Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: The Gulf Coast Study, Phase 2

Task 1: Assessing Infrastructure for Criticality in Mobile, AL

U.S. Department of Transportation

Gulf Coast Study, Phase 2

September 1, 2011

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Impacts of Climate Change and Variability on Transportation Systems and Infrastructure
The Gulf Coast Study, Phase 2

Assessing Infrastructure for Criticality in Mobile, AL

Final Technical Memo, Task 1

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ACRONYMS

ADT	Average Daily Traffic
AGR	Alabama Gulf Coast Railway
ALDOT	Alabama Department of Transportation
ASPA	Alabama State Port Authority
BNSF	Burlington Northern Santa Fe
CN	Canadian National Railroad
CSXT	CSX Transportation
DHS	Department of Homeland Security
DOT	Department Of Transportation
EJ	Environmental Justice
FAR	Federal Acquisition Regulation
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
GM&O	Gulf, Mobile, and Ohio
GTM	Gross Ton Miles
MATS	Mobile Area Transportation Study
MPO	Metropolitan Planning Organizations
NPIAS	National Plan of Integrated Airport Systems
NS	Norfolk Southern
SARPC	South Alabama Regional Planning Commission
STEP	Surface Transportation Environment and Planning
TASD	Terminal Railroad of the Alabama State Docks
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey

INTRODUCTION

The U.S. Department of Transportation's Center for Climate Change and Environmental Forecasting is conducting a comprehensive, multi-phase study of climate change impacts on transportation in the Central Gulf Coast region. This study, formally known as *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study* (hereafter, "the Gulf Coast Study"), is the first such study of its magnitude in the United States and thus represents an important benchmark in our understanding of what constitutes an effective transportation system adaptation planning effort. This report presents the findings of the first task of Phase 2 of this study—identifying critical transportation assets.

While confidence in global climate change projections has been steadily increasing over recent years, investigations into the potential impacts of projected changes on a regional scale have been scarce. The exact risks that climate change poses to transportation systems are not yet well known. As many of the nation's infrastructure components, such as rail lines, highways, bridges, and ports, are expected to last for up to 100 years, it is important that their design and long-term operations consider factors that could affect their resilience and effectiveness over their life span, such as changing environmental conditions due to climate change.

The Gulf Coast Study was initiated to better understand climate change impacts on transportation infrastructure and to identify potential adaptation strategies. This study area was selected as the study's focal point due to its dense population and complex network of transportation infrastructure, as well as its critical economic role in the import and export of oil, gas, and other goods. The study is funded under the U.S. Department of Transportation's (USDOT) Surface Transportation Environment and Planning cooperative research program, the USDOT's Center for Climate Change and Environmental Forecasting, and other USDOT offices, with FHWA managing the study for USDOT with assistance from the DOT Climate Center and individual modal administrations. The U.S. Geological Survey (USGS) has provided support for much of the climate science work.

The Gulf Coast Study includes two phases:

- **Phase 1** (2008) – During Phase 1, FHWA partnered with the USGS and the U.S. Climate Change Science Program to investigate potential climate change risks and impacts on coastal ports, road, air, rail, and public transit systems in the region from Mobile, Alabama to Houston/Galveston, Texas. The study assessed likely changes in temperature and precipitation patterns, sea level rise, and increasing severity and frequency of tropical storms. The assessment concluded that storms could increase in intensity by at least 10%, hurricanes of at least Category 3 intensity are likely to increase in frequency, average annual temperatures are expected to rise by at least 2.7°F over the next fifty years, the number of days over 90°F could increase by 50%, and relative sea level rise could increase by at least a

foot (and in many areas more) by 2050 raising the specter of widespread inundation. Phase 1 then explored how these changes could impact transportation systems. It found that a relative sea level rise of four feet would permanently inundate 27% of the Gulf Coast region's roads, 9% of its railways, and 72% of its ports; higher temperatures would likely lead to more rapid deterioration of infrastructure and higher maintenance costs; more intense precipitation events could overwhelm drainage systems and cause damage and delays; and increased hurricane intensity coupled with sea level rise would pose a significant threat to infrastructure.

- **Phase 2** (currently underway) – The purpose of Phase 2 is to provide a more detailed assessment of the vulnerability of the most critical components of the transportation system to weather events and long-term changes in climate. This work is being conducted on a single metropolitan area—the Mobile, AL region (see Box)—with the intention of making the processes used in the study replicable to other areas. USDOT is conducting Phase 2 in partnership with the Mobile Metropolitan Planning Organization, part of the South Alabama Regional Planning Commission (SARPC).

Phase 2 Study Area

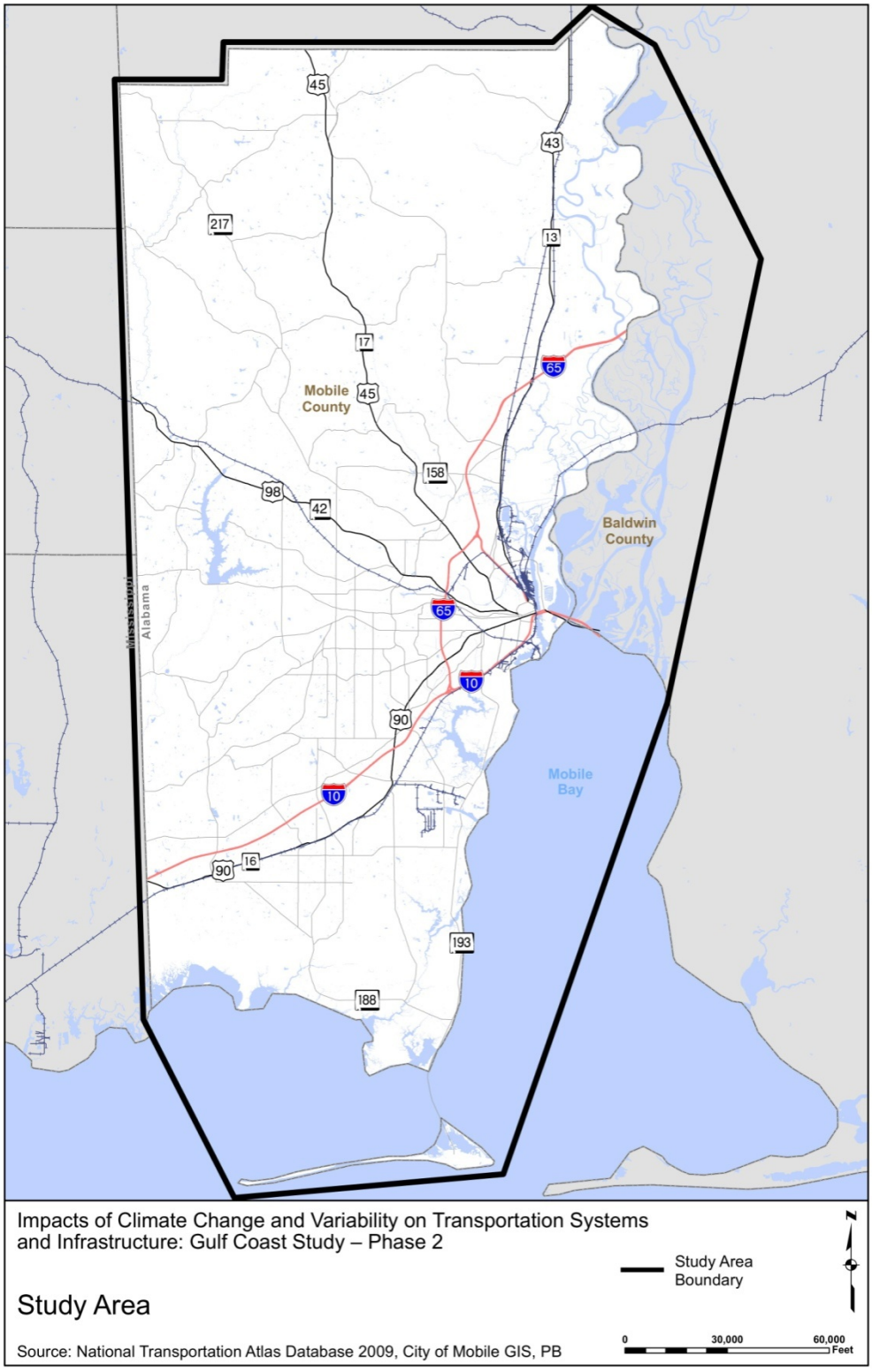
While Phase 1 took a broad look at the entire Central Gulf Coast region (between Houston/Galveston, Texas and Mobile, Alabama) with a 'big picture' view of the climate-related challenges facing infrastructure, the current effort in Phase 2 focuses on Mobile, Alabama. The area of the study includes Mobile County (including Dauphin Island) and the crossings of Mobile Bay to the east to landfall in Baldwin County (see Figure 1).

Phase 2 includes the following tasks:

- Task 1: Identify critical transportation assets.
- Task 2: Develop climate information and assess sensitivity of assets to climate stressors.
- Task 3: Determine the vulnerability for key links and assets.
- Task 4: Develop and apply detailed risk management tools.
- Task 5: Coordinate with local planning authorities and the public on the process and implications of the analysis.
- Task 6: Publish and disseminate the information learned.

This report summarizes the methodology and findings of Task 1, which identified the transportation infrastructure components most critical to the Mobile region.

Figure 1: Study Area



TASK 1: OVERVIEW

Purpose and Scope of Task 1

"Critical" infrastructure, as defined in this study, refers to infrastructure that serves to keep the mobility and accessibility functions of the transportation network viable as they enable the economic and social activities in the study area (please see Figure 1). That is, how important is each link or node in the transportation network in terms of its provision of access to various economically or socially significant locations? These critical assets are the keys to supporting important transportation services, supporting the economy, moving people and freight, and providing emergency management functions. Criticality was looked at primarily from the perspective of Mobile County—that is, what is important to the functioning of Mobile County itself? However, given the importance of Mobile County as a throughway for the movement of goods in the Gulf Coast states, the research team also considered the importance of port and rail facilities from the perspective of the greater Gulf Coast region.

The critical facilities and assets identified under Task 1 will undergo further analysis in later tasks to evaluate their potential exposure and vulnerability to climate change, as part of a larger assessment of the risks that climate change poses to the study area's transportation system. The modal assets assessed during this task included highways, transit, ports, rail, airports, and pipeline facilities.

Early in Task 1, the project team, in collaboration with USDOT, established certain boundaries for the scope of Task 1, including:

- Criticality, as defined at this point in the study, was not dependent on the risks associated with weather or climate change; therefore, Task 1 did not include a risk assessment. The findings in this report indicate only which transportation assets are of the greatest importance to the Mobile region, and do not indicate which assets are most at risk to climate change. Assessment of risk will occur later in the project.

- Assessments of both present and future operational characteristics were performed for this study. In most cases, transportation and resource agencies have strategic plans that extend between 5 and 30 years. An assessment of critical infrastructure more than 30 years in the future is thus difficult. For this reason, the focus of this assessment is on assets in place or planned through 2035. The design life of assets, however, did play a role in determining criticality.

- Because of the risk associated with catastrophic storms that combine wind and wave energy in a low-lying coastal area like Mobile, criteria relating to emergency management feature prominently in the assessment, perhaps more so than it would in other regions of the country.

Overview of the Task 1 Approach

The project team's approach to researching, screening, and identifying critical transportation assets included a multi-disciplinary team of engineers, planners, policy analysts, and climate experts and involved multiple meetings with local transportation stakeholders. Field data collection was combined with GIS assessment, evaluation of the Mobile Area Transportation Study (MATS) regional travel demand model, and desk reviews of federal, state, and industry reports. The approach adopted for undertaking Task 1 included:

1. Initial Meeting with Stakeholders – An initial meeting was held with stakeholders, including representatives from local transportation agencies such as the SARPC, to introduce the project and establish a work plan. Comments on the initial approach for determining criticality were incorporated into the methodology.

2. Formation of Modal Teams – Given the differences in data needs and methodologies for determining criticality among different travel modes, separate modal teams were established for roads, rail, ports, pipelines, airports, and transit. The methodology for determining the criticality of each mode is detailed later in this report.

3. Selection of Criteria for Criticality – The basic framework for assessing criticality was based on three criteria:

    a. Socioeconomic – Factors that contributed to the economic and social functions of Mobile County, including such considerations as community connections and access to employment centers,

    b. Use and Operational Characteristics – Factors that indicated the level of use within the infrastructure network such as Average Daily Traffic (ADT), tonnage, ridership, etc.; and

    c. Health and Safety – The extent to which segments of the network provided access to health facilities, were evacuation routes or were components of the national defense system.

Stakeholder Collaboration: A Key Component

A key element of the identification of critical infrastructure was the input from the study stakeholder group – the Mobile MPO's Climate Change Working Group (CCWG). The CCWG was convened by the MPO Executive Director and included public officials and representatives from various agencies and organizations (e.g., the Alabama Department of Transportation, Mobile County, the Dauphin Island Sea Lab, Department of Homeland Security, and others). The CCWG provided valuable feedback on the proposed methodology, draft results, and ultimate of the process and helped refine the findings to reflect local priorities.

4. Mode-specific Methodology – Criteria for evaluating the criticality of each mode were developed for each of the general categories presented in Step 3. Defining the criticality of modal assets required transportation specialists in each mode to determine which assets were most important based on mode-specific criteria.

5. Data Collection – Data collection for this project included the assembly of mapping information (primarily provided by the Mobile County GIS department) to build an infrastructure inventory; interviews with agency representatives from the USDOT, SARPC, transit and port facilities; and summaries of available planning documents for each mode that identified both existing conditions and planned improvements. Limited information was available for some transportation assets, such as port and rail facilities, due to the proprietary nature of their operations. In such cases, the project team developed a number of alternate data gathering methods to classify infrastructure links or nodes as being critical. These alternate methods included conducting field interviews to obtain data required to assist in assessing the criticality of assets.

6. Criticality Assessment – Using the information obtained in the data collection exercise, and the mode-specific methodology developed under Step 4, the project team assessed the criticality of each asset. To do so, assessment matrices were developed to score facilities based on community, use/operations, and health and safety criteria (explained in more detail in the following section of this report). The data available for each mode were specific to that mode; therefore, the scoring methods developed were mode-specific as well. Transportation professionals with many years of experience working with individual modes identified critical infrastructure, with the level of detail often depending on the amount of available information. Facilities were scored as being "low" to "high" in terms of criticality, with those in the high category advanced to the next stage of the project as critical infrastructure.

7. Review of Initial Results – The methodology and findings of the technical analysis underlying the criticality assessment were presented to the Climate Change Work Group (CCWG) as a means of checking the assumptions made by the technical team in identifying critical infrastructure. The CCWG provided valuable feedback, noting in a few instances where assets considered important to the citizens of Mobile County were not fully reflected by the analysis. This feedback was incorporated into the final analysis by building more flexibility in the approach so that local values were better captured (please see Incorporating Local Values below).

8. Finalization of the List of Critical Assets – The final list of critical assets and the accompanying report was developed based on the steps outlined above and provided to the USDOT. Modal experts within USDOT provided feedback on items within their area of expertise. This feedback was then incorporated into the final recommended list of identified critical assets.

KEY DETERMINANTS OF CRITICALITY

The project team's interest in identifying critical assets represents the first phase of a vulnerability screening process. Moreover, this process is intended to be transparent and replicable so that other jurisdictions interested in considering the impacts of climate change may borrow lessons learned and methods used in Mobile as they attempt to narrow the range of assets they consider.

Before the level of criticality of an asset can be determined, the term "criticality" itself must be clearly defined in the context of such an assessment. Traditionally, assessments of criticality may connote notions of risk but, in this case, critical assets are intended to include the assets of greatest importance. In this sense, criticality may relate to economic importance, access to jobs or healthcare facilities, emergency evacuation routes, social connectivity, cultural significance, or other core values. The extent to which each of these elements of criticality is included in such an assessment must be a reflection of the goals of the decision-makers who will ultimately use the information. In a case like this, where the focus is on a particular county, the assessment had to balance local priorities with information more applicable to other audiences as well.

Prior work on identifying critical infrastructure in other parts of the U.S. has focused primarily on major transportation facilities that serve a national purpose – primarily interstate travel and trade.[1, 2] However, assessing what is critical to a local area – i.e., the Mobile MPO area – requires that other criteria be taken into consideration, such as those related to community and economic viability. Recognizing interstate travel as the sole criterion for asset criticality might not capture the full measure of important transportation assets that support the economy of Mobile County and surrounding counties. Acknowledgement of regional and local transportation connections (including major port facilities and railroad operations), and their importance to the community, is necessary.

To ensure that the assets defined by the project team reflected the local priorities and values of the Mobile community, stakeholders were engaged at several points to help define "critical" for the purpose of this study. A draft methodology was developed by the project team, in collaboration with USDOT, and presented to the CCWG to get their input on process. Feedback provided by the CCWG was incorporated into the final methodology that was applied during the inventory and scoring stages.

Stakeholder input was also vital during the review of preliminary results of the criticality assessment. During presentation of the draft results, stakeholders noted that certain assets that

[1] U.S. Department of Homeland Security. 2007. *Transportation Systems: Critical Infrastructure and Key Resources Sector-Specific Plan as input to the National Infrastructure Protection Plan.* U.S. Department of Homeland Security, Transportation Security Administration: Washington, DC. Available at: http://www.dhs.gov/xlibrary/assets/Transportation_Base_Plan_5_21_07.pdf.

[2] Moteff, John, Claudia Copeland, and John Fischer. 2002. *Critical Infrastructure: What Makes an Infrastructure Critical?* Congressional Research Service: Washington, DC. Available at: http://www.fas.org/irp/crs/RL31556.pdf.

were regionally important (i.e., important beyond the confines of Mobile County) were not designated as highly critical based on the quantitative assessment. Local stakeholders also identified examples of assets with cultural importance, but which had not been deemed critical through the objective scoring process. These comments demonstrate the importance and value of engaging stakeholders in developing criteria for screening assets, as well as any "on top" adjustments to reflect qualitative realities that are not able to be captured in a quantitative "desk-based" assessment. The "Locally Specific Criteria" discussion at the end of this section expands on this issue.

For the purpose of this study, the determination of criticality of transportation assets in Mobile was based on the following categories of criteria:

- Socioeconomic importance,
- Use/Operational importance, and
- Health and safety importance.

Specific criteria within each category are discussed in more detail below.

Assessing Socioeconomic Importance

The socioeconomic importance of an asset relates to how it contributes to the social viability of the community, as well as its role in supporting the local economy.

Social Viability

Social viability involves measuring the importance of transportation assets to the community in terms of providing access to facilities that allow the community to function. A community is comprised of more than just its economic base. Many individual components including households, schools, libraries, government centers, retail establishments, places of worship, and other locations define a community as a whole. The role of transportation in providing connectivity between those destinations is well defined and enables community viability and livability. Figure 2 illustrates the location of various community facilities such as schools, colleges and universities, emergency service locations, government institutions, and health care facilities in the Mobile study area.

Connections to these facilities were factored into the criticality analysis in recognition of their importance to community function. For example, the project team reviewed the transportation links connecting the community to schools and government facilities. The project team also engaged the assistance of local stakeholders who identified other key transportation links such as the connection to Bayou La Batre, Dauphin Island Parkway and Route 43 connecting to the industries along the corridor. More details on this process are provided under the highways discussion in the "Detailed Methodology and Results by Mode" section.

The project team recognized the limitations of adhering to quantitative criticality criteria when considering community linkages. Therefore, direct community input on a preliminary round of criticality scores was solicited. Stakeholders were given the opportunity to adjust some criticality scores upward based on their importance to the community. The "Incorporating Local Values" section describes the changes that were made and lessons learned from this exercise.

Economic Viability

Economic viability involves an asset's role in supporting commerce[3] and providing access to major employment destinations. For purposes of this assessment, an asset's role in supporting the local economy in Mobile was the primary focus; however, assets such as ports and rail facilities can support commerce in Mobile, across the Gulf Coast region, and across the country, and so the rating criteria are designed to reflect this broader potential importance. Examples of critical commerce links in the study area include trunk rail lines, multi-modal linkages such as roads serving port facilities, and major truck routes. Major employment destinations in the study area were also identified and access to them made part of the criticality analysis. This assessment considered large individual employers as well as clusters of smaller employers that, together, formed major employment sites. Access to these facilities was considered to be an important criterion across multiple modes as the support of the economic base is a critical measure of the transportation system. More information on the economy of the Mobile area can be found in Appendix A.

Assessing Use/Operational Importance

Operational importance was assessed by considering the use of each link in the transportation network, its capacity, and the importance of the operations that the asset supports to the Mobile County economy[4]. Examples of use measures include average daily traffic (ADT) along roadways, ridership for transit, annual gross tonnage for rail lines, and cargo volumes for ports. More detailed information on operational importance can be found in the "Detailed Methodology and Results by Mode" sections throughout the report.

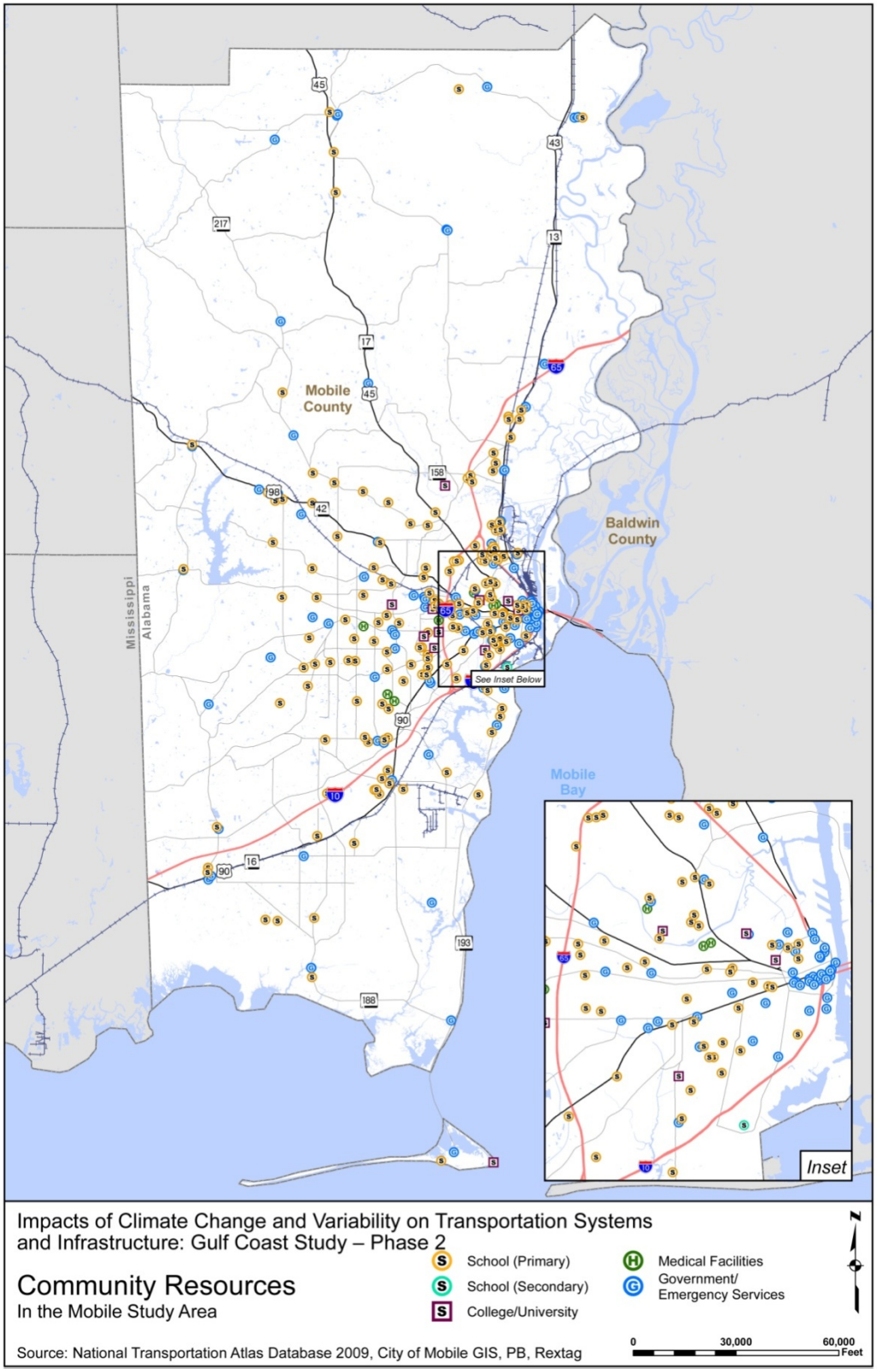
Assessing Health and Safety Importance

Health and safety considerations include the asset's role in evacuation plans; disaster relief and recovery plans; the asset's role in moving hazardous materials; inclusion in the national defense system; and the extent to which an asset provides access to health care facilities.

[3] For most modes assessed as part of this study, the role of assets in supporting commerce focused on support of *local* commerce—i.e. commerce in Mobile County. Rail and ports, however, play important roles in commerce throughout the Gulf Coast and beyond.

[4] Again, for most modes the research team considered their importance to the Mobile County economy. However, as the port and rail facilities are important components of trade in the Gulf Coast, the team considered the freight service provided by these modes, even though much of the freight is not directly tied to the economy of Mobile.

Figure 2: Community Resources



Incorporating Local Values

The methodology to determine criticality by mode was developed to capture as much objective data as possible to help inform decisions on which individual links or nodes of the various transportation systems were most important when compared to the networks in their entirety. This methodology included analysis of census data, compilation of an extensive GIS database, and feedback in interviews conducted for the purpose of understanding the utilization of each network link. Furthermore, the approach used in Mobile focused primarily on assets that are highly important to Mobile County or (for some modes) that play key roles in commerce or the movement of people in the state, the Gulf Coast region, or nationally. Therefore, the approach initially had more limited sensitivity to the importance of assets to local communities *within* Mobile County.

The scores resulting from this analysis were presented in matrices and presented to local stakeholders for feedback. The feedback provided by the local stakeholders was very informative. It was noted that certain important assets/areas had not been captured through the assessment process. In particular, it was noted that a few assets/areas that, in stakeholder opinion, defined Mobile had not been included. Specifically, the sense was that the project team had not adequately reflected the importance of access to: the Bayou La Batre port and related seafood industry activity, Dauphin Island, and large employers along the Highway 43. Stakeholders also noted how vital the local port facilities were to the Bayou La Batre community. None of these areas stood out as overall major contributors of jobs (from the County perspective) based on Census economic data; however, stakeholders were concerned that the study was not adequately capturing the economic benefits and social importance of these areas. Adjustments were therefore made to the criticality list.

In each case, the matrix developed for this analysis provided the flexibility to rank components of transportation infrastructure using a range of methods. When applied in other areas, the matrix could include weightings for each criterion that reflect items of particular importance. Decisions on what is important from a purely economic perspective, from a community cohesion perspective, or from a local accessibility perspective could drive decision-making on defining critical networks when applied in other areas. In the field, a study like this would begin with an agreement on the reasons for screening for criticality, the scope of influence the interested party or parties may have (e.g., all modes, one mode, operations, asset management, maintenance, planning, design) and the impetus for making changes (e.g., health and safety concerns, economic concerns). This task was intentionally made to be broad to encompass all modes and provide even treatment of emergency management, operations, and socioeconomic factors. The value of a systematic approach for assessing infrastructure for criticality is that it creates a baseline for decision-making and presents a tool to help streamline efforts to assess vulnerability and risk.

The project team has concluded that the effort to identify critical infrastructure would have benefited from a slightly revised form of stakeholder input. In the future, the project team would recommend holding a facilitated discussion of the draft (desk review) findings. This conversation would encourage dialogue on specific asset scores on criteria of interest to local stakeholders and would ensure that considerations not expressly included in criteria get factored into the findings early on.

DETAILED METHODOLOGY AND RESULTS BY MODE

Measuring Criticality

The project team developed a series of matrices to identify and define the level of importance of the criteria for each mode. Using a combination of data analysis and discussion with stakeholders in Mobile, the matrices identified specific criteria against which each transportation asset was evaluated. Criteria used for the three assessment categories included:

- **Socioeconomic:** The connection, function, and purpose criteria relating to linkages between modes, among populations, or to economic centers. Criteria generally included for all modes included:
  - Component of National/International Commerce System
  - Important Multi-Modal Linkage
  - Functions as Community Connection
  - Lack of System Redundancy
  - Serves Area Economic Centers

- **Use/Operational:** The use of each link or node in the system. Highly used infrastructure (in terms of volume) is viewed as more important than lesser-used segments. Classifying higher/lower use is specific to each mode. Criteria for each mode included:
  - Highways:
    - Functional Class (Interstate, Primary Arterial, etc.)
    - Usage
    - Intermodal Connectivity
  - Transit:
    - Ridership
    - Customer Facilities
    - Intermodal Connectivity
    - Garage and Maintenance Facilities
  - Railroads:
    - Main Track Classification

Using GIS to Assess Criticality

Geographic Information Systems (GIS) provided an ideal framework for assembling, displaying, and analyzing the wide variety of data likely required to analyze critical infrastructure. GIS was an essential tool for these analyses by enabling the assessment of geographic relationship (like highways and their accessibility to community facilities.) Using GIS also enabled the project team to analyze various links based on multiple criteria and maintain the outputs of each analysis in a database for later scoring. The City of Mobile provided numerous GIS shape files, many of which were applied to identify spatial relationships of transportation facilities.

- Annual Gross Tonnage
- Yard Annual Tonnage
- Current rail facility capacity utilization
- Operations (merchandise, intermodal, bulk, break bulk, etc.)
- Interchange utility (i.e., a yard-specific measure of the interchange between carriers, which is of importance in the ability to transfer rail cars within yards.)
- Local non-marine traffic

– Ports:
  - Port Use/Demand
  - Port Capacity
  - Port cargo value
  - Operations
  - Channel and berth depth
  - Maximum vessel size

– Airports:
  - Status – Civilian (public, public-private ownership, public-private use); military
  - Federal Acquisition Regulation (FAR) Part 139 Certification (i.e., level of service offered by the airport and the largest class of aircraft that uses the airport.)
  - Aircraft performance and dimensions (Approach speed codes – A, B, C, D, E; Aircraft design group – I, II, III, IV, V, VI) - largest and highest performance aircraft capable of using the airport
  - Instrumentation (precision, non-precision, visual)
  - Category within the National Plan of Integrated Airport Systems (Primary, reliever, general aviation)
  - Category within the Alabama Statewide Airport System Plan (2005) (international, national, regional, community, local)
  - Passenger enplanements
  - Annual Aircraft Operations – both Itinerant and Local, by type
  - Based Aircraft – by size category
  - Economic impact ($ millions – annual)

– Pipelines:
  - Pipeline Size (ID/OD)
  - USDOT Classification/pipeline contents (49 CFR 192 = NG; 49 CFR 195 = L and/or CO) (Design Classes I, II, III and IV)
  - Operates local pumping and/or compression facilities

  - Operates local oil refinery (CO); Gas processing (NG); Storage (S); Terminals (T)

- **Health and Safety:** The connection to emergency evacuation, disaster recovery, or national defense purposes. Criteria generally included for all modes included:
  - Identified Evacuation Infrastructure
  - Component of Disaster Relief and Recovery Plan
  - Component of National Defense System
  - Provides Access to Health Facilities

These criteria served as the basis for measuring criticality; however, criteria were modified, added, or deleted to reflect available data or updated assumptions. As an example, a link's ability to move hazardous materials was originally identified as an assessment criterion. During agency coordination, it was noted that there were no restrictions placed on area roadways for hazardous materials transport, except for the two tunnels in the area. This criterion was subsequently removed from the assessment. Similar changes were made if data were not available.

The assessment of each mode was completed to determine the relative value of links and nodes of the system according to the criteria outlined above as compared to other links and nodes in the same system. As noted, however, in instances where data was limited, professional judgment was applied to determine relative value of various assets as compared with others.

The assessment conducted for each mode was specific to that mode, and an assessment of criticality was made within each modal category. An assessment of criticality *across* modes was deemed too subjective given available data and the lack of a specific framework for comparison. The framework for assessing criticality within each mode was designed with transferability to other regions of the country in mind. Therefore, this report does not address, for example, whether critical port facilities are more or less important than critical highway segments within the study area. As the project progresses and interactions on asset vulnerability are advanced to a more detailed level, further discussions of the relative importance of particular assets will be more appropriate.

The following sections present the results of criticality assessments of Mobile's transportation infrastructure by mode. They have been identified on project maps, which depict the types of segments and nodes of infrastructure that will be carried forward into more detailed engineering analysis. Within each mode, components (as well as sub-components, when appropriate) are listed by facility or owning carrier. Each criterion was applied according to the type of asset. The overall criticality of each facility or component was assessed against various criteria organized into three assessment categories (socioeconomic, operational, and health and safety). Some of these evaluations were simple "yes or no" assessments; others were ranked as low, medium, or high in terms of value.

Highways

Introduction

The roadway network includes roadways of varying classifications, providing access to economic centers, residences, religious facilities, schools, community centers, and other uses. For the analysis of the highway mode, the study team concentrated the analysis only on roadway classifications contained in the regional long-range plan, thus eliminating local roads from the analysis. This decision reflects an understood hierarchy that local roads rarely serve a function high enough to be considered critical and also enabled integration of classification and volume data contained in the SARPC regional model into the assessment. The target network comprises a system of Interstates (10, 165 and 65), U.S. Highways (43, 45, 98, and 90), State Highways (16, 42, 17, 158, 163, 188, 193, 213, and 217), and a series of arterials and collectors. As is typical of most urban areas, the highway system carries a diverse mix of users.

The primary roadway network, which was examined for this study, is fairly expansive, made up of over 644 miles (1,847 lane-miles)[5] and approximately 630 bridges[6], with the network being defined by Interstates and U.S. Highways connecting the Mobile area to northern Alabama, the Florida panhandle to the east, and Mississippi and Louisiana to the west. Arterials radiate west from the downtown area to create connections to and among population and employment centers in the study area. Secondary and collector roads provide for localized travel providing access to specific subdivisions or retail/employment centers. This diverse mix makes up the most extensive transportation network in the study area. Because of the large size and numerous connections provided by the roadway network in the Mobile area, conducting a detailed engineering assessment of every potentially critical roadway segment was not feasible; however, during the next steps of this study, these critical roadway segments will be screened according to their vulnerability to climate impacts. The results of this screening will identify a subset of critical roadway segments that will undergo a more detailed engineering assessment in later stages of this project.

Criteria

Three assessment categories (comprising 10 individual criteria) were used to assess the criticality of highway network assets:

Socioeconomic

- Locally Identified Priority Corridors
- Functions as Community Connection
- System Redundancy
- Serves Area Economic Centers

[5] South Alabama Regional Planning Commission. 2010.
[6] Kearny, Scott. 2010.

Operational

- Functional Classification (Interstate, etc.)
- Usage (ADT)[7]
- Intermodal Connectivity

Health and Safety[8]

- Identified Evacuation Route
- Component of the Disaster Relief and Recovery Plan
- Component of the National Defense System
- Provides Access to Health Facilities

Methodology

Using an appropriate and efficient method of assessing an MPO highway network requires that the links in the network (for example, one intersection/interchange to the next) be grouped into longer segments for analysis. For this study, a series of segments (identified in the scoring matrix) were identified which grouped together consecutive links that were of the same functional class into a single segment. Scoring was applied to the segments, not for individual links.

The methodology applied for the highway mode involved the collection and analysis of field data, GIS data, and other information provided from the SARPC and Mobile County for the purpose of generating a score for each particular column in the matrix. A summary of the methodology applied to develop results for each criterion is included below. Highway segments were scored as critical if they met the following criteria:

Assessment of Socioeconomic Importance

- Locally-Identified as Priority Corridors – The study team presented the initial findings of the criticality assessment to members of the CCWG. At that meeting members identified corridors that serve as vital linkages to important employment/cultural centers that were not included as part of the identified critical highways. These roads include Dauphin Island Parkway, Route 23 near Bayou La Batre, and Route 43 stretching to northern Mobile County. Based on this input, the project team added a scoring column in the matrix and added a score of 3 (highly critical) to those links identified while other roads were scored a 1 for this criterion.
- Functions as Community Connection – To identify corridors that provide access to community facilities (schools, government buildings, etc.) outlined above, the project team ran a GIS query to determine the proximity of these facilities to segments in the

[7] Average Daily Traffic – From the MATS study area model – does not include an analysis of freight movement
[8] Hazardous Materials Routing was identified in the earlier methodology memorandum but was removed due to limited restrictions in the area. (This criterion is no longer considered a differentiator.)

network. Those providing access to a higher relative number of facilities were scored highest.

- Lack of System Redundancy – The project team determined redundancy (a measure of whether the roadway network could absorb traffic diverted from the loss of one link) using the MATS highway network. The methodology used for this redundancy test is detailed in Appendix B. The lower the redundancy, for a given area of the system, the more critical any one segment of the system is.
- Serves Area Economic Centers – Corridors that provide access to important economic activity centers are considered more critical. The employment centers analyzed are described more fully in Appendix A. GIS was used as a tool to create mapping of area economic centers. A spatial analysis of those links providing access to economic centers was performed for segments in the network. The outcome of this assessment was added to the attribute table for the highways.

Assessment of Operational Hierarchy

- Functional Classification (Interstate, etc.) – Functional classes for roadways as identified in the MATS model. There are six classifications in the model (1-6), with 1 indicating the lowest functional class (Minor Rural Collector) and 6 indicating the highest functional class (Interstate). Roads of functional classes 6 and 5 as ranked in the model were given a score of "3" (most critical). Functional classes 4 and 3 were given a score of "2" and functional classes 2 and 1 were given a score of "1."
- Use (ADT)[9] – Average Daily Traffic volumes from the MATS model. Usage was determined by a road's 2035 Annual Average Daily Traffic (AADT) volume. If a roadway's volume fell within a particular 2035 AADT range, it was assigned a score. 2035 AADT ranges for the study area were scored:
    - 0-4,000 vehicles received a score of "1"
    - 4,001-10,000 vehicles received a score of "2"
    - 10,001-17,000 vehicles received a score of "3"
    - 17,001-34,000 vehicles received a score of "4"
    - 34,001-65,000 vehicles received a score of "5"

  The final score was determined by assigning the score of "1" an overall score of "1", scores of 2 and 3 an overall score of "2," and scores of 4 and 5 an overall score of "3".
- Intermodal Connectivity – A measure of whether the link provided access to port, rail or airport facilities. This measure was determined using the GIS files provided by the City of Mobile to identify those roadway links that provided access. Those roads providing access directly to a port, rail or airport facility were graded a "3," those

[9] Average Daily Traffic – From the MATS study area model – does not include an analysis of freight movement

providing access from a major road to the modal access road were scored a "2," those providing no access were scored a "1."

Assessment of Health and Safety Importance

- Identified Evacuation Route – Denotations of evacuation routes in the area were contained as a shape file in the data provided by the City of Mobile[10]. Those roads identified as an evacuation route were scored a "3."
- Component of the Disaster Relief and Recovery Plan – Disaster Relief and Recovery Plan routes are designated routes that have to be cleared for emergency service (fire/police/rescue) vehicles as part of the Hurricane Recovery Plan. Routes that are a part of this plan were given a score of "3" for this criterion and all other routes were scored as "1".
- Component of the National Defense System – All interstate highways are considered components of the National Defense system. Interstates were given a score of "3" for this criterion and all other roads were scored as "1." Those highways designated as components of the Interstate Highway and Defense System included I-10, I-65 and I-165.
- Provides Access to Health Facilities – Scores were generated for this analysis based on a spatial assessment of roadways and their provision of access to hospitals and health facilities in the area. If a road provided direct access to a health facility, it was rated a "3," if it provided connectivity to roads deemed critical in this category it was rated a "2," if it provided no access it was rated a "1."

Results

The overall criticality score was determined by summing a roadway facility's Socio-Economic, Operational, and Health and Safety factor scores. After this summation, an overall range was developed from all of the roadway scores. This range was then divided into three smaller ranges, which were then used to define the overall Low, Medium and High Criticality scores. Applying the criticality methodology to the highway network resulted in the identification of 152 miles of roadways and 71 bridges that are considered of highest importance to operating the roadway network in the study area. This assessment identified the following roads as the links of highest importance to the area:

[10] Scott Kearny – GIS Manager , City of Mobile provided GIS shapefiles on May 5, 2010 and sent follow up data on request

- I-10
- I-165
- I-65
- US 43/SR 13 – Saraland Boulevard North and South/North Craft Highway
- US 45/SR 17 - St. Stephens Road (south of South Craft Highway)
- US 90/SR 16 - Government Street
- US 98/SR 42 – Moffett Road/Spring Hill Avenue (east of North University Boulevard)
- SR 163 - Dauphin Island Pkwy (North of Hamilton Blvd)
- SR 193 (up to I-10)
- CR 56 - Airport Boulevard (east of Snow Road)
- South University Boulevard
- Telegraph Road (from South Craft Highway and Alabama state docks)

Another 115 miles of the network and 23 bridges are considered of medium importance to the area, including US 90, University Boulevard, SR 163, and other area highways.

One hundred and sixty-nine miles and 39 bridges are considered low importance to the area based upon this analysis, including various minor roads such as Bellingrath Road (north of Industrial Road); County Roads 24, 28, 32, 33, 36, 40, 70, 72; and Irvington Bayou La Batre Highway, among others. Table 1 highlights the scoring criteria and results of the described methodology. (Note that in the table, 3 = Yes/High, 2 = Medium, 1 = No/Low.) Figure 3 presents this analysis graphically.

Figure 3: Highway Facilities Map

Table 1: Highway Criticality Assessment

Facility	Socioeconomic - Locally Identified Priority Corridors	Socioeconomic - Functions as Community Connection	Socioeconomic - System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Functional Classification (Interstate, etc.)	Operational - Usage	Operational - Intermodal Connectivity	Health & Safety - Identified Evacuation Route	Health & Safety - Component of Disaster Relief and Recovery Plan	Health & Safety - Component of National Defense System	Health & Safety - Provides Access to Health Facilities	Criticality Score: (L - Low, M - Medium, H - High)
Airport Blvd (West of Snow Rd)	1	1	1	1	2	2	1	3	1	1	1	L
Airport Blvd (East of Snow Rd)	1	3	1	3	3	3	3	3	1	1	2	**H**
Argyle Rd	1	1	2	1	1	1	1	1	1	1	1	L
Beauregard Street	1	1	1	2	3	2	3	3	3	1	1	M
Bel Air Blvd	1	1	2	1	2	2	1	1	1	1	1	L
Bellcase Rd	1	1	2	1	2	2	1	1	1	1	1	L
Bellingrath Rd (South of Industrial Rd)	1	1	2	3	2	2	1	3	1	1	1	M
Bellingrath Rd (North of Industrial Rd)	1	1	2	1	2	2	1	3	1	1	1	L
Beverly Rd	1	1	2	1	1	1	1	1	1	1	1	L
Broad Street (North of Spring Hill Ave)	1	1	1	3	3	2	2	3	3	1	1	M
Broad Street (South of Spring Hill Ave)	1	1	1	3	3	2	2	1	1	1	1	L
Canal St	1	1	1	3	2	1	1	2	1	1	1	L
County Road 24 - Half Mile Rd	1	1	2	2	1	1	1	1	1	1	1	L
County Road 28 - Old Pascagoula Rd	1	1	2	1	2	2	1	1	1	1	1	L
County Road 32 - Three Notch Rd	1	1	2	1	2	2	1	1	1	1	1	L
County Road 33 - Dawes Rd	1	3	2	1	2	2	2	1	1	1	1	L
County Road 36 - Jeff Hamilton Rd	1	3	2	1	2	1	1	1	1	1	1	L
County Road 37 - Cody Rd	1	3	2	3	1	2	1	1	1	1	2	M

Facility	Socioeconomic - Locally Identified Priority Corridors	Socioeconomic - Functions as Community Connection	Socioeconomic - System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Functional Classification (Interstate, etc.)	Operational - Usage	Operational - Intermodal Connectivity	Health & Safety - Identified Evacuation Route	Health & Safety - Component of Disaster Relief and Recovery Plan	Health & Safety - Component of National Defense System	Health & Safety - Provides Access to Health Facilities	Criticality Score: (L - Low, M - Medium, H - High)
County Road 40 - Cottage Hill Rd	1	3	2	1	2	2	1	1	1	1	2	L
County Road 70 - Old Shell Rd	1	3	2	3	2	2	2	1	1	1	1	M
County Road 70 - Tanner Williams Rd	1	1	2	1	2	2	2	1	1	1	1	L
County Road 72 - Howells Ferry Rd	1	1	2	1	1	2	1	1	1	1	1	L
Craft Hwy	3	3	2	3	3	3	3	3	1	1	1	**H**
Highway 193 - Dauphin Island Pkwy (Laurendine Rd to Baumhauer Rd)	3	3	2	3	3	2	1	3	3	1	1	**H**
Highway 163 - Dauphin Island Pkwy (North of Hamilton Blvd)	1	3	2	3	3	2	2	3	3	1	1	**H**
Highway 193 -Dauphin Island Pkwy (South of Baumhauer Rd)	3	3	3	1	3	2	3	3	1	1	1	**H**
Highway 193 - Laurendine Rd	3	3	2	3	3	2	1	3	1	1	1	**H**
Dekle St	1	1	2	3	1	2	3	3	1	1	1	M
Demetropolis Service Rd	1	3	2	1	3	2	1	1	1	1	1	L
Government Bl/US 90W (N of I10)	1	1	1	2	3	2	1	3	1	1	2	M
Government Bl/US 90W (S of I10)	1	1	2	1	3	2	1	3	3	1	1	M
Government St	1	3	1	3	3	2	2	3	3	1	1	**H**
Grand Bay Wilmer Rd S	1	1	2	1	2	2	1	3	1	1	1	L
Halls Mill Rd	1	1	2	1	2	2	1	1	1	1	1	L
Hamilton Blvd (East of Rangeline Rd)	1	1	2	3	3	2	1	3	1	1	1	M
Hamilton Blvd (West of Rangeline Rd)	1	1	2	2	3	2	1	1	1	1	1	L

Facility	Socioeconomic - Locally Identified Priority Corridors	Socioeconomic - Functions as Community Connection	Socioeconomic - System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Functional Classification (Interstate, etc.)	Operational - Usage	Operational - Intermodal Connectivity	Health & Safety - Identified Evacuation Route	Health & Safety - Component of Disaster Relief and Recovery Plan	Health & Safety - Component of National Defense System	Health & Safety - Provides Access to Health Facilities	Criticality Score: (L - Low, M - Medium, H - High)
Highpoint Blvd	1	1	2	1	2	2	1	1	1	1	1	L
Highway 217 - Lott Rd	1	1	1	1	2	2	1	1	1	1	1	L
Highway 158 - Industrial Pkwy	1	1	2	2	3	2	1	1	1	1	1	L
Highway 188	1	3	2	1	2	2	2	3	1	1	1	M
Hillcrest Rd	1	3	2	2	2	2	1	1	1	1	2	M
Holcombe Ave	1	3	2	1	1	1	1	1	1	1	1	L
I-10 (West of I-65)	1	3	1	2	3	3	2	3	1	3	1	**H**
I-10 (East of I-65)	1	3	1	3	3	3	3	3	1	3	1	**H**
I-10 (East of I-65)	1	3	1	2	3	3	3	2	1	3	1	**H**
I-165	1	3	1	3	3	3	3	3	1	3	1	**H**
I-65	1	3	2	2	3	3	2	3	1	3	2	**H**
Irvington Bayou La Batre Hwy	1	3	2	1	1	1	1	3	1	1	1	L
Laurendine Rd	1	1	2	3	2	1	1	3	1	1	1	L
Moffett Rd (W of N University Blvd)	1	3	2	2	3	2	1	3	1	1	2	M
Moffett Rd (E of N University Blvd)	1	3	2	2	3	2	1	3	3	1	2	**H**
N. University Blvd	1	3	2	2	3	2	1	1	1	1	1	M
Old Shell Rd	1	3	2	3	2	2	1	1	1	1	2	M
Padgette Switch Road	3	3	1	1	2	2	1	1	1	1	1	L
Highway 193 - Rangeline Rd	3	3	2	3	3	2	1	**3**	1	1	1	**H**
S. University Blvd	1	3	2	3	3	3	1	1	3	1	2	**H**
Saraland Blvd N/Highway 43 (US 43/SR 13)	3	3	2	3	3	2	2	3	1	1	1	**H**
Saraland Blvd S (US 43/SR 13)	3	3	2	3	3	2	3	3	1	1	1	**H**

Facility	Socioeconomic - Locally Identified Priority Corridors	Socioeconomic - Functions as Community Connection	Socioeconomic - System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Functional Classification (Interstate, etc.)	Operational - Usage	Operational - Intermodal Connectivity	Health & Safety - Identified Evacuation Route	Health & Safety - Component of Disaster Relief and Recovery Plan	Health & Safety - Component of National Defense System	Health & Safety - Provides Access to Health Facilities	Criticality Score: (L - Low, M - Medium, H - High)
Schillinger Rd N	1	1	2	1	3	2	1	2	1	1	1	L
Schillinger Rd S	1	3	2	1	3	2	3	3	1	1	1	M
Snow Rd	1	1	2	1	2	2	1	1	1	1	1	L
Sollie Rd	1	3	2	1	1	2	1	1	1	1	1	L
Spring Hill Ave	1	3	2	3	3	3	1	3	3	1	2	**H**
St. Stephen's Rd (N of S Craft Hwy)	1	3	2	2	3	2	1	3	1	1	2	M
St. Stephen's Rd (S of S Craft Hwy)	1	3	2	2	3	2	1	3	3	1	2	**H**
Telegraph Rd	3	3	2	3	3	2	3	3	3	1	1	**H**
Theodore Dawes Rd	1	1	2	1	3	2	2	2	1	1	1	L
Water St	1	1	1	3	3	2	2	3	1	1	1	M

Note: For scoring purposes, 3 = Yes/High, 2 = Medium, 1 = No/Low.

Access to Other Modal Facilities

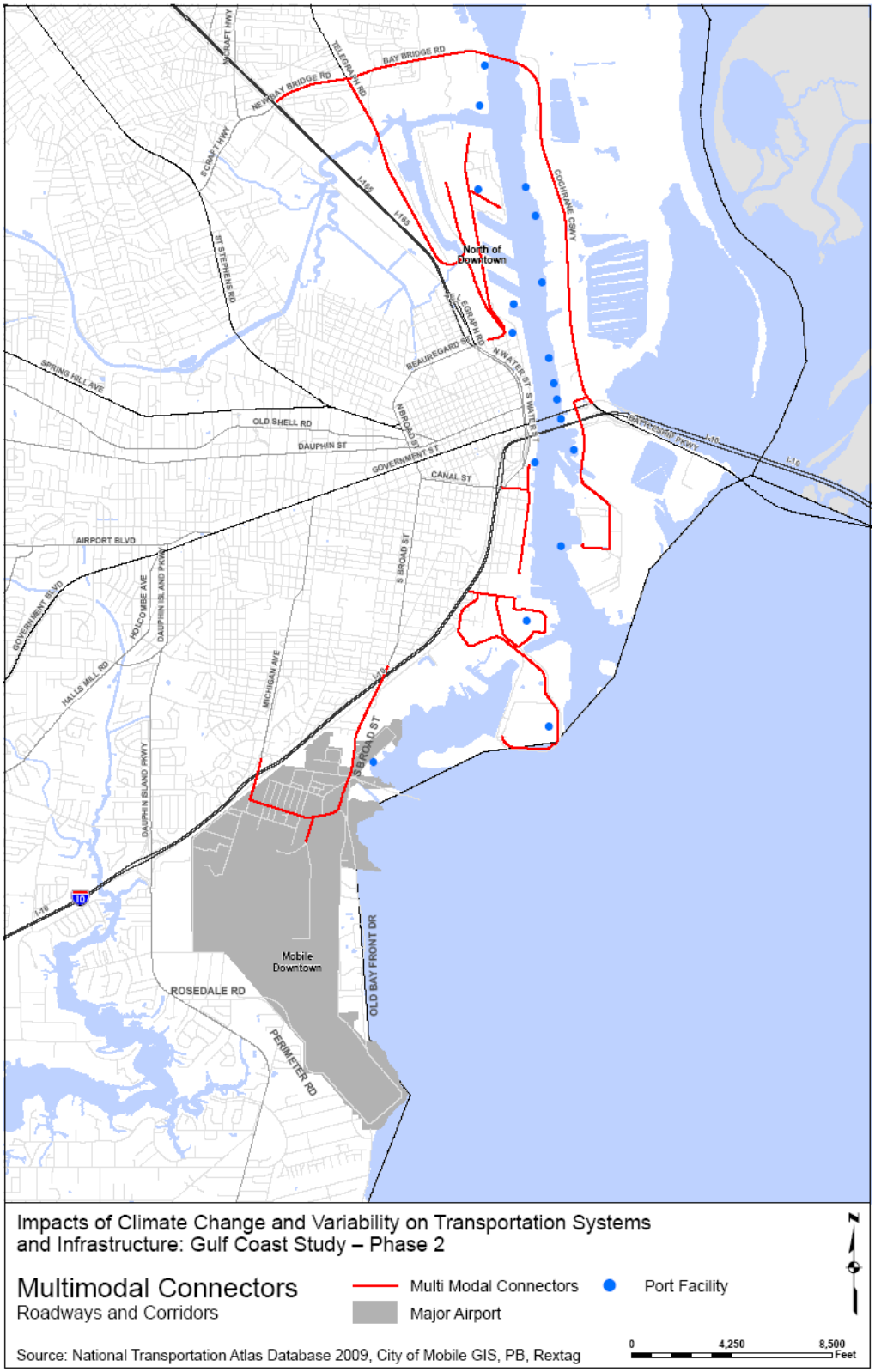
The assessment conducted for this report focused on identifying the most important roadways from a systems perspective. A number of roadways in Mobile provide connectivity to port, airport, rail, and transit facilities identified in the later sections of this report, but which would not be classified as highly critical by themselves. These connector roadways tend to be roads with lower classifications, and often do not have the traffic volume or other characteristics that would indicate criticality under this assessment.

Stakeholders expressed concern that the criticality analysis did not capture these connector roadways, and noted how vital these roads are to connect a highly critical port, rail, airport, or transit facility to nearby critical highways. To address this concern, the project team, to the

extent possible, included these connector roadways as part of the corresponding critical rail/port/airport/transit facility assessment process. Thus, these connector roadways were not included on the list of critical highways, but would be captured as part of the critical list of rail/port/airport/transit facilities.

Figure 7 identifies some of the multimodal connections in the Mobile port area, as an example, showing access to rail and port facilities in that area.

Figure 4: Multimodal Connectors



Transit

Introduction

The MATS Planning Area has a variety of transit services that play an important role in the community. Primary transit assets include those owned and managed by Wave Transit System, as it provides both fixed-route and demand-response (or brokered transportation) service. It is also the exclusive provider of paratransit service in the area. Other organizations, as identified in SARPC's coordinated human services transportation plan, receive some form of federal funding to offer demand-response services to people with special needs within the MATS Planning Area; these services are provided to a limited group of people who are clients of that particular organization.

The Mobile area does not currently have fixed-guideway transit or ferry terminals, but it does have bus and demand-response transit services. These services are, by their nature, flexible transit options with routes that are designed to facilitate access to key destinations and are periodically evaluated to determine the need for service changes (enhancements, reductions, or even cuts). Buses also can be easily rerouted onto any roadway (major or local) to adjust to planned or unexpected service disruptions. Additionally, maintenance of and improvements to roadways on which transit service is provided are subject to the decisions of other agencies. Lastly, bus routes operate along major and minor roadway arterials. With Wave Transit System operating anywhere from 30- to 60-minute headways on routes, the criticality rating of any roadway on which a route operates would not increase significantly due to the transit use. For these reasons, bus routes were not considered as "transit assets."

The key assets of the Wave Transit System evaluated were: its operations fleet (the buses and demand-response vehicles that facilitate service along fixed routes or through scheduled trips); maintenance vehicles; and operations and maintenance centers.

Criteria

The nature of transit assets in the Mobile area lend themselves toward qualitative rather than quantitative evaluations. The three primary assessment categories used throughout Task 1 to assess criticality – operational, socioeconomic, and health and safety – are used here to guide the qualitative discussion of the importance of transit to the Mobile area. Within these categories, the discussion considers the following:

- Socioeconomic
  - Ability to serve transit-dependent populations (low-income, elderly, or physically-disabled persons)
  - Ability to serve environmental-justice (low-income and minority) populations
  - Access to employment and major attractors

- Use/Operational
  - Type/Variety of services (e.g., fixed-route, demand-response, and others)
  - Fleet size
  - Facilities
- Health and Safety
  - Access to major medical, health and safety facilities
  - Role during weather emergencies and evacuations

Methodology

The assessment was primarily based on the review of Mobile MPO's 2035 MATS Long Range Transportation Plan, SARPC's 2008 Coordinated Human Services Transportation Plan, Wave Transit System's 2010 Hurricane Manual, and Wave Transit System's web site. The project team also obtained information on operations and facilities from a telephone conversation with Wave Transit System planning and operations staff[11], various publications and internet sources.

Although transit in the Mobile area relies heavily on roadway infrastructure, the project team's assessment of criticality of the transit system was based on physical infrastructure and assets under the purview of Wave Transit System. As this was a qualitative assessment, no scoring methodology was applied to the transit mode. However, as this tool will be applied to transportation systems across the county, scoring matrices used in the analyses of other modes such as railroads, in combination with some criteria used for transit, could guide assessments of larger transit systems that include fixed-guideway modes such as light, heavy, or commuter rail.

Socioeconomic

The assessment of socioeconomic factors considered service to transit-dependent and environmental justice (EJ) populations, as well as the system's ability to provide access to employment and major attractors. These factors were assessed based on a mapping overlay of fixed-route bus service and attraction zones, major employers, and EJ zones.

Use/Operational

Operational factors included the types/varieties of vehicles, fleet size, and facilities. These characteristics were assessed based on information from the long-range transportation plan and discussions with Wave Transit System staff. Typically this type of information can be used to identify the hierarchy of various facilities. However, for this study, the limited number of facilities did not lend itself to this type of analysis.

[11] Alfred and Bryant, 2010.

Health and Safety

The assessment of health and safety factors considered transit's ability to provide access to major medical, health and safety facilities and its role during weather emergencies and evacuations. These criteria were assessed using the same mapping overlay for the socioeconomic factors and Wave Transit System's hurricane manual.

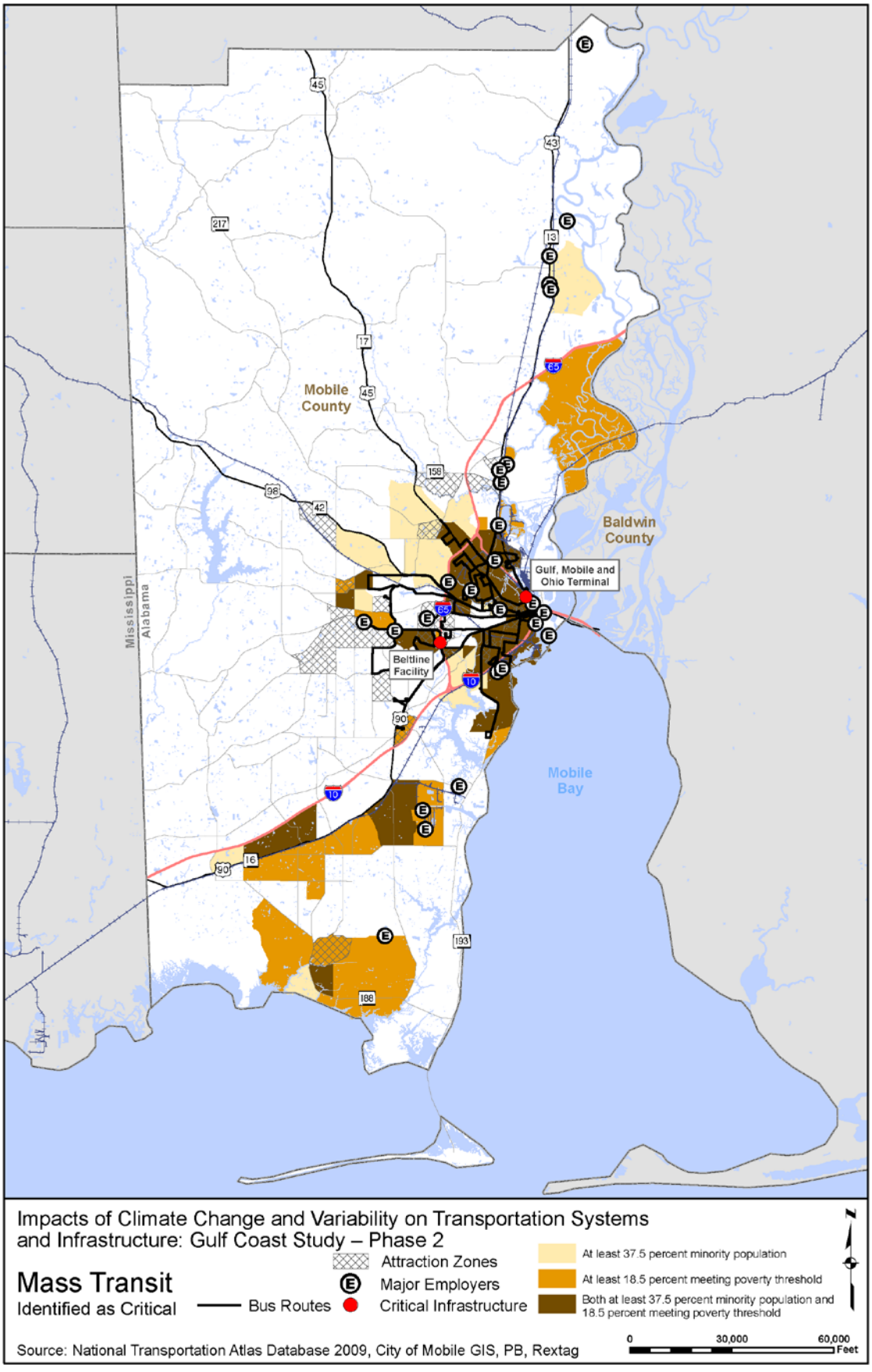
Results

The socioeconomic factors in the Mobile area address transit's ability to serve both transit-dependent and environmental justice (EJ) populations, as well as provide access to employment and major attractors for these populations using Wave Transit System's bus and demand response services. The critical assets for this factor are the operating fleet used to facilitate bus service. Service operating along the fixed routes or according to scheduled service help those served primarily by Wave Transit System connect to support networks such as family and friends living in various communities throughout the Mobile area. The service also helps ensure many of Mobile's transit-dependent and environmental justice populations have access to essential facilities and major employers. As shown in Figure 5, Wave Transit System provides vital connections among EJ populations, the centers of many essential facilities, and clusters of major employers in the Mobile area.

Fixed-route service is provided to many of the MATS Planning Area's EJ zones (or transportation analysis zones in which at least 37.5 percent and/or 18.5 percent of the population is minority and below the poverty line, respectively).[12] The service connects EJ populations to many of the area's attraction zones – medical, post-secondary educational, and retail facilities – as well as the central business district. Wave Transit Systems also provides neighborhood circulator and door-to-door services to transit-dependent customers who live in areas not served by fixed-route service or meet certain requirements for more flexible service.

[12] South Alabama Regional Planning Commission, 2010.

Figure 5: Transit Accessibility and Identified Critical Infrastructure



The operational factors address the types and variety of services offered by Wave Transit System, its fleet size, and facilities. The critical assets are the fixed and demand-response vehicles and operations and maintenance facilities. Wave Transit System administers fixed-route (11 local bus routes, Moda! downtown circulator, and Baylinc regional connection between Mobile and Baldwin Counties) and demand-response (neighborhood, Access-a-Ride, and paratransit services). Fixed-route service covered 264 round-trip miles in 2008; demand-response service was assumed to vary based on the number of subscribers and the multitude of both typical and occasional destinations. With a fleet of 38 buses and 31 demand-response vehicles, Wave Transit System provided an average of 4,100 weekday, 2,500 Saturday, and 18 Sunday trips in 2008 (Sunday is limited to demand-response service). Additionally, there are four maintenance vehicles for servicing buses and demand-response vans in need of repair. Two additional demand-response vehicles and 10 replacement buses were purchased through American Recovery and Reinvestment Act of 2009 funding. Together, the 38 buses and 33 demand-response vehicles comprising Wave Transit System's fleet can be considered critical to transit-dependent people in the MATS Planning Area.

Wave Transit System operates from two locations. One of these locations is the Gulf, Mobile and Ohio (GM&O) Terminal, which houses some of the agency's administrative functions and serves as the main and central transfer hub for most of Wave Transit System's radial fixed-route service. Nine of the 11 routes terminate at the GM&O Terminal and the facility has 12 total bus bays for use. The second location is the Beltline facility, which houses the agency's main administrative functions, demand-response scheduling service, and operations and maintenance facility. It also is the depot for Wave Transit System's operations fleet and four maintenance vehicles. As an example of the Beltline facility's importance, during Hurricane Katrina, Wave Transit System stored its fleet in the garages at the Beltline facility. While the administrative building itself sustained damage due to the storm, the fleet did not.

The health and safety factors address access to major medical, health, and safety facilities, and Wave Transit System's role during weather emergencies and evacuations. The critical assets for this factor would be the operations fleet used to facilitate various services. As previously noted under the socioeconomic factor, major medical facilities can be accessed by transit-dependent and EJ populations using Wave Transit System's services. In terms of safety, transit plays an important role during weather emergencies and evacuations. With one of the key threats to the MATS Planning Area being hurricanes, Wave Transit System, under direction from the Mobile County Emergency Management Agency, provides evacuation services. The agency focuses primarily on transporting people who are "relatively healthy and ambulatory" (*2010 Hurricane Manual*, p. 43), as well as people with special needs (those with physical, emotional, or sensory impairments who are unable to respond independently to an emergency situation). Wave Transit System provides transportation from pre-designated pick-up locations to drop-off locations at American Red Cross shelters. The agency also continues to provide demand-response service, limiting it to transport clients only to essential medical treatment. During the recovery phase,

Wave Transit System returns evacuees from drop-off locations to their pick-up points and gradually resumes fixed-route and demand-response services at normal levels.

Overall, the critical infrastructure and assets for transit in the Mobile area are the GM&O Terminal, the Beltline facility, and the entire fixed-route and demand-response fleet.

Railroads

Introduction

Five railroads operating along 589 miles of tracks[13] are located within Mobile County. Of these, three are identified as critical. Class I railroads are the largest of the national freight railroads, based on operating revenue. Smaller railroads are classified as either Class II or Class III. Mobile is served by three Class I ($250M annual operating revenue), one Class II ($20.5 to $250M), and one industrial railroad. These five railroads converge at Alabama State Docks and the facilities from the Chickasawbouge River to McDuffy Island. All five carriers operate virtually at sea level. All have rail yards and support facilities adjacent to or very near all the port facilities, as well as track entering/exiting the study area.

In the study area, CSX Transportation (CSXT) serves the Brookley Industrial Park and the Theodore Industrial Park at Theodore, Alabama. It handles approximately 40 million gross ton miles (GTM)[14] east of Mobile and 30 million GTM west of Mobile leaving 10 million GTM of freight being carried to and from Mobile each year. Norfolk Southern (NS) hauls five million to 10 million GTM with Canadian National Railway (CN) and Alabama and Gulf Coast Railway (AGR) each handling one million to five million GTM. Each of these carriers, except Terminal Railroad of the Alabama State Docks (TASD), is privately-owned and has a long history of serving Mobile.

TASD is the rail operating unit of the Alabama State Port Authority, an agency of the State of Alabama. Each carrier provides access to the national rail network. The CSXT route provides a vital link to the west through interchange connections with western rail carriers Union Pacific and Burlington Northern Santa Fe Railway (BNSF) in New Orleans as well as to the east, northeast, and the balance of the CSXT network. This expansive network makes CSXT connections of paramount importance. NS operates north to the heart of that carrier's eastern network. AGR operates over NS rail lines to Kimbrough, where it connects to its own line to Columbus, Mississippi and additionally connects to the BNSF system serving all of the American West and much of western Canada. Currently, there is no passenger train service to Mobile.

[13] Includes miles of rail located within the rail yard.
[14] Total train weight (including freight car and lading, but excluding the weight of the locomotive) multiplied by the distance traveled.

Field visits provided information on observed commodities hauled by some of the railroads. CSXT transports wood chips, miscellaneous box cars, aggregates and minerals to the ports and intermodal facilities. NS primarily hauls coal and pulp wood.

Criteria

The 16 individual criteria used to assess the criticality of railroad network assets included:

- Socioeconomic
  - Part of the national/international commerce system
  - Important multi-modal linkages
  - Functions as a community connection
  - Serves Mobile-area economic centers
- Use/Operational
  - Main track classification
  - Annual gross tonnage
  - Annual yard tonnage
  - Current rail facility capacity utilization
  - Operations (merchandise, intermodal, bulk, break bulk, etc.)
  - Interchange utility
  - Local non-marine traffic
- Health and Safety
  - Self-administered evacuation plans
  - Part of disaster relief and recovery plan
  - Identified as a hazardous materials transfer point
  - Part of the national defense system
  - Provides materials to health facilities

Methodology

Initially, the project team requested from each of the operating carriers in Mobile a broad range of data (gross tonnage, yard tonnage, operations information, etc.) to be used to evaluate the criticality of rail assets. Only one carrier, CSXT, responded, stating that that all the information requested was proprietary and of commercial value to competitors. CSXT did provide track charts for their two subdivisions serving Mobile which were used in this analysis.

Due to lack of available data, the project team assessed each of the three criteria categories (socioeconomic, operational, and health and safety) based on professional judgment and review of the following resources:

- Track charts and time tables[15]
- Professional Railroad Atlas, produced by Deskmap Systems
- Detailed maps of the Mobile area using Google Earth
- Detailed review of data provided by the City of Mobile in digital satellite format
- Previous work performed in the Mobile area

These resources enabled the project team to identify track ownership on the individual railroad operators and also various facilities comprising the assets within Mobile. Part of the data collection also considered the extent of geographic flows for each railroad and their connections to other facilities. Site visits helped verify data gathered from these various resources (e.g., operations, interchange, non-marine traffic).

The criticality of each component was evaluated as low, medium, and high based on results across a range of criteria (some of which are binary, e.g., yes/no, and others reflecting quantitative information, such as tonnage). Scoring was determined based on an assessment of the value of each facility as compared to others but not through a calculation of matrix values as applied for other modes. In some matrix cells a binary result (yes or no) was scored, in others operational information is noted. As the lack of available information made scoring difficult the assessment was made based on the data that was available. The various criteria cells in the matrix were completed using some resources (as noted above) but primarily through field investigations on site – conducted over the week of May 3, 2010. Some of the criteria scores were determined without an information resource but through knowledge of the professional assigned to this task.

Socioeconomic

– Part of the national/international commerce system – All railroads are considered part of national and international commerce as administered formally by the Surface Transportation Board. Therefore each link in the rail network received a yes in this category.

– Important multi-modal linkages – Those rail lines providing connectivity from port to rail and rail to port were assessed for these linkages. As the interchange between these two modes is an important criterion, all lines radiating from port facilities were identified as a yes for this criterion.

[15] BNSF Railway, 2003 and CSX Transportation, 2005.

- Functions as a community connection – The study team assessed whether the rail facilities serve a variety of local industries throughout the area (through import/export, etc.), mostly related to Mobile Bay connections with port facilities but elsewhere in the study area as well. The score was derived from professional judgment of connections established by port facilities. Those providing these connections were scored a yes.
- Serves Mobile-area economic centers – Rail service provides access to the downtown area and port areas and along the Route 43 corridor. Norfolk Southern and Alabama Gulf Rail provide service to industry in the Route 43 corridor. Connections were analyzed using an overlay of the rail and employment center layers provided by the City of Mobile. Since the rail network provides access to important economic centers they were rated with a yes.

Operational

- Main track classification – This classification of the classification of tracks was taken from the Alabama State Rail Plan. Higher numbers are considered higher classification and therefore more important.
- Annual gross tonnage – Annual gross tonnage was generalized from Association of American Railroads Gross Tonnage Figures. Tonnage is a primary driver of any railroad's importance, and carrier classification (Class I, II, or III) is a function of tonnage. Typically this information is considered proprietary so known operations of the railroads had to be applied.
- Annual yard tonnage – This measure was extrapolated from an assessment of AAR Gross Tonnage Figures and a balancing of interchanges with other carriers in order to develop a value for each facility. Facilities with higher tonnages were considered to be more critical.
- Current rail facility capacity utilization – This measure of the utilization of tracks and yards was based on expert judgment for utilization of the sites through site reviews. There is currently no criterion applied nationwide for how this is quantified. The scores are based on high, medium, low with high being the most important.
- Operations (merchandise, intermodal, bulk, break bulk, etc.) – The project team considered the types of material handled by the rail and at the yards. The project team made this assessment through direct, on-site observation, based on what could be seen from the outside of the rail yard (as the team was not permitted on the private property of the rail yard). The project team gave a higher criticality score to yards that appear to handle more types of material.
- Interchange utility – The criteria is a yard-specific measure of the interchange between carriers, which is of importance in the ability to transfer rail cars within yards. The project team made this assessment through direct, on-site observation, based on what

could be seen from the outside of the rail yard (as the team was not permitted on the private property of the rail yard).

- Local non-marine traffic. – As the port is such a dominant presence in shipping in the area, it was also important to understand whether non-port traffic takes place at these facilities, with multi-utility yards being of a higher level of importance. The project team made this assessment through direct, on-site observation, based on what could be seen from the outside of the rail yard (as the team was not permitted on the private property of the rail yard).

Health and Safety

- Self-administered evacuation plans – Many rail companies have evacuation plans which include efforts at system preservation during extreme weather events. This includes measures such as relocating locomotives out of the affected area and weighing down bridges by parking rail cars filled with ballast to keep the bridges in place. This criterion was assessed through professional knowledge of the industry. Those rail companies that had a plan in place were scored with a yes as these lines would be expected to suffer less damage and would therefore be expected to be available for use after a storm has passed.
- Part of disaster relief and recovery plan – Rail operations have not traditionally been directly involved in disaster relief and recovery plans. Therefore no facilities were identified here and all were given a no as a score.
- Identified as a hazardous materials transfer point – A measure of whether hazardous materials are transferred at these locations. All were scored as a no based on direct observation of materials being handled. Observation was limited to what could be seen from the outside of the rail yard (as the team was not permitted on the private property of the rail yard).
- Part of the national defense system –Based on the project team's professional knowledge of use of rail systems for defense needs, the team assumed that none of the railroads are directly part of the national defense system, even though the railroads have been used as part of the national defense system in prior instances.
- Provides materials to health facilities. – The study team assessed the rail network in Google Earth using a GIS overlay of health facilities provided by the City of Mobile to identify potential interchanges between rail facilities and health facilities. None of the facilities were noted to be in the Mobile area, so all facilities were given a score of no.

Results

Table 2 summarizes the evaluation of each facility. Of the five railroads operating within Mobile County, three are rated the highest: CSXT, NS, and TASD. Of 589 miles on which these railroads operate, 347 miles are considered critical. Within the CSXT facility, the Montgomery to Mobile and New Orleans to Mobile subdivisions and the Sibert Yard are considered most critical. The NS subdivision is also considered to be at this highest level of criticality. These

assets transport and store the highest annual tonnage compared to all the other assets in Mobile. Data for the railroads was difficult to come by as much of the details for railroad operations are not public record. Therefore, professional judgment, combined with observation, and what data was available all played a role in the determination of criticality. When available, data was used to inform judgment about criticality. When data was not available, expert judgment was based on the information that was available.

Within the "Facility" column of Table 2, those facilities which are left justified are the primary facilities. The facilities that are indented below the primary facility are the sub-facilities whose information was used to feed into the criticality assessment of the primary facility. Within the TASD facility, the Main Docks Complex, TASD Interchange Yard, and McDuffie Terminal are considered most critical. These facilities provide direct access to many of Mobile's ports, as well as provide yard access to all five railroads operating in Mobile. Because of the functions of these assets, the loss of any one of them would not only greatly affect rail operations and the transport of commodities through and within Mobile, but also employment in the area, as the operations of the railroad assets also closely relate to port operations. Overall, a higher tonnage transported within the area translates to higher economic value, which affects both operational and socioeconomic assessment categories.

CN assets are rated as medium because the annual GTM and yard tonnage it handles is low relative to the other railroad assets. AGR is rated lowest for similar reasons. Additionally, AGR serves a very local and limited purpose of providing access to local industries compared to the other assets.

Although the railroads are not directly part of the national defense system, the evaluation of the health and safety assessment category highlights the relatively low probability of delivering viable public assistance from the railroads in the Mobile area in the event of major weather events. Freight railroads such as those serving Mobile do not own passenger cars, and currently Amtrak does not serve Mobile. Amtrak's resources are fully deployed in maintaining their national intercity passenger service operation. Consequently, Amtrak does not have a readily available passenger car fleet that could be employed in an emergency situation for use in a local or broader evacuation.

Figure 6: Railroad Facilities Map

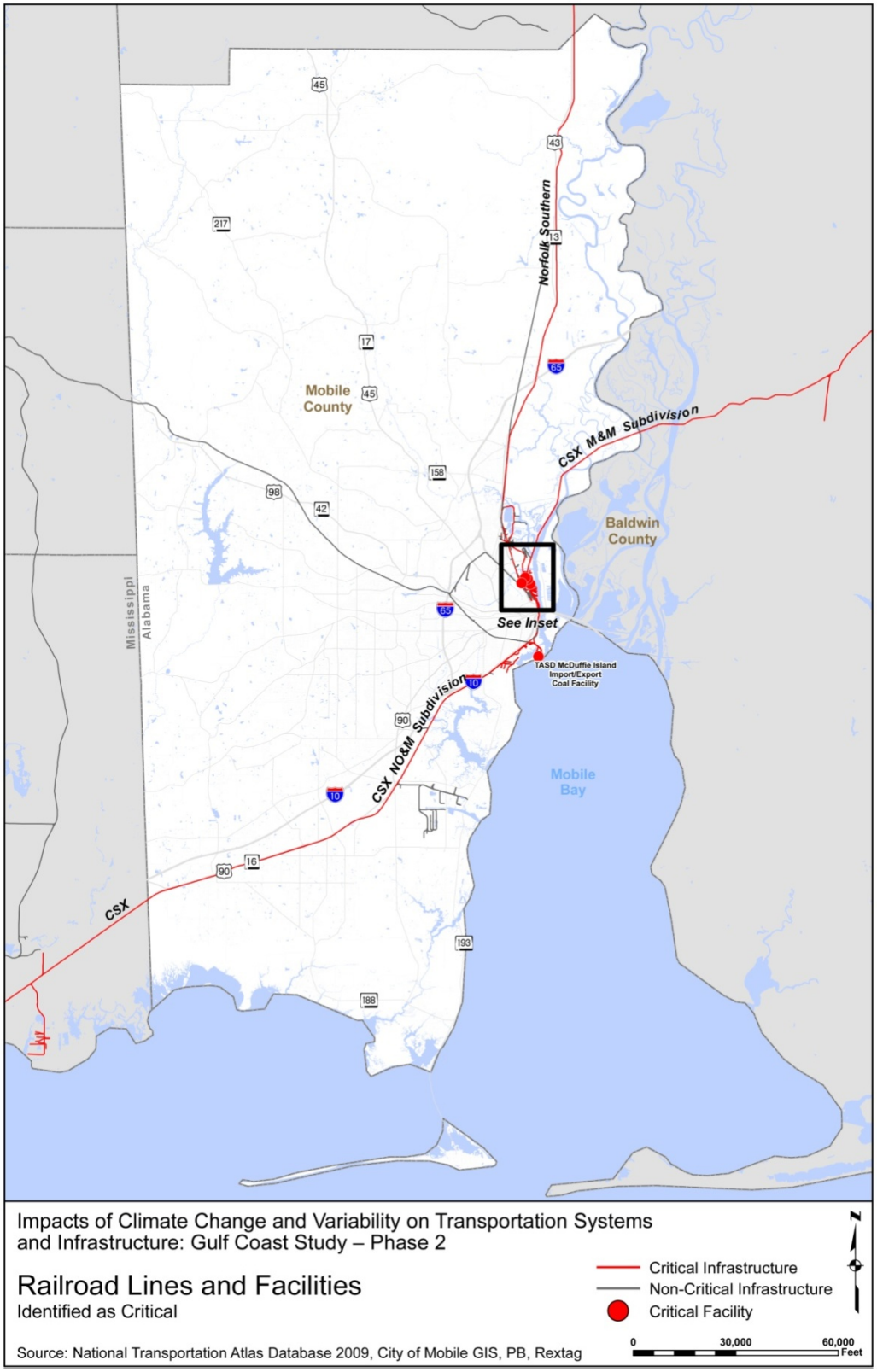


Figure 7: Railroad Facilities Map

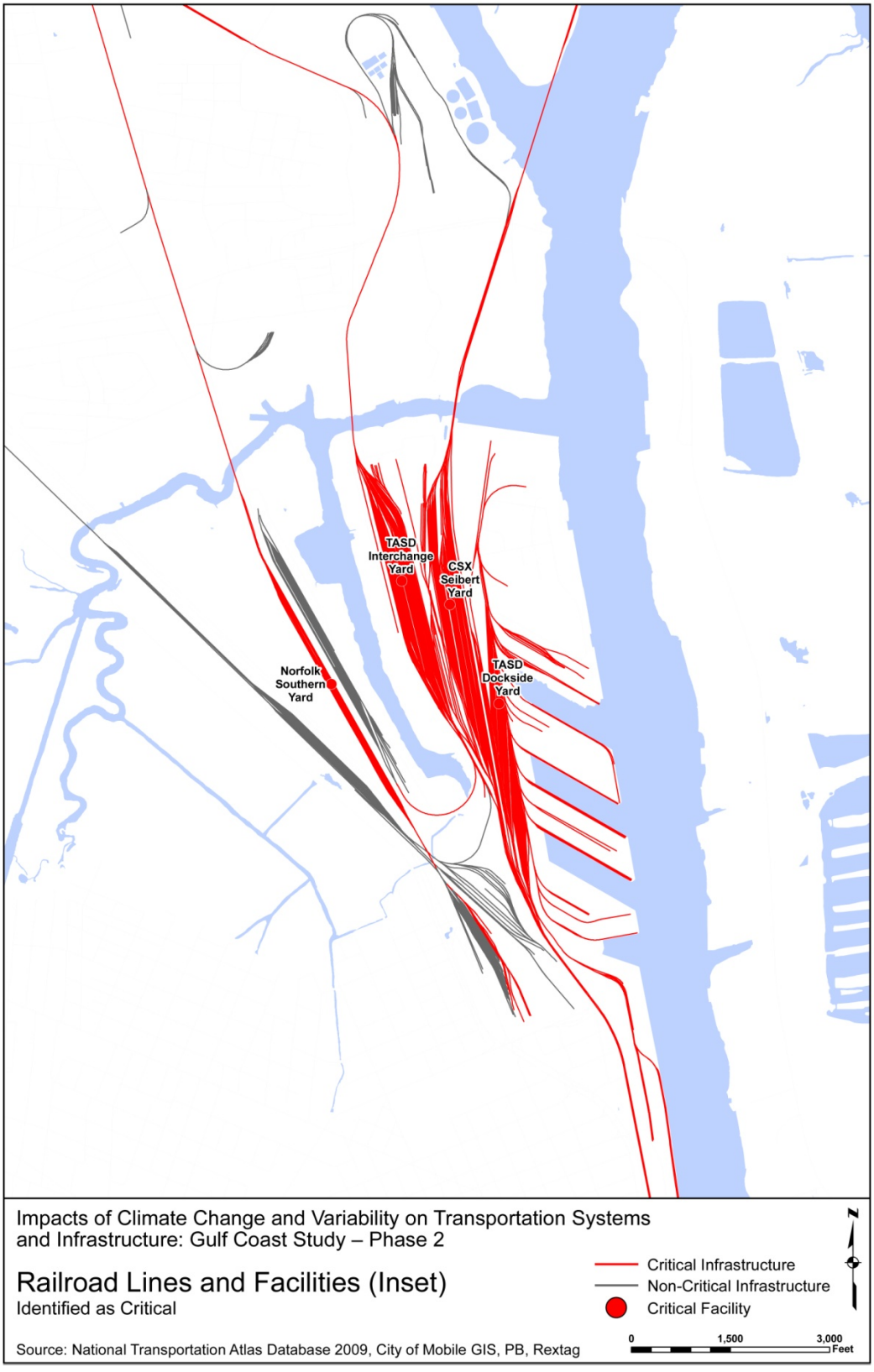


Table 2: Railroad Criticality Assessment

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
1	CSX - M&M Subdivision (Montgomery to Mobile)	Y	Y	Y	Y	4	40		M	All			Y	N	N	Y	N	**H**
1a	*CSX M&M Subdivision CTS System*	*Y*																***H***
1b	*CSX M&M Subdivision Grade Crossing Protection*	*Y*																***H***
1c	*CSX M&M Subdivision Radio Communications Equipment*	*Y*																***H***
1d	*CSX M&M Subdivision Tensaw River Swing Span Bridge MP 651.6*	*Y*																***H***
1e	*CSX M&M Subdivision Mobile River Swing Span Bridge MP 651.7*	*Y*																***H***

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
1f	*CSX M&M Subdivision Bayou Sara River Swing Span Bridge MP 658.7*	*Y*																***H***
1g	*CSX M&M Subdivision Chickasawbouge River Swing Span Bridge MP 663.2*	*Y*																***H***
1h	*CSX M&M Subdivision Threemile Creek Swing Span Bridge MP664.2*	*Y*																***H***
2	CSX - Sibert Yard MP 665.2 - 668.3	Y	Y	Y	Y	Yard		10	M	All	Good	Y	Y	N	N	Y	N	**H**
2a	*CSX - Sibert Yard, Yard Office*	*Y*																*M*
2b	*CSX - Sibert Yard Locomotive Shop - Running Repairs*	*Y*				*Yard*												*M*
2c	*CSX - Sibert Yard Turntable & turntable Pit*[i]	*Y*				*Yard*												***H***
2d	*CSX - Sibert Yard Locomotive Pit - Fueling and Inspection*	*Y*				*Yard*												*M*

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
2e	*CSX - Sibert Yard Intermodal Load/Unload Track*	*Y*				*Yard*												*L*
2f	*CSX - Sibert Yard Crew Locker room*	*Y*																*L*
2g	*CSX - Sibert Yard Car Shop*	*Y*				*Yard*												*M*
3	CSX - NO&M Subdivision (New Orleans to Mobile)	Y	Y	Y	Y	4	30		M	All			Y	N	N	Y	N	**H**
3a	*CSX - NO&M Subdivision CTS System*	*Y*																***H***
3b	*CSX - NO&M Subdivision Grade Crossing Protection*	*Y*																***H***
3c	*CSX - NO&M Subdivision Radio Communications Equipment*	*Y*																***H***
3d	CSX - NO&M Subdivision Brookley Industrial Park	Y	Y	Y	Y													**H**
3e	CSX - NO&M Subdivision Theodore Industrial Park	Y	Y	Y	Y	Yard												**H**

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
4	NS Subdivision from Birmingham to Mobile	Y	Y	Y	Y	3	5-10		L	Bulk & Brk Bulk	Good		Y	N	N	Y	N	**H**
4a	*NS Grade Crossing Protection*	*Y*																***H***
4b	*NS Subdivision Radio Communications Equipment*	*Y*																***H***
4c	*NS Mobile Yard - Along Telegraph Road*	*Y*	*Y*	*Y*	*Y*	*Yard*		*5-10*				*Y*	*Y*	*N*	*N*	*Y*	*N*	***H***
4d	*NS Transloading Facility Off Beauregard Street*	*Y*	*Y*	*Y*	*Y*	*Yard*												*M*
5	CN Subdivision from Hattiesburg to Mobile	Y	Y	Y	Y	3	1-5		L	Bulk & Mdse	Good		Y	N	N	Y	N	M
5a	*CN Grade Crossing Protection*	*Y*																*M*
5b	*CN Subdivision Radio Communications Equipment*	*Y*																*M*

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
5c	*CN Yard - Mobile Along Telegraph Road*	*Y*	*Y*	*Y*	*Y*	*Yard*		*1-5*	*L*	*Bulk & Mdse*		*low*	*Y*	*N*	*N*	*Y*	*N*	*M*
5d	*CN Locomotive Shop & Fuel Facility*	*Y*																*L*
5e	*CN Car Shop*	*Y*																*L*
6	AGR Saraland to Mobile[ii]	Y	Y	Y	Y	3	1-5		L									L
6a	*AGR Grade Crossing Protection*	*Y*																*L*
6b	*AGR Yard - Mobile Along Telegraph Road*	*Y*	*Y*			*Yard*		*1-5*		*Bulk & Mdse*	*Good*	*Y*	*Y*	*N*	*N*	*Y*	*N*	*L*
6c	*AGR Yard Office Along Telegraph Road*	*Y*																*M*
6d	*AGR Numerous industry tracks Mobile, Prichard, Chickasaw*	*Y*	*Y*	*Y*	*Y*	*Yard*				*Mdse & Brk Bulk*								*M*

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
7	TASD - Main Docks Complex - 30 some different facilities	Y	Y	Y	Y	Yard			M-H	Mdse Brk Bulk			Y	N	N	Y	N	**H**
8	TASD - International Trade Center - ASD and TASD	Y	Y	Y	Y	Yard												M
9	TASD - Mobile Container Facility	Y	Y	Y	Y	Yard			L	TOFC – COFC								M
10	TASD - McDuffie Terminal - Import & Export Coal Facility	Y	Y	Y	Y	Yard				Bulk								**H**
10a	*TASD - McDuffie Terminal Railcar Maintenance Facility*	*Y*																*M*
11	TASD - Garrow's Bend ICTF (future)	Y	Y	Y	Y	Yard			New	Future IM								M
12	TASD Terminal Yard	Y	Y	Y	Y	Yard		10-20	M-H	All								M
13	TASD Interchange Yard	Y	Y	Y	Y	Yard			M-H	All	Good							**H**

No.	Facility*	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - Serves Regional Economic Centers	Operational - Main Track Classification	Operational - Annual Gross Tonnage	Operational - Yard Annual Tonnage	Operational - Current Rail Facility Capacity Utilization	Operational - Operations (Merchandise, Intermodal, Bulk, Break Bulk etc.)	Operational - Interchange Utility	Operational - Local Non-Marine Traffic	Health & Safety - Self Administered Evacuation Plans	Health & Safety - Part of Disaster Relief & Recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Part of National Defense System	Health & Safety - Provides Materials to Health Facilities	Criticality Score: (Low, Medium, High)
13 a	*TASD Interchange Yard Locomotive Shop*	*Y*																*M*
13 b	*TASD Interchange Yard Locomotive Fuel Facility*	*Y*																*M*
13 c	*TASD Interchange Yard Equipment maintenance facility*	*Y*																*M*
13 d	*TASD Interchange Yard Track Maintenance Facility*	*Y*																*M*
14	TASD Industry Leads North of Threemile Creek	Y	Y	Y	Y	Yard			M	Mdse Brk Bulk		Y						M
14 a	*TASD Threemile Creek Draw Bridge*	*Y*																*M*

Notes:

i: Approximately five feet deep

ii: Has operating rights to Kimbrough via NS

* In the "Facility" column, the data and assessment of all of the facilities that are italicized (also indicated with a, b, c, etc.) went into the final determination of criticality for the primary facilities, which are not italicized and whose numbering contains only a number and no letters. Because of this, the data from the "sub-facilities" was not included in Table 2 as it would be largely identical to that of the primary facilities. Criticality was based on information available. In some cases, specific data points were unavailable for certain assets; in those cases, criticality was based on the information that *was* available.

Ports

Introduction

Sixty-one marine facilities are located within Mobile County. Of these, 23 are identified as critical. The major marine facilities are located within Mobile Harbor. Mobile Harbor consists of Mobile Bay (channel depth maintained at 45 feet), Mobile River (40 feet), Theodore Channel (40 feet), Chickasaw and Three Mile Creeks (13 to 39 feet), and Bayou La Batre (12.5 to 13.5 feet). Mobile County marine facilities handled around 67.5 million short tons of cargo in 2008 and 64.5 million short tons of cargo in 2007. The marine facilities consist of the public port authority, the Alabama State Port Authority (ASPA), and several privately owned facilities. The facilities operated by ASPA handle approximately 30% of the total Mobile County cargo, whereas the rest of the cargo flowing through Mobile Harbor is handled by privately owned facilities. These facilities handle various types of cargo – containers, break bulk (individually packaged items, often bound together on pallets), neo bulk (cars, lumber, scrap metal), dry bulk (coal, grain), liquid bulk and seafood—and they additionally perform ship-building and repair services. The marine facilities act as gateways for commerce for the area as well as provide support for various inland industries and the offshore oil industry.

Criteria

The 17 individual criteria used to assess the criticality of marine network assets included:

Socioeconomic

- Part of national and international commerce systems
- Important multi-modal linkages
- Functions as community connection
- No system redundancy
- Serves Mobile-area economic centers

Operational

- Use of and demand for facility
- Port capacity
- Port cargo value
- Operations
- Channel berth and depth
- Maximum vessel size

Health and Safety

- Identified in evacuation plans

- Component of disaster relief and recovery plan
- Identified hazardous materials transfer point
- Component of national defense system
- Provides materials to health facilities

Methodology

The mix of privately owned/operated facilities, publicly owned/operated facilities, and publicly owned-privately operated facilities creates a unique mix when compared with other transportation infrastructure. The highly competitive nature of these facilities results in most of the cargo and terminal operation data being deemed proprietary. The study team therefore collected data and information through internet research and public data sources, which included U.S. Army Corps of Engineers and U.S. Waterborne Commerce reports. Due to the lack of publicly available information, the team also conducted in-person interviews. The study team attempted to contact all 61 waterfront facilities within Mobile County and were only able to interview and tour with the various facilities owned by ASPA and nine private marine facilities. The rest of the marine terminals opted not to participate or were unable to commit resources due to their involvement with the BP oil spill cleanup. The private terminals were reviewed using both aerial images and by looking over their gates to verify infrastructure and assets by observing the facilities from public property.

A total of 61 marine terminals were evaluated against the criteria and were rated from high to low. Those rated high were considered to be highly critical infrastructure given the role they play in sustaining the study area's transportation economy and a lack of redundancy. Those rated medium were medium-level critical infrastructure with their role in supporting the regional and local transportation economy not considered as important as those rated high. Those rated low were considered to be low-level critical infrastructure. These assets play a role in the regional and local transportation economy; however, their function, size and redundancy within the system do not make them critical. The determination of criticality was based on a combination of professional judgment and available data. Because many of the ports are privately owned and/or operated, much of the information on port operations was not publically available. In these instances, the information and data that was available was used to inform professional judgment in assessing the criticality of the port. Figure 8 shows all the ports identified in Mobile and those that were evaluated as being most critical. Table 3 shows the marine terminals and their evaluation.

Socioeconomic

- Part of the national/international commerce system – The ports and marine facilities that play an important role in the national and international system were included based on their operation and linkages with other industries. This includes both public as well as

private facilities that contribute to the economic systems nationally and internationally. Interviews and the Army Corps Port Series (Series 18) publication[16] were used.

- Important multi-modal linkages – The ports and marine facilities that provide connectivity for transfer of cargo via multiple linkages such as pipelines for crude oil or barge connectivity were scored as a yes in providing these linkages. Interviews and physical observations were used to determine these scores.
- Functions as a community connection – Port and marine facilities serve a variety of local industries throughout the study area. Some have industrial facilities within their footprint, such as Evonik Industries, and others provide critical transport connectivity for Mobile in the form of import/export. Interviews and on the ground observations were used.
- No system redundancy – Ports and marine facilities that do not have a similar facility outside of Mobile harbor that can take over the functions are scored as yes in this category. Interviews and physical observations were used and professional judgment applied.
- Serves Mobile-area economic centers –The ports and marine facilities that directly serve the Mobile downtown area and port/industrial areas of the county were identified and given a yes if direct access was provided. Interviews and physical observations were used.

Operational

- Use of and demand for facility – Information about most port and marine facilities was obtained from a combination of interviews and physical observation. Data was also obtained where available from US Department of Commerce Waterborne Commerce Service Center[17] and US Army Corps of Engineers Series 18 publication which provides a summary of marine facilities in the Mobile area. Operational units identified varied by port with Alabama Bulk Terminal Co. (No. 19) and Plains Marketing (No. 32) operating with barrels of crude oil, the Mobile Container Terminal (No. 22) operating with twenty-foot-equivalent unit (TEU) containers, and the Mobile Cruise Terminal (No. 23) operating in passenger units. Operational information was not available for all port operations.
- Port capacity - Most of the terminals did not provide cargo throughput data and none of the terminals provided cargo value data to the team because of proprietary and competitive concerns. This could be a valuable assessment measure were this data available. Information on Alabama State Port Authority was obtained from their corporate web site[18].

[16] U.S. Army Corps of Engineers, 1998.
[17] U.S. Army Corps of Engineers, 2011.
[18] Alabama Public Port Authority, 2011.

- Port cargo value - Most of the terminals did not provide cargo throughput data and none of the terminals provided cargo value data to the team because of proprietary and competitive concerns. This could be a valuable assessment measure were this data available.
- Operations - Interviews and physical observations were used to obtain this information where possible. Actual values were input where collected.
- Channel berth and depth - Interviews and physical observations were used to obtain this information where possible. In addition, data available from the ACOE Series 18 publication, which provides a summary of marine facilities in the Mobile area, was used.
- Maximum vessel size - Interviews and physical observations were used to obtain this information where possible. The capacity for vessels of varying size would be an important measure where available. Information collected for vehicle size is shown in the table.
- Most of the terminals did not provide cargo throughput data and none of the terminals provided cargo value data to the team because of proprietary and competitive concerns. This could be a valuable assessment measure were this data available.

Health and Safety

- Identified in evacuation plans – Port and marine facilities that are identified in the regional evacuation plans were identified as yes. The US Coast Guard facility will play an important part in any evacuation procedures as well as the Alabama State Port Authority.
- Component of disaster relief and recovery plan – Similar to above, port and marine facilities that play an important part in disaster relief and recovery plans were selected. The US Coast Guard facility in particular will play an important part in any relief operations. Oil recovery companies will provide essential services in recovery plans.
- Identified hazardous materials transfer point – Ports and marine facilities that handle hazardous material have been identified as yes. Interviews and physical observations were used to obtain this information where possible. In addition, data available from ACOE Series 18 was used.
- Component of national defense system – Port and marine facilities that provide a role in national defense system were identified as “yes”. This information was determined by project team members with an understanding of operations of various marine facilities. For example, shipbuilders such as Austal provide shipbuilding services to the U.S. Navy, and the Alabama State Port Authority plays an important role in movement of military related cargo.
- Provides materials to health facilities – Ports and marine facilities that handle cargo for health facilities have been identified. Interviews and physical observations were used.

Figure 8: Port Facilities Map

Figure 8: Port Facilities Map (continued)

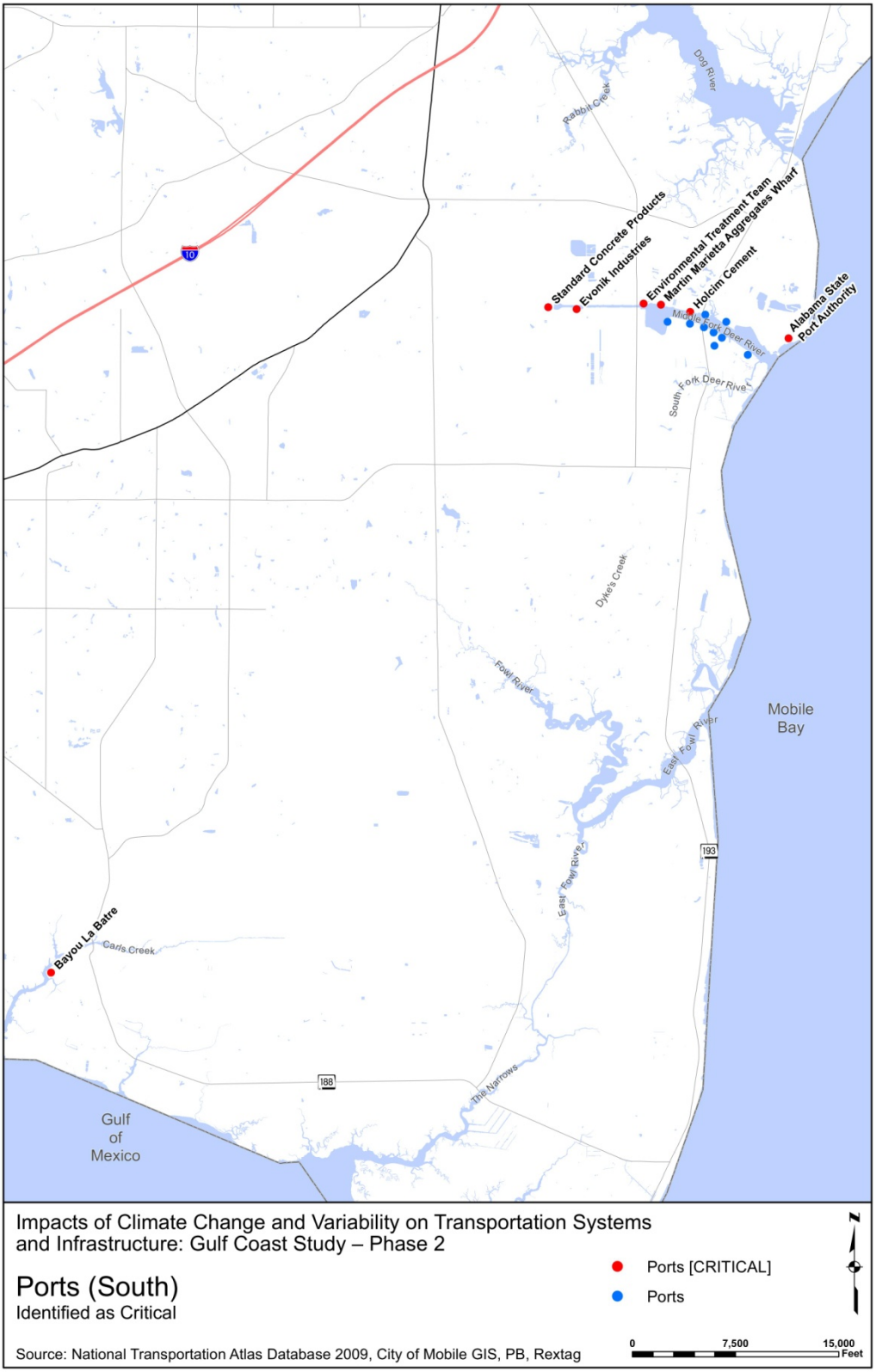


Table 3: Ports Criticality Assessment

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
1	Chickasaw Creek - B & F Terminal Co., Chickasaw Wharf	Y		Y														3
2	Chickasaw Creek - Gulf Atlantic Oil Refining Co., North Terminal	Y		Y		Y									Y			**1**
3	Chickasaw Creek - Mobile-Chickasaw Port Facility, Pier A	Y	Y	Y														2
4	Chickasaw Creek - Occidental Chemical Corp., Caustic-Soda Wharf			Y		Y									Y			2
5	Chickasaw Creek - Overseas Hardwoods Co., Chickasaw Barge Slip			Y														2
6	Chickasaw Creek - Auto Shred Recycling, Chickasaw Wharf			Y		Y												3

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
7	Chickasaw Creek - Waterways Towing and Offshore Services	Y	Y	Y		Y												2
8	Chickasaw Creek - Crimson Shipping, Chickasaw			Y		Y												3
9	Chickasaw Creek - Warrior and Gulf Navigation Co., Fuel-Oil			Y														2
10	Chickasaw Creek - Eagle's landing, USI & Kumzu marine			Y		Y												3
11	Chickasaw Creek - Tecnico			Y														3
12	Industrial Canal - Buchanan Lumber Mobile, Industrial Canal Log Dump			Y														3
13	Industrial Canal - Damrich Coatings, Mobile Wharf			Y														2
14	Industrial Canal - Goldin Industries, Mobile Barge Terminal Wharf			Y														2

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
15	Industrial Canal - H & B Welding Service, Industrial Canal Dock			Y														2
16	Industrial Canal - Lafarge, Mobile Industrial Canal Wharf			Y														2
17	Industrial Canal - Buchanan Lumber Mobile, Industrial Canal Docks			Y		Y												2
18	Industrial Canal - Crescent Towing & Salvage Co., River A Wharf			Y														**1**
19	Mobile River - Alabama Bulk Terminal Co.	Y	Y	Y		Y	5.4M barrels crude oil			1.3M barrel storage	40 feet	800' tanker			Y			**1**
20	Mobile River - P & H Construction Corp.			Y														2
21	Mobile River - Vulcan Materials Co., Blakeley Island Yard Dock			Y		Y												2

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
22	Mobile River - Mobile Container Terminal	Y	Y	Y	Y	Y		350,000 TEU			45 feet	8000 TEU vessel				Y		**1**
23	Mobile River - Mobile Cruise Terminal			Y	Y	Y	160,000 passengers	200,000 passengers			40 feet	2600 passengers						**1**
24	Mobile River - TransMontaigne Product Services	Y	Y	Y											Y			**1**
25	Mobile River - Atlantic Marine				Y	Y												**1**
26	Mobile River - Signal Shipbuilding & Repair Co.					Y												2
27	Mobile River - BP Oil Co., Mobile Terminal Barge Wharf	Y	Y	Y											Y			**1**
28	Mobile River - C & G Boat Works, Mobile Wharf					Y				Ship Repairs								3
29	Mobile River - Cargill Marketing Co., Blakeley Island Elevator Wharf	Y		Y														2

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
30	Mobile River - City of Mobile, Barge Wharf																	2
31	Mobile River - Gulf Atlantic Oil	Y	Y	Y		Y									Y			**1**
32	Mobile River - Plains Marketing	Y	Y	Y	Y	Y	5.4M barrels crude oil			1.7M barrel storage	40 feet				Y			**1**
33	Mobile River - Gulf Coast Asphalt Co., Mobile Terminal Wharf	Y		Y	Y	Y									Y			**1**
34	Mobile River - Harrison Bros. Drydock & Repair Yard Piers					Y												3
35	Mobile River - Kimberly-Clark Corp., Mobile River	Y		Y		Y												**1**
36	Mobile River - Chipco	Y		Y														2
37	Mobile River - Oil Recovery Co. of Alabama, Mobile Terminal Pier	Y		Y		Y								Y				**1**
38	Mobile River - Mobile Abrasives Pier	Y		Y		Y												2

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
39	Mobile River - National Marine, Blakeley Island Fleet Mooring																	3
40	Mobile River - Shell Chemical Co.	Y	Y	Y	Y	Y									Y			**1**
41	Mobile River - Southern Fish & Oyster Co., Mobile Dock			Y		Y												2
42	Mobile River - U.S. Coast Guard Pier			Y	Y								Y	Y		Y	Y	**1**
43	Mobile River - Mobile River Terminal Co.	Y		Y														2
44	Mobile River - Dunhill			Y											Y			2
45	Mobile River - Austal	Y			Y	Y										Y		**1**
46	Mobile River - Alabama State Port Authority[i]	Y	Y	Y	Y	Y				Wareho using	40 feet	Varies	Y		Y	Y		**1**
47	Theodore Ship Canal - Environmental Treatment Team Wharf																	**1**

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
48	Theodore Ship Canal - Evonik Industries	Y	Y	Y		Y												**1**
49	Theodore Ship Canal - Exxon Co. U.S.A. Wharf	Y	Y	Y	Y										Y			2
50	Theodore Ship Canal - Holcim Cement Wharf	Y		Y	Y	Y												**1**
51	Theodore Ship Canal - Martin Marietta Aggregates	Y	Y	Y	Y	Y												**1**
52	Theodore Ship Canal - M-I Drilling Fluids, Theodore Wharf			Y	Y										Y			3
53	Theodore Ship Canal - Midstream Fuel Service, Offshore Facility Service			Y		Y									Y			2
54	Theodore Ship Canal - Mobile Bay Wood-Chip Center, Shipping Dock			Y														2

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
55	Theodore Ship Canal - Southeast Wood Fibers, Receiving Dock			Y														2
56	Theodore Ship Canal - Standard Concrete Products			Y	Y	Y												**1**
57	Theodore Ship Canal - Theodore Industrial Port			Y														2
58	Theodore Ship Canal - Millard Refrigerated Services			Y	Y	Y												2
59	Theodore Ship Canal - Tiger Offshore			Y														3
60	Three Mile Creek - Jordan Pile Driving, Marine Yard Wharf			Y														3

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as community connection	Socioeconomic - No System Redundancy	Socioeconomic - Serves Regional Economic Centers	Operational - Port Use/Demand	Operational - Port Capacity	Operational - Port Cargo Value	Operational - Operations	Operational - Channel & Berth Depth	Operational - Maximum Vessel Size	Health & Safety - Identified in Evacuation plans	Health & Safety - Component of Disaster Relief & recovery Plan	Health & Safety - Identified Hazardous Materials Transfer Point	Health & Safety - Component of National Defense System	Health & Safety - Provides materials to Health Facilities	Criticality Score: (1-High, 2-Medium, 3-Low)
61	Bayou La Batre	Y		Y		Y	10,000 tons seafood		US$ 35 million	Seafood, Shipbuilding, OSV Operations								**1**

i. Also within Theodore Ship Channel

Results

The determination of criticality was based on a combination of professional judgment and available data on port operations, the impact the port has on commerce, the connectivity the port provides in the local community, and the port's impact on the health and safety of the community living within the study area. Because many of the ports are privately owned and/or operated, much of the information on port operations was not publically available. In these instances, the information and data that was available was used to inform professional judgment in assessing the criticality of the port.[19]

Twenty-three marine terminals were determined to be most critical among the 61 marine terminals within Mobile County. These terminals include ASPA, Atlantic Marine, Mobile Cruise Terminal, Mobile Container terminal, and crude oil terminals. All play important roles in providing essential waterborne commerce and critical intermodal linkage between ships, barges, railroads, pipelines, and trucks. Disruptions in facilities like Martin Marietta, Holcim Cement, Plains Marketing, and Alabama Bulk Terminal would cause serious damage to Mobile's economy. Others such as Austal and Atlantic Marine are the biggest shipyards on the U.S. Gulf Coast and would cause a disruption in ship repair and shipbuilding activities. Facilities such as Oil Recovery Company and the U.S. Coast Guard provide essential services as part of disaster recovery plans. Others such as Evonik rely on their waterfront infrastructure to operate their industrial facility and employ a considerable number of Mobile residents. ASPA and TransMontaigne Product Services have four and two marine terminals, respectively, in Mobile that were assessed as being most critical. The marine facilities in Bayou La Batre consist of several facilities catering to commercial fishing and offshore vessels. For this analysis, these facilities were lumped together under Port of Bayou La Batre.

Twenty-six terminals were determined to have a medium-level of criticality within Mobile County. Facilities like Lafarge, Buchanan Lumber, and Chipco use their waterfront infrastructure to handle cargo such as sand, gravel, wood chips, and other dry bulk commodities that serve industries within the area economy. A disruption in these facilities would result in costly alternatives for cargo movement for inland industries and may reduce their competitiveness nationally or regionally. These terminals also employ considerable numbers of people and provide important community connections.

Twelve of the 61 marine terminals within Mobile County were determined to have low-level criticality. In addition, most of these low-level critical terminals either have intermittent contract work, such as Tiger Offshore, or have small operations like M-I Drilling Fluids and Tecnico. If some of these facilities, such as Crimson Shipping or B&F Terminal, are disrupted, cargo could be accommodated at other terminals. These facilities still serve important functions providing for regional commerce and job generation.

[19] Professional judgment was based on the information that was available for a specific asset; in some instances, certain assets had more types of information available to inform that professional judgment, but lack of certain information for a given asset did not automatically increase or decrease the criticality rating.

In addition, it was determined that marine facilities on Theodore Channel, Mobile River, and Industrial Canal were generally found to be much more critical in function, intermodal-connections, and purpose than the ones on Chickasaw Creek and Three Mile Creek.

Airports

Introduction

Seventeen aviation facilities (airports, fields, heliports) are located within Mobile County. Four airports are publicly owned and operated, and the others are operated by either individuals or, in the case of the heliports, businesses. The four publicly owned and operated airports are Mobile Regional, Mobile Downtown (alternative known as Brookley Field), St. Elmo, and Dauphin Island Airports. Other airports within the Mobile area are typically private airfields, each consisting primarily of a turf runway and small, private hangars capable of handling nothing larger than a single-engine aircraft. There are also concrete helipads – measuring no larger than 40 feet by 40 feet – that specifically serve either a medical facility or a petroleum service company. Although they are not top-priority aviation facilities, the helipads accommodate emergency medical response or link to offshore oil platforms. In general, there are three aviation categories:

- *General Aviation* typically refers to public-use as well as private-use and non-commercial aircraft operations, which can be recreational flights or private business aircraft that are either chartered or owned directly by businesses and individuals. Most are small single- and twin-engine aircraft, but some can be business versions of the Boeing and Airbus airframes.
- *Civil Aviation* generally encompasses all non-military aircraft operations and includes commercial (scheduled and non-scheduled passenger or cargo carriers) or general aviation.
- *Military Aviation* includes aircraft operations by one of the branches of the Department of Defense or the U.S. Coast Guard. These aircraft generally operate at military or joint-use civilian/military airports.

Criteria

The 20 individual criteria used to assess the criticality of airport network assets included:

Socioeconomic

- Part of national/international commerce system
- Important multi-modal linkage
- Functions as community connection
- No system redundancy
- Serves regional economic centers

Use/Operational

- Status as a commercial use airport, military airport, or general aviation public airport or private airport
- FAR Part 139 certification, which refers to the level of service offered by the airport and the largest class of aircraft that uses the airport.
- Aircraft performance and dimensions (approach speed codes – A, B, C, D, E; Aircraft design group – I, II, III, IV, V, VI)
- Instrumentation (precision, non-precision, visual)
- Category within the National Plan of Integrated Airport Systems (NPIAS) (primary, reliever, general aviation)
- Category within Statewide Airport System Plan (international, national, regional, community, local)
- Passenger enplanements (2009)
- Annual aircraft operations (2009) which includes both takeoffs and landings.
- Based aircraft (2009)
- Economic impact ($ millions – annual) (2003), which is generally calculated in terms of the economic impact on the local community, taking into account wages and salaries paid by airport employers, and may also include multiplier impacts that include the effects in the community when airport employees make purchases at local retail establishments.

Health and Safety

- Identified in evacuation plans
- Component of a disaster relief and recovery plan
- Component of national defense system
- Provides support to health facilities
- Provides support to offshore facilities

Methodology

Where possible, criteria were identified to reflect data available in FAA planning documents to allow for efficient scoring. Generally, the assumptions in this analysis recognized that commercial airports are the most important to the area, other public airports were next and airports of lesser use and/or private ownership were lower in hierarchy.

The information collected and analyzed to determine the criticality of airports in the Mobile area came primarily from FAA and state aviation documents. Those documents include the FAA Form 5010 summaries, which are located in a database on the FAA's website and provide summaries by airport, by county or by state. These summaries are a dataset developed for each airport and include airport location, runway data, number of aircraft based at the airport, annual

operations, enplanements, and other information related to the airport. The other summary documents reviewed in developing the initial airport list and inventory are the Alabama Statewide Airport System Plan and the FAA's National Plan of Integrated Airport Systems.

For socioeconomic factors, the regional airports were assessed using information from the Alabama Statewide Airport System Plan for their contributions to economic activity in the area and whether other airports had the capacity to absorb operations should a particular facility be shut down for any reason.

Operational factors were derived directly from the National Plan of Integrated Airport Systems[20] and used to identify airport classification, usage, categories, aircraft and other characteristics that establish a hierarchy among airports.

Health and safety factors applied to a few of the aviation facilities, particularly the heliports, as some were part of medical facilities or provided support to offshore operations. No airports are identified as part of evacuation or recovery plans.

Scoring of the airports was based on grading of individual components and based on some level of professional judgment when differentiating between individual airports. There was no weighting applied but greater consideration was given to airports that were designated in the NPIAS and Statewide Airport System Plans.

Airports were evaluated against the criteria and rated from "high" to "low." Those rated "high" were considered to be essential due to their role in the national and statewide aviation systems, their levels of activity and physical capabilities which provide an unduplicated level of service to the public. Airports rated "medium" are included on the national and statewide system plans and serve support functions on a regional level within Mobile County. Airports rated "low" were privately owned, limited in purpose, and had minimal to no activity. It should be noted that documents did not confirm if Mobile Regional, Mobile, Downtown, St. Elmo and Dauphin Island Airports were identified as part of evacuation, relief, or recovery plans.

Figure 9 shows all airport facilities in Mobile and highlights the most critical facilities. Table 4 summarizes the evaluation of the airports and heliports in Mobile County against the criteria used to determine criticality of infrastructure.

Results

Mobile Regional and Mobile Downtown Airports are considered to be the most critical airports because of their level of activity, their ability to support all but the largest aircraft in public use, their capability to accommodate aircraft operations in inclement weather, and their vital importance to the economy of the area. They are the only airports identified as qualifying under the socioeconomic assessment category. Mobile Regional is part of the nationwide transportation

[20] U.S. Department of Transportation, 2008.

system; it is the only airport in Mobile County that can accommodate scheduled passenger and cargo air service. Mobile Downtown supports primarily air cargo service, with rail, highway, and maritime service in close proximity. The industrial and commercial base found at the Brookley Industrial Complex is unique to Mobile Downtown Airport. In terms of the operational assessment category, Mobile Regional and Mobile Downtown are certificated under FAR Part 139 for passenger service. Because of the length of their runways, both airports are capable of handling aircraft with Group V wingspans (maximum of 213 feet, corresponding to a Boeing 747-400), as well as Category D aircraft (approach speeds up to 166 knots). Mobile Regional is considered a primary airport under NPIAS, while Mobile Downtown is considered a general aviation airport. Under the Statewide Airport System Plan, both are considered national airports.

St. Elmo and Dauphin Island Airports rate as "medium," because they support general aviation activities in Mobile County and have durable pavements that can support heavier, higher-performance aircraft. Dauphin Island Airport's role is unique in that it is the only airport serving a barrier island and is the only means of reaching the island if vehicle access were not possible. These airports are limited to Group I (less than 49 feet) wingspans and can accommodate Category B (approach speeds under 121 knots) aircraft. Under NPIAS, both Dauphin Island and St. Elmo Airports are considered general aviation airports, and under the Statewide Airport System Plan, St. Elmo is a regional airport and Dauphin Island is a local airport.

For the health and safety factors, information on the use of airports in evacuation plans or being part of disaster relief and recovery plans was unavailable for the Mobile area and therefore could not be evaluated. However, it is important to retain these criteria as they may be important to other airports across the country.

Figure 9: Airport Facilities Map

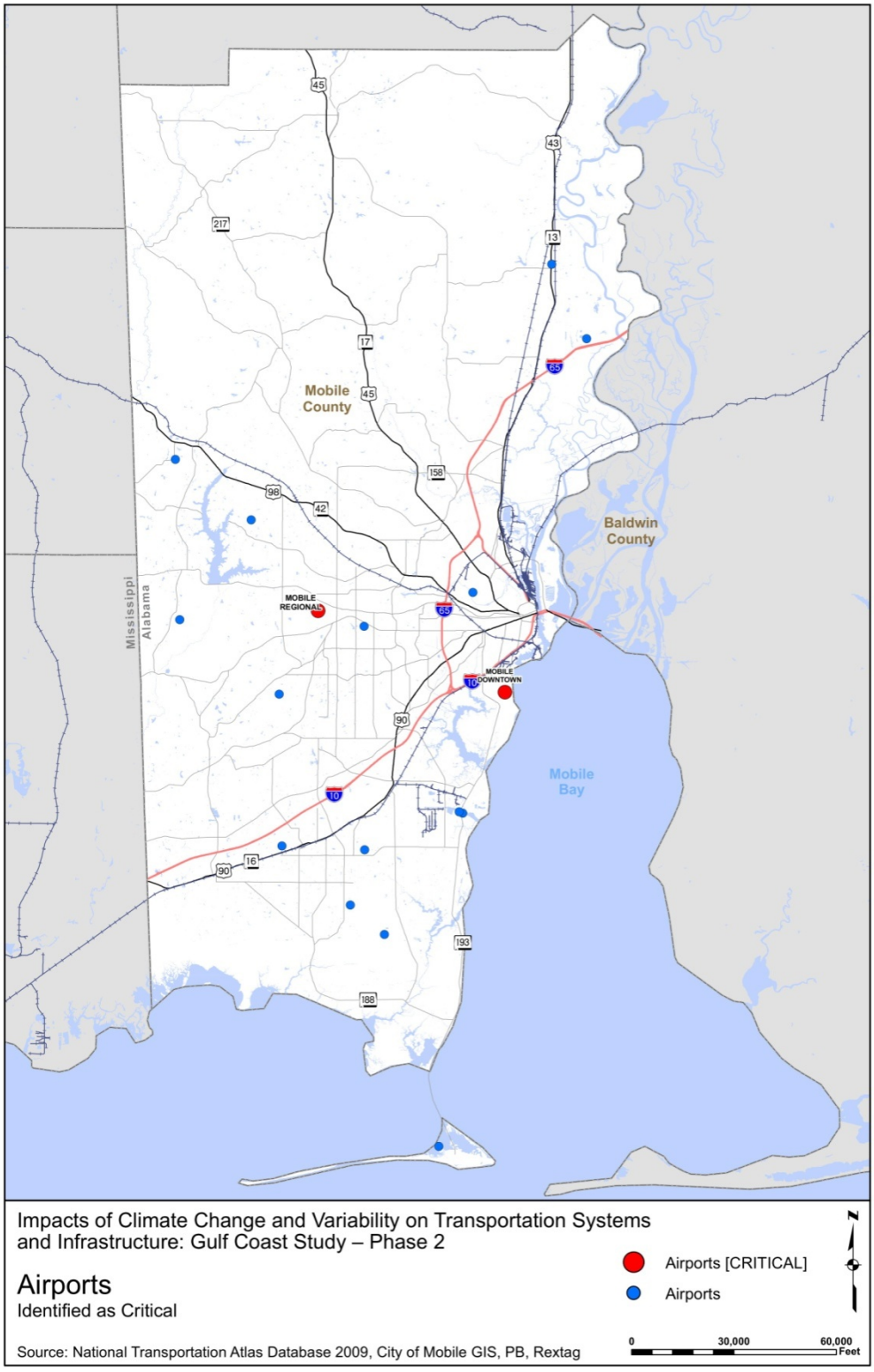


Table 4: Airports Criticality Assessment

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - No System Reducndancy	Socioeconomic - Serves Regional Economic Centers	Operational - Status (Commercial, Military, Public Use, Private)	Operational - FAR Part 139 Certification	Operational - Aircraft Performance and Dimensions (Approach Speed Codes - A,B,C,D,E; Aircraft Design Group - I, II, III, IV, V, VI)	Operational - Instrumentation (Precision, Non-Precision, Visual)	Operational - Category within National Plan of Integrated Airport Systems (Primary, Reliever, General Aviation)	Operational - Category Within Statewide Airport System Plan (International, National, Regional, Community, Local)	Operational - Passenger Enplanements (2009)	Operational - Annual Aircraft Operations (2009)	Operational - Based Aircraft (2009)	Operational - Economic Impact ($ millions - annual)(2003)	Health & Safety - Identified in Evacuation Plans	Health & Safety - Disaster Relief/Recovery Plan Component	Health & Safety - Component of National Defense System	Health & Safety - Provides Support to Health Facilities	Health & Safety - Provides Support to Offshore Facilities	Criticality Score - (H-High, M-Medium, L-Low)
1	MOBILE REGIONAL	Y		Y	Y	Y	C	I, C	D, V	P	P	N	281,806	116,757	59	$419.7			Y			**H**
2	MOBILE DOWNTOWN	Y	Y		Y	Y	PU	IV, A	D, V	P	GA	N	688	83,086	33	$417.8						**H**
3	ST ELMO						PU		B, I	NP	GA	R		20,400	32	$ 1.0						M
4	DAUPHIN ISLAND				Y		PU		B, I	V	GA	L		3,650	0	$ 0.4						M
5	ROY E. RAY						PU		A, I	V				6,978	35							L
6	MARK REYNOLDS/NORTH MOBILE COUNTY						PU		A, I	V				8,570	10							L
7	PROVIDENCE HOSPITAL						Pr			V					0					Y		L
8	PETROLEUM HELICOPTERS INC						Pr			V					1						Y	L

No.	Facility	Socioeconomic - Part of National/Intl Commerce System	Socioeconomic - Important Multi-Modal Linkage	Socioeconomic - Functions as Community Connection	Socioeconomic - No System Reducndancy	Socioeconomic - Serves Regional Economic Centers	Operational - Status (Commercial, Military, Public Use, Private)	Operational - FAR Part 139 Certification	Operational - Aircraft Performance and Dimensions (Approach Speed Codes - A,B,C,D,E; Aircraft Design Group - I, II, III, IV, V, VI)	Operational - Instrumentation (Precision, Non-Precision, Visual)	Operational - Category within National Plan of Integrated Airport Systems (Primary, Reliever, General Aviation)	Operational - Category Within Statewide Airport System Plan (International, National, Regional, Community, Local)	Operational - Passenger Enplanements (2009)	Operational - Annual Aircraft Operations (2009)	Operational - Based Aircraft (2009)	Operational - Economic Impact ($ millions - annual)(2003)	Health & Safety - Identified in Evacuation Plans	Health & Safety - Disaster Relief/Recovery Plan Component	Health & Safety - Component of National Defense System	Health & Safety - Provides Support to Health Facilities	Health & Safety - Provides Support to Offshore Facilities	Criticality Score - (H-High, M-Medium, L-Low)
9	USA MEDICAL CENTER						Pr			V					1					Y		L
10	MIDSTREAM FUEL SERVICE						Pr			V					0						Y	L
11	EXXON HELIPORT						Pr			V					1						Y	L
12	SKYWEST AIRPARK						Pr		A, I	V				820	4							L
13	LEMOYNE						Pr			V					0							L
14	EVANS FIELD						Pr		A, I	V					1							L
15	GRIMES FIELD						Pr		A, I	V					2							L
16	DALE O. GALER AERODROME						Pr		A, I	V					5							L
17	RICHARDSON FIELD						Pr		A, I	V					2							L

About half of the airports that were rated "low" have a minimal level of activity or serve niche functions within Mobile County. Two private airports, Roy E. Ray and Mark Reynolds/North Mobile County Airport, rate between "medium" and "low" due to the concentrations of based aircraft at each airport and their availability to the public for aviation activities. Heliports providing specialized support service to the petroleum industry and to the local medical centers also rated between "medium" and "low." These heliports operate on an irregular basis, but provide a niche service to the community. The functions of the heliports, while specialized, can be duplicated to some extent at the public-use airports. The airports within this rating can accommodate Category A (approach speeds under 91 knots) aircraft, and they are not part of any national or statewide airport plans. The remaining airports that rated "low" are privately owned, have limited-access facilities, and their landing and takeoff surfaces are generally composed of turf.

In terms of the health and safety assessment category, none of the public-use airports in Mobile County are identified. Mobile Regional contains both Air National Guard and U.S. Coast Guard facilities but Mobile Downtown, despite its past use as a military airfield, serves only civilian activities. Two of the heliports provide support to hospitals and three are operated by firms that provide support to the petroleum industry. The helipad at the Lemoore Industrial Park does not appear to support offshore activities specifically.

Pipelines

Introduction

Mobile County is crossed by a wide range of pipelines serving local, regional, and national users and is made up of about 652 total miles of pipelines. Approximately 426 miles of pipelines are identified as being critical. Pipelines safely transport large quantities of often flammable materials underground across the U.S. The pipeline infrastructure within the study area consists of natural gas transmission lines, and hazardous liquid pipelines containing unrefined products such as crude oil and refined products such as gasoline. Offshore production wells in the Gulf of Mexico connect to a number of the pipelines along the Alabama Gulf Coast and storage facilities near the coast. Storage tanks are primarily the jurisdiction of the EPA and the state and are therefore not included in this analysis. Tanks which are typically part of the system include break-out tanks which are tanks used to hold line pack (a.k.a pipeline inventory) if sections of a pipeline are shut down temporarily. For liquids (water, oil, gasoline, etc.), it is simply the volume of liquid contained by a section of pipe of a defined length. A one-mile section of pipe (12.00 inches, ID) contains about 31,000 gallons of liquid. Natural gas and associated gas liquids (including propane, iso-butane and natural butane) are collected offshore and are processed by treatment/separation plants upon reaching shore. Once treated, the gas flows through the various pipelines to local utility distribution systems in the Mobile area. The gas and gas liquids also flow to other end-users in states outside Alabama. Natural gas pipelines are networked to allow

flow to continue if offshore wells are "shut in" (closed off so that they are no longer producing natural gas).

This study assessed pipelines specifically, and not their related facilities. The analysis of pipelines has been limited to onshore pipelines for this analysis to facilitate discussion of potential impact in the same study area as other modes and to maintain a transportation, rather than production, focus. Onshore pipelines provide long-distance transport and distribution of oil and natural gas products and are operated primarily by pipeline companies, including Boardwalk Partners, Enterprise Products, Plains All American, Panhandle Energy, Sempra, Spectra Energy, Williams, and others. By contrast, offshore pipelines in the Gulf of Mexico serve more of a production function, operating principally to gather oil and gas from multiple locations in production fields to supply onshore distribution networks. Offshore production operations are typically run by major, integrated oil/energy companies, including BP, Chevron, ConocoPhillips, ExxonMobil, Marathon, Shell, Total, Fina, Elf, and others. This contrast is mirrored at the regulatory level. Onshore pipelines are regulated by the Pipeline and Hazardous Materials Safety Administration (PHMSA), a part of the US DOT, while some offshore pipelines are regulated by both DOT and the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), a Department of Interior (DOI) agency; most production/gathering lines are regulated by DOI.

Pipelines north and west of the Mobile area could supply natural gas to various consumers should local networks shut down for any reason. Crude oil is typically available by pipeline and from local storage depots to supply the local refinery in cases where production may be interrupted.

Criteria

The 12 individual criteria used to assess the criticality of pipeline network assets included:

Socioeconomic

- Local supply pipeline (power generation, residential, industry)
- Important backup supply after major disruption
- Local sales pipeline
- Functions as community connection
- System redundancy
- Serves regional economic centers

Use/Operational

- Range of pipeline sizes (nominal pipe size – inches)
- USDOT classification/pipeline contents under the Code of Federal Regulations (CFR) (49 CFR 192 = Natural Gas (NG); 49 CFR 195 = land and/or Crude Oil (CO))

- Operates Local Pumping and/or Compression Facilities
- Operates Local Oil Refinery (crude oil [CO]); Gas Processing (natural gas [NG]); Storage (S); Terminals (T)

Health and Safety

- Chemical facility anti-terrorism standards (CFATs) compliant
- Provides fuel to operate health/emergency facilities

Methodology

The inventory of the pipeline network in the study area was focused on identifying the location and attribute information necessary to determine the pipelines that may be most critical. Pipelines are typically (greater than 95%) buried except in areas with connections to storage facilities, processing plants, pumping/compression facilities, intermodal facilities (truck, rail, ship, etc.), or are located in areas where underground obstructions or topographic features, such as streams, require the use of a pipeline bridge as a crossing. The capacity for field observation of pipelines is limited, except by major pipeline operators who periodically patrol pipeline rights-of-way and perform periodic in-line inspection as required by state and Federal regulatory authorities.

Typically, information on pipelines can be found in the offices of state regulatory agencies that provide legal descriptions, right of way information, and pipeline maps. For this study, data vendor Rextag Strategies was identified as a source for this information as a way to streamline the data collection effort. GIS data were obtained from Rextag that identified general pipeline locations, as well as the operations information presented in the analysis table. A scoring matrix for this data was developed to reflect attribute information contained in that data set on primary pipeline connections and products – with a hierarchy of natural gas, petroleum products (jet fuel, etc.), and crude oil. Safety concerns limit the display of business owner information for pipelines so a standard system of identifying companies was developed for display in this report.

The information contained in the data resource led to the development of a general level of importance to both the Mobile area and surrounding states based primarily on whether redundant systems and operations were in place to be able to meet supply needs of identified products. Pipelines are not typically associated with evacuation planning or disaster relief programs but some recognition of the supply of material to emergency facilities was included in the matrix.

Data on specifics of individual pipeline operations from Rextag were analyzed to determine criticality. This assessment was substantially limited by the lack of readily available operations data for pipeline operators nationally.

Pipeline networks provide products for a range of needs. A general hierarchy was developed for this analysis, which was based on how important products were for various uses. This hierarchy included below identifies pipeline network assets in order of importance from high to low:

- Natural gas transmission supply
- Natural gas transmission laterals (natural gas pipelines that deliver gas to or from the mainline) to industry
- Natural gas local distribution lines to industrial customers
- Natural gas transmission laterals to residential distribution hubs
- Natural gas local distribution lines to residential customers
- Products transmission pipelines
- Natural gas transmission laterals to local power generation
- Crude oil supply transmission pipelines
- Crude oil pipeline laterals
- Crude oil delivery transmission pipeline
- Natural gas gathering lines from local production

The criteria and their scoring are denoted below:

Socioeconomic

- Local supply pipeline (power generation, residential, industry) – This criteria is a measure of pipelines supplying end users within the community, primarily with natural gas. This criterion was assessed from industry knowledge and an assessment of Google Earth maps of facilities. A score of "3" denotes those pipelines providing local supply across many uses, a score of "2" denotes those providing supply to limited users, and a score of "1" denotes those providing supply to few/no users.
- Important backup supply after major disruption – The project team identified supply that would be used after a major disaster while other links of the network are restored (an example would be a gasoline pipeline to a distribution center). These were identified based on industry knowledge. Those serving this function received a "yes."
- Local sales pipeline – A local sales pipeline is one that is used by a natural gas utility selling gas to end users. Custody transfers to end user on what goes through there, monitored with meters. A higher level of customers for sales were scored a "3", while a medium and lower level of customers were scored a "2" and "1," respectively.
- Functions as community connection – The project team identified pipelines that function as connectors. An example would be a pipeline which provides access to distribution center which supplies an incorporated area. Those that provide this connection were scored a "yes."

- System redundancy – If one pipeline can no longer carry product, there is often another that can take over delivery as an alternate source of the same product. This assessment was whether this redundancy exists. This criterion was scored as either "yes" or "no."
- Serves regional economic centers – The projected team identified pipelines that supply direct access for industrial uses, manufacturing and other commerce that supports the economy. The team identified these pipelines using a Google Earth mapping of the network and a review of manufacturing centers. Those pipelines providing this access were scored "yes."

Use/Operational

- Range of pipeline sizes (nominal pipe size – inches in diameter). This measure was taken from the Rextag data set and represents the capacity of the pipelines. There is currently no measure of throughput provided by these pipelines. Some information may be in state records or with DOT – Federal Energy Regulatory Commission (FERC). Pipeline sizes were shown where available. Generally, larger pipelines serve more population and are therefore of greater importance than a smaller pipeline. This is based on the assumption that the pipeline is not merely crossing the Mobile area, but that the pipeline terminates in and serves end-users in Mobile.
- USDOT classification/pipeline contents (49 CFR 192 = NG; 49 CFR 195 = and/or CO) This is an assessment of the contents of the pipelines with NG being natural gas and L being Petroleum Liquids. Natural gas was considered a higher priority because it is distributed via a local distribution utility and does not require the consumer to travel in order to obtain it as would be the case with liquid hydrocarbon fuels. Additionally, hospitals and residences more commonly use natural gas rather than petroleum liquid.
- Operates Local Pumping and/or Compression Facilities – This criteria is a measure of whether these companies have local facilities, such as booster stations or pump stations. Those companies with facilities are shown with a "yes."
- Operates Local Oil Refinery (crude oil [CO]); Gas Processing (natural gas [NG]); Storage (S); Terminals (T) – This criteria is a measure of whether companies operate local oil refineries. This information was obtained from industry knowledge but FERC or the State Regulatory Agency (Alabama Secretary of State Corporations in Alabama) could have some of this information. Those companies with local refineries were considered of higher value.

Health and Safety

- Chemical facility anti-terrorism standards (CFATs) compliant – The Department of Homeland Security assesses pipelines based on their being a major system with high potential degree of damage from a terrorist attack. Those facilities thus identified are considered more critical. This assessment is based on industry knowledge and is protected.

– Provides fuel to operate health/emergency facilities – The team assessed whether major hospitals buy gas directly from local providers as a measure of importance. Scored yes or no, with yes being more important.

Results

Approximately 426 miles of pipelines in Mobile County were identified as critical based on the criteria developed to assess this infrastructure. Most of the companies identified as critical operate pumping/compression facilities or refineries in the area that contribute to the national energy supply.

Figure 10 shows the major pipelines and associated facilities in the study area. Table 5 lists the various pipelines, pipeline sizes, contents (crude oil, natural gas, hydrocarbon liquids), USDOT regulatory jurisdiction, pipeline owner/operator[21], and degree of criticality (high, medium, and low). Most of these pipelines cross into other states. When offshore production is suspended, natural gas and gas liquids from inland facilities can be directed to the area in order to fuel equipment needed for recovery efforts.

[21] To protect the security of the pipeline assets, the names of the pipeline companies are not identified in this report.

Figure 10: Pipeline Facilities Map

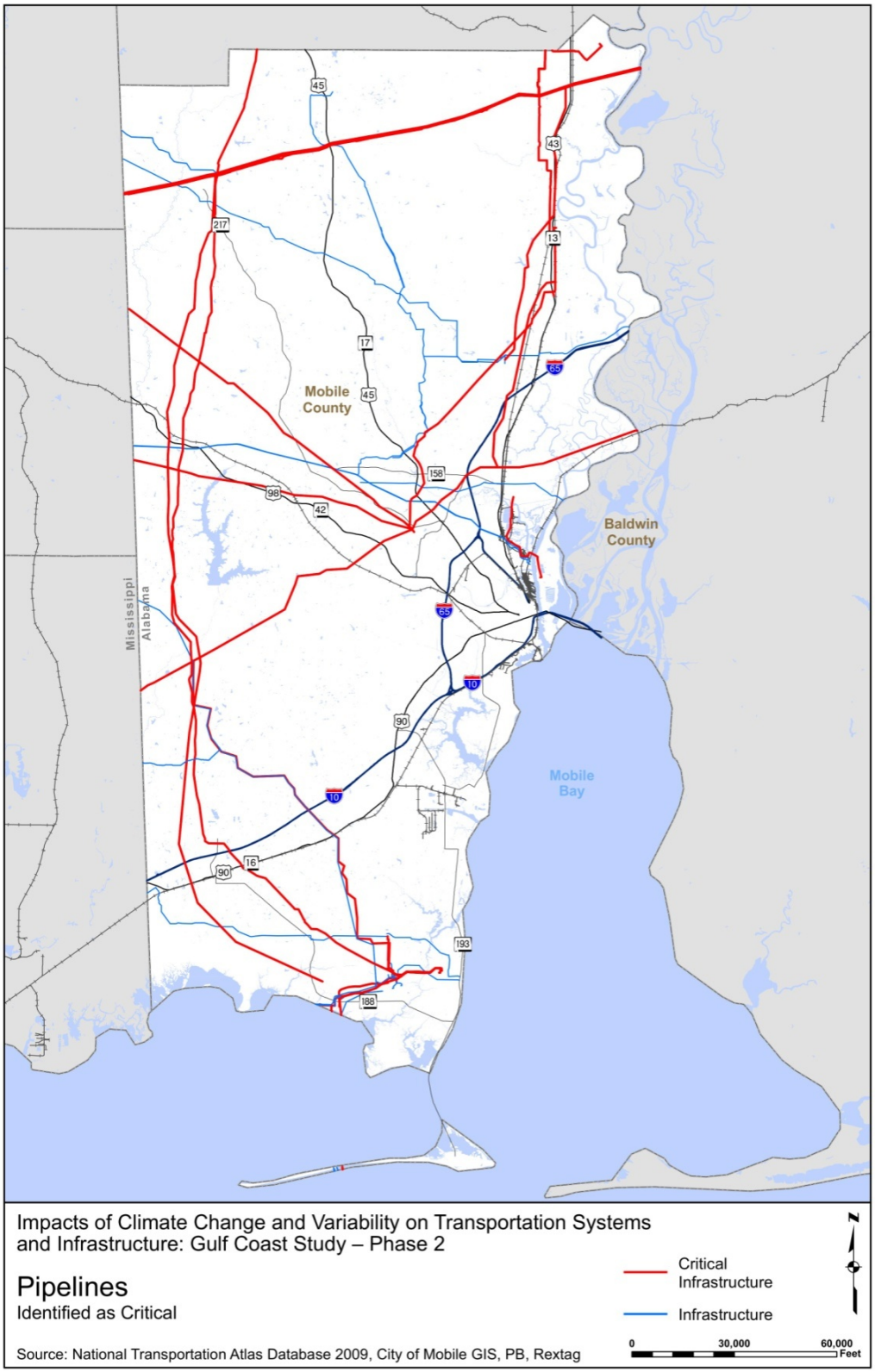


Table 5: Pipeline Criticality Assessment

No.	Owner/Oper.	Socioeconomic - Local Supply Pipeline (Power Gen, Residential, Industry)	Socioeconomic - Important Backup Supply after Major Disruption (Y = Yes / N = No)	Socioeconomic - Local Sales Pipeline	Socioeconomic - Functions as Community Connection (Y = Yes; N = No)	Socioeconomic - System Redundancy (Y = Yes; N = No)	Socioeconomic - Serves Regional Economic Centers (Y = Yes; N = No)	Operations - Range of Pipeline Sizes (Nominal Pipe Size - Inches)	Operations - DOT Classification/Pipeline Contents (49 CFR 192 = NG; 49 CFR 195 = L and/or CO)	Operations - Operates Local Pumping and/or Compression Facilities (Y = Yes; N = No)	Operations - Operates Local Oil Refinery (CO); Gas Processing (NG); Storage (S); Terminals (T)	Health & Safety - Chem Facility Anti-Terrorism Stds (CFATs) Compliant (Y = Likely; N = No)	Health & Safety - Provides Fuel to Operate Health/Emergency Facilities	Criticality Score: H = High; M = Medium; L = Low
1	Company A	1	Y	3	Y	Y	Y	12-20	NG	Y	NG			**H**
2	Company B	3		1	N				L				N	L
3	Company C	1	Y	3	Y	Y	Y	16-36	NG					**H**
4	Company D	3		1	Y	N	N		L					M
5	Company E	3	N	2	N	N	N		L		T		N	L
6	Company F	2	N	2	N	N	Y		CO	N	N		N	L
7	Company G	1	N	2	N	Y	Y	12-42	NG	Y	NG			**H**
8	Company H	1	Y	2	N	N	Y		CO	Y	T			M
9	Company I	1	Y	3	Y		Y	10-42	NG					**H**
10	Company J	1	N	2	N	Y	Y		CO	Y	Y	Y	Y	**H**
11	Company K	2	Y	0				16-36	NG	Y	N		N	**H**
12	Company L	1	Y	3			Y		NG	N	N			**H**
13	Company M	3	N	1	Y	Y	Y		L	Y	T		N	M

CONCLUSION

The evaluation of criticality for highway, transit, rail, port, airport, and pipeline modes in the Mobile study area relied on assessing each mode against socioeconomic, operational, and health and safety criteria. This analysis, conducted independently for each mode and often through application of professional judgment due to lack of available data, led to varying findings on the

criticality of modal components and their contributions to the local and regional economy and community. In this study area the various modes often operate symbiotically due to Mobile's position as an important energy-producing area and manufacturing center with multiple transfer points among various modes. Recognition of the interactions of these modes will need to be maintained as the project progresses into later assessment stages.

The findings in the preceding pages present the process that the project team used to evaluate criticality by mode and provides a framework for an objective "desk review" that could be used to narrow the universe of transportation assets in a area for the purpose of focusing further vulnerability assessments on the assets of greatest importance. The tool applied for this assessment was flexible and could be weighted to reflect a range of perspectives as to how infrastructure is assessed. Ratings for each mode based on the review conducted for this study are summarized in Table 6.

The assessment process was also designed to gather input as a final step in listing critical assets and input provided by project stakeholders added a stronger local perspective to the assessment process. This local input was critical in identifying assets that had cultural significance that did not surface from the assessment.

Subsequent tasks in this project will utilize the results of this task in further refining the asset types that will be subject to more detailed analysis. This task was an important screening process for establishing boundaries on what components of Mobile's transportation network was considered to be important for the follow-on analysis.

Table 6: Summary of Criticality Assessment by Mode

Mode	Key Stats	Critical Facilities
Highways	Total miles: 644 Total bridges: 630 Total critical miles: 152 Total critical bridges: 71	a. I-10 b. I-165 c. I-65 d. US 43/SR 13 e. US 45/SR 17 f. US 90/SR 16 g. US 98/SR 42 h. SR 163 i. SR 193 j. CR 56 k. South University Boulevard l. Telegraph Road
Transit	Total facilities: 2 Total fleet: 75 (includes 71 buses and vans and four maintenance vehicles) Total critical elements: 3 (including fleet)	a. Facilities i. Beltline O&M facility ii. GM&O Terminal b. Fleet i. Bus and demand-response vehicles
Railroads	Total facilities: 14 across five RRs Total critical facilities: 7 Total rail miles: 590 Total critical rail miles: 347	a. CSX Transportation (CSXT) i. M&M Subdivision (Mont. to Mobile) ii. Sibert Yard MP 665.2 - 668.3 iii. NO&M Subdivision b. Norfolk Southern (NS) c. Terminal Railroad Alabama State Docks (TASD) iv. Main Docks Complex v. McDuffie Terminal vi. TASD Interchange Yard
Ports	Total Ports: 61 Total Critical Ports: 23	a. Crescent Towing & Salvage Co., River A Wharf b. Alabama Bulk Terminal Co. c. Mobile Container Terminal d. Mobile Cruise Terminal e. TransMontaigne Product Services f. Atlantic Marine g. BP Oil Co., Mobile Terminal Barge Wharf h. Gulf Atlantic Oil i. Plains Marketing j. Gulf Coast Asphalt Co., Mobile Terminal Wharf k. Kimberly-Clark Corp., Mobile River l. Oil Recovery Co. of Alabama, Mobile Terminal Pier m. Shell Chemical Co. n. U.S. Coast Guard Pier o. Austal p. Alabama State Port Authority q. Environmental Treatment Team Wharf r. Evonik Industries s. Holcim Cement Wharf t. Martin Marietta Aggregates u. Standard Concrete Products v. Gulf Oil Refining, North Term. w. Bayou La Batre Docks
Airports	Total airports: 17 Total critical airports: 2	a. Mobile Regional b. Mobile Downtown
Pipelines	Total miles: 652 Total critical miles: 426	a. Company A b. Company C c. Company G d. Company I e. Company J f. Company K g. Company L

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APPENDIX A OVERVIEW OF MOBILE'S ECONOMY

According to the 2007 Economic Census, a third of Mobile's economy is tied to manufacturing (based on the value of total sales or shipments), including chemical manufacturing (28% of manufacturing total) and shipbuilding (6%). Manufacturing is also a sector that Mobile has targeted for future growth (see Table 7).

Table 7: Overview of Mobile's Economy

Sector	Percentage (of value of total sales or shipments)
Manufacturing	33%
Retail trade	24%
Wholesale trade	18%
Health care & social assistance	10%
Professional, scientific, & technical services	4%
Administrative & support & waste management & remediation service	4%
Accommodation & food services	3%
Other services (except public administration)	2%
Real estate & rental & leasing	1%
Arts, entertainment, & recreation	0%
Educational services	0%

Source: Derived from 2007 U.S. Economic Census, available at http://factfinder.census.gov

Retail trade is the second-largest sector, comprising almost a quarter of the economy, although this sector is diffused across many different locations, meaning that no single retail facility appears to be a top employer in the area. Of the retail total, 28% is related to motor vehicle sales, 19% to general merchandise stores, 13% to grocery stores, and 10% to gasoline sales.

Wholesale trade is the third most important sector, comprising 18% of the economy. The Census did not provide further detail for this sector, but wholesale trade is likely boosted by Mobile's deepwater port, and perhaps, the large manufacturing sector.

Healthcare and social assistance comprise 10% of Mobile's economy. Mobile is considered an important medical service area, and several large hospitals and healthcare centers are top employers.

The percentages in Table 7 represent the value of sales/shipments rather than total employees; however, the top sectors roughly correspond to the following primary types of employers: manufacturers, employment related to port activities, healthcare, and retail (such as Walmart).

Mobile is aggressively recruiting new businesses and manufacturing facilities, touting itself as a business-friendly community with a low cost of living and convenient access to major transportation routes. A number of facilities have either opened or expanded in Mobile recently, and Mobile hopes to attract additional facilities. Recent activities include:

- ThyssenKrupp (a steel manufacturer) initiated some of its operations at a new facility in the Mobile metropolitan area in July 2010 and expects to bring 2,700 permanent jobs in total to the area by the time all plant functions are fully operational.
- ST Aerospace Mobile, after winning a new airplane maintenance contract, is hiring 200 new workers.
- Berg Spiral Pipe Co. opened a new spiral pipe manufacturing facility in 2009 on an old International Paper site that had been vacant for several years.[22]
- The Panama Canal expansion will be completed in 2014, and could increase traffic at the Port of Mobile.

Major Single Facility Employers

The Mobile Chamber of Commerce provided data on the largest employers and largest manufacturing sites in Mobile. Table 8 shows the 13 single-facility employers with a workforce of over 500 people. This list is based on the most recent employment figures available for each location. The specific employers who meet the 500-person threshold could change from year to year as the regional economic picture changes.

Table 8: Major Single-Facility Employers (500 or more Employees)

Employer	Description	Employees	General Location
University of South Alabama*	Education and healthcare	5,000	Western Mobile County and west of Downtown Mobile
ThyssenKrupp	Steel manufacturing	2,700	Hwy 43 Corridor (north of Mobile)
Providence Hospital	Healthcare	2,150	Western Mobile County
ST Aerospace Mobile	Aircraft refurbishing	1,300	Brookley Industrial Complex
Springhill Medical Center*	Private—Healthcare	1,200	Western Mobile County
RYLA Inc.	Call center	Up to 1,200	Hwy 43 Corridor (north of Mobile)
Austal USA	Manufacturing	1,040	Port Area
Kimberly Clark Corp.	Paper products manufacturing	700	Port Area
Evonik Degussa	Chemical manufacturing	670	Theodore Channel (southern Mobile County)
Ciba Corp (part of BASF)	Chemical manufacturing	525	Hwy 43 Corridor (north of Mobile)
Atlantic Marine	Ship building and repair	500+	Port Area
C&G Boatworks	Boat manufacturing	500	Port Area
Press Register	Newspapers	500	Downtown Mobile

Source: Mobile Area Chamber of Commerce. *An Economic Overview: Mobile Bay* (page 5). Available at: http://www.mobilechamber.com/regionaloverview.pdf

* These employers actually have a few different facilities in Mobile, but have clear primary employment areas.

[22] Mobile Chamber of Commerce. http://www.mobilechamber.com/anlrpt.pdf

Important Multi-Facility Areas

The Mobile Chamber of Commerce noted four geographic areas that are particularly important from an employment point of view for major manufacturing and port-related activities. Individual facilities may not employ particularly large numbers of workers, but in aggregate, these areas are major employment centers (see Table 9 and Figure 11).

Table 9: Important Multi-facility Economic Zones

Employer	Description	Number of Employees
Brookley Industrial Complex	Industrial	3,200–3,700
Port of Mobile area	Shipping, build manufacture/repair, and related activities	Unknown, but over 2,600 at just the largest employers
US Highway 43 Corridor	Manufacturing, including chemical and steel manufacturing (ThyssenKrupp)	Unknown, but over 2,200 at just the largest employers
Theodore Ship Channel Area	Manufacturing	Unknown, but over 1,400 at just the largest employers

Source: Personal communication with Ginny Russell and Al Ruffin, Mobile Chamber of Commerce

Brookley Industrial Complex – The Brookley Industrial Complex is located by downtown Mobile, next to Mobile Bay. The complex includes 70 to 100 businesses that employ about 3,200 to 3,700 people (estimates vary). When fully developed, the industrial complex could support an additional 4,400 employees.

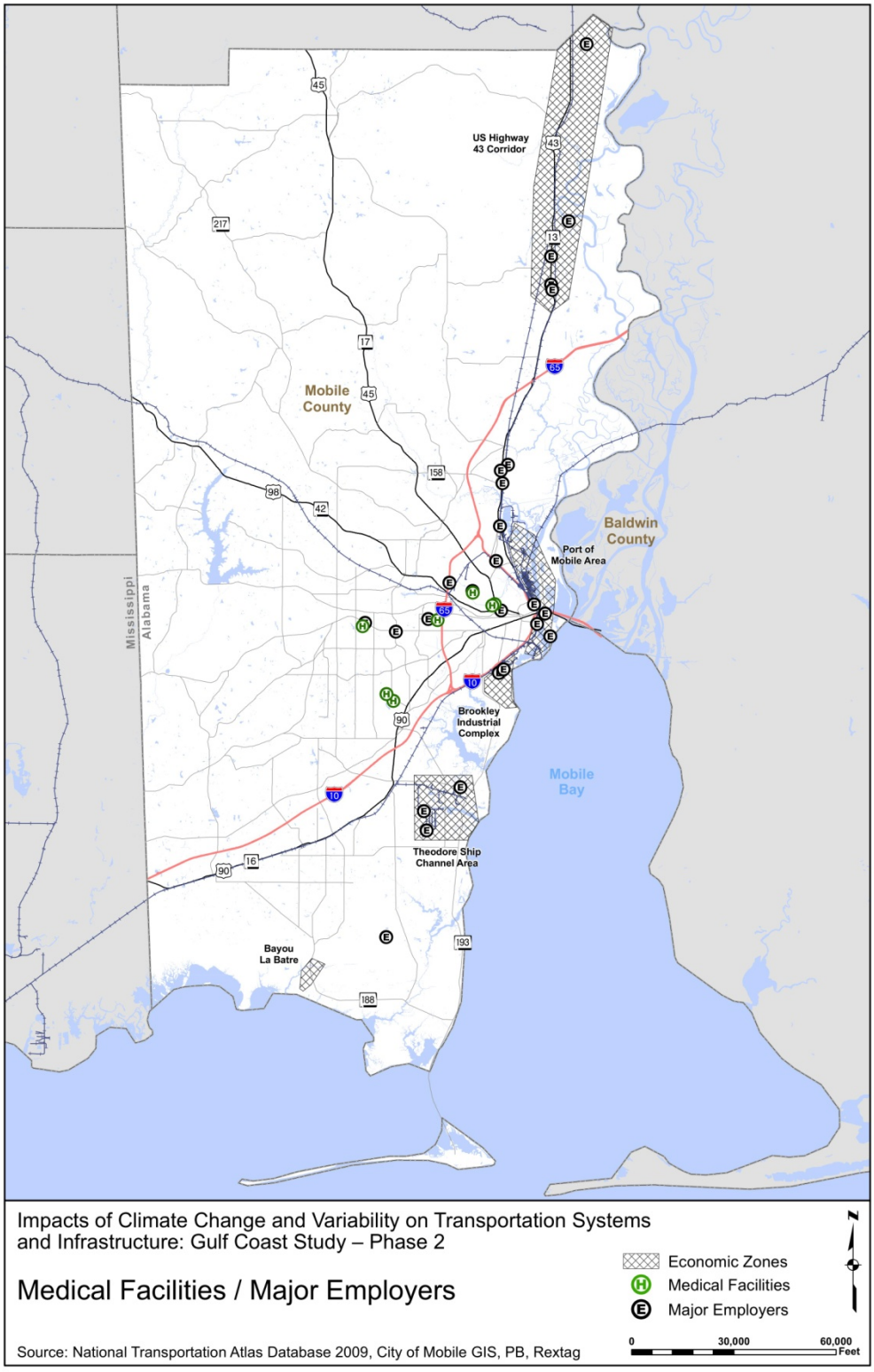
Port of Mobile Area – The Port of Mobile covers approximately 4,000 acres across several different complexes. The port itself employs about 570 people.[23] The widening of the Panama Canal, which is expected to be completed by 2014, is anticipated to increase traffic at the Container Terminal.

US Highway 43 Corridor – Extending north from Mobile, US 43 runs through Mobile County to Washington County. This corridor includes a number of manufacturing facilities, particularly chemical manufacturers. The new ThyssenKrupp steel manufacturing location (which will perhaps be one of Mobile's largest manufacturing facilities) is located along this corridor. This highway provides good access to the port and rail lines, as well as transport of freight to the north. Major employers include ThyssenKrupp, AL Power Barry Steam Plant, CIBA (BASF), SSAB Alabama, UOP, Olin, Arkema, Masland Carpet, and Dupont.

Theodore Ship Channel/Canal – This area is located in southern Mobile County and is on Mobile Bay. It is home to several manufacturing facilities, including Evonik Degussa (chemicals), Holcim (cement), Mitsubishi Polysilicon, and ExxonMobil.

[23] Source: Alabama State Port Authority, http://www.asdd.com/pdf/030810.pdf

Figure 11: Medical Facilities / Major Employers



Other Important Economic Centers

Two other economic centers within Mobile County, Bayou La Batre and Downtown Mobile, were included in this analysis. Bayou La Batre was added as a direct response to input provided by local stakeholders who provided information on the importance of the seafood industry to the Mobile area. Downtown Mobile is an important center for government and commerce.

Bayou La Batre Fishing Industry – The fishing industry in Bayou La Batre is an important economic driver for southern Mobile County and a cultural icon of the area. Total employment in the town is estimated at approximately 900, which includes fishing and seafood processing and wholesaling interests Bayou La Batre and Bayou Coden. While not a primary employment site, considering larger employers in the county, it remains an important economic driver in its distribution of seafood products to other areas of the US and internationally.

Downtown Mobile – Downtown Mobile has various government offices, businesses and cultural institutions. With about 6,260 employees, the downtown central business district (2007)[24], is the largest area of dense employment in the Mobile area.

[24] Source: SARPC (2007)

APPENDIX B METHODOLOGY APPLIED TO TEST SYSTEM REDUNDANCY

The analysis included a test to determine the availability of redundant capacity of the roadway network - using the SARPC MATS model for the year 2035. This analysis was performed on a series of selected links to represent various travel patterns within the study area. While neither the scope nor the budget permitted redundancy testing of every link in the system, the project team was able to assess redundancy of certain types of links (for example, links that connect housing and commercial areas) and then extrapolate the redundancy to the other links of the same type. The approach included the following steps:

1. Identification of links in the network that function as important connectors and represent a cross-section of roads of the same functional classification and general location. Links were chosen through a series of iterative steps, including:
    a) Identification of major roads servicing key facilities or economic centers.
    b) Identification of links both within and outside of the more heavily developed area, with the area east of University Boulevard being considered more developed than the area west of it.
    c) Identification of links that are representative of specific types of links (for example, links that are part of the arterial grid, segments that link housing and commercial areas, etc.)
2. For each selected network link, testing of the loss of that link by removing the capacity to travel that link.
3. Determination of whether the remainder of the network can function effectively, in terms of volume over capacity ratios during peak periods, or whether the impact is such that the remaining network could be considered to be at a condition where travel would be significantly affected.
4. Extrapolating the results of the tested links across the entire network to determine where redundancy exists. For example, the redundancy test for the representative link connecting housing and commercial areas indicated that this link was/was not highly redundant. Therefore, other links that connect housing and commercial areas in the same geographic area were also given a designation of highly redundant.

Findings from the analysis were used to develop a method for determining a score for redundancy for each link in the system. Those links whose loss resulted in LOS E or F conditions on the surrounding network were identified as having no system redundancy and therefore were assigned a score of 3. Those that had a medium effect were scored a 2 and those with little effect were scored a 1. Figure 12 depicts those network links that were tested to determine system resiliency.

A number of assumptions were needed to conduct the analysis. The MATS travel demand model produced daily trips, representing travel patterns in the study area; however, the question of system redundancy is more pertinent in the peak hours when the highest volumes are using the area's roadways. A methodology for conducting the test was discussed with SARPC staff, and the specific process for determining redundancy was developed.

The redundancy test made the following assumptions: the peak hour capacity for each link was equal to 9% of the identified daily capacity from the model; and the peak hour demand figure was equal to 10% of identified daily volume. These assumptions were identified in the forecasting model documentation, *Mobile Area Transportation Study – 2030 Transportation Plan – Model Documentation*.

Figure 12: Network Links Selected for Redundancy Test

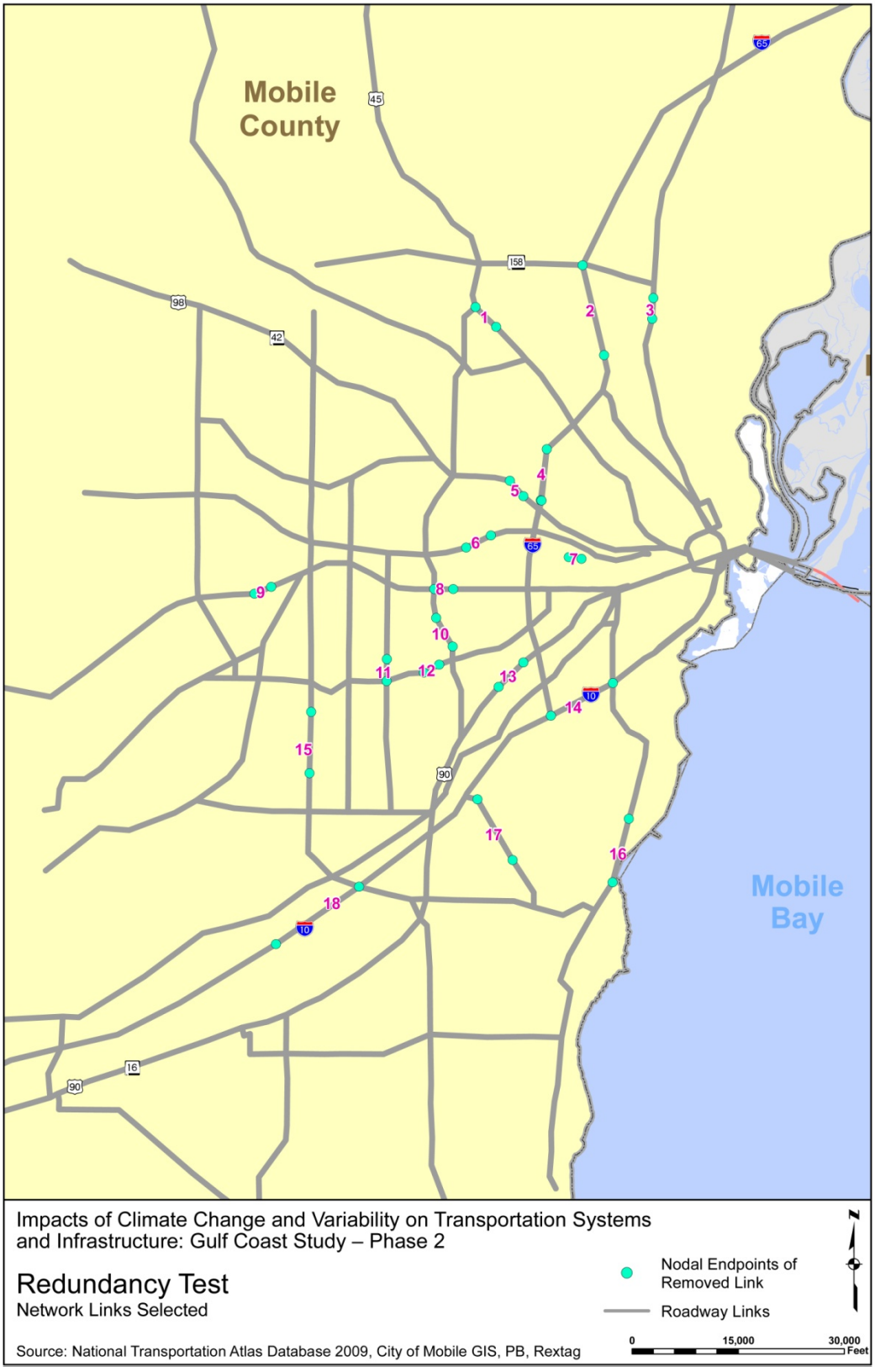


Figure 13 shows the before and after conditions, depicting peak hour level of service calculations for the roadway network in the area around I-10 near McDonald Road. The loss of link capacity on the interstate in this example results in substantial delays in the remainder of the network in the area of the link tested. This link was identified as having limited to no system redundancy available and therefore was identified as a more critical link for this measure than other links in the system.

Findings from this analysis led to a development of an understanding of the capacity of various segments of the roadway network and identified those segments at a general level where loss of a segment could be absorbed by the remaining network.

Figure 13: Before and After Redundancy Test of I-10 South of McDonald Road