

6. Medical Device Manufacturing Supply Chain

6.1 Supply Chain Economic Contribution

Over the past few decades, Florida has emerged as the nation's second-largest medical device manufacturing industry.¹ Table 46 shows the composition of the medical device manufacturing sector in Florida.

TABLE 1. MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SECTOR - COMPOSITION AND ECONOMIC CONTRIBUTION IN 2022

Industry	Employment (jobs)	Wages (Millions of USD)	GSP (Millions of USD)
NAICS 339112 Surgical and medical instrument manufacturing	8,940	\$776	
NAICS 339113 Surgical appliance and supplies manufacturing	5,435	\$403	
NAICS 339114 Dental equipment and supplies manufacturing	819	\$65	
NAICS 339115 Ophthalmic goods manufacturing	3,852	\$391	
NAICS 339116 Dental laboratories	3,572	\$215	
NAICS 3391 Medical equipment and supplies manufacturing	22,619	\$1,849	\$3,649
Florida All Industries	9,358,228	\$596,788	\$1,439,065
Medical equipment and supplies manufacturing Supply Chain Share (%)	0.24%	0.31%	0.25%

Source: Cambridge Systematics Analysis using data from BLS and BEA 2022. U.S. Bureau of Labor Statistics. Quarterly Census of Employment and Wages (QCEW). NAICS-Based Data Files <https://www.bls.gov/cew/downloadable-data-files.htm>

Table 47 lists the top five medical device manufacturing companies in Florida based on employment.

TABLE 2. TOP 10 MEDICAL DEVICE MANUFACTURING IN FLORIDA

Top Medical Equipment and Supplies Manufacturing Companies	Total Jobs	Share (%)
Johnson & Johnson Vision Care Inc	1200	5.4%
Medline Industries Inc.	852	3.8%
Point Blank Enterprises Inc.	824	3.7%
Linvatec Corporation	781	3.5%
Howmedica Osteonics Corp.	702	3.2%
Medtronic Xomed Inc.	660	3.0%
Baxter Healthcare Corporation	600	2.7%
Biomet 3i LLC	600	2.7%

¹Medical Device Manufacturing in the US [Report](#) (2023).

Top Medical Equipment and Supplies Manufacturing Companies	Total Jobs	Share (%)
Safariland LLC	425	1.9%
Bausch & Lomb Incorporated	403	1.8%
Top 10 Medical Equipment and Supplies Manufacturing Companies	7,047	31.8%
All Medical Equipment and Supplies Manufacturing Companies	22,191	100%

Source: Cambridge Systematics Analysis using data from D&B Database (Jan 2020).

Conclusion

Several key findings are associated with the medical device manufacturing supply chain's contribution to the Florida economy in 2022.

Overall Strength of Florida's Medical Device Manufacturing Sector

- o The Florida medical device manufacturing subsector, led by **surgical and medical instrument manufacturing**, significantly contributes to the state's economy with key industries collectively supporting over \$3.6 billion (.25%) to Florida's GSP, generating \$1.8 billion in wages.
- o In 2022 the top five medical device manufacturing companies in Florida collectively accounted for 32% of the total employment in the state's medical equipment and supplies manufacturing subsector in 2020.

6.2 Supply Chain Market Analysis

Commodity Flow Analysis

Table 48 presents the directional flows for the medical device manufacturing supply chain in 2022.

TABLE 3. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - DIRECTIONAL COMMODITY FLOWS BY TONNAGE AND VALUE IN 2022

Directional	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Intra	3,766	47%	\$48,750	30%
Inbound	2,786	35%	\$71,861	44%
Outbound	1,499	19%	\$41,035	25%
Total	8,051	100%	\$161,646	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include electronics (SCTG 35) and precision instruments (SCTG 38).

Table 49 presents Florida imports and exports and total trade for the medical device manufacturing supply chain, including the breakdown between domestic and international trade, in 2022.

TABLE 4. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN – DOMESTIC AND INTERNATIONAL TRADE IN 2022

Trade	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Domestic Exports	848	18%	\$31,862	27%
International Exports	962	21%	\$16,817	14%
Total Exports (E)	1,810	39%	\$48,679	41%
Domestic Imports	1,992	43%	\$54,701	46%
International Imports	837	18%	\$15,344	13%
Total Imports (I)	2,829	61%	\$70,045	59%
Total Trade = (E) + (I)	4,639	100%	\$118,724	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include electronics (SCTG 35) and precision instruments (SCTG 38).

Top Domestic Trading Partners

Table 50 shows Florida's top 10 domestic trading partners by tonnage in 2022.

TABLE 5. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY TONNAGE IN 2022

State	Export (Thousand Tons)	State	Import (Thousand Tons)
New Jersey	149	California	350
Georgia	92	Georgia	343
California	55	Tennessee	166
Virginia	51	Texas	131
Tennessee	50	Pennsylvania	93
Mississippi	41	Illinois	90
Michigan	40	New Jersey	88

State	Export (Thousand Tons)	State	Import (Thousand Tons)
Colorado	35	New York	69
Texas	34	North Carolina	68
West Virginia	33	Mississippi	65
<i>Top 10 (Tonnage)</i>	<i>580</i>	<i>Top 10 (Tonnage)</i>	<i>1,463</i>
<i>Top 10 (Percentage)</i>	<i>68%</i>	<i>Top 10 (Percentage)</i>	<i>73%</i>
Total	848	Total	1,992

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include electronics (SCTG 35) and precision instruments (SCTG 38).

Table 51 shows Florida's top 10 domestic trading partners by value in 2022.

TABLE 6. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY VALUE IN 2022

State	Export (Million USD)	State	Import (Million USD)
California	\$4,178	California	\$12,196
Texas	\$2,495	Texas	\$4,114
Virginia	\$2,246	Georgia	\$4,054
New York	\$1,958	New York	\$3,999
Illinois	\$1,911	New Jersey	\$3,705
Georgia	\$1,576	Indiana	\$2,974
North Carolina	\$1,485	Illinois	\$2,713
New Jersey	\$1,224	Pennsylvania	\$2,035
Indiana	\$1,140	Tennessee	\$1,621
Ohio	\$998	Massachusetts	\$1,356
<i>Top 10 (Tonnage)</i>	<i>\$19,211</i>	<i>Top 10 (Tonnage)</i>	<i>\$38,767</i>
<i>Top 10 (Percentage)</i>	<i>60%</i>	<i>Top 10 (Percentage)</i>	<i>71%</i>
Total	\$31,862	Total	\$54,701

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include electronics (SCTG 35) and precision instruments (SCTG 38).

California, Texas, and New York play a significant role in supporting Florida’s medical device manufacturing supply chain by providing electronics and precision instruments. Relying on few states suggests potential vulnerabilities in Florida’s medical device manufacturing supply chain should there be a disruption impacting the ability of these states in providing Florida with immediate inputs or final products.

Top Foreign Trading Partners

Table 52 depicts Florida’s top foreign trading partners for imports and exports of medical equipment and devices based on value (USD) in 2022.

TABLE 7. FLORIDA’S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - FOREIGN TRADING PARTNERS BY VALUE IN 2022

Foreign Trading Partners	International Exports (\$ Million USD)	Foreign Trading Partners	International Imports (\$ Million USD)
Netherlands	\$255	China	\$281
Canada	\$182	Germany	\$161
Brazil	\$108	Ireland	\$121
Japan	\$105	Spain	\$111
United Kingdom	\$93	Costa Rica	\$101
China	\$82	Mexico	\$93
Germany	\$73	Israel	\$73
Dominican Republic	\$61	Taiwan	\$60
Mexico	\$54	Switzerland	\$48
Australia	\$54	Thailand	\$45
Top 10 (Million USD)	\$1,067	Top 10 (Million USD)	\$1,095
Top 10 (Percentage)	61%	Top 10 (Percentage)	73%
Total	\$1,758	Total	\$1,503

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida.

Note: Commodity flows include Medical Equipment and Supplies Manufacturing (NACIS 3391).

In 2022, Florida’s international imports represented 13 percent of total Florida trade while the state international exports represented 14 percent of total Florida trade. This indicates the following:

- Florida relies on international markets to meet its demand for medical equipment and devices and that other countries also rely on Florida to meet their demand for medical equipment and devices.
- Florida medical device manufacturing supply chain involves high-value commodities and disruption of the supply chain can lead to significant economic loss. Therefore, the planning and development of strategies to mitigate the potential geographical effects of disruptions impacting the supply chain is critical to improve supply chain resilience.

Conclusion

Several key findings are associated with the supply chain market analysis of the medical devices manufacturing supply chain.

Directional Flows of the Medical Device Manufacturing Supply Chain (2022):

- **Intra-Movements:** In 2022, Florida's medical device manufacturing supply chain was dominated by intra-movements, accounting for 47 percent of tonnage (3.8 million tons) and 30% percent of value (\$49 billion).
- **Inbound Movements:** 35 percent of the total tonnage (2.8 million tons) and 44 percent of the total value (\$72 billion).
- **Outbound Movements:** 18 percent of the total tonnage (1.5 million tons), and 26 percent of the total value (\$41 billion).

Imports within Florida's Medical Device Manufacturing Supply Chain:

- Overall imports (domestic and international) comprise 61 percent of total trade by tonnage, and 59 percent of total trade by value (USD).
- Domestic imports comprise 43 percent of total trade by tonnage, and 46 percent of total value (USD).

Exports within Florida's Medical Device Manufacturing Supply Chain:

- Overall exports (domestic and international) comprise 39 percent of total trade by tonnage, and 41 percent of total trade by value (USD).
- Domestic exports comprise 18 percent of total trade by tonnage, and 27 percent of total value (USD).
- International trade exports accounted for 21% of total export tonnage and 14 percent of total export value.

Florida's Domestic Medical Device Manufacturing Trade

- Florida medical device manufacturing exports to its top 10 domestic partners accounts for 68 percent in tonnage (580 thousand tons), and 73 percent of total domestic import tonnage (over 1.4 million tons) of total domestic imports.
- Florida medical device manufacturing exports to its top 10 domestic partners accounted for 60 percent of Florida's total domestic export value, and 71 percent of total domestic import value.
- Primary domestic export destinations include New Jersey, Georgia, California, Virginia, and Tennessee, by tonnage, and California, Texas, Virginia, New York, and Illinois by value.
- Primary domestic import partners include California, Georgia, Tennessee, Texas, and Pennsylvania by tonnage, and California, Texas, Georgia, New York, and New Jersey by value.
- California, Texas, and New York are critical partners in the domestic trade.

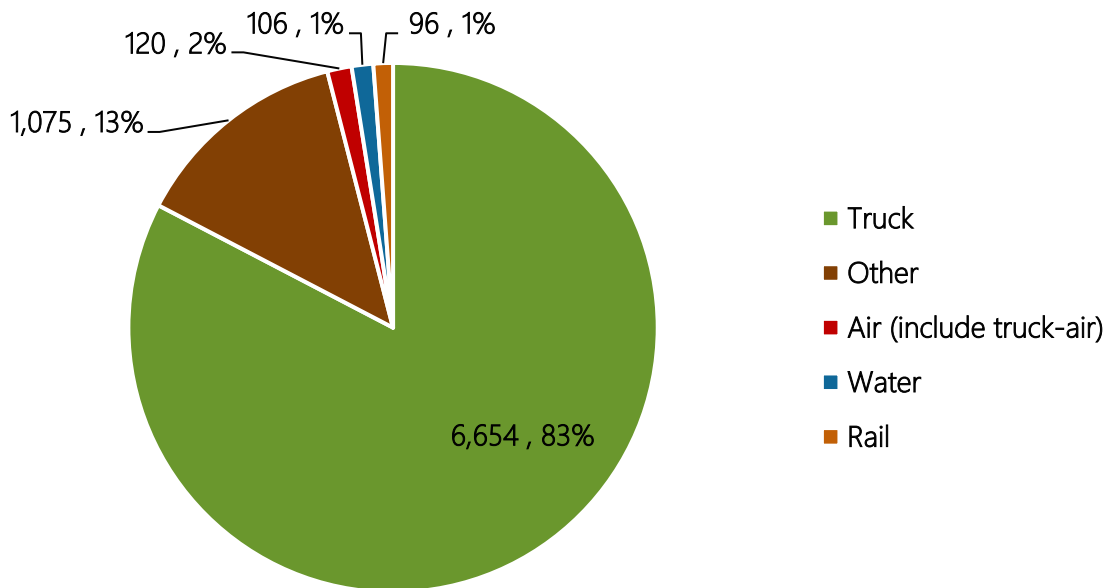
Florida's International Medical Device Manufacturing Trade

- In 2022, Florida's medical device manufacturing international imports totaled \$1.5 billion in value and international exports totaled \$1.8 billion in value.
- The state's top 3 foreign trading partners for imports include China, Germany, and Ireland.
- The state's top 3 foreign trading partners for exports include Netherlands, Canada, and Brazil.

6.3 Supply Chain Dominant Freight Modes

Figure 55 and Figure 56 show the mode split by tonnage and value for the combined intra, inbound, and outbound flows for the medical device manufacturing supply chain in Florida in 2022.

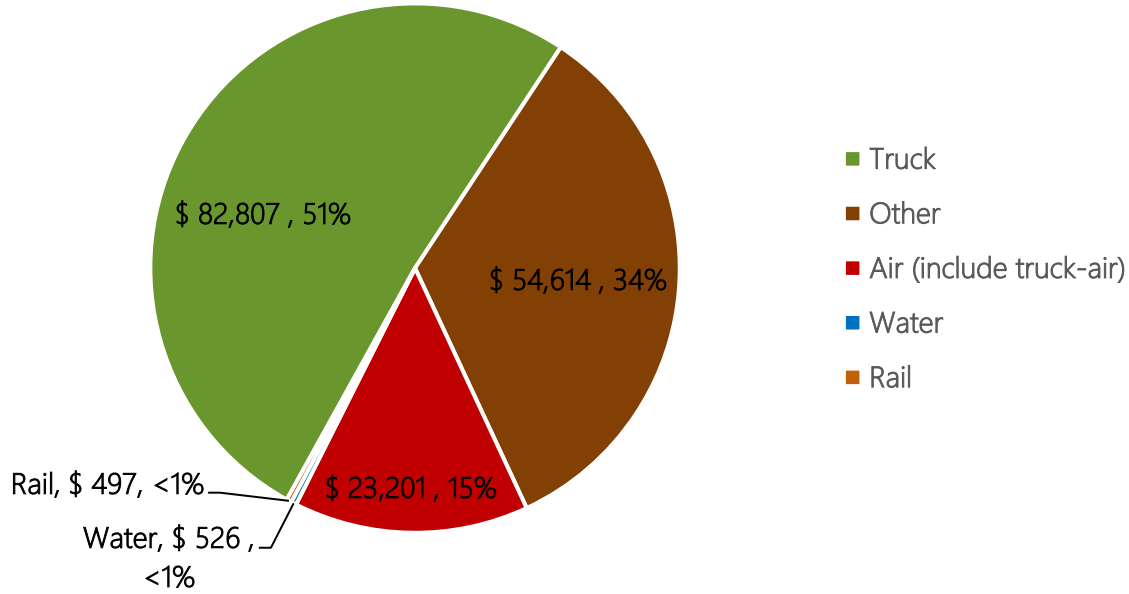
FIGURE 1. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - TONNAGE (THOUSAND TONS) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS, 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include electronic and other electrical equipment and components, and office equipment (SCTG 35) and precision instruments and apparatus (SCTG 38).

FIGURE 2. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - VALUE (MILLION USD) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS, 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include electronic and other electrical equipment and components, and office equipment (SCTG 35) and precision instruments and apparatus (SCTG 38).

Table 53 and Table 54 provide detailed insights into the mode distribution by tonnage, value, and direction within Florida's medical device manufacturing supply chain in 2022.

TABLE 8. FLORIDA'S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - MODE SPLIT BY TONNAGE IN 2022

Mode	Thousand Tonnage (Percentage)			Total by Mode
	Intra	Inbound	Outbound	
Truck	3,447 (92%)	2,047 (73%)	1,160 (77%)	6,654
"Other"	227 (6%)	584 (21%)	264 (18%)	1,075
Air (include truck-air)	<1 (<1%)	77 (3%)	43 (3%)	120
Water	82 (2%)	18 (1%)	6 (<1%)	106
Rail	9 (<1%)	61 (2%)	26 (2%)	96
Total by Direction	3,765 (100%)	2,787 (100%)	1,499 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include electronic and other electrical equipment and components, and office equipment (SCTG 35) and precision instruments and apparatus (SCTG 38).

TABLE 9. FLORIDA’S MEDICAL DEVICE MANUFACTURING SUPPLY CHAIN - MODE SPLIT BY VALUE IN 2022

Mode	Million USD (Percentage)			Total by Mode
	Intra	Inbound	Outbound	
Truck	\$41,362 (85%)	\$27,907 (39%)	\$13,537 (33%)	\$82,807
“Other”	\$6,832 (14%)	\$27,735 (39%)	\$20,047 (49%)	\$54,614
Air (include truck-air)	\$126 (<1%)	\$15,782 (22%)	\$7,292 (18%)	\$23,201
Water	\$363 (1%)	\$144 (<1%)	\$20 (<1%)	\$526
Rail	\$66 (<1%)	\$293 (<1%)	\$138 (<1%)	\$497
Total by Direction	\$48,749 (100%)	\$71,861 (100%)	\$41,034 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include electronic and other electrical equipment and components, and office equipment (SCTG 35) and precision instruments and apparatus (SCTG 38).

Conclusion

Several key findings are associated with the dominant freight mode analysis of the food manufacturing supply chain.

Mode Split in the Medical Device Manufacturing Supply Chain

- Truck transportation is the primary mode, moving 83% of total tonnage and 51% of total value (USD). It plays a crucial role in all supply chain phases.
- Shipments by “other” modes (including flyaway aircraft, undetermined mode, multiple mode shipments, and parcel delivery services) account for 13% of total tonnage and 34% of total value (USD), meeting specialized transportation needs.
- Air mode, ranking third, moves 2% of total tonnage and 15% of total value. It’s essential for timely delivery and sensitive medical supplies.

Intra Flows (Within Florida):

- Truck transportation dominates, moving 92% of goods (34 million tons) and accounting for 85% of the total intra value (\$41 billion). “Other” modes contribute 6% in tonnage (7 million tons) and 14% in value (\$7 billion).

Inbound Flows (Originating Beyond Florida):

- Trucking remains the primary mode, moving 73% of total inbound tonnage and 39% of total inbound value.

Outbound Flows (Originating Within Florida):

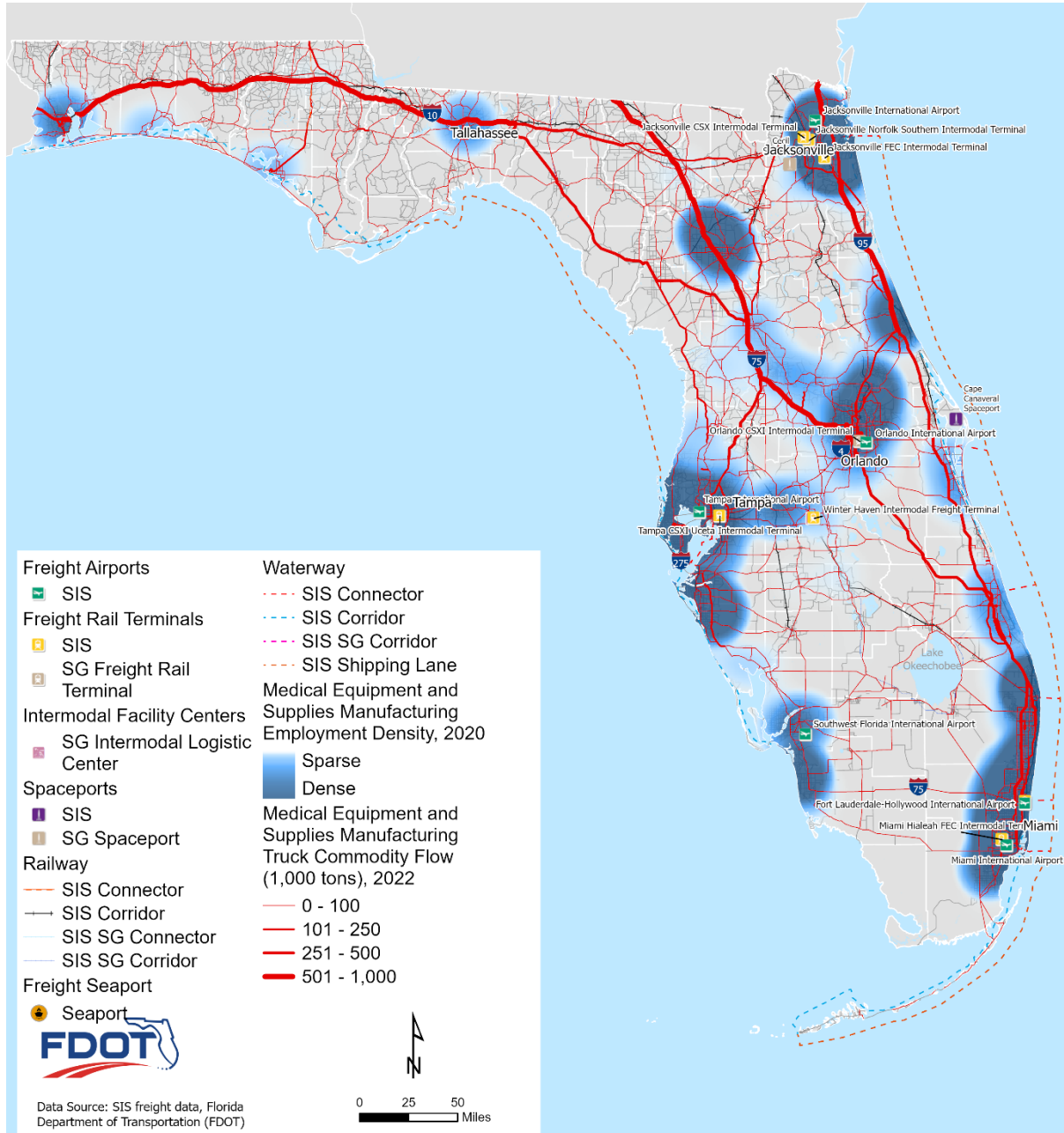
- Trucking is also predominant, moving 77% of total outbound tonnage and 33% of total outbound value. "Other" modes handle 18% of tonnage but 49% of value.

6.4 Initial Qualitative Assessment of Areas of Risk

Critical Florida Transportation Network Components

Figure 57 illustrates truck commodity flows and concentration of employment for the medical equipment and supplies manufacturing supply chain in the State. These concentrations include a range of business establishments, from small companies with 10 employees to large corporations with 1,200 employees. Among the 1,701-medical equipment and supplies manufacturing supply chain business establishments in Florida, close to 96 percent have between 1 and 50 employees, 3 percent of the businesses have between 51 and 500 employees, and only 6 businesses have over 500 employees. Truck flows on the major interstates (e.g., I-10, I-75, I-95) highlight the pivotal role of the interstate highway system in connecting the employment clusters across the State. I-10 serves as a critical corridor connecting the employment clusters in the Panhandle region. I-95 serves as a significant interstate corridor facilitating substantial movements in Southeast Florida. In Central Florida region, I-75 and Turnpike carry most of the medical equipment and supplies.

FIGURE 3. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN - COMMODITY FLOWS BY TRUCK AND EMPLOYMENT DENSITY



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

Disruptor Events and Areas of Risk

Global trade in medical devices has grown exponentially in the past 30 years, reaching a total of \$700 billion in 2022.² The medical device manufacturing supply chain remains critical to the overall public health system, ensuring technology devices and other medical products are distributed to meet the demands of healthcare providers and patients. Disruptions to the medical device manufacturing supply chain can result in delayed treatment and diagnoses, product shortages, and increased healthcare costs, causing significant strain on public healthcare systems and individual patient needs.³

According to the U.S Department of Health and Human Services, key internal vulnerabilities impacting medical device manufacturers include raw materials/product disruption, increased demand with limited production outputs, a lack in number of vendors for needed products, and damage to the manufacturing facilities or utilities. Additionally, these risk factors may be also compounded by disruptions or delays to distribution. Key vulnerabilities impacting the role of medical device distributors include access and re-entry to disaster-affected facilities or communities, secure transportation routes, road or infrastructure damage, and the transportation-related labor force.⁴

The medical device supply chain is also subject to external vulnerabilities including natural disasters (e.g., hurricanes and wildfires), human-caused disasters (e.g., cyber-attacks and equipment breakdown), and biological threats (e.g., the COVID-19 pandemic).⁵ For example, in 2017 Hurricane Maria damaged several medical device manufacturing factories in Puerto Rico which supplied hospitals in the United States with IV bags.⁶ Both medical device manufacturing and distribution plays a pivotal role in pre-event, response and recovery efforts during disasters. For example, pre-event activities may include the pre-positioning of trucks along strategic highways to enable prompt access to disaster zones whereas response activities may include the need to identify alternative transportation delivery routes.⁷ Developing and operating a resilient medical supply chain is critical to support public health needs in the state of Florida, especially in regard to medically vulnerable populations, such as children and the elderly.

² OECD, Securing Medical Supply Chains in a Post-Pandemic World: <https://www.oecd.org/health/securing-medical-supply-chains-in-a-post-pandemi-world-highlights.pdf>

³ OECD, Securing Medical Supply Chains in a Post-Pandemic World: <https://www.oecd.org/health/securing-medical-supply-chains-in-a-post-pandemi-world-highlights.pdf>

⁴ TRACIE Healthcare Emergency preparedness Information Gateway, partners with the Healthcare Supply Chain During Disasters: <https://files.asprtracie.hhs.gov/documents/aspr-tracie-partnering-with-the-healthcare-supply-chain-during-disasters.pdf>

⁵ TRACIE Healthcare Emergency preparedness Information Gateway, partners with the Healthcare Supply Chain During Disasters: <https://files.asprtracie.hhs.gov/documents/aspr-tracie-partnering-with-the-healthcare-supply-chain-during-disasters.pdf>

⁶ Harvard University, How Hurricane Maria caused U.S IV bag shortage: <https://www.hsph.harvard.edu/news/hsph-in-the-news/hurricane-maria-u-s-iv-bag-shortage/>

⁷ TRACIE Healthcare Emergency preparedness Information Gateway, partners with the Healthcare Supply Chain During Disasters: <https://files.asprtracie.hhs.gov/documents/aspr-tracie-partnering-with-the-healthcare-supply-chain-during-disasters.pdf>

Potential Impacts to Florida's SIS

Disruption events most common in Florida such as storm surge, floodplain, wildfire, sinkhole, sea level rise, strong wind, lightning, and extreme heat have the potential to damage the states roadways and other infrastructure, leading to delays and additional costs for medical device manufacturers.

Storm Surge

The medical device manufacturing supply chain utilizes local roadways, major highways, and interstates to link medical equipment and supplies manufacturing facilities with shipping routes throughout the state. The effects from storm surge of Category 1 to Category 5 storms provide significant risk to infrastructure and device manufacturing hubs around Tampa Bay, St. Pete and Sarasota, as well as along the southeast coast, Gainesville, Sanford and around Jacksonville.

Figure 58 shows that the panhandle and gulf coast regions may experience the highest levels of storm surge in the state, impacting U.S 98 and I-75. These regions do not have heavy medical device manufacturing employment density, but U.S 98 and I-75 are critical connectors between the northwest region and the rest of the state, providing access to I-10, I-4 near Orlando, I-75 and I-275 in Tampa. These connectors also have a high truck commodity flow for medical equipment and devices, so they are essential to the function of the supply chain. The highest density of medical manufacturing employment is in the Tampa area close to the St. Pete and Tampa airports, as well as near the Sarasota airport. In addition, dense medical device manufacturing employment can be found around other key infrastructure airports and rail intermodal terminals including the Jacksonville Airport, Orlando Sanford Airport, Jacksonville FEC Intermodal Terminal, Miami Hialeah FEC Intermodal Terminal, and Orlando CSXI Intermodal Terminal. These coastal facilities may be affected by storm surge, but inland facilities may be affected by traffic delays or supply chain disruptions. Effects of storm surge could also damage medical device manufacturing facilities, shipping and operations on the gulf, southeast and northeast coast, connection to I-75, and I-95, and operations at Port Tampa Bay and Seaport Manatee on the gulf coast, as well as Port of Palm Beach, Port Everglades and PortMiami in the southeast. In Jacksonville, JAXPORT and I-95 can be affected by storm surge heading north towards Georgia, as well as the I-295 loop around the city.

Floodplain

Displayed in **Figure 59**, the 100- and 500-year floodplains are a risk to the majority of the state, including areas with high medical device manufacturing employment density, the Tampa Bay/St. Pete/ Sarasota area, southeast Florida, and northeast Florida. Other small pockets of medical device employment are Sanford and Gainesville, and these areas also lie within the 100-year floodplain. Flooding may cause road closures, traffic delays, and freight shipment delays. Major Florida interstates for the medical device manufacturing supply chain, including I-10, I-75 and I-95, are also located within the 100-year floodplain. The lowest risk of the 100-year flood to the medical device manufacturing supply chain is around Jacksonville, JAXPORT, Jacksonville International Airport and the FEC intermodal terminal. The 500-year floodplain risk is most prevalent in southeast Florida, causing disruptions to distribution shipments at the Port Everglades, Miami International Airport, Miami Hialeah FEC Intermodal Terminal and PortMiami.

Wildfire

As shown in **Figure 60**, the risk of wildfires and their effects on the supply chain are spread across the state. Every region of Florida has a high to very high risk in some portions. The lowest wildfire risk area that is also a dense medical equipment employment area is the southeast coast of Florida. However, a wildfire event may pose the greatest risk to both the panhandle, central and southcentral Florida regions. Central Florida is home to high medical manufacturing employment density in Gainesville and Sanford and moderate to high wildfire risk. The major medical equipment and supplies trucking routes of I-75, I-95 and I-10 providing connection may be impacted by wildfires, which could degrade the infrastructure of roadways and bridges and cause traffic delays or congestion. Many airports utilized for medical device shipments along these interstates may also be affected by wildfires.

Sinkhole

Figure 61 shows how sinkholes pose the greatest risk to roadways in and around the panhandle region, north central Florida and the northwest coast. No other region of the state has a high potential for sinkhole activity. Luckily, the risk that is present does not affect many high medical device manufacturing employment density areas except for Gainesville and Sanford in central Florida and around the Tampa International Airport and Port Tampa Bay. Despite this, Sinkholes do have the potential to create disruptions to medical equipment shipping routes along I-10, I-75, U.S 19, U.S 98, and U.S 90. A sinkhole event along a trucking route could cause delays in the supply chain as well as major infrastructure damage.

Sea Level Rise

The hazard of sea level rise will not affect many high-volume medical device manufacturing trucking routes. The major interstates potentially affected by one foot of sea level rise are I-275 across Tampa Bay and I-95 through Jacksonville. However, sea level rise can impact every seaport in the state, including several seaports transporting medical device manufacturing shipments. Medical device manufacturing operations at and around JAXPORT, Port Everglades, Port Tampa Bay, Port of Palm Beach and Port Miami may be affected by sea level rise. The sea level rise hazard will not damage inland and infrastructure, though these areas may experience shipment delays if origin facilities along the coast are affected. The effects of the sea level rise risk across the Florida coastline is shown in **Figure 62**.

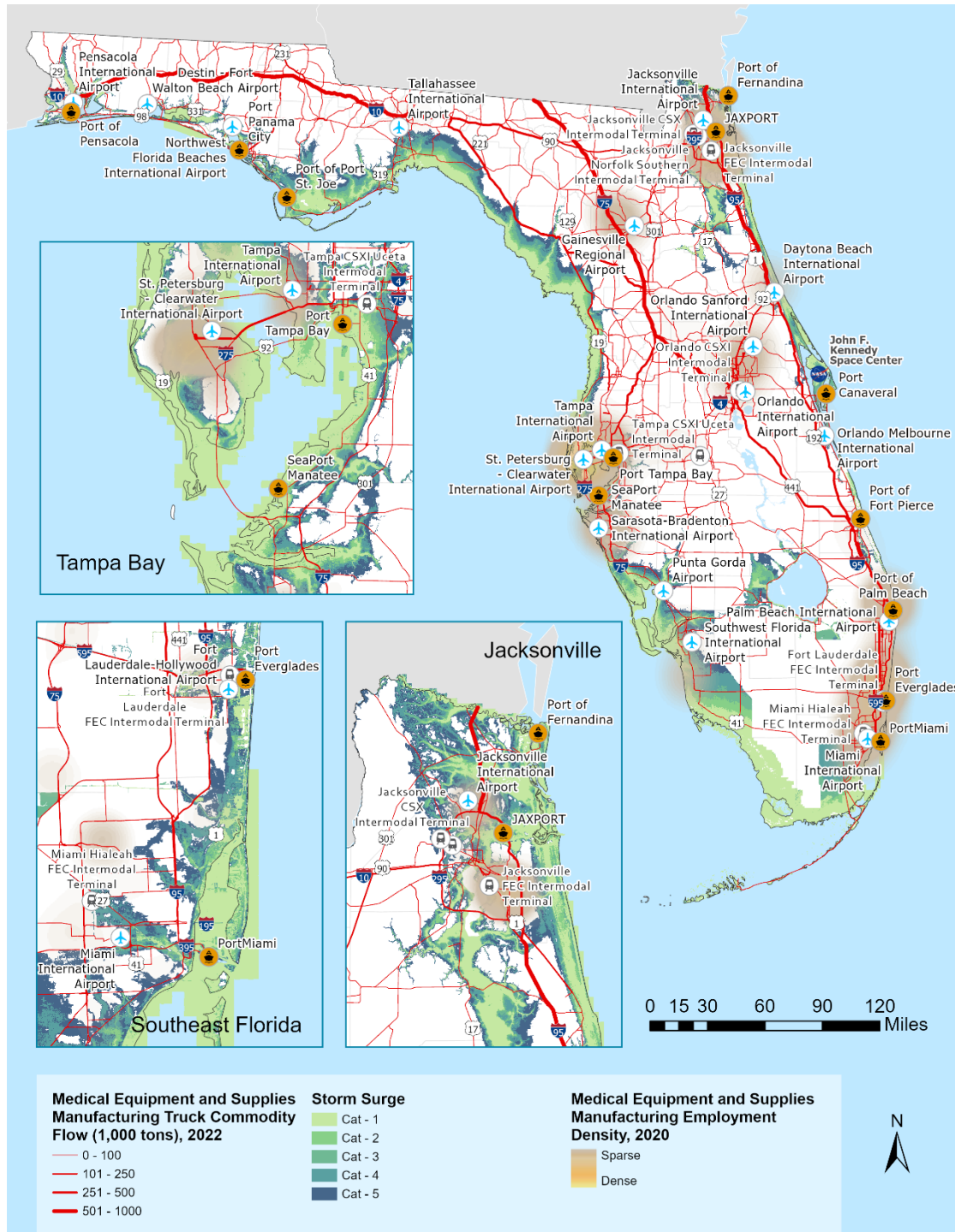
Severe Thunderstorm and Strong Winds

Severe thunderstorms are frequent in Florida, bringing the risk of lightning and strong winds and the potential to disrupt the medical device manufacturing supply chain. Strong wind can affect truck travel along medical equipment shipping routes of I-10, I-75 and I-95, blocking roadways with debris and delaying the supply chain. Strong wind risk is high in dense medical device manufacturing employment areas of Sanford and Gainesville in central Florida. **Figure 63** shows the risk for strong winds is concentrated in the panhandle and down the center of the state. **Figure 64** shows another hazard of severe thunderstorms, lightning. Lightning strikes have the potential to damage infrastructure, delay freight shipments and pose danger to supply chain workers. The potential for lightning is near constant and very high across the state and high-volume medical equipment manufacturing truck routes. These routes include the major interstates, highways and rail lines in the state. The lightning risk is very high in dense medical device manufacturing employment areas around Tampa Bay, St. Pete, Sarasota, Southeast Florida and Jacksonville and the nearby seaport and airport shipping partners.

Extreme Heat

The effects of extreme heat cause damage to roadways and other state infrastructure and impact the asphalt to deteriorate or buckle. The degradation of roadways can disrupt the medical equipment manufacturing supply chain while their shipping routes are under construction or closed. **Figure 65** shows the highest risk areas for extreme heat effects are central and southwest Florida. The high-volume medical device manufacturing trucking interstates of I-10 and I-75 are in areas with 41-50 days with temperature of 95 degrees, the most critical circumstance of extreme heat. This area contains Port Tampa Bay, Tampa Bay International Airport, and the Gainesville and Sanford airports. These areas also have higher medical device manufacturing employment density. If the state infrastructure, seaports and medical device manufacturing facilities experience damage or delays caused by extreme heat effects, the entire medical device manufacturing supply chain could see interruptions throughout the state.

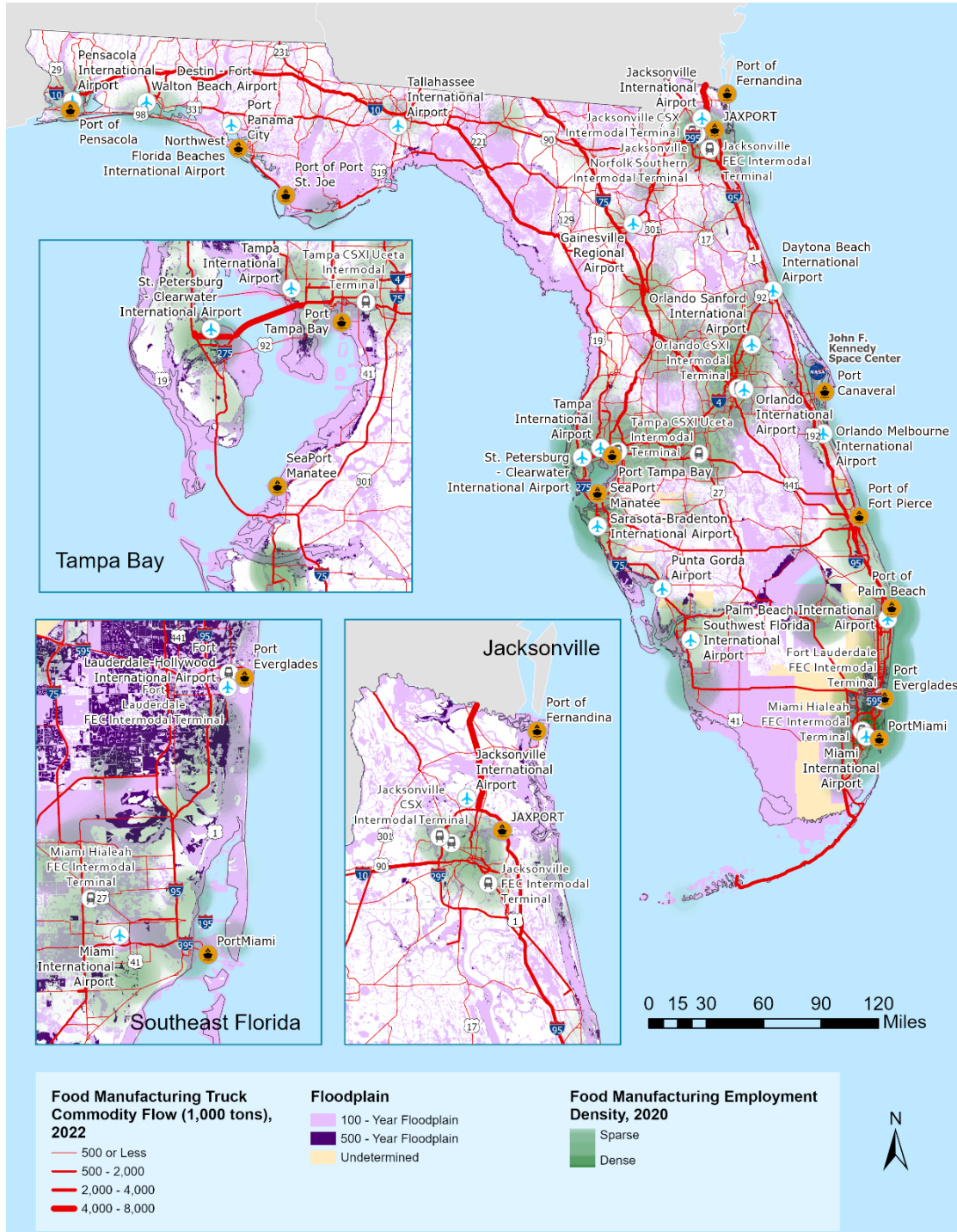
FIGURE 4. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN – STORM SURGE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

FIGURE 5. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN – FLOODPLAIN HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

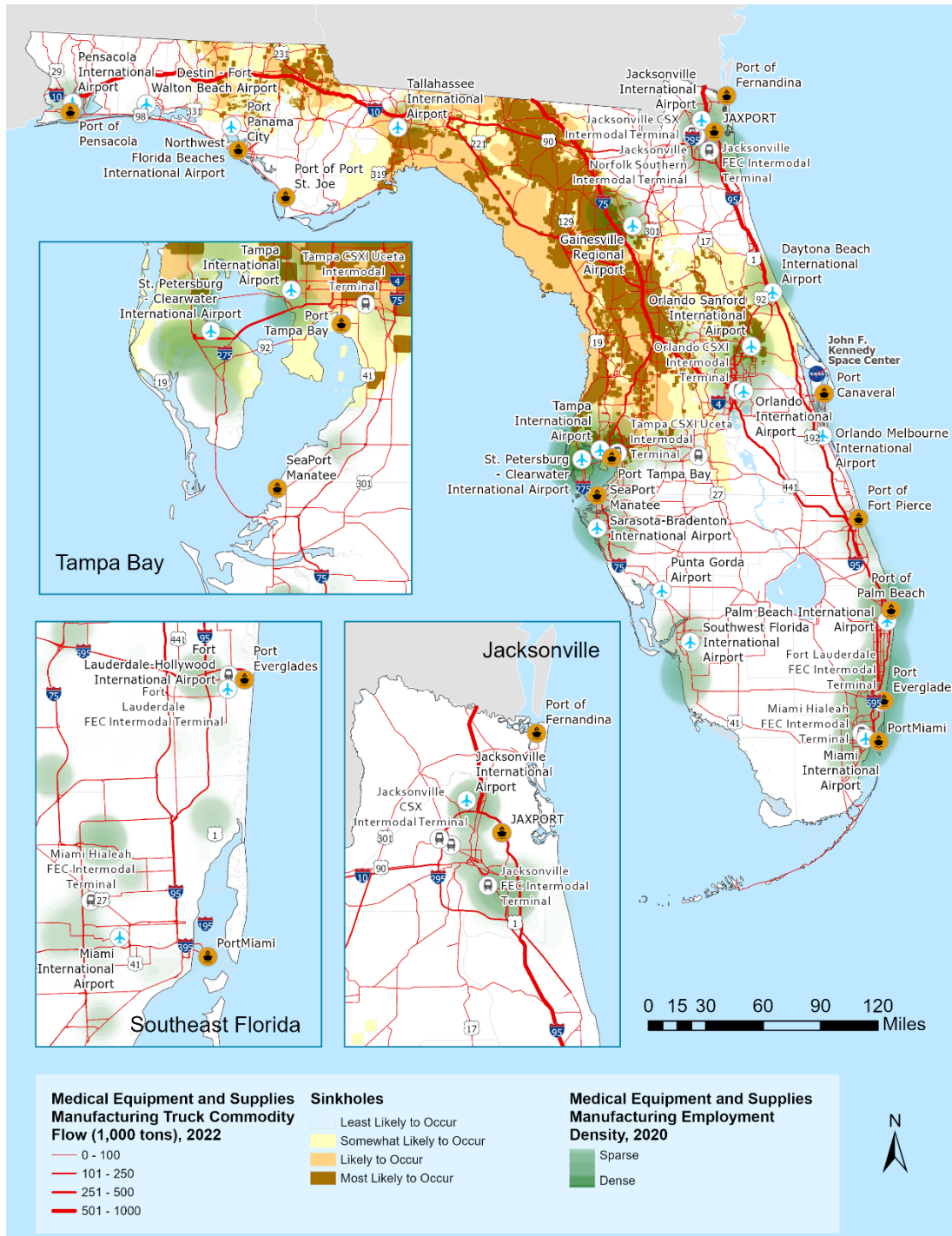
FIGURE 6. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN – WILDFIRE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

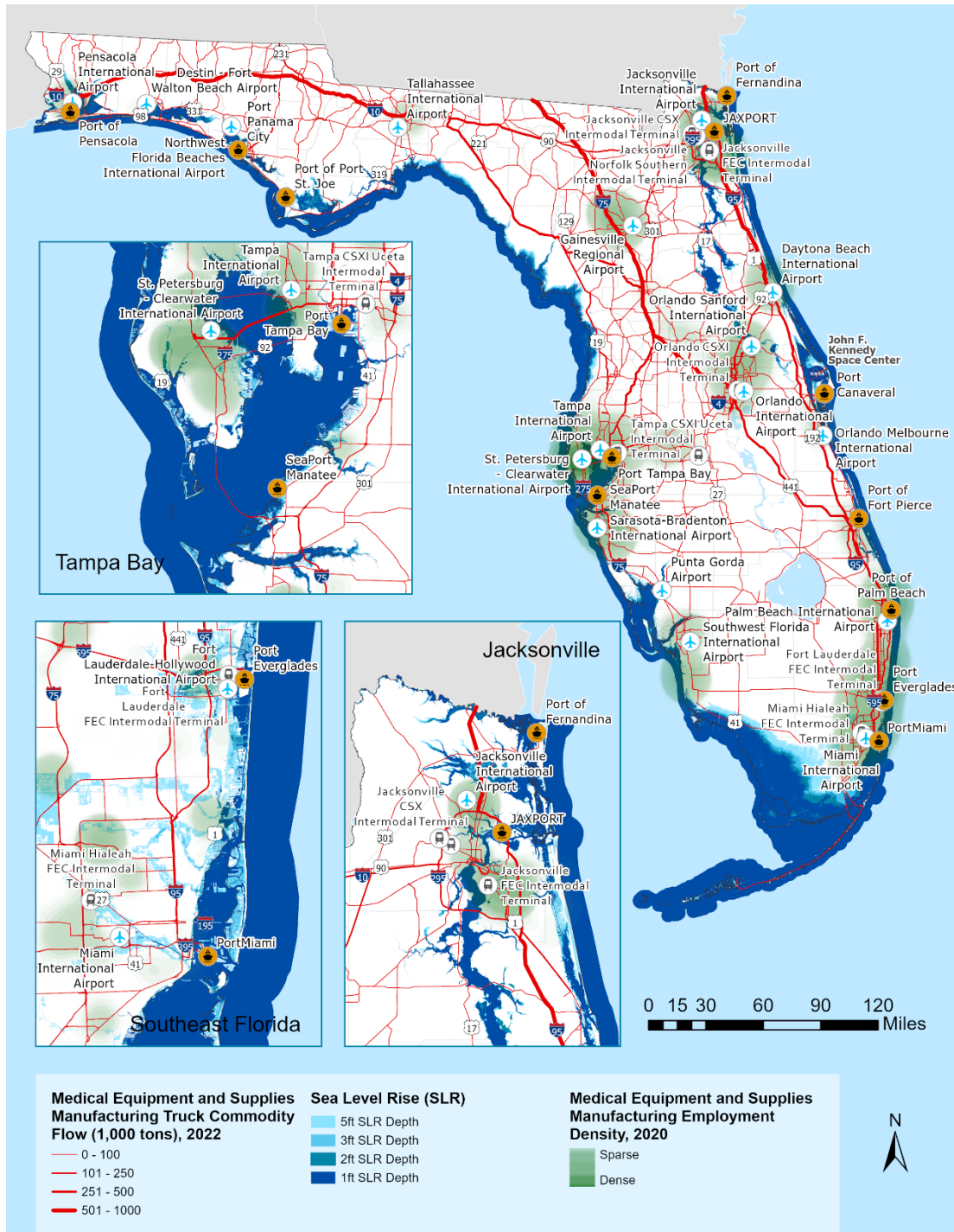
FIGURE 7. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN – SINKHOLE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

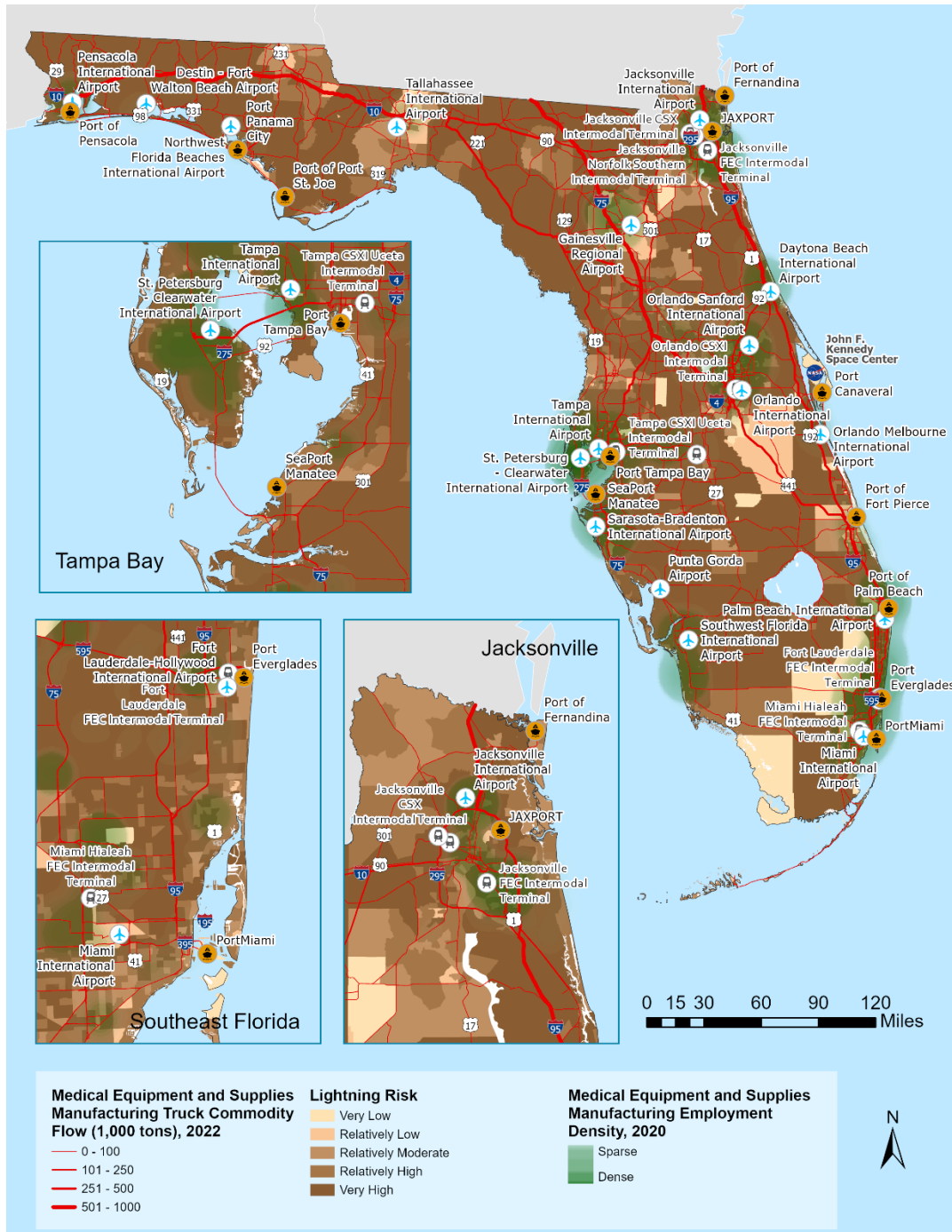
FIGURE 8. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN SEA LEVEL RISE – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

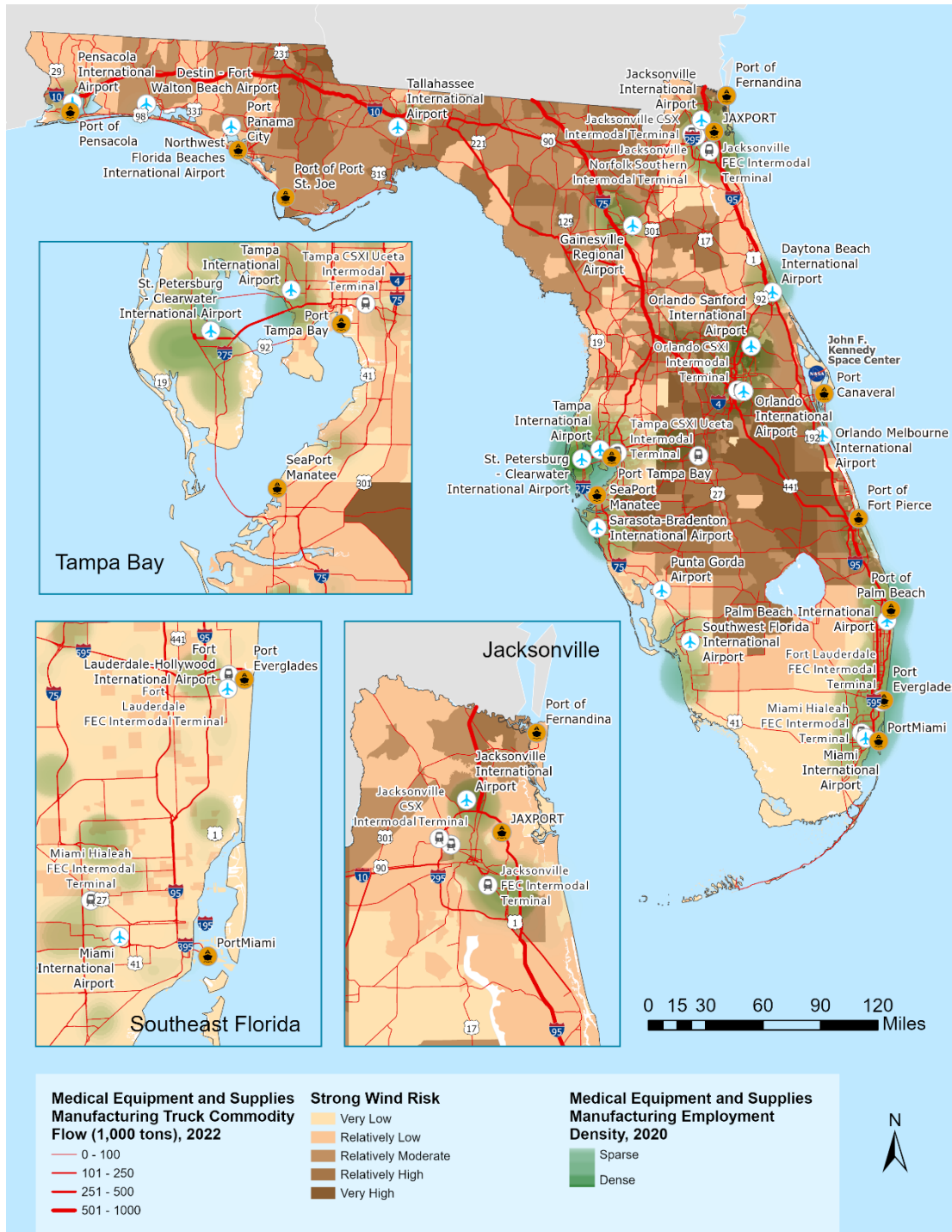
FIGURE 9. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN LIGHTNING – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

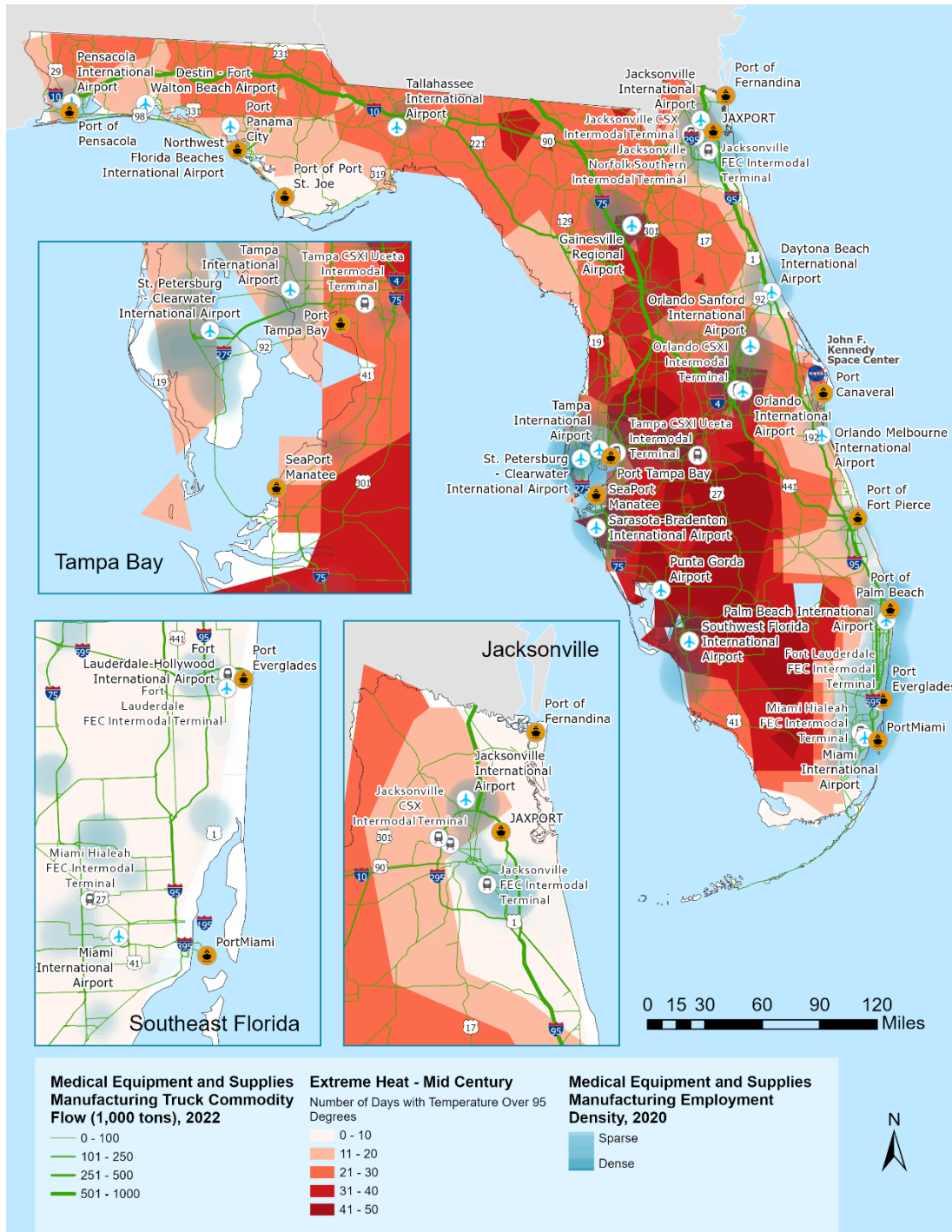
FIGURE 10. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN STRONG WINDS – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

**FIGURE 11. FLORIDA'S MEDICAL EQUIPMENT AND SUPPLIES MANUFACTURING SUPPLY CHAIN
EXTREME HEAT – HAZARD**



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Medical equipment and supplies manufacturing truck commodity tons include electronics (SCTG 35), and precision instruments (SCTG 7). Employment density includes medical equipment and supplies manufacturing (NAICS 33911).

6.5 Supply Chain Structure and Diagram

Since Florida is home to the second largest medical device manufacturing industry in the U.S.⁸, this analysis focuses on the disposable medical supplies. Most common disposable medical devices include masks, gloves, bandages, gauze, gowns, IV bags, syringes, and medical tools. This group of commodities are ubiquitous to every area of the healthcare system. These single-use commodities are crucial for patients and healthcare workers as they reduce the risk of cross contamination and infection spread.⁹ Hence, single-use medical devices represent a critical commodity in terms of a community daily life and in the event of a disruption.

Figure 66 offers a graphical illustration of the disposable medical devices supply chain. Each node in this diagram represents a key stage/facility in the supply chain lifecycle. Color-coded arrows between each node represent the modal transport that moves the commodity from one conceptual node to another, with each color representing a different modal transport as shown in the legend. The diagram focuses on adequately capturing major commodity flows and modal usage. The diagram is meant to capture general flows and will not fully capture the nuances of the supply chain within a specific industry.

The medical device manufacturing structure begins with the acquisition of raw materials and intermediate inputs including plastic resin, latex, medical fabric and metals, among others. These inputs are transported by truck to medical device manufacturing companies to being assembly and packed later.

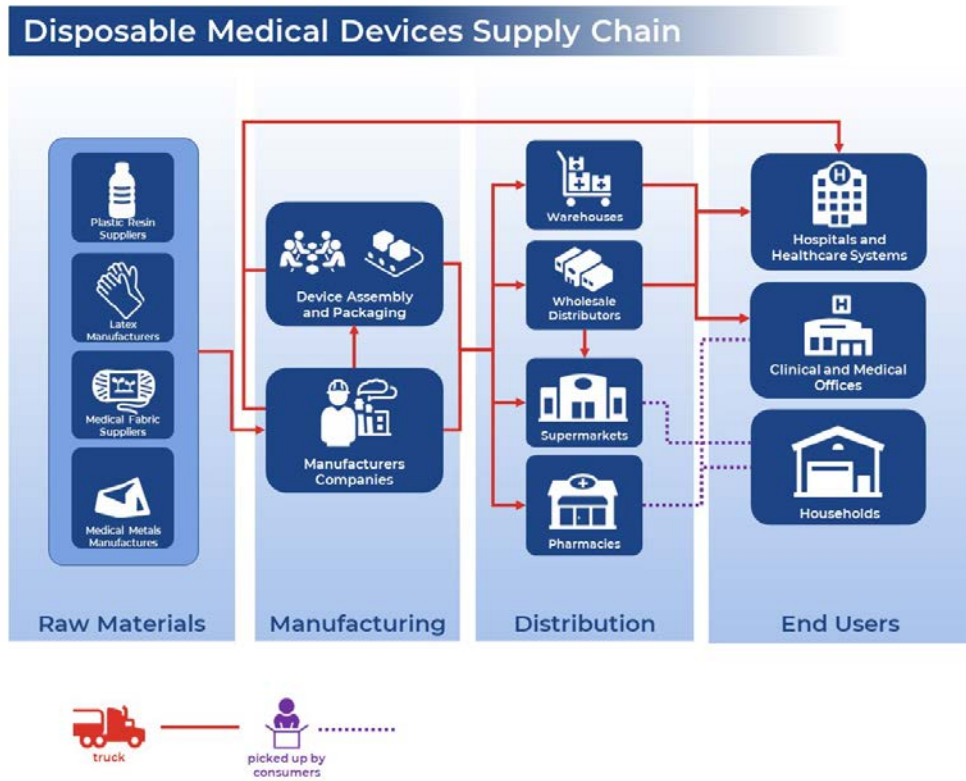
After the disposable medical devices are manufactured, they are delivered by trucks to warehouses, wholesaler distributors, pharmacies and supermarkets. Some manufacturing companies might distribute these commodities directly to hospitals and healthcare providers by truck.

The final stage of the supply chain occurs once the commodities reach the final consumers. Medical device distributors deliver these commodities to health providers by truck. Clinical and medical offices can also procure these commodities directly from pharmacies while households usually acquire these commodities directly from pharmacies and supermarkets.

⁸ SelectFlorida. Life Sciences. Industry Sector Brief. [life-sciences-industry-profile.pdf \(selectflorida.org\)](https://selectflorida.org/life-sciences-industry-profile.pdf)

⁹ Suliantoro, Hery, Intan Novita Dewi, and Naniek Utami Handayani. "Supply chain analysis of disposable medical devices." In *Proceedings of the 2016 international conference of management sciences (ICoMS 2016), Indonesia*, pp. 193-198. 2016.

FIGURE 12. DISPOSABLE MEDICAL DEVICES SUPPLY CHAIN DIAGRAM



Source: Cambridge Systematics.