Absence of freight transportation plans in state and county emergency operations plans

Christine Brown
Absence of Freight Transportation Plans in State and County Emergency Operations Plans

by Christine Brown

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Submitted by:

Christine Brown

Signature Date

Accepted by:

Franz Foltz, Thesis Advisor
Graduate Coordinator
STS/Public Policy Department/College of Liberal Arts

Signature Date

James Winebrake, Committee Member
Department Chair
STS/Public Policy Department/College of Liberal Arts

Signature Date

Jennifer Schneider, Committee Member
Civil Engineering Technology, Env. Mgmt & Safety
College of Applied Science and Technology

Signature Date
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Abstract

Natural disasters have the ability to disrupt structured systems in the United States, such as transportation systems and freight routes. When a natural disaster occurs, freight is forced to reroute around the effected areas. Rerouting slows recovery efforts, as well as normal transportation of goods within the United States. Therefore, natural disasters, with respect to freight routes, have widespread impacts and the possibility for acute hardship in disaster-prone areas. This thesis examines how comprehensive state and local level emergency operations plans are with respect to freight transportation rerouting following a natural disaster. Coastal cities can modify freight routes and this rerouting might affect recovery efforts and the normal flow of freight. First, seven coastal cities emergency operations plans are examined for specific elements of freight transportation planning. From there, the project determined how complete local level emergency operations plans are in terms of freight transportation and the framework needed for a freight transportation plan. The result of this research was policy recommendations to improve the resiliency of freight transportation networks surrounding coastal cities and incorporate freight transportation planning into emergency operations. The resiliency of freight routes following natural disasters is important because there can be widespread effects on the delivery of goods to the U.S. as well as recovery supplies to the effected area. If freight routes could be modeled to efficiently deliver rescue supplies and goods, while also minimizing the environmental effects, the benefits of uninterrupted service to the transportation system and society could possibly be substantial. The transportation system cannot encounter difficulties whenever a natural or manmade disaster occurs; therefore the United States needs to be better equipped to counteract interruptions in freight routes.
1. Introduction

Hurricane Katrina is likely to end up being the most economically-disruptive U.S. natural disaster in years. A significant amount of crude oil, natural gas and gasoline production has been halted by the hurricane with uncertainty as to when production will come back on line. The Port of South Louisiana is the largest port in the U.S. by tonnage and the fifth largest port in the world. The Port of New Orleans is the sixth largest port in the U.S. We export about a quarter of our agricultural grain production of which about a half is shipped through the ports at the mouth of the Mississippi River. Imports coming into the Ports of South Louisiana and New Orleans include petroleum products, steel, coal, chemicals, fertilizers and concrete. These ports are closed now. Our rail freight system already was operating at high rates of capacity utilization before Hurricane Katrina struck. Therefore, the transport of grain and other bulk freight by rail to other ports will strain the capacity of our rail system. Moreover, with the rise in the price of diesel fuel, the cost of rail-freight transport will increase. In addition, some non-Mississippi River ports already are operating near capacity. Lack of manpower to operate ports, pipelines and refineries in the New Orleans area also is likely to be an issue. Evacuated workers do not have homes to come back to and essential services to sustain them and their families. In short, Hurricane Katrina has temporarily constrained our economy's ability to produce goods and services (emphasis added by thesis). How long this constraint will persist is unknowable at this time (Kasriel, 2005).

In a country as developed as the United States, natural disasters are one of the few events that still set the nation back in terms of economic costs and the nation’s ability to return to normal. Currently the primary focus of the federal government is responding to natural disasters when they occur. In 2007, FEMA spent $4.8 billion on Disaster Recovery Programs and $3.6 billion on Mitigation programs (CBO, 2008). Estimates for recovery spending in future years decrease; however if a natural disaster occurs, the President has authorization to declare emergency funding available to the area impacted. The cost of this recovery-based focus was estimated to be $200 billion between 1988 and 2002, resulting from the 45 weather-related disasters.
experienced by the United States (Wallace & Millar, 2004). The $200 billion is just for weather-related disasters – it does not take into account other types of natural disasters such as wildfires or earthquakes or manmade disasters.

With so much funding being dedicated to recovering from natural disasters, allocated funds must be used in the most efficient way possible. For integral systems, like transportation, adequate attention can result in effective recovery, while also using funds to increase resiliency. Coastal transportation infrastructure networks are highly sensitive to natural disasters while also being an important resource for the success of rescue, recovery and renovation operations; as such, prompt restoration of such networks becomes of critical importance for disaster relief services (Karlaftis, Kepaptsoglou, & Lambropoulos, 2007). Transportation professionals face the challenge of maintaining and optimizing mobility during a crisis. For a comprehensive approach to resiliency and effective freight routes following a natural disaster, policy changes will need to be supported by those involved.

Disruption of freight routes has an effect on industry. For example, the flooding in the Midwest in 1993 caused disruption in freight transport for the entire nation. After floodwaters receded, the industry took stock of their losses. The Association of American Railroads, an industry group, estimated $205 million in repairs to flood-damaged track, equipment, and rolling stock in the Midwest. The industry experienced millions more in lost freight business (Pena, August 1993). Likewise, after Hurricane Katrina, restoring the freight industry resulted in high costs. Robert Gallamore, director of Northwestern University's Transportation Center, said “…in the
wake of natural disasters, commodities can be routed to other ports or simply held in storage, but it would entail a higher cost” (Rose & Schmeltzer, 2005).

Rebuilding freight transportation systems is especially important as delivering supplies to disaster-ravaged areas is one of the main challenges seen by relief agencies (Cottrill, 1998). Once rebuilding efforts begin the need for durable goods and building materials helps the freight industry recover. Trucking companies help FEMA by transporting generators, tools, and household goods as the needs arise (Roberts, 2006). FedEx has partnered with the American Red Cross since 1996, and has created a miniature version of its own Memphis, Tennessee, control room at the relief group's Washington, D.C., headquarters (Spring, 2006). INSEAD, a French business school, estimates that as much as 20 to 25 percent in the cost of rerouting and lost revenue could be saved on transport in disaster response (Spring, 2006).

Freight transportation planning following a natural disaster is both a public policy issue and a science and technology issue. Public policy is defined as the course of action a government takes to address a problem affecting society. Therefore, any emergency operations plans created at either the state or local level can be considered a policy because it is a specific course of action meant to deal with a problem (natural disaster) that most certainly affects society. Freight transportation is linked with science and technology because of the planning tools that can be applied to effectively reroute transportation systems are linked with current technology. Without applications such as GIS, it would be almost impossible to see how events may unfold in real time. Effective freight transportation planning following a natural disaster would be an accomplishment in combining both public policy and the available technology developments.
This thesis provides an examination of the importance of freight transportation being included in emergency operations plans for coastal cities following a natural disaster. Furthermore, policy recommendations will be provided regarding implementing freight transportation plans into already existing emergency operations plans. The purpose of this thesis is to address two research questions.

1) Do local emergency operations plans include more freight transportation planning than state emergency operations plans?

2) How complete is freight transportation planning at the local level?
2. Literature Review

The literature review for this thesis will take three approaches. First, this thesis will examine current transportation plans and developments within the transportation planning sector regarding route alteration in emergencies. Second, research will show the economic effects that can occur with freight transportation interruptions. The economic effects will also be highlighted with historical instances involving earthquakes and hurricanes. Third, a comprehensive review of current state emergency operations plans is included within the literature review. The state emergency operations plans were examined for their inclusion of transportation, specifically looking for any mention of freight transportation networks. The purpose of this literature review is to give sufficient background pertaining to transportation planning, economic impacts of natural disasters, and an overview of emergency operation planning at the state level.

2.1 Transportation Plans and the Importance of Freight Transportation

The issue of transportation routes being altered due to natural disasters is not an issue untouched by current research. One focus on transportation has been on the effectiveness of evacuation routes following a natural disaster. An appropriate focus of the government as the first responsibility in the case of a natural disaster is getting those in danger to safety. One analysis conducted by Liu (2007) presents a model reference adaptive control (MRAC) framework for real-time traffic management under emergency evacuation. Distinct from the well-studied evacuation planning, real-time traffic management for evacuation aims to dynamically guide (control) traffic flow under evacuation in such a way that certain system objective (e.g., minimization of fatalities or property losses) could be achieved. The proposed framework is
based on both dynamic network modeling techniques and adaptive control theory, by considering the traffic network under evacuation as a dynamic system (Liu, Ban, Ma, & Mirchandani, 2007).

Another examination of evacuation efforts, done by Wolshon and Hamilton (2005), looks specifically at evacuations following hurricanes. In a two-part series the authors review transportation-engineering aspects of hurricane evacuations, address policies and practices for transportation system planning, preparedness, and response, and summarize the state of current practice from the perspective of evacuation traffic operations, management, and control (Wolshon, et al., 2005).

Unlike the examinations focused on evacuation, there are also broader studies on emergency preparedness with a focus on the transportation sector. Sisiopiku (2007) undertook a project that developed and tested emergency response scenarios for the Birmingham, Alabama region. It used CORSIM traffic simulation software to model the major area traffic corridors into a regional transportation network. Then, the regional model was utilized to test and evaluate emergency management strategies in response to natural or human-caused disasters. Appropriate preparedness and response measures of effectiveness (MOEs) were selected to support the assessment process at the region-wide and/or corridor level. Candidate response actions were compared and evaluated on the basis of these MOEs and recommendations were developed on best practices and needs (Sisiopiku, 2007).

Lambert (2002) did another study with a tighter focus on the specific case of hurricanes. Lambert developed and demonstrated a methodology to identify and characterize the schedule
dependencies and subsequent delays that arise among federal, state, and local agencies and organizations involved in the pre and post hurricane processes in order to reduce the time for a region to recover from a natural disaster. A transportation agency could use the developed methodology to identify, prioritize, and minimize the negative effect of schedule dependencies within and among agencies in recovery from a region wide disaster (Lambert, 2002).

Transportation and freight route alterations following a natural disaster are also a concern for the Department of Transportation (DOT). The DOT has initiated a $21 million program to improve evacuations resulting from unexpected events. Through the National Academies’ report, the organization realizes the transportation system usually has redundant capacity—alternate routes and alternate transportation modes (NRC, 1999). A more important point made in the report is, “redundancy is low in some specific cases, such as passenger transport in major cities during peak commuting periods, or some types of freight transport.” Recommendations from the National Academies state that DOT should conduct a study of the system’s redundancies to determine where there is a lack of redundancy. The DOT currently focuses on tactical vulnerabilities and not strategic vulnerabilities (NRC, 1999).

The Transportation Research Board (TRB) has also looked into the issue of emergency preparedness. The TRB publishes guides for emergency transportation operations as well as emergency response preparedness information. These guides outline a coordinated, performance-oriented, all-hazard approach called “Emergency Transportation Operations” (ETO) and focus on an enhanced role for state departments of transportation as participants with the public safety community in an interagency process. Their main purpose is “to enhance the
nation’s ability to deal with the movement of people, goods, and services before, during, and after emergencies (Transportation Research Board, 2008).”

The Federal Highway Administration has conducted research on Intelligent Transportation Systems (ITS). The DOT has examined disadvantages of the transportation system. One finding is that transportation analysis tools are not used to process incident information. If transportation analysis tools were used they could inventory the information and make recommendations for specific actions that could be taken by the transportation system. These tools might lead to better management of events in real-time. The recommendations from this study focus on a more automated system for rerouting freight and transportation following a natural disaster (FHA, 2003).

There are many approaches taken by the Federal Highway Administration when examining the dilemma of freight routes following natural disasters. Another study supported by the DOT scans and synthesizes current practices and state of transportation practices as related to redundancy and recovery of Transportation Management Centers (TMCs). The recommendations from this report concentrate on methods, and procedures for planning, design, develop and implement recovery plans and redundancy of TMCs (FHA, 2007). The most consistent recommendation from these studies in general is that there needs to be a more automated approach that streamlines the system following an event.
2.2 Disruption to Freight Transportation and the Effects

Many studies have been done regarding the economic effects of interrupted freight transportation. Though the majority of these studies have focused on the effects following earthquakes, similar economic losses could be expected from other natural disasters. Therefore some parallels can be drawn between disruption of freight transportation following an earthquake and those that might occur following a hurricane.

One such study was conducted by Chang (2000) regarding the Port of Kobe (Japan) following the 1995 Great Hanshin earthquake, concerning international container traffic. The findings of the study show how freight transportation can be affected by a natural disaster. One of the most important losses suffered in the Great Hanshin (Kobe) earthquake consisted of damage to the Port of Kobe. The Port suffered extensive ground failure in the earthquake, including liquefaction and lateral displacement, that damaged all of its container berths and almost all of its non-container shipping berths. Gantry cranes, warehouses, all bridges to Rokko and Port Islands, and utility lines carried by these bridges all suffered major damage. The Port was essentially shut down as a result. Damage was estimated at 1 trillion yen (US$10 billion). Although reconstruction proceeded rapidly, the scale of damage was so great that repairs were not completed until March 1997, over two years after the earthquake. In the meantime, traffic that would have gone through Kobe was diverted to other ports (Chang, 2000).

Chang found one very important observation from examining the Port of Kobe in the wake of the earthquake. Kobe also demonstrated that in a competitive environment, the disruption caused by
major damage may lead to significant short-term loss of port revenue and long-term loss of traffic and competitive position. The issue of long-term loss represents a potentially important lesson for disaster planners in the US. In a future catastrophic earthquake, economic losses may be much larger than what these models predict, due to long-term losses arising from both the scale and the duration of disruption (Chang, 2000).

Another study completed by Satoshi Tsuchiya (2007), examined what would occur in Japan following two possible earthquake scenarios. The first scenario of disruption increases transport cost in the affected area that eventually spreads all over the region. The total transport-related losses amount to 18.5 billion yen per day. The second scenario of transportation disruption results in transport-related losses worth a total of 36.4 billion yen per day. What Tsuchiya showed with research was the extent of the impacts of transportation network disruptions and the difference of the transport-related losses that is estimated in conditions of disruption scenarios. Furthermore, the network levels of development implied the importance of network redundancy at the interregional level (Tsuchiya, 2007).

One study, conducted following an earthquake in the United States, focused on the Northridge, California earthquake of 1994. Gordon (1998) found a local impact of at least $1.5 billion associated with transportation disruptions that is a significant proportion of overall business interruption (27.3%). This research also estimated an equivalent earthquake on the longer and more dangerously located Newport-Inglewood Fault and yielded a potential total cost impact of about $80 billion (with a much higher business interruption component of $33 billion); applying the same ratios resulting from the Northridge analysis generates a transport-related business
interruption cost of $9.0 billion (Gordon, 1998). Gordon’s work shows that interruptions to freight transportation can be quite costly to a coastal area of the United States.

Another analysis of the 1994 Northridge earthquake that destroyed portions of the I-5, I-10 and other highways near Los Angeles found that road closures caused approximately 4,400 truck hours of delay each workday during reconstruction. The overall impact on the economy in terms of job loss and business closure was not calculated, but it’s estimated that the average shipping costs increased by eight percent as a result of the road closures (Wesemann, et. al. 1996).

A case study by Grenzeback and Lukmann examined the economic impacts on the transportation sector by Hurricanes Katrina and Rita. It is an especially pertinent case study because it focused on freight transportation. According to the study, even though CSX was the most negatively impacted railroad, impact on rail revenue was insignificant. Neglecting interchange traffic, CSX only delivered and received 23,000 merchandise carloads in all of Louisiana last year and a slim 15,000 carloads in Mississippi. The Port of Gulfport is the third busiest containerized port in the Gulf of Mexico and the 17th busiest nationally. The storm’s catastrophic damage affected those companies like Dole, Chiquita, and Crowley that use the port on a contractual basis. The companies were forced to reroute shipments to Port Everglades, Florida or Freeport, Texas at extra expense. The need to reroute shipments to Texas and Florida led to some low inventories of these fruits in southeastern states. Grain shipments at major Mississippi ports saw only a moderate decrease in traffic compared to previous years. At the Port of South Louisiana, shipments of soybeans and maize (the port’s two largest bulk edible commodities in 2005), were down seven percent and 12 percent respectively from 2005. The transportation sector’s
estimated costs due to these hurricanes do not account for unreported emergency operations 
expenditures, the short-term opportunity costs of lost or rerouted shipments, and the long-term 
economic cost of displaced business and trade (Grenzeback and Lukmann, 2006).

The Association of American Railroads reported in September of 2008 that freight traffic on U.S. 
railroads was off sharply during the week of September 20 in comparison with the same week in 
2007, with much of the decline being attributed to disruptions caused by Hurricane Ike which 
struck the Gulf Coast on September 13. Total volume was estimated at 32.8 billion ton-miles, 
down 6.8 percent from the comparable week in 2007. Railroads provide more than 40 percent of 
U.S. intercity freight transportation, more than any other mode, and rail traffic figures are 
regarded as an important economic indicator (AAR, 2008). After Hurricane Wilma in 2005, the 
Florida East Coast Railway’s fourth quarter revenues were reduced by approximately $1.5 to 
$2.5 million. The Railway also incurred approximately $2.5 to $3.0 million of incremental 
expenses related to clean-up costs, property damage, grade crossing operations and support and 
additional train crew costs as a result of trains operating at reduced speeds (PR Newswire, 2005).

One other study on the aftermath of the Northridge earthquake of 1994 showed the financial 
impacts felt by the trucking firms. The revenue and cost impacts of the earthquake reflected 
effects that are quite complex. Increased costs, such as wages or fuel, were expected, but firms 
also incurred increases or decreases in revenues, depending on their circumstances. The results 
showed a modest overall impact on trucking operations in Los Angeles County. The only change 
larger than 1%, either positive or negative, was a mean cost increase of 3.5% in the first quarter. 
Another unexpected result from the research was that most trucking companies did not have an
earthquake response plan in effect prior to the earthquake, nor did it stimulate them to prepare one. The dominant form of plan (if there was one) was an emergency preparedness plan for employees, not an operational plan. Only a handful of trucking firms had a rerouting plan, a communications plan, an operations management plan, or arrangements with customers (Willson, 1998). There is a lack of preparation on both the public and private side of transportation networks.

2.3 Freight Transportation Planning

A paper on the possibility of building a framework for freight transportation planning following a natural disaster developed an eight step process to develop state-wide Freight System Resiliency Plans (Caplice, et al., 2007). The eight steps are:

- **Step 1.** Identify and segment customers of the transportation system
- **Step 2.** Identify and quantify the objective of a Freight System Resilience Plan for this region
- **Step 3.** Conduct a vulnerability assessment of the region’s transportation network
- **Step 4.** Create public/private collaboration mechanisms
- **Step 5.** Determine what regulatory and policy procedures need to be put into place
- **Step 6.** Agree on priority and trigger setting processes
- **Step 7.** Conduct a failure mode analysis
- **Step 8.** Test the plan with a large scale simulation

Caplice, et.al. (2007) meant to expand on the little work that had been conducted on how to recover economically from disasters. There is limited awareness of the interdependence between
the public sector infrastructure and the private sector business community, evident in the general lack of defined plans and priorities for allocation and use of limited public sector transportation resources post-incident by private sector entities (specifically the lack of planning for freight system (rather than freight system) resumption). Caplice, et.al. (2007) felt this lack will hamper state and regional economic recovery, and this could otherwise be mitigated or possibly avoided with prior planning and public-private sector coordination. The culmination was a research project conducted with the Washington State Department of Transportation on the development of a state-wide Freight System Resiliency (FSR) Plan.

Based upon all these studies, a complete emergency plan should include certain elements for freight transportation planning. One element is a developed methodology to identify, prioritize, and minimize the negative effect of schedule dependencies within and among agencies in recovery from a region wide disaster. Another critical element is an enhanced look at redundancies in the transportation system at an interregional level. Most studies indicated that a more automated system for rerouting freight and transportation following a natural disaster is necessary. Specifically, Caplice’s study synthesized all of these elements into eight steps to create a complete emergency operations plan with respect to freight transportation. There is a lack of preparation on both the public and private side of transportation networks. The impetus to provide freight transportation planning following natural disasters exists, but is this specific type of planning evident in the current emergency operations plans?

2.4 Current State Emergency Operations Plans
FEMA designates State Emergency Operations Plans (EOP) as a document meant to address several operational response functions. These functions focus on the direction and control, warning, emergency public information, and evacuation actions that must be dealt with during the initial phase of response operations, fall outside of the Federal response mission, and are not appropriate for inclusion in Federal response plans. One major element of most EOPs is that the state is meant to assess the damage done to transportation networks such as airports, major roads and bridges, rail lines, ports, etc., which is directly related to freight transportation (FEMA, 1996). While EOPs are not meant to completely cover all recovery efforts in the long term, FEMA does suggest that state EOPs include restoration of infrastructure "lifelines," and debris removal to facilitate response. Recovery is termed by FEMA as the effort to restore infrastructure and the social and economic life of a community to normal. For the short term, recovery means bringing necessary lifeline systems (e.g., power, communication, water and sewage, and transportation) up to an acceptable standard (FEMA, 1996). It can be argued that restoring freight transportation routes is necessary for an acceptable standard of living by both citizens in the area affected by the disaster, as well as those in the region. Without freight transportation of goods through an area, the disruption can lead to vital materials being kept from different regions all across the United States. However, as will be seen, most state EOPs do not cover freight transportation in their priorities following a natural disaster, instead focusing primarily on evacuation efforts.

2.4.1 Current Emergency Operations Plan in Florida

The Comprehensive Emergency Management Plan of 2004 (CEMP) for the state of Florida establishes a framework through which the state prepares for, responds to, recovers from, and
mitigates the impacts of a wide variety of disasters that could adversely affect the health, safety and/or general welfare of the residents of the State. The Plan provides guidance to State and local officials on procedures, organization, and responsibilities, as well as provides for an integrated and coordinated local, state, and federal response (CEMP, 2004).

Based upon a Hazard Risk Assessment done in 2003, Florida established that the greatest threat comes from tropical cyclones. According to the National Hurricane Center, forty percent of all U.S. hurricanes and major hurricanes hit Florida and eighty-three percent of category 4 or higher hurricane strikes have hit either Florida or Texas (Blake and Rappaport, 2007). At least sixteen of the thirty costliest hurricanes on record from 1900-2000 in the U.S. have occurred in Florida.

More importantly the Comprehensive Emergency Management Plan of 2004 for Florida appears to give responsibility for transportation networks mainly to state governments with this statement: “Identifying critical industry and infrastructures that may be impacted by disaster or are required for emergency response efforts.” The issue of transportation following a natural disaster is under the jurisdiction of the infrastructure support branch in the operations section under the State Emergency Response Team. The function of transportation recovery is overseen by the Department of Transportation in the case of a disaster in Florida. The main component of transportation before a disaster covered by the Comprehensive Emergency Management Plan of 2004 is the possibility of reverse-lane routes. Reverse-lane routes affect major highways such as Interstate 10, Interstate 4, Florida's Turnpike, State Road 528, and Interstate 75 (CEMP, 2004).
These are the main elements concerned with transportation that are located in Florida’s Comprehensive Emergency Management Plan of 2004. No mentions of freight transportation are made nor are there any provisions outlined as to what should be done regarding major freight transportation routes following a hurricane or any other natural disaster.

2.4.2 Current Emergency Operations Plan in Georgia

The main document which covers the subject of emergency operations for the state of Georgia is the Georgia Emergency Operations Plan of 2008 (GEOP). This comprehensive state emergency operations plan is developed to ensure mitigation and preparedness, appropriate response and timely recovery from natural and manmade hazards which may affect residents of Georgia. All actions undertaken by emergency management focus on the protection of lives and property, with special sensitivity toward victims and their families (GEOP, 2008).

Based upon the Georgia Risk and Hazard Assessment, hurricanes and tropical storms are the natural disasters that put the state of Georgia at the highest risk. Tropical systems can impact the entire state of Georgia depending on a storm’s track and its forward motion. Even the weakest of systems can produce tornadoes and major flooding. Georgia is vulnerable to tropical systems coming from both the Gulf of Mexico and the Atlantic coast. Hurricanes bring the greatest threats to Georgia’s six coastal counties and immediate adjacent seven inland risk counties (GEOP, 2008).
The Department of Transportation (DOT) in Georgia is responsible for coordination of state transportation resources, assisting with evacuation and mobilizing transport of supplies and equipment in the case of a natural disaster. Actions taken by the Georgia DOT can include the identification of available transportation resources; implementing a coordinated approach among and between designated state agencies and organizations; assisting local governments in determining the most viable available transportation networks to, from and within the emergency or disaster area; coordinating the movement and flow of land, air and marine traffic in and to the disaster area for effective transport of relief supplies, personnel and equipment; and continuing to render transportation support as long as the situation exists (GEOP, 2008). The overall goal for transportation in Georgia following a natural disaster is to resume day-to-day operations as soon as possible.

These are the main elements concerned with transportation that are located in the Georgia Emergency Operations Plan of 2008. As seen in Florida’s plan there is no mention of freight transportation or any transportation planning following a natural disaster.

2.4.3 Current Emergency Operations Plan in South Carolina

The main document which covers the subject of emergency operations in South Carolina is the South Carolina Emergency Operations Plan of 2008 (SCEOP). The purpose of the SCEOP is it establishes the policies and procedures by which the State will coordinate state and federal response to disasters impacting South Carolina and its citizens. The plan also describes how the State will mobilize resources and conduct activities to guide and support local emergency
management efforts through preparedness, response, recovery, and mitigation planning (SCEOP, 2008).

Based on a hazard analysis conducted by South Carolina, hurricanes were identified as a statewide threat. The risks of many hazards were researched and reviewed against the potential impact that they may have upon South Carolina, counties, and supporting critical infrastructure. Hazards were identified as having both immediate and long-term impacts, with the potential to disrupt day-to-day activities, cause extensive property damage, and create mass casualties. Since 1851, South Carolina has experienced thirty hurricane strikes (Blake and Rappaport, 2007). Of the state's forty-six counties, six have coastlines, which border the Atlantic Ocean. These counties have over 200 miles of general coastline and all inland counties may be directly affected by these storms.

More specifically looking at the transportation recovery and response in South Carolina, the plan states that a disaster or any emergency may severely damage state and local civil transportation infrastructure. Most state/local transportation activities will be hampered by damaged roads, bridges, and disrupted communications. The state's emergency responsibility will primarily include route assessment and the allocation and prioritization of state transportation assets to include processing all transportation requests from state agencies and local governments. Further, the state must acquire and coordinate use of air, rail, and water transportation assets and provide transportation damage assessment information (SCEOP, 2008). The process of furnishing transportation services in South Carolina during a disaster situation involves two series of actions.
1) Essential immediate transportation needs are identified and actions are taken to provide for these needs.

2) As soon as possible, future continuing needs for transportation service and expected future transportation capabilities are estimated. Decisions are then made and actions taken to direct these expected future capabilities to meet the needs considered most essential. Priority will be given to restoring transportation infrastructure (roads, routes, rail, and channels) supporting mobilization sites, distribution points, staging areas, post-impact evacuations, and medical facilities (SCEOP, 2008).

This brief overview covers the main elements of transportation that are covered in the plan. While the South Carolina Emergency Operations Plan does go more into detail regarding transportation following natural disasters than other states, there still is no mention of freight transportation.

2.4.4 Current Emergency Operations Plan in North Carolina

The primary document which covers the subject of emergency operations in North Carolina is the North Carolina Emergency Operations Plan of 2008 (NCEOP). The purpose of the NCEOP is to establish a plan for a systematic, coordinated, and effective response to and recovery from emergencies or disasters occurring in the State. The plan describes a system for effective use of federal, state, and local government resources as well as private sector resources necessary to preserve the health, safety and welfare of those persons affected during various emergencies (NCEOP, 2008).
During each hurricane season (June – November), the North Carolina coast likely will be threatened, if not struck, by at least one tropical storm. Since 1851, North Carolina has experienced fifty hurricane strikes (Blake and Rappaport, 2007). These observations establish that hurricanes are a definite threat to the operations of North Carolina and the NCEOP contains a special annex pertaining specifically to operations plan following a hurricane.

The Infrastructure Branch plans, coordinates and arranges for infrastructure recovery after a disaster. Such activities include, but are not limited to debris removal, repair of highways and bridges, restoration of sewer and water systems, building inspection, and reconstitution of electrical and telephone service. Three tasks of the Public Work and Engineering Group are

1) Emergency clearance of debris for access to the damaged areas by emergency personnel and equipment for lifesaving, life protecting, health and safety purposes.

2) Temporary construction of emergency access routes that include damaged streets, roads, bridges, ports, waterways, airfields, and any other facilities necessary for passage of emergency service personnel.

3) Access to the disaster areas will be dependent upon the re-establishment of emergency routes. Debris clearance and emergency road repairs will be given top priority to support immediate lifesaving emergency response activities (NCEOP, 2008).

When looking at just the transportation elements of the NCEOP, the North Carolina Department of Transportation is meant to provide for movement of resources in support of local governmental entities, volunteer organizations and other emergency response organizations
requiring transportation capacity to perform emergency assistance missions. Specific duties for the Department of Transportation can include providing resources as required; erecting and maintaining signs, lights, barricades or other control devices as needed to maintain or control traffic along the emergency routes or required detour routes; monitoring and reporting road conditions; and marking and maintaining required evacuation routes (NCEOP, 2008).

Despite the Plan’s hefty length of over five hundred pages, the North Carolina Emergency Operations Plan does not mention freight transportation during or after a natural disaster. Other elements of transportation are included, as well as mention of regional agreements with the state of South Carolina, but an obvious absence of the routing of freight transportation.

**2.4.5 Current Emergency Operations Plan in Virginia**

The next state along the East Coast is Virginia and the main document which covers the subject of emergency management is the Commonwealth of Virginia Emergency Operations Plan of 2004 (COVEOP). The purpose of the COVEOP is an all-discipline, all-hazards plan that establishes a single, comprehensive framework for the management of statewide incidents (COVEOP, 2004). The plan provides the structure and mechanisms for the coordination of state support to impacted local governments and affected individuals and businesses. It assigns duties and responsibilities to departments, agencies, and organizations for disaster mitigation, preparedness, response, recovery, and prevention. It also provides the framework within which more detailed emergency plans and procedures can be developed and maintained by both state agencies and local governments (COVEOP, 2004).
A hazard risk analysis study done by Virginia shows that the risk for hurricanes in the state is a medium to high threat. An average of about two hurricanes each year comes close enough to affect Virginia. The three most destructive hurricanes affecting Virginia in modern times were the August (22-23) 1933 hurricane, Hazel in October 1954, and Camille in August 1969. The August 1933 hurricane moved from the southeast and made landfall south of Norfolk and Virginia Beach. Tides in Norfolk were reported to be 9.7 feet above mean low water. There were 18 fatalities and damages of $79 million (1969 dollars) were reported. The map below shows the risk area for hurricanes in yellow along the coast of Virginia.
When looking at the transportation responsibilities following a natural disaster within the state, there are specific duties listed within a separate annex of the COVEOP directed only at the issue of transportation. The state is designed to provide transportation support to assist in incident management. Activities include: processing and coordinating requests for transportation support as directed under the Commonwealth of Virginia Emergency Operations Plan (COVEOP);
reporting damage to transportation infrastructure as a result of the incident; coordinating alternate transportation services; coordinating the restoration and recovery of the transportation infrastructure; performing activities conducted under the direct authority of state agencies; and coordinating and supporting prevention, preparedness, response, recovery, and mitigation among transportation infrastructure stakeholders at the local level. The Secretary of Transportation has specific duties and will monitor and coordinate with respect to these needs:

1) Maintain the state highway system, to include debris clearance and restoration, following an emergency or disaster.

2) Facilitate, in coordination with the State Police and affected local governments, traffic movement during a large-scale evacuation and re-entry.

3) Provide an Initial Damage Assessment report within 72 hours of damages, to state highways, roads, and bridges (COVEOP, 2004).

A brief mention of commercial traffic is made in the COVEOP:

“Carriers and shippers will conduct business as usual whenever possible. If exemptions to state rules and regulations are needed to expedite delivery of essential resources to disaster areas, VDOT will coordinate with the Governor to consider and/or implement accommodations. Payments for transportation services will be made in the normal manner except when the consignor or consignee is an emergency management state or federal agency. The unit or agency involved will be billed for services. The principal change from accustomed business conditions will be controls, which may be placed upon the use of transportation to assure that service is being utilized for essential survival activities in support of disaster areas on a priority basis, and for the other areas of the state as available and required (COVEOP, 2004).”

Another annex of the COVEOP is focused on the state response following a hurricane making landfall in Virginia. The Virginia Department of Transportation (VDOT) will develop and
maintain a sub plan for hurricane evacuation traffic control. The VDOT will also coordinate the closure of high-risk roadways such as bridges, tunnels, or flood prone sections of roadway as indicated in the Transportation Emergency Operations Plan, the Chesapeake Bay Bridge-Tunnel Closure Plan although not designated as an evacuation route, and other protocols for adjusting transportation resources to meet impending emergencies (COVEOP, 2004).

The Commonwealth of Virginia Emergency Operations Plan of 2004 is the first state emergency operations plan to even acknowledge the issue of freight and commercial transportation. Yet, the issue of freight transportation is only mentioned with respect as to how supplies will be brought into the affected areas. As seen with the other state plans, there is no planning being done regarding the rerouting of freight transportation to ensure continued delivery across a region and the nation.

2.4.6 Current Emergency Operations Plan in Maryland

The last state in this examination of existing plans for emergency management is Maryland. The primary document covering the subject is the Maryland Emergency Operations Plan of 2007. This state plan outlines an approach and designates responsibilities intended to minimize the consequences of any disaster or emergency situation in which there is a need for state assistance (MEOP, 2007). The plan also indicates that Maryland must also be prepared for events that can impact citizens on a regional basis, including regions outside of Maryland (Mid Atlantic, Capital Region, etc.).
Based upon the Maryland Hazard Analysis conducted in 2000, hurricanes are a major threat to Maryland. Along with that, a Category 3 hurricane is listed as one of the more catastrophic events that could affect the state of Maryland. Maryland has only experienced two hurricane strikes since 1851, but tropical storms are still considered one of the top threats to disrupting services in the state.

Maryland supports a transportation infrastructure that sustains significant air, road, rail, and water traffic which is vulnerable to disastrous events. The purpose of the Emergency Service Function of Transportation is to coordinate the use of transportation resources and services necessary to support emergency response or recovery operations or other disaster assistance initiatives. The scope of the Maryland transportation support includes providing or utilizing land, air, rail, or watercraft for emergency response or assistance operations, as well as coordinating the use of resources to facilitate an effective, efficient, and appropriate result. The transportation element will also include providing resources or personnel that aid traffic control, relocation, and evacuation efforts. When requested, state law enforcement personnel will work with the incident commander to maintain traffic flow patterns and traffic around incident site. Restoring state roads, bridges, or transit systems, or establishing similar temporary structures is a priority. In Maryland if a disaster were to occur, the first step for transportation officials would be to take assessment of the regional transportation network to determine feasibility of different modes of travel. From there, that information would be shared with the appropriate transportation agencies and organizations to assess the use of transportation infrastructure in the affected area (MEOP, 2007).
The state of Maryland’s Emergency Operations Plan of 2007 further shows that freight transportation is not a priority following a natural disaster. Yet with connections to the welfare of the entire nation as well as the affected area, freight transportation plans should be included in emergency management in states along the East Coast. This section of the literature review shows that there is no freight transportation planning at the state level.

2.5 Research Questions

Out of this review of literature two research questions have emerged for this thesis to address:

1) Do local emergency operations plans include more freight transportation planning than state emergency operations plans?

2) How complete is freight transportation planning at the local level?

It is the duty of the government to protect the American public as best as possible from natural disasters. One step in the process of protection is ensuring continued transportation of goods and efficient delivery of recovery supplies to areas affect by natural disasters, as well as the rest of the country. In the Secretary-General's Message for October 12, 2005, Koffi Anan wrote, "We cannot stop natural calamities, but we can and must better equip individuals and communities to withstand them.” (Van Howell, 2006).
3. Methodology

The methodological approach used in this thesis will be to examine the prevalence of freight transportation planning following a natural disaster indicated at the local level. In order to address the research questions this thesis will examine county level and city level emergency operations plans (where available) to determine the priority of freight transportation planning, as well as contact being made with the emergency managers overseeing those locations. Based upon Caplice, et. al. (2007), the criteria for adequate planning for freight transportation in emergency operations plans includes four key elements. These four elements are

1) **A vulnerability assessment of the region’s transportation network** – to help determine the current state of the network

2) **Public/private collaboration mechanisms** – for communications purposes as well as to have each sector learn from the other

3) **Regulatory and policy procedures** – determine priority for different authorities involved in locality with respect to transportation, so that following an emergency, operations can run smoothly

4) **A freight transportation plan** – an actual plan that has been tested through a table top exercise or similar simulation

The locations were selected along the East Coast to provide a different perspective from studies that have looked at the Gulf Coast region following Hurricane Katrina. The cities were chosen based upon their location along a major freight route, their location along the East Coast, and as being a metropolitan area that would need transportation planning in the wake of a hurricane. The event of a hurricane was chosen due to hurricanes being identified as the main threat to each
state within their emergency operations plans. The East Coast is vital to the freight industry and connects most of the nation with the world due to its’ many port locations.

Figure 2. Freight Corridors. (Department of Transportation, 2008)
Figure 3. Freight truck volumes, 2004 (Grenzeback and Lukmann, 2006).

Figure 4. Freight-rail volumes: railcars and intermodal container/trailer units, 2004. (Grenzeback and Lukmann, 2006)
The cities selected based upon these considerations are Miami, FL; Jacksonville, FL; Savannah, GA; Charleston, SC; Wilmington, NC; Norfolk, VA; and Baltimore, MD. The state emergency operations plans for each state were included in the review. Each city and county level emergency management department was contacted in order to ensure that the plans being reviewed were similar to those used in real time post disaster planning.

3.1 Data Collection

The data used will be city and county emergency operations plans, along with the GIFT model transportation network information. First this thesis will thoroughly examine the county and city plans for the areas of Jacksonville, FL; Miami, FL; Savannah, GA; Charleston, SC; Wilmington, NC; Norfolk, VA; and Baltimore, MD. Each plan will be examined to see what mention of transportation is made in the plan, along with identification of any of the four elements needed
for freight transportation planning. Specific guidelines for reviewing the four elements are seen in the table below and were developed based upon previous transportation studies.

<table>
<thead>
<tr>
<th>Key Element</th>
<th>Expected Wording or Evidence of Element in Local Level Emergency Operations Plan</th>
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| 1) A vulnerability assessment of the region’s transportation network | • A designated vulnerability assessment of transportation infrastructure in area  
• Multiple hazards analysis for the locality with respect to transportation |
| 2) Public/private collaboration mechanisms | • Identification of private sector stakeholders within the community pertaining to freight transportation  
• Communication measures set up between public and private sector  
• These elements can be considered inclusive if they are part of the document (even if with respect to just transportation) |
| 3) Regulatory and policy procedures | • Specific procedures indicated with respect to regulations or policy in emergency operations for the transportation infrastructure  
• Authority hierarchy detailed within transportation infrastructure for clear chain of command  
• These elements can be considered inclusive if they are part of the document (even if with respect to just transportation) |
| 4) A freight transportation plan | • Actual section of emergency operations plan dedicated entirely to freight transportation following an emergency (natural disaster) |
From these observations and examinations, policy recommendations will be made regarding the inclusion of freight transportation planning at the local level. As it has already been shown, there is little to no evidence of freight transportation planning in these East Coast states at the state level.

Potential problems do exist with this methodology. There is one main difficulty in evaluating emergency operations plans at the local level. It is a subjective process and therefore open to many different interpretations. By selecting a framework to follow while examining the emergency operations plans for specific terminology, the majority of bias should be removed. As well as this consideration, while plans may exist for emergency management, it is not always the scenario seen in real time. Another difficulty is generalizing the results, because what could work for one state or locality, may not work across a region. The criteria this thesis selects to determine the choice may be different from the choices selected by a different approach. Therefore, results should also be evaluated from more than one selection of criteria. These problems present some difficulty with completing the research; however, the value of the research outweighs what it may take to resolve any problems.

The specific steps for the methodology are as follows:

1) Select seven separate coastal areas and collect emergency operations plans for the localities. The data obtained will be used to examine prevalence of freight transportation planning in emergency management in those areas.
2) Examine the documents and information provided by emergency managers for prevalence of freight transportation and the four elements selected based on previous research.

3) Develop broad policy recommendations for localities along the East Coast for inclusion of freight transportation planning following natural disasters.

The examination of the emergency operations plans at the local level should lead to recommendations for the transportation sector which will prove helpful to both freight delivery as well as localities in recovery from coastal natural disasters and future improved resiliency.
4. Results and Discussion

4.1 Current County and Local Level Emergency Operations Plans

4.1.1 Current Emergency Operations Plan in Miami, Florida

The Comprehensive Emergency Management Plan1 (CEMP) establishes the framework to ensure that Miami-Dade County and its municipalities are prepared to deal with these hazards, and is the equivalent of an emergency operations plan. The CEMP outlines the basic strategies, assumptions, operational goals and objectives, and mechanisms through which Miami-Dade County mobilizes resources and conducts activities to guide and support emergency management efforts through preparedness, response, recovery and mitigation. The plan is an operations-based plan that addresses evacuation; sheltering, post disaster response and recovery; deployment of resources; communications and warning systems (CEMP, 2008). The Comprehensive Emergency Management Plan1 is the plan this thesis will use to determine how well it includes the four key elements.

Freight transportation is mentioned in the plan, but a specific emergency operations plan for freight transportation plan is not outlined. One of the main purposes of the CEMP is to coordinate the return of essential services to a normal state as quickly and effectively as possible after a disaster. Transportation and freight transportation can be considered essential services not only for the Miami-Dade area but also the surrounding region.

The critical transportation infrastructure of Miami-Dade County includes airports, major roadways, seaports, bridges, waterways, railroads, and rail cars. Miami International Airport
(MIA) is one of the largest and most active airports in the southeast. International freight is growing at a rate of 10.8% and now exceeds 140,000 tons per month. The major roadways serving Miami-Dade County are A1A, U.S. 1, U.S. 441, I-95, Florida Turnpike, S.R. 286, U.S. 41, S.R. 997, and S.R. 836 (CEMP, 2008). The primary seaport for the County is the Dante B. Fascell Port of Miami-Dade. The Port hosts the largest passenger ship traffic in the southeast as well as one of the eastern seaboard’s largest containerized cargo operations. The Port serves as a significant point of entry for disaster relief resources and supplies. The Miami River provides an important ancillary seaport for cargo vessels under 200 feet length overall (LOA). The river is heavily utilized by ships from the Caribbean Basin. Miami-Dade County is served by four railroad systems: Florida East Coast Railroad (freight); CSX (freight); Amtrak (passenger); and Tri-Rail (passenger). The two primary railroad lines used by these companies run the length of the County parallel to each other, approximately two miles apart and in a north/south direction. These systems and their railway yards are of prime importance for the movement and transportation of relief supplies into the County during a disaster (CEMP, 2008). While the CEMP does not include a vulnerability assessment of its transportation infrastructure, past experience with disasters may have helped show where vulnerabilities are in Miami’s transportation network.

Miami-Dade County has had experience with disasters before and knows the economic toll that natural disasters can have on the economy of a region. Hurricane Andrew, a small, fast moving category 5 storm struck the sparsely populated agricultural area of southern Miami-Dade County, where only 300,000 of the County’s residents lived. The resulting damage from this storm totaled over $27 billion and posed a serious economic threat to a number of Miami-Dade’s
municipalities, the County, and the insurance industry at large. A category 5 hurricane striking in the more populated regions of the County could put over 2.4 million residents at risk and could easily result in losses of such proportions that the financial health of the county, its municipalities and many businesses in the private sector would be placed in jeopardy. A disaster of this magnitude would also pose a serious threat, on a national level, to the banking and insurance industries as well as the general economy of the country. This risk analysis specific to hurricanes is not a vulnerability assessment for freight transportation but it is a good basis for where to examine the transportation network for vulnerabilities in the future.

The Infrastructure Branch, outlined in the CEMP, is responsible for monitoring and coordinating communications, response and recovery actions relative to flooding, drainage matters, debris clearance, damage assessment, critical facilities, utilities, transportation, and engineering. Therefore the responsibility of planning for freight transportation following a natural disaster would fall to them. The County’s infrastructure includes roads, traffic controls, water and sewer systems, storm drains, streetlights, medical services, electrical and telephone services, food supplies, garbage and debris pick up and disposal. The CEMP states that:

“The short-term recovery phase begins with the restoration of these services. Full documentation of recovery efforts must be maintained especially in the event of an emergency or disaster declaration when FEMA will require such documentation to be attached to the Project Worksheets.” (CEMP, 2008)

The Infrastructure Branch must follow specified procedures and guidelines following a natural disaster. While there is flexibility with such restrictions, the element of regulatory and policy procedures regarding transportation is covered by the CEMP in respect to recovery actions. While these procedures and regulations are not specifically linked to freight transportation, they
could easily be applied and adapted in an annex of the emergency operations plan pertaining to freight transportation.

The needs of the freight transportation industry may not be addressed during the response phase following a natural disaster, but most certainly would need to be covered in the recovery phase of any emergency operations plan. The recovery phase of an emergency or disaster deals with the functional restoration of a community to the conditions prior to the disaster event. The recovery phase will include the restoration of infrastructure including roads, traffic controls, signs, canals, railroads, airports, shipping facilities, fuel supplies, potable water supplies, electricity, sewage disposal, storm drains, and flood control facilities.

The element of public and private collaboration mechanisms is covered in the CEMP in the section concerning debris removal. The process of debris removal and clearance of critical transportation infrastructure is a cooperative effort between Miami-Dade Solid Waste Management, Miami-Dade Parks & Recreation Department, Miami-Dade Public Works Department and the Florida Department of Transportation. Therefore a freight transportation planning element would need to incorporate these different agencies. The available and obtainable resources of the transportation network in Miami-Dade County will be employed, in the event of an incident or disaster to accomplish the following:

- Coordinate transportation resources for evacuations as a result of immanent threat of an incident or disaster
- Coordinate drawbridge lockdown and reopening schedules between USCG, marine interests and the bridge owners.
• Develop situation reports and action plans for all available modes of transportation and submit to the Operations Section Chief.

• Coordinate with ESF-3 (Public Works & Engineering) and Debris Removal in facilitating the removal of obstructions from and the temporary repair of the transportation infrastructure.

• Coordinate the production and distribution of transportation maps (CEMP, 2008).

All of these objectives would affect freight transportation, and one would hope that the local government would consult with both the companies involved with railways and highways to ensure the best continuation of vital needs. These issues concern not only the locality, but also the region and the nation due to the movement of freight.

In summary, Miami-Dade County does not have an official vulnerability assessment for its freight transportation network or a specific freight transportation emergency operations plan. The county does however, have public and private collaboration mechanisms in place, along with regulatory and policy procedures to be put into place following a natural disaster. These elements currently pertain to transportation in general; however the framework could be expanded to cover freight transportation as well. Therefore on the local level, Miami meets two out of the four elements needed for a complete freight transportation emergency operations plan.

While there is no specific mention of freight transportation or planning for its resumption following a natural disaster, it must be noted that Miami-Dade County has the foresight to see they may need to plan for such an event. Recognizing the threat to local economies, the Federal Emergency Management Agency (FEMA) added an Emergency Support Function, Business &
Industry, to its response and recovery tasks to address the recovery needs of the business community. The State of Florida and Miami-Dade County subsequently adopted and named ESF – 18 Business & Industry. ESF -18 is under development (CEMP, 2008). Therefore, while the current CEMP does not address the issue of freight transportation following a natural disaster fully, it looks as if Miami-Dade County plans to accomplish that objective in the near future.
4.1.2 Current Emergency Operations Plan in Jacksonville, Florida

Information regarding Jacksonville’s emergency operations plans comes from multiple sources. While there is no definitive emergency operations plan, there is a Debris Operations Plan and Hurricane Preparation and Recovery Plan. These two plans are combined with discussions with Edward Ward, an Emergency Coordination Officer for the Florida Department of Transportation in north Florida. Mr. Ward’s area covers 18 Counties in north Florida, including Duval, which is Jacksonville. An important note to make when examining the area of Jacksonville is Jacksonville and Duval County are used interchangeably. The entire area of Duval County is the City of Jacksonville. Even though a plan may state it is for Jacksonville, it actually includes all of Duval County. Each County in Florida (67 in total) has an evacuation plan for their County. District 2 is the district of Florida that has Jacksonville in its jurisdiction. The two plans along with discussion with Mr. Ward are what this thesis will use to determine how well Jacksonville, FL includes the four key elements.

Most pertinent is the Hurricane Preparation and Recovery Plan. This plan states that the Pre-Storm Mission is to maintain the mobility of people and goods while preparing to provide inter-District and intra-District assistance. The Post-Storm Mission is to open all State, Strategic Intermodal System Connector, and Federal Aid roads to traffic (HPRP, 2005). The clearing of the travel lanes of highways and connectors have a high priority basis and the status of the roads must be reported to the District emergency operations center as requested. The plan includes a detailed list of all roadways and connectors (which include ports and railways). The transportation sector of Duval County is also responsible for duties such as recommending preferred detour routes to efficiently and effectively route traffic around damaged areas,
coordinating with the railroad industry to identify critical railroad crossings and to determine the need for emergency generators or flagmen if a critical railroad crossing loses power due to the emergency (HPRP, 2005). By contacting the railroad industry, the HPRP does include some aspects of public and private collaboration mechanism that could be built upon in the future. With such a detailed list of railroads, it may be easier to connect with that private industry – which could expand into other modes of freight transportation.

Following the event of a hurricane in Jacksonville the top priority is to open roads, especially SIS Highways and Connectors, Interstates, and roads that lead to critical facilities. Mobility of people and goods is at the heart of the Mission Statement of the HPRP. Therefore the plan makes it vital to know whenever roads are closed and whenever they are opened, detailing the exact process for closing a road and notifying the appropriate authorities of the closure. The first day following the event of a natural disaster there are specific actions to be taken outlined in the Hurricane Preparation and Recovery Plan. These actions can include completing top-side inspection of bridges, opening all roads (e.g., Interstates, SIS Roads and Connectors, State Roads), and connecting 100 emergency generators at traffic signal locations if the electric companies estimate that power outage at these locations will exceed 72 hours (HPRP, 2005). Having these specific actions, including certain regulations and policy decision, outline within the Plan fulfills the element of regulatory and policy procedures.

The other document pertaining to planning following a natural disaster in the Jacksonville area is the District 2 Debris Operations Plan (DOP). The purpose of the DOP is to provide the operational framework necessary to achieve the overall Department mission:
1) To remove the volumes and types of debris, which may pose a threat to the public’s health and safety

2) To eliminate impediments to the essential flow of traffic

3) To restore the full functioning of the State and Federal transportation infrastructure within the State of Florida (DOP, 2009)

The District’s primary responsibility is for the state and interstate roadways. District 2 maintains a list of roads and facilities which are to receive priority status during the response phase of the debris removal operations. The District maintains communication with the State emergency operations center and County emergency operations center to ensure road clearance priorities and efforts reflect real-time needs. The District will continually update the list of priority roads to ensure that designated evacuation routes, emergency facilities, hospitals, critical care facilities, and major arterial roadways are targeted for immediate clearance after a debris generating event. Debris clearance contractors and District in-house debris clearance crews will be instructed to target designated priority roadways. The District expectation is for all priority roads to have at least one lane of access cleared within 24 hours (DOP, 2009). While the DOP is not as detailed as the HPRP, it provides Jacksonville with another example of regulatory and policy procedures for a transportation plan following a natural disaster.

In review, Jacksonville does not have an official vulnerability assessment for its freight transportation network or a specific freight transportation emergency operations plan. The District does however, have public and private collaboration mechanisms in place, along with regulatory and policy procedures to be put into place following a natural disaster. These elements currently pertain to transportation in general; however the framework could be
expanded to cover freight transportation as well. Therefore on the local level, Jacksonville meets two out of the four elements needed for a complete freight transportation emergency operations plan.

While both plans are quite comprehensive for the Jacksonville area, there still is little mention of freight transportation. Unlike Miami-Dade County there is no mention of future work that might include freight transportation planning for the area. The Debris Operations Plan makes opening highways within one day of a natural disaster a priority and one of the top priorities in the Hurricane Preparation and Recovery Plan is maintain the mobility of people and goods. Therefore there is a good basis for why Jacksonville should be incorporating freight transportation into their emergency operations planning, but the region has not addressed the issue. With the intersection of I-10 and I-95, it is crucial for Jacksonville to be involved in incorporating freight transportation planning following a natural disaster.
Figure 8. Freight Transportation Corridors (Department of Transportation, 2008)
4.1.3 Current Emergency Operations Plan in Savannah, Georgia

While making attempts to find an emergency operations plan for Savannah, GA and the surrounding region, the best source came from speaking with Don Sullens, a certified emergency manager for the area. What follows is Don Sullens approximation of emergency operations planning for the Savannah area from his personal experience. The information given by Mr. Sullens is what this thesis will use to determine how well Savannah, GA includes the four key elements.

Sullens states that plenty of work has been done regarding transportation requirements and assets required prior to an event, but plans dealing with post event are harder to come by. Resources needed following an event, and how those resources can be used, will depend on the event. Basically, the city of Savannah will have the task to evaluate what is needed, draw from their local resources, and once that runs out the remainder of what is needed is obtained from either State or Federal Agencies. The complete lack of any regulations or policies put into place to handle various situations is startling. With other localities, such detail was taken to ensure that some actions go smoothly by having guidelines in place, yet Savannah “plans” to shape the response to each event. While it is good to adapt to each situation, the lack of any regulations or policies could be disastrous.

Savannah has the fourth busiest port on the East coast, operated by the Georgia Ports Authority. There is a second port just south of Savannah in Brunswick. There is serious freight moving through both of these locations, and at the local level, the local government has nothing to do with their plans. Savannah is the eastern end of I16, and sits just east of I95. These two
highways are significant arteries on the east coast. The city also has an international airport, introducing aviation as another mode of freight transportation flowing through the city. There are companies either headquartered or at least have major distribution centers in Savannah including: Gulfstream, Home Depot, Target, Walmart, and Great Dane. While Savannah is aware of its transportation network and the important private corporations within the city, there is no analysis like what is needed for two out of the four elements. There is no mention of any vulnerability assessment for the transportation network despite knowing the key areas. There is also no mention of any collaboration between the government and those companies located in Savannah. There is great potential for the city to utilize a partnership with those specific companies, as there products are often vital following a natural disaster.

At the local level, Sullens is unaware of any technology or software that might help with freight transportation following natural disasters. Nor has Mr. Sullens even seen any studies on that subject for the local level. At the local level, all current plans deal with pre event transportation, and most of those considerations are for the evacuation of the population. Post event transportation considerations only deal with bringing first responders back into the area then returning those we took out. It would appear that Savannah must get a basic post event transportation plan into place before considering a plan specifically for freight transportation, but both are vital assets to the city.

Transportation issues regarding freight are really left up to those companies and agencies dealing directly with it. Sullens state that the local level government would only get involved with those issues if specific requests come in to the emergency operations center during recovery.
operations. The local emergency management plans basically end with coordinating the restoration of the basic infrastructure (including roadways and bridges), at the local level. Clearing of the river channel which accesses the port is a DOT, GPA, and Coast Guard driven event. The State of Georgia would take the lead in clearing, repairing, and restoring I16; and the Federal level would assist with I95. Again there is a lack of clarity for responsibilities following a natural disaster with respect to all transportation. The city of Savannah is in great need of solid planning for transportation in the case of an emergency.

In summary, Savannah does not have an official vulnerability assessment for its freight transportation network, a specific freight transportation emergency operations plan, public and private collaboration mechanisms in place, or regulatory and policy procedures to be put into place following a natural disaster. Therefore on the local level, Savannah meets none of the elements needed for a complete freight transportation emergency operations plan.

Sullens last comment sums up what many emergency managers feel “We can plan and make all kinds of arrangements before an event, but after it happens, all bets are off and operational plans are formulated as required.” Yet one might hope that planning for freight transportation following a natural disaster could be formulated seeing as it interests both public and private entities in Savannah, GA.
4.1.4 Current Emergency Operations Plan in Charleston, South Carolina

The Charleston County Emergency Operations Plan (CCEOP) establishes the policies and procedures by which the County will coordinate county, state, and federal response to disasters impacting the citizens of Charleston County. The Plan generally describes how the County will mobilize resources and conduct activities to guide and support local government emergency management efforts through preparedness, response, recovery, and mitigation planning. This plan also addresses responsibilities by which the County will deliver effective response and recovery operations (CCEOP, 2007). The CCEOP is what this thesis will use to determine how well Charleston, SC includes the four key elements.

Charleston County is one of the most vulnerable counties in the state to be impacted by hurricanes and tropical storms. Densely populated coastal areas, especially during peak tourist seasons, coupled with the generally low coastal elevations, significantly increase the county's vulnerability. This vulnerability can also extend to Charleston’s transportation network; however a formal vulnerability assessment has not been conducted for the area.

As stated in the CCEOP, the process of furnishing transportation services during a disaster situation involves two series of actions. First, essential immediate transportation needs are identified and actions are taken to provide for these needs. Second, as soon as possible, future continuing needs for transportation service and expected future transportation capabilities are estimated. Decisions are then made and actions taken to direct these expected future capabilities to meet the needs considered most essential (CCEOP, 2007).
Recovery activities are those actions that enable disaster victims to begin the process of rebuilding their homes; replacing property; resuming employment; restoring businesses; permanently repairing, rebuilding, or relocating public infrastructure. Some duties of the transportation entities following a natural disaster may include reporting the locations of damage to transportation infrastructure, degree of damage, and other available information as information becomes available, assisting local governments in determining the most viable, available transportation networks to, from, and within the disaster area, and regulating the use of such networks as appropriate, coordinating the Overall Damage Assessment of Charleston County to include, homes, businesses, industry and infrastructure (CCEOP, 2007). These two parts of the CCEOP cover the element of regulatory and policy procedures. Like other plans reviewed in this thesis, there are specific guidelines for post-disaster activities which will ensure some success. Most emergency operations plan are skillful at including regulations and policies that are important in decision making following a natural disaster.

One mention of commercial traffic can be noted in that high profile vehicles – 10,000 pounds or greater, will be restricted from the crossing high profile bridges when sustained winds reach 30 mph or greater. Examples of high profile vehicles include tractor trailers and panel trucks/box type trucks (UPS/FEDEX, FSI, etc.). What is most interesting about the CCEOP is that included in the annexes is a list of businesses that would be affected by an emergency operations plan. With already a clear idea of the stakeholders regarding freight transportation, it would be simple for Charleston’s local government to develop a plan with both local and freight interests in mind. One such plan would align with one of the duties of Charleston County following a natural disaster.
disaster outlined in the CCEOP, “Review the county mitigation plan and local mitigation plans for the early identification of mitigation projects and to reduce state and local socio-economic consequences” (CCEOP, 2007). Socio-economic consequences would definitely include the disruption of freight routes. The extensive list entails that Charleston is already creating public and private collaboration mechanisms that will be helpful. With such coverage on the businesses that may be effected by damage to transportation, this portion of the CCEOP is close to being complete in including aspects of freight transportation.

In review, Charleston does not have an official vulnerability assessment for its freight transportation network or a specific freight transportation emergency operations plan, but it does have public and private collaboration mechanisms in place and regulatory and policy procedures to be put into place following a natural disaster. These elements currently pertain to transportation in general; however the framework could be expanded to cover freight transportation as well. Therefore on the local level, Charleston meets two out of the four elements needed for a complete freight transportation emergency operations plan.

The Charleston County Emergency Operations Plan is unique from other emergency operations plans because it starts to incorporate the private interests that will be affected by a disruption in the transportation network. This inclusion may seem small, but the plan stands out for realizing all the places that may be impacted by a natural disaster. A disaster or any emergency may severely damage the local transportation infrastructure. Most state/local transportation activities will be hampered by damaged roads, bridges, and disrupted communications. Charleston is on
its way to having a complete emergency operations plan by including a few elements regarding freight transportation.
4.1.5 Current Emergency Operations Plan in Wilmington, North Carolina

The New Hanover County Emergency Operations Plan (NHCEOP) was developed to ensure a coordinated and effective response to any significant hazard that might threaten the county, which includes Wilmington, NC. This plan predetermines actions to be taken by government agencies and designated private organizations (in addition to their day-to-day responsibilities) within New Hanover County. Activation of the NHCEOP will reduce the vulnerability of people and property to disaster, and establish a means to respond effectively to actual disasters or threats of disaster. This plan provides for a coordinated effort to minimize the impact of natural or manmade disasters on residents and visitors (NHCEOP, 2004). The NHCEOP is what this thesis will use to determine how well Wilmington, NC includes the four key elements.

The major traffic arteries in New Hanover County are: U.S. 421, U.S. 74 / 76, Interstate 40, U.S. Highway 17, U.S. Highway 117, U.S. Highway 132 and U.S. Highway 133. Two railroads operate within the area: they are the CSX System and the N.C. State Ports Railroad. The CSX System enters New Hanover County from the west, across the Cape Fear River, just north of Wilmington downtown. The railroad track turns to the north, moving through the county just west of the airport, and exits the county at Castle Hayne. The State Ports Railroad enters and exits the county from the west, looping through the Wilmington downtown as it proceeds to and from the State Port. There is one airport, Wilmington International, located in New Hanover County. The runways are in excess of 7,000 feet in length (NHCEOP, 2004). Knowing these elements of freight transportation means that developing a specific freight transportation emergency operations plan would not be entirely difficult.
A hazard analysis and vulnerability assessment has been completed which identifies the types of threats to which the County is most vulnerable in the Multi-Jurisdictional Hazard Mitigation Plan (MJHMP). Due to the vulnerability assessing a number of roadway segments in New Hanover County and the Town of Kure Beach have been identified by the New Hanover County 911 Center as experiencing repetitive flood problems during heavy rain events. A comprehensive hurricane evacuation study was completed in 1995 / 96 for Eastern North Carolina. This study included a traffic analysis defining evacuation routes and clearance times, potential flood hazard areas, and a behavioral analysis (MJHMP, 2005). Out of all of the plans, Wilmington includes the most complete vulnerability assessment that analyzes everything that may be affected by different hazards. Using GIS-based tools along with past experiences, their vulnerability assessment indicates parts of the transportation network which are going to be most at need following a natural disaster.

The main focus of the transportation function outlined in the emergency operations plan is to coordinate the use of all transportation resources to meet the needs of the citizens as well as the other support functions to accomplish response, recovery and assistance missions. This coordination role of transportation includes prioritizing public and private transportation resources for the transport of people, materials, goods and services. The assets available for transportation will be used to assist county agencies and other functions of emergency management with their emergency efforts to move people, materials, equipment and other resources, as necessary. The priorities for allocation of these assets will be as follows:

1) Evacuation of persons from immediate danger.
2) Transportation of persons registered for evacuation assistance via local databases.

3) Transport of materials, personnel and supplies to support emergency activities.

4) Transport of relief supplies necessary for recovery activities. (NHCEOP, 2004)

The duties outlined by the NHCEOP for transportation follow along with similar plans in their inclusion of regulatory and policy procedures. There is no question over where responsibility lies for each duty following a natural disaster in Wilmington, NC. The County also realizes that coordination with private entities will be necessary and incorporates that into the emergency operations plan. Therefore the element of public and private collaboration mechanisms is in place and could be adapted for a freight transportation emergency operations plan.

In summary, Wilmington does have an official vulnerability assessment for its transportation network (along with freight), a public and private collaboration mechanisms in place, and regulatory and policy procedures to be put into place following a natural disaster. These elements currently pertain to transportation in general; however the framework could be expanded to cover freight transportation as well. The only element the New Hanover County Emergency Operations Plan is missing is a specific freight transportation emergency operations plan. Therefore on the local level, Wilmington meets three out of the four elements needed for a complete freight transportation emergency operations plan.

Importantly, New Hanover County indicates that its Emergency Operations Plan is a signed agreement among eleven jurisdictions and agencies in New Hanover County, the State of North Carolina, and the federal government. The NHCEOP provides the mechanism for coordinating the delivery of assistance and resources to the residents, visitors, and businesses of New Hanover
County during a major disaster or emergency (NHCEOP, 2004). By including businesses, Wilmington must realize that incorporating a specific freight transportation annex into its emergency operations plan is necessary to have a complete emergency operations plan.
4.1.6 Current Emergency Operations Plan in Norfolk, Virginia

The City of Norfolk, Virginia Emergency Operation Plan (NEOP) establishes an emergency organization to direct and control operations during the emergency situation by assigning responsibilities to specific entities. All essential entities are to utilize any and all available resources when mitigating against, preparing for, responding to, and recovering from a natural or man-made emergency. The purpose of this plan is to direct actions intended to preserve life and protect property from further destruction in the event of an emergency (NEOP, 2009). The NEOP is what this thesis will use to determine how well Norfolk, VA includes the four key elements.

The Elizabeth and Lafayette Rivers, along with the Hampton Roads Harbor and Willoughby and Chesapeake Bay, are the major waterways in and around the City of Norfolk. The major transportation routes in the City of Norfolk are state highways 58, 13, 60, and 168 and interstates 264, 464, 64, and 564. Based on a hazards analysis of the area, the primary hazards in City of Norfolk are flooding, major summer or winter storms, hurricanes, and hazardous materials incidents (NEOP, 2009). Combining these two points of information from the NEOP could easily lead to a vulnerability assessment of the transportation network in Norfolk. At this time, however, no such assessment exists.

Pertaining to the element of policy and regulatory procedures there is detailed information regarding the chain of command and protocol to be followed by key personnel in the NEOP. The Public Works Director is responsible for planning, directing, and coordinating the efforts of
the City's Public Works Department in responding to and recovering from disasters and other emergency situations. The Public Works Director directs all the debris clearance activities for the City after a disaster event. This Director has the authority to initiate and implement debris clearance. The Director’s duties include maintaining maps of all City and City Public Works Systems (traffic control, roads, and bridges), protecting and restoring traffic signals, signs and other traffic control facilities, and conducting post disaster damage assessments of public infrastructure including structural inspection of bridge structures (NEOP, 2009). These guidelines among other features of the plan fulfill the element of regulatory and policy procedures expected from a complete transportation plan.

Contained in the Emergency Transportation Annex of the NEOP is mention of private and public collaboration mechanism, but with respect to evacuation, not freight transportation. The Director and Coordinator of Emergency Preparedness and Response assisted by the school administration, will coordinate all transportation resources that will be utilized in the evacuation. The school system will provide school buses for transporting those people who do not have any means of transportation. If necessary, additional transportation resources will be solicited from public and private bus companies, churches, as well as private non-profit agencies that provide transportation services to special populations in the city. Local service stations and independent towing services will provide road service as necessary (NEOP, 2009). James Talbot, Assistant Director of Norfolk Emergency Preparedness & Response, indicated that while there is not an annex designated for transportation other than evacuation, the city of Norfolk is working on just such an addition to be completed and approved by October 2009.
In summary, Norfolk does not have an official vulnerability assessment for its freight transportation network or a specific freight transportation emergency operations plan, but it does have public and private collaboration mechanisms in place (if for another purpose) and regulatory and policy procedures to be put into place following a natural disaster. These elements currently pertain to transportation in general; however the framework could be expanded to cover freight transportation as well. Therefore on the local level, Norfolk meets two out of the four elements needed for a complete freight transportation emergency operations plan.

The purpose of the City of Norfolk, Virginia Emergency Operation Plan is to assign broad responsibilities to local government agencies and support organizations for disaster mitigation, preparedness, response, and recovery. Effective use of resources will ensure that casualties and property damage will be minimized and that essential services will be restored as soon as possible following such an emergency or disaster situation. One such service that must be restored is a viable freight transportation network. With Norfolk continually reviewing and revising its Emergency Operations Plan, it is hoped that a freight transportation annex will become a priority.
4.1.7 Current Emergency Operations Plan in Baltimore, Maryland

The current Emergency Operations Plan for Baltimore, MD and the Continuity of Operations Plan are the main documents used by officials of emergency management in the city of Baltimore. Unfortunately, access to the Emergency Operations Plan and Continuity of Operations Plan for Baltimore was not granted. Therefore, the information used in this thesis to determine how well Baltimore, MD includes the four key elements comes from various documents and presentations posted online by the Baltimore City Mayor’s Office of Emergency Management.

In the past 55 years, 33 hurricanes and tropical storms have passed within 200 nautical miles of Baltimore, an annual frequency of 0.6 cyclonic storms. In this time period, Baltimore did not suffer a direct hit by storms greater than a Category 1 hurricane. However, storms like Hazel, Agnes, and Isabel have caused great amounts of flooding and damage. On September 18, 2003, Tropical Storm Isabel caused massive flooding, destruction of businesses and homes. Waters up to 8 feet above normal tides surged into downtown Baltimore (Hurricane Preparedness Brochure, 2009). Baltimore’s extensive hurricane history and mapped hurricane inundation areas show that hurricanes are a significant hazard. While the inundation map is a great example of why hurricanes are a hazard to the city, there is no vulnerability analysis to determine how this inundation would affect the transportation sector.

An overview of the two major Baltimore City Emergency Plans was presented by the Mayor of Baltimore in January 2009. Baltimore considers these plans to be part of the preparedness element of emergency management for the city. The Emergency Operations Plan is an
operational plan that addresses how Baltimore will protect lives, property, the environment, and the economy in incidents that are unusually severe, widespread, prolonged, or complex; and how disparate resources from throughout the enterprise will be integrated to provide non-routine services (Maloney, 2009). Another document discussed in the Mayor’s presentation is the Continuity of Operations Plan (COOP) and it relates to Baltimore’s role as provider of numerous essential public services. It addresses how Baltimore will prevent essential services from being disrupted under adverse circumstances; and how enterprise resources will be leveraged to increase the resilience of disparate programs and services. The combined goals of the EOP and the COOP are an outline of what strategies and tactics Baltimore will employ to cope with high-impact, low-frequency events; a detailed plan of who will do what and when in the case of an emergency; and suggestions of what additional emergency management plans and procedures are needed to succeed in recovery in Baltimore, MD (Maloney, 2009).

A look at emergency response resources for Baltimore was presented by the Baltimore City Department of Transportation in March 2009. This presentation states that the Baltimore City Department of Transportation is typically a support agency during emergencies, facilitating or restricting traffic and pedestrian movement, making repairs to infrastructure, and supplying/repairing lighting, etc. In the hierarchy explained by the Baltimore DOT, there are six divisions of authority in an emergency response situation: administration, traffic, maintenance, engineering and construction, safety, and conduit (BCDOT, 2009). For freight transportation, both the maintenance and engineering divisions are most important. The maintenance division oversees highway maintenance in four different sectors, bridge maintenance, and maintenance on the Inner Harbor. The engineering division oversees resurfacing, reconstruction/streetscapes,
and bridge engineering (BCDOT, 2009). Both presentations by the Mayor and the DOT of Baltimore show that there are policy and regulatory procedures in place for the locality following a natural disaster. While these presentations do not go into specific detail of the procedures, one can assume that both the Emergency Operations Plan and the Continuity of Operations Plan follow a similar format seen in other cities, where these policy and regulatory procedures are outlined in detail.

One other presentation, “Evacuating Traffic from Baltimore City Strategy and Execution” given by the Mayor in 2009, indicates that the role of public and private collaboration mechanisms is given to the Mayor’s Office in the city of Baltimore. Under the roles and responsibilities given to the Mayor’s Office of Emergency Management it includes interagency coordination, regional coordination, and private sector coordination – all stakeholders to be included in any mechanism between private and public interactions (Dixon, 2009). This presentation may only have looked at evacuation but from all the documents seen by Baltimore, it appears that there are public and private collaboration mechanisms in place facilitated by the Mayor’s Office of Emergency Management.

In review, Baltimore does not have an official vulnerability assessment for its freight transportation network or a specific freight transportation emergency operations plan, but it does have public and private collaboration mechanisms in place, and regulatory and policy procedures to be put into place following a natural disaster. These elements currently pertain to transportation in general; however the framework could be expanded to cover freight
transportation as well. Therefore on the local level, Baltimore meets two out of the four elements needed for a complete freight transportation emergency operations plan.

The Baltimore City Mayor’s Office of Emergency Management (MOEM) states it will maintain the highest level of preparedness to protect Baltimore’s citizens, workers, visitors, and environment from the impact of natural and man-made disasters. MOEM also ensures that Baltimore’s overall emergency plans integrate the procedures and resources of all agencies and outside organizations. MOEM serves as the link between Baltimore and other entities – regional, State, Federal, non-profit, and private sector partners – for emergency planning and operations (MOEM, 2009). As freight transportation is a vital stakeholder in Baltimore, MD and the Mayor’s Office of Emergency Management needs to be doing more with respect to planning for freight transportation following a natural disaster in order to uphold its’ mission statement.
4.2 Comparison of State and Local Emergency Operations Plans with respect to Comprehensiveness of Freight Transportation Planning

There are two research questions this thesis addressed:

1) Do local emergency operations plans include more freight transportation planning than state emergency operations plans?

2) How complete is freight transportation planning at the local level?

Looking back at the first research question, this analysis shows that while local plans are better than state plans – they are nowhere at the level at which they need to be. While state plans had little to no mention of freight transportation, an analysis of the local plans showed both mention of freight transportation as well as the beginning of planning for freight transportation. More importantly, the focus in all emergency operations plans with respect to all transportation is evacuation of an area. The intent of the original four elements was meant to look for mention of freight transportation, but they were kept flexible. The results found that while there may not be one element dealing specifically with freight transportation, the element was there for transportation issues such as evacuation. Therefore, a plan was considered to have an element even if it was just with respect to transportation, and not specifically the issue of freight transportation. The only element which was not flexible was the actual freight transportation plan. Looking at both state and local level emergency operations plans, local level plans are much more inclusive of the possibility of freight transportation planning, as well as the necessary framework for future freight transportation planning.
Looking at the second research question of how complete these local plans are with respect to the four elements, the analysis showed that most localities have a halfway complete plan with respect to freight transportation. In general, most local emergency operations plans have public and private collaboration mechanisms established along with regulatory and policy procedures. These elements were most complete with respect to transportation in general, often with the focus on evacuation of an area. For the purpose of this research, having the elements in some aspect of transportation was considered having the elements. With these two elements, their completion in the emergency operations plans (while primarily for evacuation), can lead easily to their being implemented for freight transportation. These seem to be the two easier elements to be implemented within an emergency operations plan.

The most complete element in all the plans was the regulatory and policy procedural guidelines. Seen in each plan, there is a definite hierarchy established to deal with transportation following a natural disaster. This hierarchy addresses both policies and regulations that may be needed in such situations. The completeness of the plans with respect to this element is helpful because there is no question regarding authority or how each step is to be handled. These chains of command already in place could easily be transferred to the issue of transportation. Most plans also had established public and private collaboration mechanisms, but it cannot be seen from the document how strong these connections necessarily are. However, it is with this element that the most inclusion of freight transportation is seen within the plans. Having localities aware of the private stakeholders within a community could help to facilitate a dialogue to provide a complete freight transportation plan ESF or emergency operations plan. It is in the best interests of each locality to ensure the continued effort on the part of both the public and private stakeholders.
within the freight transportation sector. Yet it is promising to see how much work has been put into the emergency operations plans regarding these two elements.

The next elements expected in emergency operations plans pertaining to freight transportation are the vulnerability assessments of a region’s transportation network and the actual freight transportation plan. One locality, Wilmington, NC, does have a complete vulnerability assessment that is quite impressive. It would be the type of assessment that other cities and counties may want to duplicate. Wilmington has a multi hazards assessment that incorporates GIS technology and behavior analysis to determine the key vulnerabilities in their infrastructure. Vulnerability assessments seem to be an element the local governments should already be accomplishing and an element they could do with ease with already existing tools. As this thesis expected, there are no local level emergency operations plans specifically for freight transportation. An actual freight transportation plan is achievable given the first three elements and could be completed as a joint effort with private entities. While Miami-Dade County seems to be on the right track with their planned addition of an emergency function focused on business and industry, emergency operations plans at the local level still need an immense amount of revision to fully address the issue of freight transportation following a natural disaster.
<table>
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<th>Public/private collaboration mechanisms</th>
<th>Regulatory and policy procedures</th>
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### 4.3 Optimal Plan

What would the perfect plan look like based upon this analysis? Quite simply, it would need to include the four elements used to examine the current plans in this thesis. The first step would be to continue the thoroughness of regulatory and policy procedures seen in the existing plans. Freight transportation does not necessarily need a completely new planning tool – as seen developing in Miami, it can be included in the existing framework. The public and private collaboration mechanisms need to be supplemented with concrete contact with freight operations in the area like Charleston. Contained in each plan should be a listing of the commercial
interests in the area. In the case of a natural disaster or manmade disaster, such a resource of information could be invaluable. Each locality needs to have a vulnerability analysis and hazards assessment like Wilmington has in order to fully plan for natural disasters. The lack of this step in most localities could potentially put the city at a disadvantage in the case of an emergency. Most importantly, there needs to be a specific annex of each emergency operations plan pertaining to freight transportation. As stated before, this step can be seen as a future recommendation in Florida. Until there are guidelines for freight transportation planning following a disaster, these localities (and states) are not as prepared as they could be.

4.4 Limitations and Further Research

Limitations occur with most research and this thesis was no exception. One limitation is the framework chosen to evaluate the emergency operations plans. This thesis looked for four elements but other important elements could be selected to determine the completeness of the existing plan. From the research already done, the framework and elements were established to create consistency when evaluating a multitude of plans. When searching to evaluate plans on a local level, there was an issue of having access to emergency operations plans. All of the state plans were readily available, but that was not the case for the city and county plans. Despite freedom of information laws, this thesis could only evaluate the information provided. Most locations were cooperative, but the review could have been more complete with all of the requisite documents. The framework was created to provide a cohesive approach and the lack of documents was corrected by using what information was available, yet these are evident limitations of this thesis.
These limitations lead to recommendations on how future research could be conducted regarding freight transportation being incorporated into emergency operations plans. Future research could be given more time and authority to obtain all of the needed documents, as well as personal interviews with the emergency managers at the local levels. From the research conducted within this thesis, contact with local emergency managers was valuable and provided more insight into each emergency operations plan. Another direction in which to expand this research would be to focus on disasters other than hurricanes and flooding. The change in scope may lead to evaluations of the freight transportation network in other areas of the country. Each emergency operations plan had annexes pertaining to other types of disasters other than hurricanes, and subsequent research could focus on how other disasters impact the freight transportation industry. Influencing research in the private sector is also quite possible. Preliminary research in this thesis established that there is little emergency planning occurring in the freight transportation industry as well. A study could be done evaluating the state of emergency operations plans within the private sector. Assessing the industry may lead to more public and private collaboration in developing emergency operations plans that address freight transportation needs. All of these research ideas would further the case for incorporation of freight transportation in the planning process, as well as ensure the continued delivery of basic needs in the event of a disaster.

The results seen in this thesis are preliminary and are meant to be built upon. Emergency operations plans on both the state and local level are comprehensive but there are still elements that could improve their effectiveness. With so much emphasis put on recovery efforts, planning
to also help recover freight transportation infrastructure following a natural disaster seems like the next logical step for emergency managers.
5. Policy Implications

From a policy perspective, there is no better time to capitalize on the findings in this thesis than now. With the country’s aging infrastructure, planners are looking to both improve existing infrastructure, as well as build new infrastructure smartly. Emergency operations plans need to be complete in terms of freight transportation infrastructure in order to ensure the continued success of goods transportation in this country. As funding is directed towards the building of new infrastructure, emergency managers must seize the opportunity to plan for future disasters.

These recommendations are meant as guidelines. There are some localities that may not need freight transportation planning incorporated into their emergency operations plans. Localities should assess their needs to see if it is a vital part of planning they may need. A locality should first determine if they are a freight transportation hub and whether disruption to their freight transportation network would have long term effects both on their area, as well as possibly the nation. Second, a locality should examine the possible hazards within their region. Areas with hazards such as chemicals, nuclear power plants, etc. should consider incorporating freight transportation planning in case of a disaster affecting those sectors of the community. Other localities may be affected by earthquakes or natural disasters (other than hurricanes) and should make sure the freight transportation planning is flexible to deal with the disasters that are more prevalent within the area. Another aspect a locality should take into consideration is the population of the area. For large heavily populated areas, the focus will be on evacuation and freight transportation planning may not be an issue that can even be planned for due to the difficulties facing the normal transportation ESF. Yet, the area should still consider planning for
freight transportation if it is a hub and incorporate the difficulties of evacuation into the planning for other transportation issues. These are all attributes of a region that should be considered before beginning to craft a freight transportation plan.

**Recommendation 1: Include Freight Transportation in State and Local Emergency Operation Plans**

The direct policy goal of this thesis is the inclusion of freight transportation into emergency operations plans at the local and state level. Including freight transportation networks into emergency management planning would not necessarily need to take a whole new approach. The existing plans have the correct framework and just need to be expanded to include a section on freight transportation infrastructure in the area. This thesis showed that local level emergency operations plans are already more complete than state level plans and it may be more beneficial for freight transportation interests to be included at the local level. The issue of freight transportation could be inserted as another ESF in already existing plans or as an ancillary note for the already existing ESF for transportation. There is no need for localities to devise a completely separate plan for the issue of freight transportation but rather to fit it within the current framework. Therefore, the two elements that were seen within emergency operations (regulatory and policy procedures, and public and private collaboration) could be expanded upon to formulate a complete freight transportation plan. Recommendations for an optimal plan based upon this research can be seen in Section 4.3. The issue of transportation for evacuation has paved the way for making it easier to plan for freight transportation following a natural or manmade disaster by creating the necessary framework.
While state level plans may not be the venue for freight transportation, there does need to be an interregional approach to freight transportation in emergency operations planning as well. Disruptions to the freight transportation network due to a natural disaster affect more than one local area. Therefore, states along the East Coast should create some policies that could help with coordinated interactions between areas to smoothly restore delivery of goods across the nation following an emergency situation. As seen in this research, the issue of evacuation is fully covered. Freight transportation planning is an element that comes into consideration in the longer arc of emergency operations planning. Evacuation is an issue that is most likely covered by the third day following a manmade or natural disaster. Therefore, at either the local or state level, freight transportation planning should be covered in the recovery sections of emergency operations plans in order to be considered part of the long term goals. No matter what else is attempted, emergency managers need to follow Miami-Dade County’s example and start the process of including freight transportation networks into emergency operations plans.

**Recommendation 2: Governments Must Conduct Vulnerability Analyses**

One other policy goal is to ensure that all governments conduct full vulnerability analyses of transportation infrastructure at the local level for freight transportation hubs. As seen in Wilmington, NC, this is a relatively simple policy step on the local level that can reap great benefits for the community. By knowing where the weak spots exist in a transportation network, redundancies can be developed in order to make the system more resilient. Cities and states need to be armed with the best information in order to develop the wisest set of actions following a natural disaster. This recommendation coincides with an area needing to know what hazards to prepare for before creating a freight transportation plan (or the importance of such a plan).
Knowing both the vulnerabilities of a system as well as how it is most likely going to be disrupted will lead to a community being well equipped to deal with possible emergencies. A system can be more quickly restored if it is known where it is most likely to fail and need to be replaced quickly. The policy step of vulnerability assessments could be done before or in tandem with incorporating freight transportation into emergency operations plans.

**Recommendation 3: Continued Coordination between Public and Private Stakeholders**

An existing policy goal that should be continued with respect to emergency operations plans is to coordinate with private sector stakeholders. As was seen, most plans already incorporated public and private collaboration mechanisms. These relationships must be continued in order to create the most complete emergency operations plans. By including stakeholders within all aspects of the freight transportation industry, the plan will address all the concerns that may arise following a natural disaster. Identifying the stakeholders is not nearly enough, as there may be mutual benefits provided in an emergency between public and private entities. Partnerships are vital in a network like transportation that is used by both business and government. By creating and maintaining these partnerships in freight transportation, emergency managers on both the state and local level are creating an environment for success.
6. Conclusions

As important as evacuating citizens is, it is also as vital to efficiently reroute recovery supplies as well as normal transportation of goods across the United States. Transportation entities, such as the Department of Transportation, are beginning to examine the most effective uses of rerouting following a natural disaster. While the research on evacuation routes and emergency preparedness is necessary when examining the transportation sector in the event of a natural disaster, it does not examine what occurs after the disaster in terms of freight routes. Little or no attention is paid to freight transportation in both state and county level emergency operations plans.

It is time for emergency managers to move towards focusing on planning ahead. Mitigation is always a hard notion for anyone to sell – especially with respect to natural disasters. There is the element of “It won’t happen here”, but this thesis showed the economic effects that can occur and there are potential savings to be seen in the freight transportation industry. The preliminary steps have been taken within emergency operations plans; the framework just needs to be expanded to include sections on freight transportation networks. Using an appropriate motivation, such as partnerships with industry, could lead to the inclusion of freight transportation needs into emergency management documents being easily accomplished.

While every natural disaster will affect an area differently and every disaster will have different effects, emergency operations plans are a basic plan which emergency managers rely upon. There is always a need for costs to be reduced, and the indirect costs due to delayed delivery of
goods affect not just the city, but the entire nation. Emergency managers must be prepared and give all citizens, including industry, the tools to recover completely. FEMA states that, “Emergency managers prepare for emergencies and disasters, respond to them when they occur, help people and institutions recover from them, mitigate their effects, reduce the risk of loss, and prevent disasters from occurring” (FEMA, 2008). Until freight transportation infrastructure is an integral part of emergency operations plans, the plans are not completely comprehensive and they do not allow emergency managers to fully prepare their communities.
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