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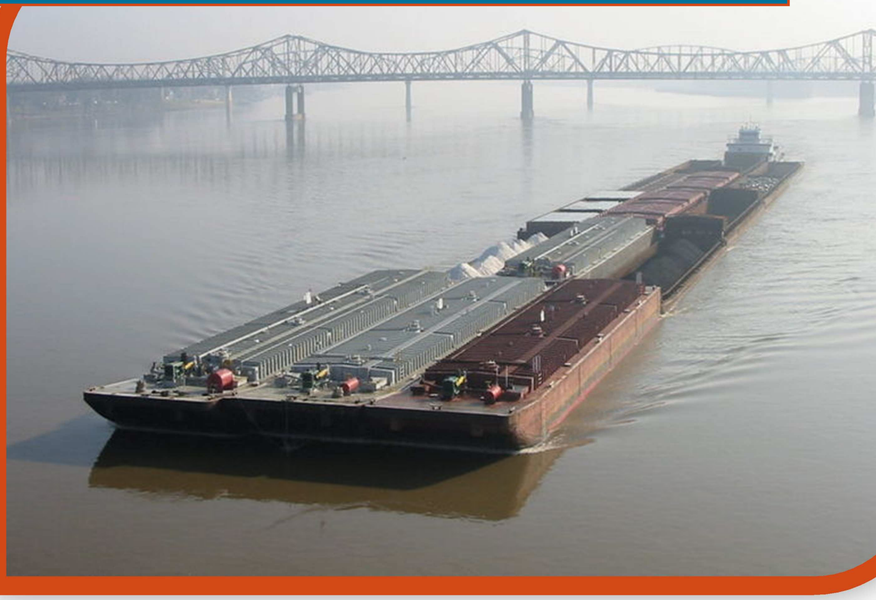
MBTC DHS 1106 – Emergency Response via Inland Waterways



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Abstract

Each catastrophic disaster has its own damage characteristics and emergency response requirements. Emergency planning involving transportation resources requires thorough contingency planning due to potential route destruction and excessive equipment demands. Incorporating multiple transportation modes into emergency operations plans is an obvious contingency action. Inland waterway transportation has the potential to provide emergency response services to a large geographic area of the United States. Our research provides a methodology to quantify the potential of communities to benefit from inland waterway emergency response through the development of a Waterway Emergency Services index and provides decision support to help emergency planners design an effective and efficient inland waterway-based emergency response system that will enhance their county-level emergency operations plans. The resulting methodology is implemented on a case study of a four state region along the lower Mississippi river region.

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1 Introduction

1.1 Research Motivation

Many emergency operations plans (EOPs) are based on the assumption that all standard means of transportation will be available and feasible when an emergency occurs. In severe cases, however, the disaster that initiates the EOP may disable emergency vehicles or destroy the roads and bridges that are vital to providing emergency response. As transportation security professionals prepare contingency plans for emergency response, it is important to recognize the resource offered by the nation's inland waterways. The United States has more than 26,000 miles of navigable waterways, which have the capability to be used in response to a variety of disasters across a large geographic area of the United States. For many communities, inland waterways can provide access to equipment and services when other means of transportation are unavailable due to capacity constraints or destruction. Inland waterways may be especially useful for emergency response in rural areas. Because of limited resources in rural communities, rural emergency planners must take an all-hazards approach to emergency planning across a large geographical area.

1.2 Research Objectives

In our previous research (Nachtmann and Pohl, 2010), a Waterway Emergency Medical Service (WEMS) index was developed to assist emergency planners in evaluating the potential of incorporating emergency medical response via inland waterways into their emergency operations planning. In this research we extend the WEMS index to expand from strictly medical emergency support to general emergency support by developing a decision support methodology to determine how many barges are required to provide a desired level of emergency response and where the barges should be initiated to provide maximum emergency response coverage.

The primary research objectives of this thesis are to:

1) Develop a waterway emergency service (WES) index to measure the potential of communities to

benefit from general inland waterway emergency response.

In our previous research (Nachtmann and Pohl, 2010), the focus was to provide emergency medical services via barge. Here we expand the developed WEMS index beyond medical services to identify and measure the capability of inland waterways to provide transportation support in general emergency response. Because of the nature and location of inland waterways, it is not feasible that every community can benefit from waterway-based emergency response. If the community is not located within a reasonable driving distance of a waterway it is more likely for people in that community to find other closer source of emergency services. To assess the potential of utilizing inland waterway emergency response services, we identify additional factors and utilize them to expand the WEMS index. These identified factors assess the emergency response capabilities of inland waterways for a given community. Through the development of a waterway emergency service index, this research provides insight into the number of communities that have access to inland waterways and their potential to benefit from waterway emergency response. Many communities have access to navigable inland waterways and potential to benefit from emergency response via barge. Barges travel slowly which may prevent the counties that are located far away from the starting location of the barge to receive emergency services via inland waterways. In addition, waterway-based emergency response is obviously limited to certain types of emergencies because of the relatively slow response time. In some cases, communities may spend weeks or even months recovering from catastrophic disasters such as tornadoes or earthquakes. In this research, emergency response is focused on response to catastrophic disasters and not immediate response to minor disasters such as building fires.

2) Provide decision support to emergency planners by developing a methodology to determine how many barges are required to provide a desired level of emergency response.

After identifying the capabilities of the inland waterways to provide emergency services and the communities that can benefit most from those services through the development of the WES index, we develop a methodology for determining the minimum number of barges required to provide emergency coverage to support communities that have the potential to benefit from inland waterway-based emergency response.

3) Provide emergency planning decision support by developing a methodology to best locate available barges to provide maximum inland waterway-based emergency response coverage for communities with the potential to benefit from inland waterway emergency support.

Covering all communities that have the potential to benefit from inland waterway emergency services may not be feasible due to limitations on the number of available barges. All emergency operation plans (EOPs) are faced with resource limitations. We provide a methodology that helps emergency planners to determine where to locate the available number of barges in order to provide a maximum level of coverage for communities with access to inland waterways.

4) Develop a multi-objective optimization methodology that combines objectives 2 and 3.

We develop a multi-objective optimization methodology which helps decision makers determine how many emergency response barges are required and where they should be located in order to provide the maximum level of waterway-based emergency response coverage. To achieve this objective we used goal programming approach. Goal programming is a branch of multi-objective optimization which in turn is a branch of multi-criteria decision analysis (MCDA). It is a method for handling multiple objectives which usually have conflicting measures. Each of these goals or measures is assigned a goal or target value to be achieved. Then the unwanted deviations from the goals or target values are to be minimized (Rardin, 1997). We used this approach to provide a methodology to study the tradeoffs of increasing the number of barges assigned to emergency response, with the increase in the level of waterway-based emergency response that will be provided.

5) Demonstrate our methodology on a four state region along the lower Mississippi river

In order to study across-state response system via inland waterways, we select four states, Arkansas, Louisiana, Mississippi, and Tennessee, along the lower Mississippi river region as our case. We collect the relevant data to demonstrate the use of our methodology on this region.

1.3 Research Contributions

This research contributes the first known systematic planning strategy to use barges on inland waterways to provide emergency response and the first known measurable index to allow emergency planners to evaluate the feasibility and potential benefit level of using inland waterways for emergency response in their community. We provide emergency planners with insight into inland waterways, an infrequently considered method of emergency response transportation that could be a useful as a supplementary means of transportation in many EOPs. After identifying the potential benefit of using inland waterways in emergency planning, the optimization-based methodology determine the number of barges required to provide the best possible waterways-based emergency support. The methodology also helps emergency response planners to determine the starting location of available barges to ensure that the communities with the potential to benefit from emergency response via inland waterways have maximum coverage. Our case study of the lower Mississippi region provides insight into the potential of communities within this region to benefit from inland waterway emergency response.

2 Literature Review

2.1 Emergency Planning

The United States has always placed a strong emphasis on emergency preparedness. Preparedness, as defined by the Department of Homeland Security (DHS), “addresses the full range of capabilities to prevent, protect against, and respond to acts of terror or other disasters” (Jenkins, 2006A). The Robert T. Stafford Disaster Relief and Emergency Assistance Act, signed into law November 23, 1988, states that federal, state, and local governments share a joint responsibility for emergency preparedness. The Act further states that the federal government should provide “necessary direction, coordination, and guidance” to ensure that an all-hazards emergency preparedness system is in place (Federal Emergency Management Agency (FEMA), 1988).

In response, the Federal Emergency Management Agency (1996) developed a comprehensive, risk-based, all-hazard approach to emergency planning entitled *Guide for All-Hazard Emergency Operations Planning* (*Guide*). Its purpose is to provide aid to state and local governments in developing a custom all-hazard EOP for their respective areas of jurisdiction. The advantage of an all-hazards approach to emergency preparedness is that it ensures “that the nation is better prepared for terrorist events while simultaneously better preparing itself to deal with natural disasters” (GAO, 2005). The *Guide* details the components necessary for a good EOP, and it identifies key personnel and resources that may be needed. The recommendations provided by the *Guide* are centered around the basic goal of emergency preparedness, which “is that first responders should be able to respond swiftly with well-planned, well-coordinated, and effective actions that save lives and property, mitigate the effects of the disaster, and set the stage for a quick, effective recovery,” as stated in the report *Emergency Preparedness and Response* (Jenkins, 2006A).

Larson et al (2006) studied five major emergencies/disasters: the Oklahoma City bombing (1995), the crash of United Airlines Flight 23 (1989), the sarin attack in the Tokyo subway (1995), Hurricane Floyd (1999), and Hurricane Charlie (2004). They discuss the July 19, 1989 crash of United Airlines Flight 232 as an excellent example of how an effective and practiced emergency response plan can save lives. The established Sioux City emergency plan was rehearsed annually with various disaster scenarios, enabling rescuers to “discern the weaknesses in their coordination efforts” and establish trust among the different branches.

Since the terrorist attacks of September 11, 2001 and the devastating Hurricane Katrina of 2005, emergency planning and response have become even higher priorities for the Federal government. With such a strong emphasis being placed on emergency preparedness, many emergency planners are seeking to identify areas in need of improvement. A search of emergency planning literature reveals *Catastrophic Disasters*, a report from the United States Government Accountability Office (GAO), which discusses the Federal government’s response to Hurricane Katrina and identifies areas of improvement in the nation’s "readiness to respond to a catastrophic disaster" (GAO, 2006). Emphasizing the importance of emergency planning, the *Catastrophic Disasters* report states that "catastrophic disasters involve extraordinary levels of mass casualties, damage, or disruption that likely will immediately overwhelm state and local responders, circumstances that make sound planning…all the more crucial." *Catastrophic Disasters* goes on to state that to improve the nation's preparedness for and response to disasters, plans should "detail what needs to be done, by whom, how, and how well" (GAO, 2006). This point is reiterated in another GAO report titled *Homeland Security: Assessment of the National Capital Region Strategic Plan*, which notes that one desirable characteristic of a strategic plan is identification of "organizational roles, responsibilities, and coordination" (Jenkins, 2006B).

2.1.1 Transportation in Emergency Planning

Transportation plays a key role in emergency planning. The movement of supplies and people is a vital component of any emergency response effort, as seen in FEMA's *Guide*. A key component of an EOP's basic plan is *Administration and Logistics*, a section that provides policies for managing the flow of resources such as materials and people. The *Guide* also lists *Evacuation* as one of the functional annexes that should exist in an effective EOP (FEMA, 1996). Effectively moving large groups of people during an emergency situation involves careful transportation planning. *Search and Rescue* is another critical part of any EOP. The *Guide* states that search and rescue teams are responsible for assisting trapped or injured persons, providing first aid, and "assisting in transporting the seriously injured to medical facilities." Emphasizing the significance of transportation, a GAO report titled *Agency Plans, Implementation, and Challenges Regarding the National Strategy for Homeland Security* identifies transportation as an important focus of the country's critical infrastructure protection effort (GAO, 2005).

Cheng and Lu (2008) define an emergency logistics system as modern information and communication technology as well as transportation, packaging, loading and unloading, handling, storing, circulating processing, distribution and information processing operations. The goal of an emergency logistics system is to make the best possible use of available emergency resources to gain maximum economic and social benefit during a reasonable time. Transportation is an important part of an emergency logistics system and is necessary to deliver emergency relief materials, rescue personnel, and medical supplies. Ambulance availability, ambulance coordination, and patient transportation are other examples of transportation needs in emergency response, and each need should be considered when developing an EOP.

Proper planning in this area can save lives. This is demonstrated by Larson et al. (2006) who analyze responses to several major emergencies in recent history. In the aftermath of the 1989 crash of United Airlines Flight 232 at the Sioux City airport in Iowa, excellent planning by police and emergency medical personnel expedited the transfer of victims injured during the crash. Mutual aid agreements between Sioux City and its neighboring communities allowed all available emergency vehicles in the surrounding area to be ready and waiting at the airport to transport injured passengers (Larson et al, 2006). In addition, police set up road blocks on the highway between the airport and the hospital, allowing the ambulances to travel much faster. “The first victims arrived at the hospital less than 16 minutes after the plane crashed while the last victim arrived within 40 minutes of the crash” (Larson et al, 2006). Proper planning in the area of transportation allowed authorities to respond quickly and efficiently, thus mitigating the effects of this deadly disaster.

While the importance of transportation is apparent in much of the emergency planning literature, very little documentation exists on emergency planning with a focus on transportation. The literature does reveal, however, that most EOPs are based on the assumption that all standard means of transportation will be available to respond to a disaster. However, tornadoes, mudslides, earthquakes, and other disasters can destroy vital roadways and bridges and disable emergency vehicles. There is little or no mention of contingency planning when the standard modes of transportation are destroyed or disabled. In natural disasters, often the damage to the transportation infrastructure can cause limited accessibility to area. If transportation and distribution operations fail, the capacity and efficiency of the emergency response activities will be drastically affected. While the initial stages of transportation in an emergency often rely on airlift, as urgency of the situation subsides, other modes of transportation, such as water, may become feasible alternatives. There is available literature for air based transportation such as Barbarosoglu et al. (2002) whose mathematical model for helicopter mission planning during a disaster relief operation is frequently cited. There is very little information found in the literature on water-based emergency transportation planning.

2.1.2 Emergency Planning in Rural Communities

There is limited research on emergency planning for rural areas, perhaps due to the relatively low population levels of rural areas as compared to urban areas. The literature focuses on high population areas where disasters are likely to affect large amounts of people. However, according to the Economic Research Service (ERS) of the United States Department of Agriculture (USDA), nonmetropolitan areas in the U.S. account for 2,052 counties, contain seventy-five percent of the Nation's land, and include seventeen percent of the U.S. population (ERS, 2003). Because these areas represent such a large physical portion of the country and are home to nearly fifty million U.S. citizens, emergency planning should play an obvious and important role in rural communities. In addition, rural areas must be able to adequately handle a "migration of large populations displaced from urban areas" after a disaster (Furbee et al., 2006). While emergency planning is important in both urban and rural settings, the planning process is different for each area.

Challenges exist in rural emergency planning because rural areas differ greatly from urban areas. For rural areas, population densities are lower, mass transit is virtually non-existent, and resources are often more scarce. Even among rural areas, differences exist. Some rural areas lie in a flood plain, others lie on a fault line, and some lie near both. Some rural areas are manufacturing communities, while others are agriculture-based. The dissimilarities between rural and urban environments suggest that emergency plans for rural areas should likely differ from emergency plans for urban areas. Further, differences are likely to exist even among individual rural emergency plans.

2.1.3 Challenges of Emergency Planning

Effective emergency planning is not a simple task. There are many challenges involved in planning for the preparedness, response, and recovery process. Cutter et al. (2003) focus specifically on the social impacts of disasters, arguing that some communities are more socially vulnerable than others. Social vulnerability is described as the social, economic, demographic, and housing characteristics that influence a community's "ability to respond to, cope with, recover from, and adapt to hazards" (Cutter et al., 2003). Each factor affects the vulnerability of each community differently. Because every community is unique, differences in these factors result in a different social vulnerability index (SoVI) for each community, thus further complicating the emergency planning process.

Additional challenges arise when adapting an all-hazards approach to emergency planning. These include proper identification of potential emergencies and the requirements for appropriate response, "assessing current capabilities against those requirements," and developing effective and coordinated plans among first responders (GAO, 2005). In its response to the GAO report *Catastrophic Disasters* (2006), DHS comments on the difficulties faced in emergency planning. "Since resources are finite…tough choices must be made about how to allocate the human and financial resources available to attain the optimal state of preparedness." The same report identifies another problem faced in emergency planning. As indicated by the varying SoVIs of U.S. communities, the diversity of areas across the United States complicates large scale emergency planning. "Because different states and areas face different risks, not every state or area should be expected to have the same capability to prepare for a catastrophic disaster" (GAO, 2006). With each community having its own set of unique characteristics, it is important for emergency planners to consider all the resources that may be available to their communities. A community with access to a navigable river, for example, should consider the waterway's potential use as a means of emergency transportation support.

2.2 Transportation in Emergency Response

Emergency response is clearly dependent on transportation. In order for first responders to reach disaster areas quickly, nearly every mode of transportation may be utilized. County roads, city roads, highways, and bridges are used every day for emergency response. Fire trucks, ambulances, buses, tractor-trailers, off-road vehicles, and even helicopters are used to transport emergency workers, accident victims, and medical supplies. The underlying assumption for everyday emergency response is that these common forms of transportation will be readily available. But what if a catastrophic disaster renders the roadways unusable? What if an earthquake destroys the only bridge on a major thoroughfare? What if thousands of isolated people need assistance and only a few helicopters are available to transport supplies and victims? To address these open questions we ask: What is the feasibility of bringing the required supplies, machinery and services to the victims via inland waterways? A waterway emergency response system could do just that.

2.3 Inland Waterways

Inland waterways are a tremendous asset to the United States, providing the most economically and environmentally sound mode of moving goods and commodities. The United States has over 26,000 miles of navigable waterways that are used to transport millions of tons of cargo every day. In fact, U.S. waterborne trades over inland waterways amounted to 522.5 million short tons in 2009 alone (USACE, 2010). The nation’s waterways are used to transport approximately 20% of America’s coal, which produces 10% of all electricity used annually, 22% of U.S. petroleum and petroleum products and 60% of the nation’s farm exports (USACE, 2009). The water transportation industry accounts for about 15% of the nation’s commerce but is responsible for only 2% of America’s freight costs (Morton, 2002).

Inland waterways offer a very cost-effective mode of transportation. The typical cost per ton-mile for a barge is approximately $1.00, compared to $2.53 for rail, and $5.35 for trucking (Nachtmann, 2001). Water transportation also offers a fuel efficient advantage over rail and truck transportation. The number of miles one ton of cargo can be carried per gallon of fuel by a barge is approximately 514 miles, as compared to 202 miles by train, and fifty-nine miles by truck (Nachtmann, 2001). Other benefits of water transportation include:

- It is the safest way to ship chemicals and toxic materials.
- It does not contribute to noise pollution,
- It does not contribute to land congestion,
- Its economical shipping costs reduce raw material costs and thus the cost of final consumer goods, and
- Industries that use barge transportation typically pay above average wages (Nachtmann, 2001).

History reveals that some barges have been used to provide medical services. In New York City, a barge served as a floating hospital providing free medical and dental care to low income families from 1866 until just recently. Tickets were mailed to eligible families, and the vessel would set sail during the summer months while children were out of school (New York Times, 1988). Barges have also been used to provide medical services to the military. During World War I, British troop casualties were evacuated via floating hospital barges. The slow speed of the vessel actually proved to be useful for the injured troops, allowing them to recover before arriving at their destination (Quaranc, 2009). The New Hampshire Public Service has used a floating power plant in one of the discarded hulls of World War I, the "Jacona" to supplement power output at various points of its system in Northeast (Wecksler, 1942). The floating power barge could move over the Great Lakes, Illinois River, Mississippi River, and along the intercoastal canal system of Gulf State to firm up the power at regions along these waterways. Also, as part of a recovery efforts in the wake of the recent January 2010 Haiti earthquake, tugs and barges participated in the vast international relief operation, carrying large volume supplies of food and aid to help ease some of the shortage (Navy Times, 2010).

2.4 Waterways Emergency Medical Services (WEMS) Index

In our previous research (Nachtmann and Pohl, 2010), a set of factors were identified to describe the potential benefit of waterway emergency medical response to a given community. The factors were combined into a Waterway Emergency Medical Service (WEMS) Index that guides emergency planners in determining the feasibility of using barge-based medical response in their emergency planning. The WEMS index represents the extent to which a particular community could potentially benefit from inland waterway emergency medical response.

Six factors were identified as important to determining a community's WEMS index value. Each county gets a value on each of the factors based on the level of potential that the county has to benefit from inland waterways-based emergency response with respect to that factor. After a factor value is determined for all six factors, the overall WEMS index value is calculated for a given community using Equation 1.

$$WEMS\ Index\ Value = A(P + PD + V + R + M) \quad (1)$$

$$where\ A = Accessibility\ to\ Navigable\ Waterway\ score$$

$$P = Proximity\ to\ Barge\ Origin\ score$$

$$PD = Population\ Demands\ score$$

$$V = Social\ Vulnerability\ score$$

$$R = Risk\ of\ Disaster\ score$$

$$M = Limited\ Access\ to\ Medical\ Services\ score$$

After the WEMS index methodology was developed, a case study of the counties in the state of Arkansas was performed to demonstrate the use of the WEMS index and evaluate the extent to which Arkansas counties could potentially benefit from barge-based emergency medical response.

Figure 1 is the resulting map which presents the WEMS Index values for all Arkansas counties. It depicts each county in Arkansas and whether the county has no, low, medium, or high potential to benefit from water-based emergency medical response as described by its WEMS Index value.

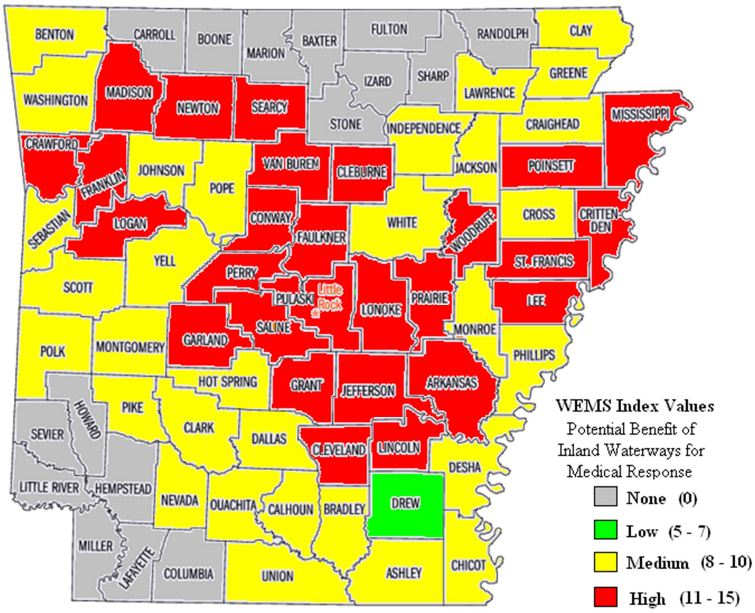

Figure 1: WEMS Index Values

There are sixteen counties in Arkansas that are more than a three hour drive from public ports on navigable inland waterways, making the use of inland waterways infeasible for emergency medical response. These counties have a WEMS index of zero and, as can be expected, are located primarily in the southwest and north-central regions of the state away from the Arkansas and Mississippi Rivers. However, all of the sixteen counties with no inland waterway access still show a medium or high need for waterway-based medical assistance based on the other WEMS factors. If private or out of state ports were taken into consideration, these counties could potentially have access to a navigable inland waterway, and thus benefit from water-based emergency response services. Only one county in Arkansas has a WEMS index less than eight (low potential). Thirty one counties have medium potential to benefit from inland waterway medical response. There are a total of twenty seven counties with high WEMS Index values including Pulaski County where the state capital is located in, resulting in a total of fifty eight counties (77%) with at least medium potential to benefit from these services.

2.5 Operations Research in Emergency Preparedness

An objective of this research is to provide emergency planning decision support by developing a methodology to determine how many barges are required to provide a desired level of emergency response and where the barges should be located to provide maximum emergency response coverage. Operations research (OR) is the main tool that helped us achieve this objective.

Operations research is the science that can have significant application in managing disaster preparedness plans and actual responses to disasters. Winston (1994) defines operations research as a scientific approach to decision making, which seeks to determine how best to design and operate a system usually under conditions requiring the allocation of scarce resources. This definition describes what we are proposing to do in our research: providing a scientific approach to help emergency planners design the best possible waterway emergency response system using their available resources.

Larson et al. (2006) address the application of operations research as a tool to help decision makers improve preparedness for and respond to an emergency situation. The areas that they found OR to be applicable include: supply and equipment prepositioning, 911 call handling, evacuation decisions, personnel scheduling, near-the-scene logistics, and telephone and radio congestion reduction. Two of the mentioned areas are related to the purpose of this study. Prepositioning supplies and equipment requires identification of possible emergencies in communities. For those emergencies with higher risk, the emergency planners need to identify required emergency response facilities and equipment. Using facility location theory as an OR tool identifies the optimal locations for those facilities. In our study, the barges are the facilities that we are considering using in emergency response; therefore we need to find the best possible ports to locate the emergency response barges to provide maximum possible response coverage to communities. In Larson et al. (2006), possible destruction of located facilities, possible inaccessibility of transportation pathways, the proximity of facilities (such as hospitals) to others are mentioned as elements that should be incorporated in planning emergency response related to homeland security.

Considering these mentioned elements strengthens the idea of using inland waterways as a transportation pathway in case of disaster.

Altay and Green (2006) employed several different classifications to study the available literature related to application of OR in disaster operation management. Their classification based on the methodologies available in literature reveals that various OR application methods such as math programming, probability and statistics, simulation, decision theory, queuing theory, fuzzy sets, stochastic programming, experts systems and AI, system dynamics, constraint programming and soft OR have been used in disaster operation planning. We anticipate that this proposed research will use facility location modeling as an OR tool to develop a methodology for determining the optimal emergency response system via inland waterways.

3 Methodology

3.1 Waterways Emergency Services (WES) Index

We conduct a feasibility analysis of providing disaster relief services by barge via inland waterways. Our goal for the feasibility analysis is to develop a set of factors that describe the potential of a given county to benefit from inland waterway emergency response. We identified seven factors that are important to determine a county's WES index value. Table 1 contains a description of each factor and its corresponding metric and scale that is used to compute a county's WES index value. The WES index represents the potential level that each county can benefit from inland waterway-based emergency service.

Table 1- WES Index Factors

Factor	Description	Metric	Scale	Total	Value
Accessibility to Navigable Inland Waterway	Proximity of a community to a navigable inland waterway. Emergency response is not feasible for communities located too far from a navigable inland waterway.	Distance between county population centroid and closest inland port/terminal	Accessible (≤ 3hr drive @ 35mph) = 1		1
			Inaccessible (> 3hr drive @ 35 mph) = 0		0
Population Demands	Size of population and its proximity to metropolitan areas. Important for identifying the level of services that may be needed during an emergency.	Rural-Urban Continuum Code	Low (7 - 9)		1
			Med (4 - 6)		2
			High (1 - 3)		3
Social Vulnerability	Social, economic, demographic, and housing characteristics that influence a community's ability to respond to, cope with, recover from, and adapt to environmental hazards. Useful for identifying which counties may need the greatest assistance during an emergency.	National percentile ranking of the Social Vulnerability Index (SoVI)	Low (0.01 - 33.33)		1
			Med (33.34 - 66.66)		2
			High (66.67 - 99.99)		3
Risk of Disaster	The risk of tornado, earthquake, flood, or terrorist attack. Useful for identifying which counties are most likely to need inland waterway-based emergency assistance.	Combined risk level of tornado, earthquake, flood, and terrorism	**Tornado**: Low (<2.5), Med (2.5 - 4.99), High (≥5)	Low (4 - 6)	1
			Earthquake: Low (<20), Med (20 - 79.9), High (≥80)	Med (7 - 9)	2
			Flood: Low (<3), Med(3 - 4), High (>4)	High (10 - 12)	3
			Terrorism: Low = 1 , Med = 2, High = 3		
Limited Access to Medical Services	Number of community hospital beds per 100,000 people, available in the areas. Important for identifying the neccessity of medical services that may be brought to the area during an emergency.	Number of community hospital beds per 100,000 people	Low (>317)		1
			Med (1 - 317)		2
			High (0)		3
Limited Access to Resources	Availability of resources including clean water supply, power supply, temporary housing, and fuel supplies. This factor is important in identifying the neccessity of providing resources via barge.	Combined availability level of water supply and irrigation systems; electric power generation, transmission, & distribution; number of hotels, motels, B&B, other travel accommodation, RV parks and camps, rooming and boarding houses; number of gasoline station establishments. To be consistent, all the metrics are measured per 100,000 people.	**Clean Water**: Low (>8), Med (1 - 8), High(0)	Low (4 - 6)	1
			Power: Low (>7), Med (1 - 7), High(0)	Med (7 - 9)	2
			Temporary Housing: Low (>23), Med (1 - 23), High(0)	High (10 - 12)	3
			Fuel: Low (>67), Med (1 - 67), High(0)		
Limited Access to Transportation Modes	Accessibility to railroad system or airports. If a county does not have easy access to other modes of transportation it has higher potential to benefit from waterway-based transportation.	Railroad passes through the county and/or at least on public airport is located in the county	Both railroad and airport(s) are accessible		1
			Railroad or airport is accessible		2
			Neither railroad nor airport is accessible		3

- Accessibility to Navigable Inland Waterway

A community that is located hundreds of miles from the nearest navigable inland waterway does not stand to benefit significantly from WES. In contrast, a community that is located directly on a navigable river could potentially benefit greatly from water-based assistance in the event of a disaster. Although ground-based vehicles could possibly be transported and deployed by a barge, the effective range of the watercraft is still limited to navigable waterways. We consider emergency assistance via an inland waterway to be infeasible if a community is located more than a three hour drive from the nearest navigable waterway with an assumed driving speed of thirty-five miles per hour. For the purposes of calculating the WES index, the *Accessibility to Navigable Inland Waterway* factor is divided into two categories: Accessible (≤ 3 hours of driving time) and Inaccessible (> 3 hours of driving time). Counties classified as Accessible or Inaccessible receive a score of one or zero respectively.

- Population Demands

It stands to reason that the larger the population, the larger the need for emergency assistance during and after a disaster. This factor helps to establish the need for emergency assistance based on a community's population and proximity to population centers. We define the metric for the *Population Demand* factor as the rural-urban continuum codes which are produced by the United States Department of Agriculture (USDA) Economic Research Service (ERS). "Rural-Urban Continuum Codes form a classification scheme that distinguishes metropolitan (metro) counties by the population size of their metro area, and nonmetropolitan (nonmetro) counties by degree of urbanization and adjacency to a metro area or areas. The metro and nonmetro categories have been subdivided into three metro and six nonmetro groupings, resulting in a nine-part county codification. The codes allow researchers working with county data to break such data into finer residential groups beyond a simple metro-nonmetro dichotomy, particularly for the analysis of trends in nonmetro areas that may be related to degree of rurality and metro proximity" (ERS, 2004B). Each county is given a code based on a scale from one to nine. The ERS defines each code in Table 2 (ERS, 2004B).

Table 2: Rural-Urban Continuum Codes

2003 Rural-Urban Continuum Codes	
Code	**Description**
Metro counties:	
1	Counties in metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population
3	Counties in metro areas of fewer than 250,000 population
Nonmetro counties:	
4	Urban population of 20,000 or more, adjacent to a metro area
5	Urban population of 20,000 or more, not adjacent to a metro area
6	Urban population of 2,500 to 19,999, adjacent to a metro area
7	Urban population of 2,500 to 19,999, not adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area

While the ERS provides codes on a scale of one to nine, for the *Population Demands* factor, we group the county codes into three categories: high (1-3), medium (4-6), and low (7-9). In order to calculate the WES index, counties classified as high, medium, or low will receive a score of three, two, or one respectively.

- Social Vulnerability

The social vulnerability of a community increases its need for emergency response services. "Generally defined, vulnerability is the potential for loss of life or property due to hazards. Social vulnerability is represented as the social, economic, demographic, and housing characteristics that influence a community's ability to respond to, cope with, recover from, and adapt to environmental hazards. County-level socioeconomic and demographic data were used to construct an index of social vulnerability to environmental hazards, called the Social Vulnerability Index (SoVI) for the United States based on 1990 data" (Hazards and Vulnerabilities Research Institute, 2008B).

The factors that are considered in the SoVI can be found in Table 3 (Cutter et al., 2003):

Table 3: SoVI Factors

Factor	Description
Personal Wealth	Wealth enables counties to absorb and recover from losses
Age	Children and elderly are most affected by disaster
Density of the Built Environment	Significant structural losses might be expected from a hazard event
Single-Sector Economic Dependence	Singular reliance on one economic sector creates economic vulnerability
Housing Stock and Tenancy	Quality and ownership of housing impacts displacement from damage
Race and Ethnicity	Racial and ethnic disparities affect access to resources and cultural difference
Occupation	Counties heavily dependent on lower wages service occupation might face slower recovery
Infrastructure	Infrastructure affects ability to divert resources in time of need

SoVI data is readily available for all U.S. counties (Hazards and Vulnerabilities Research Institute, 2008A). The database also provides the national percentile ranking for each county, which is used to categorize the counties for calculation of the WES index. For our purposes, a county with a low, medium, or high *Social Vulnerability* has a national percentile rank in the range of 0.01 to 33.33, 33.34 to 66.66, or 66.67 to 99.99 respectively. Counties with a low, medium, or high percentile are given scores of one, two, or three respectively.

- Risk of Disaster

Emergency response barges may only be effective or viable for certain types of emergencies or disasters. If a certain community is not likely to have any of these specific occurrences, then it may not benefit from the services that could be offered by the barge. We divide the *Risk of Disaster* factor into four subfactors including the risk levels for tornado, earthquake, flood/hurricane/tropical storms, and terrorist attack. The risk for each of the four disaster types can be categorized as low, medium, or high. A low rating is given a score of one, a medium rating is given a score of two, and a high rating is given a score of three. A community's overall *Risk of Disaster* level is determined by summing the individual values of its risk levels for tornado, earthquake, flood/hurricane/tropical storm, and terrorist attack. For the WES index, the *Risk of Disaster* factor is divided into three categories: low (4-6), medium (7-9), and high (10-12). Communities with overall risk levels of low, medium, or high will receive scores of one, two, or three respectively. These risk levels can be determined by the emergency planner developing the WES index based on their knowledge of their community's vulnerability to catastrophic events. Other types of disasters could be incorporated in the *Risk of Disaster* factor if deemed important.

- Limited Access to Medical Services

Medical services are one of the important emergency response services that could be provided on a barge via inland waterways. *Limited Access to Medical Services* measures the potential need for medical assistance from a barge based on the current availability of medical services in a community. Counties with limited access to medical services have a greater potential to benefit from an emergency barge. This factor is measured as the number of community hospital beds per 100,000 people in 2004 (U.S. Census Bureau, 2007). This data is readily available for each county in the United States. We use the average number of hospital beds per 100,000 people for the counties in the region of study as our breakpoint. For our purposes, we are considering the counties with zero hospital beds per 100,000 people to have a high potential of benefiting from an emergency response barge, counties with one to region's average number of community hospital beds per 100,000 people to have medium potential, and counties with more than region's average number of community hospital beds per 100,000 people to have low potential. Counties with a low, medium, or high potential are given scores of one, two, or three respectively.

- Limited Access to Resources

The availability of life sustaining resources in a community represents the potential need for a response barge that can provide relief resources in case of an emergency. We identified four types of resources that could be provided on a barge; Clean Water Supply, Power Supply, Temporary Housing, and Fuel Supplies. In order to quantify each of these subfactors we defined metrics for each one. We used the Census Bureau (2008) data for number of water supply and irrigation systems establishments per 100,000 people of a county as a measure for water supply resources, number of electric power generation, transmission, & distribution establishments per 100,000 people of a county as a measure for power supply resources, number of hotels, motels, B&B, other travel accommodation, RV parks and camps, rooming and boarding houses per 100,000 people for temporary housing supply resources, and number of gas station establishments per 100,000 people of a county as a measure for fuel supply resources. Then we categorized the counties as having low, medium, and high limited access to each of these resources. A low rating is assigned a score of one, a medium rating is assigned a score of two, and a high rating is assigned a score of three. A community's overall *Limited Access to Resources* level is measured by summing the individual values of its subfactors for limited clean water supply, power supply, temporary housing, and fuel supplies. For the WES index, the *Limited Access to Resources* factor is divided into three categories: low (4-6), medium (7-9), and high (10-12).

- Limited Access to Transportation Modes

If multiple modes of transportation are accessible to a community, the risk of all transportation modes being destroyed is less. The presence of airports or railroads in a region will make it less likely for a county to require emergency response from inland waterways. We categorized a county that has access to both rail and air transportation to have low potential to benefit from barge-based emergency response, and we assigned a score of one to that county for this factor. If a county has access to only rail or air transportation, then the county is categorized as having medium potential and gets a score of two for this factor. A county that does not have access to railroad or airport is considered to have high potential to benefit from barge-based emergency response with respect to this factor and therefore gets a score of three.

After defining each of the factors, the WES index is defined as follows:

$$WES\ Index\ Value = A(PD + V + R + M + LR + T) \qquad (2)$$

$$where\ A = Accessibility\ to\ Navigable\ Waterway\ score$$

$$PD = Population\ Demands\ score$$

$$V = Social\ Vulnerability\ score$$

$$R = Risk\ of\ Disaster\ score$$

$$M = Limited\ Access\ to\ Medical\ Services\ score$$

$$LR = Limited\ Access\ to\ Resources\ score$$

$$T = Limited\ Access\ to\ Transportation\ Modes\ score$$

The possible values for the WES index are: 0, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18. An index value of zero indicates that the county is not within a three hour drive of a public port on a navigable inland waterway, and therefore it is not feasible for that county to benefit from emergency response via inland waterway. An index value of 6, 7, 8, or 9 indicates that the county has low potential to benefit from inland waterway emergency services. An index value of 10, 11, 12, or 13 indicates that the county has medium potential to benefit from inland waterway emergency services. An index value of 14, 15, 16, 17, or, 18 indicates that the county has high potential to benefit from inland waterway emergency services. In order for a county to fall into the category of counties that have high potential to benefit from this system, the county must have at least two high scores on its index factors. For example a county with medium level of population demands, medium social vulnerability, high risk of disaster, medium level of limited access to medical services, medium level of limited access to resources, and high level of limited access to transportation modes will have a WES index of 14 and will have high potential to benefit from inland waterways emergency response.

Table 4 contains the data sources for WES index factors.

3.2 Optimal Inland Waterway Emergency Response System

We assume that a county can only benefit from emergency response services via barges on inland waterways if the barge can get to an accessible port of that county within a reasonable amount of time (12 hours). For this reason the ports where the emergency response barges are initially located are an important design variable. To use our methodology, the emergency planner needs to set a coverage range for the emergency response barges. Each emergency response barge is assumed to provide emergency response service to the ports that are within the defined coverage range. In this research, we define the base coverage range for an emergency response barge to be 12 hours, which means that a county is considered to have waterway-based emergency response coverage if a barge can get to an accessible port for that county in less than 12 hours assuming a barge travels speed of 115 river miles per day.

Table 4: Data Sources for WES Factors

Factor	Description	Source(s)
Accessibility to Navigable Inland Waterway	Proximity of a community to a navigable inland waterway. Emergency response is not feasible for communities located too far from a navigable inland waterway.	Arkansas Waterways Commission (2009B), Google Maps, U.S. Census Bureau (2001, 2009)
Population Demands	Size of population and its proximity to metropolitan areas. Important for identifying the level of services that may be needed during an emergency.	Economic Research Service (2004)
Social Vulnerability	Social, economic, demographic, and housing characteristics that influence a community's ability to respond to, cope with, recover from, and adapt to environmental hazards. Useful for identifying which counties may need the greatest assistance during an emergency.	Hazards and Vulnerability Research Institute (2008)
Risk of Disaster	The risk of tornado, earthquake, flood, or terrorist attack. Useful for identifying which counties are most likely to need inland waterway-based emergency assistance.	www.tornadoproject.com
		US Geological Survey (2009)
		Federal Emergency Management Association (2008)
		US Energy Information Administration (2010) Department of Defense (2009)
Limited Access to Medical Services	Number of community hospital beds per 100,000 people, available in the areas. Important for identifying the neccessity of medical services that may be brought to the area during an emergency.	US Census Bureau (2007)
Limited Access to Resources	Availability of resources including clean water supply, power supply, temporary housing, and fuel supplies. This factor is important in identifying the neccessity of providing resources via barge.	US Census Bureau (2008)
		US Census Bureau (2008)
		US Census Bureau (2008)
		US Census Bureau (2008)
Limited Access to Transportation Modes	Accessibility to railroad system or airports. If a county does not have easy access to other modes of transportation it has higher potential to benefit from waterway-based transportation.	National Transportation Atlas Data Base (2010)

Here we use three different approaches towards our goal of developing an optimal emergency response system via inland waterways. This phase of the research corresponds to the second, third, and fourth research objectives discussed in Section 1.2. First we develop a set covering model to determine the number of required barges and a maximal covering model to locate the response barges in order to provide maximum WES coverage considering the resource limitations. Then we develop a multi-objective optimization model using a goal programming approach to combine the two single objective models.

3.2.1 Model Notation

Here we need define the notation that is used to develop the optimization models.

There are two sets defined in this problem:

C Set of counties, indexed by *i*

P Set of ports, indexed by *j* and *k*

Parameters defined for this problem are:

a_{ij} 1 if county *i* has access to port *j* (less than 3 hours drive), 0 otherwise

d_{jk} 1 if port *j* is within the coverage range of port *k* (12 hours), 0 otherwise

n Number of available barges

R_i Value of risk of disaster factor for county *i*

S_i Value of social vulnerability factor for county *i*

m Number of ports

w_i WES index value for county *i*

Variables defined in order to model the problem are:

x_i 1 if county *i* is covered, 0 otherwise

y_j 1 if there is a barge at port *j*, 0 otherwise

3.2.2 Minimum Number of Required Barges Model

In our second research objective, the goal is to determine the minimum number of barges required to provide a certain level of emergency response coverage to the communities that have potential to benefit from inland waterway-based emergency response based on the WES index. Our optimization model helps emergency planners determine the minimum number of required barges as well as the starting ports to locate the barges. The goal is to use as few barges as possible in order to provide a desired level of inland water-based emergency response coverage to counties that have access to at least one port on an inland waterway.

The objective function (3) minimizes the number of the required barges.

$$Min \sum_{j \in P} y_j \qquad (3)$$

Constraint (4) relates upper bound of variable x_i to variable y_j. It makes sure if a county is not covered under the defined rules, x_i must be less than or equal to zero.

$$x_i \leq \sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \qquad \forall i \in C \qquad (4)$$

Constraint (5) relates lower bound of variable x_i to variable y_j. It guarantees that variable x_i must be strictly greater than zero when a county is covered under the defined conditions. Since variable x_i is a binary variable, when it is strictly greater than zero, it is set to 1.

$$\sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \leq m x_i \qquad \forall i \in C \qquad (5)$$

Optional constraint (6) verifies that all the counties must be covered. This constraint is included in the model when the emergency planner requires all of the counties to be covered. Otherwise coverage requirements can be specified by other factors of WES index. Optional constraints (7) and (8) are presented as examples of additional factor specific coverage requirement constraints.

$$x_i = 1 \qquad \forall i \in C \qquad (6)$$

Optional constraint (7) ensures that if a county has a value of 2 or 3 for the risk of disaster factor, then the county is covered by the inland waterway emergency response service.

$$R_i \leq 2(x_i + 1/2) \qquad \forall i \in C \qquad (7)$$

Optional constraint (8) ensures that if a county has a value of 3 for the social vulnerability factor, then the county is covered by the inland waterway emergency response service.

$$S_i \leq 2(x_i + 1) \qquad \forall i \in C \qquad (8)$$

Constraint (9) ensures that the binary variables only obtain values of 0 or 1.

$$x_i, y_j \in \{0,1\} \qquad \forall i \in C, \forall j \in P \qquad (9)$$

Additional coverage constraints similar to constraints (7) and (8) can be added to the model for any factor of WES index depending on the needs and priorities of the emergency planners.

3.2.3 Maximum WES Coverage Model

In our third research objective, the resource limitation on the number of available barges for emergency response is taken into account. Knowing the available number of barges, we formulate an optimization model which determines the optimal starting location for the available barges in order to provide maximum WES coverage to the counties that have potential to benefit from inland waterway-based emergency response. The goal here is to provide inland waterway-based emergency response coverage to as many counties as possible given that there are a limited number of emergency response barges available.

Objective function (10) maximizes the number of the counties covered while giving priority to counties that have higher WES index values.

$$Max \sum_{i \in C} w_i x_i \tag{10}$$

Constraints (11) and (12) are identical to constraints (4) and (5). Constraint (11) relates upper bound of variable x_i to variable y_j. It makes sure if a county is not covered under the defined rules, x_i must be less than or equal to zero.

$$x_i \leq \sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \qquad \forall i \in C \tag{11}$$

Constraint (12) relates lower bound of variable x_i to variable y_j. It guarantees that variable x_i must be strictly greater than zero when a county is covered under the defined conditions. Since variable x_i is a binary variable, when it is strictly greater than zero, it is set to 1.

$$\sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \leq m x_i \qquad \forall i \in C \tag{12}$$

Constraint (13) verifies that number of the barges used is less than or equal to number of the available barges.

$\sum_{j \in P} y_j \leq n$ (13)

Constraint (14) ensures that the binary variables only get values of 0 or 1.

$x_i, y_j \in \{0,1\} \qquad \forall i \in C, \forall j \in P$ (14)

3.2.4 Goal Programming Approach

Goal programming approach is constructed in terms of target levels to be achieved rather than quantities to be maximized or minimized. The realistic assumption in goal programming is that the importance of any criterion diminishes once a target level is achieved. Goal programming is a popular approach in finding good solutions in multicriteria problems (Rardin, 1997). In this approach we want to achieve the highest possible coverage with least number of barges, independent of how much we have already achieved on each of the individual objectives. The first step in using a goal programming approach in a multi-objective optimization is to have the decision makers define target values for each of the criteria used to evaluate the solutions. Once the target values are specified, we proceed by adding soft constraints to enforce goal achievement. If we impose the goal achievement constraints as hard constraints where each objective must achieve its goal, the problem may become infeasible. We define deficiency variables which are nonnegative variables that equal the difference between the target values and our objective function values. The objective of the goal programming model is to minimize the weighted deficiency. Assigning various weights to each criteria of the multiobjective function enables the decision makers to differentiate between their importance of the multiple objectives. Since our objective functions do not have the same scale, we need to use scaling factors to simultaneously study multiple criteria objectives.

In order to introduce target levels and deficiency variables, we define additional notation.

The additional model parameters are:

t_1 Target value for Minimum Number of Barges Required model

t_2 Target value for Maximum WES Coverage model

v_1 Scaling factor for Minimum Number of Barges Required model

v_2 Scaling factor for Maximum WES Coverage model

α Weight assigned to Minimum Number of Barges Required objective function

The additional model variables are:

d_1 Deficiency variable for Minimum Number of Barges Required model

d_2 Deficiency variable for Maximum WES Coverage model

Using the defined notation, we present the model as follows.

Objective function (15) minimizes the difference between the target values and the objective function values. Since the objective function values for two objective functions are not on the same scale, we multiply each of the objective functions by a scaling factor. By assigning weights to each objective function, the emergency planners are able to assign their importance level to the two single objective functions.

$$Min\ \alpha v_1 d_1 + (1-\alpha) v_2\, d_2 \tag{15}$$

Constraint (16) relates upper bound of variable x_i to variable y_j. It makes sure that if a county is not covered under the defined rules, x_i must be less than or equal to zero.

$$x_i \leq \sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \qquad \forall i \in C \tag{16}$$

Constraint (17) relates lower bound of variable x_i to variable y_j. It guarantees that variable x_i must be strictly greater than zero when a county is covered under the defined conditions. Since variable x_i is a binary variable, when it is strictly greater than zero, it is set to 1.

$$\sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \leq m x_i \qquad \forall i \in C \tag{17}$$

Constraint (18) defines the deficiency variable for the Minimum Number of Required Barges objective function. The difference between the target value for the number of required barges and the total number of required barges that the model assigns is our first deficiency variable.

$$\sum_{j \in P} y_j - d_1 \leq t_1 \tag{18}$$

Constraint (19) defines the deficiency variable for the Maximize WES Coverage objective function. The difference between the target value for the WES coverage and the value of the WES coverage achieved in the model is our second deficiency variable.

$$\sum_{i \in C} w_i x_i + d_2 \geq t_2 \qquad (19)$$

Constraint (20) ensures that the binary variables only get values of 0 or 1.

$$x_i, y_j \in \{0,1\} \qquad \forall i \in C, \forall j \in P \qquad (20)$$

Constraint (21) ensures the non-negativity of the deficiency variables.

$$d_1, d_2 \geq 0 \qquad (21)$$

4 Case Study

We performed a case study on the lower Mississippi River region to demonstrate the use of the WES index to evaluate the extent to which a given county can potentially benefit from barge-based emergency response. We then implemented our decision support methodology on this region by considering the public ports located on the lower Mississippi River. The output of this case study is an assessment of the WES index values for 316 counties within the four states of Arkansas, Louisiana, Mississippi, and Tennessee. We then use the resulting WES index values to implement the decision support methodology on the counties within this region that have potential to benefit from inland waterway emergency services.

4.1 Lower Mississippi River Region

The Mississippi River is the second longest river in the U.S. with a length of 2,320 miles. Its source is at Lake Itasca in Minnesota, and its mouth is in the Gulf of Mexico. The Mississippi River is part of the largest river system in North America and among the largest in the world. States that have access to the Mississippi River are Minnesota, Wisconsin, Iowa, Illinois, Missouri, Kentucky, Arkansas, Tennessee, Mississippi, and Louisiana (Wikipedia, 2010). In our case study, we consider a set of 316 counties located along the lower Mississippi River region within the states of Arkansas, Tennessee, Mississippi, and Louisiana.

The lower Mississippi River region (Figure 2) provides an excellent representation of a significant multi-modal, rural transportation network. As one example, four rail and highway bridges traverse the Mississippi River at Memphis, Tennessee. The transport of people and shipment of freight are facilitated by two major highways, I-40 and I-55, that intersect at Memphis. A large volume of railroad freight traffic moves through Memphis due to the convergence of east-west with north-south rail routes. In the case of a catastrophic disaster, the transportation system infrastructure could be destroyed or rendered unusable, possibly creating a situation where the emergency response plans could not be implemented effectively. Incorporating an inland waterway-based emergency response would then be very beneficial to this area.

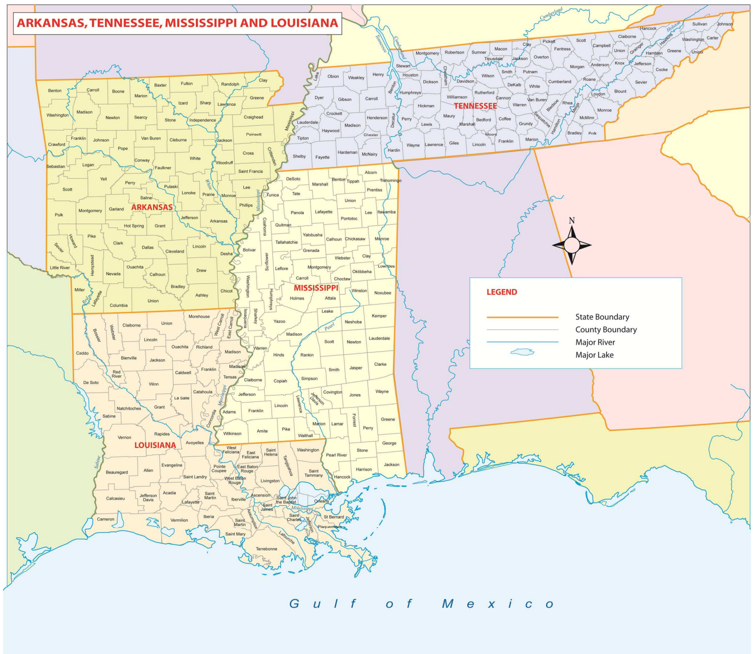

Figure 2: Lower Mississippi River Case Study Region

4.2 Data Collection

In the first step of our case study, we collected the data necessary to compute the WES index factor values. There are 75 counties in Arkansas, 64 parishes in Louisiana, 82 counties in Mississippi, and 95 counties in Tennessee. Details on the data collection for these 316 counties are provided in the remainder of this section.

4.2.1 Accessibility to Navigable Inland Waterway

In order to calculate the *Accessibility to Navigable Inland Waterway* factor values, we estimate the drive times between the origin and destination points for residents of the counties to get to the nearest public port located on the Mississippi River. In this case study we assume that the emergency response barge can only have access to public ports. We identified sixteen public ports along the Mississippi river within our four state region as shown in Table 5.

Table 5: Public Ports on Lower Mississippi River

Port Number	Port Name	State	Port Number	Port Name	State
1	Plaquemine	LA	9	Madison Parish	LA
2	St. Bernard	LA	10	Lake Providence	LA
3	New Orleans	LA	11	Greenville	MS
4	South Louisiana	LA	12	Yellow Bend	AR
5	Greater Baton Rouge	LA	13	Rosedale	MS
6	Natchez	MS	14	Helena	AR
7	Claiborne County	MS	15	Memphis	TN
8	Vicksburg	MS	16	Osceola	AR

The origin point is the county's population centroid, which is defined as "the point at which an imaginary, weightless, rigid, and flat (no elevation effects) surface representation of the [county] would balance if weights of identical size were placed on it so that each weight represented the location o[f] one person" (U.S. Census Bureau, 2001). This data was retrieved for each county in the region from the U.S. Census Bureau and can be found in Appendix I (U.S. Census Bureau, 2002).

After identifying the origin and destination points for each county, we used Google Maps (maps.google.com) to find the distances. The distances between the population centriod of each county and each of the sixteen public ports can be found in Appendix II. The drive time is computed by dividing the distance by the assumed average travel speed of thirty-five miles per hour. If one of the sixteen public ports is located within a three hour drive of a given county, it is considered to be feasible for that county to benefit from inland waterway-based emergency services. There are 145 counties within our four state region that have access to one of the sixteen public ports as listed in Appendix III.

4.2.2 Population Demand

The rural-urban continuum codes for each county in the region are provided by the Economic Research Service (ERS, 2004A). Appendix IV provides the codes for counties located in Arkansas, Louisiana, Mississippi, and Tennessee and their classification as high, medium, or low *Population Demands* according to their rural-urban continuum code as defined in Table 1. Counties with high, medium, or low *Population Demand* factor values received scores of three, two, or one respectively.

4.2.3 Social Vulnerability

As discussed in Section 3.1, a county's SoVI represents its "ability to respond to, cope with, recover from, and adapt to environmental hazards" (Hazards and Vulnerabilities Research Institute, 2008B). The SoVI value for each county in the four state region is obtained from the Hazards and Vulnerability Research Institute. In addition to the values, the database also provides the national percentile ranking for each county (Hazards and Vulnerabilities Research Institute, 2008A). We categorized the counties based on their national percentile. For the purposes of calculating the *Social Vulnerability* factor value, a low, medium, and high vulnerability is based on national percentiles from 0.01 to 33.33, 33.34 to 66.66, and 66.67 to 99.99 respectively. Counties with a low, medium, or high percentiles are given values of one, two, or three respectively. The *Social Vulnerability* factor values for 316 counties in the four state region can be found in Appendix V.

4.2.4 Risk of Disaster

When determining the *Risk of Disaster* factor value for each county in the region, data for risk of tornadoes, earthquakes, floods/hurricane/tropical storm, and terrorist attacks is needed.

4.2.4.1 Risk of Tornadoes

For the purposes of this study, we use historical tornado data to determine each county's risk level for violent tornadoes. A tornado's intensity is measured by its rating on the Fujita Scale, as seen in Table 6 (The Tornado Project, 1999). Using data from www.tornadoproject.com, we identified the total number of tornadoes and their Fujita Scale ratings for each county in the region from 1950 to 1995. This source indicates that 67% of tornado-related deaths are caused by F4 and F5 tornadoes, 29% are caused by F2 and F3 tornadoes, and only 4% are caused by F0 and F1 tornadoes, as seen in Figure 3 (The Tornado Project, 1999).

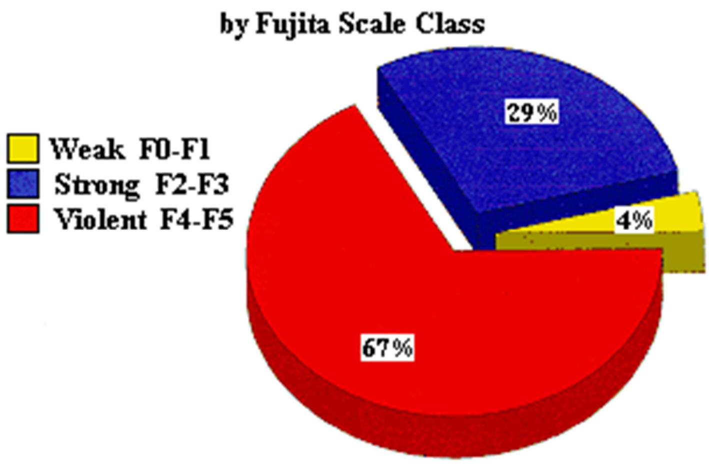

Figure 3: Percent of Tornado Related Deaths 1950-1994

Table 6: Fujita Scale Description

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in fores uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-inforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

Using this information about tornado-related deaths, we weight the total number of F0 and F1 tornadoes, F2 and F3 tornadoes, and F4 and F5 tornadoes by 4%, 29%, and 67% respectively and then sum to obtain a "tornado score" for each county, as described in Equation (22). For example, Table 7 gives the historical tornado data for Howard County, AR.

$$[0.04(F0 + F1)] + [0.29(F2 + F3)] + [0.67(F4 + F5)] = Tornado\ Risk\ Score \quad (22)$$

where F0, F1, F2, F3, F4, and F5 represent the county's total number of F0, F1, F2, F3, F4, and F5 tornadoes respectively.

Table 7: Historical Tornado Data for Howard County, Arkansas

County	Total	F0	F1	F2	F3	F4	F5	Score
Howard	18	6	5	4	1	2	0	**3.23**

In order to calculate the score for Howard County, we used the tornado data from Table 7 and applied it to Equation 22.

$$[0.04(6+5)]+[0.29(4+1)]+[0.67(2+0)]=3.23$$

The tornado scores for each county are then categorized as low risk (0 to 2.49), medium risk (2.50 to 4.99), or high risk (≥5.00). Low risk counties received a tornado subfactor value of one, medium risk counties received a tornado subfactor value of two, and high risk counties received a tornado subfactor value of three. The values for each county can be found in Appendix VI.

4.2.4.2 Risk of Earthquake

Earthquakes are capable of causing significant damage to ground structures and roads and have also been known to initiate other natural disasters including landslides and tsunamis. A powerful earthquake could easily disrupt standard means of transportation, inhibiting emergency workers from reaching victims of the disaster. Having waterway-based emergency assistance available could serve to mitigate the effects of an earthquake.

In order to determine each county's risk of earthquake, we gather information on the seismicity of the four states. The U.S. Geological Survey (USGS) measures seismicity in terms of peak acceleration during an earthquake. "During an earthquake when the ground is shaking, it also experiences acceleration. The peak acceleration is the largest acceleration recorded by a particular station during an earthquake." Figures 4-7 indicate the seismic hazard maps of Arkansas, Louisiana, Mississippi, and Tennessee, respectively (USGS, 2009).

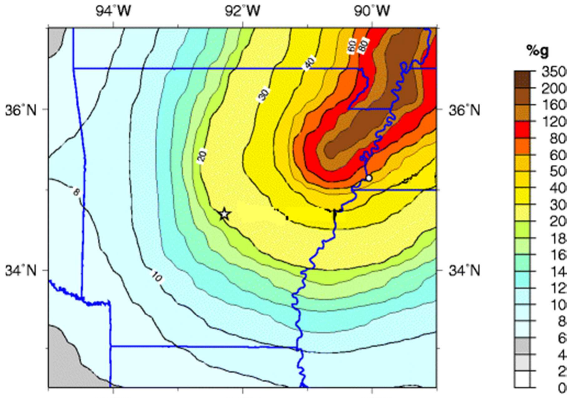

Figure 4: Arkansas Seismic Hazard Map

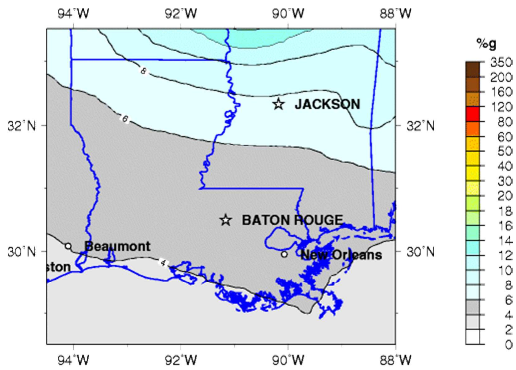

Figure 5: Louisiana Seismic Hazard Map

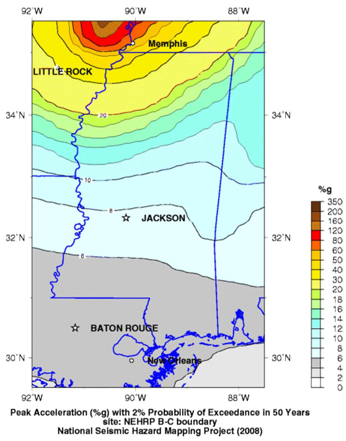

Figure 6: Mississippi Seismic Hazard Map

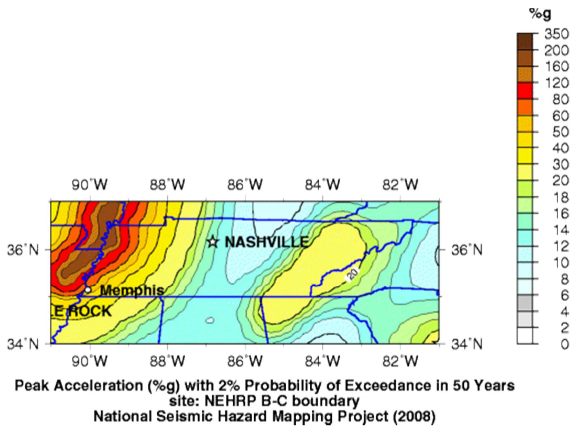

Figure 7: Tennessee Seismic Hazard Map

By overlaying the seismicity map with a map of each state's counties, we estimated the seismicity level for each county. The seismicity was then categorized into three risk levels based on peak acceleration as expressed as a percentage of the acceleration due to gravity: low risk (0-19.9), medium risk (20-79.9), and high risk (≥80). Counties with low, medium, or high risk levels are given scores of one, two, and three respectively.

4.2.4.3 Risk of Flood/ Hurricane/ Tropical Storm

The next *Risk of Disaster* subfactor we consider is flooding. Floods are extremely dangerous because they cause damage through inundation and soaking as well as the incredible force of moving water. Federal Emergency Management Agency (FEMA) provides a description for all major disasters that have occurred in each state. In order to determine the flood risk for each county, we looked at the major disaster descriptions over the last ten years. Since flooding often occurs during hurricanes and tropical storms, we studied the number of disaster declarations that include flooding, hurricane, or a tropical storm over the last ten years. The number of declarations for each county can be found in Appendix VII (FEMA, 2009). Based on the total number of flood-related disaster declarations made over the last ten years, the counties were categorized as having a low (< 3), medium (3 - 4), or high (> 4) risk of flood. Counties with a low, medium, or high risk of flood are given a score of one, two, or three respectively.

4.2.4.4 Risk of Terrorist Attacks

There is no sure way to predict future terrorism events. We assume a set of locations in the four state region that could be targets to a terrorist attack. We assume that the primary targets are active Air Force and Navy bases and nuclear power plants. Appendix VIII contains the location of Air Force and Navy bases in the four state region (Baseline Structure Report, 2009), and Appendix IX contains the information on nuclear power plants (State Nuclear Profiles, 2010). An attack on any of these targets would pose a threat to the surrounding areas. Using this information, we assign a low, medium, or high risk for terrorist attack to each county in the region based on its proximity to one or both of these locations. The counties containing one of the targets and all of their adjacent counties are categorized as being at high risk for terrorist attack. Non-high risk counties adjacent to a high risk county are categorized as having a medium risk for terrorist attack. All other counties are categorized as the low risk for terrorist attack. A county categorized as low, medium, or high risk is given a score of one, two, or three respectively. These target areas are easily adjusted in practice using the emergency planner's expertise in identifying locations at risk for terrorist attack.

After the subfactor values for tornado, earthquake, flood, and terrorist attack are determined for each county, we calculate the overall *Risk of Disaster* factor value by summing the four subfactor values for each county. A county with a score in the range 4-6, 7-9, or 10-12 is classified as having a low, medium, or high risk of disaster respectively. A disaster risk of low, medium, or high is given a *Risk of Disaster* factor value of one, two, or three respectively. The resulting *Risk of Disaster* factor values for each county are available in Appendix X.

4.2.5 Limited Access to Medical Services

To measure each county's *Limited Access to Medical Services*, we used the number of community hospital beds per 100,000 people (U.S. Census Bureau, 2007). In year 2004, the average number of hospital beds per 100,000 people for the four state region was 287 per county. The counties with zero hospital beds per 100,000 people are considered to have a high potential of benefiting from an emergency response barge, counties with one to 287 (regional average) to have medium potential, and counties with more than 287 to have low potential. Counties with a low, medium, and high potential are given scores one, two, or three respectively. The data and the classification of the counties according to their *Limited Access to Medical Services* factor values can be found in the Appendix XI.

4.2.6 Limited Access to Resources

We identified four types of resources that are feasible to be provided on a barge via inland waterways in case of disaster. These resources are clean water, power, temporary housing, and fuel. We defined a subfactor to measure the limited access of a county to each of these resources and then combined them to obtain a *Limited Access to Resources* factor value for each county.

To measure the level of available clean water supplies in each county, we use the number of water supply and irrigation systems establishments (U.S. Census Bureau, 2008A) in that county. In order to have a comparison between the values we use the population of the counties (U.S Census Bureau, 2008B) and calculate the number of water supply and irrigation systems establishments per 100,000 people. The counties with zero water supply and irrigation systems establishments per 100,000 people are considered to have a high potential of benefiting from clean water supplies and water treatment equipment provided on an emergency response barge, counties with one to eight (regional average) are considered to have medium potential, and counties with more than eight are considered to have low potential. Counties with a high, medium, and low potential to benefit are given scores of three, two, or one respectively for limited access to water supplies.

For measuring each county's level of access to power sources, we use the number of available electric power generation, transmission, & distribution establishments (U.S. Census Bureau, 2008A) per 100,000 people in a county. Counties are then categorized as having high potential to benefit from power generating supplies via barge if there are zero establishments, medium potential if there are one to seven (regional average) establishments, or low potential if it has more than seven establishments. Counties with high potential receive a subfactor value of three, counties with medium potential receive a subfactor value of two, and counties with low potential receive a subfactor value of one for limited access to power supplies.

The number of hotels, motels, B&B, other travel accommodation, RV parks and camps, rooming and boarding houses (U.S. Census Bureau, 2008A) per 100,000 people is used to measure a county's limited access to temporary housing. If a county has zero establishments that county has high potential to require waterway based assistance for temporary housing and therefore gets a value of three for this subfactor. If the county has between one and twenty-three (regional average) establishments, the county has medium potential to benefit and therefore gets a score of two. Finally if the county has more than twenty-three establishments, the county has low potential to benefit from temporary housing supplies via barge and gets a score of one.

We considered the number of gas station establishments in each county (U.S. Census Bureau, 2008A) per 100,000 people as the measure for a county's access to fuel supplies. If a county has zero establishments, it gets a score of three to represent its high potential to benefit from waterway-based assistance for fuel supplies. If the county has between one and sixty-seven (regional average) gas station establishments, it gets a score of two for this subfactor, which represents its medium potential to benefit. Finally if the county has more than sixty-seven establishments, it gets a score of one for its low potential.

After the subfactor values for limited access to water supplies, power supplies, temporary housing resources, and fuel supplies are determined for each county, we calculate the overall *Limited Access to Resources* factor value for each county by summing its scores on the four resource subfactors. A county with a score in the range 4-6, 7-9, or 10-12 is classified as having a low, medium, or high potential to require assistance via inland waterways for these resources. Low, medium, and high levels of access to these resources are given a *Limited Access to Resources* value of one, two, and three respectively. The values for each subfactor and the overall *Limited Access to Resources* factor value for all counties in the four state region are provided in Appendix XII.

4.2.7 Limited Access to Transportation Modes

There are four common modes of cargo transportation; highway, rail, air, and water. In addition to ground transportation via the highways which is available in all counties within our region, we look at two alternative transportation modes, rail and air. We use the National Transportation Atlas Database (2010) to find the number of public use airport facilities in each county. This data is available in Appendix XIII. We also use this database to identify the counties that have access to the rail system. Figure 8 shows the map of our four state region overlaid with the map of the rail system. Visual observation was used to identify which counties contain the rail system.

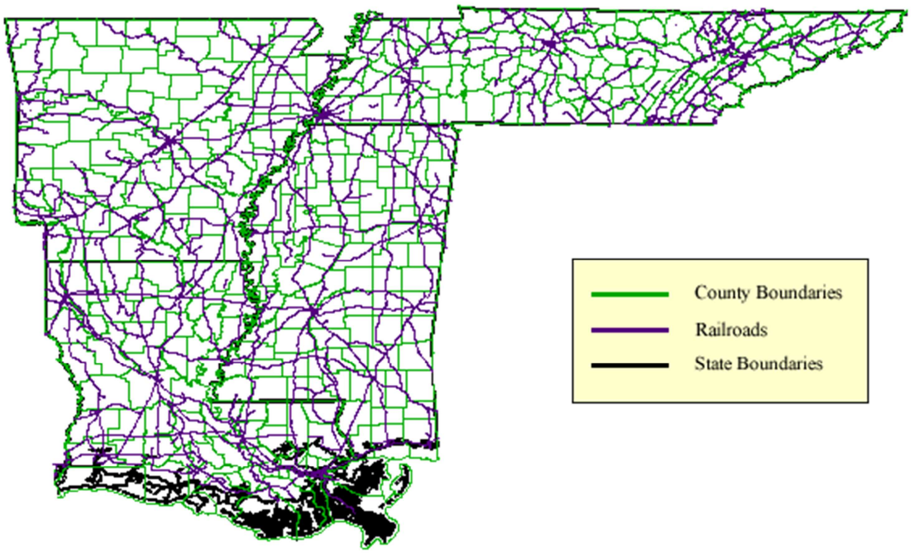

Figure 8: Railroad System in Arkansas, Louisiana, Mississippi, and Tennessee

The counties that do not have the rail system passing through them and do not have any public airports are considered to have high potential to benefit from waterway-based emergency response. If a county has access to either rail or air transportation, the county is categorized as having medium potential, and if a county has access to both modes, the county has low potential to benefit. Counties with high, medium, and low potential are assigned scores of three, two, and one respectively. A list of counties and their *Limited Access to Transportation Modes* factor values are provided in Appendix VIX.

4.3 WES Index

After the seven factor values are determined for each county in the region, the overall WES index value for each county is calculated using Equation 2. The factor values and WES index for each county in Arkansas, Louisiana, Mississippi, and Tennessee can be found in Appendix XV. Figure 9 graphically depicts the WES index value of each county in the four state region which indicated its potential to benefit from inland waterway emergency response.

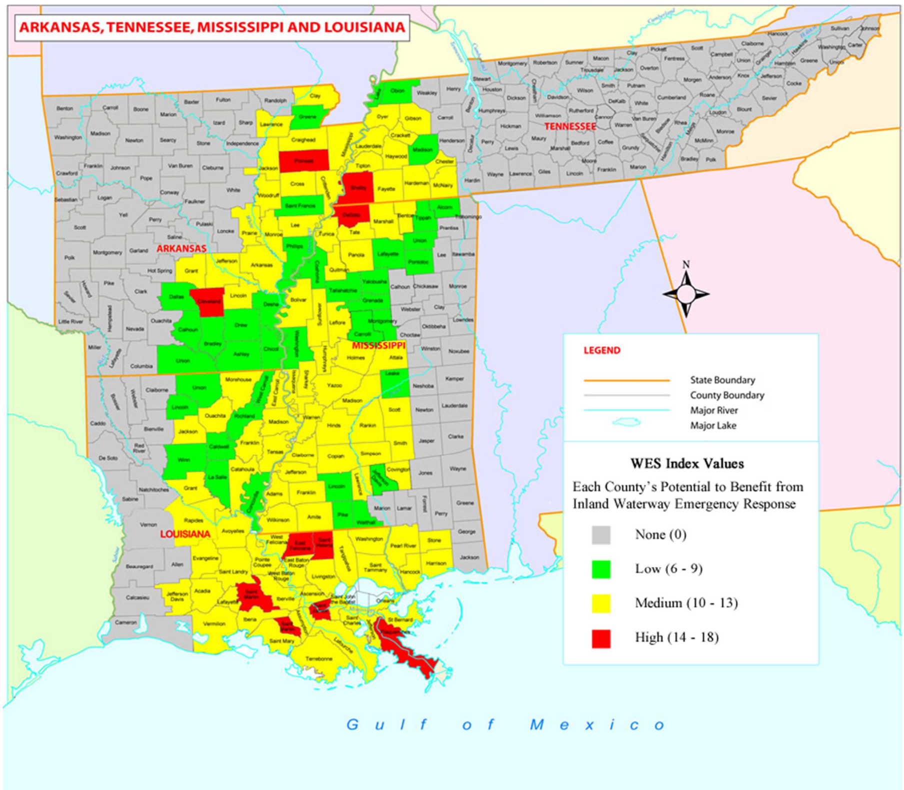

Figure 9: Final WES Index Values for Lower Mississippi River Region

There are 171 counties in the four state region that are more than a three hour drive from the public ports on the lower Mississippi River, making the use of inland waterway emergency services infeasible. These counties have a WES index of zero. Thirty-nine counties (12%) in the four state region have a WES index value of less than ten and therefore have low potential to benefit from inland waterway-based emergency response. Ninety-seven counties (31%) in the region have medium potential, and nine counties (3%) have high potential. Table 8 shows the breakdown of the final WES index results for the four state Lower Mississippi River region.

Table 8: Number of counties per WES Index Level

State	High	Medium	Low	No Access	Total
Arkansas	2	15	11	47	75
Louisiana	5	37	8	14	64
Mississippi	1	35	17	29	82
Tennessee	1	10	3	81	95
Overall Region Results	9	97	39	171	316

Overall, based on WES index values, there are 106 counties (73%) among 145 counties that have access to the Mississippi River public ports with at least medium potential to benefit from inland waterway-based emergency response. If additional inland waterways were taken into consideration, the counties that currently have WES index of zero could potentially have access to a navigable inland waterway other than the Mississippi River and therefore benefit from waterway emergency services.

4.4 Designing the Optimal Inland Waterway Emergency Response System

We implement our decision support methodology utilizing the WES index results of the lower Mississippi River region. As previously mentioned, we considered sixteen public ports along the lower Mississippi River within the four states of Arkansas, Louisiana, Mississippi, and Tennessee as potential starting locations of emergency response barges. Based on the WES index results, there are 145 counties in the region that have access to at least one of the sixteen public ports. We implement our decision support methodology on these 145 counties. The models were run in AMPL and analyzed using CPLEX on a 2.67 GHz dual core processor PC with 4 GB of RAM. The run time for each individual model was approximately 0.03 seconds. The results are presented in the following sections.

4.4.1 Minimum Number of Required Barges Results

The goal here is to determine the minimum number of emergency response barges required to satisfy the coverage criteria that is defined for the region. As discussed in Section 3.2.2., we can define performance constraints for the model to enforce the desired WES coverage criteria. Here we require that all 145 counties must be covered (Constraint 6). In our base model, we assume that a barge can provide emergency response coverage to a county if the barge can travel from its starting location to an accessible port for that county in less than 12 hours. Figure 10 depicts the resulting starting locations of the minimum number of emergency response barges required to provide complete WES coverage to all accessible counties.

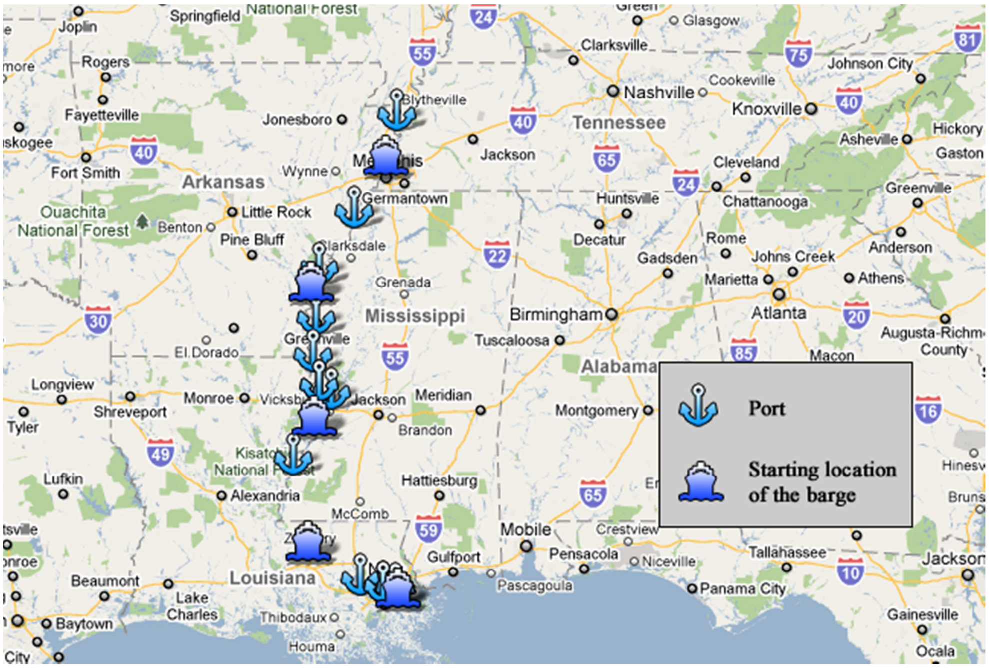

Figure 10: Origin Ports for Minimum Number of Required Barges Model with Barge Coverage Range of 12 Hours

These results show that it takes five barges to provide emergency response coverage to all 145 counties in the region. The starting locations of these five barges are Ports 1, 5, 7, 12, and 15. Ports corresponding to each number are listed in Table 5. Emergency planners may assume a different coverage range which is reflected in the value of d_{jk}. The results for various barge coverage ranges for the emergency barges to completely cover the 145 counties are presented in Table 9. The base results (d_{jk} defined for 12 hour coverage range) are shown in bold.

Table 9: Minimum Number of Required Barges Model Results

Barge Coverage Range (hours)	Min Number of Required Barges	Origin Ports
3	8	2,5,6,8,9,12,15,16
6	7	2,5,6,8,12,15,16
12	**5**	**1,5,7,12,15**
24	3	3,9,15
48	2	4,13

4.4.2 Maximum WES Coverage Results

Here we assume the number of barges available for emergency response is predetermined. Table 10 shows the results of our base model (d_{jk} defined for 12 hour coverage range) for various numbers of available barges.

Table 10: Maximum WES Coverage Model Results for Barge Coverage Range of 12 Hours

Number of Available Barges	Origin Ports	Number of Covered Counties (% covered)	Coverage Scores (Objective Function Values)
1	7	69 (48%)	712
2	**7,15**	**110 (76%)**	**1148**
3	5,7,15	133 (92%)	1423
4	1,5,7,15	139 (96%)	1494

Figure 11 depicts graphically the optimal starting locations of the barges along the lower Mississippi River for the case that two emergency response barges are available. Ports 5 and 15 are the selected ports and 110 counties (76%) with access to Mississippi River public ports are covered. We implement the model considering additional barge coverage ranges (d_{jk} defined for 3, 6, 24, and 48 hours coverage range). Table 11 contains the results for these barge coverage ranges. As expected, when we have a limit on the number of available barges with shorter barge coverage ranges, fewer counties can have inland waterway-based emergency response coverage.

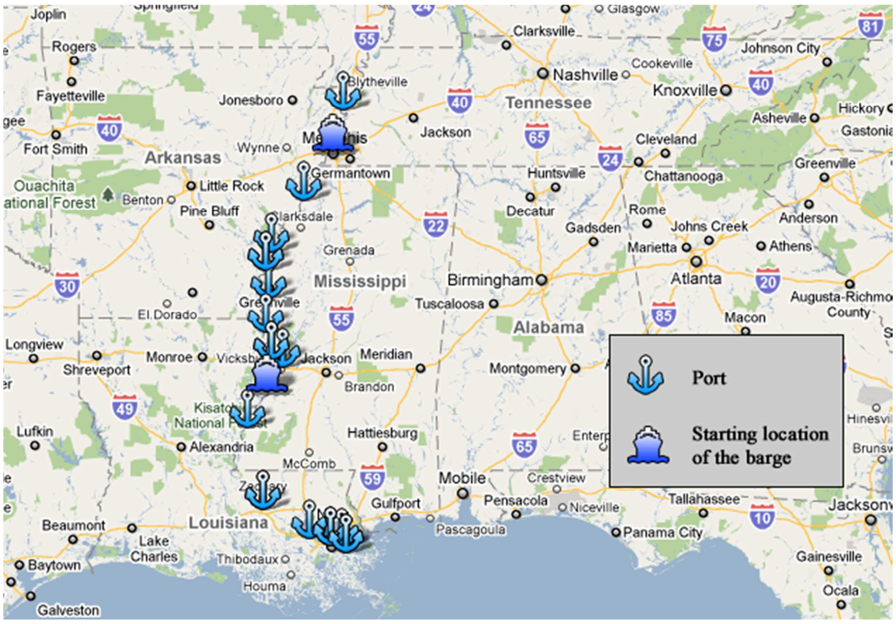

Figure 11: Origin Ports for Maximum WES Coverage Model with Barge Coverage Range of 12 Hours (2 Barges Available)

Table 11: Maximum WES Coverage Model Results for Various Barge Coverage Ranges

Barge Coverage Range (hours)	Number of Available Barges	Origin Ports	Number of Covered Counties (% covered)	Coverage Scores (Objective Function Values)
3	1	9	50 (34%)	501
	2	9,15	89 (61%)	917
	3	5,9,15	122 (84%)	1313
	4	2,5,9,15	129 (89%)	1393
6	1	8	58 (40%)	582
	2	8,15	97 (67%)	998
	3	5,8,15	127 (88%)	1362
	4	2,5,8,15	134 (92%)	1442
24	1	9	75 (52%)	772
	2	3,12	115 (79%)	1248
	3	3,9,15	145 (100%)	1553
	4	3,9,15	145 (100%)	1553
48	1	13	116 (80%)	1207
	2	1,13	145 (100%)	1553
	3	1,13	145 (100%)	1553
	4	1,13	145 (100%)	1553

4.4.3 Goal Programming Approach

The first step in using a goal programming approach is to set the target values for each decision criteria. Here we used the results from the previous models to help us define our target levels to be achieved. For the Minimize the Number of Barges model, the ideal situation is to have only one barge and still be able to cover the entire region, so the target value for this objective function is set to one ($t_1 = 1$).

In the Maximize WES Coverage model, the ideal situation is to locate the barges in a way that all the counties with access to the Lower Mississippi River are covered. For our region of interest, results from the previous model showed that the maximum objective function value is 1553, which is set as our second target value ($t_2 = 1553$).

In order to scale the two objective functions appropriately, we need to find appropriate scaling factors for each objective function. The lower bound for minimum number of barges required is one and, for the upper bound, we consider the number of barges required to cover the entire region with the shortest coverage range of four hours. The results in Section 4.4.1 show that when we assume d_{jk} was defined for three hour barge coverage range, we need eight barges to cover the entire region. Therefore the upper bound on the number of available barges is set to eight. To set the lower bound on the maximum WES coverage, we look at the coverage score for d_{jk} defined for three hour coverage range with only one barge available (Section 4.4.2) which is 501. The upper bound for maximum WES coverage is the coverage score for the case when all the 145 counties are covered, which is 1553. We use these bounds to compute the normalized scaling factors for the goal programming objective function. By solving Equations 23 and 24, we obtain 0.9934 as the scaling factor value for the Minimum Number of Required Barges objective function (v_1) and 0.0066 as the scaling factor value for Maximum WES Coverage objective function (v_2).

$$(8-1)v_1 = (1553-501)v_2 \qquad (23)$$

$$v_1 + v_2 = 1 \qquad (24)$$

Initially we solve the goal programming model giving equal weight to each objective functions ($\alpha = 0.5$).

$$Min\ \alpha v_1 d_1 + (1-\alpha) v_2\, d_2 \qquad (25)$$

$$x_i \leq \sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \qquad \forall i \in C \qquad (26)$$

$$\sum_{j \in P} \sum_{k \in P} y_j d_{jk} a_{ik} \leq m x_i \qquad \forall i \in C \qquad (27)$$

$\sum_{j \in P} y_j - d_1 \leq t_1$ (28)

$\sum_{i \in C} w_i x_i + d_2 \geq t_2$ (29)

$x_i, y_j \in \{0,1\}$ $\quad \forall i \in C, \forall j \in P$ (30)

$d_1, d_2 \geq 0$ (31)

We tested the models using the following parameters:

$t_1 = 1 \qquad t_2 = 1553 \qquad v_1 = 0.9934 \qquad v_2 = 0.0066 \qquad \alpha = 0.5$

Figure 12 demonstrates the results of our goal programming analysis when d_{jk} defined based on a twelve hour coverage range.

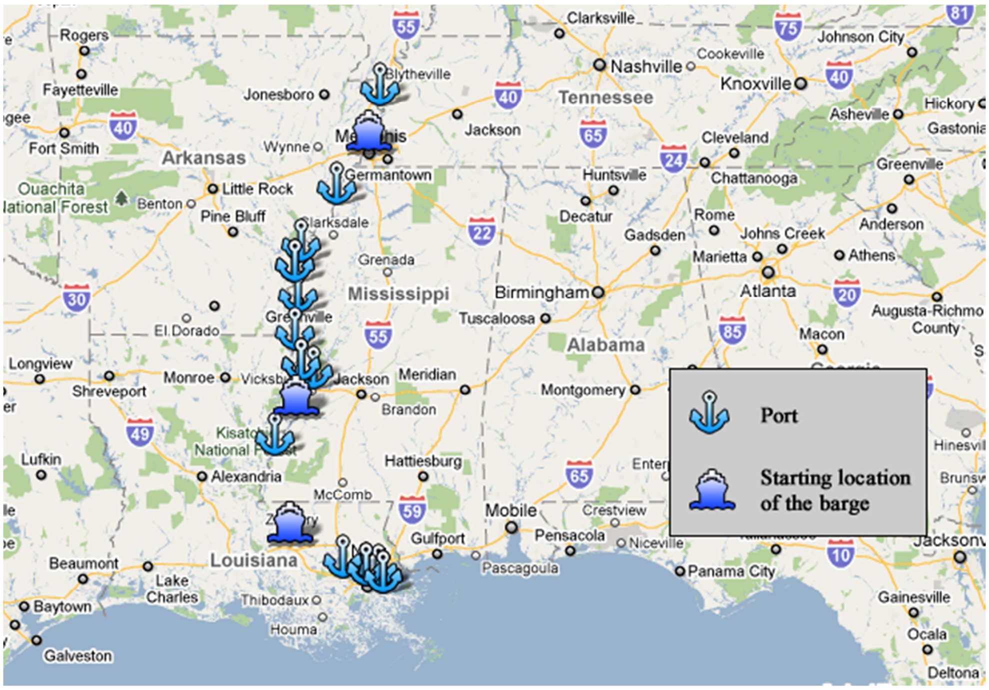

Figure 12: Origin Ports for Goal Programming Model with Barge Coverage Range of 12 Hours

Based on these results, it is recommended to have three barges for emergency response located at Ports 3, 5, and 7. These three barges are able to provide emergency response coverage to ninety-two percent of the counties.

We tested the model for various barge coverage ranges. Table 12 contains the obtained results.

Table 12: Goal Programming Model Results for Various Barge Coverage Ranges

Barge Coverage Range (hours)	Number of Available Barges	Origin Ports	Number of Covered Counties (% covered)	Coverage Scores (Objective Function Values)
3	3	5,9,15	122 (84%)	1312
6	3	5,8,15	127 (88%)	1362
12	**3**	**5,7,15**	**133 (92%)**	**1423**
24	3	3,9,15	145 (100%)	1553
48	2	1,13	145 (100%)	1553

Based on the results of the goal programming analysis with d_{jk} defined based on 3, 6, 12, and 24 hours coverage range, there are three barges required in the optimal solution. Only in the case where d_{jk} is defined based on a forty-eight hour coverage range does the number of required barges reduce to two.

4.4.4 Sensitivity Analysis

The Goal Programming model is initially solved assuming that both objective functions have the same weight ($\alpha = 0.5$). In some cases, the emergency planner may decide to give higher priority to one objective function by assigning a greater weight. To study the effects of various function weights, we solve the model with multiple values of α. Assigning greater values to α corresponds gives higher priority to the Minimize Number of Required Barges objective over the Maximum WES Coverage objective. Table 13 shows the results for various values of α for different barge coverage ranges.

Table 13: Comparison of Goal Programming Model Results for Various α Levels and Various Barge Coverage Ranges

Results	Barge Coverage Range	Weights				
		(α = 0.9)	(α = 0.7)	(α = 0.5)	(α = 0.3)	(α = 0.1)
Number of Required Barges	3	1	3	3	4	8
Origin Ports		9	5,9,15	5,9,15	2,5,9,15	2,5,6,8,9,12,15,16
Number of Covered Counties (% covered)		50(34%)	122(84%)	122(84%)	129(89%)	145(100%)
Coverage Score		501	1313	1313	1393	1553
Number of Required Barges	6	1	3	3	4	7
Origin Ports		8	5,8,15	5,8,15	2,5,8,15	2,5,6,8,12,15,16
Number of Covered Counties (% covered)		58(40%)	127(88%)	127(88%)	134(92%)	145(100%)
Coverage Score		582	1362	1362	1442	1553
Number of Required Barges	**12**	**1**	**2**	**3**	**4**	**5**
Origin Ports		**7**	**7,15**	**5,7,15**	**1,5,7,15**	**1,5,7,12,15**
Number of Covered Counties (% covered)		**69(48%)**	**110(76%)**	**133(92%)**	**139(96%)**	**145(100%)**
Coverage Score		**712**	**1148**	**1423**	**1494**	**1553**
Number of Required Barges	24	1	2	3	3	3
Origin Ports		12	3,12	3,9,15	3,9,15	3,9,15
Number of Covered Counties (% covered)		75(52%)	115(79%)	145(100%)	145(100%)	145(100%)
Coverage Score		772	1248	1553	1553	1553
Number of Required Barges	48	2	2	2	2	2
Origin Ports		1,13	1,13	1,13	1,13	1,13
Number of Covered Counties (% covered)		145(100%)	145(100%)	145(100%)	145(100%)	145(100%)
Coverage Score		1553	1553	1553	1553	1553

The results of the sensitivity analysis show the tradeoffs between desiring fewer number of barges and higher WES coverage. Sensitivity analysis results confirm that the model behaves as expected. When assigning higher weight to the Minimize the Number of Required Barges objective, fewer number of barges are recommended. However the WES coverage is then lower in the optimal solution. Placing a higher weight on the Maximize WES Coverage objective results in covering more counties while requiring an increase in number of required barges.

In our base model (d_{jk} defined for 12 hour coverage range), full coverage of all counties is achieved when the Maximize WES Coverage objective is weighted nine times greater than the weight of Minimize the Number of Required Barges objective. In contrast, when the Minimize the Number of Required Barges objective is weighted nine times greater than the Maximize WES Coverage objective, forty-eight percent (69) of the counties are covered.

5 Conclusions and Future Work

5.1 Conclusions

This research provides emergency planners with insights into the benefits of inland waterway emergency response. It provides the first known systematic planning strategy to utilize barges on inland waterways for emergency services. We develop a decision support methodology to aid emergency planners in designing the most efficient and effective inland waterway-based emergency response system.

First a waterway emergency service (WES) index is developed to measure the potential of individual counties to benefit from inland waterway emergency response. The WES index consists of seven factors; accessibility to navigable waterways, population demand, social vulnerability, risk of disaster, limited access to medical services, limited access to resources, and limited access to transportation modes. We obtained the WES index values for four states, Arkansas, Louisiana, Mississippi, and Tennessee, along the lower Mississippi River. The results showed that, among all the counties that have access to Mississippi River, more than 73% have at least medium level of potential to benefit from emergency response via this river. Specially in Louisiana, there are several counties that have high potential to benefit from emergency response via the Mississippi River.

We develop an optimization model to help emergency planners determine the minimum number of barges required to provide a pre-defined level of emergency response coverage. Then, considering the resource limitations, we formulate an optimization model to determine the optimal starting location for the available barges in order to provide maximum WES coverage. Finally we develop a multi-objective optimization model that combines the two single objectives. Implementation of these three models on our case study shows that, if we assume that barges can provide emergency response to counties within their twelve hours travel time on the river, three barges are required to provide emergency response coverage to ninety-two percent of the counties in the four states.

While some general assumptions were made, local emergency planners are likely to be more knowledgeable about available resources via inland waterways and are encouraged to adjust the index and adopt the methodology according to their specific needs.

5.2 Future Work

This research investigates the feasibility of emergency response via inland waterways and provides a framework for finding the optimal starting locations of emergency response barges. This idea could be further explored to determine if the strategic locations should change based on the time of year or risk of events. For example, during tornado season, it may be prudent to dock an emergency response barge at a port such that it can get to those counties at higher risk for tornado as fast as possible. Further research may even result in a policy for dispatching response barges prior to an emergency. For example, if a large storm cell is moving into a certain part of the state, authorities could dispatch a barge to that location in anticipation of an emergency situation.

In this research we mainly focus on each county's potential to benefit from waterway-based emergency response while we assume that waterways will be available and feasible to be used for transportation in the event of a disaster. Navigability of waterways is a challenging factor that could be considered outside of the

WES index. For example, in case of a major disaster including flooding, it may not be feasible to use inland waterways for transportation. In our study we also did not consider the traffic on the river which also may affect the navigability of the river.

In this research we only considered public port as potential origins of the emergency response barges. The problem could be expanded by including private ports which would increase the size of the problem beyond one that can be solved to optimality and would require heuristic development. A greedy heuristic could be developed to reach good solutions without requiring any specialized optimization software.

Further research could include determining which resources could and should be offered by an emergency response barge and how these resources should be allocated. Available funding and specifications of the barge may limit the number and type of emergency services that could be provided. It may be useful to explore the layout, capacity, and potential capabilities of various barge configurations in order to identify what level of service could be provided.

It may prove valuable to explore the use of watercraft other than barges to provide emergency response assistance. While the capacity may be significantly less than that of a barge, a smaller faster boat (or a fleet of boats) could respond to emergencies more quickly. This could potentially expand the list of emergencies for which inland waterway response would be viable.

The economic feasibility of emergency response via inland waterways is another area in which there is potential for future research. Because all emergency operations plans are limited by a budget, estimating the costs of equipment, personnel, supplies, maintenance, and daily operations of a response barge would prove useful to emergency planners. The results of the economic analysis can even be used in implementing the methodology presented here by determining the number of available response barges.

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Appendix I: County Population Centroid

Table A 1: County Population Centroid for Arkansas

COUNTY NAME	POPULATION	LATITUDE	LONGITUDE
Arkansas	20,749	34.40301	-91.459196
Ashley	24,209	33.177045	-91.866194
Baxter	38,386	36.332991	-92.382632
Benton	153,406	36.337502	-94.228754
Boone	33,948	36.263928	-93.098603
Bradley	12,600	33.562711	-92.104368
Calhoun	5,744	33.590853	-92.489603
Carroll	25,357	36.372427	-93.568801
Chicot	14,117	33.324721	-91.322099
Clark	23,546	34.089618	-93.121952
Clay	17,609	36.371498	-90.381036
Cleburne	24,046	35.512308	-92.038432
Cleveland	8,571	33.913456	-92.146001
Columbia	25,603	33.259054	-93.24561
Conway	20,336	35.21191	-92.706081
Craighead	82,148	35.834606	-90.665157
Crawford	53,247	35.496842	-94.282906
Crittenden	50,866	35.177923	-90.221065
Cross	19,526	35.256341	-90.770807
Dallas	9,210	33.869653	-92.525697
Desha	15,341	33.774625	-91.412646
Drew	18,723	33.628245	-91.778361
Faulkner	86,014	35.104972	-92.403053
Franklin	17,771	35.441909	-93.889674
Fulton	11,642	36.379308	-91.756597
Garland	88,068	34.50804	-93.07985
Grant	16,464	34.307144	-92.412275
Greene	37,331	36.076562	-90.522811
Hempstead	23,587	33.700517	-93.624328
Hot Spring	30,353	34.354001	-92.890833
Howard	14,300	33.981031	-93.912183
Independence	34,233	35.748	-91.609343
Izard	13,249	36.123787	-91.908597
Jackson	18,418	35.621544	-91.242807
Jefferson	84,278	34.231899	-92.035952
Johnson	22,781	35.475522	-93.475226
Lafayette	8,559	33.294097	-93.550847
Lawrence	17,774	36.068145	-91.062072

COUNTY NAME	POPULATION	LATITUDE	LONGITUDE
Lee	12,580	34.785481	-90.772871
Lincoln	14,492	33.982624	-91.755165
Little River	13,628	33.698967	-94.197333
Logan	22,486	35.227283	-93.769652
Lonoke	52,828	34.882218	-91.962568
Madison	14,243	36.052002	-93.754229
Marion	16,140	36.282392	-92.664406
Miller	40,443	33.399824	-93.986739
Mississippi	51,979	35.840346	-89.994573
Monroe	10,254	34.773206	-91.216396
Montgomery	9,245	34.518934	-93.625655
Nevada	9,955	33.718145	-93.353947
Newton	8,608	35.980112	-93.175948
Ouachita	28,790	33.574107	-92.839362
Perry	10,209	34.998654	-92.785359
Phillips	26,445	34.522919	-90.709707
Pike	11,303	34.179409	-93.623754
Poinsett	25,614	35.598208	-90.556826
Polk	20,229	34.518213	-94.260312
Pope	54,469	35.311631	-93.095177
Prairie	9,539	34.856543	-91.532857
Pulaski	361,474	34.772275	-92.303666
Randolph	18,195	36.305243	-90.985782
St. Francis	29,329	35.015001	-90.765196
Saline	83,529	34.591205	-92.543326
Scott	10,996	34.904893	-94.0929
Searcy	8,261	35.919717	-92.659811
Sebastian	115,071	35.320594	-94.356789
Sevier	15,757	34.012161	-94.29901
Sharp	17,119	36.176192	-91.520638
Stone	11,499	35.857996	-92.141827
Union	45,629	33.206069	-92.643279
Van Buren	16,192	35.570187	-92.419834
Washington	157,715	36.088391	-94.173184
White	67,165	35.249876	-91.756135
Woodruff	8,741	35.221242	-91.253394
Yell	21,139	35.112768	-93.295401

Table A 2: Parish Population Centroid for Louisiana

COUNTY NAME	POPULATION	LATITUDE	LONGITUDE	COUNTY NAME	POPULATION	LATITUDE	LONGITUDE
Acadia	58,861	30.274473	-92.350973	Madison	13,728	32.400206	-91.195862
Allen	25,440	30.679264	-92.766754	Morehouse	31,021	32.787134	-91.884116
Ascension	76,627	30.241691	-90.929949	Natchitoches	39,080	31.762009	-93.100599
Assumption	23,388	29.9256	-91.06442	Orleans	484,674	29.977005	-90.050805
Avoyelles	41,481	31.050178	-92.063029	Ouachita	147,250	32.511728	-92.126209
Beauregard	32,986	30.73813	-93.291786	Plaquemines	26,757	29.63048	-89.807351
Bienville	15,752	32.391658	-93.077175	Pointe Coupee	22,763	30.675709	-91.502725
Bossier	98,310	32.555985	-93.656816	Rapides	126,337	31.284471	-92.459467
Caddo	252,161	32.476078	-93.79977	Red River	9,622	32.056365	-93.310157
Calcasieu	183,577	30.228661	-93.262739	Richland	20,981	32.441914	-91.71086
Caldwell	10,560	32.079319	-92.104805	Sabine	23,459	31.581758	-93.564993
Cameron	9,991	29.894431	-93.232815	St. Bernard	67,229	29.930386	-89.935839
Catahoula	10,920	31.689558	-91.821872	St. Charles	48,072	29.938886	-90.376075
Claiborne	16,851	32.829727	-93.035794	St. Helena	10,525	30.793994	-90.692869
Concordia	20,247	31.593625	-91.547275	St. James	21,216	30.020474	-90.740344
De Soto	25,494	32.090382	-93.772958	St. John the	43,044	30.070055	-90.514672
East Baton	412,852	30.464976	-91.103294	St. Landry	87,700	30.520532	-92.110782
East Carroll	9,421	32.771924	-91.199356	St. Martin	48,583	30.219237	-91.829653
East Feliciana	21,360	30.829706	-91.091493	St. Mary	53,500	29.743453	-91.350818
Evangeline	35,434	30.682291	-92.36114	St. Tammany	191,268	30.3763	-89.934652
Franklin	21,263	32.138947	-91.695386	Tangipahoa	100,588	30.57871	-90.458531
Grant	18,698	31.545407	-92.563978	Tensas	6,618	31.969161	-91.295873
Iberia	73,266	29.992048	-91.808994	Terrebonne	104,503	29.586756	-90.717889
Iberville	33,320	30.272988	-91.239707	Union	22,803	32.798824	-92.408082
Jackson	15,397	32.282546	-92.643438	Vermilion	53,807	29.984629	-92.174294
Jefferson	455,466	29.945222	-90.15353	Vernon	52,531	31.095054	-93.242786
Jefferson Davis	31,435	30.238588	-92.733762	Washington	43,926	30.835598	-89.977099
Lafayette	190,503	30.209046	-92.042563	Webster	41,831	32.704101	-93.341805
Lafourche	89,974	29.676813	-90.60819	West Baton	21,601	30.447108	-91.264284
La Salle	14,282	31.731234	-92.173283	West Carroll	12,314	32.812876	-91.430324
Lincoln	42,509	32.549364	-92.648543	West Feliciana	15,111	30.890217	-91.450009
Livingston	91,814	30.48135	-90.837927	Winn	16,894	31.932121	-92.673258

Table A 3: County Population Centroid for Mississippi

COUNTY NAME	POPULATION	LATITUDE	LONGITUDE
Adams	34,340	31.547728	-91.360602
Alcorn	34,558	34.908682	-88.529602
Amite	13,599	31.182794	-90.819534
Attala	19,661	33.06465	-89.588695
Benton	8,026	34.812448	-89.20618
Bolivar	40,633	33.77752	-90.780931
Calhoun	15,069	33.927754	-89.307593
Carroll	10,769	33.455043	-89.922951
Chickasaw	19,440	33.931491	-88.929649
Choctaw	9,758	33.34027	-89.240059
Claiborne	11,831	31.931129	-90.966015
Clarke	17,955	32.052278	-88.727134
Clay	21,979	33.625385	-88.69733
Coahoma	30,622	34.22267	-90.568036
Copiah	28,757	31.895614	-90.381769
Covington	19,407	31.640899	-89.549487
DeSoto	107,199	34.930935	-89.96554
Forrest	72,604	31.312969	-89.291607
Franklin	8,448	31.471424	-90.878607
George	19,144	30.872795	-88.597608
Greene	13,299	31.195648	-88.632942
Grenada	23,263	33.770148	-89.80182
Hancock	42,967	30.362854	-89.404629
Harrison	189,601	30.421788	-89.060356
Hinds	250,800	32.30985	-90.251496
Holmes	21,609	33.095054	-90.034072
Humphreys	11,206	33.155957	-90.520931
Issaquena	2,274	32.878313	-91.014089
Itawamba	22,770	34.291734	-88.40107
Jackson	131,420	30.435342	-88.647547
Jasper	18,149	31.967698	-89.142864
Jefferson	9,740	31.716008	-91.055413
Jefferson Davis	13,962	31.575792	-89.817047
Jones	64,958	31.671012	-89.163966
Kemper	10,453	32.757776	-88.668827
Lafayette	38,744	34.362664	-89.522397
Lamar	39,070	31.253093	-89.441875
Lauderdale	78,161	32.401073	-88.689448
Lawrence	13,258	31.555497	-90.106826
Leake	20,940	32.736803	-89.509464
Lee	75,755	34.268785	-88.703031
Leflore	37,947	33.518339	-90.217678
Lincoln	33,166	31.554865	-90.453647
Lowndes	61,586	33.514169	-88.395897
Madison	74,674	32.513672	-90.092873
Marion	25,595	31.248454	-89.828529
Marshall	34,993	34.810681	-89.537906
Monroe	38,014	33.922988	-88.499397
Montgomery	12,189	33.496097	-89.680343
Neshoba	28,684	32.753086	-89.116155
Newton	21,838	32.411213	-89.126214
Noxubee	12,548	33.129991	-88.551113
Oktibbeha	42,902	33.449622	-88.831627
Panola	34,274	34.351505	-89.942556
Pearl River	48,621	30.641689	-89.631889
Perry	12,138	31.2598	-88.988024
Pike	38,940	31.21235	-90.437218
Pontotoc	26,726	34.250833	-89.01297
Prentiss	25,556	34.630125	-88.55202
Quitman	10,117	34.271615	-90.266826
Rankin	115,327	32.27313	-90.034904
Scott	28,423	32.402509	-89.525787
Sharkey	6,580	32.923525	-90.856763
Simpson	27,639	31.915408	-89.852616
Smith	16,182	31.96989	-89.501418
Stone	13,622	30.816147	-89.136042
Sunflower	34,369	33.598866	-90.586947
Tallahatchie	14,903	33.970924	-90.168674
Tate	25,370	34.647399	-89.940139
Tippah	20,826	34.768278	-88.92638
Tishomingo	19,163	34.724144	-88.228225
Tunica	9,227	34.684985	-90.366258
Union	25,362	34.486155	-89.008586
Walthall	15,156	31.147518	-90.118039
Warren	49,644	32.324659	-90.849406
Washington	62,977	33.369994	-91.009167
Wayne	21,216	31.651416	-88.658271
Webster	10,294	33.582315	-89.230999
Wilkinson	10,312	31.126255	-91.240475
Winston	20,160	33.086561	-89.045427
Yalobusha	13,051	34.080085	-89.696282
Yazoo	28,149	32.823178	-90.382468

Table A 4: County Population Centroid for Tennessee

COUNTY NAME	POPULATION	LATITUDE	LONGITUDE
Anderson	71,330	36.082673	-84.182728
Bedford	37,586	35.5106	-86.464338
Benton	16,537	36.072011	-88.090281
Bledsoe	12,367	35.619117	-85.191807
Blount	105,823	35.755569	-83.97069
Bradley	87,965	35.165839	-84.861605
Campbell	39,854	36.38622	-84.124847
Cannon	12,826	35.800976	-86.061712
Carroll	29,475	36.015985	-88.46471
Carter	56,742	36.317509	-82.201083
Cheatham	35,912	36.26339	-87.064201
Chester	15,540	35.434503	-88.622433
Claiborne	29,862	36.490813	-83.644448
Clay	7,976	36.555056	-85.56079
Cocke	33,565	35.94871	-83.173716
Coffee	48,014	35.449118	-86.12866
Crockett	14,532	35.789699	-89.124913
Cumberland	46,802	35.950733	-85.022878
Davidson	569,891	36.146772	-86.750506
Decatur	11,731	35.611523	-88.126886
DeKalb	17,423	35.968738	-85.838682
Dickson	43,156	36.108787	-87.349651
Dyer	37,279	36.057118	-89.360884
Fayette	28,806	35.20299	-89.455803
Fentress	16,625	36.371033	-84.933811
Franklin	39,270	35.206965	-86.113494
Gibson	48,152	35.945202	-88.885568
Giles	29,447	35.191337	-87.031504
Grainger	20,659	36.27306	-83.479865
Greene	62,909	36.176982	-82.834009
Grundy	14,332	35.340754	-85.71962
Hamblen	58,128	36.215573	-83.296667
Hamilton	307,896	35.091899	-85.210944
Hancock	6,786	36.521188	-83.228799
Hardeman	28,105	35.222733	-89.019386
Hardin	25,578	35.198695	-88.22738
Hawkins	53,563	36.464696	-82.871692
Haywood	19,797	35.585205	-89.272179
Henderson	25,522	35.647334	-88.400292
Henry	31,115	36.318773	-88.29713
Hickman	22,295	35.847589	-87.410148
Houston	8,088	36.307006	-87.707701
Humphreys	17,929	36.070918	-87.776956
Jackson	10,984	36.330732	-85.630662
Jefferson	44,294	36.071024	-83.455875
Johnson	17,499	36.453021	-81.841093
Knox	382,032	35.974039	-83.979665
Lake	7,954	36.355484	-89.467166
Lauderdale	27,101	35.764377	-89.540968
Lawrence	39,926	35.230101	-87.357191
Lewis	11,367	35.535606	-87.527478
Lincoln	31,340	35.111084	-86.573117
Loudon	39,086	35.761177	-84.286385
McMinn	49,015	35.422666	-84.597086
McNairy	24,653	35.177021	-88.544919
Macon	20,386	36.535259	-86.021527
Madison	91,837	35.642237	-88.822395
Marion	27,776	35.107054	-85.603908
Marshall	26,767	35.478514	-86.775471
Maury	69,498	35.614686	-87.056189
Meigs	11,086	35.505544	-84.814468
Monroe	38,961	35.512631	-84.357686
Montgomery	134,768	36.54432	-87.364348
Moore	5,740	35.29746	-86.340076
Morgan	19,757	36.102243	-84.588765
Obion	32,450	36.396272	-89.081352
Overton	20,118	36.352423	-85.319697
Perry	7,631	35.652822	-87.860007
Pickett	4,945	36.566128	-85.138061
Polk	16,050	35.122774	-84.558235
Putnam	62,315	36.163044	-85.502746
Rhea	28,400	35.561361	-84.951968
Roane	51,910	35.885631	-84.524957
Robertson	54,433	36.486873	-86.834463
Rutherford	182,023	35.891101	-86.440371
Scott	21,127	36.452949	-84.506461
Sequatchie	11,370	35.350196	-85.393148
Sevier	71,170	35.857932	-83.578426
Shelby	897,472	35.127123	-89.913322
Smith	17,712	36.242228	-85.964836
Stewart	12,370	36.495666	-87.798295
Sullivan	153,048	36.531666	-82.395271
Sumner	130,449	36.396955	-86.536565
Tipton	51,271	35.484165	-89.746367
Trousdale	7,259	36.393247	-86.167587
Unicoi	17,667	36.149083	-82.396469
Union	17,808	36.241887	-83.81882
Van Buren	5,508	35.72416	-85.452008
Warren	38,276	35.695663	-85.79129
Washington	107,198	36.323347	-82.432512
Wayne	16,842	35.258833	-87.793194
Weakley	34,895	36.2913	-88.76984
White	23,102	35.937084	-85.48719
Williamson	126,638	35.93339	-86.86197
Wilson	88,809	36.199756	-86.396588

Appendix II: Distance from Population Centroid of County to Each Port

Table A 5: Distance from Population Centroid of County to Each Port

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Arkansas, AR	406	395	389	366	326	236	207	183	160	131	113	75.1	126	68.2	126	163
Ashley, AR	339	328	322	280	229	139	140	117	96	75.5	62.4	62.9	97.4	158	210	264
Baxter, AR	610	600	594	571	499	409	393	369	346	317	299	266	272	214	200	196
Benton, AR	653	642	636	613	560	471	454	430	407	378	360	327	380	322	340	378
Boone, AR	582	571	565	542	489	399	383	359	336	307	289	256	309	251	233	229
Bradley, AR	378	367	361	319	268	178	179	155	138	109	95.6	60.4	131	142	197	234
Calhoun, AR	399	388	382	340	289	199	200	176	156	132	119	87.8	154	163	207	244
Carroll, AR	609	599	593	570	517	427	411	387	364	335	316	284	337	279	261	257
Chicot, AR	318	307	301	278	243	153	119	95.5	72.1	43.1	25	33.5	59.9	121	172	227
Clark, AR	481	470	464	438	380	252	253	229	209	188	175	155	244	186	204	242
Clay, AR	531	520	514	491	504	434	397	369	333	304	277	249	234	156	121	73.8
Cleburne, AR	546	536	530	507	414	324	307	284	260	231	213	181	204	146	136	155
Cleveland, AR	391	380	374	351	291	202	192	168	145	116	97.8	72	133	132	176	213
Columbia, AR	369	358	352	326	268	204	205	181	161	154	149	149	184	214	273	311
Conway, AR	494	483	477	454	402	312	295	272	248	219	201	169	221	163	182	219
Craighead, AR	478	467	461	438	451	381	344	316	281	252	223	196	181	104	67.3	53.1
Crawford, AR	590	580	574	551	502	408	392	368	345	316	297	265	318	260	278	315
Crittenden, AR	423	412	406	383	396	326	288	261	241	212	168	165	126	74.3	12.3	49.8
Cross, AR	458	447	441	418	431	312	266	236	246	217	173	161	121	61.8	47.2	66.2
Dallas, AR	422	412	406	363	312	223	223	200	179	142	129	90.5	164	152	206	244
Desha, AR	353	342	336	313	274	184	154	130	107	78	59.9	27.5	94.8	97.5	159	197
Drew, AR	356	346	340	317	259	169	158	134	111	81.5	63.4	37.6	98.4	119	181	218
Faulkner, AR	473	463	457	433	381	291	274	251	227	198	180	148	201	142	161	171
Franklin, AR	570	559	553	530	477	388	371	347	324	295	277	244	297	239	257	295
Fulton, AR	575	564	558	535	548	478	441	413	351	322	321	286	278	220	164	161
Garland, AR	474	464	458	435	379	289	276	252	229	200	181	149	230	172	191	228
Grant, AR	425	414	409	385	333	243	226	203	179	150	132	99.6	167	127	168	205
Greene, AR	500	489	483	460	473	403	366	338	302	273	246	218	203	125	89.5	57.1
Hempstead, AR	442	432	426	399	341	258	259	235	215	201	196	160	231	228	246	284
Hot Spring, AR	456	445	439	416	403	270	257	233	210	181	163	130	221	163	181	219
Howard, AR	459	449	443	416	358	289	290	266	246	236	231	188	266	249	268	305
Independence, AR	530	520	514	490	444	354	338	312	291	262	244	211	197	138	120	116
Izard, AR	576	566	560	537	550	390	373	347	326	297	279	247	232	174	166	162
Jackson, AR	501	490	484	461	474	349	318	288	285	256	226	205	173	115	90.1	86.5
Jefferson, AR	400	389	383	360	310	220	201	177	154	125	107	74.1	141	103	147	184
Johnson, AR	542	532	526	503	450	360	343	320	297	267	249	217	270	211	230	267
Lafayette, AR	394	384	378	351	293	227	228	204	184	202	176	177	211	256	275	312
Lawrence, AR	510	499	493	470	483	413	376	348	306	277	256	222	213	155	99.6	96
Lee, AR	407	397	391	367	380	277	231	201	202	173	138	117	85.4	26.7	57.5	95
Lincoln, AR	381	370	364	341	296	206	182	158	135	106	87.5	55.1	122	104	170	207
Little River, AR	436	425	419	393	335	293	294	270	250	268	225	210	260	277	296	333
Logan, AR	564	554	548	524	485	382	365	342	318	289	271	239	291	233	252	289
Lonoke, AR	467	456	450	427	375	285	268	245	221	192	174	142	164	106	124	162
Madison, AR	613	602	596	573	521	431	414	390	367	338	320	288	340	282	300	338
Marion, AR	577	566	560	537	485	395	378	354	331	302	284	252	304	246	219	215
Miller, AR	410	399	393	367	309	267	268	244	224	242	201	202	236	260	279	316
Mississippi, AR	473	463	457	434	447	377	339	311	292	263	219	220	177	132	63	14.8
Monroe, AR	425	415	409	386	399	273	249	219	197	168	156	112	103	45.2	82.8	120

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Montgomery, AR	528	517	511	485	427	305	306	283	261	232	214	182	267	209	227	264
Nevada, AR	406	396	390	363	305	242	242	219	198	190	184	147	219	221	239	277
Newton, AR	578	568	562	539	486	396	380	356	333	304	286	253	306	248	266	239
Ouachita, AR	398	388	382	339	288	199	199	176	155	152	139	108	174	177	221	258
Perry, AR	488	477	471	448	396	306	289	265	242	213	195	162	217	159	178	215
Phillips, AR	391	380	374	351	364	260	214	184	187	158	121	107	68.8	10.6	78.5	116
Pike, AR	490	480	474	447	389	285	285	262	241	226	213	193	275	217	235	273
Poinsett, AR	460	449	443	420	433	363	326	298	278	249	205	195	163	119	49.4	45.8
Polk, AR	511	500	494	468	410	368	369	345	325	274	261	229	314	256	274	312
Pope, AR	517	506	500	477	424	335	318	294	271	242	224	191	244	186	204	242
Prairie, AR	459	449	443	419	364	275	245	221	198	169	151	113	137	79	97.4	135
Pulaski, AR	446	436	430	407	354	264	247	224	200	171	153	121	178	120	138	176
Randolph, AR	523	512	506	483	496	426	388	360	319	290	268	234	226	167	112	109
St. Francis, AR	455	444	438	415	428	295	248	218	220	191	156	135	103	44.4	44.6	82.1
Saline, AR	459	448	442	419	367	277	260	236	213	184	166	134	195	137	155	193
Scott, AR	547	536	530	503	445	350	351	327	306	277	259	227	312	254	272	310
Searcy, AR	540	529	523	500	448	358	341	318	294	265	247	215	267	209	191	188
Sebastian, AR	590	579	573	547	489	422	405	382	358	329	311	279	332	273	292	329
Sevier, AR	462	451	445	419	361	319	320	296	276	294	251	211	286	261	279	317
Sharp, AR	552	541	535	512	525	391	418	390	327	298	297	248	255	175	141	138
Stone, AR	570	559	553	530	452	362	345	322	298	269	251	219	228	169	160	151
Union, AR	367	356	350	308	257	167	168	144	123	119	113	104	148	193	237	274
Van Buren, AR	511	500	494	471	419	329	312	288	265	236	218	186	238	180	162	181
Washington, AR	634	623	617	594	541	452	435	411	388	359	341	308	361	303	321	359
White, AR	517	506	500	477	400	310	294	270	247	218	199	167	174	116	106	125
Woodruff, AR	488	478	472	448	461	310	286	256	234	205	193	149	141	82.3	77.8	96.8
Yell, AR	534	524	518	495	442	352	335	312	288	259	241	209	262	203	222	259
Acadia, LA	174	163	157	131	76.1	159	199	229	218	247	280	280	315	430	458	512
Allen, LA	216	206	200	173	115	131	172	215	194	212	255	255	290	351	403	457
Ascension, LA	75.6	65	59	32.4	27.6	110	150	180	183	212	278	283	311	352	379	434
Assumption, LA	94.9	84.3	78.3	46.6	55.7	143	183	219	216	245	304	316	337	378	405	460
Avoyelles, LA	183	172	166	139	81.3	86.9	128	157	146	175	234	225	241	334	395	450
Beauregard, LA	259	248	242	216	161	157	198	238	218	236	279	279	314	374	501	539
Bienville, LA	315	305	299	272	214	147	166	143	122	140	176	176	211	269	313	350
Bossier, LA	344	334	328	301	243	193	194	170	150	167	203	203	238	280	350	387
Caddo, LA	336	326	320	293	235	202	203	179	158	176	212	212	247	289	350	388
Calcasieu, LA	225	214	208	182	127	210	251	280	251	269	312	312	347	408	509	563
Caldwell, LA	262	252	246	219	168	78.4	121	97.6	77	94.9	140	140	175	235	287	342
Cameron, LA	253	243	226	212	159	242	282	312	301	307	350	350	384	513	541	595
Catahoula, LA	220	210	204	177	126	36.5	77.3	104	83.1	101	143	162	178	239	290	345
Claiborne, LA	336	326	320	293	235	172	173	149	128	146	154	155	189	238	282	319
Concordia, LA	198	188	182	155	104	14.3	55	84.8	66.6	95.2	149	166	184	261	323	377
De Soto, LA	317	307	301	274	216	176	232	209	188	206	242	242	277	319	381	419
East Baton Rouge, LA	98.7	88.1	82.2	55.5	14	90.3	130	160	163	192	237	263	310	351	378	433
East Carroll, LA	274	263	257	234	195	105	75.1	51.5	28.2	3.6	57.2	75.1	92.1	153	205	259
East Feliciana, LA	134	123	117	90.6	39.8	69.3	89.2	119	137	165	196	237	239	312	340	394
Evangeline, LA	185	174	168	142	83.7	132	173	213	192	210	253	253	288	349	442	497
Franklin, LA	240	230	224	197	146	56.4	89.6	66	45.5	63.4	105	123	140	201	252	307

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Grant, LA	235	225	219	192	134	88.6	129	148	127	145	189	190	224	285	337	391
Iberia, LA	149	138	132	126	77.6	160	201	231	219	248	311	311	346	432	459	514
Iberville, LA	104	93	87	55.3	14.7	106	146	176	179	208	253	279	328	369	396	451
Jackson, LA	293	282	276	250	192	125	148	124	104	122	157	157	192	253	305	349
Jefferson, LA	29.1	18.5	12.3	25.9	82.3	170	184	206	228	257	291	328	324	365	392	447
Jefferson Davis, LA	196	185	179	153	98.2	181	222	251	240	255	298	298	333	452	480	534
Lafayette, LA	155	144	138	111	56.8	139	180	210	199	227	291	291	326	411	438	493
Lafourche, LA	70.7	60.1	54.1	47.4	107	194	208	230	252	281	315	352	348	389	417	471
La Salle, LA	245	234	228	202	151	61.1	102	125	105	123	167	167	202	263	315	369
Lincoln, LA	332	322	316	273	208	133	133	110	89.2	107	143	143	178	239	290	326
Livingston, LA	96.7	86.1	80.1	56.9	25.6	109	150	172	194	223	257	281	290	331	358	413
Madison, LA	246	236	230	206	167	77.4	47.3	23.7	0.8	29.5	83.1	101	118	179	231	285
Morehouse, LA	307	296	290	247	196	107	108	84	63.5	47.5	82.6	82.7	118	179	230	285
Natchitoches, LA	269	258	252	226	168	126	167	171	150	168	204	204	239	300	351	462
Orleans, LA	16.2	5.6	2.1	31.7	85.4	173	187	209	231	260	294	331	327	368	395	450
Ouachita, LA	300	290	284	241	191	101	102	77.9	57.3	75.2	109	109	144	205	256	311
Plaquemines, LA	28	38.4	45	75	129	216	230	252	274	303	337	375	370	411	439	493
Pointe Coupee, LA	133	122	116	89.5	31.4	91.2	132	162	151	179	238	250	268	338	390	445
Rapides, LA	211	200	194	167	109	78.3	119	162	141	159	202	202	237	298	349	404
Red River, LA	301	290	284	257	199	145	208	185	164	182	218	218	253	297	341	378
Richland, LA	276	266	260	237	175	84.7	77.4	53.8	33.3	51.4	102	102	137	198	250	304
Sabine, LA	296	286	280	253	195	162	203	207	186	204	240	240	275	358	424	462
St. Bernard, LA	7.7	3	9.6	39.6	93.3	181	195	217	239	268	302	339	335	376	403	458
St. Charles, LA	39.8	29.2	23.2	16.5	75.7	163	177	199	221	250	284	322	317	358	386	440
St. Helena, LA	108	97.1	91.1	67.9	51.1	92.6	117	139	162	190	224	262	257	298	326	380
St. James, LA	67.3	56.7	50.7	19.4	46.5	134	181	204	226	254	289	307	322	363	390	445
St. John the Baptist, LA	49	38.4	32.4	3	55.1	143	165	187	209	238	272	310	305	346	374	428
St. Landry, LA	162	151	145	119	60.7	118	159	188	177	206	269	269	304	365	419	474
St. Martin, LA	150	139	133	107	52	144	184	213	209	237	290	301	335	406	434	488
St. Mary, LA	115	105	98.6	91.8	75.1	167	252	275	257	285	360	349	393	434	461	516
St. Tammany, LA	53.4	44.8	46.4	70.9	83.8	163	168	190	212	241	275	313	308	349	377	431
Tangipahoa, LA	80.3	69.7	63.7	40.5	56	121	126	148	171	199	233	271	266	307	335	389
Tensas, LA	229	218	212	186	135	45.2	77	53.3	32.6	61.3	115	133	150	211	301	355
Terrebonne, LA	75.9	65.3	59.3	52.6	88.3	176	213	235	258	286	320	358	353	394	422	476
Union, LA	333	322	316	274	223	133	134	110	89.6	84.6	117	118	152	207	270	308
Vermilion, LA	170	159	153	131	76.7	159	200	230	218	247	310	311	345	431	458	513
Vernon, LA	252	241	235	209	151	133	174	214	194	212	259	259	294	355	472	509
Washington, LA	95.3	86.7	88.3	89.3	102	131	136	158	180	209	243	280	276	317	344	399
Webster, LA	347	336	330	304	246	179	180	156	136	154	179	180	214	263	319	356
West Baton Rouge, LA	103	92.2	86.3	59.7	5.1	96.7	137	166	170	198	243	269	318	359	387	441
West Carroll, LA	290	280	274	250	196	107	91.4	67.8	47	19.7	53.5	71.3	88.4	149	201	255
West Feliciana, LA	138	128	122	95	44.2	63.3	103	133	136	165	210	236	253	309	365	419
Winn, LA	263	252	247	220	162	94.6	135	140	119	137	173	173	208	269	320	374
Adams, MS	192	182	176	145	94.4	6.2	41.8	71.6	89.2	118	148	178	192	248	309	364
Alcorn, MS	395	386	388	406	419	349	311	288	309	270	227	267	188	158	95.9	151
Amite, MS	135	125	119	95.5	65	68.9	73.4	103	121	149	180	221	240	281	309	363
Attala, MS	251	273	267	244	257	187	150	122	144	172	102	160	116	141	152	207
Benton, MS	406	397	406	383	396	326	289	261	283	233	189	214	150	105	65.7	120

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bolivar, MS	325	315	309	286	299	189	143	113	123	94	50.1	93.7	17.4	70.3	114	168
Calhoun, MS	357	347	341	318	331	261	223	195	217	180	136	179	115	112	119	173
Carroll, MS	302	291	285	262	275	205	150	119	144	125	81.6	125	81.4	106	131	186
Chickasaw, MS	336	328	329	328	341	271	234	206	228	199	155	199	134	135	127	181
Choctaw, MS	286	277	298	275	288	218	180	153	174	169	125	169	125	150	157	211
Claiborne, MS	205	194	188	165	134	45.5	6.9	36.7	54.3	82.9	113	154	157	213	284	338
Clarke, MS	190	182	183	210	243	192	178	154	176	205	221	276	254	243	271	326
Clay, MS	304	296	297	316	329	259	220	197	219	201	157	200	157	160	156	210
Coahoma, MS	355	345	339	315	328	222	176	146	156	127	82.9	126	41.6	28.1	74.1	129
Copiah, MS	173	162	156	133	146	76.2	47.4	57.3	79.5	108	142	180	175	216	244	298
Covington, MS	142	133	135	161	180	123	108	105	127	156	172	227	205	246	269	324
DeSoto, MS	397	387	381	357	370	300	263	235	257	199	155	177	113	68.4	17.4	72
Forrest, MS	119	110	112	138	172	151	137	134	156	184	201	256	234	275	298	353
Franklin, MS	160	149	143	120	91.8	38.9	47.6	77.3	94.9	124	154	195	197	254	290	344
George, MS	145	136	138	164	198	208	196	193	215	244	260	315	293	334	357	412
Greene, MS	162	153	155	181	215	203	184	181	203	231	248	303	281	322	345	400
Grenada, MS	317	307	301	278	291	221	183	155	177	140	96.1	139	75.1	97.1	99.3	154
Hancock, MS	64.2	55.6	57.1	83.6	118	197	202	218	239	268	285	340	318	359	382	437
Harrison, MS	83.4	74.8	76.4	103	137	217	204	201	223	252	268	323	301	342	366	420
Hinds, MS	205	194	188	165	178	108	67.4	39.5	61.4	90.1	106	162	139	180	209	264
Holmes, MS	266	256	250	226	239	169	132	89	126	126	72.9	125	99.3	124	158	213
Humphreys, MS	273	262	256	233	246	149	103	72.8	96.9	90.5	37.7	90.2	73.5	114	158	212
Issaquena, MS	277	266	260	237	221	133	86.4	56.3	80.5	86.2	35	85.9	78.4	142	186	240
Itawamba, MS	359	351	352	384	397	327	289	265	287	260	216	260	178	151	127	181
Jackson, MS	120	111	113	139	173	253	233	231	252	281	298	353	331	372	395	450
Jasper, MS	175	166	168	194	228	163	132	116	137	166	182	238	215	236	248	303
Jefferson, MS	187	177	171	148	112	28.9	19.4	49.1	66.7	95.4	126	167	169	226	287	341
Jefferson Davis, MS	157	148	150	148	161	104	97.4	103	125	154	171	226	204	244	268	322
Jones, MS	146	137	138	165	199	148	133	131	152	181	198	253	231	271	295	349
Kemper, MS	237	228	230	256	290	228	189	166	188	216	167	229	185	210	216	271
Lafayette, MS	376	365	359	336	349	279	242	214	236	186	142	185	103	77	83.8	138
Lamar, MS	115	106	108	134	168	144	128	137	159	188	204	259	237	278	302	356
Lauderdale, MS	209	200	202	228	262	200	161	138	160	188	205	260	196	220	232	286
Lawrence, MS	149	140	153	130	143	85.9	74.5	83	105	134	156	205	201	242	270	324
Leake, MS	228	219	221	219	232	162	123	100	122	151	126	179	142	167	178	233
Lee, MS	348	339	341	360	372	303	264	241	263	236	192	235	153	127	106	161
Leflore, MS	299	289	283	260	273	179	133	102	127	105	61.4	105	61.2	85.5	131	185
Lincoln, MS	149	138	132	109	122	64.7	52.1	77.1	99.3	128	162	199	195	236	264	318
Lowndes, MS	298	289	291	317	333	263	224	201	223	216	173	216	172	197	171	226
Madison, MS	221	211	205	181	194	124	87	59.2	81.1	110	101	154	134	167	191	246
Marion, MS	118	109	111	129	142	117	122	126	148	177	193	248	226	267	291	345
Marshall, MS	412	401	395	372	385	315	278	250	272	222	178	203	139	93.8	47	102
Monroe, MS	329	320	322	348	356	286	247	224	246	239	195	239	167	151	141	195
Montgomery, MS	300	289	283	260	273	203	166	138	160	137	93.5	137	93.2	118	125	179
Neshoba, MS	239	230	232	247	260	190	152	129	150	179	140	202	158	183	194	249
Newton, MS	209	201	202	232	245	175	137	113	135	164	180	235	184	209	220	275
Noxubee, MS	266	257	259	285	319	235	196	173	195	224	182	226	182	206	188	243
Oktibbeha, MS	304	296	297	290	303	233	194	171	193	194	150	193	150	174	181	236

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Panola, MS	356	346	340	316	329	259	222	194	216	164	120	163	81.2	53	58.5	113
Pearl River, MS	65.4	56.9	58.4	84.9	119	198	203	189	211	239	256	311	289	330	353	408
Perry, MS	135	127	128	155	189	176	164	161	183	212	228	283	261	302	326	380
Pike, MS	125	115	109	85.4	98.4	76.8	81.6	104	126	155	189	226	222	263	290	345
Pontotoc, MS	353	344	346	347	360	290	253	225	247	216	172	215	133	107	97.5	152
Prentiss, MS	378	369	371	389	402	332	294	271	292	253	209	253	171	144	116	171
Quitman, MS	373	362	356	333	346	237	191	160	170	141	97.7	141	58.9	37	66.6	121
Rankin, MS	211	201	195	172	185	115	76.1	52.8	74.7	103	119	175	152	193	217	272
Scott, MS	206	197	199	205	218	148	109	85.7	108	136	138	208	168	192	203	258
Sharkey, MS	266	256	250	226	210	122	75.9	45.8	69.9	83.9	36.5	83.6	82.2	131	175	229
Simpson, MS	171	163	164	166	179	109	80.3	79.2	101	130	146	201	179	220	244	298
Smith, MS	174	165	167	193	198	141	111	95.9	118	147	162	218	195	221	233	287
Stone, MS	107	98.1	99.7	126	160	173	174	171	193	222	238	293	271	312	335	390
Sunflower, MS	312	301	295	272	285	185	139	109	119	89.9	46	89.6	43.9	80.4	124	178
Tallahatchie, MS	348	338	332	308	321	223	177	146	165	136	92.2	136	66.6	63.5	97.4	152
Tate, MS	379	368	362	339	352	282	245	217	239	189	145	170	105	60.9	36.7	91.3
Tippah, MS	396	387	389	380	393	323	286	258	280	243	199	236	160	127	86.8	141
Tishomingo, MS	392	384	385	415	428	358	319	296	318	279	235	278	196	183	121	175
Tunica, MS	403	393	387	363	376	259	212	182	192	163	120	142	77.1	32.6	38.5	93.1
Union, MS	373	364	366	357	370	300	263	235	257	220	176	220	137	111	81.2	136
Walthall, MS	120	111	95.9	111	124	98.6	103	126	148	176	211	248	244	285	312	367
Warren, MS	222	211	205	182	164	76	29.8	3.6	23.8	52.5	78.7	124	122	178	249	304
Washington, MS	319	308	302	279	256	167	121	91.2	86.1	57.1	10.6	56.8	39.7	105	149	203
Wayne, MS	180	171	173	199	233	182	167	165	186	215	232	287	265	275	303	357
Webster, MS	329	321	318	295	308	238	200	172	194	171	128	171	127	146	148	203
Wilkinson, MS	157	146	140	114	63	35.6	75.6	105	109	137	182	208	225	282	342	397
Winston, MS	267	258	260	262	275	205	166	143	165	193	144	194	151	175	182	237
Yalobusha, MS	342	332	326	302	315	245	208	180	202	164	121	164	99.8	88.4	90.7	145
Yazoo, MS	243	233	227	204	217	127	80.8	50.8	74.9	104	66.1	119	99.1	140	187	242
Anderson, TN	612	603	605	632	665	603	565	541	563	592	535	554	493	448	383	404
Bedford, TN	506	497	499	525	559	497	458	435	457	437	393	411	350	306	241	262
Benton, TN	500	535	529	506	519	449	412	384	406	339	295	313	252	208	143	145
Bledsoe, TN	548	539	541	567	601	539	501	477	499	528	485	526	465	420	355	376
Blount, TN	613	605	606	633	666	604	566	542	564	593	552	570	509	465	400	421
Bradley, TN	530	522	523	550	584	522	483	460	482	510	467	510	467	445	380	401
Campbell, TN	643	635	636	663	696	634	596	572	594	623	582	600	539	495	430	451
Cannon, TN	566	557	559	585	619	557	518	495	517	465	421	439	379	334	269	290
Carroll, TN	526	516	510	487	500	430	392	364	386	319	275	294	233	188	123	121
Carter, TN	724	715	717	743	777	715	676	653	675	703	662	681	620	575	510	531
Cheatham, TN	559	551	552	575	588	518	481	453	475	408	364	382	321	277	212	233
Chester, TN	435	427	428	437	450	380	343	315	337	292	248	267	206	161	96.2	132
Claiborne, TN	654	646	647	674	707	645	607	583	605	634	593	611	550	506	441	462
Clay, TN	628	619	621	647	679	609	572	544	566	499	455	473	412	368	303	324
Cocke, TN	657	648	650	677	710	648	610	586	608	637	596	614	553	509	443	464
Coffee, TN	514	506	507	534	568	506	467	444	466	479	435	453	392	348	283	304
Crockett, TN	488	477	471	448	461	391	354	326	348	281	237	255	195	150	84.7	88.5
Cumberland, TN	576	568	569	596	629	567	529	505	527	523	479	498	437	392	327	348
Davidson, TN	539	530	532	558	592	525	487	459	481	414	370	389	328	284	218	239

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Decatur, TN	461	452	454	496	509	439	402	374	396	329	285	303	242	198	133	154
DeKalb, TN	580	571	573	599	633	571	547	519	541	474	430	448	387	343	278	299
Dickson, TN	547	539	540	545	558	488	451	423	445	378	334	352	292	247	182	203
Dyer, TN	491	481	475	451	464	394	357	329	351	284	240	254	198	153	83.2	65.1
Fayette, TN	450	440	434	411	424	354	316	288	310	243	199	221	157	112	50.1	101
Fentress, TN	611	602	604	630	664	602	563	540	562	536	492	510	450	405	340	361
Franklin, TN	494	485	487	514	547	485	447	423	445	474	382	472	344	366	301	322
Gibson, TN	507	496	490	467	480	410	373	345	367	300	256	274	214	169	104	94.9
Giles, TN	471	463	464	491	525	463	424	401	423	451	336	369	304	260	198	253
Grainger, TN	642	634	635	662	695	633	595	571	593	622	581	599	538	494	428	449
Greene, TN	677	668	670	696	730	668	629	606	628	656	615	634	573	528	463	484
Grundy, TN	523	515	516	543	577	514	476	453	474	503	460	485	424	379	314	335
Hamblen, TN	648	639	641	667	701	639	600	577	599	627	586	604	544	499	434	455
Hamilton, TN	507	498	500	526	560	498	459	436	458	486	443	487	443	421	356	377
Hancock, TN	676	667	669	695	729	667	628	605	627	655	614	632	572	527	462	483
Hardeman, TN	449	438	432	409	422	352	314	287	309	259	222	244	180	135	73	128
Hardin, TN	436	427	429	447	460	390	352	328	350	309	272	294	230	185	123	175
Hawkins, TN	681	673	674	701	735	673	634	611	633	661	620	638	578	533	468	489
Haywood, TN	470	460	454	431	444	374	336	308	330	263	219	238	177	132	67.2	103
Henderson, TN	454	445	447	478	491	421	384	356	378	311	267	285	225	180	115	136
Henry, TN	553	542	536	513	526	456	419	391	413	346	302	320	259	215	150	145
Hickman, TN	536	528	529	537	550	480	443	415	437	370	326	344	283	239	174	195
Houston, TN	536	579	573	549	562	492	455	427	449	382	338	357	296	251	186	194
Humphreys, TN	513	556	550	526	539	469	432	404	426	359	315	334	273	228	163	165
Jackson, TN	619	610	612	638	672	607	570	542	564	497	453	471	410	366	300	322
Jefferson, TN	640	631	633	659	693	631	592	569	591	620	578	597	536	491	426	447
Johnson, TN	752	744	745	772	805	743	705	681	703	732	691	709	648	604	538	559
Knox, TN	605	597	598	625	659	596	558	535	556	585	544	562	501	457	392	413
Lake, TN	510	500	494	470	483	413	376	348	370	303	259	279	217	172	102	71
Lauderdale, TN	464	454	448	424	437	367	330	302	324	257	213	227	171	126	56.2	85.1
Lawrence, TN	492	484	485	512	546	445	407	383	405	364	327	349	285	240	178	219
Lewis, TN	493	484	486	532	545	475	437	410	432	364	321	339	278	234	168	189
Lincoln, TN	474	465	467	493	527	465	426	403	425	453	362	405	323	302	240	272
Loudon, TN	584	575	577	603	637	575	536	513	535	564	521	553	492	448	382	403
McMinn, TN	555	547	548	575	608	546	508	484	506	535	492	535	492	448	383	404
McNairy, TN	415	406	408	427	440	370	331	308	330	288	252	274	209	165	102	154
Macon, TN	598	589	591	617	649	579	542	514	536	469	425	443	382	338	273	294
Madison, TN	453	483	477	454	467	397	360	332	354	287	243	261	200	156	90.6	112
Marion, TN	504	495	497	524	557	495	457	433	455	484	441	484	377	392	327	348
Marshall, TN	490	481	483	509	543	481	442	419	441	418	374	393	332	287	222	243
Maury, TN	505	496	498	524	558	496	457	434	456	396	352	371	310	265	200	221
Meigs, TN	550	542	543	570	604	541	503	480	501	530	487	530	483	439	373	394
Monroe, TN	576	567	569	595	629	567	528	505	527	556	512	556	518	473	408	429
Montgomery, TN	590	582	583	571	584	514	476	449	471	403	360	378	317	273	207	203
Moore, TN	494	485	487	513	547	485	447	423	445	474	382	427	343	321	256	277
Morgan, TN	593	585	586	613	647	584	546	523	544	573	525	543	482	438	373	394
Obion, TN	521	511	505	481	494	424	387	359	381	314	270	299	228	183	113	91.5
Overton, TN	613	605	606	633	667	605	584	556	578	511	467	485	425	380	315	336

County	Ports															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Perry, TN	480	472	473	512	525	455	417	389	411	344	300	319	258	214	148	169
Pickett, TN	633	624	626	652	686	624	603	575	597	530	486	505	444	399	334	355
Polk, TN	549	540	542	568	602	540	501	478	500	529	486	529	485	463	398	419
Putnam, TN	594	586	587	614	647	600	563	535	557	490	446	464	404	359	294	315
Rhea, TN	542	533	535	561	595	533	494	471	493	521	478	522	472	427	362	383
Roane, TN	578	570	571	598	632	570	531	508	530	558	510	528	468	423	358	379
Robertson, TN	567	558	560	586	618	548	511	483	505	438	394	412	351	307	241	263
Rutherford, TN	538	530	531	558	592	529	491	468	489	440	397	415	354	310	244	265
Scott, TN	626	617	619	645	679	617	578	555	577	569	525	543	483	438	373	394
Sequatchie, TN	525	517	518	545	579	517	478	455	477	505	462	506	400	403	337	358
Sevier, TN	633	624	626	652	686	624	585	562	584	612	571	589	529	484	419	440
Shelby, TN	419	409	403	379	392	322	285	257	279	212	168	190	126	81.2	18.9	63.7
Smith, TN	588	579	581	607	641	576	539	511	533	466	422	440	379	335	270	291
Stewart, TN	585	574	568	545	558	488	450	423	444	377	334	352	291	247	181	177
Sullivan, TN	707	698	700	727	760	698	660	636	658	687	646	664	603	559	493	514
Sumner, TN	567	559	560	587	619	549	511	483	505	438	394	413	352	308	242	263
Tipton, TN	441	431	425	402	415	345	307	279	301	234	191	204	148	104	33.5	84.8
Trousdale, TN	583	574	576	602	636	565	527	499	521	454	410	429	368	323	258	279
Unicoi, TN	707	699	700	727	761	699	660	637	659	687	646	664	604	559	494	515
Union, TN	629	620	622	648	682	620	581	558	580	608	567	585	525	480	415	436
Van Buren, TN	564	556	557	584	618	556	517	494	516	544	477	495	434	390	325	346
Warren, TN	567	558	559	586	620	558	519	496	518	482	438	457	396	352	286	307
Washington, TN	702	694	695	722	756	693	655	632	653	682	641	659	598	554	489	510
Wayne, TN	462	454	455	474	487	417	378	355	377	335	299	321	256	212	149	191
Weakley, TN	538	527	521	498	511	441	404	376	398	331	287	325	244	200	135	117
White, TN	578	570	571	598	631	569	531	507	529	505	461	479	419	374	309	330
Williamson, TN	524	515	517	543	577	515	476	453	475	407	363	381	320	276	210	231
Wilson, TN	558	549	551	577	611	545	508	480	502	435	391	409	349	304	239	260

Appendix III: County's Accessibility to Mississippi River Ports

Table A 6: County's Accessibility to Mississippi River Ports

County	Access	County	Access	County	Access
Arkansas, AR	1	Lonoke, AR	0	Calcasieu, LA	0
Ashley, AR	1	Madison, AR	0	Caldwell, LA	1
Baxter, AR	0	Marion, AR	0	Cameron, LA	0
Benton, AR	0	Miller, AR	0	Catahoula, LA	1
Boone, AR	0	Mississippi, AR	1	Claiborne, LA	0
Bradley, AR	1	Monroe, AR	1	Concordia, LA	1
Calhoun, AR	1	Montgomery, AR	0	De Soto, LA	0
Carroll, AR	0	Nevada, AR	0	East Baton Rouge, LA	1
Chicot, AR	1	Newton, AR	0	East Carroll, LA	1
Clark, AR	0	Ouachita, AR	0	East Feliciana, LA	1
Clay, AR	1	Perry, AR	0	Evangeline, LA	1
Cleburne, AR	0	Phillips, AR	1	Franklin, LA	1
Cleveland, AR	1	Pike, AR	0	Grant, LA	1
Columbia, AR	0	Poinsett, AR	1	Iberia, LA	1
Conway, AR	0	Polk, AR	0	Iberville, LA	1
Craighead, AR	1	Pope, AR	0	Jackson, LA	1
Crawford, AR	0	Prairie, AR	1	Jefferson, LA	1
Crittenden, AR	1	Pulaski, AR	0	Jefferson Davis, LA	1
Cross, AR	1	Randolph, AR	0	Lafayette, LA	1
Dallas, AR	1	St. Francis, AR	1	Lafourche, LA	1
Desha, AR	1	Saline, AR	0	La Salle, LA	1
Drew, AR	1	Scott, AR	0	Lincoln, LA	1
Faulkner, AR	0	Searcy, AR	0	Livingston, LA	1
Franklin, AR	0	Sebastian, AR	0	Madison, LA	1
Fulton, AR	0	Sevier, AR	0	Morehouse, LA	1
Garland, AR	0	Sharp, AR	0	Natchitoches, LA	0
Grant, AR	1	Stone, AR	0	Orleans, LA	1
Greene, AR	1	Union, AR	1	Ouachita, LA	1
Hempstead, AR	0	Van Buren, AR	0	Plaquemines, LA	1
Hot Spring, AR	0	Washington, AR	0	Pointe Coupee, LA	1
Howard, AR	0	White, AR	0	Rapides, LA	1
Independence, AR	0	Woodruff, AR	1	Red River, LA	0
Izard, AR	0	Yell, AR	0	Richland, LA	1
Jackson, AR	1	Acadia, LA	1	Sabine, LA	0
Jefferson, AR	1	Allen, LA	0	St. Bernard, LA	1
Johnson, AR	0	Ascension, LA	1	St. Charles, LA	1
Lafayette, AR	0	Assumption, LA	1	St. Helena, LA	1
Lawrence, AR	1	Avoyelles, LA	1	St. James, LA	1
Lee, AR	1	Beauregard, LA	0	St. John the Baptist, LA	1
Lincoln, AR	1	Bienville, LA	0	St. Landry, LA	1
Little River, AR	0	Bossier, LA	0	St. Martin, LA	1
Logan, AR	0	Caddo, LA	0	St. Mary, LA	1

County	Access
St. Tammany, LA	1
Tangipahoa, LA	1
Tensas, LA	1
Terrebonne, LA	1
Union, LA	1
Vermilion, LA	1
Vernon, LA	0
Washington, LA	1
Webster, LA	0
West Baton Rouge, LA	1
West Carroll, LA	1
West Feliciana, LA	1
Winn, LA	1
Adams, MS	1
Alcorn, MS	1
Amite, MS	1
Attala, MS	1
Benton, MS	1
Bolivar, MS	1
Calhoun, MS	0
Carroll, MS	1
Chickasaw, MS	0
Choctaw, MS	0
Claiborne, MS	1
Clarke, MS	0
Clay, MS	0
Coahoma, MS	1
Copiah, MS	1
Covington, MS	1
DeSoto, MS	1
Forrest, MS	0
Franklin, MS	1
George, MS	0
Greene, MS	0
Grenada, MS	1
Hancock, MS	1
Harrison, MS	1
Hinds, MS	1
Holmes, MS	1
Humphreys, MS	1
Issaquena, MS	1
Itawamba, MS	0

County	Access
Jackson, MS	0
Jasper, MS	0
Jefferson, MS	1
Jefferson Davis, MS	1
Jones, MS	0
Kemper, MS	0
Lafayette, MS	1
Lamar, MS	0
Lauderdale, MS	0
Lawrence, MS	1
Leake, MS	1
Lee, MS	0
Leflore, MS	1
Lincoln, MS	1
Lowndes, MS	0
Madison, MS	1
Marion, MS	0
Marshall, MS	1
Monroe, MS	0
Montgomery, MS	1
Neshoba, MS	0
Newton, MS	0
Noxubee, MS	0
Oktibbeha, MS	0
Panola, MS	1
Pearl River, MS	1
Perry, MS	0
Pike, MS	1
Pontotoc, MS	1
Prentiss, MS	0
Quitman, MS	1
Rankin, MS	1
Scott, MS	1
Sharkey, MS	1
Simpson, MS	1
Smith, MS	1
Stone, MS	1
Sunflower, MS	1
Tallahatchie, MS	1
Tate, MS	1
Tippah, MS	1
Tishomingo, MS	0

County	Access
Tunica, MS	1
Union, MS	1
Walthall, MS	1
Warren, MS	1
Washington, MS	1
Wayne, MS	0
Webster, MS	0
Wilkinson, MS	1
Winston, MS	0
Yalobusha, MS	1
Yazoo, MS	1
Anderson, TN	0
Bedford, TN	0
Benton, TN	0
Bledsoe, TN	0
Blount, TN	0
Bradley, TN	0
Campbell, TN	0
Cannon, TN	0
Carroll, TN	0
Carter, TN	0
Cheatham, TN	0
Chester, TN	1
Claiborne, TN	0
Clay, TN	0
Cocke, TN	0
Coffee, TN	0
Crockett, TN	1
Cumberland, TN	0
Davidson, TN	0
Decatur, TN	0
DeKalb, TN	0
Dickson, TN	0
Dyer, TN	1
Fayette, TN	1
Fentress, TN	0
Franklin, TN	0
Gibson, TN	1
Giles, TN	0
Grainger, TN	0
Greene, TN	0
Grundy, TN	0

County	Access
Hamblen, TN	0
Hamilton, TN	0
Hancock, TN	0
Hardeman, TN	1
Hardin, TN	0
Hawkins, TN	0
Haywood, TN	1
Henderson, TN	0
Henry, TN	0
Hickman, TN	0
Houston, TN	0
Humphreys, TN	0
Jackson, TN	0
Jefferson, TN	0
Johnson, TN	0
Knox, TN	0
Lake, TN	1
Lauderdale, TN	1
Lawrence, TN	0
Lewis, TN	0
Lincoln, TN	0
Loudon, TN	0
McMinn, TN	0
McNairy, TN	1
Macon, TN	0
Madison, TN	1
Marion, TN	0
Marshall, TN	0
Maury, TN	0
Meigs, TN	0
Monroe, TN	0
Montgomery, TN	0
Moore, TN	0
Morgan, TN	0
Obion, TN	1
Overton, TN	0
Perry, TN	0
Pickett, TN	0
Polk, TN	0
Putnam, TN	0
Rhea, TN	0
Roane, TN	0
Robertson, TN	0
Rutherford, TN	0
Scott, TN	0
Sequatchie, TN	0
Sevier, TN	0
Shelby, TN	1
Smith, TN	0
Stewart, TN	0
Sullivan, TN	0
Sumner, TN	0
Tipton, TN	1
Trousdale, TN	0
Unicoi, TN	0
Union, TN	0
Van Buren, TN	0
Warren, TN	0
Washington, TN	0
Wayne, TN	0
Weakley, TN	0
White, TN	0
Williamson, TN	0
Wilson, TN	0

Appendix IV: 2003 Rural-Urban Continuum Codes for Counties

Table A 7: Rural-Urban Continuum Codes for Counties

State	County Name	2003 Rural-urban Continuum Code	Scores
AR	Arkansas County	6	2
AR	Ashley County	7	1
AR	Baxter County	7	1
AR	Benton County	2	3
AR	Boone County	7	1
AR	Bradley County	6	2
AR	Calhoun County	9	1
AR	Carroll County	6	2
AR	Chicot County	7	1
AR	Clark County	7	1
AR	Clay County	7	1
AR	Cleburne County	6	2
AR	Cleveland County	3	3
AR	Columbia County	7	1
AR	Conway County	6	2
AR	Craighead County	3	3
AR	Crawford County	2	3
AR	Crittenden County	1	3
AR	Cross County	6	2
AR	Dallas County	6	2
AR	Desha County	6	2
AR	Drew County	7	1
AR	Faulkner County	2	3
AR	Franklin County	2	3
AR	Fulton County	9	1
AR	Garland County	3	3
AR	Grant County	2	3
AR	Greene County	6	2
AR	Hempstead County	6	2
AR	Hot Spring County	6	2
AR	Howard County	7	1
AR	Independence County	7	1
AR	Izard County	9	1
AR	Jackson County	6	2
AR	Jefferson County	3	3
AR	Johnson County	6	2
AR	Lafayette County	8	1
AR	Lawrence County	6	2
AR	Lee County	6	2
AR	Lincoln County	3	3
AR	Little River County	6	2
AR	Logan County	6	2
AR	Lonoke County	2	3
AR	Madison County	2	3
AR	Marion County	9	1
AR	Miller County	3	3
AR	Mississippi County	4	2
AR	Monroe County	7	1
AR	Montgomery County	8	1
AR	Nevada County	7	1
AR	Newton County	9	1
AR	Ouachita County	7	1
AR	Perry County	2	3
AR	Phillips County	7	1
AR	Pike County	9	1
AR	Poinsett County	3	3
AR	Polk County	7	1
AR	Pope County	5	2
AR	Prairie County	8	1
AR	Pulaski County	2	3
AR	Randolph County	7	1
AR	St. Francis County	6	2
AR	Saline County	2	3
AR	Scott County	6	2
AR	Searcy County	9	1
AR	Sebastian County	2	3
AR	Sevier County	7	1
AR	Sharp County	7	1
AR	Stone County	9	1
AR	Union County	5	2
AR	Van Buren County	8	1
AR	Washington County	2	3
AR	White County	4	2
AR	Woodruff County	9	1
AR	Yell County	6	2
LA	Acadia Parish	4	2
LA	Allen Parish	6	2
LA	Ascension Parish	2	3
LA	Assumption Parish	6	2
LA	Avoyelles Parish	6	2
LA	Beauregard Parish	6	2
LA	Bienville Parish	6	2
LA	Bossier Parish	2	3
LA	Caddo Parish	2	3

State	County Name	2003 Rural-urban Continuum Code	Scores
LA	Calcasieu Parish	3	3
LA	Caldwell Parish	8	1
LA	Cameron Parish	3	3
LA	Catahoula Parish	9	1
LA	Claiborne Parish	7	1
LA	Concordia Parish	7	1
LA	De Soto Parish	2	3
LA	East Baton Rouge Parish	2	3
LA	East Carroll Parish	7	1
LA	East Feliciana Parish	2	3
LA	Evangeline Parish	6	2
LA	Franklin Parish	7	1
LA	Grant Parish	3	3
LA	Iberia Parish	4	2
LA	Iberville Parish	2	3
LA	Jackson Parish	6	2
LA	Jefferson Parish	1	3
LA	Jefferson Davis Parish	6	2
LA	Lafayette Parish	3	3
LA	Lafourche Parish	3	3
LA	La Salle Parish	6	2
LA	Lincoln Parish	4	2
LA	Livingston Parish	2	3
LA	Madison Parish	7	1
LA	Morehouse Parish	6	2
LA	Natchitoches Parish	6	2
LA	Orleans Parish	1	3
LA	Ouachita Parish	3	3
LA	Plaquemines Parish	1	3
LA	Pointe Coupee Parish	2	3
LA	Rapides Parish	3	3
LA	Red River Parish	6	2
LA	Richland Parish	6	2
LA	Sabine Parish	6	2
LA	St. Bernard Parish	1	3
LA	St. Charles Parish	1	3
LA	St. Helena Parish	2	3
LA	St. James Parish	6	2
LA	St. John the Baptist Parish	1	3
LA	St. Landry Parish	4	2
LA	St. Martin Parish	3	3
LA	St. Mary Parish	4	2

State	County Name	2003 Rural-urban Continuum Code	Scores
LA	St. Tammany Parish	1	3
LA	Tangipahoa Parish	4	2
LA	Tensas Parish	9	1
LA	Terrebonne Parish	3	3
LA	Union Parish	3	3
LA	Vermilion Parish	4	2
LA	Vernon Parish	4	2
LA	Washington Parish	6	2
LA	Webster Parish	6	2
LA	West Baton Rouge Parish	2	3
LA	West Carroll Parish	9	1
LA	West Feliciana Parish	2	3
LA	Winn Parish	6	2
MS	Adams County	5	2
MS	Alcorn County	7	1
MS	Amite County	8	1
MS	Attala County	6	2
MS	Benton County	8	1
MS	Bolivar County	5	2
MS	Calhoun County	7	1
MS	Carroll County	9	1
MS	Chickasaw County	7	1
MS	Choctaw County	9	1
MS	Claiborne County	6	2
MS	Clarke County	9	1
MS	Clay County	7	1
MS	Coahoma County	5	2
MS	Copiah County	2	3
MS	Covington County	8	1
MS	DeSoto County	1	3
MS	Forrest County	3	3
MS	Franklin County	9	1
MS	George County	3	3
MS	Greene County	8	1
MS	Grenada County	7	1
MS	Hancock County	3	3
MS	Harrison County	3	3
MS	Hinds County	2	3
MS	Holmes County	6	2
MS	Humphreys County	7	1
MS	Issaquena County	9	1
MS	Itawamba County	7	1

State	County Name	2003 Rural-urban Continuum Code	Scores
MS	Jackson County	3	3
MS	Jasper County	9	1
MS	Jefferson County	7	1
MS	Jefferson Davis County	8	1
MS	Jones County	4	2
MS	Kemper County	9	1
MS	Lafayette County	6	2
MS	Lamar County	3	3
MS	Lauderdale County	5	2
MS	Lawrence County	8	1
MS	Leake County	6	2
MS	Lee County	5	2
MS	Leflore County	5	2
MS	Lincoln County	6	2
MS	Lowndes County	5	2
MS	Madison County	2	3
MS	Marion County	6	2
MS	Marshall County	1	3
MS	Monroe County	7	1
MS	Montgomery County	7	1
MS	Neshoba County	7	1
MS	Newton County	7	1
MS	Noxubee County	7	1
MS	Oktibbeha County	5	2
MS	Panola County	6	2
MS	Pearl River County	6	2
MS	Perry County	3	3
MS	Pike County	7	1
MS	Pontotoc County	7	1
MS	Prentiss County	7	1
MS	Quitman County	6	2
MS	Rankin County	2	3
MS	Scott County	6	2
MS	Sharkey County	9	1
MS	Simpson County	2	3
MS	Smith County	8	1
MS	Stone County	3	3
MS	Sunflower County	5	2
MS	Tallahatchie County	7	1
MS	Tate County	1	3
MS	Tippah County	7	1
MS	Tishomingo County	8	1

State	County Name	2003 Rural-urban Continuum Code	Scores
MS	Tunica County	1	3
MS	Union County	7	1
MS	Walthall County	9	1
MS	Warren County	4	2
MS	Washington County	5	2
MS	Wayne County	7	1
MS	Webster County	9	1
MS	Wilkinson County	8	1
MS	Winston County	7	1
MS	Yalobusha County	7	1
MS	Yazoo County	6	2
TN	Anderson County	2	3
TN	Bedford County	6	2
TN	Benton County	7	1
TN	Bledsoe County	8	1
TN	Blount County	2	3
TN	Bradley County	3	3
TN	Campbell County	6	2
TN	Cannon County	1	3
TN	Carroll County	6	2
TN	Carter County	3	3
TN	Cheatham County	1	3
TN	Chester County	3	3
TN	Claiborne County	6	2
TN	Clay County	8	1
TN	Cocke County	6	2
TN	Coffee County	4	2
TN	Crockett County	8	1
TN	Cumberland County	7	1
TN	Davidson County	1	3
TN	Decatur County	9	1
TN	DeKalb County	6	2
TN	Dickson County	1	3
TN	Dyer County	5	2
TN	Fayette County	1	3
TN	Fentress County	9	1
TN	Franklin County	6	2
TN	Gibson County	4	2
TN	Giles County	6	2
TN	Grainger County	3	3
TN	Greene County	6	2
TN	Grundy County	8	1

State	County Name	2003 Rural-urban Continuum Code	Scores
TN	Hamblen County	3	3
TN	Hamilton County	2	3
TN	Hancock County	8	1
TN	Hardeman County	6	2
TN	Hardin County	6	2
TN	Hawkins County	3	3
TN	Haywood County	6	2
TN	Henderson County	6	2
TN	Henry County	7	1
TN	Hickman County	1	3
TN	Houston County	8	1
TN	Humphreys County	6	2
TN	Jackson County	8	1
TN	Jefferson County	3	3
TN	Johnson County	6	2
TN	Knox County	2	3
TN	Lake County	9	1
TN	Lauderdale County	6	2
TN	Lawrence County	6	2
TN	Lewis County	6	2
TN	Lincoln County	6	2
TN	Loudon County	2	3
TN	McMinn County	4	2
TN	McNairy County	6	2
TN	Macon County	1	3
TN	Madison County	3	3
TN	Marion County	2	3
TN	Marshall County	6	2
TN	Maury County	4	2
TN	Meigs County	8	1
TN	Monroe County	6	2
TN	Montgomery County	3	3
TN	Moore County	9	1
TN	Morgan County	6	2
TN	Obion County	7	1
TN	Overton County	7	1
TN	Perry County	8	1
TN	Pickett County	9	1
TN	Polk County	3	3
TN	Putnam County	4	2
TN	Rhea County	6	2
TN	Roane County	4	2

State	County Name	2003 Rural-urban Continuum Code	Scores
TN	Robertson County	1	3
TN	Rutherford County	1	3
TN	Scott County	6	2
TN	Sequatchie County	2	3
TN	Sevier County	4	2
TN	Shelby County	1	3
TN	Smith County	1	3
TN	Stewart County	3	3
TN	Sullivan County	3	3
TN	Sumner County	1	3
TN	Tipton County	1	3
TN	Trousdale County	1	3
TN	Unicoi County	3	3
TN	Union County	2	3
TN	Van Buren County	9	1
TN	Warren County	6	2
TN	Washington County	3	3
TN	Wayne County	8	1
TN	Weakley County	7	1
TN	White County	7	1
TN	Williamson County	1	3
TN	Wilson County	1	3

Appendix V: SoVI Values for Counties

Table A 8: Arkansas SoVI

County	SOVI 2000	National Percentile Ranking	Score
Arkansas County	2.71	77.2	3
Ashley County	1.14	59	2
Baxter County	5.48	93.4	3
Benton County	-1.54	21.6	1
Boone County	1.11	58.5	2
Bradley County	1.02	57.1	2
Calhoun County	-0.89	30.7	1
Carroll County	-1.23	25.9	1
Chicot County	3.8	85.5	3
Clark County	-3.25	7.5	1
Clay County	1.8	67.9	3
Cleburne County	1.11	58.5	2
Cleveland County	-0.28	39.5	2
Columbia County	0.91	55.8	2
Conway County	-5.13	2.2	1
Craighead County	-0.6	34.8	2
Crawford County	0.79	54.2	2
Crittenden County	6.8	96.1	3
Cross County	1.85	68.7	3
Dallas County	1.48	63.8	2
Desha County	6.42	95.5	3
Drew County	-1.12	27.2	1
Faulkner County	-2.27	14.2	1
Franklin County	1.48	63.7	2
Fulton County	3.37	82.7	3
Garland County	1.69	66.8	3
Grant County	-3.7	5.7	1
Greene County	-1.16	26.6	1
Hempstead County	1.22	60.1	2
Hot Spring County	-0.96	29.3	1
Howard County	-1.39	23.4	1
Independence County	-0.87	31	1
Izard County	3.24	81.6	3
Jackson County	3.13	80.6	3
Jefferson County	4.12	87.9	3
Johnson County	-0.82	31.8	1
Lafayette County	1.58	65.4	2
Lawrence County	3.38	82.9	3

County	SOVI 2000	National Percentile Ranking	Score
Lee County	2.28	73.8	3
Lincoln County	-2.83	10	1
Little River County	5.44	93.2	3
Logan County	1.67	66.5	2
Lonoke County	-0.3	39.3	2
Madison County	2.07	71.7	3
Marion County	1.12	58.7	2
Miller County	1.15	59	2
Mississippi County	3.88	86.1	3
Monroe County	2.23	73.4	3
Montgomery County	-3.39	7.1	1
Nevada County	0.49	50.6	2
Newton County	-0.59	35	2
Ouachita County	2.97	79.4	3
Perry County	-2.57	11.7	1
Phillips County	8.95	98.1	3
Pike County	1.36	62.3	2
Poinsett County	0.55	51.4	2
Polk County	2.04	71.1	3
Pope County	-0.66	33.8	2
Prairie County	1.36	62.3	2
Pulaski County	2.32	74.2	3
Randolph County	1.73	67.3	3
Saline County	-4.3	3.7	1
Scott County	-2.31	13.8	1
Searcy County	1.44	63.2	2
Sebastian County	-0.23	40.1	2
Sevier County	1	56.9	2
Sharp County	6.09	94.9	3
St. Francis County	6.85	96.1	3
Stone County	2.13	72.4	3
Union County	0.86	55.2	2
Van Buren County	4.46	89.5	3
Washington County	-0.22	40.4	2
White County	-1.38	23.5	1
Woodruff County	5.27	92.7	3
Yell County	-0.75	32.6	1

Table A 9: Louisiana SoVI

County	SOVI 2000	National Percentile Ranking	Score
Acadia Parish	4	87.1	3
Allen Parish	-1.36	23.9	1
Ascension Parish	-1.47	22.5	1
Assumption Parish	-0.42	37.4	2
Avoyelles Parish	3.34	82.6	3
Beauregard Parish	-0.31	39.1	2
Bienville Parish	2.59	76.5	3
Bossier Parish	-0.35	38.5	2
Caddo Parish	3.62	84.4	3
Calcasieu Parish	0.39	48.9	2
Caldwell Parish	-0.41	37.5	2
Cameron Parish	-2.35	13.4	1
Catahoula Parish	2.51	76	3
Claiborne Parish	5.09	91.9	3
Concordia Parish	6.43	95.5	3
De Soto Parish	2.82	78.2	3
East Baton Rouge Parish	2.14	72.6	3
East Carroll Parish	5.38	93	3
East Feliciana Parish	1.83	68.3	3
Evangeline Parish	3.82	85.7	3
Franklin Parish	4.04	87.4	3
Grant Parish	-0.58	35	2
Iberia Parish	3.29	82	3
Iberville Parish	1.54	64.9	2
Jackson Parish	2.47	75.6	3
Jefferson Davis Parish	3.53	83.7	3
Jefferson Parish	1.65	66.3	2
La Salle Parish	-2.77	10.5	1
Lafayette Parish	0.45	49.9	2
Lafourche Parish	-0.28	39.6	2
Lincoln Parish	0.04	44.3	2
Livingston Parish	-2.87	9.6	1
Madison Parish	6.21	95.1	3
Morehouse Parish	5.27	92.7	3
Natchitoches Parish	2.67	77	3
Orleans Parish	7.47	96.8	3
Ouachita Parish	2.81	78.1	3
Plaquemines Parish	4.02	87.2	3
Pointe Coupee Parish	4.05	87.5	3
Rapides Parish	1.93	69.9	3
Red River Parish	4.24	88.4	3
Richland Parish	4.56	90	3
Sabine Parish	-0.82	31.7	1
St. Bernard Parish	4.28	88.7	3
St. Charles Parish	1.49	64	2
St. Helena Parish	3.65	84.6	3
St. James Parish	5.21	92.3	3
St. John the Baptist Parish	4.67	90.3	3
St. Landry Parish	5.08	91.8	3
St. Martin Parish	1.75	67.5	3
St. Mary Parish	3.58	84.1	3
St. Tammany Parish	-1.11	27.4	1
Tangipahoa Parish	1.89	69.3	3
Tensas Parish	1.03	57.5	2
Terrebonne Parish	1.66	66.3	2
Union Parish	-1.12	27.2	1
Vermilion Parish	0.76	53.9	2
Vernon Parish	3.16	81	3
Washington Parish	2.99	79.5	3
Webster Parish	4.04	87.3	3
West Baton Rouge Parish	1.47	63.6	2
West Carroll Parish	2.83	78.3	3
West Feliciana Parish	-4.45	3.4	1
Winn Parish	1.55	65.1	2

Table A 10: Mississippi SoVI

County	SOVI 2000	National Percentile Ranking	Scores
Adams County	3.92	86.4	3
Alcorn County	-0.57	35.3	2
Amite County	1.9	69.4	3
Attala County	0.61	52.1	2
Benton County	1.05	57.8	2
Bolivar County	7.98	97.3	3
Calhoun County	-0.01	43.3	2
Carroll County	-3.2	7.7	1
Chickasaw County	0.8	54.4	2
Choctaw County	-2.2	15.2	1
Claiborne County	6.57	95.7	3
Clarke County	-0.64	34.2	2
Clay County	5.42	93.1	3
Coahoma County	9.44	98.3	3
Copiah County	3.74	85.2	3
Covington County	1.97	70.3	3
DeSoto County	2.62	76.8	3
Forrest County	1.23	60.1	2
Franklin County	2.45	75.2	3
George County	-2.08	16.1	1
Greene County	-4.59	3.1	1
Grenada County	2.35	74.3	3
Hancock County	-2.04	16.6	1
Harrison County	1.3	61.3	2
Hinds County	4.61	90.1	3
Holmes County	9.21	98.2	3
Humphreys County	8.89	97.9	3
Issaquena County	12.7	99.4	3
Itawamba County	-2.3	13.9	1
Jackson County	-0.06	42.5	2
Jasper County	0.7	53.3	2
Jefferson County	10.54	98.8	3
Jefferson Davis County	3.52	83.7	3
Jones County	-0.67	33.6	2
Kemper County	2.53	76.2	3
Lafayette County	-5.07	2.3	1
Lamar County	-1.44	22.9	1
Lauderdale County	1.21	60	2
Lawrence County	0.28	47.6	2
Leake County	1.37	62.5	2
Lee County	-1.79	19.1	1
Leflore County	7.28	96.7	3
Lincoln County	1.45	63.4	2
Lowndes County	4.93	91.2	3
Madison County	-0.23	40.1	2
Marion County	1.27	60.7	2
Marshall County	3.18	81.1	3
Monroe County	1.85	68.7	3
Montgomery County	6.86	96.2	3
Neshoba County	1.58	65.4	2
Newton County	1.27	60.6	2
Noxubee County	4.47	89.5	3
Oktibbeha County	-2.42	12.8	1
Panola County	2.73	77.4	3
Pearl River County	-0.54	35.6	2
Perry County	-0.25	39.9	2
Pike County	4.91	91.1	3
Pontotoc County	-1.11	27.3	1
Prentiss County	1.46	63.4	2
Quitman County	8.02	97.4	3
Rankin County	-1.02	28.7	1
Scott County	1.47	63.6	2
Sharkey County	9.4	98.3	3
Simpson County	0.37	48.7	2
Smith County	-1.43	23	1
Stone County	-0.56	35.4	2
Sunflower County	4.12	87.9	3
Tallahatchie County	5.32	92.8	3
Tate County	0.32	48.1	2
Tippah County	-0.85	31.3	1
Tishomingo County	-1.93	17.3	1
Tunica County	0.38	48.8	2
Union County	-1.64	20.6	1
Walthall County	4.42	89.4	3
Warren County	2.79	77.9	3
Washington County	7.78	97.1	3
Wayne County	0.79	54.4	2
Webster County	-0.1	42.1	2
Wilkinson County	4.66	90.3	3
Winston County	2.83	78.3	3
Yalobusha County	0.54	51.2	2
Yazoo County	5.28	92.8	3

Table A 11: Tennessee SoVI

County	SOVI 2000	National Percentile Ranking	Scores
Anderson County	2.84	78.5	3
Bedford County	0.05	44.4	2
Benton County	4.31	88.8	3
Bledsoe County	-4.42	3.5	1
Blount County	-2.81	10.1	1
Bradley County	-2.28	14.1	1
Campbell County	0.81	54.5	2
Cannon County	-1.9	17.7	1
Carroll County	4.7	90.4	3
Carter County	-2.2	15.3	1
Cheatham County	-3.45	6.7	1
Chester County	-3.89	5	1
Claiborne County	-2.06	16.5	1
Clay County	2.86	78.6	3
Cocke County	1.71	67.1	3
Coffee County	0.42	49.3	2
Crockett County	0.37	48.6	2
Cumberland County	-0.08	42.3	2
Davidson County	2.06	71.6	3
Decatur County	-1.66	20.5	1
DeKalb County	-3.55	6.3	1
Dickson County	-0.95	29.6	1
Dyer County	2.56	76.3	3
Fayette County	1.11	58.6	2
Fentress County	-0.09	42.2	2
Franklin County	-2.08	16.2	1
Gibson County	2.51	75.9	3
Giles County	-1.03	28.6	1
Grainger County	-4.35	3.5	1
Greene County	-2.02	16.8	1
Grundy County	1.18	59.6	2
Hamblen County	-1.85	18.4	1
Hamilton County	1.67	66.4	2
Hancock County	2.45	75.3	3
Hardeman County	0.93	56.2	2
Hardin County	-0.63	34.3	2
Hawkins County	-2.51	12.3	1
Haywood County	3.95	86.6	3
Henderson County	-1.86	18.3	1
Henry County	1.07	58	2
Hickman County	-4.16	4	1
Houston County	3.19	81.2	3
Humphreys County	-0.77	32.5	1
Jackson County	-0.49	36.2	2
Jefferson County	-4.22	3.9	1
Johnson County	-2.07	16.3	1
Knox County	0.61	52.2	2
Lake County	-1.72	19.8	1
Lauderdale County	0.36	48.5	2
Lawrence County	-0.24	40	2
Lewis County	-3.11	8.1	1
Lincoln County	-0.46	36.7	2
Loudon County	-0.91	30.3	1
Macon County	-1.52	22	1
Madison County	0.55	51.4	2
Marion County	-1.8	19	1
Marshall County	-4.07	4.5	1
Maury County	-0.63	34.4	2
McMinn County	-0.63	34.2	2
McNairy County	-0.22	40.3	2
Meigs County	1.63	66.1	2
Monroe County	-2.37	13.3	1
Montgomery County	1.96	70.1	3
Moore County	3.55	83.9	3
Morgan County	-2.33	13.5	1
Obion County	-1.33	24.2	1
Overton County	0.7	53.4	2
Perry County	-2.62	11.4	1
Pickett County	1.32	61.6	2
Polk County	-2.97	8.8	1
Putnam County	-1.16	26.7	1
Rhea County	-0.98	29.1	1
Roane County	-0.12	41.7	2
Robertson County	-1.31	24.6	1
Rutherford County	-2.03	16.7	1
Scott County	-1.48	22.4	1
Sequatchie County	-1.83	18.6	1
Sevier County	-5.37	1.9	1
Shelby County	8.38	97.7	3
Smith County	0.21	46.4	2
Stewart County	3.94	86.5	3
Sullivan County	-0.26	39.8	2
Sumner County	-2.94	9	1
Tipton County	0.44	49.6	2
Trousdale County	-2.54	12.1	1
Unicoi County	1.66	66.4	2
Union County	3.31	82.1	3
Van Buren County	0.78	54.2	2
Warren County	-2.57	11.6	1
Washington County	-0.87	31	1
Wayne County	-5.11	2.3	1
Weakley County	-2.07	16.2	1
White County	3.65	84.5	3
Williamson County	-4.44	3.4	1
Wilson County	-1.63	20.8	1

Appendix VI: Tornadoes by County 1950-1995

Table A 12: Arkansas Tornadoes

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Arkansas	7	7	8	3	0	25	3.75	2
Ashley	4	3	9	1	0	17	3.18	2
Baxter	1	1	2	3	0	7	1.53	1
Benton	8	13	5	3	0	29	3.16	2
Boone	1	1	2	2	0	6	1.24	1
Bradley	4	2	1	3	1	11	2.07	1
Calhoun	0	2	2	1	0	5	0.95	1
Carroll	1	1	4	0	0	6	1.24	1
Chicot	2	8	4	0	0	14	1.56	1
Clark	6	10	5	1	0	22	2.38	1
Clay	2	4	2	0	0	8	0.82	1
Cleburne	0	2	6	6	1	15	4.23	2
Cleveland	2	1	3	0	0	6	0.99	1
Columbia	2	9	5	1	1	18	2.85	2
Conway	5	9	3	4	0	21	2.59	2
Craighead	5	3	4	5	2	19	4.27	2
Crawford	0	5	2	4	0	11	1.94	1
Crittenden	4	3	3	1	0	11	1.44	1
Cross	5	1	1	1	1	9	1.49	1
Dallas	1	0	4	0	0	5	1.2	1
Desha	3	5	6	1	0	15	2.35	1
Drew	0	2	4	1	0	7	1.53	1
Faulkner	0	4	14	9	1	28	7.5	3
Franklin	0	3	1	0	0	4	0.41	1
Fulton	2	3	2	1	1	9	1.74	1
Garland	5	4	6	3	0	18	2.97	2
Grant	3	3	2	1	0	9	1.11	1
Greene	2	3	6	3	0	14	2.81	2
Hempstead	3	4	2	3	1	13	2.4	1
Hot Spring	2	6	6	4	0	18	3.22	2
Howard	6	5	4	1	2	18	3.23	2
Independence	1	8	6	2	2	19	4.02	2
Izard	2	4	4	2	0	12	1.98	1
Jackson	5	4	7	3	3	22	5.27	3
Jefferson	4	3	6	2	0	15	2.6	2
Johnson	3	4	9	5	0	21	4.34	2
Lafayette	0	1	1	1	0	3	0.62	1
Lawrence	1	1	6	1	0	9	2.11	1
Lee	2	3	2	1	0	8	1.07	1
Lincoln	5	3	3	0	1	12	1.86	1
Little River	1	3	3	2	0	9	1.61	1
Logan	1	4	7	2	0	14	2.81	2
Lonoke	7	9	9	2	1	28	4.5	2
Madison	1	3	2	0	0	6	0.74	1

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Marion	1	1	0	4	0	6	1.24	1
Miller	1	2	7	0	0	10	2.15	1
Mississippi	6	7	8	6	1	28	5.25	3
Monroe	4	4	4	1	0	13	1.77	1
Montgomery	1	3	1	0	0	5	0.45	1
Nevada	0	5	2	3	0	10	1.65	1
Newton	1	3	1	0	0	5	0.45	1
Ouachita	3	1	1	3	1	9	1.99	1
Perry	0	2	5	0	0	7	1.53	1
Phillips	2	6	4	1	0	13	1.77	1
Pike	3	1	2	1	0	7	1.03	1
Poinsett	6	7	5	4	3	25	5.14	3
Polk	3	2	6	1	0	12	2.23	1
Pope	1	3	5	2	0	11	2.19	1
Prairie	2	6	7	1	0	16	2.64	2
Pulaski	8	14	15	3	0	40	6.1	3
Randolph	0	3	2	0	0	5	0.7	1
Saline	1	3	7	4	0	15	3.35	2
Scott	0	2	2	0	0	4	0.66	1
Searcy	2	3	5	0	0	10	1.65	1
Sebastian	3	7	4	0	1	15	2.23	1
Sevier	3	2	4	1	1	11	2.32	1
Sharp	0	1	2	1	1	5	1.58	1
St. Francis	4	2	3	3	0	12	1.98	1
Stone	1	3	3	1	0	8	1.32	1
Union	5	4	7	2	0	18	2.97	2
Van Buren	1	2	5	3	1	12	3.11	2
Washington	3	5	5	2	0	15	2.35	1
White	6	6	8	4	1	25	4.63	2
Woodruff	2	6	6	7	1	22	4.76	2
Yell	2	2	6	2	0	12	2.48	1

Table A 13: Louisiana Tornadoes

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Acadia	9	17	7	5	0	38	4.52	2
Allen	3	2	1	1	0	7	0.78	1
Ascension	0	3	3	1	0	7	1.28	1
Assumption	4	2	6	0	0	12	1.98	1
Avoyelles	4	10	7	2	0	23	3.17	2
Beauregard	3	13	3	0	0	19	1.51	1
Bienville	4	11	2	4	0	21	2.34	1
Bossier	1	20	4	7	2	34	5.37	3
Caddo	6	28	8	7	1	50	6.38	3
Calcasieu	21	31	6	4	0	62	4.98	2
Caldwell	0	0	0	0	0	0	0	1
Cameron	17	13	5	2	0	37	3.23	2
Catahoula	3	5	3	2	0	13	1.77	1
Claiborne	0	10	4	3	0	17	2.43	1
Concordia	2	12	2	3	0	19	2.01	1
De Soto	3	16	6	6	1	32	4.91	2
East Baton Rouge	4	13	7	3	0	27	3.58	2
East Carroll	1	10	7	2	1	21	3.72	2
East Feliciana	3	4	3	1	0	11	1.44	1
Evangeline	2	11	2	0	0	15	1.1	1
Franklin	1	9	7	1	0	18	2.72	2
Grant	1	6	3	1	1	12	2.11	1
Iberia	6	5	4	0	0	15	1.6	1
Iberville	1	4	3	1	0	9	1.36	1
Jackson	2	10	5	1	0	18	2.22	1
Jefferson	8	11	9	0	0	28	3.37	2
Jefferson Davis	8	9	7	2	0	26	3.29	2
Lafayette	3	14	6	1	0	24	2.71	2
Lafourche	2	15	1	0	1	19	1.64	1
La Salle	2	2	1	1	1	7	1.41	1
Lincoln	4	3	7	0	0	14	2.31	1
Livingston	2	14	2	1	0	19	1.51	1
Madison	6	12	12	5	0	35	5.65	3
Morehouse	2	16	4	1	1	24	2.84	2
Natchitoches	4	8	5	5	0	22	3.38	2
Orleans	2	6	4	0	0	12	1.48	1
Ouachita	10	14	3	1	1	29	2.79	2
Plaquemines	3	8	4	0	0	15	1.6	1
Pointe Coupee	0	8	1	2	0	11	1.19	1
Rapides	6	13	8	4	1	32	4.91	2
Red River	0	2	4	0	0	6	1.24	1
Richland	2	8	5	3	0	18	2.72	2
Sabine	3	5	5	5	0	18	3.22	2
St. Bernard	1	3	1	0	0	5	0.45	1

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
St. Charles	0	4	1	1	0	6	0.74	1
St. Helena	0	3	3	1	0	7	1.28	1
St. James	0	0	0	0	0	0	0	1
St. John the Baptist	5	3	1	1	1	11	1.57	1
St. Landry	1	18	6	3	0	28	3.37	2
St. Martin	2	5	4	1	0	12	1.73	1
St. Mary	1	10	3	1	0	15	1.6	1
St. Tammany	7	9	3	0	0	19	1.51	1
Tangipahoa	7	17	9	1	0	34	3.86	2
Tensas	4	6	5	3	0	18	2.72	2
Terrebonne	5	10	1	1	0	17	1.18	1
Union	3	13	6	2	0	24	2.96	2
Vermilion	9	20	3	3	0	35	2.9	2
Vernon	3	14	6	0	1	24	3.09	2
Washington	2	9	2	1	0	14	1.31	1
Webster	3	17	6	4	1	31	4.37	2
West Baton Rouge	3	3	3	1	0	10	1.4	1
West Carroll	0	6	7	2	0	15	2.85	2
West Feliciana	0	3	2	1	0	6	0.99	1
Winn	0	11	4	3	0	18	2.47	1

Table A 14: Mississippi Tornadoes

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Adams	1	6	1	0	0	8	0.57	1
Alcorn	1	5	4	2	1	13	2.65	2
Amite	0	12	2	1	0	15	1.35	1
Attala	2	9	1	2	3	17	3.32	2
Benton	1	2	1	1	0	5	0.7	1
Bolivar	4	11	6	0	0	21	2.34	1
Calhoun	1	4	4	1	0	10	1.65	1
Carroll	1	2	3	2	0	8	1.57	1
Chickasaw	2	10	1	1	0	14	1.06	1
Choctaw	3	1	1	0	2	7	1.79	1
Claiborne	3	6	4	1	0	14	1.81	1
Clarke	6	7	5	1	1	20	2.93	2
Clay	2	2	3	2	0	9	1.61	1
Coahoma	2	11	5	2	0	20	2.55	2
Copiah	6	11	6	4	3	30	5.59	3
Covington	2	4	4	2	0	12	1.98	1
DeSoto	4	5	6	1	0	16	2.39	1
Forrest	2	8	3	1	0	14	1.56	1
Franklin	0	4	2	0	0	6	0.74	1
George	0	5	4	2	0	11	1.94	1
Greene	0	2	3	2	0	7	1.53	1
Grenada	0	4	7	2	1	14	3.44	2
Hancock	3	12	7	1	0	23	2.92	2
Harrison	8	19	11	5	0	43	5.72	3
Hinds	3	24	11	4	0	42	5.43	3
Holmes	6	2	3	2	1	14	2.44	1
Humphreys	2	2	10	0	2	16	4.4	2
Issaquena	0	6	4	1	1	12	2.36	1
Itawamba	0	3	3	0	0	6	0.99	1
Jackson	9	15	9	0	0	33	3.57	2
Jasper	3	6	2	5	1	17	3.06	2
Jefferson	0	4	1	1	1	7	1.41	1
Jefferson Davis	2	2	4	4	0	12	2.48	1
Jones	1	11	12	5	1	30	6.08	3
Kemper	2	6	3	2	1	14	2.44	1
Lafayette	0	5	5	2	1	13	2.9	2
Lamar	3	5	4	0	0	12	1.48	1
Lauderdale	12	5	3	1	2	23	3.18	2
Lawrence	3	4	3	1	2	13	2.78	2
Leake	0	5	5	6	2	18	4.73	2
Lee	1	6	4	2	1	14	2.69	2
Leflore	2	3	10	4	1	20	4.93	2
Lincoln	4	10	10	2	1	27	4.71	2
Lowndes	0	6	11	1	0	18	3.72	2

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Madison	2	13	9	3	1	28	4.75	2
Marion	1	6	7	1	0	15	2.6	2
Marshall	4	4	1	1	1	11	1.57	1
Monroe	2	8	6	3	0	19	3.01	2
Montgomery	1	5	3	1	0	10	1.4	1
Neshoba	2	10	9	4	0	25	4.25	2
Newton	1	8	5	2	2	18	3.73	2
Noxubee	0	6	6	1	0	13	2.27	1
Oktibbeha	1	3	3	1	1	9	1.99	1
Panola	1	5	3	0	1	10	1.78	1
Pearl River	2	8	9	0	0	19	3.01	2
Perry	0	4	0	2	0	6	0.74	1
Pike	4	4	5	0	1	14	2.44	1
Pontotoc	1	4	5	1	0	11	1.94	1
Prentiss	1	6	4	4	0	15	2.6	2
Quitman	0	1	4	1	0	6	1.49	1
Rankin	4	17	13	1	4	39	7.58	3
Scott	1	9	5	0	3	18	3.86	2
Sharkey	1	8	3	2	3	17	3.82	2
Simpson	2	13	9	5	4	33	7.34	3
Smith	2	15	4	3	3	27	4.72	2
Stone	0	9	2	0	0	11	0.94	1
Sunflower	1	5	4	2	0	12	1.98	1
Tallahatchie	0	5	8	1	1	15	3.48	2
Tate	1	4	2	0	0	7	0.78	1
Tippah	3	3	1	3	1	11	2.07	1
Tishomingo	0	6	5	2	0	13	2.27	1
Tunica	2	4	3	0	0	9	1.11	1
Union	0	3	6	2	0	11	2.44	1
Walthall	1	8	5	0	0	14	1.81	1
Warren	2	13	5	1	1	22	3.01	2
Washington	1	7	6	0	3	17	4.07	2
Wayne	1	3	1	3	1	9	1.99	1
Webster	1	3	0	2	0	6	0.74	1
Wilkinson	0	6	2	0	0	8	0.82	1
Winston	0	2	5	0	1	8	2.2	1
Yalobusha	0	2	4	1	1	8	2.2	1
Yazoo	7	6	6	0	1	20	2.93	2

Table A 15: Tennessee Tornadoes

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Anderson	1	0	1	1	0	3	0.62	1
Bedford	0	2	1	0	0	3	0.37	1
Benton	0	0	2	1	0	3	0.87	1
Bledsoe	3	2	0	0	0	5	0.2	1
Blount	0	3	1	1	0	5	0.7	1
Bradley	0	2	1	5	0	8	1.82	1
Campbell	0	0	0	0	0	0	0	1
Cannon	0	0	0	1	0	1	0.29	1
Carroll	0	7	1	2	1	11	1.82	1
Carter	0	1	0	0	0	1	0.04	1
Cheatham	1	0	1	0	0	2	0.33	1
Chester	1	3	2	0	1	7	1.41	1
Claiborne	0	0	0	0	0	0	0	1
Clay	0	0	0	0	0	0	0	1
Cocke	1	0	2	0	0	3	0.62	1
Coffee	1	5	1	2	0	9	1.11	1
Crockett	0	2	1	2	0	5	0.95	1
Cumberland	2	2	4	2	0	10	1.9	1
Davidson	1	6	5	0	0	12	1.73	1
Decatur	0	1	0	0	0	1	0.04	1
DeKalb	1	3	0	1	0	5	0.45	1
Dickson	1	4	0	0	0	5	0.2	1
Dyer	3	6	1	2	2	14	2.57	2
Fayette	7	2	4	2	0	15	2.1	1
Fentress	1	3	4	0	1	9	1.99	1
Franklin	0	4	0	1	2	7	1.79	1
Gibson	2	5	5	0	1	13	2.4	1
Giles	1	2	5	2	1	11	2.82	2
Grainger	1	1	0	0	0	2	0.08	1
Greene	0	5	2	0	0	7	0.78	1
Grundy	0	1	1	1	0	3	0.62	1
Hamblen	0	1	0	0	0	1	0.04	1
Hamilton	3	3	1	1	0	8	0.82	1
Hancock	0	0	1	0	0	1	0.29	1
Hardeman	4	2	2	1	1	10	1.78	1
Hardin	1	3	2	2	0	8	1.32	1
Hawkins	1	0	1	0	0	2	0.33	1
Haywood	1	2	3	0	0	6	0.99	1
Henderson	2	3	2	0	2	9	2.12	1
Henry	2	0	1	1	0	4	0.66	1
Hickman	0	0	1	0	0	1	0.29	1
Houston	0	0	0	0	0	0	0	1
Humphreys	3	1	1	0	0	5	0.45	1
Jackson	1	2	0	0	0	3	0.12	1

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Jefferson	1	0	1	0	0	2	0.33	1
Johnson	0	0	0	0	0	0	0	1
Knox	3	2	1	1	0	7	0.78	1
Lake	2	0	1	0	0	3	0.37	1
Lauderdale	4	8	2	2	0	16	1.64	1
Lawrence	1	6	3	3	1	14	2.69	2
Lewis	1	0	1	0	0	2	0.33	1
Lincoln	2	5	4	1	2	14	3.07	2
Loudon	1	1	2	1	0	5	0.95	1
McMinn	1	3	2	5	1	12	2.86	2
McNairy	0	2	4	2	0	8	1.82	1
Macon	0	2	1	0	0	3	0.37	1
Madison	3	8	3	1	0	15	1.6	1
Marion	3	4	1	0	0	8	0.57	1
Marshall	2	7	1	0	0	10	0.65	1
Maury	1	3	0	1	0	5	0.45	1
Meigs	0	0	0	1	1	2	0.96	1
Monroe	0	1	2	1	0	4	0.91	1
Montgomery	1	5	1	0	1	8	1.2	1
Moore	0	0	0	0	1	1	0.67	1
Morgan	1	1	0	1	0	3	0.37	1
Obion	3	1	5	0	0	9	1.61	1
Overton	1	2	1	1	1	6	1.37	1
Perry	0	0	0	0	0	0	0	1
Pickett	1	0	0	0	1	2	0.71	1
Polk	0	0	2	3	0	5	1.45	1
Putnam	1	4	0	1	1	7	1.16	1
Rhea	0	1	0	0	0	1	0.04	1
Roane	1	1	0	1	0	3	0.37	1
Robertson	1	2	3	0	1	7	1.66	1
Rutherford	1	9	2	1	0	13	1.27	1
Scott	0	0	0	2	0	2	0.58	1
Sequatchie	0	0	2	0	0	2	0.58	1
Sevier	0	0	0	0	0	0	0	1
Shelby	5	24	9	7	0	45	5.8	3
Smith	0	4	0	0	0	4	0.16	1
Stewart	3	0	1	0	0	4	0.41	1
Sullivan	1	1	0	0	0	2	0.08	1
Sumner	2	7	6	1	1	17	3.06	2
Tipton	4	7	1	1	0	13	1.02	1
Trousdale	0	1	1	0	0	2	0.33	1
Unicoi	0	0	0	1	0	1	0.29	1
Union	0	1	0	0	0	1	0.04	1
Van Buren	1	0	0	0	0	1	0.04	1

County	F0	F1	F2	F3	F4	Total	Tornado Risk	Score
Warren	1	4	4	1	0	10	1.65	1
Washington	0	0	1	0	0	1	0.29	1
Wayne	1	2	2	2	0	7	1.28	1
Weakley	3	7	5	1	0	16	2.14	1
White	0	5	2	0	1	8	1.45	1
Williamson	1	4	0	1	1	7	1.16	1
Wilson	2	7	4	1	0	14	1.81	1

Appendix VII: Flood Related Disaster Declarations

Table A 16: Arkansas Flood Declaration

	Declarations														
County	1872	1861	1845	1804	1793	1758	1751	1744	1528	1516	1472	1400	1363	Total	Score
Arkansas			1			1	1							3	2
Ashley					1							1		2	1
Baxter							1	1		1				3	2
Benton						1	1		1		1			4	2
Boone		1					1			1				3	2
Bradley	1	1	1		1				1				1	6	3
Calhoun	1	1	1		1		1		1					6	3
Carroll		1		1			1			1				4	2
Chicot			1		1						1			3	2
Clark	1		1	1	1		1		1				1	7	3
Clay				1			1					1		3	2
Cleburne		1				1	1				1	1		5	3
Cleveland	1	1	1		1								1	5	3
Columbia		1							1		1	1	1	5	3
Conway		1	1		1	1	1	1			1		1	8	3
Craighead	1			1			1				1	1	1	6	3
Crawford							1							1	1
Crittenden						1					1	1		3	2
Cross		1					1				1			3	2
Dallas	1	1	1		1								1	5	3
Desha							1							1	1
Drew	1		1		1								1	4	2
Faulkner							1				1			2	1
Franklin		1					1		1	1		1	1	6	3
Fulton		1	1				1				1			4	2
Garland					1		1							2	1
Grant	1	1	1		1	1								5	3
Greene	1		1	1			1					1		5	3
Hempstead	1		1	1			1		1				1	6	3
Hot Spring			1		1		1						1	4	2
Howard			1	1			1		1					4	2
Independence							1	1		1		1		4	2
Izard		1		1			1	1						4	2
Jackson	1	1	1				1			1	1	1		7	3
Jefferson	1		1				1							3	2
Johnson		1					1			1				3	2
Lafayette	1	1	1	1					1				1	6	3
Lawrence		1		1			1							3	2
Lee			1				1							2	1
Lincoln	1	1	1		1							1	1	6	3
Little River			1	1			1		1			1	1	6	3
Logan		1					1					1		3	2
Lonoke	1					1	1				1			4	2
Madison				1			1			1				3	2
Marion		1	1				1			1				4	2

County	Declarations													Total	Score
	1872	1861	1845	1804	1793	1758	1751	1744	1528	1516	1472	1400	1363		
Miller	1		1	1			1						1	5	3
Mississippi						1	1							2	1
Monroe	1	1	1				1					1		5	3
Montgomery				1	1									2	1
Nevada	1	1	1	1			1		1		1		1	8	3
Newton		1		1			1			1			1	5	3
Ouachita	1	1	1						1				1	5	3
Perry			1		1		1				1			4	2
Phillips			1			1	1				1			4	2
Pike			1	1			1		1					4	2
Poinsett	1	1	1				1				1	1		6	3
Polk			1										1	2	1
Pope			1				1	1						3	2
Prairie	1	1	1		1		1					1	1	7	3
Pulaski		1				1	1							3	2
Randolph		1		1			1	1						4	2
St. Francis		1	1				1				1			4	2
Saline			1		1	1	1							4	2
Scott		1					1					1		3	2
Searcy			1				1			1				3	2
Sebastian							1							1	1
Sevier									1					1	1
Sharp		1		1			1	1						4	2
Stone		1	1				1	1		1		1		6	3
Union		1	1										1	3	2
Van Buren		1		1	1	1	1	1			1			7	3
Washington							1			1				2	1
White	1	1					1				1	1	1	6	3
Woodruff	1	1					1			1	1	1		6	3
Yell							1							1	1

Table A 17: Louisiana Flood Declaration

	Declarations													
County	**1863**	**1792**	**1786**	**1668**	**1607**	**1603**	**1601**	**1548**	**1521**	**1437**	**1435**	**1380**	**Total**	**Score**
Acadia		1	1		1	1			1	1			6	3
Allen		1	1	1	1	1				1			6	3
Ascension			1		1	1		1		1		1	6	3
Assumption			1			1		1		1		1	5	3
Avoyelles			1			1		1		1			4	2
Beauregard	1	1	1	1	1	1		1		1		1	9	3
Bienville			1			1							2	1
Bossier	1		1			1		1					4	2
Caddo			1			1		1					3	2
Calcasieu		1	1	1	1	1				1			6	3
Caldwell	1		1	1		1				1			5	3
Cameron		1	1		1	1				1			5	3
Catahoula			1	1		1				1			4	2
Claiborne	1		1			1							3	2
Concordia			1			1		1					3	2
De Soto	1		1		1	1							4	2
East Baton Rouge			1			1		1		1	1	1	6	3
East Carroll			1			1							2	1
East Feliciana			1			1		1		1		1	5	3
Evangeline			1	1	1	1				1			5	3
Franklin			1	1		1							3	2
Grant			1	1		1		1					4	2
Iberia		1	1		1	1				1	1	1	7	3
Iberville			1			1			1	1		1	5	3
Jackson			1			1							2	1
Jefferson		1	1		1	1	1	1		1	1	1	9	3
Jefferson Davis		1	1	1	1	1			1	1			7	3
Lafayette			1		1	1		1	1	1		1	7	3
Lafourche		1	1		1	1	1	1		1	1	1	9	3
La Salle			1	1		1				1			4	2
Lincoln			1			1							2	1
Livingston		1	1		1	1		1	1	1	1	1	9	3
Madison			1	1		1							3	2
Morehouse			1	1		1							3	2
Natchitoches	1	1	1	1	1	1				1			7	3
Orleans		1	1			1		1		1	1	1	7	3
Ouachita	1		1			1		1		1			5	3
Plaquemines		1	1		1	1	1	1		1	1		8	3
Pointe Coupee			1			1			1	1		1	5	3
Rapides			1		1	1		1		1			5	3
Red River			1			1							2	1
Richland			1	1		1							3	2
Sabine		1	1	1	1	1							5	3
St. Bernard			1			1	1	1		1	1	1	7	3
St. Charles			1			1	1	1		1	1	1	7	3

	Declarations													
County	**1863**	**1792**	**1786**	**1668**	**1607**	**1603**	**1601**	**1548**	**1521**	**1437**	**1435**	**1380**	**Total**	**Score**
St. Helena			1	1		1		1		1		1	6	3
St. James			1			1		1		1	1	1	6	3
St. John the Baptist			1			1		1		1	1	1	6	3
St. Landry			1	1	1	1			1	1			6	3
St. Martin		1	1		1	1		1	1	1		1	8	3
St. Mary		1	1		1	1				1	1	1	7	3
St. Tammany		1	1			1		1		1	1	1	7	3
Tangipahoa		1	1			1		1		1	1	1	7	3
Tensas			1			1							2	1
Terrebonne		1	1		1	1		1		1	1	1	8	3
Union	1		1			1							3	2
Vermilion		1	1		1	1				1		1	6	3
Vernon		1	1	1	1	1				1			6	3
Washington			1			1		1		1		1	5	3
Webster	1		1			1							3	2
West Baton Rouge			1		1	1			1	1		1	6	3
West Carroll			1			1							2	1
West Feliciana			1			1				1		1	4	2
Winn			1	1		1							3	2

Table A 18: Mississippi Flood Declaration

	Declarations													
County	**1916**	**1906**	**1837**	**1794**	**1753**	**1604**	**1594**	**1550**	**1459**	**1436**	**1382**	**1365**	**Total**	**Score**
Adams				1		1		1					3	2
Alcorn	1					1							2	1
Amite			1	1		1		1	1	1			6	3
Attala		1				1	1		1			1	5	3
Benton	1					1							2	1
Bolivar					1	1							2	1
Calhoun						1	1						2	1
Carroll						1							1	1
Chickasaw						1	1						2	1
Choctaw		1				1	1						3	2
Claiborne				1		1		1	1				4	2
Clarke						1	1	1	1				4	2
Clay						1	1						2	1
Coahoma						1							1	1
Copiah				1		1		1	1	1			5	3
Covington						1	1	1					3	2
DeSoto						1							1	1
Forrest				1		1	1	1					4	2
Franklin				1		1		1	1				4	2
George				1		1	1	1		1	1		6	3
Greene			1			1	1	1		1			5	3
Grenada						1							1	1
Hancock				1		1	1	1		1	1		6	3
Harrison				1		1	1	1		1	1		6	3
Hinds						1	1	1	1				4	2
Holmes		1				1			1			1	4	2
Humphreys						1							1	1
Issaquena				1		1			1				3	2
Itawamba						1	1						2	1
Jackson			1	1		1	1	1		1	1		7	3
Jasper						1	1	1	1				4	2
Jefferson				1		1		1	1				4	2
Jefferson Davis			1	1		1	1	1	1				6	3
Jones						1	1	1					3	2
Kemper						1	1	1	1				4	2
Lafayette	1					1							2	1
Lamar						1	1	1					3	2
Lauderdale						1	1	1	1				4	2
Lawrence			1	1		1		1	1				5	3
Leake						1	1		1			1	4	2
Lee						1	1					1	3	2
Leflore						1							1	1
Lincoln			1	1		1		1	1	1			6	3
Lowndes						1	1	1					3	2
Madison						1	1		1				3	2

	Declarations													
County	**1916**	**1906**	**1837**	**1794**	**1753**	**1604**	**1594**	**1550**	**1459**	**1436**	**1382**	**1365**	**Total**	**Score**
Marion				1		1		1	1				4	2
Marshall	1					1							2	1
Monroe		1				1	1						3	2
Montgomery						1							1	1
Neshoba						1	1	1	1			1	5	3
Newton						1	1	1	1				4	2
Noxubee						1	1	1					3	2
Oktibbeha		1				1	1						3	2
Panola						1							1	1
Pearl River				1		1	1	1	1	1	1		7	3
Perry						1	1	1					3	2
Pike				1		1		1	1	1			5	3
Pontotoc						1	1					1	3	2
Prentiss	1					1							2	1
Quitman						1							1	1
Rankin						1	1	1	1				4	2
Scott						1	1	1	1				4	2
Sharkey						1							1	1
Simpson			1			1	1	1	1				5	3
Smith						1	1	1	1				4	2
Stone			1	1		1	1	1		1			6	3
Sunflower						1							1	1
Tallahatchie						1							1	1
Tate						1							1	1
Tippah	1					1							2	1
Tishomingo	1					1							2	1
Tunica						1							1	1
Union	1	1				1							3	2
Walthall			1	1		1		1	1				5	3
Warren		1			1	1		1	1				5	3
Washington				1	1	1							3	2
Wayne			1			1	1	1	1				5	3
Webster						1	1						2	1
Wilkinson			1	1	1	1		1					5	3
Winston						1	1						2	1
Yalobusha						1							1	1
Yazoo		1				1			1				3	2

Table A 19: Tennessee Flood Declaration

County	Declarations													Total	Score
	1909	1856	1851	1839	1821	1745	1568	1464	1456	1441	1408	1387	1331		
Anderson								1	1	1	1		1	5	3
Bedford								1		1	1			3	2
Benton	1			1		1		1					1	5	3
Bledsoe								1	1	1	1			4	2
Blount								1			1			2	1
Bradley								1						1	1
Campbell	1						1	1	1					4	2
Cannon	1							1	1		1			4	2
Carroll	1							1		1				3	2
Carter							1		1			1		3	2
Cheatham	1							1					1	3	2
Chester	1	1						1						3	2
Claiborne									1		1			2	1
Clay	1	1					1				1			4	2
Cocke							1	1			1	1		4	2
Coffee								1		1				2	1
Crockett	1							1		1				3	2
Cumberland							1	1	1	1	1			5	3
Davidson	1							1					1	3	2
Decatur	1	1						1	1		1			5	3
DeKalb	1							1			1			3	2
Dickson	1							1						2	1
Dyer	1				1			1						3	2
Fayette	1		1			1		1						4	2
Fentress						1			1	1	1			4	2
Franklin														0	1
Gibson	1							1		1				3	2
Giles	1						1	1			1			4	2
Grainger									1		1			2	1
Greene												1		1	1
Grundy							1	1						2	1
Hamblen														0	1
Hamilton							1	1						2	1
Hancock									1		1			2	1
Hardeman	1							1						2	1
Hardin	1					1		1	1		1			5	3
Hawkins											1			1	1
Haywood	1		1			1		1			1			5	3
Henderson	1							1		1				3	2
Henry	1				1			1					1	4	2
Hickman	1					1		1					1	4	2
Houston	1					1		1	1				1	5	3
Humphreys	1			1				1	1					4	2

	Declarations														
County	**1909**	**1856**	**1851**	**1839**	**1821**	**1745**	**1568**	**1464**	**1456**	**1441**	**1408**	**1387**	**1331**	**Total**	**Score**
Jackson	1	1					1	1	1		1		1	7	3
Jefferson								1						1	1
Johnson							1		1			1		3	2
Knox								1					1	2	1
Lake					1			1					1	3	2
Lauderdale	1							1	1		1			4	2
Lawrence	1							1			1			3	2
Lewis	1					1		1	1		1			5	3
Lincoln								1			1			2	1
Loudon								1	1		1			3	2
McMinn				1				1						2	1
McNairy	1					1					1			3	2
Macon	1					1		1			1			4	2
Madison	1					1		1		1				4	2
Marion								1	1					2	1
Marshall	1							1		1	1			4	2
Maury	1							1			1			3	2
Meigs							1	1	1	1	1			5	3
Monroe								1						1	1
Montgomery	1				1	1		1		1				5	3
Moore														0	1
Morgan								1		1				2	1
Obion	1				1			1					1	4	2
Overton		1									1			2	1
Perry	1					1		1					1	4	2
Pickett	1												1	2	1
Polk							1	1						2	1
Putnam														0	1
Rhea							1	1	1					3	2
Roane							1	1	1	1	1			5	3
Robertson	1							1						2	1
Rutherford	1			1				1		1				4	2
Scott									1	1	1			3	2
Sequatchie				1				1	1					3	2
Sevier								1			1			2	1
Shelby	1		1			1		1				1		5	3
Smith	1							1						2	1
Stewart	1				1			1	1				1	5	3
Sullivan														0	1
Sumner	1					1		1		1				4	2
Tipton	1					1		1		1				4	2
Trousdale	1					1		1						3	2
Unicoi							1		1			1		3	2

	Declarations														
County	**1909**	**1856**	**1851**	**1839**	**1821**	**1745**	**1568**	**1464**	**1456**	**1441**	**1408**	**1387**	**1331**	**Total**	**Score**
Union														0	1
Van Buren									1	1	1			3	2
Warren								1		1	1			3	2
Washington												1		1	1
Wayne	1	1				1		1			1			5	3
Weakley					1			1					1	3	2
White								1						1	1
Williamson	1					1		1						3	2
Wilson	1							1						2	1

Appendix VIII: Air Force and Navy Bases

Table A 20: Air Force and Navy Bases in Each State

Arkansas	Louisiana		Mississippi		Tennessee	
Air Force	Air Force	Navy	Air Force	Navy	Air Force	Navy
Little Rock Air Force Base	Barksdale Air Force Base	NASJRB New Orleans	Columbus Air Force Base	NCBC Gulfport	Arnold Air Force Base	NSA Mid-South
	New Orleans Joint Reserve Base		Keesler Air Force Base	NAS Meridian		
				NS Pascagoula		

Appendix IX: Nuclear Power Plants

Table A 21: U.S. Nuclear Power Plants by State

State	Plants
Arkansas	Arkansas Nuclear One
Louisiana	River Bend
Mississippi	Grand Gulf
Tennessee	Sequoyah

Appendix X: Overall Risk of Disaster

Table A 22: Risk of Disaster for Arkansas

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Arkansas	2	2	2	2	2
Ashley	2	1	1	1	1
Baxter	1	2	2	2	2
Benton	2	1	2	1	1
Boone	1	1	2	2	1
Bradley	1	1	3	1	1
Calhoun	1	1	3	1	1
Carroll	1	1	2	2	1
Chicot	1	1	2	1	1
Clark	1	1	3	1	1
Clay	1	3	2	1	2
Cleburne	2	2	3	2	2
Cleveland	1	1	3	2	2
Columbia	2	1	3	2	2
Conway	2	2	3	3	3
Craighead	2	3	3	1	2
Crawford	1	1	1	1	1
Crittenden	1	3	2	3	2
Cross	1	3	2	2	2
Dallas	1	1	3	2	2
Desha	1	2	1	1	1
Drew	1	1	2	1	1
Faulkner	3	2	1	3	2
Franklin	1	1	3	2	2
Fulton	1	2	2	1	1
Garland	2	1	1	2	1
Grant	1	1	3	3	2
Greene	2	3	3	1	2
Hempstead	1	1	3	2	2
Hot Spring	2	1	2	2	2
Howard	2	1	2	1	1
Independence	2	2	2	1	2
Izard	1	2	2	1	1
Jackson	3	2	3	1	2
Jefferson	2	2	2	3	2
Johnson	2	1	2	3	2
Lafayette	1	1	3	3	2
Lawrence	1	2	2	1	1
Lee	1	2	1	2	1
Lincoln	1	1	3	2	2
Little River	1	1	3	2	2
Logan	2	1	2	3	2
Lonoke	2	2	2	3	2
Madison	1	1	2	2	1

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Marion	1	1	2	2	1
Miller	1	1	3	3	2
Mississippi	3	3	1	2	2
Monroe	1	2	3	1	2
Montgomery	1	1	1	2	1
Nevada	1	1	3	2	2
Newton	1	1	3	3	2
Ouachita	1	1	3	1	1
Perry	1	1	2	3	2
Phillips	1	2	2	1	1
Pike	1	1	2	1	1
Poinsett	3	3	3	2	3
Polk	1	1	1	1	1
Pope	1	1	2	3	2
Prairie	2	2	3	2	2
Pulaski	3	2	2	3	3
Randolph	1	2	2	1	1
St. Francis	1	3	2	2	2
Saline	2	1	2	3	2
Scott	1	1	2	2	1
Searcy	1	2	2	3	2
Sebastian	1	1	1	1	1
Sevier	1	1	1	1	1
Sharp	1	2	2	1	1
Stone	1	2	3	2	2
Union	2	1	2	1	1
Van Buren	2	2	3	3	3
Washington	1	1	1	1	1
White	2	2	3	2	2
Woodruff	2	2	3	1	2
Yell	1	1	1	3	1

Table A 23: Risk of Disaster for Louisiana

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Acadia	2	1	3	1	2
Allen	1	1	3	1	1
Ascension	1	1	3	2	2
Assumption	1	1	3	2	2
Avoyelles	2	1	2	2	2
Beauregard	1	1	3	1	1
Bienville	1	1	1	3	1
Bossier	3	1	2	3	2
Caddo	3	1	2	3	2
Calcasieu	2	1	3	1	2
Caldwell	1	1	3	1	1
Cameron	2	1	3	1	2
Catahoula	1	1	2	2	1
Claiborne	1	1	2	2	1
Concordia	1	1	2	2	1
De Soto	2	1	2	2	2
East Baton Rouge	2	1	3	2	2
East Carroll	2	1	1	1	1
East Feliciana	1	1	3	3	2
Evangeline	1	1	3	1	1
Franklin	2	1	2	2	2
Grant	1	1	2	1	1
Iberia	1	1	3	1	1
Iberville	1	1	3	2	2
Jackson	1	1	1	2	1
Jefferson	2	1	3	3	2
Jefferson Davis	2	1	3	1	2
Lafayette	2	1	3	1	2
Lafourche	1	1	3	3	2
La Salle	1	1	2	1	1
Lincoln	1	1	1	2	1
Livingston	1	1	3	2	2
Madison	3	1	2	2	2
Morehouse	2	1	2	1	1
Natchitoches	2	1	3	2	2
Orleans	1	1	3	3	2
Ouachita	2	1	3	1	2
Plaquemines	1	1	3	3	2
Pointe Coupee	1	1	3	3	2
Rapides	2	1	3	1	2
Red River	1	1	1	3	1
Richland	2	1	2	1	1
Sabine	2	1	3	1	2
St. Bernard	1	1	3	3	2

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
St. Charles	1	1	3	3	2
St. Helena	1	1	3	2	2
St. James	1	1	3	2	2
St. John the Baptist	1	1	3	3	2
St. Landry	2	1	3	2	2
St. Martin	1	1	3	2	2
St. Mary	1	1	3	1	1
St. Tammany	1	1	3	2	2
Tangipahoa	2	1	3	2	2
Tensas	2	1	1	3	2
Terrebonne	1	1	3	2	2
Union	2	1	2	1	1
Vermilion	2	1	3	1	2
Vernon	2	1	3	1	2
Washington	1	1	3	2	2
Webster	2	1	2	3	2
West Baton Rouge	1	1	3	2	2
West Carroll	2	1	1	1	1
West Feliciana	1	1	2	3	2
Winn	1	1	2	2	1

Table A 24: Risk of Disaster for Mississippi

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Adams	1	1	2	2	1
Alcorn	2	2	1	1	1
Amite	1	1	3	2	2
Attala	2	1	3	2	2
Benton	1	2	1	2	1
Bolivar	1	1	1	1	1
Calhoun	1	1	1	1	1
Carroll	1	1	1	1	1
Chickasaw	1	1	1	2	1
Choctaw	1	1	2	2	1
Claiborne	1	1	2	3	2
Clarke	2	1	2	3	2
Clay	1	1	1	3	1
Coahoma	2	2	1	1	1
Copiah	3	1	3	3	3
Covington	1	1	2	1	1
DeSoto	1	2	1	3	2
Forrest	1	1	2	2	1
Franklin	1	1	2	2	1
George	1	1	3	3	2
Greene	1	1	3	2	2
Grenada	2	1	1	1	1
Hancock	2	1	3	3	2
Harrison	3	1	3	3	3
Hinds	3	1	2	3	2
Holmes	1	1	2	1	1
Humphreys	2	1	1	1	1
Issaquena	1	1	2	2	1
Itawamba	1	1	1	2	1
Jackson	2	1	3	3	2
Jasper	2	1	2	2	2
Jefferson	1	1	2	3	2
Jefferson Davis	1	1	3	1	1
Jones	3	1	2	1	2
Kemper	1	1	2	3	2
Lafayette	2	2	1	2	2
Lamar	1	1	2	2	1
Lauderdale	2	1	2	3	2
Lawrence	2	1	3	2	2
Leake	2	1	2	2	2
Lee	2	1	2	2	2
Leflore	2	1	1	1	1
Lincoln	2	1	3	2	2
Lowndes	2	1	2	3	2

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Madison	2	1	2	2	2
Marion	2	1	2	2	2
Marshall	1	2	1	3	2
Monroe	2	1	2	3	2
Montgomery	1	1	1	1	1
Neshoba	2	1	3	3	2
Newton	2	1	2	3	2
Noxubee	1	1	2	3	2
Oktibbeha	1	1	2	3	2
Panola	1	2	1	1	1
Pearl River	2	1	3	3	2
Perry	1	1	2	2	1
Pike	1	1	3	1	1
Pontotoc	1	1	2	1	1
Prentiss	2	1	1	1	1
Quitman	1	2	1	1	1
Rankin	3	1	2	2	2
Scott	2	1	2	2	2
Sharkey	2	1	1	1	1
Simpson	3	1	3	2	2
Smith	2	1	2	2	2
Stone	1	1	3	3	2
Sunflower	1	1	1	1	1
Tallahatchie	2	1	1	1	1
Tate	1	2	1	2	1
Tippah	1	2	1	1	1
Tishomingo	1	1	1	1	1
Tunica	1	2	1	2	1
Union	1	1	2	2	1
Walthall	1	1	3	1	1
Warren	2	1	3	3	2
Washington	2	1	2	1	1
Wayne	1	1	3	2	2
Webster	1	1	1	2	1
Wilkinson	1	1	3	3	2
Winston	1	1	1	3	1
Yalobusha	1	1	1	1	1
Yazoo	2	1	2	2	2

Table A 25: Risk of Disaster for Tennessee

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Anderson	1	2	3	2	2
Bedford	1	1	2	3	2
Benton	1	2	3	1	2
Bledsoe	1	1	2	3	2
Blount	1	2	1	1	1
Bradley	1	2	1	3	2
Campbell	1	1	2	1	1
Cannon	1	1	2	3	2
Carroll	1	2	2	1	1
Carter	1	1	2	1	1
Cheatham	1	1	2	1	1
Chester	1	2	2	1	1
Claiborne	1	2	1	1	1
Clay	1	1	2	1	1
Cocke	1	2	2	1	1
Coffee	1	1	1	3	1
Crockett	1	2	2	1	1
Cumberland	1	1	3	3	2
Davidson	1	1	2	2	1
Decatur	1	2	3	1	2
DeKalb	1	1	2	2	1
Dickson	1	1	1	1	1
Dyer	2	3	2	1	2
Fayette	1	2	2	3	2
Fentress	1	1	2	2	1
Franklin	1	1	1	3	1
Gibson	1	2	2	1	1
Giles	2	1	2	2	2
Grainger	1	2	1	1	1
Greene	1	1	1	1	1
Grundy	1	1	1	3	1
Hamblen	1	2	1	1	1
Hamilton	1	2	1	3	2
Hancock	1	1	1	1	1
Hardeman	1	2	1	2	1
Hardin	1	2	3	1	2
Hawkins	1	1	1	1	1
Haywood	1	2	3	2	2
Henderson	1	2	2	1	1
Henry	1	2	2	1	1
Hickman	1	1	2	1	1
Houston	1	2	3	1	2
Humphreys	1	2	2	1	1
Jackson	1	1	3	1	1
Jefferson	1	2	1	1	1
Johnson	1	1	2	1	1
Knox	1	2	1	2	1
Lake	1	3	2	1	2
Lauderdale	1	3	2	2	2

Counties	Tornado	Earthquake	Flood	Terrorist Attack	Overall Risk of Disaster
Lawrence	2	1	2	1	1
Lewis	1	1	3	1	1
Lincoln	2	1	1	3	2
Loudon	1	2	2	2	2
McMinn	2	2	1	2	2
McNairy	1	2	2	1	1
Macon	1	1	2	1	1
Madison	1	2	2	1	1
Marion	1	1	1	3	1
Marshall	1	1	2	2	1
Maury	1	1	2	1	1
Meigs	1	2	3	3	2
Monroe	1	2	1	3	2
Montgomery	1	2	3	1	2
Moore	1	1	1	1	1
Morgan	1	1	1	2	1
Obion	1	3	2	1	2
Overton	1	1	1	2	1
Perry	1	2	2	1	1
Pickett	1	1	1	1	1
Polk	1	2	1	2	1
Putnam	1	1	1	2	1
Rhea	1	2	2	3	2
Roane	1	2	3	3	2
Robertson	1	1	1	1	1
Rutherford	1	1	2	3	2
Scott	1	1	2	1	1
Sequatchie	1	1	2	3	2
Sevier	1	2	1	1	1
Shelby	3	2	3	3	3
Smith	1	1	1	1	1
Stewart	1	2	3	1	2
Sullivan	1	1	1	1	1
Sumner	2	1	2	1	1
Tipton	1	3	2	3	2
Trousdale	1	1	2	1	1
Unicoi	1	1	2	1	1
Union	1	2	1	1	1
Van Buren	1	1	2	2	1
Warren	1	1	2	3	2
Washington	1	1	1	1	1
Wayne	1	1	3	1	1
Weakley	1	2	2	1	1
White	1	1	1	2	1
Williamson	1	1	2	2	1
Wilson	1	1	1	2	1

Appendix XI: Limited Access to Medical Services

Table A 26: Community Hospitals

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Arkansas, AR	2	122	607	1
Ashley, AR	1	36	153	2
Baxter, AR	1	266	668	1
Benton, AR	4	333	185	2
Boone, AR	1	125	355	1
Bradley, AR	1	49	398	1
Calhoun, AR	-	-	0	3
Carroll, AR	2	60	226	2
Chicot, AR	1	35	265	2
Clark, AR	1	25	108	2
Clay, AR	1	35	209	2
Cleburne, AR	1	18	72	2
Cleveland, AR	-	-	0	3
Columbia, AR	1	62	249	2
Conway, AR	-	-	0	3
Craighead, AR	3	476	555	1
Crawford, AR	1	103	182	2
Crittenden, AR	1	121	235	2
Cross, AR	1	15	79	2
Dallas, AR	1	25	288	1
Desha, AR	2	75	516	1
Drew, AR	1	58	312	1
Faulkner, AR	1	149	157	2
Franklin, AR	1	25	139	2
Fulton, AR	1	40	337	1
Garland, AR	3	469	509	1
Grant, AR	-	-	0	3
Greene, AR	1	129	332	1
Hempstead, AR	2	104	444	1
Hot Spring, AR	1	81	262	2
Howard, AR	-	-	0	3
Independence, AR	1	174	503	1
Izard, AR	1	25	188	2
Jackson, AR	2	169	956	1
Jefferson, AR	1	373	454	1
Johnson, AR	1	80	337	1
Lafayette, AR	-	-	0	3

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Lawrence, AR	1	214	1232	1
Lee, AR	-	-	0	3
Lincoln, AR	-	-	0	3
Little River, AR	1	25	189	2
Logan, AR	2	41	179	2
Lonoke, AR	-	-	0	3
Madison, AR	-	-	0	3
Marion, AR	-	-	0	3
Miller, AR	-	-	0	3
Mississippi, AR	2	136	281	2
Monroe, AR	-	-	0	3
Montgomery, AR	-	-	0	3
Nevada, AR	-	-	0	3
Newton, AR	-	-	0	3
Ouachita, AR	1	98	359	1
Perry, AR	-	-	0	3
Phillips, AR	1	100	411	1
Pike, AR	1	32	291	1
Poinsett, AR	-	-	0	3
Polk, AR	1	58	289	1
Pope, AR	1	154	275	2
Prairie, AR	-	-	0	3
Pulaski, AR	11	2,504	686	1
Randolph, AR	1	45	244	2
St. Francis, AR	1	70	249	2
Saline, AR	1	106	119	2
Scott, AR	1	24	218	2
Searcy, AR	-	-	0	3
Sebastian, AR	4	750	638	1
Sevier, AR	1	44	273	2
Sharp, AR	-	-	0	3
Stone, AR	1	25	215	2
Union, AR	1	140	314	1
Van Buren, AR	2	192	1164	1
Washington, AR	5	585	336	1
White, AR	2	318	451	1
Woodruff, AR	-	-	0	3

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Yell, AR	2	62	291	1
Acadia, LA	3	237	401	1
Allen, LA	1	59	234	2
Ascension, LA	3	140	161	2
Assumption, LA	1	6	26	2
Avoyelles, LA	2	72	172	2
Beauregard, LA	1	60	176	2
Bienville, LA	-	-	0	3
Bossier, LA	-	-	0	3
Caddo, LA	8	2,224	886	1
Calcasieu, LA	7	896	485	1
Caldwell, LA	1	25	234	2
Cameron, LA	1	33	343	1
Catahoula, LA	-	-	0	3
Claiborne, LA	1	60	367	1
Concordia, LA	2	65	333	1
De Soto, LA	1	57	218	2
East Baton Rouge, LA	7	1,740	423	1
East Carroll, LA	1	11	124	2
East Feliciana, LA	-	-	0	3
Evangeline, LA	2	261	740	1
Franklin, LA	1	57	275	2
Grant, LA	-	-	0	3
Iberia, LA	2	166	224	2
Iberville, LA	1	75	231	2
Jackson, LA	1	18	118	2
Jefferson, LA	6	1,616	357	1
Jefferson Davis, LA	1	60	192	2
Lafayette, LA	7	1,069	547	1
Lafourche, LA	3	234	254	2
La Salle, LA	2	95	674	1
Lincoln, LA	1	124	293	1
Livingston, LA	-	-	0	3
Madison, LA	1	25	198	2
Morehouse, LA	1	60	197	2
Natchitoches, LA	1	190	495	1
Orleans, LA	9	2,712	588	1

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Ouachita, LA	7	1,061	716	1
Plaquemines, LA	-	-	0	3
Pointe Coupee, LA	1	25	111	2
Rapides, LA	5	721	564	1
Red River, LA	1	25	261	2
Richland, LA	2	83	404	1
Sabine, LA	1	44	187	2
St. Bernard, LA	1	194	296	1
St. Charles, LA	1	56	112	2
St. Helena, LA	1	25	243	2
St. James, LA	1	16	76	2
St. John the Baptist, LA	1	60	132	2
St. Landry, LA	3	354	396	1
St. Martin, LA	1	25	50	2
St. Mary, LA	2	75	144	2
St. Tammany, LA	5	714	334	1
Tangipahoa, LA	3	252	240	2
Tensas, LA	-	-	0	3
Terrebonne, LA	2	404	380	1
Union, LA	2	36	158	2
Vermilion, LA	4	109	200	2
Vernon, LA	1	60	121	2
Washington, LA	2	91	206	2
Webster, LA	2	219	531	1
West Baton Rouge, LA	-	-	0	3
West Carroll, LA	1	21	176	2
West Feliciana, LA	1	22	146	2
Winn, LA	1	60	372	1
Adams, MS	2	210	647	1
Alcorn, MS	1	157	446	1
Amite, MS	-	-	0	3
Attala, MS	1	71	362	1
Benton, MS	-	-	0	3
Bolivar, MS	1	143	366	1
Calhoun, MS	1	150	1016	1
Carroll, MS	-	-	0	3
Chickasaw, MS	1	84	436	1

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Choctaw, MS	1	72	752	1
Claiborne, MS	1	32	279	2
Clarke, MS	1	40	226	2
Clay, MS	1	60	279	2
Coahoma, MS	1	175	599	1
Copiah, MS	1	49	168	2
Covington, MS	1	50	247	2
DeSoto, MS	1	199	152	2
Forrest, MS	2	563	756	1
Franklin, MS	1	36	428	1
George, MS	1	53	255	2
Greene, MS	-	-	0	3
Grenada, MS	1	142	624	1
Hancock, MS	1	104	227	2
Harrison, MS	4	917	476	1
Hinds, MS	7	2,767	1108	1
Holmes, MS	1	42	198	2
Humphreys, MS	1	25	235	2
Issaquena, MS	-	-	0	3
Itawamba, MS	-	-	0	3
Jackson, MS	1	388	287	1
Jasper, MS	1	126	694	1
Jefferson, MS	1	30	315	1
Jefferson Davis, MS	1	101	768	1
Jones, MS	1	349	532	1
Kemper, MS	-	-	0	3
Lafayette, MS	1	217	539	1
Lamar, MS	1	211	488	1
Lauderdale, MS	5	648	836	1
Lawrence, MS	1	25	185	2
Leake, MS	1	69	308	1
Lee, MS	1	757	969	1
Leflore, MS	1	175	480	1
Lincoln, MS	1	109	323	1
Lowndes, MS	1	328	544	1
Madison, MS	1	34	41	2
Marion, MS	1	79	313	1

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Marshall, MS	1	40	113	2
Monroe, MS	2	120	316	1
Montgomery, MS	2	44	374	1
Neshoba, MS	1	204	689	1
Newton, MS	1	49	221	2
Noxubee, MS	1	85	693	1
Oktibbeha, MS	1	96	233	2
Panola, MS	1	53	150	2
Pearl River, MS	2	211	407	1
Perry, MS	-	-	0	3
Pike, MS	2	193	494	1
Pontotoc, MS	1	73	261	2
Prentiss, MS	1	66	258	2
Quitman, MS	1	33	339	1
Rankin, MS	1	134	104	2
Scott, MS	1	55	192	2
Sharkey, MS	-	-	0	3
Simpson, MS	2	105	381	1
Smith, MS	-	-	0	3
Stone, MS	1	25	173	2
Sunflower, MS	2	145	445	1
Tallahatchie, MS	1	77	539	1
Tate, MS	1	52	198	2
Tippah, MS	1	110	524	1
Tishomingo, MS	1	48	252	2
Tunica, MS	-	-	0	3
Union, MS	1	153	580	1
Walthall, MS	1	49	322	1
Warren, MS	1	374	760	1
Washington, MS	2	270	454	1
Wayne, MS	1	80	378	1
Webster, MS	1	74	730	1
Wilkinson, MS	1	25	244	2
Winston, MS	1	185	929	1
Yalobusha, MS	1	103	775	1
Yazoo, MS	1	25	88	2
Anderson, TN	1	161	223	2

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Bedford, TN	1	176	428	1
Benton, TN	1	30	182	2
Bledsoe, TN	1	28	219	2
Blount, TN	1	258	227	2
Bradley, TN	2	234	257	2
Campbell, TN	2	210	518	1
Cannon, TN	1	55	414	1
Carroll, TN	2	59	201	2
Carter, TN	1	121	206	2
Cheatham, TN	1	8	21	2
Chester, TN	-	-	0	3
Claiborne, TN	1	45	146	2
Clay, TN	1	34	425	1
Cocke, TN	1	103	297	1
Coffee, TN	3	285	569	1
Crockett, TN	-	-	0	3
Cumberland, TN	1	156	311	1
Davidson, TN	11	3,300	577	1
Decatur, TN	1	40	342	1
DeKalb, TN	1	51	281	2
Dickson, TN	1	116	256	2
Dyer, TN	1	105	280	2
Fayette, TN	1	10	30	2
Fentress, TN	1	71	419	1
Franklin, TN	1	198	486	1
Gibson, TN	3	117	244	2
Giles, TN	1	95	325	1
Grainger, TN	-	-	0	3
Greene, TN	2	330	511	1
Grundy, TN	-	-	0	3
Hamblen, TN	2	278	468	1
Hamilton, TN	5	1,578	509	1
Hancock, TN	-	-	0	3
Hardeman, TN	1	37	131	2
Hardin, TN	1	119	462	1
Hawkins, TN	1	50	90	2
Haywood, TN	1	62	315	1

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Henderson, TN	1	36	137	2
Henry, TN	1	271	865	1
Hickman, TN	1	65	275	2
Houston, TN	1	31	390	1
Humphreys, TN	1	25	138	2
Jackson, TN	-	-	0	3
Jefferson, TN	1	58	122	2
Johnson, TN	1	6	33	2
Knox, TN	6	1,927	481	1
Lake, TN	-	-	0	3
Lauderdale, TN	1	14	52	2
Lawrence, TN	1	98	241	2
Lewis, TN	-	-	0	3
Lincoln, TN	1	327	1022	1
Loudon, TN	1	30	71	2
McMinn, TN	2	143	281	2
McNairy, TN	1	38	151	2
Macon, TN	1	25	117	2
Madison, TN	2	733	778	1
Marion, TN	1	68	246	2
Marshall, TN	1	77	275	2
Maury, TN	1	267	357	1
Meigs, TN	-	-	0	3
Monroe, TN	1	59	140	2
Montgomery, TN	1	206	145	2
Moore, TN	-	-	0	3
Morgan, TN	-	-	0	3
Obion, TN	1	85	262	2
Overton, TN	1	67	328	1
Perry, TN	1	53	696	1
Pickett, TN	-	-	0	3
Polk, TN	1	44	276	2
Putnam, TN	1	207	315	1
Rhea, TN	1	131	442	1
Roane, TN	1	66	125	2
Robertson, TN	1	90	152	2
Rutherford, TN	1	199	95	2

County	Community hospitals, 2004			Scores
	Number	Beds		
		Number	Rate per 100,000 persons	
Scott, TN	1	77	354	1
Sequatchie, TN	-	-	0	3
Sevier, TN	1	108	140	2
Shelby, TN	11	3,447	380	1
Smith, TN	2	88	478	1
Stewart, TN	-	-	0	3
Sullivan, TN	4	959	630	1
Sumner, TN	2	185	131	2
Tipton, TN	1	54	99	2
Trousdale, TN	1	25	333	1
Unicoi, TN	1	94	532	1
Union, TN	-	-	0	3
Van Buren, TN	-	-	0	3
Warren, TN	1	127	322	1
Washington, TN	4	670	604	1
Wayne, TN	1	78	462	1
Weakley, TN	1	65	193	2
White, TN	1	44	184	2
Williamson, TN	1	131	89	2
Wilson, TN	1	245	251	2

Appendix XII: Limited Access to Resources

Table A 27: Limited Access to Resources

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Arkansas, AR	3	1	1	1	6	1
Ashley, AR	3	1	2	2	8	2
Baxter, AR	2	2	1	2	7	2
Benton, AR	2	2	2	2	8	2
Boone, AR	2	2	2	2	8	2
Bradley, AR	1	1	2	1	5	1
Calhoun, AR	3	1	3	2	9	2
Carroll, AR	3	1	1	2	7	2
Chicot, AR	1	1	1	1	4	1
Clark, AR	2	1	1	2	6	1
Clay, AR	3	1	3	2	9	2
Cleburne, AR	2	1	1	2	6	1
Cleveland, AR	1	3	3	2	9	2
Columbia, AR	1	2	1	1	5	1
Conway, AR	3	1	1	1	6	1
Craighead, AR	3	2	2	2	9	2
Crawford, AR	3	2	2	2	9	2
Crittenden, AR	3	2	1	2	8	2
Cross, AR	3	1	1	2	7	2
Dallas, AR	3	1	1	1	6	1
Desha, AR	1	1	1	1	4	1
Drew, AR	1	2	1	1	5	1
Faulkner, AR	2	2	2	2	8	2
Franklin, AR	2	1	1	2	6	1
Fulton, AR	1	1	1	2	5	1
Garland, AR	2	2	1	2	7	2
Grant, AR	1	1	2	2	6	1
Greene, AR	2	2	2	2	8	2
Hempstead, AR	2	2	1	1	6	1
Hot Spring, AR	2	1	2	2	7	2
Howard, AR	2	1	2	1	6	1
Independence, AR	2	1	2	2	7	2
Izard, AR	2	3	1	1	7	2
Jackson, AR	2	1	2	2	7	2
Jefferson, AR	2	1	1	2	6	1
Johnson, AR	1	3	2	1	7	2
Lafayette, AR	3	1	3	2	9	2
Lawrence, AR	3	1	2	1	7	2
Lee, AR	1	1	2	2	6	1
Lincoln, AR	2	2	2	1	7	2
Little River, AR	3	3	2	2	10	3
Logan, AR	2	2	2	2	8	2
Lonoke, AR	2	2	2	2	8	2
Madison, AR	3	2	2	1	8	2

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Marion, AR	3	2	1	2	8	2
Miller, AR	3	2	2	2	9	2
Mississippi, AR	2	1	1	2	6	1
Monroe, AR	3	3	1	1	8	2
Montgomery, AR	3	3	1	1	8	2
Nevada, AR	3	3	2	1	9	2
Newton, AR	1	1	1	2	5	1
Ouachita, AR	2	1	2	2	7	2
Perry, AR	1	1	2	1	5	1
Phillips, AR	2	1	2	2	7	2
Pike, AR	3	1	1	2	7	2
Poinsett, AR	2	2	2	1	7	2
Polk, AR	1	1	1	2	5	1
Pope, AR	1	2	2	2	7	2
Prairie, AR	1	3	1	1	6	1
Pulaski, AR	2	1	1	2	6	1
Randolph, AR	3	2	2	2	9	2
St. Francis, AR	2	1	1	1	5	1
Saline, AR	3	2	2	2	9	2
Scott, AR	3	1	2	2	8	2
Searcy, AR	1	1	1	1	4	1
Sebastian, AR	2	2	2	2	8	2
Sevier, AR	3	1	2	1	7	2
Sharp, AR	1	2	2	2	7	2
Stone, AR	1	1	1	2	5	1
Union, AR	3	2	1	1	7	2
Van Buren, AR	1	2	2	1	6	1
Washington, AR	2	2	1	2	7	2
White, AR	2	2	2	2	8	2
Woodruff, AR	3	1	2	2	8	2
Yell, AR	2	2	2	2	8	2
Acadia, LA	2	1	2	2	7	2
Allen, LA	1	2	1	2	6	1
Ascension, LA	2	2	2	2	8	2
Assumption, LA	3	1	2	1	7	2
Avoyelles, LA	1	1	1	1	4	1
Beauregard, LA	1	2	2	2	7	2
Bienville, LA	1	2	2	1	6	1
Bossier, LA	2	2	1	2	7	2
Caddo, LA	2	1	2	2	7	2
Calcasieu, LA	2	2	1	2	7	2
Caldwell, LA	1	1	3	1	6	1
Cameron, LA	3	1	1	2	7	2
Catahoula, LA	1	1	2	2	6	1

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Claiborne, LA	1	2	2	1	6	1
Concordia, LA	2	1	2	1	6	1
De Soto, LA	1	1	2	2	6	1
East Baton Rouge, LA	2	2	2	2	8	2
East Carroll, LA	1	3	2	2	8	2
East Feliciana, LA	2	2	2	2	8	2
Evangeline, LA	2	1	2	2	7	2
Franklin, LA	1	1	2	1	5	1
Grant, LA	1	3	2	2	8	2
Iberia, LA	2	3	3	3	11	3
Iberville, LA	3	1	2	2	8	2
Jackson, LA	1	2	2	1	6	1
Jefferson, LA	2	2	2	2	8	2
Jefferson Davis, LA	2	1	2	2	7	2
Lafayette, LA	3	2	1	2	8	2
Lafourche, LA	3	2	2	2	9	2
La Salle, LA	2	2	2	1	7	2
Lincoln, LA	1	2	1	1	5	1
Livingston, LA	2	2	2	2	8	2
Madison, LA	2	1	1	1	5	1
Morehouse, LA	1	2	2	2	7	2
Natchitoches, LA	2	2	1	1	6	1
Orleans, LA	3	1	1	2	7	2
Ouachita, LA	2	2	2	2	8	2
Plaquemines, LA	3	2	1	2	8	2
Pointe Coupee, LA	1	1	2	1	5	1
Rapides, LA	2	1	2	1	6	1
Red River, LA	1	3	2	2	8	2
Richland, LA	1	1	2	2	6	1
Sabine, LA	2	2	1	2	7	2
St. Bernard, LA	3	2	2	2	9	2
St. Charles, LA	3	1	2	2	8	2
St. Helena, LA	1	1	2	2	6	1
St. James, LA	3	3	2	2	10	3
St. John the Baptist, LA	3	1	1	2	7	2
St. Landry, LA	1	1	2	2	6	1
St. Martin, LA	1	3	2	2	8	2
St. Mary, LA	3	3	3	3	12	3
St. Tammany, LA	2	2	2	2	8	2
Tangipahoa, LA	2	2	2	1	7	2
Tensas, LA	1	1	3	1	6	1
Terrebonne, LA	2	2	2	3	9	2
Union, LA	1	2	2	1	6	1
Vermilion, LA	2	2	2	2	8	2

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Vernon, LA	1	2	1	2	6	1
Washington, LA	2	2	2	2	8	2
Webster, LA	1	2	2	1	6	1
West Baton Rouge, LA	3	1	1	1	6	1
West Carroll, LA	1	1	2	2	6	1
West Feliciana, LA	3	1	1	2	7	2
Winn, LA	1	3	2	2	8	2
Adams, MS	1	2	1	1	5	1
Alcorn, MS	2	2	2	1	7	2
Amite, MS	1	1	3	1	6	1
Attala, MS	1	1	2	1	5	1
Benton, MS	3	3	3	1	10	3
Bolivar, MS	2	1	2	1	6	1
Calhoun, MS	1	1	2	1	5	1
Carroll, MS	1	3	3	2	9	2
Chickasaw, MS	1	2	2	1	6	1
Choctaw, MS	1	1	3	2	7	2
Claiborne, MS	1	1	2	2	6	1
Clarke, MS	1	1	2	1	5	1
Clay, MS	1	2	2	1	6	1
Coahoma, MS	2	2	1	1	6	1
Copiah, MS	1	2	2	1	6	1
Covington, MS	1	3	2	2	8	2
DeSoto, MS	2	3	3	3	11	3
Forrest, MS	2	1	1	1	5	1
Franklin, MS	1	3	3	1	8	2
George, MS	1	1	2	1	5	1
Greene, MS	1	2	3	2	8	2
Grenada, MS	1	2	1	1	5	1
Hancock, MS	2	2	1	2	7	2
Harrison, MS	2	1	1	2	6	1
Hinds, MS	2	1	1	2	6	1
Holmes, MS	1	2	1	1	5	1
Humphreys, MS	3	1	3	1	8	2
Issaquena, MS	3	3	3	3	12	3
Itawamba, MS	1	2	2	2	7	2
Jackson, MS	2	2	1	2	7	2
Jasper, MS	1	1	2	1	5	1
Jefferson, MS	1	1	2	2	6	1
Jefferson Davis, MS	3	3	2	1	9	2
Jones, MS	1	2	2	1	6	1
Kemper, MS	1	1	2	1	5	1
Lafayette, MS	1	2	1	2	6	1
Lamar, MS	1	1	2	2	6	1

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Lauderdale, MS	1	1	1	1	4	1
Lawrence, MS	1	1	2	2	6	1
Leake, MS	1	2	2	1	6	1
Lee, MS	2	2	1	1	6	1
Leflore, MS	3	2	1	1	7	2
Lincoln, MS	1	2	1	1	5	1
Lowndes, MS	1	2	1	1	5	1
Madison, MS	2	2	1	2	7	2
Marion, MS	1	1	2	1	5	1
Marshall, MS	2	2	2	1	7	2
Monroe, MS	2	2	2	2	8	2
Montgomery, MS	1	1	1	1	4	1
Neshoba, MS	2	2	2	2	8	2
Newton, MS	1	1	2	1	5	1
Noxubee, MS	1	1	1	1	4	1
Oktibbeha, MS	2	2	1	2	7	2
Panola, MS	1	2	1	1	5	1
Pearl River, MS	2	2	2	2	8	2
Perry, MS	1	1	3	1	6	1
Pike, MS	1	1	1	1	4	1
Pontotoc, MS	1	2	2	2	7	2
Prentiss, MS	1	1	2	2	6	1
Quitman, MS	1	1	3	2	7	2
Rankin, MS	1	2	2	2	7	2
Scott, MS	1	2	2	1	6	1
Sharkey, MS	3	1	3	1	8	2
Simpson, MS	1	2	2	1	6	1
Smith, MS	1	1	2	2	6	1
Stone, MS	3	1	2	1	7	2
Sunflower, MS	3	1	2	1	7	2
Tallahatchie, MS	1	3	3	1	8	2
Tate, MS	1	2	2	1	6	1
Tippah, MS	1	1	2	2	6	1
Tishomingo, MS	1	2	2	2	7	2
Tunica, MS	3	1	1	1	6	1
Union, MS	1	3	2	2	8	2
Walthall, MS	1	3	2	2	8	2
Warren, MS	2	1	1	1	5	1
Washington, MS	2	1	1	1	5	1
Wayne, MS	1	1	2	1	5	1
Webster, MS	1	1	3	1	6	1
Wilkinson, MS	1	3	2	1	7	2
Winston, MS	1	2	1	1	5	1
Yalobusha, MS	1	3	2	1	7	2

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Yazoo, MS	1	2	2	2	7	2
Anderson, TN	3	3	1	2	9	2
Bedford, TN	2	2	2	2	8	2
Benton, TN	3	3	2	1	9	2
Bledsoe, TN	3	1	2	2	8	2
Blount, TN	2	3	1	2	8	2
Bradley, TN	3	2	1	2	8	2
Campbell, TN	3	3	2	1	9	2
Cannon, TN	3	2	3	2	10	3
Carroll, TN	3	3	2	1	9	2
Carter, TN	2	2	2	2	8	2
Cheatham, TN	3	3	2	2	10	3
Chester, TN	3	2	2	2	9	2
Claiborne, TN	3	2	2	2	9	2
Clay, TN	3	1	2	1	7	2
Cocke, TN	3	2	1	1	7	2
Coffee, TN	3	2	1	1	7	2
Crockett, TN	2	2	2	1	7	2
Cumberland, TN	3	2	1	1	7	2
Davidson, TN	3	3	1	2	9	2
Decatur, TN	3	3	1	1	8	2
DeKalb, TN	3	3	2	3	11	3
Dickson, TN	3	3	1	1	8	2
Dyer, TN	3	3	2	2	10	3
Fayette, TN	3	2	2	2	9	2
Fentress, TN	3	2	2	2	9	2
Franklin, TN	3	2	2	1	8	2
Gibson, TN	3	2	2	1	8	2
Giles, TN	3	3	2	1	9	2
Grainger, TN	3	3	2	2	10	3
Greene, TN	2	3	2	1	8	2
Grundy, TN	3	2	1	1	7	2
Hamblen, TN	3	2	2	1	8	2
Hamilton, TN	2	3	1	2	8	2
Hancock, TN	3	1	3	2	9	2
Hardeman, TN	3	3	2	1	9	2
Hardin, TN	3	2	2	2	9	2
Hawkins, TN	3	2	2	2	9	2
Haywood, TN	3	1	1	1	6	1
Henderson, TN	3	3	2	1	9	2
Henry, TN	3	3	1	2	9	2
Hickman, TN	3	1	2	2	8	2
Houston, TN	3	1	2	2	8	2
Humphreys, TN	3	2	1	2	8	2

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Jackson, TN	3	1	2	1	7	2
Jefferson, TN	3	2	2	2	9	2
Johnson, TN	3	2	1	2	8	2
Knox, TN	3	3	2	2	10	3
Lake, TN	3	1	1	1	6	1
Lauderdale, TN	3	2	2	1	8	2
Lawrence, TN	3	3	2	1	9	2
Lewis, TN	3	1	1	1	6	1
Lincoln, TN	3	3	2	1	9	2
Loudon, TN	2	3	1	2	8	2
McMinn, TN	3	3	1	1	8	2
McNairy, TN	2	2	2	2	8	2
Macon, TN	3	1	2	2	8	2
Madison, TN	3	2	1	2	8	2
Marion, TN	2	2	1	1	6	1
Marshall, TN	3	2	2	1	8	2
Maury, TN	3	2	2	2	9	2
Meigs, TN	3	1	2	1	7	2
Monroe, TN	3	2	1	2	8	2
Montgomery, TN	3	2	1	2	8	2
Moore, TN	3	1	2	2	8	2
Morgan, TN	3	2	3	1	9	2
Obion, TN	3	2	1	2	8	2
Overton, TN	3	2	2	2	9	2
Perry, TN	3	1	1	1	6	1
Pickett, TN	3	1	1	1	6	1
Polk, TN	3	2	1	1	7	2
Putnam, TN	2	2	1	1	6	1
Rhea, TN	3	2	1	1	7	2
Roane, TN	3	3	2	2	10	3
Robertson, TN	3	2	2	2	9	2
Rutherford, TN	3	2	2	2	9	2
Scott, TN	3	2	2	1	8	2
Sequatchie, TN	3	2	2	1	8	2
Sevier, TN	3	3	1	1	8	2
Shelby, TN	3	3	2	2	10	3
Smith, TN	3	2	2	2	9	2
Stewart, TN	3	1	2	1	7	2
Sullivan, TN	2	2	2	2	8	2
Sumner, TN	3	2	2	2	9	2
Tipton, TN	3	2	2	2	9	2
Trousdale, TN	3	1	3	1	8	2
Unicoi, TN	3	3	2	2	10	3
Union, TN	3	3	3	2	11	3

County	Clean Drinking Water	Power Plants	Temporary Housing	Fuel Supply	Sum	Limited Acccess to Resources
Van Buren, TN	3	1	1	2	7	2
Warren, TN	3	2	2	1	8	2
Washington, TN	3	3	2	2	10	3
Wayne, TN	3	2	2	1	8	2
Weakley, TN	3	3	2	1	9	2
White, TN	3	2	2	1	8	2
Williamson, TN	3	2	2	2	9	2
Wilson, TN	3	2	2	2	9	2

Appendix XIII: Number of Public Use Airport Facilities in Counties

Table A 28: County's Public Airports

County	State	Number of Public Airports
Arkansas	AR	2
Ashley	AR	1
Baxter	AR	2
Benton	AR	5
Boone	AR	1
Bradley	AR	1
Calhoun	AR	1
Carroll	AR	1
Chicot	AR	2
Clark	AR	2
Clay	AR	3
Cleburne	AR	1
Cleveland	AR	0
Columbia	AR	1
Conway	AR	2
Craighead	AR	1
Crawford	AR	0
Crittenden	AR	1
Cross	AR	1
Dallas	AR	1
Desha	AR	2
Drew	AR	1
Faulkner	AR	2
Franklin	AR	1
Fulton	AR	1
Garland	AR	1
Grant	AR	1
Greene	AR	1
Hempstead	AR	1
Hot Spring	AR	1
Howard	AR	1
Independence	AR	1
Izard	AR	3
Jackson	AR	1
Jefferson	AR	2
Johnson	AR	1
Lafayette	AR	0
Lawrence	AR	1
Lee	AR	1
Lincoln	AR	1
Little River	AR	0
Logan	AR	2
Lonoke	AR	1
Madison	AR	1
Marion	AR	1
Miller	AR	1
Mississippi	AR	4
Monroe	AR	3
Montgomery	AR	1
Nevada	AR	1
Newton	AR	0
Ouachita	AR	2
Perry	AR	0
Phillips	AR	1
Pike	AR	0
Poinsett	AR	2
Polk	AR	1
Pope	AR	1
Prairie	AR	2
Pulaski	AR	2
Randolph	AR	1
St. Francis	AR	1
Saline	AR	1
Scott	AR	1
Searcy	AR	1
Sebastian	AR	1
Sevier	AR	1
Sharp	AR	1
Stone	AR	1
Union	AR	2
Van Buren	AR	2
Washington	AR	2
White	AR	2
Woodruff	AR	2
Yell	AR	1
Acadia	LA	2
Allen	LA	1
Ascension	LA	1
Assumption	LA	0
Avoyelles	LA	2
Beauregard	LA	1
Bienville	LA	1
Bossier	LA	1
Caddo	LA	5
Calcasieu	LA	4
Caldwell	LA	1
Cameron	LA	0
Catahoula	LA	1
Claiborne	LA	1
Concordia	LA	1
De Soto	LA	1
East Baton Rouge	LA	1
East Carroll	LA	1
East Feliciana	LA	0
Evangeline	LA	0
Franklin	LA	1
Grant	LA	1
Iberia	LA	2
Iberville	LA	0
Jackson	LA	1
Jefferson	LA	1
Jefferson Davis	LA	2
Lafayette	LA	1
Lafourche	LA	1
La Salle	LA	2
Lincoln	LA	1
Livingston	LA	0
Madison	LA	2
Morehouse	LA	1
Natchitoches	LA	1
Orleans	LA	2
Ouachita	LA	1
Plaquemines	LA	0
Pointe Coupee	LA	1
Rapides	LA	4
Red River	LA	1
Richland	LA	2
Sabine	LA	1
St. Bernard	LA	0
St. Charles	LA	0
St. Helena	LA	0
St. James	LA	0
St. John the Baptist	LA	1
St. Landry	LA	3
St. Martin	LA	0
St. Mary	LA	1
St. Tammany	LA	2
Tangipahoa	LA	1
Tensas	LA	1
Terrebonne	LA	2
Union	LA	1
Vermilion	LA	1
Vernon	LA	1
Washington	LA	2
Webster	LA	2

County	State	Number of Public Airports	County	State	Number of Public Airports	County	State	Number of Public Airports
West Baton Rouge	LA	0	Leflore	MS	0	Blount	TN	1
West Carroll	LA	1	Lincoln	MS	1	Bradley	TN	1
West Feliciana	LA	0	Lowndes	MS	2	Campbell	TN	1
Winn	LA	2	Madison	MS	1	Cannon	TN	0
Adams	MS	0	Marion	MS	1	Carroll	TN	1
Alcorn	MS	0	Marshall	MS	1	Carter	TN	1
Amite	MS	0	Monroe	MS	1	Cheatham	TN	0
Attala	MS	0	Montgomery	MS	1	Chester	TN	0
Benton	MS	0	Neshoba	MS	1	Claiborne	TN	1
Bolivar	MS	0	Newton	MS	1	Clay	TN	0
Calhoun	MS	0	Noxubee	MS	1	Cocke	TN	0
Carroll	MS	1	Oktibbeha	MS	2	Coffee	TN	1
Chickasaw	MS	2	Panola	MS	1	Crockett	TN	0
Choctaw	MS	1	Pearl River	MS	2	Cumberland	TN	1
Claiborne	MS	0	Perry	MS	1	Davidson	TN	3
Clarke	MS	1	Pike	MS	1	Decatur	TN	0
Clay	MS	1	Pontotoc	MS	1	DeKalb	TN	1
Coahoma	MS	1	Prentiss	MS	1	Dickson	TN	1
Copiah	MS	1	Quitman	MS	1	Dyer	TN	1
Covington	MS	0	Rankin	MS	1	Fayette	TN	2
DeSoto	MS	2	Scott	MS	1	Fentress	TN	1
Forrest	MS	1	Sharkey	MS	0	Franklin	TN	2
Franklin	MS	0	Simpson	MS	1	Gibson	TN	2
George	MS	0	Smith	MS	0	Giles	TN	1
Greene	MS	0	Stone	MS	1	Grainger	TN	0
Grenada	MS	1	Sunflower	MS	2	Greene	TN	1
Hancock	MS	2	Tallahatchie	MS	1	Grundy	TN	0
Harrison	MS	2	Tate	MS	0	Hamblen	TN	1
Hinds	MS	2	Tippah	MS	1	Hamilton	TN	3
Holmes	MS	1	Tishomingo	MS	2	Hancock	TN	0
Humphreys	MS	1	Tunica	MS	2	Hardeman	TN	1
Issaquena	MS	0	Union	MS	1	Hardin	TN	1
Itawamba	MS	0	Walthall	MS	1	Hawkins	TN	1
Jackson	MS	2	Warren	MS	1	Haywood	TN	1
Jasper	MS	1	Washington	MS	2	Henderson	TN	1
Jefferson	MS	0	Wayne	MS	1	Henry	TN	1
Jefferson Davis	MS	1	Webster	MS	1	Hickman	TN	1
Jones	MS	2	Wilkinson	MS	0	Houston	TN	1
Kemper	MS	0	Winston	MS	1	Humphreys	TN	1
Lafayette	MS	1	Yalobusha	MS	1	Jackson	TN	1
Lamar	MS	1	Yazoo	MS	1	Jefferson	TN	0
Lauderdale	MS	1	Anderson	TN	0	Johnson	TN	1
Lawrence	MS	0	Bedford	TN	2	Knox	TN	1
Leake	MS	1	Benton	TN	1	Lake	TN	1
Lee	MS	1	Bledsoe	TN	0	Lauderdale	TN	1

County	State	Number of Public Airports
Lawrence	TN	1
Lewis	TN	1
Lincoln	TN	1
Loudon	TN	0
McMinn	TN	1
McNairy	TN	1
Macon	TN	1
Madison	TN	1
Marion	TN	1
Marshall	TN	1
Maury	TN	1
Meigs	TN	0
Monroe	TN	1
Montgomery	TN	1
Moore	TN	0
Morgan	TN	1
Obion	TN	1
Overton	TN	1
Perry	TN	1
Pickett	TN	0
Polk	TN	2
Putnam	TN	0
Rhea	TN	1
Roane	TN	0
Robertson	TN	1
Rutherford	TN	2
Scott	TN	1
Sequatchie	TN	0
Sevier	TN	1
Shelby	TN	4
Smith	TN	0
Stewart	TN	0
Sullivan	TN	1
Sumner	TN	2
Tipton	TN	1
Trousdale	TN	0
Unicoi	TN	0
Union	TN	0
Van Buren	TN	0
Warren	TN	1
Washington	TN	1
Wayne	TN	1
Weakley	TN	0
White	TN	1
Williamson	TN	0

County	State	Number of Public Airports
Wilson	TN	1

Appendix XIV: Limited Access to Transportation Modes

Table A 29: Limited Access to Transportation Modes

County	Railroad	Airport	Total	Score
Arkansas, AR	1	1	2	1
Ashley, AR	1	1	2	1
Baxter, AR	1	1	2	1
Benton, AR	1	1	2	1
Boone, AR	1	1	2	1
Bradley, AR	1	1	2	1
Calhoun, AR	1	1	2	1
Carroll, AR	0	1	1	2
Chicot, AR	1	1	2	1
Clark, AR	1	1	2	1
Clay, AR	1	1	2	1
Cleburne, AR	0	1	1	2
Cleveland, AR	1	0	1	2
Columbia, AR	1	1	2	1
Conway, AR	1	1	2	1
Craighead, AR	1	1	2	1
Crawford, AR	1	0	1	2
Crittenden, AR	1	1	2	1
Cross, AR	1	1	2	1
Dallas, AR	1	1	2	1
Desha, AR	1	1	2	1
Drew, AR	1	1	2	1
Faulkner, AR	1	1	2	1
Franklin, AR	1	1	2	1
Fulton, AR	1	1	2	1
Garland, AR	1	1	2	1
Grant, AR	1	1	2	1
Greene, AR	1	1	2	1
Hempstead, AR	1	1	2	1
Hot Spring, AR	1	1	2	1
Howard, AR	1	1	2	1
Independence, AR	1	1	2	1
Izard, AR	0	1	1	2
Jackson, AR	1	1	2	1
Jefferson, AR	1	1	2	1
Johnson, AR	1	1	2	1
Lafayette, AR	1	0	1	2
Lawrence, AR	1	1	2	1
Lee, AR	1	1	2	1
Lincoln, AR	1	1	2	1
Little River, AR	1	0	1	2
Logan, AR	1	1	2	1
Lonoke, AR	1	1	2	1
Madison, AR	0	1	1	2
Marion, AR	1	1	2	1

County	Railroad	Airport	Total	Score
Miller, AR	1	1	2	1
Mississippi, AR	1	1	2	1
Monroe, AR	1	1	2	1
Montgomery, AR	1	1	2	1
Nevada, AR	1	1	2	1
Newton, AR	0	0	0	3
Ouachita, AR	1	1	2	1
Perry, AR	1	0	1	2
Phillips, AR	1	1	2	1
Pike, AR	1	0	1	2
Poinsett, AR	1	1	2	1
Polk, AR	1	1	2	1
Pope, AR	1	1	2	1
Prairie, AR	1	1	2	1
Pulaski, AR	1	1	2	1
Randolph, AR	1	1	2	1
St. Francis, AR	1	1	2	1
Saline, AR	1	1	2	1
Scott, AR	1	1	2	1
Searcy, AR	0	1	1	2
Sebastian, AR	1	1	2	1
Sevier, AR	1	1	2	1
Sharp, AR	1	1	2	1
Stone, AR	0	1	1	2
Union, AR	1	1	2	1
Van Buren, AR	0	1	1	2
Washington, AR	1	1	2	1
White, AR	1	1	2	1
Woodruff, AR	1	1	2	1
Yell, AR	1	1	2	1
Acadia, LA	1	1	2	1
Allen, LA	1	1	2	1
Ascension, LA	1	1	2	1
Assumption, LA	1	0	1	2
Avoyelles, LA	1	1	2	1
Beauregard, LA	1	1	2	1
Bienville, LA	1	1	2	1
Bossier, LA	1	1	2	1
Caddo, LA	1	1	2	1
Calcasieu, LA	1	1	2	1
Caldwell, LA	1	1	2	1
Cameron, LA	0	0	0	3
Catahoula, LA	1	1	2	1
Claiborne, LA	1	1	2	1
Concordia, LA	1	1	2	1

County	Railroad	Airport	Total	Score
De Soto, LA	1	1	2	1
East Baton Rouge, LA	1	1	2	1
East Carroll, LA	1	1	2	1
East Feliciana, LA	1	0	1	2
Evangeline, LA	1	0	1	2
Franklin, LA	1	1	2	1
Grant, LA	1	1	2	1
Iberia, LA	1	1	2	1
Iberville, LA	1	0	1	2
Jackson, LA	1	1	2	1
Jefferson, LA	1	1	2	1
Jefferson Davis, LA	1	1	2	1
Lafayette, LA	1	1	2	1
Lafourche, LA	1	1	2	1
La Salle, LA	1	1	2	1
Lincoln, LA	1	1	2	1
Livingston, LA	1	0	1	2
Madison, LA	1	1	2	1
Morehouse, LA	1	1	2	1
Natchitoches, LA	1	1	2	1
Orleans, LA	1	1	2	1
Ouachita, LA	1	1	2	1
Plaquemines, LA	1	0	1	2
Pointe Coupee, LA	1	1	2	1
Rapides, LA	1	1	2	1
Red River, LA	1	1	2	1
Richland, LA	1	1	2	1
Sabine, LA	1	1	2	1
St. Bernard, LA	1	0	1	2
St. Charles, LA	1	0	1	2
St. Helena, LA	0	0	0	3
St. James, LA	1	0	1	2
St. John the Baptist, LA	1	1	2	1
St. Landry, LA	1	1	2	1
St. Martin, LA	0	0	0	3
St. Mary, LA	1	1	2	1
St. Tammany, LA	1	1	2	1
Tangipahoa, LA	1	1	2	1
Tensas, LA	1	1	2	1
Terrebonne, LA	1	1	2	1
Union, LA	1	1	2	1
Vermilion, LA	0	1	1	2
Vernon, LA	1	1	2	1
Washington, LA	1	1	2	1
Webster, LA	1	1	2	1

County	Railroad	Airport	Total	Score
West Baton Rouge, LA	1	0	1	2
West Carroll, LA	1	1	2	1
West Feliciana, LA	1	0	1	2
Winn, LA	1	1	2	1
Adams, MS	1	0	1	2
Alcorn, MS	1	0	1	2
Amite, MS	1	0	1	2
Attala, MS	1	0	1	2
Benton, MS	1	0	1	2
Bolivar, MS	1	0	1	2
Calhoun, MS	1	0	1	2
Carroll, MS	1	1	2	1
Chickasaw, MS	1	1	2	1
Choctaw, MS	1	1	2	1
Claiborne, MS	1	0	1	2
Clarke, MS	1	1	2	1
Clay, MS	1	1	2	1
Coahoma, MS	1	1	2	1
Copiah, MS	1	1	2	1
Covington, MS	1	0	1	2
DeSoto, MS	1	1	2	1
Forrest, MS	1	1	2	1
Franklin, MS	1	0	1	2
George, MS	1	0	1	2
Greene, MS	1	0	1	2
Grenada, MS	1	1	2	1
Hancock, MS	1	1	2	1
Harrison, MS	1	1	2	1
Hinds, MS	1	1	2	1
Holmes, MS	1	1	2	1
Humphreys, MS	1	1	2	1
Issaquena, MS	1	0	1	2
Itawamba, MS	1	0	1	2
Jackson, MS	1	1	2	1
Jasper, MS	1	1	2	1
Jefferson, MS	1	0	1	2
Jefferson Davis, MS	1	1	2	1
Jones, MS	1	1	2	1
Kemper, MS	1	0	1	2
Lafayette, MS	1	1	2	1
Lamar, MS	1	1	2	1
Lauderdale, MS	1	1	2	1
Lawrence, MS	1	0	1	2
Leake, MS	1	1	2	1
Lee, MS	1	1	2	1

County	Railroad	Airport	Total	Score
Leflore, MS	1	0	1	2
Lincoln, MS	1	1	2	1
Lowndes, MS	1	1	2	1
Madison, MS	1	1	2	1
Marion, MS	1	1	2	1
Marshall, MS	1	1	2	1
Monroe, MS	1	1	2	1
Montgomery, MS	1	1	2	1
Neshoba, MS	1	1	2	1
Newton, MS	1	1	2	1
Noxubee, MS	1	1	2	1
Oktibbeha, MS	1	1	2	1
Panola, MS	1	1	2	1
Pearl River, MS	1	1	2	1
Perry, MS	1	1	2	1
Pike, MS	1	1	2	1
Pontotoc, MS	1	1	2	1
Prentiss, MS	1	1	2	1
Quitman, MS	1	1	2	1
Rankin, MS	1	1	2	1
Scott, MS	1	1	2	1
Sharkey, MS	1	0	1	2
Simpson, MS	1	1	2	1
Smith, MS	1	0	1	2
Stone, MS	1	1	2	1
Sunflower, MS	1	1	2	1
Tallahatchie, MS	1	1	2	1
Tate, MS	1	0	1	2
Tippah, MS	1	1	2	1
Tishomingo, MS	1	1	2	1
Tunica, MS	1	1	2	1
Union, MS	1	1	2	1
Walthall, MS	1	1	2	1
Warren, MS	1	1	2	1
Washington, MS	1	1	2	1
Wayne, MS	1	1	2	1
Webster, MS	1	1	2	1
Wilkinson, MS	1	0	1	2
Winston, MS	1	1	2	1
Yalobusha, MS	1	1	2	1
Yazoo, MS	1	1	2	1
Anderson, TN	1	0	1	2
Bedford, TN	1	1	2	1
Benton, TN	1	1	2	1
Bledsoe, TN	1	0	1	2

County	Railroad	Airport	Total	Score
Blount, TN	1	1	2	1
Bradley, TN	1	1	2	1
Campbell, TN	1	1	2	1
Cannon, TN	1	0	1	2
Carroll, TN	1	1	2	1
Carter, TN	1	1	2	1
Cheatham, TN	1	0	1	2
Chester, TN	1	0	1	2
Claiborne, TN	1	1	2	1
Clay, TN	0	0	0	3
Cocke, TN	1	0	1	2
Coffee, TN	1	1	2	1
Crockett, TN	1	0	1	2
Cumberland, TN	1	1	2	1
Davidson, TN	1	1	2	1
Decatur, TN	0	0	0	3
DeKalb, TN	1	1	2	1
Dickson, TN	1	1	2	1
Dyer, TN	1	1	2	1
Fayette, TN	1	1	2	1
Fentress, TN	0	1	1	2
Franklin, TN	1	1	2	1
Gibson, TN	1	1	2	1
Giles, TN	1	1	2	1
Grainger, TN	1	0	1	2
Greene, TN	1	1	2	1
Grundy, TN	1	0	1	2
Hamblen, TN	1	1	2	1
Hamilton, TN	1	1	2	1
Hancock, TN	0	0	0	3
Hardeman, TN	1	1	2	1
Hardin, TN	1	1	2	1
Hawkins, TN	1	1	2	1
Haywood, TN	1	1	2	1
Henderson, TN	1	1	2	1
Henry, TN	1	1	2	1
Hickman, TN	1	1	2	1
Houston, TN	1	1	2	1
Humphreys, TN	1	1	2	1
Jackson, TN	0	1	1	2
Jefferson, TN	1	0	1	2
Johnson, TN	0	1	1	2
Knox, TN	1	1	2	1
Lake, TN	1	1	2	1
Lauderdale, TN	1	1	2	1

County	Railroad	Airport	Total	Score
Lawrence, TN	1	1	2	1
Lewis, TN	1	1	2	1
Lincoln, TN	1	1	2	1
Loudon, TN	1	0	1	2
McMinn, TN	1	1	2	1
McNairy, TN	1	1	2	1
Macon, TN	0	1	1	2
Madison, TN	1	1	2	1
Marion, TN	1	1	2	1
Marshall, TN	1	1	2	1
Maury, TN	1	1	2	1
Meigs, TN	0	0	0	3
Monroe, TN	1	1	2	1
Montgomery, TN	1	1	2	1
Moore, TN	1	0	1	2
Morgan, TN	1	1	2	1
Obion, TN	1	1	2	1
Overton, TN	0	1	1	2
Perry, TN	0	1	1	2
Pickett, TN	0	0	0	3
Polk, TN	1	1	2	1
Putnam, TN	1	0	1	2
Rhea, TN	1	1	2	1
Roane, TN	1	0	1	2
Robertson, TN	1	1	2	1
Rutherford, TN	1	1	2	1
Scott, TN	1	1	2	1
Sequatchie, TN	1	0	1	2
Sevier, TN	0	1	1	2
Shelby, TN	1	1	2	1
Smith, TN	1	0	1	2
Stewart, TN	1	0	1	2
Sullivan, TN	1	1	2	1
Sumner, TN	1	1	2	1
Tipton, TN	1	1	2	1
Trousdale, TN	1	0	1	2
Unicoi, TN	1	0	1	2
Union, TN	1	0	1	2
Van Buren, TN	1	0	1	2
Warren, TN	1	1	2	1
Washington, TN	1	1	2	1
Wayne, TN	0	1	1	2
Weakley, TN	1	0	1	2
White, TN	1	1	2	1
Williamson, TN	1	0	1	2
Wilson, TN	1	1	2	1

Appendix XV: Final WES Index Values

Table A 30: Final WES Index Values

NO	County	WES Factor Scores							WES Index Value	Scaled WES Index Value
		Accessibility to Navigable Inland Waterway	Population Demands	Social Vulnerability	Risk of Disaster	Limited Access to Medical Services	Limited Access to Resources	Limited Access to Transportation Modes		
1	Arkansas, AR	1	2	3	2	1	1	1	10	2
2	Ashley, AR	1	1	2	1	2	2	1	9	1
3	Baxter, AR	0	1	3	2	1	2	1	0	0
4	Benton, AR	0	3	1	1	2	2	1	0	0
5	Boone, AR	0	1	2	1	1	2	1	0	0
6	Bradley, AR	1	2	2	1	1	1	1	8	1
7	Calhoun, AR	1	1	1	1	3	2	1	9	1
8	Carroll, AR	0	2	1	1	2	2	2	0	0
9	Chicot, AR	1	1	3	1	2	1	1	9	1
10	Clark, AR	0	1	1	1	2	1	1	0	0
11	Clay, AR	1	1	3	2	2	2	1	11	2
12	Cleburne, AR	0	2	2	2	2	1	2	0	0
13	Cleveland, AR	1	3	2	2	3	2	2	14	3
14	Columbia, AR	0	1	2	2	2	1	1	0	0
15	Conway, AR	0	2	1	3	3	1	1	0	0
16	Craighead, AR	1	3	2	2	1	2	1	11	2
17	Crawford, AR	0	3	2	1	2	2	2	0	0
18	Crittenden, AR	1	3	3	2	2	2	1	13	2
19	Cross, AR	1	2	3	2	2	2	1	12	2
20	Dallas, AR	1	2	2	2	1	1	1	9	1
21	Desha, AR	1	2	3	1	1	1	1	9	1
22	Drew, AR	1	1	1	1	1	1	1	6	1
23	Faulkner, AR	0	3	1	2	2	2	1	0	0
24	Franklin, AR	0	3	2	2	2	1	1	0	0
25	Fulton, AR	0	1	3	1	1	1	1	0	0
26	Garland, AR	0	3	3	1	1	2	1	0	0
27	Grant, AR	1	3	1	2	3	1	1	11	2
28	Greene, AR	1	2	1	2	1	2	1	9	1
29	Hempstead, AR	0	2	2	2	1	1	1	0	0
30	Hot Spring, AR	0	2	1	2	2	2	1	0	0
31	Howard, AR	0	1	1	1	3	1	1	0	0
32	Independence, AR	0	1	1	2	1	2	1	0	0
33	Izard, AR	0	1	3	1	2	2	2	0	0
34	Jackson, AR	1	2	3	2	1	2	1	11	2
35	Jefferson, AR	1	3	3	2	1	1	1	11	2
36	Johnson, AR	0	2	1	2	1	2	1	0	0
37	Lafayette, AR	0	1	2	2	3	2	2	0	0
38	Lawrence, AR	1	2	3	1	1	2	1	10	2
39	Lee, AR	1	2	3	1	3	1	1	11	2
40	Lincoln, AR	1	3	1	2	3	2	1	12	2
41	Little River, AR	0	2	3	2	2	3	2	0	0
42	Logan, AR	0	2	2	2	2	2	1	0	0
43	Lonoke, AR	0	3	2	2	3	2	1	0	0
44	Madison, AR	0	3	3	1	3	2	2	0	0
45	Marion, AR	0	1	2	1	3	2	1	0	0
46	Miller, AR	0	3	2	2	3	2	1	0	0
47	Mississippi, AR	1	2	3	2	2	1	1	11	2
48	Monroe, AR	1	1	3	2	3	2	1	12	2
49	Montgomery, AR	0	1	1	1	3	2	1	0	0
50	Nevada, AR	0	1	2	2	3	2	1	0	0
51	Newton, AR	0	1	2	2	3	1	3	0	0
52	Ouachita, AR	0	1	3	1	1	2	1	0	0
53	Perry, AR	0	3	1	2	3	1	2	0	0
54	Phillips, AR	1	1	3	1	1	2	1	9	1
55	Pike, AR	0	1	2	1	1	2	2	0	0

NO	County	WES Factor Scores							WES Index Value	Scaled WES Index Value
		Accessibility to Navigable Inland Waterway	Population Demands	Social Vulnerability	Risk of Disaster	Limited Access to Medical Services	Limited Access to Resources	Limited Access to Transportation Modes		
56	Poinsett, AR	1	3	2	3	3	2	1	14	3
57	Polk, AR	0	1	3	1	1	1	1	0	0
58	Pope, AR	0	2	2	2	2	2	1	0	0
59	Prairie, AR	1	1	2	2	3	1	1	10	2
60	Pulaski, AR	0	3	3	3	1	1	1	0	0
61	Randolph, AR	0	1	3	1	2	2	1	0	0
62	St. Francis, AR	1	2	1	2	2	1	1	9	1
63	Saline, AR	0	3	1	2	2	2	1	0	0
64	Scott, AR	0	2	2	1	2	2	1	0	0
65	Searcy, AR	0	1	2	2	3	1	2	0	0
66	Sebastian, AR	0	3	2	1	1	2	1	0	0
67	Sevier, AR	0	1	3	1	2	2	1	0	0
68	Sharp, AR	0	1	3	1	3	2	1	0	0
69	Stone, AR	0	1	3	2	2	1	2	0	0
70	Union, AR	1	2	2	1	1	2	1	9	1
71	Van Buren, AR	0	1	3	3	1	1	2	0	0
72	Washington, AR	0	3	2	1	1	2	1	0	0
73	White, AR	0	2	1	2	1	2	1	0	0
74	Woodruff, AR	1	1	3	2	3	2	1	12	2
75	Yell, AR	0	2	1	1	1	2	1	0	0
76	Acadia, LA	1	2	3	2	1	2	1	11	2
77	Allen, LA	0	2	1	1	2	1	1	0	0
78	Ascension, LA	1	3	1	2	2	2	1	11	2
79	Assumption, LA	1	2	2	2	2	2	2	12	2
80	Avoyelles, LA	1	2	3	2	2	1	1	11	2
81	Beauregard, LA	0	2	2	1	2	2	1	0	0
82	Bienville, LA	0	2	3	1	3	1	1	0	0
83	Bossier, LA	0	3	2	2	3	2	1	0	0
84	Caddo, LA	0	3	3	2	1	2	1	0	0
85	Calcasieu, LA	0	3	2	2	1	2	1	0	0
86	Caldwell, LA	1	1	2	1	2	1	1	8	1
87	Cameron, LA	0	3	1	2	1	2	3	0	0
88	Catahoula, LA	1	1	3	1	3	1	1	10	2
89	Claiborne, LA	0	1	3	1	1	1	1	0	0
90	Concordia, LA	1	1	3	1	1	1	1	8	1
91	De Soto, LA	0	3	3	2	2	1	1	0	0
92	East Baton Rouge, LA	1	3	3	2	1	2	1	12	2
93	East Carroll, LA	1	1	3	1	2	2	1	10	2
94	East Feliciana, LA	1	3	3	2	3	2	2	15	3
95	Evangeline, LA	1	2	3	1	1	2	2	11	2
96	Franklin, LA	1	1	3	2	2	1	1	10	2
97	Grant, LA	1	3	2	1	3	2	1	12	2
98	Iberia, LA	1	2	3	1	2	3	1	12	2
99	Iberville, LA	1	3	2	2	2	2	2	13	2
100	Jackson, LA	1	2	3	1	2	1	1	10	2
101	Jefferson, LA	1	3	3	2	1	2	1	12	2
102	Jefferson Davis, LA	1	2	2	2	2	2	1	11	2
103	Lafayette, LA	1	3	1	2	1	2	1	10	2
104	Lafourche, LA	1	3	2	2	2	2	1	12	2
105	La Salle, LA	1	2	2	1	1	2	1	9	1
106	Lincoln, LA	1	2	2	1	1	1	1	8	1
107	Livingston, LA	1	3	1	2	3	2	2	13	2
108	Madison, LA	1	1	3	2	2	1	1	10	2
109	Morehouse, LA	1	2	3	1	2	2	1	11	2
110	Natchitoches, LA	0	2	3	2	1	1	1	0	0

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		Accessibility to Navigable Inland Waterway	Population Demands	Social Vulnerability	Risk of Disaster	Limited Access to Medical Services	Limited Access to Resources	Limited Access to Transportation Modes		
111	Orleans, LA	1	3	3	2	1	2	1	12	2
112	Ouachita, LA	1	3	3	2	1	2	1	12	2
113	Plaquemines, LA	1	3	3	2	3	2	2	15	3
114	Pointe Coupee, LA	1	3	3	2	2	1	1	12	2
115	Rapides, LA	1	3	3	2	1	1	1	11	2
116	Red River, LA	0	2	3	1	2	2	1	0	0
117	Richland, LA	1	2	3	1	1	1	1	9	1
118	Sabine, LA	0	2	1	2	2	2	1	0	0
119	St. Bernard, LA	1	3	3	2	1	2	2	13	2
120	St. Charles, LA	1	3	2	2	2	2	2	13	2
121	St. Helena, LA	1	3	3	2	2	1	3	14	3
122	St. James, LA	1	2	3	2	2	3	2	14	3
123	St. John the Baptist, LA	1	3	3	2	2	2	1	13	2
124	St. Landry, LA	1	2	3	2	1	1	1	10	2
125	St. Martin, LA	1	3	3	2	2	2	3	15	3
126	St. Mary, LA	1	2	3	1	2	3	1	12	2
127	St. Tammany, LA	1	3	1	2	1	2	1	10	2
128	Tangipahoa, LA	1	2	3	2	2	2	1	12	2
129	Tensas, LA	1	1	2	2	3	1	1	10	2
130	Terrebonne, LA	1	3	2	2	1	2	1	11	2
131	Union, LA	1	3	1	1	2	1	1	9	1
132	Vermilion, LA	1	2	2	2	2	2	2	12	2
133	Vernon, LA	0	2	3	2	2	1	1	0	0
134	Washington, LA	1	2	3	2	2	2	1	12	2
135	Webster, LA	0	2	3	2	1	1	1	0	0
136	West Baton Rouge, LA	1	3	2	2	3	1	2	13	2
137	West Carroll, LA	1	1	3	1	2	1	1	9	1
138	West Feliciana, LA	1	3	1	2	2	2	2	12	2
139	Winn, LA	1	2	2	1	1	2	1	9	1
140	Adams, MS	1	2	3	1	1	1	2	10	2
141	Alcorn, MS	1	1	2	1	1	2	2	9	1
142	Amite, MS	1	1	3	2	3	1	2	12	2
143	Attala, MS	1	2	2	2	1	1	2	10	2
144	Benton, MS	1	1	2	1	3	3	2	12	2
145	Bolivar, MS	1	2	3	1	1	1	2	10	2
146	Calhoun, MS	0	1	2	1	1	1	2	0	0
147	Carroll, MS	1	1	1	1	3	2	1	9	1
148	Chickasaw, MS	0	1	2	1	1	1	1	0	0
149	Choctaw, MS	0	1	1	1	1	2	1	0	0
150	Claiborne, MS	1	2	3	2	2	1	2	12	2
151	Clarke, MS	0	1	2	2	2	1	1	0	0
152	Clay, MS	0	1	3	1	2	1	1	0	0
153	Coahoma, MS	1	2	3	1	1	1	1	9	1
154	Copiah, MS	1	3	3	3	2	1	1	13	2
155	Covington, MS	1	1	3	1	2	2	2	11	2
156	DeSoto, MS	1	3	3	2	2	3	1	14	3
157	Forrest, MS	0	3	2	1	1	1	1	0	0
158	Franklin, MS	1	1	3	1	1	2	2	10	2
159	George, MS	0	3	1	2	2	1	2	0	0
160	Greene, MS	0	1	1	2	3	2	2	0	0
161	Grenada, MS	1	1	3	1	1	1	1	8	1
162	Hancock, MS	1	3	1	2	2	2	1	11	2
163	Harrison, MS	1	3	2	3	1	1	1	11	2
164	Hinds, MS	1	3	3	2	1	1	1	11	2
165	Holmes, MS	1	2	3	1	2	1	1	10	2

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		Accessibility to Navigable Inland Waterway	Population Demands	Social Vulnerability	Risk of Disaster	Limited Access to Medical Services	Limited Access to Resources	Limited Access to Transportation Modes		
166	Humphreys, MS	1	1	3	1	2	2	1	10	2
167	Issaquena, MS	1	1	3	1	3	3	2	13	2
168	Itawamba, MS	0	1	1	1	3	2	2	0	0
169	Jackson, MS	0	3	2	2	1	2	1	0	0
170	Jasper, MS	0	1	2	2	1	1	1	0	0
171	Jefferson, MS	1	1	3	2	1	1	2	10	2
172	Jefferson Davis, MS	1	1	3	1	1	2	1	9	1
173	Jones, MS	0	2	2	2	1	1	1	0	0
174	Kemper, MS	0	1	3	2	3	1	2	0	0
175	Lafayette, MS	1	2	1	2	1	1	1	8	1
176	Lamar, MS	0	3	1	1	1	1	1	0	0
177	Lauderdale, MS	0	2	2	2	1	1	1	0	0
178	Lawrence, MS	1	1	2	2	2	1	2	10	2
179	Leake, MS	1	2	2	2	1	1	1	9	1
180	Lee, MS	0	2	1	2	1	1	1	0	0
181	Leflore, MS	1	2	3	1	1	2	2	11	2
182	Lincoln, MS	1	2	2	2	1	1	1	9	1
183	Lowndes, MS	0	2	3	2	1	1	1	0	0
184	Madison, MS	1	3	2	2	2	2	1	12	2
185	Marion, MS	0	2	2	2	1	1	1	0	0
186	Marshall, MS	1	3	3	2	2	2	1	13	2
187	Monroe, MS	0	1	3	2	1	2	1	0	0
188	Montgomery, MS	1	1	3	1	1	1	1	8	1
189	Neshoba, MS	0	1	2	2	1	2	1	0	0
190	Newton, MS	0	1	2	2	2	1	1	0	0
191	Noxubee, MS	0	1	3	2	1	1	1	0	0
192	Oktibbeha, MS	0	2	1	2	2	2	1	0	0
193	Panola, MS	1	2	3	1	2	1	1	10	2
194	Pearl River, MS	1	2	2	2	1	2	1	10	2
195	Perry, MS	0	3	2	1	3	1	1	0	0
196	Pike, MS	1	1	3	1	1	1	1	8	1
197	Pontotoc, MS	1	1	1	1	2	2	1	8	1
198	Prentiss, MS	0	1	2	1	2	1	1	0	0
199	Quitman, MS	1	2	3	1	1	2	1	10	2
200	Rankin, MS	1	3	1	2	2	2	1	11	2
201	Scott, MS	1	2	2	2	2	1	1	10	2
202	Sharkey, MS	1	1	3	1	3	2	2	12	2
203	Simpson, MS	1	3	2	2	1	1	1	10	2
204	Smith, MS	1	1	1	2	3	1	2	10	2
205	Stone, MS	1	3	2	2	2	2	1	12	2
206	Sunflower, MS	1	2	3	1	1	2	1	10	2
207	Tallahatchie, MS	1	1	3	1	1	2	1	9	1
208	Tate, MS	1	3	2	1	2	1	2	11	2
209	Tippah, MS	1	1	1	1	1	1	1	6	1
210	Tishomingo, MS	0	1	1	1	2	2	1	0	0
211	Tunica, MS	1	3	2	1	3	1	1	11	2
212	Union, MS	1	1	1	1	1	2	1	7	1
213	Walthall, MS	1	1	3	1	1	2	1	9	1
214	Warren, MS	1	2	3	2	1	1	1	10	2
215	Washington, MS	1	2	3	1	1	1	1	9	1
216	Wayne, MS	0	1	2	2	1	1	1	0	0
217	Webster, MS	0	1	2	1	1	1	1	0	0
218	Wilkinson, MS	1	1	3	2	2	2	2	12	2
219	Winston, MS	0	1	3	1	1	1	1	0	0
220	Yalobusha, MS	1	1	2	1	1	2	1	8	1

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221	Yazoo, MS	1	2	3	2	2	2	1	12	2
222	Anderson, TN	0	3	3	2	2	2	2	0	0
223	Bedford, TN	0	2	2	2	1	2	1	0	0
224	Benton, TN	0	1	3	2	2	2	1	0	0
225	Bledsoe, TN	0	1	1	2	2	2	2	0	0
226	Blount, TN	0	3	1	1	2	2	1	0	0
227	Bradley, TN	0	3	1	2	2	2	1	0	0
228	Campbell, TN	0	2	2	1	1	2	1	0	0
229	Cannon, TN	0	3	1	2	1	3	2	0	0
230	Carroll, TN	0	2	3	1	2	2	1	0	0
231	Carter, TN	0	3	1	1	2	2	1	0	0
232	Cheatham, TN	0	3	1	1	2	3	2	0	0
233	Chester, TN	1	3	1	1	3	2	2	12	2
234	Claiborne, TN	0	2	1	1	2	2	1	0	0
235	Clay, TN	0	1	3	1	1	2	3	0	0
236	Cocke, TN	0	2	3	1	1	2	2	0	0
237	Coffee, TN	0	2	2	1	1	2	1	0	0
238	Crockett, TN	1	1	2	1	3	2	2	11	2
239	Cumberland, TN	0	1	2	2	1	2	1	0	0
240	Davidson, TN	0	3	3	1	1	2	1	0	0
241	Decatur, TN	0	1	1	2	1	2	3	0	0
242	DeKalb, TN	0	2	1	1	2	3	1	0	0
243	Dickson, TN	0	3	1	1	2	2	1	0	0
244	Dyer, TN	1	2	3	2	2	3	1	13	2
245	Fayette, TN	1	3	2	2	2	2	1	12	2
246	Fentress, TN	0	1	2	1	1	2	2	0	0
247	Franklin, TN	0	2	1	1	1	2	1	0	0
248	Gibson, TN	1	2	3	1	2	2	1	11	2
249	Giles, TN	0	2	1	2	1	2	1	0	0
250	Grainger, TN	0	3	1	1	3	3	2	0	0
251	Greene, TN	0	2	1	1	1	2	1	0	0
252	Grundy, TN	0	1	2	1	3	2	2	0	0
253	Hamblen, TN	0	3	1	1	1	2	1	0	0
254	Hamilton, TN	0	3	2	2	1	2	1	0	0
255	Hancock, TN	0	1	3	1	3	2	3	0	0
256	Hardeman, TN	1	2	2	1	2	2	1	10	2
257	Hardin, TN	0	2	2	2	1	2	1	0	0
258	Hawkins, TN	0	3	1	1	2	2	1	0	0
259	Haywood, TN	1	2	3	2	1	1	1	10	2
260	Henderson, TN	0	2	1	1	2	2	1	0	0
261	Henry, TN	0	1	2	1	1	2	1	0	0
262	Hickman, TN	0	3	1	1	2	2	1	0	0
263	Houston, TN	0	1	3	2	1	2	1	0	0
264	Humphreys, TN	0	2	1	1	2	2	1	0	0
265	Jackson, TN	0	1	2	1	3	2	2	0	0
266	Jefferson, TN	0	3	1	1	2	2	2	0	0
267	Johnson, TN	0	2	1	1	2	2	2	0	0
268	Knox, TN	0	3	2	1	1	3	1	0	0
269	Lake, TN	1	1	1	2	3	1	1	9	1
270	Lauderdale, TN	1	2	2	2	2	2	1	11	2
271	Lawrence, TN	0	2	2	1	2	2	1	0	0
272	Lewis, TN	0	2	1	1	3	1	1	0	0
273	Lincoln, TN	0	2	2	2	1	2	1	0	0
274	Loudon, TN	0	3	1	2	2	2	2	0	0
275	McMinn, TN	0	2	1	2	2	2	1	0	0

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276	McNairy, TN	1	2	2	1	2	2	1	10	2
277	Macon, TN	0	3	1	1	2	2	2	0	0
278	Madison, TN	1	3	1	1	1	2	1	9	1
279	Marion, TN	0	3	2	1	2	1	1	0	0
280	Marshall, TN	0	2	2	1	2	2	1	0	0
281	Maury, TN	0	2	2	1	1	2	1	0	0
282	Meigs, TN	0	1	2	2	3	2	3	0	0
283	Monroe, TN	0	2	1	2	2	2	1	0	0
284	Montgomery, TN	0	3	3	2	2	2	1	0	0
285	Moore, TN	0	1	3	1	3	2	2	0	0
286	Morgan, TN	0	2	1	1	3	2	1	0	0
287	Obion, TN	1	1	1	2	2	2	1	9	1
288	Overton, TN	0	1	2	1	1	2	2	0	0
289	Perry, TN	0	1	1	1	1	1	2	0	0
290	Pickett, TN	0	1	2	1	3	1	3	0	0
291	Polk, TN	0	3	1	1	2	2	1	0	0
292	Putnam, TN	0	2	1	1	1	1	2	0	0
293	Rhea, TN	0	2	1	2	1	2	1	0	0
294	Roane, TN	0	2	2	2	2	3	2	0	0
295	Robertson, TN	0	3	1	1	2	2	1	0	0
296	Rutherford, TN	0	3	1	2	2	2	1	0	0
297	Scott, TN	0	2	1	1	1	2	1	0	0
298	Sequatchie, TN	0	3	1	2	3	2	2	0	0
299	Sevier, TN	0	2	1	1	2	2	2	0	0
300	Shelby, TN	1	3	3	3	1	3	1	14	3
301	Smith, TN	0	3	2	1	1	2	2	0	0
302	Stewart, TN	0	3	3	2	3	2	2	0	0
303	Sullivan, TN	0	3	2	1	1	2	1	0	0
304	Sumner, TN	0	3	1	1	2	2	1	0	0
305	Tipton, TN	1	3	2	2	2	2	1	12	2
306	Trousdale, TN	0	3	1	1	1	2	2	0	0
307	Unicoi, TN	0	3	2	1	1	3	2	0	0
308	Union, TN	0	3	3	1	3	3	2	0	0
309	Van Buren, TN	0	1	2	1	3	2	2	0	0
310	Warren, TN	0	2	1	2	1	2	1	0	0
311	Washington, TN	0	3	1	1	1	3	1	0	0
312	Wayne, TN	0	1	1	1	1	2	2	0	0
313	Weakley, TN	0	1	1	1	2	2	2	0	0
314	White, TN	0	1	3	1	2	2	1	0	0
315	Williamson, TN	0	3	1	1	2	2	2	0	0
316	Wilson, TN	0	3	1	1	2	2	1	0	0