SUPPLY CHAIN ANALYSIS CAPABILITIES AND EXPERIENCE

CNA is a nationally recognized research and analysis organization with a 76-year record of impactful work in the areas of national security, homeland security, and emergency management. Since 1999, CNA has supported local and state clients with emergency management services, with a particular focus on preparedness activities such as assessments, planning, and exercises, as well as the provision of disaster support. Over the past five years, CNA has pioneered the analysis of regional food, fuel, and water networks and the analysis of the supply chains of other lifeline commodities to support emergency management planning and operations. Our work in these areas has been featured in presentations at the Big City Emergency Managers and the National Emergency Management Association conferences. In this paper, we present selected highlights of our recent supply chain analysis work.

A SCALABLE FRAMEWORK FOR CHARACTERIZING COMMODITY FLOWS IN THE PUGET SOUND REGION

To address commodity flows in the Puget Sound region, CNA led a project for the US Department of Homeland Security (DHS) National Risk Management Center through the National Institute for Hometown Security (NIHS). CNA developed the Supply Chain Operational Engagement (CNA SCOPE™) method to identify bottlenecks in commodity flow networks and determine effective options to address flow disruptions during disasters that affect large urban areas. CNA conducted a comprehensive literature review that examined existing methodologies and approaches to analyzing supply chains and commodity flows. We identified the most relevant methodologies and then customized them, creating a scalable analytic framework to characterize commodity networks for food, fuel, and water, as they operate during steady-state conditions in the Puget Sound region. CNA collected open-source data to substantiate these flows and identified specific concentrations of supply sourcing, volume, velocity, and demand.

We vetted the framework with DHS Region X, state and local emergency management in the state of Washington, and private-sector stakeholders. To validate our network characterizations, flow maps, and analytic findings, we worked closely with the private sector in the Puget Sound region, including the fuel industry (terminal operators), the grocery industry (Albertson's, Kroger, Costco, UNFI), and water utilities (Seattle Public Utilities, Tacoma Water, City of Everett).

Next we assessed the grocery network under a disaster scenario and conducted a public/private exercise to identify likely bottlenecks that would constrain commodity flows and options for exploiting remaining capacity at surviving bottlenecks. Through these efforts, CNA provided the Puget Sound region with a significantly enhanced understanding of food, fuel, and water networks and flows across the region, their vulnerabilities to disruption, and cooperative planning actions that industry and government can undertake to enhance overall system resilience. For DHS, CNA produced a scalable analytic framework for assessing food, fuel, and water supply chains, ready for application in other high-risk regions, that can enhance its understanding of lifeline supply chain networks and the operational support that DHS may provide to enable continuity of commodity flows during disasters.
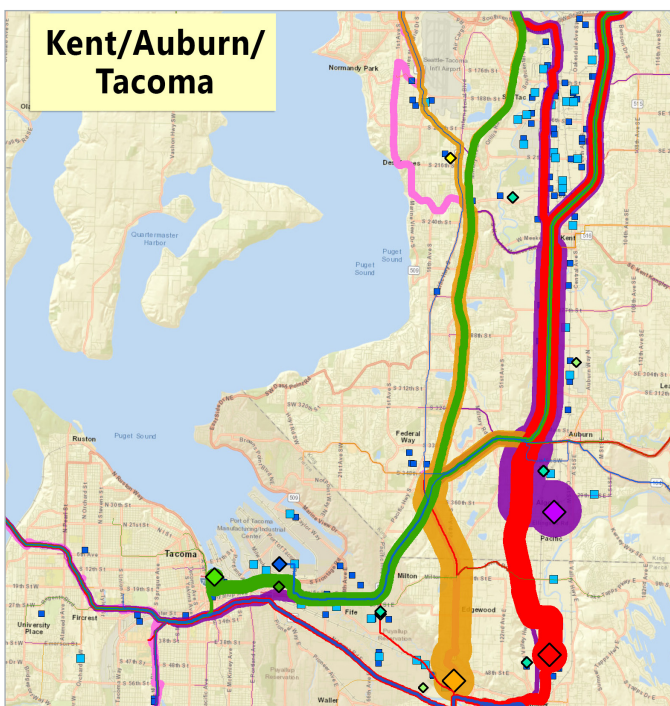

Figure 1. Visualizing proportional flow along key routes for a cluster of grocery distribution centers in the Puget Sound region
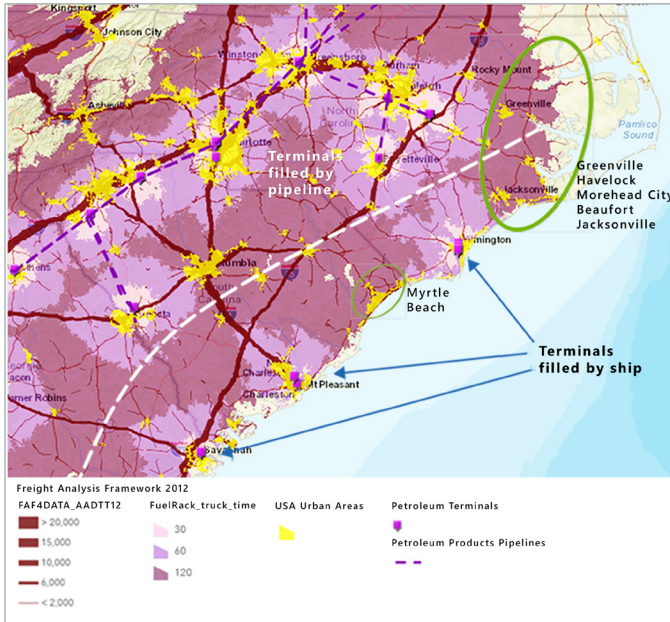
Figure 2. Sample graphic from CNA fuel analysis during Hurricane Dorian activation

FEDERAL EMERGENCY MANAGEMENT AGENCY SUPPLY CHAIN ANALYSIS NETWORK 2019 HURRICANE SEASON ACTIVATIONS

CNA established a Supply Chain Analysis Network (SCAN), composed of an experienced team of supply chain analysts, engineers, geographic information systems technicians, and emergency management professionals, to support the FEMA Logistics Management Directorate, as a subcontractor to Dewberry Engineers Inc., and in partnership with the Massachusetts Institute of Technology's Center for Transportation and Logistics and the America Logistics Aid Network. This team has activated for three hurricanes in 2019, collecting and analyzing data on the supply chain for Hawaii in preparation for and in the aftermath of Hurricanes Erick/Flossie as the twin tropical storms moved toward and passed through/near the Hawaiian Islands in late July and early August. On August 30, 2019, CNA again supported a SCAN activation to collect and analyze data on the supply chain for Puerto Rico, the US Virgin Islands, and the US mainland in preparation for and in the aftermath of Hurricane Dorian as it travelled through the Caribbean and up the Eastern Seaboard.

In both activations, SCAN provided FEMA's assistant administrator for logistics management with timely and valuable analysis of supply availability of critical life-sustaining commodities, such as food/groceries, fuel, bottled water, electrical power, medical supplies/pharmaceuticals, as well as the critical enablers of these commodities, including the transportation infrastructure, the electrical power grid, pipelines, and telecommunications and banking systems in the private sector.

In support of the Hurricane Dorian response, SCAN's fuel analysis allowed FEMA to better prepare response actions in Virginia in case the hurricane had caused significant damage in the Commonwealth. SCAN developed a detailed analysis of the fuel supply chain in the Hampton Roads, Virginia region. The analysis demonstrated that (1) the Colonial Pipeline is the main source of petroleum products (e.g., motor gasoline) into coastal Virginia; (2) Kinder Morgan's Plantation Pipeline also serves Virginia but is farther from the coastal areas in Hampton Roads; (3) most of the Hampton Roads area is within 60 minutes of a terminal fuel rack either at Norfolk/Portsmouth or Richmond; and (4) additional fuel racks (for contingency purposes) are available in North Carolina and the DC/Maryland area.

BAY AREA SECURITY INITIATIVE GROCERY SECTOR ANALYSIS

In support of the Bay Area Security Initiative, and in cooperation with Filler Security Strategies, CNA is developing a network characterization of the grocery sector and analyzing its potential vulnerability to disruption as well as opportunities to enhance its resilience.

As part of this analysis, CNA has identified and mapped the sources of supply, demand, key nodes, and links in the grocery supply chain serving the more than 8 million people living in the 12 County Bay Area. From a network of 429 full-service conventional grocery stores, and more than 4,200 retailers certified to conduct Supplemental Nutrition Assistance Program, or SNAP, transactions across the 12 counties, CNA identified five key sources of supply that handle more than
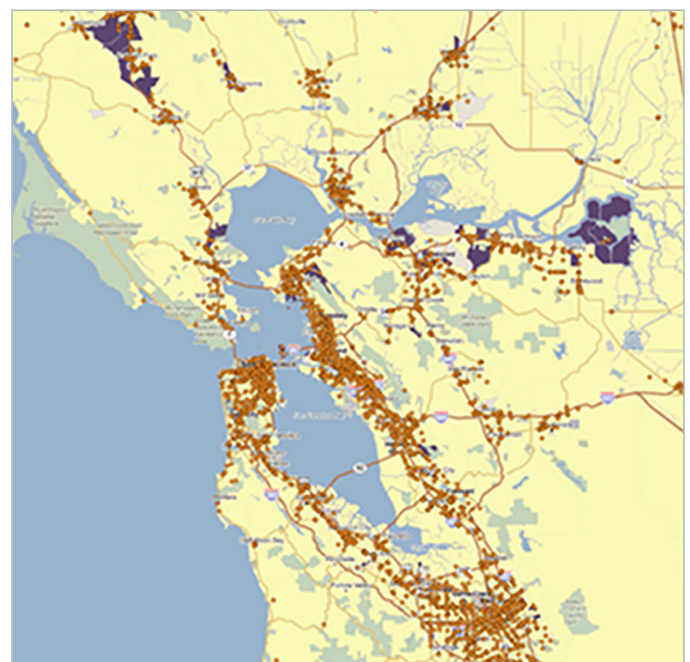

Figure 3. SNAP retail locations and USDA designated food deserts in the Bay Area

80 percent of the groceries purchased in the region. We then analyzed these sources of strategic capacity and their vulnerability to disruption from a significant earthquake. We found that these key supply nodes do not face a direct seismic risk, but that there are important questions for private-public exploration and collaboration that can meaningfully enhance overall system resilience in a catastrophic event. We also paid particular attention to the locations of vulnerable populations with more limited access to grocery stores.

2017 HURRICANE SEASON ANALYSIS OF FOOD, FUEL, AND WATER SUPPLY CHAIN RESILIENCE

CNA supported the National Academies of Science, Engineering, and Medicine (NAS) in developing a consensus report on the impacts of the 2017 Atlantic hurricane season on the supply chain, funded by the FEMA Logistics Management Directorate. Specifically, CNA developed an after-action analysis of impacts to key lifeline supply chains from Hurricanes Harvey, Irma, and Maria. CNA conducted field research and interviews in the areas affected by these storms and developed a set of case studies that illustrate challenges to the supply chains for lifeline commodities including fuel, food, and water. CNA staff traveled to Texas, Florida, Puerto Rico, and the US Virgin Islands to interview federal, state, and local officials and private-sector representatives about the key challenges they faced during response and recovery from the 2017 hurricanes.

CNA developed six case studies for the NAS committee working on the consensus report and delivered targeted briefings on the key case study findings to the committee and officials at FEMA. In developing the case studies, CNA used open-source research, data analysis, and a range of geospatial analytic techniques to supplement the in-depth and comprehensive interviews. CNA's analysis shed new light on the way the public-sector "relief channel" and private-sector supply chains interact and occasionally collide by competing for scarce resources. In many cases, particularly in Puerto Rico, CNA's work highlighted a profound, mutual lack of awareness between public- and private-sector relief and recovery efforts.

In addition to providing information to the NAS committee, CNA briefed the findings of this analysis to FEMA's Office of Response and Recovery, Logistics Management Directorate, Response Directorate, and Private Sector Office. CNA also presented its findings at the

National Emergency Management Association Annual Meeting in Savannah, Georgia, in October 2018.

CNA's work has led directly to significant changes in FEMA's operational approach to supporting the resilience of lifeline supply chains. FEMA's Response and Recovery leadership at the time called CNA's work "transformational," and noted it should be required reading for all FEMA response and recovery employees. CNA is currently providing FEMA with on-call supply chain analysis support, applying the findings
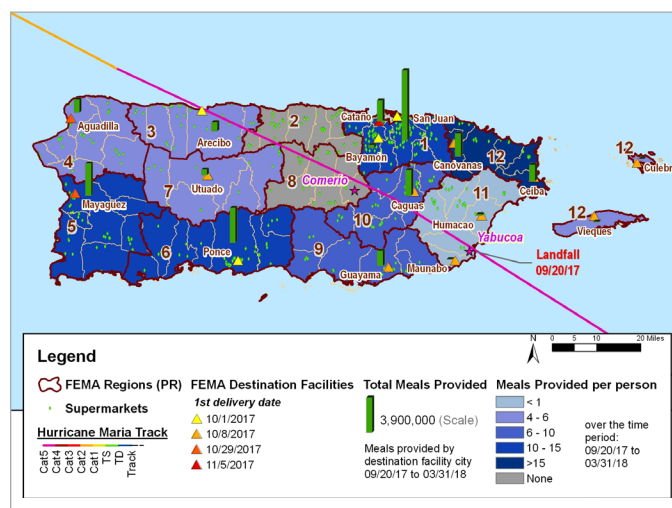

Figure 4. Geospatial analysis - FEMA food deliveries to Puerto Rico (normalized to population) did not align with the storm track
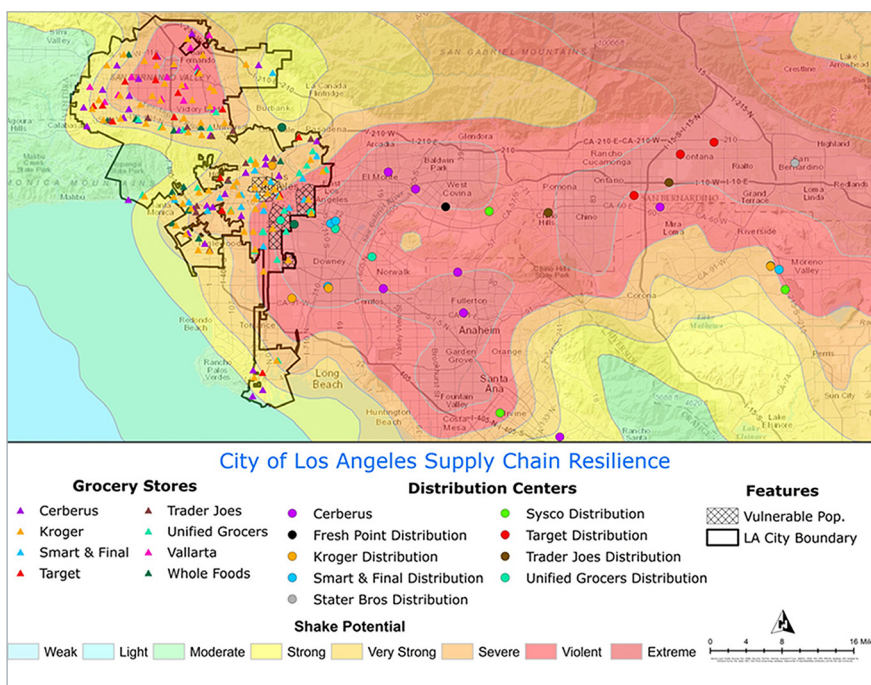

Figure 5. Key nodes in the Los Angeles grocery supply chain overlaid with earthquake

FEMA SUPPLY CHAIN TECHNICAL ASSISTANCE

Since 2015, CNA has provided the lead subject matter expert for FEMA's Supply Chain Resilience Technical Assistance program. Through this program, CNA is supporting the mapping of lifeline supply chains—including fuel—and the development of local supply chain analytic capabilities in Boston, Chicago, Dallas, Los Angeles, Memphis, Philadelphia, San Diego, San Francisco, and Washington, DC, a multi-jurisdictional coalition in Puget Sound, and the state of Utah. CNA supports these jurisdictions through a variety of methods, including in-person workshops, targeted expert assistance, and opportunities for peer-to-peer learning.

Of particular note, CNA provided subject matter expertise to assist in the development of FEMA's recently released *Supply Chain Resilience Guide* (April 2019), which provides emergency managers with recommendations and best practices for analyzing local supply chains and working with the private sector to enhance supply chain resilience using a five-phased approach. The guide also identifies how emergency managers can use information from the supply chain resilience process to support restoration of supply chains and inform development or refinement of logistics plans or annexes.

SOUTHEASTERN PENNSYLVANIA FUEL STUDY

CNA conducted a comprehensive fuel assessment for the Southeastern Pennsylvania Region (SEPA), including the city of Philadelphia and Bucks, Chester, Delaware, and Montgomery Counties, in 2017–2018. For this assessment, we collected fuel-related data from open sources, government sources, and surveys distributed widely to public and private facilities. We conducted qualitative, quantitative, and geospatial analysis to map the fuel supply chain, analyze fuel reliability (fuel demand/usage, storage, needs, supply) during steady-state and disaster conditions, and identify public- and private-sector vulnerabilities and mitigation opportunities. We used
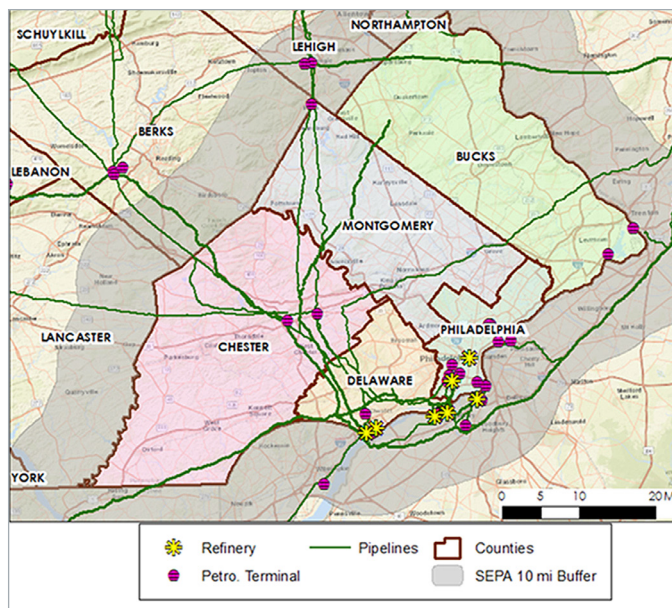

Figure 6. Map of key SEPA regional fuel network nodes

interactive methods to engage stakeholders to evaluate and prioritize actions that would strengthen the fuel supply chain, both specific to each county and to the region as a whole.

CNA examined existing fuel management planning efforts and resilient capacity at both municipal and retail motor fuel stations throughout the region; identified opportunities to improve cross-county operational coordination regarding municipal contracts, fuel supplies, and distribution; and developed cost-effective recommendations, tailored to each county, to improve the overall resilience of the region to withstand a fuel emergency. The outcomes of this project enabled SEPA to prepare better for a severe fuel disruption during a disaster, understand how and where to employ emergency assistance (e.g., generators) during disasters with prolonged power outages, and fill gaps in the data and create relationships with the retail fuel sector.

ABOUT CNA CORPORATION

CNA is a nonprofit research and analysis organization dedicated to the safety and security of the nation. It operates the Institute for Public Research — which serves civilian government agencies — and the Center for Naval Analyses, the Department of the Navy's federally funded research and development center (FFRDC). CNA is dedicated to developing actionable solutions to complex problems of national importance. With nearly 700 scientists, analysts and professional staff, CNA takes a real-world approach to gathering data, working side-by-side with operators and decision-makers around the world. CNA's research portfolio includes global security and great power competition, homeland security, emergency management, criminal justice, public health, data management, systems analysis, naval operations and fleet and operational readiness.

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