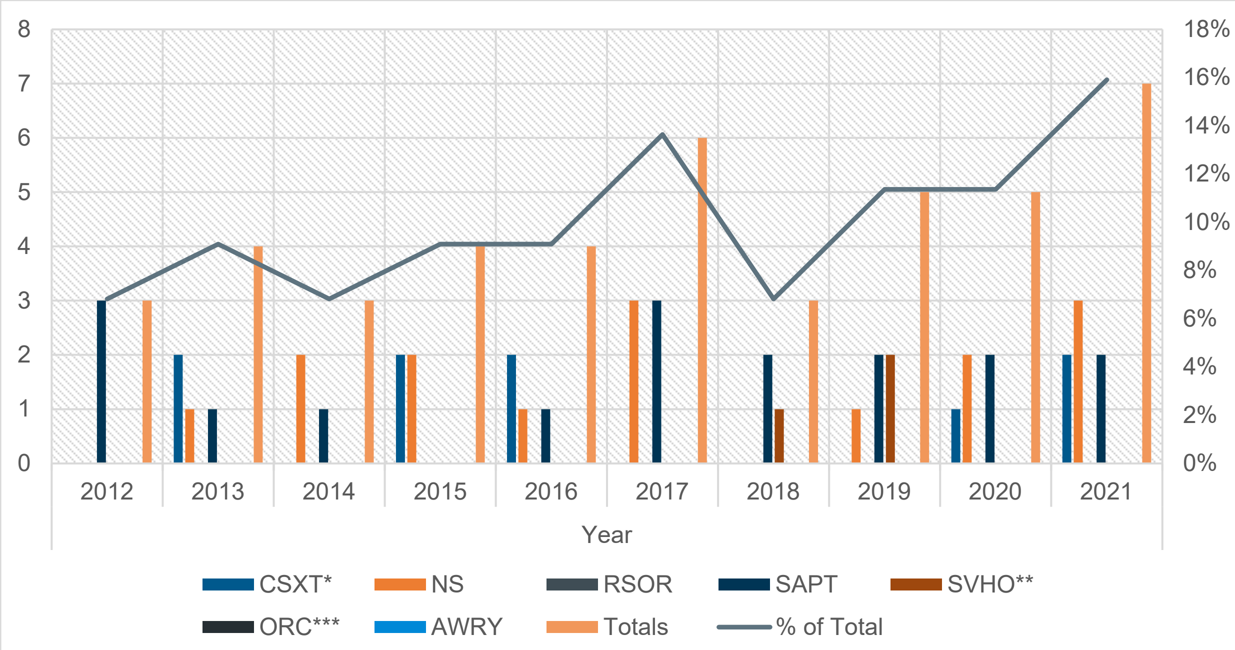
TABLE 3.12 FOCUS AREA HIGHWAY-RAIL CROSSING INCIDENTS BY YEAR, 2012 – 2021

Railroad Owner	Year										Total	% Total
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021		
CSXT*	0	2	0	2	2	0	0	0	1	2	9	20%
NS	0	1	2	2	1	3	0	1	2	3	15	34%
RSOR	0	0	0	0	0	0	0	0	0	0	0	0%
SAPT	3	1	1	0	1	3	2	2	2	2	17	39%
SVHO**	0	0	0	0	0	0	1	2	0	0	3	7%
ORC***	0	0	0	0	0	0	0	0	0	0	0	0%
AWRY	0	0	0	0	0	0	0	0	0	0	0	0%
Totals	3	4	3	4	4	6	3	5	5	7	44	100%
% of Total	7%	9%	7%	9%	9%	14%	7%	11%	11%	16%	100%	

* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.15 HIGHWAY-RAIL CROSSING INCIDENTS BY YEAR WITHIN FOCUS AREA, 2012 - 2021



* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

Multiple Rail Incidents Per Year Within Focus Area

The number of multiple incidents at study area crossings by type of warning device are detailed in Table 3.13. Multiple incident crossing locations are more likely to occur at passive warning device crossings than active crossings. Locations with multiple reported incidents between 2012 and 2021 within the focus area are shown in Figure 3.16. Approximately 27 percent of locations with multiple incidents occur at passive crossings, which occurred at one location (Gibbons Road Crossing) along an SAPT railroad. Active device crossing locations recorded 43 percent of multiple incident locations while making up 13 percent of all crossings in the focus area.

TABLE 3.13 FOCUS AREA HIGHWAY-RAIL CROSSING LOCATIONS WITH MULTIPLE INCIDENTS, 2012 – 2021

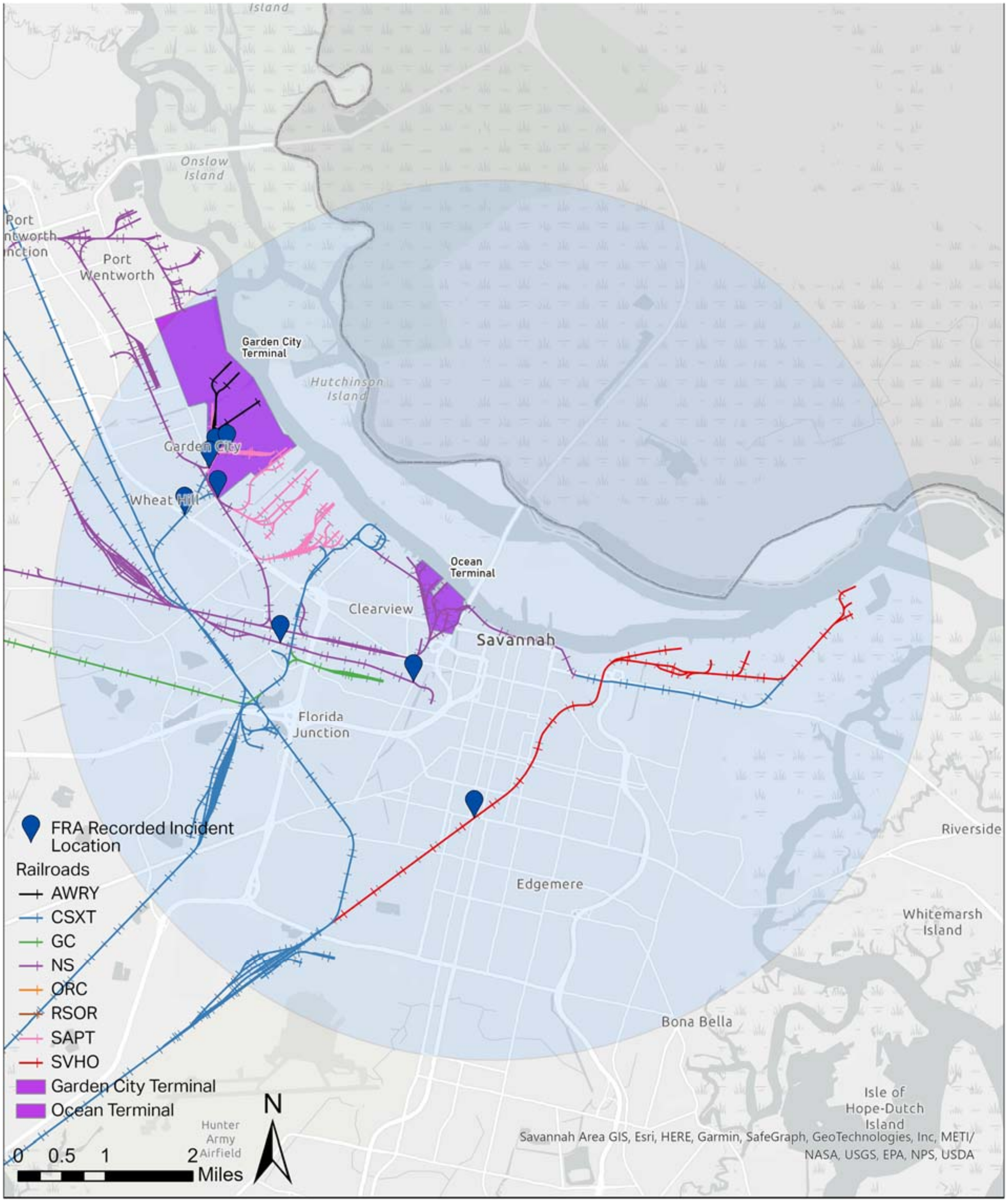
Railroad Owner	Passive		Active	
	Crossings	Incidents	Crossings	Incidents
CSXT*	0	0	1	4
NS	0	0	4	11
RSOR	0	0	0	0
SAPT	1	12	1	2
SVHO**	0	0	1	2

Railroad Owner	Passive		Active	
	Crossings	Incidents	Crossings	Incidents
ORC***	0	0	0	0
AWRY	0	0	0	0
Totals	1	12	7	19
% of Total	1%	27%	13%	43%

* GIMY, GC, DOD incidents included under CSXT. **GSWY, WATX incidents under SVHO. ***GMR incidents under ORC.

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 3.16 HIGHWAY-RAIL CROSSING MULTIPLE INCIDENT LOCATIONS WITHIN FOCUS AREA, 2012 - 2021



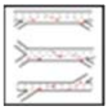
Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

4 SYSTEM GAPS, RESTRICTIONS, AND OTHER BOTTLENECKS

This section of the report explores physical constraints that may be contributing factors to freight chokepoints throughout the region. Geometric bottlenecks are caused by infrastructure restrictions that impact trucks and may require them to take longer routes, carry smaller loads, or move at different times of day. They are related to the physical characteristics of the highway, arterials and other roads and influence how trucks operate on them. Examples of geometric bottlenecks are shown in Figure 4.1.

Based on feedback from stakeholders, the inventory of the region's freight assets, and the information presented in sections 2-3 of this report, there are few types of restrictions that are particularly relevant for the region. These include at-grade crossings, vertical clearances, lane drops, and access management.

FIGURE 4.1 COMMON LOCATIONS FOR GEOMETRIC-RELATED BOTTLENECKS

Lane Drops		Bottlenecks can occur at lane drops, particularly mid-segment where one or more traffic lanes ends or at a low-volume exit ramp. They might occur at jurisdictional boundaries, just outside the metropolitan area, or at the project limits of the last megaproject. Ideally, lane drops should be located at exit ramps where there is a sufficient volume of exiting traffic.
Weaving Areas		Bottlenecks can occur at weaving areas, where traffic must merge across one or more lanes to access entry or exit ramps or enter the freeway main lanes. Bottleneck conditions are exacerbated by complex or insufficient weaving design and distance.
Freeway On-Ramps		Bottlenecks can occur at freeway on-ramps, where traffic from local streets or frontage roads merges onto a freeway. Bottleneck conditions are worsened on freeway on-ramps without auxiliary lanes, short acceleration ramps, where there are multiple on-ramps in close proximity and when peak volumes are high or large platoons of vehicles enter at the same time.
Freeway Exit Ramps		Freeway exit ramps, which are diverging areas where traffic leaves a freeway, can cause localized congestion. Bottlenecks are exacerbated on freeway exit ramps that have a short ramp length, traffic signal deficiencies at the ramp terminal intersection, or other conditions (e.g., insufficient storage length) that may cause ramp queues to back up onto freeway main lanes. Bottlenecks also could occur when a freeway exit ramp shares an auxiliary lane with an upstream on-ramp, particularly when there are large volumes of entering and exiting traffic.
Freeway-to-Freeway Interchanges		Freeway-to-freeway interchanges, which are special cases on on-ramps where flow from one freeway is directed to another. These are typically the most severe form of physical bottlenecks because of the high-traffic volumes involved.
Changes in Highway Alignment		Changes in highway alignment, which occur at sharp curves and hills and cause drivers to slow down either because of safety concerns or because their vehicles cannot maintain speed on upgrades. Another example of this type of bottleneck is in work zones where lanes may be shifted or narrowed during construction.

Tunnels/Underpasses		Bottlenecks can occur at low-clearance structures, such as tunnels and underpasses. Drivers slow to use extra caution, or to use overload bypass routes. Even sufficiently tall clearances could cause bottlenecks if an optical illusion causes a structure to appear lower than it really is, causing drivers to slow down.
Narrow Lanes/Lack of Shoulders		Bottlenecks can be caused by either narrow lanes or narrow or a lack of roadway shoulders. This is particularly true in locations with high volumes of oversize vehicles and large trucks.
Traffic Control Devices		Bottlenecks can be caused by traffic control devices that are necessary to manage overall system operations. Traffic signals, freeway ramp meters, and tollbooths can all contribute to disruptions in traffic flow.

Source: Recurring Traffic Bottlenecks: A Primer. Focus on Low-Cost Operational Improvements, FHWA-HOP-12-012, April 2012.

4.1 At-Grade Crossings

At-grade rail crossings are prevalent throughout the CORE MPO region and generally represent a physical constraint that contributes to freight bottlenecks. These crossings are points where the highway and rail systems interact and have the potential for conflict. Grade-level rail crossings can impose significant delays to trucks and other vehicles as they wait for trains to pass. There are 192 at-grade crossings throughout the CORE MPO region. Nearly half of them are within a 5-mile radius of the Port of Savannah and impact key freight corridors such as SR 21, SR 25, SR 307, and Presidents Street.

Some bottlenecks associated with at-grade crossings are being addressed as part of ongoing initiatives. For example, rail traffic at the Brampton Road-Norfolk Southern crossing near Georgia Ports Authority Gate 3 can cause significant delays (as much as 11 minutes) to trucks trying to access the Garden City Terminal. Trucks that are waiting to enter the terminal back up on SR 25 and Brampton Road/ SR21 Spur.[2] This delay creates a bottleneck at the railroad and the nearby intersection as well as a high risk at grade railroad crossing for trucks and other vehicles. The Brampton Road Connector project will provide a more direct connection between Georgia Ports Authority Gate 3 and I-516 as well as separate the existing grade crossing.[3]

4.2 Access Management

Access management is another physical restriction that contributes to bottlenecks along certain freight corridors. The Federal Highway Administration (FHWA) defines Access Management as the "proactive management of vehicular access points to land parcels adjacent to all manner of roadways. Good access management promotes safe and efficient use of the transportation network. Access management goals include reducing traffic delay and congestion, promoting properly designed access and circulation systems for development, providing property owners and customers with safe access to roadways and fostering safe pedestrian and bicycle travel."

[2] GDOT, Approved Revised Concept Report, P.I. #0006328, March 17, 2020.

[3] https://www.dot.ga.gov/applications/geopi/Pages/Dashboard.aspx?ProjectID=0006328

According to the GDOT Regulations for Driveway & Encroachment Control Manual, the spacing between driveway pairs along a roadway should be at least equal to the distance traveled, at the posted speed limit, during a driver's normal perception and reaction time plus the distance traveled as the vehicle decelerates. While this manual is intended for constructing new driveways along state highway facilities, it serves as a good guideline for all roadways with significant passenger and freight traffic. Adhering to these standards minimizes congestion by reducing locations where vehicles must slow down to turn and improves safety by presenting fewer conflict points for drivers. Additionally, it allows for more uniform gaps in traffic, which is especially important for large trucks, as they need more time and space to make turns.

Access management challenges are perhaps most pronounced on SR 21. The SR 21 Access Management Study determined that the SR 21 corridor, particularly between Minus Avenue and Smith Avenue, has clusters of driveways near other driveways and/or intersections, which can make it either difficult or confusing for vehicles to make their desired turning movement at the driveways. It further observed that driveway density and crash rates show a strong correlation, which is evident for the crash rates and driveway density along SR 21. Other major freight corridors that appear to have a high density of driveways include U.S. 80 and DeRenne Avenue.

4.3 Vertical Clearances

Bottlenecks can occur at low-clearance structures, such as tunnels and underpasses as drivers slow to use extra caution. Even sufficiently tall clearances could cause bottlenecks if an optical illusion causes a structure to appear lower than it really is, causing drivers to slow down. In the case of trucks, low vertical clearances can contribute to bottlenecks if trucks are forced to divert to bypass routes due to insufficient vertical clearance. Additionally, trucks sometimes fail to recognize there is insufficient vertical clearance to use certain routes. As a result, they strike the bridge or get stuck in the underpass which can temporarily shut down the roadway. For routes where this happens regularly, it is a source of non-recurring impacting event that results in a bottleneck. Feedback from stakeholders indicated that the underpass on E. Lathrop Ave. north of its intersection with Louisville Rd. is a location where trucks often misjudge the clearance and become stuck (see Figure 4.2).

FIGURE 4.2 VERTICAL CLEARANCE AT E. LATHROP AVENUE

Source: Google.

Similarly, the Savannah & Old Fort Railroad, which serves as a short line for CSX, runs across downtown Savannah from the north end of Hunter Army Airfield northeast to multiple dock facilities on the eastern end of the Savannah River. There only two below grade crossings along the rail line: westbound East Henry Street (see Figure 4.3) and East Gwinnett Street. Both rail bridges only provide a 13-foot clearance.

FIGURE 4.3 VERTICAL CLEARANCE AT EAST HENRY STREET

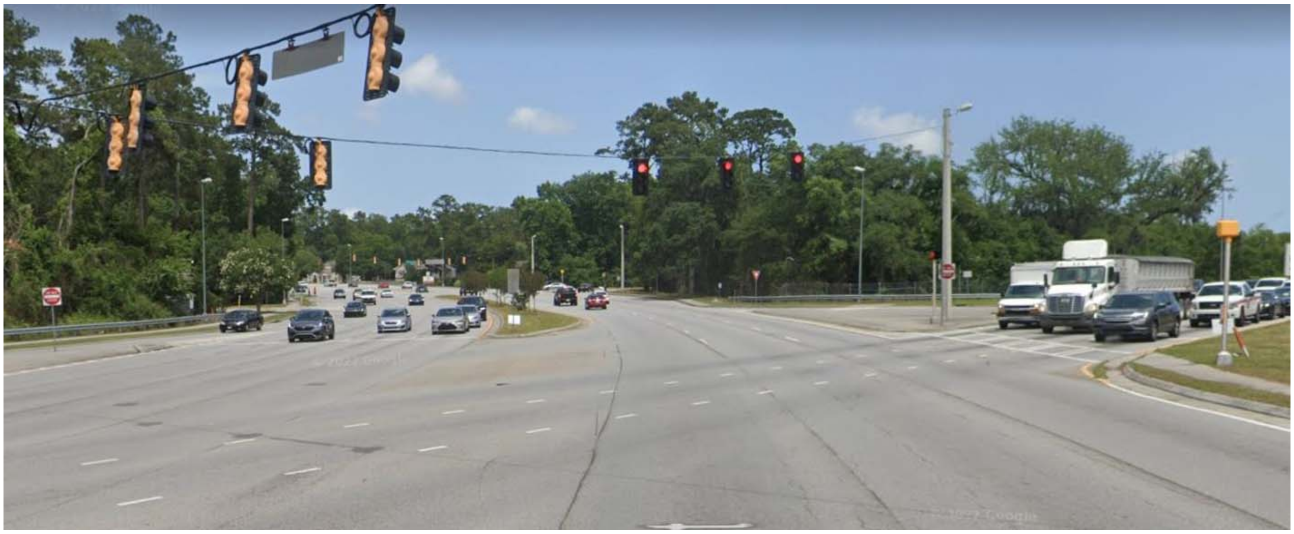
Source: Google.

4.4 Lane Drops

Bottlenecks can occur at lane drops, which are locations where one or more traffic lanes end. They might occur at jurisdictional boundaries, just outside the metropolitan area, or at the project limits of a previous large project. In the CORE MPO region, one of the most significant lane drops occurs along I-95 in Chatham County at the South Carolina border. The number of lanes reduces from 6 to 4 as I-95 is a 4-lane highway throughout much of South Carolina. The impact of the lane reduction is reflected in TTI, BTI, and other performance measures for this corridor.

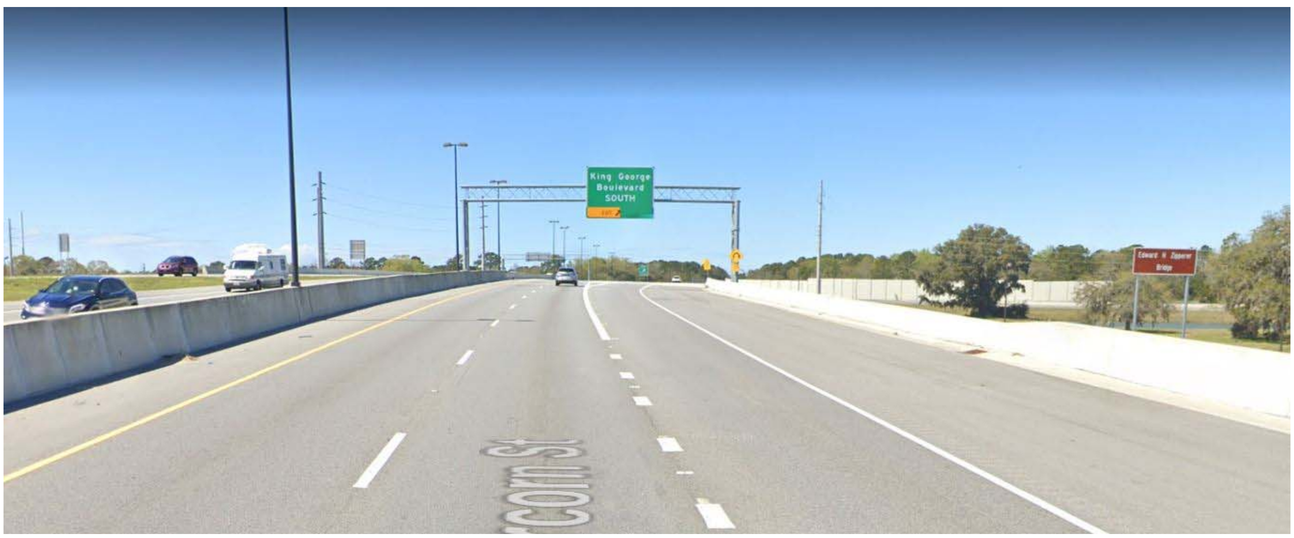
On the south side of Savannah, the Truman Parkway abruptly ends at SR 204/Abercorn Street (see Figure 4.4) merging three lanes of parkway traffic onto the existing westbound three lanes of SR 204/Abercorn Street leading to increased congestion. This is the principle east west corridor between Truman Parkway and I -95. Approximately 4.5 miles west of the Abercorn Street/SR 204 and Truman Parkway, SR 204/Abercorn Street Westbound drops from three to two lanes at King George Boulevard (see Figure 4.5).

FIGURE 4.4 HARRY S. TRUMAN PARKWAY LANE DROP AT SR204



Source: Google.

FIGURE 4.5 SR 204 LANE DROP AT KING GEORGE BOULEVARD



Source: Google.

4.5 Freeway-to-Freeway Interchanges

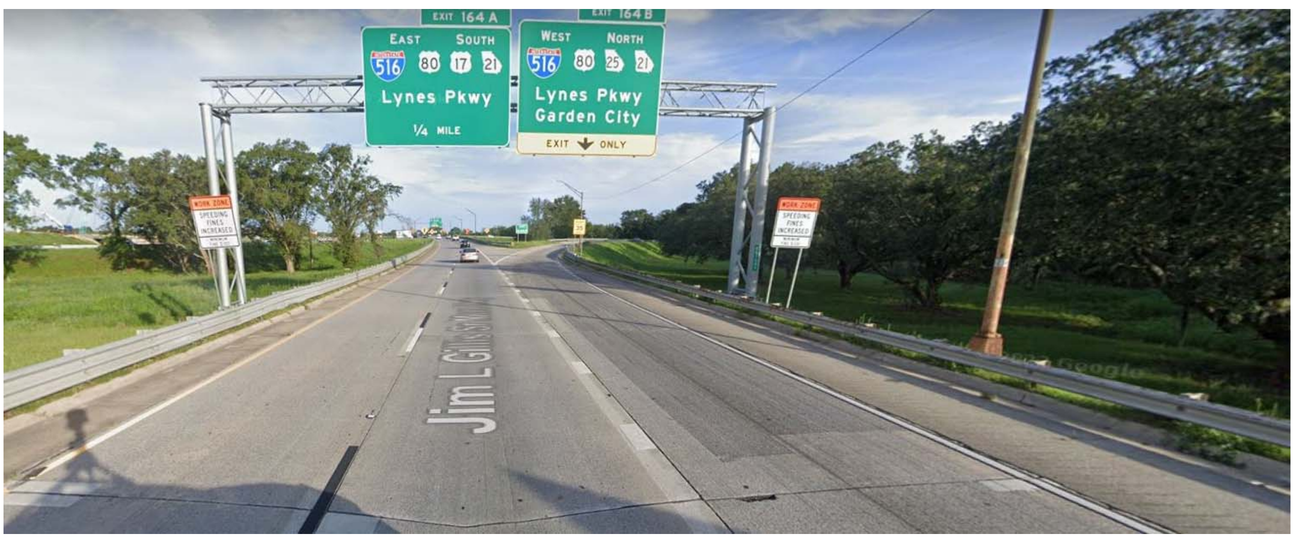
Freeway-to-freeway interchanges are typically the most severe form of physical bottlenecks because of the high-traffic volumes involved. In the CORE MPO region, the I-16/I-95 has been identified by multiple previous studies (including the 2016 Regional Freight Transportation Plan and the 2018 Georgia Statewide Freight & Logistics Action Plan) as a freight bottleneck. As part of its Major Mobility Investment Program, GDOT is reconstructing this interchange (along with making other investments upstream and downstream of the interchange along I-16 and I-195) with the goal of easing congestion (see Figure 4.6), decreasing travel times, and increasing safety and operational efficiencies for passenger and freight vehicles.

FIGURE 4.6 I-95 SOUTH AT I-16 EAST

Source: Google.

When traveling eastbound on I-16 both off ramps to I-516 are narrow with short exit lanes (see Figure 4.7). The off ramp from 516 south to I-16 east is equally narrow and short. This generates long queues and has the potential of causing crashes. For trucks, this level of congestion increases the complexity to navigate this road section.

FIGURE 4.7 I-16 AT 516



Source: Google.

5 SUMMARY

This technical memorandum identified system deficiencies related to congestion, travel time reliability, and safety across the region's multimodal freight network. It provides the foundation for identifying needs related to bottlenecks and safety so that the region may develop effective strategies to address those needs. Some key insights from this memorandum include:

- **Congestion and Reliability**
  - Truck delay is largely concentrated on a handful of the region's major freight corridors. These include I-95, I-16, I-516, and SR 21.
  - Congestion as captured by TTI is more widespread. However, some of the impacted routes have lower volumes of truck traffic relative to major routes such as the region's Interstate highways, SR 21, and Jimmy Deloach Parkway.
  - Reliability challenges are largely concentrated on the region's non-Interstate highways. These corridors are impacted by intersection control devices, driveways, and other factors that contribute to reliability challenges. Much of the region's Interstate highway corridors perform relatively well in terms of reliability, though there are challenges on certain portions.
- **Safety Performance**
  - While minor and (to a lesser extent) severe injury truck-involved crashes are broadly distributed across the region's highway network, fatal injury crashes appear to have primarily occurred on a few key freight routes. These include I-16, I-95, SR 21, SR 17/SR 30, and U.S. 17.
  - Between 2012 and 2021, there were 62 highway-rail incidents involving freight railroads. Some crossings have had multiple incidents over this time frame. Of the region's 62 highway-rail incidents, 38 occurred at 11 crossings.
- **System Gaps, Restrictions, and Other Bottlenecks**
  - At-grade crossings and access management appear to be contributing factors to the region's congestion and travel time reliability challenges. Corridors near the Port of Savannah are particularly impacted by these factors.