REGIONAL FREIGHT TRANSPORTATION PLAN

FREIGHT NEEDS ASSESSMENT AND ANALYSIS

OCTOBER 30, 2023

CORE
COASTAL REGION MPO

Regional Freight Transportation Plan

Freight Needs Assessment and Analysis

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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. In addition, the region is an emerging manufacturing hub for businesses looking to create and ship a diverse portfolio of finished products to clients around the globe. 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 paints a comprehensive picture of existing and projected freight system performance and needs. Key elements of the needs assessment includes points of system failure given lack of roadway capacity, poor roadway design, pavement or bridge deficiencies, and land use/zoning conflicts; safety hot spots; points of modal conflict (e.g., road/rail) that are impeding system performance; and points of community conflict (e.g., high levels of trucking activity within residential areas).

1.1 Existing Plans and Studies Impacting Freight

In recent years, there have been several studies performed at the statewide or regional levels that have an impact on freight in the CORE MPO region. This section of the report provides a brief overview of recent studies that are particularly relevant for understanding existing and future freight movements throughout the region.

Georgia Department of Transportation (GDOT) Freight and Logistics Plan Update, 2013 (2018 Update)

The GDOT Statewide Freight and Logistics Action Plan was completed in 2013 and updated in 2018 to be compliant with the Fixing America's Surface Transportation (FAST) Act. The plan performed an assessment of the State's multimodal freight needs and provided a strategy for addressing those needs. It was conducted in conjunction with the private sector to facilitate a strategic, business-oriented approach to develop specific freight and logistics improvement solutions with the largest economic returns. The Plan integrated freight modes into GDOT activities and serves as an economic development tool for marketing Georgia and growing jobs and investment. It should be noted that GDOT has begun the process of updating the statewide freight plan.

Some key findings from the Georgia Freight and Logistics Action Plan include the following:

- Trucking is the dominant mode of moving freight in Georgia and is expected to continue to be the dominant mode over the long term. It is also the primary connecting mode for marine, rail, and air cargo to final destinations in Georgia. The trucking industry experiences a significant amount of congestion, primarily but not limited to Metro Atlanta, where both long-haul and local/distribution truck traffic are the highest. This congestion is forecast to get more severe (in terms of delay per vehicle), longer (in terms of the duration of peak periods), and more prevalent on the interstate corridors that connect Atlanta with key trading partners including the CORE MPO region.

- The Port of Savannah is the key distinguishing feature of the freight infrastructure in Georgia. It has been successful in capturing discretionary container traffic along the East Coast and boosting Georgia's economy. Deepening the Savannah Harbor and channel to accommodate the larger ships is critical to maintaining this distinction. To maximize Georgia's full potential to move marine cargo in the longer term, an additional port in Jasper County, South Carolina will be needed along with expansion of the rail and road connections to both the Port of Savannah and the Jasper Port.

- The Georgia Freight and Logistics Action Plan determined that by investing $18-$20 billion over the next 40 years in freight improvement projects, the State could generate over $65 billion in additional economic output and thousands of new jobs. This includes investments in the CORE MPO region such as the I-16/I-95 interchange reconstruction.

GDOT Georgia State Rail Plan, 2020

The GDOT Georgia State Rail Plan was developed for the purpose of guiding the state's freight and passenger rail transportation planning activities and project development plans for the next 20 years. The 2020 Georgia State Rail Plan provided updates to the 2015 Plan on conditions that have changed and important short-term and long-term opportunities for investment including:

- The increasing demand for passenger and freight rail services;

- Upgrades to state owned rail to ensure economic competitiveness; and

- Supporting operational improvements to maximize efficiency of the rail network and multimodal connections.

A key finding of the 2020 Georgia State Rail Plan was that the state's position in freight rail has risen since the 2015 State Rail Plan was completed. Georgia increased in ranking among states in terms of number of freight railroads, originated rail tons, and originated rail carloads. The 2020 State Rail Plan also found that while total freight rail tonnage had decreased, the number of rail carloads had increased with the rise of intermodal traffic in the state.

Additionally, the 2020 Georgia State Rail Plan identified some key opportunities related to freight rail that would impact the CORE MPO region:

- **Sea and Inland Ports.** Continued investment in rail connectivity to ports drives the capacity and ability of the rail and port network to increase job growth, attract new commerce, and sustain economic competitiveness.

- **Blocked Crossings.** Extended blockages of highway-rail crossings create mobility and safety issues. Eliminating or reducing these blockages is a key freight rail investment area for the state.

- **Short Line Improvements.** Investments that upgrade the infrastructure of the short line rail network (such improved weight capacity to handle 286,000-lb. axle loads) would boost rural economic development and help to divert freight traffic from the state's highway network.

- **Increasing the Usage of Freight Rail.** A single freight train can remove several hundred trucks from Georgia's highways leading to reduced greenhouse gas emissions and improved safety (i.e., the rate of fatalities per ton-mile for rail is substantially lower than trucking).

The 2020 State Rail Plan's emphasis on improving the efficiency and usage of freight rail would impact freight-intensive industries in the study area as well as the Port of Savannah. The 2020 State Rail Plan noted that logistics and supply chain is a key industry supported by rail in Georgia and there are several warehouses and distribution centers located throughout the study area.

CORE MPO Metropolitan Transportation Plan, 2020

Mobility 2045 is the CORE MPO Metropolitan Transportation Plan that serves as a guide for comprehensive, cooperative, and continuing transportation planning throughout the Coastal Region MPO planning area. The plan defines the vision to meet travel demands expected over the next 26 years with a focus on supporting a planning process that incorporates community values, needs, land use, and modal alternatives. It should be noted that the CORE MPO is in the process of updating its long-range plan – Mobility 2050.

Mobility 2045 was guided by the following goal areas, many of which specifically include freight in their definitions or in their supporting objectives:

- **System Performance.** An efficient, reliable, multi-modal transportation system that supports economic competitiveness and enhances tourism.

- **Safety and Security.** A safe, secure, and resilient transportation system for all types of users and for freight.

- **Accessibility, Mobility and Connectivity.** Access and mobility, equitably and reliably available, for people and for freight, through a range of travel options and an integrated, connected transportation system.

- **Environment and Quality of Life.** Healthy sustainable environment through the compatible integration of land use and transportation while taking into consideration the impact of transportation including that of stormwater.

- **State of Good Repair.** Maintain a state of good repair.

- **Intergovernmental Coordination.** Wise use of public funds through coordination and a performance-based planning process.

Mobility 2045 recognized that the movement of freight and goods, especially from the Port of Savannah, will continue to greatly impact the region's transportation network. Although the roadway network is the primary mode over which freight is moved, the region also relies on its rail network and its various operators to efficiently move freight to and from the region. Many of the recommendations developed as part of the CORE MPO's 2015 Regional Freight Transportation Plan were incorporated into Mobility 2045.

CORE MPO Regional Freight Transportation Plan, 2016

The CORE MPO Regional Freight Transportation Plan was prepared in 2016 to provide the region's long-term blueprint for enhancing freight mobility across the Savannah region and improving its economic competitiveness. The plan assessed freight transportation assets, identified needs, and provided recommendations for achieving the region's vision and goals for freight.

A key finding of the 2016 Regional Freight Transportation Plan was that freight traffic and freight-oriented land use developments would continue to grow in the region over the long term. Furthermore, this growth would exacerbate the region's current freight-related challenges. The 2016 Regional Freight Transportation Plan also identified some specific corridors and areas that should be the focus of improvements. Examples include SR 21 which was identified as a top ten crash hotspot. SR 307, SR 21, and Brampton Road along with other corridors providing primary access to the Port of Savannah were identified as freight bottlenecks. US 17 through Richmond Hill and the SR 21/I-95 interchange were also identified as hotspots for congestion. In addition, the communities surrounding SR 21 and adjacent to the Port of Savannah were identified as environmental justice areas.

The 2016 Regional Freight Transportation Plan made several recommendations regarding land use and freight infrastructure improvements. Some key recommendations included:

- Develop an ITS/Traffic Messaging System for communication with trucks to utilize alternative routes on the freight transportation network.
- Develop corridor signal timing on major truck routes – example GDOT Regional Traffic Operations Program (RTOP). RTOP candidates for the CORE MPO region would include US 80, SR 21, and SR 307.
- Develop a wayfinding system between Port of Savannah and interstate corridors.
- Continue the CORE MPO Freight Advisory Committee (FAC).

SR 307 Corridor Study, 2021

The SR 307 Corridor Study was completed in 2021 and focuses on SR 307 between SR 25/US 17/Ogeechee Road to the south and SR 25/Coastal Highway at the Port of Savannah's Garden City Terminal to the north. As a freight corridor that serves as a primary artery to the Georgia Ports Authority's (GPA) Garden City Terminal, SR 307 is a critical component of the region's economic and community vitality. In addition, the corridor serves not just as a gateway to the Port of Savannah and adjacent activity centers, but also as a required point of passage to and from downtown Savannah. The SR 307 Study focused on maintaining mobility and safety along the corridor to promote the long-term success of the surrounding area. More specifically, the primary goals and objectives of the SR 307 Corridor Study were:

- Identify and prioritize short-term (0-5 Years) and long-term (5+ Years) improvement projects needed for the SR 307 corridor to operate at an acceptable level of service.
- Prioritize recommended improvements to facilitate planning and programming of projects through the CORE MPO Metropolitan Transportation Plan (MTP) process.

- Justify the future programming of projects in the CORE MPO's Transportation Improvement Program (TIP) and Total Mobility Plan.

One key finding of the study was that bottlenecks at SR 26/US 80/Louisville Road and SR 21/Augusta Road are likely to continue to contribute to significant delays for freight and passenger vehicle trips traversing the corridor during the peak periods of the day. Another key finding was that existing crash history suggests that peak hour congestion may contribute to a high frequency of rear-end collisions at these locations. The crash data also indicated that a lack of access management and conflicts between the tractor-trailer and commuting passenger car traffic streams result in SR 307 between Pine Meadow Drive and Robert B. Miller Road being particularly susceptible to collisions. The SR 307 Corridor Study developed several project recommendations for addressing safety and mobility needs along the corridor.

SR 21 Access Management Study, 2021

The SR 21 Access Management Study was completed in 2021 and focuses on SR 21/Augusta Road from SR 25/Burnsed Boulevard to Grange Road. SR 21 is a major thoroughfare that provides access to the Port of Savannah, I-95, and I-516. It is characterized by the presence of freight-oriented land uses (including industrial and warehousing developments) along with low density retail, restaurants, and grade schools. Furthermore, the Savannah Chatham County Public School System is constructing a new K-12 campus along the corridor. The purpose of the SR 21 Access Management Study was to analyze existing and future roadway conditions and provide recommendations to address the corridor's operations and safety, multimodal improvements, streetscape elements, and economic development.

One key finding of the SR 21 Access Management Study was that as much as 40 percent of the roadside is given over to curb cuts including driveways and intersection openings. Portions of the corridor have driveway densities as high as 79 driveways per mile. That means there are turning and deceleration conflicts occurring along the entire length of the segment which impacts all roadway users including freight vehicles. Another key finding was that crashes along the corridor exceeded statewide averages for similar roadways, indicating that safety is a particular concern for the corridor. The SR 21 Access Management Study developed several project recommendations for addressing safety and mobility needs along the corridor. Among them, it recommended that the existing two-way-left-turn lane between Minus Avenue and Smith Avenue be replaced with a raised landscaped median to improve safety and access management along the corridor.

Effingham County Transportation Master Plan, 2021

Since 1960, Effingham County has experienced substantial and accelerating growth in both industry and population, growing from around ten thousand residents in 1960 to over sixty-five thousand today. This growth is showing no sign of slowing as Effingham County is estimated to have grown by over twenty-five percent from 2010 to 2020, the sixth-fastest growing county in the state (on a percentage basis). This growth has already begun to put a substantial strain on Effingham County's transportation network, increasing congestion and safety concerns along its roadways. The Effingham County Transportation Master Plan outlined recommended improvements to address the County's current and future transportation needs.

The Master Plan noted that the dynamics of freight movement throughout Effingham County are of special concern. Much of the economic activity in Effingham County is linked – directly or indirectly – to activities at the Port of Savannah or to the Norfolk Southern and CSX rail lines that run through the county. Recently Effingham County enacted a truck route ordinance which focuses truck traffic on specific routes with the appropriate characteristics and facilities to support them. Furthermore, the Master Plan observed that large concentrations of freight-related employment follow the County's freight corridors. However, access to these corridors is increasingly limited and does not provide direct, simple access to properties along the rail lines near the center of the county.

Some key recommendations from the Effingham County Transportation Master Plan for addressing freight and other needs include:

- Thirty-one intersection projects ranging from additional turn lanes to new traffic signals.
- An expansion of the freight network throughout the County and projects to improve existing roadways to connect SR 17, SR 21, SR 119, and Effingham Parkway.
- Increased network including new routes parallel to SR 21 and Blue Jay Road to provide redundancy and improve reliability.
- Improved connectivity to areas outside the County including a new connection west to improve connectivity to I-16 and a widening of SR 21 towards I-95 and the Port of Savannah.
- Countywide bicycle and pedestrian facilities connecting the Cities of Guyton, Springfield, and Rincon, improving quality of life and providing alternative ways to move around the county.

2 EXISTING AND FUTURE GOODS MOVEMENT ASSESSMENT

The Existing and Future Freight and Goods Movement Assessment provides a comprehensive picture of existing goods movement in the region and how they may evolve over the long-term. There are four main components to the assessment: (1) commodity flow analysis, (2) truck origin-destination pattern analysis, (3) inventory of warehouses and distribution centers, and (4) analysis of train and truck volumes at the Port of Savannah.

2.1 Commodity Flow Analysis

The needs of the Savannah region's freight system are driven by both the current and future demand for freight transportation. Overall, in 2019 about 163 million tons of freight worth $367 billion were transported to, from, within, or through the CORE MPO Region. This is projected to more than double in 2050 and grow to over 392 million tons worth $895 billion.

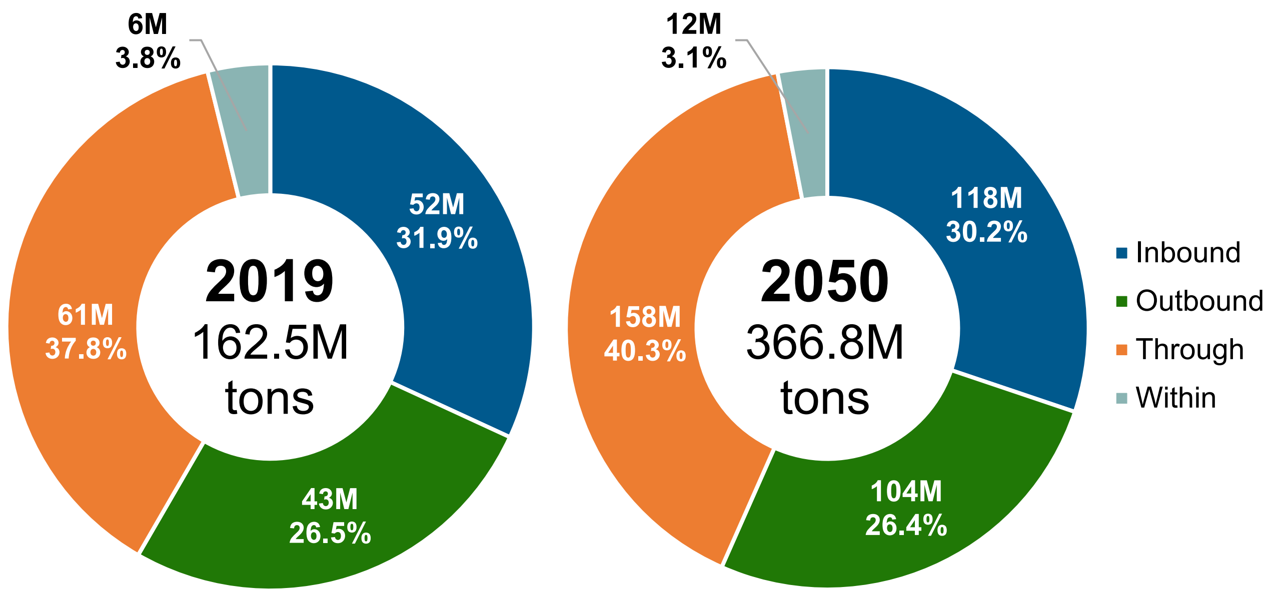
This chapter examines the demand for freight transportation services in the CORE MPO region by analyzing the commodities flows underlying that demand. The analysis examines flows of goods by truck, rail, water, and air freight modes. This includes analyzing how and where the commodities moved and the region's predominant trading partners across three geographies: within Georgia, within the United States, and internationally.

It is important to note that two data sources were used to complete this analysis: S&P Global's TRANSEARCH and the U.S. Census Bureau's USA Trade Online. TRANSEARCH was the primary data source. This database consists of commodity flows by mode for a 2019 base year and a 2050 horizon year. As TRANSEARCH only reports international trade between United States-Mexico-Canada Agreement (USMCA) nations, this data was supplemented with information from USA Trade Online. The U.S. Census Bureau's USA Trade Online database contains information on all U.S. international trade and is compiled from multiple sources including the following: Electronic Export Information (EEI); automated data submitted through the U.S. Customs' Automated Commercial System; and information compiled from import entry summary forms, warehouse withdrawal forms, and Foreign Trade Zone documents. Data on 2019 international trade via water and air for the CORE MPO region were collected and incorporated into the analysis. Since the USA Trade Online database contains current and historical trade data only, 2050 horizon year international commodity flow estimates for the study area were produced using commodity-specific growth rates derived from the TRANSEARCH database.

Directional Split

Figure 2.1 shows the flow of goods by tonnage across the study region by direction in 2019 and 2050. In 2019, almost 38 percent of all freight tonnage was moved through the region without making a stop. Through movements accounted for the largest share of tonnage. This is due, in large part, to freight shipments traveling along I-95 as it provides access to Florida and major population centers along the east coast. The prevalence of through movements is also due to the region's rail network as CSX Transportation and Norfolk Southern have main lines traversing the study area.

FIGURE 2.1 CORE MPO TONS BY DIRECTION, 2019 AND 2050



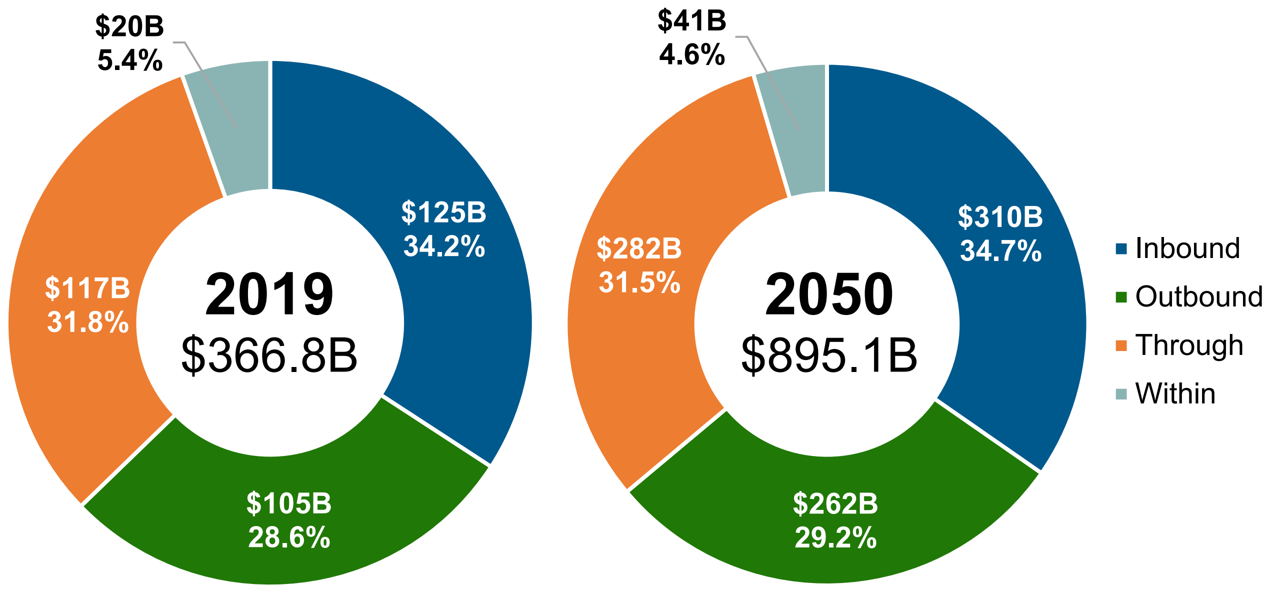
Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Inbound shipments accounted for the next highest share of goods by total tonnage. They represented 32 percent of total tons in 2019. Outbound shipments represented 27 percent of goods in 2019. About 4 percent of tonnage has an origin or destination within the region.

By 2050, the proportions of tonnage by direction are projected to remain largely consistent with 2019 values. Through tonnage will have grown 2.5 percent to over 40 percent by 2050, while the remaining directions will have decreased slightly from their respective 2019 percentages. Inbound shipments are estimated to still exceed outbound shipments in terms of total tonnage, but the gap between them will shrink from about 5.4 percentage points in 2019 to 3.8 percentage points in 2050.

Figure 2.2 shows the breakdown of freight movements in the CORE MPO region by direction with respect to value for 2019 and 2050. By value, inbound shipments comprise the highest share of value by direction with about 34 percent in 2019. Through movements comprise the next highest share at nearly 32 percent. Outbound and within shipments make up approximately 29 percent and 5 percent of total value. That the share by total value of inbound, outbound, and inbound shipments exceed their shares by total tonnage implies that those goods have a higher average value per ton of freight than those that pass through the region without stopping. Outbound freight falls into a similar category of having a higher percentage of freight value in each year than freight tonnage. 2050 projections of value by direction are largely consistent with the 2019 results.

FIGURE 2.2 CORE MPO VALUE BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

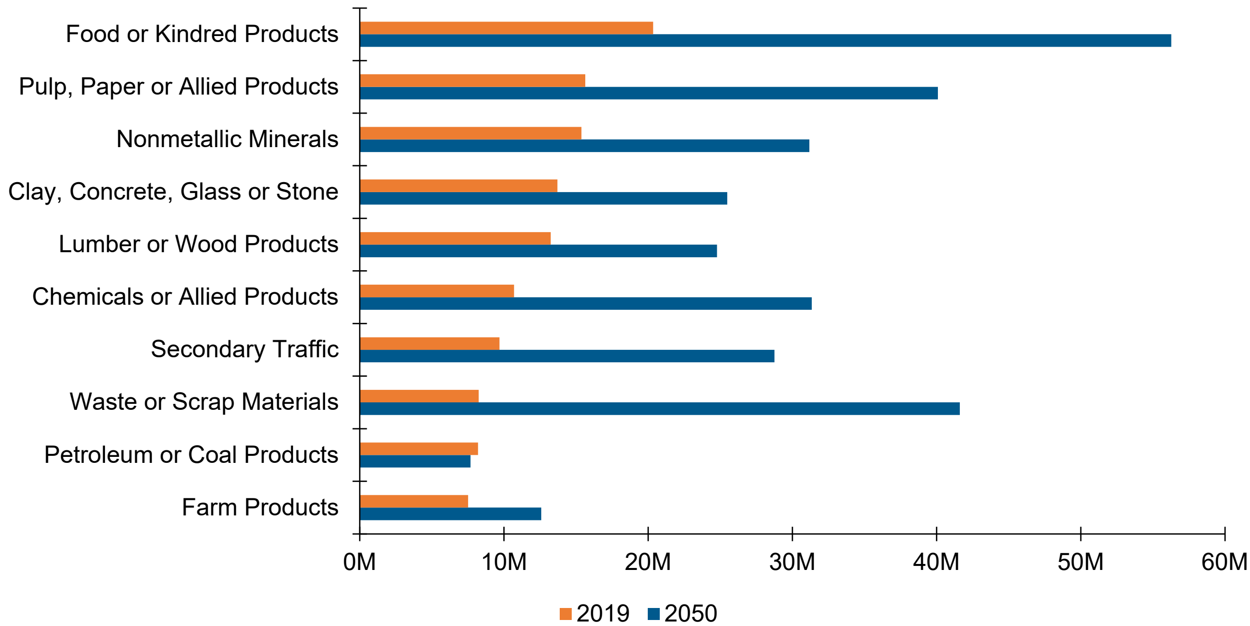
Top Commodities

All Directions

The top commodities by total tonnage across all directions for 2019 and 2050 are shown in Figure 2.3. In 2019, "food or kindred products" was the largest commodity type shipped in the CORE MPO region. Over 20 million tons of food or kindred products was transported in the region, which accounts for about 12.5 percent of the total tonnage in 2019. This commodity includes goods such as meat, milk, fruits, vegetables, and flour, among others. This is followed by "pulp, paper, or allied products" and "nonmetallic minerals" (e.g., gravel, sand with about 15 million tons each. Many of these commodities can be linked to major industry sectors in the coastal region and throughout Georgia. For example, forestry is a significant industry throughout Georgia with multiple lumber mills processing logs from harvested timber. Paper and paper products is another example as there processing facilities in the CORE MPO region and in nearby Liberty County. Other commodities – such as nonmetallic minerals and "clay, concrete, glass, or stone" – represent bulk goods that tend to account for higher shares of tonnage.

By 2050, nearly all of the 2019 top 10 commodities are projected to increase in magnitude. However, this growth will not be distributed evenly among the top commodities. "Clay, concrete, glass, or stone" is the fourth-highest commodity by tonnage in 2019 and will only grow 86 percent from 2019 to 2050. Other commodities are projected to grow substantially such as "chemicals or allied products" (e.g., soap, paints, drugs) by 193 percent and "secondary traffic" (e.g., shipments between warehouses and distribution centers) by 197 percent. The largest-growing commodity is "waste or scrap materials," which will grow 404 percent from 8.2 million tons in 2019 to 42 million tons in 2050. This is projected the become the second-highest commodity by tonnage in 2050 and account for 11 percent of total tonnage. Food or kindred products will remain the most common commodity by tonnage. Notably, "petroleum or coal products" (which does not include lump coal but instead includes paving and roofing materials and refined petroleum products such as fuels and liquefied gases) are projected to decrease in total tonnage by about 5 percent.

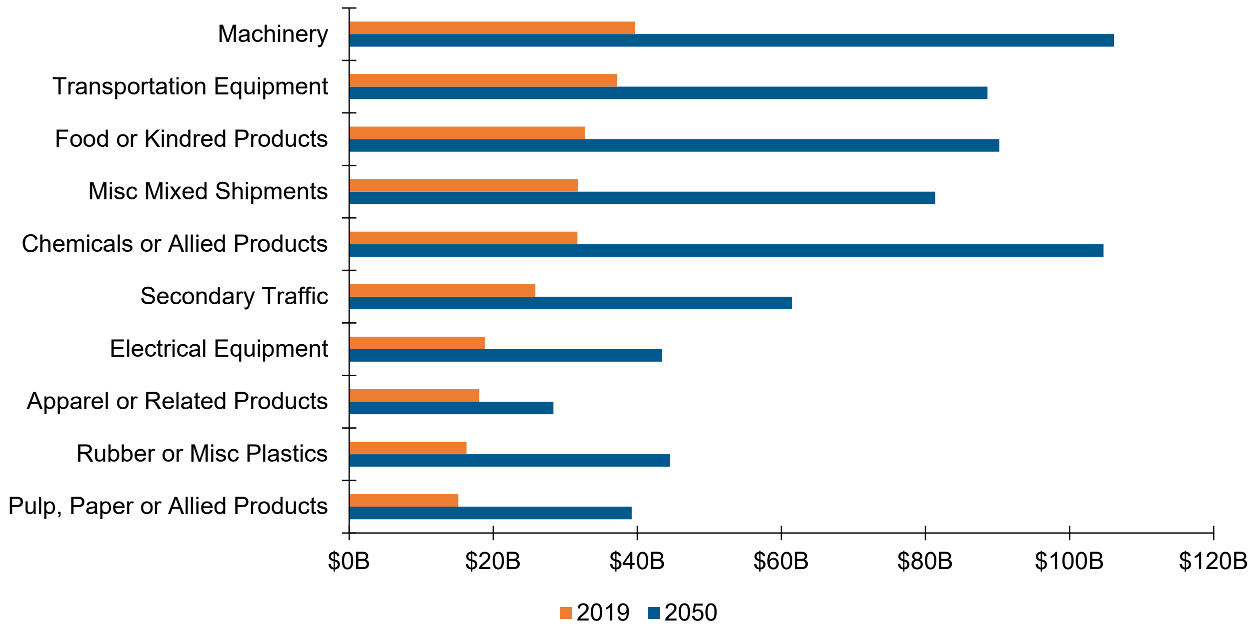
FIGURE 2.3 TOP COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

By value in 2019 (as opposed to by weight), Figure 2.4 shows that the top commodity in both 2019 and 2050 is "machinery". In 2019, machinery transported throughout the region was valued at almost $40B; in 2050, this grew to over $106B, a growth of 167 percent. In 2019, this is followed by "transportation equipment" ($37B) and "food and kindred products" ($33B), the top commodity by tonnage. In 2050, the order of the top five commodities change as "chemicals and allied products" becomes the second-highest commodity by value with over $100B. "Chemicals and allied products" grows the most out of the top 10 commodities between 2019 and 2050 with an increase of 230 percent between the analysis years.

FIGURE 2.4 TOP COMMODITIES BY VALUE, 2019 AND 2050



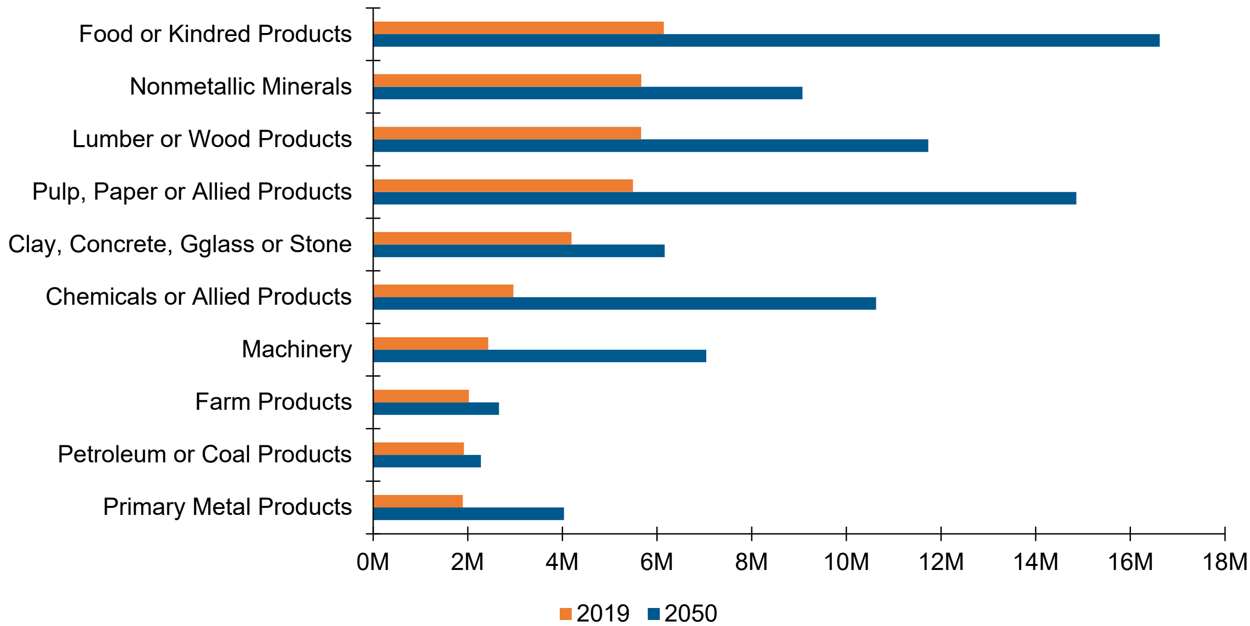
Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Inbound and Outbound Shipments

Figure 2.5 shows the top commodities for inbound shipments for 2019 and 2050. Food or kindred products was the top commodity shipped into the region. In 2019 it accounted for nearly 6.15 million tons and is projected to increase to over 16 million tons by 2050. This commodity includes goods such as meat, milk, fruits, vegetables, and flour, among others. It was followed by nonmetallic minerals, lumber or wood products, pulp and paper products, and clay, concreted, glass, or stone. As previously mentioned, many of these commodities can be linked to major industry sectors in the coastal region and throughout Georgia – such as forestry and paper products manufacturing. By 2050, lumber and wood products and pulp and paper products are projected to surpass nonmetallic minerals in total tonnage.

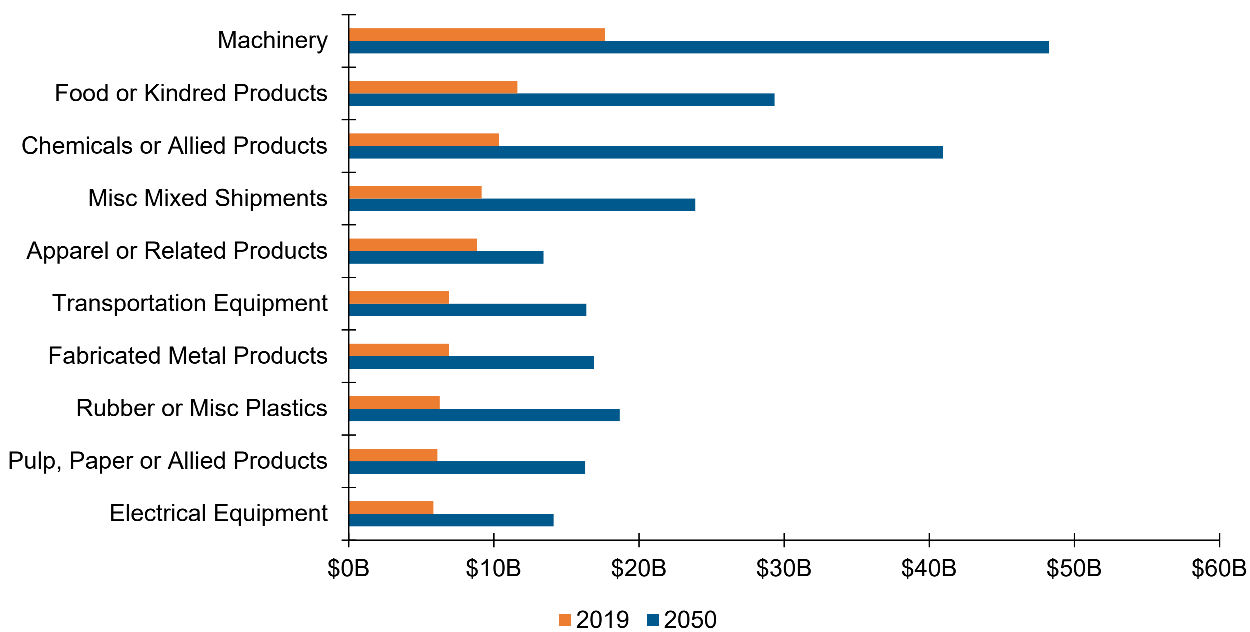
Figure 2.6 shows the top inbound commodities by value. Machinery was the top commodity shipped into the region representing $17.7 billion worth of engines, farm equipment, construction equipment, cranes, and other goods. By 2050, this is projected to increase to over $48.2 billion. Machinery was followed by food or kindred products, chemicals, mixed shipments (e.g., various goods that are grouped together for shipping), and apparel as top commodities. Chemicals or allied products (e.g., soap, paints, drugs) are projected to surpass food or kindred products as the second highest value commodity class shipped inbound to the region by 2050.

FIGURE 2.5 TOP INBOUND COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.6 TOP INBOUND COMMODITIES BY VALUE, 2019 AND 2050

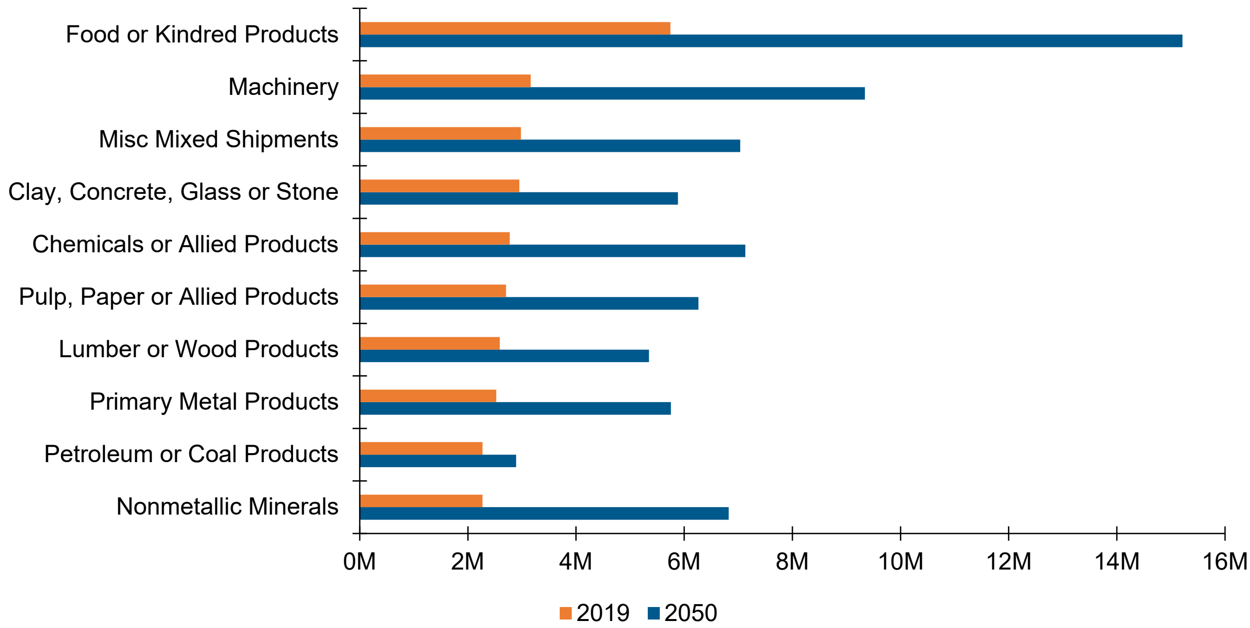


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Figure 2.7 shows the top commodities for outbound shipments for 2019 and 2050. The most prevalent goods shipped outbound from the region are largely consistent with the top inbound shipments. The exception is that “miscellaneous mixed shipments” replaces farm products as a top commodity. Miscellaneous mixed shipments are two or more different commodity types packaged together for shipping. Food or kindred products was a top commodity for both inbound (6 million tons in 2019 and 16 million tons in 2050) and outbound (6 million tons in 2019 and 15 million tons in 2050) flows in both analysis years. Shipments of clay, concrete, glass, or stone is the only other commodity in the top five for both inbound and outbound.

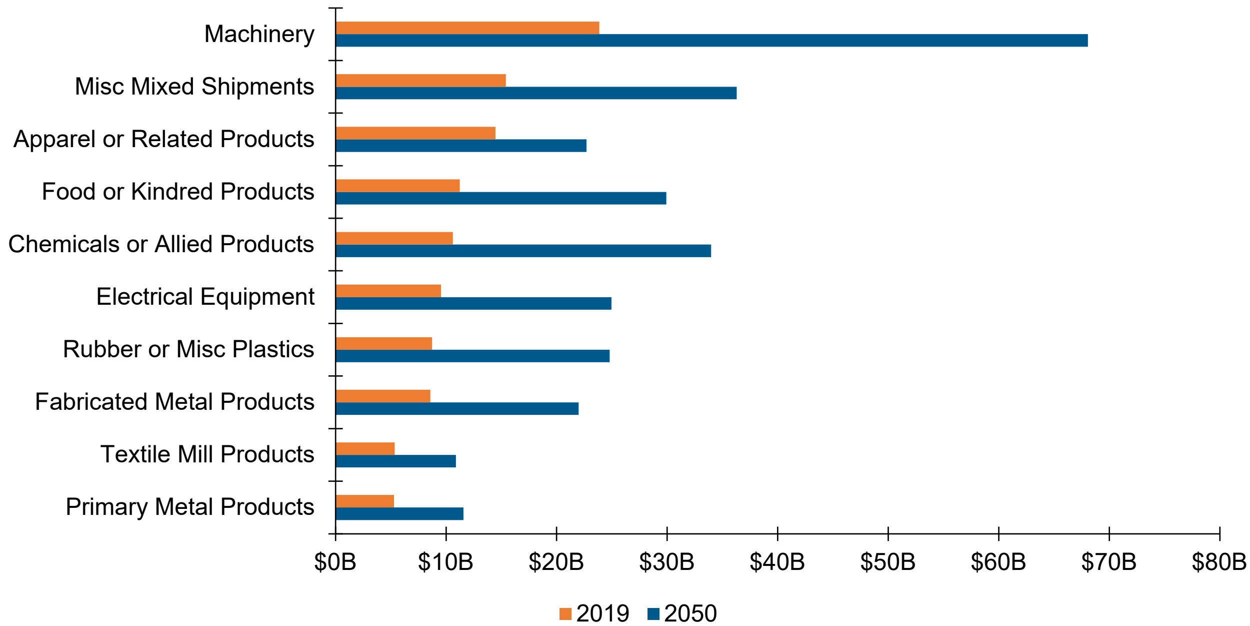
Figure 2.8 contains the top outbound commodities by value. The top 10 commodities by value are the same as those by weight except that the “textile mill products” and “primary metal products” commodity groups replacing the “transportation equipment” and “pulp, paper, or allied products” commodity groups. Textile mill products include goods such as fabrics, floor coverings, yarn and thread, and tire cords and fabrics, among others. Primary metal products include steel works and rolling mill products, iron and steel castings, and metal basic shapes as examples. Machinery is the top outbound commodity by value.

FIGURE 2.7 TOP OUTBOUND COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.8 TOP OUTBOUND COMMODITIES BY VALUE, 2019 AND 2050



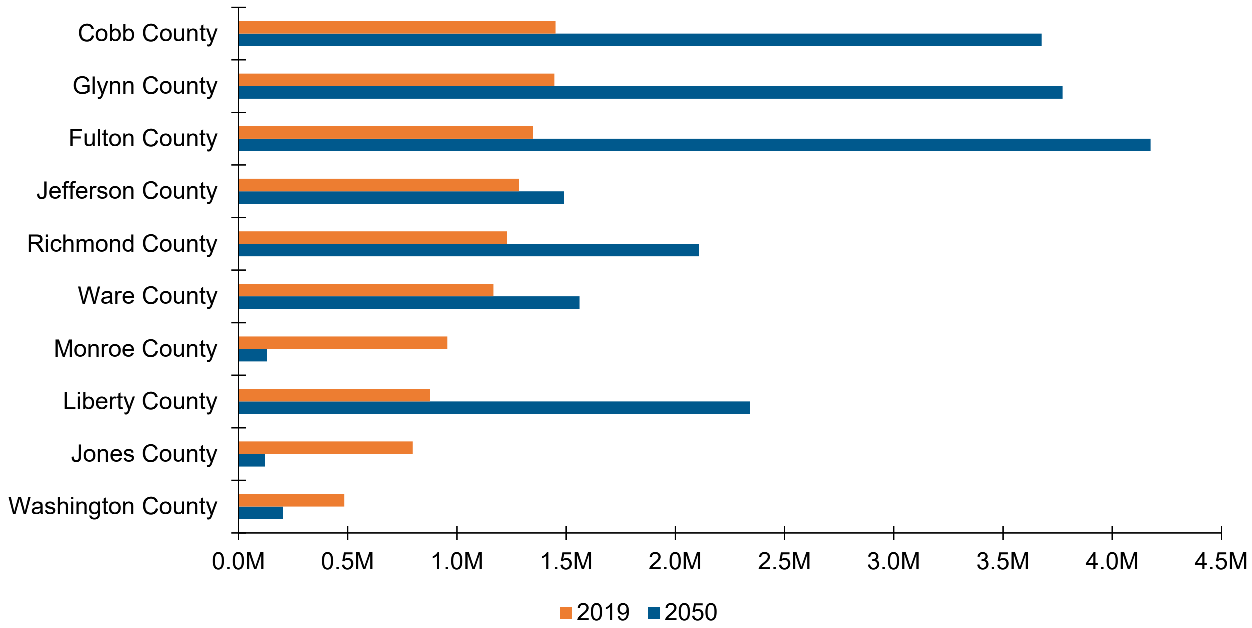
Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Top Trading Partners

Intrastate Trading Partners

Being a major center for trade on the eastern coast of the United States, the CORE MPO region has an abundance of trade partners across the world. In 2019, 13 percent of the region's total tonnage consisted of trade with other Georgia counties. This is projected to increase in magnitude but decrease in total share to 11 percent by 2050. Figure 2.9 shows the region's top in-state trading partners. Two of the three top in-state trading partners are in Metro Atlanta as Cobb and Fulton Counties each traded about 1.4 million tons with the CORE MPO region in 2019. Glynn County, the other county in the top three, encompasses the city of Brunswick and the Port of Brunswick which is another freight activity center in the state. Together, the top three counties account for about 20 percent of the region's in-state trade.

FIGURE 2.9 TOP INTRASTATE TRADING PARTNERS BY INBOUND AND OUTBOUND TONNAGE, 2019 AND 2050

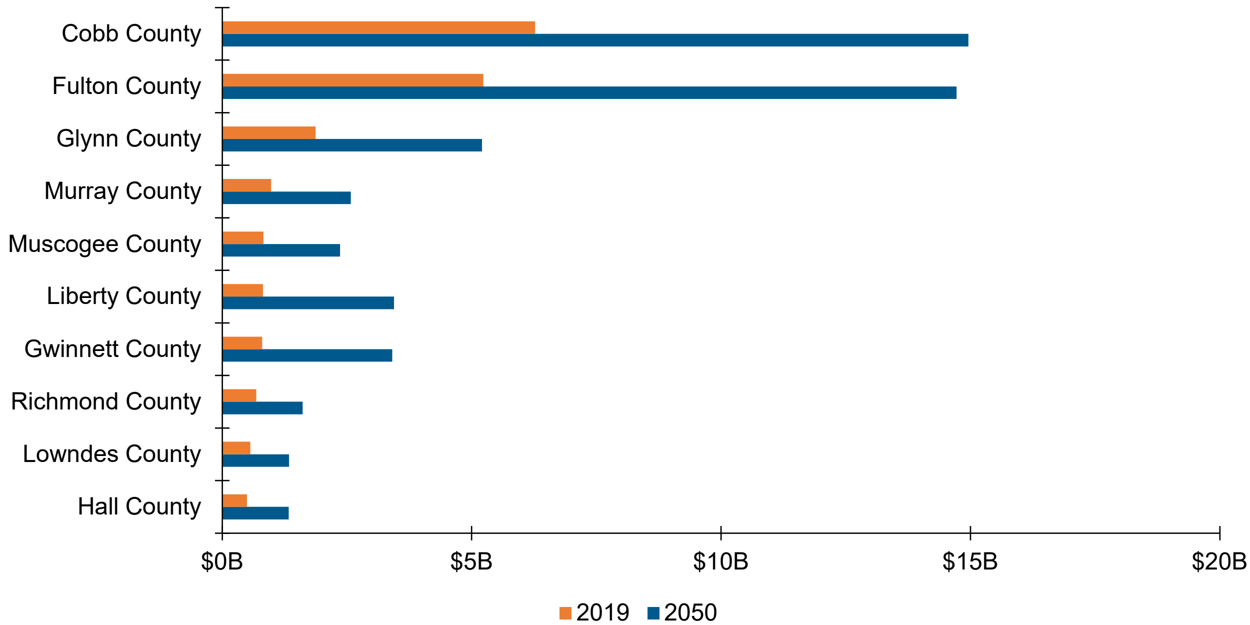


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

By 2050, all three of these trade destinations are projected to increase their trade tonnage with the CORE MPO region by between 150 and 210 percent. They are also expected to remain the top three in-state trading partners. Their share of in-state trade is projected to grow from about 20 percent to over 26 percent by 2050. This suggests a further concentration of intrastate trade with these top counties.

Figure 2.10 shows the top intrastate trading partners by value. The same top three in-state trading partners by tonnage are the same when ranked by value. Cobb, Fulton, and Glynn Counties accounted for about $13.2 billion in total trade with the CORE MPO region. This is projected to increase to approximately $34.9 billion by 2050. Collectively, Cobb, Fulton, and Glynn Counties account for about 47 percent of total intrastate trade value.

FIGURE 2.10 TOP INTRASTATE TRADING PARTNERS BY INBOUND AND OUTBOUND VALUE, 2019 AND 2050

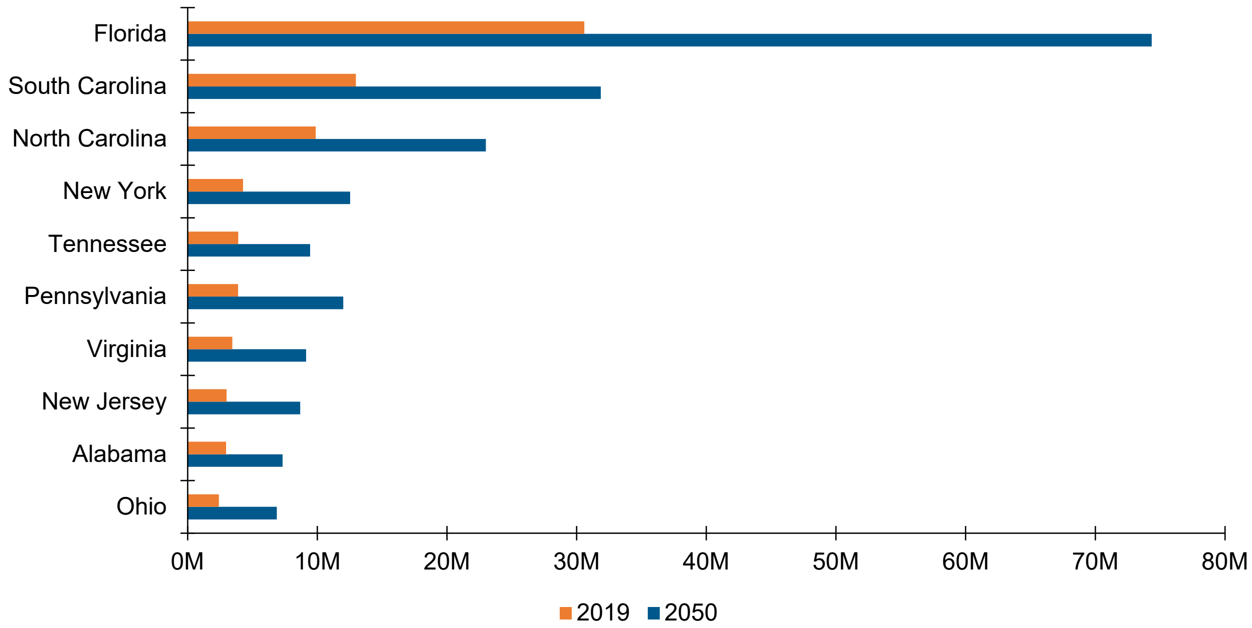


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Interstate Trading Partners

In 2019, 60 percent of the CORE MPO region's total tonnage was traded with states besides Georgia. This is projected to increase to approximately 63 percent by 2050. Figure 2.11 shows the CORE MPO region's top 10 interstate trading partners. Florida is the largest trading partner as it accounted for 31 million tons of total trade (about 32 percent of total interstate trade) in 2019. It is expected that Florida will remain the region's top interstate trading partner by 2050 with 74 million tons of total trade. Four of the top five trading partners – Florida, South Carolina, North Carolina, and Tennessee – are located in the Southeast. Other interstate trading partners with at least 3 million tons of annual trade include New York, Pennsylvania, Virginia, and New Jersey.

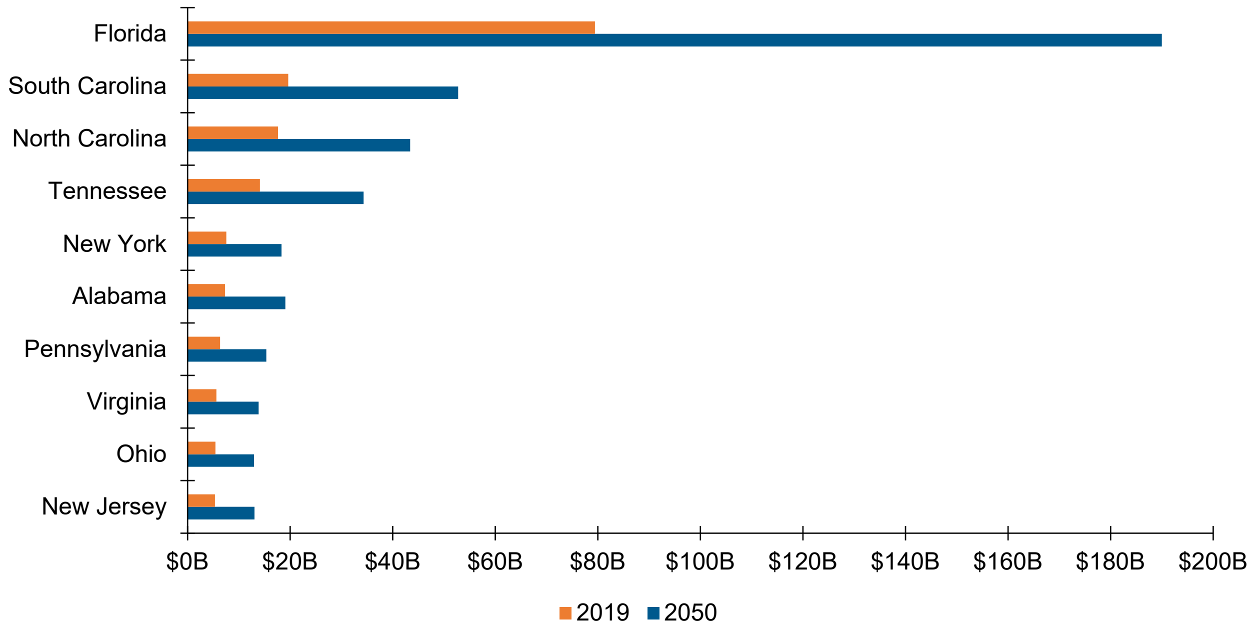
FIGURE 2.11 TOP INTERSTATE TRADING PARTNERS BY INBOUND AND OUTBOUND TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

By value, about 60 percent of the region's total trade was with states besides Georgia. The top trading partners by value, shown in Figure 2.12, are largely consistent with the top trading partners by tonnage. Florida is the top interstate trading partner with 37 percent of trade by value in both 2019 ($79 billion) and 2050 ($190 billion). It is followed by South Carolina, North Carolina, New York, and Tennessee.

FIGURE 2.12 TOP INTERSTATE TRADING PARTNERS BY INBOUND AND OUTBOUND VALUE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

International Trading Partners

International trade comprises about 26 percent of total tonnage and approximately 31 percent of total value of the CORE MPO's total trade. Table 2.1 summarizes the region's international trade. Asia is the region's top trading partner both in terms of tonnage (24M and 56M in 2019 and 2050) and value ($71B and $166B in 2019 and 2050). It is followed by Europe with about 10.15 million tons of total trade. The CORE region has substantial trade with Canada and Mexico as well. Trade with Mexico is projected to increase the most among the region's international trading partners. By 2050, the total tonnage and value of trade with Mexico is expected to increase 210 percent and 231 percent, respectively.

TABLE 2.1 CORE MPO INTERNATIONAL TRADE SUMMARY

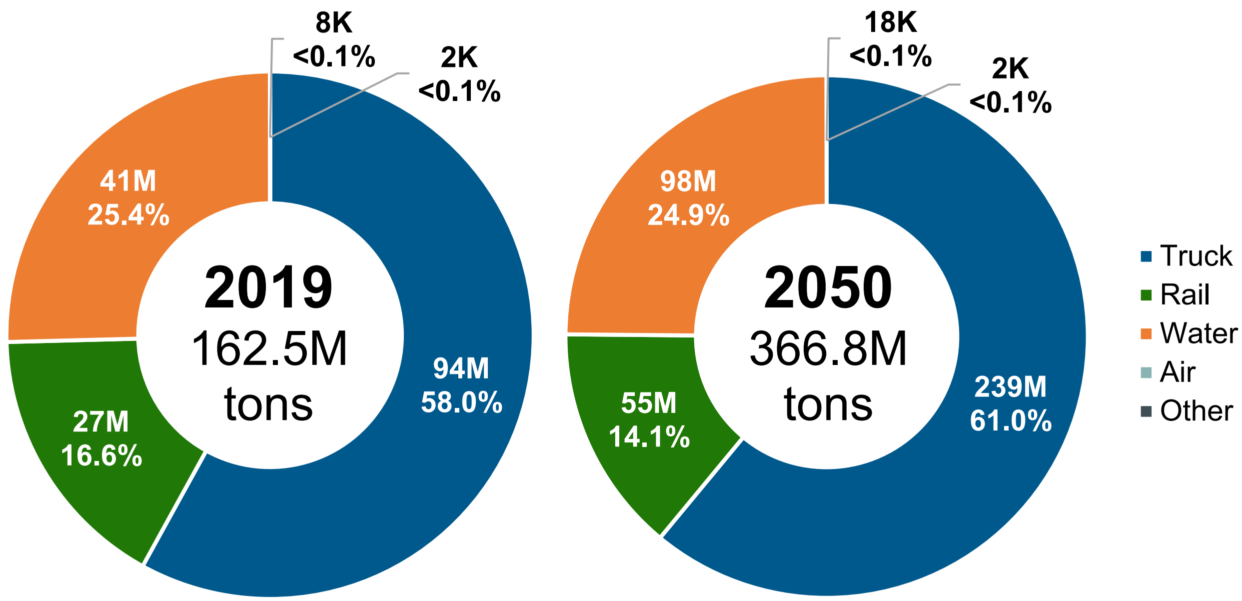
Trading Partner	2019 Tonnage	2050 Tonnage	2019 Value	2050 Value
Asia	23.74 M	55.78 M	$70.87 B	$166.16 B
Europe	10.15 M	24.77 M	$24.41 B	$65.74B
South/Central America	3.91 M	9.32 M	$4.62 B	$10.86 B
Canada	1.48 M	3.51 M	$2.63 B	$8.15 B
Africa	1.14 M	2.84 M	$2.11 B	$4.78 B
Mexico	0.94 M	2.92 M	$1.56 B	$5.16 B
Australia and Oceania	0.47 M	1.27 M	$3.09 B	$8.50 B
Greenland	< 0.01 M	< 0.01 M	< $0.01 B	< $0.01 B

Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Modal Split

Figure 2.13 shows the total tonnage by mode for 2019 and 2050. The majority of freight in the CORE MPO region is moved by truck – over 58 percent in 2019. By 2050, trucking is projected to increase its share of total goods moved throughout the region to about 61 percent.

FIGURE 2.13 CORE MPO TONS BY MODE, 2019 AND 2050

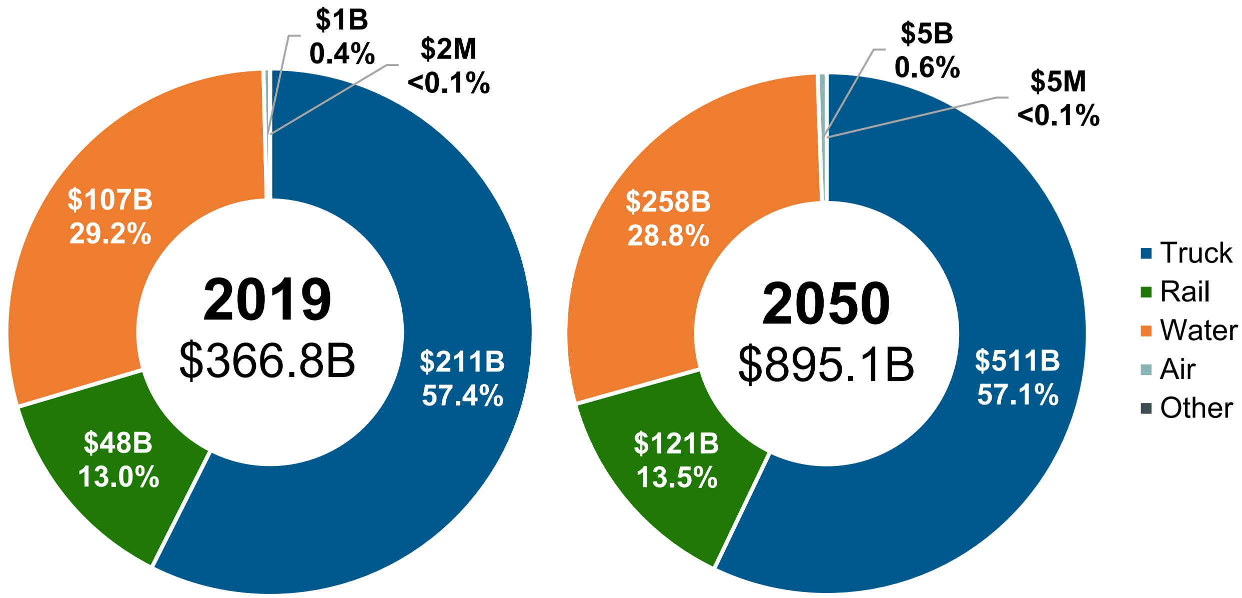


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

After trucking, the region's ports and waterways accounted next largest share of total tons. In 2019, about 25 percent of the region's goods were transported by water. This share was projected to remain nearly constant at about 25 percent in 2050. Rail was the next largest mode by total tonnage. It accounted for about 17 percent of the region's total tonnage in 2019. By 2050, though the magnitude of goods shipped by rail throughout the region is projected to increase, the share is expected to decrease to about 14 percent by 2050. Air and "other modes" account for small shares, less than 1 percent, of the region's freight activity in terms of tonnage.

Figure 2.14 examines mode share in the CORE MPO region by value. By value, the majority of the region's goods are moved by truck. In 2019, trucking accounted for over 57 percent (about $211 billion) of the region's goods movement in terms of value. This share is projected to remain nearly constant over the long term. By 2050, trucking is expected to carry about $511 billion worth of goods through the region which represents about 57 percent of total value. Waterborne goods account for the next largest share of freight by value. In 2019, the share of freight value moved by water was about 29 percent. This is projected to remain nearly constant through 2050. Goods transported by air tend to have higher values than those shipped by other freight modes. In 2019, about $1 billion in goods were transported to or from the region via air. This is projected to grow to about $5 billion by 2050.

FIGURE 2.14 CORE MPO VALUE BY MODE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Table 2.2 shows this average value per ton by mode in 2019 and 2050. The results imply that over the long term the region's rail, water, and air freight assets will increasingly carry higher value goods. All of these modes show an increase in the value per ton over the 2019-2050 horizon. As strategies and recommendations are developed for addressing the region's freight needs, these results show the importance of solutions that take a multimodal perspective.

TABLE 2.2 AVERAGE VALUE PER TON BY MODE

Mode	Value per Ton in 2019	Value per Ton in 2050
Truck	$2,234	$2,136
Rail	$1,772	$2,188
Water	$2,591	$2,643
Air	$194,862	$276,761
Other	$821	$2,555

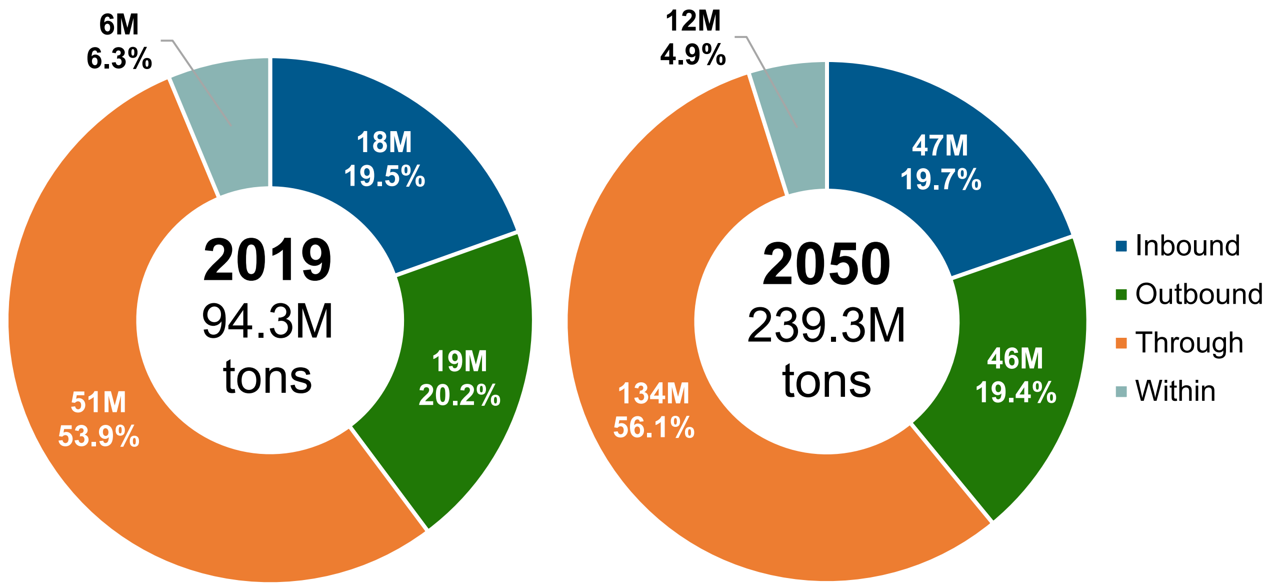
Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Truck

Over 94.3 million tons of goods valued at nearly $210.7 billion were transported by truck in the CORE MPO region in 2019 as shown in Figure 2.15 and Figure 2.16. The largest share of freight by tonnage on CORE MPO highways consists of through traffic – goods traveling through the region without stopping. In 2019, over 51 million tons of goods were estimated to pass through the region (nearly 54 percent of total tonnage). Over 37 million tons of highway freight (nearly 40 percent) consists of inbound or outbound commodity flows. Freight originating in other states or in-state regions (i.e., inbound movements) and freight destined for other states or in-state regions (i.e., outbound movements) each account for about 20 percent of total flows. A smaller share of the highway freight produced in the CORE MPO region remains in the 3-county area.

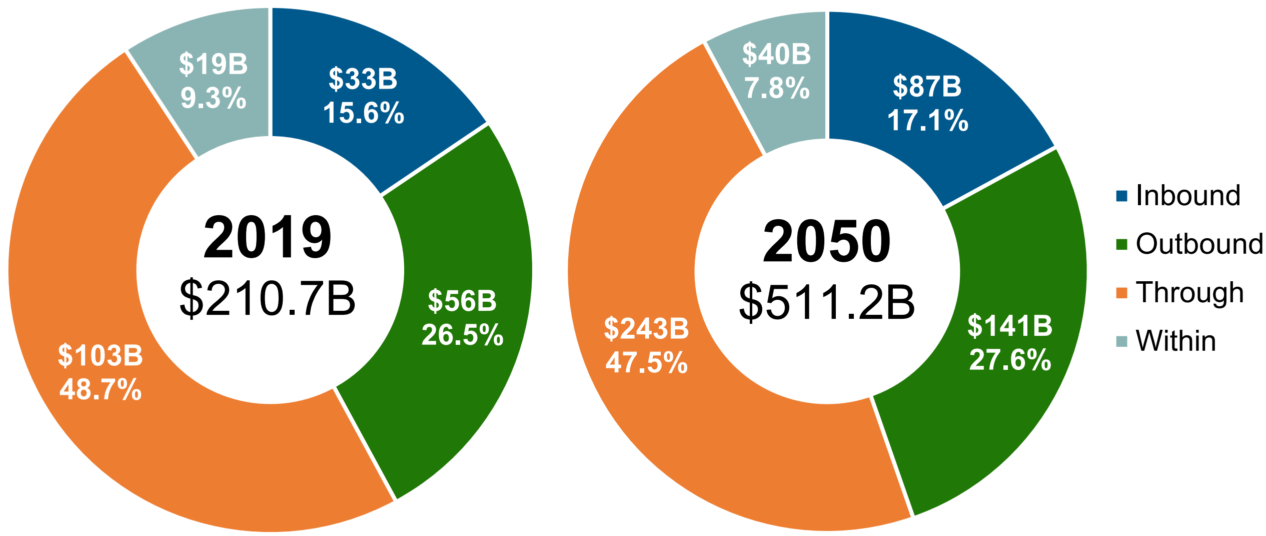
Around 239 million tons of goods, valued at over $511 billion, are expected to be shipped through, into, within, and out of the CORE MPO region in 2050 via highway as shown in Figure 2.15 and Figure 2.16. In terms of tonnage, through movements are projected to account for the largest share at 56 percent. Inbound and outbound flows are nearly balanced at nearly 19.7 percent and 19.4 percent, respectively. The analysis indicates a considerable increase in through movements from 51 million tons to 134 million tons from 2019 to 2050. This implies that in the future the region's highways will increasingly serve as a conduit for the national movement for goods.

FIGURE 2.15 CORE MPO TRUCK TONS BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.16 CORE MPO TRUCK VALUE BY DIRECTION, 2019 AND 2050



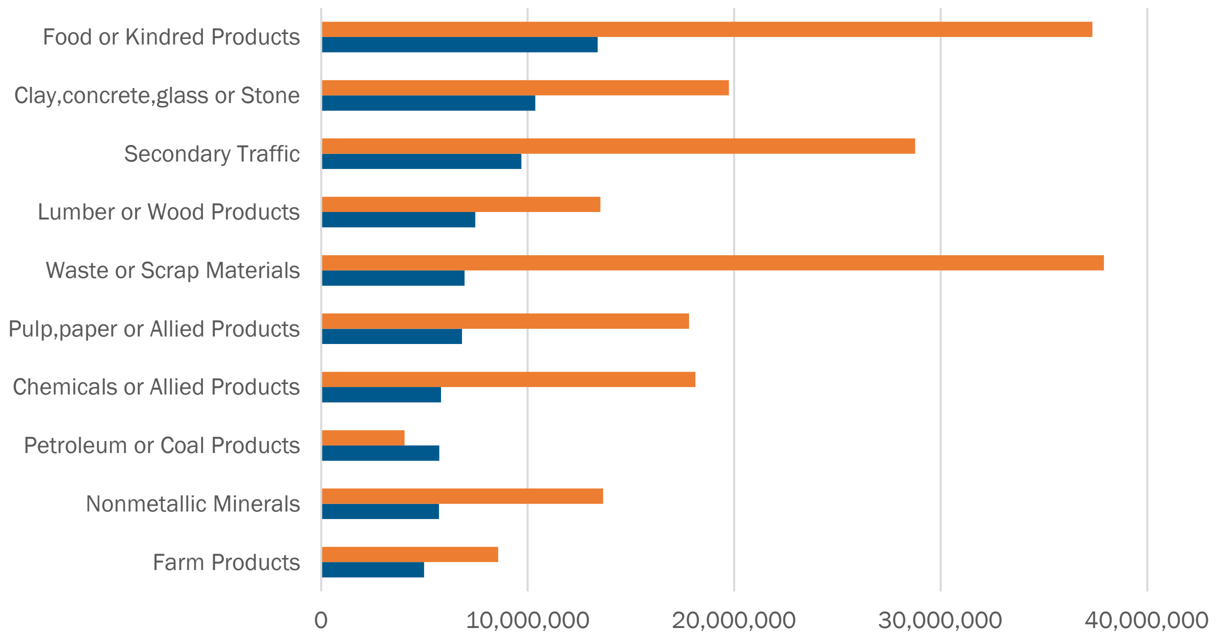
Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

In terms of value, through movements are projected to account for the largest portion of total value at nearly 48 percent in 2050. Through movements are followed in terms of total value by outbound (nearly 28 percent) and inbound (about 17 percent) as shown in Figure 2.16. The substantial projected increase in through tonnage has a correspondingly large expected increase in value. In 2019, the value of through movements was estimated to exceed $103 billion. By 2050, these movements are expected to double to about $243 billion. The value of goods outbound from the CORE MPO region is expected to more than double from about $56 billion to approximately $141 billion in 2050. Inbound shipments are expected to increase in value from about $33 billion in 2019 to approximately $87 billion in 2050. Overall, the CORE MPO region’s highways are expected to experience higher tonnages as well as an influx of goods with much higher values. It will be imperative to prepare for this growth as some roadways may not currently be able to manage this demand.

Figure 2.17 and Figure 2.18 show the top commodities by total tonnage and value, respectively, transported on the CORE MPO region's highway system. Bulk commodities – such as concrete and stone, lumber and wood products, waste and scrap, and farm products – are representative of the heaviest goods on the region's highway system. Many of these goods also reflect the state's and the region’s large agricultural, natural resources, and manufacturing industries. The prevalence of secondary traffic, which consists of truck movements between warehouses and distribution centers, reflects the region’s role as a logistics hub for the Southeast and nationally. Combined, the top ten commodities by tonnage account for approximately 82 percent of the total tonnage for commodities transported by truck in the region in both years.

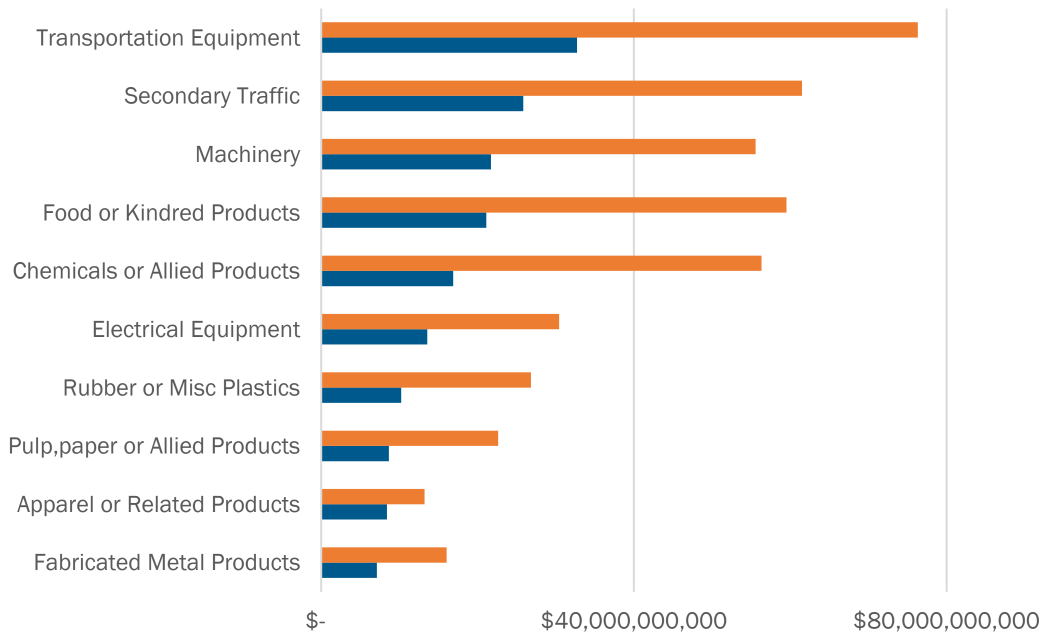
By value, the top commodities are reflective of the region’s and the state’s manufacturing base which includes transportation equipment (e.g., automobiles, aircraft, vehicle parts), chemicals, small engines, and paper products. Top commodities by value include transportation equipment, secondary traffic, machinery, food products, and chemicals. Combined, the top ten commodities by value account for approximately 80 percent of the total value for commodities transported by truck in the region in both years.

FIGURE 2.17 TOP TRUCK COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.18 TOP TRUCK COMMODITIES BY VALUE, 2019 AND 2050



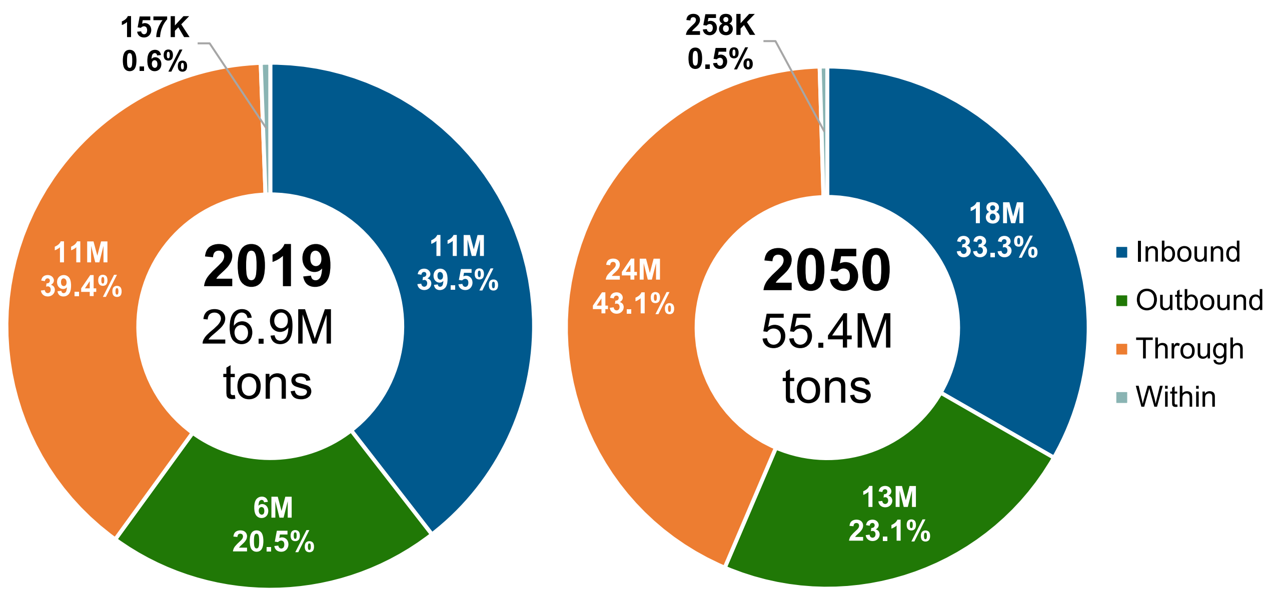
Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Rail

The region's rail network transported nearly 27 million tons of freight valued at nearly $47.7 billion in 2019 as shown in Figure 2.19 and Figure 2.20. Inbound and through movements comprise the largest shares of freight by tonnage on CORE MPO railroads at about 39.5 percent and 39.4 percent, respectively. Together, they accounted for approximately 22 million tons of freight. In 2019, outbound freight rail movements accounted for about 20.5 percent of total flows. Only a very small share of the rail freight produced in the CORE MPO region remains in the three-county area, less than one percent.

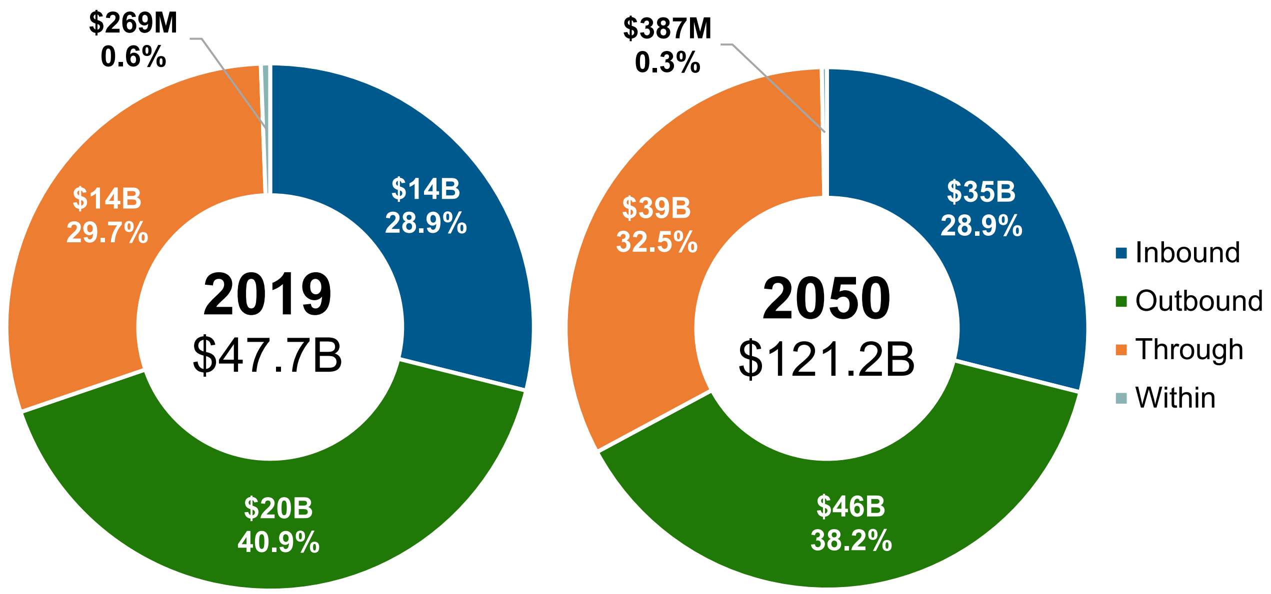
Over 55 million tons of goods, valued at over $121 billion, are expected to be shipped through, into, within, and out of the CORE MPO region in 2050 via rail as shown in Figure 2.19 and Figure 2.20. In terms of tonnage, through movements are projected to increase their share of freight rail traffic to account for the largest share at about 43 percent. Inbound movements are project to grow in magnitude (from about 11 million tons in 2019 to 18 million tons in 2050), but to decrease in total share from about 39.5 percent to 33.3 percent. Outbound flows are expected to grow in magnitude and increase their total share, from about 20.5 percent of total rail flows to over 23 percent. Similar to the analysis of highway commodity flows, the data implies that in the future the region's railroads will increasingly serve national movements of goods that pass through without stopping.

FIGURE 2.19 CORE MPO RAILTONS BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.20 CORE MPO RAIL VALUE BY DIRECTION, 2019 AND 2050

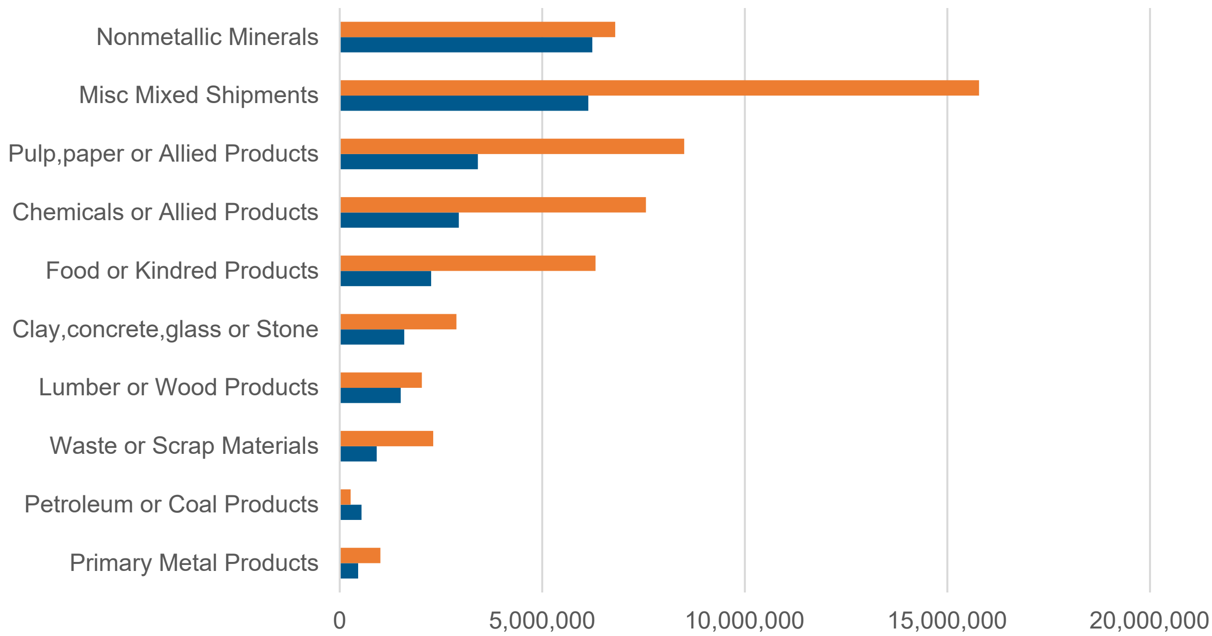


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

In terms of value, outbound movements are projected to account for the largest portion of total freight rail value at nearly 38 percent in 2050. Outbound movements are followed in terms of total value by through (nearly 33 percent) and inbound (about 29 percent) as shown in Figure 2.20. All freight movement directions except “within” are projected to more than double in value from 2019 to 2050. Outbound movements will increase the most, with an additional $26 billion in value, followed by through movements with an additional $25 billion and inbound movements with an additional $21 billion. Overall, the CORE MPO region’s highways are expected to experience higher tonnages as well as an influx of goods with much higher values. It will be imperative to prepare for this growth as some roadways may not currently be able to manage this demand.

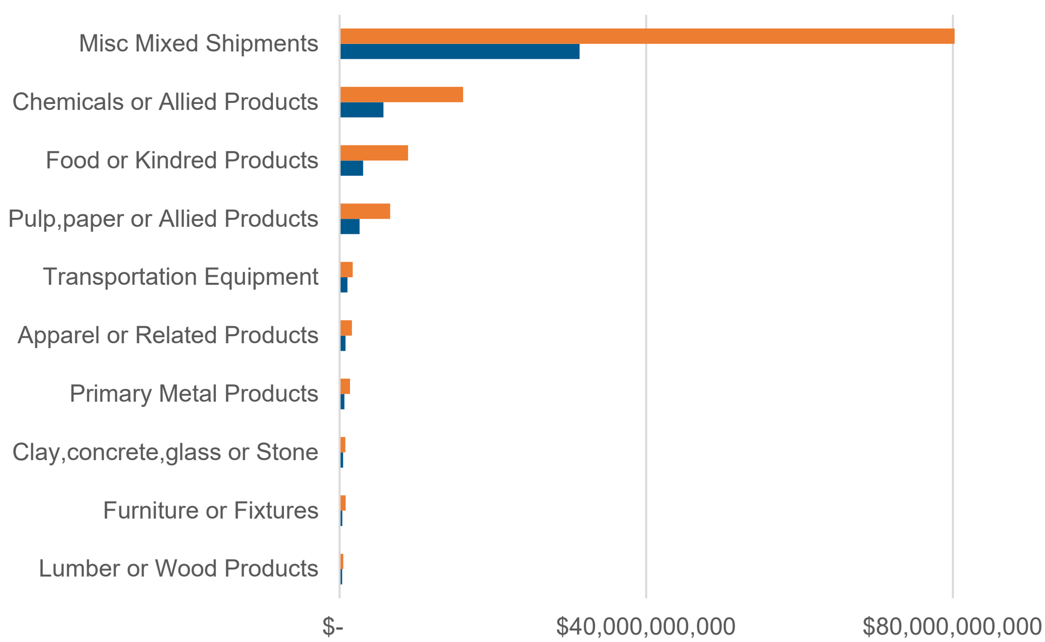
Figure 2.21 and Figure 2.22 show the top commodities by total tonnage and value, respectively, transported on the CORE MPO region's freight rail network. Bulk commodities including nonmetallic minerals (e.g., stone, sand, gravel, chemical and fertilizer minerals), pulp and paper products, chemicals, lumber and wood products, waste and scrap, and clay and stone are among the heaviest goods on the region's railroads. By value, the top freight rail commodities include transportation equipment, miscellaneous mixed shipments, chemicals, food products, pulp and paper products, and transportation equipment. Combined, the top ten commodities by tonnage account for approximately 96 percent of the total tonnage and 97 percent of the total value for commodities transported by rail in the region.

FIGURE 2.21 TOP RAIL COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.22 TOP RAIL COMMODITIES BY VALUE, 2019 AND 2050

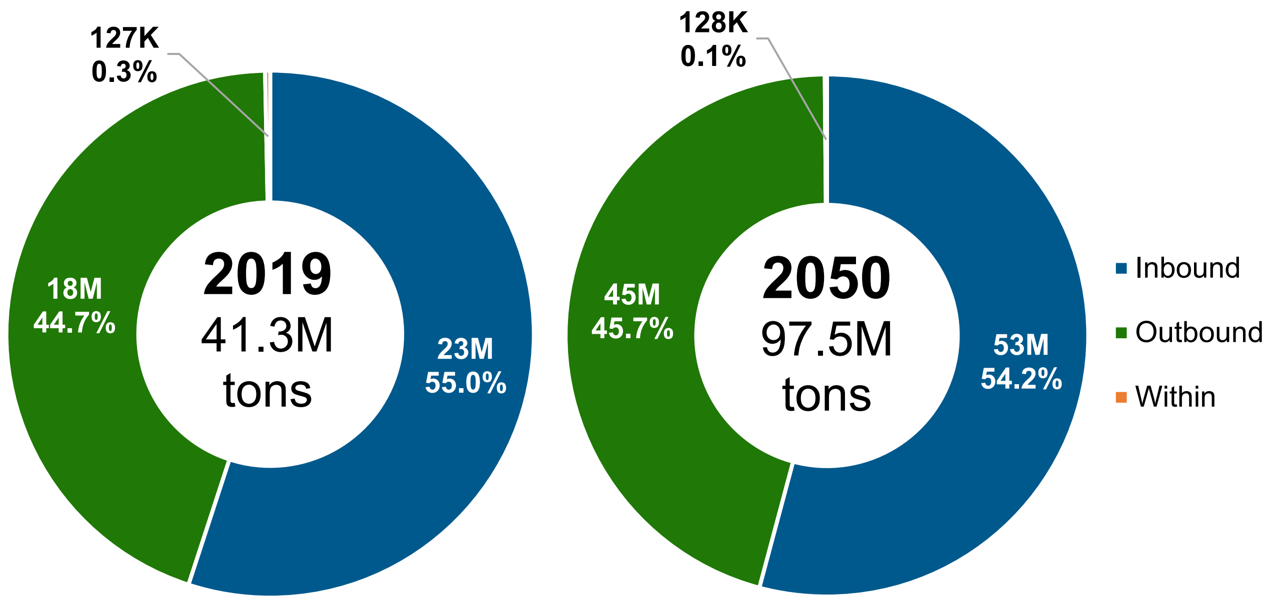


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Water

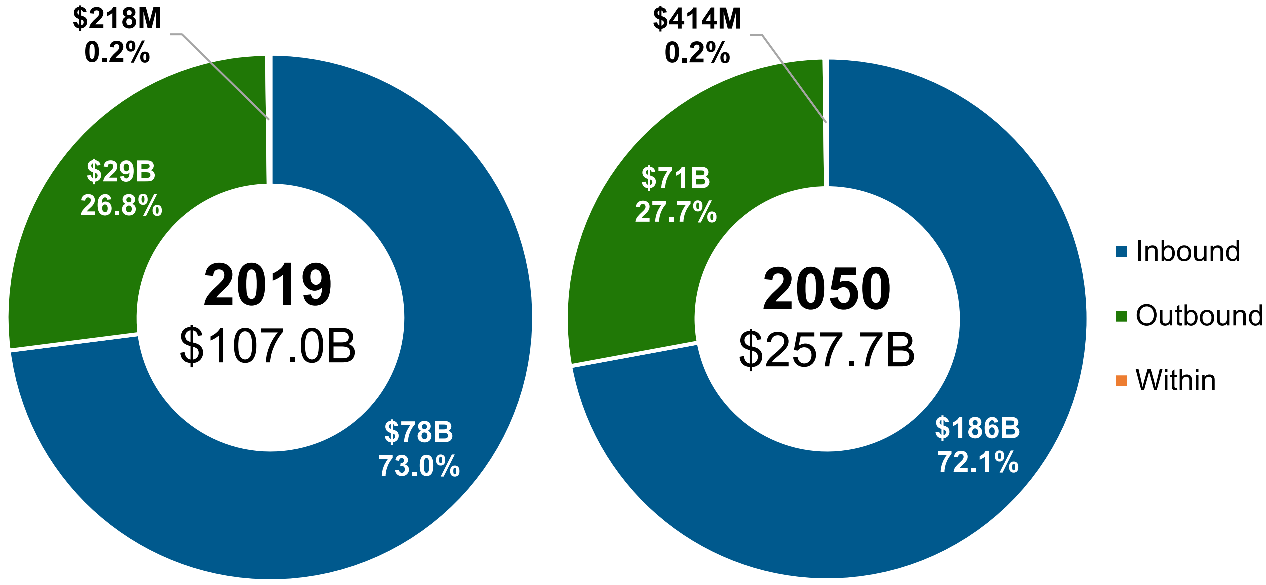
Over 41 million tons of freight valued at over $107 billion was transported by the CORE MPO region's ports and waterways in 2019 as shown in Figure 2.23 and Figure 2.24. Inbound and outbound movements accounted for about 55 percent and 44.7 percent of total flows, respectively. Only a very small share of the waterborne freight produced in the CORE MPO region remains in the three-county area, less than one percent. By 2050, the amount of waterborne goods shipped in the region are projected to grow to nearly 98 million tons of goods, valued at nearly $258 billion as shown in Figure 2.23 and Figure 2.24. The directional split in waterborne freight (i.e., inbound, outbound, and within) is expected to remain largely consistent with 2019 values.

FIGURE 2.23 CORE MPO WATER TONS BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.24 CORE MPO WATER VALUE BY DIRECTION, 2019 AND 2050

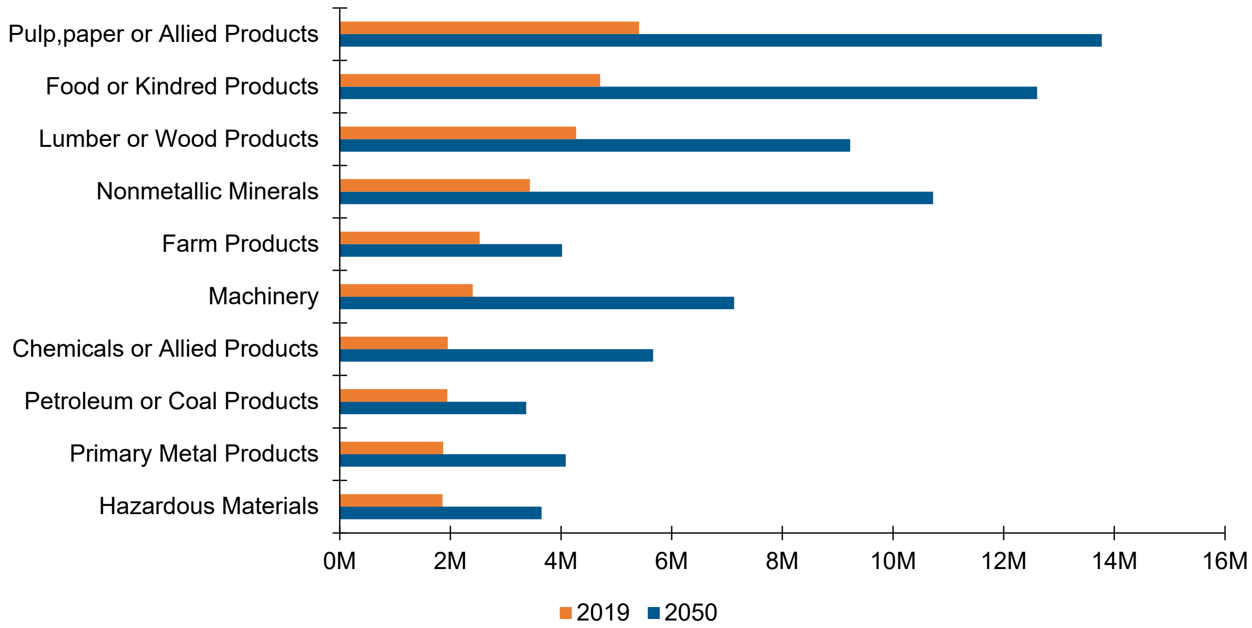


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

In terms of value, inbound movements are projected to account for the largest portion of total waterborne value at about 72 percent in 2050. The remainder of value is largely captured by outbound movements at about 27.7 percent with less than 1 percent of value consisting of within movements as shown in Figure 2.24. The breakdown in value by direction is generally consistent between the 2019 and 2050 estimates.

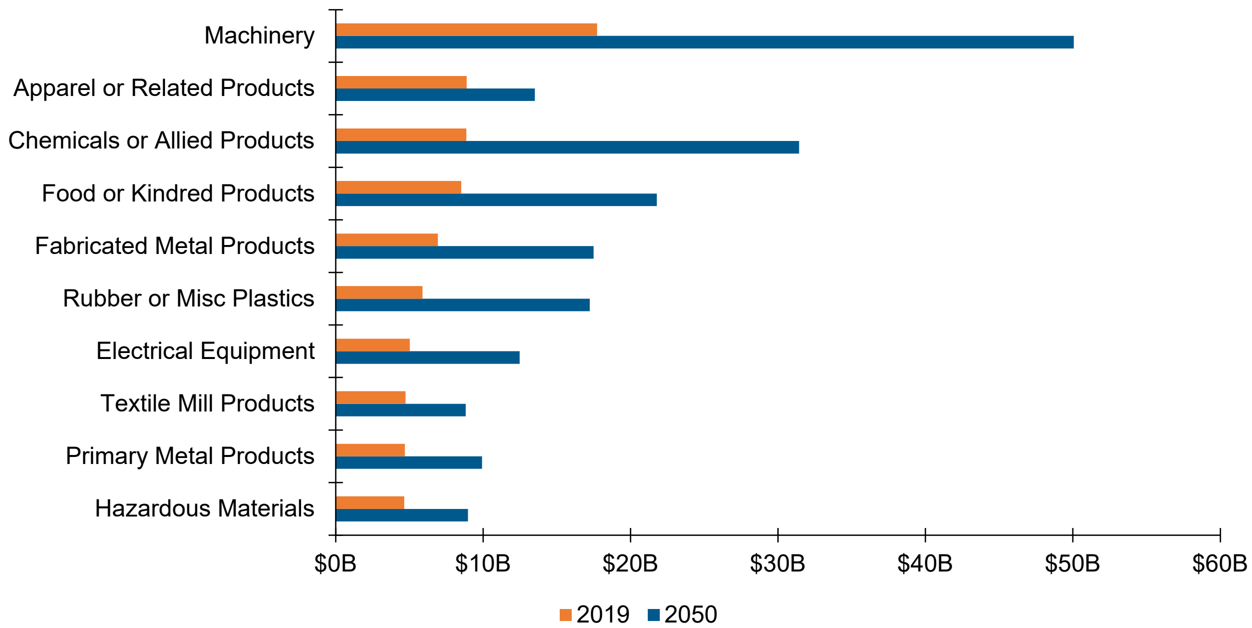
Figure 2.25 and Figure 2.26 show the top commodities by total tonnage and value, respectively, transported by the CORE MPO region's waterways. These include pulp and paper products, food products, lumber and wood products, nonmetallic minerals, and farm products. By value, the top waterborne commodities include machinery, apparel, chemicals, food products, and fabricated metal products (e.g., cutlery, plumbing fixtures and heating equipment, wire, bolts and other fasteners, and structural metal products). Combined, the top ten commodities account for approximately 74 percent of the total tonnage and 72 percent of the total value for commodities transported by water in the region.

FIGURE 2.25 TOP WATER COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.26 TOP WATER COMMODITIES BY VALUE, 2019 AND 2050

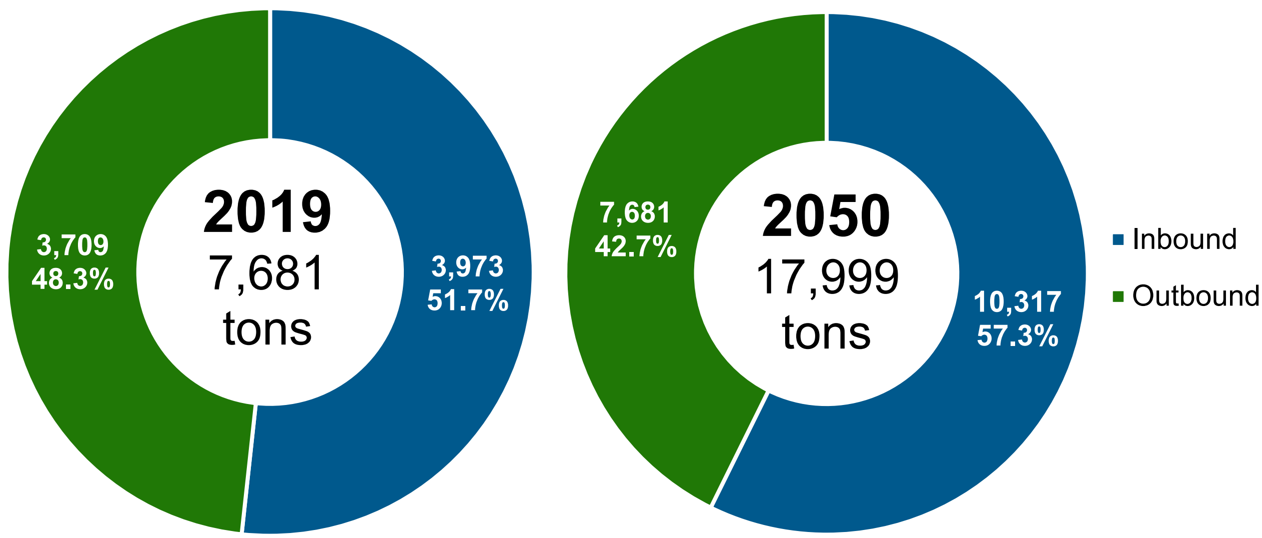


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

Air

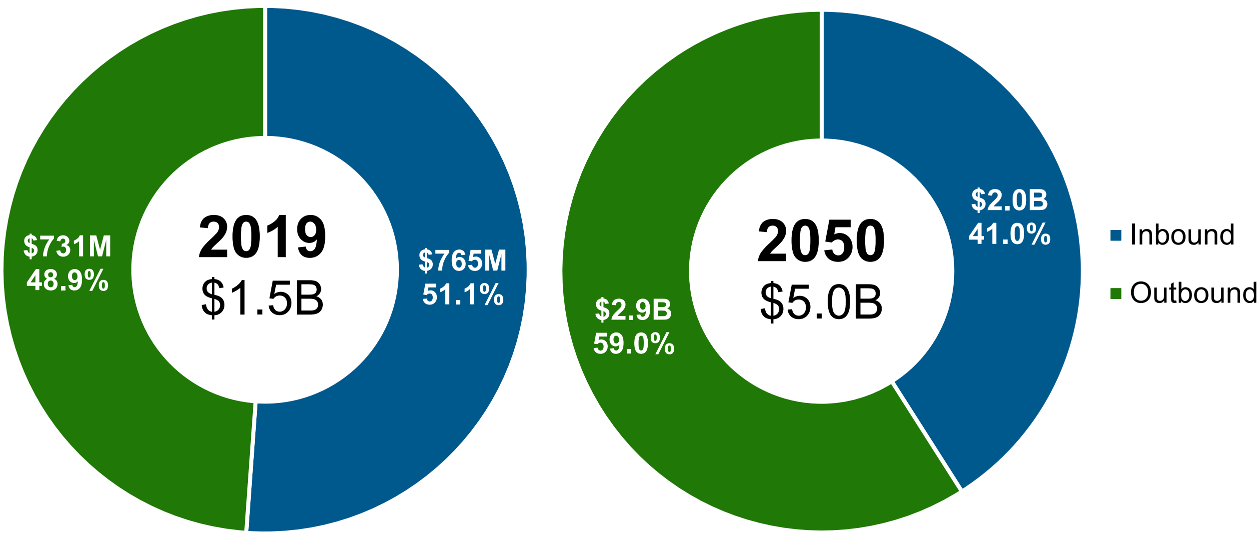
The region's airports transport a relatively small amount of freight. However, the types of goods handled by the air cargo network tend to be high value. As shown in Figure 2.27 and Figure 2.28, nearly 7,700 tons of freight valued at about $1.5 billion was transported by the CORE MPO region's airports. Inbound and outbound movements accounted for about 52 percent and 48 percent of total flows, respectively. By 2050, the amount of goods shipped via air are projected to grow to nearly 18,000 tons, valued at about $5 billion.

FIGURE 2.27 CORE MPO AIR TONS BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.28 CORE MPO AIR VALUE BY DIRECTION, 2019 AND 2050

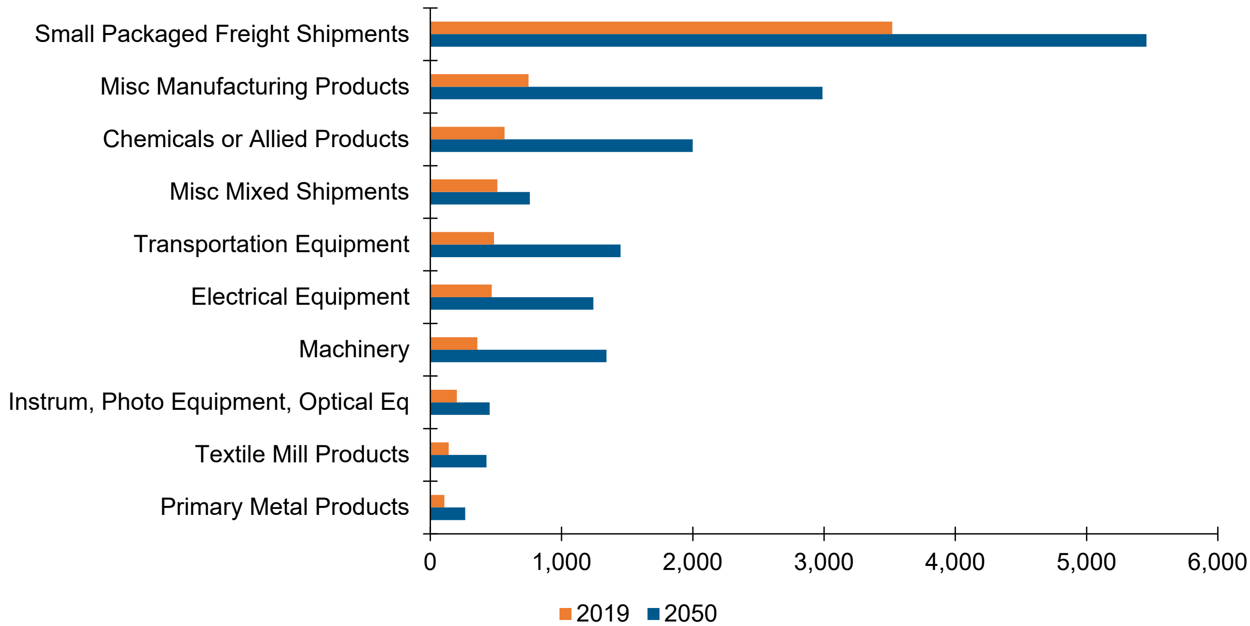


Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

The directional split between inbound and outbound movements by tonnage is expected to remain largely consistent between 2019 and 2050. However, in terms of value outbound movements are projected to overtake inbound movements and account for the largest portion of total air freight value at about 59 percent in 2050. This is largely driven by projected growth miscellaneous manufactured products (e.g., toys, sporting and athletic goods, office supplies, novelties).

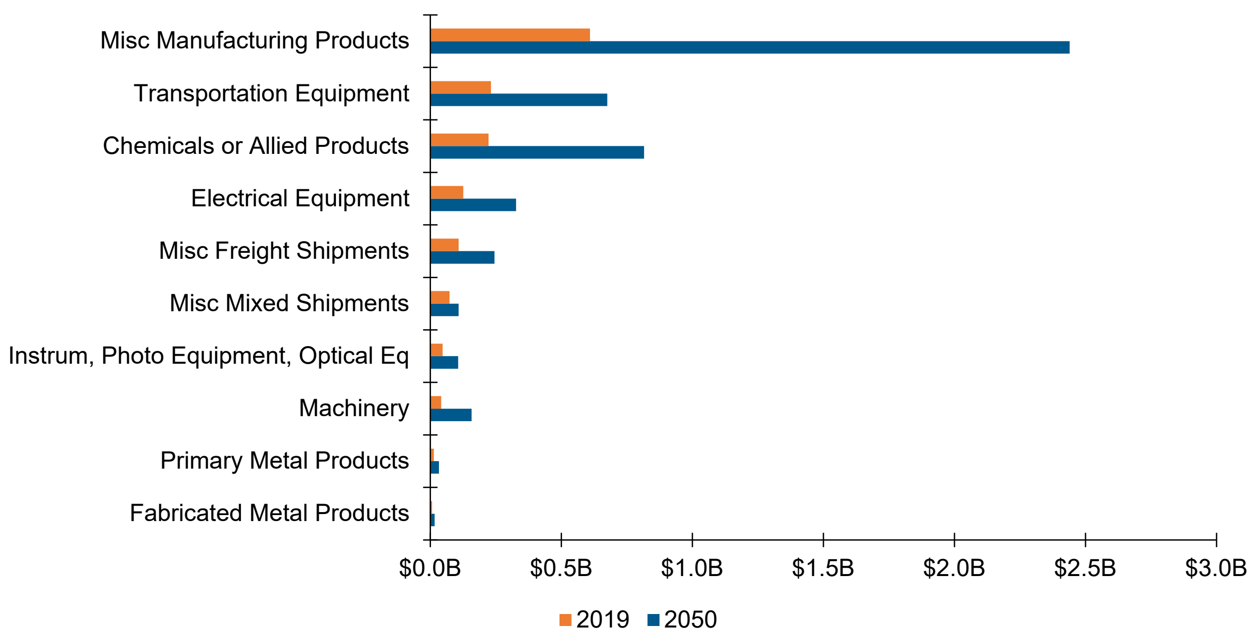
Figure 2.29 and Figure 2.30 show the top commodities by total tonnage and value, respectively, transported by air in the CORE MPO region. By both tonnage and value, these primarily consist of low-weight, high-value goods such as small packages (e.g., e-commerce types of goods), miscellaneous manufactured products, chemicals (which include drugs and other pharmaceutical products), electronics, and transportation equipment which includes vehicle parts. Combined, the top ten commodities account for approximately 92 percent of the total tonnage and 99 percent of the total value for commodities transported by air in the region.

FIGURE 2.29 TOP AIR COMMODITIES BY TONNAGE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 2.30 TOP AIR COMMODITIES BY VALUE, 2019 AND 2050



Source: TRANSEARCH; U.S. Census Bureau, USA Trade Online; Cambridge Systematics, Inc. analysis.

2.2 Freight Activity Patterns

This section of the report examines freight activity patterns throughout the three-county region. It provides insight into where, when, and how freight moves across the region's multimodal freight network. This can be important for supporting long-range planning and operations. The analysis gathers data from multiple sources – including commodity flow data from TRANSEARCH, truck global positioning (GPS) data from INRIX, and daily train volume data at at-grade crossings from the Federal Railroad Administration – to paint a comprehensive picture of freight activity in the region.

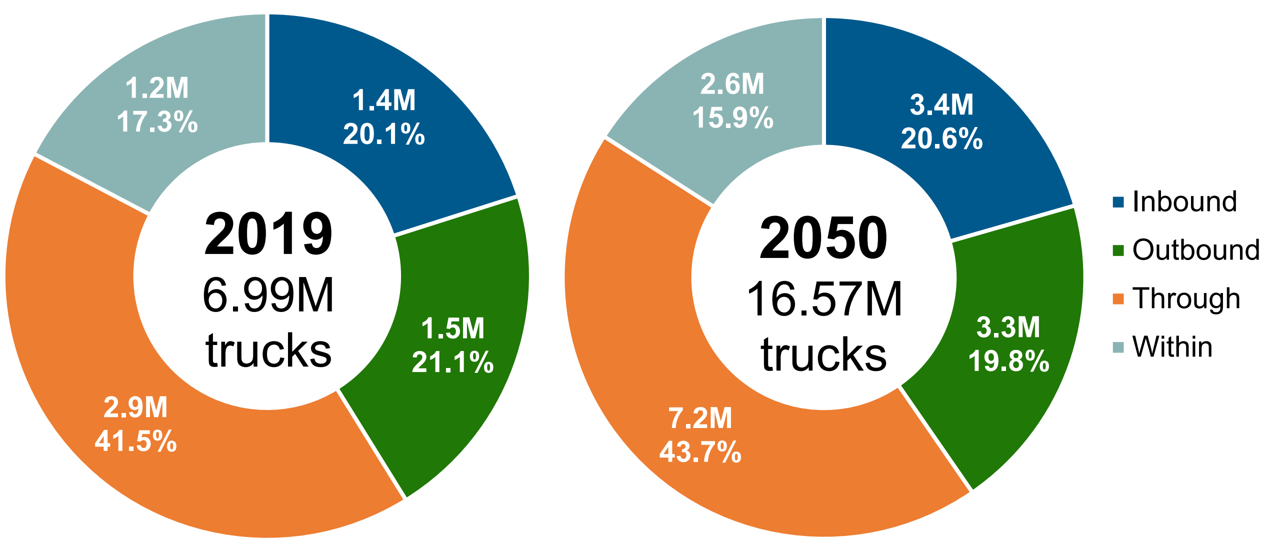
Routing of Truck and Rail Commodity Flows

The following section contains information on routed truck and rail commodity flows. This analysis was produced by assigning TRANSEARCH data to the highway network to estimate the number of units along roadways and railways in the region. In addition, the analysis examines data on daily train volumes at at-grade crossings near the Port of Savannah using information from the Federal Railroad Administration.

Truck Commodity Flows

Figure 2.31 is a breakdown of truck unit movements by direction in both 2019 and 2050. In 2019, about 7 million total trucks moved throughout the region, with about 40 percent of those movements passing through the region without stopping. This share increases slightly to 44 percent of the total 16.7 million trucks in 2050. About 20 percent of truck movements originated in the CORE MPO region in both years, as well as 20 percent of truck units terminating in the region. Between 16-17 percent of movements in the analysis years stayed within the region.

FIGURE 2.31 CORE MPO TRUCK UNITS BY DIRECTION, 2019 AND 2050

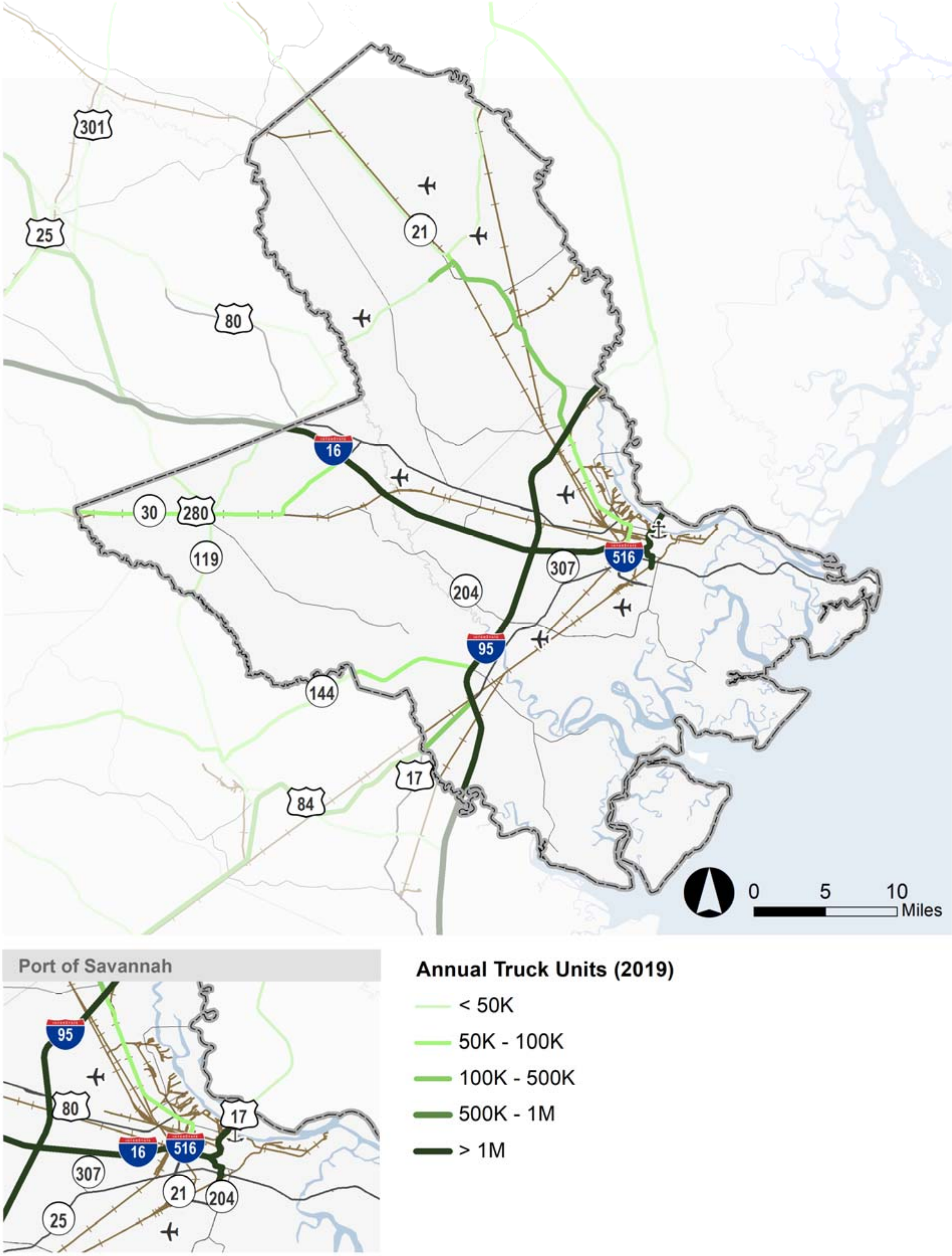


Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

Figure 2.32 and Figure 2.33 show the routed TRANSEARCH data in the CORE MPO region for 2019 and 2050, respectively. The results indicate that Interstate highways carry over 1,000,000 trucks in each analysis year. Except for the Truman Parkway, which is a limited-access highway, no other roadways experience such high levels of truck traffic. It is interesting to note that the data suggests that most of the region's truck traffic enters and exits the region through I-16 going west and I-95 going south. Not as many trucks are estimated to travel into South Carolina.

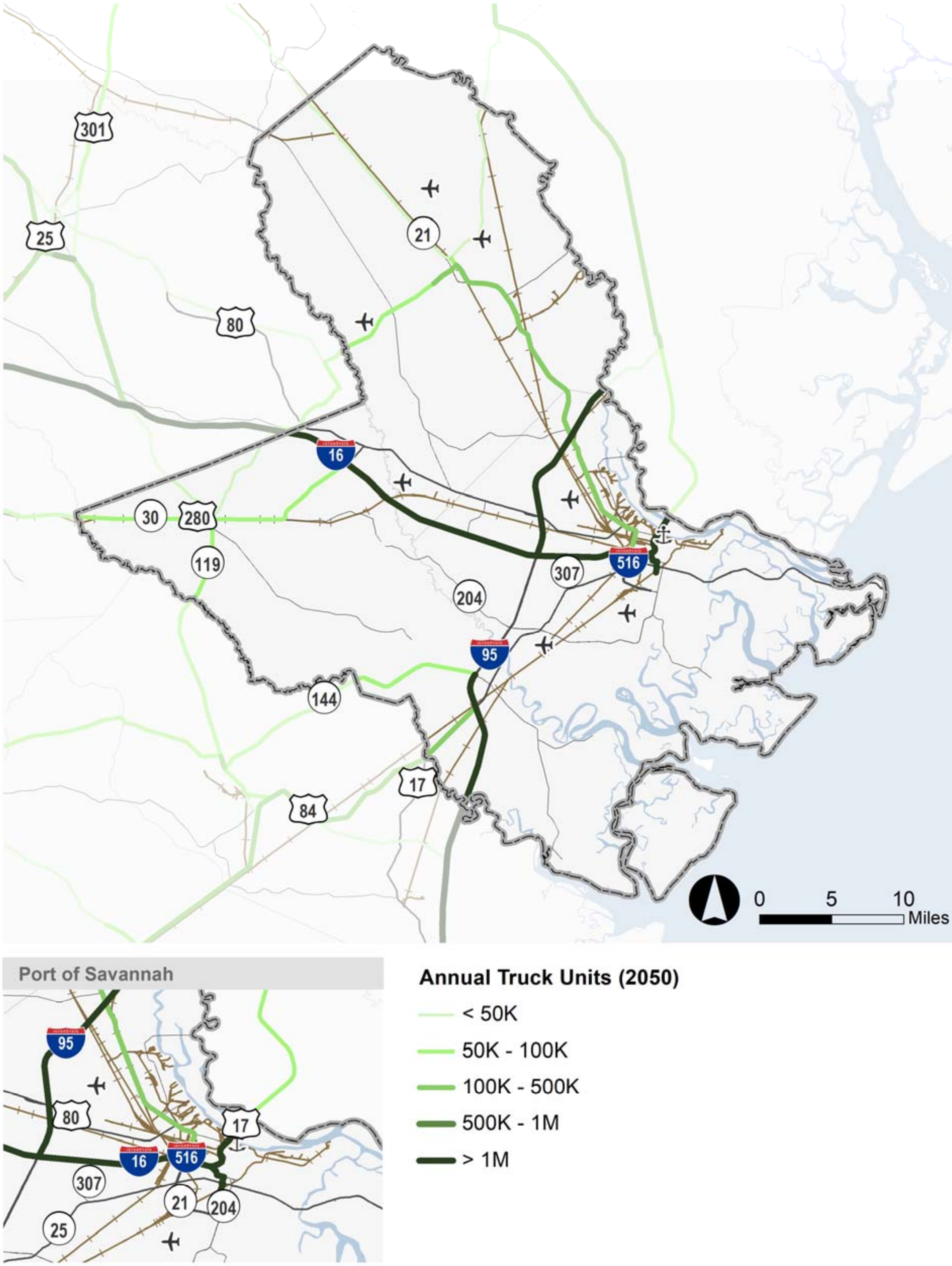
Other roadways that experience high levels of truck traffic include US 17 in the southern part of the region, US 280 in the western part of the region, and SR 21 going northwest from downtown Savannah towards the Port of Savannah. These roadways experience over 100,000 trucks in each analysis year. Similar patterns exist in 2050 as shown in Figure 2.33.

FIGURE 2.32 TRUCK FLOWS IN THE CORE MPO REGION, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

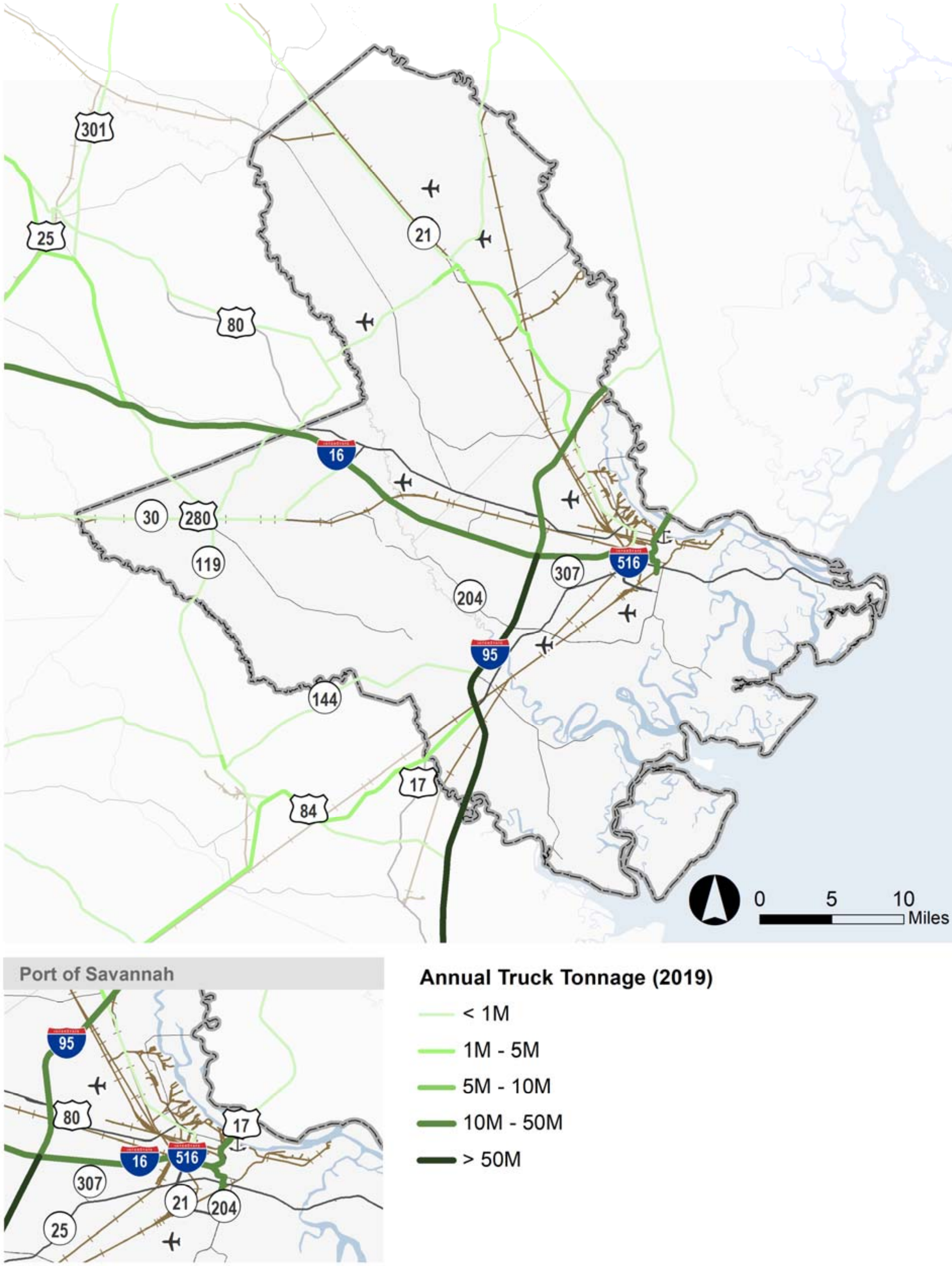
FIGURE 2.33 TRUCK FLOWS IN THE CORE MPO REGION, 2050



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

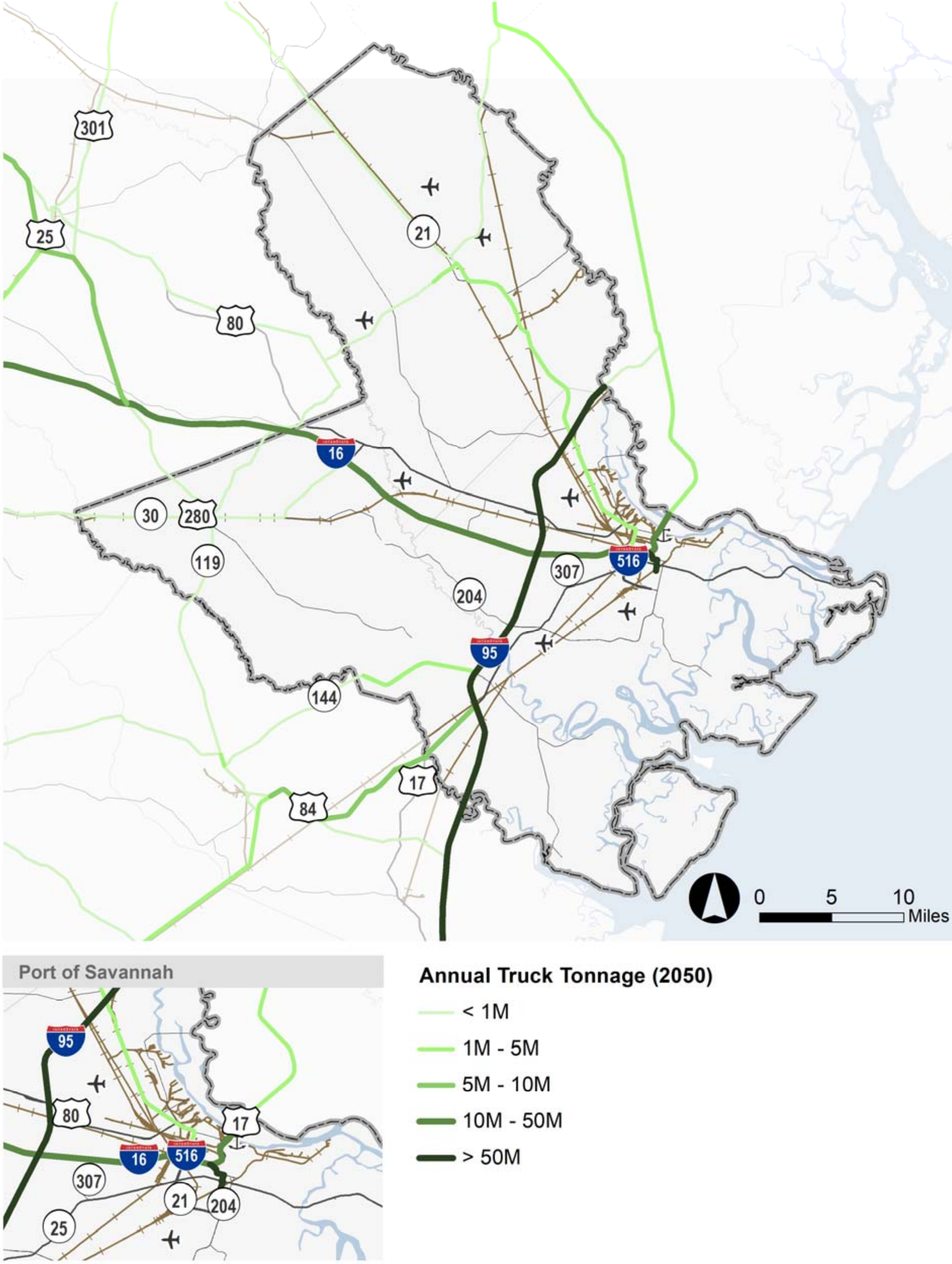
Figure 2.34 and Figure 2.35 are similar to the previous two figures, but instead display routed truck tonnage (as opposed to routed truck units). This is important from an asset management perspective because routes that carry higher tonnages of freight experience greater and more rapid pavement deterioration. Similarly, Interstate highways have the highest truck tonnages in the region. I-95 south of its interchange with I-16 is estimated to carry over 50 million tons annually in 2019 and 2050. Other Interstate corridors are estimated to generally carry between 10 million and 50 million tons annually in 2019 and 2050. By 2050, the entirety of I-95 in the CORE MPO region is projected to carry over 50 million tons annually, as well a small portion of I-516.

FIGURE 2.34 ROUTED TRUCK TONNAGE IN THE CORE MPO REGION, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 2.35 ROUTED TRUCK TONNAGE IN THE CORE MPO REGION, 2050

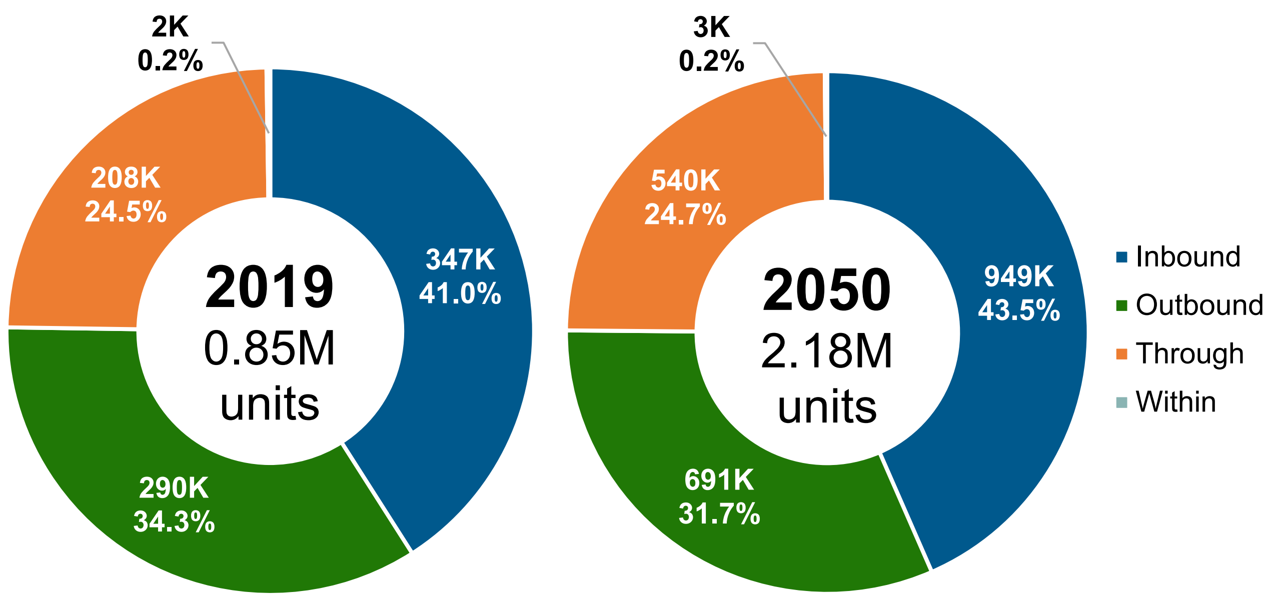


Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

Rail Commodity Flows

Figure 2.36 shows the rail unit movements (i.e., carloads and trailers/containers on flatcars) by direction in 2019 and 2050. In 2019, just nearly 850,000 total rail units moved throughout the region, with about 41 percent of those consisting of inbound movements to the region. By 2050, inbound movements are projected to grow to represent about 43.5 percent of the region's approximately 2.18 million total rail units. Outbound movements are estimated to comprise just over 34 percent of rail units in 2019 and are projected to decrease in total share of traffic to nearly 32 percent by 2050. Just under 25 percent of the rail units are estimated to pass through the region without stopping.

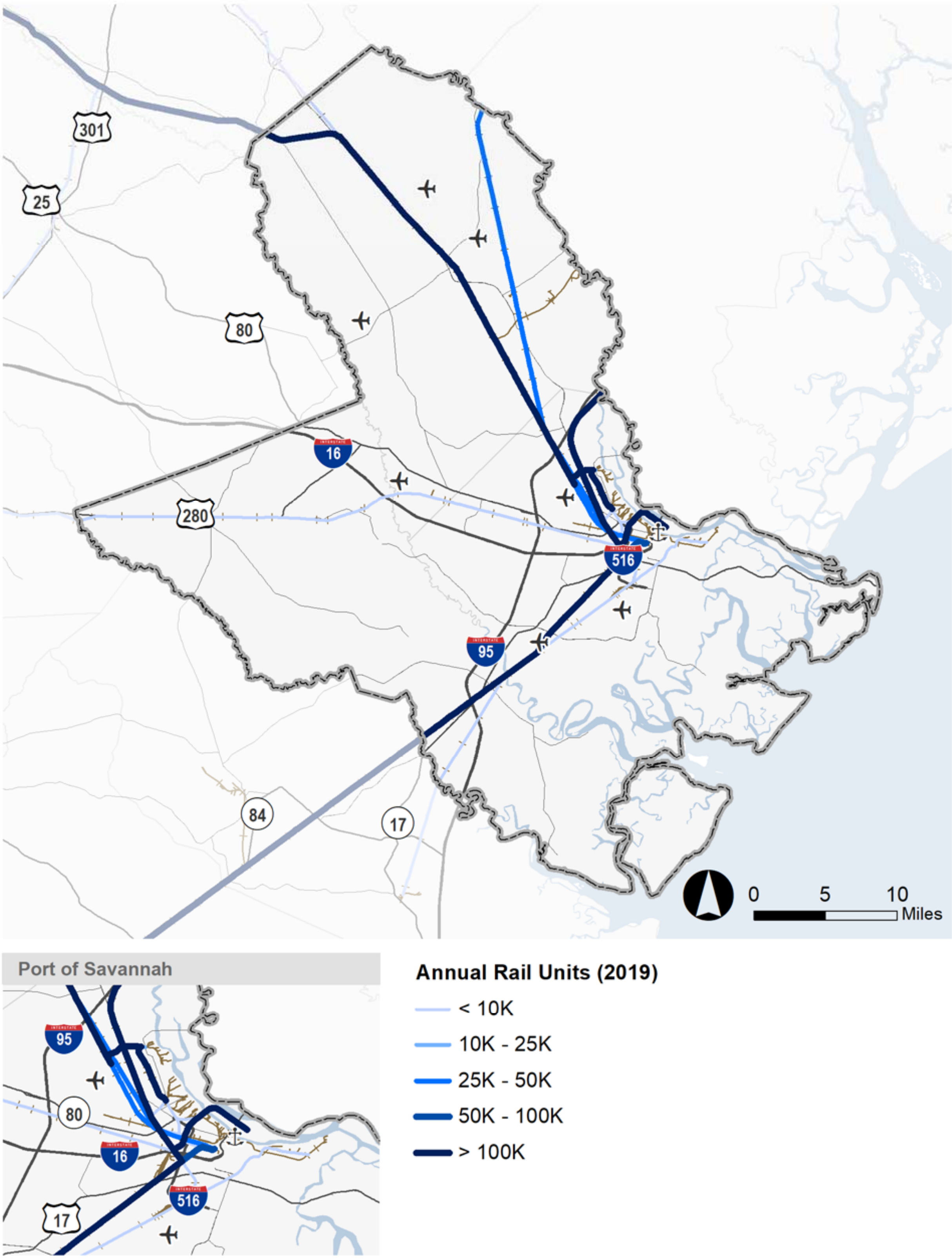
FIGURE 2.36 CORE MPO RAIL UNITS BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

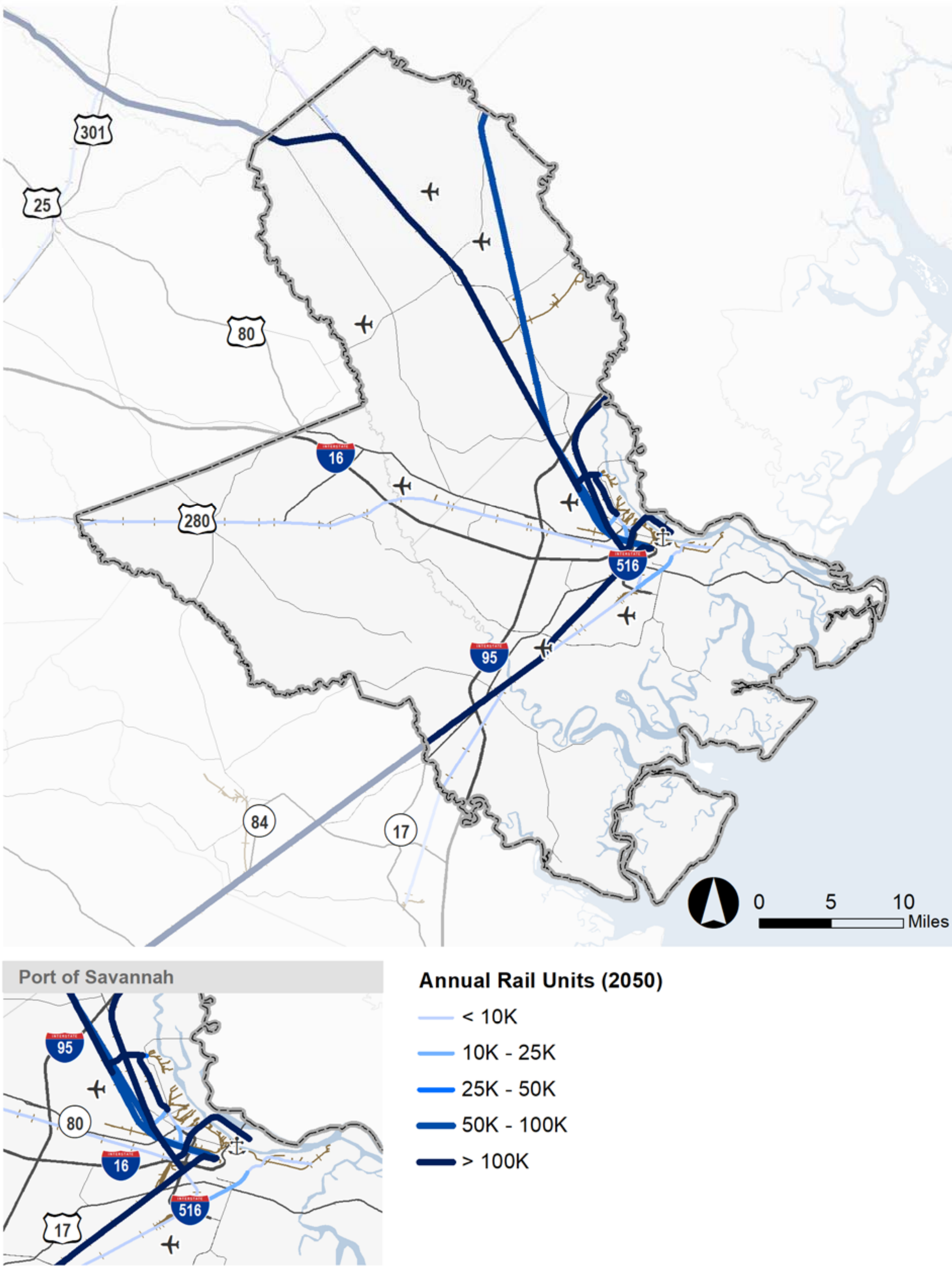
Figure 2.37 and Figure 2.38 show the routed TRANSEARCH rail data for the CORE MPO region for 2019 and 2050, respectively. In both years, the highest concentration of rail traffic is experienced by segments proximate to the Port of Savannah and along the Savannah River. These segments of track are estimated to carry over 100,000 rail units annually in 2019 and 2050. Based on the data, the highest volume segments in the region include: (1) the CSX Transportation line north of the Port of Savannah into South Carolina which parallels I-95; (2) the Norfolk Southern line northwest from the port; and (3) the CSX Transportation southwest from the port. All of these lines are expected to increase in traffic by 2050.

FIGURE 2.37 RAIL FLOWS IN THE CORE MPO REGION, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

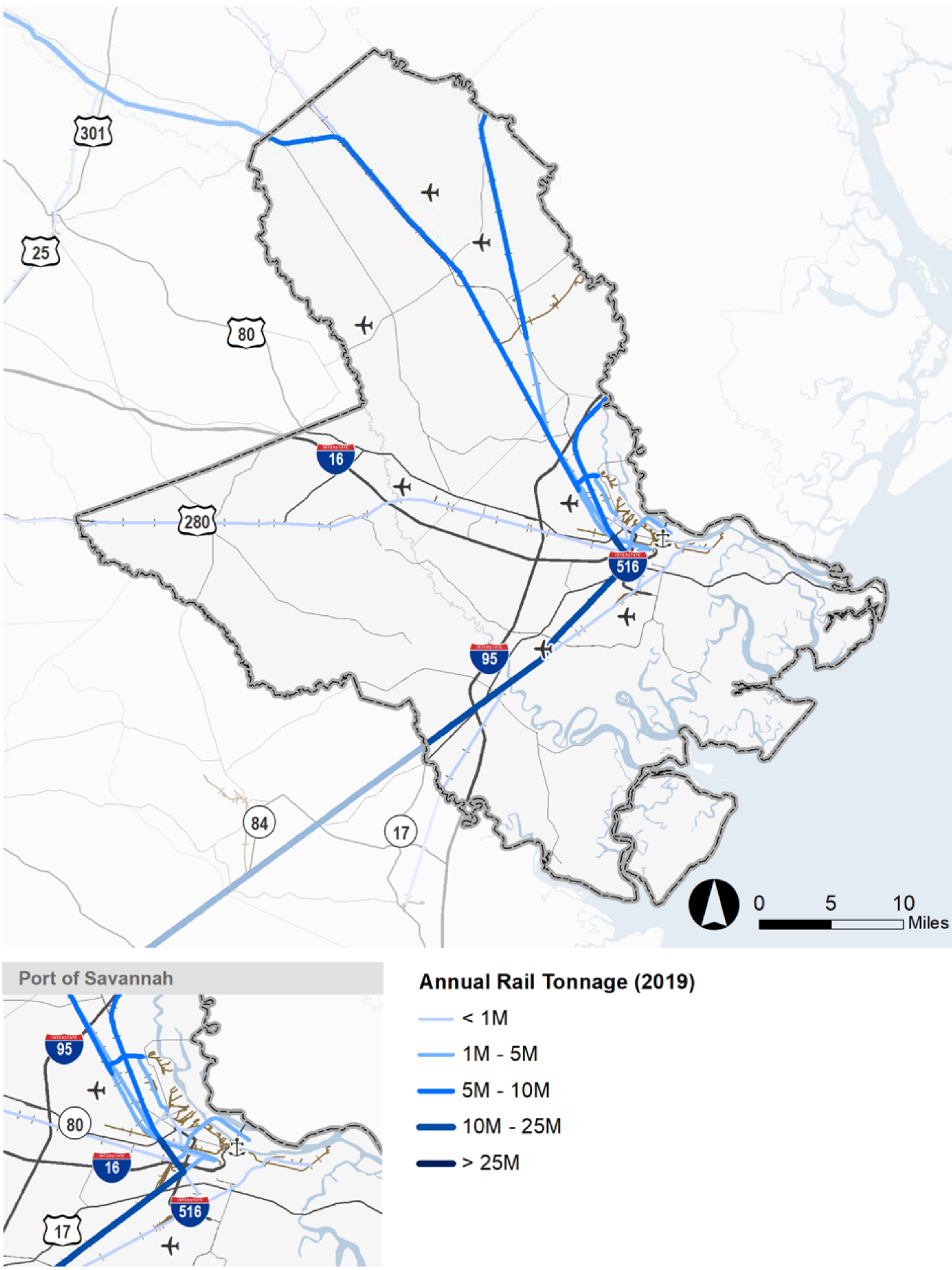
FIGURE 2.38 RAIL FLOWS IN THE CORE MPO REGION, 2050



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

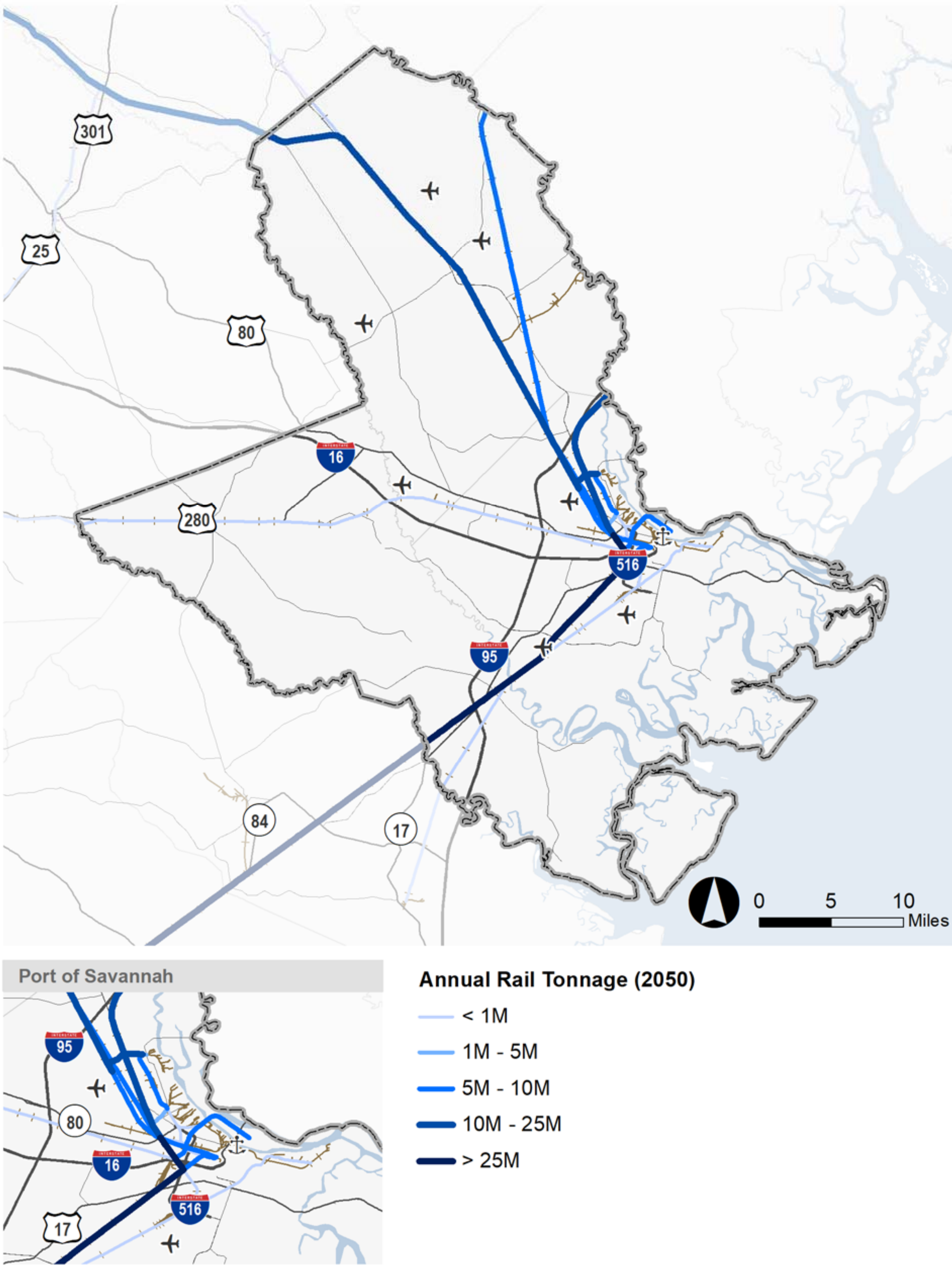
Figure 2.39 and Figure 2.40 are similar to the previous two figures, but instead display routed tonnage (as opposed to routed units) on the rail network. These maps highlight the same routes as before but provide context as to how much tonnage they carry. The same routes previously discussed carry at least 5 million tons annually in 2019 and over 10 million annually in 2050. The CSX rail line southwest from the Port of Savannah is estimated to carry the most tonnage with about 15 million tons in 2019 and 34 million tons in 2050.

FIGURE 2.39 ROUTED RAIL TONNAGE IN THE CORE MPO REGION, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 2.40 ROUTED RAIL TONNAGE IN THE CORE MPO REGION, 2050

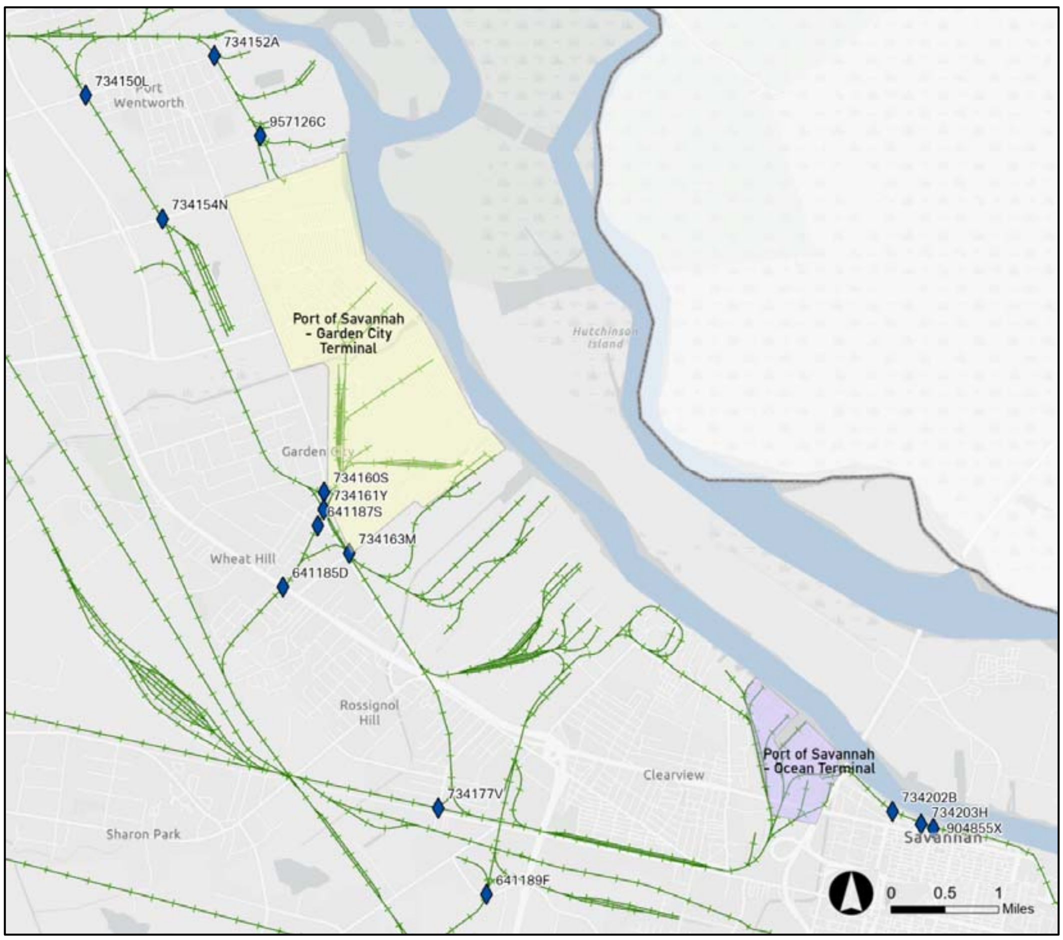


Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

Port of Savannah Train Volumes

Generally, the Port of Savannah generates about 6 trains daily out of its Garden City and Ocean Terminals based on feedback from the Georgia Ports Authority. Some additional insights on train activity at the Port of Savannah can be developed using information published in the Federal Railroad Administration (FRA) highway-rail crossing database. For this analysis, 15 at-grade, public, open railroad crossings were considered due to their location on high volume tracks around the entrances to the Port of Savannah's Garden City Terminal (North) and Ocean Terminal (South). These 15 crossings are shown in Figure 2.41. Four of these 15 crossings, primarily those east of the Ocean Terminal, reported no activity. The reason is because the Georgia Ports Authority (GPA) does not often load trains with cargo at that location.

FIGURE 2.41 AT-GRADE RAIL CROSSINGS NEAR THE PORT OF SAVANNAH



Source: Federal Railroad Administration; AECOM.

Table 2.3 contains the FRA data on total through and switching train movements for at-grade crossings that report some level of train activity. Through train movements are those where a train passes a crossing en route to its destination. Switching movements are those associated with building rail units into trains or breaking down trains into units so that they may be delivered to a customer or attached to a different train. The largest volume of daily through train movements occur across four crossing locations: crossings 734152A and 957126C north of the Garden City Terminal, crossing 641187S south of the Garden City Terminal, and crossing 734177V south of the port across the east-west stretch of railroad between the two terminals. These total daily through train volumes equate to approximately 4,000 to 6,500 trains annually around the two terminals.

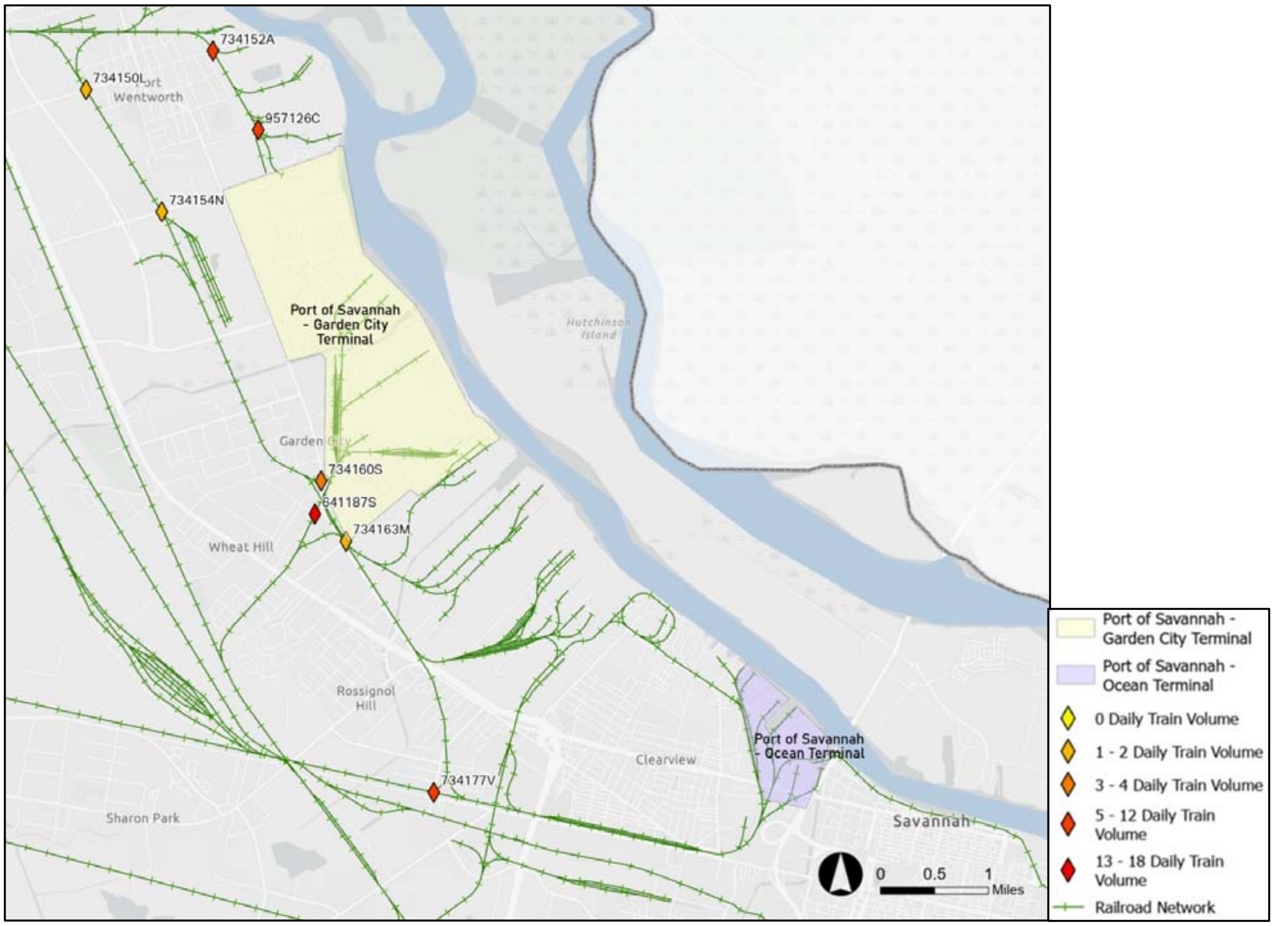
TABLE 2.3 TRAIN MOVEMENTS AT AT-GRADE CROSSINGS NEAR THE PORT OF SAVANNAH

Crossing ID	Railroad	Switching Movements	Through Train Movements
641187S	CSX	3	18
641189F	CSX	6	0
641213E	CSX	2	0
734150L	NS	0	2
734152A	NS	10	12
734154N	NS	0	2
734160S	NS	2	4
734161Y	NS	8	0
734163M	NS	2	2
734177V	NS	10	11
957126C	NS	10	12

Source: Federal Railroad Administration, 2022; AECOM; Cambridge Systematics.

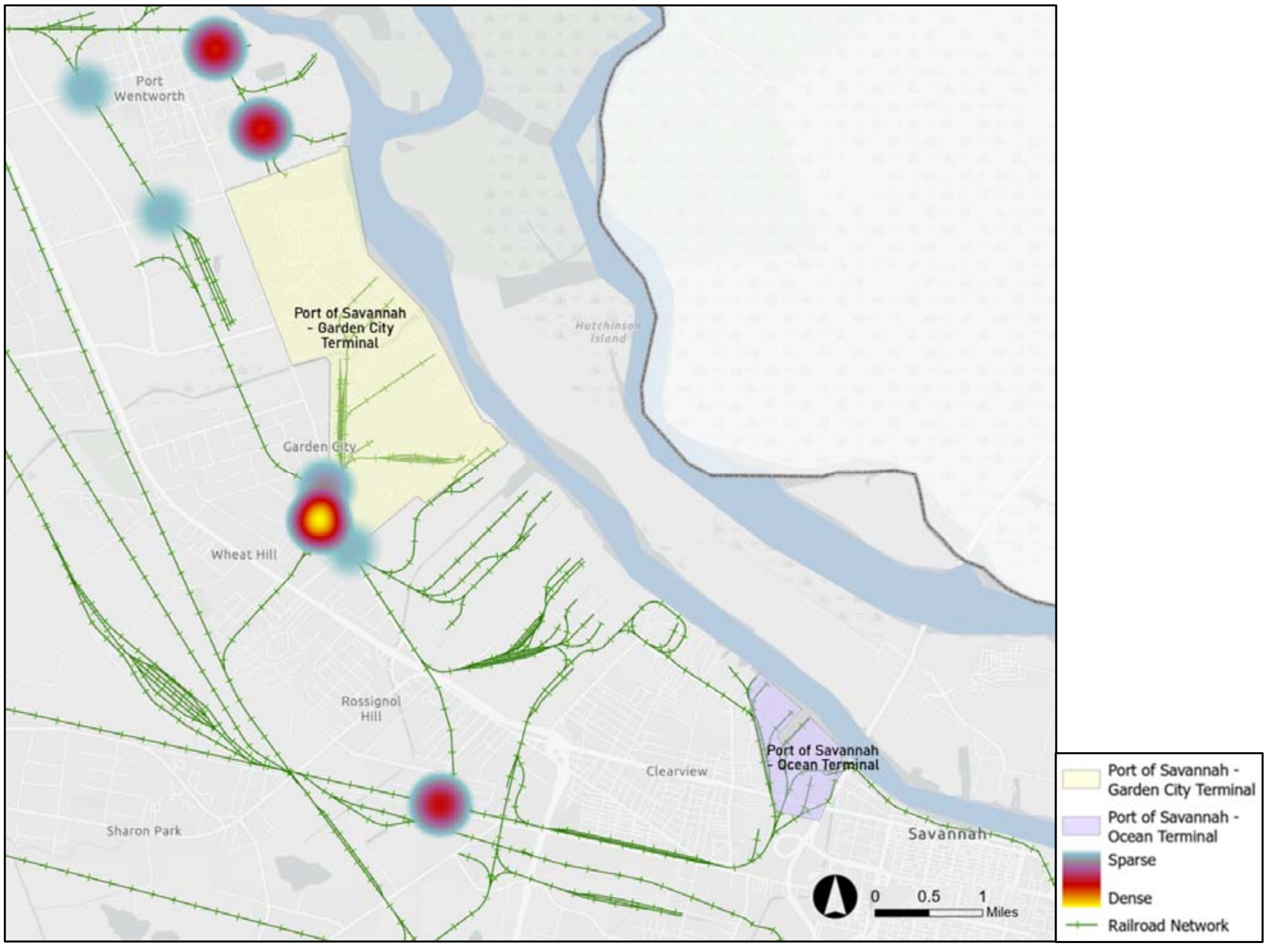
Figure 2.42 shows the average daily train volumes for the crossings. This data can be visualized as a heat map to accentuate the high train volume areas near the Port of Savannah. These four hot spots are shown in Figure 2.43. The densest hot spot area is to the south entrance of the Garden City Terminal, where crossings 641187S and 743160S are located. These patterns may change because of the recently opened Mason Mega Rail Terminal, which added over 97,000 feet of new rail and expanded the Garden City Terminal for a total of 34 miles of track. It will enable the Port of Savannah to receive six 10,000-foot trains simultaneously, thereby greatly increasing capacity and potentially redistributing train patterns.

FIGURE 2.42 TRAIN VOLUMES AT AT-GRADE CROSSINGS PROXIMATE TO THE PORT OF SAVANNAH



Source: Federal Railroad Administration, 2022; AECOM; Cambridge Systematics.

FIGURE 2.43 HEATMAP OF TRAIN VOLUMES AT AT-GRADE CROSSINGS PROXIMATE TO THE PORT OF SAVANNAH



Source: Federal Railroad Administration, 2022; AECOM; Cambridge Systematics.

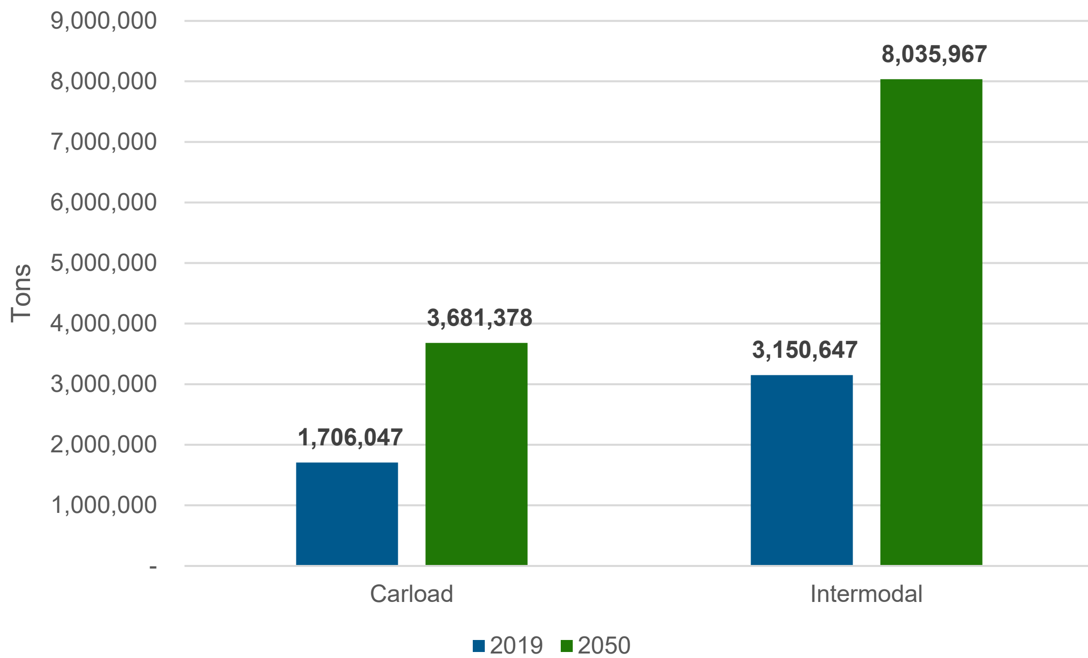
In addition to the FRA data, information from the TRANSEARCH database also provides insights into train volumes associated with the Port of Savannah. TRANSEARCH flags international shipments as either import or exports. Given that the Port of Savannah is the only international gateway in the region for shipments arriving or departing via rail, international rail shipments to and from the region were assumed to be served by the Port of Savannah. It is important to note that the forecasted routing does not consider network or operational changes that may impact the specific rail routes taken to and from the Port of Savannah.

Figure 2.44 shows the estimated tonnage of rail by traffic type served by the Port of Savannah in 2019 and 2050. Carload traffic consists of boxcars, hopper cars, and tankers and is typically used to transport bulk goods such as agricultural products, sand, gravel, coal, and chemicals or other liquids. Intermodal traffic consists of containers or trailers and can be used to transport a variety of goods. For the Savannah region, the top five containerized commodities to or from the port by rail in 2019 include freight all kinds (FAK) shipments[1], metal scrap or tailings, chemical preparations, plastic materials or synthetic fibers, and tires or inner tubes. In 2019, over 1.7 million carload tons and 3.1 million intermodal tons are estimated to have been

[1] FAK shipments consists of various goods that have been grouped together so that they may be transported as a single shipment at a fixed rate.

shipped to or from the Port of Savannah. By 2050, those values are projected to increase to nearly 3.7 million carload tons and over 8 million intermodal tons. This represents an increase of nearly 116 percent for carload tonnage and 155 percent for intermodal tonnage.

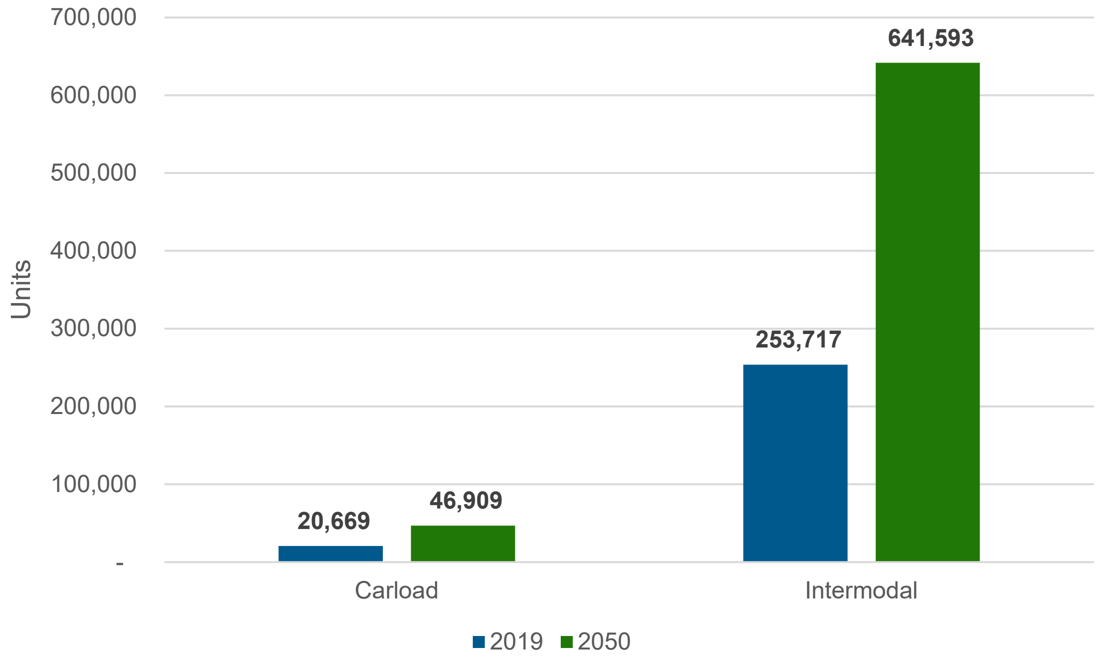
FIGURE 2.44 PORT OF SAVANNAH RAIL TONNAGE BY TRAFFIC TYPE, 2019 AND 2050



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

In terms of units (i.e., carloads and containers on flatcars) of rail traffic serving the Port of Savannah, in 2019 nearly 21 carloads and 254,000 intermodal containers are estimated to have been shipped to or from the Port of Savannah. By 2050, those values are projected to increase to nearly 47,000 carloads and nearly 642,000 intermodal tons. This represents an increase of nearly 127 percent for carload tonnage and 153 percent for intermodal tonnage.

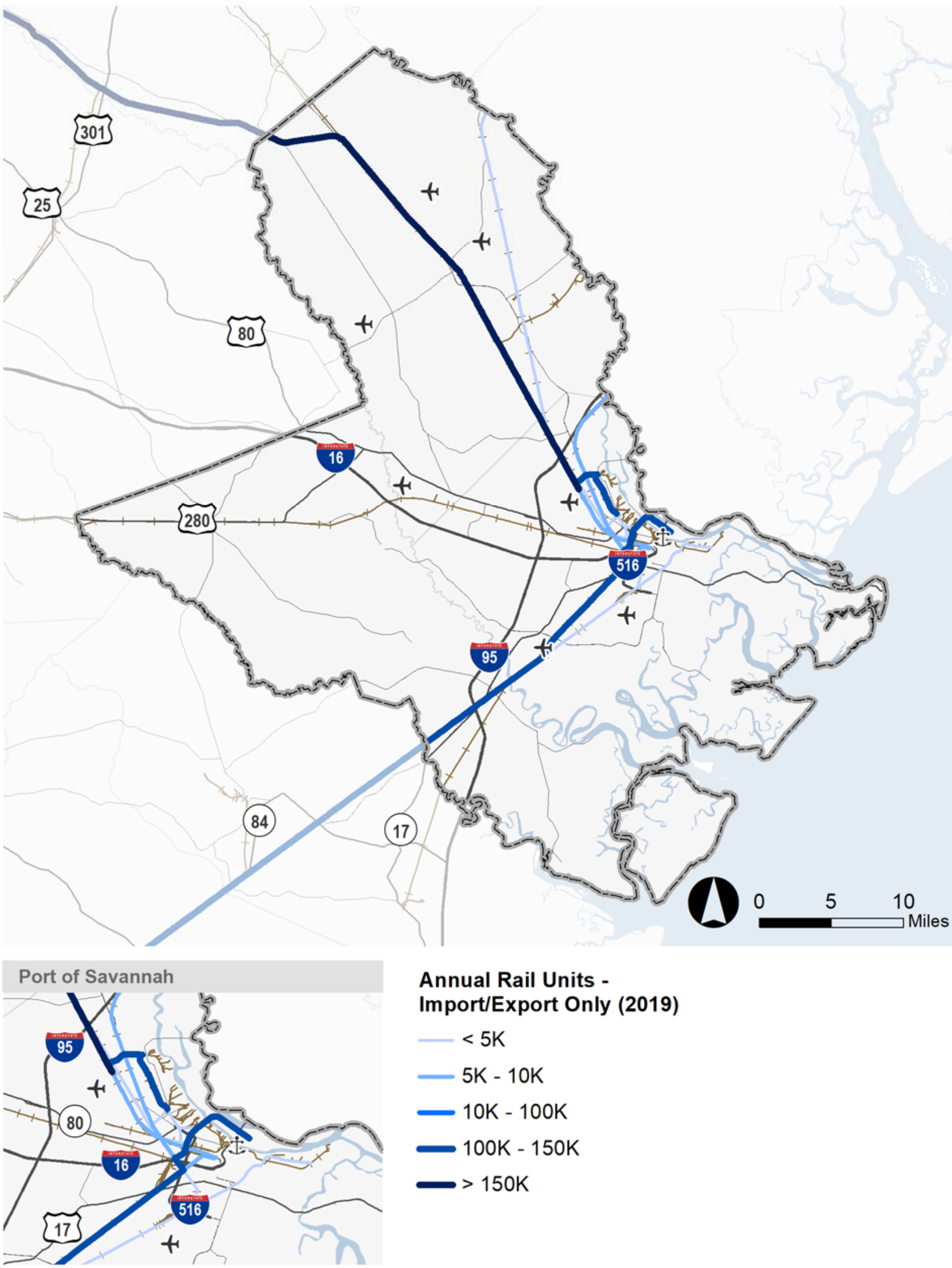
FIGURE 2.45 PORT OF SAVANNAH RAIL UNITS BY TRAFFIC TYPE, 2019 AND 2050



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

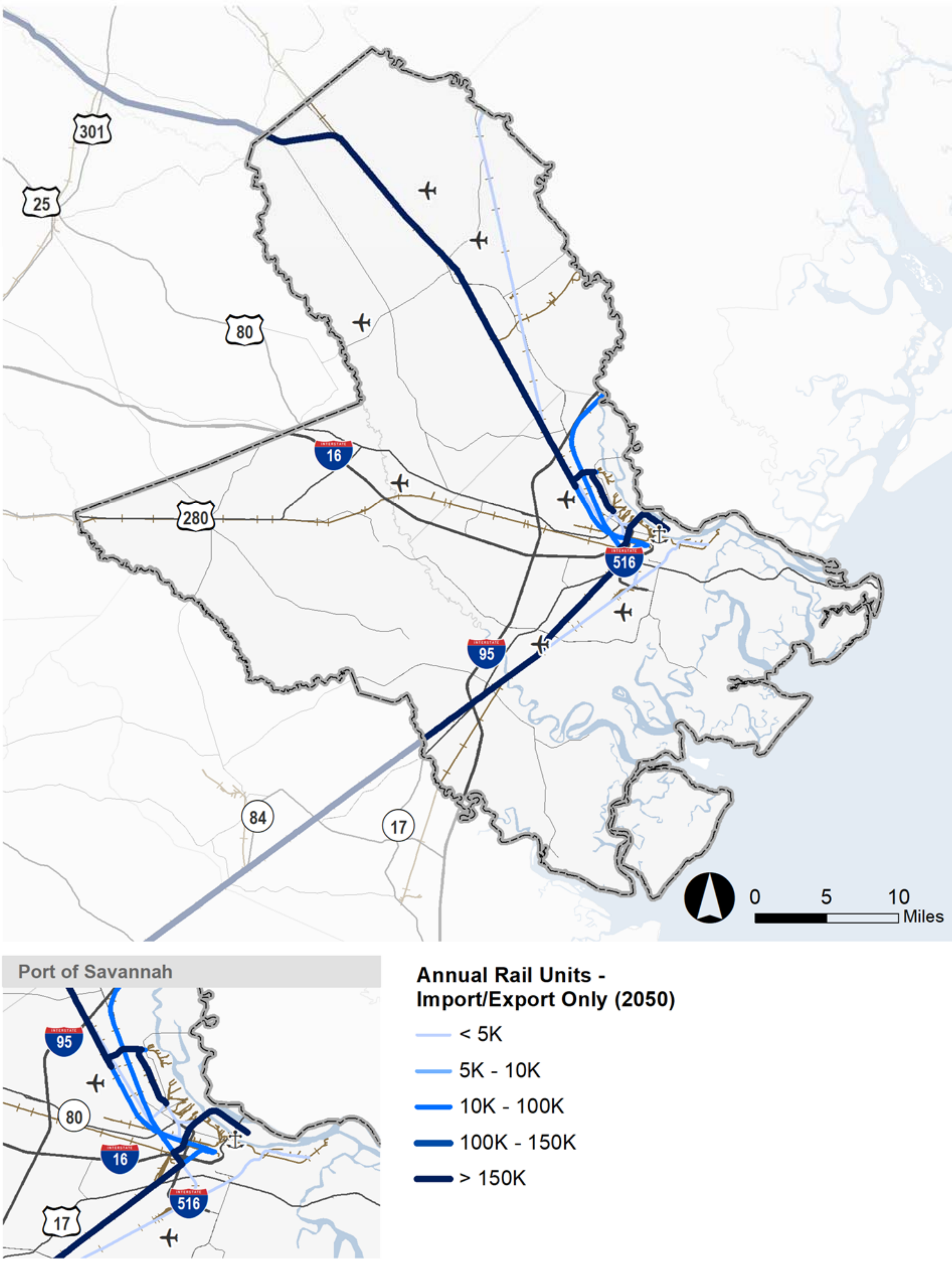
Figure 2.46 and Figure 2.47 show 2019 and 2050 annual rail flows that originate or end in Chatham County and are assumed to be attributed to activity at the Port of Savannah. The highest volume routes in the region for port rail traffic are similar to the overall highest volume routes in the previous set of figures. The highest-trafficked routes include: (1) the two Norfolk Southern and CSX Transportation spur lines directly into the western and eastern portions of the port, respectively, with over 150,000 annual units in 2019 and 2050; (2) the Norfolk Southern line northwest from the port with over 150,000 annual units in 2019 and 2050; and (3) the CSX Transportation southwest from the port with over 100,000 annual units in 2019 and 150,000 annual units in 2050. All of these lines are expected to increase in traffic by 2050.

FIGURE 2.46 INTERNATIONAL RAIL FLOWS IN THE CORE MPO REGION, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

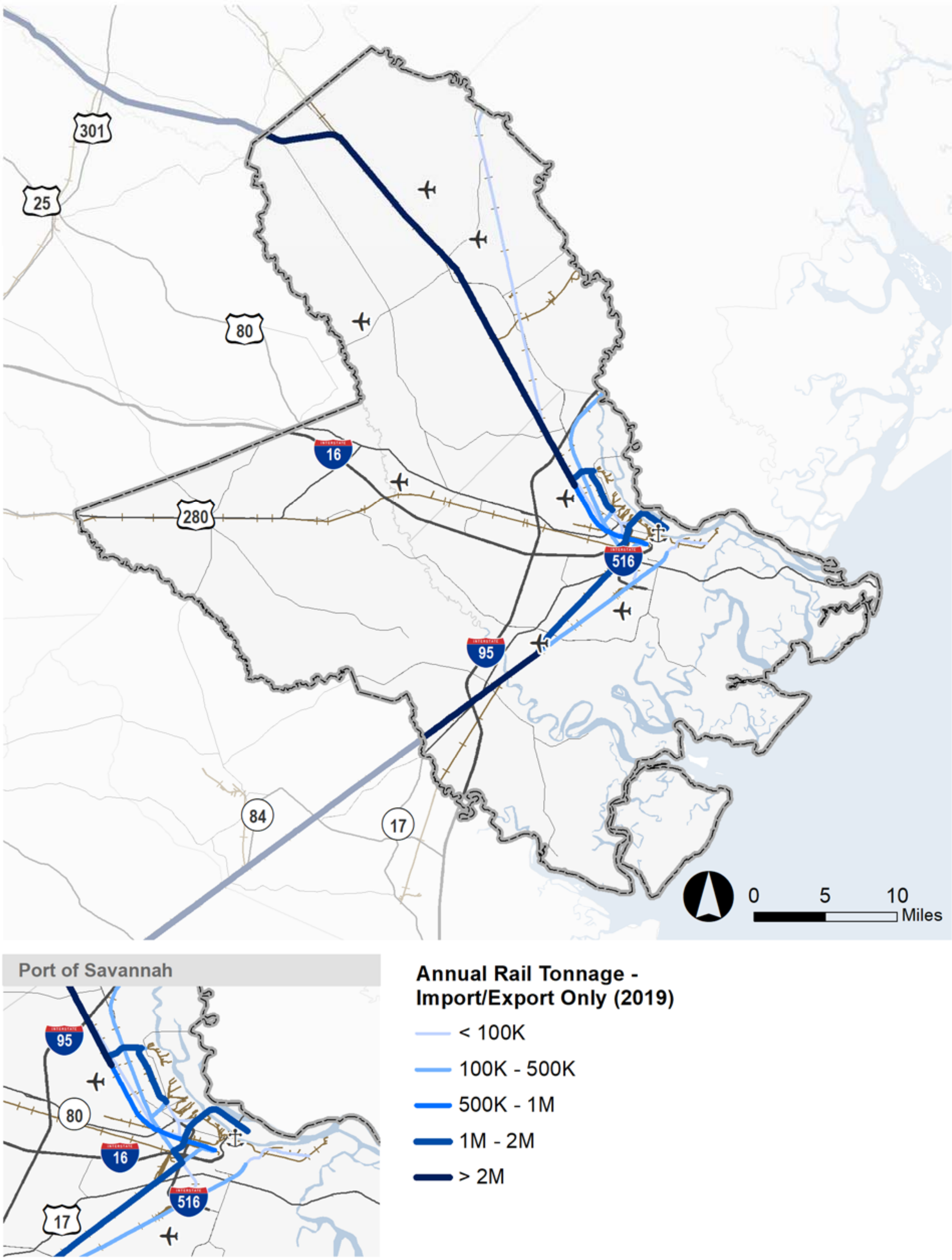
FIGURE 2.47 INTERNATIONAL RAIL FLOWS IN THE CORE MPO REGION, 2050



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

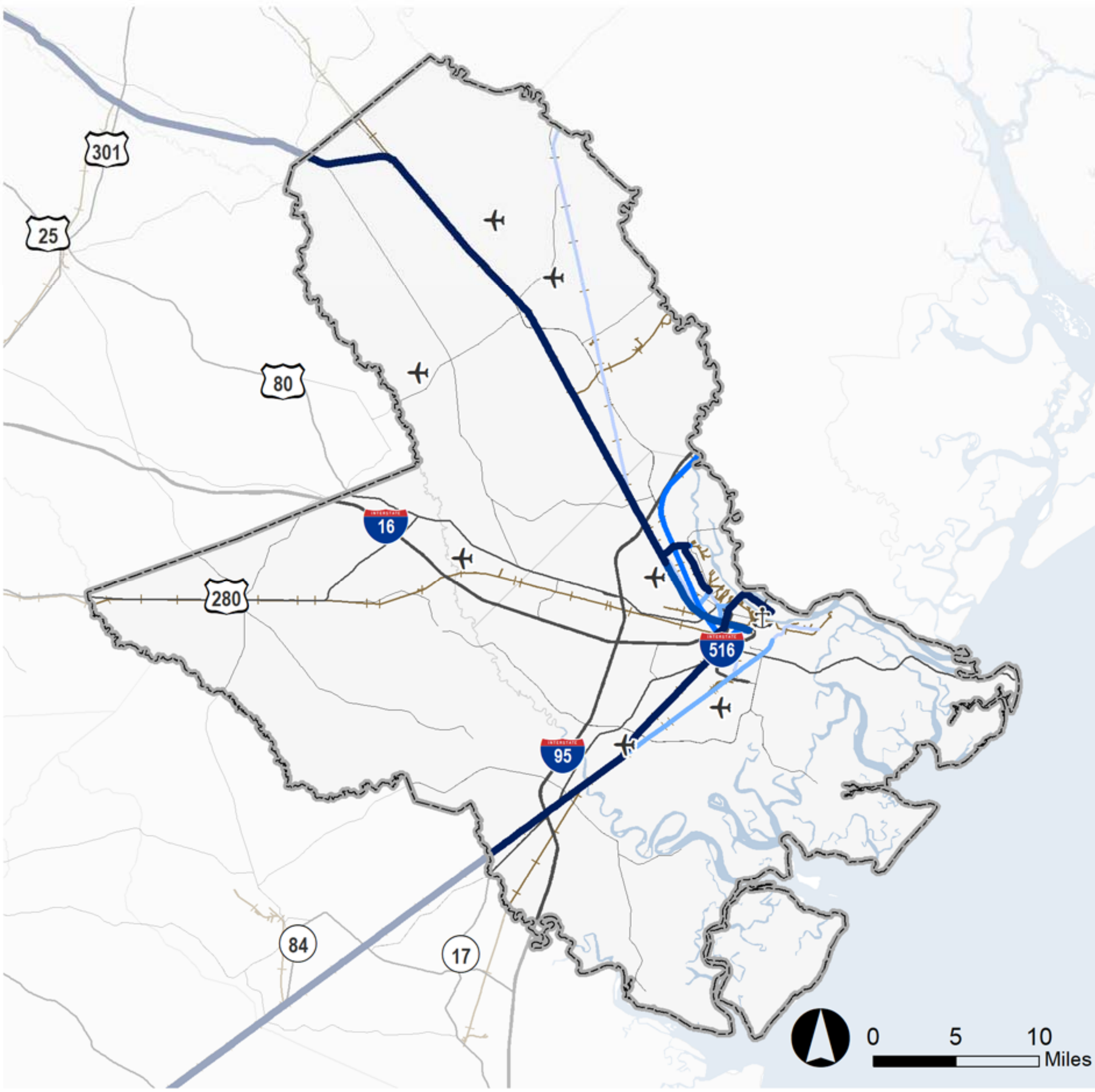
Figure 2.48 and Figure 2.49 display the same international rail shipments as the previous two figures, but display the annual tonnage as opposed to annual rail flows. The same routes – the Norfolk Southern route to the northwest, the CSX line to the southwest, and the two spurs directly into the port – have the highest amounts of tonnage in both analysis years, more than 1 million tons in 2019 and 2 million tons in 2050. When comparing the results of the TRANSEARCH data analysis for rail volumes attributed to the port to general rail volumes, there are two lines that exhibit high tonnages and volumes for general rail movements but not for those associated with the port. These include the CSX line north from downtown Savannah into South Carolina and the CSX line north-northeast from downtown Savannah into South Carolina. This suggests freight rail shipments serving the Port of Savannah are generally not routed through South Carolina.

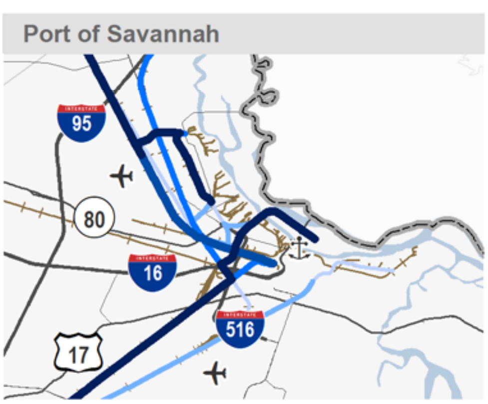
FIGURE 2.48 INTERNATIONAL ROUTED RAIL TONNAGE IN THE CORE MPO REGION, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 2.49 INTERNATIONAL ROUTED RAIL TONNAGE IN THE CORE MPO REGION, 2050





Annual Rail Tonnage - Import/Export Only (2050)

- < 100K
- 100K - 500K
- 500K - 1M
- 1M - 2M
- > 2M

Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

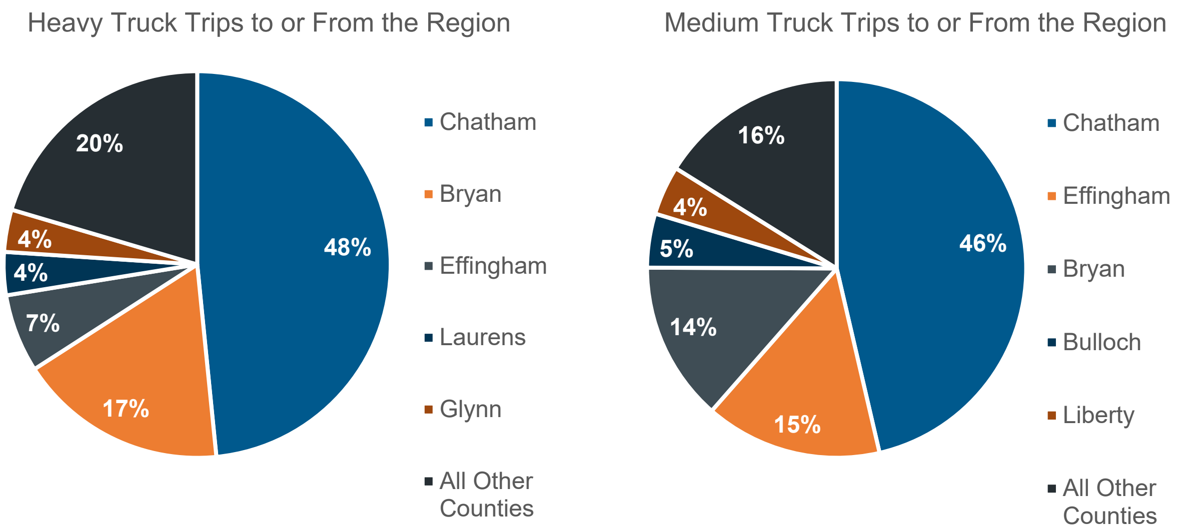
Truck Origin-Destination Patterns

In addition to commodity flow data, freight activity patterns were investigated using truck GPS data from INRIX. The GPS data provide information on the origins and destinations of medium and heavy-duty trucks in the state of Georgia for the months of February, August, and October of 2019. These data were analyzed to derive average daily weekday estimates of truck trip patterns for the region. While the data provide a real-world look at how trucks navigate the CORE MPO region, it is important to note that the data only represent a sample of trucks and not all trucks that operate in the region.

Truck Trips in the Study Area

The first component of the analysis examined the average daily origin-destination patterns of heavy and medium truck trips throughout the 3-county region. About 72 percent of heavy truck trips and 75 percent of medium truck trips began and ended in the region as shown in Figure 2.50. Outside of the region, Laurens, Glynn, Liberty, and Bulloch Counties were substantial generators of truck traffic into and out of the region.

FIGURE 2.50 AVERAGE DAILY TRUCK TRIPS BY COUNTY IN THE STUDY AREA, 2019

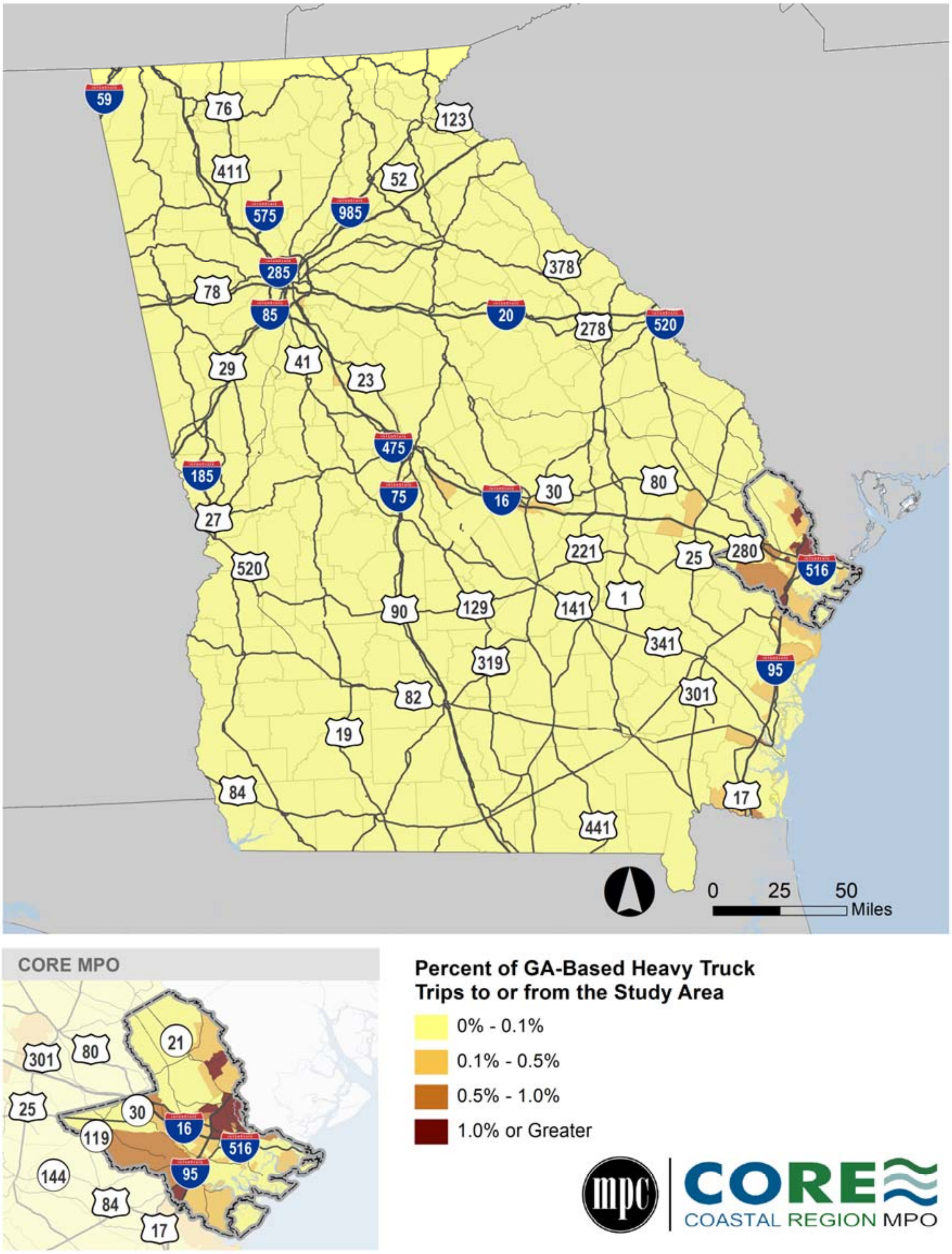


Source: INRIX; Cambridge Systematics, Inc. analysis.

Though outside of the 3-county region, Glynn, Liberty, and Bulloch Counties are proximate to the CORE MPO study area. Furthermore, major shippers (such as Target, SNF, Georgia Pacific) are located in those counties that rely on freight assets in the study area – namely the Port of Savannah and the CSX and Norfolk Southern intermodal rail terminals. Truck trips with and endpoint in Laurens County likely reflect the prevalence of truck parking facilities in the county, which are situated along I-16. There are at least 4 commercial truck stops providing more than 150 truck parking spaces in Laurens County. In addition, there are two rest areas along I-16 Eastbound and Westbound that provide 22 and 14 truck parking spaces, respectively.

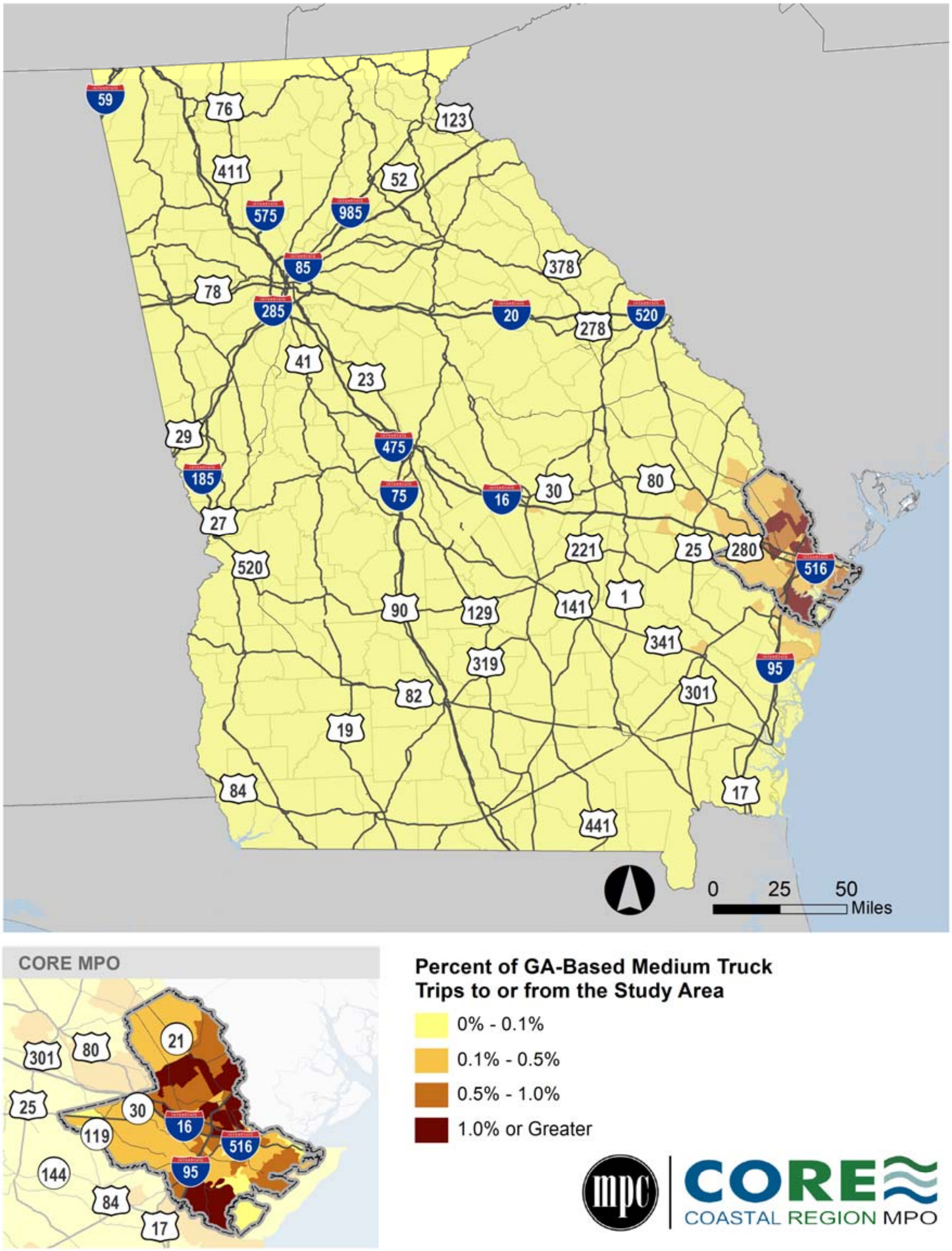
Figure 2.51 and Figure 2.52 show heavy and medium duty truck trips that have an endpoint in a traffic analysis zone (TAZ) in the study area. Both figures reflect the concentration of truck trip ends within the 3-county region. They also depict the prevalence of truck trips that begin or end along the I-95 corridor south of the CORE MPO region. Portions of Liberty, McIntosh, Glynn, and Camden Counties along I-95 were all found to generate truck trips to and from the CORE MPO study area. In addition, communities along the I-16 corridor (primarily Laurens and Bibb Counties) and the US 80 corridor (namely Bulloch County) show concentrations of truck trips to and from the study area.

FIGURE 2.51 HEAVY TRUCK TRIPS TO OR FROM THE STUDY AREA



Source: INRIX; Cambridge Systematics, Inc. analysis.

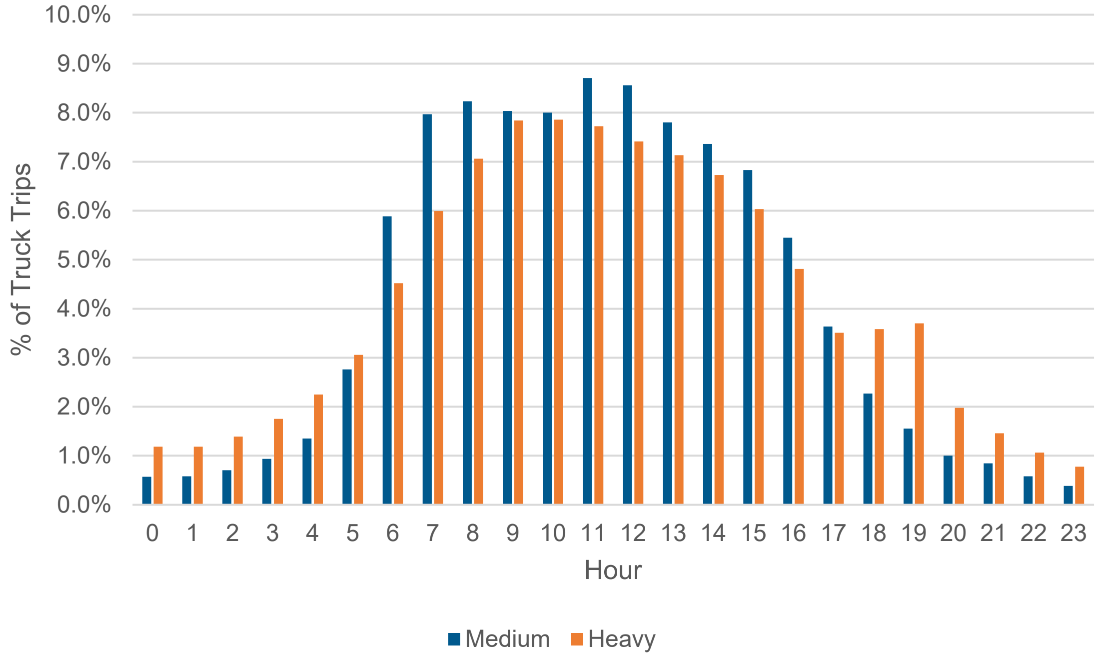
FIGURE 2.52 MEDIUM TRUCK TRIPS TO OR FROM THE STUDY AREA



Source: INRIX; Cambridge Systematics, Inc. analysis.

The analysis also examined the time-of-day distribution of truck trips with an endpoint in the study area. Figure 2.53 shows that freight activity begins around 5 a.m. with about three percent of truck trips (both medium and heavy trucks) starting around this time. Activity quickly accelerates into the early morning hours as about 25 percent of medium truck trips and 20 percent of heavy truck trips begin during the 5 – 8 a.m. hours. Activity continues to increase throughout the morning before beginning to recede around 11 a.m. Notably, heavy truck activity is substantially higher than activity for medium trucks from the evening to early morning hours (i.e., 5 p.m. – 4 a.m.). Multiple factors contribute to this including the use heavy trucks for longer distance trips which require longer operating hours. It also reflects the need for heavy trucks to find overnight parking during the evening hours. Medium duty trucks are primarily used for local trips and have a home base within or near the region to return to, obviating the need to find overnight parking in the evening.

FIGURE 2.53 TIME OF DAY DISTRIBUTION OF DAILY AVERAGE TRUCK TRIPS TO OR FROM THE STUDY AREA

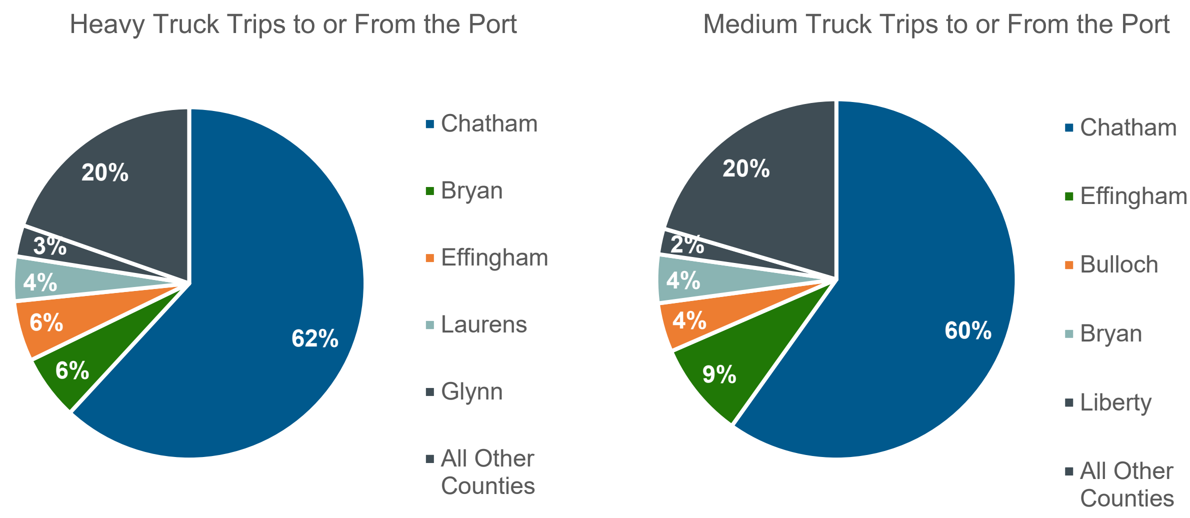


Source: INRIX; Cambridge Systematics, Inc. analysis.

Truck Trips at the Port of Savannah

While the previous analysis examined all truck trips with an endpoint in the study area, this analysis investigates only truck trips with an endpoint in a traffic analysis zone (TAZ) that includes the Port of Savannah. As shown in Figure 2.54, the results indicate that nearly 73 percent of heavy and medium truck trips that originate or terminate at the Port of Savannah have an endpoint in the region. Outside of the region, Laurens, Glynn, Liberty, and Bulloch Counties were substantial generators of truck traffic into and out of the port.

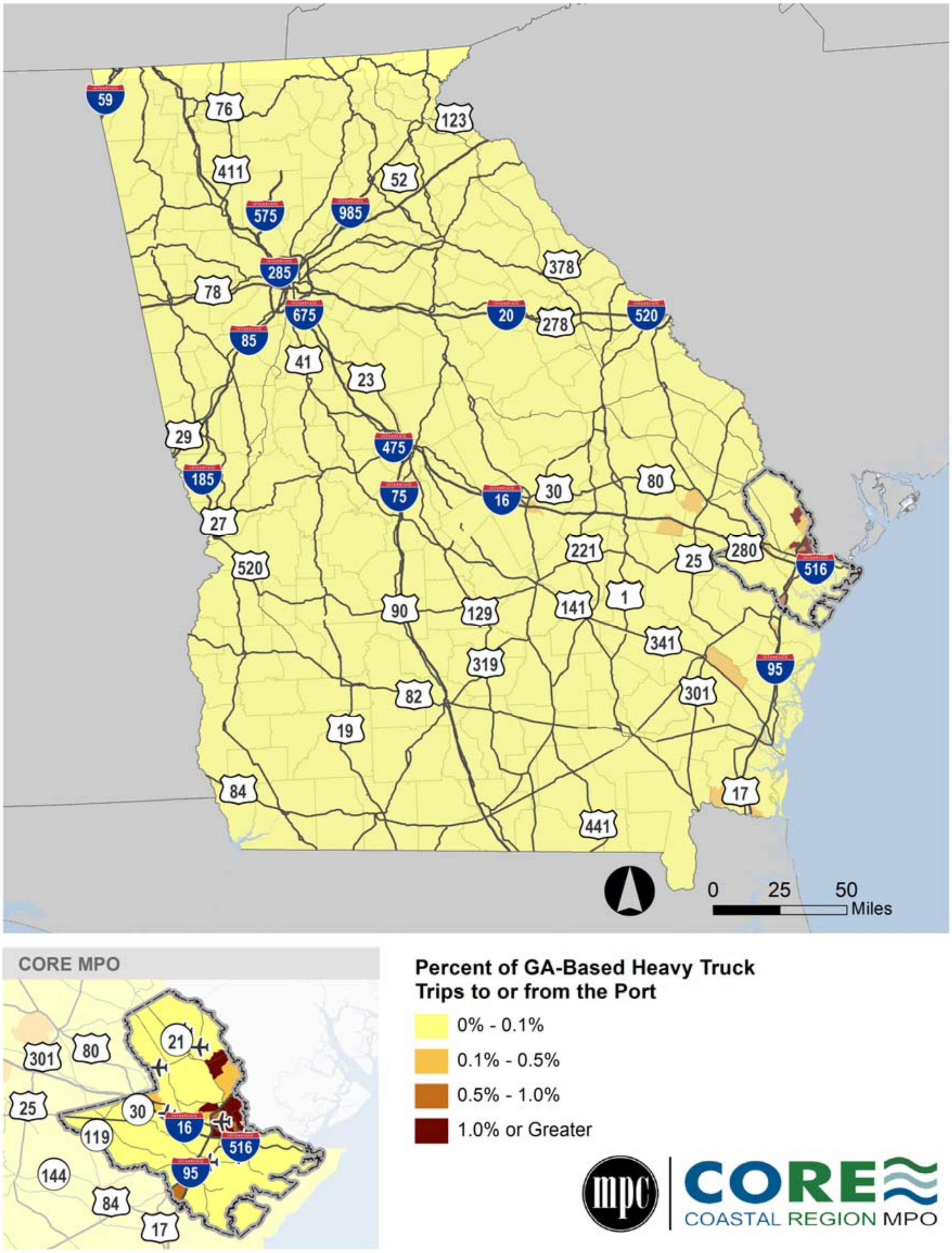
FIGURE 2.54 AVERAGE DAILY TRUCK TRIPS BY COUNTY TO AND FROM THE PORT



Source: INRIX; Cambridge Systematics, Inc. analysis.

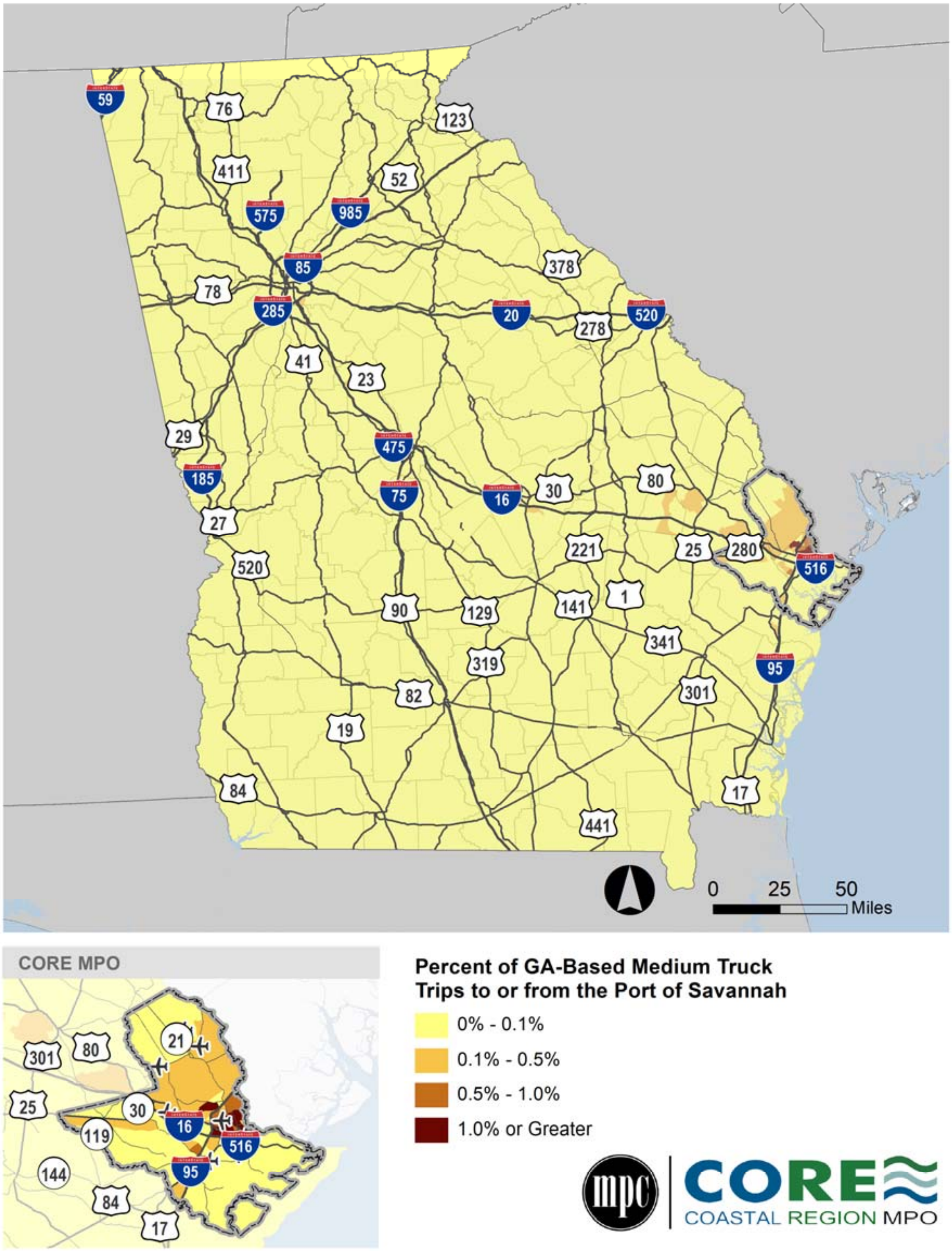
Similar to the truck trip end results for the entire study area, though Glynn, Liberty, and Bulloch Counties are outside the three-county region, they are proximate to the CORE MPO study area and contain major shippers that likely rely on the port. Figure 2.55 and Figure 2.56 show heavy and medium duty truck trips that have an endpoint at the port. Both figures reflect the concentration of truck trip ends in areas immediately north and west of the port, along the SR 21, SR 25, US 80, and Jimmy Deloach Pkwy. Several distribution centers serving retailers such as Walmart, Target, IKEA, and others are located in this area. This area also has a large truck parking facility with over 100 spaces. The figures also depict the prevalence of truck trips that begin or end along the US 80 corridor in Bulloch County.

FIGURE 2.55 HEAVY TRUCK TRIPS TO OR FROM THE PORT OF SAVANNAH



Source: INRIX; Cambridge Systematics, Inc. analysis.

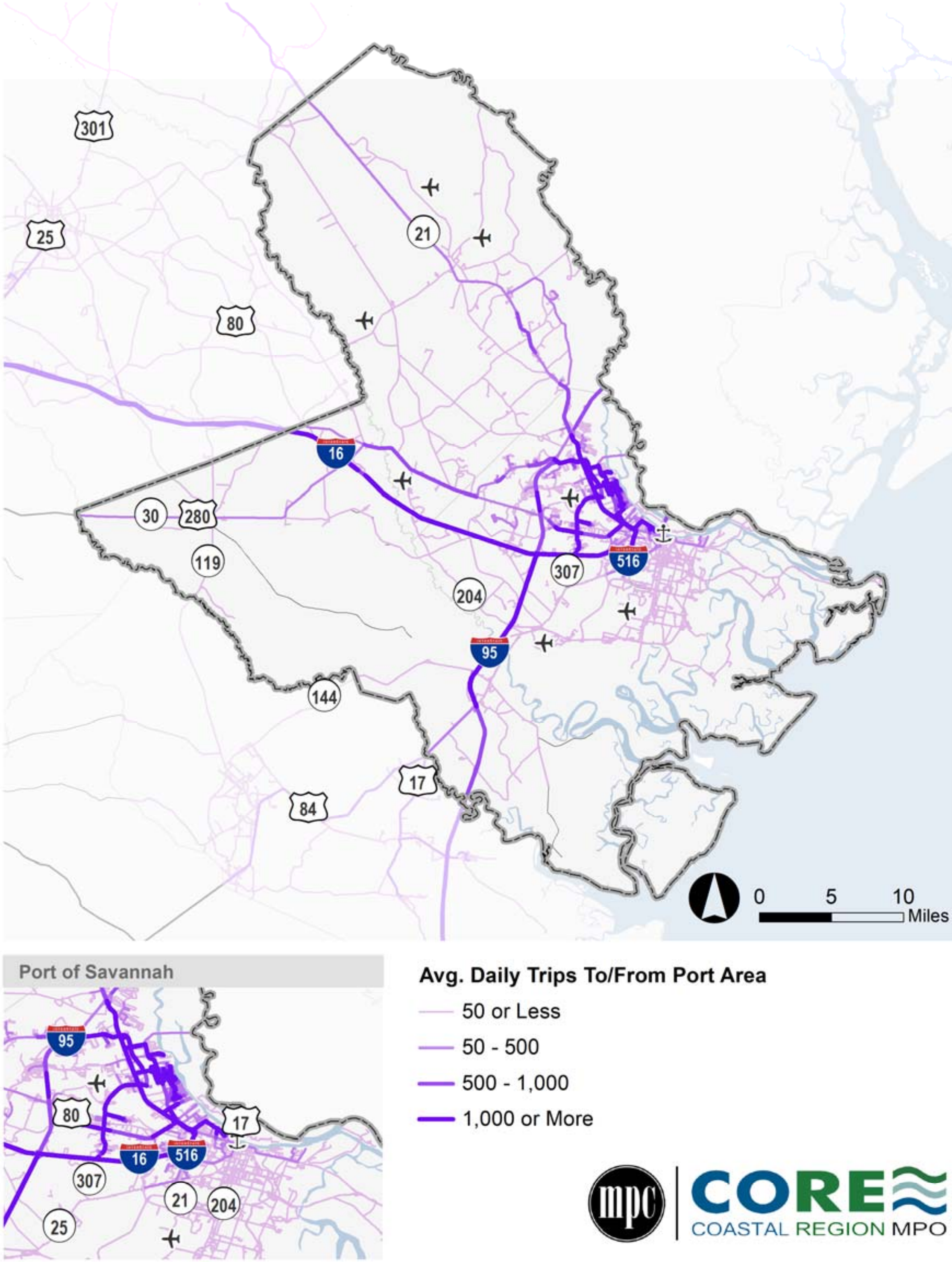
FIGURE 2.56 MEDIUM TRUCK TRIPS TO OR FROM THE PORT OF SAVANNAH



Source: INRIX; Cambridge Systematics, Inc. analysis.

Heavy truck trips to and from the Port of Savannah area were linked to the region's roadway network. Figure 2.57 shows the routes taken by heavy trucks for port-related trips on an average daily basis. Portions of interstate highways – including I-16, I-95, and I-16 – were estimated to carry over 2,000 port-related heavy truck trips on a daily basis. Non-interstate corridors near the port were also estimated to carry substantial volumes of port-related traffic. Examples include SR 21, US 80, and Jimmy Deloach Parkway which all have portions that were estimated to carry as many as 2,000 port-related truck trips per day. Interestingly, the data shows where I-16-to-US 280-to-US 80 and I-16-to-Jimmy Deloach Parkway are prevalent routes taken by heavy trucks traveling along the I-16 corridor.

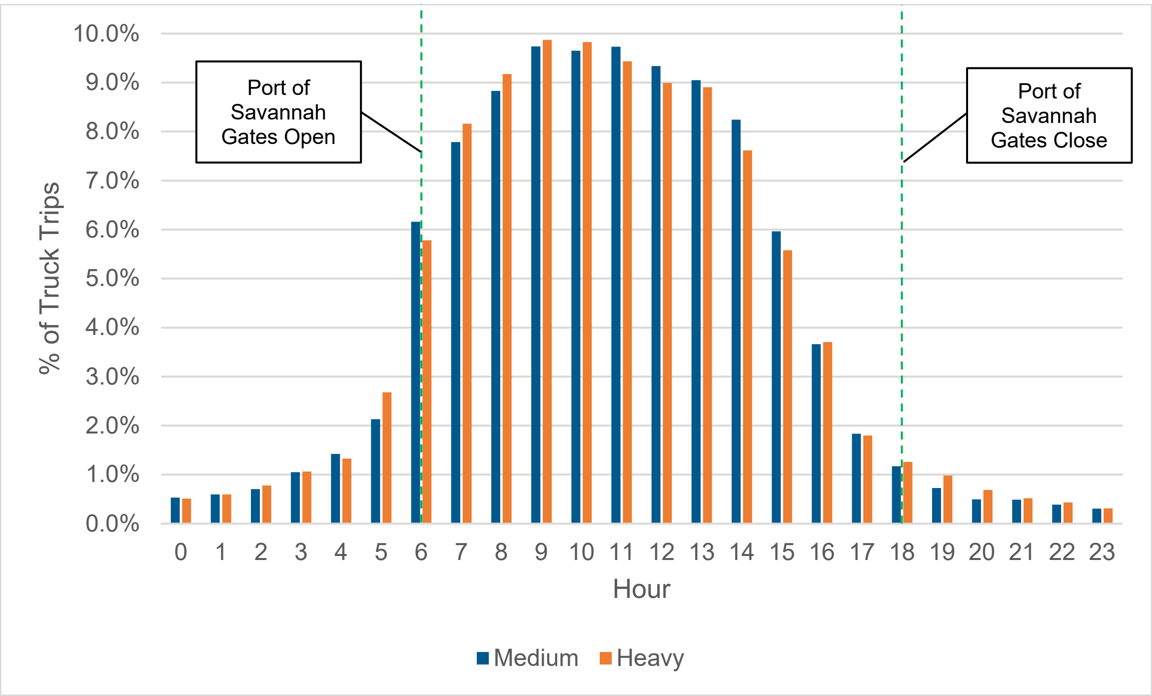
FIGURE 2.57 HEAVY TRUCK TRIP ROUTES TO OR FROM THE PORT OF SAVANNAH



Source: INRIX; Cambridge Systematics, Inc. analysis.

The analysis also examined the time-of-day distribution of truck trips with an endpoint near the port. Overall, truck trip activity appears to follow the Port of Savannah's gate hours which are from 6 a.m. to 6 p.m. during weekdays. Figure 2.58 shows that there is a sharp increase in activity when the port gates open at 6 a.m. Activity quickly accelerates throughout the morning before beginning to recede around midday. After 4 p.m., about two hours ahead of the gates closing, very little activity occurs.

FIGURE 2.58 TIME OF DAY DISTRIBUTION OF TRUCK TRIPS TO OR FROM THE PORT OF SAVANNAH



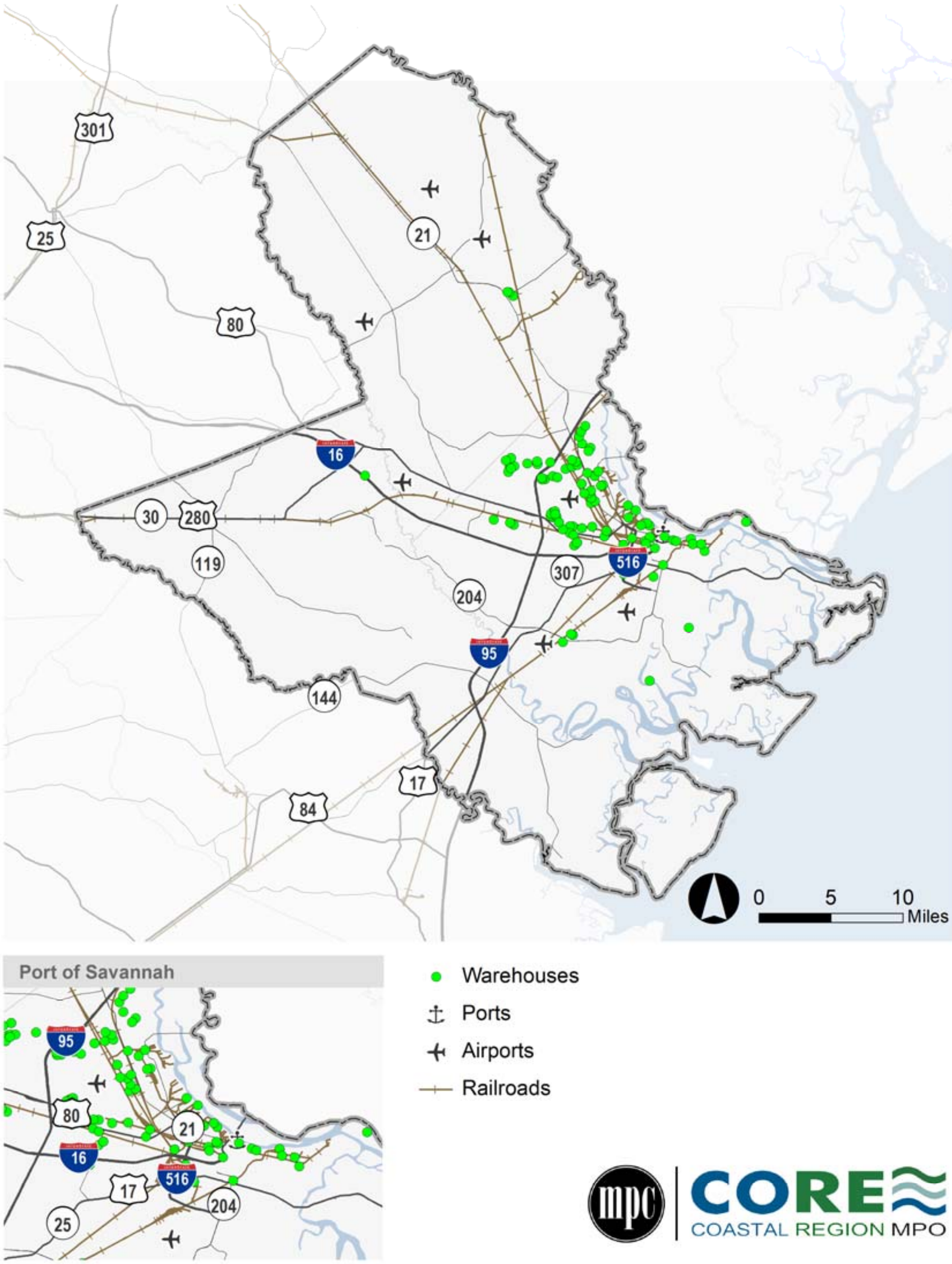
Source: INRIX; Cambridge Systematics, Inc. analysis.

Freight Transportation and Warehousing Facilities

Warehouses, distribution centers, truck terminals, and other logistics facilities are significant generators of freight traffic. Understanding where these facilities are located throughout the region provide insight into freight trip activity patterns. This analysis develops an inventory of the locations of businesses in the freight transportation and warehousing industry sector in the study area. It relies on data collected from the Savannah Economic Development Authority (SEDA) and U.S. Census Bureau's County Business Patterns database.

Figure 2.59 depicts warehouses in the CORE MPO region using data collected from the SEDA. It shows a heavy concentration of warehousing and logistics establishments north and west of the Port of Savannah. These establishments are primarily along the SR 21, SR 25, US 80, and Jimmy Deloach Pkwy. corridors. It also shows that there are numerous warehouses and other logistics facilities east of downtown Savannah. These facilities are concentrated in the area bounded by the Savannah River to the north and President Street to the south.

FIGURE 2.59 WAREHOUSES IN THE SAVANNAH REGION



Source: Savannah Economic Development Authority; Cambridge Systematics, Inc. analysis.

The data provided by SEDA was supplemented with County Business Patterns data from the U.S. Census Bureau in order to investigate the locations of businesses in the freight transportation and warehousing industry sector in the study area. This sector includes businesses that provide transportation of goods, warehousing and storage of goods, and support activities related to freight transportation. These businesses were identified at the zip code level according to the following 3-digit NAICS codes: 481 (Air Transportation), 482 (Rail Transportation), 483 (Water Transportation), 484 (Truck Transportation), 486 (Pipeline Transportation), 488 (Support Activities for Transportation), 492 (Couriers and Messengers), and 493 (Warehousing and Storage).

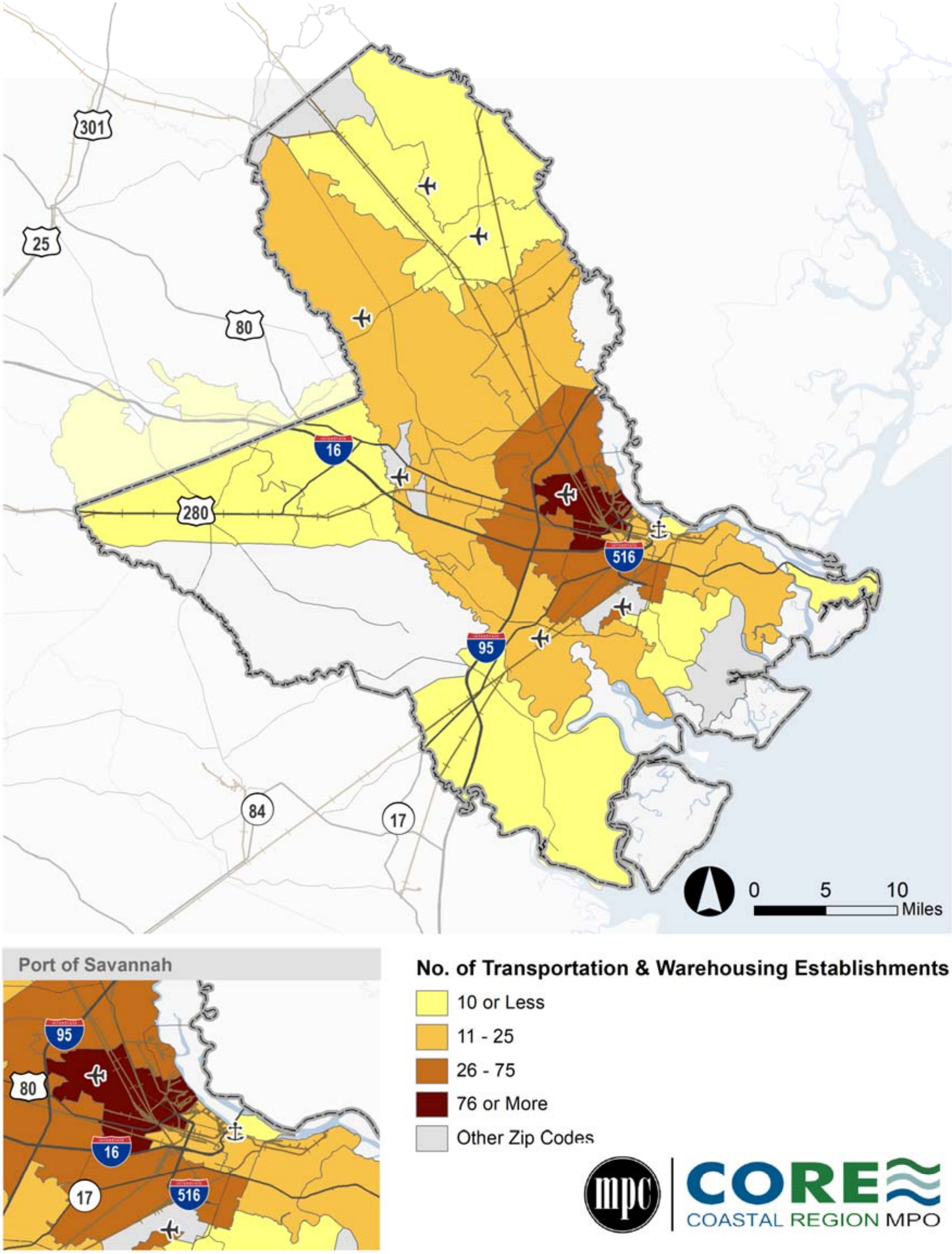
Table 2.4 and Figure 2.60 show the results of the analysis. The largest concentrations of transportation and warehousing establishments are in the 31408 (e.g., Garden City and west Savannah), 31407 (e.g., Port Wentworth), 31322 (e.g., Pooler), and 31405 (e.g., south Savannah) zip codes. These four zip codes contain over half of the region's freight transportation establishments. Other areas with concentrations of transportation and warehousing establishments include the 31326 (e.g., Rincon), 31415 (e.g., west Savannah including the areas west of US 17 along Louisville Road, Gwinnett St, and Chatham Pkwy. Towards US 80), and 31401 (e.g., areas of Savannah north of Victory Dr. including Hutchinson Island, west of Waters Ave., and east of Martin Luther King Blvd.).

TABLE 2.4 TRANSPORTATION AND WAREHOUSING IN THE CORE MPO REGION

Zip Code	Description	No. of Transportation and Warehousing Establishments	Percent of Total
31408	Garden City and West Savannah	108	24%
31407	Port Wentworth	64	14%
31322	Pooler	47	10%
31405	South Savannah	41	9%
31326	Rincon	25	5%
31415	West Savannah	24	5%
31401	Savannah – Historic District, Metropolitan, Thomas Square, Hutchinson Island, and Riverfront west of US 17	20	4%
31410	Whitemarsh Island, Wilmington Island	19	4%
31404	East Savannah, Thunderbolt, Elba Island	16	4%
31302	Bloomingdale	15	3%
31419	Coffee Bluff/ Rose Dhu, Gateway West, Georgetown	15	3%
31312	Guyton	12	3%
31324	Richmond Hill	10	2%
31406	Vernonburg	10	2%
31308	Ellabell	6	1%
31321	Pembroke	5	1%
31402	Savannah – Yamacraw Village	4	1%
31421	Hutchinson Island	4	1%
31303	Clyo	3	1%
31328	Tybee Island	3	1%
31329	Springfield	3	1%
31418	Garden City	3	1%
Total		**457**	**100%**

Source: U.S. Census Bureau, County Business Patterns; Cambridge Systematics, Inc. analysis.

FIGURE 2.60 TRANSPORTATION AND WAREHOUSING IN THE CORE MPO REGION



Source: U.S. Census Bureau, County Business Patterns; Cambridge Systematics, Inc. analysis.

While the analysis of SEDA and Census data provide an indication of where transportation and warehousing establishments are currently located, they do not provide an indication of where new facilities may be developed. The Savannah Harbor-Interstate 16 Corridor Joint Development Authority (JDA) includes the development authorities of Bryan, Bulloch, Chatham, and Effingham Counties. The JDA combines the resources of its member counties to attract and facilitate regionally significant projects. Figure 4.8 shows the JDA industrial sites throughout the CORE MPO region. These sites comprise over 13,000 acres of land that is likely to be developed to include substantial volumes of warehouse, distribution, and other logistics space. As shown in Figure 4.8, these sites are concentrated along the I-16 corridor with much of the acreage being located in Bryan and Effingham Counties. It suggests that the I-16 corridor will facilitate much of the region's freight-oriented growth. A more detailed assessment of future land uses in the region is performed as part of the land use assessment in Task 3.

3 PERFORMANCE MEASURES

The purpose of this section of the report is to provide a set of recommended freight performance measures for the CORE MPO region using recommended best practices for freight performance measurement. This includes determining what parameters should be measured, identifying the necessary tools and data to implement, and ensuring that they align with the region's freight goals and objectives. In addition, it links the recommended performance measures to the region's freight vision, goals, and objectives.

3.1 Overview of Freight Performance Measures

Transportation performance management (TPM) is a strategy used to guide investment decision-making by linking goals to quantifiable performance measures.[2] It ensures that data helps to drive a more informed and cost-effective decision-making process. Performance measures enable agencies to gauge system condition and use, evaluate transportation programs and projects, and help to identify beneficial projects and investments where funding is constrained. Some important outcomes that performance measures aid agencies in achieving include[3]:

- **Link Actions to Goals.** Performance measures help to link plans and actions to agency goals and objectives.
- **Prioritize Projects.** Performance measures can provide information needed to invest in projects and programs that provide the greatest benefits.
- **Manage Performance.** Applying performance measures can improve the management and delivery of programs, projects, and services.
- **Communicate Results.** Performance measures can help communicate the value of transportation investments by providing quantifiable, understandable indicators that the public can observe.
- **Strengthen Accountability.** Performance measures promote accountability by revealing whether transportation investments are providing the expected performance or demonstrate the need for improvement.

The application of TPM principles to freight planning require the development and use of freight performance measures. Freight performance may be broadly defined in terms of the characteristics and quality of freight system condition, utilization, operations, and economic outcomes. Figure 3.1 shows the categories of freight performance measures as defined and used in this report. They include measures of network supply, utilization, and condition that characterize the physical infrastructure and the freight volumes on it; measures of travel time and congestion that characterize the quality of freight mobility; measures of safety; environmental measures that gauge the environmental impacts of freight; and economic and freight demand measures that gauge the freight system's economic impacts.

[2] https://www.fhwa.dot.gov/tpm/

[3] https://dot.nebraska.gov/media/10761/nebraska-freight-plan.pdf

FIGURE 3.1 CATEGORIES OF FREIGHT PERFORMANCE MEASURES

Network Supply, Utilization, and Condition	• Characterize the extent, usage, and state of good repair of the freight network
Travel Time and Congestion	• Ability of the freight network to provide for reliable, uncongested travel
Safety	• Ability of the freight network to facilitate the movement of goods with minimal incidents
Environmental Impacts	• Magnitude of negative externalities generated from goods movement
Economic and Freight Demand	• Magnitude of the economic impacts of the freight system

Source: Cambridge Systematics, Inc.

- **Network Supply, Utilization, and Condition.** These measures gauge the performance of the multimodal freight system by characterizing the extent, utilization, and condition of the system. In characterizing the extent and condition of the system, network supply and infrastructure condition-based measures provide insight into the accessibility of the multimodal freight system for its users.

- **Travel Time and Congestion.** Travel time and congestion-based freight performance measures are important as they have a direct impact on the cost of freight operations. Delays can be costly to shippers as they wait for delivery of time-sensitive goods and also to carriers as contracts for carriage typically include provisions for on-time deliveries that contain financial penalties for failing to do so. In addition, travel time and congestion-based freight performance measures reflect the costs associated with factoring buffer time into schedules (and the associated labor, fuel, and other vehicle costs) to account for unanticipated delays.

- **Safety.** Traffic incidents are a major cause of nonrecurring congestion and associated delay for freight operations. Furthermore, those incidents involving trucks or trains tend to be costlier in terms of the severity of crash outcomes and incident clearance times. Freight safety performance measures help to ensure the safety and security of people and goods movement on the multimodal transportation network.

- **Environmental.** Environmental freight performance measures are critical to mitigating the negative externalities caused by the movement of freight. Trucks account for just under 10 percent of annual vehicle miles traveled,[4] but emit nearly 23 percent of all greenhouse gas emissions across all transportation modes.[5]

- **Economic and Freight Demand.** Economic and freight demand performance measures provide insight into the factors that drive shippers to consume freight services and ultimately result in the physical manifestation of that demand – freight vehicles operating on the multimodal transportation network. A region's or state's ability to provide a reliable freight network directly impacts available jobs, delivery times for consumer goods, standard of living, and other measures of economic competitiveness.

National Freight Performance Measures

The Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act transformed the Federal-aid highway program. They required State Departments of Transportation (DOT) and Metropolitan Planning Organizations (MPO) to engage in performance-based planning. Performance-based planning is the process of integrating performance measures into the planning process to maximize return on investment and increase transparency and accountability to the public. [6] The performance management framework focuses on seven national performance goals: safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays.

The performance-based planning requirements legislated by MAP-21 and the FAST Act were codified in the Code of Federal Regulations (CFR) through several final rulemakings. These rulemakings developed regulations on performance measures in the areas of highway safety, pavement and bridge performance, system performance, freight performance, and CMAQ program performance. They outline required performance measures, target setting procedures, data collection and management requirements, reporting requirements, and determination of significant progress. Furthermore, they require that MPOs work with their respective state DOTs to measure performance and achieve performance targets.

The System Performance/Freight/CMAQ Final Rule (System Performance Rule), codified in 23 CFR 490, established the national freight performance measure that states and MPOs must calculate as part of performance reporting. The Truck Travel Time Reliability (TTTR) Index is a type of travel time-based freight performance measure and is the only freight-specific measure required by federal mandate. Reporting for the TTTR Index is divided into five periods: morning peak (6-10 a.m.), midday (10 a.m.-4 p.m.) and afternoon peak (4-8 p.m.) Mondays through Fridays; weekends (6 a.m.-8 p.m.); and overnights for all days (8 p.m.-6 a.m.). The TTTR ratio is calculated by dividing the 95th percentile truck travel time by the 50th percentile truck travel time for each segment. The TTTR Index is calculated by multiplying each segment's largest ratio of the five periods by its length, then dividing the sum of all length-weighted segments by the total length of Interstate. Higher values of the TTTR Index indicate less reliable truck travel while lower values indicate more reliable truck travel.

[4] https://www.bts.gov/share-highway-vehicle-miles-traveled-vehicle-type

[5] Bureau of Transportation Statistics, Freight Facts and Figures, Table 6-15, 2019, https://www.bts.gov/us-greenhouse-gas-emissions-domestic-freight-transportation. Note: Trucking accounted for approximately 429 million metric tonnes of CO2 equivalent in 2018, while the total for all domestic transportation was 1,887 million metric tonnes.

[6] https://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

State Freight Performance Measures

The Georgia Statewide Freight and Logistics Action Plan is currently undergoing a major update. As part of that update, the state's freight performance measures will be reevaluated. However, the 2018 Update of the Georgia Statewide Freight and Logistics Action Plan does outline recommended freight performance measures for the state. These measures are presented in Table 3.1.

TABLE 3.1 GEORGIA STATEWIDE FREIGHT AND LOGISTICS ACTION PLAN (2018 UPDATE) RECOMMENDED FREIGHT PERFORMANCE MEASURES

National Goal	State Goal	Performance Measure	Description
Improve the safety, security and resilience of freight transportation	Reduction in crashes resulting in loss of life	Annual Crashes involving Trucks	This measure tracks the number of truck-involved crashes in the state.
	Optimized throughput of people and goods through network assets throughout the day	Average Coordinated Highway Assistance and Maintenance Program (CHAMP) Response Time	This measure quantifies incident response time for CHAMP.
Use innovation and advanced technology to improve the safety, efficiency, and reliability of the National Multimodal Freight Network	Efficiency and reliability of freight, cargo, and goods movement	Intelligent Transportation System (ITS) Miles Managed/ Number of ITS Devices	This measure quantifies how much of the state's system is managed by its intelligent transportation system.
Reduce the adverse environmental impacts of freight movement on the national freight network	Reduce emissions, improve air quality statewide, limit footprint		
Improve the economic efficiency and productivity of the National Multimodal Freight Network	Efficiency and reliability of freight, cargo, and goods movement	Truck Travel Time Reliability Index	This is the national freight performance measure which gauges the reliability on Interstate highways for freight travel.

Source: Georgia Department of Transportation, Statewide Freight and Logistics Action Plan, 2018.

The 2018 Update of the Georgia Statewide Freight and Logistics Action Plan also observed that several statewide performance measures that are designated in the Statewide Transportation Plan (SWTP) and Statewide Strategic Transportation Plan (SSTP) impact goods movement. Furthermore, those measures are consistent with Georgia's goals as well as the goals of the National Multimodal Freight Policy and the National Highway Freight Program. These include the following: annual fatalities on Georgia's roadways, percent of state-owned bridges meeting GDOT standards, percent of non-interstate roads meeting GDOT maintenance standards, and percent of interstate roads meeting GDOT maintenance standards. State performance measures are listed in Table 3.2.

TABLE 3.2 GEORGIA SWTP/SSTP PERFORMANCE MEASURES

Performance Area	Performance Measure	Geographic Area
Safety	Reduction in Annual Highway Fatalities	Statewide
	Average Highway Emergency Response Operators (HERO) Response Time	Statewide
Maintenance	Percent of State-Owned Bridges Meeting GDOT Standards	Statewide
	Percent of Interstates Meeting Maintenance Standards	Statewide
	Percent of State-Owned Non-Interstate Roads Meeting Maintenance Standards	Statewide
Planning and Construction	Percent of Right-of-Way Authorized on Time	Statewide
	Percent of Construction Authorized on Time	Statewide
	Percent of Projects Constructed on Time	Statewide
	Percent of Projects Constructed on Budget	Statewide
	Annual Congestion Cost per Peak Auto Commuter	Statewide
	Morning Peak-Hour Speeds on General Lanes	Metro Atlanta
	Evening Peak-Hour Speeds on General Lanes	Metro Atlanta

Source: Georgia Department of Transportation, Statewide Transportation Plan/ Statewide Strategic Transportation Plan, 2021.

Best Practices in Freight Performance Management

The 2017 Freight Performance Measure Primer produced by the FHWA provides national best practices and recommendations to create a comprehensive freight performance measurement program. In order to increase infrastructure efficiency and guide future investments, the Primer recommended that agencies develop freight measures to predict and track the implications of investments across multiple modes. It noted that the aim of most DOTs and MPOs is to increase infrastructure efficiency through focused investments. Therefore, measures should be able to predict the impact of investment on transportation flows through the State or MPO region and to project potential modal shifts. The Primer further observed that predicting these impacts will require performance measures for multiple freight modes supported by data that relates transportation goals by mode.

The Freight Performance Measure Primer recommended several performance measures split across five categories. Those categories and a sample of recommended performance measures are listed below:

- **Safety.** Recommendations included the number of heavy truck-related fatalities, train derailments per ton moved, and the total cost of freight loss and damage per vehicle miles traveled (VMT), among others.

- **Maintenance and Preservation.** Percent of pavement in good condition on freight-significant highways, number of weight-restricted bridges per total number of bridges, and percent of bridges that are in good condition were among the recommendations.

- **Mobility, Reliability, and Congestion.** Recommendations included the percent of Interstate providing reliable travel times, incident clearance times, and percent of rail track-miles with 286,000-pound railcar capacity, among others.

- **Accessibility and Connectivity.** Triple trailer VMT as a percent of total freight VMT, percent of shippers within 50 miles of a freight rail intermodal terminal, and average travel time delay for trucks on airport access roads were among the recommendations.

- **Environmental.** Recommended measures included total tons of emissions reduced from Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects, pounds of greenhouse gas emissions, increase in energy consumed or costs related to energy consumption, and increase in air pollution impacts/costs.

A complete list of the FHWA's Freight Performance Measure Primer recommendations is provided in the Appendix.

The American Association of State Highway and Transportation Officials (AASHTO) also developed freight performance measure recommendations through its Standing Committee on Performance Management Task Force on Performance Measure Development, Coordination, and Reporting (SCOPM Task Force). The SCOPM Task Force was formed following the passage of MAP-21 to help inform the USDOT rulemaking process on freight performance measures. Specifically, the purpose of the SCOPM Task Force was to serve as a single clearinghouse for recommended national-level performance measures identified by those AASHTO committees with in-depth knowledge of the technical aspects of the individual performance measure areas. It included representatives from each performance management area and other leaders within the AASHTO organization.

For freight, the AASHTO SCOPM Task Force recommended two performance measures: Annual Hours of Truck Delay (AHTD) and Truck Reliability Index (RI_{80}). AHTD is the amount of extra time spent by each truck traveling on a corridor based upon a pre-determined threshold of what constitutes congestion. AHTD is a summation of the number of truck-hours of delay due to congestion along Interstate corridors within a State. The Truck Reliability Index is defined as the ratio of the 80^{th} percentile worst travel time recorded during the weekday peak periods each year to a pre-determined threshold travel time. It reflects the total travel time needed to ensure on-time arrival at a desired destination. Because the Truck Reliability Index performance measure is independent of distance, it can be used to measure and compare corridors of any length.

3.2 Assessment of Current Freight Performance Measures

The 2015 Regional Freight Transportation Plan did not establish freight performance measures for the region. Instead, it recommended that the region adopt a subset of its existing long-range transportation plan's – Mobility 2045 – measures as freight performance measures. This section of the report examines the Mobility 2045 performance measures and assesses their ability to serve as freight performance measures. It is important to note that CORE MPO is in the process of developing a new long-range plan – Mobility 2050.

However, the goals, objectives and performance measures being revised as part of that initiative are expected to be largely consistent with Mobility 2045.

Table 3.3 contains the goals, objectives, and performance measures developed as part of Mobility 2045, the region's long-range transportation plan. Performance measures were developed across Mobility 2045's six goal areas: system performance; safety and security; accessibility, mobility, and connectivity; environment and quality of life; state of good repair; and intergovernmental coordination.

TABLE 3.3 MOBILITY 2045 PERFORMANCE MEASURES

Goal	Objective(s)	Performance Measures
System performance: An efficient, reliable, multi-modal transportation system that supports economic competitiveness and enhances tourism.	• Minimize work and freight trip congestion • Promote projects which provide the maximum travel benefit per cost • Improve efficient access to job centers • Enhance tourism offering efficient multi modal options to visit the region • Maximize efficiency of signalized intersections	• Project cost/vehicle miles of travel (VMT) • Reductions in VMT • Reductions in work trip vehicle hours of travel (VHT) • Increased Sustainable development incorporating mixed-use, pedestrian-oriented design • Level of Service (LOS) • Percent of person-miles traveled on the interstate system that are reliable • Percent of person-miles traveled on the non-interstate NHS that are reliable • Reductions in travel times • Truck Travel Time Reliability (TTTR) Index • Percent of jobs within 1/2 miles access to frequent transit service • Percent of the system actively managed with ITS • Increase access to alternative transportation options to job centers (transit, bike facilities, sidewalks) • Maximize transportation system mobility during disruptive events (such as reductions in time to clear major crashes from through lanes, CHAMP clearance times) • Increased modal options and amenities assisting tourist travel (for examples wayfinding, sidewalks, bike sharing, airport bus express route, car sharing, shuttles, ferry etc.)
Safety and Security: A safe, secure, and resilient transportation system for all types of users and for freight.	• Eliminate at-grade railroad crossings • Minimize frequency and severity of vehicular accidents	• Reduce number of fatalities • Reduce number of serious injuries • Increased implementation of safety projects

	• Minimize conflicts and increase safety for non-motorized users • Promote projects which aid in hurricane evacuation • Adequately prepare for coordinated responses to incidents • Monitor vulnerable infrastructure through visual and other inspection methods • Enhance tourism offering a safe multi modal options to visit the region	• Number of at-grade crossings reduced • Reduce rate of serious injuries per 100 million VMT • Reduce rate of fatalities per 100 million VMT • Reduce number of non-motorized fatalities and serious injuries • Hurricane evacuation route status (The project enhances or improve reliability on a hurricane evacuation route) • Improved emergency responses (e.g., ambulance travel times to hospitals, emergency signal preemption) • Minimize clearance times during disruptive events to avoid secondary crashes (such as reductions in time to clear major crashes from through lanes, CHAMP clearance times) • Reduction in vulnerability of the transportation system (such as implementation of actively monitoring infrastructure, shoulder stabilization, battery backup for signals etc.)
Accessibility, Mobility and Connectivity: Access and mobility, equitably and reliably available, for people and for freight, through a range of travel options and an integrated, connected transportation system.	• Minimize congestion delays • Maximize regional population and employment accessibility • Provide efficient and reliable freight corridors • Minimize delays in corridors served by transit • Encourage use of transit and non-motorized modes, focusing on areas with low rates of automobile ownership or high population of elderly and/or disabled populations • Expand transit service area and increase service frequency • Ensure access to essential services • Expand use of Traveler information to accommodate people, freight and tourism	• Base year vs. future year volume/capacity ratios for various modes • Percent of population within ½ mile of a multimodal (transit or bicycle) route or facility connecting to regional activity center(s) • Percent of last mile and other freight strategies identified in the Freight Plan completed • On time performance of the transit and paratransit system • Increase in transit ridership • Expanded coverage of ITS to share traveler information (On time bus arrival, way finding, commercial vehicle systems) • Fewer transit user complaints

		• Increase access and connectivity to alternative transportation options to job centers (transit, bike facilities, sidewalks)
Environment and Quality of Life: A healthy sustainable environment through the compatible integration of land use and transportation while taking into consideration the impact of transportation including that of stormwater.	• Protect wetlands, historic resources, neighborhoods, recreational facilities and other important resources • Support infill development • Implement green infrastructure to reduce region's impact on stormwater pollution and address potential impacts from a changing climate. • Reduce negative impacts of transportation on stormwater • Reduce emissions and maintain a healthy air quality • Reduce energy consumption	• Less impacts to natural environment (such as rate of development of greenspace compared to the rate of greenspace preservation). • Less impacts to historic and cultural and natural resources (tree canopies, waterways and historic roadways) • Increase in promoting infill and brownfield development • Flood zone risk status • Decreased vehicle miles of travel through increased use of alternative modes to single occupancy vehicles • Project exceeds local and or state storm water management plan requirements • Increased percent of green infrastructure (GI) and/or Low Impact Development (LID) installation (swales (GI), permeable pavements (LID), green streets (LID) etc.) • Increased percent of low emission projects (such as electric buses, bike share etc.) • Total emissions
State of Good Repair: Maintain a state of good repair.	• Maintain a state of good repair for bridges • Maintain a state of good repair for pavement • Maintain a state of good repair for non-motorized facilities • Maintain a state of good repair for transit vehicles and facilities	• Bicycle and pedestrian facility surface conditions • Percent of NHS Bridges in Poor condition as a percentage of total NHS bridge deck area • Percent of NHS Bridges in Good condition as a percentage of total NHS bridge deck area • Percent of interstate NHS pavements in POOR condition • Percent of interstate NHS pavement in GOOD condition • Percent of NHS pavements in POOR condition

		• Transit assets considered in a state of good repair • Percent of NHS pavements in GOOD condition
Intergovernmental Coordination: Wise use of public funds through coordination and a performance-based planning process.	• Enhance coordination between CORE MPO, Georgia Department of Transportation, County departments, City governments, Georgia Ports Authority, modal agencies (CAT and airport) and advocacy groups (Savannah Bicycle Campaign) • Implement transportation performance management utilizing a performance based planning and programming process	• CORE MPO represented at project development meetings (concept meetings and public information meetings) • Establishment of coordination policies to promote communications between various agencies • Establishment of a prioritization process based on cooperatively developed objectives and performance measures.

Source: CORE MPO.

Many of the region's current measures can be applied to freight performance as shown in Table 3.4. In several cases, many of these measures can simply be modified to focus on freight vehicles or on portions of the region's multimodal network that serve a significant share of freight activity. For example, several current Mobility 2045 safety performance measures (such as the number and rate of serious injuries and fatalities) are applicable to freight performance and could be modified to focus on crashes involving freight vehicles. Measures that reflect the condition of pavement and bridges are relevant for freight from a network supply, utilization, and condition standpoint. Pavement and bridge conditions can impact routing decisions and can result in loss or damage to goods and vehicles. From the perspective of travel time and congestion, existing Mobility 2045 measures such LOS and TTTR reflect freight mobility and are consistent with recommended best practices and federal guidelines. Regarding environmental impacts of freight, total emissions is a relevant freight performance measure as trucks account for a substantial share of greenhouse gas emissions.

TABLE 3.4 APPLICABILITY OF CURRENT MEASURES TO FREIGHT PERFORMANCE

Network Supply, Utilization, and Condition	Travel Time and Congestion	Safety	Environmental Impacts
• Percent of NHS Bridges in Poor condition as a percentage of total NHS bridge deck area • Percent of NHS Bridges in Good condition as a percentage of total NHS bridge deck area • Percent of interstate NHS pavements in POOR condition • Percent of interstate NHS pavement in GOOD condition • Percent of NHS pavements in POOR condition • Percent of NHS pavements in GOOD condition	• Level of Service (LOS) • Reductions in travel times • Truck Travel Time Reliability (TTTR) Index • Percent of the system actively managed with ITS	• Reduce number of fatalities • Reduce number of serious injuries • Increased implementation of safety projects • Number of at-grade crossings reduced • Reduce rate of serious injuries per 100 million VMT • Reduce rate of fatalities per 100 million VMT • Reduce number of non-motorized fatalities and serious injuries • Minimize clearance times during disruptive events to avoid secondary crashes (such as reductions in time to clear major crashes from through lanes, CHAMP clearance times) • Reduction in vulnerability of the transportation system (such as implementation of actively monitoring infrastructure, shoulder stabilization, battery backup for signals etc.)	• Total emissions

3.3 Recommended Goals, Objectives, and Freight Performance Measures

This section of the report contains the recommended freight vision, goals, objectives, and performance measures for the CORE MPO region. Mobility 2045 served as the foundation for these recommendations as its vision, goals and objectives, and performance measures were augmented to suit the needs of the multimodal freight system. Consideration was also made to also align with goals established through the Georgia Statewide Freight and Logistics Action Plan as well as requirements related to the recently passed Bipartisan Infrastructure Law (BIL).[7] In addition, the CORE MPO's Economic Development and Freight Advisory Committee (EDFAC) provided guidance on the development of these recommendations. The freight vision, goals and objectives, and performance measures presented in the sections that follow reflect their input.

Freight Vision

The vision for the Regional Freight Transportation Plan reflects the 2045 Metropolitan Transportation Plan's vision. That vision emphasized the importance of taking a comprehensive approach to addressing transportation needs that incorporates community values, needs, land use and modal alternatives. To that end, the freight vision for the CORE MPO region is as follows:

The vision for the Regional Freight Transportation Plan is to promote sustainable economic growth throughout the region by ensuring safe, equitable, and quality access to an efficient and resilient shared multimodal network for people and goods.

Goals and Objectives

Defining goals and objectives is a critical first step for determining the strategic direction of the Regional Freight Transportation Plan and generally for taking a TPM-based approach to long range planning[8]. Goals and objectives establish the means to measure and manage performance. Goals are broad statements articulating a desired end state that provide strategic direction for an agency. Objectives are specific, measurable statements that support achievement of a goal.[9]

The goals and objectives of the 2045 Metropolitan Transportation Plan are the foundation for the Regional Freight Transportation Plan's goals. The goals and objectives, presented in Figure 3.2 and Figure 3.3 respectively, follow the same 6 major goal areas established in the 2045 Metropolitan Transportation Plan:

[7] Sec. 21104, Each State freight plan under this section shall include a requirement that the State, in carrying out activities under the State freight plan: enhance reliability or redundancy of freight transportation; or incorporate the ability to rapidly restore access and reliability with respect to freight transportation; determine strategies and goals to decrease (A) the severity of impacts of extreme weather and natural disasters on freight mobility; (B) the impacts of freight movement on local air pollution; (C) the impacts of freight movement on flooding and stormwater runoff; and (D) the impacts of freight movement on wildlife habitat loss.

[8] https://www.tpmtools.org/guidebook/chapter-01/

[9] https://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

Safety and Security; State of Good Repair; Accessibility, Mobility, and Connectivity; System Performance; Environment and Quality of Life; and Intergovernmental Coordination.

FIGURE 3.2 REGIONAL FREIGHT TRANSPORTATION PLAN GOALS

Safety and Security

Provide a safe and secure multimodal freight network.

System Performance

Improve the reliability of freight movements and the resiliency of the multimodal freight network to support economic competitiveness.

State of Good Repair

Maintain a state of good repair of infrastructure critical to goods movement.

Environment & Quality of Life

Improve equity by preventing or minimizing adverse impacts of freight operations on communities and the environment while increasing community awareness of freight's importance to providing a high quality of life.

Accessibility, Mobility, & Connectivity

Improve the accessibility and connectivity of the multimodal freight network to freight and industrial hubs, enhance connectivity between freight modes, and reduce barriers to mobility.

Intergovernmental Coordination

Build public and private freight partnerships to help maximize freight funding opportunities and the transportation and economic development impacts of the investments brought by those funds.

FIGURE 3.3 REGIONAL FREIGHT TRANSPORTATION PLAN OBJECTIVES

Safety and Security	State of Good Repair	Accessibility, Mobility, and Connectivity	System Performance	Intergovernmental Coordination	Environment and Quality of Life
• Reduce the number and rate of fatalities and injuries involving freight movements. • Improve access to truck parking in the region.	• Maintain freight assets at acceptable conditions.	• Reduce the number and magnitude of freight bottlenecks. • Increase the number and improve the quality of connections between freight modes. • Improve and enhance the safety, mobility and system connectivity through integration of intelligent transportation systems (ITS) technologies.	• Provide reliable and predictable travel times along freight corridors using intelligent transportation systems (ITS) technologies and other methods. • Improve system resiliency by increasing redundancy and reducing the risk of disruptions due to environmental conditions and man-made events.	• Facilitate partnerships between CORE MPO, GDOT, Georgia Ports Authority, freight service providers (including motor carriers, railroads, and others), and city and county governments.	• Prevent (where possible) and reduce disproportionate negative freight impacts to environmental justice communities. • Reduce emissions and other environmental impacts associated with freight movements.

Performance Measures

Performance measures are another component of the first step to determining the strategic direction of the Regional Freight Transportation Plan. Performances measures are based on metrics that are used to track progress toward goals, objectives, and achievement of established performance targets.[10] They should be manageable, sustainable, and based on collaboration with partners and stakeholders. Also, it is important that measures are selected so that they rely on data that is timely, available, and of good quality. Otherwise, the measures will provide little value for determining progress towards meeting targets and generally for managing performance. If measures are supported with reliable data of good quality, then they provide an effective basis for evaluating strategies for performance improvement.

The recommended performance measures for the Regional Freight Transportation Plan are shown in Table 3.5. Table 3.5 also shows how the measures align with the region's freight goals and objectives as well as identifies the data needed to support the measures. Importantly, the recommended measures reflect the modes and performance outcomes over which the CORE MPO has the most influence. As a result, the recommended measures have a greater focus on highway freight, environmental, and equity impacts. While non-highway freight modes are critical, other agencies or the private sector have greater influence on their performance outcomes.

[10] https://www.tpmtools.org/guidebook/chapter-01/

TABLE 3.5 FREIGHT PERFORMANCE MEASURES

Goals and Objectives	Performance Measures	Data (Sources)
Safety and Security: Provide a safe and secure multimodal freight network. • Reduce the number and rate of fatalities and injuries involving freight movements. • Improve access to truck parking in the region.	• Annual rate of crashes involving heavy trucks • Annual rate of serious injury crashes involving heavy trucks • Annual rate of fatal crashes involving heavy trucks • Annual number of highway-rail crashes • Number of public truck parking facilities and spaces	• Crashes by severity (GDOT Numetrics) • Annual average daily traffic (GDOT Traffic Analysis and Data Application, FHWA Highway Performance Monitoring System [HPMS]) • Truck parking inventory (FHWA Jason's Law Truck Parking Survey; UC Berkeley Transportation Sustainability Research Center American Truck Parking; Field surveys conducted by CORE MPO and GDOT)
State of Good Repair: Maintain a state of good repair of infrastructure critical to goods movement. • Maintain freight assets at acceptable conditions.	• Annual percentage of bridges on freight corridors in good condition • Annual percentage of pavements on freight corridors in good condition	• Bridge inventory and conditions (FHWA National Bridge Inventory) • Pavement inventory and conditions (FHWA HPMS)
Accessibility, Mobility, and Connectivity: Improve the accessibility and connectivity of the multimodal freight network to freight and industrial hubs, enhance connectivity between freight modes, and reduce barriers to mobility. • Reduce the number and magnitude of freight bottlenecks. • Increase the number and improve the quality of connections between freight modes. • Improve and enhance the safety, mobility and system connectivity through integration of intelligent transportation systems (ITS) technologies.	• Annual Mean Truck Travel Time Index (MTTI) on freight corridors • Annual total truck delay on freight corridors • Annual percentage of freight corridors actively managed with ITS	• Truck travel times (FHWA NPMRDS) • Inventory of ITS devices and corridors (GDOT Office of Traffic Operations)
System Performance: Improve the reliability of freight movements and the resiliency of the multimodal freight network to support economic competitiveness. • Provide reliable and predictable travel times along freight corridors using intelligent transportation systems (ITS) technologies and other methods.	• Truck Travel Time Reliability (TTTR) Index on Interstate corridors	• Truck travel times (FHWA NPMRDS)

• Improve system resiliency by increasing redundancy and reducing the risk of disruptions due to environmental conditions and man-made events.		
Environment and Quality of Life: Improve equity by preventing or minimizing adverse impacts of freight operations on communities and the environment while increasing community awareness of freight's importance to providing a high quality of life. • Prevent (where possible) and reduce disproportionate negative freight impacts to environmental justice communities. • Reduce emissions and other environmental impacts associated with freight movements.	• Annual rate of total crashes, serious injury crashes, and fatal crashes involving heavy trucks in environmental justice communities. • Annual number of highway-rail incidents in environmental justice communities.	• Crashes by severity (GDOT Numetrics) • Highway-rail crashes (Federal Railroad Administration Highway/Rail Grade Crossing Incidents) • Sociodemographic data by Census tract (U.S. Census Bureau Decennial Census)
Intergovernmental Coordination: Build public and private freight partnerships to help maximize freight funding opportunities and the transportation and economic development impacts of the investments brought by those funds. • Facilitate partnerships between CORE MPO, GDOT, Georgia Ports Authority, freight service providers (including motor carriers, railroads, and others), and city and county governments.	• Annual amount of external grant funds for projects impacting freight. • Activity level with Economic Development and Freight Advisory Committee (EDFAC) meetings/communication.	• Amount of external funding for freight projects (CORE MPO) • Number of EDFAC meetings and count of attendance (CORE MPO)

The recommended performance measures provide the ability to track the region's freight performance, determine progress towards meeting established targets, and to manage the region's multimodal freight network's performance. More detail on the recommended freight performance measures is included in the list below:

- **Safety and Security.** These measures capture the safety and resiliency of the CORE MPO multimodal freight network. Measures include the annual rate of truck-involved crashes ($Total\ No.of\ Truck\ Involved\ Crashes/100\ Million\ Vehicle\ Miles$), annual rate of serious injury crashes involving heavy trucks ($Total\ No.of\ Serious\ Injury\ Truck\ Involved\ Crashes/100\ Million\ Vehicle\ Miles$), annual rate of fatal crashes involving heavy trucks ($Total\ No.of\ Fatal\ Truck\ Involved\ Crashes/100\ Million\ Vehicle\ Miles$), annual number of highway-rail crashes, and the annual number of truck parking facilities and spaces. The crash and traffic data on which these measures rely are regularly collected and maintained by GDOT, FHWA, and the FRA. Data on truck parking is also collected as part of FHWA and other initiatives but would benefit from routine field surveys led by the CORE MPO and GDOT to collect data on commercial truck parking facilities.

- **State of Good Repair.** Measures in this goal area reflect the condition of the region's freight network. They include the annual percentage of bridges in good[11] condition and the annual percentage of pavements in good[12] condition. "Good" conditions for pavements and bridges are as defined in the final transportation performance management rulemakings. The data necessary for these measures are collected annually by state DOTs and FHWA as part of the National Bridge Inventory (NBI) and the Highway Performance Monitoring System (HPMS) databases.

- **Accessibility, Mobility, and Connectivity.** These measures capture the ease, or difficulty, of freight travel and primarily rely on travel time data. Measures include the annual mean truck travel time index on freight corridors ($Mean\ Truck\ Travel\ Time_{Segment}/Reference\ Truck\ Travel\ Time_{Segment}$)[13], total annual truck delay on freight corridors ($Truck\ VHT_{Segment} - \left[Truck\ Volume_{Segment} \times Reference\ Truck\ Travel\ Time_{Segment} \times \frac{1}{60}\right]$[14]), and the annual percentage of freight corridors actively managed with ITS ($[Miles\ of\ Freight\ Corridors\ Managed\ with\ ITS/Total\ Miles\ of\ Freight\ Corridors] \times 100\%$). The travel time data needed for these measures is available through the FHWA's National Performance Management Research Data Set (NPMRDS) and the ITS data can be obtained from the GDOT Office of Traffic Operations.

- **System Performance.** The system performance measure is the TTTR, which is the designated metric under FHWA's transportation performance management final rulemakings[15]. It is calculated as the ratio of the 95th percentile travel time to the 50th percentile travel time ($95th\ Percentile\ Truck\ Travel\ Time/$

[11] U.S. Department of Transportation, Federal Highway Administration. Code of Federal Regulations, 23 CFR 490; Final Rulemaking, 82 FR 5886, https://www.federalregister.gov/documents/2017/01/18/2017-00550/national-performance-management-measures-assessing-pavement-condition-for-the-national-highway.

[12] Ibid.

[13] U.S. Department of Transportation, Federal Highway Administration. Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report. FHWA-HOP-15-033, https://ops.fhwa.dot.gov/publications/fhwahop15033/fhwahop15033.pdf.

[14] Ibid.

[15] U.S. Department of Transportation, Federal Highway Administration. Code of Federal Regulations, 23 CFR 490; Final Rulemaking, 82 FR 5970, https://www.federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system.

$50th\ Percentile\ Truck\ Travel\ Time$). The TTTR relies on travel time data which is available through the NPMRDS.

- **Environment and Quality of Life.** These measures apply the safety and security freight performance measures to environmental justice communities. The purpose is to determine if there are disproportionate negative impacts of goods movement on those communities. In addition to the GDOT, FHWA, and FRA data sources needed for the safety and security freight performance measures, socioeconomic data must also be obtained from the U.S. Census Bureau to identify environmental justice communities.

- **Intergovernmental Coordination.** The intergovernmental coordination freight performance measures indicate the level of involvement of the region's freight stakeholders. It is measured as the number of EDFAC meetings and average attendance.

4 FUTURE FREIGHT GROWTH

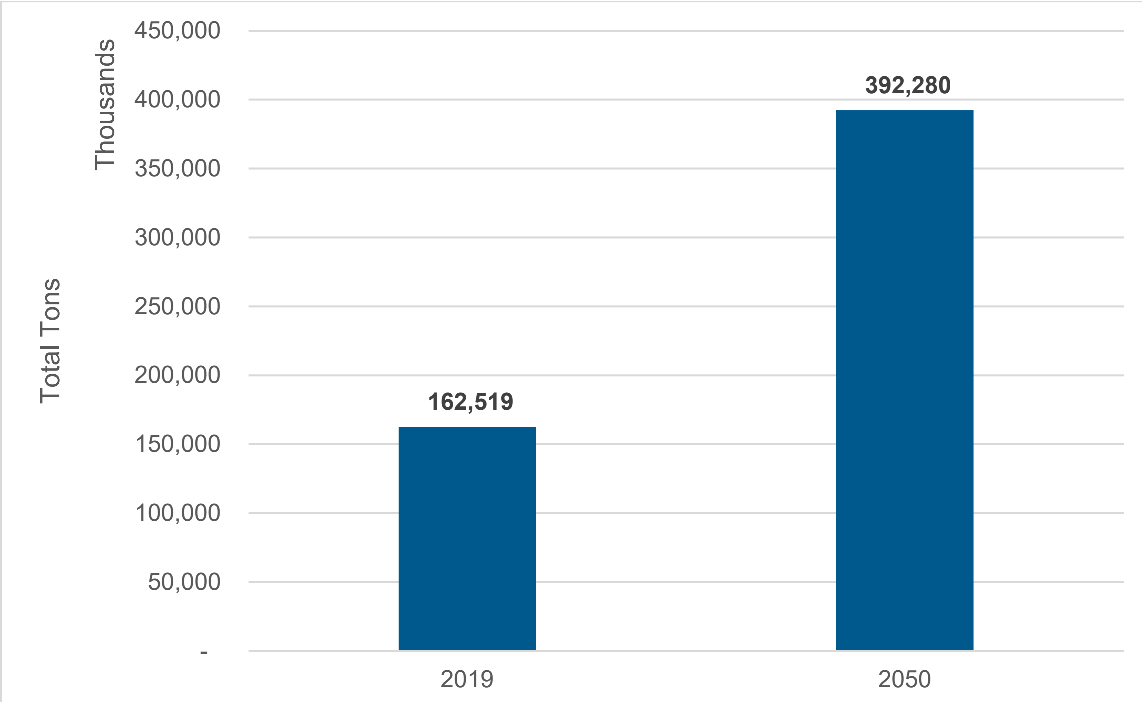
Section 4 estimates the future trends, characteristics, and freight volumes by mode and commodity for the CORE MPO region. Understanding how goods will be moved throughout the region in the future will help identify the deficiencies and constraints to handling that growth. Furthermore, the analysis highlights aspects of freight demand that may change relative to the current baseline such as new freight activity centers or emerging modes.

4.1 Future Freight Growth

The needs of the Savannah region's freight system are driven by both the current and future demand for freight transportation. This section of the report examines the demand for freight transportation services in the region by analyzing the commodities flows underlying that demand. Overall, in 2019 nearly 163 million tons of freight worth $367 billion were transported to, from, within, or through (i.e., truck and rail only) the CORE MPO Region as shown in Figure 4.1. This is projected to more than double in 2050 and grow to over 392 million tons worth $895 billion as shown in Figure 4.2.

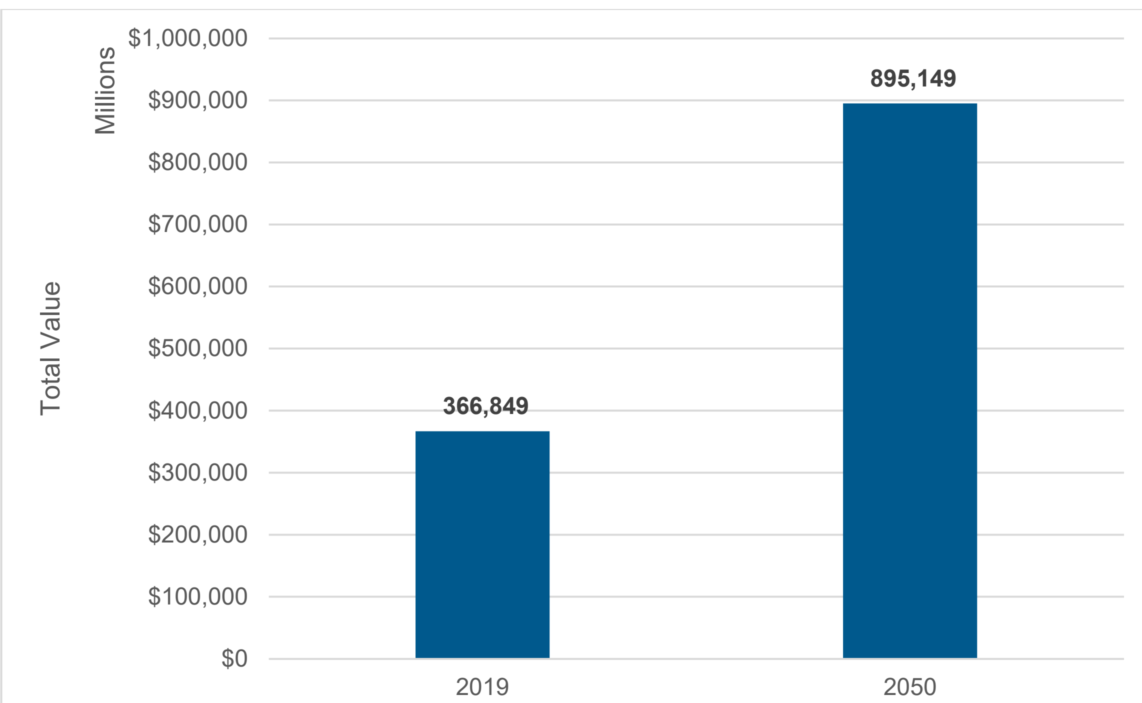
Future freight growth throughout the region will be driven by increased demand for several different types of goods. Examples of the key commodities driving increased demand include "food or kindred products" (e.g., meat, milk, fruits, vegetables), "pulp, paper, or allied products," "nonmetallic minerals" (e.g., gravel, sand), "clay, concrete, glass, or stone," "chemicals or allied products" (e.g., soap, paints, drugs), "waste and scrap materials," "farm products," and "secondary traffic" (e.g., shipments between warehouses and distribution centers). All of these commodities are projected to increase in magnitude through 2050. This ranges from about an 86 percent increase for "clay, concrete, glass, or stone" to a 404 percent for "waste and scrap materials." Furthermore, many of these commodities support major industry sectors in the coastal region and throughout Georgia such as forestry, paper products manufacturing, and chemical manufacturing.

FIGURE 4.1 CORE MPO TOTAL TONS, 2019 AND 2050



Source: TRANSEARCH; USA Trade Online; Cambridge Systematics, Inc. analysis.

FIGURE 4.2 CORE MPO TOTAL VALUE, 2019 AND 2050

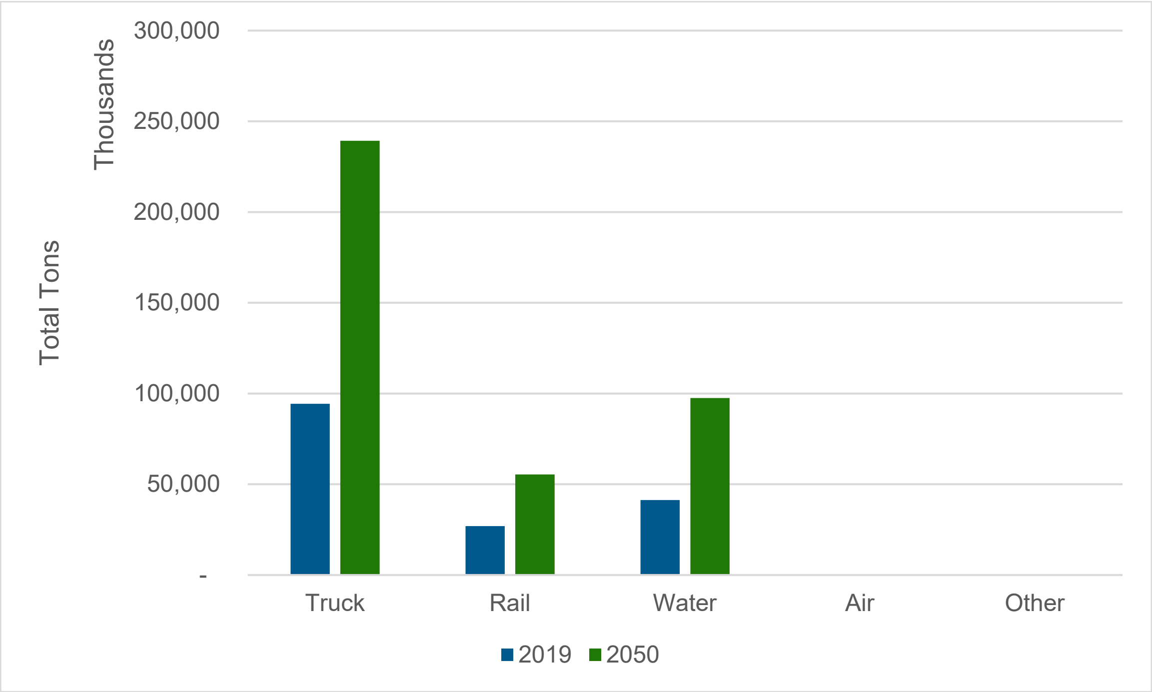


Source: TRANSEARCH; USA Trade Online; Cambridge Systematics, Inc. analysis.

Figure 4.3 shows the total tonnage by mode for 2019 and 2050. The majority of freight in the CORE MPO region is moved by truck – over 94.3 million tons (about 58 percent) in 2019. After trucking, the region's ports and waterways accounted next largest share of total tons. In 2019, about 41.3 million tons (approximately 25 percent) of the region's goods were transported by water. Rail was the next largest mode with nearly 27 million tons of goods – about 17 percent of the region's total tonnage in 2019. Air and "other modes" account for small shares of the region's freight activity, less than 10,000 tons combined.

Growth through 2050 is projected for all modes as shown in Figure 4.3. Trucking is projected to grow to about 239.3 million tons and increase its share of total goods moved throughout the region to about 61 percent. The region's ports and waterways are estimated to transport over 97.5 million tons by 2050 while the rail network will handle about 55.4 million tons of goods. Air and "other modes" will continue to account for small shares of total tonnage and only handle about 20,000 tons of goods.

FIGURE 4.3 CORE MPO TOTAL TONS BY MODE, 2019 AND 2050

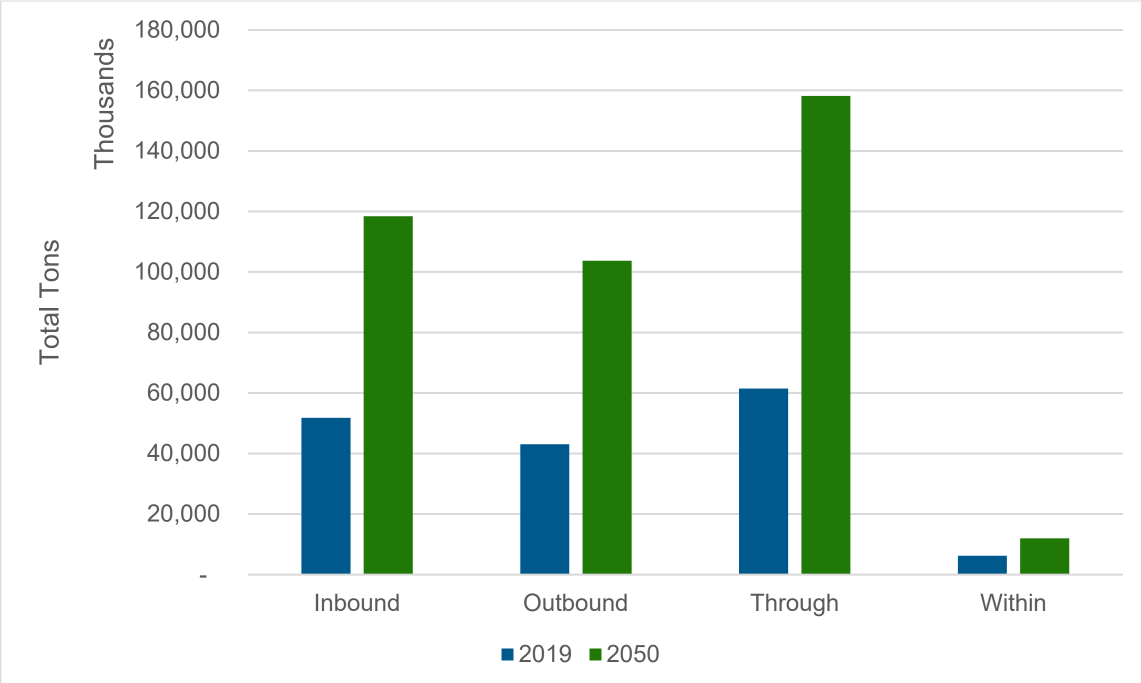


Source: TRANSEARCH; USA Trade Online; Cambridge Systematics, Inc. analysis.

In 2019, over 61.4 million tons (almost 38 percent of all freight tonnage) of freight moved through the region without making a stop as shown in Figure 4.4. Through movements, which are estimated for truck and rail only, accounted for the largest share of tonnage. Inbound shipments accounted for nearly 51.8 million tons in 2019 (about 32 percent of total tons) and outbound shipments were about 43 million tons (about 27 percent of total tons). Over 6.2 million tons of goods (about 4 percent) had an origin or destination within the region.

By 2050, rail and truck through movements will have grown to over 158.1 million tons (about 40 percent of total tons) as shown in Figure 4.4. Inbound and outbound shipments are projected to more than double to over 118.4 million tons and approximately 103.7 million tons, respectively. Freight shipments beginning and ending in the region are projected to remain the smallest movement with just over 12 million tons.

FIGURE 4.4 CORE MPO TOTAL TONS BY DIRECTION, 2019 AND 2050



Source: TRANSEARCH; USA Trade Online; Cambridge Systematics, Inc. analysis.

4.2 Potential Factors Impacting Baseline Freight Demand

While the previous section of the report examined the existing and future demand for freight transportation services in the region by analyzing the commodities flows underlying that demand, this section of the report investigates how future demand may be impacted other factors. Emerging freight modes, new freight activity centers, and changes in the growth trajectory for the Port of Savannah all have the potential to alter where and how goods move on the region's multimodal freight network. Understanding the potential for these factors to impact long-term growth is important for developing strategies and recommendations that hedge against the uncertainty of long-term forecasts.

Emerging Freight Modes

While freight modes such as trucks and trains have been in use for over a century, advancements in technology have begun to change available modes to include options such as drones, delivery robots, and connected and autonomous trucks deployed in platoons. This section of the report discusses these emerging modes and their potential to impact freight demand and operations.

Unmanned Aerial Vehicles and Delivery Robots

Drones are lightweight aircraft which operate remotely without a pilot physically onboard whereas a delivery robot is an automated robot which conducts deliveries on the ground. Drones must, however, be operated by a pilot registered with the Federal Aviation Administration (FAA).[16] Through 2021, over 850,000 drones have been registered with nearly 260,000 remote pilots receiving their certification.

FIGURE 4.5 EXAMPLE OF A DELIVERY DRONE

Source: Amazon; USA Today.

The concept of drone delivery for freight purposes began in 2013 with an announcement from Amazon that drones, also known as unmanned aerial vehicles (UAVs), would be used to deliver lightweight commercial products (see Figure 4.5).[17] [18] Since then, the FAA has set up Small Unmanned Aircraft Systems (UAS) test sites seven locations across the nation. While drones are not envisioned to fully replace trucks, they can offer an advantage for last-mile deliveries. This reduces vehicle miles traveled on the roadway and offers a solution to truck driver shortages for limited markets, although drone pilots are needed to operate the UAVs. The allowable use of drones has continued to evolve with night operations allowed as of April 2021.[19] These changes to the FAA's UAS Rule, Part 107 also allowed for drones under 0.55 pounds to fly over people and moving vehicles. Such changes can allow for remote traffic monitoring and surveying to enhance traffic information. For flight operations over vehicles restrictions include either:

- The UAV must remain within a closed or restricted-access site, and all individuals inside any moving vehicle within the designated area must be on notice of the operation; or

[16] Code of Federal Regulations. Title 14, Chapter I, Subchapter F, Part 107 – Small Unmanned Aircraft Systems, § 107.12 Requirement for a remote pilot certificate with a small UAS rating. https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107

[17] BBC News. "Amazon Testing Drones for Deliveries." (December 2, 2013).

[18] Light commercial products. Drone deliveries are limited by the carrying capacity of the UAVs. While most hobby drones can only carry a few pounds, professional drones may be able to transport upwards of 200 pounds. However, as the allowable payload increases, so too does cost. For example, a Dragon X12 U11 Drone has a recommended payload of up to 100 pounds and costs over $30,000.

[19] Code of Federal Regulations. Title 14, Chapter I, Subchapter F, Part 107 – Small Unmanned Aircraft Systems. https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107

- The UAV does not maintain sustained flight over moving vehicles.

Delivery robots (also called personal delivery devices) are being deployed mostly in urban markets (see Figure 4.6).[20] Their adoption took off during the pandemic lockdowns, but regulation of the technology has been uneven. Nuro's R2 received USDOT and NHTSA autonomous vehicle exemption to operate on public roads without certain equipment required of passenger vehicles, such as side mirrors or a windshield.[21] Refraction AI, a robotics company focused on last-mile deliveries, began operating in cities in 2021.[22] California-based Coco launched food delivery within a two-mile radius, utilizing pedestrian routes.[23]

FIGURE 4.6 EXAMPLE OF A PERSONAL DELIVERY DEVICE

Source: Amazon.

In Georgia, state law was amended to account for the advent of personal delivery devices on the state's transportation network.[24] House Bill 1009 was passed in 2022 which amended Title 40 (Motor Vehicles and Traffic) of the Official Code of Georgia Annotated to include personal delivery devices. Specifically, it allows personal delivery devices to be operated on bicycle lanes, sidewalks, shared use paths, and non-limited access highways. Additionally, House Bill 1009 established regulations for personal delivery devices pertaining to maximum operating speeds (4 miles per hour on sidewalks and shared use paths, 20 miles per hours on bicycle lanes and highways), weight limits (500 pounds unladen and 600 pounds loaded with

[20] Gizmodo. (2021). "Domino's Has a New Pizza Delivery Robot That Lets You Track Your Order While It Drives It Over." https://gizmodo.com/domino-s-has-a-new-pizza-delivery-robot-lets-you-track-1846710108

[21] U.S. Department of Transportation, Automated Vehicles Comprehensive Plan, January 11, 2021, https://www.transportation.gov/sites/dot.gov/files/2021-01/USDOT_AVCP.pdf

[22] KXAN. (June 2021). "Delivery Robots will be on the Road in Austin starting Monday." https://www.kxan.com/news/delivery-robots-will-be-on-the-road-in-austin-starting-monday/

[23] Culture Map Houston. (March 2022). California Company Rolls into Houston with Robot Food Delivery in 15 Minutes. https://houston.culturemap.com/news/innovation/03-22-22-coco-food-delivery-robots-houston/

[24] https://www.legis.ga.gov/api/legislation/document/20212022/207968

cargo), and requirements for lights and prominently displayed contact and identification information, among others.

Connected and Autonomous Vehicles

Connected vehicle (CV) technology utilizes short-range communications (commonly referred to as V2X or vehicle-to-everything) to sense what other travelers are doing and to identify potential hazards. Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) allow for vehicles to have an awareness of each other's location. Connected and autonomous trucks (see Figure 4.7) may be viewed as a distinct new freight mode, especially in the case of trucks deployed in platoons. Fleet operators that are able to deploy trucks in platoons can potentially realize fuel cost savings, labor cost savings, and greater operational efficiencies. Truck platoons use vehicle-to-vehicle (V2V) communications and autonomous vehicle control technology to electronically "tether" tractor-trailers together in a convoy formation. Platooning can yield greater fuel efficiency due to reduced aerodynamic drag on the following vehicle(s).[25] It can yield labor cost savings if the following trucks in the convoy are not operated by humans, but instead are tethered to a lead truck with a human driver. Combined with the potential fuel and labor cost savings, the ability to deploy trucks in a platoon would result in greater operational efficiencies for the trucking industry.

FIGURE 4.7 EXAMPLE OF A CONNECTED AND AUTONOMOUS HEAVY TRUCK

Source: TUSimple.

Emerging Freight Activity Centers

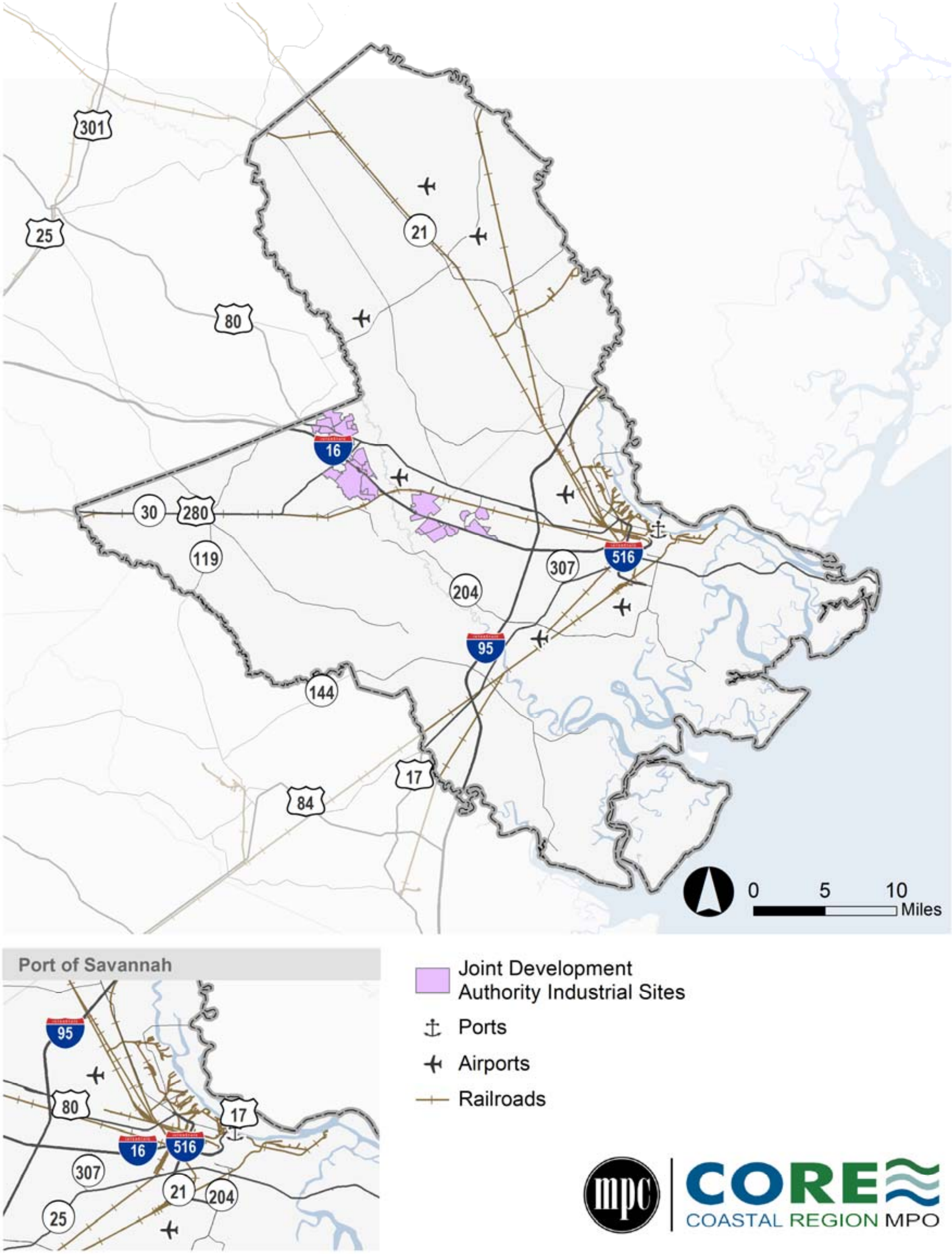
Data available from the region's various economic development agencies indicate that there are multiple emerging freight activity centers in the region. While historically the region's industrial and freight activity centered on areas adjacent to the Port of Savannah and east of downtown along President Street, new activity centers are being developed to the north (i.e., north Effingham County), south (i.e., Rockingham Industrial Park in Savannah and the Belfast Commerce Park in Bryan County), and west (i.e., West I-16) of the region's urban core. The emergence of these freight activity centers will impact freight traffic patterns

[25] Lammert, M., Duran, A., Diez, J., Burton, K. et al., "Effect of Platooning on Fuel Consumption of Class 8 Vehicles Over a Range of Speeds, Following Distances, and Mass," SAE Int. J. Commer. Veh. 7(2):2014, doi:10.4271/2014-01-2438.

throughout the region. As Hyundai Motor Company is currently developing a major assembly plant in the region, the emergence of these freight activity centers will be hastened as automotive parts suppliers have already begun acquiring land within these areas in anticipation of the new plant.

The Savannah Harbor-Interstate 16 Corridor Joint Development Authority (JDA) includes the development authorities of Bryan, Bulloch, Chatham, and Effingham Counties. The JDA combines the resources of its member counties to attract and facilitate regionally significant projects. Figure 4.8 shows the JDA industrial sites throughout the CORE MPO region. These sites comprise over 13,000 acres of land that is likely to be developed to include substantial volumes of warehouse, distribution, and other logistics space. They include the Bryan County megasite that will contain the Hyundai Motor Company assembly plant. The development of the plant in the CORE MPO region has already begun to attract automotive parts suppliers who will consume some of the available land, which is a departure from warehousing/distribution center development which has historically been most prevalent in the region. As shown in Figure 4.8, these sites are concentrated along the I-16 corridor with much of the acreage being located in Bryan and Effingham Counties. It suggests that the west I-16 corridor is an emerging freight activity center.

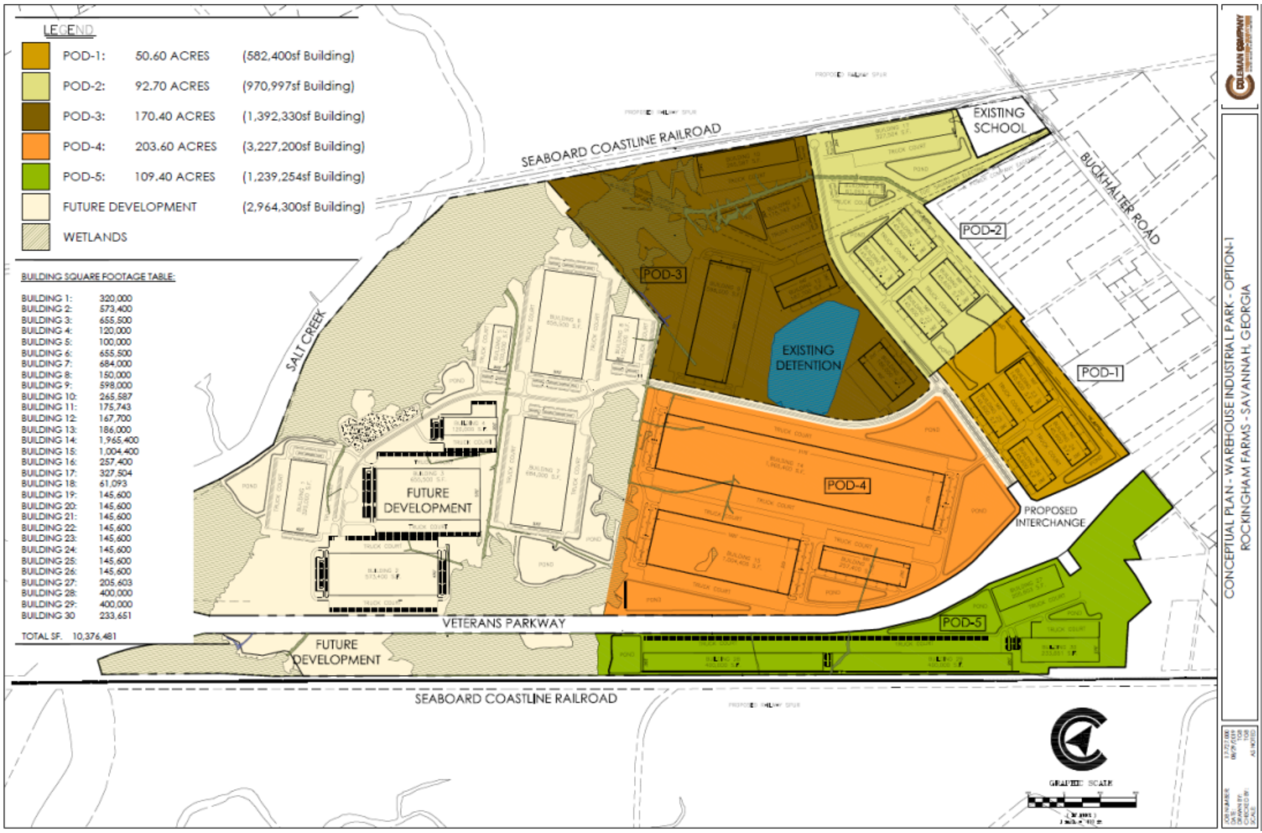
FIGURE 4.8 JOINT DEVELOPMENT AUTHORITY INDUSTRIAL SITES IN THE CORE MPO REGION



Source: U.S. Census Bureau, County Business Patterns; Cambridge Systematics, Inc. analysis.

To the region's south, the Rockingham Farms Industrial Park is also an emerging freight activity center. The industrial park is currently under development along Veterans Parkway south of US 17 and east of a tributary of the Ogeechee River. It will occupy approximately 1,125 acres with the capacity to build up to 10 million square feet of warehouses, distribution centers, factories, and other light industrial facilities as shown in Figure 4.9. The site is rail and highway-accessible with a new interchange under construction along Veterans Parkway to provide greater access.

FIGURE 4.9 ROCKINGHAM FARMS INDUSTRIAL PARK

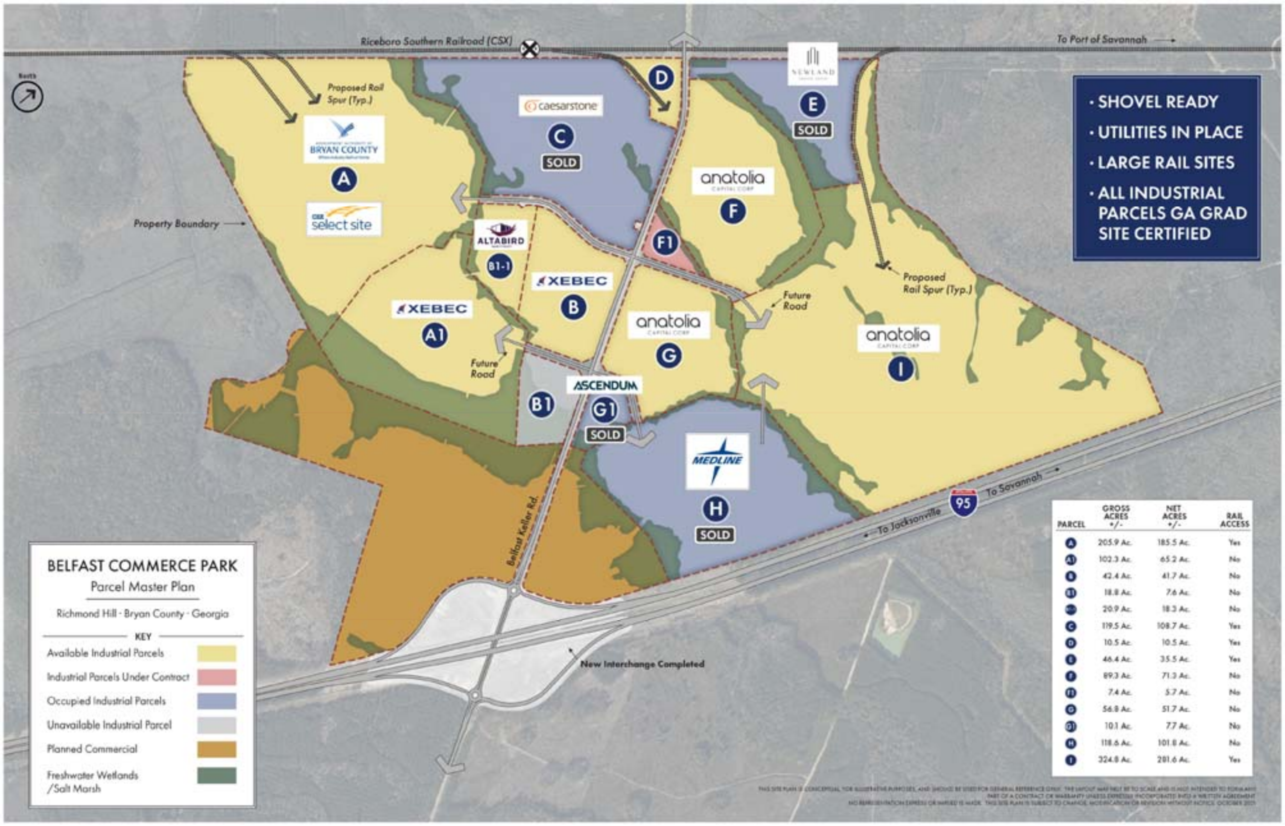


Source: City of Savannah.

Further south in Bryan County, the Belfast Commerce Park is another emerging freight activity center. The industrial park is currently under development along Belfast Keller Road near its interchange with I-95 in Bryan County. It will occupy approximately 1,174 acres and provide both highway and rail access as shown in Figure 4.10. A Federal Express (FedEx) distribution center has already been constructed on the site. In November 2022, automotive parts supplier Hyundai Mobis announced it will locate a 1.2 million square foot manufacturing facility in Belfast Commerce Park.[26] Together with the Rockingham Farms Industrial Park, the development of the Belfast Commerce Park will result in a new freight activity center to the region's south.

[26] Snyder, F., "New Hyundai Mobis plan expected to bring 1,500 jobs to Richmond Hill," WTOC 11, https://www.wtoc.com/2022/11/28/new-hyundai-mobis-plant-expected-bring-1500-jobs-richmond-hill/

FIGURE 4.10 BELFAST COMMERCE PARK



PARCEL	GROSS ACRES +/-	NET ACRES +/-	RAIL ACCESS
A	205.9 Ac.	185.5 Ac.	Yes
A1	102.3 Ac.	65.2 Ac.	No
B	42.4 Ac.	41.7 Ac.	No
B1	18.8 Ac.	7.6 Ac.	No
B1-1	20.9 Ac.	18.3 Ac.	No
C	119.5 Ac.	108.7 Ac.	Yes
D	10.5 Ac.	10.5 Ac.	Yes
E	46.4 Ac.	35.5 Ac.	Yes
F	89.3 Ac.	71.3 Ac.	No
F1	7.4 Ac.	5.7 Ac.	No
G	56.8 Ac.	51.7 Ac.	No
G1	10.1 Ac.	7.7 Ac.	No
H	118.6 Ac.	101.8 Ac.	No
I	324.8 Ac.	281.6 Ac.	Yes

Source: Bryan County Economic Development Agency.

In Effingham County, large industrial developments are planned in the northern part of the county along McCall Road, Old Augusta Road, and SR 21.[27] Along McCall Road, the Savannah Gateway Industrial Hub occupies approximately 2,635 acres. The property has access to McCall Road, SR 21, and Class I rail service. The Grande View industrial site occupies about 448 acres and is located east of Old Augusta Road and south of the Georgia Pacific plant. The proposed Georgia International Rail Park sits on 1,416 acres and is located west of SR 21 and east of McCall Road near Rincon. The property has access to both the CSX and NS networks. The development of these properties would create a new freight activity center in the northern part of the CORE MPO region.

Port of Savannah Growth

Infrastructure expansion efforts currently underway at the Port of Savannah will grow its annual throughput capacity from 6 million twenty-foot equivalent units (TEUs) to approximately 10.7 million TEUs per year.[28] Discussed in detail in the Task 2.4 technical memorandum, these investments include the following: an expansion of the Garden City West Terminal; a cross dock facility upriver from the Garden City Terminal; the Peak Capacity Project which expands the Port's footprint and adds container handling space; improvements to Berth 1 so that it may to simultaneously serve four 16,000-TEU vessels; the development of the Northeast Inland Port in Hall County; and the development of the Savannah Container Terminal which will be a new

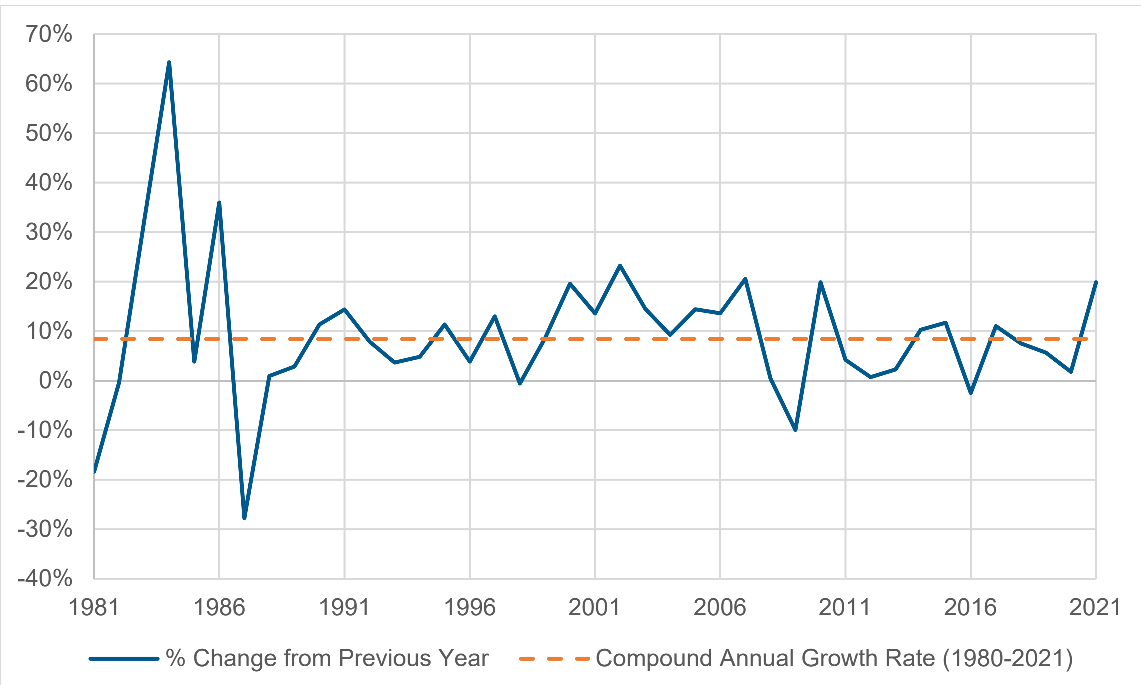
[27] https://effinghamindustry.com/doing-business-here/available-properties/

[28] Georgia Ports Authority, 2021 Annual Report.

facility on Hutchinson Island.[29] In addition, not included in the 6 million TEU capacity expansion is the proposed Jasper Ocean Terminal.[30] This would be a new 7 million TEU marine container terminal along the north bank of the Savannah River in Jasper County, South Carolina – about 8 miles upriver from the Garden City Terminal. However, there is no current timeline for the development of this facility.

Given historical growth trends, the Port's current infrastructure expansion efforts is expected to meet future demand. Historically, the Port of Savannah has experienced annual growth in container trade of about 8.5 percent based on 1980-2021 container volumes as shown in Figure 4.11.[31] However, since the onset of the COVID-19 pandemic annual growth has been closer to about 10.5 percent based on 2019-2021 container volumes. Container traffic increased from nearly 4.6 million TEUs in 2019 to over 5.6 million in 2021. 2022 container volumes are on track to exceed 2021 levels.[32]

FIGURE 4.11 PORT OF SAVANNAH CONTAINER TRADE (TEUS), 1980 - 2021



Source: Georgia Ports Authority; American Association of Port Authorities.

A key question is will growth return to the historical norm, or has the pandemic changed the trajectory of growth and represents a new normal. Returning to this historical rate of growth, the Port of Savannah would reach the limit of its published program of expanded capacity (i.e., 10.7 million TEUs) by 2029. Should the recent higher growth rate which has been experiences since the onset of the COVID-19 pandemic continue, the port would reach the limit of its published program of expanded capacity by 2027. Given that the port

29 https://gaports.com/press-releases/gpa-details-capacity-operations-expansion/

30 http://www.jasperoceanterminaleis.com/Project.aspx

31 Georgia Ports Authority, "By the Numbers," Total Annual Container Trade for Calendar Years 2017 through 2021, May 2022, https://gaports.com/wp-content/uploads/2022/05/CY21-Annual-Container-Trade.pdf?1667954238; American Association of Port Authorities, "Port Industry Statistics", North America Container Traffic 1980-2018, https://www.aapa-ports.org/unifying/content.aspx?ItemNumber=21048.

32 Georgia Ports Authority, "Port of Savannah TEU Throughput by Month (through September 2022)," https://gaports.com/sales/by-the-numbers/, Accessed November 8, 2022.

generally prefers to maintain a 20 percent buffer between demand and capacity so that spikes in demand or other unforeseen challenges can be accommodated[33], the higher growth rate would imply that the Port of Savannah would need to begin considering additional capacity expansions as soon as 2025. Very recent shipping indicators in October and November 2022 point to a return to normal or less than normal growth due to uncertainty in the U.S. and global economy.

Implications for Factors Impacting Baseline Future Demand

Overall, the various factors considered in this report have the potential to increase the baseline future demand for freight in the CORE MPO region. The implications of these factors by mode are summarized in Table 4.1. They are discussed in greater detail in the subsections that follow.

TABLE 4.1 IMPLICATIONS OF FACTORS FOR BASELINE FUTURE FREIGHT DEMAND

Aspect of Freight Demand	Description	Impact on Freight Demand
Emerging Freight Modes	Last-mile alternatives such as delivery bots and unmanned aerial vehicles (UAVs)	Truck ↓ (Minor to no effect) Rail ↔ (Minor to no effect) Port ↔ (Minor to no effect) Air ↔ (Minor to no effect)
	Connected and autonomous trucks deployed in platoons	Truck ↑ (Significant) Rail ↓ (Minor to moderate) Port ↔ (Minor to no effect) Air ↔ (Minor to no effect)
Emerging Freight Activity Centers	Emergence of new freight activity centers in the northern, southern, and western portions of the region	Truck ↑ (Significant) Rail ↑ (Minor to moderate) Port ↔ (Minor to no effect) Air ↔ (Minor to no effect)
Sustained Higher than Normal Growth at the Port of Savannah	Continuation of the recent higher growth rate experienced since the onset of the COVID-19 pandemic	Truck ↑ (Significant) Rail ↑ (Significant) Port ↑ (Significant) Air (Minor to no effect)

Source: Cambridge Systematics.

Note: ↑ = Increase in demand, ↓ = Decrease in demand, ↔ = No increase or decrease in demand.

Implications of Emerging Freight Modes

Emerging freight modes (such as drones, delivery robots, and connected and autonomous trucks deployed in platoons) have the potential to increase the demand for freight transportation services on the CORE MPO region's multimodal network. Regarding drones and robots, their use for freight delivery remains early in the testing and development stage. The continued adoption of drone and robot delivery systems would likely have a minor impact on freight demand. Specifically, the demand for that mode may reduce demand for smaller delivery trucks and step vans for making last-mile deliveries. Removing heavier delivery vehicles from the roadway system would reduce vehicle miles traveled which in turn potentially reduce crashes, emissions, congestion, and roadway maintenance costs.

[33] Interview with Georgia Ports Authority, October 31, 2022.

Regarding connected and autonomous trucks deployed in platoons, this emerging mode has the potential to increase demand for trucking and reduce demand for rail. This is because rail and trucking compete for many of the same types of freight traffic such as containerized cargo and moderate-value bulk goods. Competition may be enhanced in regions that contain both extensive rail and highway networks. On a per-mile basis, labor and fuel are the two highest operational costs for the trucking industry. Connected and autonomous trucks deployed in platoons would lower these costs for the trucking industry and make motor carriers more cost competitive for shipments that might have otherwise traveled by rail. As a result, the implication of this emerging mode for the CORE MPO region is that it could generate greater demand on the highway network while lowering demand on the rail network.

Implications of Emerging Freight Activity Centers

Regarding emerging freight activity centers, the implication is that these new centers can result in an increase in freight demand throughout the region especially on the highway and rail networks. This is because the facilities (e.g., warehouses, distribution centers, manufacturing plants) developed at these freight activity centers increase the region’s capacity to handle and process goods. Increases in freight volumes are likely to be concentrated on the highway and rail networks with highways experiencing more significant increases. Furthermore, the increase in highway freight volumes will be more pronounced on regional freight routes (such as US 280, Veterans Parkway, and Belfast Keller Road) than on Interstate highways.

In addition, these new centers will alter where freight moves in the region. While historically the region’s industrial and freight activity centered on areas adjacent to the Port of Savannah and east of downtown along President Street, new activity centers are being developed to the north (i.e., north Effingham County), south (i.e., Rockingham Industrial Park in Savannah and the Belfast Commerce Park in Bryan County), and west (i.e., West I-16) of the region’s urban core. The emergence of these freight activity centers will impact freight traffic patterns throughout the region.

Implications of Sustained Higher than Normal Growth at the Port of Savannah

Sustained higher than normal growth at the Port of Savannah would substantially increase freight demand across all of the region’s primary freight modes – trucking, rail, and ports/waterways. Goods imported or exported by water must also travel on the region’s highway and rail networks. As a result, these modes would experience a significant increase in demand on par with increased growth at the Port of Savannah.

Another implication of sustained higher than normal growth at the Port of Savannah is that in addition to completing its published program of expanded capacity, the Georgia Ports Authority would have to begin considering other expansion opportunities. These could be expansions within the CORE MPO region or projects located outside the study area, such as additional inland ports in other parts of the state. Expansions within the region would alter existing land uses and impact freight activity patterns, primarily on the highway network. In the event that expansions occur outside the region in the form of inland ports or other facilities, the region is still likely to experience greater volumes on its rail network and impacts to at-grade crossings.

5 REGIONAL FREIGHT PROFILES AND ASSESSMENT

Section 5 performs an inventory of existing multimodal freight assets in the CORE MPO region and assess their performance and conditions. The assessment is performed by mode and covers highways, rail, ports, and air cargo. Documenting the existing system and its challenges helps identify strategies and solutions to aid the region going forward.

5.1 Recent and Ongoing Major Freight Investments

Since the 2015 Regional Freight Transportation Plan was completed, much has changed in the region and across Georgia that impacts the Savannah region's multimodal freight network. Recent completed and ongoing major freight investments include the Savannah Harbor Expansion Project (SHEP), the Mason Mega Rail Project, the Appalachian and Northeast Georgia regional ports, and the Major Mobility Investment Program. Each of these impacts the manner and the magnitude of freight flowing through the study area.

The Savannah Harbor Expansion Project (SHEP) was completed in March 2022. The SHEP deepened the Port of Savannah's main navigation channel from 42 feet to 47 feet. This allows the harbor to accommodate deeper draft vessels without tidal restrictions. Vessels carrying as many as 16,000 containers are now able to call on the port at low tide.

The Mason Mega Rail Project was completed in 2022 and has substantially increased on-dock rail capacity at the Port of Savannah. The project increased the number of working tracks from 8 to 18 and added about 97,000 feet of new rail to the Garden City Terminal. This brings the total amount of on-dock rail at the terminal to approximately 34 miles. In addition, the Mason Mega Rail Project increases the lift capacity at the Port of Savannah to approximately 1 million containers per year.

The Appalachian Regional Port opened in 2018 and is joint venture between Murray County, the Georgia Ports Authority and CSX Transportation. The port was conceived, in part, to provide an alternative to trucking for freight trips between the Port of Savannah and northwest Georgia. The facility has an annual capacity of about 50,000 containers and has a direct rail route via CSX Transportation to the Port of Savannah.

Though not yet complete, another inland port is being developed in Hall County. The Northeast Georgia Inland Port will provide a rail alternative to trucking for freight trips between the Port of Savannah and northeast Georgia. The facility will have an annual lift capacity of about 80,000 containers and will have a direct rail route via Norfolk Southern to the Port of Savannah.

Another freight investment currently under development that impacts the Savannah region is the Georgia Department of Transportation's (GDOT's) Modern Mobility Improvement Program (MMIP). The MMIP is expanding the region's highway network and implementing operational improvements through the "16@95" project. The project is scheduled to be completed in 2023 and key components include:

- Widening I-16 mainline corridor toward the inside median from two to three lanes in each direction from I-95 to I-516;

- Replacing the existing (I-95 southbound to I-16 eastbound and the I-16 westbound to I-95 southbound) loop ramps located on the west side of I-95 with "partial turbine" configuration ramps to provide smoother, more direct connections;
- Adding a collector-distributor (CD) lane on I-95 northbound to help improve traffic flow and safety to and from I-16 and I-95;
- Adding lighting at the I-16/I-95 Interchange;
- Installing Intelligent Transportation System (ITS) technology, including cameras, and changeable message signs to provide real-time driving conditions;
- Installing ramp meters at SR 307/Dean Forest Road and Chatham Parkway on-ramps;
- Constructing a two-lane, emergency-use median crossover on I-16 between I-95 and SR 307/Dean Forest Road to aid in evacuations; and
- Constructing/rehabilitating 13 bridges.

The implication of these investments for the region is that they help it to facilitate greater volumes of freight, enhancing its role as a global logistics hub. Recent and ongoing investments in inland ports may have the long-term impact of diverting to rail freight shipments that would have otherwise been transported by truck.

5.2 Highways

In the Savannah region, freight moves through a transportation system that encompasses all modes. The region is served by a deepwater port, two Class I railroads, three rail terminals (including the Mason Mega Rail Terminal), and one commercial service airport that also provides cargo services. The region's roadway network connects all these assets to provide truck access from the intermodal terminals (seaports, rail yards, and airports) to origins or destinations of goods. This section of the report describes the condition and performance of the Savannah region's highway freight assets.

Inventory of Assets

The roadway network provides a critical connection between users and producers of goods throughout the state, the nation, and the world. The Savannah region's roads provide nearly 8,700 centerline miles. This section of the report provides an inventory of highway networks in the Savannah region. It also discusses other critical elements of these networks, specifically intelligent transportation systems (ITS).

Functional Classification

There are approximately 8,694 miles of roadways in the study area as shown in Table 5.1 and Figure 5.1[34]. Nearly 71 percent of these roadways are classified as local. Local roadways can be described as smaller roadways not intended for use in long distance travel, except at the origin or destination end of a trip. [35] Collectors are the next largest category of roadways in the study area at just over 13 percent. These

[34] Highway Performance Monitoring System, Year 2020.

[35] Federal Highway Administration, *Highway Functional Classification Concepts, Criteria and Procedures*, 2013 Edition.

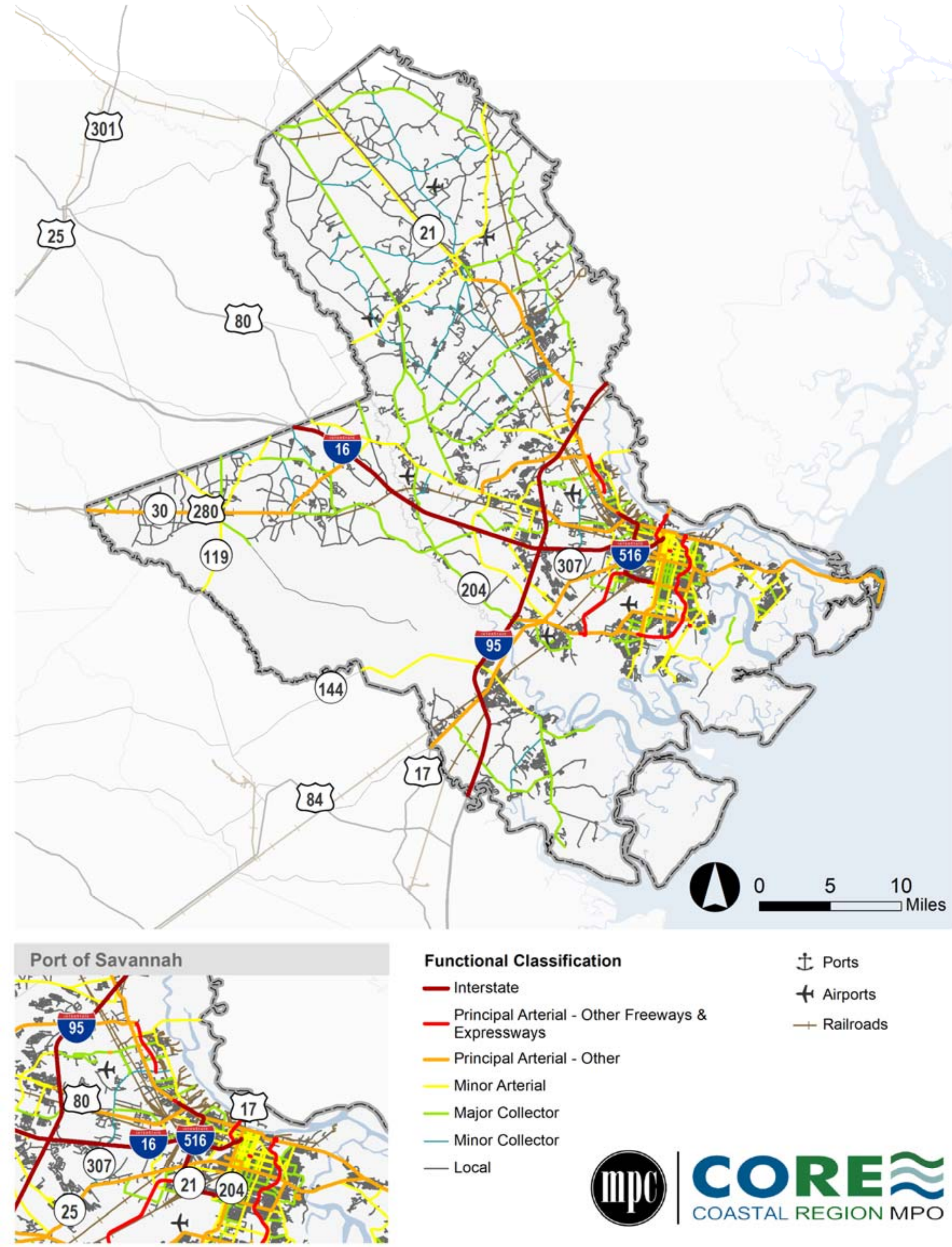
roadways primarily facilitate intra-county travel and funnel traffic from local roads to the arterial network. About 8 percent of the region's roadways are minor arterials which function to distribute traffic to smaller geographic areas. Just over 5 percent of the study area's roadways are classified as principal arterials, which provide for travel over multiple counties at relatively high speeds. Nearly 2.4 percent of the study area's roadways are Interstate highways. Interstate highways provide for travel over much longer distances and at higher speeds. Goods movement relies primarily on the interstate and arterial networks. However, collector and local roadways often represent the first and last miles for freight shipments.

TABLE 5.1 FUNCTIONAL CLASSIFICATION OF ROADWAYS IN THE STUDY AREA, 2020

Functional Classification	Miles	Percent of Total
Interstate	207.92	2.4%
Principal Arterial – Other Freeways and Expressways	71.25	0.8%
Principal Arterial – Other	407.44	4.7%
Minor Arterial	688.97	7.9%
Major and Minor Collector	1,140.37	13.1%
Local	6,179.02	71.1%
Total	8,693.96	**100.0%**

Source: Federal Highway Administration, HPMS, 2020.

FIGURE 5.1 FUNCTIONAL CLASSIFICATION OF ROADWAYS IN THE STUDY AREA



Source: Federal Highway Administration, HPMS.

Highway Freight Networks

The National Highway Freight Network (NHFN) was defined at the national level by the Fixing America's Surface Transportation (FAST) Act passed in 2015 for the purpose of strategically directing federal resources and policies toward improved performance of highway portions of the U.S. freight transportation system. The NHFN includes the following subsystems of roadways:

- **Primary Highway Freight System (PHFS):** This is a network of highways identified as the most critical highway portions of the U.S. freight transportation system determined by measurable and objective national data. The network consists of 41,518 centerlines miles Interstate and non-Interstate roads such as National Highway System (NHS) freight intermodal connectors. Georgia has just under 1,170 miles of roadway included on the PHFS. In the Savannah region, this includes I-16, I-95, and portions of I-516, SR 21, and SR 25.

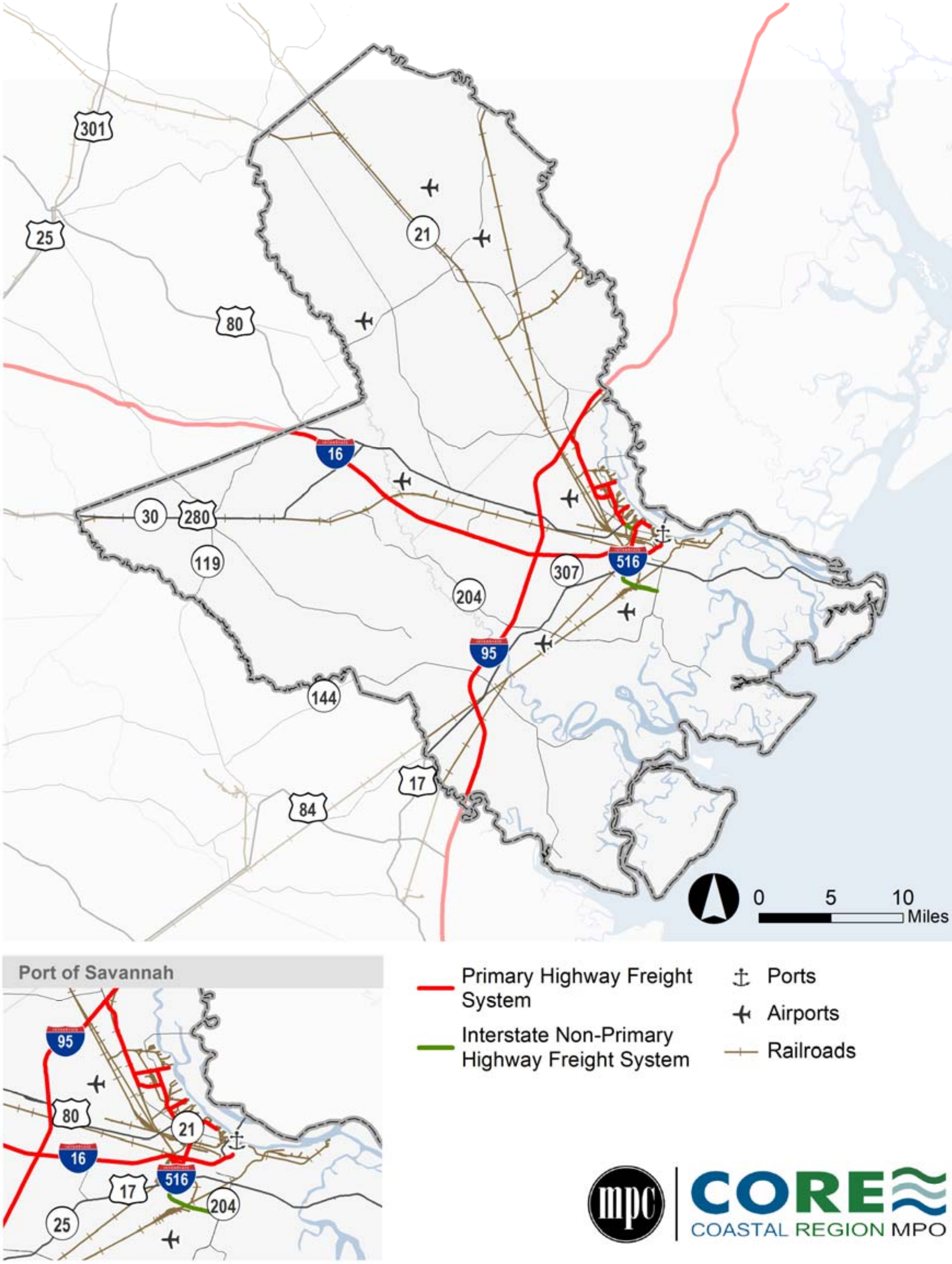
- **Other non-PHFS Interstate:** These highways consist of the remaining portion of Interstate roads not included in the PHFS. These routes provide important continuity and access to freight transportation facilities. I-516 between US 80 and W. Lathrop Ave. is included in this subsystem.

- **Critical Rural Freight Corridors (CRFCs):** These are public roads not in an urbanized area which provide access and connection to the PHFS and the Interstate with other important ports, public transportation facilities, or other intermodal freight facilities. Georgia has not designated any CRFCs.

- **Critical Urban Freight Corridors (CUFCs):** These are public roads in urbanized areas which provide access and connection to the PHFS and the Interstate with other ports, public transportation facilities, or other intermodal transportation facilities. Georgia has not designated any CUFCs.

The NHFN in the Savannah region is shown in Figure 5.2.

FIGURE 5.2 NATIONAL HIGHWAY FREIGHT NETWORK



Source: Federal Highway Administration.

NHS intermodal connectors, also known as the “first or last mile” linkages, provide critical connections between major freight nodes and designated NHS highways. This designation assists federal, state, and local governments with prioritizing operations, maintenance, and improvements of these key arterial connections to ensure that these networks support the ports, rail yards, airports, and other freight-intensive nodes efficiently. When designed, maintained, and operated with freight in mind, connector routes facilitate the best use of individual modes and improve the overall efficiency of regional highway networks.

Designation as a freight intermodal connector depends on a roadway meeting one of several primary and/or secondary criteria established by FHWA, which are summarized in Table 5.2 for facilities that serve freight movements. These criteria primarily revolve around terminals meeting volume thresholds for trucks, twenty-foot equivalent units (TEUs), or tonnages. Roadways that are designated as NHS freight intermodal connectors are included on the PHFS.

TABLE 5.2 FHWA CRITERIA FOR NHS INTERMODAL CONNECTOR DESIGNATION FOR FREIGHT TERMINALS

Freight Terminal	Primary Criteria	Secondary Criteria
Airports	100 trucks per day in each direction on the principal connecting route; or 100,000 tons per year arriving or departing by highway mode.	• Intermodal terminals that handle more than 20 percent of freight volumes by mode within a state. • Intermodal terminals identified either in the Intermodal Management System or the state and metropolitan transportation plans as a major facility. • Significant investment in, or expansion of, an intermodal terminal. • Connecting routes targeted by the state, metropolitan planning organization (MPO), or others for investment to address an existing, or anticipated deficiency because of increased traffic.
Ports	Terminals that handle more than 50,000 20-foot equivalent units (TEU) per year, or other units measured that would convert to more than 100 trucks per day in each direction; or bulk commodity terminals that handle more than 500,000 tons per year by highway or 100 trucks per day in each direction on the principal connecting route.	
Rail	50,000 TEUs per year, or 100 trucks per day, in each direction on the principal connecting route, or other units measured that would convert to more than 100 trucks per day in each direction.	
Pipelines	100 trucks per day in each direction on the principal connecting route.	

Source: Federal Highway Administration.

As shown in Table 5.3, there are 4 freight-related NHS intermodal connectors (i.e., those facilities connecting to an airport, port, or rail/truck terminal) in the Savannah region. These connectors contain multiple roadway segments to comprise a route leading from the freight terminal to the mainline NHS. In addition, some freight terminals are served by multiple connector routes as indicated by the connector number column in Table 5.3. Near the Port of Savannah, portions of SR 21, SR 25, SR 307, and River Street are designated as intermodal connectors serving the Garden City and Ocean Terminals. Tremont Road west of I-516 and Safety First Road are designated as freight intermodal connectors serving the CSX Savannah Yard.

TABLE 5.3 FREIGHT INTERMODAL CONNECTORS

Facility	Type	Connector No.	Description	Length	Facility ID
Garden City Terminal	Port Terminal	1	From SR 25/SR 21 northwesterly on SR 25, westerly on SR 307 (Bourne Ave) to SR 21/SR 17	4.88	GA24P
Ocean Terminal	Port Terminal	2	From W Lathrop Ave (CR 1142); SE on Lathrop Ave (CR 740), continue on River St. (Savannah City St. 145) to the terminal	1.52	GA25P
CSX Intermodal Terminal	Truck/Rail Facility	1	From I-516: N&W 0.70 mi on Tremont Rd, N 0.1 mi on Tremont Ave, W 0.2 mi on Safety First Rd.	1.00	GA26R
Port of Savannah	Port Terminal	2	From SR 21 northeasterly on Grange Road to terminal facilities	1.09	GA33P

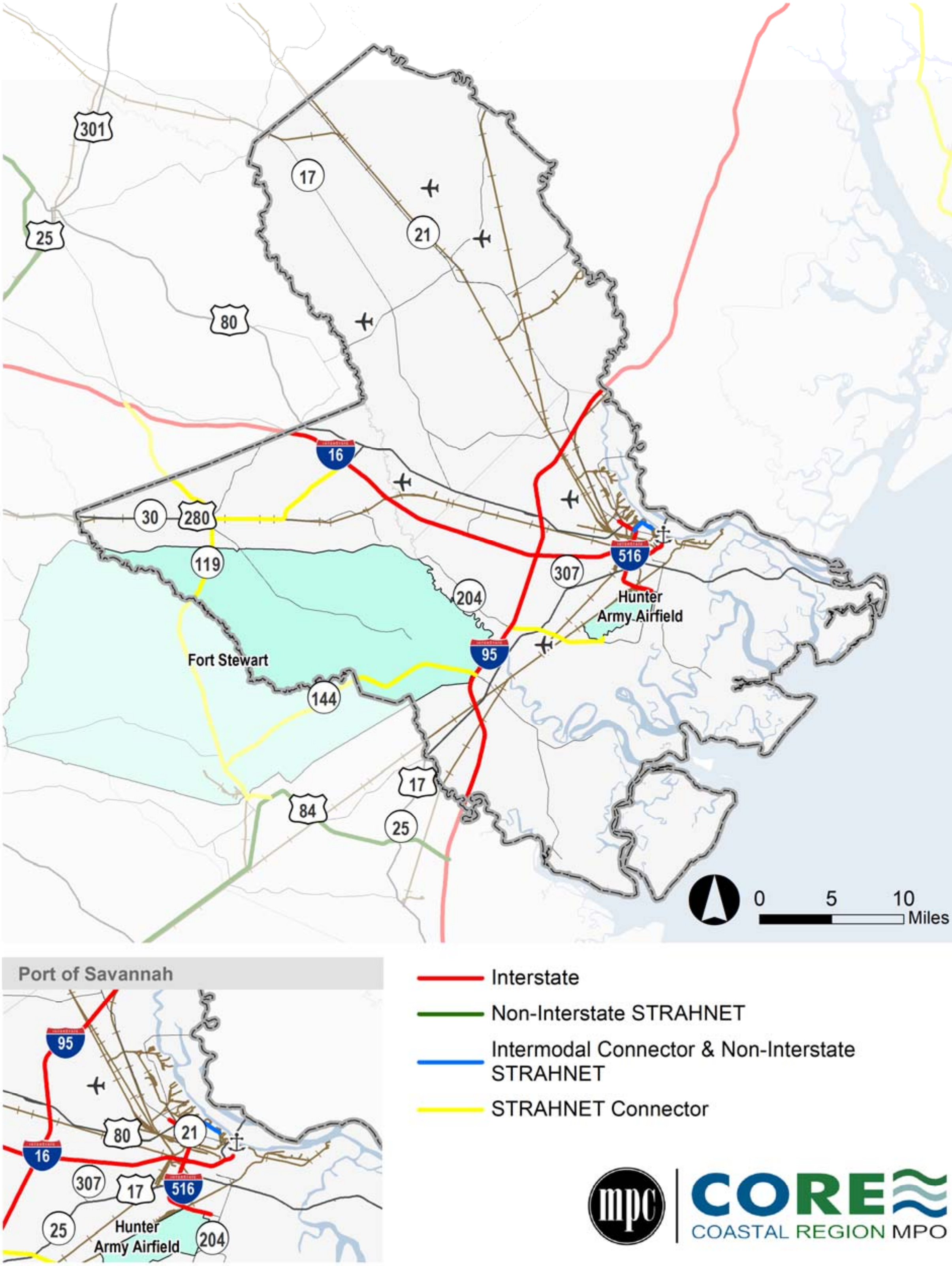
Source: Federal Highway Administration.

Another important highway freight network is the Strategic Highway Network (STRAHNET). The STRAHNET is a system of roads deemed necessary for emergency mobilization and peacetime movement of heavy armor, fuel, ammunition, repair parts, food, and other commodities to support U.S. military operations. It provides defense, continuity, and emergency capabilities for the nation's military installations. There are over 62,000 miles of STRAHNET roadways which consists of both Interstate and non-Interstate routes.

The STRAHNET through the Savannah region is shown in Figure 5.3. It includes all the region's Interstate highways. It also includes corridors that provide access to Hunter Army Airfield and Fort Stewart in Bryan and Liberty Counties. These corridors include US 280, SR 67, SR 119, SR 144, and SR 204. Within the CORE MPO region, the STRAHNET is also inclusive of the Department of Defense's Power Projection Platform (PPP) routes – highway routes connecting vital military installations to seaports and airports.[36]

[36] https://www.sddc.army.mil/sites/TEA/Functions/SpecialAssistant/HND_Publications/Fort%20Stewart%20-%20PPP%20Route.pdf

FIGURE 5.3 STRAHNET



Source: Federal Highway Administration HPMS; U.S. Census Bureau, TIGER/Line Shapefiles Database.

Intelligent Transportation Systems

This section of the report inventories the current intelligent transportation system (ITS) and technology programs in the study area. Specifically, it summarizes the devices, systems, and data available within GDOT's existing ITS program. This is important for freight as most of the state's goods travel on the highway system. In this regard, the state's ITS is critical for facilitating the efficient movement of goods and for mitigating disruptions on the system due to crashes and other forms of non-recurring congestion.

GDOT NaviGAtor

GDOT ITS assets located within the study area, or that are physically outside the study area but provide coverage, include the GDOT NaviGAtor, Traffic Management Center (TMC), and various field equipment. The GDOT NaviGAtor is the State's Advanced Traffic Management System (ATMS). The NaviGAtor system was first incepted in 1996 for the Olympic Games to help handle the expected influx of roughly 2 million visitors. The NaviGAtor system provides real time speed, volume, and travel time data by using field devices like closed circuit television and detection cameras, ramp meters and dynamic message signs.

GDOT Traffic Management Center

The various elements of the state's ITS are managed by the GDOT Traffic Management Center (TMC). TMCs serve as operational centers with one or more human operators that provide access to all data collection, processing, and dissemination equipment available. In this sense, they serve as a hub for data movement in traffic management systems. Typically, TMCs correspond to larger metropolitan areas that experience higher traffic volumes.

The GDOT TMC is the headquarters and information clearinghouse for NaviGAtor. It monitors travel conditions on the State's roadways and collects real-time information from video detection system cameras and other field devices. The GDOT TMC then communicates to the traveling public (i.e., via dynamic message signs, the NaviGAtor web, and other means) useful information to improve safety, improve travel time reliability, and mitigate congestion, among others.

It should be noted that the City of Savannah and GDOT are in the process of developing a traffic control center (TCC) that will be integrated into the broader statewide system.[37] The TCC would serve as a regional traffic management center supporting ITS infrastructure and operational improvements throughout the region.

ITS Field Devices

Table 5.4 identifies the ITS field devices that are throughout the study area. Though not included in the inventory of devices, it should be noted that several traffic signals throughout the region are monitored and managed as part of GDOT's Regional Traffic Operations Program (RTOP). RTOP uses cameras and remote communication capabilities to actively manage arterial traffic flows thereby relieving congestion and improving reliability.

[37] GDOT PI #0017973, https://www.dot.ga.gov/applications/geopi/Pages/Dashboard.aspx?ProjectID=0017973.

TABLE 5.4 ITS DEVICE TYPES

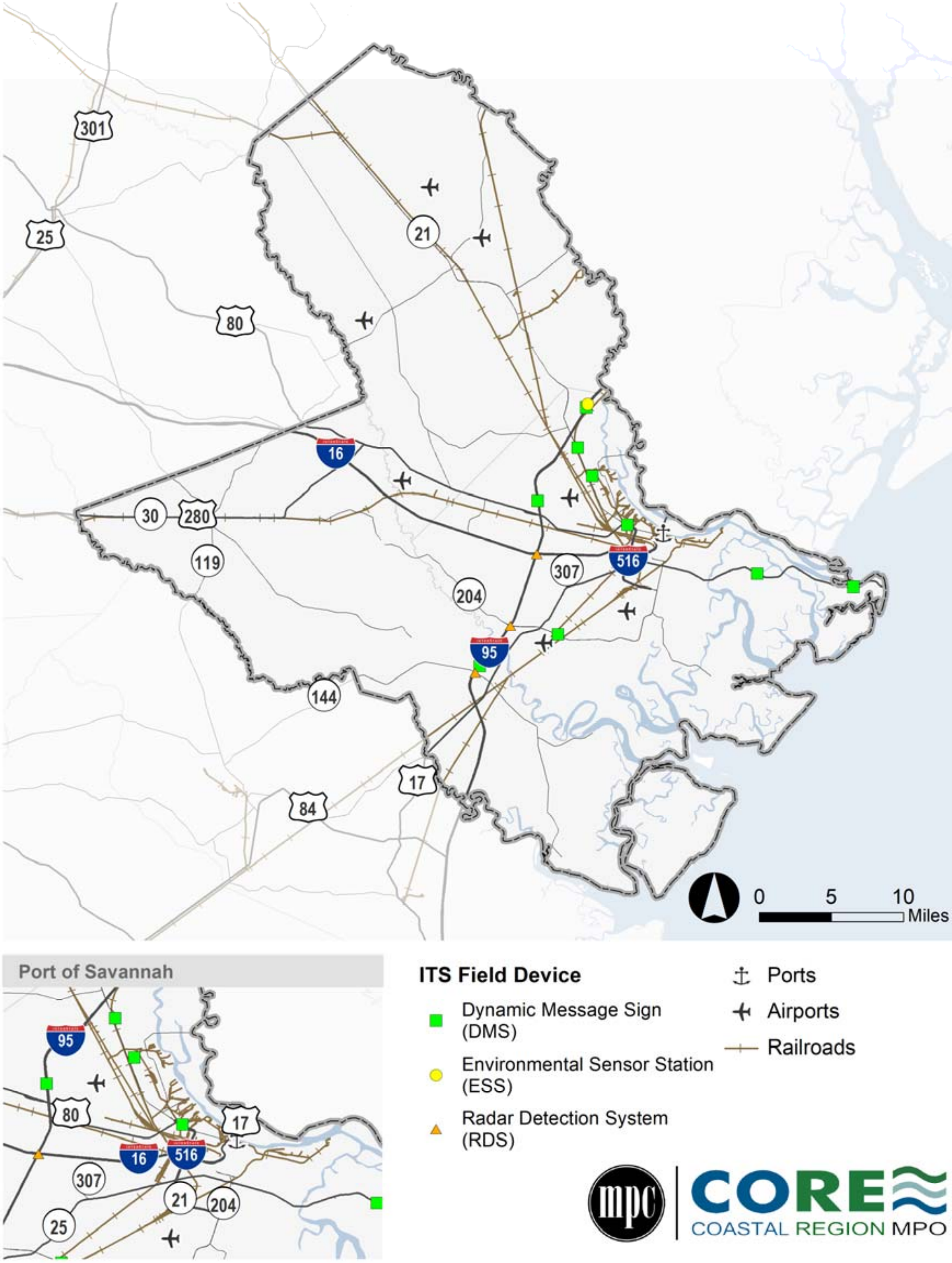
Device	Description
Closed-Circuit Television (CCTV) Camera	CCTV cameras provide coverage on high-traffic corridors. They feed back to the traffic management centers, allowing for quick response times to incidents on the road network.
Dynamic Message Signs (DMS)	Dynamic message signs display important messages to drivers on key corridors.
Weigh in Motion Stations (WIM)	WIM stations capture and record truck axle weights and gross vehicle weights as they drive over a sensor. They can also be used to provide vehicle counts.
Classification Count Stations (CCS)	Classification count stations provide information on both the volume of vehicles traversing a section of roadway and their classification according to the FHWA 13-vehicle classification system.
Radar Detection System (RDS)	Radar detection systems provide information on traffic conditions such as volume and speed.
Environmental Sensor Stations (ESS)	Environmental sensor stations are fixed roadway locations with one or more sensors measuring atmospheric, surface (i.e., pavement and soil), and/or hydrologic (i.e., water level) conditions.

Dynamic message signs (DMS) are electronic signs that have the capability of changing part or all of a sign's message. Most DMS are the large electronic signs that appear over highways, but smaller versions can be found on other routes. DMS can be used for many applications regarding traffic management, public safety, and evacuation. Together with CCTV cameras, DMS are important for mitigating disruptions on the system due to incidents and other unpredictable events as they allow GDOT to convey timely information on travel conditions to the traveling public. As shown in Figure 5.4Figure 5.4, there are 9 DMS deployed at the following locations throughout the region:

- SR 21 Southbound south of International Trade Parkway;
- Jimmy Deloach Parkway Southbound at Crossgate Road;
- I-95 Northbound north of SR 144;
- I-95 Southbound near US 80;
- I-95 Southbound south of the South Carolina state line;
- SR 204 Westbound 3 miles before I-95;
- I-516 Northbound before SR 25;
- US 80 Westbound at Old US 80; and
- US 80 Eastbound east of Bryan Woods Drive.

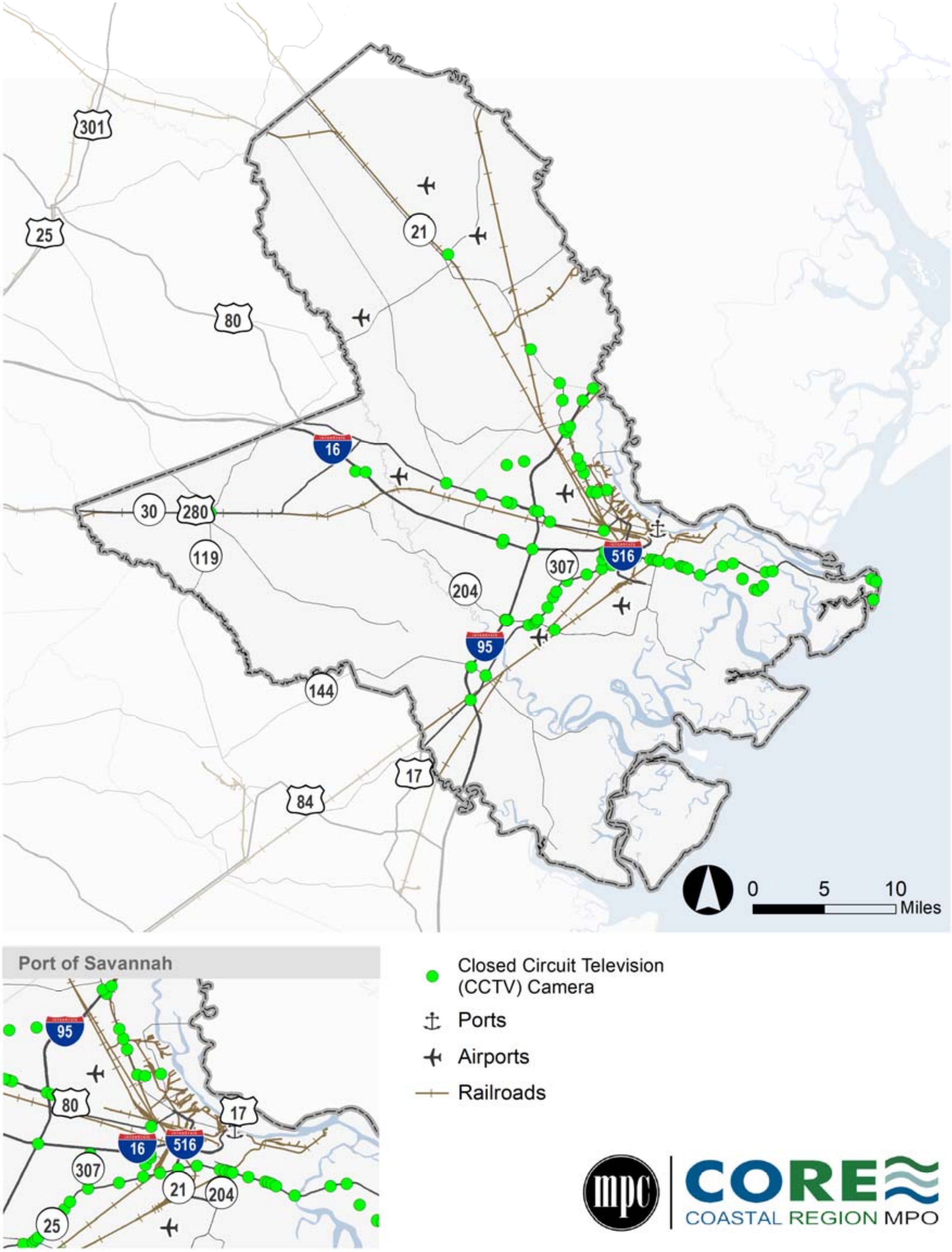
There are 77 CCTV cameras in the region as shown in Figure 5.5.

FIGURE 5.4 ITS FIELD DEVICES



Source: GDOT, Transportation Management Center.

FIGURE 5.5 CCTV CAMERAS



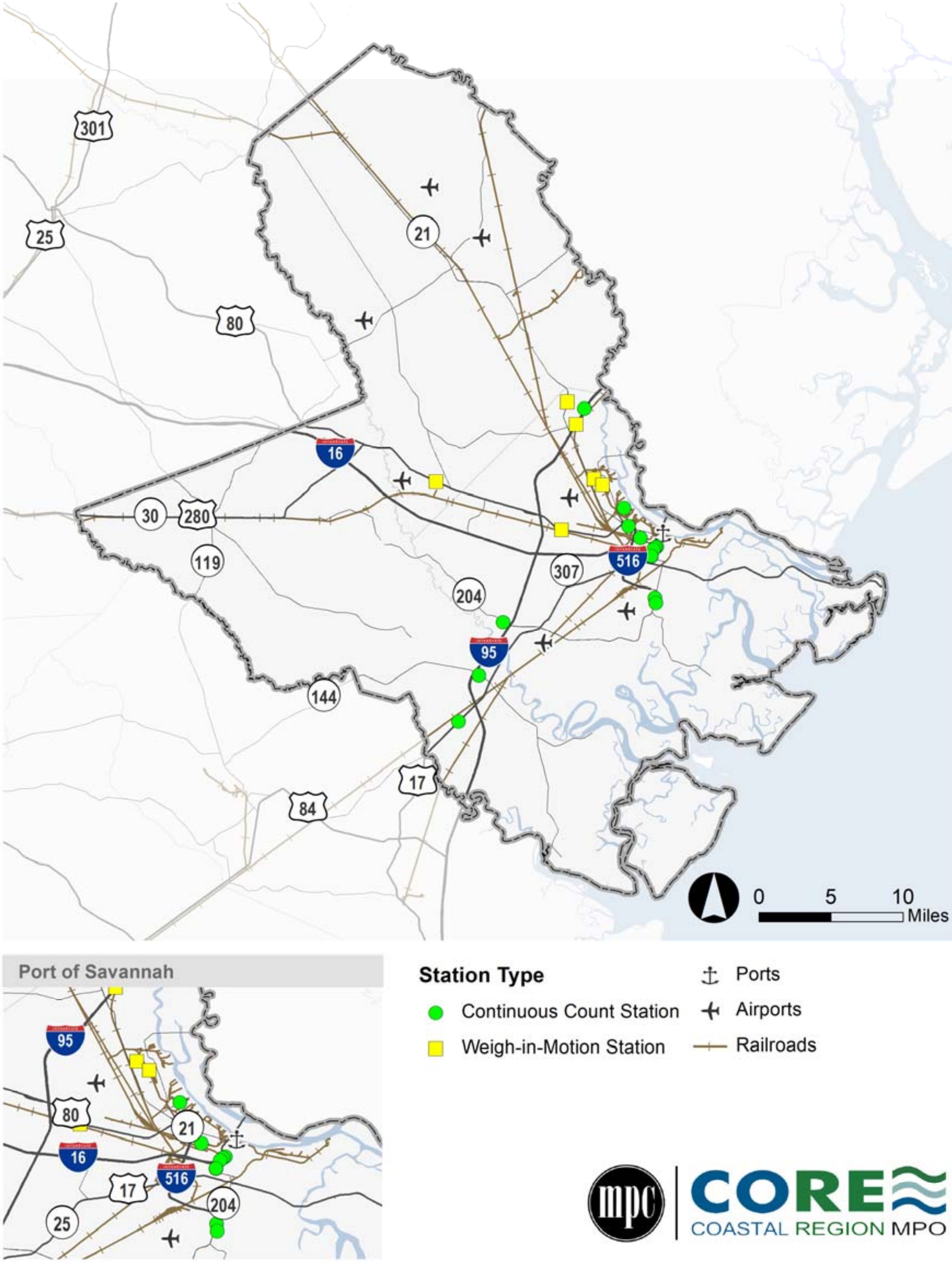
Source: GDOT, Transportation Management Center.

Environmental sensor stations (ESS) are fixed roadway locations with one or more sensors measuring atmospheric, surface (i.e., pavement and soil), and/or hydrologic (i.e., water level) conditions. As shown in Figure 5.4, there is one ESS deployed along I-95 south of the Georgia-South Carolina state line.

Radar detection systems (RDS) are roadside devices that capture and transmit data on traffic conditions such as volume and speed. There are 3 RDS deployed in the Savannah region as shown in Figure 5.4. Two are located on I-95 at its interchanges with SR 144 and SR 204; the remaining RDS is located along I-16 at its interchange with I-95.

GDOT owns dedicated Weigh-In-Motion (WIM) and continuous count stations (CCS) around the state that are used to collect data for planning purposes. While CCS are both owned and operated by GDOT, WIM stations are owned by GDOT but jointly operated with the Department of Public Safety's Motor Carrier Compliance Division. WIM is a technology that estimates vehicle weights of at-speed trucks to (1) inventory the percentage of overweight vehicles at a given location, (2) collect and classify traffic data for planning activities, and (3) provide notification of a likely overweight vehicle for law enforcement to investigate. Continuous count stations collect average annual daily traffic information and other data, typically through loop detectors. Figure 5.6 shows the deployment of WIM and continuous count stations in the region. There are 6 WIM stations and 15 CCS deployed throughout the region.

FIGURE 5.6 PERMANENT COUNT STATIONS



Source: Georgia Department of Transportation, Traffic Analysis and Data Application.

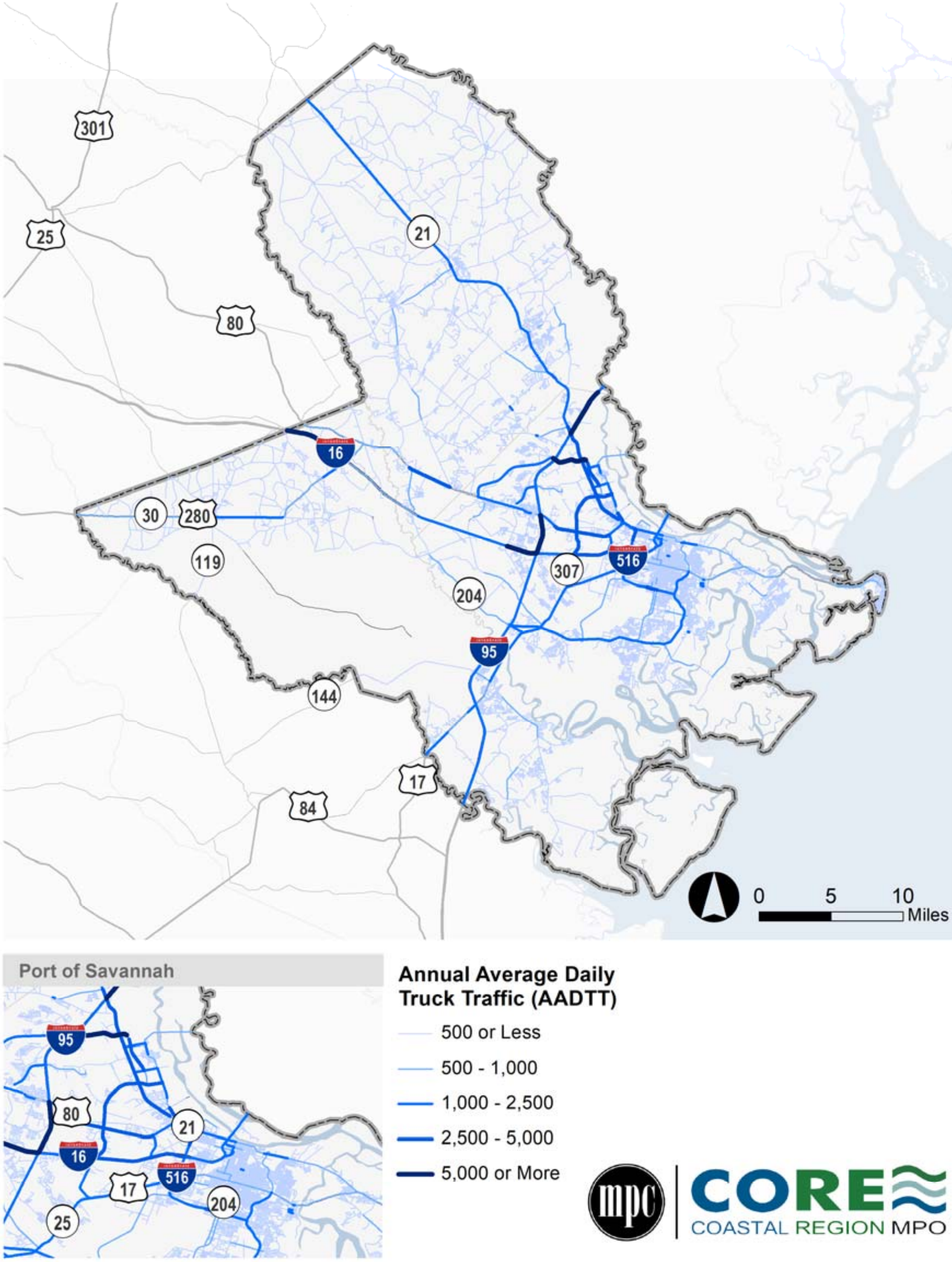
Conditions and Performance

This section of the report examines the condition and performance of the region's highway network. Specifically, it investigates usage as reflected by truck traffic volumes; performance as captured by truck travel time reliability on Interstate corridors, safety, and the prevalence of at-grade crossings; and conditions as captured by bridge and pavement conditions. It should be noted that while a truck travel time reliability analysis is included in this report, it focuses on Interstate corridors and a more detailed analysis of truck bottlenecks and highway performance will be performed as part of Task 2.5: Freight Network Congestion, Bottleneck, and Safety and Security Issues. Task 2.5 will also include a detailed safety analysis for the region's highways.

Truck Traffic Volumes

Truck traffic count data is important as it provides insight on where trucking activity is most prevalent in the state. This can be one factor in determining which portions of the highway freight network are most important for goods movement and where investments should be focused. Figure 5.7 shows the annual average daily truck traffic (AADTT) for the region using data from the 2020 Highway Performance Monitoring System (HPMS).

FIGURE 5.7 ANNUAL AVERAGE DAILY TRUCK TRAFFIC, 2020



Source: Federal Highway Administration, HPMS.

I-95 is the busiest freight corridor in the Savannah region. The data indicate that I-95 between I-16 and US 80 carries over 10,700 trucks per day. Between SR 21 and the Georgia-South Carolina state line, I-95 carries nearly 10,000 trucks per day. The prevalence of truck traffic on I-95 implies a strong north-south directionality to the region's truck activity. After I-95, I-16 west of US 280 in Bryan County is the second busiest freight corridor in the region as it handles nearly 7,000 trucks per day. Just west of I-95, about 6,700 trucks per day travel on I-16.

Several non-Interstate roadways also carry significant freight volumes throughout the Savannah region. Non-Interstate routes that provide access to the Port of Savannah exhibit some of the region's highest truck volumes. For example, SR 17/Jimmy Deloach Parkway between I-95 and SR 21 carries over 5,400 trucks per day. In addition to providing access to the port, this route also serves multiple warehouses and distribution centers. SR 307/Bourne Ave., which provides direct access to Gate 4 at the Port of Savannah, is estimated to carry over 4,700 trucks per day.

Truck Travel Time Reliability

Truck travel time reliability on the CORE MPO region's Interstate highway system is captured by calculating the Truck Travel Time Reliability (TTTR) metric. The TTTR is the freight performance metric adopted by the Federal Highway Administration (FHWA) that must be reported for Interstate highways.[38] It is calculated as the ratio of the 95th percentile travel time to the 50th percentile travel time: TTTR = 95th Percentile Truck Travel Time/50th Percentile Truck Travel Time. High TTTR values indicate unreliable truck travel times while low TTTR values indicate more reliable travel times. For example, a TTTR value equal to two indicates that truck travel times may be twice as long as average travel times for a given time period. Per 23 CFR 490.611, the TTTR metric is calculated over the following time periods:

- AM Peak: 6 a.m.–10 a.m. Monday–Friday.
- Midday: 10 a.m.–4 p.m. Monday–Friday.
- PM Peak: 4 p.m.–8 p.m. Monday–Friday.
- Overnight: 8 p.m.–6 a.m. Monday–Friday; and
- Weekend: 6 a.m.–8 p.m. Saturday–Sunday.

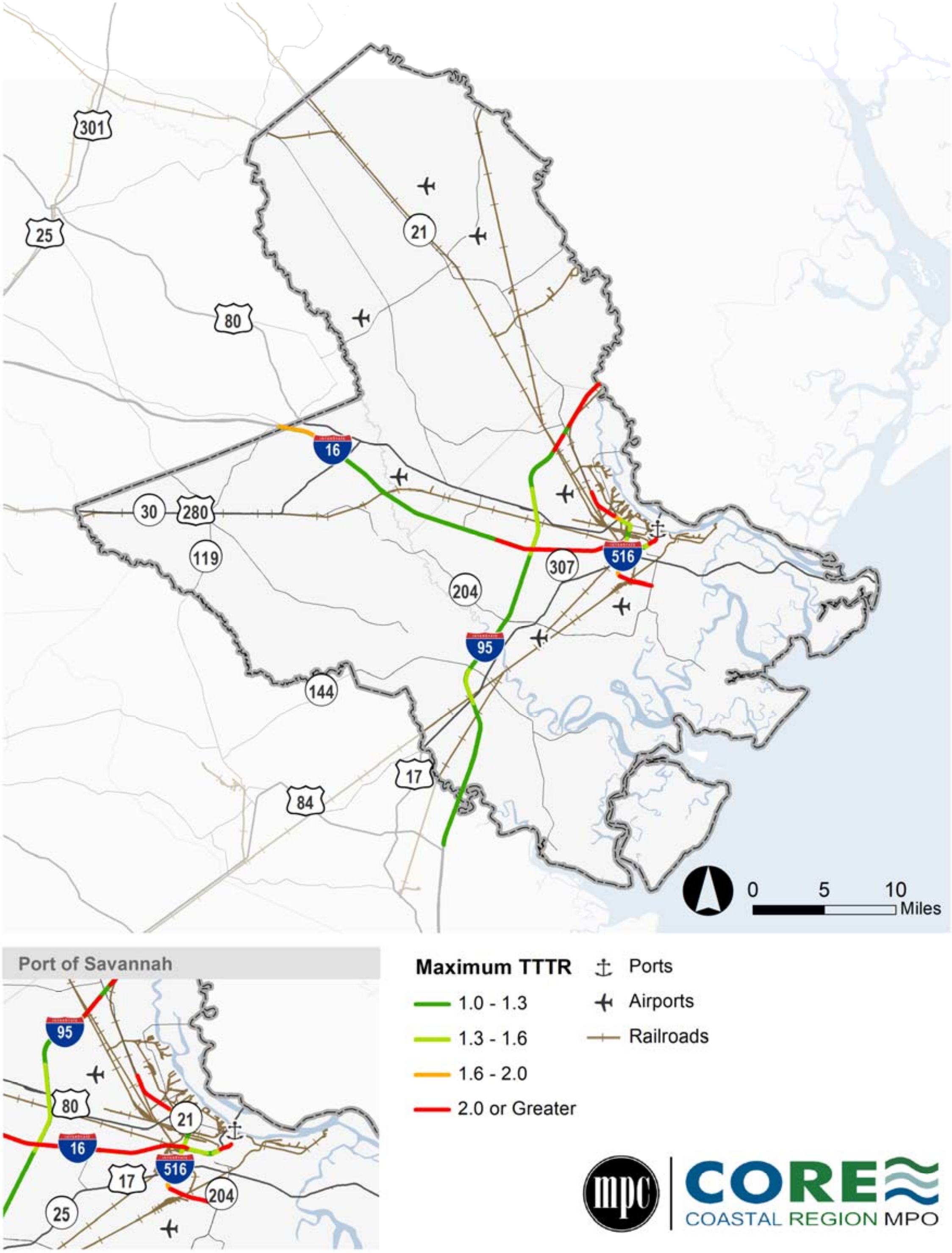
The TTTR metric is an indicator of how variable travel times are on the highway network. Highly variable, or inconsistent, truck travel times result in unreliable service over the highway network. Unreliability is a direct cost to motor carriers as they must hedge against unreliable travel times by budgeting additional time into their schedules. This translates into higher transportation costs that may be passed on to shippers. In addition, wasted time resulting from the needed buffer time reduces available hours of service for truck drivers. The TTTR metrics are derived from travel time data from the National Performance Management Research Data Set (NPMRDS).

Figure 5.8 shows the maximum TTTR index observed over all time periods for Interstate highways in the Savannah region. The results indicate that trucks experience poor reliability on I-16 between Pooler Parkway and I-516 and also west of US 280 in Bryan County. I-16 exhibits a TTTR exceeding 2.0 at both of these locations indicating very unreliable travel times. These locations are also two of the region's busiest corridors

[38] National Performance Management Measures: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program, *Federal Register*, Volume 82, Number 11, January 18, 2017, https://www.federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system.

for freight traffic. This is important as it implies that many motor carriers must plan around uncertain travel times.

FIGURE 5.8 MAXIMUM TRUCK TRAVEL TIME RELIABILITY (TTTR) ON INTERSTATE HIGHWAYS



Source: National Performance Management Research Data Set; Cambridge Systematics, Inc analysis.

I-95 north of SR 17/Jimmy Deloach Pkwy. also experiences poor reliability with maximum TTTR values exceeding 2.0. Some amount of this performance challenge may be attributed to trucks and other vehicles accessing the Port of Savannah and the large cluster of warehouses and distribution centers located along SR 17/Jimmy Deloach Pkwy. and SR 21. However, the unreliability exhibited by this portion of I-95 is likely due to the reduction in number of lanes as the highway crosses into South Carolina – dropping from a 6-lane to a 4-lane highway.

Table 5.5 shows how TTTR varies across the region's Interstate highways. It contains length-weighted averages of TTTR by time period for I-16, I-95, and I-516. The results show that I-95 generally provides better reliability than I-16 and I-516. For I-95, the length-weighted average TTTR does not exceed 1.3 across time periods while values for I-16 and I-516 mostly exceed that threshold. The results for I-16 indicate that reliability is poorest during the midday period with an average TTTR of 1.63. For I-516, the PM peak is the most unreliable time period for truck travel, but performance is generally challenged throughout the day on this corridor.

TABLE 5.5 WEIGHTED AVERAGE TRUCK TRAVEL TIME RELIABILITY (TTTR) BY INTERSTATE HIGHWAY

Interstate	AM Peak TTTR	Midday TTTR	PM Peak TTTR	Overnight TTTR	Weekend TTTR
I-16	1.37	1.63	1.32	1.20	1.14
I-95	1.06	1.13	1.15	1.07	1.22
I-516	1.46	1.45	1.73	1.56	1.63

Source: National Performance Management Research Data Set; Cambridge Systematics, Inc analysis.

Table 5.6 contains the share of Interstate highway directional miles by time period for four categories of TTTR values: 1.0 – 1.3, 1.3 – 1.6, 1.6 – 2.0, and 2.0 or greater. The results show that the majority of the region's directional miles of Interstate highway are performing at the highest levels of reliability for truck travel. Over three quarters of Interstate directional miles exhibit TTR values less than 1.3 during the AM, midday, and PM peak periods. The results also show that the midday period is the most challenging time period for reliable truck travel. Over 18 percent of the region's Interstate highway directional miles exhibit a TTTR exceeding 1.6. This is substantially higher than the 10.3 and 14.5 percent of directional miles experiencing these conditions during the AM and PM peak periods.

TABLE 5.6 TRUCK TRAVEL TIME RELIABILITY (TTTR) BY SHARE OF DIRECTIONAL MILES ON INTERSTATE HIGHWAYS

Analysis Period	1.0 - 1.3	1.3 - 1.6	1.6 - 2.0	>= 2.0	Total
	Percent of Interstate Highway Directional Miles				
AM Peak	85.7%	4.1%	3.6%	6.7%	**100.0%**
Midday	76.7%	5.2%	8.2%	10.0%	**100.0%**
PM Peak	78.4%	7.1%	5.7%	8.8%	**100.0%**

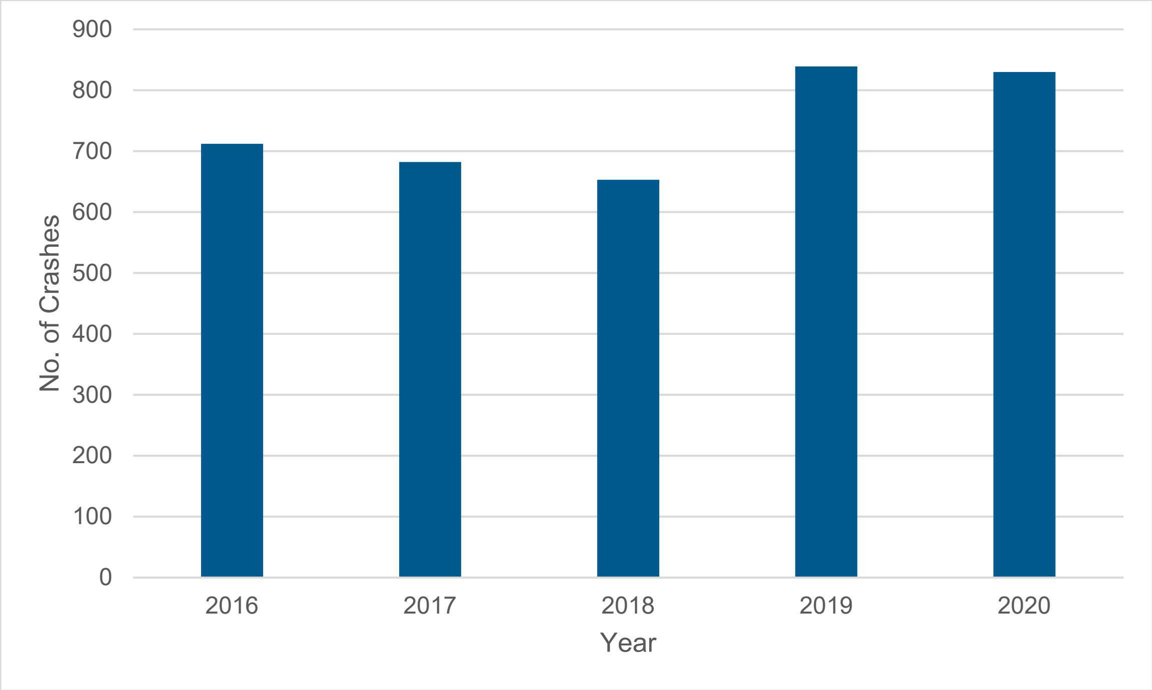
Source: National Performance Management Research Data Set; Cambridge Systematics, Inc analysis.

Safety

This section of the report examines the safety performance of the study area's highway network. Transportation safety is extremely important and is one of the highest priorities at all levels of transportation planning and engineering – national, statewide, regional and local. The safety analysis was conducted using data provided by the GDOT Numetrics database for the 2016 to 2020 time period. This analysis provides an overview of truck-involved crashes[39] on the region's highway network while a more detailed analysis will be conducted as part of Task 2.5.

There were 3,716 crashes involving trucks in the 3-county region based on 2016-2020 data as shown in Figure 5.9. This represents about 6.5 percent of all crashes in the study area. In comparison, between 2016 and 2020 commercial vehicle crashes averaged about 4.4 percent of total crashes statewide.[40] Crashes declined from 2016 to 2018 before experiencing an increase in 2019 and remaining nearly constant in 2020. Over the analysis period, the annual number of truck-involved crashes in the region ranged from a low of 653 crashes in 2018 to a high of 839 in 2019.

FIGURE 5.9 TRUCK-INVOLVED CRASHES BY YEAR, 2016 - 2020



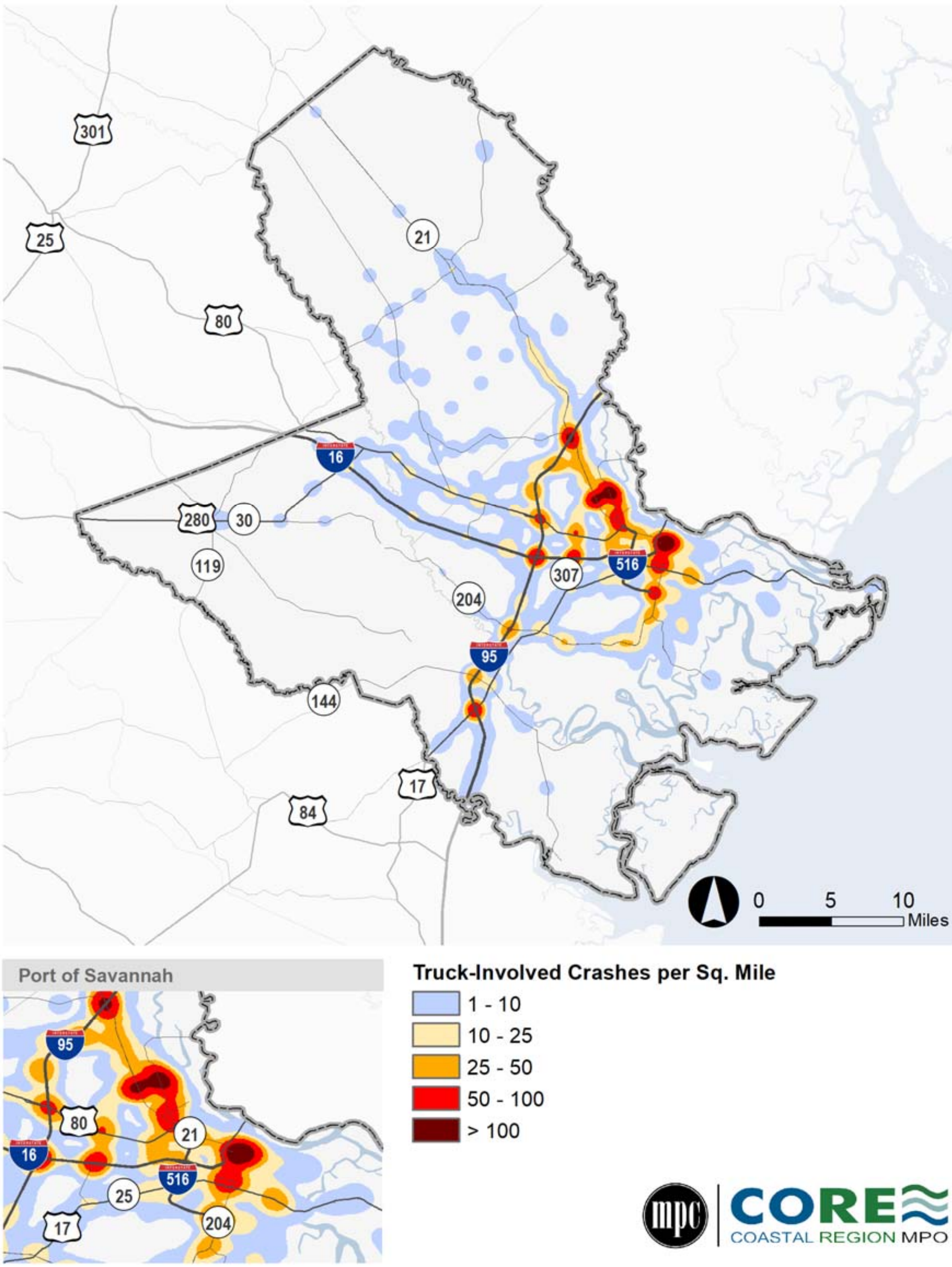
Source: GDOT Numetrics Database; Cambridge Systematics, Inc. analysis.

Figure 5.10 depicts 2016-2020 truck-involved crashes in the study area. Over 83 percent of those crashes occurred in Chatham County as shown in Table 5.7. This is driven, in part, by Chatham County containing a substantial share of the region's highway freight network and freight activity. Chatham County contains approximately 55 percent of the region's lane-miles and 67 percent of truck vehicle-miles traveled based on FHWA HPMS data.

[39] For this analysis, the following vehicle types in the GDOT Numetrics database are considered trucks: tractor/trailer, single unit truck, panel truck, truck tractor (bobtail), logging tractor/trailer, tractor with twin trailers, and logging truck.

[40] GDOT Georgia Electronic Accident Reporting System (GEARS) Database, www.gearsportal.com, accessed May 15, 2021.

FIGURE 5.10 TRUCK-INVOLVED CRASHES, 2016 - 2020



Source: GDOT Numetrics Database; Cambridge Systematics, Inc. analysis.

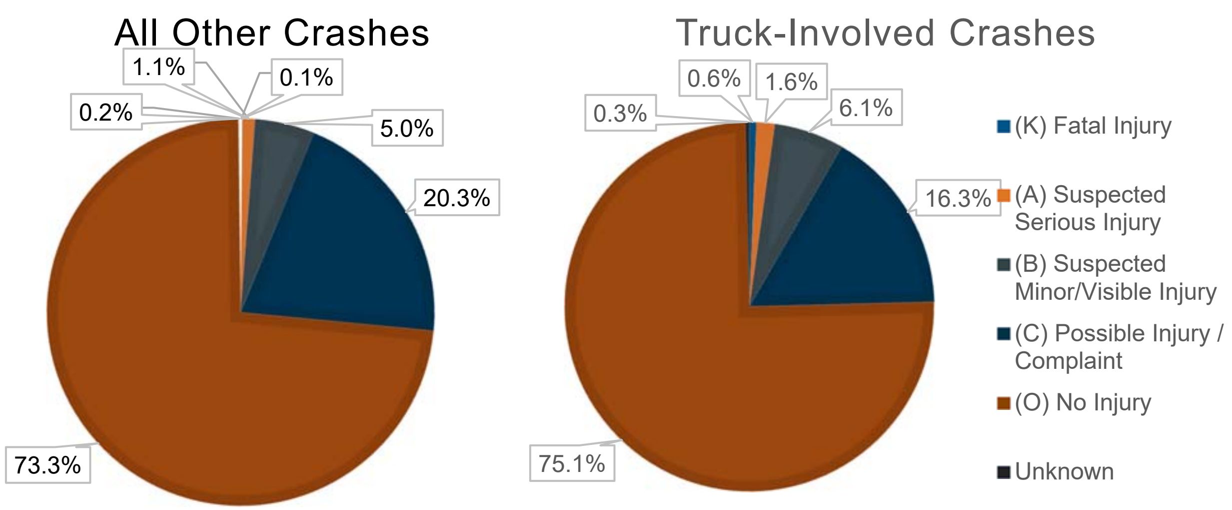
TABLE 5.7 TRUCK-INVOLVED CRASHES BY COUNTY, 2016 - 2020

County	No. of Truck-Involved Crashes	Percent of Total
Chatham	3,094	83.3%
Bryan	323	8.7%
Effingham	299	8.0%
Total	**3,716**	**100.0%**

Source: GDOT Numetrics Database; Cambridge Systematics, Inc. analysis.

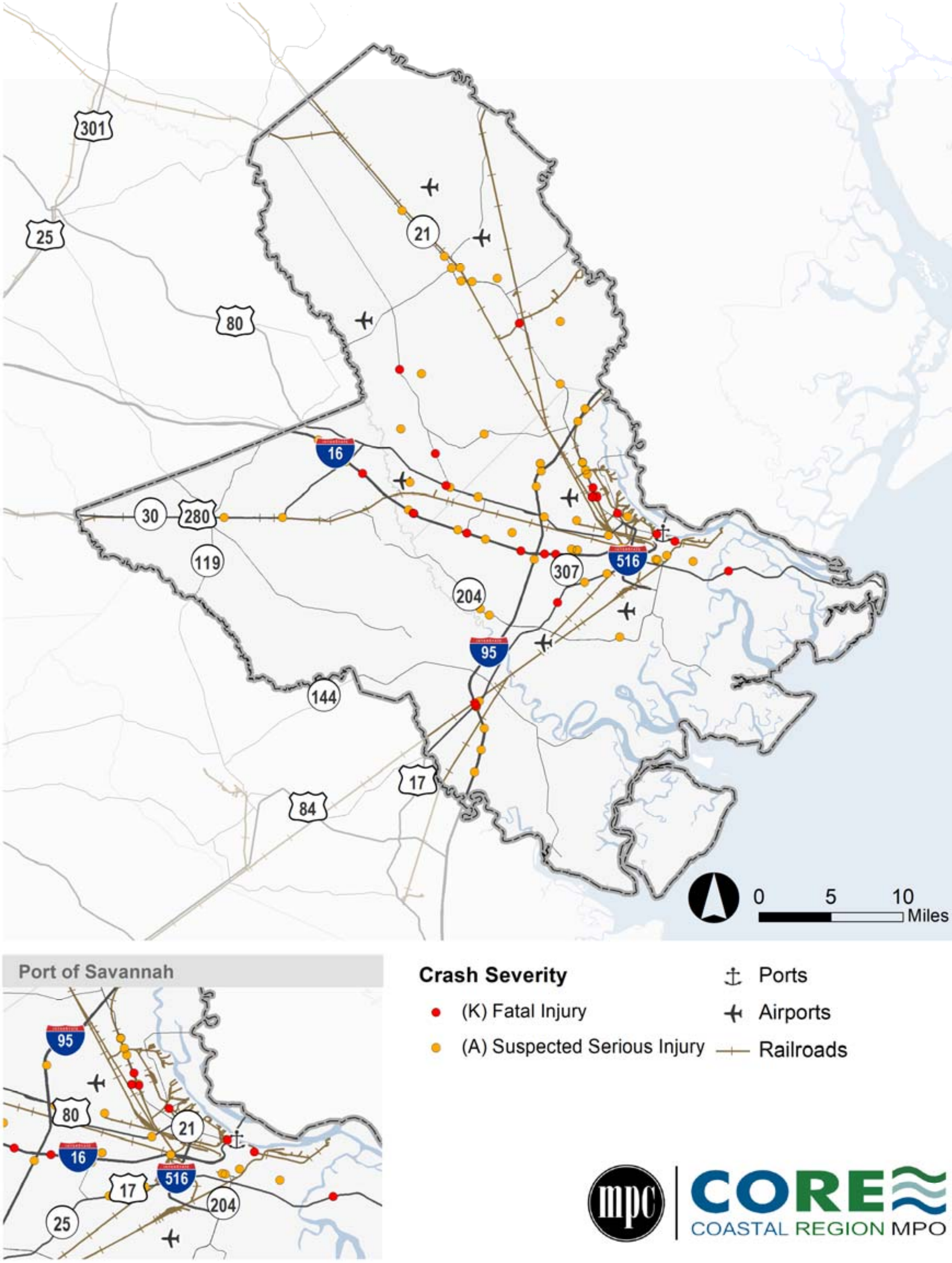
Most crashes in the region did not result in an injury. As shown in Figure 5.11, over 75 percent of truck-involved crashes and 73 percent of non-truck-involved crashes did not result in an injury. About 2.2 percent truck-involved crashes (82 in total) did result in a serious injury or fatality. This is higher than the total percentage of non-truck-involved crashes resulting in serious injury or death (about 1.2 percent). Fatal and serious injury truck crashes are shown in Figure 5.12.

FIGURE 5.11 CRASHES BY SEVERITY, 2016 - 2020



Source: GDOT Numetrics Database; Cambridge Systematics, Inc. analysis.

FIGURE 5.12 FATAL OR SEVERE TRUCK-INVOLVED CRASHES, 2016 - 2020



Source: GDOT Numetrics Database; Cambridge Systematics, Inc. analysis.

For crashes involving trucks, angle, sideswipe - same direction, and rear end collision types were the most prevalent as shown in Figure 5.13 (refer to Table 5.8 for descriptions of collision types). These accounted for nearly 67 percent of truck-involved crashes observed during the analysis period. Head - on and angle collisions (left, right, and other) are the most severe crash types, accounting for approximately 1.4 percent and 27.5 percent of truck-involved crashes, respectively. The prevalence of angle crashes may be due to many factors, including excessive speed, drivers not obeying traffic signals, and poor visibility of traffic signals due to the prevalence of large trucks.[41] Lane width and worn or inadequate pavement markings are typical contributing factors for sideswipe crashes.[42] For rear end crashes, congestion and inappropriate approach speeds are contributing factors.[43]

Angle, sideswipe - same direction, and rear end were also the most common collision types for crashes that did not involve trucks. They accounted for about 96 percent of crashes for all other vehicles. However, rear end was a much more prevalent collision type and sideswipe (same direction) was a much less prevalent collision type when compared to truck-involved crashes. Nearly 46 percent of crashes for all other vehicle types were rear end compared to 32 percent for truck-involved crashes. About 13 percent of crashes for all other vehicle types were sideswipe - same direction, compared to 34 percent for truck-involved crashes. The differences between the physical and operational characteristics of trucks compared to passenger vehicles likely contribute to this observation. For instance, because trucks are much larger than passenger vehicles and occupy a greater share of lane width, they may be more susceptible to sideswipe crashes.

TABLE 5.8 MANNER OF COLLISION DESCRIPTIONS

Manner of Collision	Description
Angle	Collision results from two or more motor vehicles traveling in directions that are perpendicular.
Rear End	Collision results from two motor vehicles traveling in the same direction.
Head-on	A collision in which the front end of one motor vehicle collides with the front end of another motor vehicle, while the two vehicles are traveling in opposite directions.
Sideswipe – Same Direction	A collision where two motor vehicles collide side to side while proceeding in the same direction.
Sideswipe – Opposite Direction	A collision where two motor vehicles collide side to side while proceeding in the opposite direction.
Not a Collision with a Motor Vehicle	A motor vehicle collision that does not involve another motor vehicle, overturning, or pedestrian.

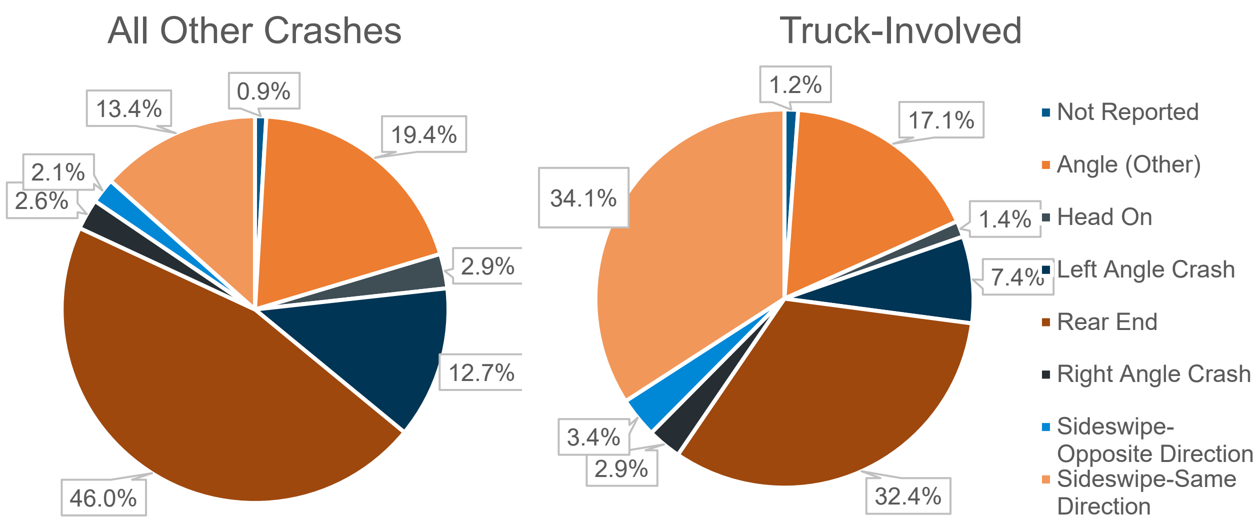
Source: Georgia Uniform Motor Vehicle Accident Report Training Manual, version 3.0, January 2018.

[41] American Association of State Highway and Transportation Officials (2009). *Highway Safety Manual*. Exhibit 6-4 and Exhibit 6-5, pgs. 6-6 to 6-7, 1st edition.

[42] Ibid.

[43] Ibid.

FIGURE 5.13 CRASHES BY MANNER OF COLLISION, 2016 - 2020

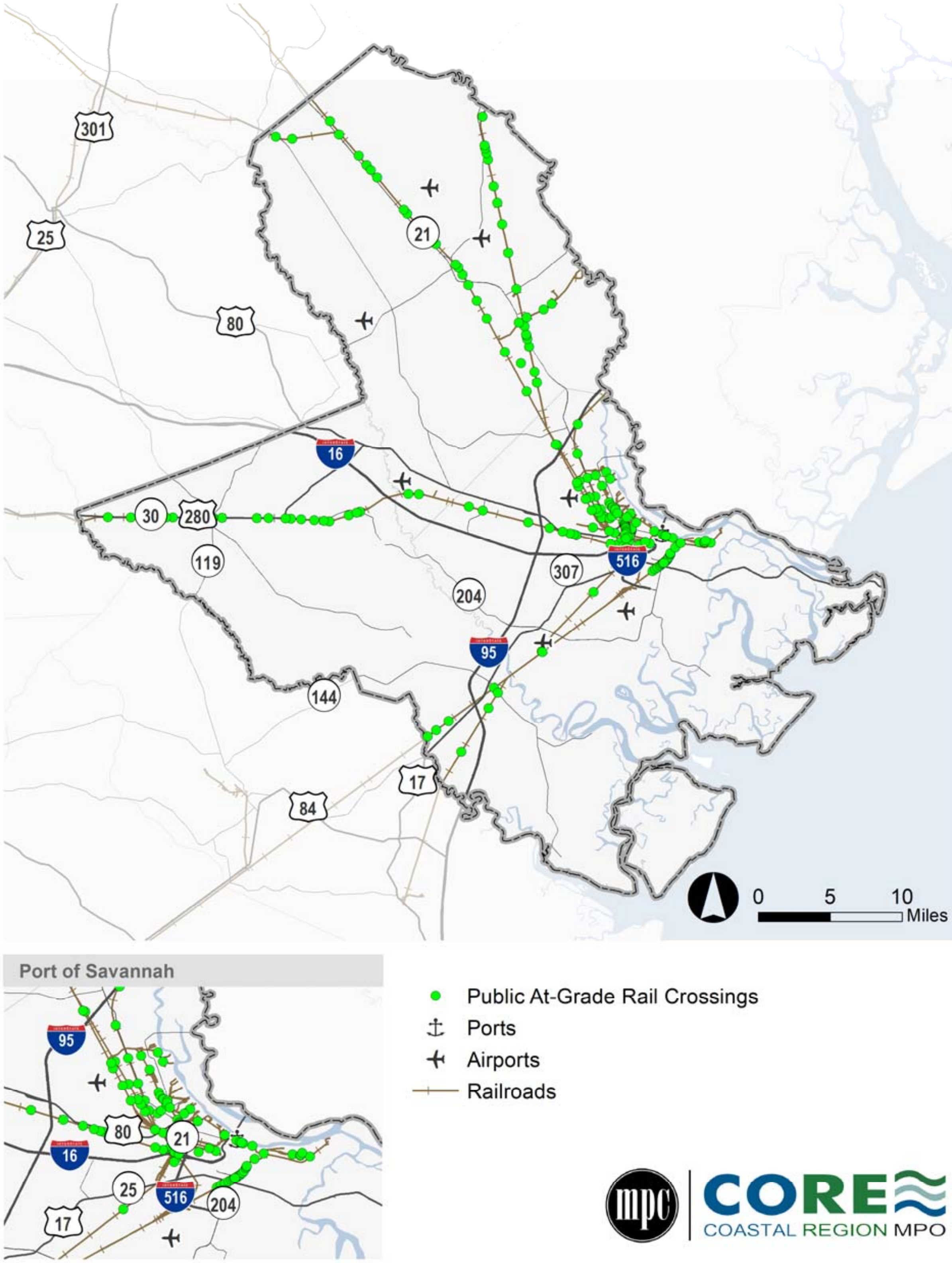


Source: GDOT Numetrics Database; Cambridge Systematics, Inc. analysis.

At-Grade Rail Crossings

At-grade rail crossings represent points where the highway and rail systems interact and have the potential for conflict (see Figure 5.14). Grade-level rail crossings can impose significant delays to trucks and other vehicles as they wait for trains to pass. In addition, trucks idling at crossings emit more pollutants especially as they must accelerate from a complete stop. Furthermore, at-grade crossings are a potential safety hazard as they present an opportunity for trains to collide with vehicles, pedestrians, or other roadway users. In total, there are 192 public at-grade rail crossings in the 3-county region which are shown in Figure 5.14.

FIGURE 5.14 PUBLIC AT-GRADE RAIL CROSSINGS



Source: Federal Railroad Administration, Highway-Rail Crossing Inventory, 2022; AECOM; Cambridge Systematics, Inc.

Table 5.9 shows the busiest at-grade rail crossings in terms of total trains (i.e., through and switching train movements) for the region. The busiest at-grade rail crossing is crossing 641179A on Telfair Road near the I-16/I-516 interchange in the City of Savannah. The crossing is located on the CSX Transportation network and it is adjacent to a substantial amount of freight-intensive land uses. On average, about 40 trains per day (30 through movements and 10 switching) use this crossing. Telfair Rd. also has a substantial amount of truck activity as about 25 percent of the estimated 2,730 vehicles per day using this roadway (over 680 trucks per day) consists of trucks.

TABLE 5.9 BUSIEST PUBLIC AT-GRADE RAIL CROSSINGS

Crossing ID	Railroad	County	Location	AADT	AADTT	Trains per Day
641179A	CSX	Chatham	Telfair Road, Savannah (Near Tremont Road)	2,730	683	40
734148K	NS	Chatham	Big Hill Road, Garden City (Near Charlie Gay Dr.)	1,569	63	31
637579L	CSX	Bryan	SR 144/Ford Ave, Richmond Hill (Near Richard Davis Dr.)	23,300	1,864	24
734152A	NS	Chatham	Crossgate Drive, Port Wentworth (Near Ray St.)	800	48	22
957126C	NS	Chatham	Oxnard Drive, Port Wentworth (Near Sugar Ave and Imperial Sugar Company)	250	No Estimate	22
637338X	CSX	Bryan	Cartertown Road, Richmond Hill (Near Bryan and Liberty County line and Mt. Hope Circle)	350	11	21
637588K	CSX	Bryan	Daniel Siding Road, Richmond Hill (Between Daniel Siding Loop Rd. and Roger Clark Rd.)	600	18	21
637337R	CSX	Bryan	Clarktown Road, Richmond Hill (Near David Myrick Rd.)	600	18	21
641187S	CSX	Chatham	Nelson Avenue, Garden City (Near SR 25)	500	10	21
632473Y	CSX	Chatham	SR 307/Bourne Avenue, Garden City (Near SR 21)	18,000	3,600	19

Source: Federal Railroad Administration, Highway-Rail Crossing Inventory, 2022; Cambridge Systematics, Inc. analysis.

Crossing 734148K is the second busiest rail crossing in the region. It is located on the Norfolk Southern network and sits along Big Hill Road near Charlie Gay Drive (a private road which provides access to the nearby NS Savannah Yard) in Garden City. About 31 trains per day (17 through trains and 14 switching movements) use this crossing. Traffic volumes on the roadway are relatively low as the roadway terminates just west of the crossing and the adjacent land uses are primarily undeveloped land and low-density residential.

Crossing with substantial train and traffic volumes include crossings 637579L and 632473Y. Crossing 637579L is the third busiest in the region and sits along SR 144/Ford Ave. between Richard Davis Drive and Frances Meeks Way in Richmond Hill. It is on the CSX Transportation network and carries about 24 trains per day, primarily through movements, on average. A large amount of vehicle traffic also uses this crossing as SR 144/Ford Ave. carries over 23,000 vehicles per day. Crossing 632473Y is SR 307/Bourne Ave. west of SR 21/Augusta Rd. in Garden City. In addition to 19 trains per day, this crossing carries approximately 18,000 vehicles per day including about 3,600 trucks per day. This roadway provides direct access to Gate 4 at the Port of Savannah.

Bridge Conditions

Bridges which cannot handle typical truck sizes or weights may contribute to congestion and lead to significant re-routing as trucks find alternative detours. If a truck cannot pass over a bridge and does not have a close alternative route, the detour can prove costly in both time and money. One of the reasons a bridge can be a barrier for certain trucks is if the bridge is in poor condition. The National Bridge Inventory rates bridges on a 0-10 scale (10 being best condition and 0 being worst) based on numerous factors including their:

- Deck condition;
- Superstructure condition;
- Substructure condition; and
- Culvert condition.

Per federal inspection standards, bridges are assigned a rating that represents the general condition of the structure. In accordance with the bridge performance measures final rulemaking, published in January of 2017[44], bridge condition is determined by the lowest rating of National Bridge Inventory (NBI) condition ratings for Item 58 (Deck), Item 59 (Superstructure), Item 60 (Substructure), or Item 62 (Box Culvert). If the lowest rating is greater than or equal to 7, the bridge is classified as Good; if it is less than or equal to 4, the classification is Poor; if the lowest rating is 5 or 6 the classification is Fair.

There are 311 bridges and 96 box culverts in the study area as shown in Table 5.10. Figure 5.15 shows the locations of bridges in the study area. About 29 percent of the region's bridges are located on Interstate highways, approximately 43 percent are on arterials (i.e., minor, principal, and other freeways/expressways), 24 percent are on collector routes, and about 21 percent are on local roads. The region's box culverts are primarily located on arterials, collectors, and local roads as only about 8 percent of box culverts carry Interstate highways.

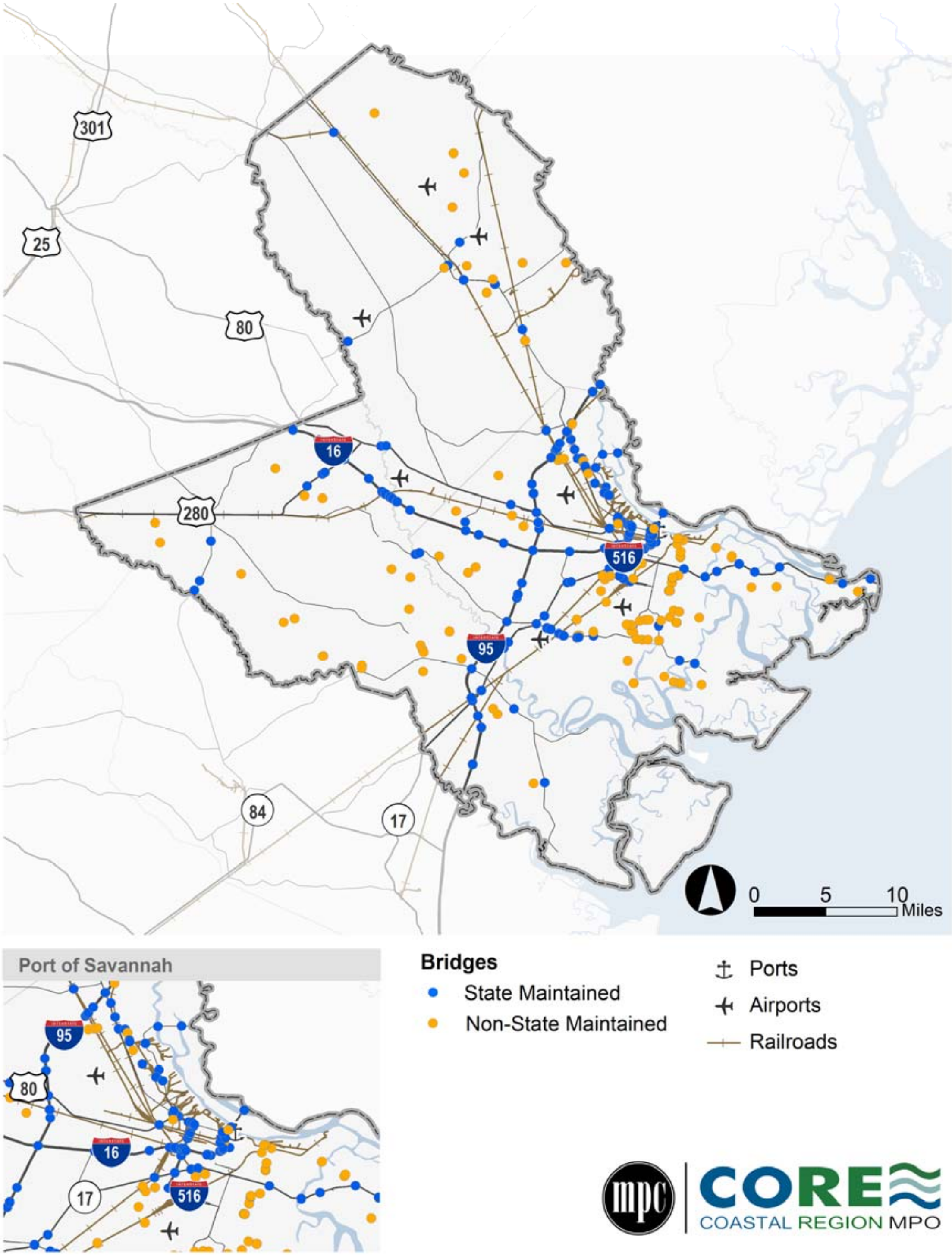
[44] U.S. Department of Transportation. Federal Highway Administration. Bridge Performance Measures. Final Rulemaking. Available at: https://www.fhwa.dot.gov/tpm/pubs/PM2BridgeFactSheet.pdf.

TABLE 5.10 STRUCTURES BY HIGHWAY FUNCTIONAL CLASS, 2021

Functional Class	Bridges	Percent of Total	Box Culverts	Percent of Total
Interstate	89	29%	8	8%
Other Freeways and Expressways	4	1%	0	0%
Other Principal Arterial	88	28%	20	21%
Minor Arterial	42	14%	20	21%
Collector	24	8%	23	24%
Local	64	21%	25	26%
Total Structures	**311**	**100%**	**96**	**100%**

Source: U.S. Department of Transportation, National Bridge Inventory, 2022.

FIGURE 5.15 LOCATION OF BRIDGES IN THE STUDY AREA, 2021



Source: U.S. Department of Transportation, National Bridge Inventory, 2022.

Table 5.11 shows the distribution of the condition ratings of bridges and box culverts by the entity responsible for their maintenance. Over 82 percent of the region's 311 bridges are in good condition. Of the 256 bridges in good condition, nearly two-thirds are maintained by the state and the remainder are maintained by counties, cities, and other entities in the region. Only 2 bridges, less than 1 percent, are in poor condition. Both of these bridges are maintained by the state and are located along SR 25 in Port Wentworth as shown in Figure 5.16. Bridge ID #5100540 is the historic Houlihan Bridge which carries SR 25 over the Savannah River. Bridge #5100550 carries SR 25 over the Middle River. Both bridges are in the process of being replaced[45]. Once replaced, bridge ID #5100540 will be raised so that it has about 65 ft. of clearance above the Savannah River.

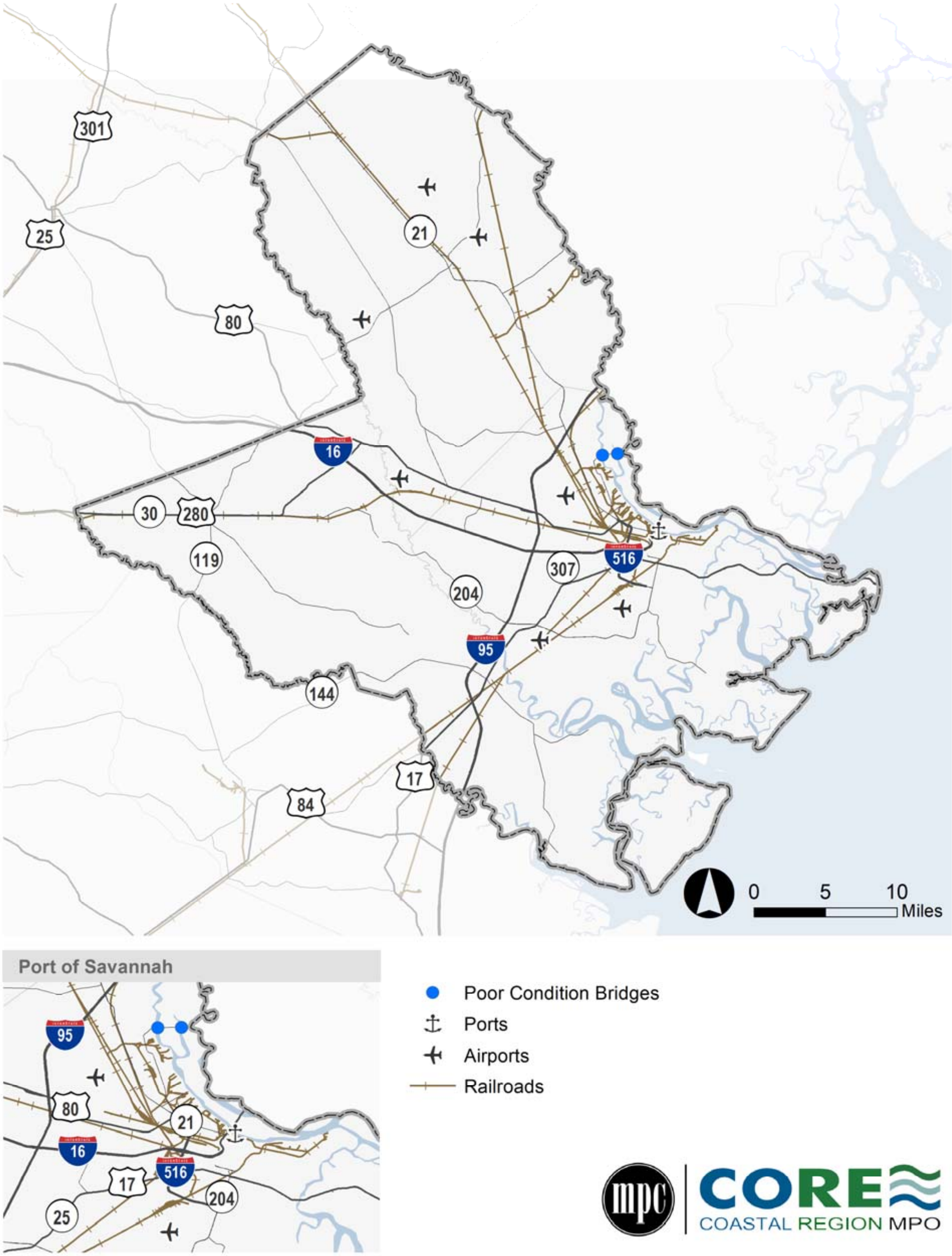
TABLE 5.11 CONDITION RATING OF STRUCTURES BY AGENCY RESPONSIBLE FOR THEIR MAINTENANCE, 2021

Maintenance Responsibility	In Good Condition	Share of Structures in Good Condition	In Fair Condition	Share of Structures in Fair Condition	In Poor Condition	Share of Structures in Poor Condition	Total Number
Bridges							
State	164	64%	27	51%	2	100%	193
County	56	22%	9	17%	0	0%	65
City	27	11%	5	9%	0	0%	32
Others	9	4%	12	23%	0	0%	21
Total Bridges	**256**	**100%**	**53**	**100%**	**2**	**100%**	**311**
Box Culverts							
State	41	47%	5	63%	0	0%	46
County	40	46%	1	13%	0	0%	41
City	2	2%	1	13%	0	0%	3
Others	4	5%	1	13%	1	100%	6
Total Box Culverts	87	100%	8	100%	1	100%	96
Total Structures	**343**	**100%**	**61**	**100%**	**3**	**100%**	**407**

Source: U.S. Department of Transportation, National Bridge Inventory, 2022; Cambridge Systematics, Inc.

[45] Georgia Department of Transportation, GeoPI Database, Project ID #0013741, https://www.dot.ga.gov/applications/geopi/Pages/Dashboard.aspx?ProjectID=0013741; Project ID #0013742, https://www.dot.ga.gov/applications/geopi/Pages/Dashboard.aspx?ProjectID=0013742.

FIGURE 5.16 LOCATION OF BRIDGES IN POOR CONDITION, 2021



Source: U.S. Department of Transportation, National Bridge Inventory, 2022; Cambridge Systematics, Inc.

Vertical clearance is another issue that can impact freight mobility as trucks are forced to divert to less efficient routes if a facility does not have sufficient vertical clearance. Specific requirements vary by daily volumes, urban versus rural setting, design speed, and other factors, but the GDOT Design Policy Manual[46] generally calls for the following vertical clearances by functional class:

- Local: minimum vertical clearance of 14.5 ft., but 16.75 ft. is desirable.
- Collectors and Arterials: minimum vertical clearance of 16.5 ft., but a clearance of 16.75 ft. is desirable.
- Freeways: minimum vertical clearance of 16.5 ft., but a clearance of 17 ft. is desirable.

In general, bridges with less than 16.5 feet of vertical clearance can impose significant challenges to the movement of goods. Of the region's 311 bridges, 104 cross over roadways (including bridges that cross roadways in addition to other features such as railroads or water bodies). Table 5.12 summarizes the distribution of vertical clearances for these bridges.

TABLE 5.12 DISTRIBUTION OF VERTICAL CLEARANCE ON ROADWAY BRIDGES BY FUNCTIONAL CLASS, 2021

Roadway Type	14.5 ft. – 16.5 ft.	16.5 ft. - 17 ft.	>=17 ft.	Total
Local	0	4	5	**9**
Minor or Major Collector	1	5	2	**8**
Minor Arterial	1	4	4	**9**
Other Principal Arterial (incl. Freeways and Expressways)	3	6	25	**33**
Interstate	4	14	27	**45**
Total	**9**	**33**	**62**	**104**

Source: U.S. Department of Transportation, National Bridge Inventory, 2022.

Importantly, the results show that 9 bridges across the region do not meet the current GDOT standard for minimum vertical clearance. Some of these bridges cross over arterials, which typically carry substantial volumes of freight traffic. The 9 bridges that do not meet current standards are listed below and shown in Figure 5.17:

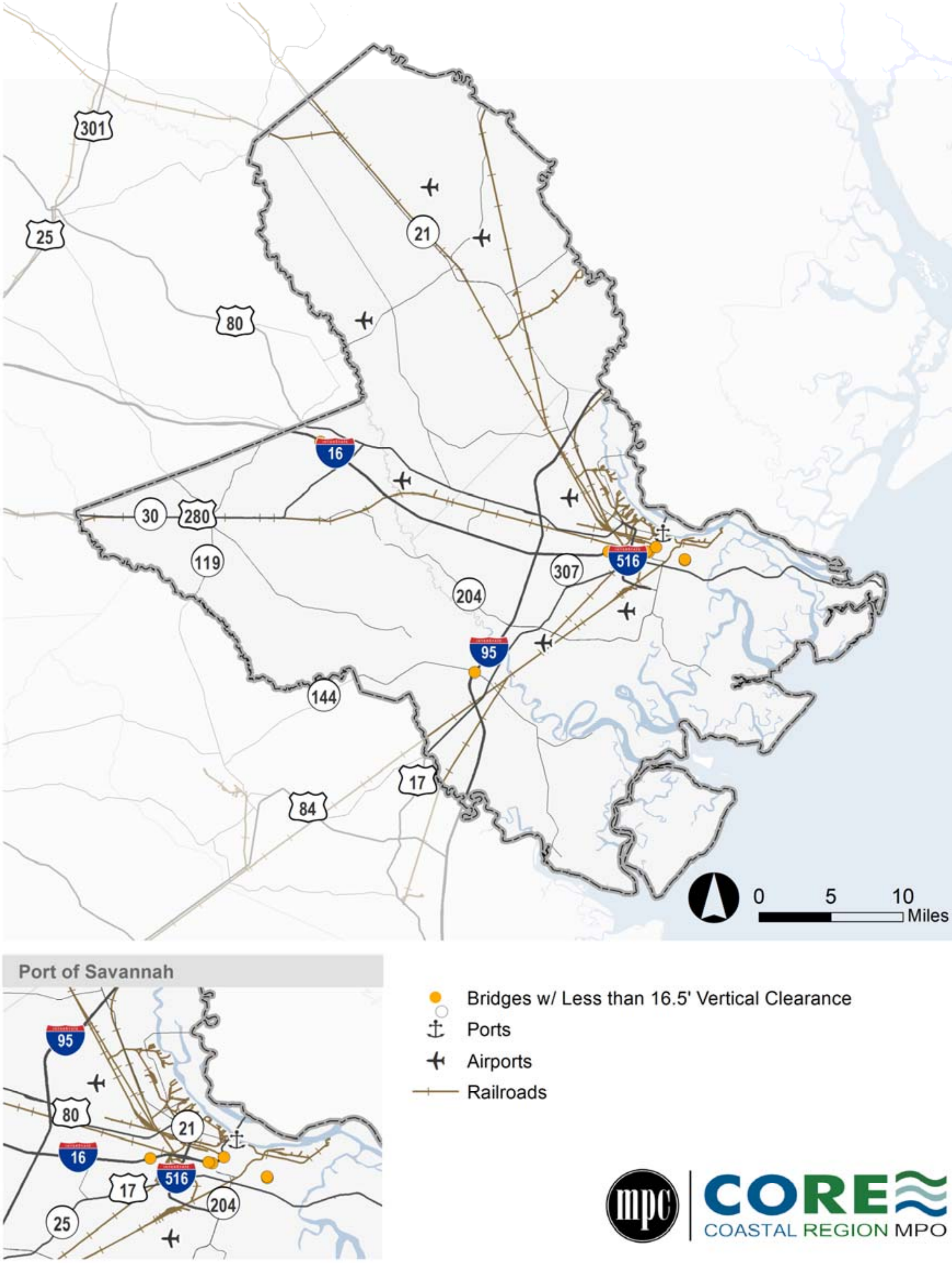
- Minor and Major Collectors
  - Structure No. 2900020: Olive Brand Road over I-16 in Bryan County north of Ellabell.
- Minor Arterials
  - Structure No. 5101560: Chatham Parkway over I-16 in at Garden City-City of Savannah border.
- Other Principal Arterials

[46] GDOT Design Policy Manual, 6/8/2022, Revision 6.9, http://www.dot.ga.gov/PartnerSmart/DesignManuals/DesignPolicy/GDOT-DPM.pdf

- Structure No. 5100780: W. 37th St. over I-16 in the City of Savannah.
- Structure No. 5150440: Truman Parkway over Anderson St. in the City of Savannah.
- Structure No. 5150450: Truman Parkway over Henry St. in the City of Savannah.

- Interstates
  - Structure No. 2900430: I-95 over SR 144 in Bryan County north of Richmond Hill.
  - Structure No. 5100070: I-516 over SR 25/US 17 in the City of Savannah.
  - Structure No. 5100950: I-16 over Stiles Ave. in the City of Savannah.
  - Structure No. 5101000: I-16 over Boundary St. in the City of Savannah.

FIGURE 5.17 HIGHWAY BRIDGES WITH LESS THAN 16.5' OF VERTICAL CLEARANCE, 2021

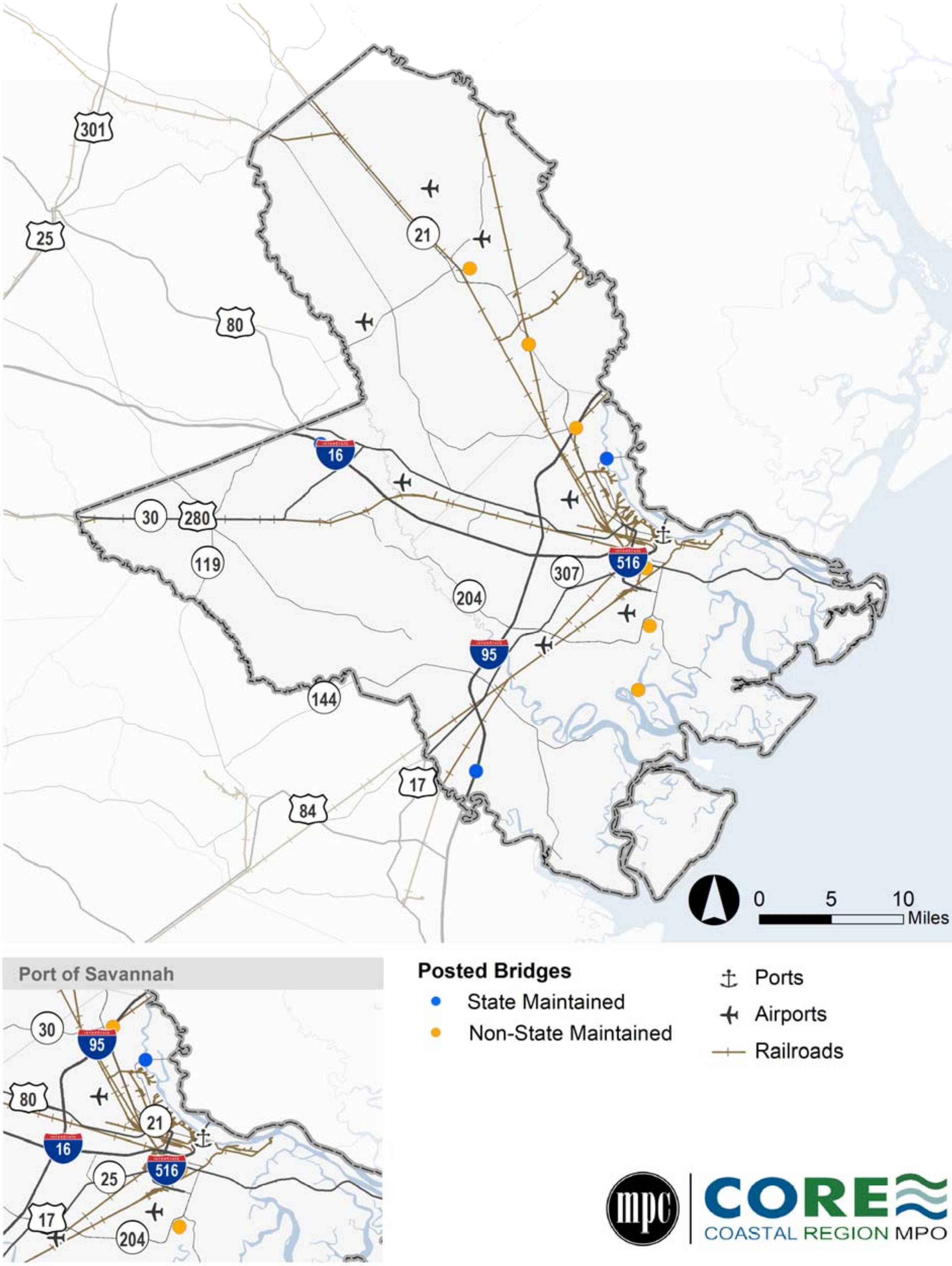


Source: U.S. Department of Transportation, National Bridge Inventory, 2022.

Posted bridges are another challenge to efficient freight movement. A posted bridge is one that has a weight limit below the standard truck axle distribution weight, which means heavier trucks may not be able to use the bridge. The heavier truck must either detour around the bridge or reduce its payload, which would lead to more trucks on the road for the same haul. In total, there are 9 posted bridges in the region as listed below and shown in Figure 5.18.

- Local
  - Structure No. 5150820: Rose Dhu Island Drive over Houston Creek on Rose Dhu Island.
  - Structure No. 10350280: Carolina Ave. over Dasher Creek in the City of Rincon.
  - Structure No. 5150010: O'Leary Road over Black Creek in the City of Port Wentworth.
  - Structure No. 5150190: 48th Street over Springfield Canal in the City of Savannah.
- Minor and Major Collectors
  - Structure No. 2900150: Belfast Keller Road over I-95 south of Richmond Hill.
  - Structure No. 10300330: Stillwell Road over Ebenezer Creek in the City of Springfield.
  - Structure No. 2900020: Olive Brand Road over I-16 in Bryan County north of Ellabell.
  - Structure No. 5101480: Atwood St. over the Vernon River in the City of Savannah.
- Other Principal Arterials
  - Structure No. 5100540: SR 25 over the Savannah River.

FIGURE 5.18 POSTED BRIDGES, 2021



mpc | CORE COASTAL REGION MPO

Source: U.S. Department of Transportation, National Bridge Inventory, 2022.

Pavement Conditions

Roadway pavement condition can impact the cost and safety of travel for passengers and freight. Cracked and rutting roadway surfaces can cause additional wear and tear on freight vehicles as well as damage the goods they are transporting. Poor pavement conditions can also impact travel time-based performance measures if vehicles must decrease their speeds to avoid potholes or other condition-related hazards. Pavement conditions may also impact safety performance.

The U.S. Department of Transportation under the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act requires states to submit pavement performance measure data in a variety of areas to the Federal Highway Administration (FHWA). These last two laws have introduced reforms into the Federal-Aid Highway Program by establishing new requirements for pavement performance management to foster efficient investment of federal transportation funds. Pavement condition performance measures based on the FHWA rulemaking are shown in Table 5.13.

TABLE 5.13 FHWA PAVEMENT PERFORMANCE RATING AND THRESHOLD

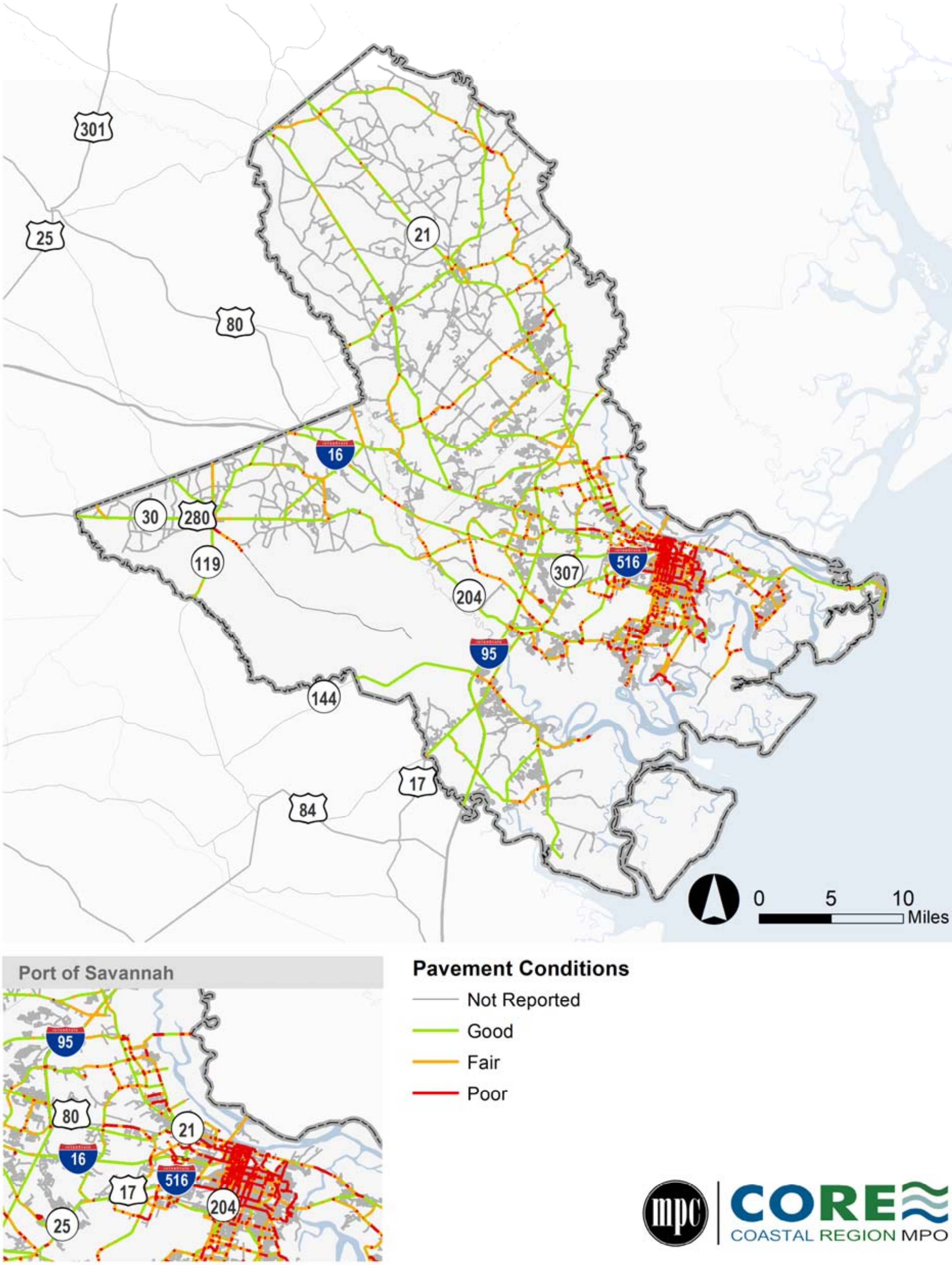
Metric	Good	Fair	Poor
IRI (inches/mile)	< 95	95–170	> 170
PSR (0.0–5.0 value)	≥ 4.0	2.0–4.0	≤ 2.0
Cracking Percent (%)	< 5	CRCP: 5–10 Jointed Concrete: 5–15 Asphalt: 5–20	> 10 > 15 > 20
Rutting (inches)	< 0.20	0.20–0.40	> 0.40
Faulting (inches)	< 0.10	0.10–0.15	> 0.15

Source: Federal Highway Administration (FHWA) Rulemaking for pavement.

Notes: IRI stands for International Roughness Index; PSR stands for Present Serviceability Index and may be used only on routes with posted speed limit <40 mph; CRCP stands for Continuously Reinforced Concrete Pavement.

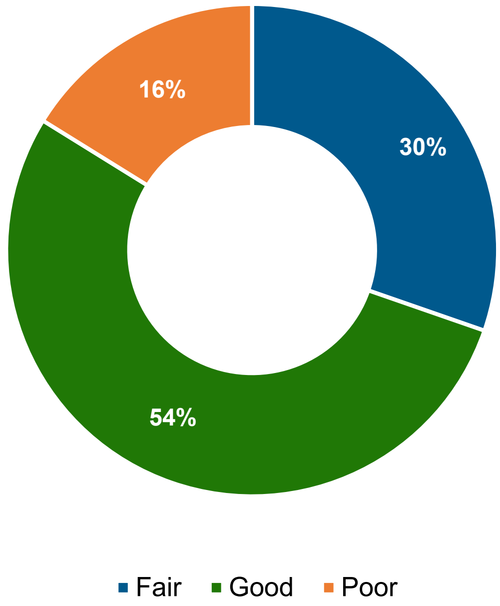
Pavement conditions throughout the CORE MPO region are depicted in Figure 5.19. It shows that poor pavements are largely concentrated in the urban center of the region in the City of Savannah. Corridors in this part of the region generally have IRI values that exceed 170. Poor pavement conditions can also be observed on corridors throughout the region including those with heavy volumes of freight traffic. Examples include SR 21 near the Port of Savannah and portions of SR 307/Bourne Avenue. However, as shown in Figure 5.20 the majority of the region’s roadway network has pavements that are in good to fair condition - about 84 percent.

FIGURE 5.19 PAVEMENT CONDITIONS ON STUDY AREA ROADWAYS, 2020



Source: Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc.

FIGURE 5.20 PERCENT OF LANE-MILES BY CONDITION CATEGORY, 2020



Source: Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc.

Table 5.14 shows pavement conditions in the region by functional classification. Generally, poorer pavements are concentrated on minor arterials and major collectors. These roadways have over 20 percent of lane-miles that are in poor condition compared to 11-12 percent for minor collectors and principal arterials. Often, minor arterials and major collectors represent the first and last miles for freight shipments. It should be noted that although the HPMS data indicate that over 60 percent of lane-miles of local roads are in poor condition, data was reported for only a small portion of these corridors.

TABLE 5.14 PERCENT OF LANE-MILES BY FUNCTIONAL CLASS AND CONDITION CATEGORY, 2020

Roadway Type	Local[47]	Minor Collector	Major Collector	Minor Arterial	Principal Arterial	Interstate	Total
Good	9.4%	49.6%	39.0%	46.0%	56.1%	84.7%	**53.5%**
Fair	30.4%	38.0%	38.9%	29.9%	32.3%	12.9%	**30.3%**
Poor	60.2%	12.5%	22.1%	24.1%	11.5%	2.4%	**16.2%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc.

[47] Note that pavement condition data was available only for a small share of local roadways.

5.3 Rail

With a history of service that dates to the 1830's, freight rail in Georgia has been a prominent and critical economic driver for the state and the southeast region more broadly. Bryan, Chatham, and Effingham Counties represent a key node in the statewide freight rail system, a status that is only growing as the Port of Savannah continues to experience record freight volumes year over year. Ongoing rail capacity expansion projects at the Port of Savannah should further cement the region's status as a critical freight hub for Georgia and the southeastern United States, and freight rail service will continue to play a major role in this dynamic in the years ahead. This section details the current features, resources, service assets, conditions, performance, and safety records related to freight rail lines in the region.

Inventory of Assets

The statewide rail network has 4,684 miles of track, which places Georgia as the seventh-largest network in the country.[48] Of that total, 278.9 miles of the state's system are located within the three-county region. Freight railroads are categorized as Class I, Class II, or Class III based on their annual revenues.[49] Class I railroads are the largest, and generally include those operators that carry freight longer distances across state lines and into other regions of the United States or internationally into Canada and Mexico. As shown in Table 5.15 and Figure 5.21, there are two Class I railroads operating in the region, Norfolk Southern and CSX Transportation. The remaining five railroads operating in the study area are Class III railroads and include: the Georgia Central Railway, the PVTX (a private railroad serving Georgia Power and Georgia Pacific facilities in the study area), Savannah Port Terminal Railroad, Savannah & Old Fort Railroad, Riceboro Southern Railway, Ogeechee Railroad Company, and Allegheny & Western Railway Company. Class III railroads are typically short-line operations that provide direct, last-mile connections to key destinations in the freight network, including ports, industrial facilities, and warehousing and distribution centers. Each of these freight rail operators are described in more detail in the subsections that follow, as are the major terminals that make up the freight rail network in the three-county region.

TABLE 5.15 STUDY AREA RAILROADS

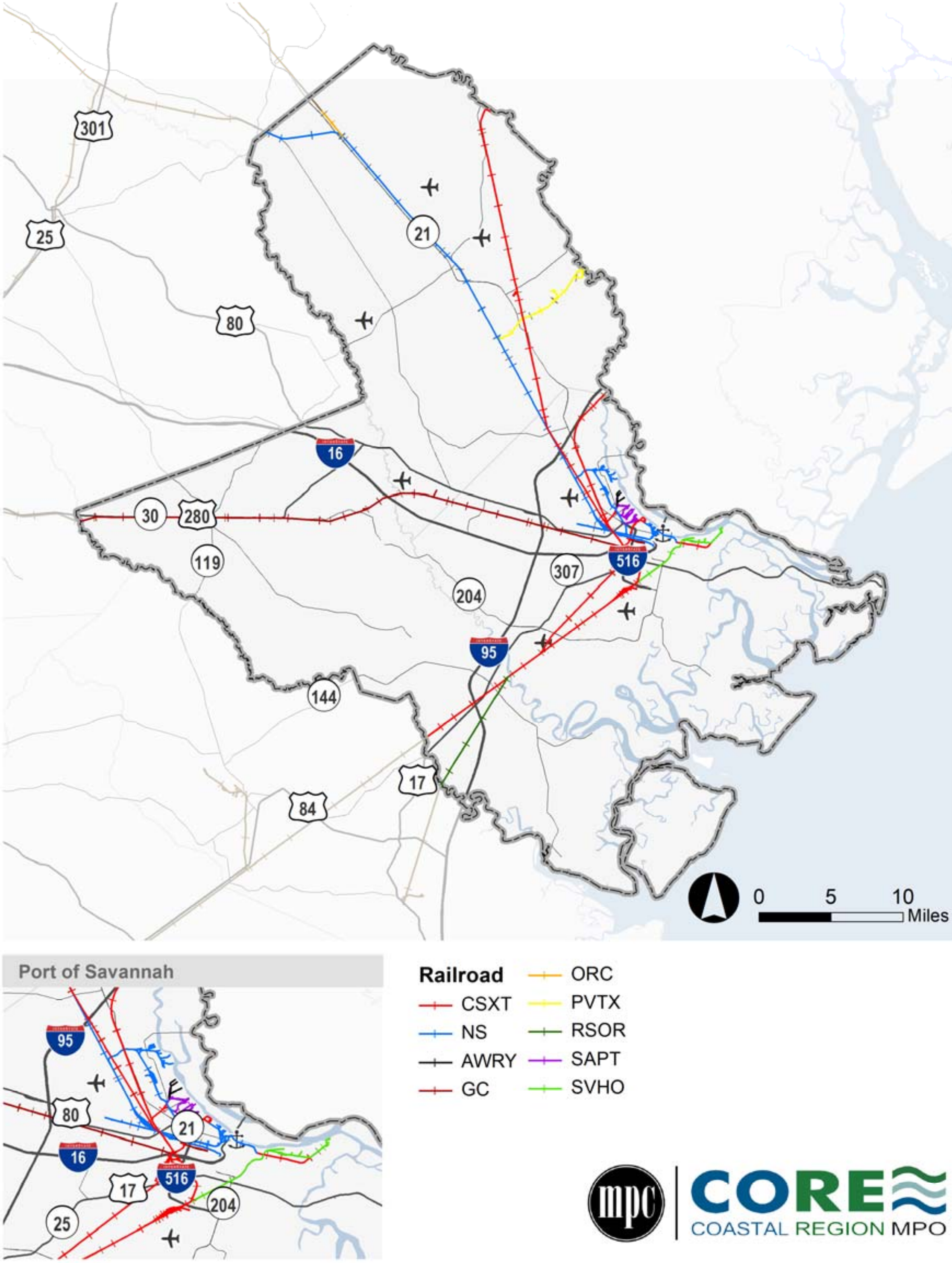
Railroad	Reporting Mark	Miles
Class I Railroads		
CSXT Transportation	CSXT	104.0
Norfolk Southern Railway Company	NS	80.5
Class III Railroads		
Georgia Central Railway	GC	42.9
Savannah Port Terminal Railroad	SAPT	15.3
PVTX	PVTX	11.0
Savannah & Old Fort Railroad	SVHO	10.3
Riceboro Southern Railway	RSOR	8.8
Ogeechee Railroad Company	ORC	2.3
Allegheny & Western Railway Company	AWRY	3.6
Total		**278.9**

Source: Bureau of Transportation Statistics, National Transportation Atlas Database, 2022; AECOM; Cambridge Systematics.

[48] GDOT, Georgia State Rail Plan, 2021.

[49] Current Surface Transportation Board thresholds establish Class I carriers as any carrier earning revenue greater than $943.9 million, Class II carriers as those earning revenue between $42.4 million and $943.9 million, and Class III carriers as those earning revenue less than $42.4 million (https://www.stb.gov/reports-data/economic-data/).

FIGURE 5.21 STUDY AREA RAILROADS, 2022



Source: Bureau of Transportation Statistics, National Transportation Atlas Database, 2022.

Class I Railroads

CSX Transportation

CSX Transportation (CSXT) operates the nation's third-largest rail network serving all major metropolitan areas east of the Mississippi River with extensions into the Canadian provinces of Ontario and Quebec. CSXT operates 21,000 route miles across 23 states, including the District of Columbia. CSXT provides rail, intermodal and rail-to-truck transload services to customers across a broad array of markets, including energy, industrial, construction, agricultural, and consumer products.

CSXT has access to more than 70 ocean, river, and lake port terminals along the Atlantic and Gulf Coasts, the Mississippi River, the Great Lakes, and the St. Lawrence Seaway. CSXT also serves thousands of production and distribution facilities through track connections to 230 short line railroads.

CSXT owns and operates nearly 1,500 miles of freight rail in Georgia, including 104 miles of rail within the three-county study area. CSXT's assets in the study area include rail lines heading north and southwest from the Port of Savannah, Savannah Yard near the I-16/I-516 interchange, Southover Yard adjacent to Hunter Army Airfield, and spur line connections to key destinations on the Savannah River such as Colonial Terminals. In addition, CSXT and Norfolk Southern jointly operate the Mason Mega Rail Terminal, the Port of Savannah's Garden City Terminal on-dock rail terminal that replaced CSXT's standalone Chatham Intermodal Container Transfer Facility (ICTF).

Norfolk Southern Railway

Norfolk Southern Railway (NS), owned and operated by Norfolk Southern Corporation, operates 21,000 route miles in 22 eastern states, the District of Columbia, and the Province of Ontario. Its service network, which generated over $11.3 billion in railroad operating revenue in 2019, blankets the eastern United States, with principal western gateways at Chicago, St. Louis, Kansas City, Memphis, and New Orleans.[50] With headquarters in Atlanta, Georgia, Norfolk Southern owns and operates approximately 1,735 miles of freight rail statewide, including 80.5 miles within the study area.[51]

NS's network in the study area includes Dillard Yard in Garden City and a rail line extending northwest from Dillard Yard through Effingham County to points further west. Other key NS assets in the study area include the S Line Yard along Louisville Road in Savannah and several spur lines connecting to industrial locations along the Savannah River. Norfolk Southern also jointly operates Mason Mega Rail Terminal with CSXT.

Class III Railroads

Savannah Port Terminal Railroad

Savannah Port Terminal Railroad (SAPT) has provided contracted rail intermodal and merchandise service, railcar switching and yardmaster services, and track inspection and maintenance to the Port of Savannah since 1998. SAPT is owned by Genesee & Wyoming, a railroad operator that owns or operates more than 13,000 track miles of freight rail across 43 US states and four Canadian provinces and who specializes

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[50] Norfolk Southern reports fourth-quarter and full-year 2019 results. Available from: http://nscorp.com/content/nscorp/en/news/norfolk-southern-reports-fourth-quarter-and-full-year-2019-resul.html

[51] GA State Rail Plan page 2-5.

shortline services. [52] SAPT currently operates 24/7 over 18 track-miles inside the Port. The railroad interchanges with CSX and Norfolk Southern, offering port customers broader access to the North American rail-freight network and additional markets. Starting in April 2021, SAPT expanded their services to include services to the new Mason Mega Rail Terminal which includes 15 track-miles and the ability to build and receive six 10,000-foot trains. The SAPT has a track capacity of 286,000 lbs.

Georgia Central Railway

The Georgia Central Railway (GC) is a subsidiary of Genesee & Wyoming, Inc. The GC operates a regional rail line that connects CSX's Savannah Yard to points west of the study area, including interchanges with the Heart of Georgia Railroad in Vidalia and Norfolk Southern in Macon. GC primarily hauls agricultural products, lumber, stone, minerals, pulp, and paper. GC's route also features connections to key distribution hubs such as the Savannah Port Logistics Center in Pooler, Georgia, with direct service to Plastic Express and other key industrial clients.[53] The GC has a track capacity of 286,000 lbs.

Savannah & Old Fort Railroad

The Savannah & Old Fort Railroad (SVHO) is a short-line railroad that runs from points along the industrial waterfront east of downtown Savannah to CSX's Southover Yard on the northern edge of Hunter Army Airfield. SVHO is owned and operated by Watco, a global transportation and supply chain services company with facilities throughout North America and Australia and headquarters in Pittsburg, Kansas. SVHO's connection to Southover Yard allows for the movement of a range of commodities from this line to CSX's broader network. Goods including sulfuric acid, sulfur, gypsum, pulpboard, wood pellets, and petroleum shipped to and from facilities on the Savannah River. [54] These include the Peeples Industries' East Coast Terminal, Georgia-Pacific's Savannah Gypsum facility, and Conoco Phillips' Savannah terminal. The SVHO has a track capacity of 286,000 lbs.

Ogeechee Railroad Company

Ogeechee Railroad Company (ORC) operates a short-line railroad in northwest Effingham County that connects to industrial facilities in Screven County, including a spur connection to Evans Concrete's plant in Sylvania, Georgia. ORC's line connects with Norfolk Southern's line in Effingham County, allowing ORC access to the larger freight rail network in the Savannah region. This line is owned by GDOT and leased to ORC. This is one of eight such lines in the state, and the only GDOT-owned line within the three-county study area.[55]

Allegheny & Western Railway Company

Allegheny & Western Railway Company (AWRY) is a subsidiary of CSX Transportation with operations in the study area. AWRY is a short-line railroad that manages several spur lines that run into the Port of Savannah. These spurs connect to both the CSXT and NS rail networks just outside the Port, allowing direct access to

[52] www.gwrr.com/about-us/

[53] https://www.gwrr.com/gc/

[54] https://www.watco.com/service/rail/savannah-old-fort-svho/

[55] Georgia State Rail Plan, Final Report, 2021.

the regional rail system for freight entering and leaving the Port. AWRY is based in Chicago, Illinois, with operations in several states.[56]

Riceboro Southern Railway

The Riceboro Southern Railway (RSOR) is a short-line railroad (i.e., Class II and III railroads) which operates in the study area. It is a subsidiary of Genesee & Wyoming, Inc.[57] The RSOR interchanges with CSX in Richmond Hill, providing access to the Port of Savannah and the entire CSX network. Outside of the study area in Liberty County, major shippers including Interstate Paper Corporation, SNF, and International Greetings USA have spurs connecting them to the RSOR rail line. The RSOR has a track capacity of 286,000 lbs.

PVTX

This is a private railroad in Effingham County that serves Georgia Power's Plant McIntosh and Georgia Pacific. It is operated by Norfolk Southern and CSX Transportation.

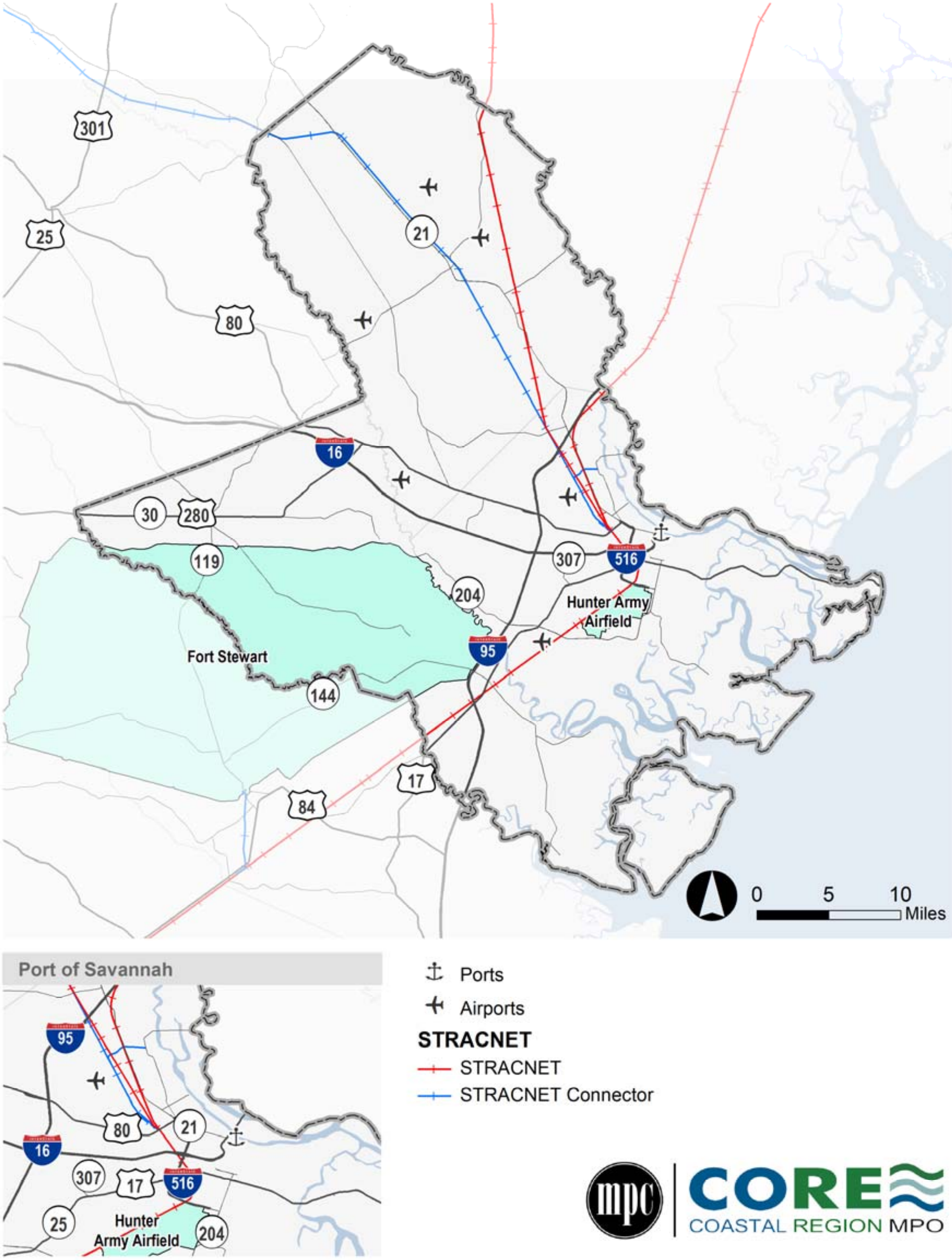
Strategic Rail Corridor Network

Fort Stewart and Hunter Army Airfield are the two military installations in the region. The transportation needs of those, and other military installations outside the region and state, are served by the STRAHNET (discussed in section 2.1) and the Strategic Rail Corridor Network (STRACNET). The STRACNET (see Figure 5.22) is an interconnected and continuous rail line network consisting of over 36,000 miles of track serving over 120 defense installations. It ensures the readiness capability of the national railroad network to support defense deployment and peacetime needs.

[56] awrail.com

[57] https://www.gwrr.com/railroads/north_america/riceboro_southern_railway#m_tab-one-panel

FIGURE 5.22 STRACNET, 2022



Source: Bureau of Transportation Statistics, National Transportation Atlas Database, 2022; U.S. Census Bureau, TIGER/Line Shapefiles Database.

Major Freight Rail Terminals

Multimodal freight facilities are defined as facilities where any transfer of freight between transportation modes occurs, including but not limited to the movement of containers and trailers, bulk transloads, and automobile distribution. These facilities are critical components in the study area's freight system. This subsection discusses major rail terminals in the study area. However, in addition to these there are multiple rail-served facilities in the region.

Rail Intermodal Terminals

Rail intermodal terminals are those facilities that allow for the transfer of shipping containers between rail and other modes, including cargo ships and tractor trailers. Two rail intermodal terminals are components of the freight rail system in the three-county study area. Those facilities include:

- **Mason Mega Rail Terminal.** The Mason Mega Rail Terminal is a rail intermodal terminal adjacent to the Port of Savannah's Garden City Terminal that opened at full capacity in 2022. This terminal combines the existing Chatham Intermodal Container Transfer Facility (ICTF), operated by CSX, and the existing Mason ICTF, operated by Norfolk Southern. Combining these two formerly separate facilities allows for the addition of 97,000 new feet of rail at Garden City Terminal, a more efficient terminal design that can use higher productivity loaders shortening freight transfer times while doubling the Port of Savannah's rail lift capacity to 1 million containers annually. Both Class I railroads will continue to operate from this location and benefit from the resulting expansion of the Port of Savannah's service area, which now stretches west to Dallas and Memphis and into the midwestern United States.[58]

- **CSX Savannah Yard.** Savannah Yard is a rail intermodal terminal operated by CSX. It is located southwest of the I-16/I-516 interchange. The CSX Savannah Yard has approximately 4,800 feet of loading track and can handle as many as 50,000 lifts per year.

Rail Bulk and Other Terminals

In addition to rail intermodal terminals, rail bulk and carload terminals also comprise important components of the regional freight rail network. Rail bulk terminals are those facilities that allow for the transfer of dry or liquid bulk goods such as petroleum products and minerals between rail and trucks. Other types of terminals include roll-on roll-off facilities and breakbulk terminals, which allow for the transfer of automobiles and other types of goods on and off of the freight rail network. Key facilities in the study area include:

- **Colonial Terminals.** Colonial Terminals operates two bulk goods terminals southeast of the Port of Savannah on the Savannah River. Terminal 1 supports the storage and transfer of liquid bulk goods via a 55-acre facility with capacity for 2.65 million barrels, including products ranging from acids and alcohols to petroleum and food-grade materials. Terminal 1 is serviced by spur routes operated by Norfolk Southern. Terminal 2 accommodates both liquid and dry bulk goods on a 90-acre facility, with storage capacity for 1.03 million barrels of liquids alongside 40 storage silos and 70,000 square feet of warehouse space for dry commodities. Products supported at Terminal 2 include asphalt, chemicals, renewable fuels, fertilizer, grain, and wood pellets, among others. Terminal 2 features direct rail access via spur lines operated by CSX.[59]

[58] Mason Mega Rail - Georgia Ports Authority (gaports.com)

[59] Terminal 1 – Liquid Bulk – Colonial Terminals Inc.

- **CSX TRANSFLO.** Co-located with CSX's Savannah Yard, CSX Transportation's TRANSFLO terminal supports the transfer of bulk goods between railcars and trucks. CSX Transportation's TRANSFLO facility is capable of handling a range of commodities, including chemicals, oil, dry goods, food-grade products, and other materials. This terminal has a capacity of 45 railcars.[60]

- **CSX Southover Yard.** CSX Transportation also operates the Southover Yard which is located south of I-516 near the Hunter Army Airfield. The facility occupies over 200 acres and has connections to the Savannah & Old Fort Railroad (SVHO). The Southover Yard likely primarily handles goods including sulfuric acid, sulfur, gypsum, pulpboard, wood pellets, and petroleum shipped to and from facilities on the Savannah River as those are the main commodities shipped on the SVHO.

- **NS Dillard Yard.** Dillard Yard formerly operated as a Norfolk Southern rail intermodal terminal. It is located approximately one and a half miles from the Port of Savannah. Recently, it has been used as a container yard to relieve overflow at the Port of Savannah.[61]

- **Vopak Terminal Savannah.** Vopak Terminal Savannah is a bulk goods terminal located immediately adjacent to the Port of Savannah on the Savannah River. Vopak's terminal features 56 tanks that can accommodate asphalt, vegetable oils, biofuels, chemicals, and petroleum products.[62] The terminal has direct access to the larger regional freight rail network via spur lines operated by the Savannah Port Terminal Railroad.

- **Georgia Ports Authority Ocean Terminal.** The Georgia Ports Authority operates the Ocean Terminal at the Port of Savannah, a 200-acre terminal offering roll-on, roll-off and breakbulk, and container services with direct intermodal connections to Norfolk Southern's rail network via spur lines at the terminal. The terminal offers four shipping berths, open storage, and more than 1.4 million square feet of warehouse space, among other amenities.[63] The Ocean Terminal is in the process of being converted to primarily serve container traffic.

- **Southeastern Ship Terminal.** The Southeastern Ship Terminal is located along N. Lathrop Ave. east of I-516 in the City of Savannah. [64] The facility handles bulk and breakbulk cargo and has approximately 200,000 sq. ft. of warehousing space.

- **Savannah Marine Terminal.** The Savannah Marine Terminal is a 40-acre transloading complex that is served by both CSXT and Norfolk Southern.[65] It is located northeast of the I-16/I-516 along Magazine Ave. and Feeley Ave. in the City of Savannah. The Savannah Marine Terminal has approximately 80,000 sq. ft. of warehousing space. Agricultural products, forest products and logs, animal and vegetable products, liquid bulk products, stone and other dry bulk goods, and pipes are among the primary commodities served by this facility.

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[60] Georgia-Savannah | Transflo

[61] https://gaports.com/press-releases/kemp-georgia-ports-mark-mega-rail-milestone/

[62] Vopak Terminal Savannah | Royal Vopak

[63] Ocean Terminal - Georgia Ports Authority (gaports.com)

[64] http://ssterminal.com/index-1.html

[65] https://www.savannahmarineterminal.com/

- **Seaonus Stevedoring-Savannah.** Seaonus Stevedoring-Savannah is located along Altamaha St. east of downtown Savannah.[66] It specializes in breakbulk, forest products, and project cargo. The facility is owned and operated by Patriot Rail.

Conditions and Performance

This section of the report discusses current conditions and performance of freight rail corridors in the Savannah region. Freight rail network capacity is critical in keeping the study area's network economically competitive. Potential for growth is dependent on sufficient excess capacity to handle increased movements. Key elements that determine physical capacity limits are as follows:

- **Weight limits.** The gross (total) weight of a rail car plus any cargo it is carrying. Railcars continue to increase in weight, with standard for a four-axle car reaching 286,000 pounds.

- **Vertical clearances.** Distance between the rail bed and the bottom of overhead structures. Modern railcars, including double-stacked containers and tri-level auto-rack cars need more space than previous generations of equipment.

- **Traffic control and signaling.** Signaling systems help ensure safe operations and affect permissible passenger and freight train speeds, while traffic control systems improve capacity utilization in an efficient manner. Traffic management systems can range from simple to complex, with lines experiencing higher traffic volumes benefiting from more advanced systems. These include automated technologies that help ensure operational safety (such as automatic block signals) and computerized dispatching systems that help manage the flow of trains over a route.

The analysis also has a focus on rail safety. Transportation safety is one of the highest priorities for transportation planning and engineering and is a key consideration for a range of stakeholders. An overview of freight rail safety is included in this section with a more detailed analysis to be provided as part of Task 2.5: Freight Network Congestion, Bottleneck, and Safety and Security Issues.

Weight-Limited Rail Lines

Rail lines that have not been abandoned but are either out of service (i.e., embargoed) or of such condition that they cannot handle standard 286,000-pound (i.e., 286K) railcars can have an adverse impact on shippers and the local economies that rely on the shippers for jobs and revenues. As traffic on rail lines diminishes, or as funds are not available for needed maintenance, lines are sometimes taken out of service or are abandoned. In some cases, abandoned lines are rail-banked, meaning they are converted to other uses, to retain the underlying right of way for future rail use.

Data available from the 2021 Georgia State Rail Plan, the 2018 Georgia Statewide Freight and Logistics Action Plan, and various railroad websites indicate that nearly all of the freight rail corridors in the Savannah region meet the 286K standard. Based on information from the 2018 Georgia Statewide Freight and Logistics Action Plan, the only corridor that does not meet this standard is the Ogeechee Railroad Company (ORC) corridor in Effingham County which connects to the Norfolk Southern network. However, track capacity on

[66] https://patriotrail.com/patriot-ports/ports/savannah/

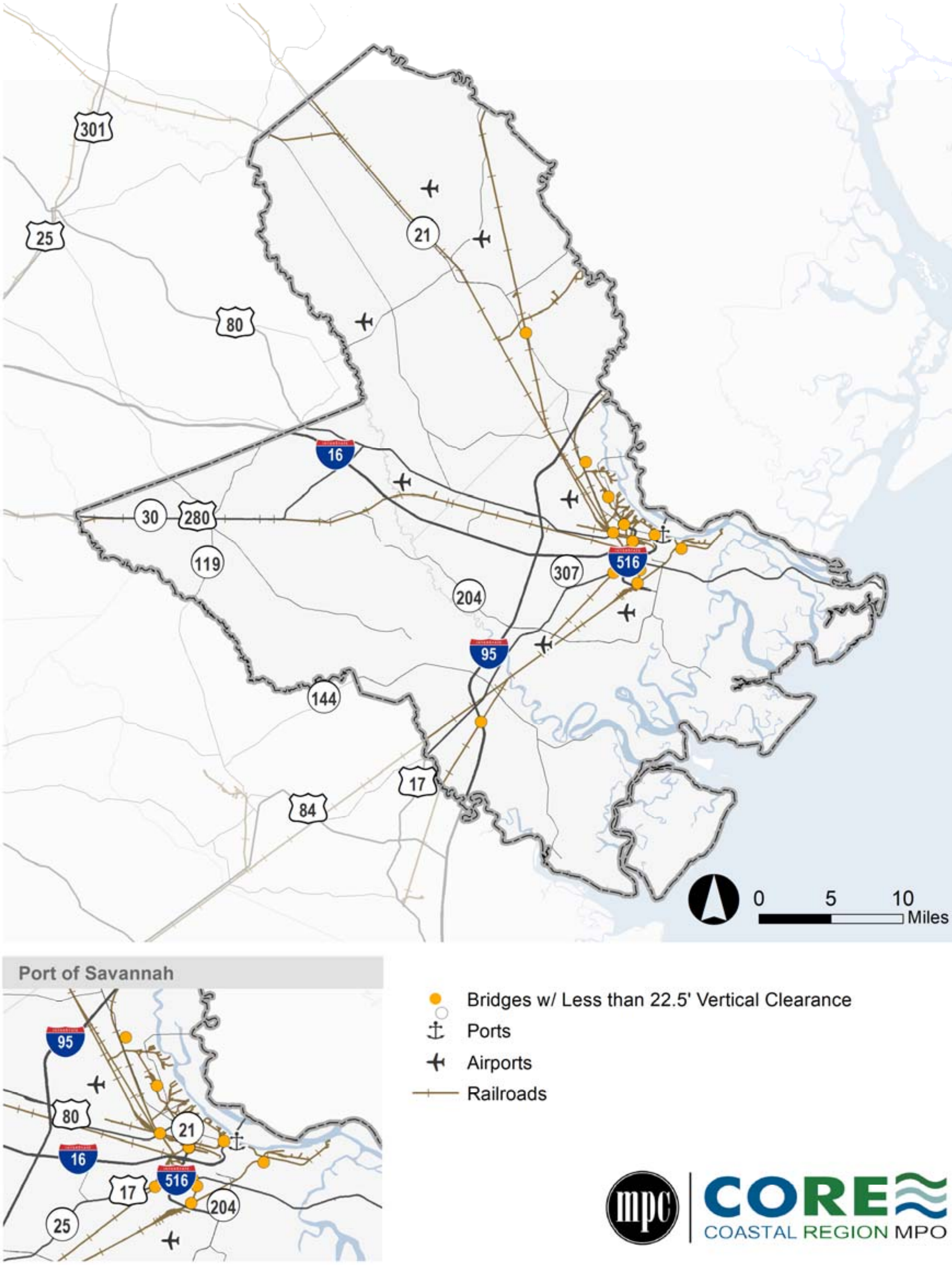
this line may have been increased since the completion of the 2018 Statewide Freight and Logistics Action Plan but public information was not released.

Vertical Clearances

To allow unrestricted access for all standard rail car configurations, including double-stacked intermodal cars and tri-level auto carriers, 22 feet 6 inches is needed between the rail bed and the underside of any overhead structure. For lines handling intermodal traffic, double-stacked domestic containers can fit under a vertical clearance of 20 feet 8 inches—anything less than this restricts the corridor to single-stacked containers with accompanying efficiency and competitiveness issues.

There are 57 bridges in the region that intersect rail corridors. Of this total, 15 do not provide the ideal vertical clearance of 22’-6” as shown in Figure 5.23. Twelve of these bridges are maintained by GDOT, 2 are maintained by Chatham County, and 1 is maintained by the City of Savannah. Despite not having the ideal vertical clearance, only two bridges intersecting rail corridors do not meet the minimum standard of 20’-8” for double-stacked operations. These include structure #5150980 which carries Jimmy Deloach Parkway over CSXT in the City of Port Wentworth and structure #5100110 which carries I-516 over CSXT and Gwinnett Street in the City of Savannah.

FIGURE 5.23 VERTICAL UNDERCLEARANCE ISSUES ON BRIDGES OVER RAILROADS, 2022



Source: U.S. Department of Transportation, National Bridge Inventory, 2022.

Traffic Control Systems

Positive Train Control (PTC) technology can prevent train-to-train collisions, over-speed derailments and casualties or injuries to roadway workers (e.g., maintenance of way workers, bridge workers, and signal maintainers). The technology combines GPS locating of trains, infrastructure, speed restrictions, and traffic conditions with real-time wireless communications between locomotives and other operating equipment, dispatchers, and work crews. The Rail Safety Improvement Act of 2008 (RSIA) mandated the widespread installation of PTC systems on all lines handling passenger trains or hazardous materials, a network totaling approximately 80,000 miles.[67]

The mandate for PTC excludes all Class II and III railroads regardless of tonnage or number of cars transporting TIH materials if no passenger trains travel over the lines. However, some Class II and Class III railroads must access Class I rail lines. Class I railroads may require these carriers to equip their locomotives with PTC as prerequisite to access their lines. As of July 1, 2019, Class I railroads had equipped all relevant locomotives with PTC, installed wayside units, towers, and trained employees.

Rail Safety Incident History

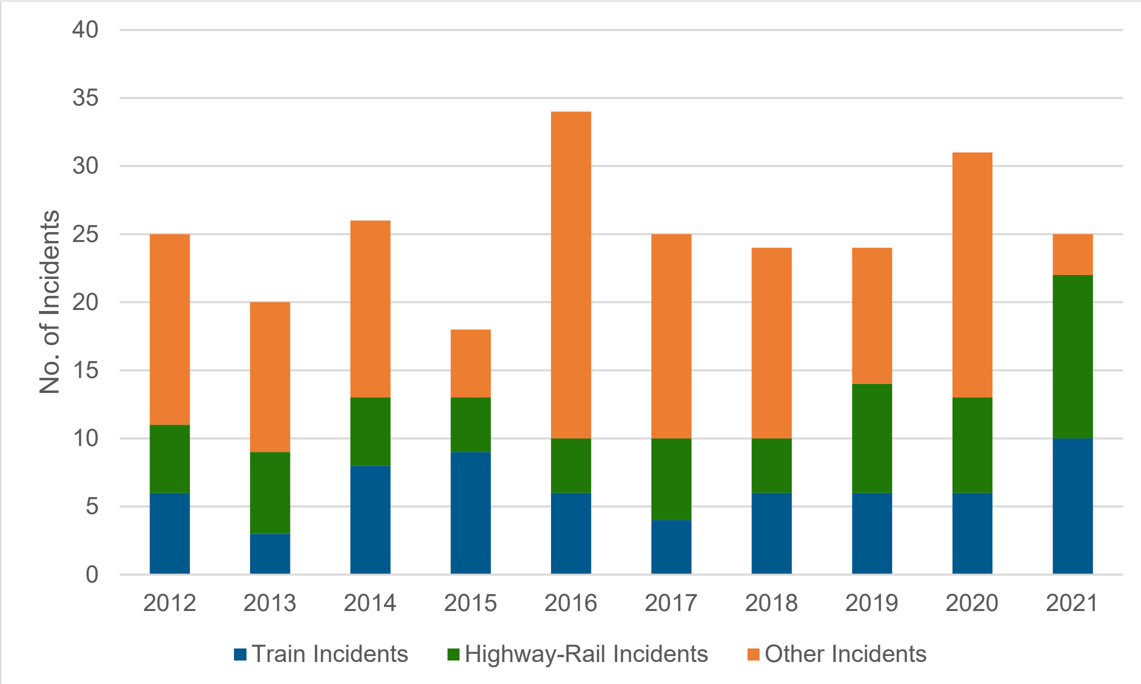
Railroad incidents for the last full 10-year period 2012-2021 in the study area are summarized in Figure 5.24. The Federal Railroad Administration (FRA) assigns rail-related accidents/incidents to one of three categories:

- Train accidents are train collisions, derailments of trains or other incidents that cause damage to railroad equipment, track, or structures.
- Highway-rail accidents are collisions where trains hit or are struck by cars, bicycles, or pedestrians at highway-rail grade crossings.
- Other accidents/incidents do not fit into the first two categories. Railroad employees are required to report any work-related injuries or sickness, which are categorized as “other accidents/incidents.” Situations where trespassers, railroad employees, or contractors are struck by trains also fall into the “other” category.

Passenger rail data was included to present a full history of rail incidents as AMTRAK uses CSXT and Norfolk Southern owned and maintained rail lines. Reportable incidents include highway-rail grade crossing accidents or incidents as well as train derailments, collisions, and any accident involving railroad employees or trespassers that occur on railroad property and result in fatalities, injuries, or property damage exceeding an amount established by FRA. Because property damage-only crashes are included, there is no direct correlation between the number of fatalities/non-fatalities and the total number of incidents.

[67] FRA, 49 CFR 236.1005.

FIGURE 5.24 FRA REPORTABLE RAILROAD INCIDENTS 2011 – 2020



Source: FRA Office of Safety Analysis, 10-Year Accident/Incident Overview 2012-2021; AECOM.

More detailed information on the severity of railroad incidents is summarized in Table 5.16. This 10-year look at incident history shows a general decrease in incidents resulting in fatalities. In particular, there has not been an incident at a highway-rail crossing resulting in a fatality since 2016. However, while there appears to be a reduction in the severity of crashes, the overall rate of incident occurrence remains relatively steady.

TABLE 5.16 FRA REPORTABLE RAILROAD INCIDENTS 2011 – 2020

Incident	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total Incidents	25	20	26	18	34	25	24	25	32	26
Deaths		3	1	1	1	1	1			
Injuries	14	19	15	7	24	14	18	12	18	6
Train Incidents	6	3	8	9	6	4	6	6	6	10
Deaths										
Injuries		2					4			
Highway-Rail Incidents	5	6	5	4	4	6	4	8	7	12
Deaths		2	1	1						
Injuries		7	2	2	1			1		3
Other Incidents	14	11	13	5	24	15	14	10	18	3
Deaths		1			1	1	1			
Injuries	14	10	13	5	23	14	14	10	18	3

Source: FRA Office of Safety Analysis, 10-Year Accident/Incident Overview 2012-2021; AECOM.

5.4 Ports

The Savannah River and the region's coastal location provides a valuable waterborne connection to national and international markets. The Port of Savannah is critically important to the regional and state economy and generates much of the freight traffic through the region. In addition, the Port of Savannah is designated by the Department of Defense (DOD) as a strategic seaport.[68] The strategic seaport program is jointly administered by the DOD and USDOT and its purpose is to facilitate the movement of deploying military forces through the 18 commercial seaports that are designated as strategic seaports. These ports serve as significant transportation hubs and are important to DOD's readiness and cargo handling capacity.

Inventory of Assets

The Port of Savannah is the largest and fastest growing container terminal in America and the 3rd busiest container port complex in U.S., after L.A./ Long Beach and New York-New Jersey.[69] It is the largest gateway for agricultural exports. In 2021, despite the COVID-19 pandemic's substantial disruption of national and international supply chains, the Georgia Ports Authority handled 41.6 million tons of trade including 5.6 million twenty-foot equivalent container units (TEUs).

The Port of Savannah is comprised of two terminals: Garden City and Ocean (see Table 5.17). As indicated in Table 5.17, the Garden City Terminal handles container traffic and has on-terminal rail intermodal access. Both Norfolk Southern (NS) and CSX Transportation operate at the Mason Mega Rail Terminal located on the Garden City Terminal. The Ocean Terminal handles breakbulk, roll-on/roll-off (Ro/Ro), and container traffic. However, this facility is in the process of being converted to primarily handle containers. It also has on-dock rail access via NS and CSX.

TABLE 5.17 DEEPWATER TERMINALS AT THE PORT OF SAVANNAH, 2022

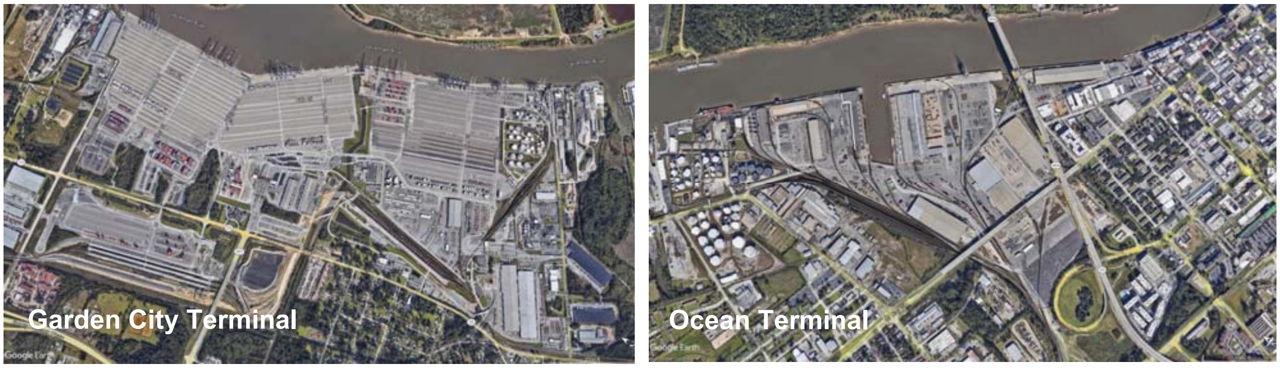
	Garden City Terminal	Ocean Terminal
Terminal Area	1,345 acres	200.4 acres
Commodities Handled	Containers	Breakbulk, Ro/Ro, Containers, Heavy Lift, and Project Cargo

Source: Georgia Ports Authority.

[68] https://www.maritime.dot.gov/ports/strong-ports/national-port-readiness-network-nprn

[69] Georgia Ports Authority, https://gaports.com/facilities/port-of-savannah/.

FIGURE 5.25 DEEPWATER TERMINALS AT THE PORT OF SAVANNAH



Source: Google Earth.

The Ocean Terminal serves breakbulk, Roll-on / Roll-off, and containers. It covers 200.4 acres and provides more than 1.4 million square feet of storage[70]. The Garden City Terminal is the Port of Savannah's primary container handling facility and is the 4th busiest container terminal in the United States. It occupies about 1,345 acres and handled approximately 538,000 rail containers in 2021[71]. Over 1.1 million square feet of warehousing is located at the Garden City Terminal.[72] There are ongoing efforts to expand the Garden City Terminal (i.e., Garden City Terminal West) to include a container yard with a capacity of 750,000 TEUs.

While the inventory of assets focuses on facilities owned by the Georgia Ports Authority, it is important to note that there are several rail terminals, truck terminals, rail-served docks, and other facilities that effectively expand the footprint of the port and the amount of capacity it may handle. This is apparent when viewing the cargo-serving docks (i.e., as opposed to docks used for maintenance, tourism, or other purposes) and industrial zoned properties within the port statistical area (see Figure 5.26). The port statistical area represents the port limits as defined by legislative enactments of state, county, or city governments. Along with the cargo-serving docks and industrial zoned properties, the port statistical area provides an indication of the broader reach of the port in terms of the facilities that support port operations.

[70] https://gaports.com/facilities/port-of-savannah/ocean-terminal/

[71] Georgia Ports Authority, 2021 Annual Report, https://gaports.dcatalog.com/v/FY21-Annual-Report/?1655986353.

[72] Georgia Ports Authority, https://gaports.com/facilities/port-of-savannah/garden-city-terminal/

FIGURE 5.26 INDUSTRIAL PROPERTIES AND CARGO-SERVING DOCKS WITHIN THE PORT OF SAVANNAH'S PORT STATISTICAL AREA, 2022

Source: U.S. Army Corps of Engineers; CORE MPO; Cambridge Systematics, Inc. analysis.

Conditions and Performance

This section of the report examines the condition and performance of the region's port assets. Specifically, it investigates port capacity, throughput, and vessel dwell times. These three dimensions of performance are measured by the Bureau of Transportation Statistics as part of the Port Performance Freight Statistics Program, which was established by the Fixing America's Surface Transportation (FAST) Act of 2015.

Port Capacity and Throughput

Port capacity is a measure of the maximum throughput that a port and its marine terminals can handle over a given time period[73]. This maximum can be set by physical constraints and factors such as air draft restrictions, channel depths, the number and type of container cranes, and the proximity of rail connections. Port throughput can be measured by the amount of cargo or the number of vessels that a port handles over a given time period.

Air draft restrictions can limit port capacity, especially as increasingly larger vessels come into service[74]. These restrictions may not affect all terminals in a port as some ports might have terminals with no air draft restrictions because no bridges cross their navigation channels. Air draft restrictions may be eliminated or reduced as bridges are either raised or replaced. In general, bridges with higher vertical clearances allow more stacked containers to pass under. The Port of Savannah's air draft is 185 feet due to the Talmadge Memorial Bridge which carries SR 404/US 17 over the Savannah River. GDOT is currently considering improvements to the Talmadge Memorial Bridge (alternatives include raising the existing bridge, building a new bridge or building a tunnel) to increase the air draft to 215-220 feet.[75]

The number and type of container cranes are another indicator of port capacity. Container cranes link the waterside and landside port assets, including truck and rail connections or the container yard used for short-term storage[76]. The number and size of cranes affects the number and sizes of container vessels a terminal can service simultaneously. The Port of Savannah has 38 ship-to-shore cranes. Of that total, 30 are Super Post-Panamax cranes, a class of crane that can fully load and unload containers from the largest container vessels currently in operation that can be up to 24-rows of containers in width.

Port capacity is also impacted by the proximity of rail connections. All major ports are either directly connected to the rail system or have facilities that are nearby. The Port of Savannah's on-terminal facility at the Garden City terminal is the Mason Mega Rail Terminal. It is served by Norfolk Southern and CSX Transportation and replaced the Chatham Intermodal Container Transfer Facility (ICTF) and the James D. Mason ICTF. The Ocean Terminal also has an on-terminal facility that is served by both Norfolk Southern and CSX Transportation.

Regarding throughput, 2020 data from the U.S. Army Corps of Engineers Waterborne Commerce Center indicate that the Port of Savannah ranked 13th in total tonnage among U.S. ports. This is an increase over its 2016 ranking at number 18. In 2020, the Port of Savannah handled over 43.4 million tons of goods as shown in Figure 5.27. In comparison, the Port of Charleston and the Port of Jacksonville handled approximately

73 https://data.bts.gov/stories/s/mign-rc8p

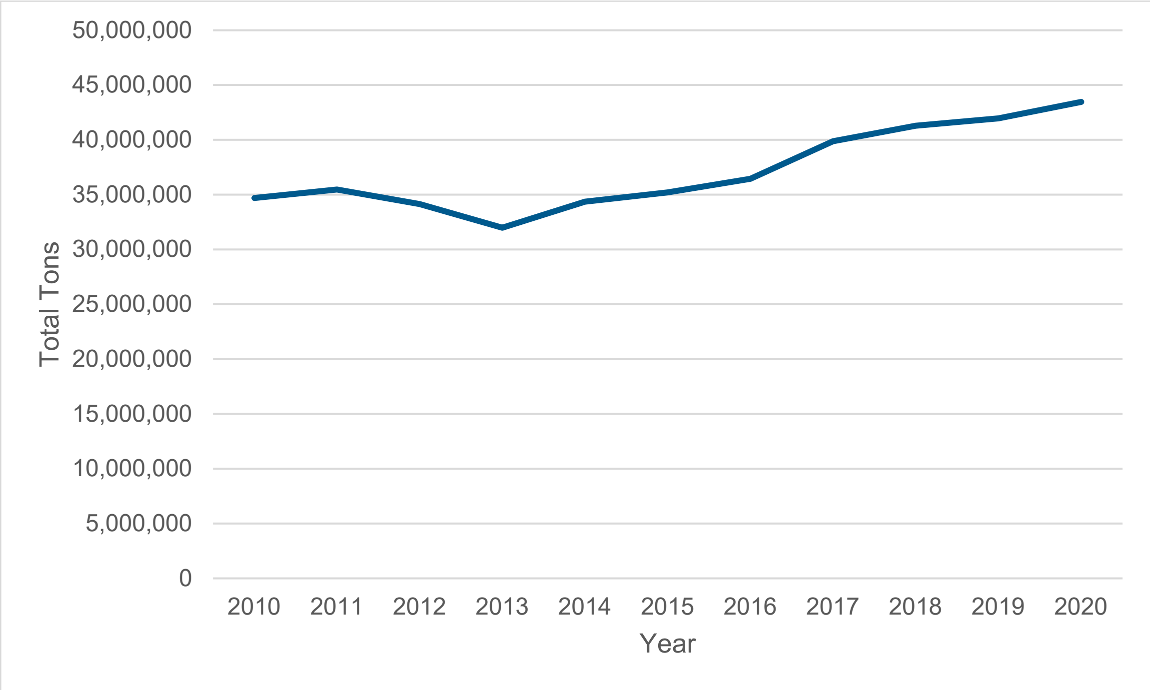
74 https://data.bts.gov/stories/s/Air-Draft-Channel-Depths/prsc-k6eu

75 Merrigan, J. and D. Jones, "State studying Talmadge Bridge: Accommodating all large ships, possible replacement," WSAV, https://www.wsav.com/news/local-news/savannah/state-studying-whether-talmadge-bridge-can-accommodate-all-large-ships-looking-for-possible-replacement-alternatives/

76 https://data.bts.gov/stories/s/Container-Cranes/r3bp-uzdb

24.9 million tons and 16.7 million tons in 2020 making them the 27th and 38th ranked ports by total tonnage, respectively. Of that total, about 56 percent were imports, 41 percent exports, and nearly 3 percent domestic shipments. Top commodities for the Port of Savannah include manufactured products, pulp and waste paper, rubber and plastics, textile products, and paper and paperboard. The Port of Savannah is the top U.S. port for agricultural exports (e.g., forest products, clay, cotton, poultry) as it accounted for nearly 16 percent of the nation's agricultural container exports in 2019.[77]

FIGURE 5.27 PORT OF SAVANNAH TONNAGE, 2011-2020

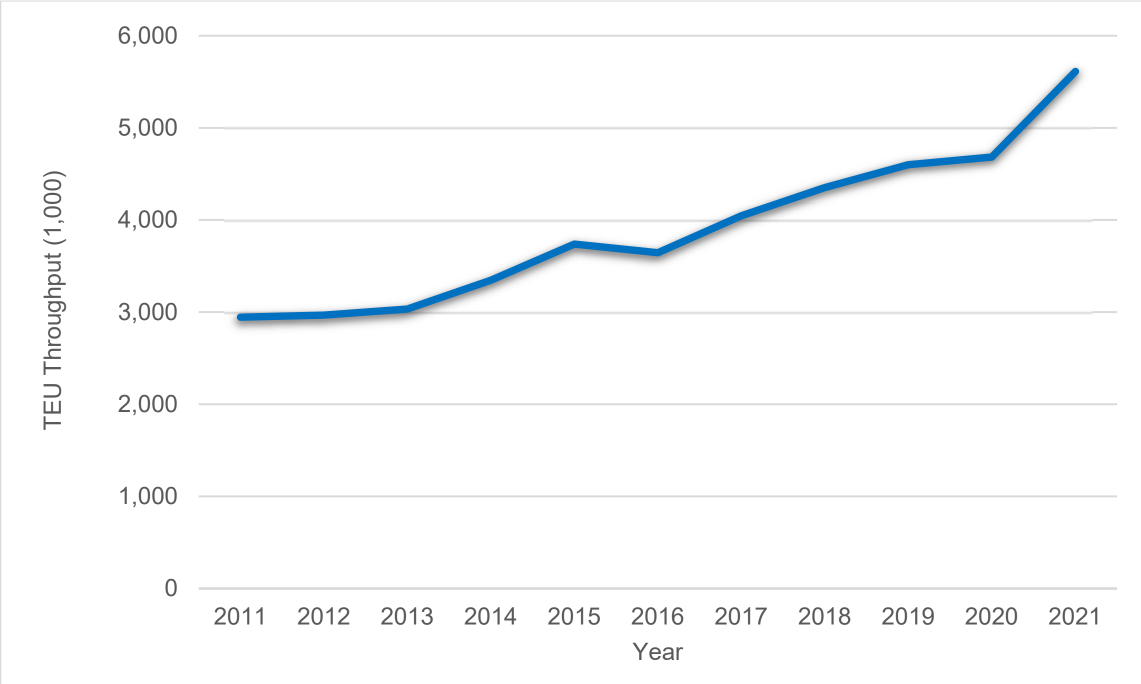


Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.

The Port of Savannah's throughput (measured in the number of import, export, and empty containers processed) has steadily increased over the 2011-2021 time period as shown in Figure 4.10. Total growth in throughput (TEUs) over this period was approximately 90 percent. In 2021, Savannah's total container trade expanded 19.9 percent over the 2020 value to reach 5.61 million TEUs. From 2017 to 2021, total container trade at the Port of Savannah grew 39 percent with an annual compound growth rate of about 8.5 percent.

[77] https://gaports.com/press-releases/savannah-now-the-top-us-port-for-ag-exports/

FIGURE 5.28 PORT OF SAVANNAH THROUGHPUT (TEUS), 2011-2021

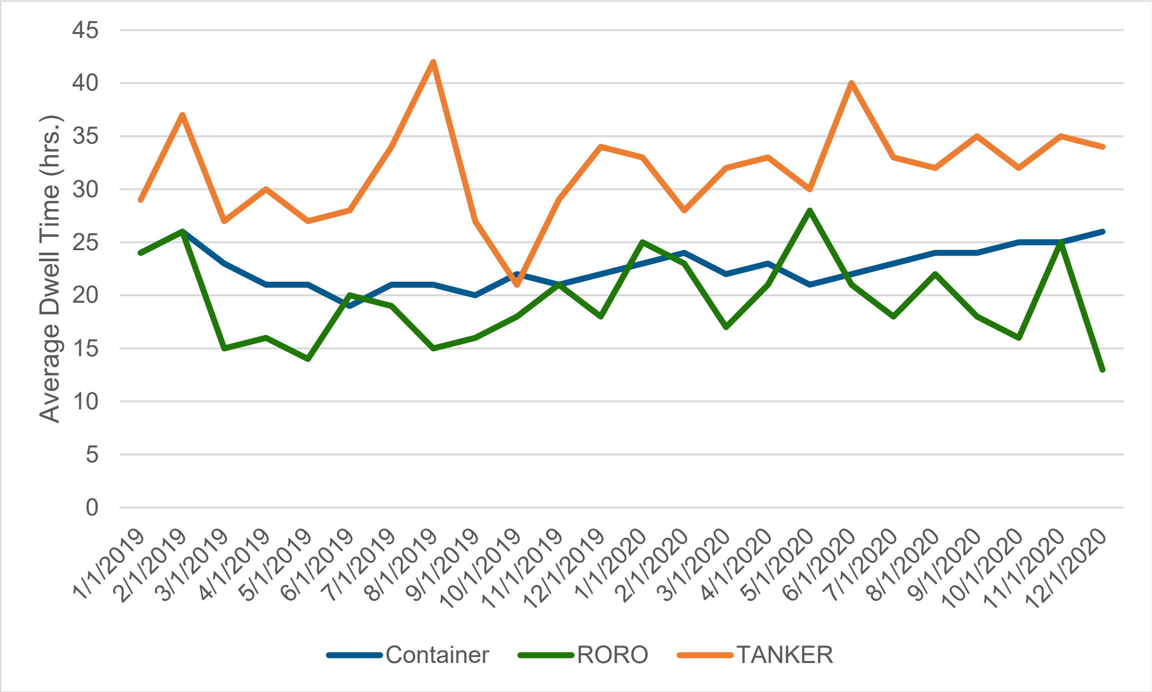


Source: Georgia Ports Authority.

Vessel Dwell Times

The amount of time a vessel spends in a port is a major factor contributing to cargo throughput and performance. Vessel dwell time reveals the amount of time a vessel spends at the port terminal. The Bureau of Transportation Statistics estimates dwell times at select U.S. ports for container, liquid bulk (tanker), and roll-on/roll-off (Ro/Ro) vessels using U.S. Coast Guard Automatic Identification System (AIS) data. Monthly average vessel dwell times by cargo type for 2019-2020 are shown for the Port of Savannah in Figure 5.29.

FIGURE 5.29 PORT OF SAVANNAH MONTHLY AVERAGE VESSEL DWELL TIME (HOURS), 2019-2020



Source: Bureau of Transportation Statistics, Port Performance Freight Statistics Program.

The data indicate that average vessel dwell times for container cargo has largely been consistent over the 2019-2020 time period, while dwell times for Ro/Ro and tanker vessels have greater fluctuation. Monthly average container vessel dwell times over the analysis period ranged from 20 to 26 hours with a 2020 annual average of 23.5 hours. For comparison, the 2020 average container vessel dwell time at the top 25 U.S. container ports was 28.1 hours[78]. The monthly average vessel dwell times for tankers ranged from 21 hours to as high as 42 hours. The 2020 annual average for the Port of Savannah was just over 33 hours which was less than the national average of about 41.4 hours[79]. In general, tanker dwell times are longer than container vessel dwell times most likely because it takes more time to pump petroleum and crude oil than to lift shipping containers from a vessel of similar size[80]. For Ro/Ro, the range over this time period was 14 to 28 hours with a 2020 annual average of about 20.5 hours. This was lower than the national average of about 23 hours in 2020[81].

Planned Capacity Investments

Georgia Ports Authority (GPA) has multiple ongoing and planned capacity investments for the Port of Savannah. These investments will increase the port's annual operating capacity from about 6 million TEUs to 10.7 million TEUs per year.[82] These investments include:

[78] https://data.bts.gov/stories/s/Container-Vessel-Dwell-Times/pbag-pyes

[79] https://data.bts.gov/stories/s/Tanker-Vessel-Dwell-Times/ari2-ub6a

[80] Ibid

[81] https://data.bts.gov/stories/s/Ro-Ro-Vessel-Dwell-Times/mu69-gcck

[82] Georgia Ports Authority, 2021 Annual Report.

- **Ship-to-Shore Cranes.** The Garden City Terminal will receive 8 additional ship-to-shore cranes. This will bring the terminal's total number of ship-to-shore cranes to 38.
- **Garden City Terminal West Expansion.** Garden City Terminal West opened in January 2022 with a new chassis yard. The 92-acre facility will be expanded to include a container yard with a capacity of 750,000 TEUs in 2024.
- **SR 21 Chassis Yard.** A 25-acre chassis yard is planned along SR 21.
- **Cross Dock Facility.** The Port of Savannah will add a transloading facility on a 90-acre parcel just upriver from Garden City Terminal. A cross-docking warehouse will be served by a yard with nine rubber-tired gantry cranes and an annual capacity of 400,000 TEUs.
- **Peak Capacity Project.** The project will add 1.2 million TEUs of annual capacity and includes three new rubber-tired gantry crane rows and 2,100 container slots. This project is located along SR 25 east of the Mason Mega Rail Terminal.
- **Berth 1 Improvements.** This project will add a new dock which will provide a new big ship berth. This will allow the Port of Savannah to simultaneously serve four 16,000-TEU vessels, and three additional ships. The Berth 1 Improvements project is expected to be completed in 2023.
- **Northeast Georgia Inland Port.** This project will develop an inland rail yard in Hall County. Providing a rail alternative for shippers in and near northeast Georgia can lower costs and help to relieve highway congestion. This project is expected to be completed in 2024.

Other projects represent major expansions to meet long-term demand. These include the proposed Savannah Container Terminal and the Jasper Ocean Terminal. The Savannah Container Terminal would be a new facility on Hutchinson Island and provide an additional 2.7 million TEUs of capacity.[83] The GPA has purchased 152 acres of land on the island for the Savannah Container Terminal and other future expansion needs.[84] The first phase of the proposed terminal is expected to be completed in 2025.

Though located in South Carolina, the proposed Jasper Ocean Terminal would represent a major expansion in capacity for the Port of Savannah.[85] The proposed Jasper Ocean Terminal includes the construction and operation of a marine container terminal on an approximately 1,500-acre site along the north bank of the Savannah River in Jasper County, South Carolina – about 8 miles upriver from the Garden City Terminal. One of the primary motivations for Jasper Ocean Terminal are capacity limitations at existing Georgia Ports Authority and South Carolina Ports Authority assets. Development of the Jasper Ocean Terminal would provide an additional 7 million TEUs of capacity to both states. In 2008, the Joint Project Office (JPO) for the Jasper Ocean Terminal was created under an Intergovernmental Agreement between South Carolina and Georgia and purchased the 1,500-acre site from GDOT.

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[83] https://gaports.com/press-releases/gpa-details-capacity-operations-expansion/
[84] https://gaports.com/timeline/hutchinson-island-land-purchased/
[85] http://www.jasperoceanterminaleis.com/Project.aspx

5.5 Air Cargo

Air cargo has a significant role in the multimodal freight network as it provides the fastest service for long-distance shipments of goods. The high service quality provided by air cargo results in higher shipping costs for this mode. As a result, air cargo tends to be limited to high-value and low-weight goods such as medical supplies, flowers, and electronics. This section of the report describes the condition and performance of air cargo assets in the Savannah region. It also identifies major cargo carriers and cargo handling airports throughout the region.

Inventory of Assets

There are seven airports in the 3-county region. These include Cypress Lake, Swaids Field, Hodges Airpark, Briggs Field, and Briar Patch which are privately owned and do not handle cargo. Savannah-Hilton Head International Airport (SAV) is the only public airport and the only one that handles cargo in the region. Dedicated cargo carriers at SAV include Air Cargo Carriers, Federal Express (FedEx), Martinaire Aviation, Sky Way Enterprises, and Suburban Air Freight.[86,87] In total, there is about 138,000 square feet of air cargo warehouse space at SAV.[88] This includes an approximately 80,000-square foot general cargo building open to all carriers as well as an approximately 58,000-square foot air cargo facility dedicated to a single tenant. Both facilities are along Bob Harmon Road which is accessed by SR 307/Dean Forest Road. As air cargo is typically interchanged with highway freight, SAV impacts these and surrounding roadways by generating truck traffic to and from its air cargo facilities.

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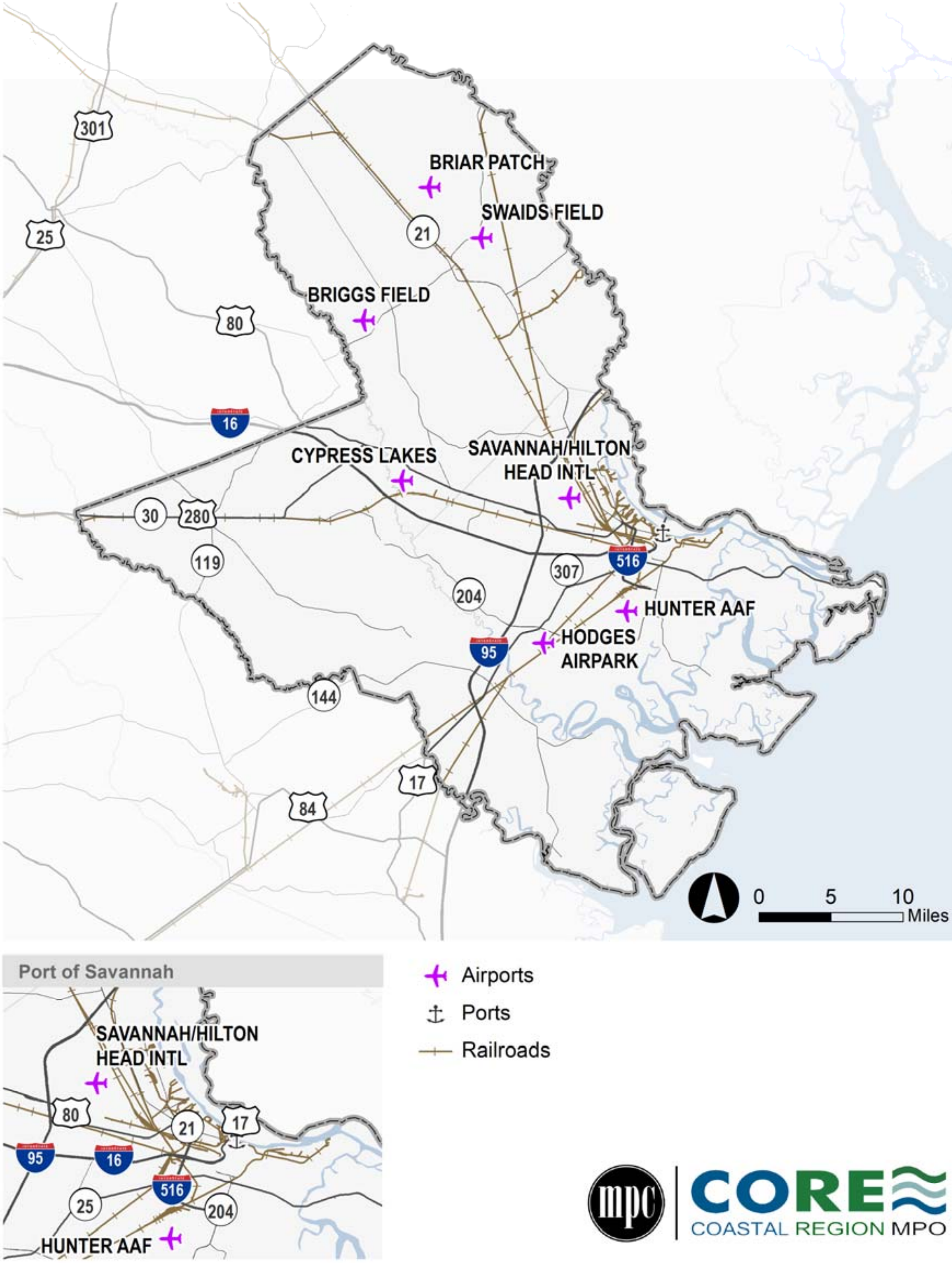
[86] Savannah-Hilton Head International Airport, *Comprehensive Annual Financial Report*, 2020, https://savannahairport.com/wp-content/uploads/2021/07/Savannah-Airport-Commission-2020-Comprehensive-Annual-Financial-Report.pdf .

[87] http://savannahairport.com/about/general-aviation

[88] Savannah/Hilton Head International Airport Short-Term Development Program Draft Environmental Assessment, November 2019, https://savannahairport.com/wp-content/uploads/2019/11/191111_SAV-Short-Term-CIP-Draft-EA_rev1a_2s_rfs.pdf

FIGURE 5.30 AIRPORTS IN THE STUDY AREA, 2022

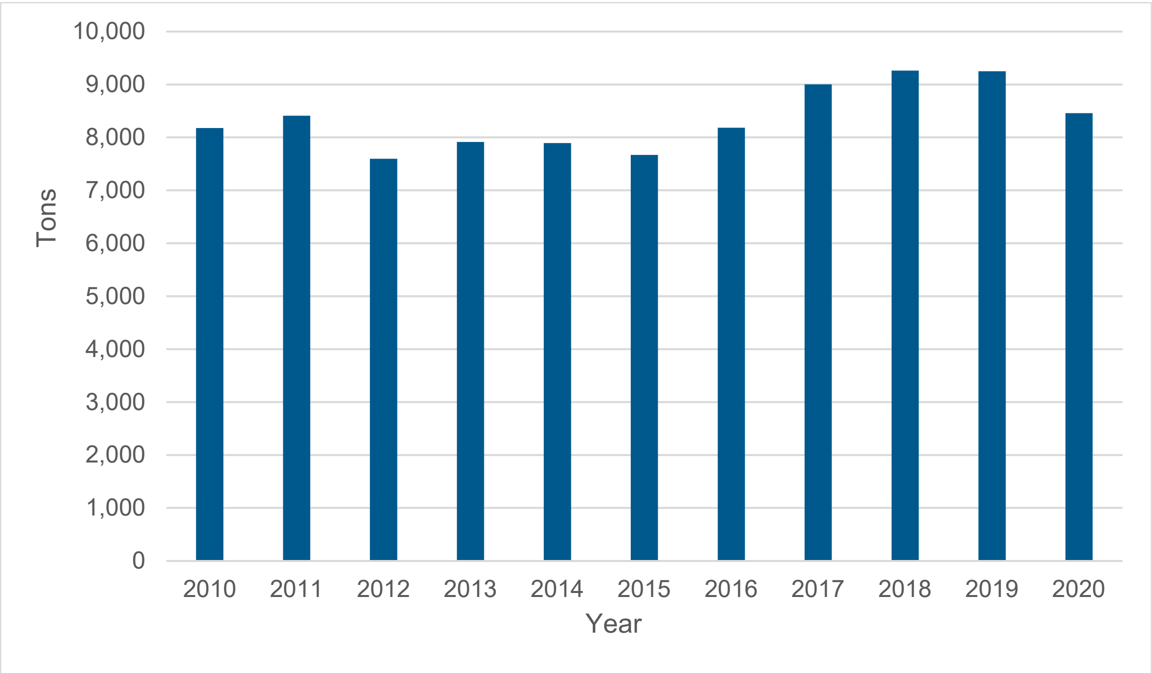


Source: Bureau of Transportation Statistics, National Transportation Atlas Database, 2022.

Conditions and Performance

Throughput is an important indicator of air cargo performance and is measured by the annual tonnage served by an airport. Figure 5.2 presents historical data on tonnage served by SAV for 2010- 2020. Air cargo usage exceeded 8,000 tons in 2010 and 2011 before experiencing significant decline over the 2012 to 2015 time period. Air cargo usage recovered to pre-2012 levels in 2016 as the 8,000-ton threshold was exceeded. Overall, throughput is largely stable over the analysis period as values range from a low of 7,595 tons in 2012 and a peak of 9,262 in 2018. The 2010-2020 average was about 8,346 tons.

FIGURE 5.31 AIR CARGO TONNAGE AT SAV, 2010-2020



Source: Savannah-Hilton Head International Airport Annual Reports, 2010-2020.

In 2020, the Savannah-Hilton Head International Airport had a throughput of about 0.06 tons of cargo per square foot of warehouse space. As a point of comparison, in 2020 throughput at the Hartsfield-Jackson Atlanta International Airport (which processed about 660,482 short tons of cargo in 2020[89] and has approximately 1.3 million square feet of warehouse space[90]) was 0.51 tons of cargo per square foot of warehouse space. This implies that current warehouse facilities could handle substantially more demand.

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89 https://www.atl.com/business-information/statistics/

90 Hartsfield-Jackson Atlanta International Airport, http://www.atl.com/about-atl/atl-factsheet/.

6 FREIGHT NETWORK CONGESTION, BOTTLENECK, SAFETY AND SECURITY ISSUES

Section 6 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 section:

- **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.
- **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.

6.1 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 of 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.

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

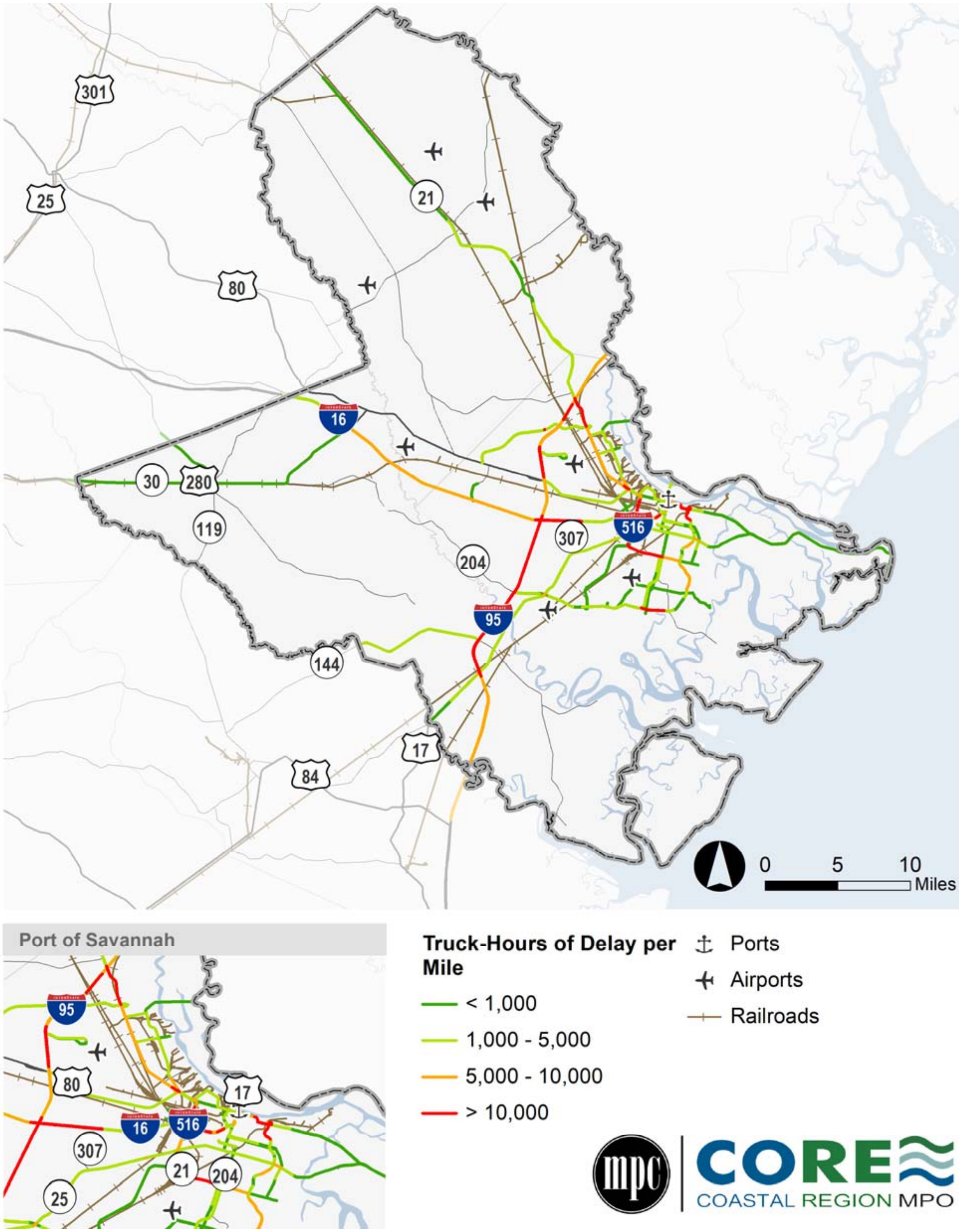
Annual Truck Hours of Delay per Mile was calculated using the 2021 NPMRDS travel time data as follows:

- 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.[91] 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 6.1. 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.

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

FIGURE 6.1 TRUCK-HOURS OF DELAY PER MILE

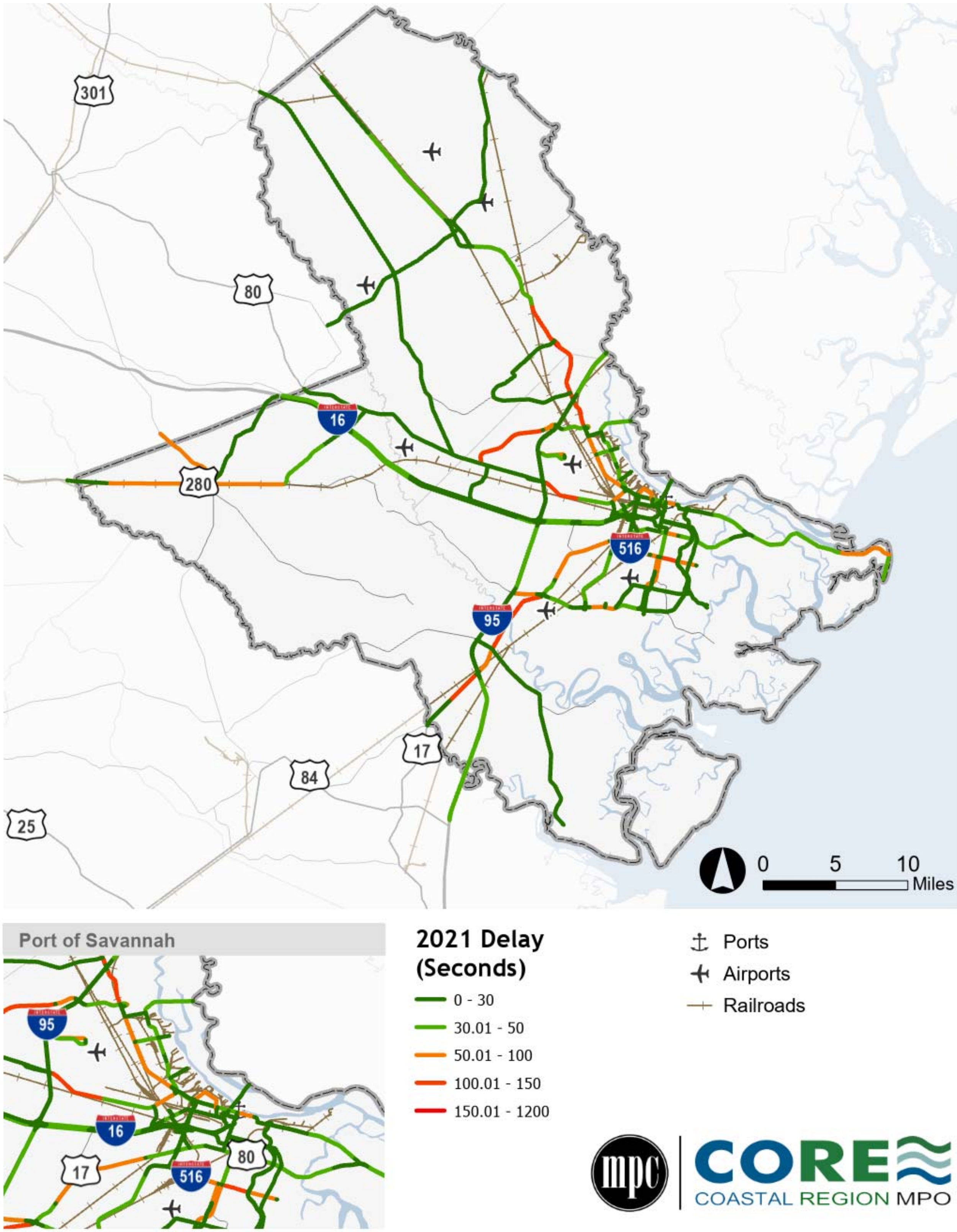


Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

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 6.2, 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 6.2 AVERAGE DAILY TRUCK DELAY, 2021



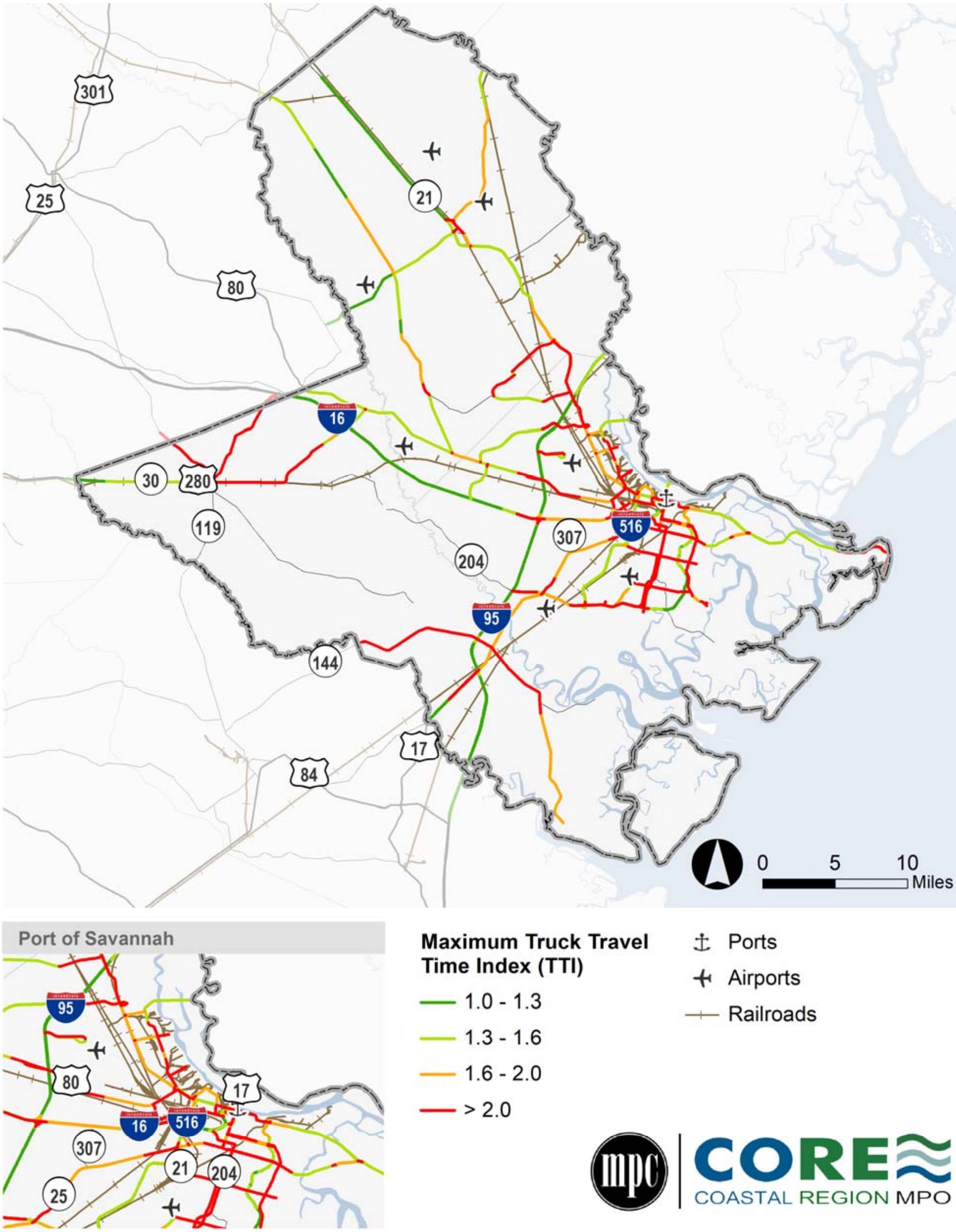
Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

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 (see Figure 6.3 and Table 6.1). 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 6.3 TRUCK TRAVEL TIME INDEX, 2021



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

TABLE 6.1 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 6.2 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 6.2 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

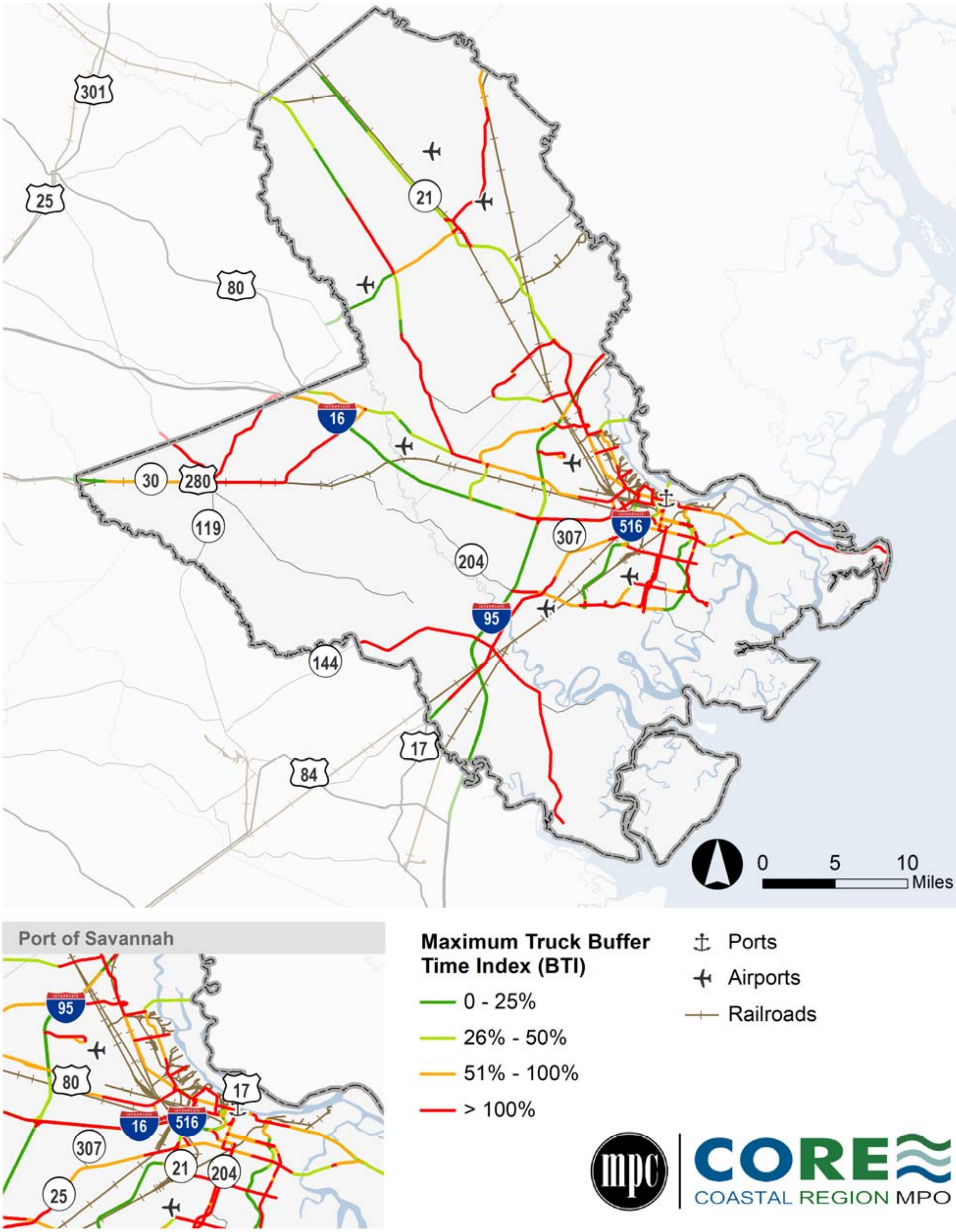
An analysis was also done to gauge truck travel time reliability in the CORE MPO region. In general, measures of reliability gauge the variability of travel times between peak and non-peak periods. Roadway segments with highly variable travel times are deemed less reliable than those with more consistent 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 (see Figure 6.4 and Table 6.3). 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 6.4 TRUCK BUFFER TIME INDEX, 2021



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

TABLE 6.3 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 6.4 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 6.4 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%

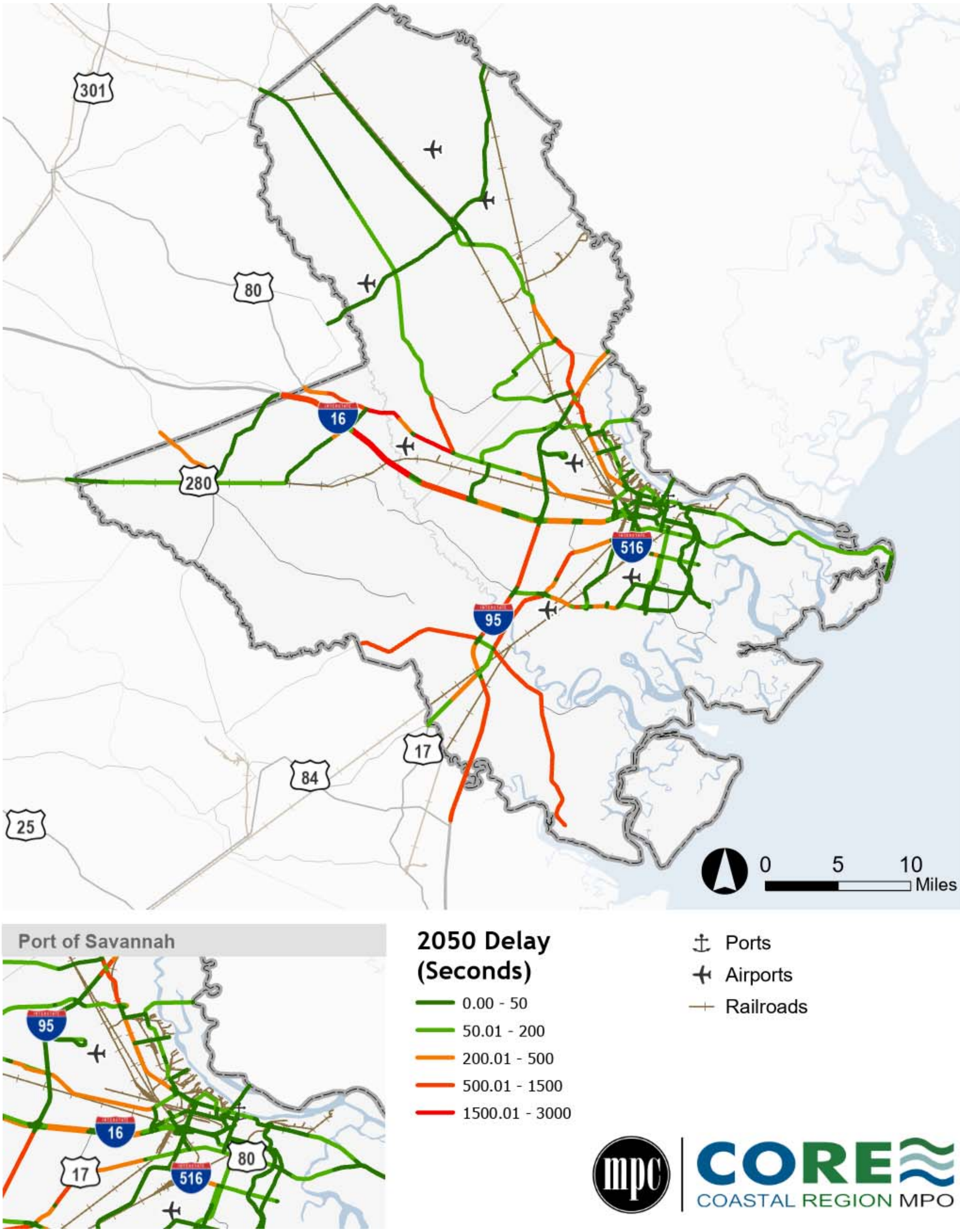
Source: National Performance Management Research Data Set, 2021; AECOM; Cambridge Systematics.

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 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 6.5 which is the summation of delay across each segment. 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 3,000 seconds.

FIGURE 6.5 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 6.6 shows the results of this analysis while Figures 6.7 to 6.9 depict the freight routes. Overall, the results imply substantial increases in truck delay. However, it should be noted that there are current projects on these routes that will mitigate growth in delay. Specifically, the “16@95” project is scheduled to be completed in 2023 and, among other improvements, includes: widening I-16 from two to three lanes; adding a collector-distributor lane on I-95 northbound; and installing intelligent transportation system (ITS) technology, including cameras, and changeable message signs to provide real-time driving conditions.

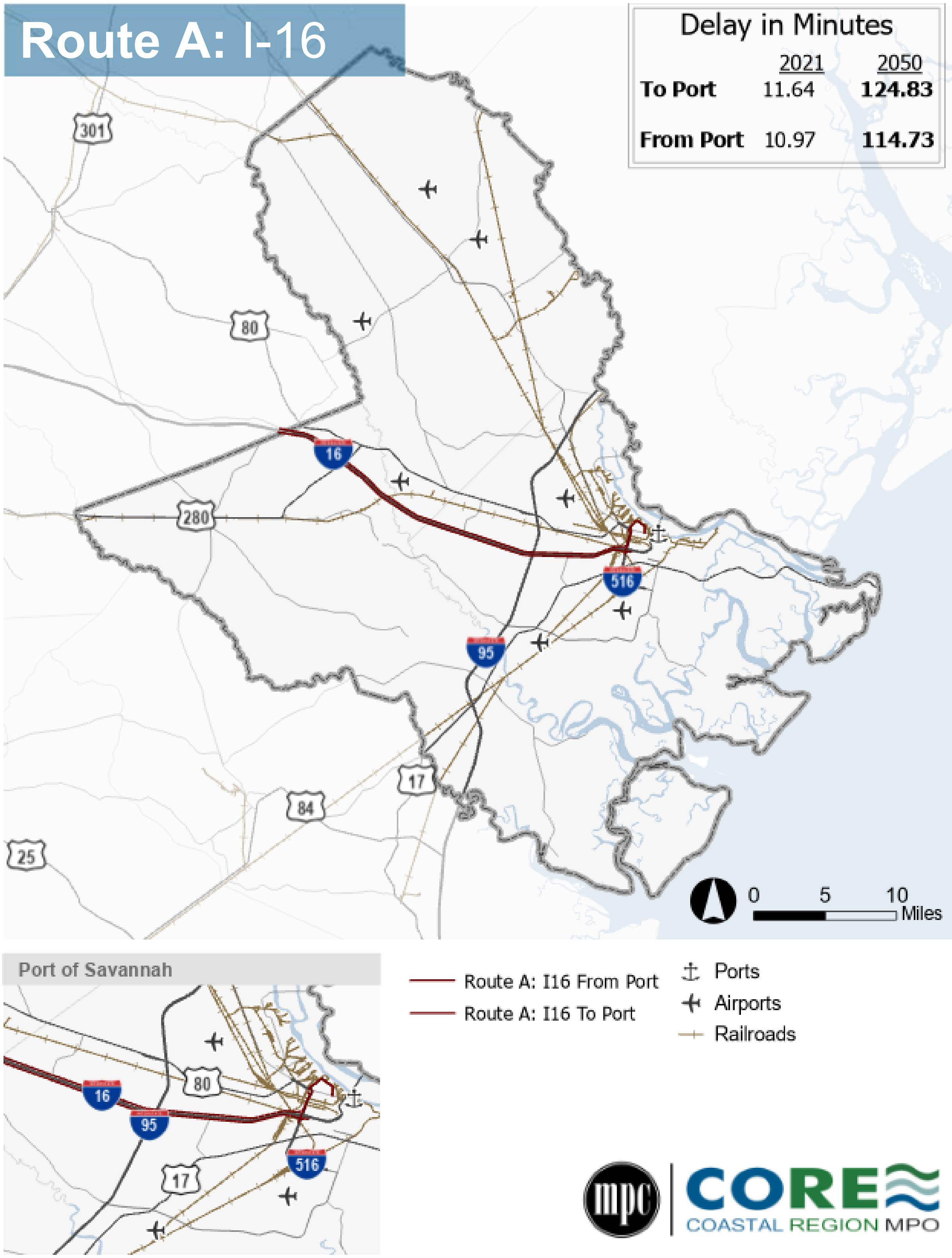
FIGURE 6.6 2050 TRUCK DELAY ON PRIMARY FREIGHT ROUTES

Delay in Minutes

	Route A: I-16		Route B: I-516, Veterans Pkwy., and I-95		Route C: SR 21 and SR 25	
	2020	2050	2020	2050	2020	2050
To Port	**15.35**	**131.96**	**14.61**	**68.51**	**24.26**	**78.98**
From Port	**15.5**	**122.49**	**15.25**	**73.92**	**23.93**	**68.58**

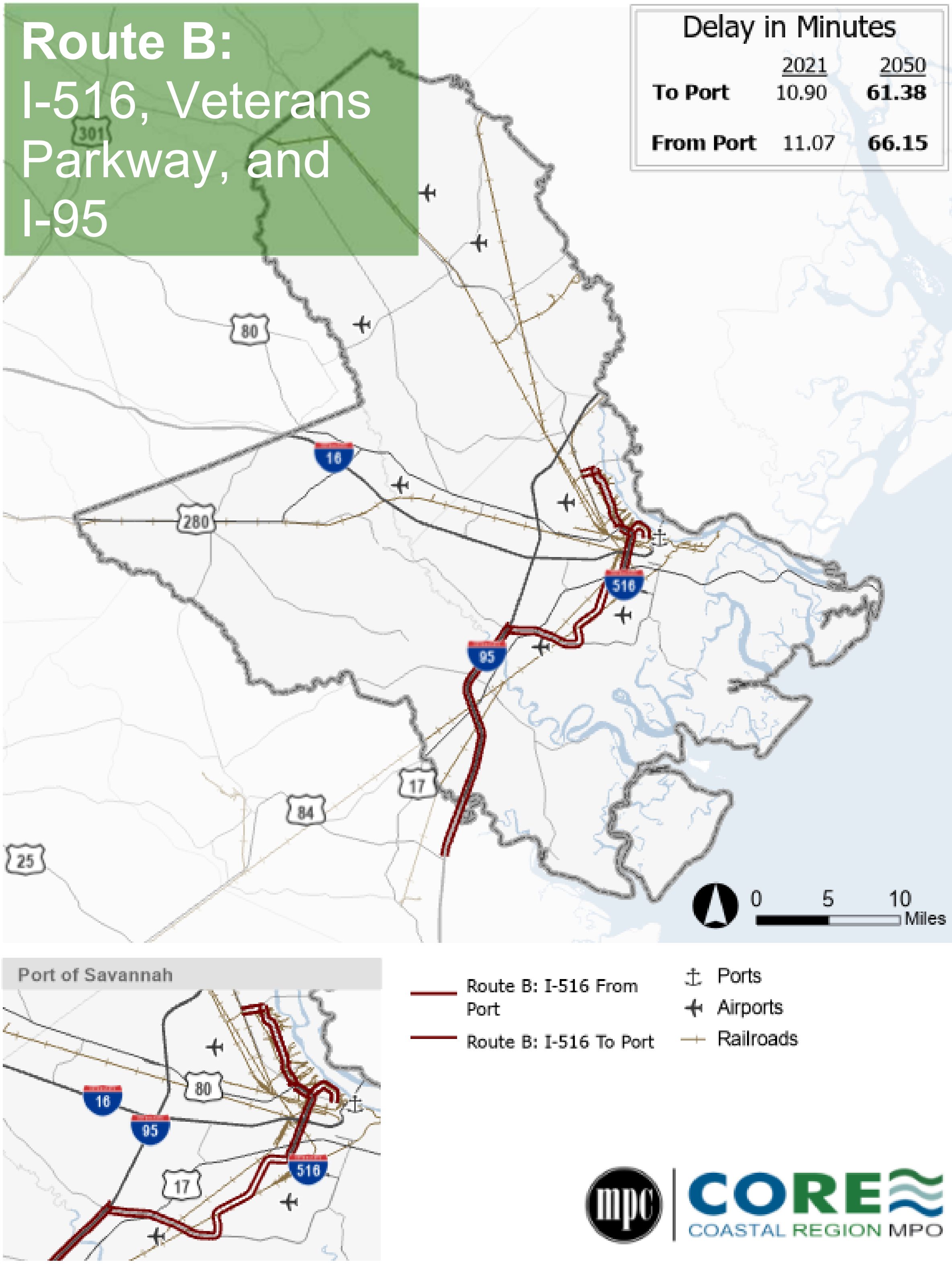
Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

FIGURE 6.7 2050 TRUCK DELAY – I-16 CORRIDOR



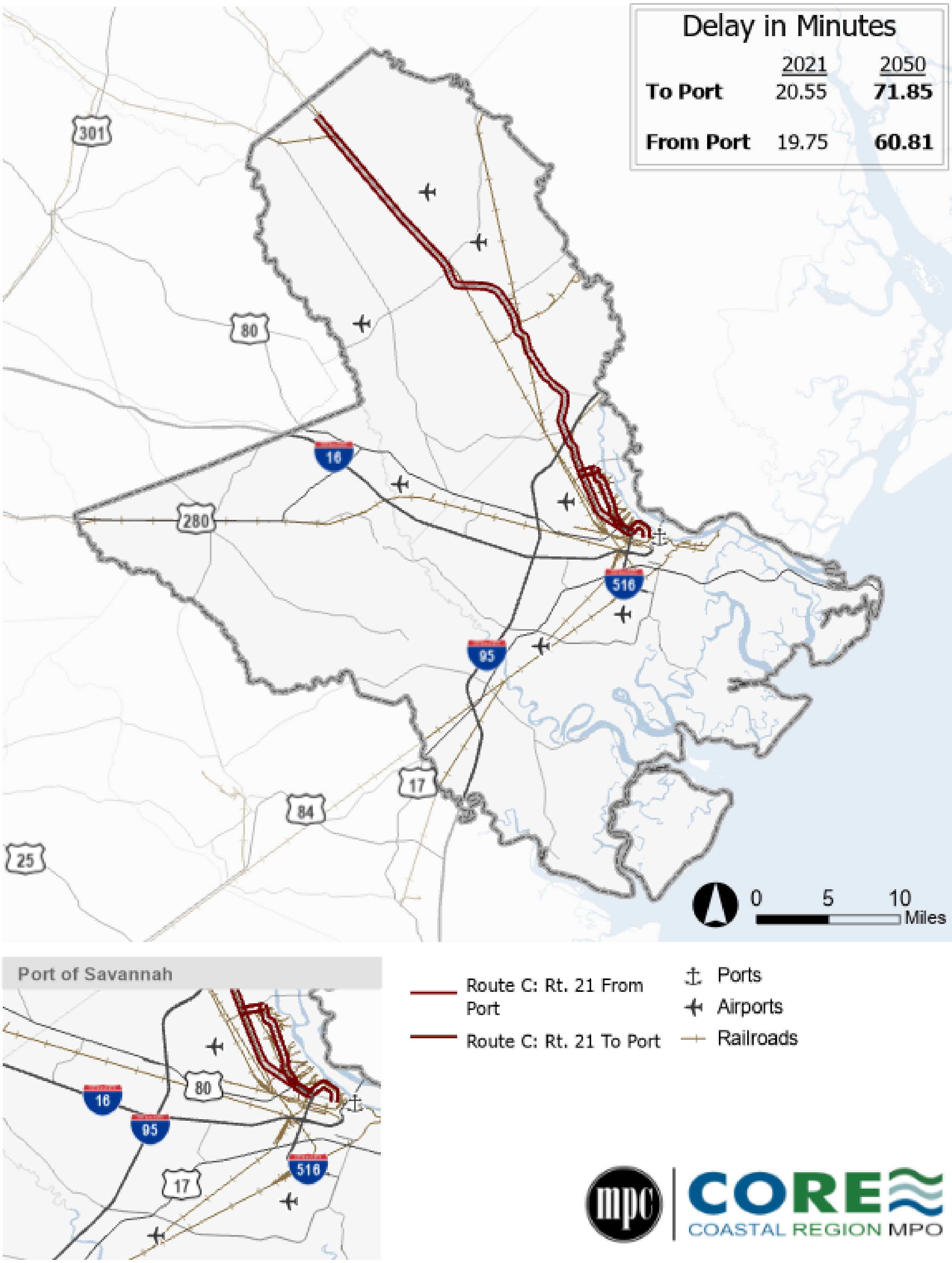
Source: National Performance Management Research Data Set, 2021; CORE MPO Travel Demand Model; AECOM.

FIGURE 6.8 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 6.9 2050 TRUCK DELAY - SR 21 CORRIDOR



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

Potential Solutions for Freight Congestion and Reliability Issues

Given the findings from the bottleneck analysis, there is an opportunity to consider operational and low cost "spot-specific" fixes or improvements at high congestion stretches, at the "corridor level", of the road network to ease congestion and reduce overall truck travel times. However, it is important to note that the focus of the bottleneck analysis was not on localized areas of the road network to identify each bottleneck cause. Instead, the analysis was performed at the macro level and the network's overall signature trigger – the peak hour conditions which have proven to induce bottlenecks due to the over-demand of volume. Accordingly, the potential solutions discussed here for addressing bottlenecks are also identified at the macro level. As part of the Regional Freight Plan's recommendations, opportunities will be identified for more detailed research and analysis in order to make location and context specific solutions for mitigating bottlenecks.

Recurring predictable bottlenecks and delays in traffic are accentuated along major freight routes like I-16 (Route A), I-516, Veterans Pkwy and I-95 (Route B), and SR 21 and SR 25 (Route C) for future conditions up to 2050. There are likely multiple contributing factors to truck travel time delay along these routes, such as the design of certain ramps, merges, underpasses, or narrow lanes, to name a few. Several mitigation strategies could be implemented to address these challenges that do not include expanding capacity, as it will become increasingly challenging and expensive to add new capacity (e.g., truck only toll lanes[92]) given the region's economic and population growth. Therefore, operational and congestion mitigation strategies will be important for addressing the region's bottlenecks. Potential operational strategies include frontage roads, ramp metering, vehicle tracking via automatic vehicle locating (AVL) systems, improving merge areas and ramps (e.g., widening, extending, or consolidating where appropriate), and allowing for the use of shoulder lanes.

Specific to bottlenecks associated with at-grade rail crossings and trucks serving the Port of Savannah, the region could work with GDOT and other state, federal, and regional partners to expand existing intelligent transportation systems (ITS) capabilities for diverting trucks away from port gates that are blocked by trains stopped at at-grade crossings. GDOT currently has this capability along Jimmy Deloach Pkwy. and SR 21 using dynamic message signs (DMS), video detection systems, and other ITS field devices. In coordination with the planned City of Savannah Traffic Control Center[93], this capability could be extended to non-state routes with at-grade crossings that are proximate to the port. Future improvements to the system could also explore an optimization component that provides roadway users with predictions of the potential duration of at-grade crossing blockages based on historic train operations.

[92] David Forkenbrock and Jim March, "Issues in The Financing of Truck-Only Lanes", FHWA, accessed on January 27, 2022, https://highways.dot.gov/public-roads/septemberoctober-2005/issues-financing-truck-only-lanes

[93] GDOT Project ID 0017973, https://www.dot.ga.gov/applications/geopi/Pages/Dashboard.aspx?ProjectID=0017973

6.2 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.

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 6.5 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 6.5 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 6.6. 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 6.7, 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 6.6 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 6.7 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%**

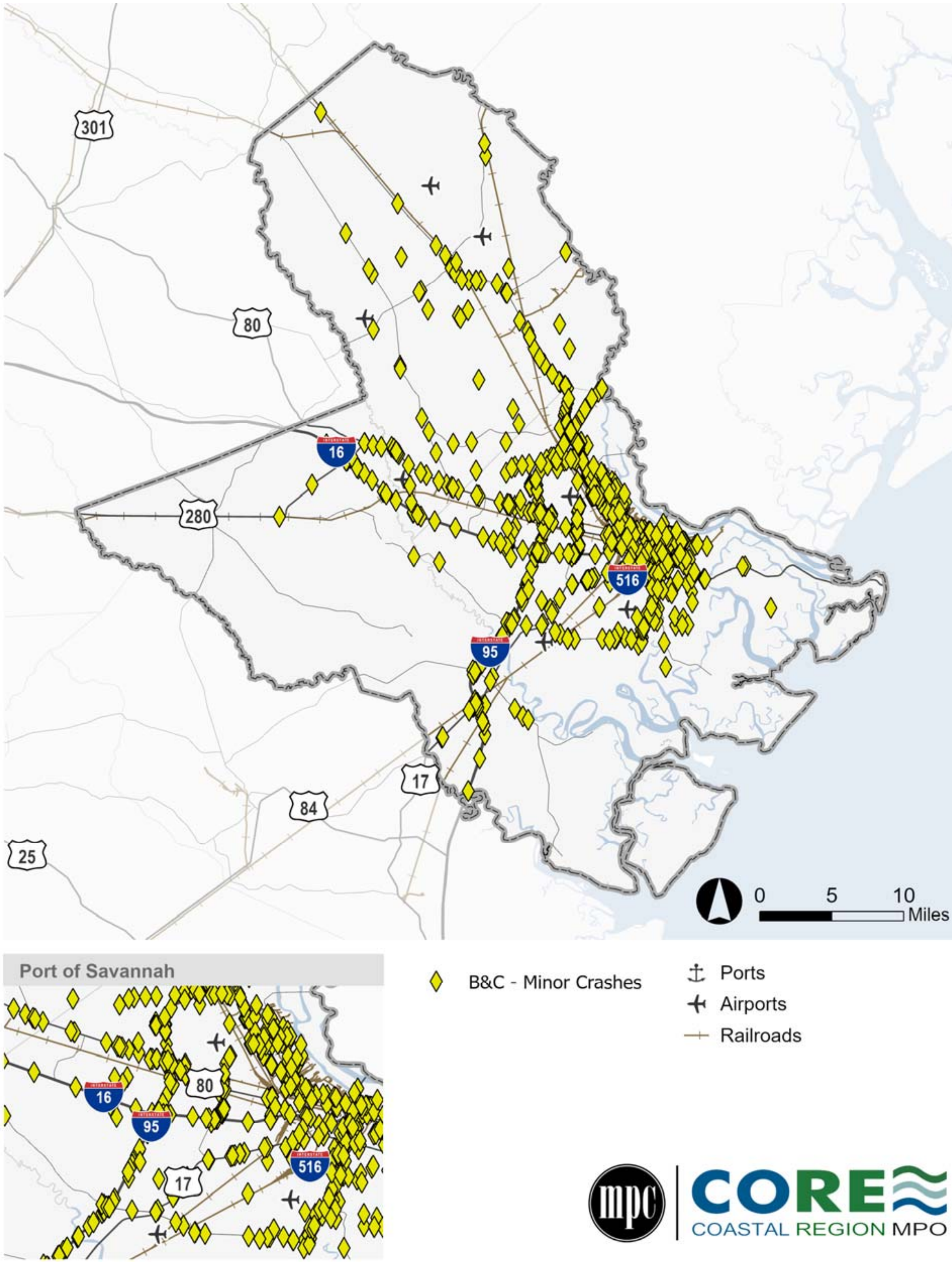
KABCO Severity of Crashes in Effingham							
	2016	2017	2018	2019	2020	2016 - 2020 Total	% Share
(A) Suspected Serious Injury	2	1	5	2	5	15	5%
(B) Suspected Minor/Visible Injury	7	13	12	7	5	44	15%
(C) Possible Injury / Complaint	16	10	11	8	11	56	19%
(K) Fatal Injury	3	1	0	0	2	6	2%
(O) No Injury	39	32	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.

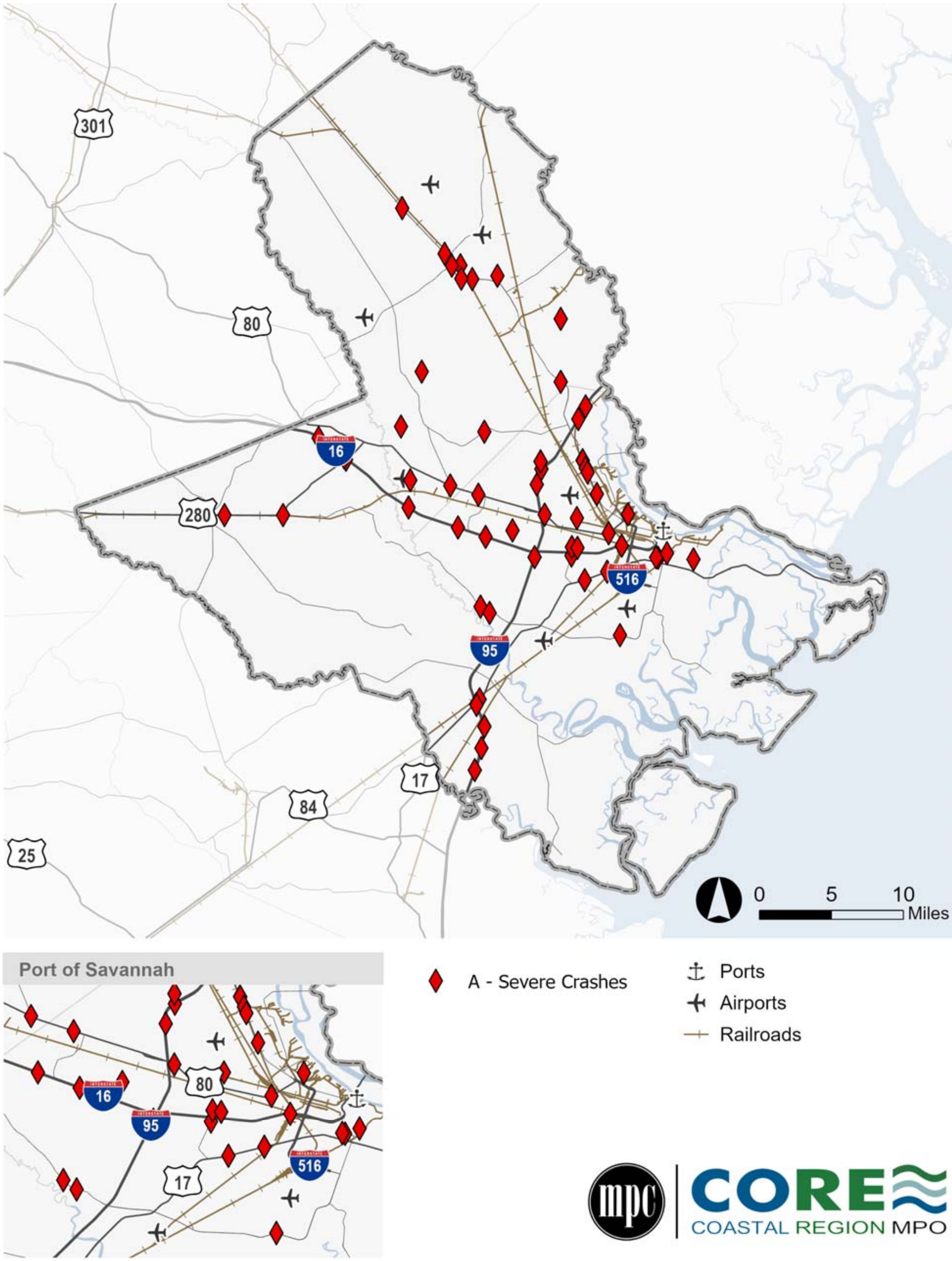
Figures 6.10 to 6.12 show the locations of minor injury (B and C), severe injury (A), and fatal injury (K) truck-involved crashes. While minor and (to a lesser extent) severe injury truck-involved crashes are broadly distributed across the region’s highway network, fatal injury crashes appear to have 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 6.10 MINOR INJURY TRUCK-INVOLVED CRASHES, 2016 - 2020



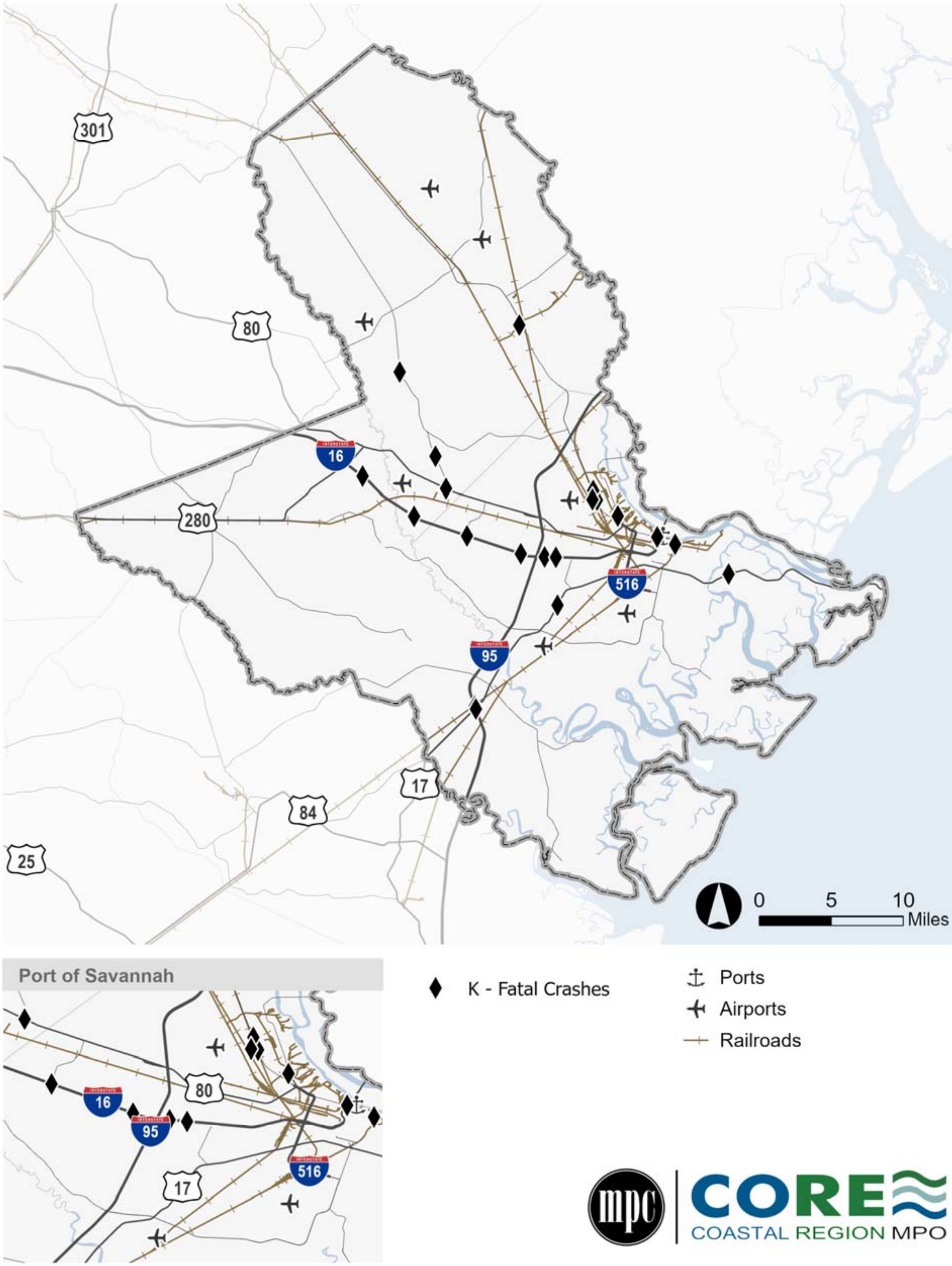
Source: GDOT Numetrics Database; AECOM.

FIGURE 6.11 SEVERE INJURY TRUCK-INVOLVED CRASHES, 2016 - 2020



Source: GDOT Numetrics Database; AECOM.

FIGURE 6.12 FATAL INJURY TRUCK-INVOLVED CRASHES, 2016 - 2020

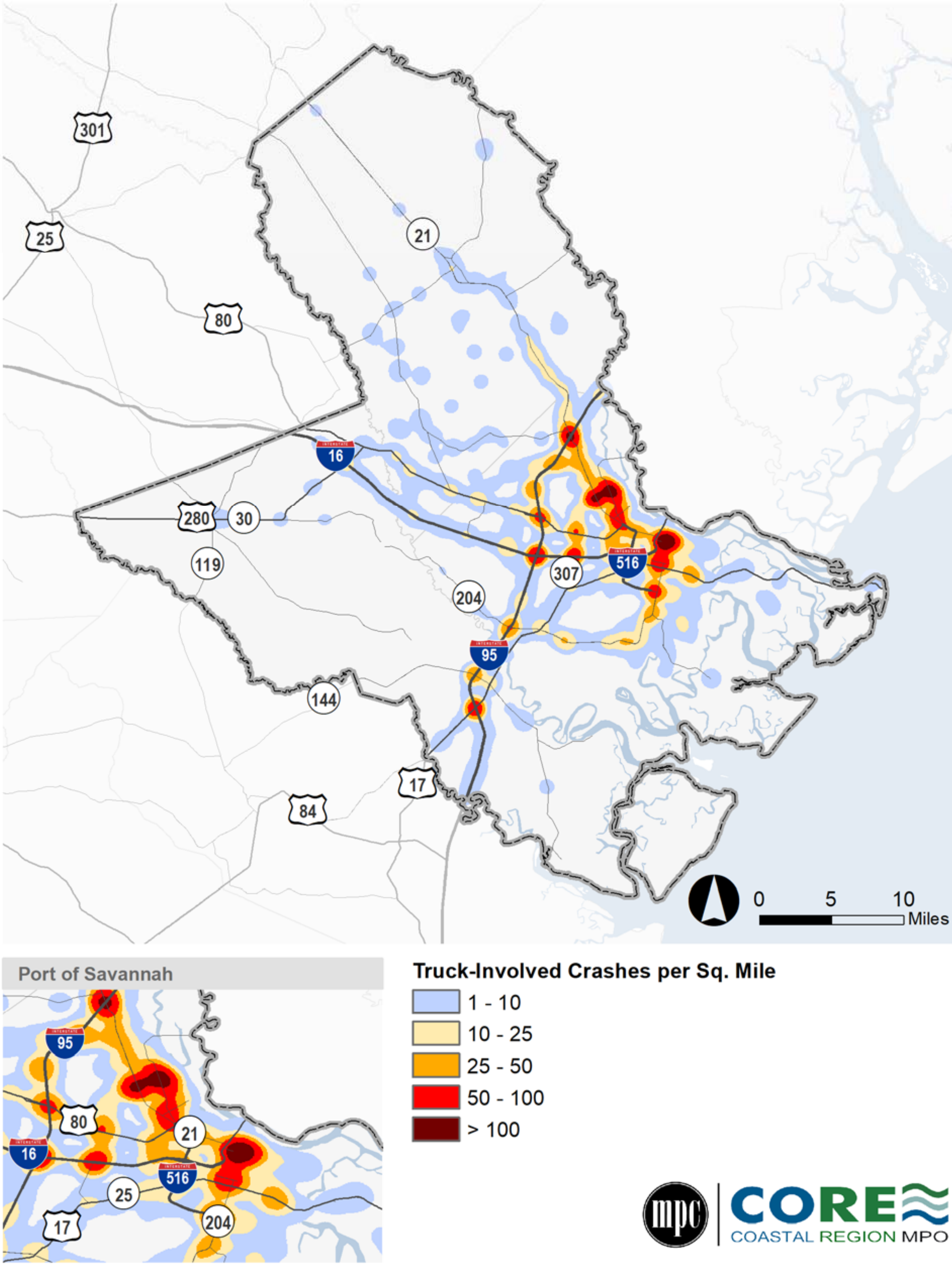


Source: GDOT Numetrics Database; AECOM.

Figure 6.13 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 6.13 HEAT MAP OF TRUCK-INVOLVED CRASHES, 2016 - 2020

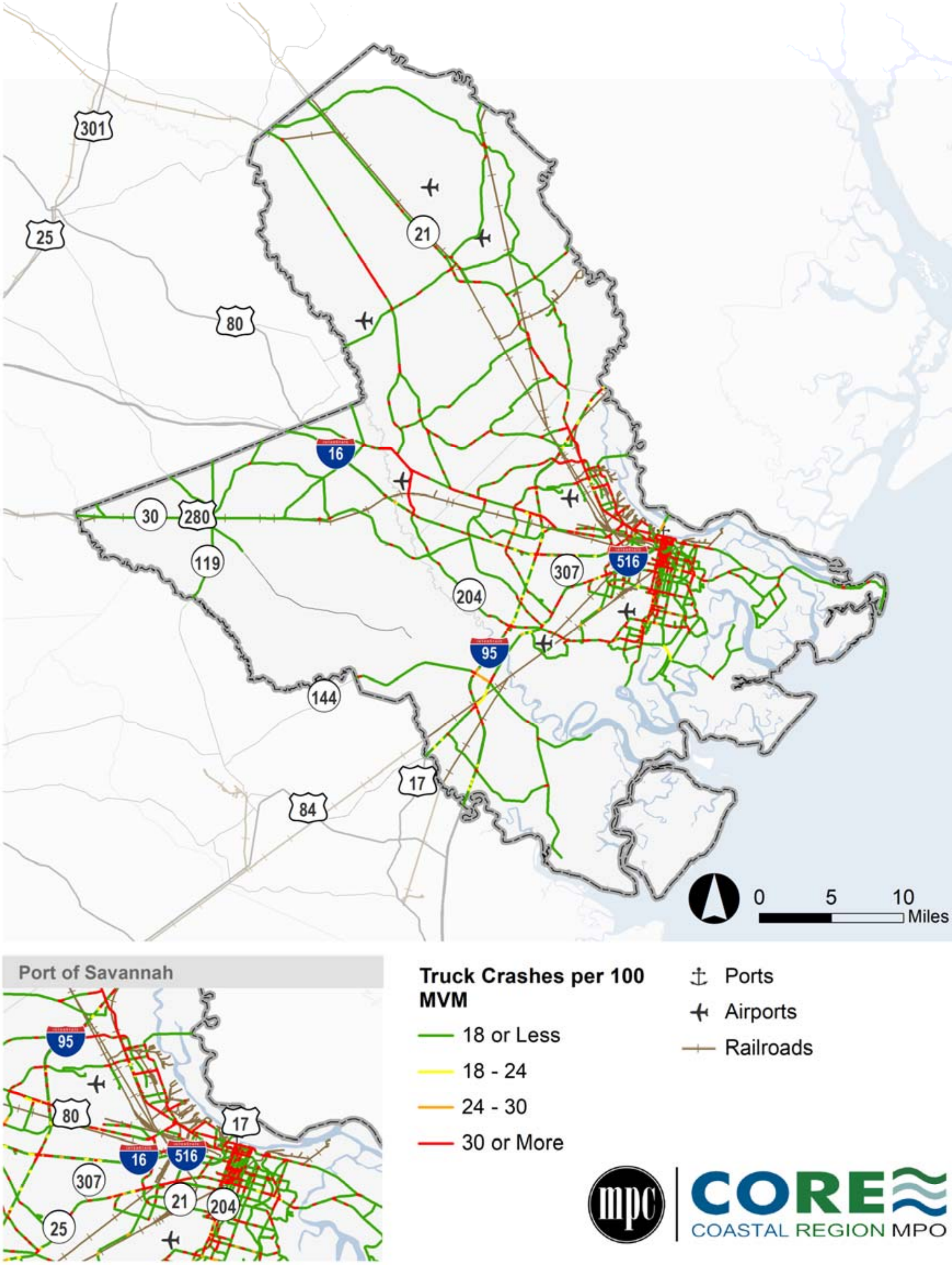


Source: GDOT Numetrics Database; AECOM.

Figure 6.14 and Figure 6.15 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.

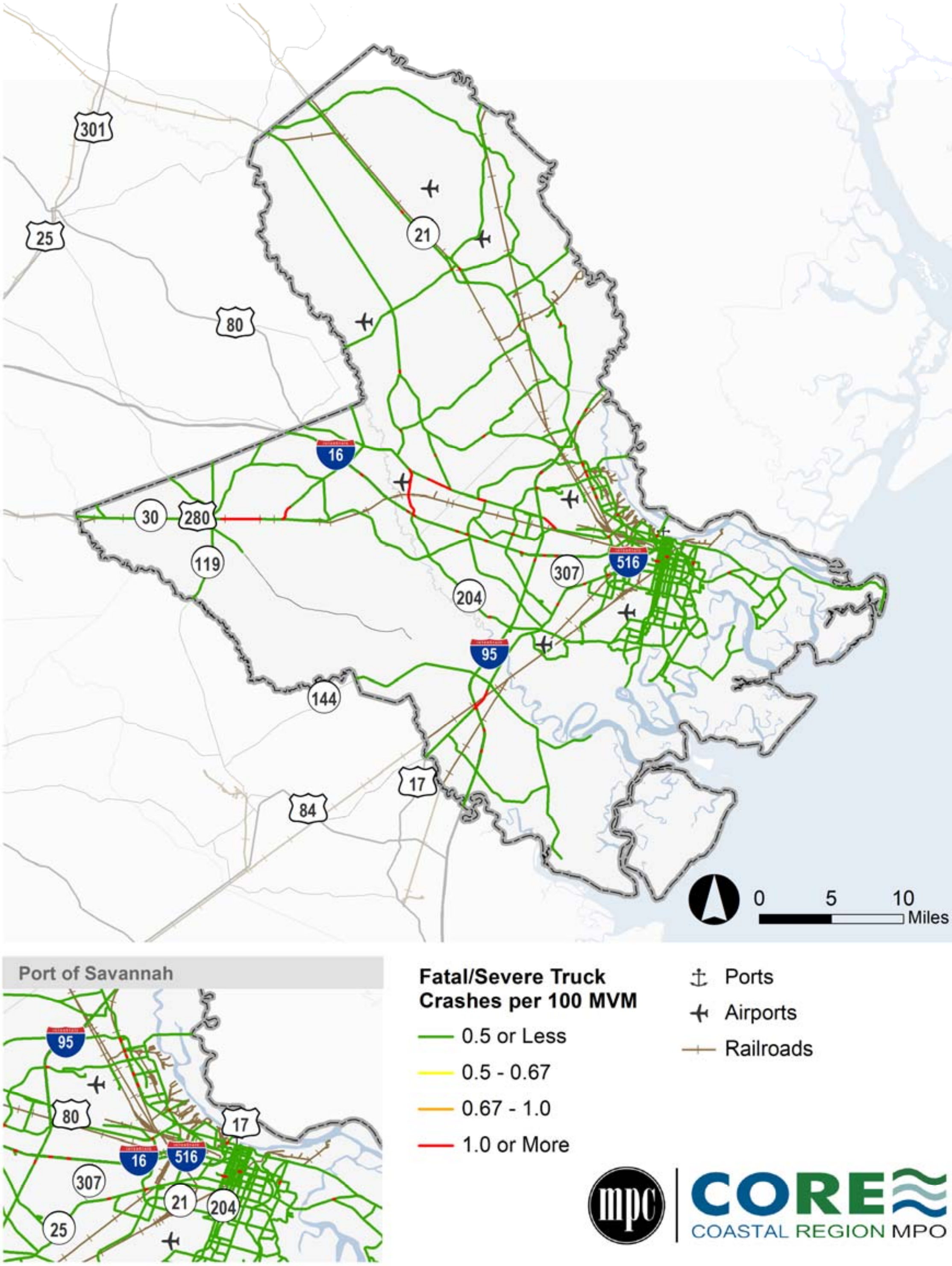
Overall, the results indicate that corridors that exceed the regional average truck crash rate are concentrated in the urban core of the region and along the Savannah River. For corridors in downtown Savannah, the truck-involved crash rates are likely being driven by box trucks and smaller delivery vehicles 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 6.14 ANNUAL AVERAGE TRUCK-INVOLVED CRASH RATE, 2016 - 2020



Source: GDOT Numetrics Database; AECOM; Cambridge Systematics.

FIGURE 6.15 ANNUAL AVERAGE FATAL OR SEVERE TRUCK-INVOLVED CRASH RATE, 2016 - 2020

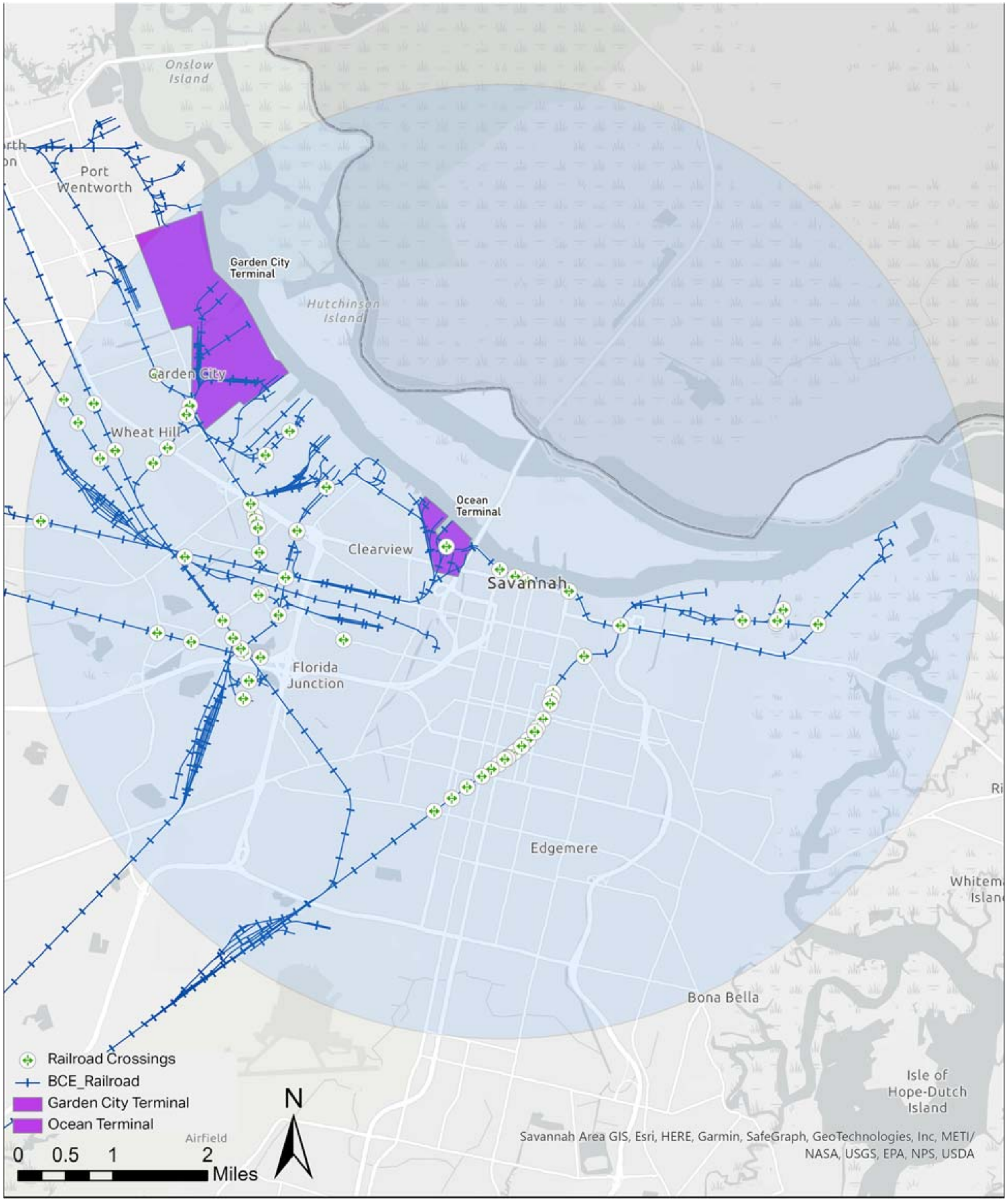


Source: GDOT Numetrics Database; AECOM; Cambridge Systematics.

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 6.16. 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 6.16 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 6.8. 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 6.8 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 6.9. 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 6.9, 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 6.9 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 6.10 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 6.10 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 6.11, 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 6.11 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 6.12. 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 6.17. However, when incidents per crossing are considered, SAPT remains highest at 283 percent followed by CSXT at 15 percent. Figure 6.18 depicts the locations of the 62 highway-rail incidents that occurred between 2012 and 2021 within the region and Figure 6.19 shows the severity of these incidents.

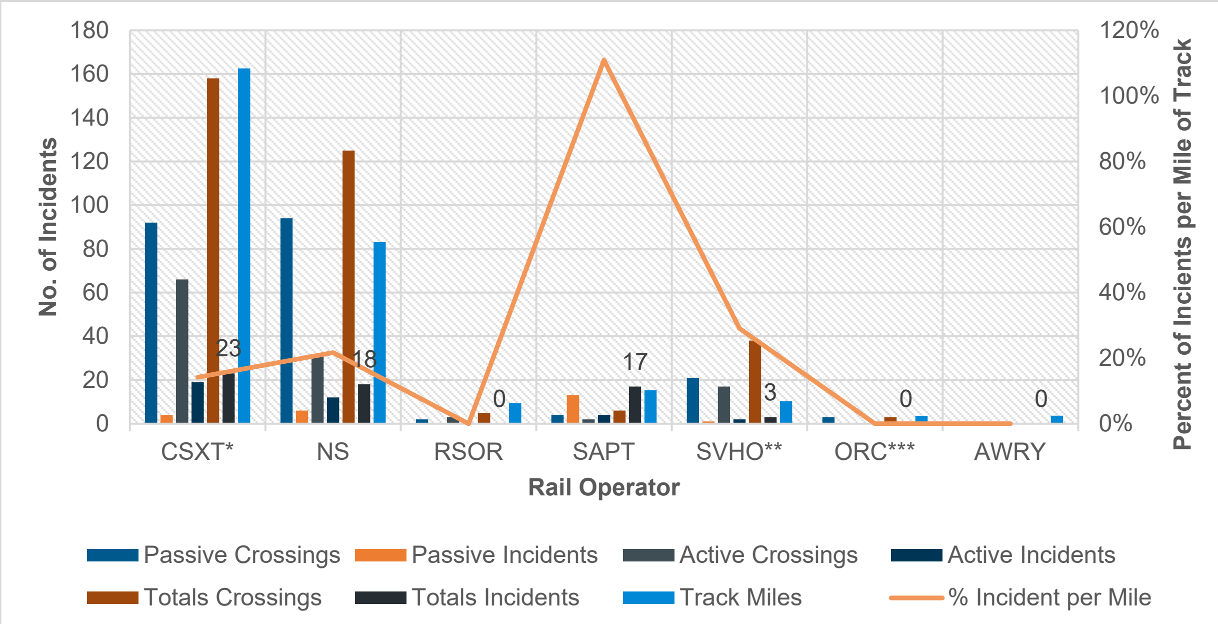
TABLE 6.12 REGION-WIDE HIGHWAY RAIL CROSSING INCIDENTS BY OPERATOR, 2012-2021

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.

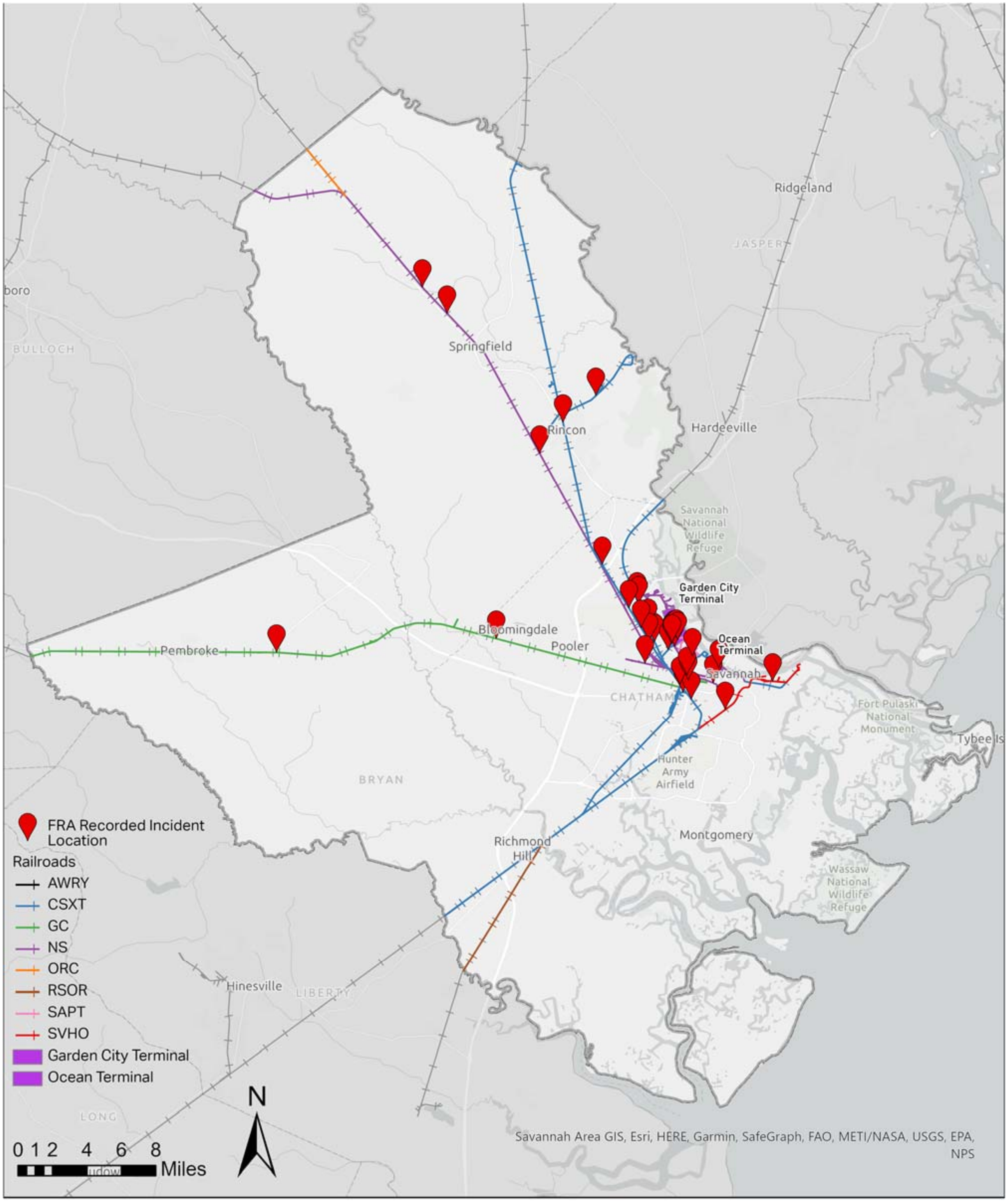
FIGURE 6.17 REGION-WIDE HIGHWAY-RAIL CROSSING INCIDENTS BY OPERATOR, 2012 - 2021



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

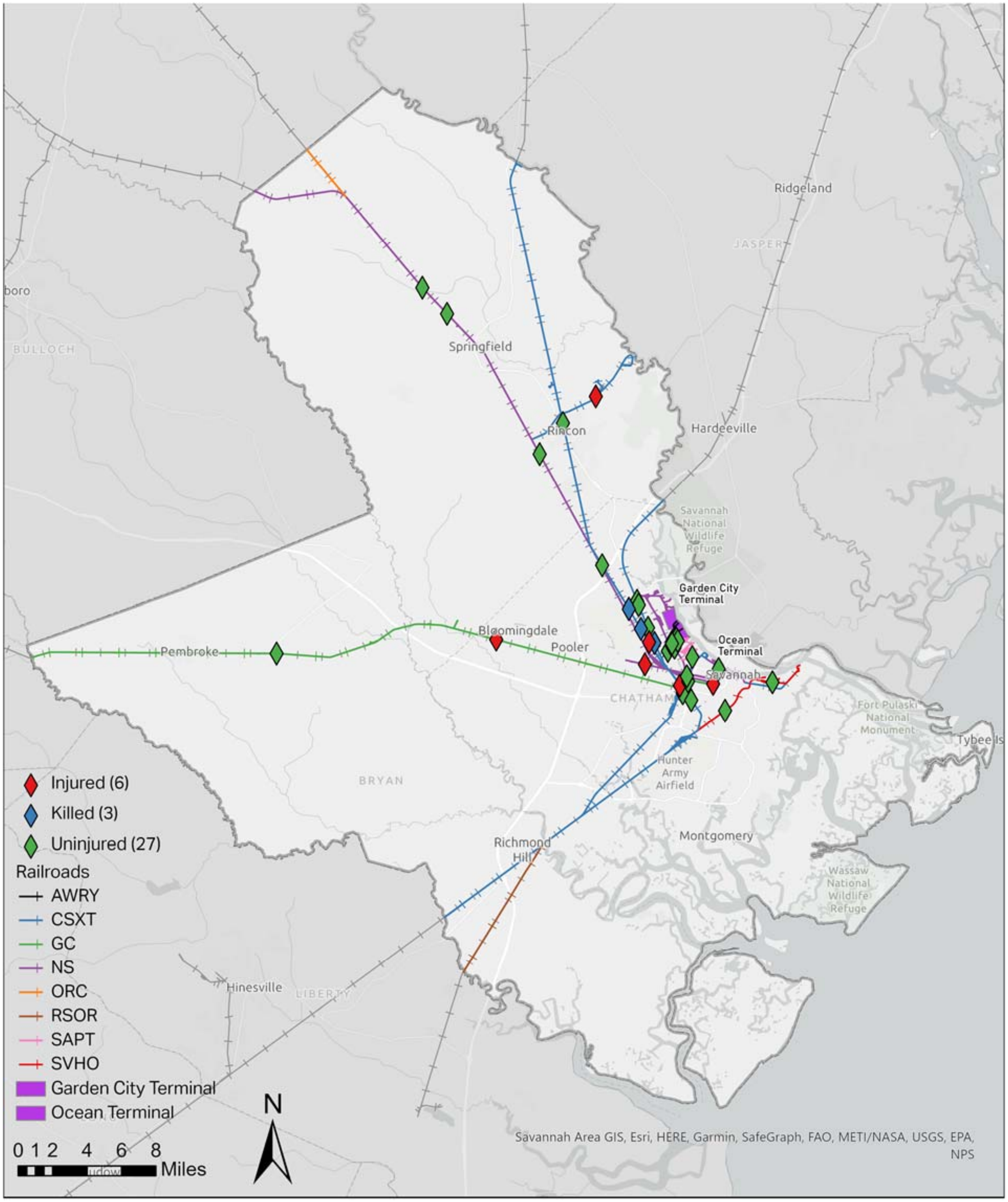
Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

FIGURE 6.18 REGION-WIDE HIGHWAY-RAIL CROSSING INCIDENTS, 2012 - 2021



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

FIGURE 6.19 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 2021 and within the study area is summarized in Table 6.13 and depicted graphically in Figure 6.20. 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.

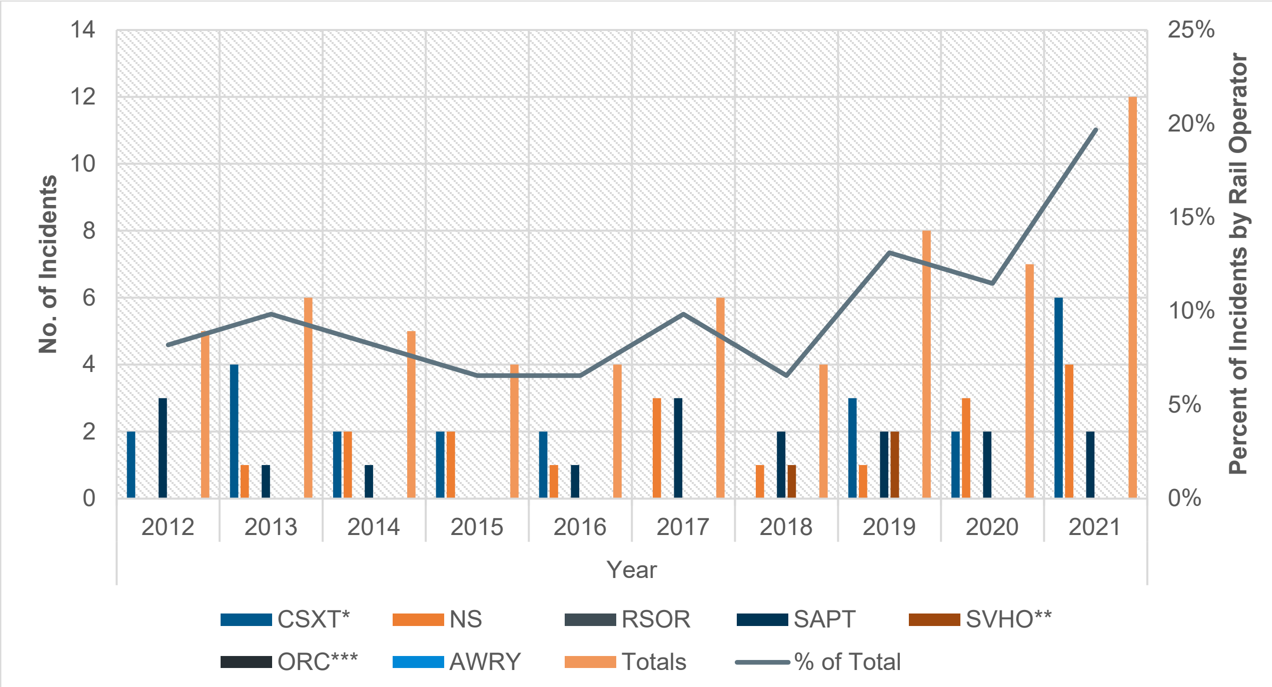
TABLE 6.13 REGION-WIDE HIGHWAY-RAIL CROSSING INCIDENTS BY YEAR, 2012-2021

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 6.20 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 Region

The numbers of multiple incidents at study area crossings for the data period by type of warning device are detailed in Table 6.14. 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 6.21. Nearly 26 percent of locations with multiple incidents occur at passive crossings. 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.

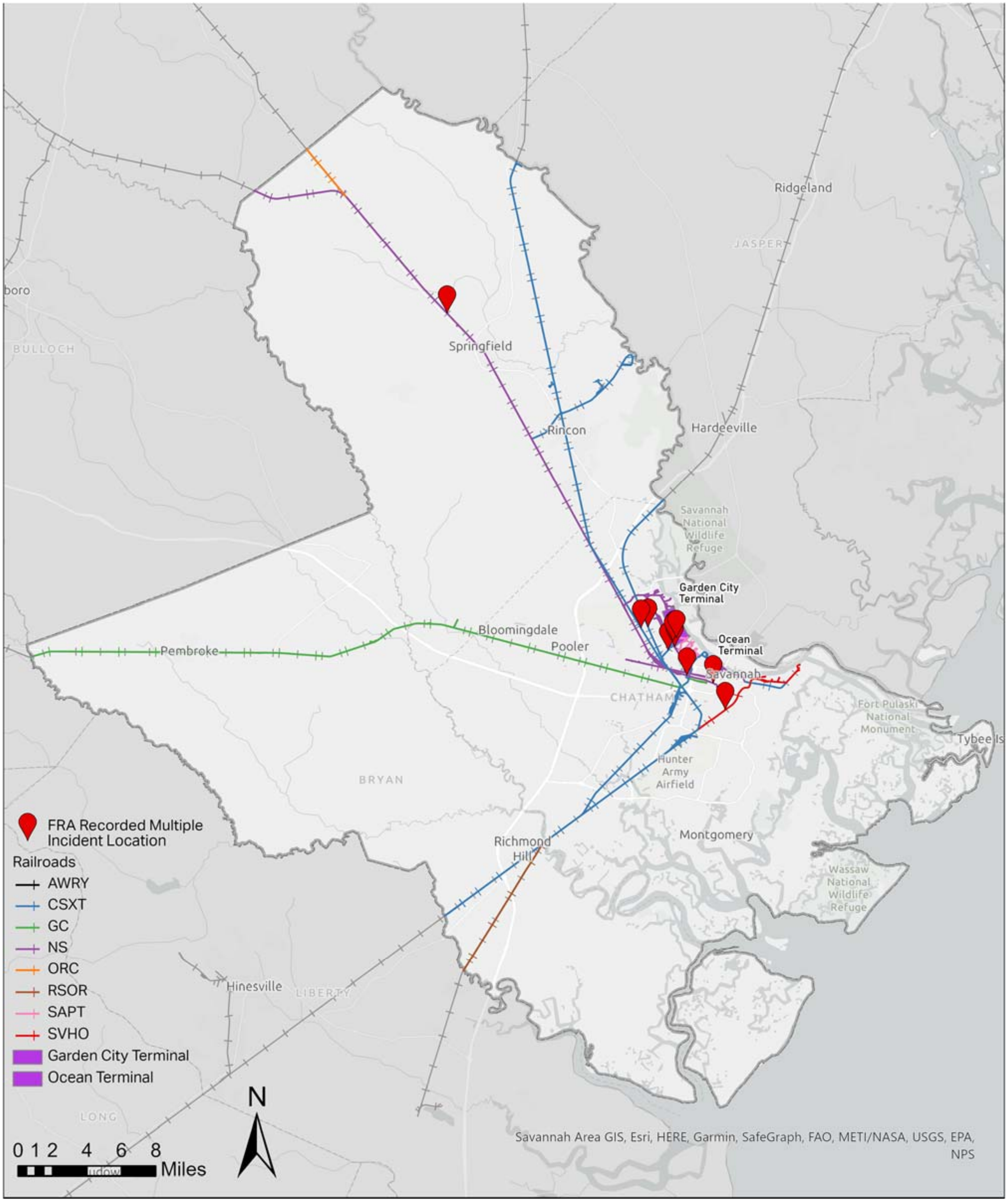
TABLE 6.14 REGION-WIDE HIGHWAY-RAIL CROSSING LOCATIONS WITH MULTIPLE INCIDENTS, 2012 – 2021

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
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 6.21 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 6.15. 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 6.22. When incidents per crossing are considered, SAPT is highest at 267 percent followed by NS at 26 percent. Figure 6.23 depicts the locations of all 44 highway-rail incidents that occurred between 2012 and 2021 within the focus area.

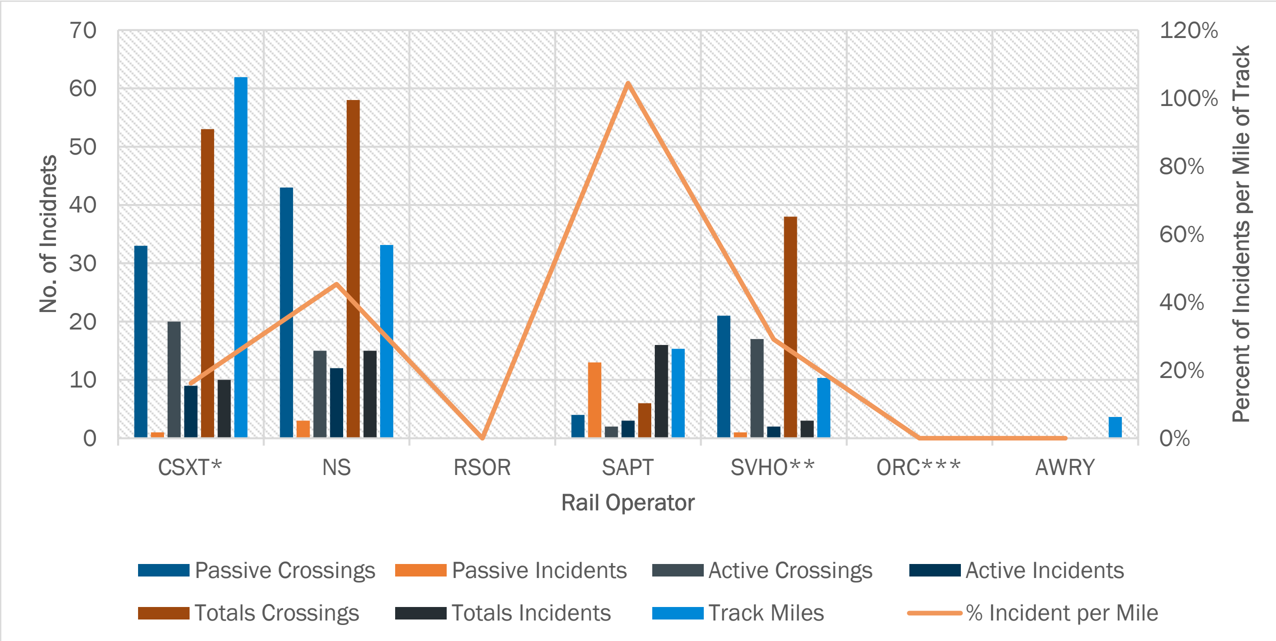
TABLE 6.15 FOCUS AREA HIGHWAY-RAIL CROSSING INCIDENTS BY OPERATOR, 2012 – 2021

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.

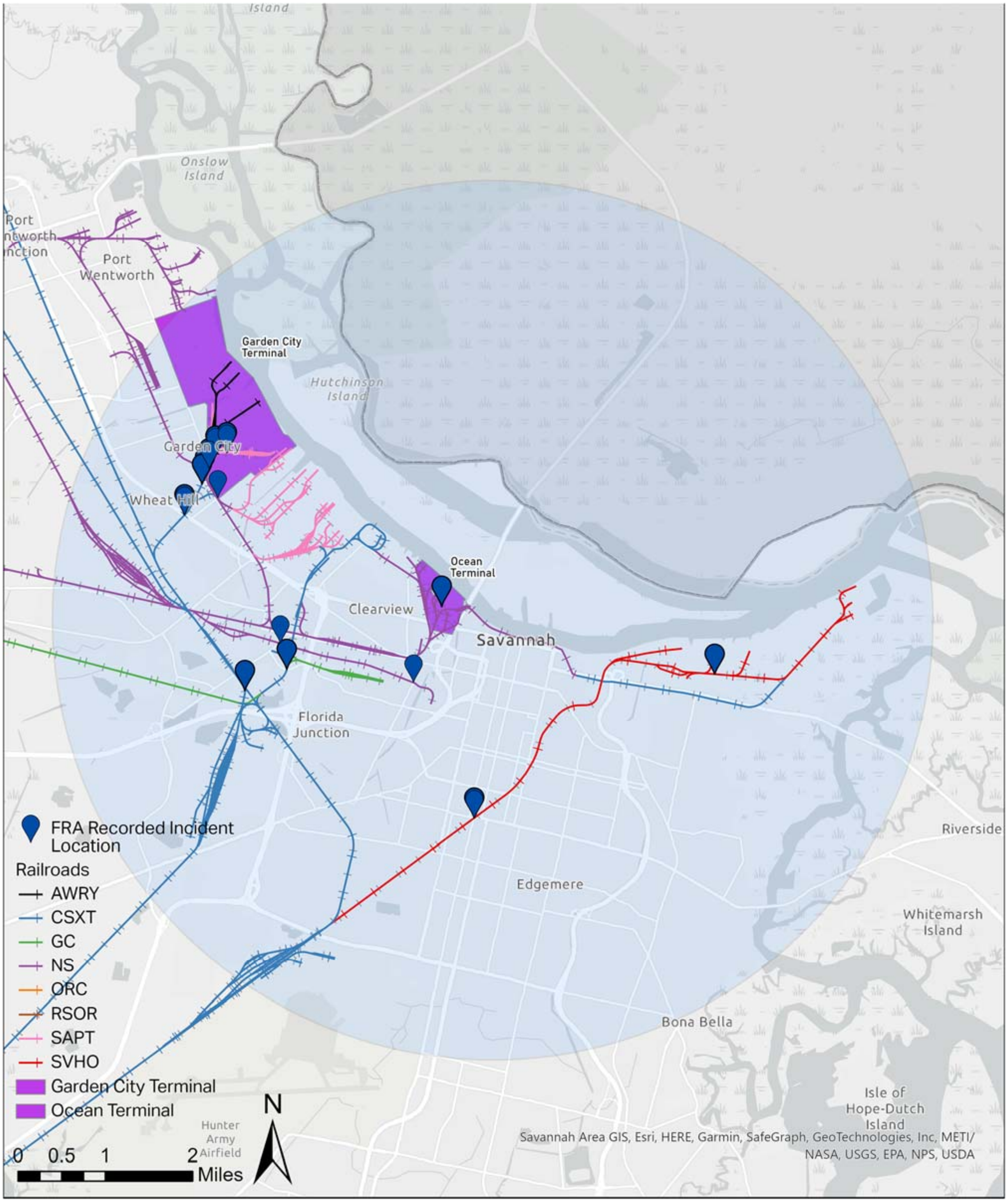
FIGURE 6.22 HIGHWAY-RAIL CROSSING INCIDENTS BY OPERATOR WITHIN FOCUS AREA, 2012 - 2021



*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 6.23 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 6.16 and depicted graphically in Figure 6.24. 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

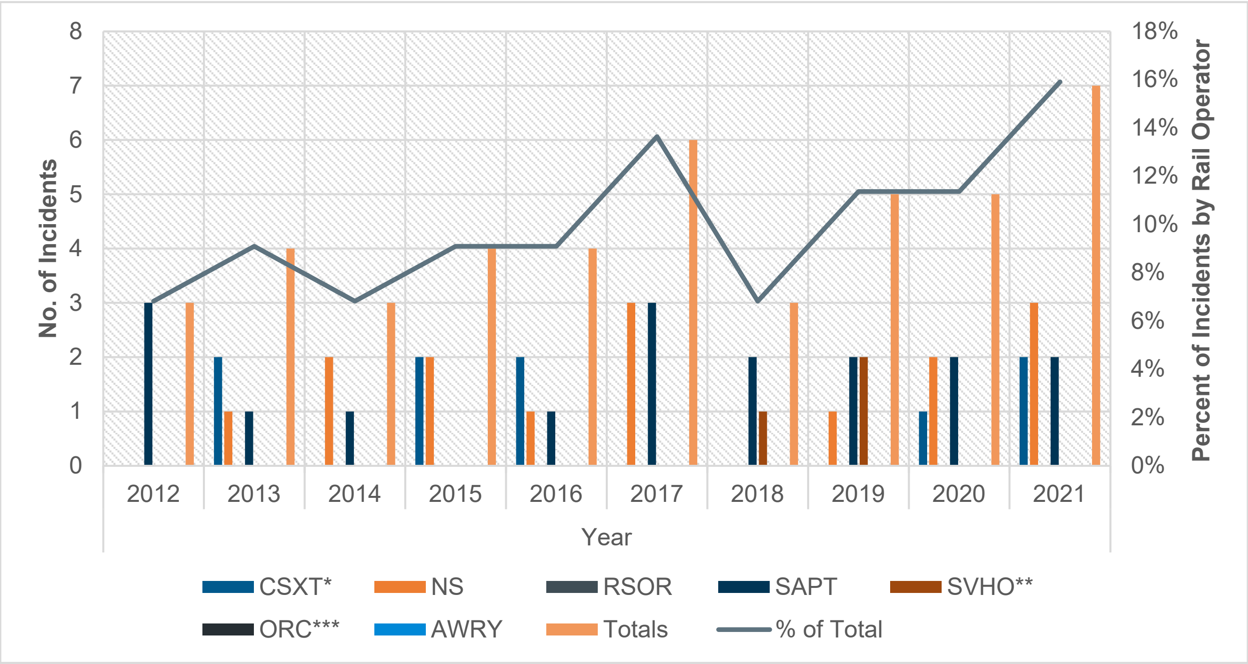
TABLE 6.16 FOCUS AREA HIGHWAY-RAIL CROSSING INCIDENTS BY YEAR, 2012 – 2021

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 6.24 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 6.17. 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 6.25. 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.

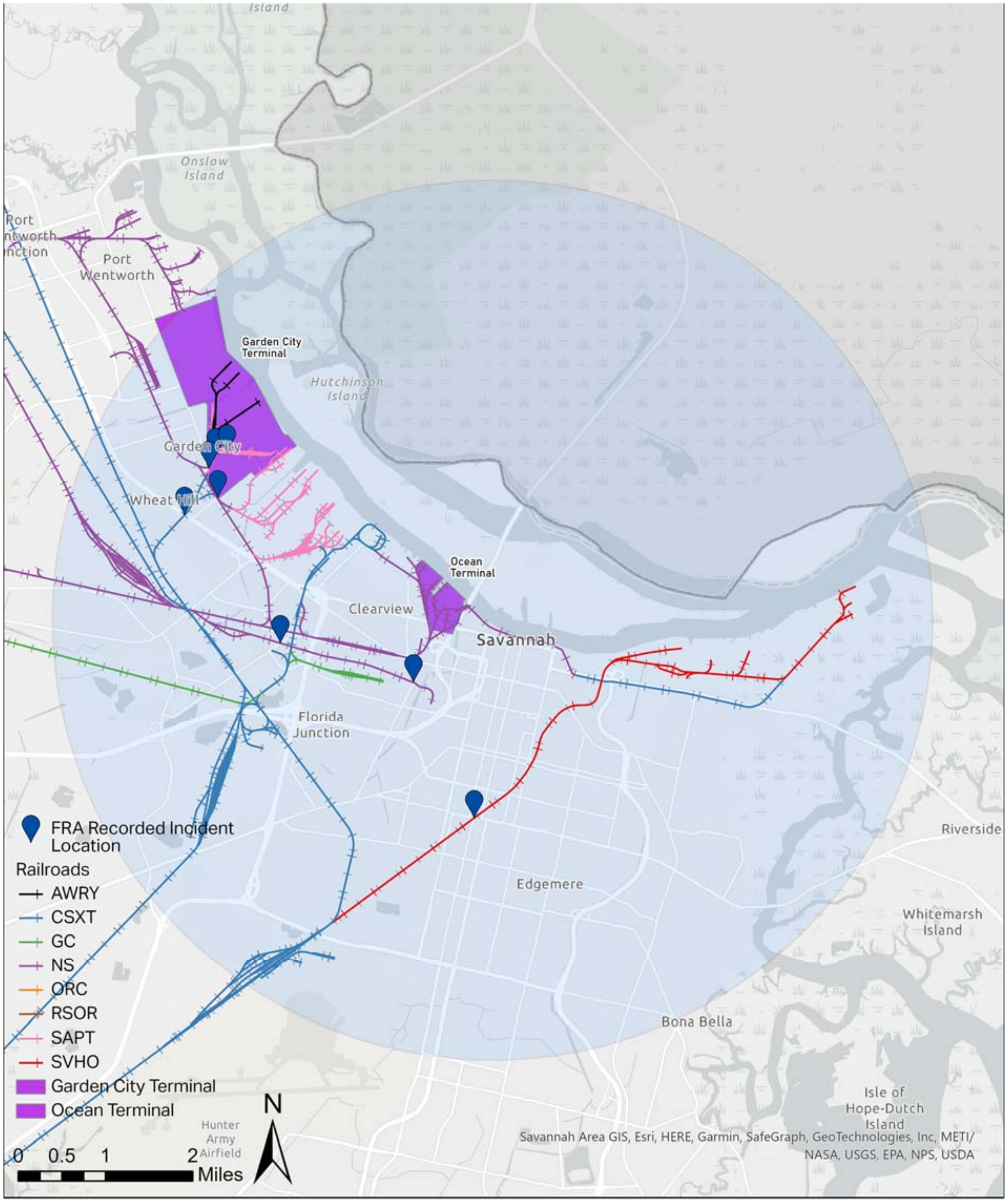
TABLE 6.17 FOCUS AREA HIGHWAY-RAIL CROSSING LOCATIONS WITH MULTIPLE INCIDENTS, 2012 – 2021

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



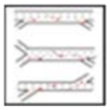
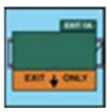
Source: Federal Railroad Administration, Highway-Rail Crossing Inventory; AECOM.

6.3 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 6.26.

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 a few types of restrictions that are particularly relevant for the region. These include at-grade crossings, vertical clearances, lane drops, and access management.

FIGURE 6.26 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-18-013, November 2017.

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.[94] 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.[95]

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."

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

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

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

density along SR 21. Other major freight corridors that appear to have a high density of driveways include U.S. 80 and DeRenne Avenue.

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 6.27).

FIGURE 6.27 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 6.28) and East Gwinnett Street. Both rail bridges only provide a 13-foot clearance.

FIGURE 6.28 VERTICAL CLEARANCE AT EAST HENRY STREET

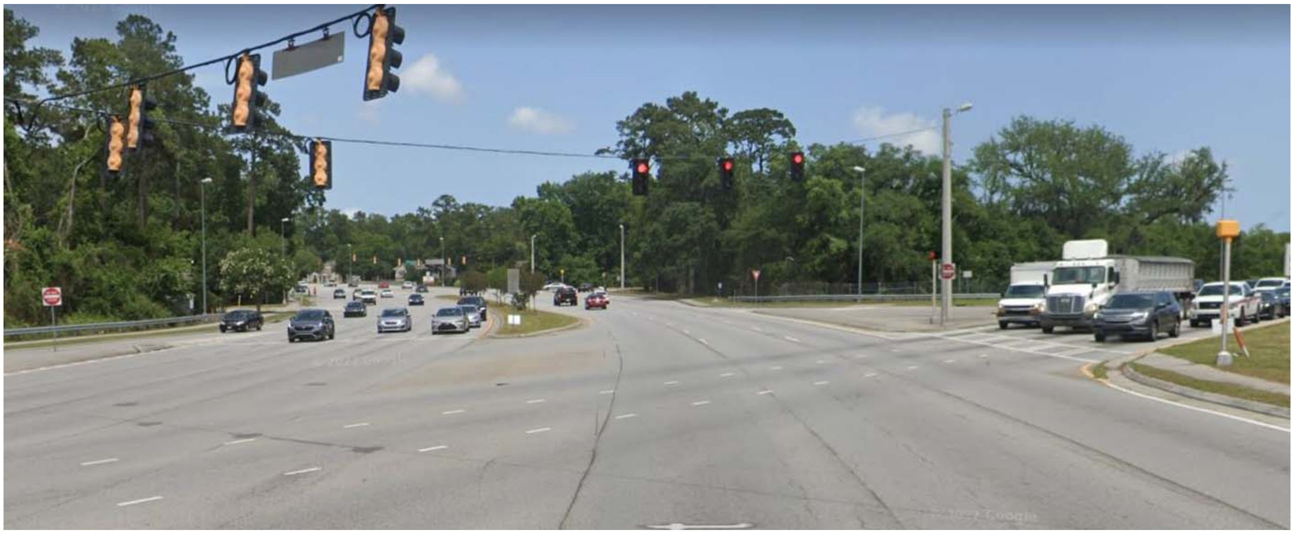
Source: Google.

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.

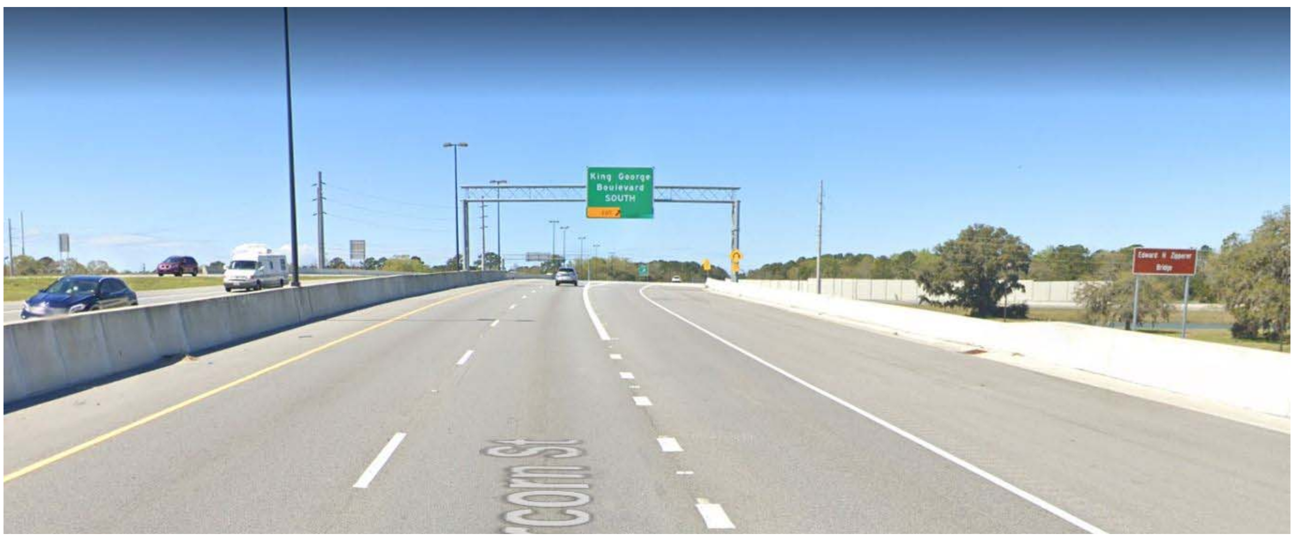
On the south side of Savannah, the Truman Parkway abruptly ends at SR 204/Abercorn Street (see Figure 6.29) merging three lanes of parkway traffic onto the existing westbound three lanes of SR 204/Abercorn Street leading to increased congestion. This is the principle east west corridor between Truman 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 6.30).

FIGURE 6.29 HARRY S. TRUMAN PARKWAY LANE DROP AT SR204



Source: Google.

FIGURE 6.30 SR 204 LANE DROP AT KING GEORGE BOULEVARD



Source: Google.

Freeway-to-Freeway Interchanges

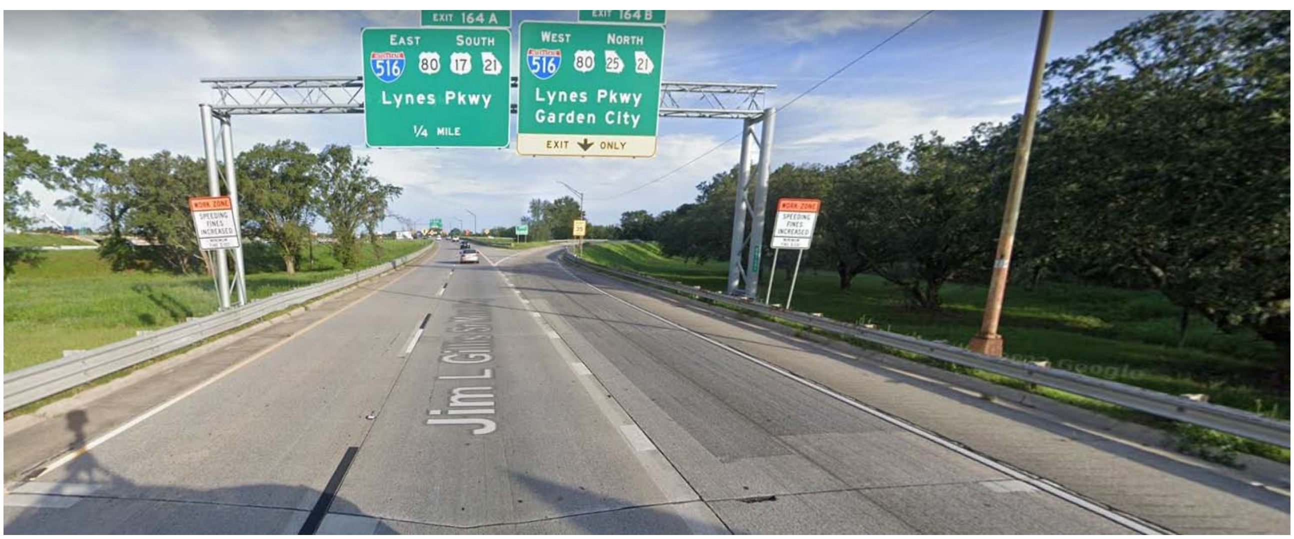
Freeway-to-freeway interchanges are typically the most severe form of physical bottlenecks because of the high-traffic volumes involved. In the CORE MPO region, the I-16/I-95 has been identified by multiple previous studies (including the 2016 Regional Freight Transportation Plan and the 2018 Georgia Statewide Freight & Logistics Action Plan) as a freight bottleneck. As part of its Major Mobility Investment Program (MMIP), 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 6.31 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 6.32). 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. This interchange will be improved as part of the MMIP as GDOT is widening I-16 between I-516 and I-95. Additionally, the GDOT 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 that impacts this interchange.

FIGURE 6.32 I-16 AT I-516



Source: Google.

7 TRUCK PARKING INVENTORY AND TRUCK RESTRICTIONS

The purpose of this section of the report is to develop an inventory of truck parking and to review and discuss the various truck parking restrictions and regulations imposed by county and municipal governments in the CORE MPO region. Truck parking and truck restrictions are critical aspects of the region's multimodal freight network as they impact the safety of roadway users and the quality of life of the region's residents.

7.1 Truck Parking

Why Truck Drivers Need to Park

Truck drivers need to park for different reasons and there are unique challenges for various types of parking needs (see Figure 7.1). Drivers must adhere to Federal hours of service (HOS) regulations that place specific time limits on driving and rest intervals. Drivers almost always need to park and wait for delivery windows at shippers and receivers, and sometimes are impacted by unexpected road closures or congestion. Finally, truck drivers are essential workers, who need to take personal breaks for rest and safety.

FIGURE 7.1 REASONS TRUCK DRIVERS PARK

Source: Cambridge Systematics, Inc.

Laws and Regulations

This section of the report focuses on laws and regulations that impact the need and availability of truck parking. It describes laws and regulations implemented at the federal and local levels. Though there are state laws and regulations that impact truck parking, federal mandates on when and for how long drivers are allowed to operate is a major driving force behind the need to address truck parking as part of regional freight planning. Local laws and regulations have a significant impact on the availability of truck parking as land use is controlled by local governments. For these reasons, this section focuses on federal and local laws and regulations.

Federal Laws and Regulations

Moving Ahead for Progress in the 21st Century (MAP-21)

One of the key provisions in the Moving Ahead for Progress in the 21st Century (MAP-21) transportation bill was the Jason's Law Truck Parking Survey ("Jason's Law").[96] Named for Jason Rivenburg, a truck driver who was killed at an abandoned gas station while waiting for a nearby delivery site to open, this bill began the process to address the shortage of long-term parking for commercial vehicles on the National Highway System (NHS) and seeks to improve safety for truck drivers nationwide. Jason's Law requires the USDOT to evaluate the nation's capability to provide adequate truck parking and rest facilities for safe parking of commercial motor vehicles (CMV), address the volume of CMV traffic in each state, and develop a method to measure the adequacy of CMV parking in each state.[97]

As directed by MAP-21, the Federal Highway Administration (FHWA) completed a survey on truck parking issues in August 2015. State DOTs, commercial motor vehicle safety enforcement agencies, truck drivers and fleet managers, and truck stop owners and operators comprised the survey respondents. The purpose of the survey was to evaluate the capability of states to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation. Key indicators used in the Jason's Law report included lack of capacity (shortages), unauthorized parking, number of spaces in relation to vehicle miles traveled (VMT), and number of spaces in relation to National Highway System (NHS) miles (e.g., number of parking spaces per 100 miles of NHS, number of parking spaces per 100,000 daily truck VMT, etc.). By all indicators included in the 2015 survey results, nearly every state in the country, including Georgia, indicated a need for more truck parking.

As MAP-21 required USDOT to make periodic updates to the Jason's Law Truck Parking Survey, a new survey was conducted in 2019. Though a full report was not released, a high-level summary of the results was made publicly available.[98] In addition to the original entities surveyed, the 2019 survey was expanded to include port authorities. The survey results indicated a modest increase in truck parking capacity between 2014 and 2019, a 6 percent increase in public truck parking spaces and an 11 percent increase in private truck parking spaces. Despite the reported increase, the 2019 survey results determined that truck parking shortages remain in areas originally identified in the 2015 survey.

Hours of Service (HOS) Regulations

Commercial motor vehicle (CMV) labor regulations are under the purview of the U.S. Federal Motor Carrier Safety Administration (FMCSA). FMCSA propagates rules to increase safety on the road. For CMVs – broadly defined as vehicles used as part of a business, involved in interstate commerce, weighing 10,001 pounds or more, or transporting certain commodities or passengers – the mandatory hours of service (HOS)

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[96] MAP-21; P. L. 112-141, Section 1401 (c).

[97] FHWA Office of Freight Management and Operations, "Jason's Law Commercial Motor Vehicle Parking Survey and Comparative Analysis," 2015, https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/ch1.htm

[98] FHWA Office of Freight Management and Operations, "Jason's Law Commercial Motor Vehicle Parking Survey and Comparative Assessment," December 1, 2020, Presentation to the National Coalition on Truck Parking, https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/workinggroups/2020/mtg/nctptpwnmtg12012020.pdf

regulations have the greatest impact on truck parking. The most recent HOS regulations, updated in September 2020, are outlined below in Table 7.1.

TABLE 7.1 SUMMARY OF HOURS-OF-SERVICE RULES FOR PROPERTY-CARRYING DRIVERS

Regulation	Description
11-Hour Driving Limit	May drive a maximum of 11 hours after 10 consecutive hours off duty.
14-Hour Limit	May not drive beyond the 14th consecutive hour after coming on duty, following 10 consecutive hours off duty. Off-duty time does not extend the 14-hour period.
30-Minute Driving Break	Drivers must take a 30-minute break when they have driven for a period of 8 cumulative hours without at least a 30-minute interruption. The break may be satisfied by any non-driving period of 30 consecutive minutes (i.e., on-duty not driving, off-duty, sleeper berth, or any combination of these taken consecutively).
60/70 Hour Limit	May not drive after 60/70 hours on duty in 7/8 consecutive days. A driver may restart a 7/8 consecutive day period after taking 34 or more consecutive hours off duty.
Sleeper Berth Provision	Drivers may split their required 10-hour off-duty period, as long as one off-duty period (whether in or out of the sleeper berth) is at least 2 hours long and the other involves at least 7 consecutive hours spent in the sleeper berth. All sleeper berth pairings must add up to at least 10 hours. When used together, neither time period counts against the maximum 14- hour driving window.
Adverse Driving Conditions	Drivers are allowed to extend the 11-hour maximum driving limit and 14-hour driving window by up to 2 hours when adverse driving conditions are encountered.
Short-Haul Exception	A driver is exempt from the requirements of §395.8 and §395.11 if: the driver operates within a 150 air-mile radius of the normal work reporting location, and the driver does not exceed a maximum duty period of 14 hours. Drivers using the short-haul exception in §395.1(e)(1) must report and return to the normal work reporting location within 14 consecutive hours, and stay within a 150 air-mile radius of the work reporting location.

Source: https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations, September 29, 2020.

HOS regulations are strongly enforced by state agencies, and penalties can be high. Motor carriers that exceed driving-time limits may be fined up to $15,691 for each violation. Drivers may be fined up to $3,923 for each violation. Motor carriers and drivers that exceed driving-time limits by more than three hours are deemed to have committed an egregious violation with FMCSA being able to levy penalties up to the maximum permitted by law.[99] To avoid these steep fines, drivers are under pressure to find parking as quickly and efficiently as possible to avoid violating HOS regulations while trying to make pick-ups/deliveries as efficiently as possible.

Electronic Logging Device (ELD) Regulations

In order to increase compliance with HOS regulations, most CMV drivers are required to track their HOS with an electronic logging device (ELD) as described **Error! Reference source not found.**. [100] An ELD is technology that automatically records a driver's driving time and other HOS data. An ELD monitors a vehicle's engine to capture data on whether the engine is running, whether the vehicle is moving, miles

[99] 49 CFR Part 386 Appendix B, https://www.ecfr.gov/cgi-bin/text-idx?SID=c84cf37b8194f6d754cfa649af3a6ee2&mc=true&node=pt49.5.386&rgn=div5#ap49.5.386_184.b, March 30, 2021.

[100] Federal Register, Vol. 80, No. 241, December 16, 2015.

driven, and duration of engine operation (engine hours). Though most CMV drivers are required to have an ELD, there are exceptions:

- Drivers who use paper logs no more than 8 days during any 30-day period;
- Driveaway-towaway drivers (transporting a vehicle for sale, lease, or repair), provided the vehicle driven is part of the shipment or the vehicle being transported is a motor home or recreational vehicle trailer; and
- Drivers of vehicles manufactured before model year 2000.

This approach to HOS monitoring replaced a paper version which provided drivers with some leeway in finding parking within the HOS limits. With the full implementation of the ELD mandate in December 2019, time and location is now tracked much more precisely. This allows for closer enforcement of existing HOS regulations which makes finding parking within allowable time limits even more critical.

Interstate Rest Areas – Commercial Use Restrictions

The availability of amenities (e.g., food, showers, fuel, etc.) is viewed as an important factor in the utilization of truck parking. In the 2015 Jason's Law survey results, drivers indicated that they are hesitant to park at rest areas because they do not have amenities.[101] In most states in the U.S., the sale of food, fuel, and most other commodities at Interstate rest areas is not allowed. This is due to a 1956 prohibition on commercializing Interstate rights-of-way which states, "No charge to the public may be made for goods and services at safety rest areas except for telephone and articles dispensed by vending machines."[102] Tolled segments of highways in 14 states (shown in Figure 7.2) are exempted from the ban because they were operating commercialized rest areas prior to 1956.[103]

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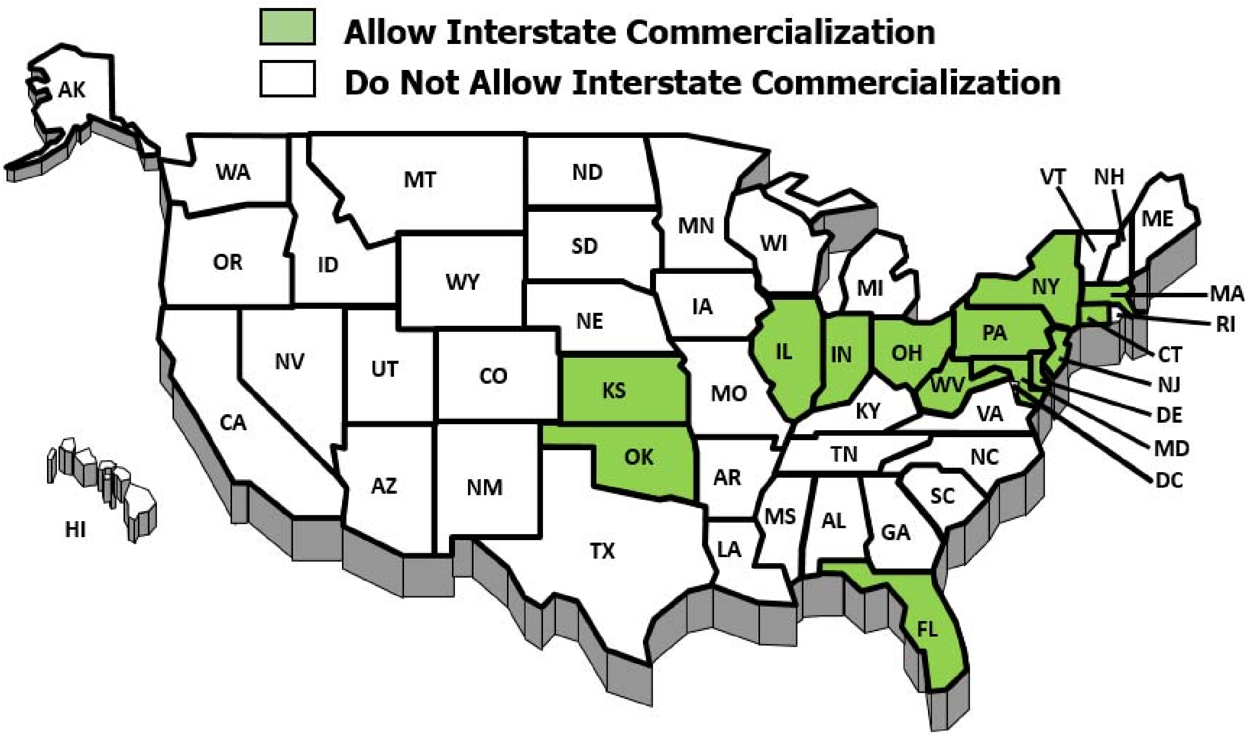
[101] FHWA Office of Freight Management and Operations, "Jason's Law Commercial Motor Vehicle Parking Survey and Comparative Analysis," 2015, https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/ch3.htm#s36

[102] 23 CFR 753.5(g)

[103] NATSO. "Rest Area Commercialization and Truck Parking Capacity: Commercialization is Not the Answer to Truck Parking Needs." February 2010. Note that Connecticut allows commercialization at all interstate rest areas.

FIGURE 7.2 STATES ALLOWING INTERSTATE COMMERCIALIZATION



Source: Texas Department of Transportation, "Truck Parking State of the Practice, Laws and Regulations Memo," March 27, 2019.

Parking of Trucks Transporting Hazardous Materials

Trucks carrying hazardous materials such as explosives, radioactive material, and various gases and flammable liquids are subject to additional parking regulations as defined in 49 CFR Part 397.7.[104] Motor vehicles containing hazardous materials in Division 1.1 (Mass Explosive Hazard), Division 1.2 (Projection Hazard) or Division 1.3 (Mass Fire Hazard) may not be parked on or within five feet of the traveled portion of a public street or highway. They are also not permitted on private property (including private truck stops) at any time without consent from the property owner or manager and are restricted from parking within 300 feet of bridges, tunnels, residential dwellings, offices, or other areas where people assemble. These additional restrictions provide significant challenges for this segment of the trucking community.

Clean Air Act

The 1990 Clean Air Act regulates air pollution in the U.S. The transportation sector as a whole is a major contributor to air pollution, responsible for more than half of nitrogen oxide[105] and approximately 28 percent of greenhouse gas emissions in 2018.[106] Heavy truck diesel engines are a prime emission source, estimated

[104] https://www.fmcsa.dot.gov/regulations/hazardous-materials/how-comply-federal-hazardous-materials-regulations

[105] https://www.epa.gov/transportation-air-pollution-and-climate-change/smog-soot-and-local-air-pollution

[106] https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

to account for about 24 percent of total U.S. transportation sector carbon dioxide emissions and equal to nearly 9 percent of total U.S. energy-related carbon dioxide emissions in 2019.[107]

Specific to parking, trucks that are idling their engines in order to provide temperature control or power are a source of air pollution. To counter this, alternative fuels such as compressed natural gas, liquid natural gas, and propane, as well as plug-in electric vehicles are increasing in number. These options typically have fewer fueling locations and may have higher cost (depending on prevalent oil and gas prices), which can be an issue for drivers who do not have a set daily route or routinely return to a depot.

Another set of solutions to reduce emissions from idling trucks is the use of onboard or external equipment that provides services, such as heating and cooling, which are otherwise powered by engine idling.[108] Examples of onboard equipment include auxiliary power units (vehicle-mounted systems that provide power), cab or bunk heaters, and battery-electric air conditioners, among others. External equipment to reduce truck idling generally refers to truck stop electrification. Truck stop electrification usually takes one of two forms: single-system or dual-system electrification. Single-system truck stop electrification provides heating, ventilation, and air conditioning (HVAC) directly to the truck via a gantry- or pedestal-mounted duct (see Figure 7.3). Dual-system electrification provides plug-in power for a truck's auxiliary electric HVAC system and accessories.

FIGURE 7.3 TRUCK STOP ELECTRIFICATION – KNOXVILLE, TN

Source: https://www.fhwa.dot.gov/publications/publicroads/05mar/02.cfm.

[107] https://www.eia.gov/energyexplained/diesel-fuel/diesel-and-the-environment.php

[108] https://afdc.energy.gov/conserve/idle_reduction_equipment.html

Local Laws and Regulations

Truck parking in urban areas has been noted as a struggle for commercial motor vehicle operators across the U.S. Municipalities often view truck parking as incompatible with residential areas and not the highest and best use of valuable land area. Several local governments in the region have regulations for truck parking. Types of regulations commonly enacted by local governments are shown in Figure 7.4.

FIGURE 7.4 TYPES OF LOCAL TRUCK PARKING REGULATIONS

Source: Cambridge Systematics, Inc.

These ordinances are meant to improve safety and quality of life and protect against some of the negative externalities associated with truck parking. Examples include the City of Springfield prohibits truck parking within the city limits except for construction activity and for making pick-ups or deliveries to businesses. The City of Port Wentworth prohibits trucks from parking or standing in right-of-way, except for pick-ups or deliveries, for longer than 1 hour.[109] The City of Rincon also prohibits parking, standing of any truck or other freight carrying vehicle on any street or right of way except loading and unloading materials.[110] Furthermore, the City of Rincon regulates parking of truck used for transportation of hazardous or highly flammable solids, liquids or gas in the city limits.[111] Trucks with more than 6,000 pounds are prohibited on streets except for delivery activities. The City of Port Wentworth has similar ordinances that generally prohibit trucks from parking on city streets and places greater restrictions on those transporting hazardous materials. Table 7.2 summarizes frequently occurring truck parking ordinances across the region.

[109] City of Port Wentworth, Code of Ordinances, Chapter 13 – Motor Vehicles and Traffic, Section 13-2. – Parking trucks in street.

[110] City of Rincon, Code of Ordinances, Chapter 78 –Traffic, Section 78-8. - No parking of trucks in the street.

[111] City of Rincon, Code of Ordinances, Chapter 78 –Traffic, Section 78-9. - Trucks carrying hazardous substances.

TABLE 7.2 MOST COMMON TRUCK PARKING ORDINANCES IN THE CORE MPO STUDY AREA

City or County	Broad restrictions for public ROW or residential zones	Weight	Time	Other
Bryan County	●			●
Chatham County	●			
Effingham County	●			
Bloomingdale	●			
Garden City	●	●		●
Pooler	●	●		
Port Wentworth	●	●	●	●
Richmond Hill	●	●	●	●
Rincon	●	●	●	
Savannah	●	●	●	
Springfield	●	●	●	
Thunderbolt		●		

Source: Cambridge Systematics, Inc.

Some cities and counties have notable truck parking regulations in terms of development standards and in identifying more specific (as opposed to broad or general) locations where truck parking is prohibited. Codified development standards for truck parking are important as these impact the cost-effectiveness and feasibility of developing parking in certain jurisdictions. Often, the explicit prohibition of truck parking on specific routes is an indicator of where unauthorized truck parking has been a challenge for local governments. Examples of notable truck parking regulations in the CORE MPO study area include the following:

- The City of Richmond Hill does not allow vehicles exceeding 10,000 lbs. to be parked on city streets.[112] Section 66-3 generally prohibits truck parking in residential districts and specifically identifies SR 25 as a corridor on which truck parking is prohibited. The city's official code also specifies development standards for truck stops, which are distinct from service stations, in its Unified Development Ordinance. Among other requirements, Section 13.7 H of its Unified Development Ordinance requires a minimum lot size of 2 acres, a minimum width of 200 feet on an arterial street, and that no driveway be closer than 600 feet from an interchange on- or off-ramp. The Unified Development Ordinance also sets truck parking minimums for cartage, express, parcel delivery facility, and freight and intermodal terminal developments. These facilities must provide two truck spaces per truck berth or loading dock (Section 14.3 Table 14-3). The Unified Development Ordinance also prohibits the overnight parking of trucks in parking lots that have not been specifically approved for that purpose (Section 14.4 E).

- Effingham County prohibits parking in deceleration or acceleration lanes in Section 74-4 of its official code.[113] It also prohibits trucks from county roads that are not designated as truck routes unless they are

[112] City of Richmond Hill, Code of Ordinances, Chapter 66 –Traffic, Section 66-4. – Load limit on designated streets.

[113] Effingham County, Code of Ordinances, Chapter 74 –Traffic, Section 77-4. – Parking in deceleration or acceleration lanes prohibited.

performing a pickup, delivery, or some other service.[114] In the County's official code, trucks are defined as Federal Highway Administration (FHWA) class 6 through 13 vehicles according to the FHWA 13-vehicle classification scheme included in Appendix C of the agency's Traffic Monitoring Guide publication.[115]

- Bryan County generally prohibits the parking of large trucks in residential zoned districts (Section 114-713), but its official code does not contain language to address parked trucks in public right-of-way.[116] Exceptions are made for residential districts with large lots (e.g., 1.5 acres or more). Section 114-747 establishes development and operating standards for truck stops. It requires a minimum parcel area for new truck stops or travel plazas of ten acres with at least 200 feet of direct road frontage on a collector or arterial road. The parcel on which the truck stop/travel plaza is located must be within 2,000 feet of the centerline of the nearest interstate highway exit/entry ramp. If the parcel on which the truck stop or travel plaza is located is within 1,320 feet of a residential zoning district, then a noise impact study must be prepared and include mitigation measures to ensure that noise levels at the boundary of the residential zoning district will not exceed 60 A-weighted decibels (dBA) between the hours of 10:00 p.m. and 7:00 a.m. The study must also propose idling time restrictions and a plan for compliance. Overnight parking is not allowed at newly developed truck stops/travel plazas unless it is electrified. The code requires that electrified parking spaces be installed for each overnight space to allow truck drivers to provide power to necessary systems (e.g., heating, air conditioning) without idling the engine.

- In addition to general restrictions based on residential zones, weight, and time, Garden City and the City of Port Wentworth have specific parking restrictions for routes that carry high volumes of freight. Garden City prohibits parking on SR 21, SR 25, and US 80 within its limits.[117] The City of Port Wentworth specifically prohibits parking on Traveler's Way, which is just north of the SR 21/I-95 interchange and proximate to a truck parking facility.[118]

Truck Parking Inventory

The inventory of truck parking facilities covers both public and commercial facilities. Public facilities include rest areas, weigh stations (as Georgia allows overnight truck parking at these facilities), and welcome centers which are state-owned and are located adjacent to state highways to provide temporary parking for rest and access to restrooms, vending machines, and other basic services. They do not provide food, fuel, or other commercial amenities. Data on the location and capacity of public truck parking facilities was gathered from GDOT, the Georgia Department of Economic Development, and FHWA.

Commercial truck parking facilities are private businesses that provide fuel, and often offer food, rest, and other services for truck drivers. Because of federal limitations on the types of amenities that may be offered at public facilities, drivers often prefer commercial truck stops. Data on the location and capacity of

[114] Effingham County, Code of Ordinances, Chapter 74 –Traffic, Section 77-8. – Designated truck routes.

[115] Federal Highway Administration, Appendix C. Vehicle Types, *Traffic Monitoring Guide*, 2013, https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm.

[116] Bryan County, Code of Ordinances, Subpart B, Chapter 114, Article VII, Division 2, Section 114-713. - Storage or parking of vehicles and major recreational equipment and commercial vehicles.

[117] Garden City, Code of Ordinances, Appendix B – Traffic Schedule, Article IX – Parking Prohibited at all Times.

[118] City of Port Wentworth, Code of Ordinances, Chapter 13 – Motor Vehicles and Traffic, Section 13-13. - On-street parking prohibited on Traveler's Way.

commercial truck parking facilities was gathered from FHWA, third-party websites (e.g., AllStays.com, truckstopsandservices.com), company websites (e.g., Pilot Flying J, Loves Travel Stops).

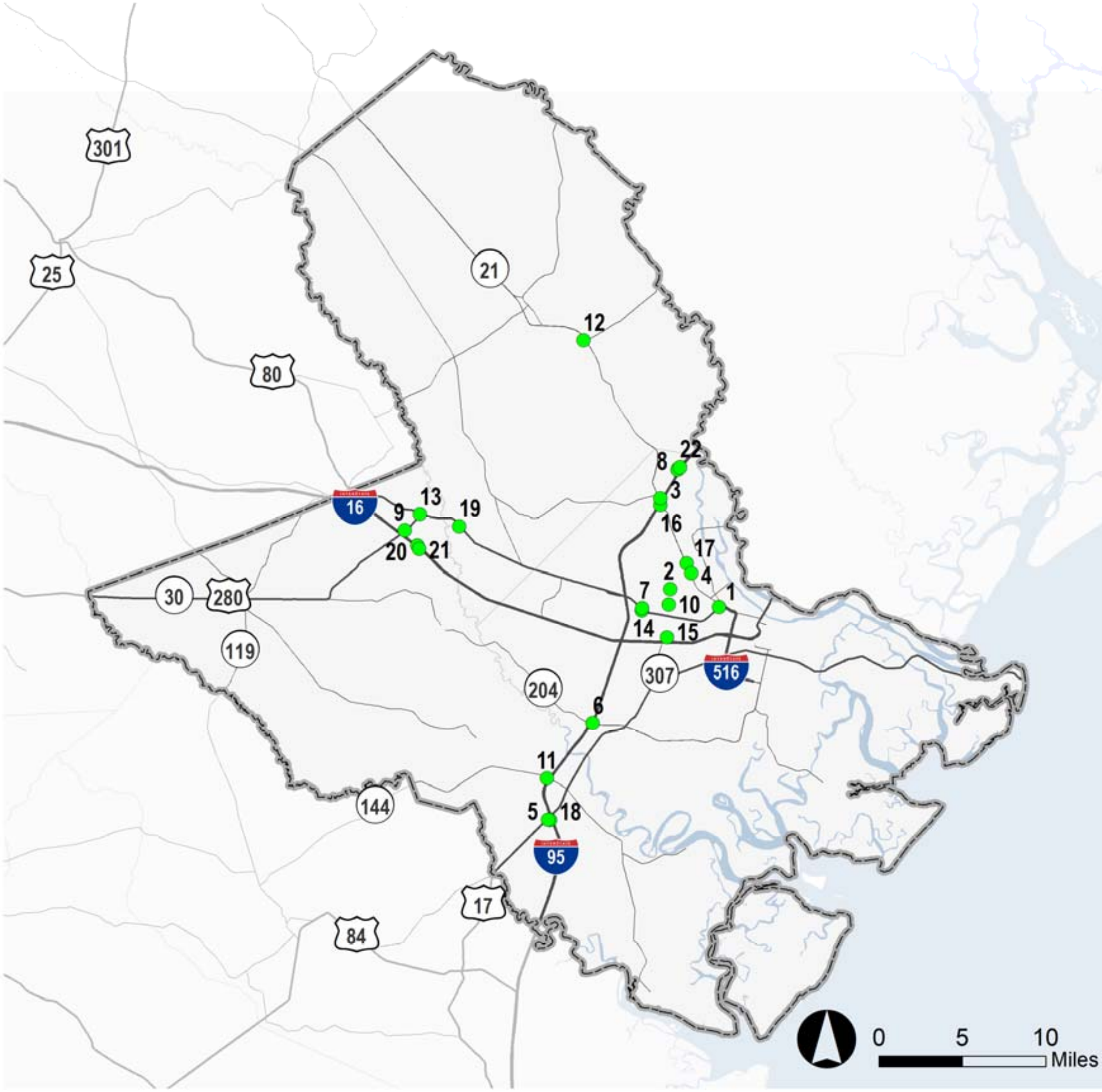
Table 7.3 and Figure 7.5 show the results of the truck parking inventory. In total, there are 22 truck parking facilities - 4 public and 18 commercial. Smaller facilities, such as those with 10 or fewer spaces, work to meet drivers' needs for short-term parking. Short-term parking is needed so that drivers may take mandated 30-minute rest breaks, eat a meal, and access restrooms as examples. These facilities also are likely used for staging. Often, shippers do not provide space for drivers to wait on site ahead of scheduled pickup or delivery windows. When this occurs, drivers are forced to park in unauthorized locations (e.g., ramps, local streets, retailer parking lots) to wait for their scheduled window unless there is parking facility nearby.

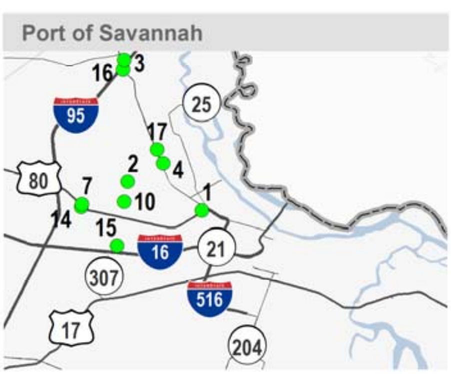
TABLE 7.3 TRUCK PARKING FACILITIES AND NUMBER OF PARKING SPACES, 2022

Map ID	Facility Name	Facility Type	Number of Spaces
1	80 Quik Stop – Garden City	Commercial	2
2	Circle K - Garden City	Commercial	8
3	Circle K - Port Wentworth	Commercial	10
4	Circle K - Savannah	Commercial	26
5	El Cheapo - Richmond Hill	Commercial	2
6	El Cheapo - Savannah	Commercial	2
7	Enmarket - Pooler	Commercial	25
8	I-95 Southbound Welcome Center	Public	88
9	Love's - Ellabell	Commercial	146
10	Love's - Garden City	Commercial	97
11	Love's - Richmond Hill	Commercial	140
12	Love's - Rincon	Commercial	74
13	Parker's - Ellabell	Commercial	10
14	Parker's - Pooler	Commercial	20
15	Parker's - Savannah	Commercial	16
16	Pilot - Port Wentworth	Commercial	112
17	Port Fuel Center – Port Wentworth	Commercial	50
18	TA Travel Center – Richmond Hill	Commercial	222
19	Wildwood Truck Stop - Bloomingdale	Commercial	25
20	Georgia Weigh Station - I-16 West	Public	35
21	Georgia Weigh Station - I-16 East	Public	35
22	Georgia Weigh Station - I-95 South	Public	18
Total			**1,163**

Source: Cambridge Systematics, Inc.

FIGURE 7.5 TRUCK PARKING FACILITIES IN THE SAVANNAH REGION, 2022





● Truck Parking Facility

Source: Cambridge Systematics, Inc.

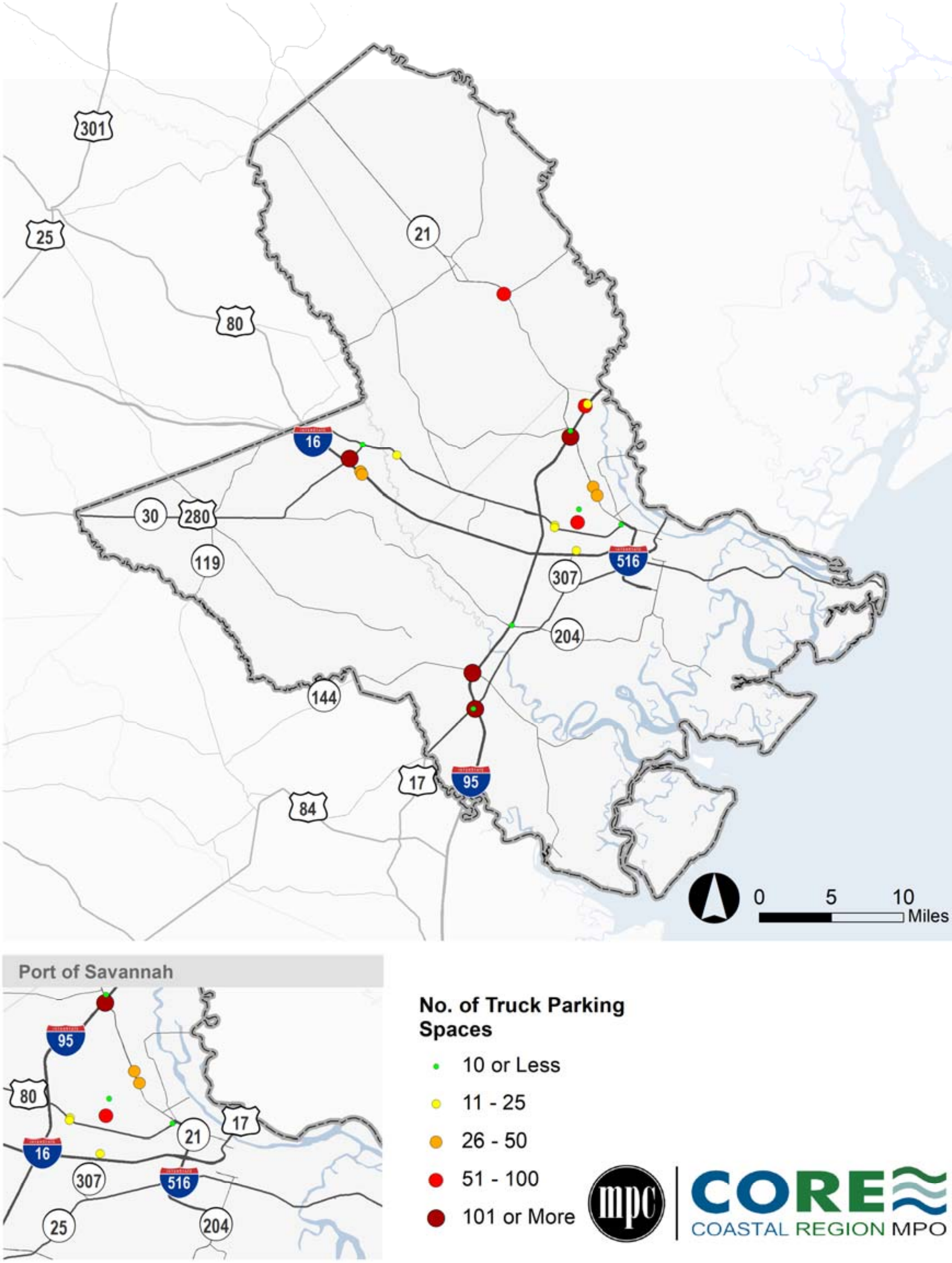
Table 7.4 summarizes the amount of truck parking by county in the CORE MPO study area. The region's 22 facilities provide an estimated 1,163 truck parking spaces. Just over 50 percent of capacity in terms of total spaces is located in Bryan County. Chatham County provides nearly 41 percent of the region's capacity with the remainder in Effingham County. Figure 7.6 shows truck parking facilities along with their estimated capacities.

Notably, Bryan County has about 32 percent of the region's truck parking facilities but over 50 percent of capacity. The facilities in Bryan are generally larger than those in other parts of the region with multiple facilities that contain more than 100 truck parking spaces. These types of facilities tend to be used to meet drivers' needs for 10-hour mandated rest breaks and overnight parking. Chatham County has about 59 percent of the region's truck parking facilities and nearly 41 percent of capacity. It has a mix of small (e.g., 10 spaces or fewer), medium (e.g., 11 to 50 spaces), and large (e.g., 100 or more spaces) facilities. Small parking facilities are important for meeting drivers' needs for short-term parking which includes 30-minute federally mandated rest breaks and staging. The concentration of small parking facilities in Chatham County likely reflects the limited availability of parcels for larger facilities and the prevalence of manufacturing plants, port facilities, and other businesses that would require drivers to stage pick-ups or deliveries.

TABLE 7.4 TRUCK PARKING BY COUNTY, 2022

County	Number of Facilities	Percent of Total Facilities	Number of Spaces	Percent of Total Spaces
Bryan	7	31.8%	590	50.7%
Chatham	13	59.1%	474	40.8%
Effingham	2	9.1%	99	8.5%
Total	**22**	**100.0%**	**1,163**	**100.0%**

FIGURE 7.6 CAPACITY OF TRUCK PARKING FACILITIES IN THE SAVANNAH REGION, 2022



Source: Cambridge Systematics, Inc.

Truck Parking Demand

The demand for truck parking was investigated using truck GPS data from INRIX. The GPS data provide information on the origins and destinations of heavy-duty trucks in the state of Georgia for the months of February, August, and October of 2019. These data were analyzed to derive average daily estimates of truck trips to and from truck parking facilities. Specifically, the analysis consisted of the following steps:

- **Geofence Truck Parking Facilities.** A geofence was designated around the region's public and commercial truck parking facilities.
- **Overlay Truck Trips Data**. The truck trip ends were overlayed on the region's truck parking facilities to identify the arrival and departure time of trucks at the facility.
- **Estimate Hourly Utilization**. The hourly arrivals and departures were calculated to estimate the total trucks parked at the region's parking facilities at any given hourly interval. This is the basis for the estimate of the utilization of truck parking spaces.
- **Develop and Apply Expansion Factor.** Because the INRIX data represents a sample of trucks, an expansion factor was developed using classification count data from the GDOT Traffic Analysis Data Application (TADA). INRIX heavy truck counts were compared to GDOT truck counts so that the data may be expanded to reflect the population of heavy trucks. The expansion factor was applied to the hourly utilization of truck parking spaces.

It is important to note that some of the region's truck parking facilities were built after 2019. For example, the Port Fuel Center opened in October 2021[119], the Love's Ellabell facility opened in June 2020[120], and the Love's Garden City facility opened in November 2021[121]. As a result, data is not available for these facilities and they are omitted from the remainder of the analysis. Furthermore, while the data provide a real-world look at how trucks use the CORE MPO region's truck parking facilities, it is important to note that the data only represent a sample of trucks and not all trucks.

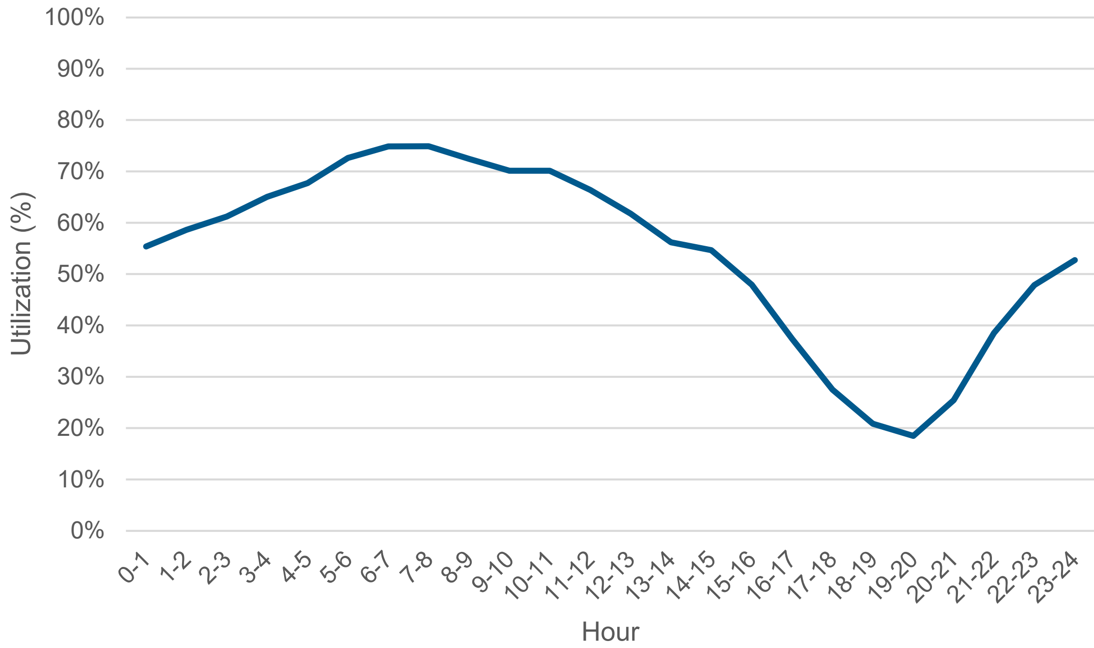
Overall, the results of the analysis indicate that the demand for truck parking at truck stops, rest areas, and other authorized locations generally does not exceed the region's capacity. Peak demand was estimated to occur at 6 a.m. and during this period about 75 percent of the region's truck parking capacity is consumed as shown in Figure 7.7. However, demand may be higher than what was captured with this analysis as trucks sometimes park in unauthorized locations such as industrial parks, commercial parking lots, roadway shoulders, and on-/off-ramps. Unauthorized locations were not included in the analysis.

[119] https://www.overdriveonline.com/life/article/15065175/new-truck-stop-and-cngpower-push-coming-at-port-of-savannah

[120] https://www.loves.com/en/news/2020/june/loves-travel-stops-opens-in-georgia

[121] https://www.loves.com/en/news/2021/november/loves-travel-stops-opens-new-locations-in-ohio-florida-and-georgia

FIGURE 7.7 AVERAGE HOURLY TRUCK PARKING DEMAND



Source: INRIX; Cambridge Systematics, Inc.

Public truck parking in the CORE MPO region is provided by a welcome center and weigh stations. Parking demand at the I-95 Southbound Welcome Center was estimated to exceed capacity. In some hours, demand was estimated to be as high as 128 percent. Demand in excess of 100 percent implies that trucks are parking along the ramps and other portions of the facility that are not designated for truck parking. For the region's weigh stations, the results indicated that parking demand at those facilities generally do not exceed capacity. However, this may also be reflective of a reluctance of motor carriers to park at these facilities.

Though demand was not found to exceed capacity at authorized parking locations at the region-wide level, continued growth in truck volumes and freight-intensive land uses will contribute to increased long-term demand. Truck shipments exceeding 500 miles traveling into, out of, and through the region are projected to grow at about 3 percent annually. These are the types of trips that could result in a driver needing to park overnight in the region. Among other tools, the FHWA Truck Parking Development Handbook presents case studies that show the relationship between land use and truck parking demand. Commercial and industrial land uses – two types of development that are increasingly prevalent in the region – generated the highest demand. The combination of growing truck volumes along with increasing commercial and industrial development indicate that the long-term demand for truck parking will continue to grow. Furthermore, though the region's truck parking supply does not appear to capacity-constrained, this may change given current trends.

7.2 Truck and Other Freight Restrictions

While truck restrictions are important for limiting the impact of freight traffic on surrounding communities (e.g., noise, emissions, vibrations, etc.) and also for roadway safety by shifting truck traffic away from roadways that were not designed for heavy vehicles, they can also contribute to increased vehicle miles traveled. In most cases, local city codes and ordinances across the region do not differ from each other substantially, each dealing with the same types of restrictions and nuisance prohibitions. Pertaining to freight transportation, local ordinances in the region include:

- **Trucks to operate only on designated routes or are generally restricted from local routes**. This ordinance requires that commercial vehicles operate only along designated truck routes, or generally restricts vehicles above certain gross weight thresholds from operating on local routes except in the limited cases of local pickups or deliveries.

- **Prohibition of commercial vehicle parking within public right of way**. This was the most prevalent ordinance across the region. There were certain variations on this theme; for example, most provided caveats for loading/unloading, and some limited restrictions only to residential areas.

- **Prohibition on parking commercial vehicles carrying hazardous cargo within public right of way**. Some cities placed further restrictions on truck parking, specifically identifying commercial vehicles transporting hazardous materials.

- **Engine brakes prohibited**. One city included ordinances prohibiting the use of engine or “jake” brakes (i.e., using compressed air), which emit loud noises.

- **Blocking or obstruction of streets by trains prohibited.** Several cities have enacted ordinances that prohibit trains from stopping or standing at crossings beyond specified time thresholds (e.g., 5 minutes, 10 minutes).

These ordinances are meant to improve safety and quality of life and protect against some of the negative externalities associated with freight. Table 7.5 illustrates frequently occurring ordinances across the study area. In general, counties and municipalities across the region have some form of an ordinance that restricts truck parking in public right-of-way.

TABLE 7.5 MOST COMMON FREIGHT TRANSPORTATION ORDINANCES

City or County	Prohibition on truck parking in public ROW	Designated truck routes or local restrictions	Trucks with hazardous cargo are restricted from parking on public ROW	Engine/jake brake prohibited	Trains stopping at at-grade crossings prohibited
Bryan County					●
Chatham County	●	●			●
Effingham County	●	●			●
Bloomingdale	●	●			●
Garden City	●	●			●
Pooler	●	●		●	●
Port Wentworth	●	●	●		●
Richmond Hill	●	●			●
Rincon	●	●	●		●
Savannah	●	●			●
Springfield	●	●			●
Thunderbolt	●	●			●

Source: Cambridge Systematics, Inc.

Only Effingham County has a designated truck route system to which drivers must adhere. [122] The county prohibits the use of medium and heavy-duty vehicles, defined as commercial vehicles Federal Highway Administration class 6 through 13, on routes not listed as designated truck routes. The designated truck routes include:

- SR 21;
- SR 17;
- SR 119;
- SR 30;
- SR 275;
- US 80;
- Old Augusta Road South;
- Old Augusta Central Road;
- I-16; and

[122] Effingham County, Code of Ordinances, Chapter 74 –Traffic, Section 77-8. – Designated truck routes.

- I-95.

The Cities of Port Wentworth and Rincon have ordinances that place additional truck parking restrictions on commercial vehicles transporting hazardous cargo. Section 13-3 of the City of Port Wentworth's official code prohibits any tank or tanker or other like truck used for the transportation of hazardous or highly flammable substances to be parked or stopped at any time on any street or right-of-way thereof in the city unless such vehicle is in the charge of an awake and immediately present attendant at all times. [123] Section 78-9 of the City of Rincon's official code has a similar prohibition. [124]

Only the City of Pooler has an ordinance prohibiting engine or "jake" brakes. Engine brake or compression brake is a device used primarily on trucks for the conversion of the engine from an internal combustion engine to an air compressor for the purpose of braking without the use of wheel brakes.[125] Section 82-43 of the City's code prohibits the use of these devices. In addition, trucks are specifically prohibited on Old Louisville Road and Pine Barren Road. [126]

For state routes and U.S. highways, cities and counties cannot restrict through trucks from operating on these routes though they can prohibit parking. State routes comprise all of the region's Interstates and principal arterials, and several minor arterials and major collectors as well. Interstates and arterials generally facilitate inter- and intrastate truck travel.

As discussed at the beginning of this section, local routes throughout the region generally have some restrictions on truck traffic. These are typically restrictions on gross vehicle weight and limit the use of local routes for serving a business or accessing a driver's home base. For those reasons, the analysis of truck route restrictions focuses on roadways that are functionally classified as arterials or collectors. Collectors primarily facilitate intra-county travel and funnel traffic from local roads to the arterial network. They often represent the first and last miles for freight shipments. The map in Figure 7.8 summarizes truck restrictions and designated truck routes in the CORE MPO study area.

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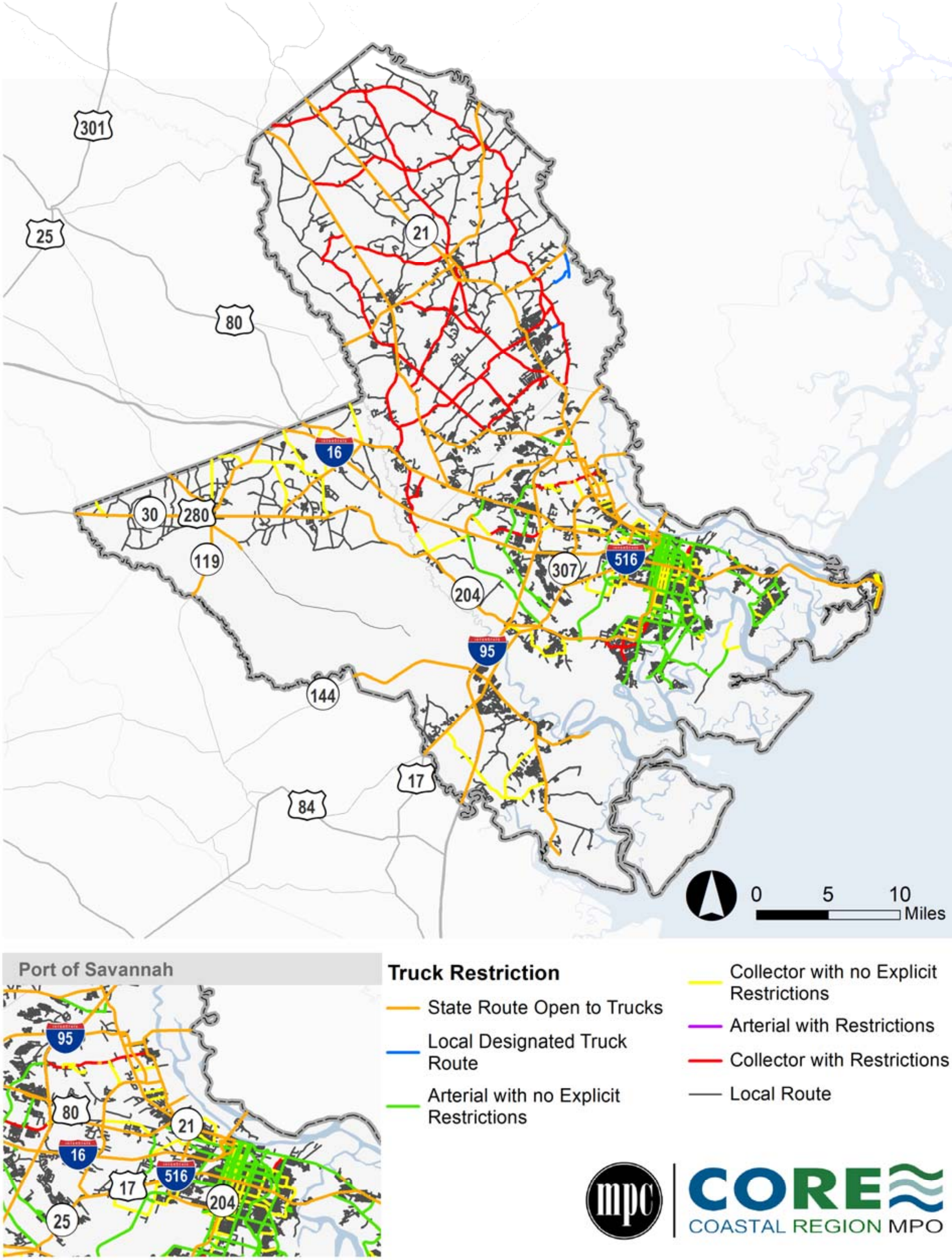
[123] City of Port Wentworth, Code of Ordinances, Chapter 13 –Motor Vehicles and Traffic, Section 13-3. - Trucks carrying hazardous substances.

[124] City of Rincon, Code of Ordinances, Chapter 78 –Traffic, Section 78-9. - Trucks carrying hazardous substances.

[125] City of Pooler, Code of Ordinances, Chapter 82 – Traffic and Vehicles, Sections 82-43. - Use of engine brakes and compression brakes prohibited.

[126] City of Pooler, Code of Ordinances, Chapter 82 – Traffic and Vehicles, Sections 82-4 and 82-5.

FIGURE 7.8 THROUGH TRUCK ROUTE RESTRICTIONS IN THE CORE MPO STUDY AREA



Source: Cambridge Systematics, Inc.

In Bryan and Effingham Counties, arterials are all on the state's network so they are open to through truck traffic. In Chatham County, arterials are generally not restricted to through truck traffic except for those that traverse downtown Savannah. These include portions of Oglethorpe Avenue, Liberty Street, and Bay Street in the City of Savannah.

Only Effingham County has collectors from which through truck traffic is specifically prohibited due to its official code. These include corridors such as Springfield Road, Clyo-Kildare Road, Stillwell Clyo Road, Blue Jay Road, and Goshen Road. Generally, these routes traverse rural and residential areas of the county and are not proximate to freight-intensive land uses. In the City of Pooler, through trucks are specifically prohibited from Old Louisville Road and Pine Barren Road which are classified as collectors. There are some freight-intensive land uses near the intersection of these two corridors including a truck parking facility. The City of Port Wentworth prohibits through trucks from Gulfstream Road and Airways Avenue. These corridors provide access to the Savannah-Hilton Head International Airport. Collector roadways in Bryan County are not specifically prohibited to through truck traffic as part of its official code.

8 FREIGHT RESILIENCY

Over the last decade, metropolitan planning organizations (MPOs), state departments of transportation (DOTs), and other transportation agencies have taken steps to assess the vulnerability of transportation infrastructure to extreme weather events and to integrate resilience planning considerations into transportation decision-making. The Federal Highway Administration (FHWA) defines resilience as "the ability to anticipate, prepare for, and adapt to, changing conditions and withstand, respond to, and recover rapidly from disruptions."[127] Freight resiliency entails the ability of the multimodal freight network to withstand disruptions with minimal impacts to safety and the economy. As large-scale disruptions to the freight network and associated supply chains have become more common, resiliency has become a much more important component of freight transportation planning.

Section 8 first identifies the risks, or hazards, which could disrupt the flow of goods across the region's freight network. It then performs a hazard assessment for a select group of those risks, focusing on identifying those parts of the CORE MPO region which are most susceptible. From there, the hazard assessment identifies vulnerable freight transportation assets. Vulnerable freight assets include bridges, roadways, railroads, and other components of the multimodal freight network that are within areas that are at risk for flooding, sea level rise, major storms (e.g., hurricanes) and other risks. By identifying vulnerable freight assets, the region will then know which particular assets may need to be "hardened" in order to withstand disruption and enhance resiliency. Lastly, the report develops preliminary strategies for mitigating those risks. Preliminary strategies include a range of actions that the CORE MPO may take, including planning, operations, and capital investments.

8.1 Freight Network Risks and Disruptors

This section of the report identifies the risks, or hazards, which could disrupt the flow of goods across the region's freight network. It then performs a hazard assessment for a select group of those risks and identifies the parts of the CORE MPO region that are most susceptible to the select group of risks. After that, this section of the report identifies the bridges, roadways, railroads, and other freight assets that are most vulnerable to disruption from the identified risks.

Risks and Disruptor Identification

Identifying threats and hazards is the first step in developing a hazard assessment. Hazards can be natural events (e.g., severe weather), technological (e.g., bridge failure), or human-caused (e.g., terrorism). For the RFTP Update, relevant hazards for the CORE MPO region were identified using information from the Federal Emergency Management Agency (FEMA) National Risk Index (NRI) and the statewide resiliency analysis performed as part of the 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP).

The National Risk Index (NRI) from the Federal Emergency Management Agency (FEMA) is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state, and federal governments; and private industry. The Risk Index leverages available source data for natural hazard and

[127] FHWA: https://www.fhwa.dot.gov/legsregs/directives/orders/5520.cfm

community risk factors to develop a baseline relative risk measurement for each U.S. county and census tract. The NRI is intended to help users better understand the natural hazard risk of their communities. The hazards covered by the NRI include:

- Avalanche
- Coastal Flooding
- Cold Wave
- Drought
- Earthquake
- Hail
- Heat Wave
- Hurricane
- Ice Storm
- Landslide
- Lightning
- Riverine Flooding
- Strong Wind
- Tornado
- Tsunami
- Volcanic Activity
- Wildfire
- Winter Weather

The resiliency analysis completed as part of the 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP) was the state's first comprehensive resiliency assessment completed as part of the long-range transportation planning process. It assessed GDOT's spending in response to weather related events, the level of risk to the transportation network in Georgia, and resiliency of the system to potential natural, technological, and human-made hazards. Relevant hazards to statewide transportation assets included in the 2050 SWTP/2020 SSTP resiliency analysis are shown in Table 8.1.

TABLE 8.1 NATURAL, TECHNOLOGICAL AND HUMAN-CAUSED HAZARDS REFLECTED IN THE 2050 SWTP/2020 SSTP RESILIENCY ANALYSIS

Natural	Technological	Human Caused
• Hurricane • Storm Surge • Inland Flooding • Tornado • Earthquake • Drought • Extreme Heat • Winter Storm • Sinkhole • Landslide	• Hazardous Materials Release • Pipeline Explosion • Dam Failure	• Cyber Attack Against Infrastructure

Source: Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

A key finding of the 2050 SWTP/2020 SSTP resiliency analysis was that the southeast corner of the state is at the highest risk for multiple hazards, including flooding, hurricane, and storm surge, among others. All modes of transportation in this region could face operation disruptions, structural damage and washout, and erosion of the coastal facilities caused by these hazards, including the Port of Savannah, Port of Brunswick, Savannah-Hilton Head International Airport, Brunswick-Golden Isles Airport, I-95, I-516, and other roadways, railways, and transit systems. Hazards that occur without warning will also pose challenges for evacuation.

Upon consultation with the RFTP steering committee, a subset of national and statewide risks was selected for a detailed investigation as part of the RFTP Update resiliency analysis. These include the following:

- Sea Level Rise/Coastal Flooding.
- Riverine Flooding.
- Hurricanes.
- Supply Chain Disruptors

The following subsections describe the hazards, their ability to disrupt freight flows, and their potential to damage freight assets.

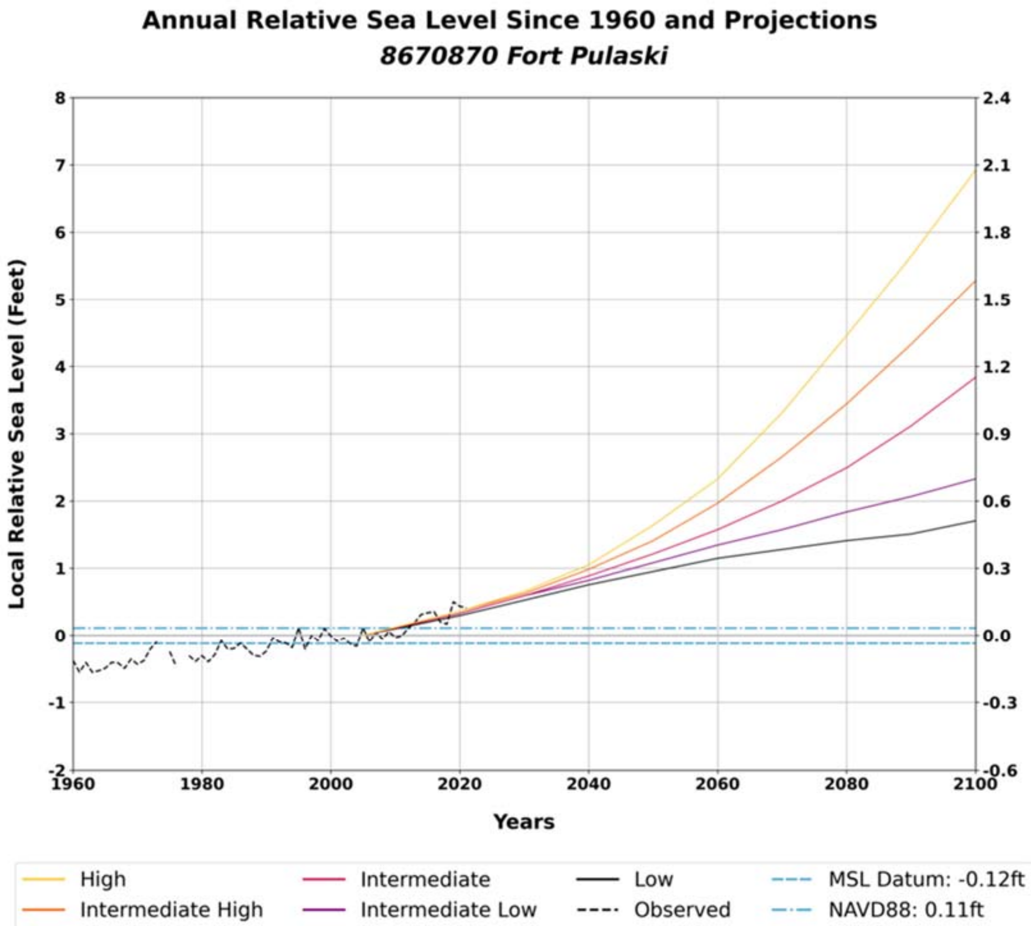
Sea Level Rise/ Coastal Flooding

The sea level around Georgia has increased up to 11 inches higher than it was in the 1950s as a result of both Georgia's sinking land and global warming.[128] In addition, sea level around Georgia is rising at an increasing speed, by as much as 1 inch every 2 years.[128] The sea level around Fort Pulaski has increased around 6 inches in the past 20 years; however, it is forecasted to rise another 6 inches in just the next 14 years.[129] Figure 8.1 below shows historical and projected sea level rise for the region using data from the National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services. It is projected that the sea level around Georgia will increase between 1 to 6.5-feet between 2020 and 2100.

[128] NOAA Tides and Currents – Fort Pulaski, Georgia (www.tidesandcurrents.noaa.gov).

[129] USACE High Projection (www.corpsclimate.us).

FIGURE 8.1. REDANNUAL RELATIVE SEA LEVEL RISE AND PROJECTIONS FOR FORT PULASKI

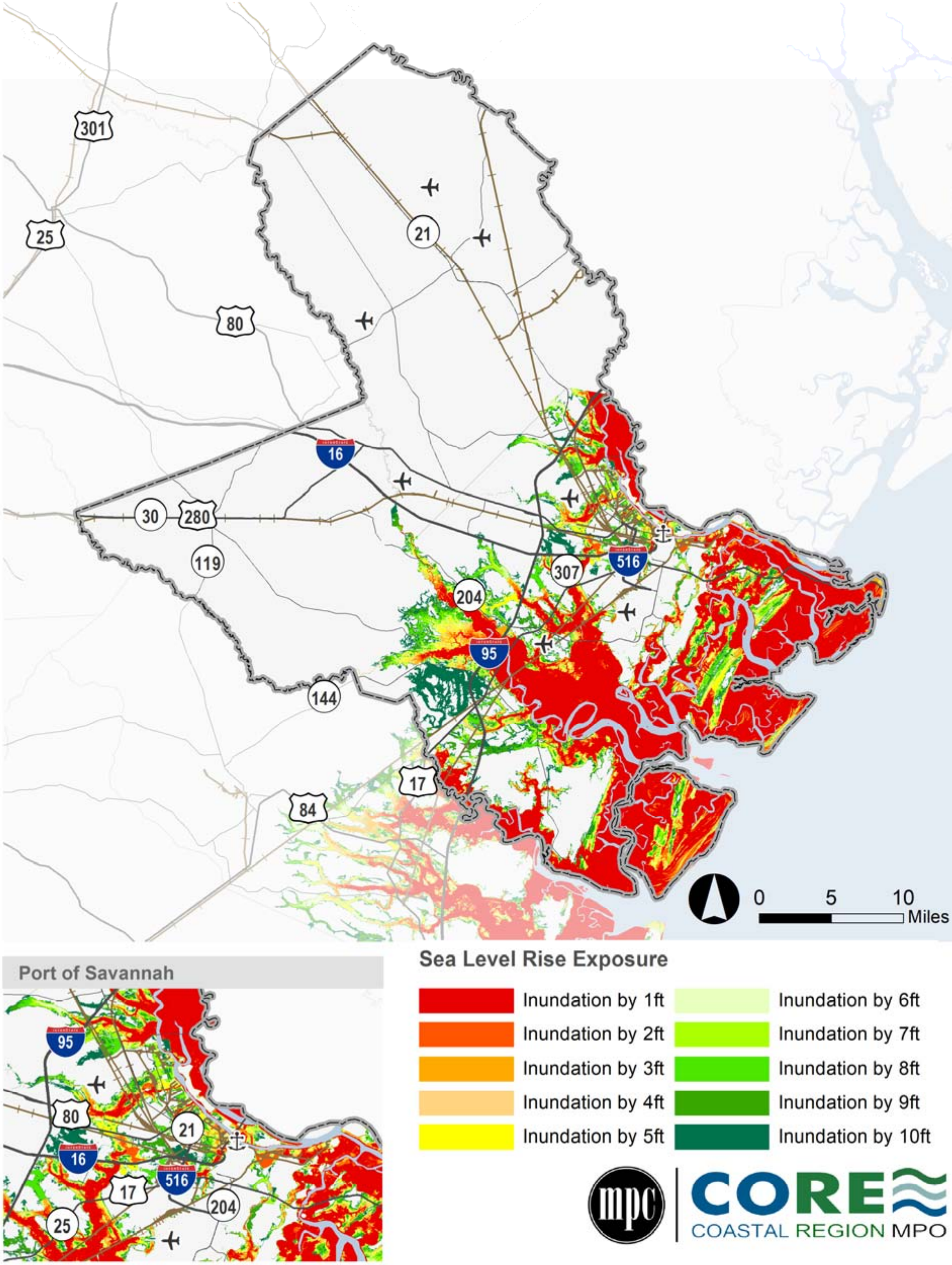


Source: National Oceanic and Atmospheric Administration, Center for Operational Oceanographic Products and Services, Sea Level Trends, https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8670870.

Based on geography alone, the CORE MPO region will be susceptible to sea level rise in the future. This includes the people, property, and infrastructure in the region. Sea level rise will not only affect areas of the CORE MPO region closest to the ocean. When the sea level rises, more ocean water will enter drainage systems that currently empty into the ocean, and water will cause backpressure in these pipes. Water can spill out into the streets far away from the ocean and cause additional flooding.

Figure 8.2 shows sea level rise vulnerability in the CORE MPO region, based on areas that are likely to be inundated by different scales of sea level rise. Areas along the major rivers such as the Savannah and Ogeechee Rivers, as well as most of the marshlands in the eastern part of the region are most susceptible to sea level rise, with only one foot of additional sea level enough to inundate most of these locations. It should be noted that though inundation by 5 or more feet of sea level rise is included in Figure 8.2, that magnitude of sea level rise is linked to very long-term projections - beyond the turn of the century. Inundation by 4-feet or less is more consistent with a 30- to 50-year planning horizon.

FIGURE 8.2 SEA LEVEL RISE EXPOSURE



Source: National Oceanic Atmospheric Administration, 2022.

Related to sea level rise is storm surge, which is defined as "an abnormal rise in sea level accompanying a hurricane or other intense storm, and whose height is the difference between the observed sea surface and the level that would have occurred in the absence of the cyclone"[130]. Storm surge can be produced by tropical cyclones, nor'easters, or strong winter storms, although the latter two are rarely seen in Georgia. Along the Georgia Coast, the difference between low tide and high tide can be up to 10 feet during the spring[131]. Combined with the waves driven by strong winds, the impact of storm surge could cause erosion in coastal areas and damage transportation assets.

Table 8.2 lists major storm surge events that affected the CORE MPO region and surrounding areas since the early 1800s[132]. The extent of storm surge can reach close to 20 feet above normal. The *2019 Georgia Hazard Mitigation Strategy* estimated that the recurrence interval for a major hurricane making landfall in Georgia is approximately once every 36 years.

[130] National Weather Service, 2022

[131] Georgia Hazard Mitigation Strategy, 2019

[132] This list only includes events with recorded storm tide elevations. Other events during this period may have produced storm surge or coastal flooding, but no storm tide records are available.

TABLE 8.2 NOTABLE STORM SURGE EVENTS IN GEORGIA FROM TROPICAL CYCLONES

Date	Event	Description of Impact on Georgia
September 7–8, 1804	"Great Gale of 1804"	St. Simons Island was flooded with water 7 feet above normal. The tide rose 10 feet above mean sea level on the Savannah waterfront, severely flooding Pablo Creek (currently the intracoastal waterway). More than 500 persons drowned.
September 16–17, 1813	Category 3–4 Hurricane	Storm surge of at least 19 feet above mean low water.
September 8, 1854	Category 3 Hurricane	Fort Pulaski—Storm tide elevation 10.50 feet above normal.
August 27, 1881	Hurricane	Fort Pulaski—Storm tide level 11.57 feet above normal. Isle of Hope—11.82 feet above normal.
August 27, 1893	Category 3 Hurricane	Fort Pulaski—Storm tide elevation between 12 to 13 feet above normal. Heavy storm surge of approximately 16 feet in other areas.
October 2, 1898	Category 4 Hurricane	Hutchinson Island, opposite Savannah, was completely inundated to a depth of 4 to 8 feet. Campbell Island, near Darien, was inundated, while Darien reported a tidal wave of about 13 feet above mean high water mark and Sapelo Island reported about 18 feet above the same. Brunswick experienced a 16-foot storm surge in its downtown. This hurricane caused 179 deaths and damage was estimated at $2.5 million.
October 14, 1947	Hurricane	High tides along the Georgia and South Carolina coasts ranged from 12 feet above mean low tide at Savannah Beach and 9.6 feet at St. Simons Island near Brunswick.
September 4, 1979	Hurricane David	Storm surge of 3 to 5 feet and heavy surf.
October 8–9, 2016	Hurricane Matthew	FEMA Disaster 4284; Storm surge of 2 to 8 feet along the entire Georgia coast, including a surge of 7.5 feet at Fort Pulaski.
September 11–13, 2017	Hurricane Irma	FEMA Disaster 4338; Storm surge of 4 to 8 feet along the entire Georgia coast, including a surge of 5 feet at Fort Pulaski, compounded by a rising tide resulting in the second highest water level on record.

Source: Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

The combined effect of rising sea level and other related phenomenon such as king tide, storm surge, shoreline erosion, and other natural disasters could result in a catastrophic impact on infrastructure and human life.

Riverine Flooding

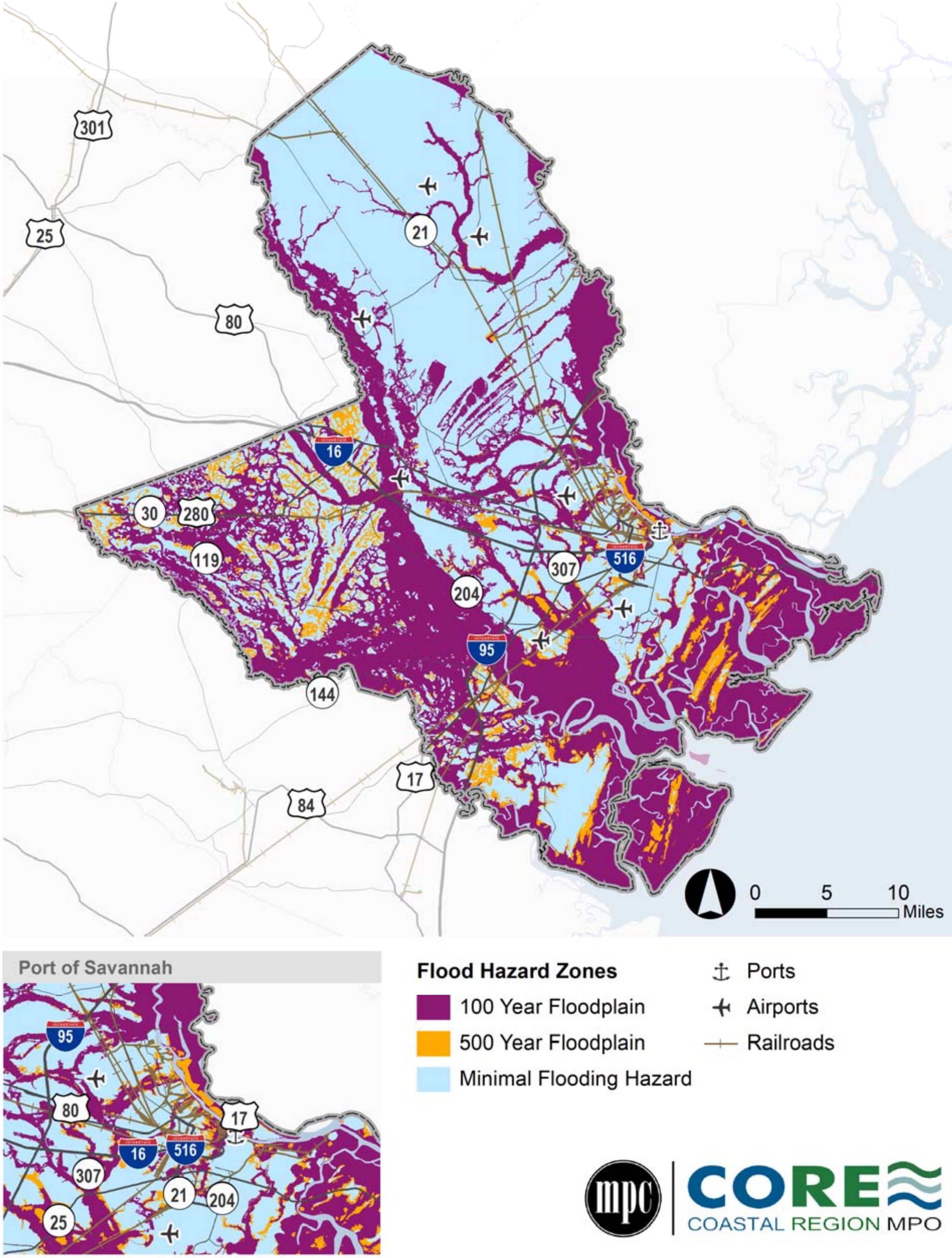
Floods occur when water from different sources overflow their typical boundaries, causing any general or temporary inundation of normally dry land areas. Floods are considered a natural and inevitable occurrence; they happen with seasonal rains or when stormwater drains into river basins and fills them beyond their capacity. However, floods can cause widespread damage to private property and transportation infrastructure and can lead to road closures, bridge damage, and disruptions of travel routes across large areas. Flash floods, which are caused by strong storms and can appear rapidly with little warning, can cause significant damage and dangerous conditions to people and roads.

Floodplain data from the Federal Emergency Management Agency (FEMA) is used to show areas that are vulnerable to riverine flooding. FEMA uses digital flood insurance rate maps (DFIRM), which are flood risk maps that show flood hazard areas like the 100- and 500-year floodplains. This corresponds to a 1 percent chance or a 0.2 percent chance, respectively, of an area being flooded in a given year.

These floodplains are not static and are updated periodically when land erodes, more impervious surfaces are built in the region, and weather patterns change. For example, paving a parking lot will force water to flow into rivers and streams more quickly than if the land was covered with a pervious surface like grass and will cause more flash floods and overwhelm the banks of streams more easily.

These areas of flood vulnerability are mapped in Figure 8.3. Areas in the east, south, and west parts of the region are most susceptible to riverine flooding as most of these areas are in 100-year floodplains. Many of these areas overlap with those susceptible to sea level rise, but also include areas further up the Savannah and Ogeechee Rivers, as well as areas to the west of I-95 and south of I-16.

FIGURE 8.3 FLOOD HAZARD ZONES



Source: Federal Emergency Management Agency's Flood Insurance Rate Map, 2022.

Table 8.3 lists some of the most notable flood events in the CORE MPO region.

TABLE 8.3 NOTABLE FLOOD EVENTS IN THE CORE MPO REGION

Year	Area Affected	Recurrence Interval	Remarks
1881	Savannah Area	>100 years	335 deaths; $1.5 million in damages
1893	Savannah Area	>100 years	2,500 deaths; $10 million in damages
1929	Savannah, Ogeechee, and Altamaha Rivers	25 to >100 years	6–10 inches of rain; $3 million in damages
1940	Ogeechee and Savannah Rivers	10 to 75 years	25 deaths; $850,000 in damages; hurricane
1990	Savannah, Ogeechee, and Ohoopee Rivers	>100 years	FEMA Disaster 880; $7.6 million in damages, tropical storm
1991	Altahama, Apalachicola, Ochlockonee, Ogeechee, Satilla, and Savannah Rivers	25 to 50 years	FEMA Disaster 897; $3.4 million in damages
1994	Savannah area	25 to >100 years	FEMA Disaster 1042; 15 inches of rain $10.5 million in damages

Source: Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

Hurricanes

Hurricanes and tropical storms (also known under their formal name as tropical cyclones) are potentially severe storms that have a low-pressure center, colloquially called the “eye” of the storm, surrounded by a distinctive rotating pattern of storms. They bring strong winds and heavy rains that can impact areas stretching hundreds of miles. For the CORE MPO region, tropical cyclones form over the Atlantic Ocean between June 1 and November 30 during the Atlantic hurricane season. They are ranked in order of severity, with tropical depressions having surface wind speeds below 38 mph, tropical storms having a wind speed between 39 and 73 mph, and hurricanes having a windspeed of 74 mph or greater.

Hurricanes are ranked on the Saffir-Simpson Hurricane Wind Scale based on the sustained wind speed. Those categories and associated damage are listed in Table 8.4.

TABLE 8.4 SAFFIR-SIMPSON HURRICANE WIND SCALE

Category	Sustained Wind Speed (mph)	Types of Damage due to Hurricane Winds
1	74-95	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted,

Category	Sustained Wind Speed (mph)	Types of Damage due to Hurricane Winds
		blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130-156	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	> 157	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center.

Not only can these high winds cause damage, but storm surge that accompanies hurricanes making landfall can be just as deadly. These storm surges are typically caused by the force of the hurricane's winds pushing ocean waters toward the coast, though the low pressure at the center of the hurricane also contributes to a lesser extent.

There have been 23 hurricanes recorded in Georgia since 1851. Most recently, Hurricane Mathew impacted the coastal region in 2016, Irma impacted the entire state in 2017, and Michael impacted southwest and central Georgia in 2018. The *2019 Georgia Hazard Mitigation Strategy* estimated that over a 200-year historical period, 36 tropical cyclones affected the state (not necessarily a direct impact) using the Georgia's tropical cyclone history. This translates to about an 18 percent chance of a tropical cyclone affecting Georgia per year or approximately one hurricane every 5.5 years[133]. Table 8.5 summarizes the number of hurricanes that tracked over Georgia since 1851 by category.

TABLE 8.5 TOTAL NUMBER OF HURRICANES THAT TRACKED OVER GEORGIA (1851 - 2022)

Hurricane Intensity	# of Hurricanes
Category 1	15
Category 2	5
Category 3	2
Category 4	1
Category 5	0
Total	**23**

Source: National Oceanic Atmospheric Administration; Spatial Hazard Events and Losses Database for the United States (SHELDUS); Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

[133] 2019 Georgia Hazard Mitigation Strategy

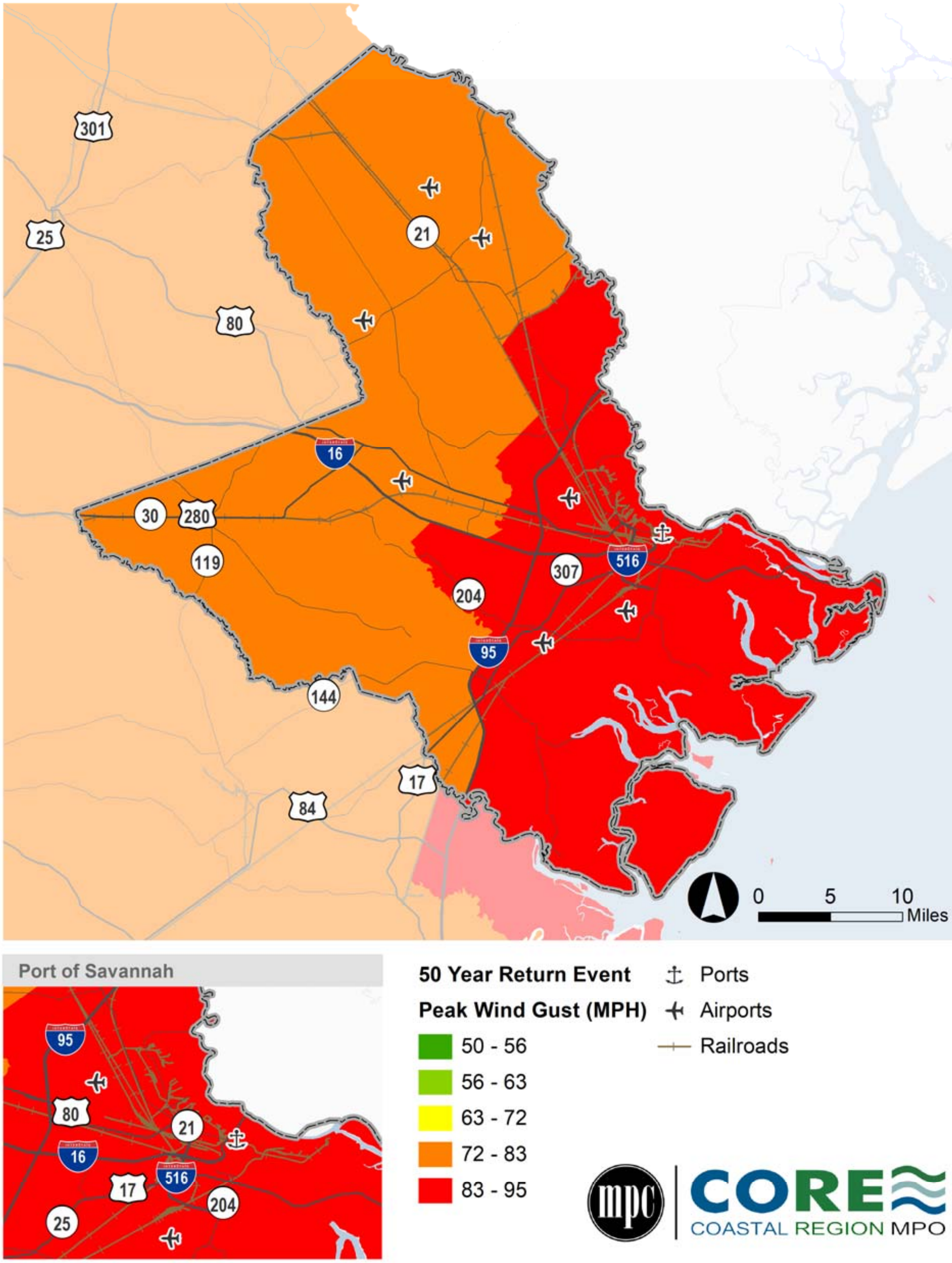
Table 8.6 describes notable and historic tropical cyclonic events that affected the CORE MPO region since 1804. Figure 8.4 depicts the peak wind gusts experienced by the region during storm events.

TABLE 8.6 NOTABLE AND HISTORIC TROPICAL CYCLONIC EVENTS AFFECTING GEORGIA

Year	Name	Area Affected	Details
1804	N/A	Savannah Area	Hutchison Island inundated; 3 deaths
1813	N/A	Coastal Georgia	28 deaths
1881	N/A	Savannah Area	$1.5 million in damages; 335 deaths
1893	N/A	Savannah Area	$10 million in damages; 1,000 deaths
1898	N/A	Coastal Georgia	Category 4; 120 deaths
1911	N/A	Coastal Georgia	18” of rain in 24 hours
1928	N/A	Savannah Area	11” of rain
1940	N/A	Coastal Georgia	>$1 million in damages
1947	N/A	Savannah Area	>$2 million in damages
1959	Gracie	Coastal Georgia	$5 million in damages
1964	Dora	Coastal Georgia	Death Rate 177; $8 million in damages
1979	David	Coastal Georgia	2 deaths
1994	Alberto	Statewide	FEMA Disaster1033; Extreme flooding on Flint and Ocmulgee Rivers; >$400 million in damages
2004	Frances, Ivan, and Jeanne	Statewide	FEMA Disaster 1554 and 1560; Wind/rain damage in 107 counties
2005	Dennis	Statewide	Wind/rain damage; Flooding
2016	Matthew	Coastal Georgia	FEMA Disaster 4284; Wind/rain/coastal flooding in 20 Southeast Georgia counties; $175 million in damages
2017	Irma	Statewide	FEMA Disaster 4338; Wind/rain/coastal flooding affecting all 159 Georgia counties; 1.5 million out of power; 5 fatalities; est. $150 million in uninsured damages

Source: Spatial Hazard Events and Losses Database for the United States (SHELDUS); Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

FIGURE 8.4 PEAK WIND GUST



Source: National Oceanic and Atmospheric Administration, Office for Coastal Management, Hazards U.S. Multihazards (HAZUS-MH) Tool.

Supply Chain Disruptions

As supply chains have become more global and the world economy has become more connected, there is greater potential for disruptions to impact the flow of goods and processes necessary to make supply chains run seamlessly. Disruptions can include a range of events including weather events, labor shortages, pandemics, political unrest, trade wars, infrastructure failures, cyber-attacks, and other natural and man-made events. In recent years, disruptions have become more common, requiring the private sector to adjust their supply chains more frequently. This section explores additional disruptions (beyond those discussed in the previous section) that may impact supply chains, and subsequent freight flows, in the CORE MPO region.

Extreme Weather Events

While the first portion of this section focused on natural hazards and weather events that are most prevalent in the CORE MPO region, there are multiple extreme weather events that could impact the region and disrupt supply chains.

Droughts are climate events of prolonged shortage of water supply caused by a deficiency of precipitation, dry seasons, or El Nino over an extended period (usually a season or more)[134]. Although the adverse effects of droughts are primarily on environmental, agricultural, and social aspects, there also are transportation system impacts. The shortage of water supply creates challenges for inland waterway transport. Long-term droughts could cause cracks in the asphalt and damage the roadway pavements, leading to wildfires, and creating safety hazards for vehicles and pedestrians. This type of damage to the freight network would limit the ability of supply chains function effectively. Table 8.7 lists some of the most notable drought events in Georgia.

[134] 2019 Georgia Hazard Mitigation Strategy.

TABLE 8.7 NOTABLE DROUGHT EVENTS IN GEORGIA

Year	Area Affected	Remarks
1903–1905	Statewide	Severe
1924–1927	North-Central Georgia	One of the most severe of the century
1930–1935	Mostly statewide	Affected most of the U.S.
1938–1944	Statewide	Regional drought
1950–1957	Statewide	Regional drought
1968–1971	Southern and Central Georgia	Variable severity
1977	Statewide	Disaster 3044
1985–1990	North and Central Georgia	Regional drought
1999–2009	Statewide	Severe
2011–2013	Statewide	Variable severity
2016	Northwest Georgia	Severe drought, associated with North Georgia wildfires

Source: Spatial Hazard Events and Losses Database for the United States (SHELDUS); Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

Earthquakes are sudden motions or shaking of the earth's surface resulting from an abrupt release of energy in the earth's lithosphere creating seismic waves[135]. The size of earthquakes can range from unnoticeable to those violent enough to destroy buildings, roadways, bridges, and infrastructure. While no earthquake events were recorded in Georgia from 1952 to 2017[136], seismic activities outside the state could impact the CORE MPO region. For example, a significant earthquake event on the U.S. West Coast would divert maritime traffic to Savannah and other East Coast ports.

FEMA defines extreme heat as a long period (two to three days) of high heat and humidity with temperatures above 90° F (https://www.ready.gov/heat). Besides health concerns, extreme heat impacts the freight network. It can cause concrete to expand and buckle, crack, or shatter, and asphalt to deform, making the roadways uneven and creating potential safety hazards for driving. Extreme heat can cause steel rails to overheat, causing rails to bend, particularly around curves, increasing the need for slow orders and the risk of train derailments. Extreme heat will also lead to delays or cancelation of flights as airplanes lose lift at higher temperatures which impacts air cargo operations. In addition, extreme heat increases the likelihood of afternoon thunderstorms that can impact air cargo operations (in the form of delayed flights which further cause operational constraints at runways) and result in poor roadway conditions (e.g., low visibility, slick pavements) that would impact trucking.

135 Disaster Preparedness Plan: Get Prepared Today (https://grizzlytarps.com/blog/disaster-preparedness-plan-get-prepared-today/)

136 Spatial Hazard Events and Losses Database for the United States (SHELDUS); Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

Climate change driven increase in the frequency of extreme heat events would have an outsized impact on workers in freight and freight-dependent industries such as truck drivers, construction workers, longshoremen, and other workers whose jobs require them to be outdoors. The added cautionary steps needed to keep workers safe could lead to higher business costs and job losses. An increased frequency in extreme heat events would also exacerbate the heat island effect, which would also have a disproportionate impact on freight workers and vulnerable populations. Heat islands are urbanized areas that experience higher temperatures than outlying areas due to structures such as buildings, roads, and other infrastructure absorbing and re-emitting the sun's heat more than natural landscapes such as forests and water bodies.[137] As a result, daytime temperatures in urban areas are about 1–7°F higher than temperatures in outlying areas and nighttime temperatures are about 2-5°F higher. As shown in Table 8.8, there were 31 extreme heat events in Georgia between 1980 and 2017.

[137] https://www.epa.gov/heatislands

TABLE 8.8 NOTABLE EXTREME HEAT EVENTS IN GEORGIA (1980 – 2017)

Begin Date	End Date	Duration (days)	Impacted Counties
7/1/1980	7/31/1980	31	Statewide
8/1/1980	8/31/1980	31	Statewide
6/1/1985	6/1/1985	1	Muscogee, Montgomery, Henry, Peach
5/20/1987	5/20/1987	1	Thomas
6/2/1987	6/2/1987	1	Muscogee
7/10/1987	7/10/1987	1	Bibb
7/14/1987	7/14/1987	1	Muscogee
7/2/1987	7/2/1987	1	Richmond
7/31/1987	7/31/1987	1	Muscogee
8/1/1987	8/31/1987	31	Carroll, Muscogee, Richmond, Bibb, Burke
6/18/1988	6/18/1988	1	Dodge
6/24/1988	6/24/1988	1	Whitfield
6/27/1988	6/27/1988	1	Bibb
7/1/1988	7/1/1988	1	Dougherty
7/15/1988	7/15/1988	1	Dodge
8/5/1988	8/5/1988	1	Muscogee
7/9/1990	7/9/1990	1	Gwinnett
7/11/1992	7/11/1992	1	Muscogee
6/9/1995	6/9/1995	1	Fulton, Greene
7/20/1999	7/31/1999	12	Coweta
8/1/1999	8/1/1999	1	Elbert, Hart, Coweta
8/8/1999	8/8/1999	1	Sumter
7/31/2006	7/31/2006	1	Rockdale
8/1/2007	8/27/2007	27	Floyd, Fulton
8/11/2007	8/11/2007	1	Burke
7/23/2010	7/24/2010	2	Bleckley
7/26/2010	7/26/2010	1	Twiggs
9/5/2015	9/5/2015	1	Walker
7/26/2016	7/26/2016	1	Muscogee
8/4/2016	8/4/2016	1	Carroll
8/5/2016	8/5/2016	1	Muscogee

Source: Spatial Hazard Events and Losses Database for the United States (SHELDUS); Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

Extreme cold and winter storms can be just as disruptive to supply chains as extreme heat. Winter storms are events in which varieties of precipitation, such as snow, sleet, or freezing rain, are formed due to low temperatures. Winter storms can cause damage to transportation infrastructure, malfunction of traffic control and monitoring devices, and delays or closure of roadways, railways, airports, and seaports. The treatment of roadways with salt during winter storms contributes to pavement deterioration and can also cause wear and tear on freight vehicles. In addition, the excessive snow and ice will often increase the likelihood of traffic accidents.

Though counties in northern Georgia are more susceptible to severe winter weather/winter storm events, there is some level of exposure for the CORE MPO region. Furthermore, severe winter weather/winter storm events in other parts of the state could impact freight assets and supply chains that are tied to the CORE MPO region. For example, a winter weather/winter storm event that results in the temporary suspension of operations at the Appalachian Regional Port would impact the Port of Savannah. Or, as another example, Interstate highway closures in Metro Atlanta due to snow or ice would impact truck traffic and truck parking in the CORE MPO region.

A tornado forms from strong low-pressure systems often as part of a cold front when a column of air extends from the cloud and comes in contact with the surface of the ground, resulting in a violently rotating funnel with a very strong updraft. With the strong winds, condensation, dust, and debris they usually contain, tornados are very destructive and often uproot trees, roll vehicles, topple buildings, and launch objects hundreds of yards. Tornadoes can occur anywhere within the state. They can disrupt supply chains by interrupting airport and seaport operations, damaging traffic and rail operating equipment (such as signals, cameras, and other electronic devices), and also by damaging roadway pavement and rail tracks. Table 8.9 lists some of the most notable tornado events that affected the State of Georgia.

TABLE 8.9 NOTABLE TORNADO EVENTS IN GEORGIA

Year	Area Affected	Description
1903	Gainesville Area	200 deaths; 400 injuries; 1,500 homeless
1936	Gainesville Area	203 deaths; >1,000 injuries; 800 homes destroyed
1944	Hall and Franklin Counties	18 deaths
1974	Dawsonville Area	4 deaths
1992*	Lumpkin County	FEMA Disaster 69; F4 tornado; 6 deaths; 170 injuries; >1,000 homes damaged; $2 million in damages
1993*	Hall County	FEMA Disaster 980; 44 homes damaged; $2.5 million in damages
1994*	Northwest Georgia	FEMA Disaster1020; 19 deaths; >200 injuries; $67.5 million in damages
1994*	Camden County	FEMA Disaster 1042; F2 intensity
1995*	Albany Area	FEMA Disaster 1076; 36 injuries; 250 buildings damaged
1998*	Hall County and Metro Atlanta	FEMA Disaster 1209; tornadoes causing extensive damage to homes and critical facilities
1999*	Dooly and Candler Counties	FEMA Disaster 1271; tornadoes causing damage to homes, especially in Vienna
2000*	Southwest Georgia	FEMA Disaster 1315; 18 deaths; >100 injuries; $5 million in damages

Source: Spatial Hazard Events and Losses Database for the United States (SHELDUS); Georgia Department of Transportation, 2050 Statewide Transportation Plan (SWTP)/2020 Statewide Strategic Transportation Plan (SSTP), *Resiliency*, November 2020.

*Note: Presidential declared disaster.

Pandemics

In January 2020, the first case of COVID-19 in the U.S. was confirmed. It had been more than a century since the U.S. had dealt with a virus that was as contagious and deadly. The COVID-19 pandemic had a profound impact on people's day-to-day lives. The impacts to transportation and trip-making behavior were particular notable and include:

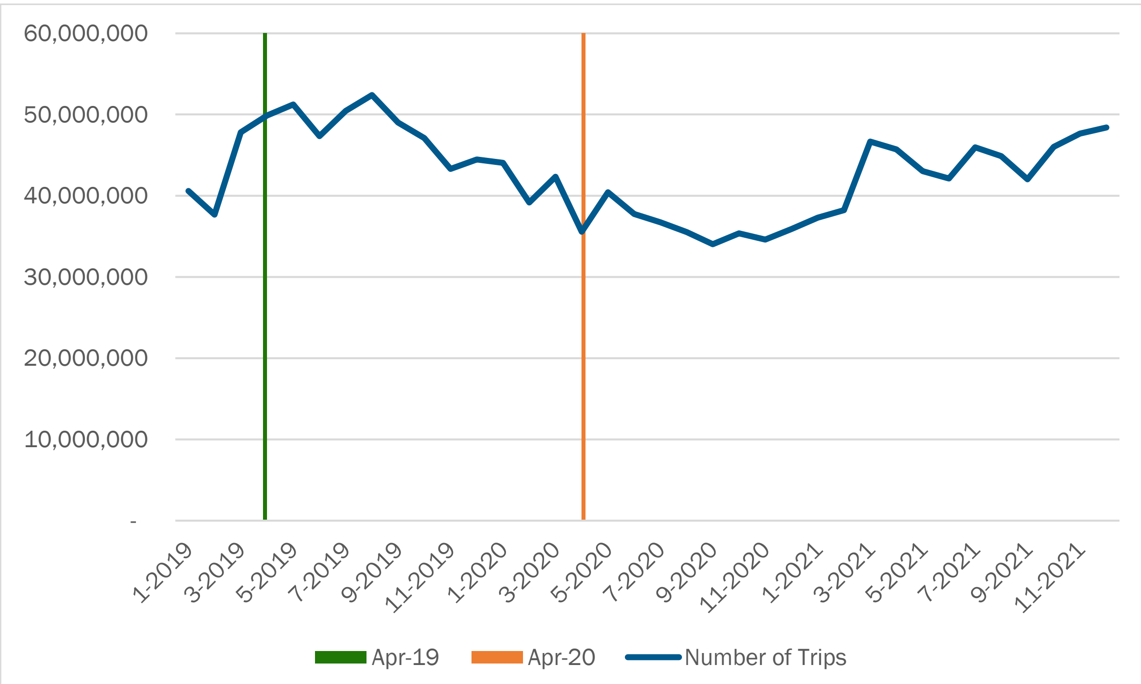
- In 2020, passengers traveling by air decreased by 63 percent.[138]
- Monthly trips in the CORE MPO region decreased by about 29 percent between April 2019 and April 2020 (see Figure 8.5).[139]

[138] Airports Council International. "The impact of COVID-19 on the airport business and the path to recovery." March 25, 2021. https://aci.aero/2021/03/25/the-impact-of-covid-19-on-the-airport-business-and-the-path-to-recovery/

[139] Bureau of Transportation Statistics, Daily Travel during the COVID-19 Public Health Emergency, https://www.bts.gov/daily-travel.

- In mid-March 2021, 36 percent of people made more purchases online because of COVID-19. This habit peaked during the 2020 holiday shopping season when 56 percent of people made more purchases online because of COVID-19.[140]
- In a 2021 survey, 65 percent of workers reported wanting to work remotely permanently, about one-third of workers want a hybrid work schedule with some days at home and some in the office, and less than 5 percent of workers wanted to work in the office full-time.[141]

FIGURE 8.5 MONTHLY TRIPS IN THE CORE MPO REGION



Source: Bureau of Transportation Statistics, Daily Travel during the COVID-19 Public Health Emergency, https://www.bts.gov/daily-travel; Cambridge Systematics, Inc. analysis.

The pandemic caused a historic demand for goods which had a huge impact on supply chains. Retailers struggled to re-stock store shelves and warehouses as the demand for goods coupled with the substantial increase in e-commerce as the preferred method of shopping led to trucking capacity shortages – an industry with pre-existing labor challenges. In addition, labor shortages in warehouses, distribution centers, and factories due to the pandemic caused capacity constraints on the production side as well. These and the changes listed above are the immediate impacts of the pandemic. At this moment, it is unclear how many, if any, of these impacts may become long-term trends. For instance, some travel patterns and traffic volumes have already exceeded pre-pandemic figures while others have not returned to their pre-pandemic levels.

140 Bureau of Transportation Statistics. "Effects of COVID-19 on In-Person vs. Online Shopping." https://www.bts.gov/browse-statistical-products-and-data/covid-related/effects-covid-19-person-vs-online-shopping

141 US DOT Presentation on Transportation Challenges Post COVID-19, Nov. 18, 2020.

The impacts that do remain as long-term trends will continue to impact supply chains and subsequently alter how supply chains should be considered in the context of freight transportation planning.

Labor Shortages

Labor shortages caused by the COVID-19 pandemic greatly impacted global supply chains as millions succumbed to illness, many more were unable to work due to ailment, and still others could not safely do their jobs while maintaining public health guidelines on social distancing. The pandemic also greatly impacted how, where, and for whom people worked. In 2021, nearly 39 million people quit their jobs.[142] In April 2021, job openings across the country rose to an unprecedented 9.3 million which surpassed the previous January 2019 record of 7.5 million jobs[143], according to data from the Bureau of Labor Statistics.[144] In Georgia, there were 338,000 job openings in April 2021. The trend of increasing job openings continued through March 2022, when job openings rose to 11.9 million nationally and 419,000 in Georgia.[145] However, job openings in Georgia actually peaked several months later at 440,000 in June 2022.

The labor shortage challenges caused by the COVID-19 pandemic exacerbated existing labor shortages within the transportation industry as it was already suffering a labor shortage long before pandemic. The American Trucking Association has reported a truck driver shortage since 2005. This labor shortage acutely impacts the transportation system because trucks move more freight than any other mode and 44 percent of trucking's operational costs is driver compensation.[146] Besides transportation, associated industries such as warehousing and distribution also felt the impacts of pandemic-related labor shortages, worsening the ability of supply chains to keep up with global demand.

Cyberattacks and Infrastructure Failures

Cyberattacks are of concern for public agencies and private companies in the transportation industry, such as airlines, pipeline owners and operators, and trucking companies. On the public sector side, transportation system and infrastructure impacts from cyberattacks include disruptions to highway traffic control and Intelligent Transportation Systems (ITS), port operations and communication, and airport traffic control and communication systems. In addition, as Supervisory Control and Data Acquisition (SCADA) systems are becoming more prevalent in City Management and Public Works departments, public assets that are critical to supply chains are more exposed to ransomware, malware, and other cyberattacks.[147] For example, SCADA systems are used in distribution systems such as electrical power grids and water distribution and

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142 MarketWatch. "'The Great Resignation' slowed in October, but 4.2 million Americans still quit jobs." December 8, 2021. https://www.marketwatch.com/story/people-quit-jobs-at-slightly-slower-rate-in-october-11638976546

143 U.S. Bureau of Labor Statistics. "Monthly Labor Review." June 2020. https://www.bls.gov/opub/mlr/2020/article/job-openings-hires-and-quits-set-record-highs-in-2019.htm

144 U.S. Bureau of Labor Statistics. "Job Openings and Rates by Industry and Region, Seasonally Adjusted." December 2022. data.bls.gov.

145 U.S. Bureau of Labor Statistics. "Job Openings Levels and Rates by Industry and Region, Seasonally Adjusted." June 2022. https://www.bls.gov/news.release/jolts.t01.htm

146 American Trucking Association. "An Analysis of the Operational Costs of Trucking: 2022 Update." August 2022. https://truckingresearch.org/wp-content/uploads/2022/08/ATRI-Operational-Cost-of-Trucking-2022.pdf

147 2018 Georgia Hazard Identification and Risk Assessment

wastewater collection systems. [148] They are also used by the private sector to manage oil and natural gas pipelines, railway transportation systems, and other critical infrastructure.

On the private sector side, transportation system and infrastructure impacts from cyberattacks include disruptions to railroad freight operations and communication systems as well as natural gas and refined petroleum pipeline operations and safety control systems. Though privately owned, there is a clear public interest in limiting disruptions to these systems. Between June 2020 and June 2021 there was a 186 percent increase in weekly ransomware attacks on the transportation industry at the national level.[149] Furthermore, cyberattacks are a growing risk as technology becomes increasingly integrated into the transportation industry, especially in the form of connected and autonomous technologies. If outside parties gain unauthorized access to networked transportation systems, these incidents may result in crashes, malfunctions, and damaged infrastructure. Some motor carriers have cited concerns over cybersecurity attacks as a source of hesitation for implementing Advanced Driver Assistance Systems (ADAS) and other connected vehicle technologies in their fleets.[150]

Cyberattacks have the potential to greatly disrupt supply chains. They can create circumstances where freight transportation providers are unable to operate or cannot operate in a safe fashion. Thus, adaption strategies focused on minimizing risks associated with cyberattacks are important for the region to consider.

8.2 Hazard Assessment for Sea Level Rise, Riverine Flooding, Hurricanes, and Supply Chain Disruptions

Application of the FEMA NRI to the CORE MPO Region

Natural hazard risk, in the most general terms, is often defined as the likelihood (or probability) of a natural hazard event happening multiplied by the expected consequence if a natural hazard event occurs, as shown in the equation below.

$$Risk = Likelihood \times Consequence \times Vulnerability$$

As described in section 2.1, the National Risk Index (NRI) dataset and online tool from the Federal Emergency Management Agency (FEMA) illustrates the risk level for 18 natural hazards across the U.S. The primary output of the dataset and tool is the NRI score, a baseline relative risk measurement for each U.S. county and census tract defined at the national level. [151] Essentially, the NRI score is risk weighted by sociodemographic factors to identify populations that are more exposed to hazards and are most vulnerable for experiencing negative

[148] Cyberthreats, Vulnerabilities and Attacks on SCADA Networks, Rose Tsang, 2010 (https://www.researchgate.net/publication/242464191_Cyberthreats_Vulnerabilities_and_Attacks_on_SCADA_Networks).

[149] Cybertalk.org. "Ransomware attacks on the transportation industry, 2021." July 28, 2021. https://www.cybertalk.org/2021/07/28/ransomware-attacks-on-the-transportation-industry-2021/

[150] Truckinginfo. "ATRI: Class 8 Carriers Hesitant of ADAS Adoption." April 28, 2021. https://www.truckinginfo.com/10142325/atri-class-8-carriers-hesitant-of-adas-adoption

[151] Federal Emergency Management Agency, National Risk Index Technical Documentation, version 1.18.1, November 2021.

outcomes. [152] Communities, at the Census tract or county level, are classified as having “Very Low” to “Very High” risk based on their NRI score.

The risk element of the NRI score is the “Expected Annual Loss” (EAL), which quantifies the anticipated economic damage resulting from natural hazards each year as the average economic loss in dollars. It does this by combining the expected loss of building value, population, and agriculture value each year due to natural hazards.

$$EAL = Annualized\ Frequency \times Historic\ Loss\ Ratio \times Exposure$$

The EAL aligns with the general risk equation where:

- Likelihood = Annualized Frequency (i.e., the number of occurrences of a hazard over time);
- Consequence = Historic Loss Ratio (i.e., the representative percentage of a location’s hazard type exposure that experiences loss due to a hazard occurrence or the average rate of loss associated with the hazard occurrence); and
- Vulnerability = Exposure (i.e., the representative value of buildings, population, or agriculture potentially exposed to a natural hazard).

Because of this, Expected Annual Loss can be considered a robust indicator of risk and consequently be used to develop an indicator-based approach to assess the risks of sea level rise, riverine flooding, and hurricanes to the CORE MPO region’s multimodal freight network. This process is outlined in Figure 8.6.

[152] The formal definition for the FEMA NRI score is: $Risk = Expected\ Annual\ Loss \times Social\ Vulnerability \times {}^{1}/_{Community\ Resilience}$. “Expected annual loss” is the average economic loss in dollars resulting from a natural hazard. “Social vulnerability” is the susceptibility of social groups to the adverse impacts of natural hazards. It is based on median age, per capita income, unemployment, and other factors. “Community resilience” is the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. It acts as a reduction factor to the consequence of a hazard as communities that are considered more resilient with have lesser negative consequences from a hazard.

FIGURE 8.6 QUANTIFYING RISK FOR THE CORE MPO REGION'S FREIGHT NETWORK

1

FEMA National Risk Index

- Collect risk data on the relevant hazards for the CORE MPO region from the National Risk Index dataset and tool.

2

Define Georgia-Specific Risk Thresholds

- Re-scale the Expected Annual Loss risk thresholds using Georgia data only.

3

Calculate Composite Risk for the CORE MPO Region

- Using the Georgia-specific thresholds, calculate the composite risk.
- The composite risk is the summation of risk across all hazards.

4

Identify Vulnerable Freight Assets

- Determine the vulnerability of the region's freight assets to the selected hazards.

Source: Federal Emergency Management Agency, 2022; Cambridge Systematics.

The process first collected risk data for sea level rise/coastal flooding, riverine flooding, and hurricanes from the FEMA NRI dataset and tool. Specifically, Expected Annual Loss data for each of the hazards was collected for all Census tracts in the 3-county region. The reason the process focuses on Expected Annual Loss, as opposed to the NRI score which accounts for sociodemographic factors, is because the focus on this risk assessment is on the freight network as opposed to a broader societal assessment of risk.

The process then defined Georgia-specific risk thresholds (i.e., "Very Low" to "Very High") using the Expected Annual Loss data for Georgia only. This is in contrast to the FEMA NRI dataset and tool, which defines risk thresholds based on national-level percentiles. This prevented the analysis from overlooking areas of the region that might not be considered at-risk from a national perspective but are important for Georgia.

Next, the process calculated the composite risk by taking the sum of Expected Annual Loss across all hazards. This shows which portions of the region are most susceptible to multiple hazards. Lastly, the process identified which of the region's freight assets (e.g., highways, railroads, etc.) are most vulnerable to the selected hazards. This was done by examining the location of freight assets in relation to the zones of risk as determined by the composite risk calculation.

Quantifying Risk for the CORE MPO Region

Risk data was collected from the FEMA NRI dataset and tool for the CORE MPO region for three natural hazards: sea level rise/coastal flooding, riverine flooding, and hurricanes. Specifically, Expected Annual Loss data (the anticipated economic damage resulting from natural hazards measured in dollars) for each of the hazards was collected. The process then defined Georgia-specific risk thresholds (i.e., "Very Low" to "Very High") using the Expected Annual Loss data for Georgia only. These thresholds are shown in Table 8.10.

TABLE 8.10 EXPECTED ANNUAL LOSS BY HAZARD TYPE FOR GEORGIA

Category	Quintile	Coastal Flooding	Riverine Flooding	Hurricanes
Very Low	0% - 20%	$0 - $131	$0 - $2,667	$0 - $516
Low	20% - 40%	$131 - $4,716	$2,667 - $8,370	$516 - $1,060
Moderate	40% - 60%	$4,716 - $26,690	$8,370 - $17,838	$1,060 - $3,716
High	60% - 80%	$26,690 - $76,545	$17,838 - $39,071	$3,716 - $19,606
Very High	80% - 100%	$76,545 - $314,135	$39,071 - $560,878	$19,606 - $1,073,459

Source: FEMA National Risk Index; Cambridge Systematics analysis.

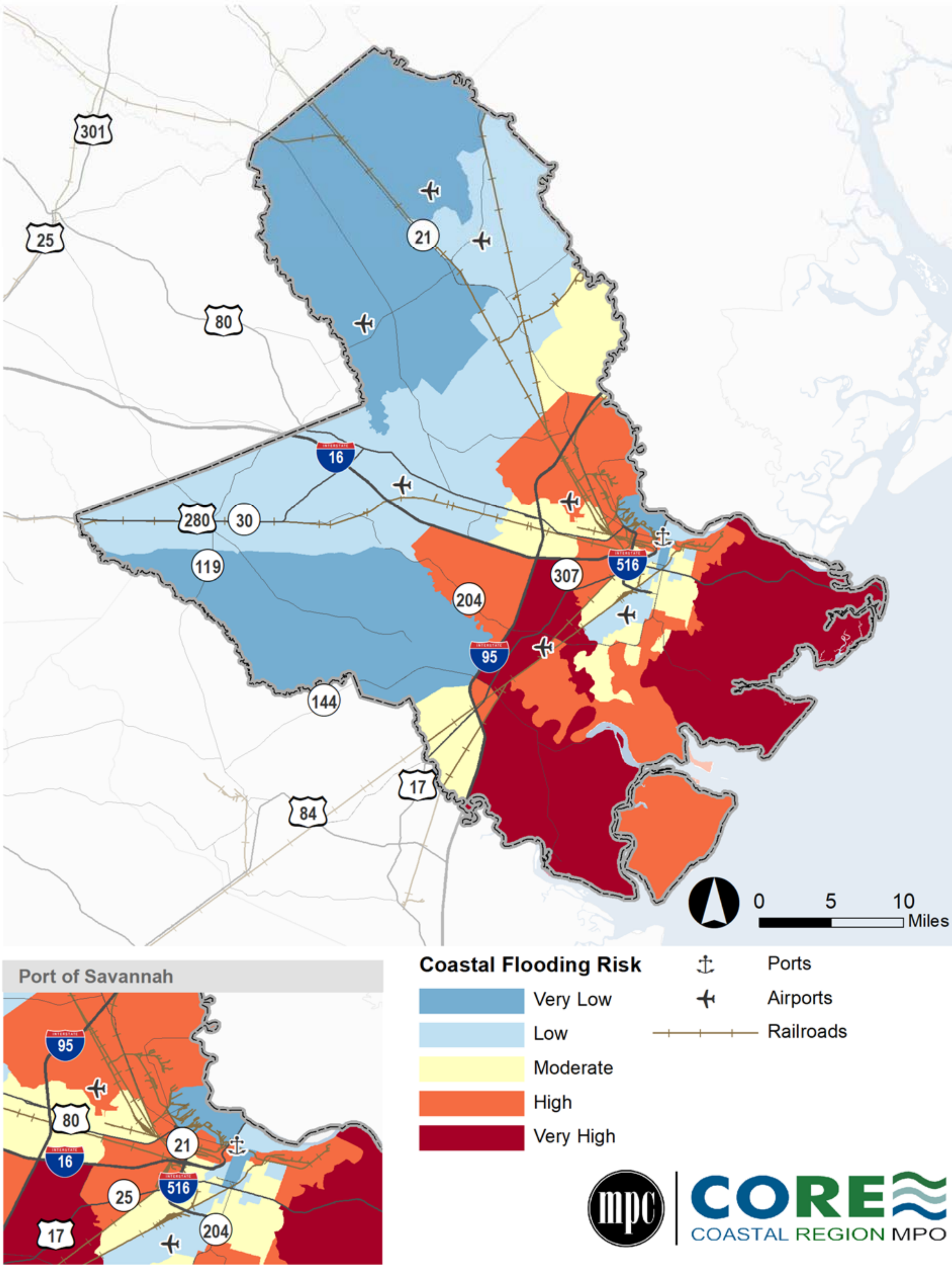
Figure 8.7, Figure 8.8, and Figure 8.9 show these individual EALs as mapped throughout the CORE MPO region. The sea level rise risk map (Figure 8.7) shows that the locations that are most at-risk due to coastal flooding are those closest to the Atlantic Ocean in the eastern part of the region. Much of the region to the east of I-95 is at either very high or high risk to sea level rise. The exception is for the city center of Savannah where the higher elevations translate to a moderate or low risk.[153]

The riverine flooding risk map (Figure 8.8) reveals that the areas most susceptible to riverine flooding are in the easternmost part of the study area near Tybee Island (where there are many small streams through the marshes), areas south of the Ogeechee River, and areas east of I-95. Other high-risk areas include areas to the west of downtown Savannah such as Pooler, Port Wentworth, Bloomingdale, and Eden. Notably, areas along the banks of the Savannah River generally exhibit low to moderate risk for riverine flooding.

The hurricane risk map (Figure 8.9) indicates that most of the region is at-risk to hurricane damage. The highest risk locations are in north Effingham County, along the I-95 corridor, and the south and eastern parts of the region near the Atlantic Ocean. Much of the remaining part of the study area is at high risk except for a few areas west of I-95 and south of US 280.

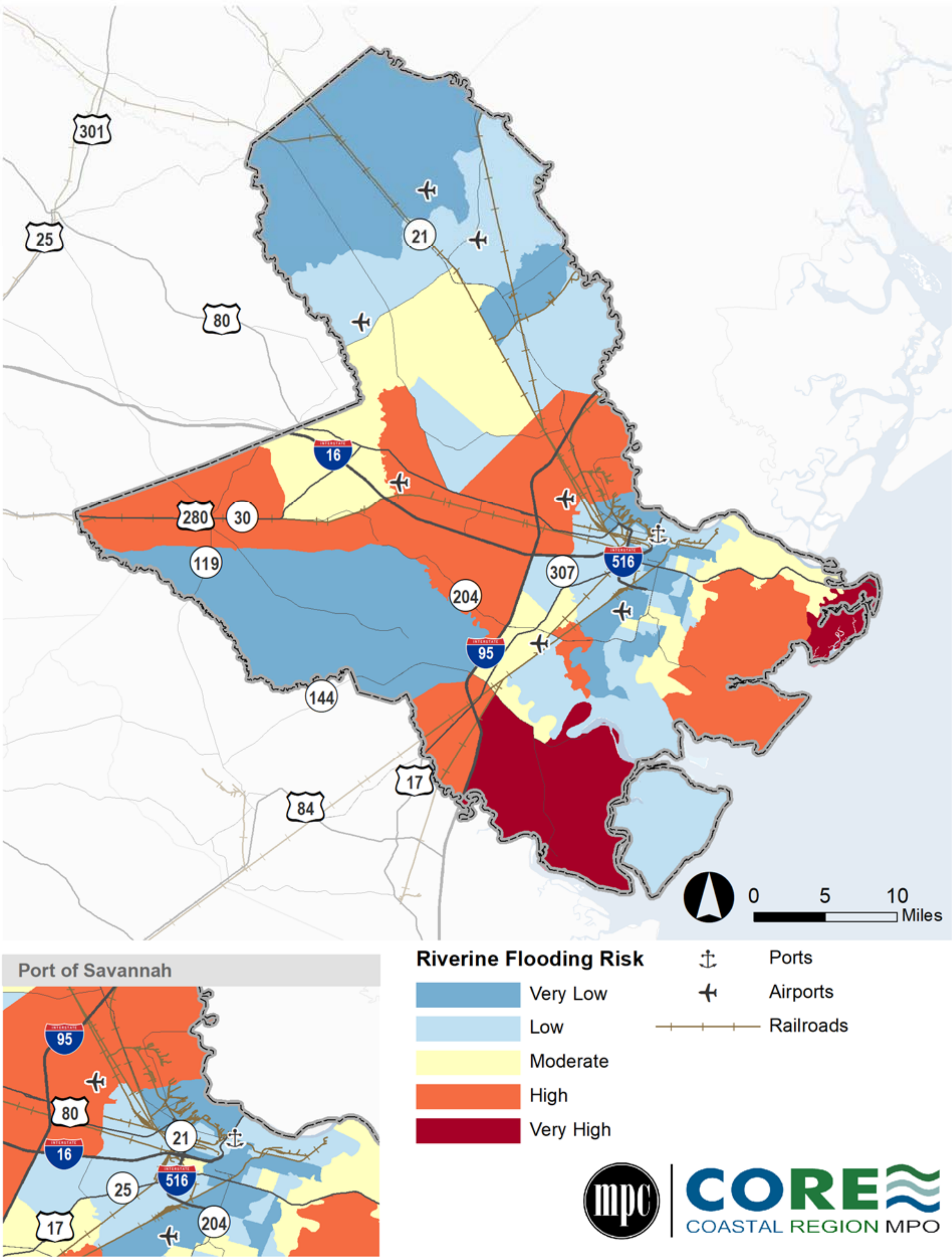
[153] The City of Savannah has an elevation of 49 feet. This is much higher compared to other coastal U.S. southeastern cities such as Charleston (19.69 feet), Jacksonville (16 feet), and Miami (6.6 feet).

FIGURE 8.7 SEA LEVEL RISE/COASTAL FLOODING RISK



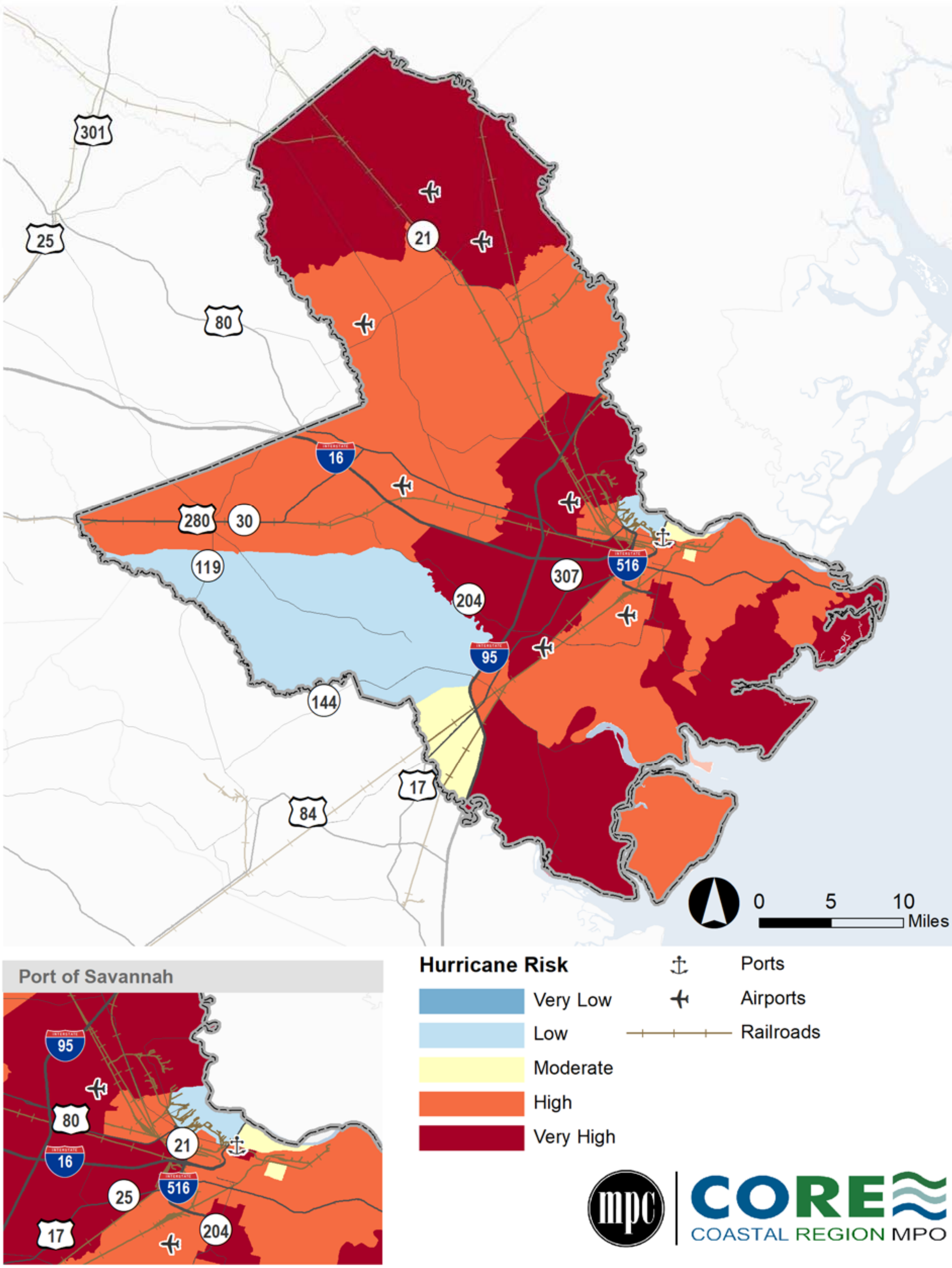
Source: Federal Emergency Management Agency, 2022; Analysis by Cambridge Systematics.

FIGURE 8.8 RIVERINE FLOODING RISK



Source: Federal Emergency Management Agency, 2022; Analysis by Cambridge Systematics.

FIGURE 8.9 HURRICANE RISK



Source: Federal Emergency Management Agency, 2022; Analysis by Cambridge Systematics.

For the CORE MPO region, a composite risk value was calculated by summing the individual EALs of sea level rise, riverine flooding, and hurricanes, as shown in the equation below.

$$Composite\ Risk = EAL_{Sea\ Level\ Rise} + EAL_{Riverine\ Flooding} + EAL_{Hurricanes}$$

Table 8.11 shows the breakdown for the total composite risk quintiles for the state of Georgia. Census tracts in Figure 8.10 are symbolized based on these composite risk EAL values.

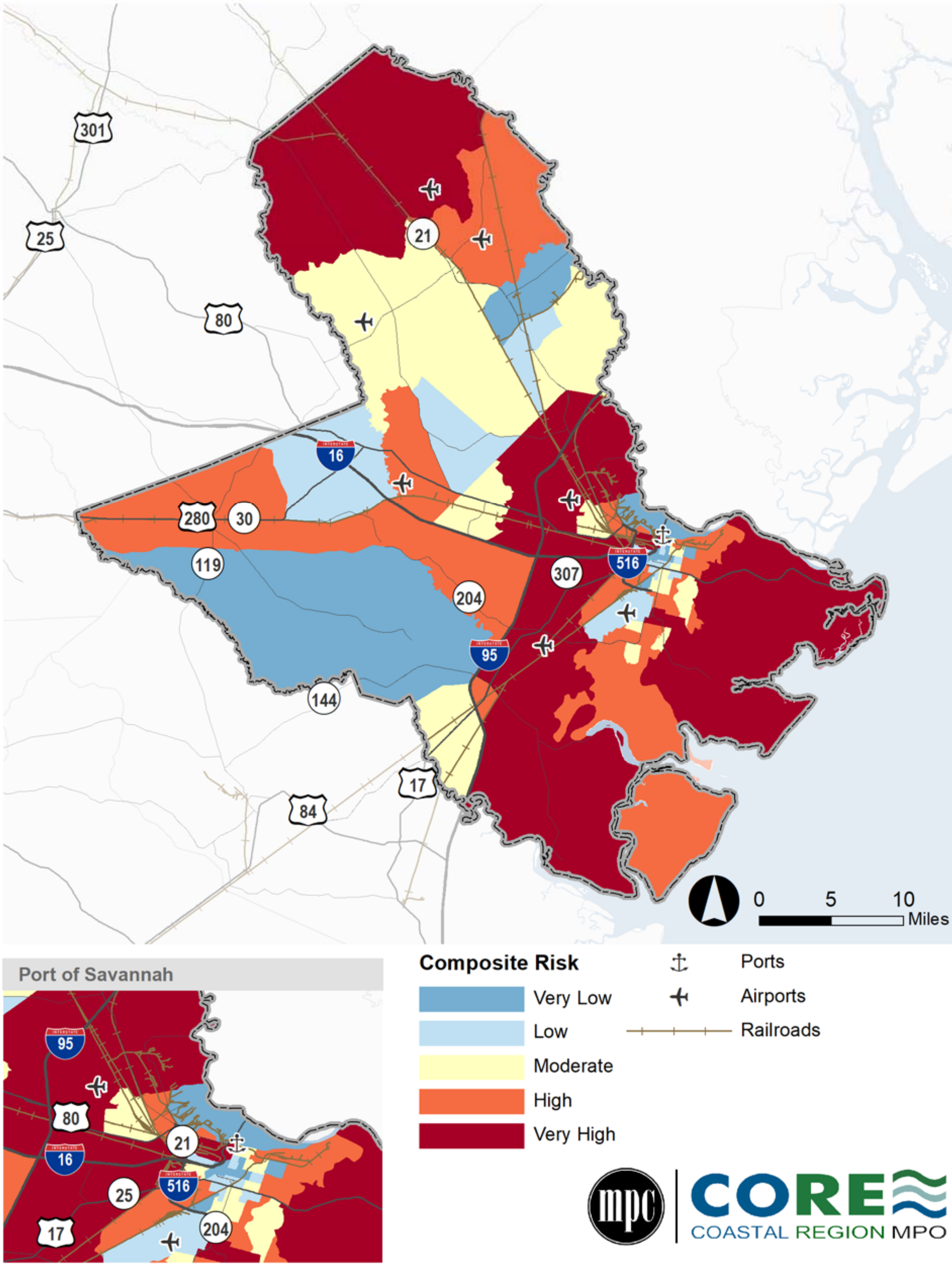
TABLE 8.11 COMPOSITE RISK EAL CATEGORIES FOR GEORGIA

Category	Quintile	Composite Risk
Very Low	0% - 20%	$0 - $7,654
Low	20% - 40%	$7,654 - $17,626
Moderate	40% - 60%	$17,626 - $33,292
High	60% - 80%	$33,292 - $72,807
Very High	80% - 100%	$72,807 - $1,134,797

Source: Federal Emergency Management Agency, 2022; Cambridge Systematics, Inc. analysis.

Figure 8.10 shows the census tracts most at risk for all three risk categories (sea level rise, riverine flooding, and hurricanes). Most of the areas to the east of I-95 are either very high risk or high risk, with the most damaging risks being either along I-95 or close to the ocean. The only other area under very high risk is the extreme north part of the region; the “very high” categorization of this area is due mainly to the hurricane EALs.

FIGURE 8.10 COMPOSITE RISK



Source: Federal Emergency Management Agency, 2022; Analysis by Cambridge Systematics.

Vulnerable Freight Assets to Sea Level Rise/Coastal Flooding, Riverine Flooding, and Hurricanes

This section presents freight assets within the CORE MPO region that are under the three risks identified by FEMA in the previous section. The following assets were included in the analysis of vulnerable freight assets:

- Ports.
- Highways and Bridges.
- Railroads.
- Air.
- Truck parking facilities.

In general, much of the area around the Port of Savannah and Savannah/Hilton Head International Airport is under either “very high” or “high risk. Because there is so much freight activity in that area, many of the freight assets such as railroads, highways/bridges, and truck parking facilities are under severe risk levels as well.

Vulnerability of the Port of Savannah

The Port of Savannah is the most significant freight asset in the region and the State. The riverine flooding risk ranges from “high” to “low” with port assets to the north (e.g., Garden City Terminal) generally exhibiting higher risk than those to the south and east (e.g., Ocean Terminal). Similarly, the risk from sea level rise/coastal flooding also ranges from “high” to “low” with port assets to the north generally exhibiting higher risk than those to the south and east. The risk from hurricanes for Port of Savannah facilities is generally “moderate” to “very high” with some centrally located assets (i.e., portions of the Garden City Terminal) showing “low” risk. Given the large amount of area occupied by the Port of Savannah, altogether these three risks combined indicate that the Port ranges from “low” to “very high” composite risk, as seen in Figure 8.10.

While the Port of Savannah’s Garden City and Ocean Terminals are generally in lower risk areas, key routes that provide access for trucks to these terminals are in areas of “high” to “very high” combined risk. These include SR 21, SR 307/Dean Forest Road, and Jimmy Deloach Parkway. Furthermore, while the Port of Savannah has infrastructure and mitigation measures in place to limit the impacts of disruptions, their effectiveness is limited if the routes providing access to the port’s facilities are unable to function.

Vulnerability of the Savannah/Hilton Head International Airport

The Savannah/Hilton Head International Airport is the most significant air cargo asset in the region as it is the only facility that handles air freight. Despite being further from the Savannah River, the airport is surrounded by numerous small creeks and streams which have the ability to cause significant riverine flooding, which gives the airport a “high” riverine flooding risk. The risk of coastal flooding is similarly “high,” and the risk of hurricanes is considered “very high.” The three risks combined to put the Savannah/Hilton Head International Airport in an area of “very high” combined risk, seen in Figure 8.10.

In addition, key routes that provide access for trucks to the airport are in areas of "very high" combined risk. These include Gulfstream Road and SR 307/Dean Forest Road. The effectiveness of any infrastructure and mitigation measures in place at the Savannah/Hilton Head International Airport to minimize the impacts of disruptions is limited if the routes providing access to the airport are unable to function.

Vulnerable Highway and Bridge Assets

Figure 8.11 shows highway assets in the CORE MPO region and depicts their composite risk vulnerability. Only arterial roadways and Interstate highways are included in the map. Many roadways to the west of downtown Savannah are under "very high" composite risk or "high" risk. This includes major freight corridors such as SR 21, SR 307/Dean Forest Road, and Jimmy Deloach Parkway as well as several portions of I-95 and I-16.

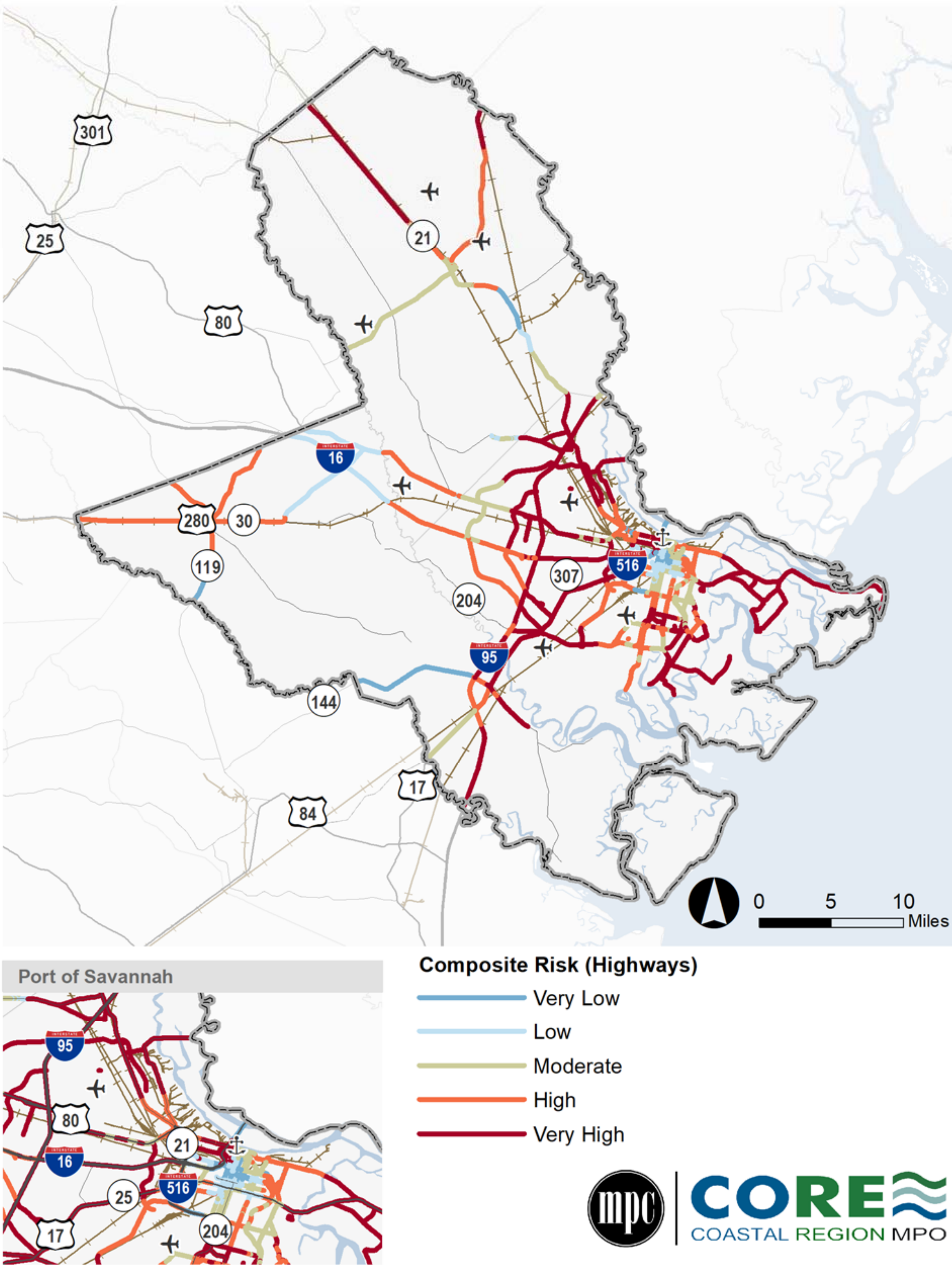
Table 8.12 shows the mileage of arterial roadways and Interstate highways that are within the various composite risk categories. As the risk gets worse, the mileage within each category gets higher. Over 42 percent of the region's arterials and Interstate highways (almost 600 miles of roadways) are under "very high" risk. Nearly 28 percent of the region's arterials and Interstate highways (almost 300 miles) under "high" risk.

TABLE 8.12 VULNERABLE INTERSTATE AND ARTERIAL MILEAGE

Risk Category	Mileage	% of Total Mileage
Very Low	83.3	6.0%
Low	126.7	9.1%
Moderate	206.1	14.9%
High	286.6	27.9%
Very High	583.6	42.1%
Total	**1,286.3**	**100.0%**

Source: FEMA, 2022; Highway Performance Management System, 2021; Cambridge Systematics, Inc. analysis.

FIGURE 8.11 VULNERABLE HIGHWAY ASSETS



Source: FEMA, 2022; Highway Performance Management System, 2021; Cambridge Systematics, Inc. analysis.

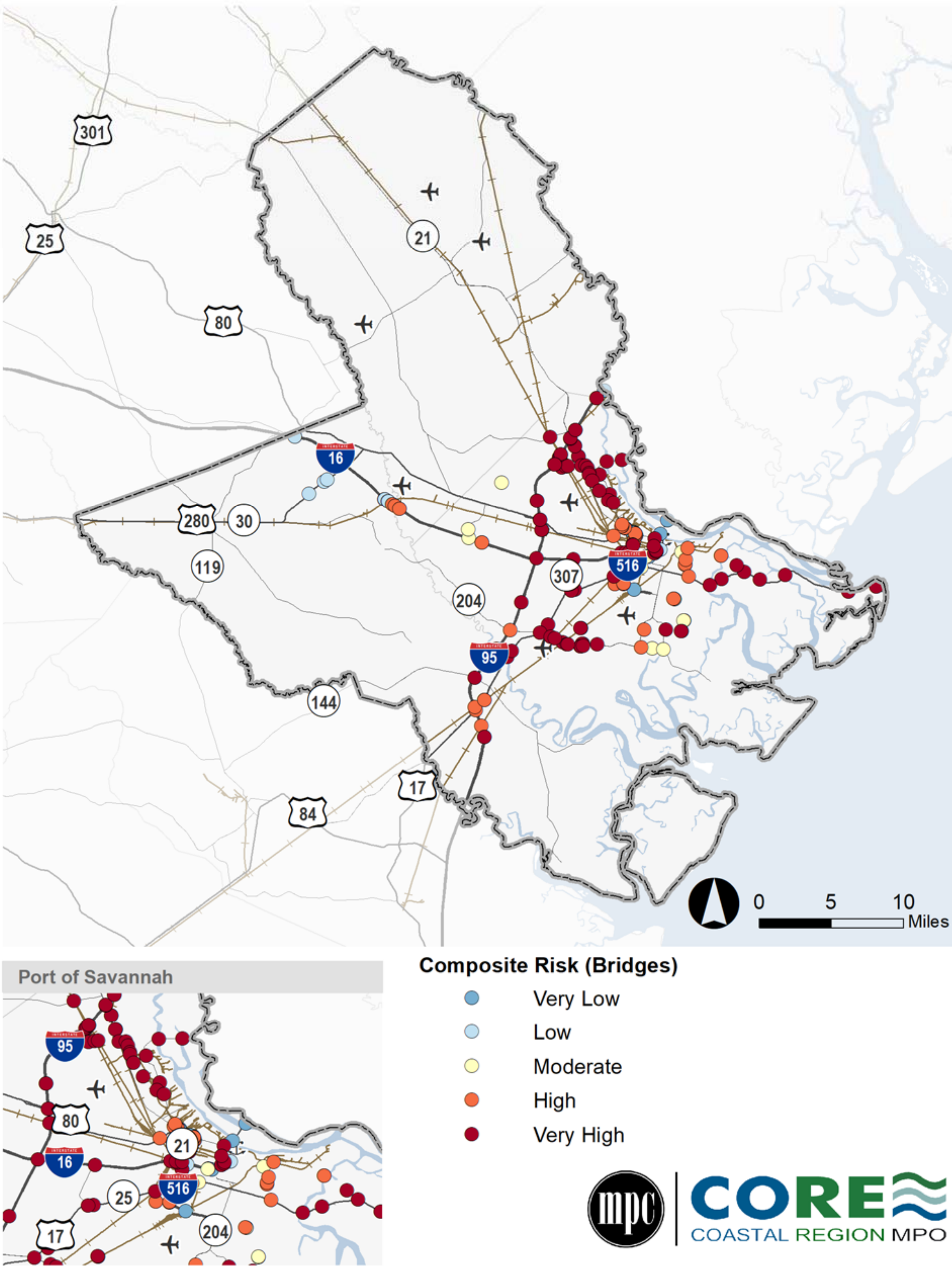
Figure 8.12 depicts the region's bridges and their composite risk vulnerability. Only bridges that carry arterial roadways and Interstate highways are shown. In total, out of 181 bridges, over half are located in areas under "very high" risk (94 in total) and another 46 bridges (over 25 percent) are in "high" risk areas as shown in Table 8.13.

TABLE 8.13 VULNERABLE BRIDGES ON INTERSTATES AND ARTERIALS

Risk Category	# of Bridges	% of Total Bridges
Very Low	14	7.7%
Low	14	7.7%
Moderate	13	7.2%
High	46	25.4%
Very High	94	51.9%
Total	**181**	**100.0%**

Source: FEMA, 2022; National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.

FIGURE 8.12 VULNERABLE BRIDGE ASSETS



Source: FEMA, 2022; National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.

Vulnerable Railroad Assets

Figure 8.13 depicts the region's railroads and their composite risk vulnerability. It also shows the location of three of the region's major rail yards:

- CSX Southover Yard (the southernmost rail yard)
- CSX Savannah Yard
- Norfolk Southern Dillard Yard (the northernmost rail yard)

Similar to the other assets, the railroads to the west of downtown Savannah, especially the railroads serving the Port of Savannah, are under "very high" composite risk from riverine flooding, coastal flooding, and hurricanes.

Table 8.14 shows the mileage of railways in the region under the various risk levels. Over 60 percent of the region's railway mileage (over 200 miles) is under either "very high" or "high" risk, with over 120 miles of that being under "very high" risk.

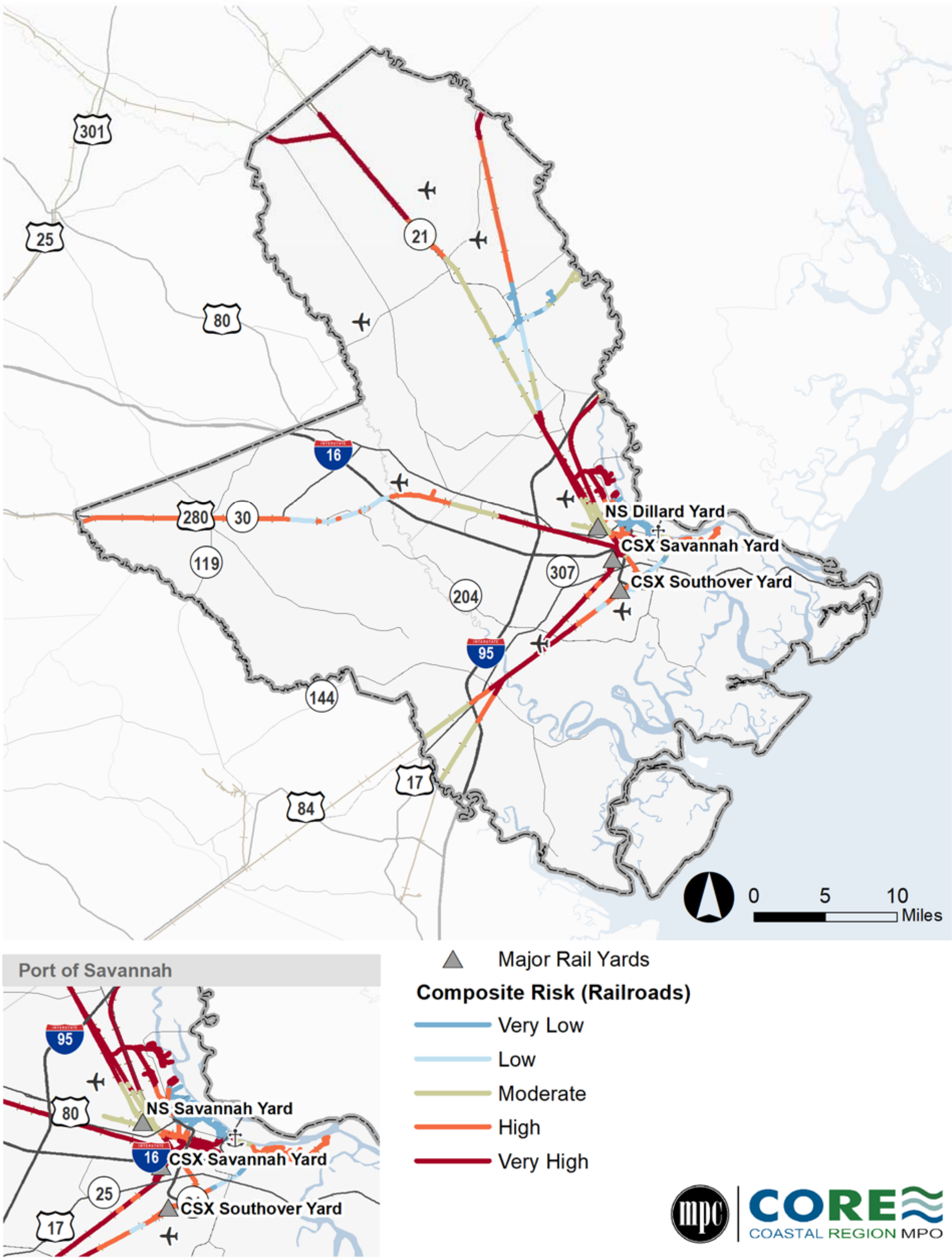
TABLE 8.14 VULNERABLE RAILWAY MILEAGE

Risk Category	Mileage	% of Total Mileage
Very Low	40.5	12.3%
Low	24.7	7.5%
Moderate	57.3	17.4%
High	86.1	26.1%
Very High	121.2	36.7%
Total	**329.8**	**100.0%**

Source: FEMA, 2022; Federal Railway Administration, 2021 Cambridge Systematics, Inc. analysis.

The three major rail yards in the region are all in risk areas of at least "moderate" combined risk. The CSX Southover Yard and the Savannah Yard are within "high" risk areas, while the Norfolk Southern Dillard Yard is in a "moderate" risk area.

FIGURE 8.13 VULNERABLE RAILROAD ASSETS



Source: FEMA, 2022; Federal Railway Administration, 2021; Cambridge Systematics, Inc. analysis.

Vulnerable Truck Parking Assets

Figure 8.14 depicts the region's truck parking facilities and their composite risk scores. The pattern is the same as the other freight assets: the facilities to the west of downtown Savannah and between the port and the airport are under the most risk from flooding and hurricanes. Table 8.15 also shows this information and includes breakdowns of the actual truck parking spaces in each risk category.

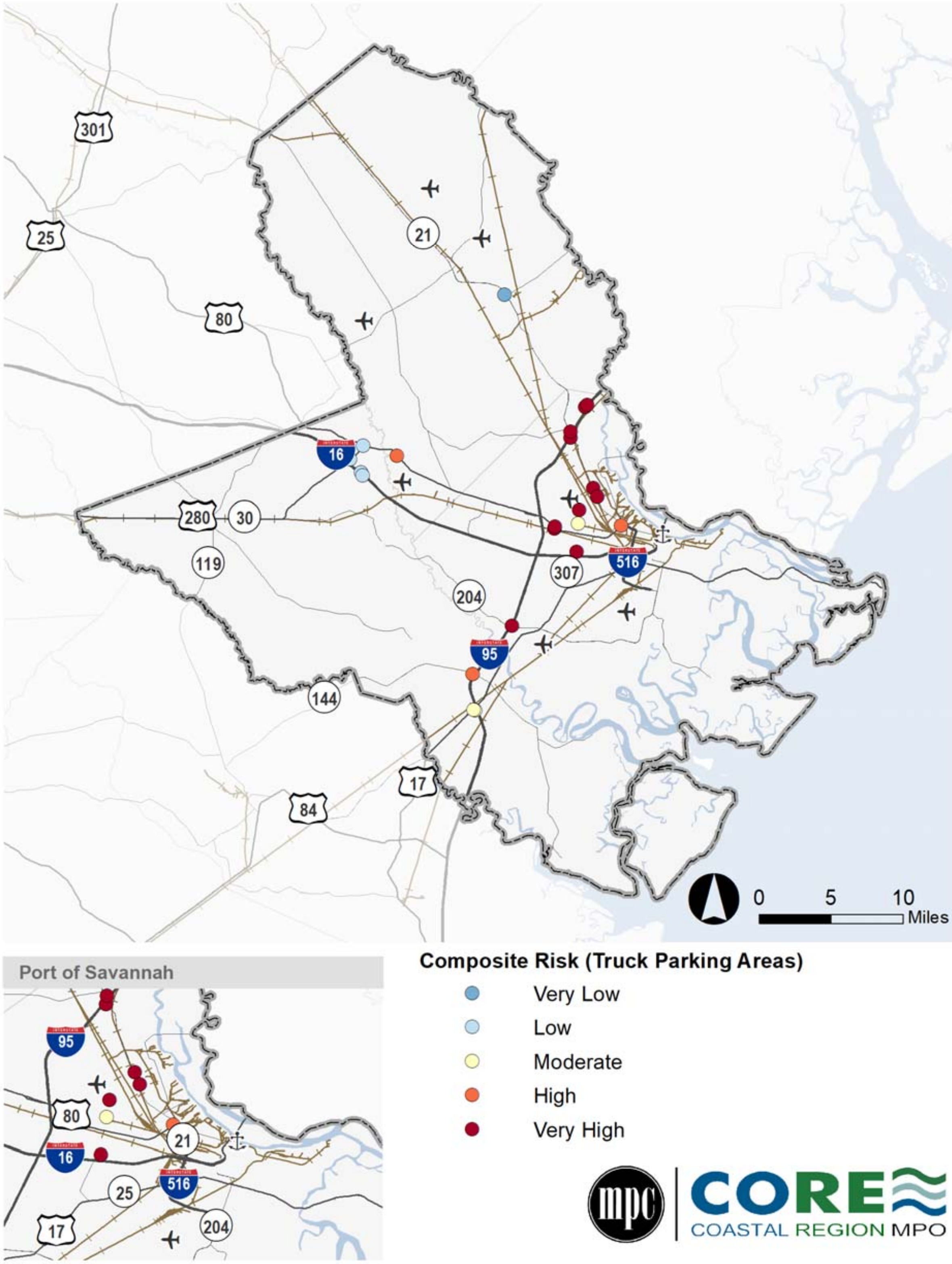
Out of the 22 truck parking facilities in the region, half are under "very high" risk, with another six being either under "high" or "moderate" risk. Regarding truck parking spaces, almost half of the more than 1,000 truck parking spaces in the region are under "very high" or "high" risk. If including spaces under "moderate" risk, almost 75 percent of all spaces in the region are under a significant threat.

TABLE 8.15 VULNERABLE TRUCK PARKING ASSETS

Risk Category	# of Truck Parking Facilities	% of Total Facilities	# of Truck Parking Spaces	% of Total Spaces
Very Low	1	4.5%	74	6.4%
Low	4	18.2%	226	19.4%
Moderate	3	13.6%	321	27.6%
High	3	13.6%	167	14.4%
Very High	11	50.0%	375	32.2%
Total	**22**	**100.0%**	**1,163**	**100.0%**

Source: FEMA, 2022; Federal Railway Administration, 2021; Analysis by Cambridge Systematics.

FIGURE 8.14 VULNERABLE TRUCK PARKING ASSETS



Source: FEMA, 2022; FHWA Jason's Law Truck Parking Survey, 2019; Various third party and travel plaza company websites; Cambridge Systematics, Inc. analysis.

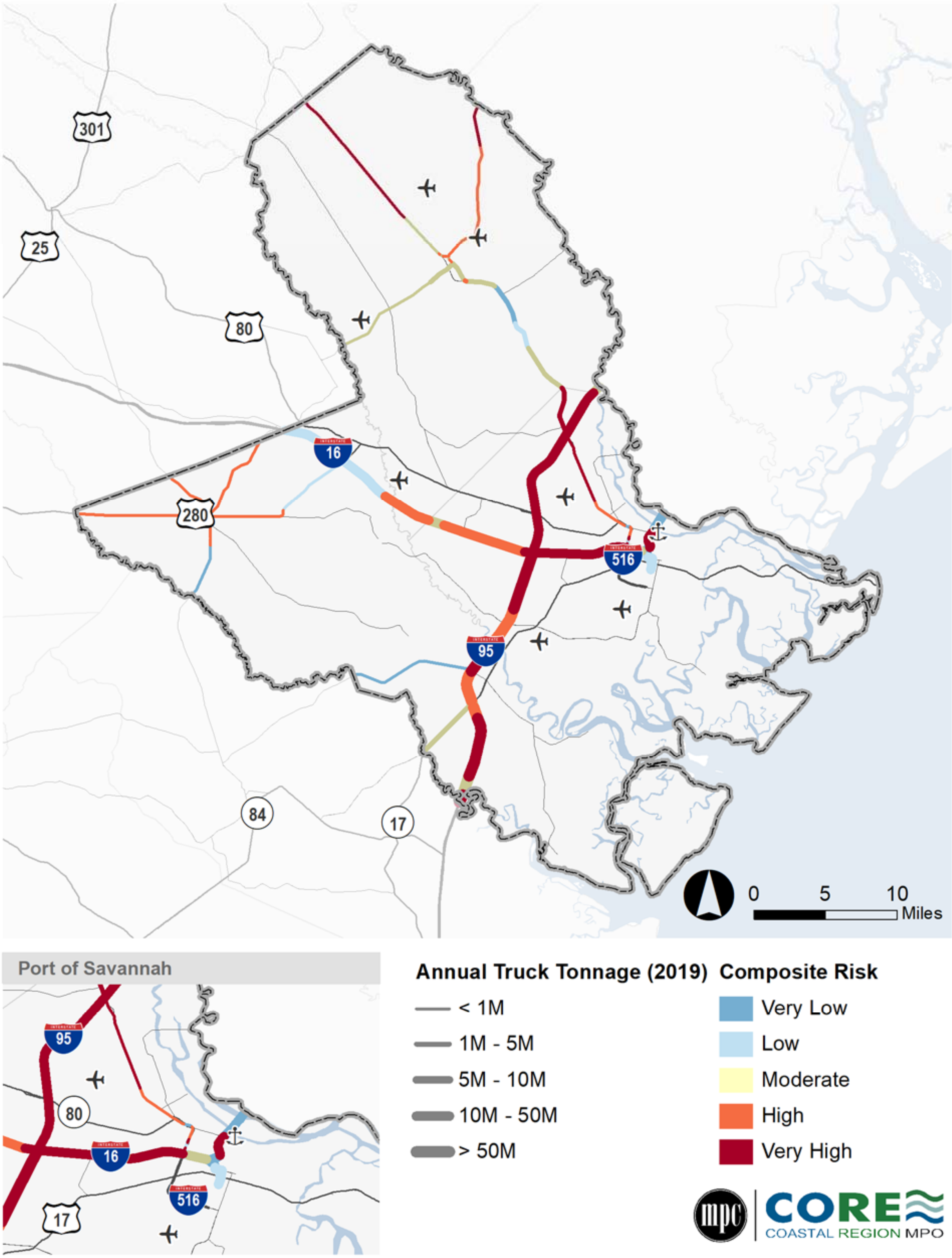
Hazard Assessment for Supply Chain Disruptions

As freight assets are put at risk, so too are the supply chains of which those assets are a part. As vital roads, railroads, airport assets, and port assets are disrupted due to flooding, hurricanes, or other events, those crucial supply chain links are hindered or even broken. As a result, freight movements are forced to find alternative and often unsuitable routes. In order to understand how supply chains are impacted by resiliency challenges in the CORE MPO region, routed tonnages of goods traveling by truck and rail from TRANSEARCH were overlayed with the composite risk assessment results for the region. The results are shown in Figure 8.15 and Figure 8.16.

The map of routed highway tonnages in Figure 8.15 shows that the region's two major interstates, I-95 and I-16, pass through areas of "very high" risk. Other major routes in terms of total tonnage, such as SR 21 and U.S. 17, also traverse high risk areas. As these routes are the primary truck routes for freight flows in the region, a blockage on any of them, would severely impact the supply chains that depend on these routes. In addition, given the volume of truck traffic carried by these routes, blockages would result in increased emissions from idling and further contribute to poorer air quality, increased levels of particulate matter, and noise.

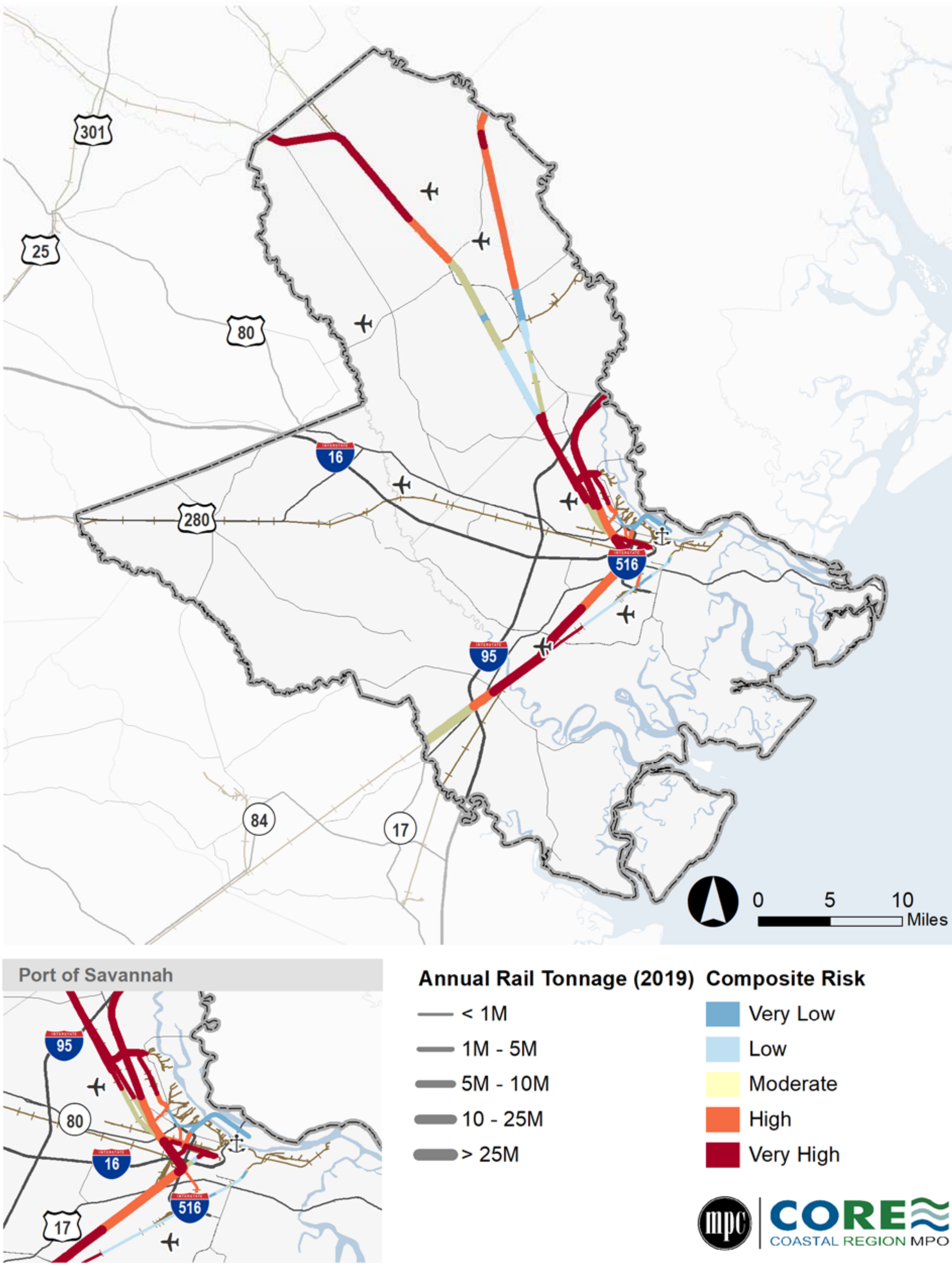
Figure 8.16 shows the routed rail tonnage overlaid on the composite risk categories. It shows that there are no viable freight rail routes serving the Port of Savannah that do not pass through a zone of "very high" composite risk. If a disruption occurs on one or both of these routes, then it would be very difficult or even impossible for rail traffic to enter or leave the Port of Savannah. In 2019 and 2050, this would mean at least 25 percent of the region's total freight tonnage and at least 30 percent of the region's total freight value would not be able to move along the supply chain.

FIGURE 8.15 TRUCK FREIGHT TONNAGE AND COMPOSITE RISK



Source: FEMA, 2022; TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 8.16 RAIL FREIGHT TONNAGE AND COMPOSITE RISK



Source: FEMA, 2022; TRANSEARCH; Cambridge Systematics, Inc. analysis.

To provide an indication of the magnitude of the importance of these highway routes in supporting various supply chains, Table 8.16 shows their percentages of the region's total tonnage and value. In 2019, I-95 carried about 58 percent of the region's total truck tonnage and 53 percent of its value. I-16 carried approximately 22 percent of truck tonnage and 21 percent of value in 2019. About 16 percent of the region's truck tonnage and 20 percent of its value was carried on US 17. These results demonstrate how valuable these routes are to the supply chains that depend on them. If any of these major truck routes were to be blocked, then trucks would have to either find an alternative path or delay their trips. Either option would cause delays that would ripple through the entire supply chain.

TABLE 8.16 TRUCK TONNAGES & VALUE ON MAJOR TRUCK ROUTES

Major Truck Route	% of Total 2019 Truck Tonnage	# of Total 2019 Truck Value
Interstate 95	58%	53%
Interstate 16	22%	21%
US 17	16%	20%
State Route 21	1%	1%

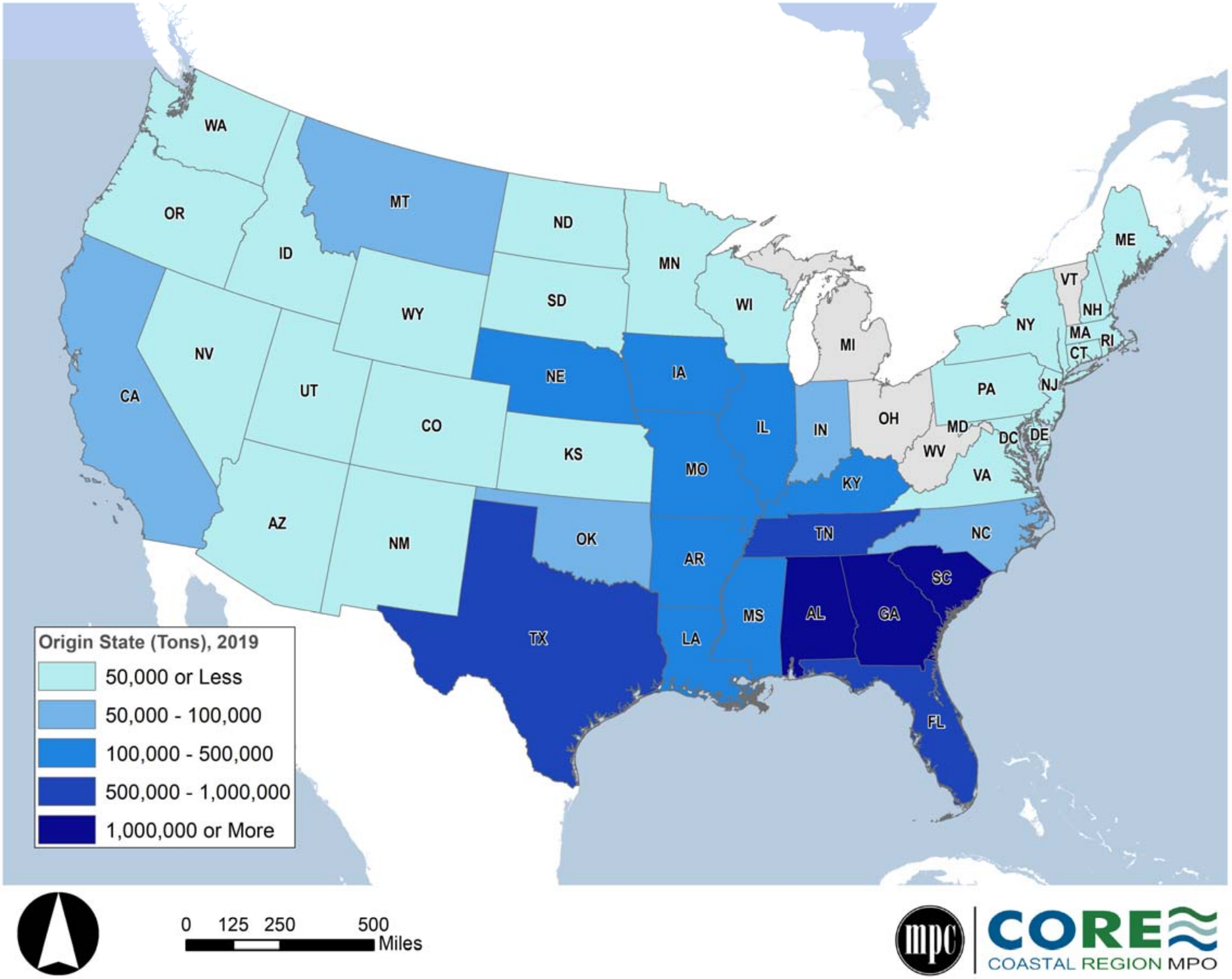
Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

The magnitude of the importance of these highway routes to various supply chains is also illustrated by examining the freight trips served by a single segment – I-16 between Old River Road and Jimmy Deloach Parkway. As shown in Figure 8.17, in 2019 45 states including the District of Columbia were estimated to originate truck trips that traverse that segment. Those trips were destined for 46 different states including the District of Columbia as shown in Figure 8.18.

In addition to facilitating substantial volumes of highway freight between states, I-16 between Old River Road and Jimmy Deloach Parkway also carried a broad range of commodities. For example, in 2019 six different states (such as Texas, Missouri, and California) originated truck trips on I-16 between Old River Road and Jimmy Deloach Parkway that carried over 300 different types of commodities as indicated by 4-digit Standard Transportation Commodity Codes (STCC) as shown in Figure 8.19.[154] As shown in Figure 8.20, ten different states were the destinations of truck trips on I-16 between Old River Road and Jimmy Deloach Parkway that carried over 300 different types of commodities. The magnitude of the unique commodity types using this single link in the CORE MPO region's freight network indicates how disruptions on the network can impact national and global supply chains.

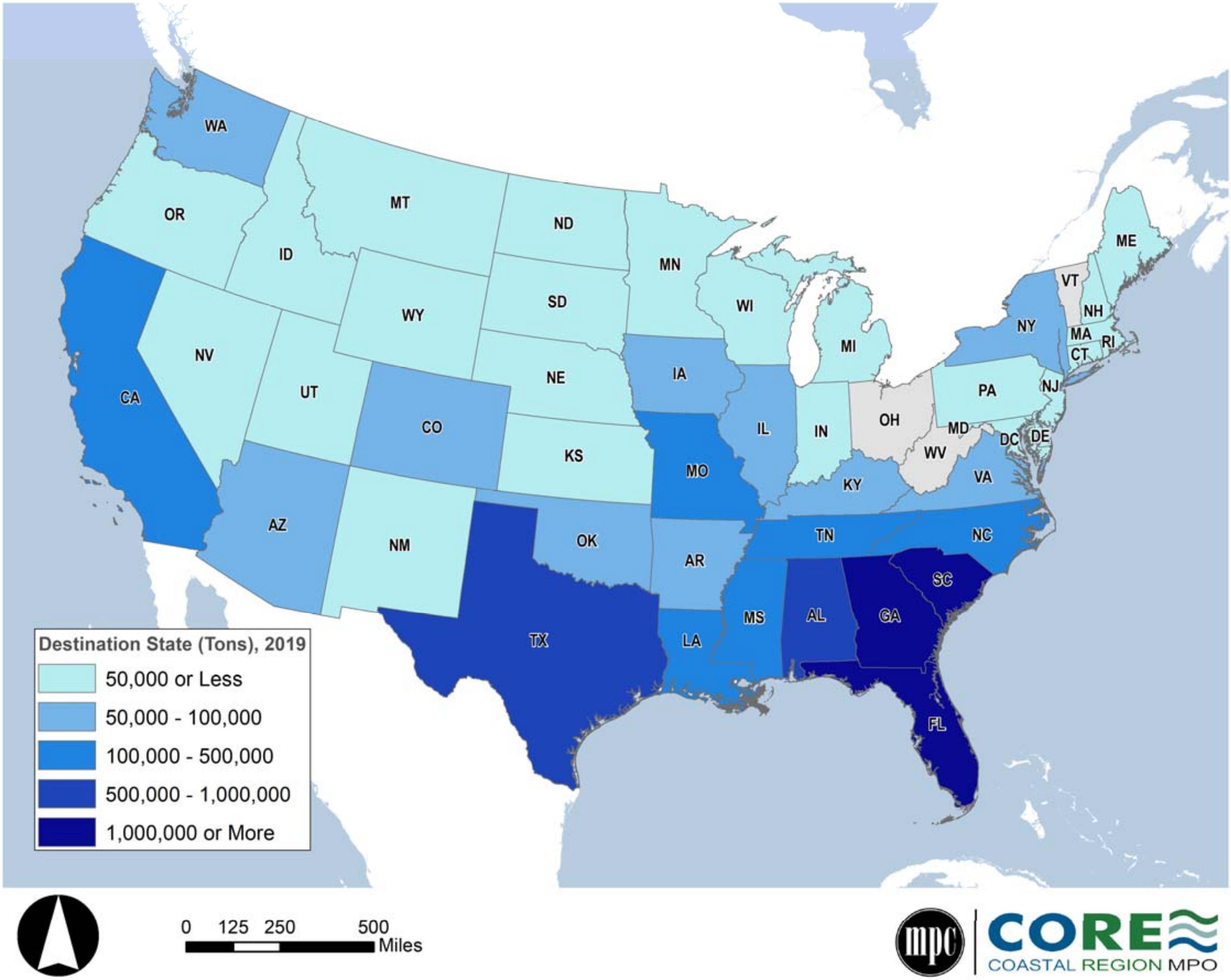
[154] https://public.railinc.com/resources/standard-transportation-commodity-code

FIGURE 8.17 STATE OF ORIGIN FOR FREIGHT FLOWS ON I-16, 2019



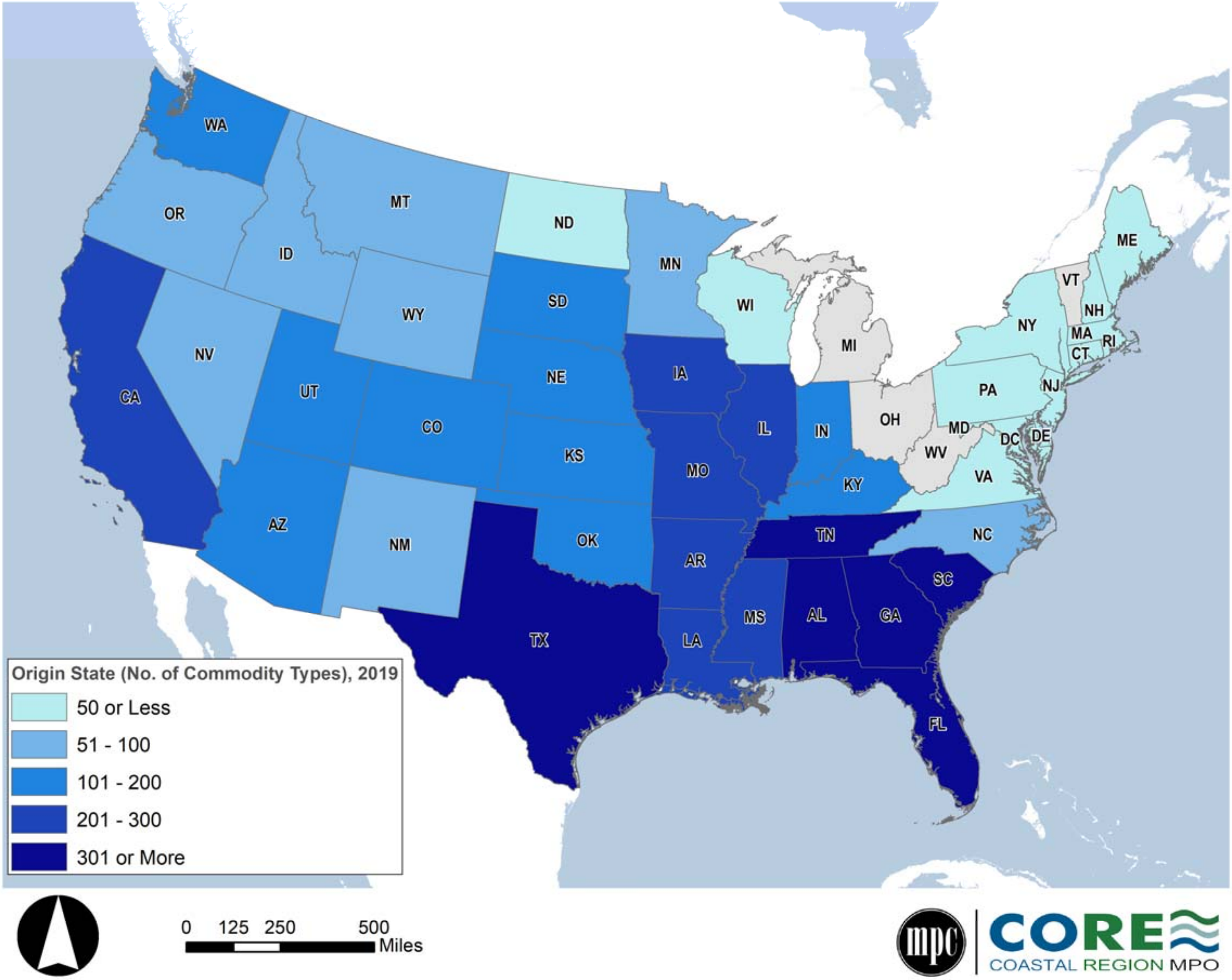
Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 8.18 STATE OF DESTINATION FOR FREIGHT FLOW TONNAGES ON I-16, 2019



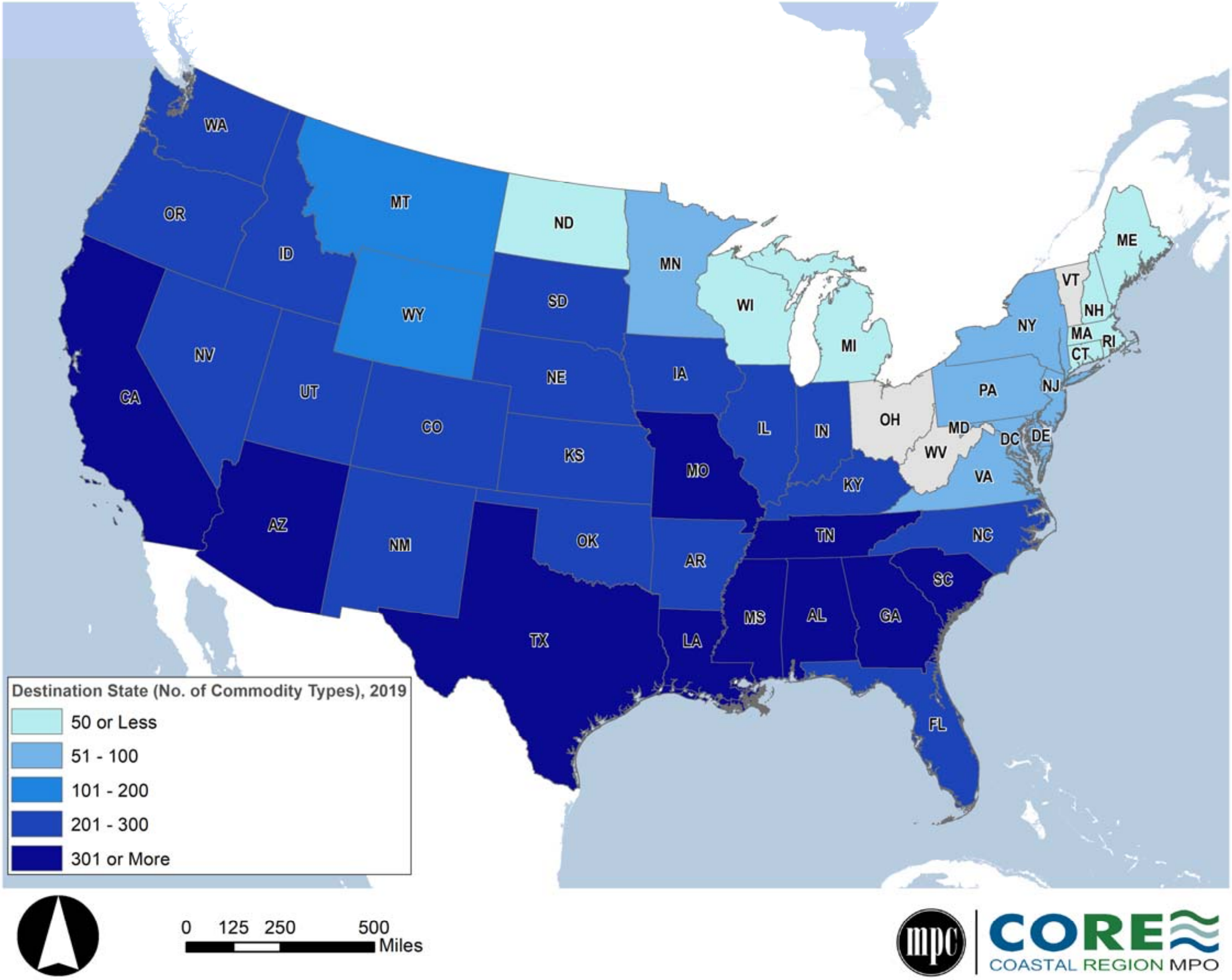
Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 8.19 STATE OF ORIGIN FOR UNIQUE COMMODITY TYPES ON I-16, 2019



Source: TRANSEARCH; Cambridge Systematics, Inc. analysis.

FIGURE 8.20 STATE OF DESTINATION FOR UNIQUE COMMODITY TYPES ON I-16, 2019



Source: TRANSEARCH; Analysis by Cambridge Systematics.

8.3 Risk Adaption Strategies

This section of the report presents potential strategies for addressing the region's freight resiliency needs. The strategies consist of actions the region may take to "harden" freight assets so that the potential for disruption is limited, and to quickly recover in the event that disruptions do occur. These strategies are not final recommendations, but instead represent starting points for addressing freight resiliency challenges. Recommended strategies will be identified as part of Task 7.

Sea Level Rise/Coastal Flooding

Potential strategies for improving freight resiliency against sea level rise/coastal flooding include the following:

- **Relocate and Reroute Freight Assets to Avoid Flooding Risks.** The avoiding risk strategy moves critical freight assets out of harm's way where possible. In some cases, roadways may be relocated and alignments can be changed to avoid flooding risks.
- **Harden Freight Assets to Inundation, Flooding, and Scour.** Hardening freight assets entails modifying aspects of their design so that they are less susceptible to disruption. This potential strategy is further divided into slow onset and rapid onset actions. Slow onset actions are those that take a greater amount of time to implement and focus on the long-term impacts of sea level rise/coastal flooding. Rapid onset actions are those that focus on mitigating more near-term disruptions.
    - » **Slow Onset of Sea Level Rise/Coastal Flooding Actions.** This includes actions such as redesigning roadway embankments and scour protection for bridges and elevating roadways, bridges, rail lines, runways, and other critical transportation facilities so they are less prone to flooding.
    - » **Rapid Onset Disruptions from Sea Level Rise/Coastal Flooding Actions.** This includes actions such as strengthening roadway slopes and shoulders; implementing bridge scour monitoring techniques; and maintaining culverts to remove debris.
- **Increase Network Redundancy around Areas at Risk to Sea Level Rise/Coastal Flooding.** This strategy focuses on studying and identifying opportunities for redundant roadway and rail access to major freight terminals. It also includes opportunities for parallel routes along major freight corridors.
- **Develop Protective Barriers.** A number of safeguards can be implemented to limit the exposure of freight assets to sea level rise/coastal flooding. These include constructing flood mitigation infrastructure (e.g., levees, sea walls, flood gates, pumping facilities, etc.); implementing vegetation management, living shoreline protection (e.g., natural barriers, etc.), and green infrastructure; constructing sand dunes; and implementing backflow prevention techniques.
- **Information Sharing to Manage Coastal Flooding Events.** This strategy focuses on information sharing as means of limiting the impacts of disruptive events such as heavy precipitation or hurricanes. These include using intelligent transportation systems (ITS) for detour management, creating an information sharing back-up system in the event of storm/power outages, and upgrading/maintaining event response systems for maintenance crews to be ready to respond to debris clearance. The Smart Sea Level Sensors Project (https://www.sealevelsensors.org/) being led by the Chatham County Emergency Management Agency (CEMA), the City of Savannah, and the Georgia Institute of Technology provides an example of how real-time data on coastal flooding can be incorporated into this strategy. The project includes a network of water-level sensors across flood vulnerable areas of Chatham County. The real-time data on coastal flooding can be used for emergency planning and response during a flooding event.
- **Align Truck Parking and Emissions Reduction Investments.** Because freight is a significant contributor to greenhouse gas emissions which in turn is a contributing factor to sea level rise,

aligning future investments in the region's truck parking capacity with emissions reductions initiatives (such as idling reduction technologies and zero emissions fuels) represents an opportunity to improve the region's resiliency. For example, truck stop electrification is an emissions reduction strategy that uses external equipment to provide services to truck drivers, such as heating and cooling, which are otherwise powered by engine idling. Truck parking facilities can be co-located electric truck charging or other alternative fuel infrastructure to encourage the adoption of those technologies.

Hurricanes

Potential strategies for improving freight resiliency against hurricanes include the following:

- **Wind Resistant Roadside Assets.** Take steps to ensure that signage, controller cabinets, signals and other roadside assets are wind resistant. This will limit hurricane damage to those assets as well as their potential to cause danger to people or damage other infrastructure.
- **Prune Vegetation.** Prune branches and other vegetation near major freight corridors that are susceptible to wind. This strategy would also include removing dead or dying trees that could topple over in a hurricane. Pruning vegetation would limit the potential for freight corridors to be blocked by debris resulting from hurricane winds.
- **Debris Management.** This strategy focuses on upgrading and/or maintaining event response systems to be ready to respond to debris clearance. It may also include maintenance activities such as removing debris from roadways and culverts and other drainage assets.
- **Coordinate with the Georgia Ports Authority.** Coordinate with the Georgia Ports Authority to implement adaptation measures such as strengthening mooring and berthing fixtures at port facilities; and installing fender or dolphin systems to protect vulnerable piers from vessel impacts and debris.
- **Strengthen and Expand Natural Barriers to Protect Against Hurricanes.** This strategy takes a watershed instead of a project-by-project approach for improving freight resiliency against hurricanes. In the event of heavy rainfall or storm surge, green infrastructure such as wetlands and parks can be flooded to delay or offset impacts to people and freight assets. Vegetation management and living shoreline solutions also fall under this strategy. Living shorelines use plants or other natural elements (sometimes in combination with harder shoreline structures) to stabilize estuarine coasts, bays, and tributaries.[155]
- **Information Sharing to Manage Hurricane Events.** This strategy is consistent with the information sharing strategy outlined for sea level rise/coastal flooding events. It focuses on information sharing as means of limiting the impacts of hurricanes and includes detour management, information sharing back-up systems in the event of storm/power outages, upgrading/maintaining event response systems for maintenance crews to be ready to respond to debris clearance, and coordination with state and local emergency management agencies. It also includes information sharing to more effectively stage materials and equipment needed for recovery such as signal heads, backhoes, and generators among others.

In addition to these, all of the potential strategies identified for sea level rise/coastal flooding are applicable to hurricane events. This is because hurricanes are often accompanied by storm surge that results in coastal flooding events.

[155] https://www.fisheries.noaa.gov/insight/understanding-living-shorelines#what-is-a-living-shoreline?

Riverine Flooding

Potential strategies for improving freight resiliency against riverine flooding include the following:

- **Upgrade and Maintain Drainage Systems.** This strategy focuses on upgrading and maintaining drainage systems to handle riverine flooding events. It includes actions such as re-designing drainage systems; increasing culverts' carrying capacity by replacing with larger culverts or with bridges; adding new culverts where none exist; adding inlets/intakes; and installing pumps.
- **Strengthen and Expand Natural Barriers to Protect Against Riverine Flooding.** This strategy is consistent with the natural barriers strategy outlined for hurricanes. It takes a watershed approach for improving freight resiliency against riverine flooding through green infrastructures such as wetlands and parks. Those areas can be flooded to delay or offset impacts to people and freight assets.
- **Stormwater Runoff.** Reduce storm water run-off by reducing the amount of impervious surfaces near freight corridors and by incorporating green infrastructure into roadway designs. Green infrastructure such as bioswales, planter boxes, and street trees can serve as another layer of flooding control for freight corridors. It can also help to preserve existing, aging gray infrastructure (e.g., curbs, gutters, pipes) as green infrastructure would divert some stormwater before it enters those systems.

In addition to these, the adaption strategies identified for sea level/coastal flooding events are applicable to riverine flooding events. Particularly, slow onset and rapid onset actions related to hardening freight assets to inundation, flooding, and scour are applicable.

Supply Chain Disruptions

All of the natural hazards investigated as part of this report have the potential to disrupt supply chains by reducing or eliminating the ability of freight assets to move goods. Thus, all of the potential strategies discussed in sections 3.1 to 3.3 can be considered as components of a broader strategy to limit supply chain disruptions. Additional potential components of a broader supply chain resiliency strategy include the following:

- **Harden Freight Assets Against Other Extreme Weather Events.** Though sea level rise/coastal flooding, riverine flooding, and hurricanes occur more frequently in the region than other hazards, other extreme weather events still pose a risk to freight assets and supply chains. CORE MPO, along with its state and local partners, may need to consider adjusting pavement standards to minimize disruptions to the roadway network from an increase in the number of droughts, extreme heat events, and extreme cold events. Tornadoes can occur anywhere within Georgia and disrupt key nodes in supply chains including airports, seaports, roadways, and rail lines. Similar to strategies to mitigate risks from hurricanes, the region should take steps to ensure that signage, controller cabinets, signals and other roadside assets are wind resistant and can withstand power disruptions.

- **Develop an Action Plan for Handling Disruptions to Freight Assets Outside the Region.** Disruptions to freight assets outside the region that are critical to goods movement at the national level can impact supply chains within the region. For example, a significant earthquake event on the U.S. West Coast would divert maritime traffic to Savannah and other East Coast ports. This strategy focuses on developing a plan of action for how the region would handle these types of supply chain disruptions. The pop-up container yards established by the Georgia Ports Authority to alleviate supply chain strains throughout 2021 is an example of the types of actions that could be proactively identified as part of a strategic plan for handling disruptions.[156]

- **Develop an Action Plan for Handling Cyberattacks.** Cyberattacks and infrastructure incidents require the ability to quickly repair a wide variety of infrastructure and sometimes reroute traffic safely around incidents. The types of infrastructure that may need repair include both physical infrastructure and electronic and network systems. CORE MPO and partners should have staff and materials on hand to respond to these incidents. In addition, CORE MPO and partner agencies should take preventive measures to increase security to minimize the number of cyberattacks and the impact from cyberattacks. This includes enhancing security to critical computer systems, developing routine backup plans of computer systems and data, and coordinating with GDOT, the Georgia Emergency Management Agency and local emergency management agencies, and others to develop/initiate an immediate regional response plan.

[156] Van Cleave, K. "Georgia port uses pop-up concept to alleviate supply chain strain," CBS Evening News, https://www.cbsnews.com/news/supply-chain-issues-georgia-port-pop-up-concept/, Accessed November 5, 2022.

9 NEEDS ASSESSMENT

This section of the report summarizes the key investment needs for the CORE MPO region. These needs were identified based on the results of the technical analyses presented in sections 2-6, feedback gathered from stakeholders, and the findings of previous studies and planning efforts including the SR 21 Access Management Study, the SR 307Corridor Study, the Effingham County Transportation Master Plan, the Georgia Statewide Freight and Logistics Action Plan, the Georgia State Rail Plan, and other studies and plans that have been developed for the region.

Stakeholders have been engaged throughout the development of the Needs Assessment using multiple methods including online surveys, one-on-one interviews, steering committee meetings, and the MPO's Economic Development and Freight Advisory Committee (EDFAC) meetings. These initiatives provided insight on the region's industries use of the freight system, identified the challenges associated with goods movement within the region, and opportunities for improvement. While stakeholder engagement is ongoing throughout the Regional Freight Transportation Plan process, a few major themes related to the region's freight needs emerged and are summarized below:

- **Economic Growth and Emerging Freight Activity Centers.** Stakeholders stated that while historically the region's industrial and freight activity centered on areas adjacent to the Port of Savannah and east of downtown along President Street, new activity centers are being developed throughout the region. The most significant of these is the western portion of I-16 in Bryan and Chatham Counties (i.e., West I-16) where the Hyundai assembly plant will be located. The development of the Hyundai plant is expected to attract suppliers wanting to set up manufacturing plants near the main facility. Besides the West I-16 area, freight activity centers are also emerging to the north (i.e., north Effingham County) and south (i.e., Rockingham Industrial Park in Savannah and the Belfast Commerce Park in Bryan County) of the region's urban core. Furthermore, existing freight activity centers like the President Street corridor still have land available, and plans under development, to add more production capacity. The emergence new freight activity centers, and the growth of existing ones, will impact freight traffic patterns throughout the region.

- **Congestion and Reliability.** Stakeholders acknowledged that there have been multiple investments in the region's transportation network over the years that have helped to improve freight mobility. An example is the extension of Jimmy Deloach Parkway to I-16. In addition, there are several ongoing efforts to address the region's challenges such as the redesign of the I-16/I-95 interchange. However, given the region's growth there still remain freight mobility challenges on key corridors such as SR 21, SR 204, I-16, and I-95. In several cases, stakeholders observed that commuter traffic volume is the primary driver of challenges on these corridors as opposed to truck traffic.

- **Infrastructure Conditions.** The primary infrastructure condition issues raised by stakeholders include rough at-grade crossings, poor pavement conditions, and low vertical clearances. Crossings are worn down and made rough by high volumes of vehicle and rail traffic. Regarding pavement conditions, stakeholders observed that pavements on smaller roadways near the Port of Savannah, such as Foundation Drive and Lathrop Avenue, are in poor condition. They also noted that overweight truck trips directly between port facilities do not require a permit which is likely a contributing factor. Stakeholders only identified one location where vertical clearance was a challenge. Trucks often get stuck in the underpass for a rail bridge where E. Lathrop Avenue intersects with Louisville Road.

- **Freight Network Connectivity.** Stakeholders identified two primary challenges that impact network connectivity in the region: (1) at-grade crossings and (2) lack of east-west roadway connectivity in certain areas. At-grade crossings are prevalent throughout the region and create mobility and accessibility challenges. These challenges are most prevalent in the Garden City area, the SR 21 corridor, and the President Street corridor.

  Regarding east-west roadway connectivity, stakeholders primarily identified Effingham County and the President Street area east of downtown Savannah as being challenged. For Effingham County, east-west connectivity between SR 21 and I-16 was viewed as critical for accommodating growth and addressing existing challenges on SR 21. The Effingham County Transportation Master Plan identified this project as one of its most critical. For the President Street area, the primary routes providing access to interstate highways or the Port of Savannah's terminals are President Street-to-Bay Street and Truman Parkway-to-DeRenne Avenue. The President Street-to-Bay Street route is the most direct, but goes through the core of the Historic District impacting its cultural resources. The Truman Parkway-to-DeRenne Avenue route avoids the Historic District, but is longer and has challenges related to queueing at intersections, travel time delay, access management, and pedestrian safety and mobility. The City of Savannah and GDOT have an ongoing project to address these issues, but it remains a current challenge for network connectivity.

- **Truck Parking.** Some stakeholders noted truck parking challenges in the region. For example, stakeholders stated that unauthorized truck parking occurs in industrial parks and sometimes on roadway shoulders. The Crossroads Business Park, Savannah River International Trade Park, and Morgan Lakes Industrial Park were cited as examples. Other stakeholders stated that the region generally lacks truck parking. They observed that, though outside the 3-county study area, rest areas along I-16 are lined with trucks and that trucks sometime park on shoulders (which creates a safety challenge). Anecdotally, long-haul drivers sometimes compete for space at truck stops with local owner-operators who do not have a dedicated terminal for their trucks. Third-party companies that connect drivers with private property owners willing to allow them to park are very active in the region (e.g., SecurSpace, Park My Truck).

An overview of the region's needs and opportunities is presented in Table 9.1 and discussed in greater detail in the sections that follow. Note that in addition to these infrastructure-based needs, additional needs and opportunities related to land use, community impacts, and environmental impacts were identified as part of Tasks 3 and 5. Overall, freight demand on the CORE MPO region's multimodal freight network is projected to grow substantially over the long-term. This implies that the region's existing freight challenges will be exacerbated unless actions are taken now.

TABLE 9.1 OVERVIEW OF NEEDS AND OPPORTUNITIES

Need or Opportunity	Summary
Congestion and Reliability	• Multiple freight routes exhibit high levels of congestion or unreliable travel times. • The prevalence of at-grade crossings contributes to the region's congestion and reliability challenges.
Infrastructure Conditions	• Several freight corridors have poor pavement conditions. • Some bridges crossing freight routes have low vertical clearances and act as physical constraints to freight mobility.
Freight Network Connectivity	• Related to congestion and reliability challenges is the lack of roadway connectivity in certain parts of the region.

	• At-grade crossings and infrastructure conditions (i.e., pavement conditions and low vertical clearances) contribute to access challenges for existing multimodal connections.
Safety	• Multiple corridors that are critical to freight mobility exhibit crash rates that exceed region-wide averages. • Some at-grade rail crossings have experienced multiple crashes over the past ten years.
Truck Parking	• Truck parking capacity appears to satisfy current demand, but capacity is becoming constrained. Future growth in trucking activity may quickly consume existing capacity and worsen the existing need.
Resiliency	• Several of the region's freight assets are at risk to disruption from multiple hazards.

9.1 Congestion and Reliability

Trucks experience poor reliability on I-16 between Pooler Parkway and I-516 and also west of US 280 in Bryan County. I-95 north of SR 17/Jimmy Deloach Pkwy. also experiences poor reliability. For I-16, some of this performance may be attributed to ongoing construction work as part of the GDOT Major Mobility Investment Program (MMIP). However, this portion of the I-16 corridor has been considered for some time to be challenged from a freight mobility perspective, hence the MMIP investments. Regarding I-95, some amount of this performance challenge may be attributed to trucks and other vehicles accessing the Port of Savannah and the large cluster of warehouses and distribution centers located along SR 17/Jimmy Deloach Pkwy. and SR 21. However, the unreliability exhibited by this portion of I-95 is likely due to the reduction in number of lanes as the highway crosses into South Carolina – dropping from a 6-lane to a 4-lane highway. Both of these locations are among the region's busiest corridors for freight traffic.

9.2 Infrastructure Conditions

Infrastructure conditions - including poor pavements and bridges with low vertical clearance – represent an investment need for the CORE MPO region. Roadway pavement condition can impact the cost and safety of travel for passengers and freight. Cracked and rutting roadway surfaces can cause additional wear and tear on freight vehicles as well as damage the goods they are transporting. They can also result in increased travel times and negatively impact safety if drivers maneuver into other lanes to avoid potholes or other condition-related hazards.

Poor pavements are largely concentrated in the urban center of the region in the City of Savannah and on corridors outside the urban center that carry heavy volumes of freight traffic. Examples include SR 21 near the Port of Savannah and portions of SR 307/Bourne Avenue. By functional classification, poorer pavements are concentrated on minor arterials and major collectors. These roadways have over 20 percent of lane-miles that are in poor condition compared to 11-12 percent for minor collectors and principal arterials. Often, minor arterials and major collectors represent the first and last miles for freight shipments.

Generally, the region's bridges are in good condition. Only two of the region's bridges were rated as being in poor condition and both of these bridges have been programmed to be replaced. Posted bridges are those with a weight limit below the standard truck axle distribution weight, which means heavier trucks must either detour around the bridge or reduce its payload. In total, there are 9 posted bridges in the region. Only two of these generally handle truck traffic.

However, bridge vertical clearance does represent an investment need for the region. Vertical clearance can impact freight mobility as trucks are forced to divert to less efficient routes if a facility does not have sufficient vertical clearance. There are 9 bridges across the region that do not meet the current GDOT standard for minimum vertical clearance. Some of these bridges cross over arterials, which typically carry substantial volumes of freight traffic.

9.3 Freight Network Connectivity

Related to the region's congestion and reliability as well as infrastructure condition challenges, are challenges related to network connectivity. As the region has grown and new freight activity centers are emerging, formerly rural communities are now experiencing an influx of freight-oriented developments. While these developments are situated on or adjacent to major freight corridors, the existing freight network does not efficiently handle the origin-destination patterns generated by these developments.

Effingham County provides an example of this challenge. Warehouses, distribution centers, and other freight-oriented land uses have been developed along or near freight corridors such as SR 21, McCall Road, and Old Augusta Road. While the current roadway network provides good north-south connectivity to I-95 and the Port of Savannah, it does not provide good east-west connectivity to I-16. This contributes to congestion and reliability challenges on corridors such as SR 21 as they must facilitate east-west freight trips generated by these land uses due to a lack of connectivity.

Connectivity challenges also impact established freight activity centers such as the President Street corridor. Trucks traveling east-west across the region have few direct options other than DeRenne Avenue or Bay Street. Shippers along this corridor are also impacted by grade crossings along President Street that cause delays to motor carriers and commuters.

9.4 Freight Safety

Roadway safety represents an important measure of performance not only because of the potential loss of life and damage to property, but also because of the role it plays in congestion and unreliability. There were 3,716 crashes involving trucks in the 3-county region based on 2016-2020. Most crashes in the region did not result in an injury. However, about 2.2 percent truck-involved crashes (82 in total) did result in a serious injury or fatality. This is higher than the total percentage of non-truck-involved crashes resulting in serious injury or death (about 1.2 percent).

For crashes involving trucks, angle, sideswipe - same direction, and rear end collision types were the most prevalent and accounted for nearly 67 percent of truck-involved crashes observed during the analysis period. Lane width and worn or inadequate pavement markings are typical contributing factors for sideswipe crashes.[157] For rear end crashes, congestion and inappropriate approach speeds are contributing factors.[158]

Prior studies have proposed various operational and intersection improvements that will positively impact safety. For example, the SR 307 Corridor Study and the SR 21 Access Management Study identified several

[157] Ibid.

[158] Ibid.

improvements for the SR 307 and SR 21 corridors. However, the analysis of crash data, field review results, and stakeholder feedback indicate that safety continues to represent an investment need for the region.

9.5 Truck Parking

Truck parking capacity appears to satisfy current demand, but capacity is becoming constrained. The analysis of truck trip trajectory data suggests that during peak periods, about 75 percent of the region's truck parking spaces were estimated to be occupied. However, demand may actually be higher than estimated in the analysis of truck GPS data as it did not include roadway shoulders, on-/off-ramps, and other locations where unauthorized truck parking typically occurs. Some stakeholders noted that the region generally lacks truck parking given the level of trucking activity and provided examples of unauthorized truck parking occurring in industrial parks and on roadway shoulders. Growth in freight activity will worsen existing truck parking needs. Based on the analysis of commodity flow data, long-distance (i.e., 500 miles or greater) truck moves into, out of, and through the region are anticipated to grow rapidly (about 3 percent annually) which will contribute to the erosion of existing capacity.

9.6 Freight Network Resiliency

Much of the region, and its multimodal freight network, is at risk to disruption from multiple hazards – namely sea level rise/coastal flooding, riverine flooding, and hurricanes. The areas of the region that are most at-risk due to sea level rise/coastal flooding are those closest to the Atlantic Ocean in the eastern part of the region. Much of the region to the east of I-95 is at either very high or high risk to sea level rise. For riverine flooding, the areas in the easternmost part of the region near Tybee Island, areas south of the Ogeechee River, and areas east of I-95 are most at-risk to riverine flooding. Other high-risk areas include Pooler, Port Wentworth, Bloomingdale, and Eden. Most of the region is at-risk to hurricane damage. The highest risk locations are in north Effingham County, along the I-95 corridor, and the south and eastern parts of the region near the Atlantic Ocean.

These hazards place several of the region's major freight terminals at risk to disruption. For example, the Port of Savannah is the most significant freight asset in the region and the State. Its composite risk ranges from "low" to "very high" given the significant amount of land occupied by the port. Generally, the Savannah/Hilton Head International Airport in an area of "very high" combined risk. The three major rail yards in the region are all in risk areas of at least "moderate" combined risk. The CSX Southover Yard and Savannah Yard are within "high" risk areas, while the Norfolk Southern Savannah Yard is in a "moderate" risk area. Out of the 22 truck parking facilities in the region, half are under "very high" risk. Because of this, resiliency is considered an investment need for the CORE MPO region.