Transportation Infrastructure
In
Alabama

Meeting the Needs for Economic Growth

Final Report on the Requirements for Infrastructure and Transportation to Support the Transformation of the Alabama Economy

Submitted by

The Office of Infrastructure, Logistics and Transportation

The Office for Economic Development

The University of Alabama in Huntsville

William R. Killingsworth, Ph.D., Director
William.Killingsworth@uah.edu
256.824.4434

Gregory A. Harris, P.E., Deputy Director
harrisg@uah.edu
256.824.6060

This study was sponsored by the U.S. Department of Transportation, Office of the Secretary, Grant No. DTTS59-03-G-00008

This research was accomplished through the diligent efforts of the following team members:

William R. Killingsworth, Ph.D.
Director, Office for Economic Development

Program Manager
Gregory A. Harris, P.E.
Office of Infrastructure, Logistics & Transportation

Researchers
Michael D. Anderson, Ph.D.
Civil Engineering, UAH

Matthew J. Faulkner
Office for Economic Development

Anthony Holden
Office for Economic Development

Jim Hutcheson
Huntsville/Madison County Airport Authority

Lauren C. Jennings
Office of Infrastructure, Logistics & Transportation

Sharla A. Mondesir
Office of Infrastructure, Logistics & Transportation

Maruf Rahman, Ph.D.
Office for Economic Development

Niles C. Schoening, Ph.D.
College of Administrative Science, Economics, UAH

Rajeev Seetharam
Civil Engineering, UAH

Jeff Siniard
Office for Economic Development

Karen Stanley
Office for Economic Development

Jeff Thompson
Office for Economic Development

Alisha D. Youngblood, Ph.D.
Industrial & Systems Engineering, UAH

Table of Contents

Table of Tables

Table of Figures

Executive Summary

The efficient and effective movement of freight is a critical component in the transformation and growth of the Alabama economy. The Alabama economy has experienced dramatic changes in composition and structure over the past five decades. In recent years, the changes have been most evident in the rapid growth of the automotive, aerospace, and life science industries and declines in the textile, apparel, agricultural, and natural resource industries. All of these trends are very likely to continue. As an example, approximately 240,000 automobiles were assembled in Alabama in 2003. By 2006, that number is expected to grow to almost 800,000 arising from the expansion of the Mercedes and Honda plants and the construction of a new Hyundai plant.[1] In addition to the rapid growth of the automotive industry, tomorrow's economy will likely include biomedical, robotics, advanced logistics, and other knowledge-based industries. In a very real sense, over the past twenty years, Alabama has transitioned rapidly into a manufacturing economy from an agricultural and natural resource economy while simultaneously beginning the additional transition to a knowledge-based economy. The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure.

During a hearing of the U.S. House Subcommittee on Highways and Transit (June 2002), the following was included in the background statements prior to witness testimony: "No matter how functional the individual parts of the system may be, the effectiveness of the overall system depends on the interconnectivity of the different parts and modes…Connections now must reach beyond a single mode, to foster an integrated and efficient transportation system."[2] The focus of this project is the research and development of an integrated systemic approach to infrastructure planning for dynamic economies in transition.

Such an approach must incorporate the interaction between economic activity, infrastructure, population, and congestion. As an economy grows, it generates traffic from both workers and freight shipments, increasing levels of congestion. Similarly, economic growth tends to attract workforce and increase population. Both phenomenon, again, tend to increase congestion. In turn, congestion tends to constrict economic growth and population growth within a region. Each of the interactions occurs with differing strengths and response or delay times. Finally, pressures from congestion and economic growth can lead to additional infrastructure, leading to what is often a short-term reduction in congestion.

Figure ES-1 depicts the interrelationships between population, infrastructure and economic activity. As later sections of this report will detail, the interconnectivity of the factors and congestion combine to determine the outcome of decisions on resource allocations made previously. For example, without infrastructure to support economic activity, congestion will eventually impede growth and population will cease to increase. A decreasing population will have a negative effect on economic activity and thus congestion will be reduced. Therefore, the decision not to provide infrastructure eventually affects population growth and economic activity.

The focus of the current effort is a result of the research finding that common freight forecasting methods rely heavily on trend analysis and averages to develop transportation infrastructure plans. In many, if not most cases these tools are not adequate due to the fact they ignore dynamic interrelationships between system factors. There are interrelationships between transportation infrastructure, population and economic activity that, if not considered as a system, can skew decisions away from more desirable solutions. Additionally, industry specific trend analysis and averaging do not take into account the broad composition of industry clusters.

The transportation networks in Alabama are challenged in several areas by congestion, deteriorating infrastructure and a diminishing highway maintenance and improvement budget. The preliminary findings of this research indicate the very real possibility that lack of adequate transportation infrastructure may constrain and limit the growth of Alabama's economy. Moreover, these infrastructure limitations may constrain regional growth opportunities as well.

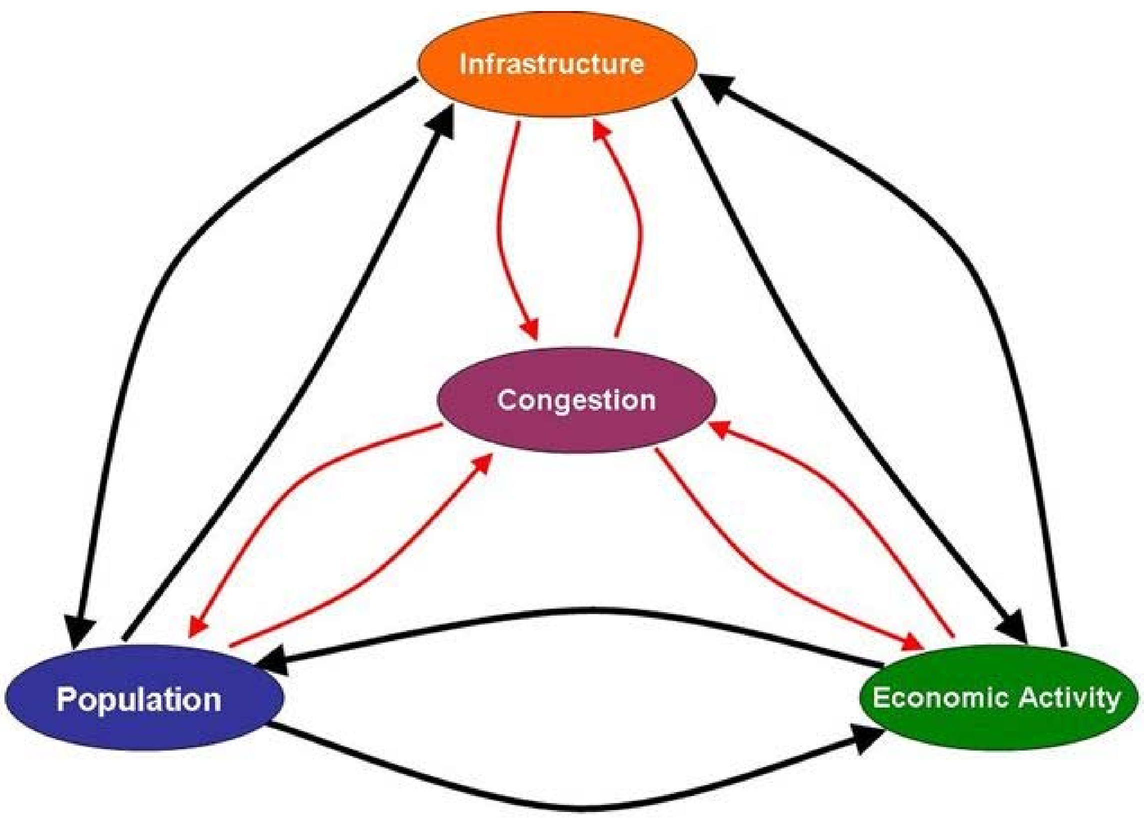


Figure ES-1
P-I-E Interrelationship Model

All is not bleak. Opportunities abound for those with the foresight to establish a position to take advantage of global trade and freight developments. With growing congestion at major United States east and west coast ports, alternative ports such as Mobile, Alabama now have significant opportunities for growth. Alabama, with a deep water port, inland waterways, intermodal facilities, and a well-established international cargo airport could very well take advantage of this opportunity and thus become a major component of the global supply chain and a major contributor to regional economic growth. This regional opportunity, along with in-state economic growth, may be foregone due to inadequate infrastructure.

What transportation infrastructure is needed to both support the growth of the Alabama economy and serve as a stimulus for regional growth is the fundamental question to be addressed. The eventual goal of this research is to answer this question by developing analytical tools, investigating benefits of alternative investments and formulating specific infrastructure plans.

The Office of Infrastructure, Logistics, and Transportation was established at the University of Alabama in Huntsville in 2003 with the mission: "To increase prosperity and economic development in Alabama by identifying, promoting, and supporting the development of the transportation and information infrastructure necessary to support the long-term growth and transformation of the Alabama economy." The objectives of the Office are:

- To identify the infrastructure needs and future requirements of the major business clusters in Alabama.

- To evaluate alternative means for improving the infrastructure and meeting future needs.

- To assess the infrastructure needs of the rural and underdeveloped regions of Alabama and to assess how infrastructure can promote economic development of these areas.

- To identify infrastructure strategies that will promote business cluster growth.

Following the structure of Figure ES-1, this report presents an assessment of the current status of:

- Transportation Infrastructure
- Population
- Economic Activity
- Likely Future Congestion

Transportation Infrastructure

The components of the transportation infrastructure system researched in Alabama are highways, rail, inland waterways, ports, airways and the intermodal combinations of each.

Highways

Alabama has 29,209 miles of Federal Aid Highway, of which, 906 miles are interstate. In total, there are 94,311 miles of all weather roads in the state.[3] Highways in Alabama have experienced steadily increasing volume for the last three decades. For example, at mile 260 of Interstate 65 in Birmingham, Alabama, which is approximately one mile south of the I-65/I-59 intersection, traffic volume has grown from an Annual Average Daily Traffic Volume (AADT) of less than 40,000 vehicles per day in 1970 to almost 150,000 in 2002, a growth rate of nearly 275%. The graph of this mile marker is shown in Figure ES-2.[4] Similar data is available for the other major highway facilities in the state.

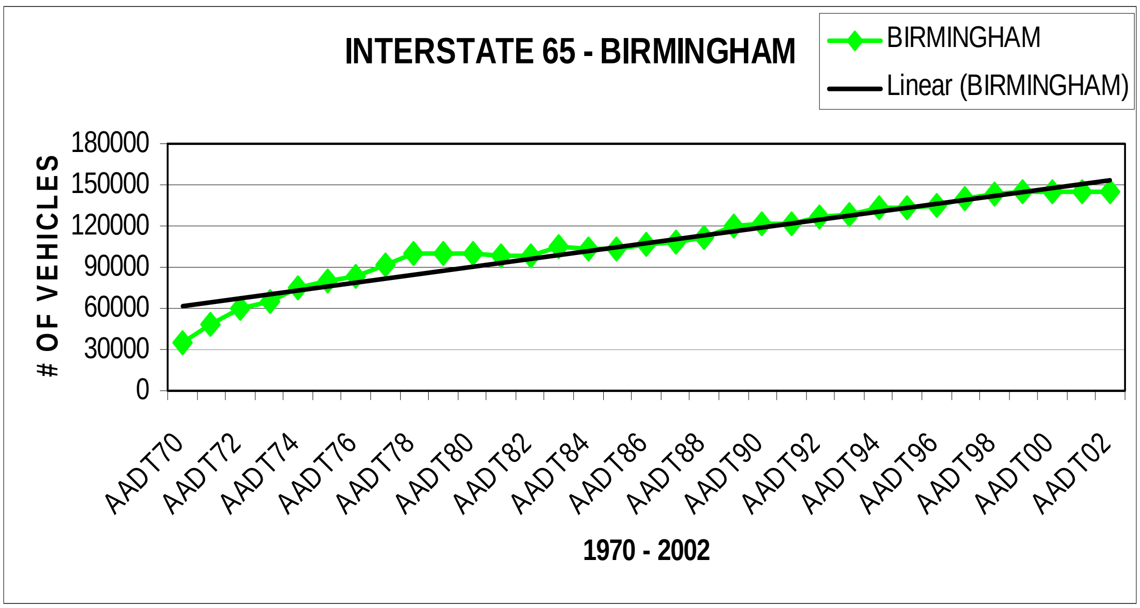


Figure ES-2

Figure ES-3 is a visual depiction of the congestion on Alabama highways based on 2002 volumes. This figure is output from the traffic demand model which is described later in this report. The wide, dark red areas indicate a congested facility during an average day. A congested facility, in the context of this model output, indicates that the volume of vehicles attempting to pass through the area exceeds the capacity guideline of that segment of road as defined by the Alabama Department of Transportation (ALDOT).

Congested Locations 2002
Alabama DOT Volumes

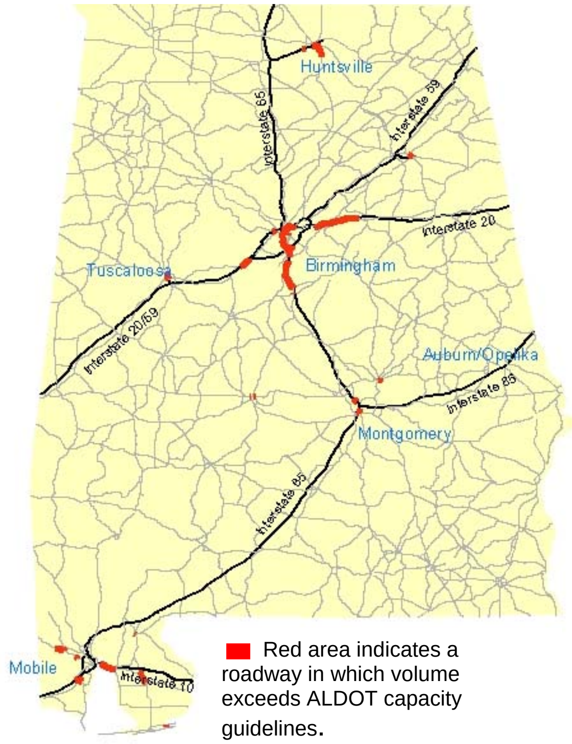


Figure ES-3

Rail

There are approximately 3,687 miles of railroad lines in Alabama hauling 150 million tons of freight annually. By a significant margin the highest volume commodity moved by railroads in Alabama is coal, more than 36 million tons annually.[5] The railroads work to fill their available capacity, but the incentive to grow beyond their current capacity is limited due to the significant capital investment required and the potential risk of return.

Container freight, domestic or international, has not yet become a significant portion of the rail activity in the state. There are several reasons this situation exists. The seaports in Mobile, Alabama and surrounding states have not yet become a force in the international container business, which would be a source of business for the railroads in Alabama. The railway system in Alabama is extensive yet it lacks a north-south intermodal designated track. With all north-south rails designated for merchandise, it can take longer for a container to get from Mobile to Huntsville than it takes a container to get from Long Beach, California to Huntsville. To designate a track from Mobile to Huntsville as intermodal, the railroads want assurance of a certain amount of freight (usually 50 to 70 containers per day) but manufacturers want the assurance of intermodal timed delivery before they will commit to the freight volume. The railroads are currently functioning at the upper end of capacity, and have no incentive to increase that capacity. The situation is a model Catch-22.

Inland Waterways

Alabama has 1,270 miles of navigable inland waterways that are underutilized.[6] The traffic on Alabama's inland waterways has been dropping steadily since the peak between 1995 and 1998. The Tennessee-Tombigbee Waterway has never reached its potential freight capacity. The Coosa River has experienced a significant reduction in river traffic due mainly to the lack of ability to maintain a nine foot depth to allow barge traffic. The Apalachicola-Chattahoochee-Flint river system in east Alabama has seen waterborne commerce come to a complete stop with the last barge company ceasing operations in 2002.

There is a perception within the waterway shipping industries that it is not possible to support a Just-In-Time manufacturing environment with inland waterway freight shipping. There is not currently a Third Party Logistics (3PL) service provider that works using the waterways of Alabama as the preferred mode of transportation. Alabama does have abundant natural resources in the inland waterway system but has not yet been able to fully utilize it to enhance economic growth. A study of the waterways in Alabama should be initiated to determine the efficiency and operating constraints of the waterway lock and dam system and the operating parameters by which it is managed.

Seaports

The Port of Mobile is a strategic link in the transportation infrastructure of the state and region. The port is currently executing a plan to develop Choctaw Point, a container port operation capable of handling 250,000 to 300,000 TEU's (Twenty Foot Equivalent Units, a container) annually; an increase from the 50,000 TEU's handled today. The Port of Mobile is in position to become a major player in the container freight business in addition to being a major port for bulk materials, but the port must overcome cost and delivery obstacles to succeed. This success, though, will result in an issue of how to move the freight out of the Mobile area in such a way as to not cause traffic congestion that eventually impedes economic growth.

The Port of Mobile also contains one of the largest coal terminals in the country and is a strategic partner in the power generation industry that supports a significant portion of Alabama and surrounding states. Southern Company, one of the port's largest import customers, expressed a desire to double the amount of import coal coming through the McDuffie Island Coal Terminal operation at the Port of Mobile. The current throughput of coal is about 12 million tons. As part of this effort, UAH worked with the Alabama State Port Authority to develop a plan for productivity improvement to reach the desired import goal.

The Port of Mobile will need to develop a culture of continuous improvement within an environment where this kind of thinking has not been supported in the past. The Alabama State Port Authority has taken steps in that direction. The McDuffie Island Coal Terminal is well on its way to becoming the preeminent coal handling facility in

North America. These efforts should be fully funded and supported by the state and the management of the Alabama State Port Authority.

Airways

Air freight data for the period 1993-2002 was obtained from the U.S Department of Transportation, Bureau of Transportation Statistics. Huntsville, Birmingham, Montgomery and Mobile all have freight air facilities with Huntsville being an international port of entry. Of these, only Huntsville has shown significant growth in the volume of freight with a percentage annual growth rate of 30.2% from 1993 to 2002.[7]

Air freight is often considered the transportation mode of last resort due to the perceived cost of shipment. Air cargo tends to be utilized for high cost, low weight products and components. Several actions are happening that may bring the cost of airfreight down to the level where more manufacturers will consider it as a viable alternative. Pemco Aviation in Dothan, Alabama has been working with a customer on converting Boeing 737's into 737 QC's which consists of installing a large door in the place of the personnel door and rails on the floors. Freight can be moved into and out of the plane on those rails but pallets of seats can also be installed quickly into the plane. Air transportation companies in the Far East are using the planes to fly passengers during the day, and then change the plane over in 30 minutes to fly cargo at night. By managing their airplane resources in this manner, the companies are able to get better utilization out of the equipment and lower the cost of freight shipments.

The increased security since 9/11/01 has caused some delay in importing shipments through customs. Even with this increased security, the Port of Huntsville has a daily flight nonstop from Europe and has recently initiated weekly flights to Asia.

Intermodal

Intermodal freight activity is the act of exchanging freight between two or more modes of freight transportation. The majority of this happens between railroad and truck, typically at an inland site, or between ocean going vessel and either train or truck at a seaport. The four primary Class-1 railroads in the United States each operate their own defined intermodal systems. These systems consist of intermodal terminals at or near major container seaports and inland intermodal terminals, which are typically at or near major population centers. The railroads serve these terminals using dedicated intermodal trains, traveling along lanes designated for intermodal traffic. These lanes are generally established based on density of container volume and the ability to accommodate the double-stacking of containers.

International containers, arriving at U.S. seaports, are transported inland via both truck and rail. Trucks generally deliver containers within a 200-mile radius of the seaport. Rail is generally used to move containers to inland points beyond 200 miles of the seaports. Once the containers arrive at a designated inland terminal, trucks will then deliver the containers, generally within a 200-mile radius of the inland terminal. The process is reversed for containers moving to the seaports for export. The radius distance is not a set number. Exceptions to this distance frequently occur due to many variables.

Domestic containers and rail trailers move from point to point within the U.S. Domestic intermodal freight is typically used for long-haul situations, in excess of 500 miles. Once the containers arrive at a destination terminal, trucks will then deliver the containers, generally within a 100-mile radius of the terminal. The domestic service radius of an intermodal terminal is generally less than the international radius, due to competition with over-the-road truck rates.

Presently there are three primary intermodal rail terminals located in Alabama, each served by a different Class-1 railroad. Huntsville is served by Norfolk-Southern; Birmingham is served by BNSF; and Mobile is served by CSX. Additionally, Norfolk-Southern operates a small intermodal terminal in Birmingham to exclusively serve the Mercedes-Benz plant in Vance, AL. Both Huntsville and Mobile are served by eastbound and westbound intermodal train service. Birmingham is the eastern-most terminus for the BNSF railroad. Therefore, there is no eastbound intermodal train service from the BNSF terminal in Birmingham.

Due to the fact that Mobile, at present, is not a major container port, the railroads hold that there is not sufficient container volume to justify a north-south intermodal rail connection between Mobile and Birmingham and/or Mobile and Huntsville. Both CSX and Norfolk-Southern have rail lines extending from Mobile into central and north Alabama. However, the viability of those rail lines being usable for intermodal rail traffic would have to be determined by the individual railroads. CSX does not have an intermodal terminal in either Birmingham or Huntsville and Norfolk-Southern will usually utilize their intermodal hub terminal, in Austell, GA, to link Mobile to Huntsville.

Even though the Port of Huntsville has access to rail, air and highway modes of transportation, the intermodal nature of the freight dictates the modes of delivery. Freight will typically transfer between truck to rail and truck to air. Very seldom does a product transfer from air to rail or rail to air due to the weight and delivery time requirements. Air freight will carry high value, low weight, time definite delivery items and rail will carry high weight, lower cost, non-time sensitive materials.

Research by the Federal Highway Administration makes it clear that if the freight system within the U.S. continues to rely on trucks and highways, the demand for freight transportation over the next two decades will far outpace the available infrastructure capacity.[8] Intermodal freight movement offers an efficient and socially beneficial alternative, but there are many obstacles to overcome before manufacturers in the U.S. will be persuaded to change their current behavior.

Population

Understanding the infrastructure in Alabama was the first step to the development of an integrated systemic approach to infrastructure planning for dynamic economies in transition. The second important factor to understand is the population of the state and how historical and current dynamics are establishing the future requirements for economic growth.

Population trends do have an effect on the economy and infrastructure of a region. Economic activity needs population to grow. A growing economy attracts population, thus creating a cycle of growth and prosperity. The opposite is also true. An economy in decline will lose population as people leave the region to look for opportunity elsewhere, thus creating a downward spiral from which it is very difficult to pull out. The transportation infrastructure in a region is either an enabler or restrictor of growth. The presence of infrastructure is not necessarily a stimulus for growth, but the lack of infrastructure can extinguish growth.

Population growth in Alabama, although positive, has lagged behind the southeast and the nation for the past two decades, as can be seen in Figure ES-4.

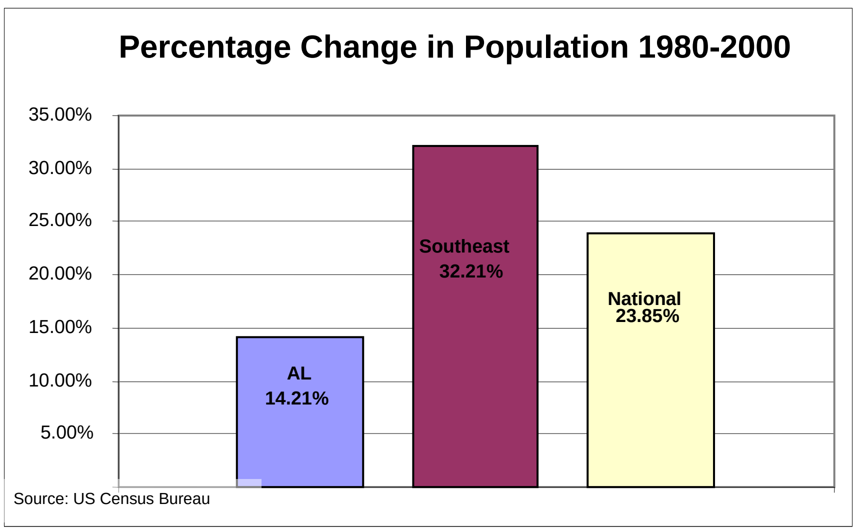
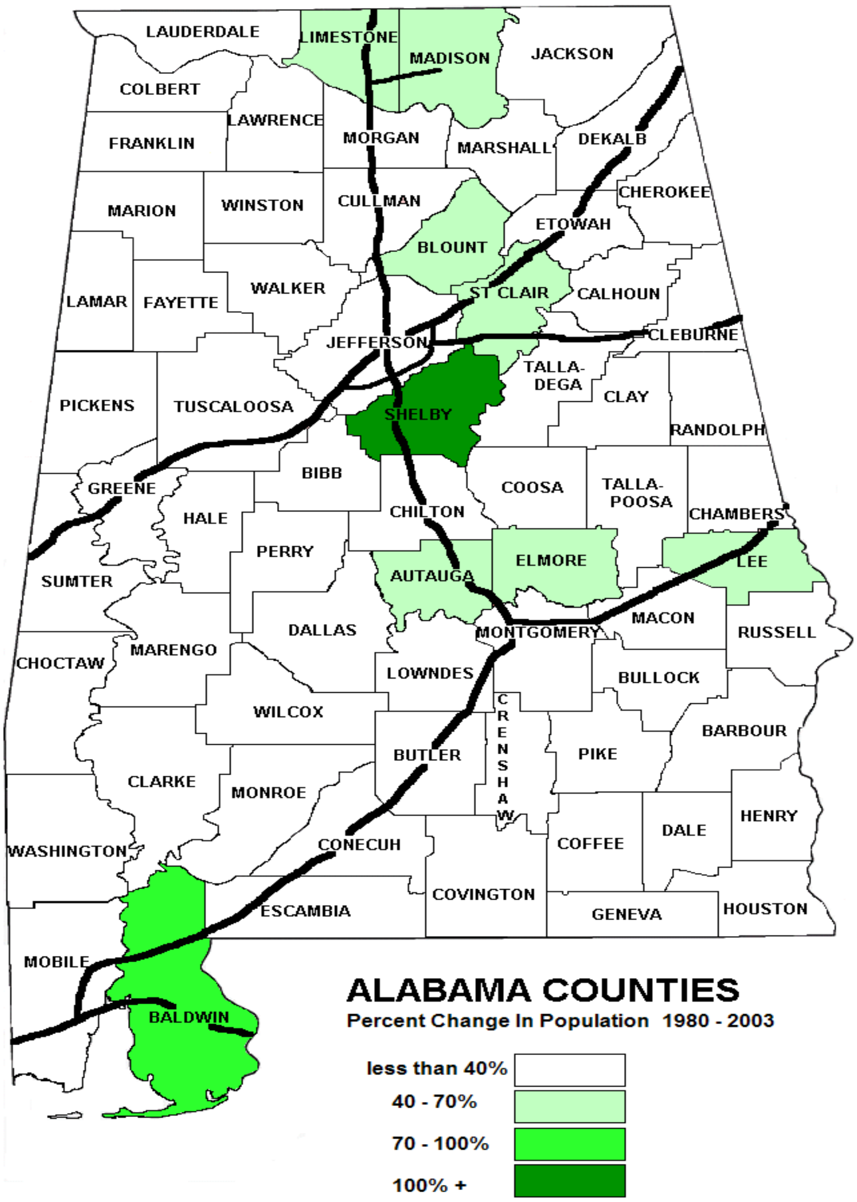


Figure ES-4
Relative Population Growth: Alabama, Southeast, and U.S. (1980 to 2000)

Research into population growth and trends yields evidence that there is a movement within the state toward the counties in and around which the major transportation arteries traverse. This, in turn increases congestion on those major transportation arteries. Population tends to increase economic activity, which tends to increase freight requirements. The growing economy, then, increases the attraction for additional population.



Source: Alabama Department of Industrial Relations

Figure ES-5
Population Growth in Alabama, 1980 to 2003

According to the 2000 census, there are 55 counties (out of 67) with less than 100,000 people in residence.[9] Alabama is predominately a rural state. In rural areas, infrastructure needs are not necessarily related to transportation. In the broader definition of infrastructure (which would include education, employment opportunities, commerce, financial resources, in addition to transportation) it may be that there is a greater need for factors other than transportation facilities. To this end, urban transportation planning methods are inadequate for use due to the significant weights given to population and economic activity. Sustainable economic momentum is a basic premise in urban transportation planning but rural transportation planning must be capable of predicting sudden changes in economic activity. Trend analysis will not suffice. Rural Alabama is not lacking in the amount of attention being paid to the unique set of problems in that region. In 2004 there were not less than 16 different Black Belt Initiatives underway to address workforce and economic development issues in this rural and economically depressed area of the state. Coordination and policy directives seem necessary to ensure that the rural regions initiatives provide value added assistance for the investment made.

Economic Activity

The third of the interrelated factors in Figure ES-1 is that of the economic activity in the state and region. This includes identification of what areas of the economy are growing, areas that are in decline and the reasons for each. To achieve this level of understanding, the research team employed the concept of industry clusters developed by Dr. Michael Porter at the Harvard Business School.

Identifying Industry Clusters in Alabama

The primary business clusters and sub-clusters were identified for eleven regions in Alabama. For each cluster, total employment and the change in employment over a ten year period were detailed. For examples, see Figures ES-6 and ES-7.[10] This research also focused in part on overlapping clusters and opportunities for future growth. An understanding of industry clusters is necessary to better evaluate how enterprises, connected by a common purpose, create value and economic activity. By developing this understanding, the characteristics of a cluster can be used to determine how that cluster generates freight needs and the appropriate infrastructure required to satisfy those needs. Combinations of industry clusters in a region will generate a unique set of infrastructure requirements that must be supported for the region to grow and thrive. Each individual industry cluster is composed of a unique set of infrastructure requirements that must be understood if the economic activity is to appropriately model the outcome of resource decisions.

Two particular industry clusters in Alabama, the automotive and aerospace industries, were of significant interest to this research due to the size of the clusters and/or the rate of growth each industry has experienced in recent history.

The Automotive Manufacturing Survey

A survey of the automotive manufacturing cluster in Alabama was conducted to document the growth in the industry from prior years and on future transportation and distribution needs, both in the near and long term. Figures ES-8 and ES-9 present an overview of the results of this task.

	Decatur	Florence	Huntsville	
1	Prefabricated Enclosures	Apparel	Business Services	
2	Forest Products	Prefabricated Enclosures	Automotive	
3	Motor Driven Products	Metal Manufacturing	Information Technology	
4	Textiles	Automotive	Education and Knowledge Creation	
5	Metal Manufacturing	Business Services	Analytical Instruments	
	Anniston	**Gadsden**	**Tuscaloosa**	**Birmingham**
1	Metal Manufacturing	Motor Driven Products	Heavy Construction Services	Business Services
2	Heavy Construction	Business Services	Motor Driven Products	Financial Services
3	Textiles	Metal Manufacturing	Automotive	Metal Manufacturing
4	Prefabricated Enclosures	Heavy Construction Services	Plastics	Heavy Construction Services
5	Furniture	Publishing and Printing	Business Services	Hospitality and Tourism
	Auburn-Opelika	**Dothan**	**Mobile**	**Montgomery**
1	Motor Driven Products	Transportation and Logsitics	Business Services	Business Services
2	Automotive	Hospitality and Tourism	Transportation and Logistics	Finanical Services
3	Business Services	Business Services	Heavy Construction Services	Heavy Construction Services
4	Heavy Construction Services	Motor Driven Products	Chemical Products	Motor Driven Products
5	Textiles	Heavy Construction Services	Hospitality and Tourism	Plastics

Source: Industry Cluster Analysis for Alabama

Figure ES-6
Top 5 Clusters by Metropolitan Area 2001

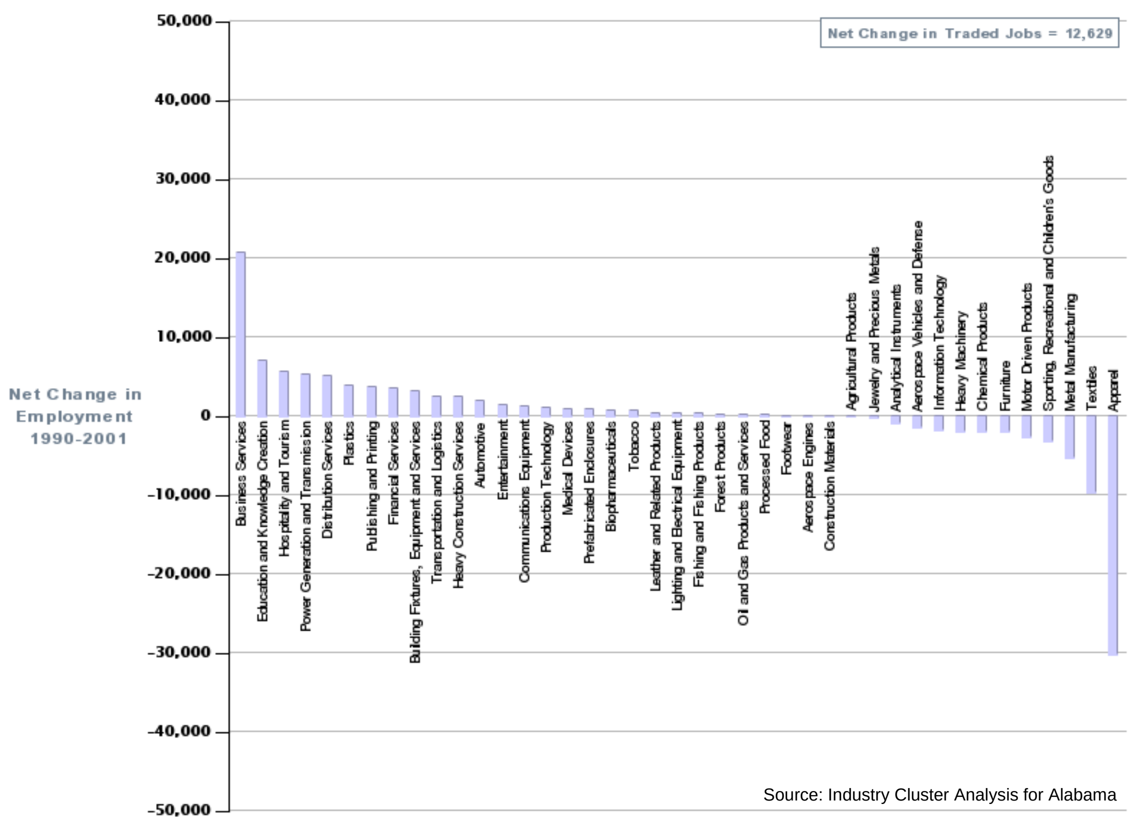
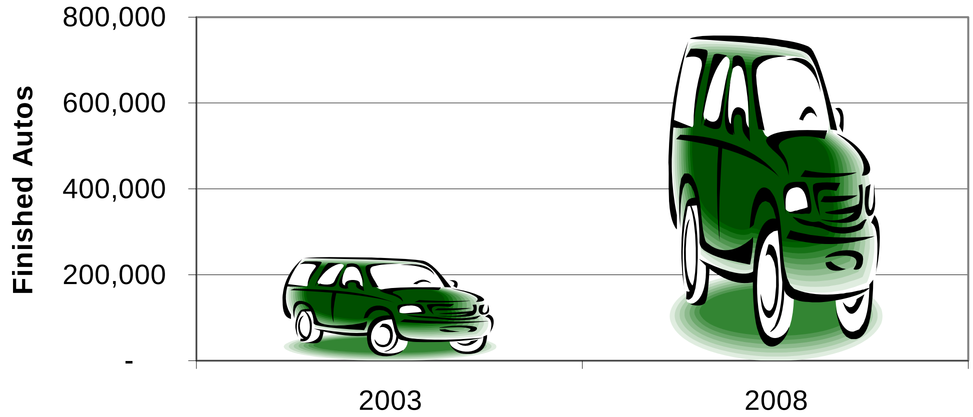


Figure ES-7
Alabama Job Creation by Traded Cluster, 1990-2001

Automotive Production Capacity Expands by 520,000



Source: Presentation of Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry

Figure ES-8

With the cooperation of the Alabama Automotive Manufacturers Association the survey was conducted and, based upon the distribution of companies and the supplier network, implications for infrastructure were identified and described.

The automotive industry in Alabama is continuing to grow and thrive. The automotive industry has provided high wage jobs and employment growth to the state during a time in which several traditional industries have been in decline. This welcome growth brings with it transportation infrastructure issues such as traffic congestion, that will have to be addressed. This industry will continue to put a strain on the transportation infrastructure as production increases and shipping volume due to Just-In-Time manufacturing requirements escalate. The impact on road infrastructure in Alabama will certainly be noticed as annual automotive truck shipments grow by 150% from 750,000 in 2003 to 1,880,000 by 2008 (see Figure ES-9).

In any given hour of the business day, there are 156 trucks carrying automotive freight on Alabama roads. This average will grow to 392 per hour by 2008.[11] Unfortunately, most of this growth will occur in the region of the state where road capacities are reached or exceeded regularly during normal business hours. Coupled with other truck freight flowing within and through Alabama, significant congestion may result in the locations where business activity can least afford the delays.

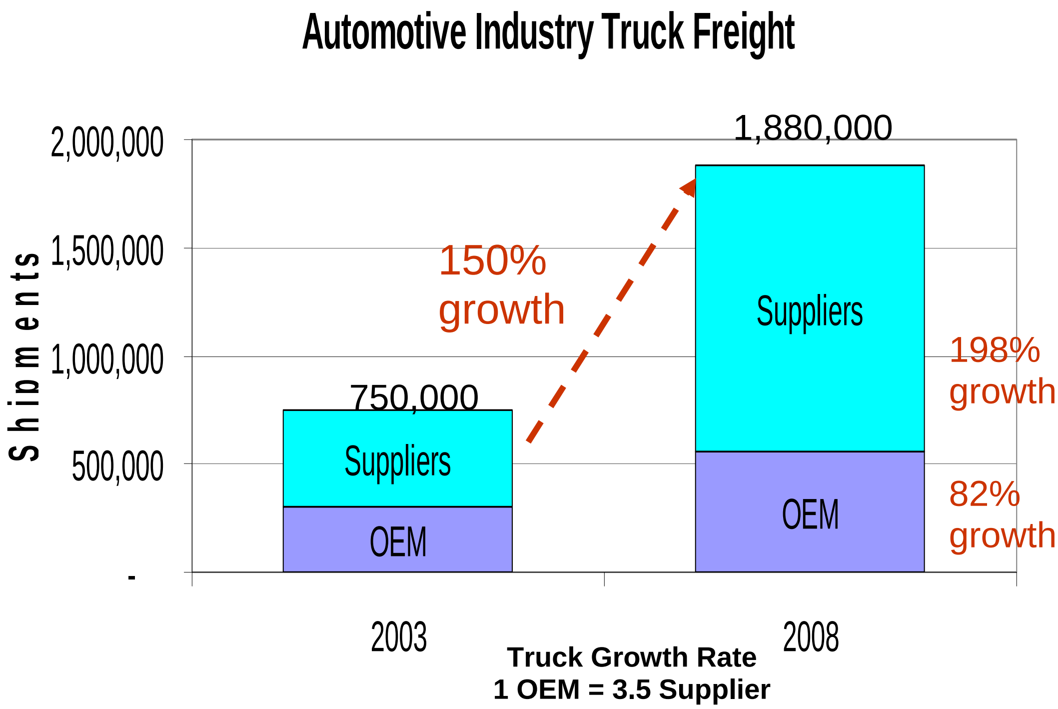
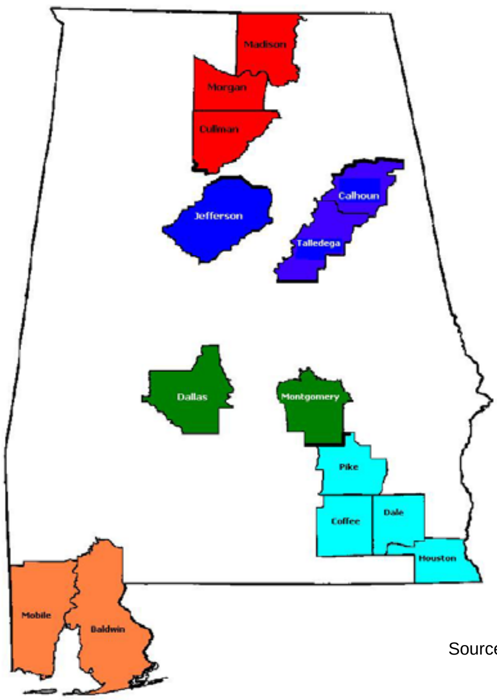


Figure ES-9

<u>The Aerospace Industry Survey</u>

A survey of the aerospace industry cluster in Alabama was conducted and, in addition to employment and geographical distribution in the state, the survey focused on the transportation and distribution needs of the aerospace cluster, both in the near and long term. Figure ES-10 presents the regions in which participants in the aerospace industry cluster can be found in the state. The survey was conducted with the cooperation of the Alabama Aerospace Industry Association (AAIA).

The Aerospace industry in Alabama is composed of two sectors, those companies involved in commercial products and those involved in military/space products. These two components are distinct and different in terms of the workforce needs, facilities and freight requirements. In its current configuration, the aerospace industry does not put strain upon the transportation infrastructure in the state. Most of the freight moved by the aerospace companies surveyed has a domestic origin and destination, with the volume of freight being low relative to other industry clusters. For comparison, 94% of the tonnage and 97% of the truck (LTL & bulk) shipments is domestic freight versus 6% or less freight originating or terminating outside of the United States.[12] Based on the responses to the survey, international outsourcing by Alabama's aerospace industries has not significantly impacted aerospace manufacturing in the state. The aerospace industry growth in Alabama takes place in the counties that already contain aerospace companies and is not expanding throughout the rest of the state.



Region #1
(Madison, Morgan, Cullman Counties)
66.7% of total aerospace jobs in the state

Region #2
(Calhoun, Jefferson, Talladega Counties)
5.7% of total aerospace jobs in the state

Region #3
(Montgomery, Dallas Counties)
8.0% of total aerospace jobs in the state

Region #4
(Dale, Pike, Coffee, Houston Counties)
12.3% of total aerospace jobs in the state

Region #5
(Mobile, Baldwin Counties)
6.7% of total aerospace jobs in the state

Rest of State
<1% of total aerospace jobs in the state

Source: Alabama Aerospace Industry 2002: Industry Survey Report

Figure ES-10
Five Major Aerospace Regions Counties with 100+ Aerospace Jobs Private Sector

Survey of Transportation Requirements

A survey of the distribution and transportation modes and requirements of Alabama manufacturers was conducted. The focus of this survey was on existing and future modes and requirements for transportation and distribution including air, rail, truck and water. The report identified the current highway, sea, air and rail requirements and any current shortcomings.

Information on Alabama's industrial base was gathered through face-to-face interviews with 240 companies across Alabama. The benefits of this time-consuming task became apparent as inputs were organized by clusters of industry. It was the combination of inputs from companies within an industry cluster that yielded the best insight into the transportation issues and requirements.

Researchers observed conflicting signals from manufacturers. For example, a common complaint from manufacturers was that they could not get trucks to pick up their products in a timely manner, especially in a peak demand situation. This would imply a shortage of trucks in the system. On the other hand, trucking companies indicated that they did not want to send trucks to Alabama for deliveries because they would often have a return trip with an empty trailer. This indicates that the capacity of trucks exceeds the volume of product to be shipped. The fact that these two situations simultaneously exist would indicate that there is a communication gap between the freight service providers and the freight customers they serve.

Regardless of whether an industry sector was growing (automotive), stable (aerospace), or declining (apparel, textiles), the advantages of organizing information by industry cluster were evident. Alabama manufacturing companies in general are primarily focused on their current (short-term) business needs. Future business forecasts are either not being shared or not being incorporated into the transportation department information of the company. Only by connecting the inputs from executive-levels with transportation department data, can reasonable forecasts for industry clusters be made. The disconnect between the board-room and loading dock suggests that transportation information gathered through traditional channels may not be sufficient in planning for the transportation infrastructure of tomorrow. Enhancing the systems for transportation planning should include information beyond the transportation data channels. Planning must incorporate methods of associating data within and across industry clusters.

Freight Transportation Modeling

Modeling freight transportation and the ability to predict future growth in freight transportation has been performed with limited success in this country. The primary reason the forecasting of freight movements has been ineffective is that the current state-of-the-practice is focused on examining historical growth, then forecasting the historical growth trends into the future, essentially utilizing the notion that previous growth is a good predictor of future growth. Unfortunately, this model of freight prediction is limited with respect to the facts that freight growth trends do not follow historical trends and growth in freight transportation is generated by large, independent events that require a multitude of factors to come together in a symbiotic fashion.

Growth in freight transportation occurs when a new facility is opened, not as a gradual process. A roadway or rail-line that has been experiencing limited freight movement will see an abrupt increase in transportation after the construction of a manufacturing plant or timber processing facility. Second, the development of facilities that will be instrumental in affecting the amount of freight transportation on roadways and rail-lines occur when a specific set of external factors are in place to foster the development of such facilities. These factors include the economy, level of productivity, industry clusters in the area, and economies of scale associated with production. It is the combination of discrete freight generating events and external factors that limit the effectiveness of trends line analysis for freight forecasting.

To improve freight forecasting methodologies, this research effort attempted to utilize urban transportation planning models as a tool to model statewide freight transportation. These models, used in almost every metropolitan area in the country, take input levels of transportation demand (in the form of trips produced from one area and trips attracted to another area) and transportation supply (in the form of roadways available to accommodate the trips) and predict future traffic volumes on city streets. The output of these models are used to identify current deficiencies in the transportation system, and with forecasted population and employment data, to identify future transportation system deficiencies that will arise at a specified horizon year. The advantage these models have over trend line forecasting is that the model inputs can be adjusted for discrete events, or sudden changes in employment and/or changes in the transportation network.

The specific items addressed in this research were the application of the urban transportation planning methodology to freight transportation. Relationships between common economic and population factors were developed from the freight transportation survey conducted as part of the research effort and discussed earlier. After defining the relationships, a projected demand for transportation services was generated with knowledge of the industry employment for a county and overall county population.

The model approach undertaken in this research effort follows the traditional four-step urban transportation planning process. The first step required preparation of a highway infrastructure network model. The Alabama specific network used counties as traffic zones. The roadways were attributed with distance, capacity (using Alabama Department of Transportation guidelines), and speed.

Statistical analysis was performed on the survey data to determine the relationship between industry size and type to the resulting freight flow. Statistical relationships were developed to convert socio-economic data to trips and/or freight flow. As freight flow was a primary focal point for this work, a statistical analysis was performed on the relationship between freight flow and the industries located in Alabama to determine the overall county freight movement. The specific tasks performed were: data collection, definition of a relationship between industry and freight flow, network development, and assignment of traffic. Traffic was assigned to the Alabama specific network using the socio-economic data for the counties in Alabama and an equilibrium assignment algorithm. The trips were determined using the relationships developed for freight flow from the survey information and personal travel characteristics.

The input data required by the model are summarized by the following:
- Survey of freight users
- Commodity Flow Data/Railway Bill data
- Modes of freight movement
- Highway/Rail/Waterway networks
- Employment data
- County freight flow relationships
- Origin and destination of freight

The model outputs are:
- Volume of incoming and outgoing freight
- Volume to capacity ratios for interstate and secondary highways
- Visual depiction of demand

The major advantage this methodology provided was the ability to develop future scenarios that were reflective of discrete events where the demand for transportation services would change. For example, the development of a new manufacturing plant in a specific county could be input to the model as a change in employment, which would be reflected as a change in demand for transportation services on that county. The model would then be able to predict the future transportation requirements and allow the user to identify deficiencies in the infrastructure that might need to be addressed to ensure the growth scenario identified is brought to fruition. An example of this is a demonstration utilizing the highway network and the specific growth anticipated in the automotive and aerospace industries in Figures ES-13 through ES-15.

The application of the urban transportation planning model provided a tool to improve the ability to forecast freight transportation needs in the state. The model proved superior to the trend line analysis because of the ability to account for plant openings and discrete changes in the industrial landscape of the state. However, the model was limited in its ability to incorporate the entire universe of economic and social changes that influence freight transportation. The future improvements to the model need to focus obtaining a better understanding the relationships between productivity and freight transportation needs, and ultimately, understanding the universe of external factors that cause industry growth and development.

The Figures ES-11 through ES-15 are output charts from the model. A congested facility, in the context of this model output, is defined by ALDOT to be a volume of greater than 75% in a rural area or 90% in an urban area of the maximum capacity of the highway (Volume to Capacity Ratio). Examples of the Volume to Capacity Ratio are shown from the model in Figures ES-11 and ES-12 for Interstates I-20 and I-65. Note that, in both charts, there are areas where current volumes exceed the available facility capacity guideline. Using the model forecasted volume created by including specific cluster growth knowledge, the area at or over capacity greatly expands by 2008.

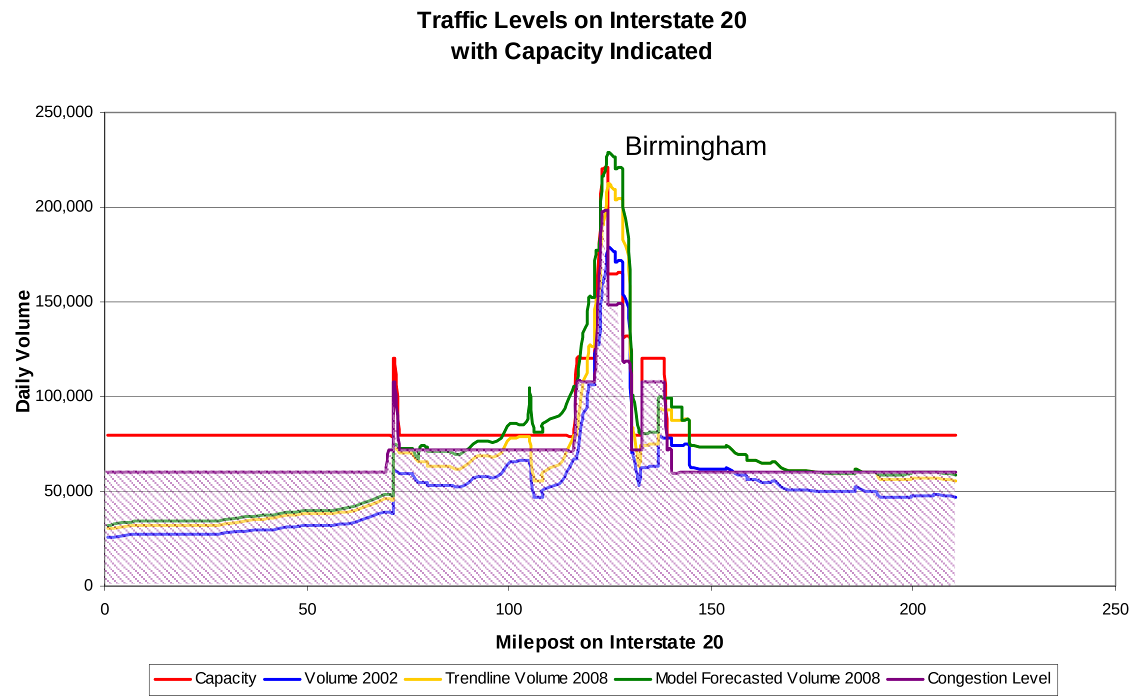


Figure ES-11

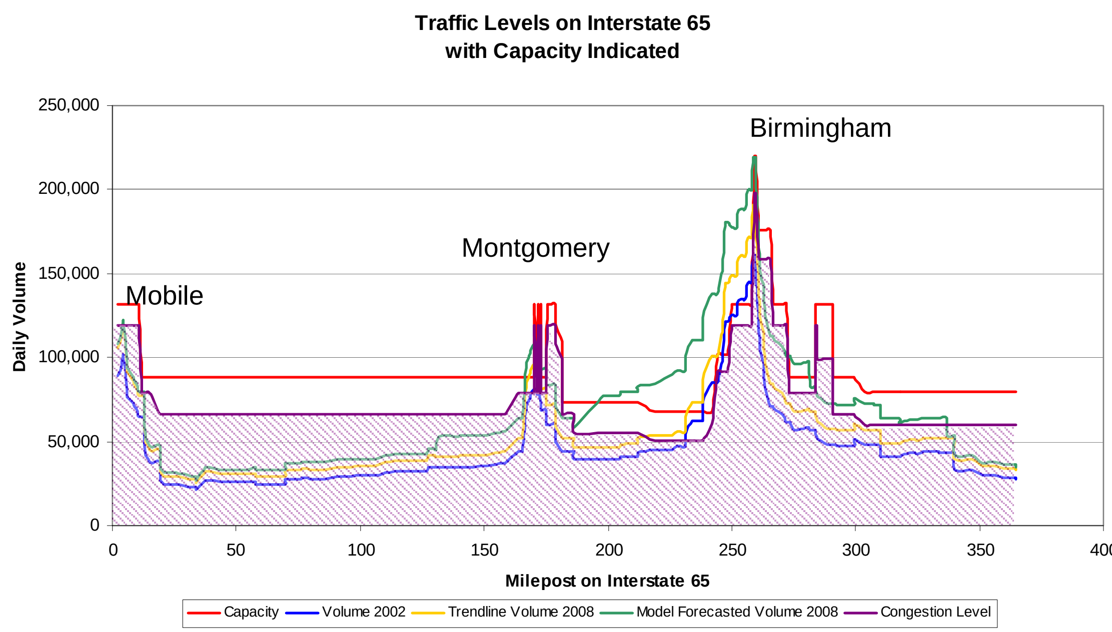


Figure ES-12

The Figures ES-13, ES-14 and ES-15 are output maps from the model. Figure ES-13 shows the current levels of congestion on the highway network. A congested facility, in the context of this model output, means that the volume of vehicles attempting to pass through the area exceeds the ALDOT guidelines for congestion of that segment of road. In Figure ES-13, the total miles of road considered as congested are 455.

Congested Locations 2002
Alabama DOT Volumes

455 Miles of Congested Facility

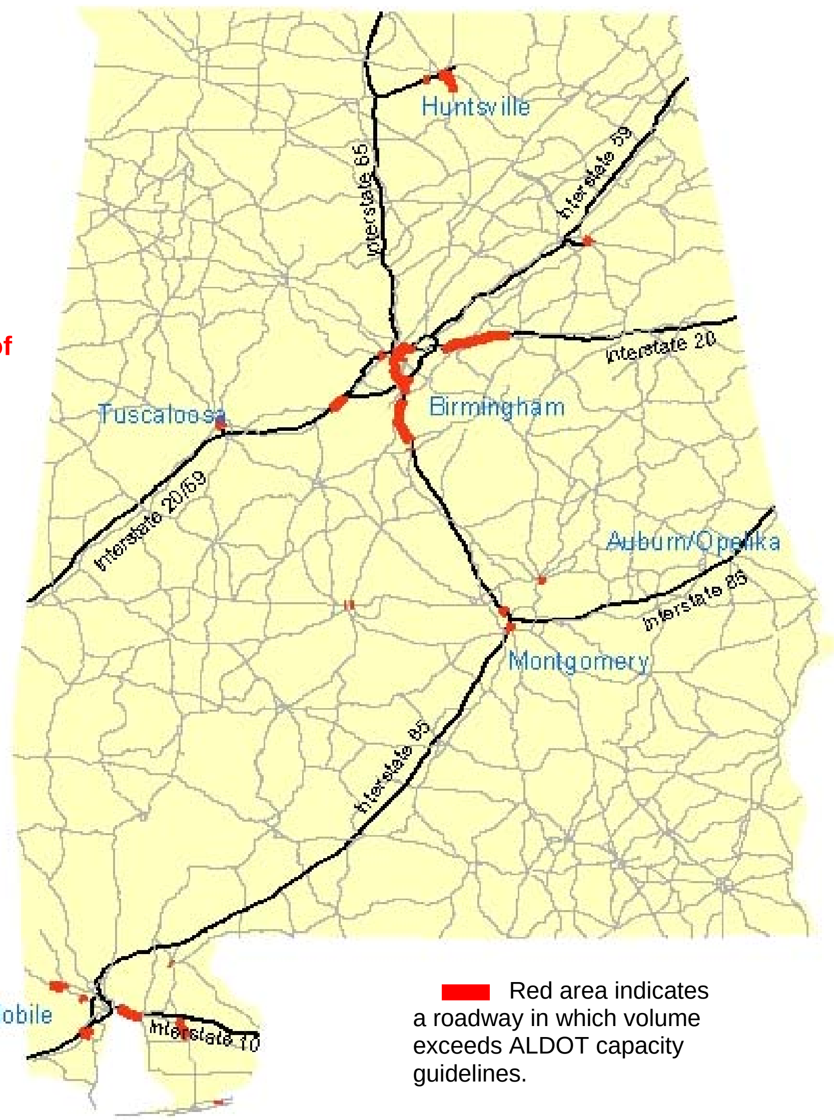


Figure ES-13

Figure ES-14 shows anticipated congestion in 2008 assuming historical economic growth rates, and Figure ES-15 presents the much greater congestion in 2008 arising from the automobile and aerospace industry clusters over the next several years. In Figure ES-14 the total miles of congested roadway is projected to be 1035, a 128% increase over 2002.

Congested Locations 2008
Alabama DOT Volumes

1035 Miles of Congested Facility

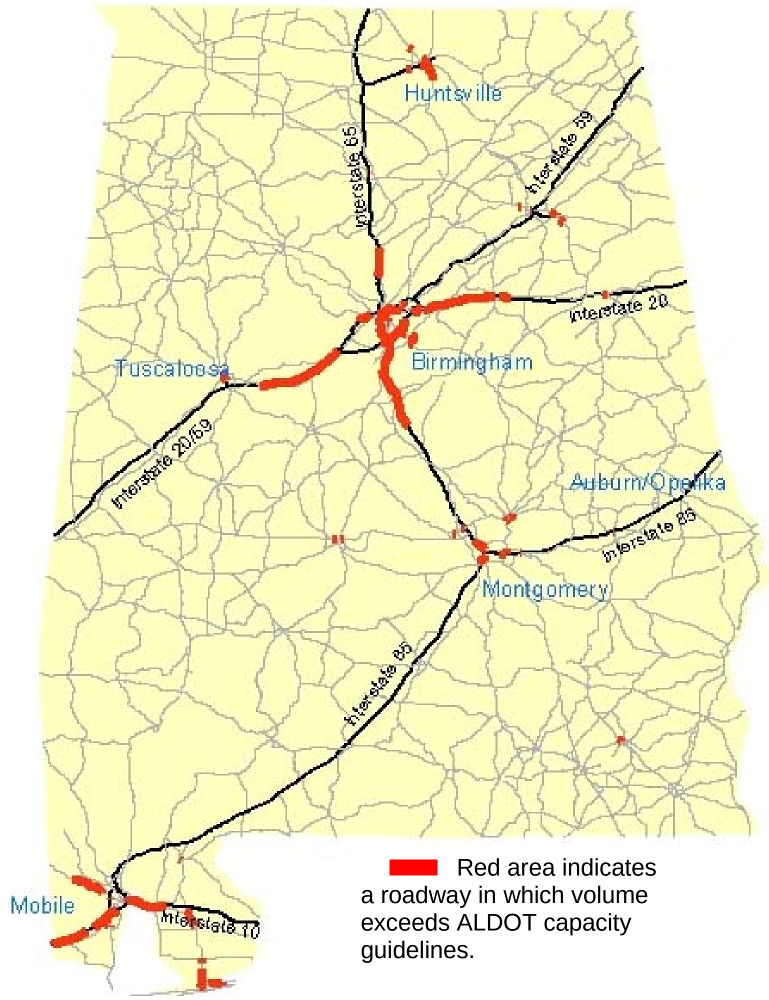
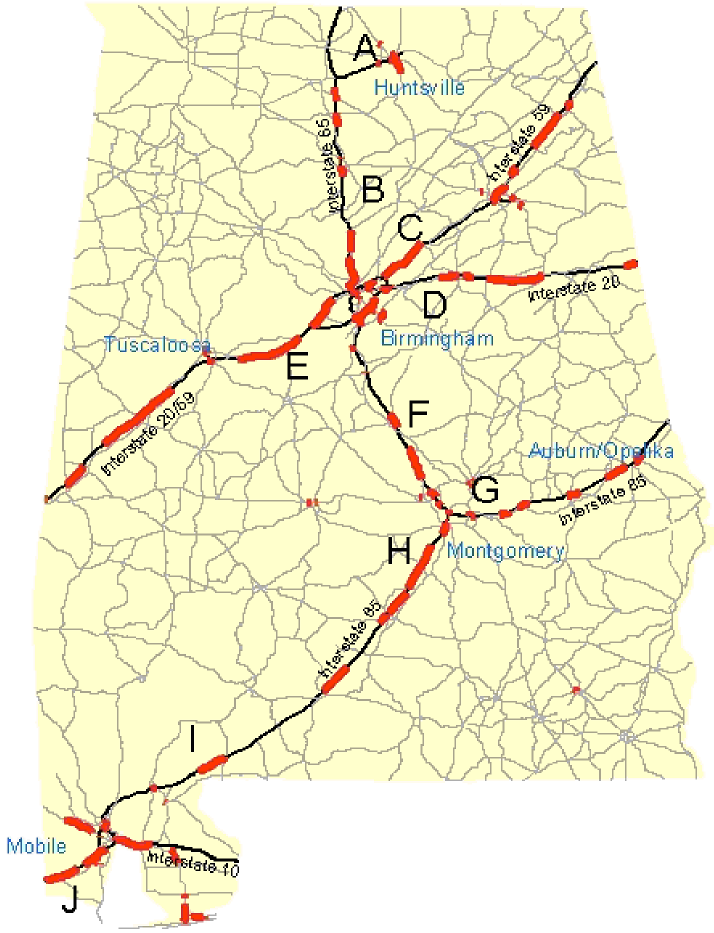


Figure ES-14
Forecast Using Historical Trend Analysis

In Figure ES-15, the total miles of congested roadway is projected to be 1760. This forecast predicts a growth in congested roadways of 287% over 2002. Additionally, the inclusion of industry cluster knowledge in traffic forecasting identified 70% more congested roadway than the historical trend forecasting method (Table ES-1).

Year	Model Methodology	Miles of Congested Highway
2002	Actual Volume of Traffic	455
2008	Historical Trend Analysis Forecast	1035
2008	Industry Cluster Knowledge of Growth Projections	1760

Table ES-1
Model Output of Congested Highway Miles



Map Location	2002 AADT	2008 AADT Historical Trend Forecast	% Increase from 2002 Using Trend Line Forecast	2008 AADT Forecast with Specific Cluster Growth	% Increase from 2002 Using Industry Cluster Analysis
A	57,121	67,842	18.8%	78,577	37.6%
B	48,901	58,080	18.8%	73,494	50.3%
C	29,680	35,251	18.8%	52,885	78.2%
D	61,773	73,367	18.8%	79,853	29.3%
E	53,117	63,087	18.8%	71,112	33.9%
F	43,591	51,773	18.8%	82,589	89.5%
G	84,332	100,148	18.8%	137,207	62.7%
H	34,427	40,942	18.9%	52,735	53.2%
I	26,082	30,978	18.8%	33,165	27.2%
J	53,729	63,814	18.8%	65,314	21.6%

Figure ES-15
2008 Volume to Capacity Ratios with Automotive and Aerospace Cluster Information Included

The construction of the traffic demand model brought forth several observations. First, forecasting traffic based on historical rates and growth is going to leave the state unprepared to deal with infrastructure demands shown in Figures ES-14 and ES-15. In these two depictions of model output, historical growth was applied to ES-14 and knowledge based on specific industry characteristics and growth was applied to ES-15. If traditional methods were used to plan, as shown in ES-14, a severe lack of capacity would develop with little or no warning from the forecasting tools. It is quite apparent that a traffic plan established for a 128% increase in congested roadway would be inadequate for an actual increase of 287%.

An additional issue with forecasting tools comes from the source of data used to prepare the forecast. Traditional freight forecasting models utilize employment and SIC or NACIS codes to calculate freight generated. This method of forecasting does not take into consideration the productivity improvements implemented by a company to improve the competitiveness of the organization. Productivity improvement can result in an increase in production with the same number of employees or the same production with fewer employees. In either instance the traditional forecasting methods will understate the freight requirements. This leads to the realization that employment and industry codes are not adequate predictors of freight need generation in a region, a finding of this research during the modeling phase.

Another finding from the modeling effort was that the lead time to add capacity to Alabama's transportation infrastructure is often longer than the time period by which the infrastructure will be at, and over, capacity. There needs to be substantial effort made to investigate alternatives to building capacity.

Conclusions and Recommendations

Alabama infrastructure requires substantial financial resources for improvement and maintenance. It is imperative that funding for the Alabama Department of Transportation be increased to meet the needs of future economic growth. With the problems and opportunities facing Alabama, it is especially important that funding be preserved and not diverted from ALDOT for non-transportation related projects, as frequently happens.

The research described above produced two major findings: first, anticipated growth in major industry clusters will strain the existing infrastructure and potentially limit future growth; and second, because of its current industrial base, geographical location, and natural resources, Alabama has the potential to assume a major role in transportation, logistics, and distribution as the Freight Gateway to Mid-America. This potential new role in the global supply chain will only enhance the current outlook for the state's economy. Alabama is in a unique position to benefit from an increase in the globalization of trade. But to take full advantage of this opportunity, it is important that a systems approach be taken in the evaluation and understanding of the transportation infrastructure. By evaluating and acting on the transportation network as a functioning, interacting system, Alabama can become the Freight Gateway to Mid-America.

Industry Cluster Research

It is important that the understanding of the industry clusters developed during the course of this research be continued and enhanced. The automotive and aerospace industries are vital parts of the Alabama economy and periodic surveys will be necessary to stay abreast of the growth and impact. This process should be expanded to include additional industry clusters in the state. Not only is an understanding of the growth of the industry important but additional information specific to industry clusters can be acquired and used to enable growth.

Establish Freight Demand Functions Based Upon Industry Clusters

The forecasting of freight traffic is commonly performed by estimating truck traffic as a percentage of a forecast for overall traffic flow. The percentage of truck traffic used in the forecast is calculated by randomly sampling a segment of overall highway traffic. This is a very indirect method for forecasting freight and essentially separates the forecast from the specifics of the underlying industry and any specific changes or growth in the industry mix. A direct freight forecast based upon industry economic activity offers an improvement to the forecast based upon a percentage of overall traffic flow. A project to establish a more direct relationship between the major traded industry clusters in a region and the freight traffic generated as a result of that cluster activity should be undertaken. Both gross cluster product and the number of cluster employees should be investigated as indicators of cluster economic activity in the relationships for forecasted freight traffic. The task result would be a methodology to build a forecast based upon the traded cluster makeup of the region and the ability to more accurately forecast demand on the infrastructure created by economic growth and industry recruitment.

Impact of Modern Supply Chain Strategies on Freight Traffic

Many industries in the U.S. are heavily focused on reducing waste, improving efficiencies and increasing return on assets. Supply chain strategies are increasingly being used to achieve these goals. For example, excess inventory is a waste and an unnecessary financial asset. Companies are increasingly turning to Just-In-Time delivery in order to reduce inventories. The frequent deliveries, however, often multiple times a day for large assembly plants, increases truck traffic on a daily basis. Similarly, demand for precise deliveries often results in less than truck load deliveries, again increasing truck traffic. On the other hand, vendor managed inventory facilities located in close proximity to manufacturing facilities, reduces inventory owned by the manufacturer as well as reducing traffic flow. A project to develop a multi-stage (customer, distributor, manufacturer, first, second and third tier suppliers) system dynamics model of the supply chain should be developed. The model would be used to develop estimates for truck traffic based upon alternative supply chain and inventory management policies including JIT (just-in-time) and VMI (vendor managed inventory). The results of this project would be used in the development of an Alabama Transportation Infrastructure Model and a long-term system dynamics model.

Develop an Intermodal Traffic Simulation Model for Alabama

The highway traffic model developed in 2004 calculated a deterministic "snapshot" of average traffic flow during a day. Peak traffic flows were estimated based upon ratios to average flow. The model incorporated no interrelationships between modes of shipping, i.e., truck, rail, air or water. The Alabama Transportation Infrastructure Model (ATIM) would overcome many of the limitations of the earlier model. The proposed model would be a discrete simulation that will create traffic flows over a twenty-four hour day. Automobile traffic and truck traffic would be independently calculated and used to simulate overall traffic flows. The model will also incorporate dynamics between modes of shipping. The ATIM should be stochastic in that it will incorporate the random variation inherent in transportation systems as well as the complex interactions of how freight moves over the transportation network and through intermodal connector points.

The ATIM could then be used to estimate how changes in the network or changes in utilization of network components will impact the performance of the overall transportation system and effectively communicate the expected performance of system investment alternatives through powerful visualization and animation presentations. ATIM outputs would include the transportation mode freight movement by system segment and time of day, the ability to perform "What-If" scenarios that can be compared to determine cost/benefit analysis and the ability to highlight problem areas by time of day providing an understanding peak demand system needs.

Determine the Infrastructure Requirements of Targeted Industry Clusters

This project would determine the infrastructure requirements of targeted industry clusters, develop economic payback models of improvement scenarios, identify interrelationships among specific cluster growth rates and input factors (tax and incentive policy, shipping requirements, workforce needs, etc.). This would provide information to the system dynamics model of Alabama infrastructure.

Analyze the Dynamics of Changing Freight Mode

It is necessary to understand and examine the factors that cause a company to review and change their existing mode of shipping freight. The key variables that influence a company to switch freight modes would be incorporated into model equations. Delays, constraints, and limitations to intermodal shifts will be identified. This task will provide input components to the system dynamics model of Alabama infrastructure.

Development of Preliminary System Dynamics Model of the Alabama Transportation Infrastructure

The highway traffic model developed in 2004 provided a calculated average snapshot of highway traffic for a day for the interstate and secondary highways of Alabama. Alternative assumptions for economic growth could be used to generate snapshots of future congestion. This model, however, did not show variation during the day nor did it include other forms of transportation and shipping. The ATIM model described above will simulate all forms of shipping and transportation during a twenty four hour day. This will allow investigation of peak congestion and impacts of network and infrastructure improvements. Neither of these models however has the ability to examine the long-term interaction between a state's economy and the transportation infrastructure. These dynamics are influenced by several long-term feedback loops that interact, influence, and in many ways determine the evolution of a state's well being. One positive feedback loop is the dominant loop identified for cluster growth: as a cluster grows, support resources such as workforce, knowledge base, etc. also increase, thereby supporting continued growth of that cluster. Silicon Valley, Boston and Austin are often cited as examples of cluster growth. On the other hand, traffic congestion is often cited as a constraint to cluster growth. This negative loop arises from cluster growth leading to traffic and congestion and thus inhibiting future industry growth. Another set of dynamic interrelationships involve growth, tax revenues, and future infrastructure improvements to ease congestion. Policies affecting transfer of freight from truck to rail or water can also have multiple impacts through the various relationships, both on highway traffic and the economy. In this project a preliminary system dynamics model that will quantify these interrelationships and develop long-term outlooks for the Alabama economy based on alternative investments in infrastructure would be developed.

In conclusion, the need for a systems approach to freight and traffic analysis and planning was noted in the current USDOT strategic plan: "Americans have built a vast and highly productive network of transportation assets based on the strengths of individual modes – air, marine, highway, transit and rail. Now, our challenge is to become the architects of the future blending these separate constituencies into a single, fully coordinated system – one that connects and integrates the individual modes in a manner that is at once safe, economically efficient, equitable, and environmentally sound."[13]

The truth of the above statement was evident during the research performed by the Office for Infrastructure, Logistics and Transportation at UAH during this project. To handle the effect of increased global trade we must begin to look at the movement of freight as a system of interconnected and interrelated resources that can be flexible and efficient enough to move freight when it needs to be moved, to where it needs to be taken and at a cost that can sustain the network and keep U.S. companies competitive in a global marketplace.

The University of Alabama in Huntsville

Transportation Infrastructure
In
Alabama

Meeting the Needs for Economic Growth

Final Report on the Requirements for Infrastructure and Transportation to Support the Transformation of the Alabama Economy

1. INTRODUCTION

The efficient and effective movement of freight is a critical component in the transformation and growth of the Alabama economy. The Alabama economy has experienced dramatic changes in composition and structure over the past five decades. In recent years, the changes have been most evident in the rapid growth of the automotive, aerospace, and life science industries and declines in the textile, apparel, agricultural, and natural resource industries. All of these trends are very likely to continue. As an example approximately 240,000 automobiles were assembled in Alabama in 2003. By 2006, that number is expected to grow to almost 800,000 arising from the expansion of the Mercedes and Honda plants and the construction of a new Hyundai plant.[1] In addition to the rapid growth of the automotive industry, tomorrow's economy will likely include biomedical, robotics, advanced logistics, and other knowledge-based industries. In a very real sense, over the past twenty years, Alabama has transitioned rapidly into a manufacturing economy from an agricultural and natural resource economy while simultaneously beginning the additional transition to a knowledge-based economy. The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure.

During a hearing of the U.S. House Subcommittee on Highways and Transit (June 2002), the following statement was included in the background statements prior to witness testimony: "No matter how functional the individual parts of the system may be, the effectiveness of the overall system depends on the interconnectivity of the different parts and modes…Connections now must reach beyond a single mode, to foster an integrated and efficient transportation system."[2] The focus of this project is the research and development of an integrated systemic approach to infrastructure planning for dynamic economies in transition.

P-I-E Interrelationship Model

Such an approach must incorporate the interaction between economic activity, infrastructure, population, and congestion. As an economy grows, it generates traffic from both workers and freight shipments, increasing levels of congestion. Similarly, economic growth tends to attract workforce and increase population. Both phenomenon, again, tend to increase congestion. In turn, congestion tends to constrict economic growth and population growth within a region. Each of the interactions occurs with differing strengths and response or delay times. Finally, pressures from congestion and economic growth can lead to additional infrastructure, leading to what is often a short-term reduction in congestion.

Figure 1-1 depicts the interrelationships between population, infrastructure and economic activity. As later sections of this report will detail, the interconnectivity of the factors and congestion combine to determine the outcome of decisions on resource allocations made previously. For example, without infrastructure to support economic activity, congestion will eventually impede growth and population will cease to increase. A decreasing population will have a negative effect on economic activity and thus congestion will be reduced. Therefore, the decision not to provide infrastructure eventually affects population growth and economic activity.

Current freight forecasting methods rely heavily on trend analysis and averages to develop transportation infrastructure plans and these tools are not adequate due to the fact they ignore dynamic interrelationships between system factors. There are interrelationships between transportation infrastructure, population and economic activity that, if not considered as a system, can skew decisions away from more desirable solutions. Trend analysis and averaging do not take into account industry clusters and the freight generation characteristics of a region or the overall economy and productivity in a given area of commerce.

The transportation networks in Alabama are challenged in several areas by congestion, deteriorating infrastructure and a diminishing highway maintenance and improvement budget. The preliminary findings of this research indicate the very real possibility that lack of adequate transportation infrastructure may constrain and limit the growth of Alabama's economy. Moreover, these infrastructure limitations may constrain regional growth opportunities as well.

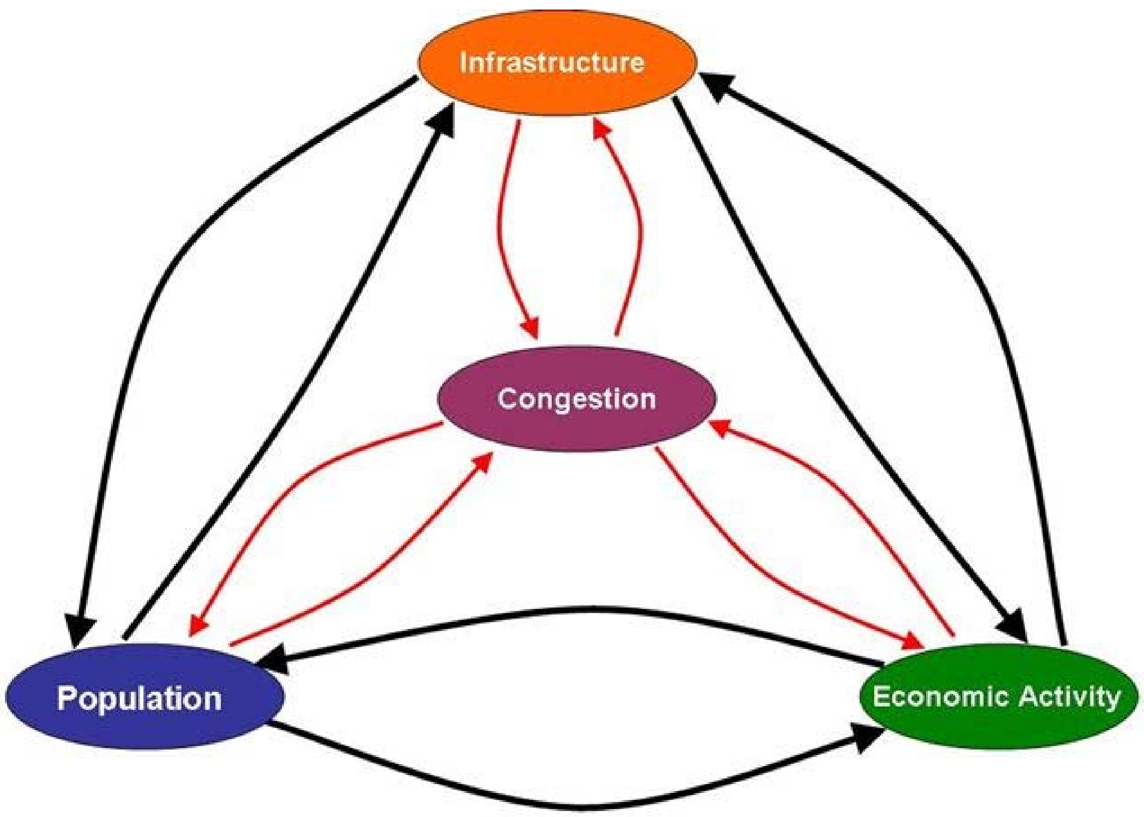


Figure 1-1
P-I-E Interrelationship Model

All is not bleak. Opportunities abound for those with the foresight to establish a position to take advantage of global trade and freight developments. With growing congestion at major United States east and west coast ports, alternative ports such as Mobile, Alabama now have significant opportunities for growth. Alabama, with a deep water port, inland waterways, intermodal facilities, and a well-established international cargo airport could very well take advantage of this opportunity and thus become a major component of the global supply chain and a major contributor to regional economic growth. This regional opportunity, along with in-state economic growth, may be foregone due to inadequate infrastructure.

What transportation infrastructure is needed to both support the growth of the Alabama economy and serve as a stimulus for regional growth is the fundamental question to be addressed. The eventual goal of this research is to answer this question by developing analytical tools, investigating benefits of alternative investments and formulating specific infrastructure plans.

The Office of Infrastructure, Logistics, and Transportation was established at the University of Alabama in Huntsville in 2003 with the mission: "To increase prosperity and economic development in Alabama by identifying, promoting, and supporting the development of the transportation and information infrastructure necessary to support the long-term growth and transformation of the Alabama economy." The objectives of the Office are:

- To identify the infrastructure needs and future requirements of the major business clusters in Alabama.

- To evaluate alternative means for improving the infrastructure and meeting future needs.

- To assess the infrastructure needs of the rural and underdeveloped regions of Alabama and to assess how infrastructure can promote economic development of these areas.

- To identify infrastructure strategies that will promote business cluster growth.

The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure. The analytical effort described in this report addresses this important issue. This assessment required the accomplishment of several major tasks:

- Assessment of the current transportation infrastructure;
- Assessment of the current economic and industry base;
- Determining the likely evolution of the Alabama economy; and
- Determining the transportation infrastructure needed to support that economic growth and transformation.

These tasks were approached through the lens of system analysis using, as the basis of analysis, the P-I-E Interrelationship Model shown in Figure 1-1.

Chapter 2 of this report details the approach taken in the investigative analysis of the current state of transportation infrastructure in Alabama. The traditional approach to transportation issues was rejected in favor of a “systems view” of the transportation network in the state. This “systems approach” allows the analysis of existing data in such a way as to uncover previously undiscovered issues and the development of previously unknown solutions.

It must be stressed that any assessment of this type must include all transportation modes, highway, rail, inland waterways, seaports, airways, and the intermodalism of each. Each of these transportation modes can play a vital role in the development path of a growing and changing economy. Indeed, there is a very real “chicken or egg” problem in considering the interplay between economic development and transportation infrastructure. The presence of frequent international air cargo flights, such as in Huntsville, Alabama, for example, can lead to growth in industries that rely on rapid, time definite delivery. Similarly, the presence of a major deep water port such as in Mobile, Alabama, can create the conditions for the growth of industries with that particular transportation need. On the other hand, the rapid growth of the automotive industry implies the need for adequate movement of raw materials and finished goods. Economic development, industry growth, and the transportation infrastructure are inseparably intertwined. Just as the double helix of the DNA molecule determines cell growth, the intertwined helix of industry and transportation determine the path of future economic growth.

Chapter 3 delves into the analysis of the second factor of the interrelationship model shown in Figure 1-1, population. Population trends have an effect on the economy and infrastructure of a region. Economic activity requires population to grow. A growing economy attracts population, thus creating a cycle of growth and prosperity. The opposite is also true. An economy in decline will lose population as people leave the region to look for opportunity elsewhere, thus creating a downward spiral from which it is very difficult to pull out. The transportation infrastructure in a region is either an enabler or inhibitor of growth. The presence of infrastructure is not necessarily a stimulus for growth, but the lack of infrastructure can extinguish growth.

Rural Alabama is also addressed in Chapter 3. Rural Alabama, and particularly the area of Alabama labeled the Black Belt, is an area known for its depressed and distressed economic climate. High unemployment, low family incomes, and slim chances for economic development have plagued these areas for generations. Many studies have been conducted documenting the poverty in the Black Belt, but few have been followed up with investments to alleviate the distress. Generally, the transportation needs identified were secondary barriers to business success.

In Chapter 4, the third factor in the interrelationship model, economic activity, is assessed. This is accomplished using the industry cluster approach as developed by Professor Michael Porter at the Harvard Business School. (The clusters evaluated in this report are traded clusters the Harvard Business School defines as "traded industries that sell products and services across economic areas, so they are concentrated in the specific regions where they choose to locate production, due to the competitive advantages afforded by these locations.")[3] Clusters typically include end product or service companies, suppliers of specialized inputs, components, machinery, specialized services, financial institutions, and firms in related industries. To understand the interrelationships between industry clusters and transportation infrastructure, a more detailed assessment of the automotive and aerospace industries in Alabama including their current state, likely growth, and future transportation requirements was conducted. The results of these surveys are presented and analyzed.

Chapter 5 presents the development of a quantitative model to address the transportation needs of the growing and changing Alabama economy. This model is an integrated decision support tool that can be used to optimize decision making on limited resources available for infrastructure support and improvement.

In Chapter 6, conclusions and recommendations are presented along with topics for further research.

Introduction to the Systems Analysis Approach

Deficiencies of Traditional Infrastructure Analysis

Analysis of freight transportation and logistics has traditionally been along discrete functional lines. For example, studies on truck freight typically include size of vehicle, routes, speeds, delivery time, costs, etc. These studies do not typically address other forms of shipping. Modes of freight movement, however, are traditionally competing for the same customers. Most competition has tended to focus on the efficiencies of one mode of shipping freight over another such as trucking versus rail. This leads to optimization at the sub-system level, but sub-optimization at the system level.

The term "Systems Thinking" describes the ability to see the world as a complex system, understanding there is interconnectivity between the pieces of the system. "Systems Analysis" describes the process of studying the network of interactions of a system and the development of new and improved methods for performing value added activities. Using a systems thinking approach to the issue of efficient freight movement, the focus is on the entire freight network, not simply the mode of movement. Focusing on the mode can optimize cost for that mode, but not necessarily for the movement of that freight. By focusing on the system, the movement of goods is optimized, therefore reducing cost, improving delivery time and network utilization.

Turning Data into Information

Data can be found in a variety of places and formats. The job of the researcher is to examine the data, determine the appropriateness of the data for a particular application, and present the data in an informative format that allows the user of the information to make reasonable, informed decisions. The approach taken by the research team was to learn as much as possible in a short time about the shape of freight movement in Alabama by analyzing data from two general areas. First, basic research data was generated by executing a survey of the current condition of freight movement by manufacturers in the state. The second source of data was gathered from reputable data collection sources responsible for management and oversight of particular segments of the transportation infrastructure, then mining the data to determine applicability to the research question at hand. These sources of data are listed in Table 1-2.

Manufacturing Survey

In September of 2003, a team of researchers and transportation experts were assembled to create a survey instrument designed to collect data from manufacturers detailing the current situation in freight shipping, both domestic and international and their freight projections for the next five and ten year periods. The survey instrument was qualified through field application in interviews of four manufacturers. Modifications were made to the survey instrument based on the field tests and interviewers were trained in completing the revised survey instrument. The survey data was collected by interview rather than mail, telephone or electronic means to increase the accuracy, response rate and quality of the responses. The information being collected was open to interpretation by the respondent therefore clarification of the data being requested was required by the interviewer to achieve consistency in data collection.

In November 2003, researchers at the University of Alabama in Huntsville (UAH) began surveying Alabama’s manufacturing industries to determine the future demands on the transportation infrastructure arising from industrial growth in Alabama, and to determine the infrastructure requirements necessary to support the continued growth of industry in Alabama. The survey process was completed in May 2004. As data was collected, initial concentration was placed on the Automotive and Aerospace industries. Additionally a list of leading Alabama companies in 13 other major industry clusters was developed. Sales and employment information for each company listed was determined where information was available. In total, 240 companies were interviewed. These companies comprised more than 26% of total employment for these 15 clusters. The collected data was entered into a database for analysis. The companies surveyed represented a significant cross-section of major industries from all geographic regions of the state. The data was gathered for 2003 actual shipments as well as projected shipments for 5 and 10 years in the future.

The fifteen major industry clusters surveyed include the following:

Aerospace	Fabricated Metals	Primary Metals
Apparel	Food Products	Printing
Automotive	Industrial Machines	Rubber
Chemicals	Lumber	Textiles
Electronics	Paper	Transportation Equipment

Table 1-1

Data mining techniques were used to understand more completely the status and operation of freight transportation modes in the state. By also gathering data from multiple sources, shown in Table 1-2, the team was able to cross-reference multiple measures of performance and usage to obtain a clearer picture of modal activity.

Alabama Dept. of Transportation • Traffic flow on interstates and highways • Railroad maps with company rail line designation	**Federal Highway Administration** • Traffic flow on interstates and highways • Historical traffic growth
Private Industry Sources • CSX Intermodal • Norfolk Southern Intermodal • BNSF Intermodal • Moffit and Nichols – Choctaw Point Report	**Army Corp of Engineers** • River borne commerce for Alabama • Freight by port
Dept. of Geography University of Alabama • Maps of Alabama	**American Association of Railroads** • Freight carried on Alabama railways
Bureau of Transportation Statistics • Air Freight data by airport • Commodity flow survey	

Table 1-2
Data Sources

Educating Stakeholders on Infrastructure Reality

As the research team created information from the volumes of data, a separate but necessary task began, which was to enlighten stakeholders as to the condition of the transportation infrastructure network in Alabama. This effort was accomplished by presenting information to groups or individuals as soon as the findings of the research were presentable and getting feedback from those stakeholders. This commentary, in turn, was incorporated into the research when appropriate. Presentations of the information compiled and analyzed were made whenever and wherever opportunities were available. Some of the more noteworthy presentations made are listed in Table 1-3.

Details of how the data was collected and analyzed can be reviewed in the Report Appendix. In that section, the data to information process is described for each mode of freight transportation: highway, railway, waterway and air.

Presentation	Content	Date
The Commission on Manufacturing Economic Stimulus and Free and Fair Trade	Presentation to a subcommittee of the Governor's Commission on Manufacturing	March 31, 2004
Presentation to the Freight Policy Task Force - US Department of Transportation	Presentation on the status of the research program and methodology of data gathering and refinement	August 23, 2004
Alabama Department of Transportation	Don Vaughn, Asst. Transportation Director, Commitment to participate and assist in research	September 8, 2004
Alabama International Trade Association	Presentation on the import and export plans for 200+ manufacturing firms in the top 15 industries in Alabama	October 1, 2004
ACF River Issues Conference	Presented the transportation findings from the automotive industry survey	October 18, 2004
AEC Economic Development Conference	Presented findings from the Automotive Industry Survey along with the Automotive transportation survey and Industry Cluster Analysis	November 3, 2004

Table 1-3
Presentations of Research Findings

In the next chapter the current state of transportation infrastructure and background on the modes of transportation will be discussed. It is imperative that the history and current status of infrastructure within the state be understood in depth so that the information gathered can be appropriately used to develop forecasts and to enhance decision making across the entire system.

Figure 2-0
Alabama Highways

Source: Alabama DOT

2. TRANSPORTATION

The Transportation Infrastructure System

This chapter presents historical data on the utilization of the transportation infrastructure in Alabama. Data is presented for highways, railroads, inland waterways, seaports, airways and intermodal freight capabilities. This data in its entirety provides a picture of a system and its growth and evolution over time. It will be seen that each mode has a unique historical pattern that reflects transportation choices by users. Public policy and investments can affect future utilization patterns. Before embarking upon an analysis of these potential policies and investments, however, the current trends and conditions must be fully understood for these represent the takeoff point for the future.

2.1 Highways

Alabama has 29,209 miles of Federal Aid Highway, of which, 906 miles are interstate (figure 2-0). In total, there are 94,311 miles of all weather roads in the state. Highways in Alabama have experienced steadily increasing volume for the last three decades. For example, at mile 260 of Interstate 65 in Birmingham, Alabama, which is approximately one mile south of the I-65/I-59 intersection, traffic volume has grown from an Annual Average Daily Traffic Volume (AADT) of less than 40,000 vehicles per day in 1970 to almost 150,000 in 2002, a growth rate of nearly 275%, shown in Figure 2-1. Similar data is presented in the following for the other major highway facilities in the state.

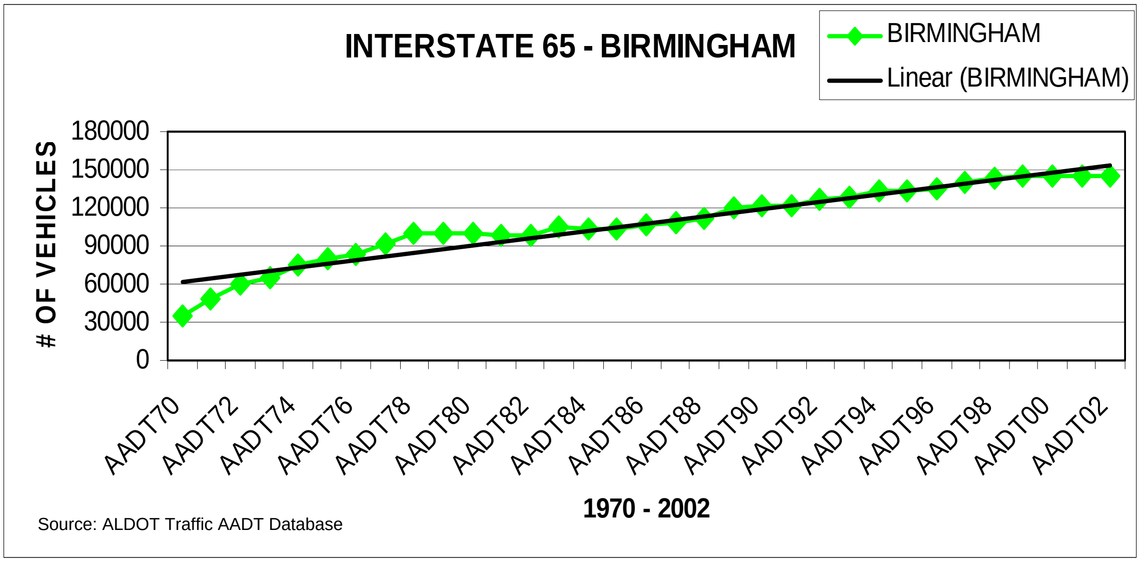


Figure 2-1
Traffic Volume at Mile 260, 1 Mile South of I-65/I-59 Intersection

Highway traffic data was obtained from the Federal Highway Administration and the Alabama Department of Transportation (AL DOT, www.dot.state.al.us). A database of historical traffic counts containing traffic volumes for all interstates and major highways in Alabama was obtained from AL DOT. These traffic volumes date back to 1980 for all roads and, in many cases, back to 1960. Table 2-1 below illustrates data provided by AL DOT. This chart presents the volume of traffic by year from 1998 to 2002 for sections of highway between a beginning mile marker and an ending mile marker for a particular route (I-65 in this case) around the city of Birmingham. The TADT column indicates the percentage of traffic volume that is designated as commercial and the HVY column is the percentage of commercial traffic deemed as heavy (3 axles or more).

CITY	RTE	BEGINML	ENDML	1998	1999	2000	2001	2002	TADT	HVY
BIRMINGHAM	65	238.46	242	54930	59420	58790	59540	60630	17	79
BIRMINGHAM	65	242	246.06	66510	68640	69020	69930	71320	16	76
BIRMINGHAM	65	246.06	247.26	77310	79390	82360	82950	84150	14	75
BIRMINGHAM	65	247.26	248.57	97100	98990	102980	102980	104530	13	72
BIRMINGHAM	65	248.57	250.08	97100	98990	102980	102980	104530	13	72
BIRMINGHAM	65	250.08	251.97	106330	109140	110210	110210	109720	11	70
BIRMINGHAM	65	251.97	253.92	113170	116380	114940	114940	116160	10	70
BIRMINGHAM	65	253.92	255.22	115510	118900	118860	118860	118490	10	70

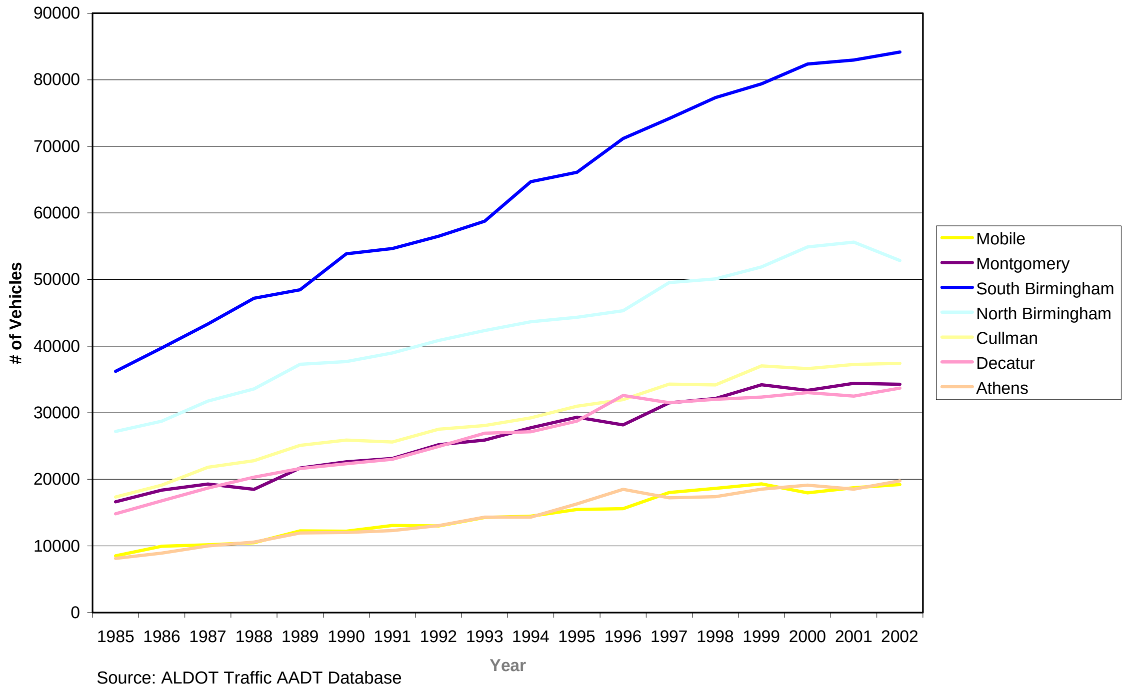
Source: ALDOT Traffic AADT Database

Table 2-1
AL DOT Traffic Volume Chart – Sample Data

The research began by analyzing the traffic count database. AADT, TADT and HVY counts for every mile of interstate were obtained for the years 1985 – 2002.

Figures 2-2 through 2-7 present AADT data over time for segments of road on several of the interstates in Alabama. For example, in Figure 2-2 the growth for seven mile markers on Interstate 65 is shown. Each line represents traffic growth over time at a particular location. Each of the mile markers chosen are located at or near a city on Interstate 65. Figures 2-3 and 2-5 present the miles after interstates 20 and 59 split outside of Birmingham. It may be seen in Figures 2-3 and 2-5 that very little growth took place on each of the mile markers for the years 1995 through 2002. From the other figures it is apparent that most of the growth in traffic has occurred in and around the Birmingham MSA.

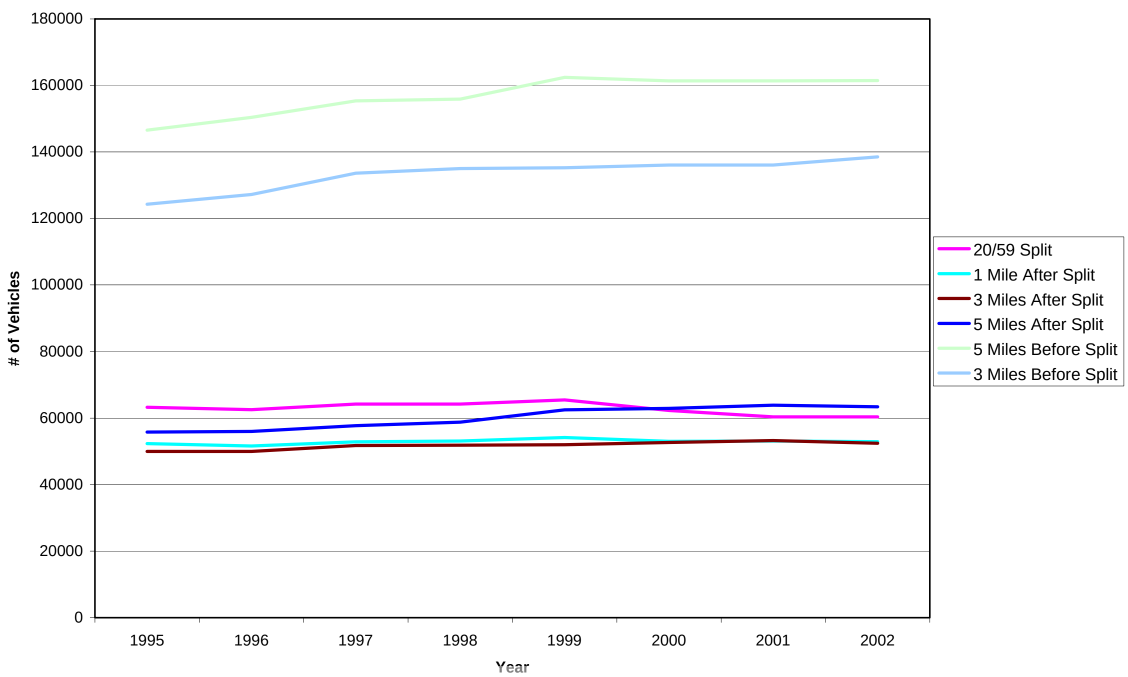
Interstate 65 Annual Average Daily Traffic



Source: ALDOT Traffic AADT Database

Figure 2-2

Interstate 20 (at 20/59 split) Annual Average Daily Traffic



Source: ALDOT Traffic AADT Database

Figure 2-3

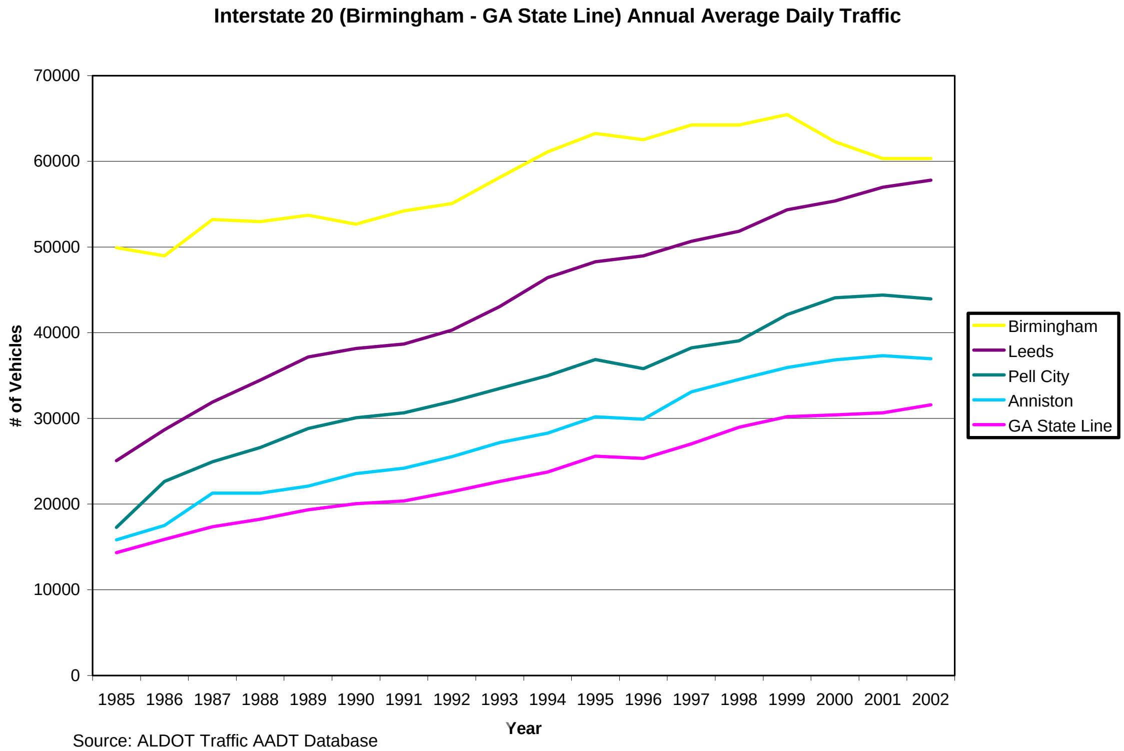


Figure 2-4

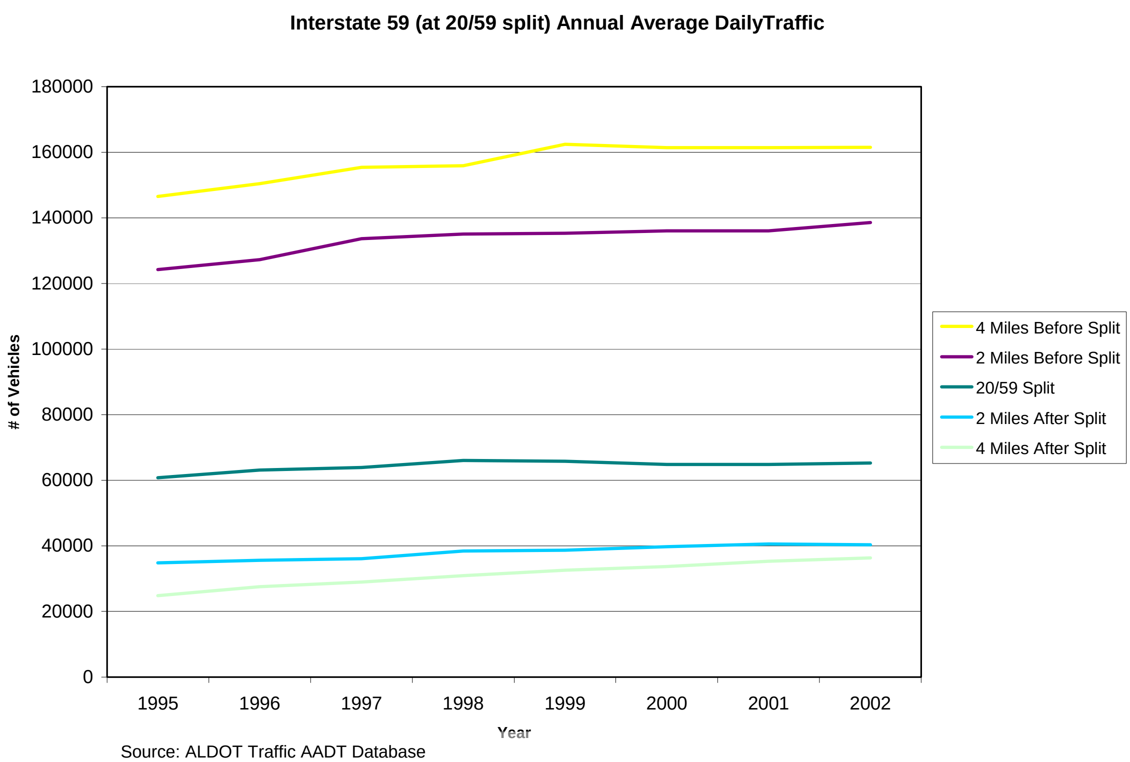


Figure 2-5

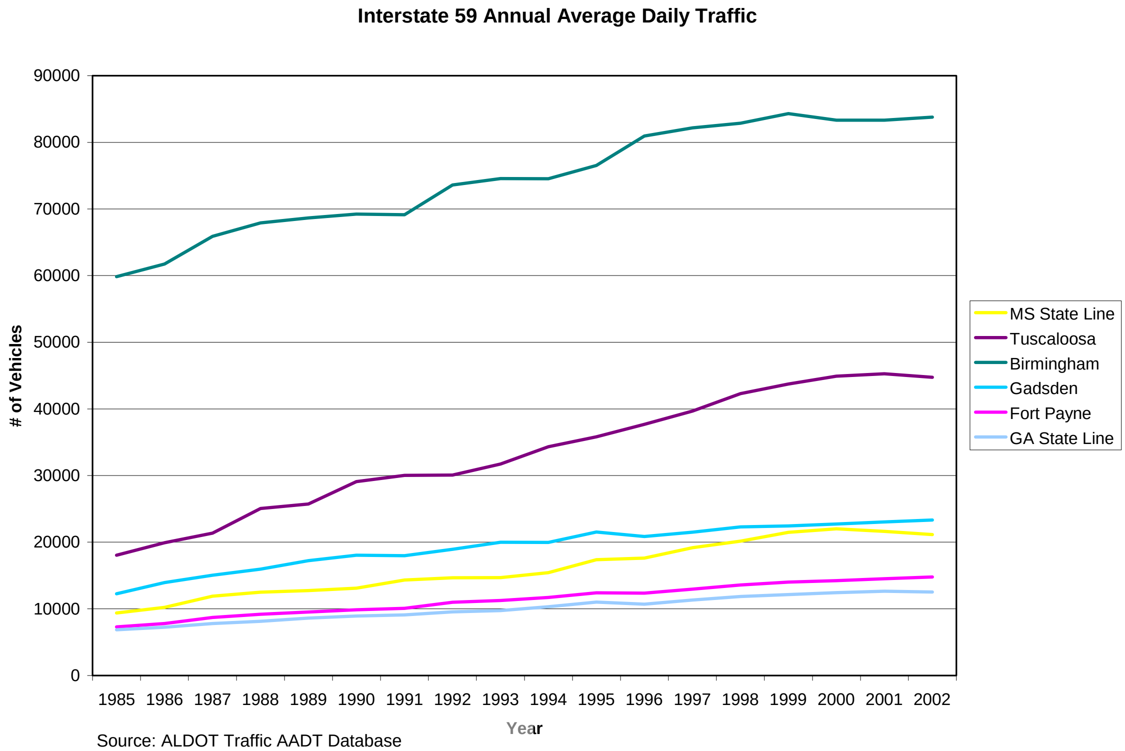


Figure 2-6

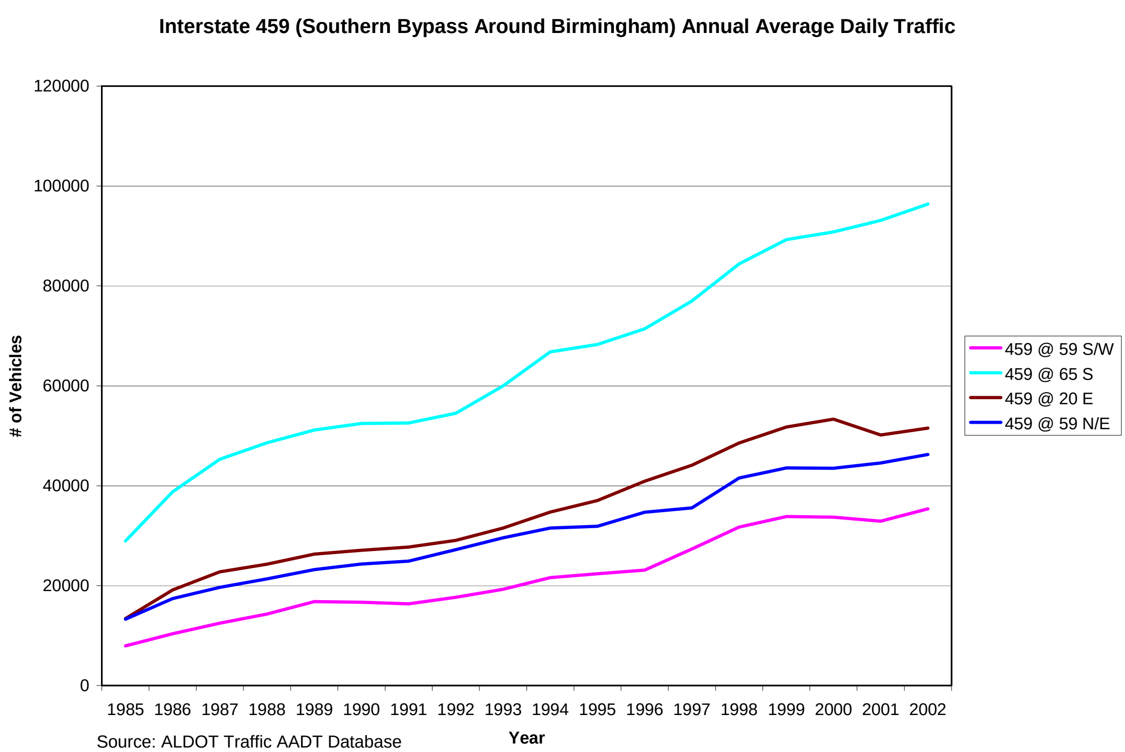


Figure 2-7

Figure 2-8 represents the growth of the average annual daily traffic on Interstate 65, a major interstate running from Mobile in the south to the Alabama – Tennessee state line in the north. This chart presents the AADT for mile markers running south to north. Each line represents a different year. It can be seen, for example, that the greatest daily traffic counts occur around Mobile at mile number 5, near Montgomery at mile number 170, and then around Birmingham at mile marker 260. This chart provides a visual image of traffic flows going south to north through the state. From this chart it can be seen that not only has the number of vehicles traveling on interstate 65 increased, but the spread of high traffic areas and congestion has also increased. For example the total traffic in Birmingham at mile 260, the tip of the peak, grew by approximately 45,000 vehicles from 1985 to 2002. Moreover, it shows that the spread of areas with 40,000 AADT or more increased from 19 miles (267-248) to a distance of 55 miles (286-231), nearly a tripling of miles of congestion at high traffic periods. Figure 2-9 shows the capacity of Interstate 65 compared to the 2002 AADT from Figure 2-8. As can be seen in the chart, the average daily volume exceeds capacity in Birmingham and the ALDOT congestion guidelines in Montgomery and Birmingham. Figure 2-10 breaks down the AADT to show total traffic volumes, plus those that are commercial traffic (TADT) and the number of vehicles that are commercial and over 3 axles (HVY). The dramatic decrease that occurs around mile 265 in Figure 2-10 is due to the intersection on Interstate 65 with Interstate 20/59. Figure 2-11 is a closer look at the TADT and HVY for Interstate 65 in 2002. Figure 2-12 shows the growth in commercial traffic on Interstate 65 between the years 1985 and 2002. Figure 2-13 represents the growth in commercial traffic that is 3 axles or more for the same time period. The same process and charts are depicted in Figures 2-14 through 2-38 for Interstates 20, 59, 10, 85, and 459.

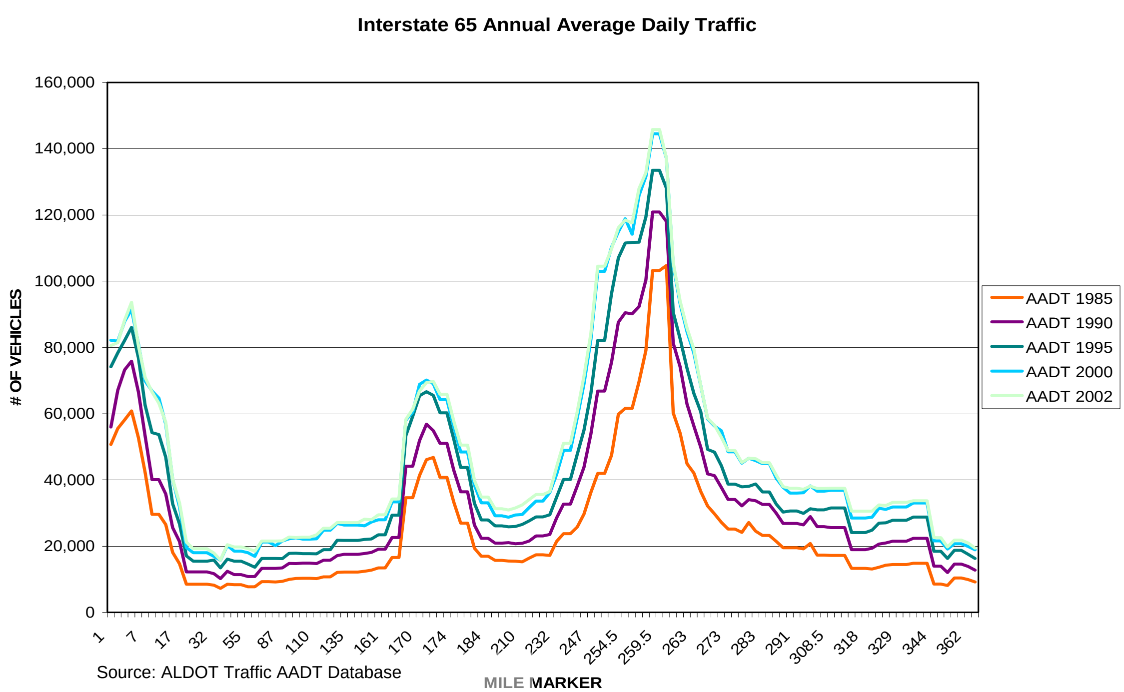


Figure 2-8

Traffic Levels on Interstate 65
with Capacity Indicated

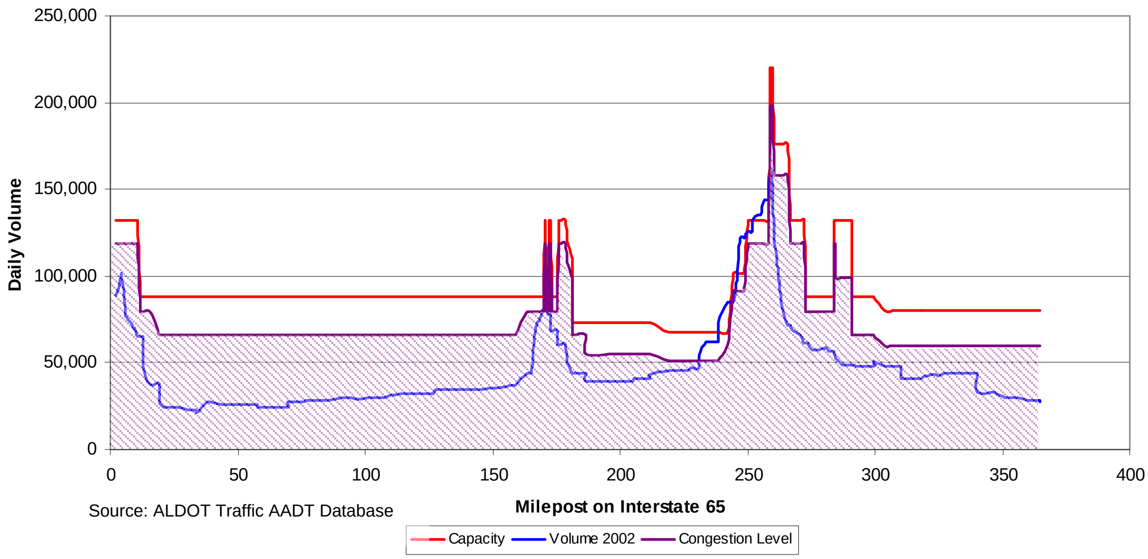


Figure 2-9

Interstate 65 Annual Average Daily Traffic With Commercial And Heavy Traffic 2002

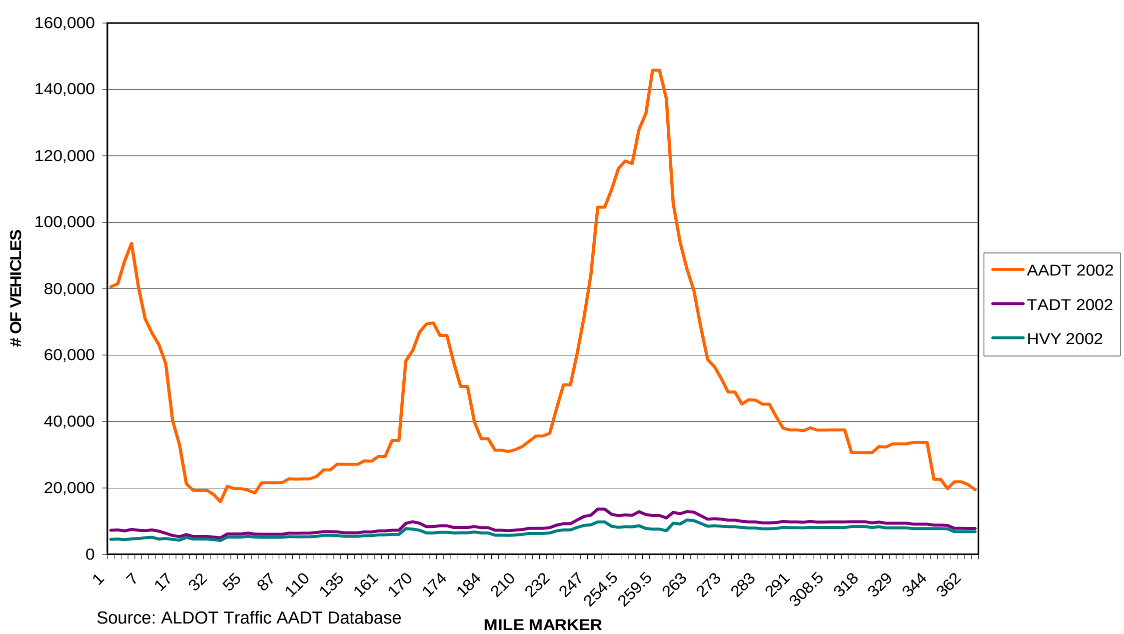


Figure 2-10

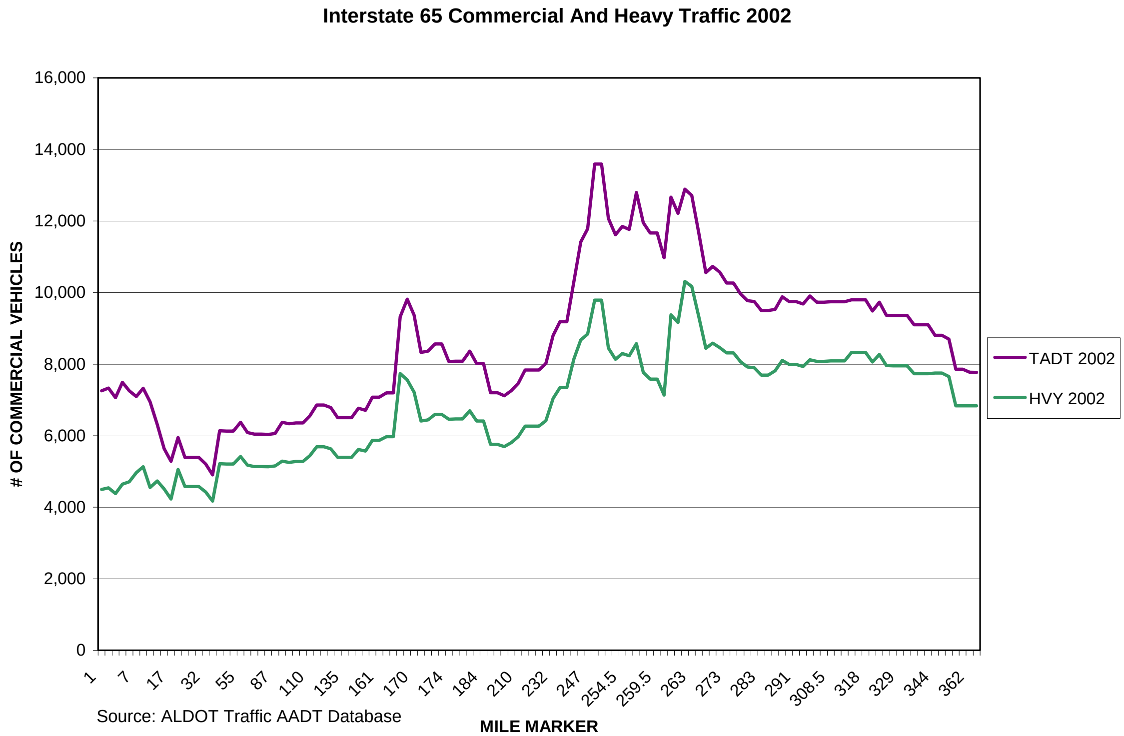


Figure 2-11

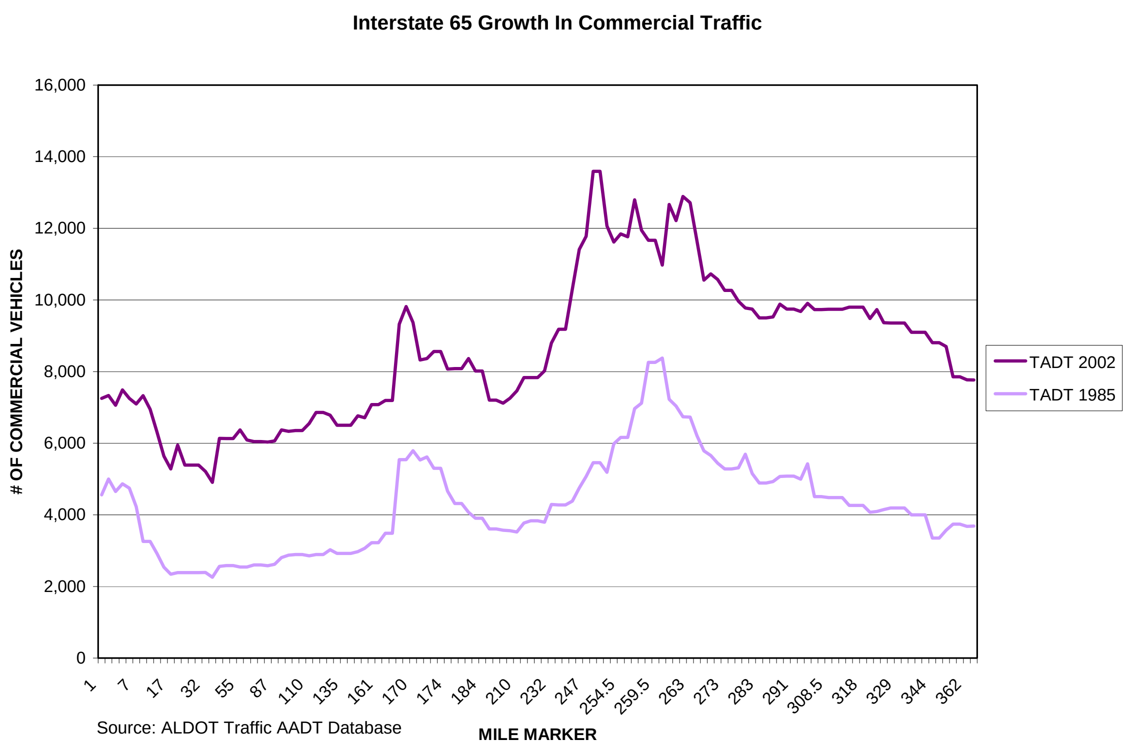
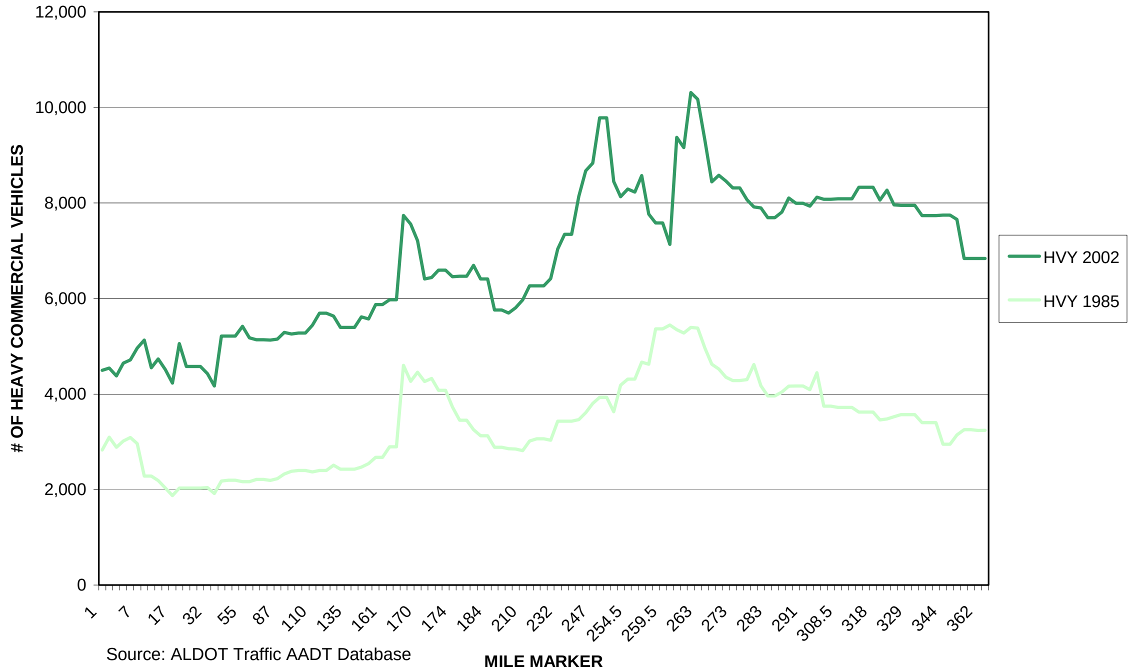


Figure 2-12

Interstate 65 Growth In Heavy Commercial Traffic



Source: ALDOT Traffic AADT Database

Figure 2-13

Figures 2-14 through 2-19 present the data for Interstate 20. One thing to note in Figure 2-16 is the sudden decline in traffic at mile 133. This decrease is due to the split of Interstates 20 and 59. It is also interesting to note in Figures 2-18 and 2-19 that both commercial traffic and commercial traffic with 3 or more axles grew significantly on Interstate 20 between 1985 and 2002. TADT and HVY traffic volumes increased approximately 50% near mile marker 86 on the west side of Birmingham and near mile marker 168 on the east side of Birmingham. This growth is likely tied to the opening of the Mercedes vehicle assembly plant near mile marker 86 and the Honda vehicle manufacturing plant near mile marker 168.

Interstate 20 Annual Average Daily Traffic

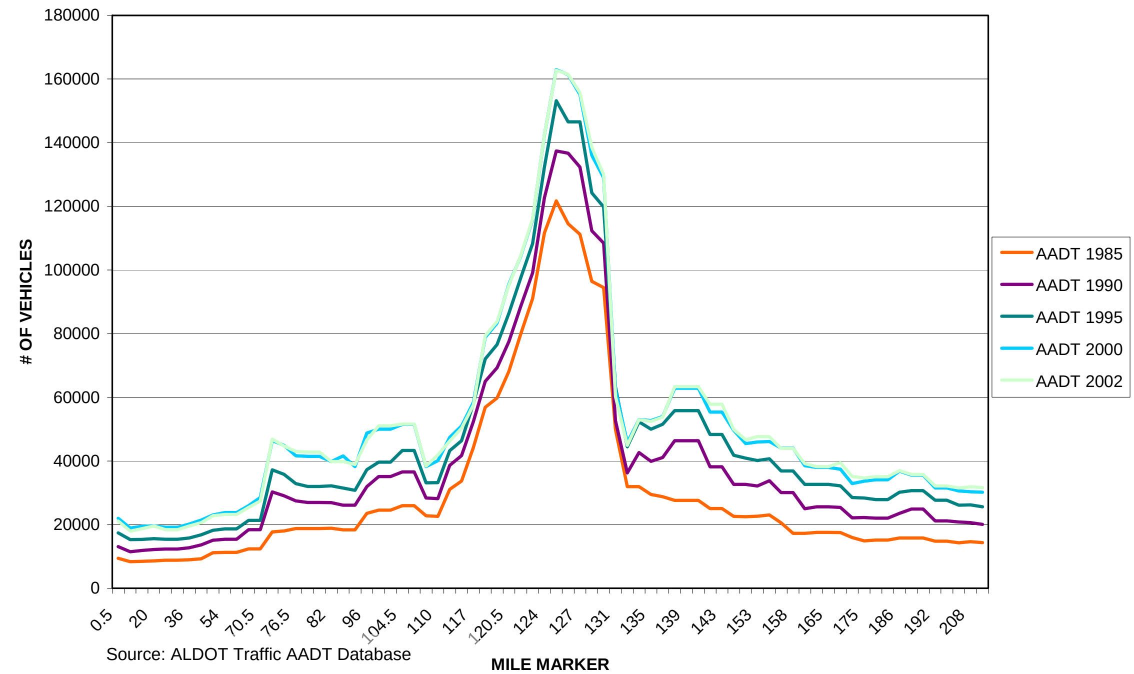


Figure 2-14

Traffic Capacity on Interstate 20

Traffic Levels on Interstate 20 with Capacity Indicated

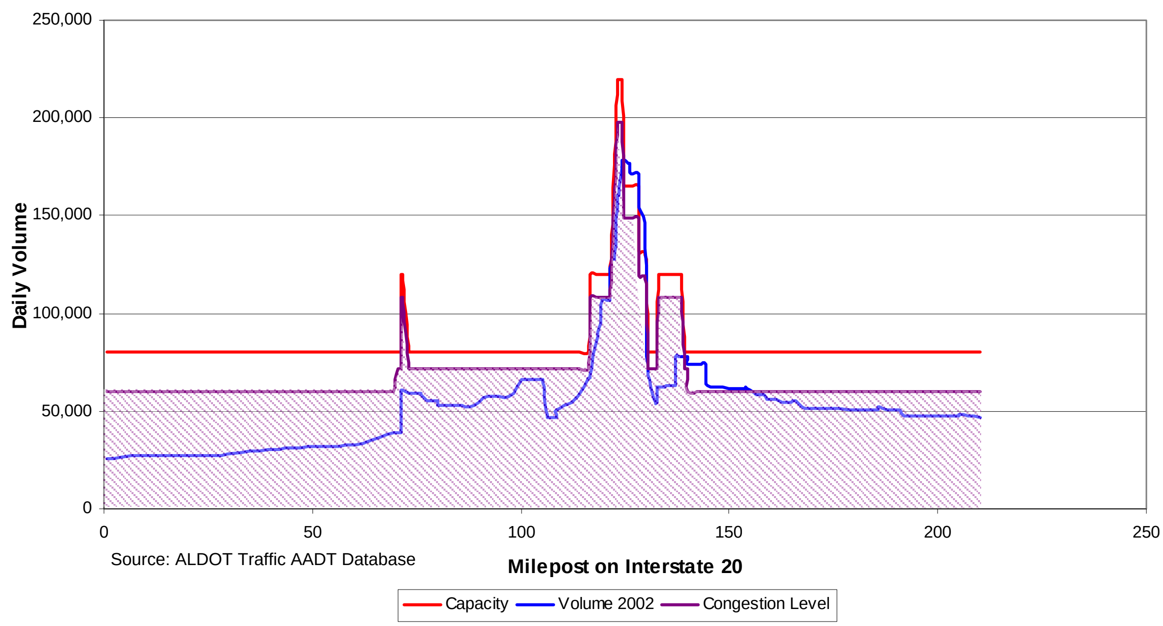


Figure 2-15

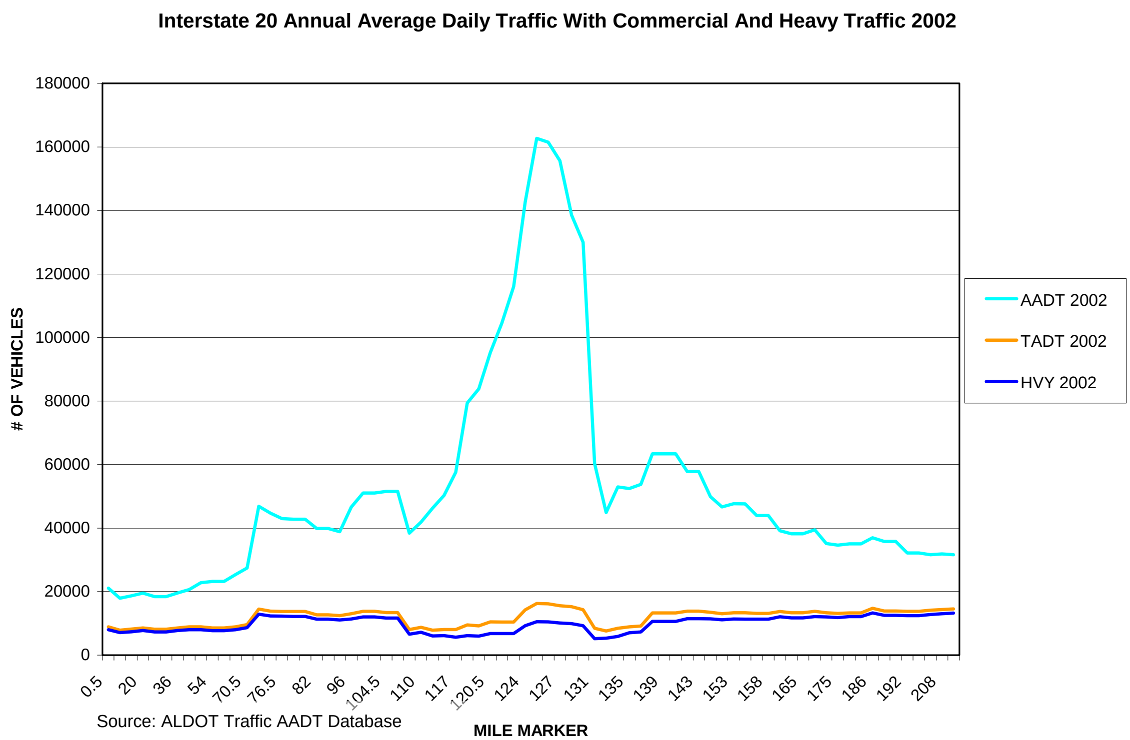


Figure 2-16

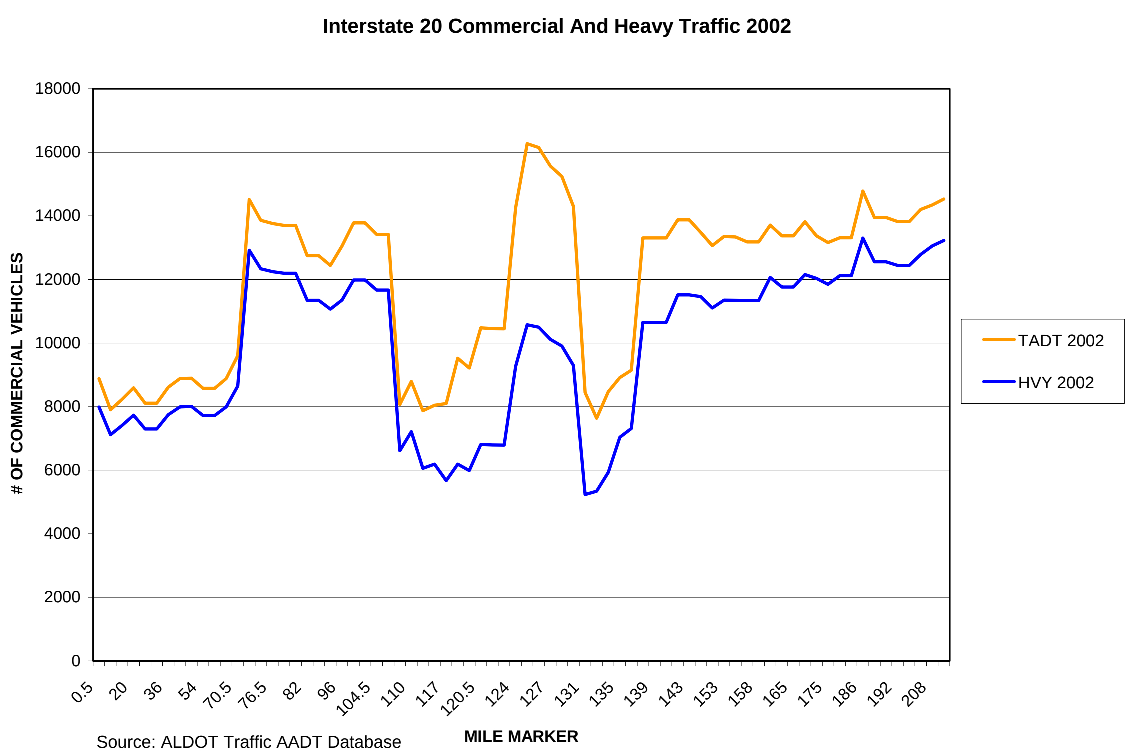
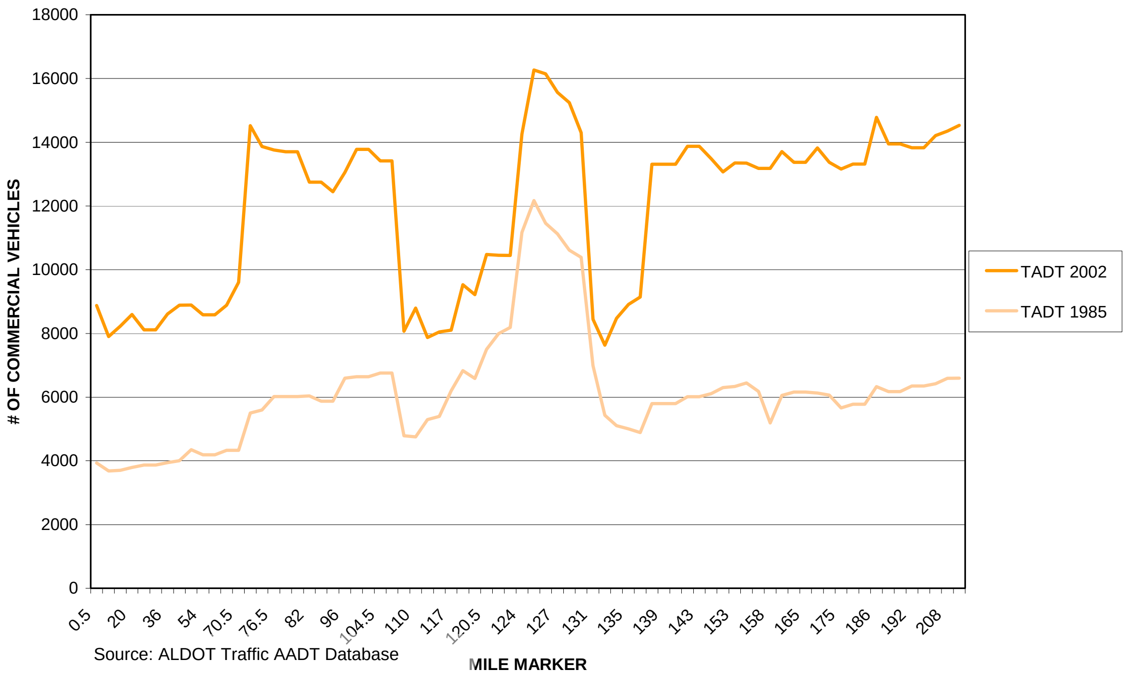


Figure 2-17

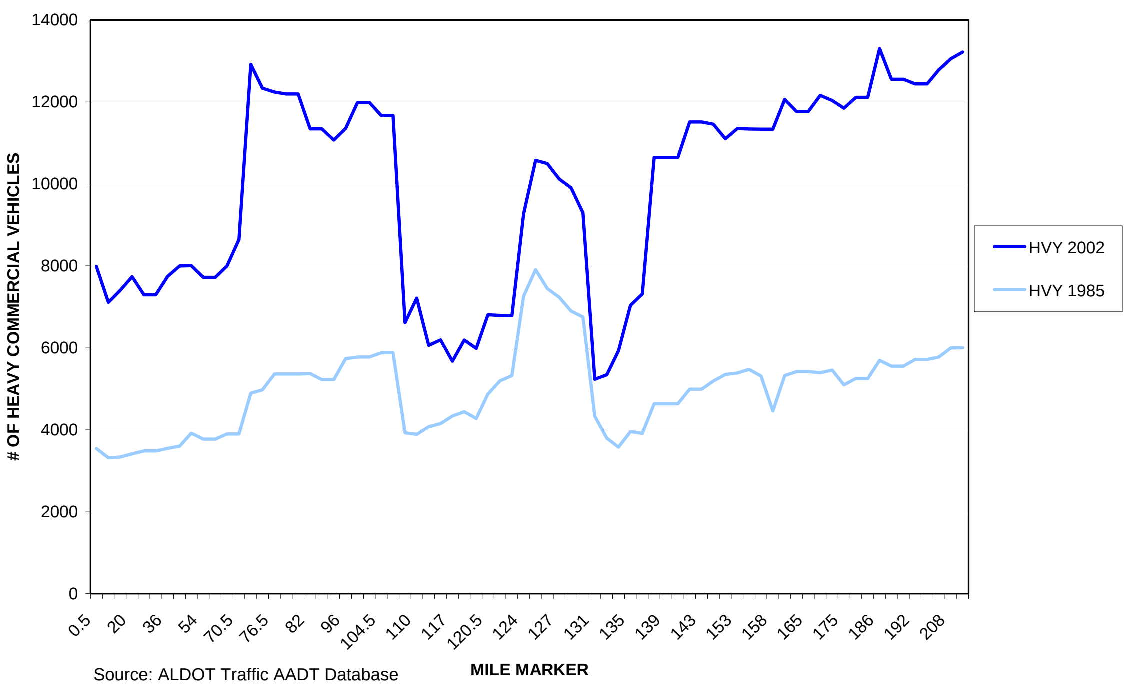
Interstate 20 Growth In Commercial Traffic



Source: ALDOT Traffic AADT Database

Figure 2-18

Interstate 20 Growth In Heavy Commercial Traffic

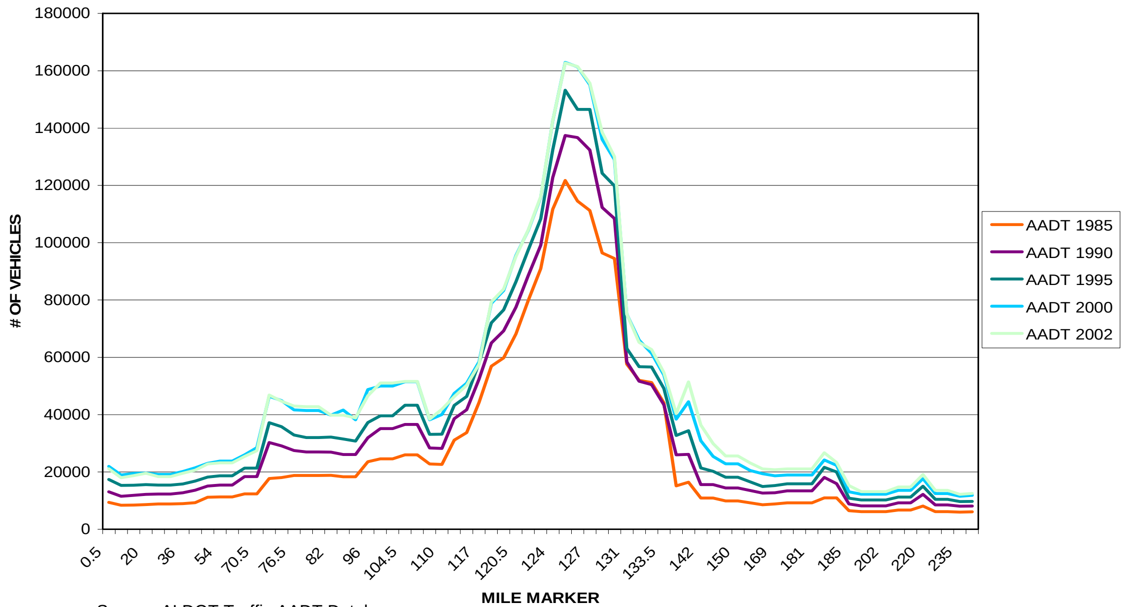


Source: ALDOT Traffic AADT Database

Figure 2-19

Figures 2-20 through 2-24 represent traffic volumes on Interstate 59. Figure 2-21, like Figure 2-16, shows the split of Interstates 20 and 59, which results in a diversion of traffic from I-59.

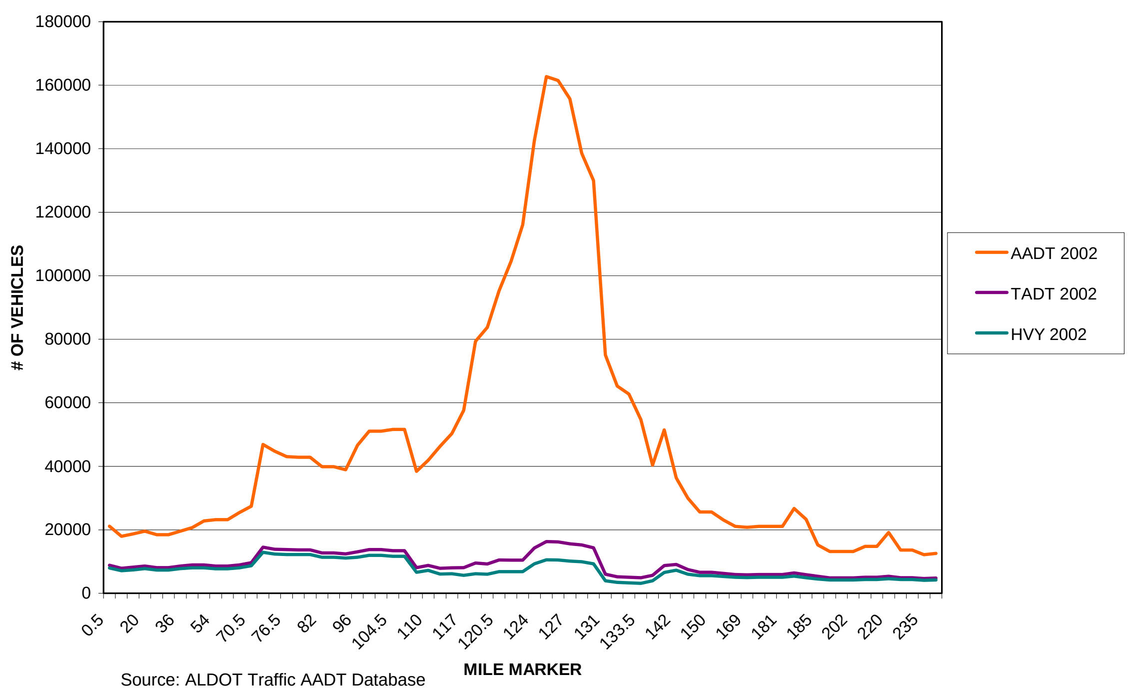
Interstate 59 Annual Average Daily Traffic



Source: ALDOT Traffic AADT Database

Figure 2-20

Interstate 59 Annual Average Daily Traffic With Commercial And Heavy Traffic 2002



Source: ALDOT Traffic AADT Database

Figure 2-21

Interstate 59 Commercial And Heavy Traffic 2002

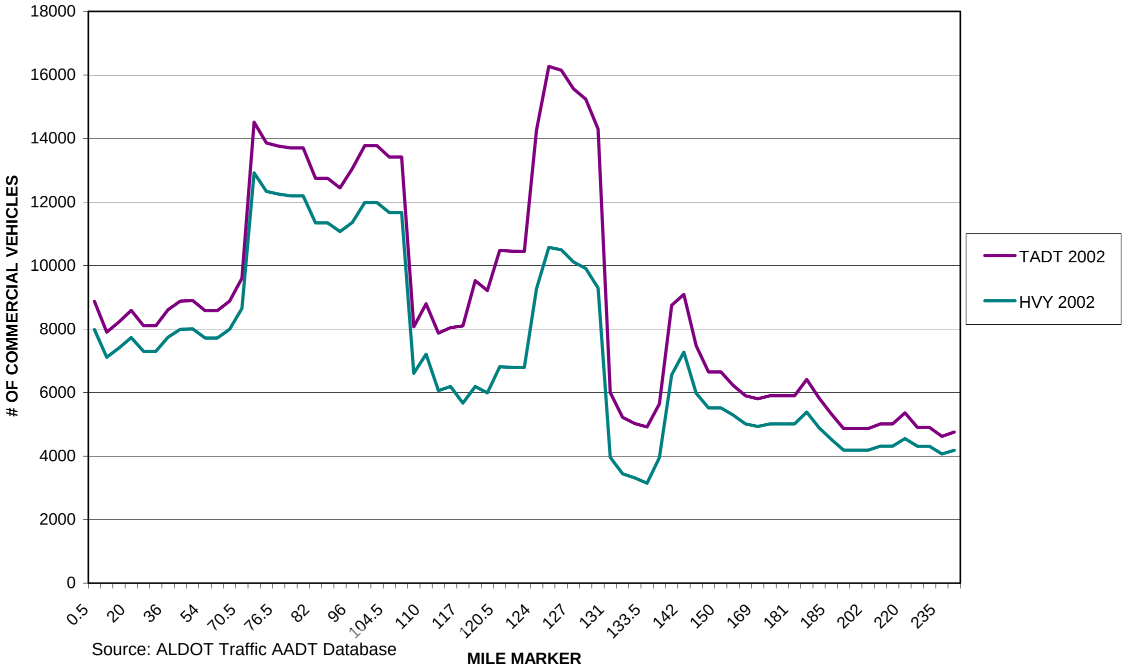


Figure 2-22

Interstate 59 Growth In Commercial Traffic

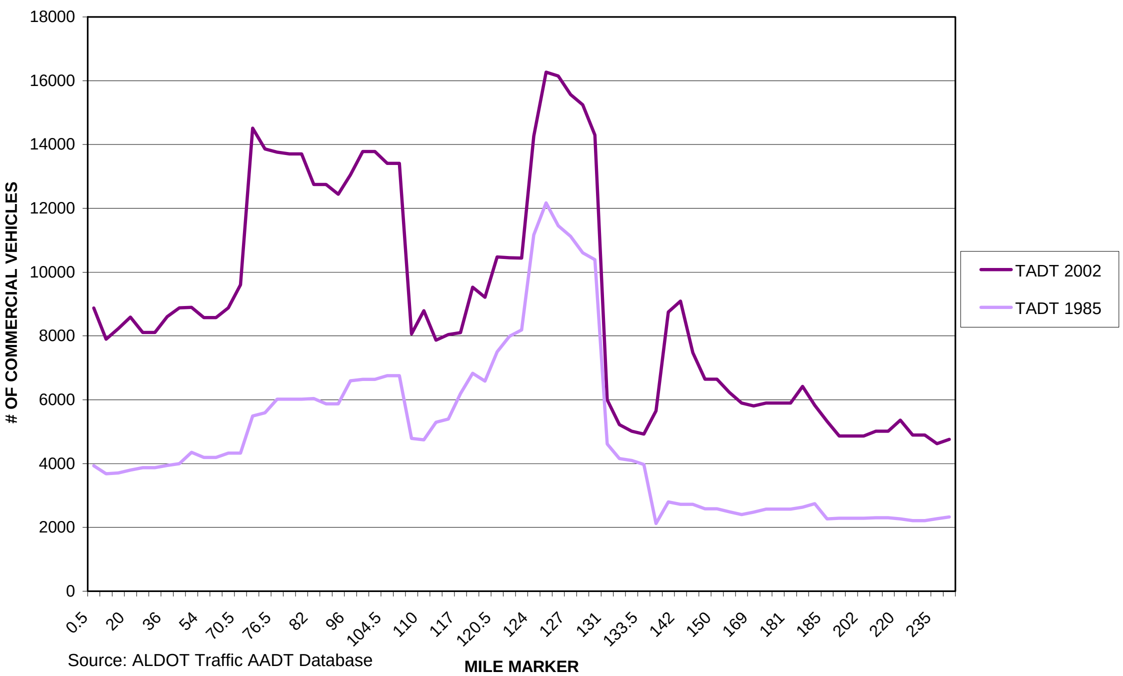


Figure 2-23

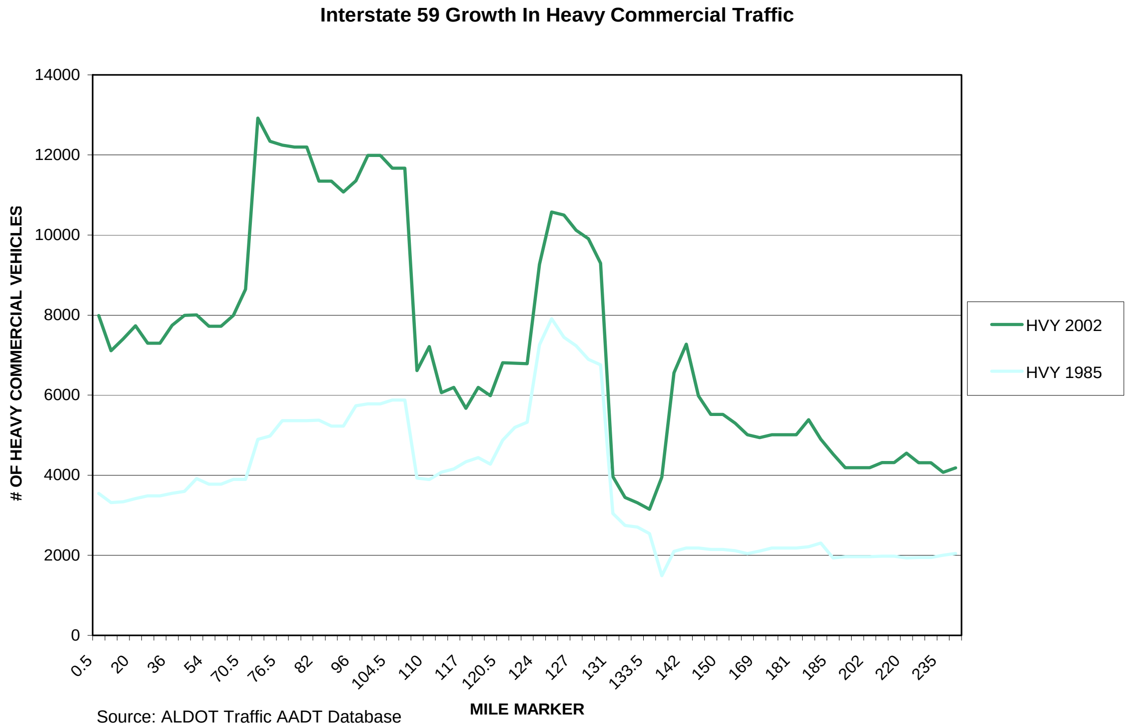


Figure 2-24

Figures 2-25 through 2-29 represent Interstate 10. In Figure 2-26, the peak at mile marker 17 is the point where Interstate 10 and Interstate 65 intersect and where Interstate 65 ends. It is possible to see from the charts that Interstate 10 has experienced steady growth.

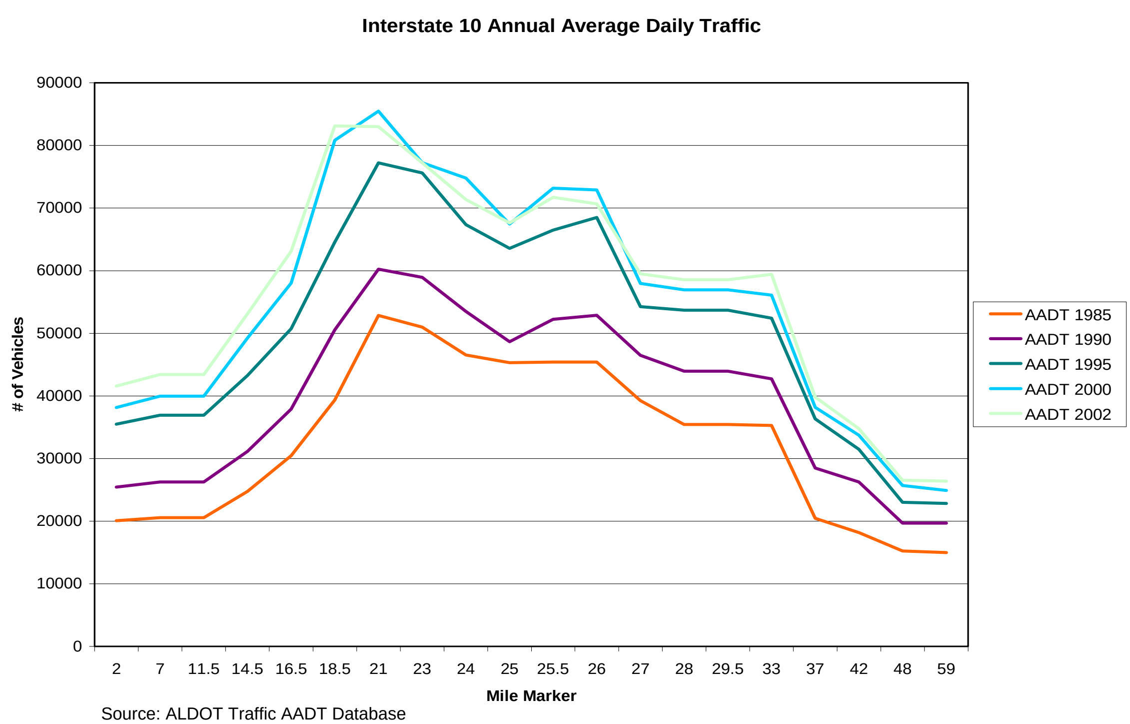


Figure 2-25

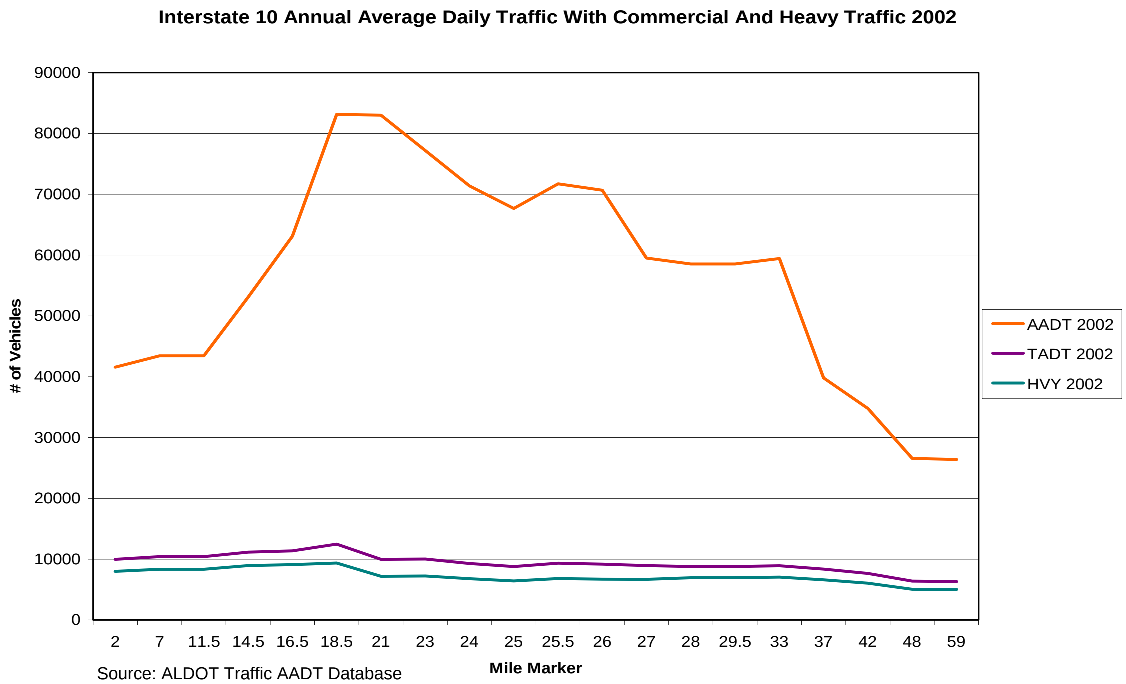


Figure 2-26

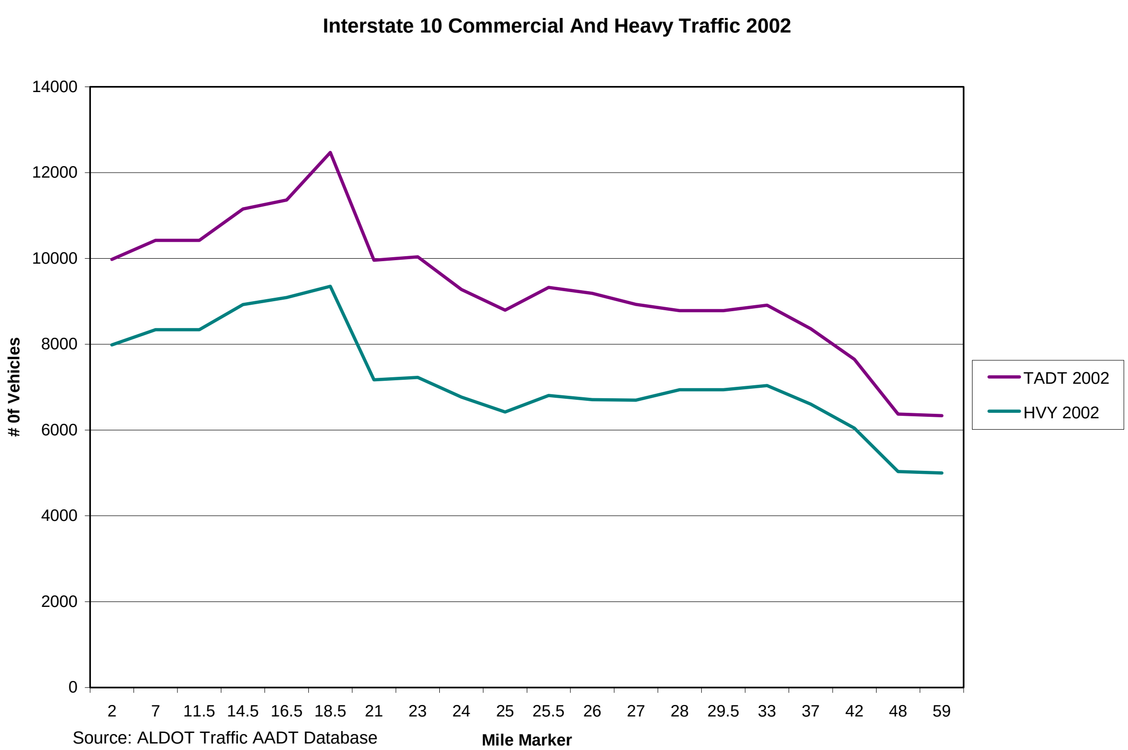
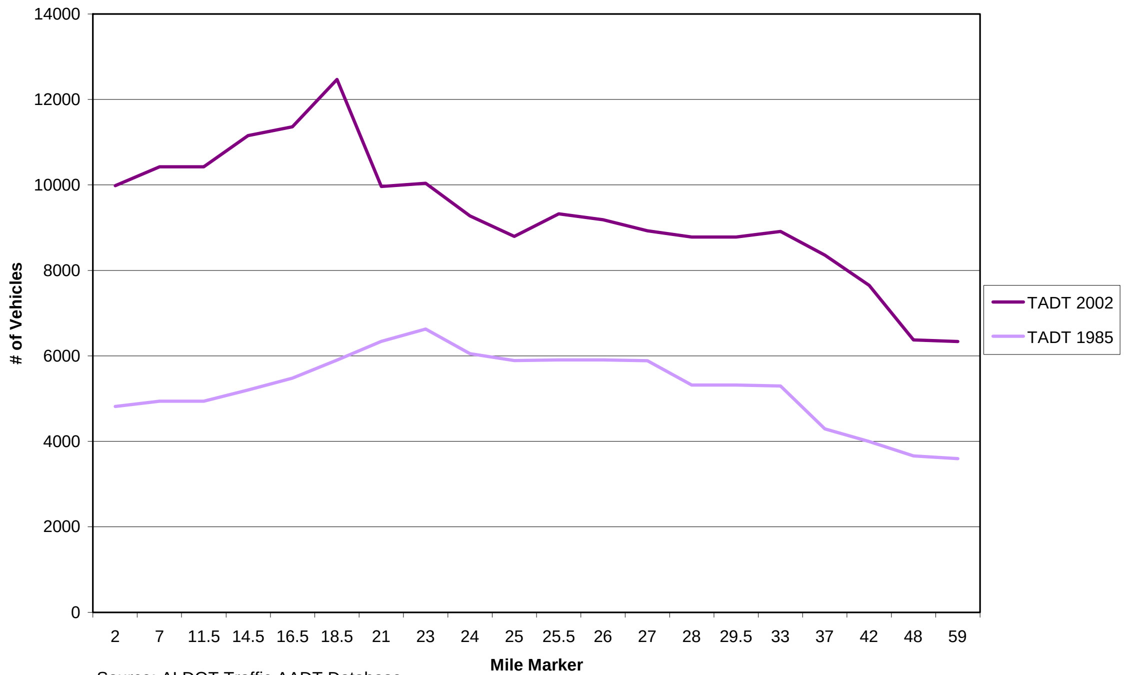


Figure 2-27

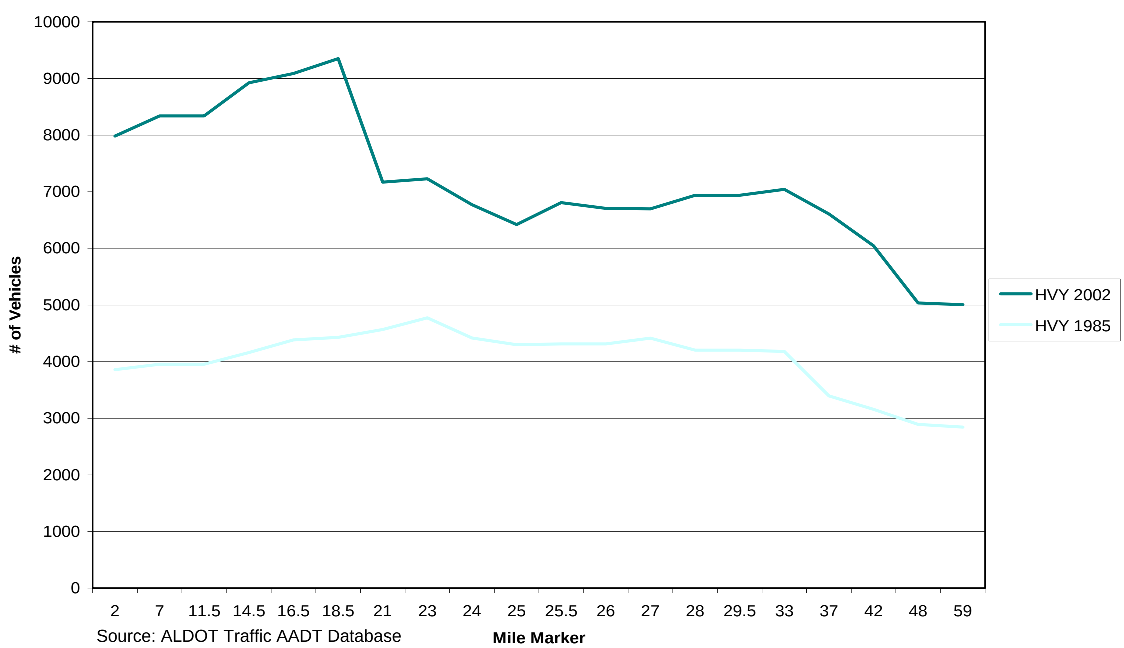
Interstate 10 Growth In Commercial Traffic



Source: ALDOT Traffic AADT Database

Figure 2-28

Interstate 10 Growth In Heavy Commercial Traffic



Source: ALDOT Traffic AADT Database

Figure 2-29

Figures 2-29 through 2-33 represent traffic volumes on Interstate 85 from Montgomery east to the Georgia state line. In the charts, mile 0 through 10 is the city of Montgomery. The small increase in traffic near mile 60 is Auburn–Opelika and Auburn University.

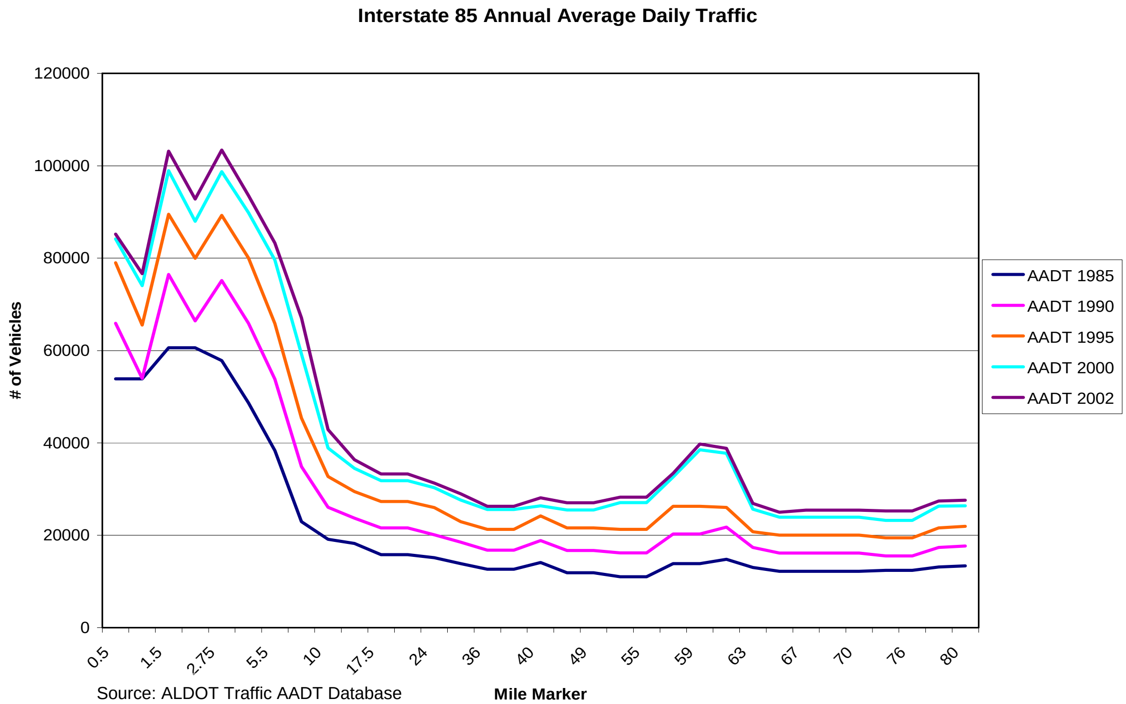


Figure 2-30

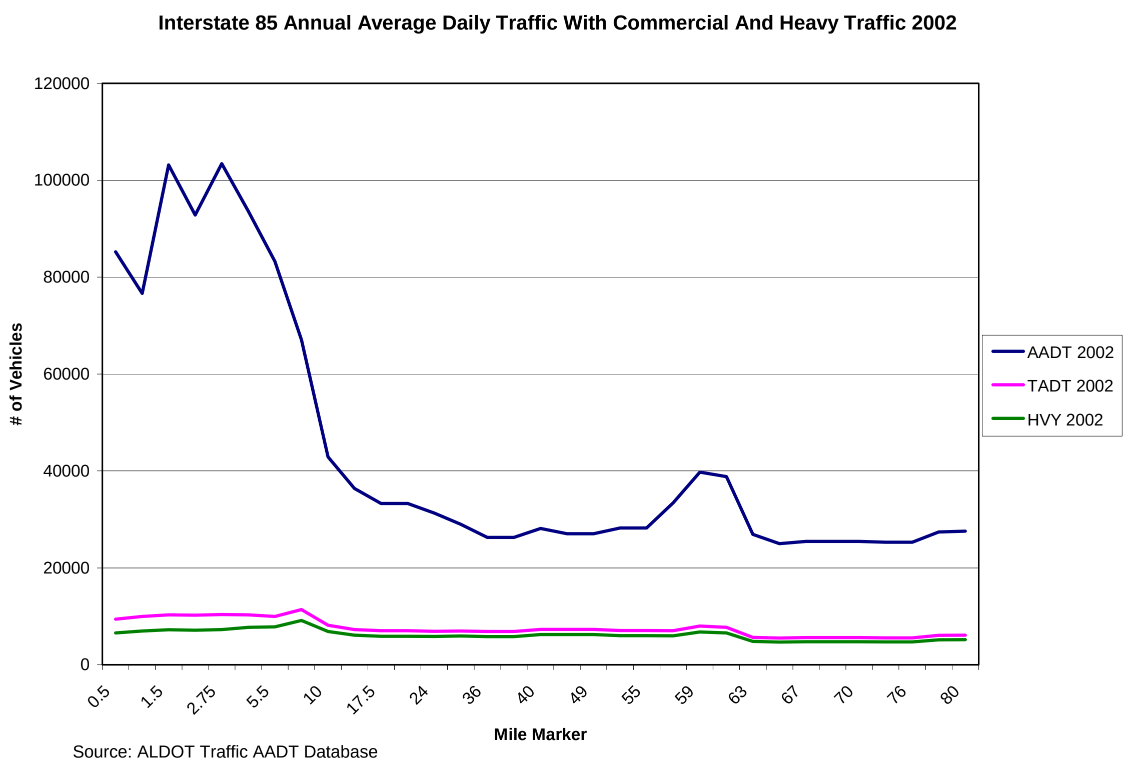
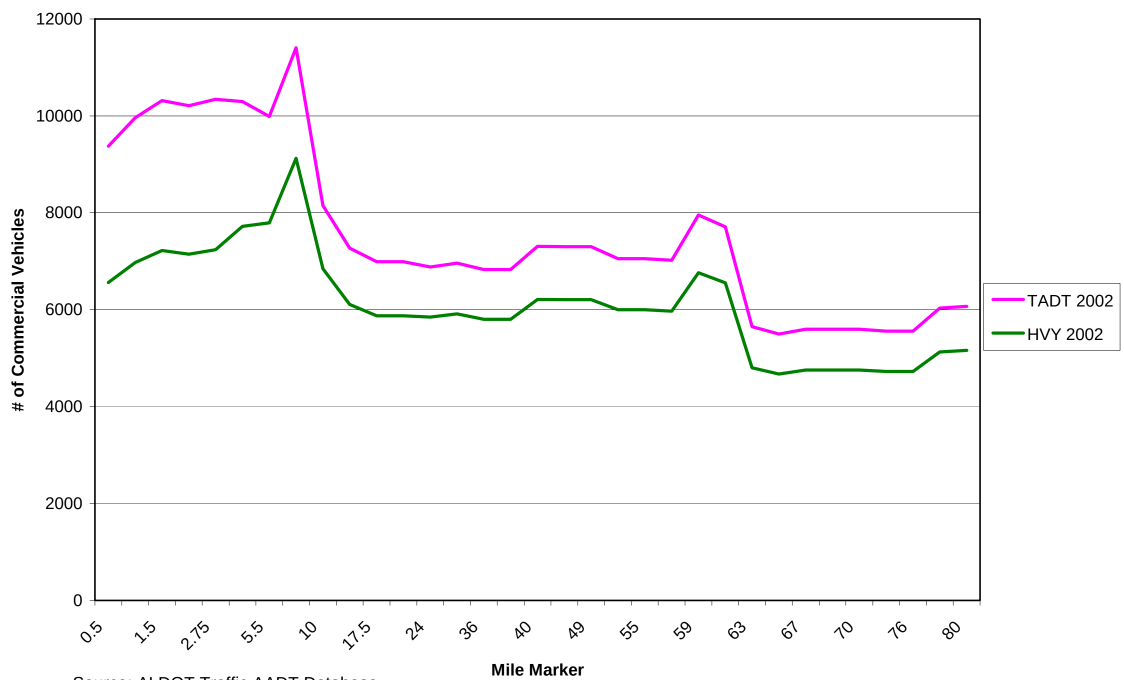


Figure 2-31

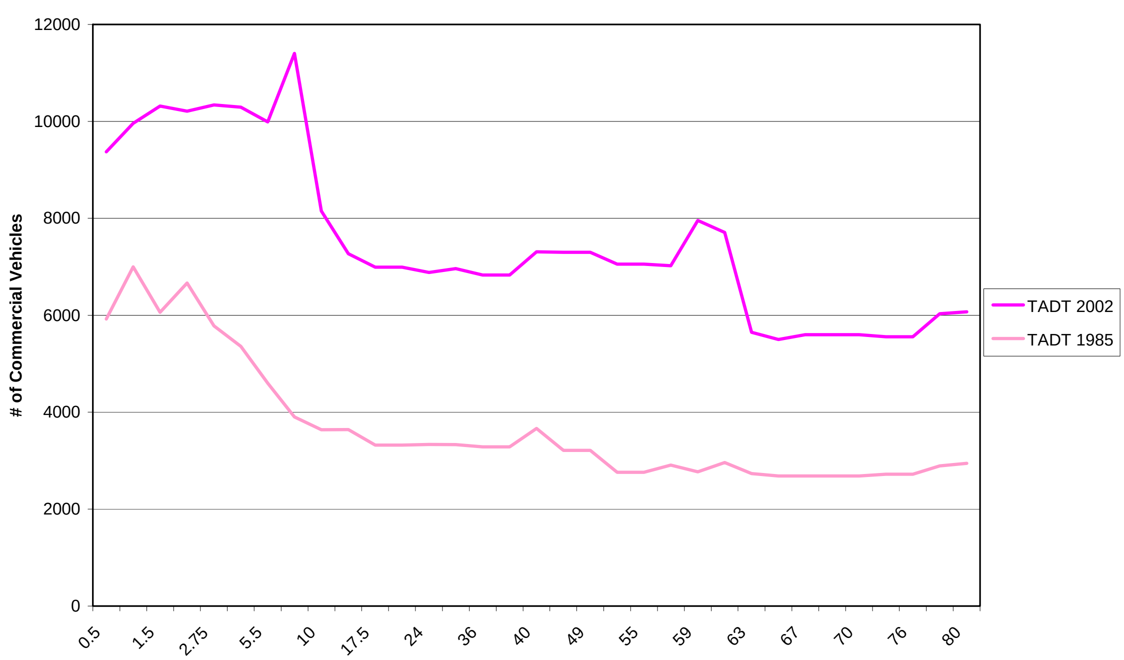
Interstate 85 Commercial And Heavy Traffic 2002



Source: ALDOT Traffic AADT Database

Figure 2-32

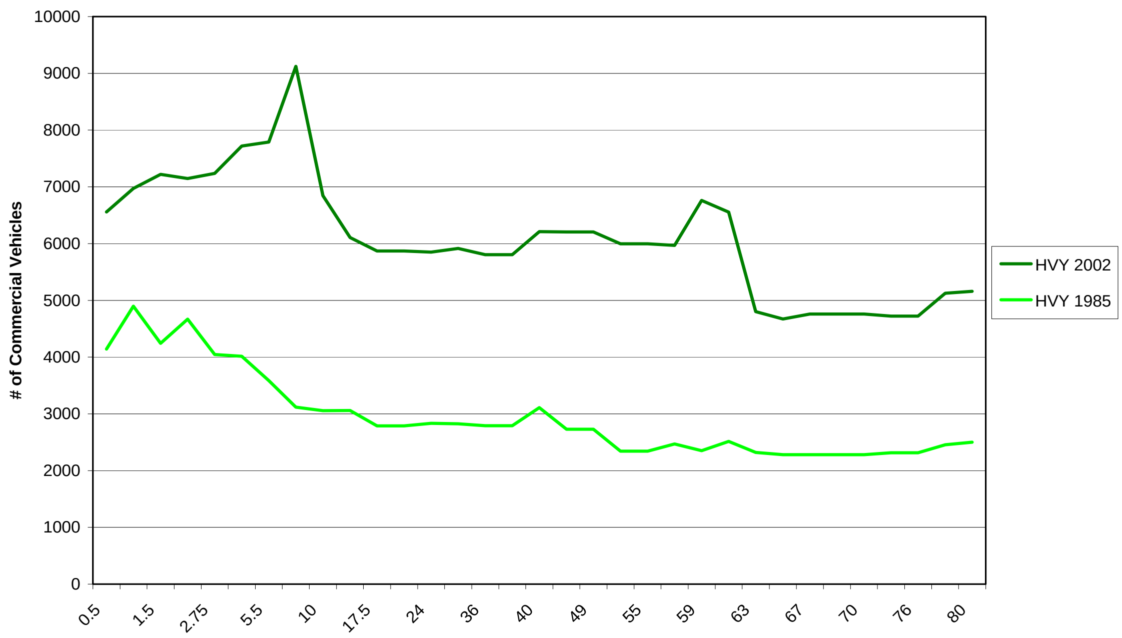
Interstate 85 Growth In Commercial Traffic



Source: ALDOT Traffic AADT Database

Figure 2-33

Interstate 85 Growth In Heavy Commercial Traffic

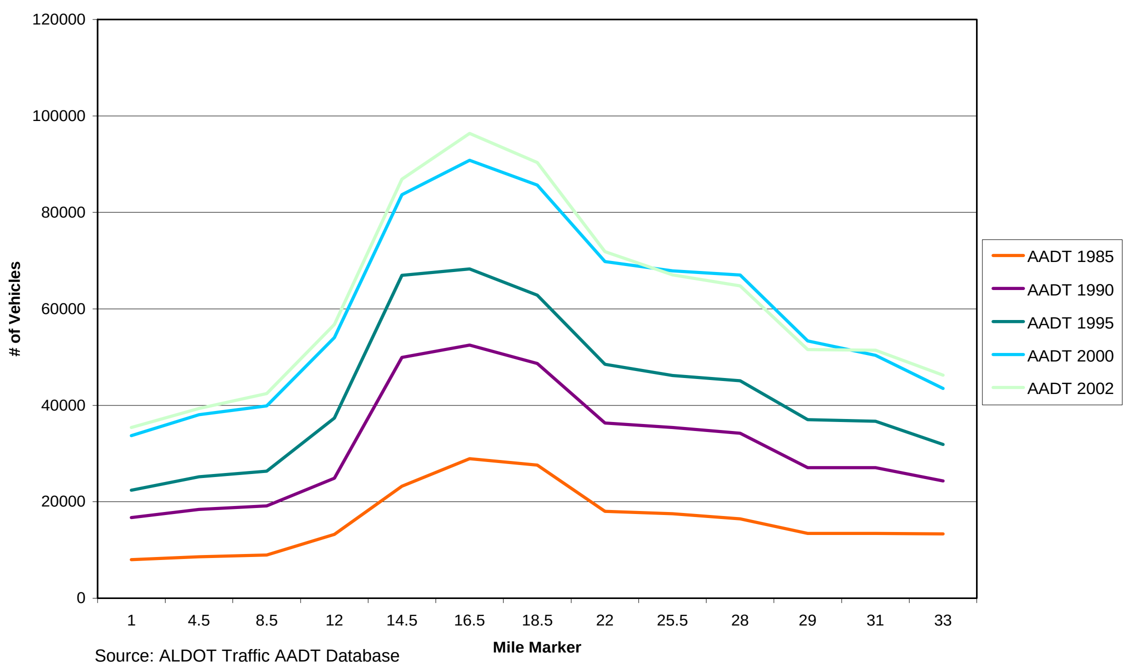


Source: ALDOT Traffic AADT Database

Figure 2-34

Figures 2-35 through 2-39 present Interstate 459, a southern loop around Birmingham. It is interesting to note that commercial traffic has increased approximately 300% from 1985 to 2002, shown in Figures 2-38 and 2-39.

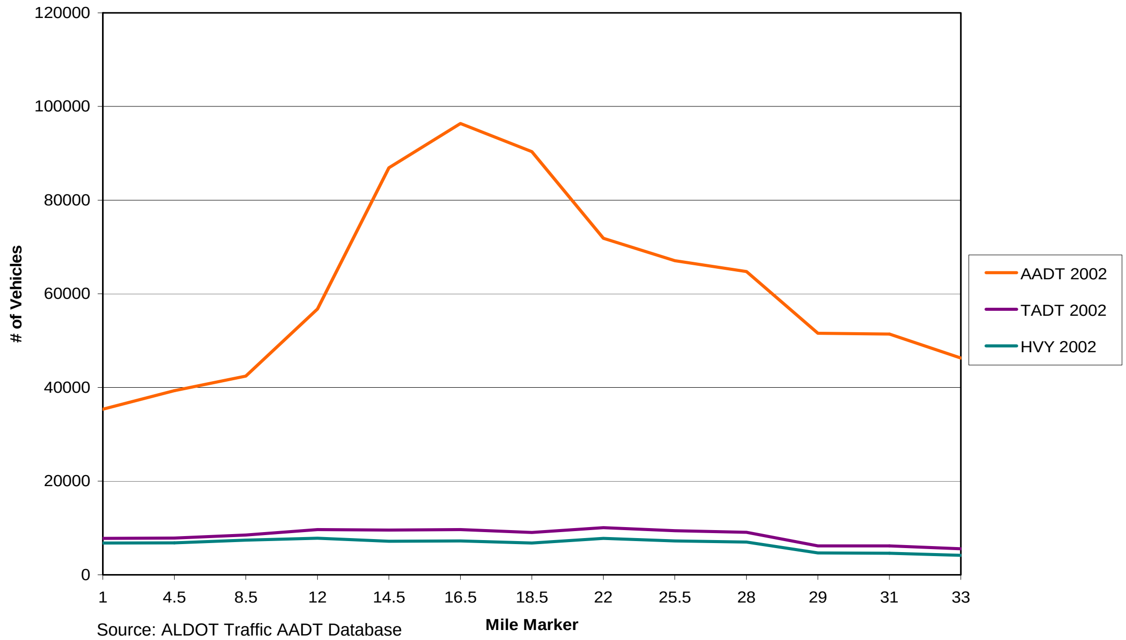
Interstate 459 Annual Average Daily Traffic



Source: ALDOT Traffic AADT Database

Figure 2-35

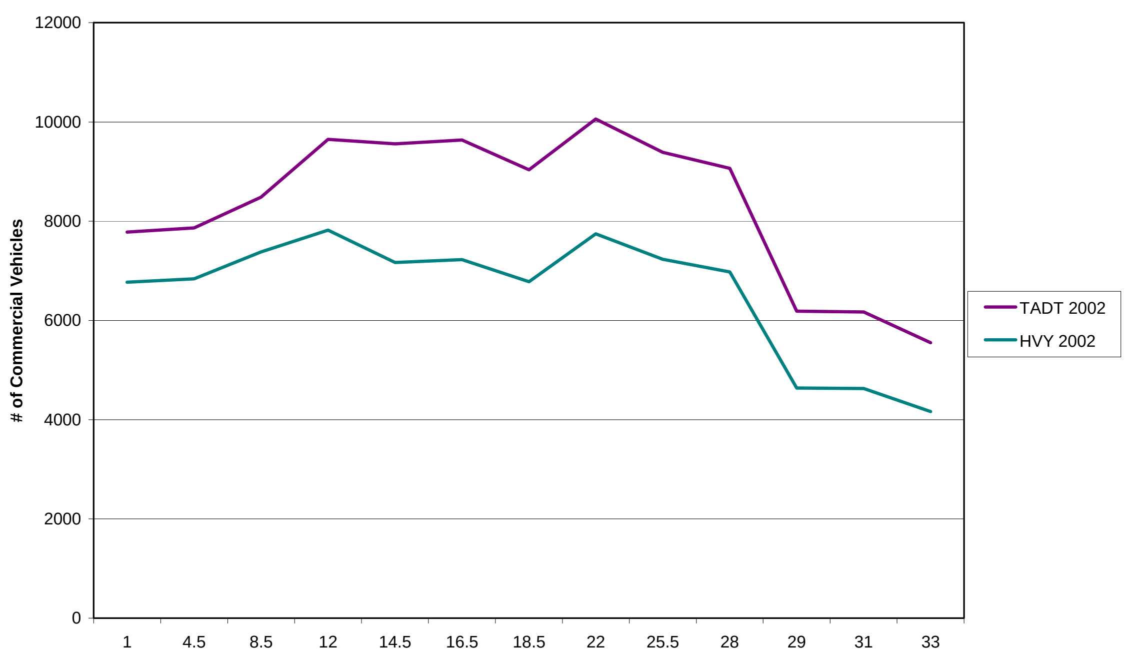
Interstate 459 Annual Average Daily Traffic With Commercial And Heavy Traffic 2002



Source: ALDOT Traffic AADT Database

Figure 2-36

Interstate 459 Commercial And Heavy Traffic 2002



Source: ALDOT Traffic AADT Database

Figure 2-37

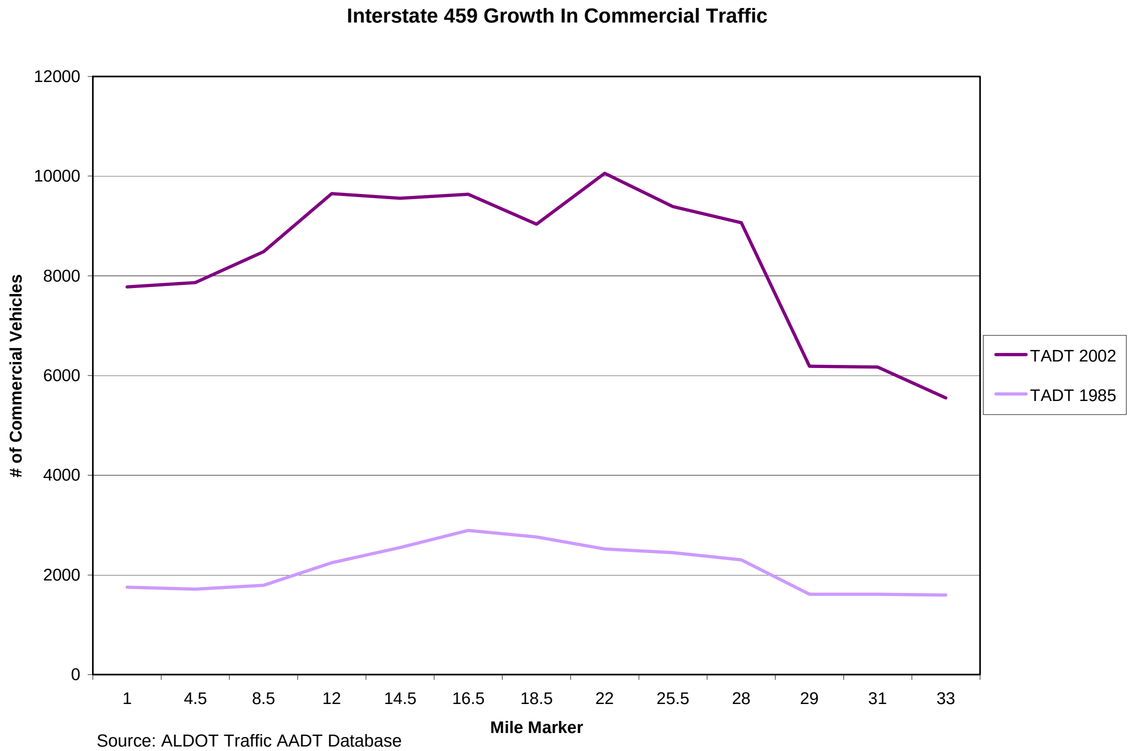


Figure 2-38

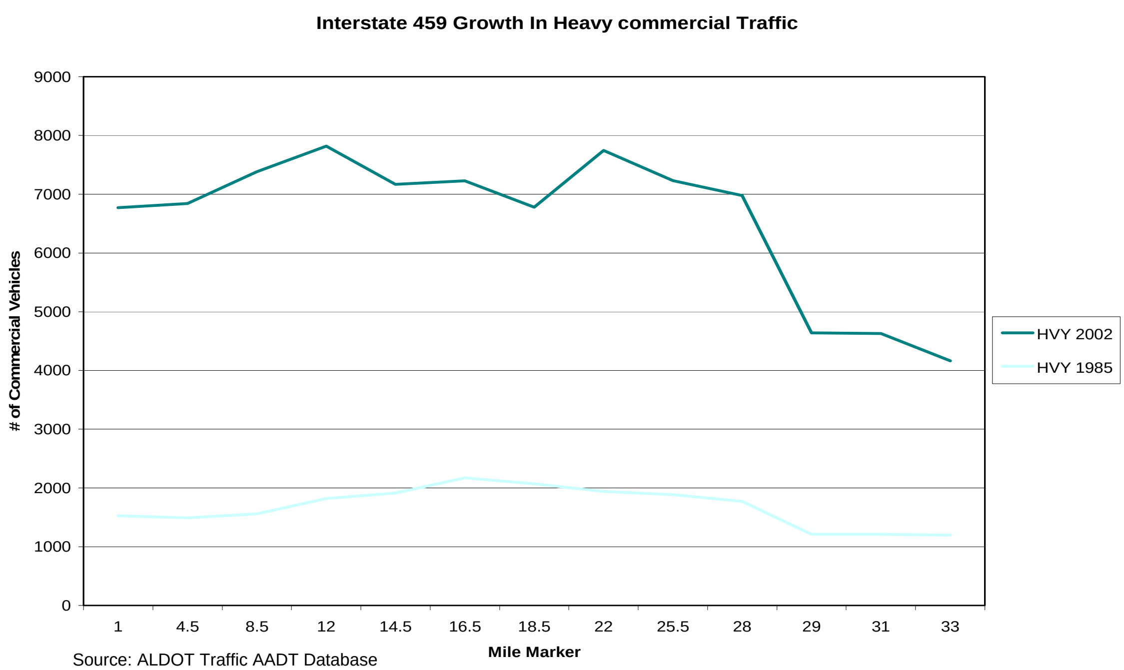


Figure 2-39

Figures 2-40 through 2-46 show the miles of U.S. highways that run through Birmingham. These charts were created to determine if the use of secondary highways had grown due to the congestion on the interstates. From these charts it is possible to see that some highways have experienced growth in areas where they intersect interstates. Areas where the AADT for 2002 is significantly greater than that of the previous years may also suggest the use of alternate highways to avoid congested interstates.

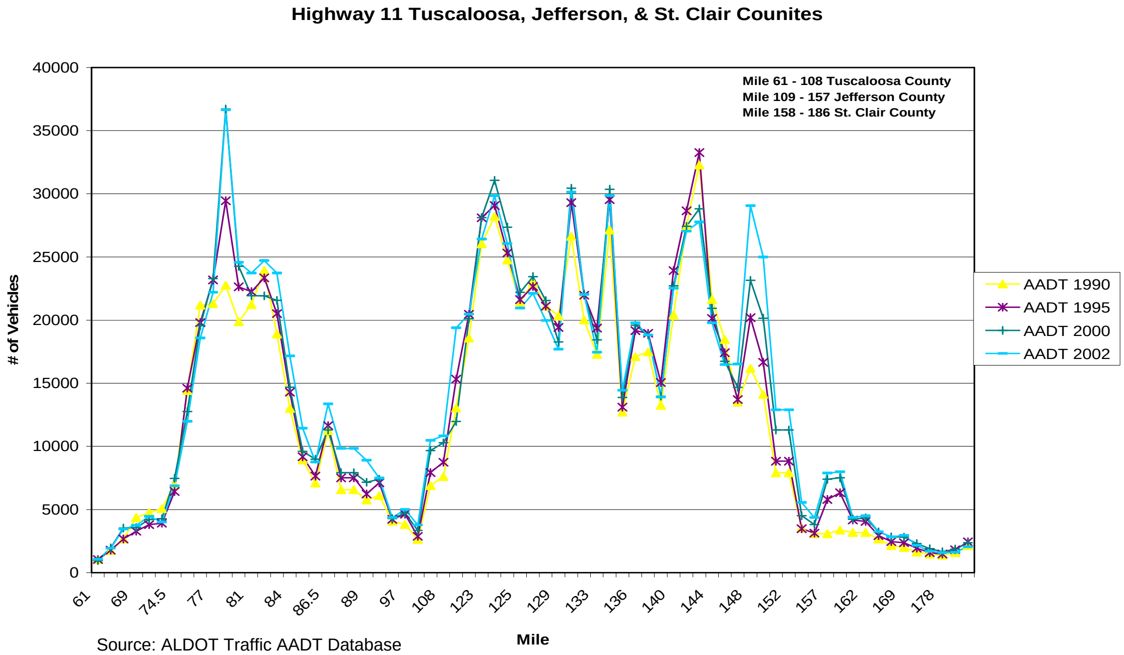


Figure 2-40

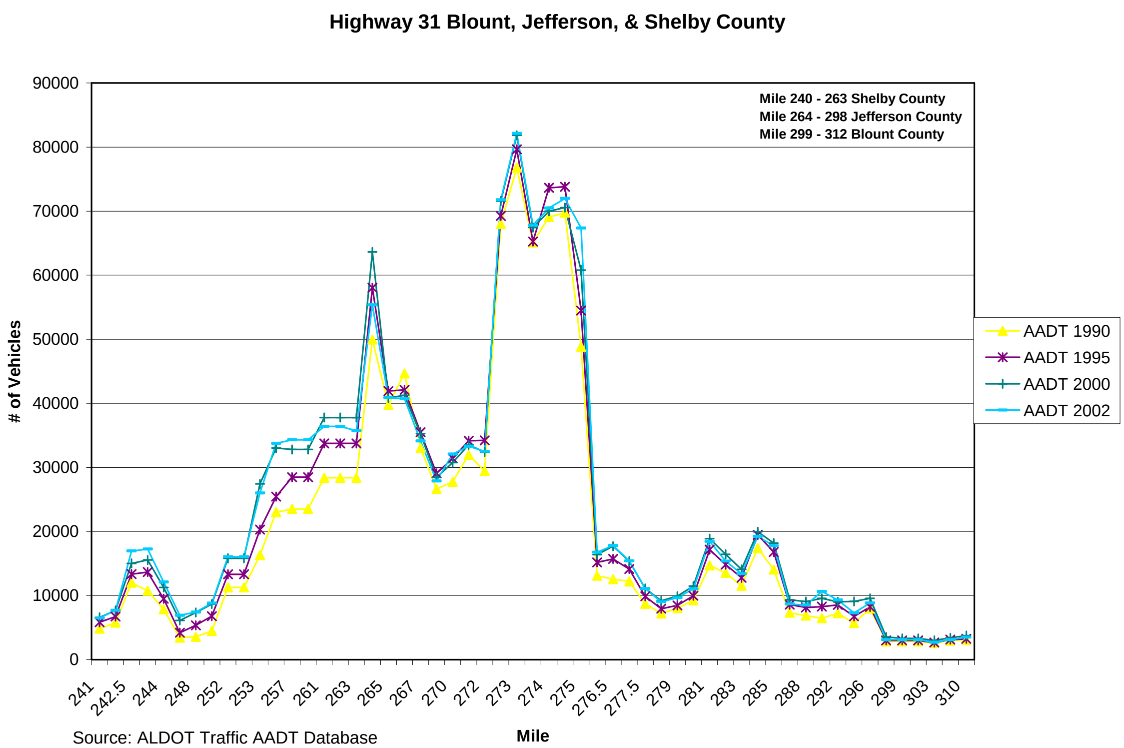


Figure 2-41

Highway 231 St. Clair and Blount Counties

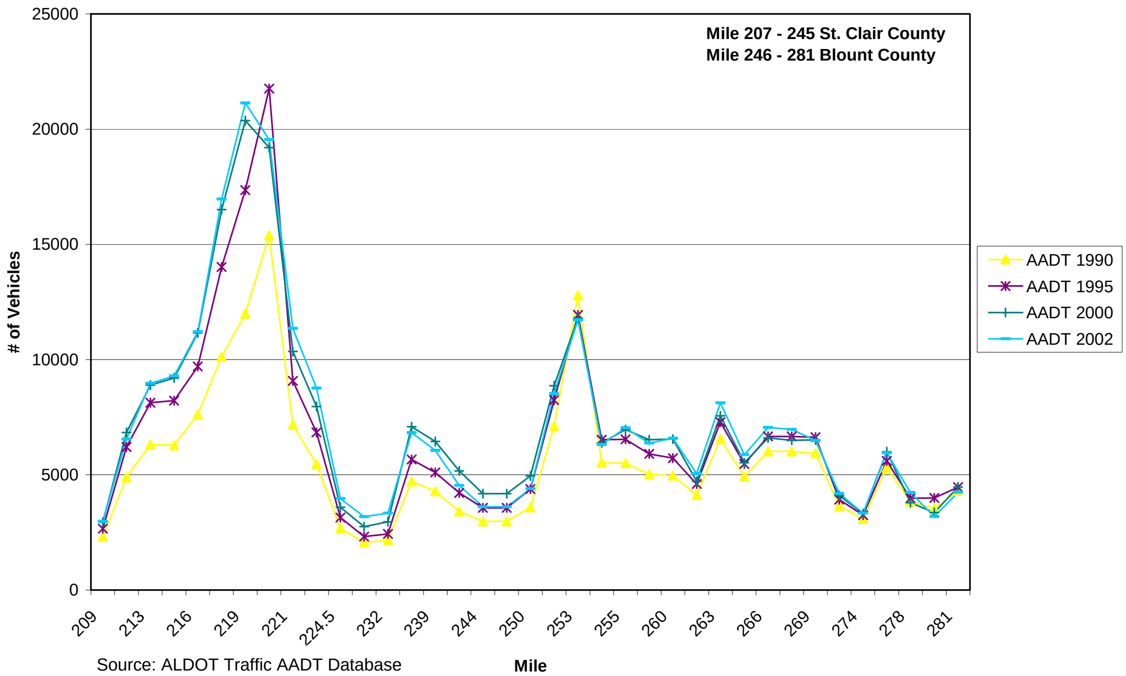


Figure 2-42

Highway 78 Jefferson & Walker Counties

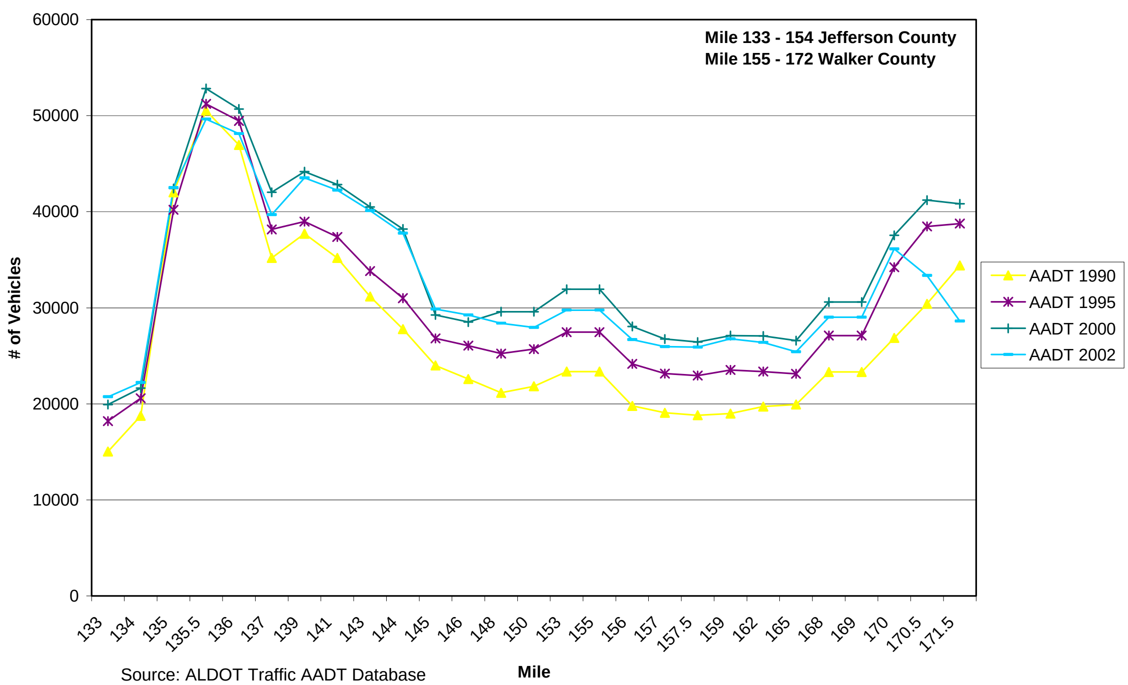


Figure 2-43

Highway 78 Jefferson & St. Clair Counties

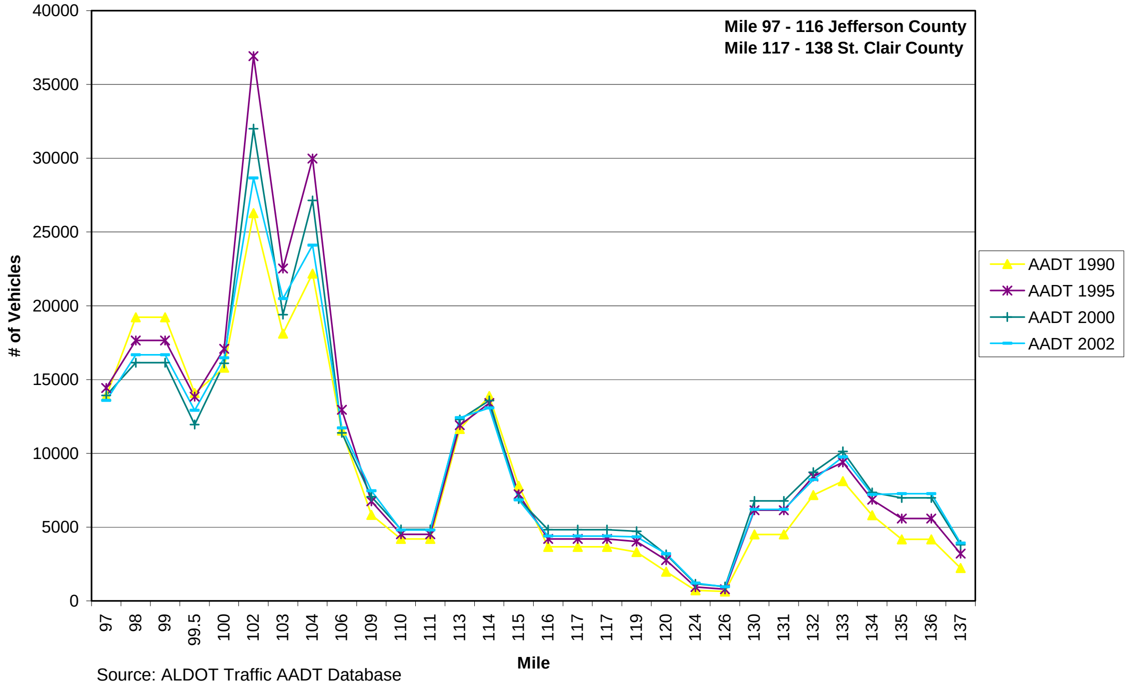


Figure 2-44

Highway 280 Jefferson & Shelby Counties

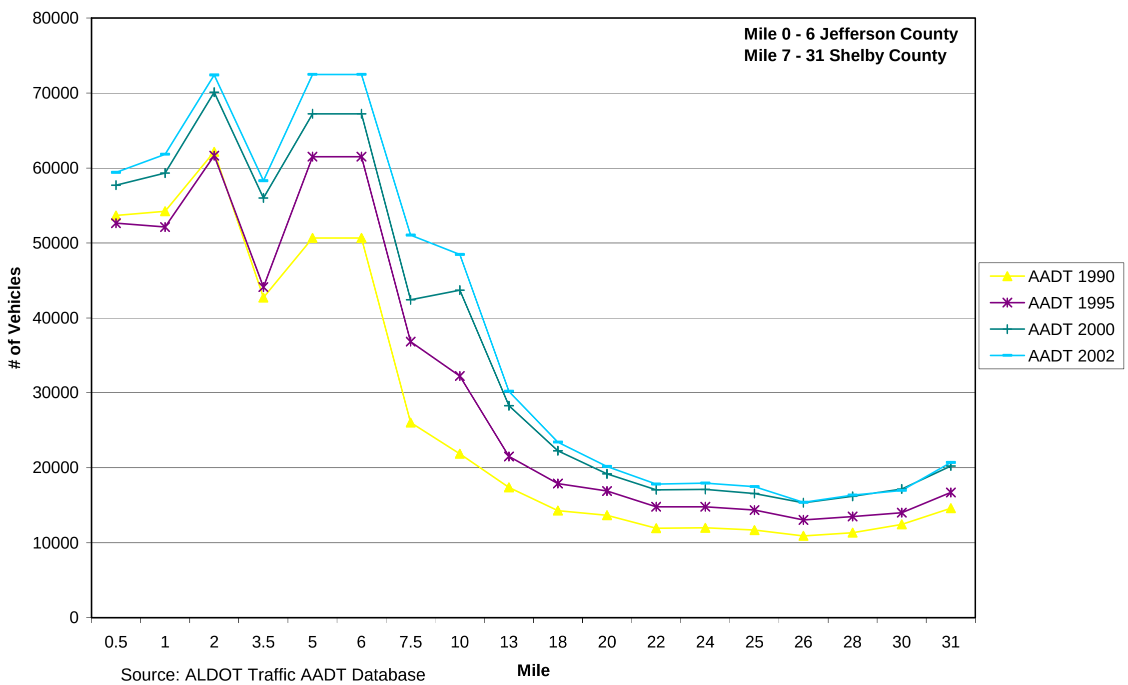


Figure 2-45

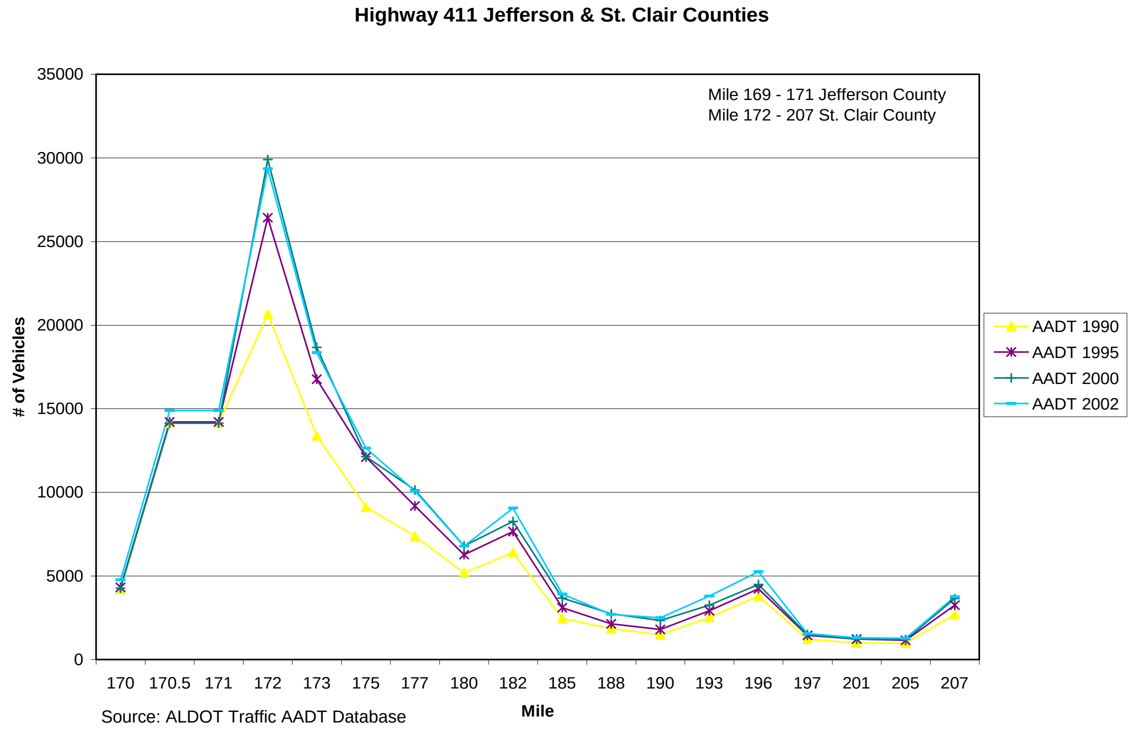


Figure 2-46

The highway infrastructure in Alabama is at a crossroads. The condition of the roads and bridges in the state would seem to be in jeopardy. A report on infrastructure by The Pew Charitable Trusts (www.pewtrusts.org) (The Government Performance Project's (GPP) "Grading the States 2005", http://results.gpponline.org/Alabama) places Alabama last out of the 50 states in infrastructure and management of roadway resources. According to the findings of The Government Performance Project's Report, Alabama's bridges are quickly approaching their 50 year life span and there does not seem to be adequate lead time to replace or upgrade these bridges in the time it would normally require.

According to information from the Federal Highway Administration, in 2001, 2,677 (17%) of the 15,641 highway bridges in Alabama were rated as structurally deficient and 2,245 (14%) were judged functionally obsolete.[2] The total of highway bridges with structural or functional issues (31.5%) in Alabama is slightly higher than the U.S. average of 14% structurally deficient and 14% functionally obsolete (28% total). The maintenance of roadways has suffered from under funding for several years. Managers within Alabama DOT agree that while the volume of traffic on the roads of Alabama has continued to grow, especially in freight, the budget to maintain those roads and make improvements has not changed significantly in the past decade. The funding is not adequate to complete all of the projects that the AL DOT are directed to initiate therefore schedules slip as the resources are spread in an attempt to pacify all stakeholders, satisfying none. Alabama is losing ground every day on the upkeep and deteriorating conditions of Alabama roadways.

2.2 Railroads

Railroads account for more than 40% of the intercity freight in terms of ton-miles in the U.S with coal being a main commodity for this transportation mode. This is also true in Alabama where coal is the highest volume commodity moved by Alabama railroads at 36 million tons annually (Figures 2-50 and 2-51). There are 3,687 miles of railroad track operated in Alabama, approximately 2.1% of the total track in the U.S.[1] The railroads work to fill their available capacity, but the incentive to grow beyond their current capacity is limited due to the significant capital investment required and the potential risk of return.

Container freight, domestic or international, has not yet become a significant portion of the rail activity in the state. There are several reasons this situation exists. The seaports in Mobile, Alabama and surrounding states have not yet become a force in the international container business, which would be a source of business for the railroads in Alabama. The railway system in Alabama is extensive yet it lacks a north-south intermodal designated track. With all north-south rails designated for merchandise, it can take longer for a container to get from Mobile to Huntsville than it takes a container to get from Long Beach, California to Huntsville. To designate a track from Mobile to Huntsville as intermodal, the railroads want assurance of a certain amount of freight (usually 50 to 70 containers per day) but manufacturers want the assurance of intermodal timed delivery before they will commit to the freight volume. The railroads are currently functioning at the upper end of capacity, and have no incentive to increase that capacity. The situation is a model Catch-22.

Data on Alabama railroads was obtained from the Bureau of Transportation Statistics, the Association of American Railroads (AAR) and CSX Transportation, Inc. The data had been collected over an eleven year period, from 1991 to 2002.

Each data set included:

- railroad statistics such as the number of railroads in Alabama, the total miles of rail, the number of rail cars handled, and the total tons carried by rail,

- top commodities originated (the first time the commodity is put on the rail) in Alabama,

- top commodities terminated (when the commodity comes off the rail) in Alabama, and

- miles of railroad operated for that year (the total miles of Alabama railroads that were used by each rail company).

The process began by analyzing the data provided by AAR. A sample of the data is in Table 2-2.

Alabama Railroads

1991 Railroad Statistics	
Number of Railroads	24
Total Rail Miles	3,688
Rail Cars Handled	1,929,088
Total Tons Carried By Rail	121,431,405
Total Railroad Employment	4,564
1991 Top Commodities - Originated In Alabama	
Coal	17,745,773
Pulp and Paper	4,345,012
Lumber, Wood Products	4,190,596
Ores	3,023,906
Glass and Stone	2,973,900
1991 Top Commodities - Terminated in Alabama	
Coal	17,414,561
Ores	4,148,896
Lumber, Wood Products	3,360,200
Chemicals	3,167,680
Farm Products	2,529,886

Table 2-2

The data was analyzed and informational charts were created to show the total tons of freight carried and the total carloads of freight carried on Alabama railways for the years 1991 to 2002. The output of this effort is shown in Figures 2-47 and 2-48.

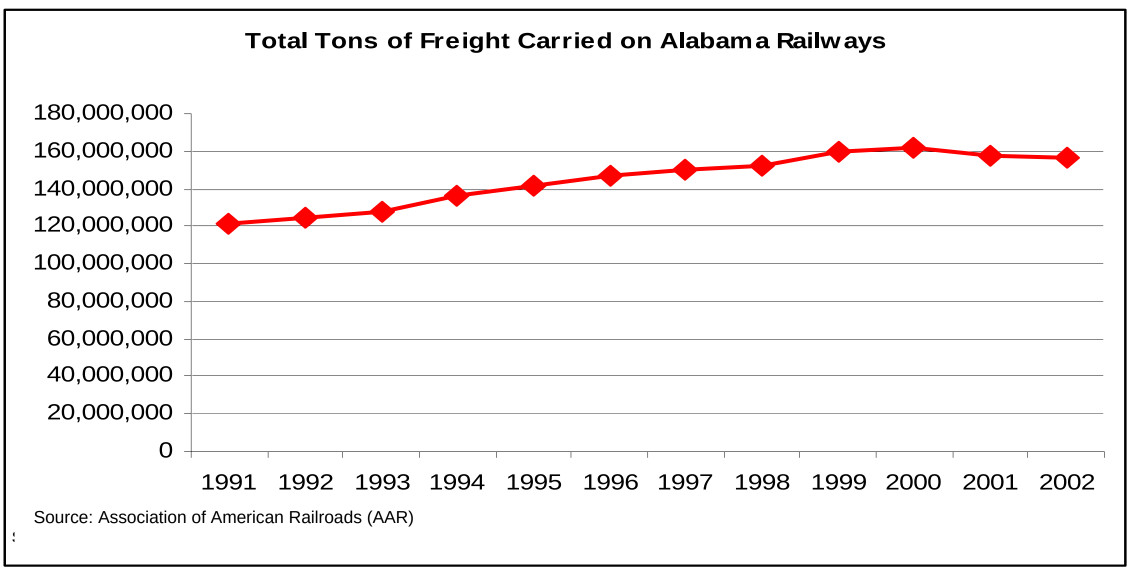


Figure 2-47

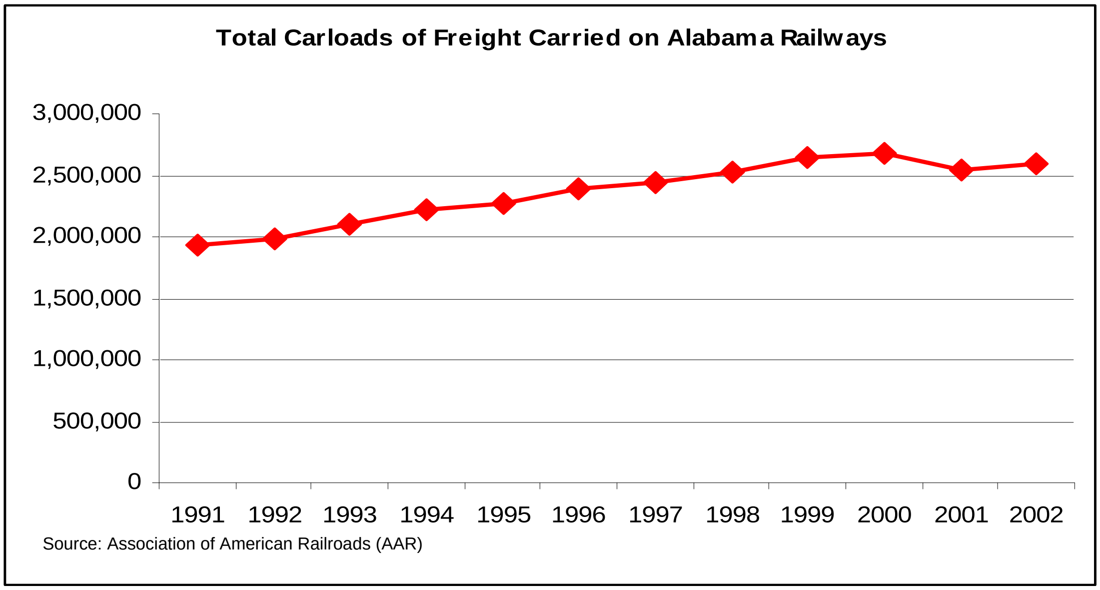


Figure 2-48

A chart depicting the total tons of freight originated and terminated in Alabama was also created from this data. The results are shown in figure 2-49.

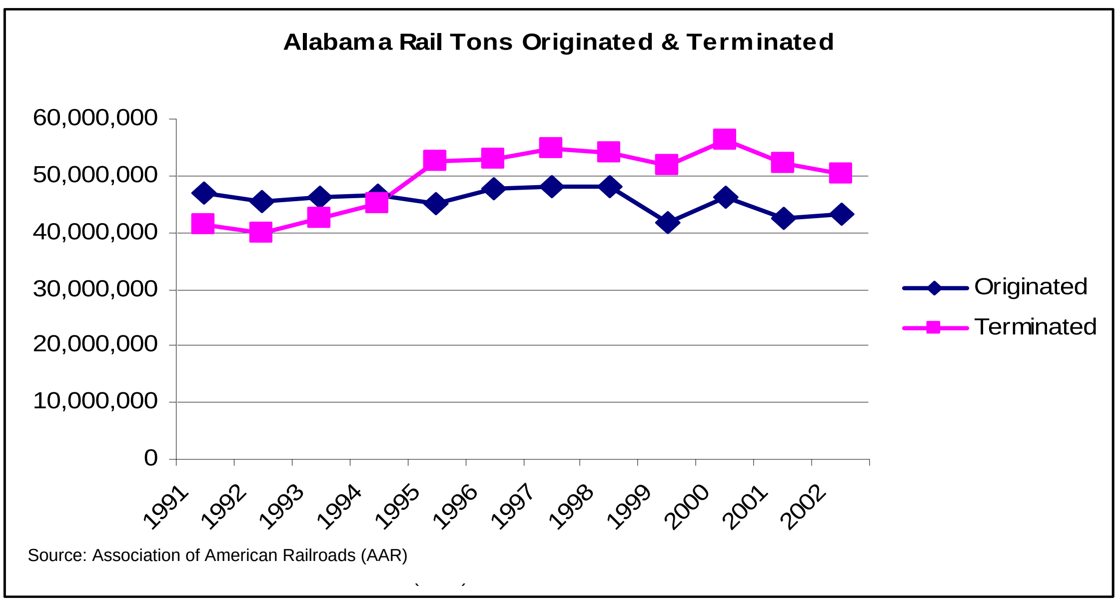


Figure 2-49

After reviewing this information, a more detailed chart was created to show a pareto analysis of the commodities that originated and terminated in Alabama. The tonnage for each commodity is shown for 2002 (Figures 2-50 and 2-51).

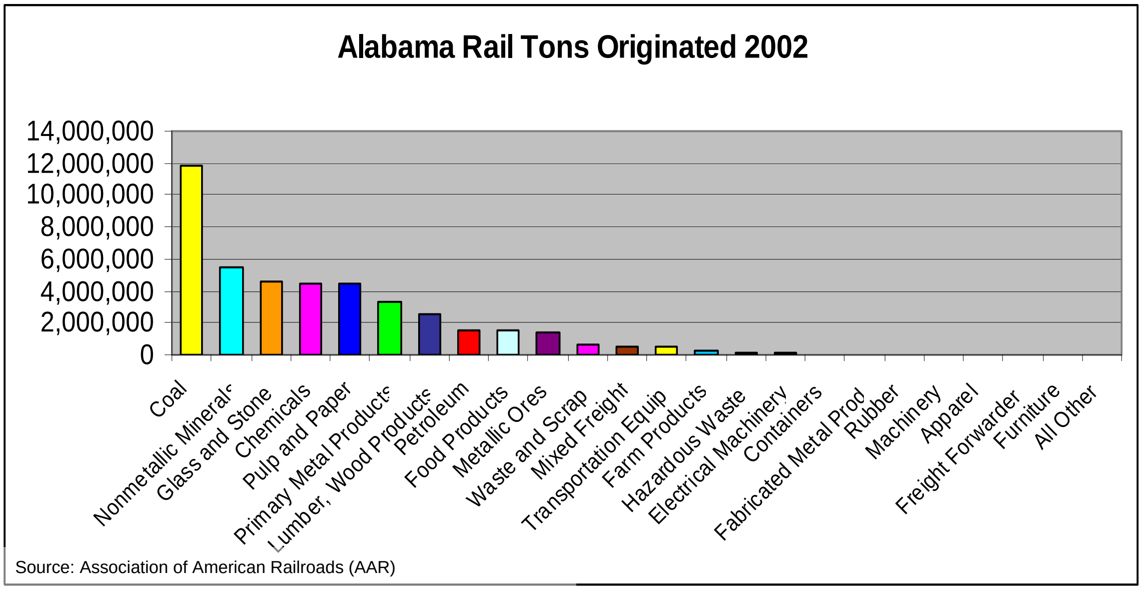


Figure 2-50

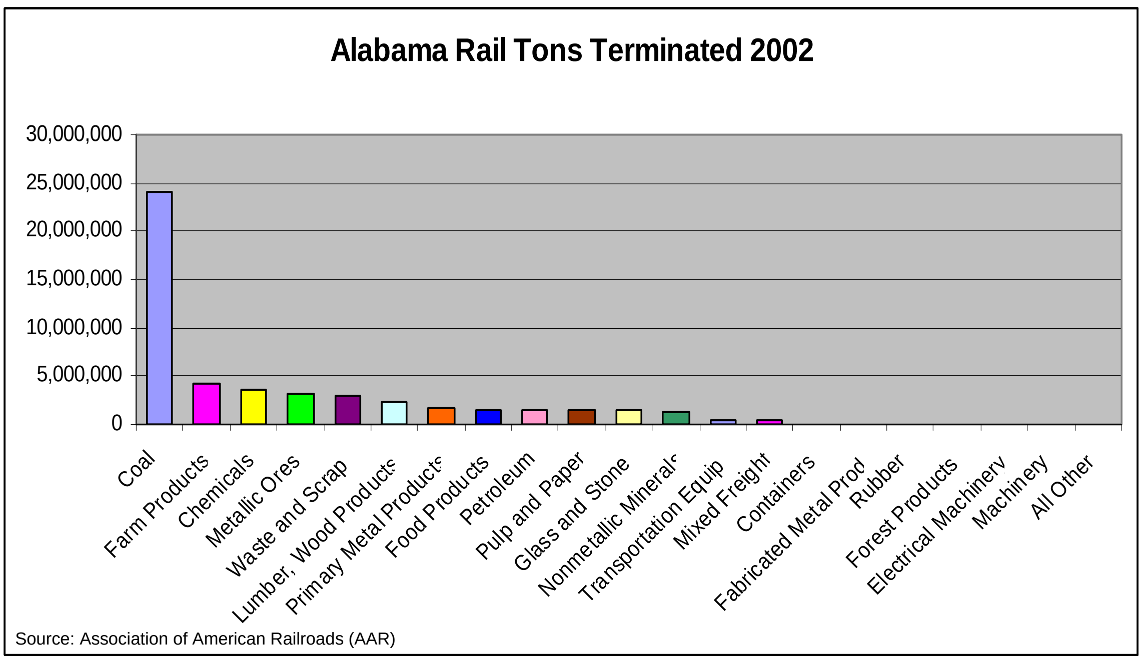


Figure 2-51

Further analysis was performed to identify growth or decline in the top commodities originated and terminated in Alabama for 1991 – 2002. Results for Alabama's top commodity, both originated and terminated in total tons, are shown in Figure 2-52.

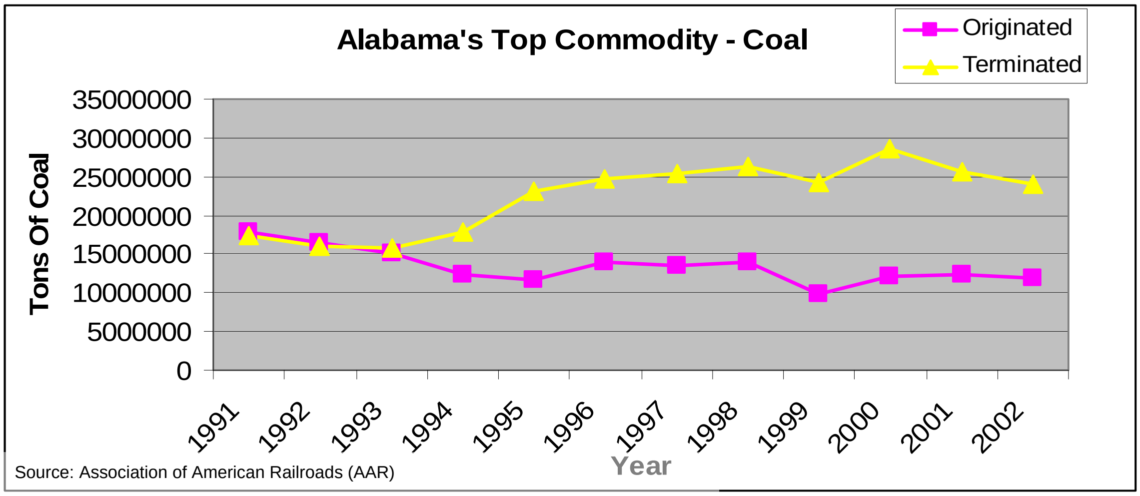


Figure 2-52

The rail system in Alabama is primarily a bulk materials/merchandise system. Alabama has not yet tapped into the intermodal container industry in any major way. The rail map of Alabama can be seen in Figure 2-53.

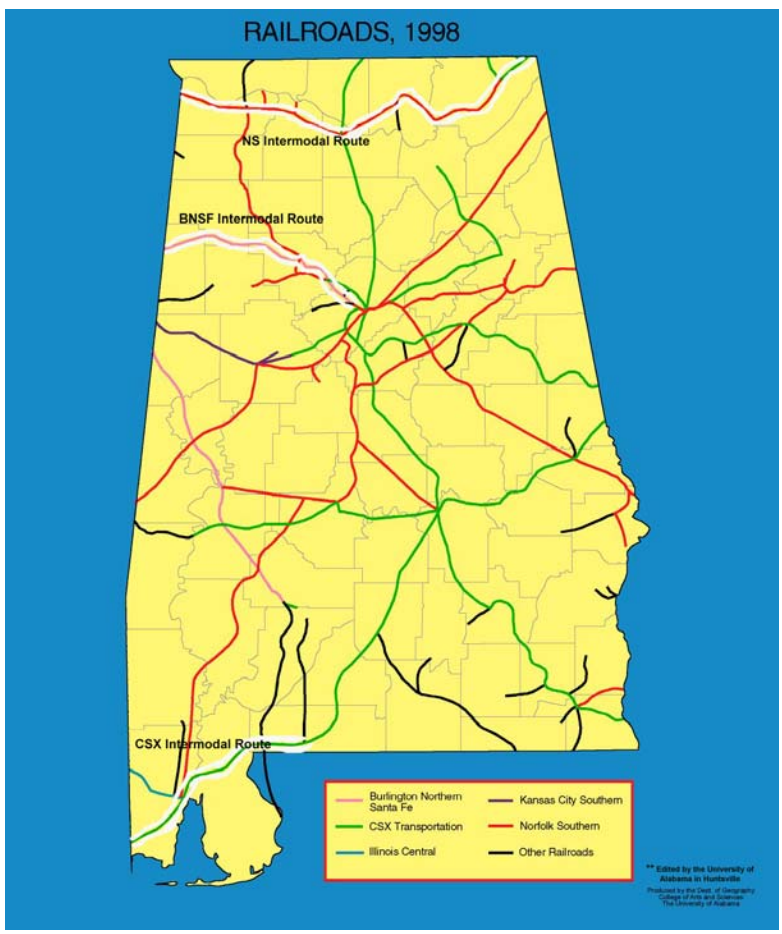


Figure 2-53
Railroads in Alabama

The intermodal aspects of rail will be discussed later in this chapter, but it is important to state here that the wide distribution of manufacturing entities in the U.S. create an environment where it is required for railroads and trucking companies to work together to move freight through the network. In a very real sense, railroads tend to move materials and products that are heavy and less time sensitive in delivery requirements from the customer than the products shipped by truck. The products and commodities tend to be high volume, heavy and bulky. The automotive manufacturing industry is a growing segment of railroad shipping in Alabama, as the volume of vehicles produced in the state grows from 240,000 units in 2003 to almost 800,000 units in 2008. This growth was verified by the industry survey conducted as a part of this research and will be discussed further in Chapter 4.

2.3 Inland Waterways

Alabama has 1,270 miles of navigable inland waterways that are underutilized.[3] The traffic on Alabama's inland waterways has been dropping steadily since the peak between 1995 and 1998. The Tennessee-Tombigbee Waterway has never reached its potential freight capacity. The Coosa River has experienced a significant reduction in river traffic due mainly to the lack of ability to maintain a nine foot depth to allow barge traffic. The Apalachicola-Chattahoochee-Flint river system in east Alabama has seen waterborne commerce come to a complete stop with the last barge company ceasing operations in 2002.

There is a perception within the waterway shipping industries that it is not possible to support a Just-In-Time manufacturing environment with inland waterway freight shipping. There is not currently a Third Party Logistics (3PL) service provider that works using the waterways of Alabama as the preferred mode of transportation. Time critical products tend to move on modes of freight travel other than waterways. This is mainly due to the amount of time it takes to move product on the rivers through locks and the number of barges that can be moved at one time. The average speed of a barge on the Tombigbee Waterway is 4 ½ miles per hour. At this speed it takes approximately 5 days to traverse the waterways between Mobile and Decatur which is 540 miles and 14 locks. Barge tows are typically 6 or 8 barges at a time.[4] If a barge is left at a lock because it is not headed for the same final destination as the rest of the tow, it could be weeks before another tow comes by that has an open space to add the idle barge so that it may continue to its destination. Even at a low cost, there are many manufacturing operations that cannot tolerate that amount of variation and volatility in delivery time, regardless of the cost. More product is shipped downstream than upstream, resulting in a costly empty run back up river. Alabama has not yet been able to fully utilize it to enhance economic growth.

Alabama's navigable waterways can be seen in Figure 2-54. A look at any map of waterways in the U.S. will quickly reveal that Alabama is uniquely situated to prosper from the use of waterways (Figure 2-55). Even with all of the logical reasoning for Alabama to be a major force in freight shipment on inland waterways they are still not employed as a significant part of the freight network. All navigable waterways in Alabama are experiencing a downward trend in freight tonnage. A recent upturn in shipping volume due to a one time opportunity for coal exporting has stemmed the decline, but unless something changes, the waterways will continue to be a minor factor in the freight transportations system.

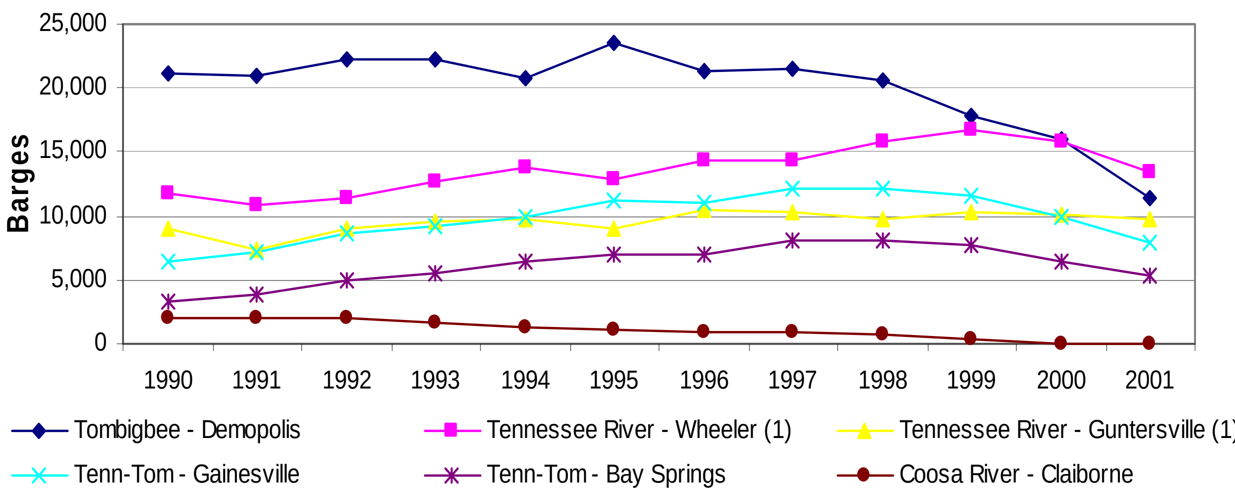
Waterway freight data was obtained from the Army Corps of Engineers, who monitors the number of barges and the total tons of commodities flowing through Alabama's navigable waterways (both Upbound and Downbound). Figure 2-56 represents total (Upbound and Downbound) barge traffic flowing through Alabama's navigable waterways.

Source: ALDOT
Edited By University of Alabama Huntsville

Figure 2-54

Figure 2-55

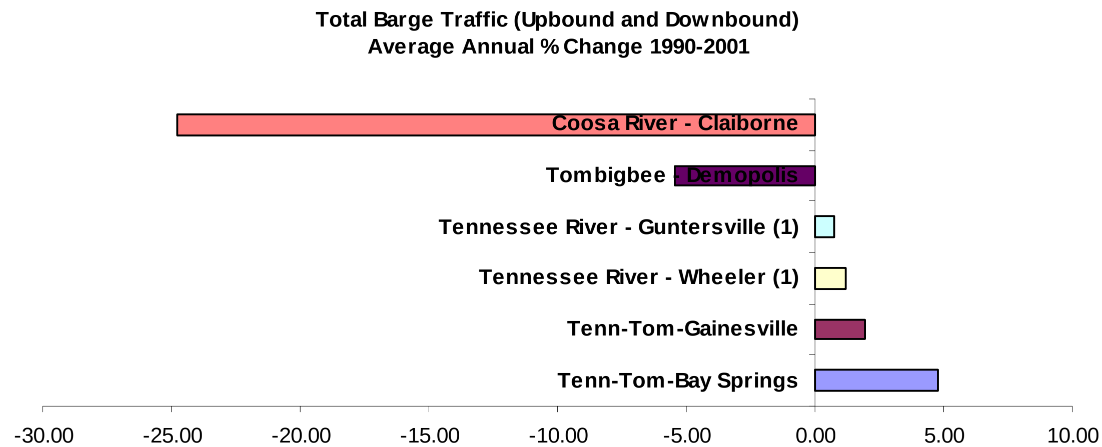
Total Barge Traffic (Upbound & Downbound)



Source: Army Corps of Engineers, Compiled by the University of Alabama in Huntsville, Office for Economic Development

Figure 2-56

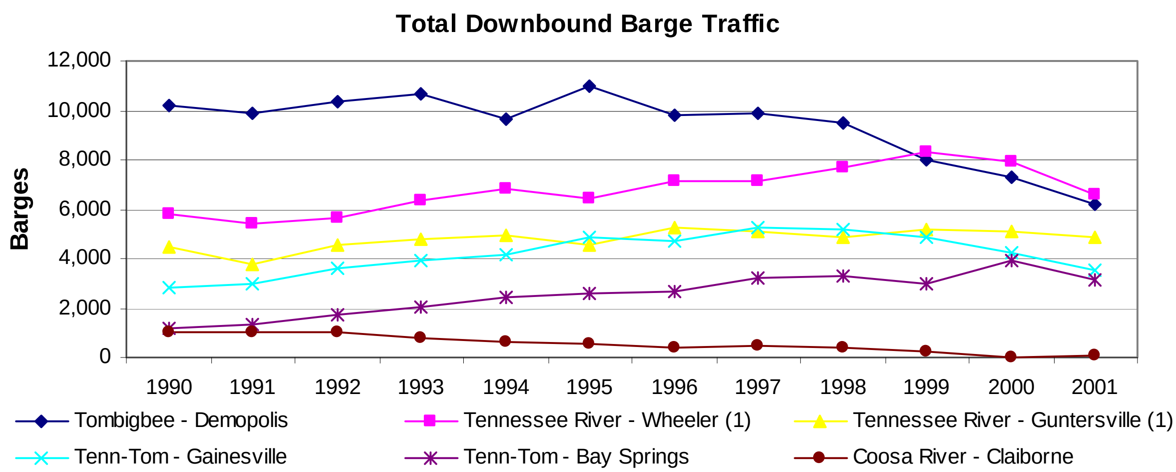
The total number of barges traveling on Alabama's rivers from 1990-2001 has declined. This decline is more prominent during the period 1995-2001, and can be attributed to the decline in barge traffic on the Tombigbee Waterway. In 2001, the Tombigbee—Demopolis Lock had approximately ten thousand fewer barges traveling through its waters than it did in 1990. The Coosa River—Claiborne Lock also experienced sharp declines in barge traffic for the period 1990-2001. Approximately 89 barges were traveling through its waters in 2001 compared to 2,039 barges in 1990. Figure 2-57 indicates a slight positive trend for barge traffic on Tenn-Tom—Bay Springs Lock and Tenn Tom—Gainesville Lock.



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

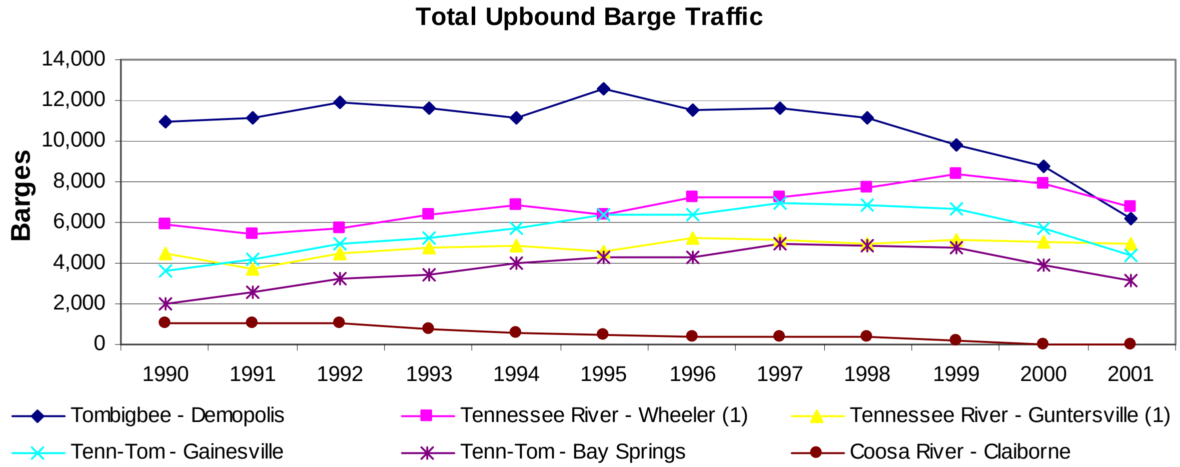
Figure 2-57

Figure 2-58 represents total Downbound and Figure 2-59 represents total Upbound barge traffic on Alabama's navigable waterways. Total Downbound and Upbound traffic slowly increased from 1990-1998 and then declined from 1999-2001.



Source: Army Corps of Engineers, Compiled by the University of Alabama in Huntsville, Office for Economic Development

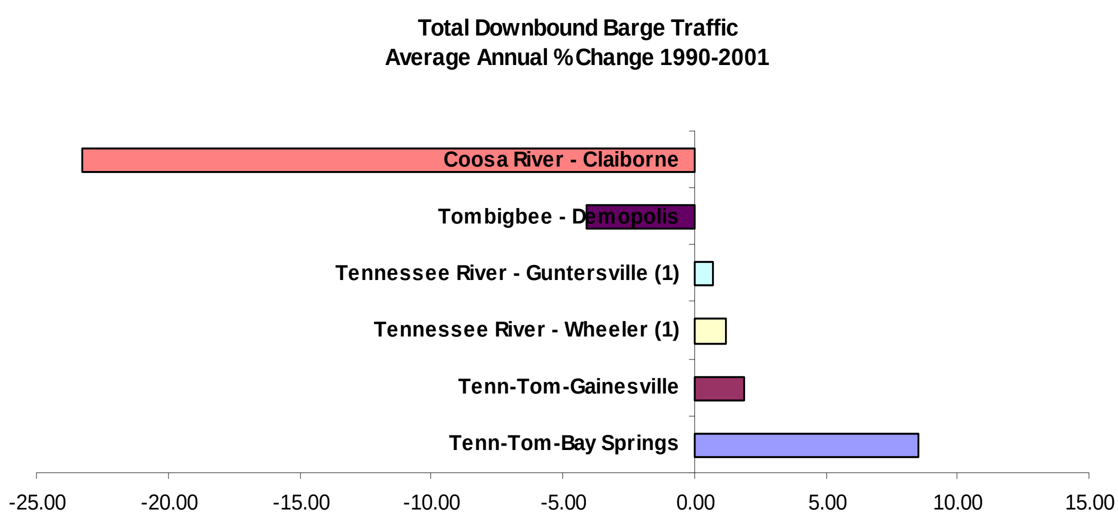
Figure 2-58



Source: Army Corps of Engineers, Compiled by the University of Alabama in Huntsville, Office for Economic Development

Figure 2-59

The Coosa River—Claiborne experienced the largest percentage decline for both Downbound and Upbound barge traffic as shown in Figure 2-60 and 2-61. This decline may be as a result of the inability to maintain a river water depth of at least 9 ft to facilitate barge freight movement.



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-60

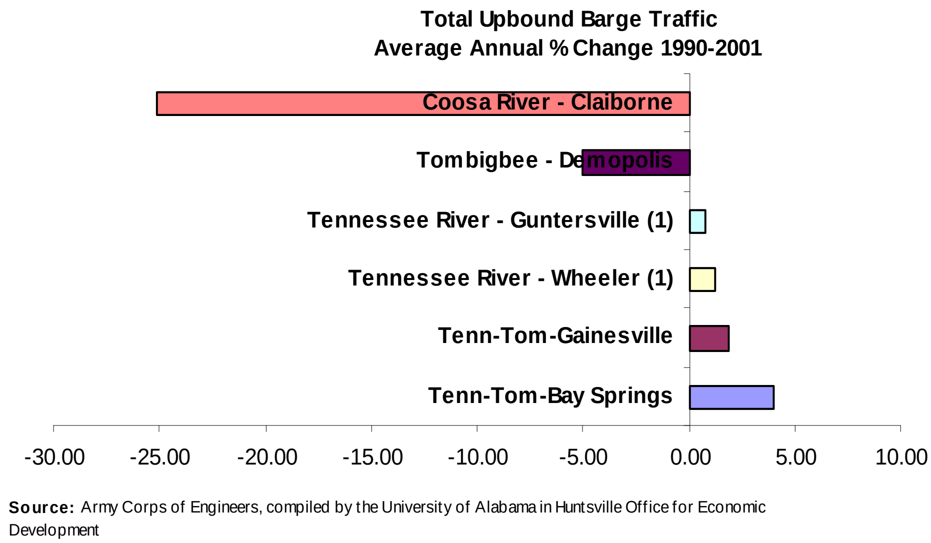


Figure 2-61

Located in Northeast Mississippi, the Tenn-Tom—Bay Springs Lock & Dam experienced some overall growth in Upbound and Downbound barge traffic from 1990-1996. Growth in barge traffic peaked in 1997 and slowly declined from 1999-2001. The largest percentage increase in Upbound traffic occurred during the period 1991-1992 where barge traffic grew 27 percent from 2,528 barges in 1990 to 3,213 barges in 1992. The largest percentage increase in Downbound traffic occurred during the period 1991-1992 where barge traffic grew 29 percent form 3,839 barges in 1991 to 4,968 barges in 1992 (Figures 2-62 and 2-63).

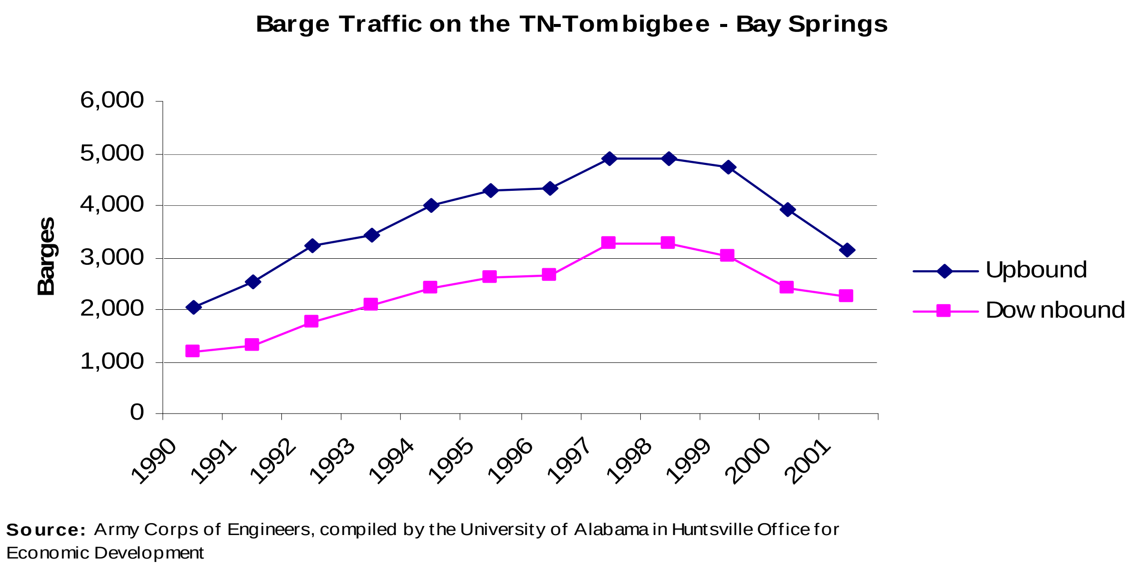
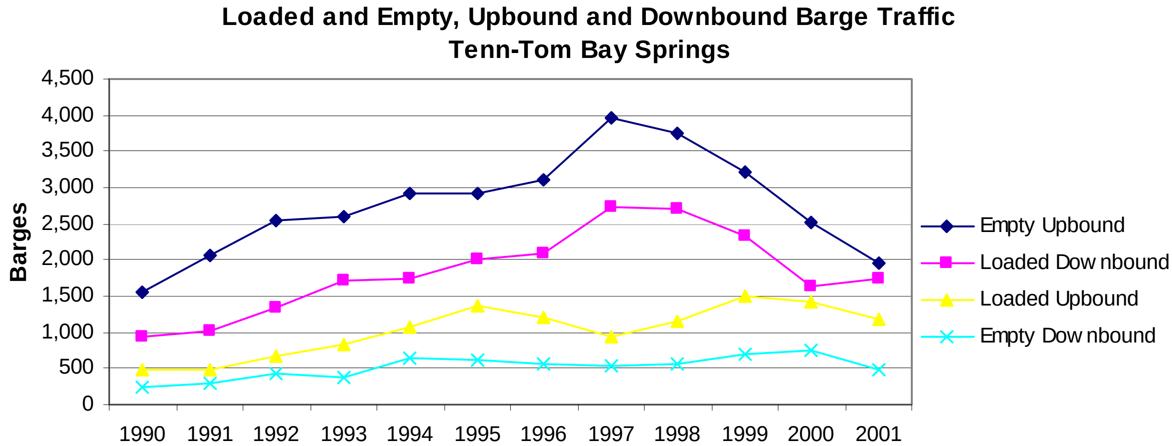


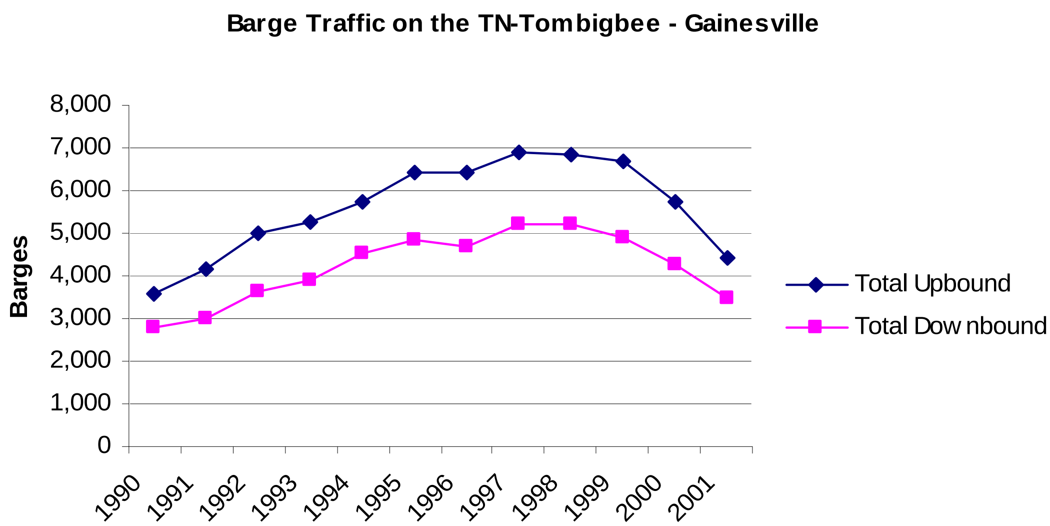
Figure 2-62



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville, Office for Economic Development

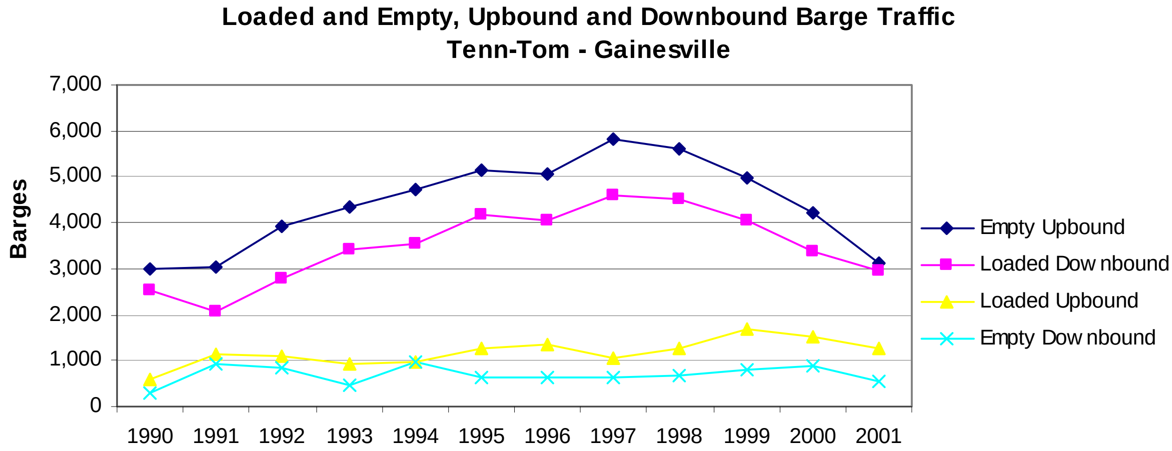
Figure 2-63

Located in Greene County, Alabama the Tenn-Tom—Gainesville Lock & Dam experienced steady growth in Upbound and Downbound barge traffic from 1990-1995. Growth in barge traffic dropped slightly in 1996 and peaked in 1997 with Upbound barge traffic of 6,852 and Downbound barge traffic of 5,222. Barge traffic slowly declined from 1998-2000, and declined drastically from 2000-2001. Upbound barge traffic for 2000 and 2001 was 5,744 and 4,405 barges respectively, indicating a 23 percent decline in barge traffic. Downbound barge traffic for 2000 and 2001 was 4,260 and 3,500 barges respectively, indicating an 18 percent decline in barge traffic (Figures 2-64 and 2-65).



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

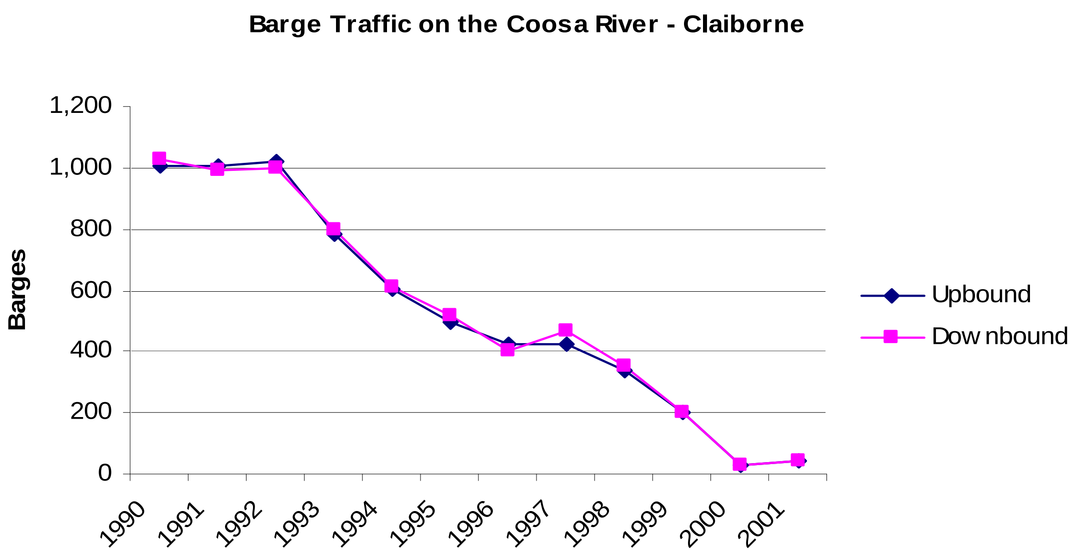
Figure 2-64



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville, Office for Economic Development

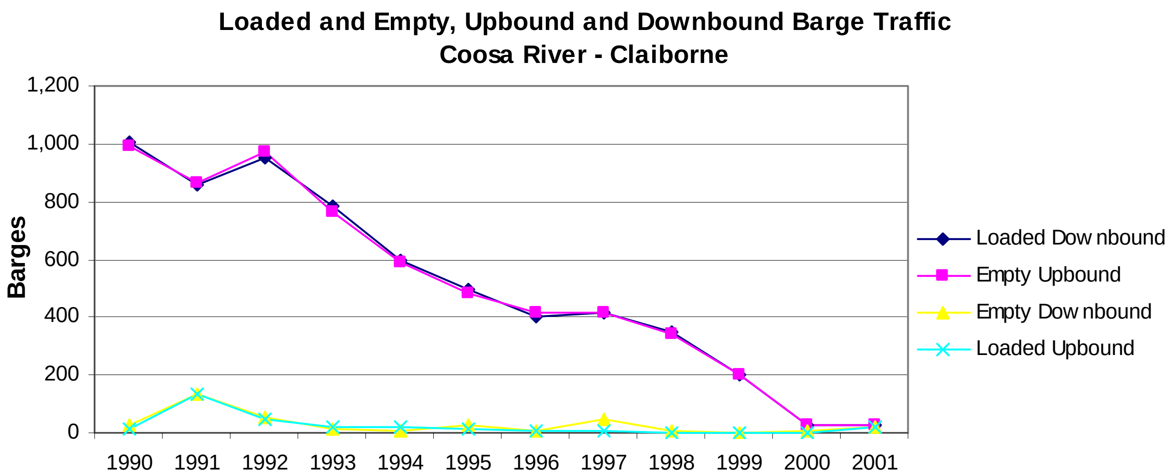
Figure 2-65

Figure 2-66 to Figure 2-73 represents Upbound and Downbound barge traffic flowing through other navigable waterways in Alabama.



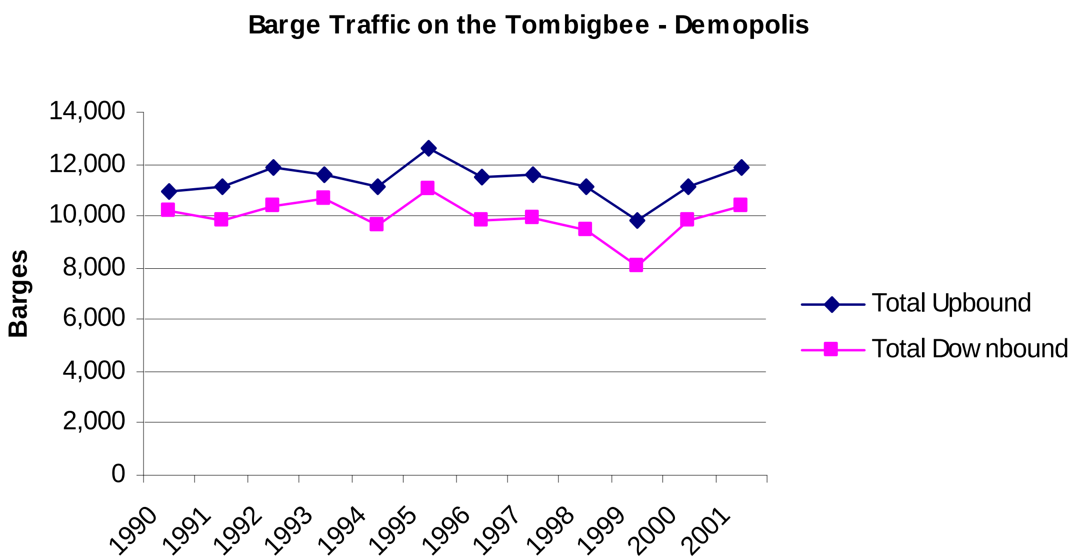
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-66



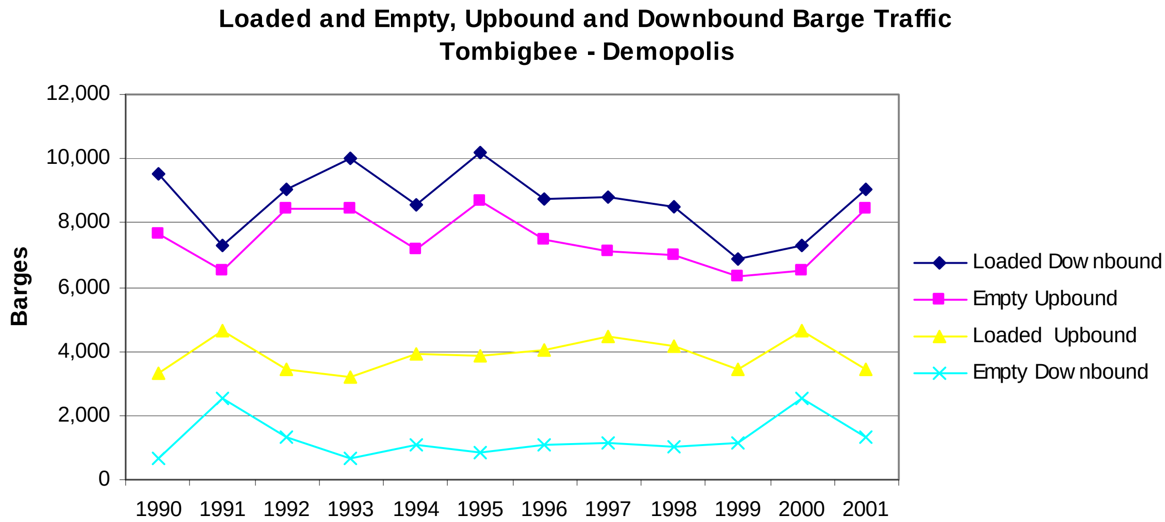
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville, Office for Economic Development

Figure 2-67



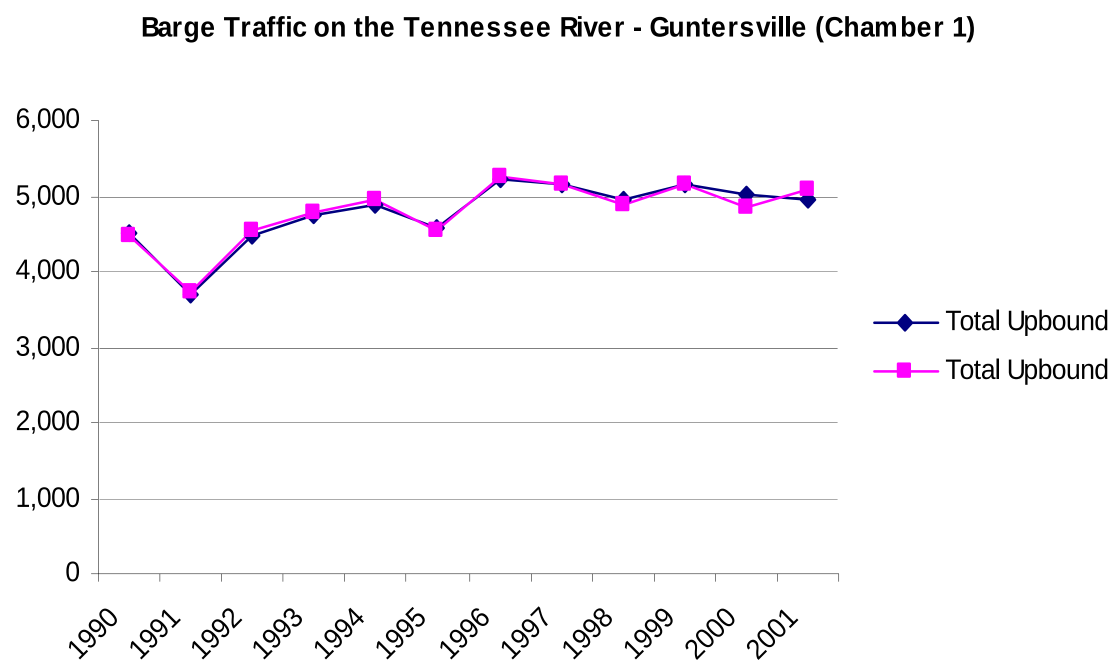
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-68



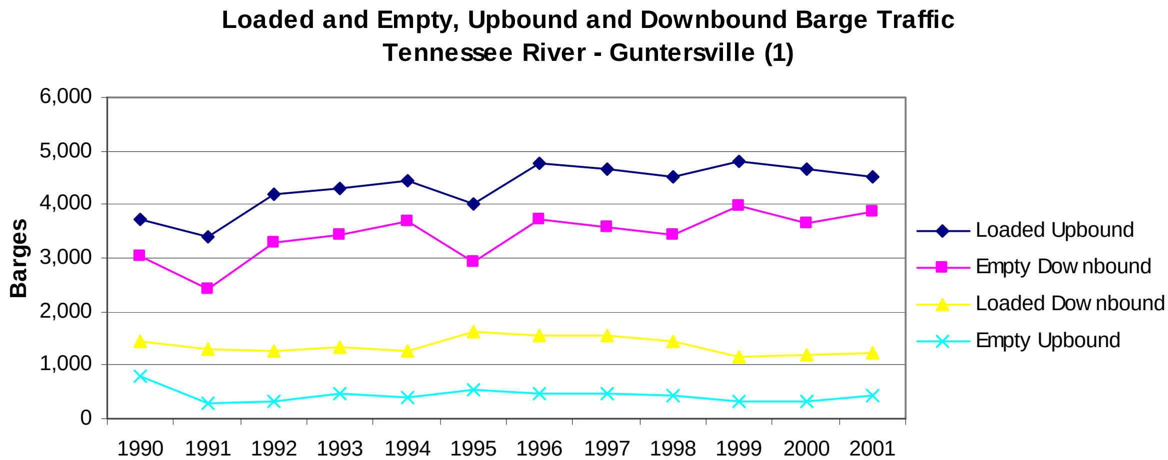
Source: Army Corps of Engineers, compiled by the Universtiy of Alabama in Huntsville, Office for Economic Development

Figure 2-69



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

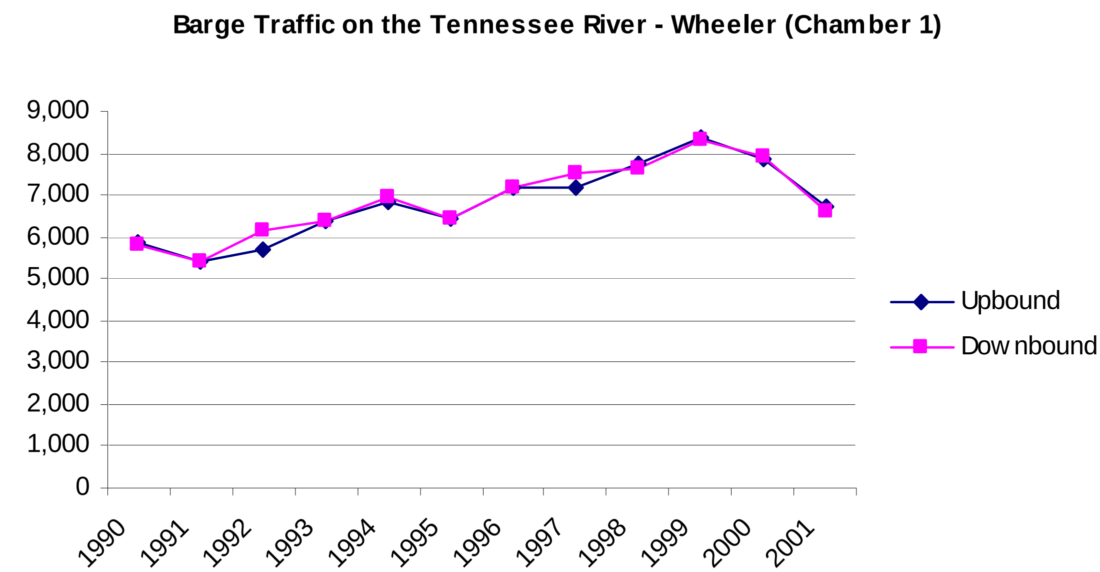
Figure 2-70



Source: Army Corps of Engineers, compiled by the Universtiy of Alabama in Huntsville, Office for Economic Development

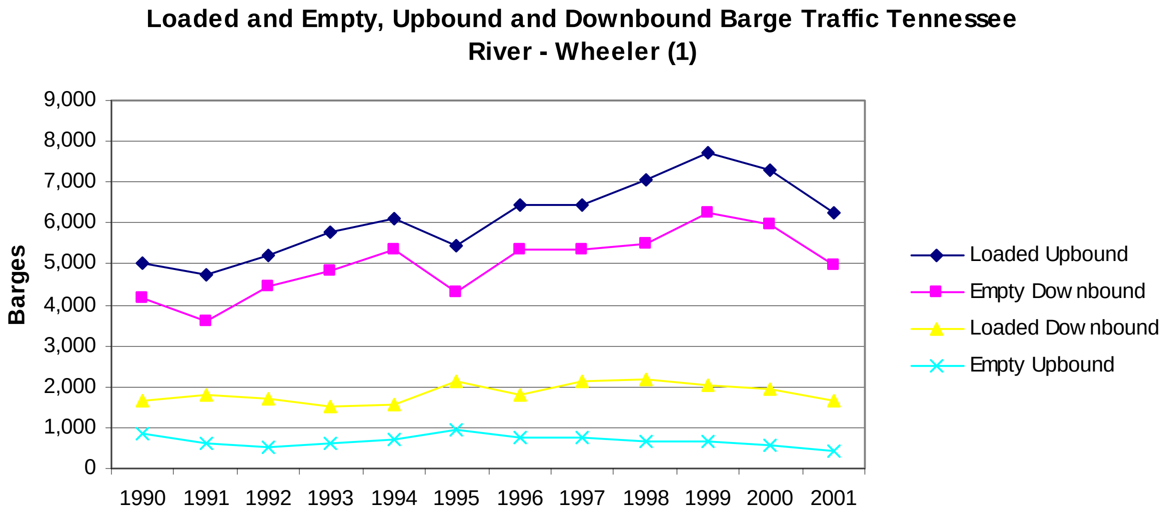
Figure 2-71

Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

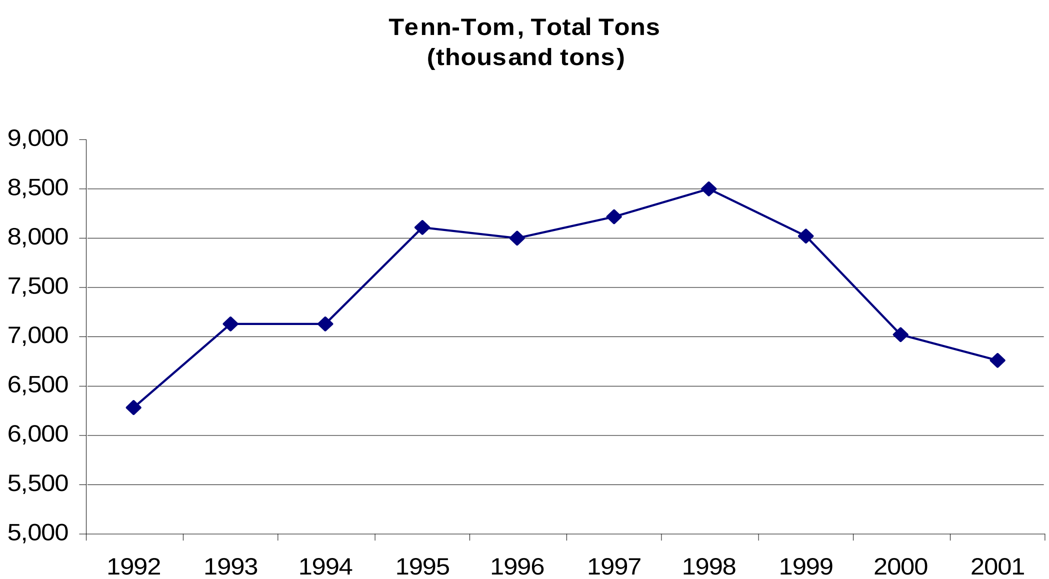
Figure 2-72



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville, Office for Economic Development

Figure 2-73

Total freight tonnage on the Tenn-Tom in 1992 was 6,287 (thousand) tons. Freight tonnage peaked in 1998 with 8,509 (thousand) tons and fell to 6,797 (thousand) tons in 2001 (Figure 2-74).

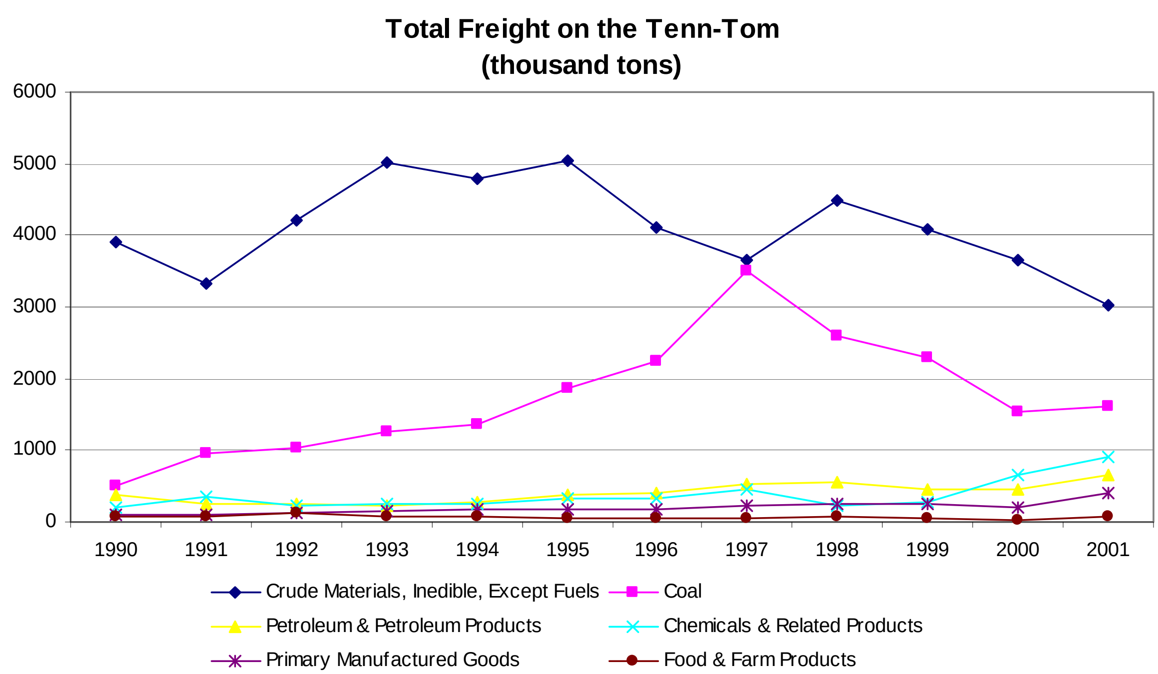


Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-74

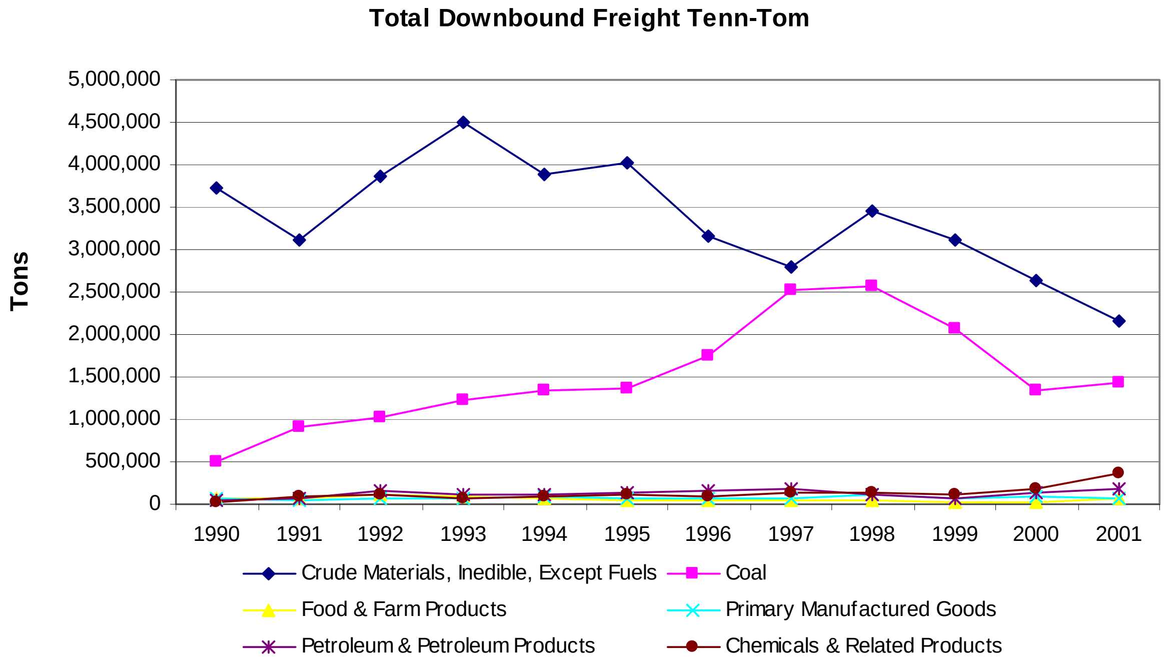
Figure 2-75 shows the total freight tonnage on the Tenn-Tom for selected industries. The graph clearly reflects Crude Materials (Except Fuels) and Coal as the industries with the largest freight tonnage for the period 1990-2001. In 1990, 3.1 million tons of Crude Materials (Except Fuel) and 511,000 tons of Coal were shipped on the Tenn-Tom. In 2001, 3.0 million tons of Crude Materials (Except Fuel) and 1.6 million tons of Coal was shipped on the Tenn-Tom. In 1997 shipments on the Tenn-Tom for Crude Materials (Except Fuel) and Coal differed by 136,000 tons.

Total Downbound freight on the Tenn-Tom for the industries indicated on Figure 2-76 show Coal and Crude Materials (Except Fuels) as the major commodities shipped Downbound for the period 1990-2001. In the case of Total Upbound freight (Figure 2-77) from 1992-1996 and 1998-2001 Crude Materials (Except fuels) had the largest freight shipment. The industry with the second largest freight shipment varied. In 1997, Coal shipments on the Tenn-Tom exceeded Crude Material (Except Fuel) shipments by 149 thousand tons.



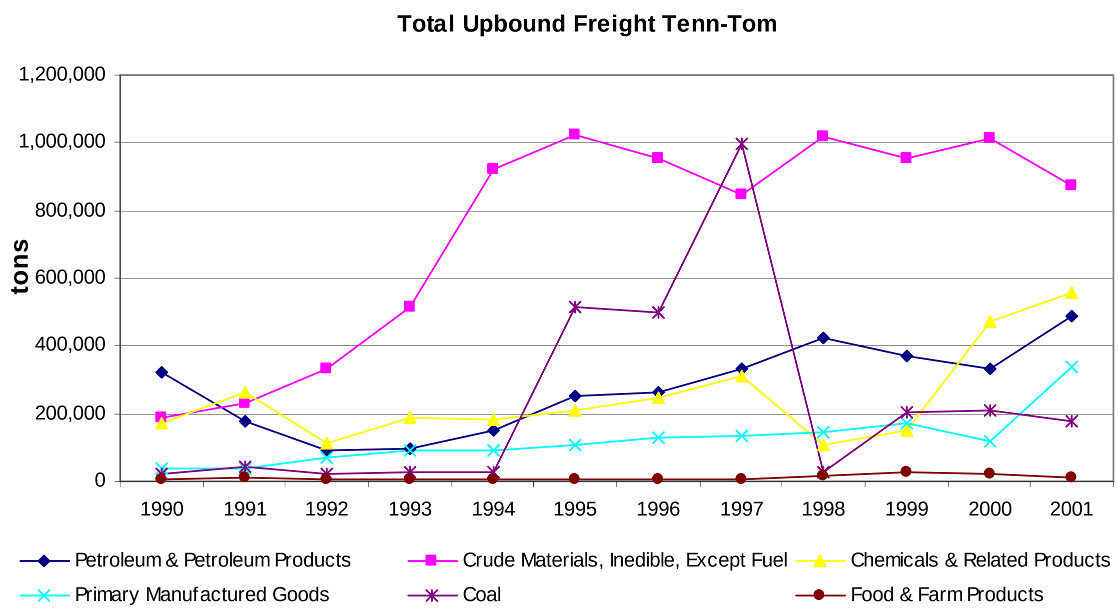
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville, Office for Economic Development

Figure 2-75



Source: Army Corps of Engineers, Data compiled by the University of Alabama in Huntsville, Office for Economic Development

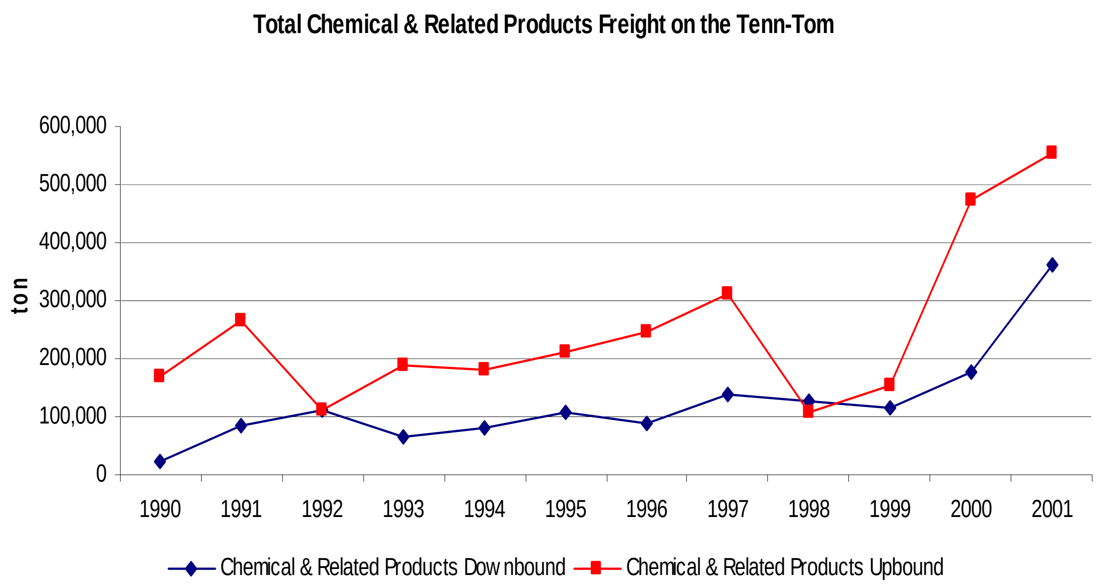
Figure 2-76



Source: Army Corps of Engineers, Data compiled by the University of Alabama in Huntsville, Office for Economic Development

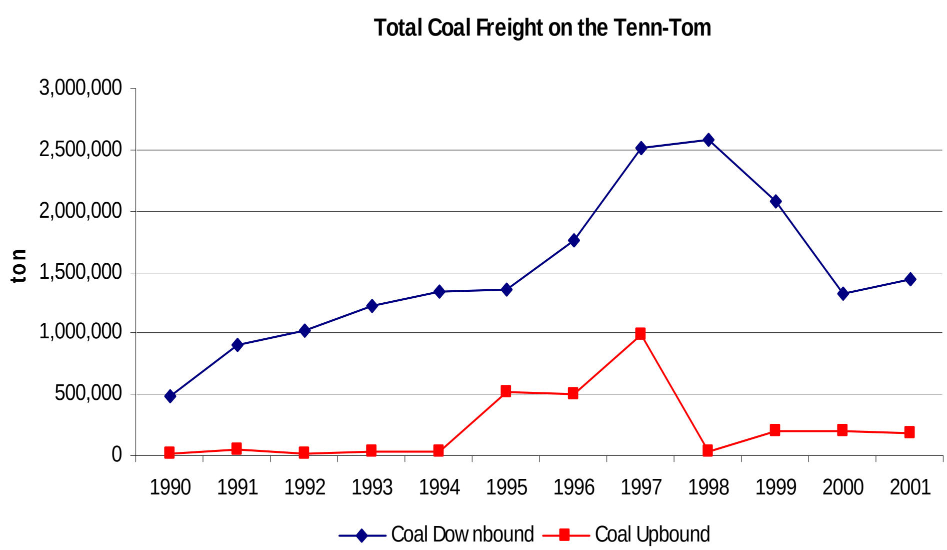
Figure 2-77

Figure 2-78 to Figure 2-81 represents Upbound and Downbound tonnage on the Tenn-Tom for selected Industries



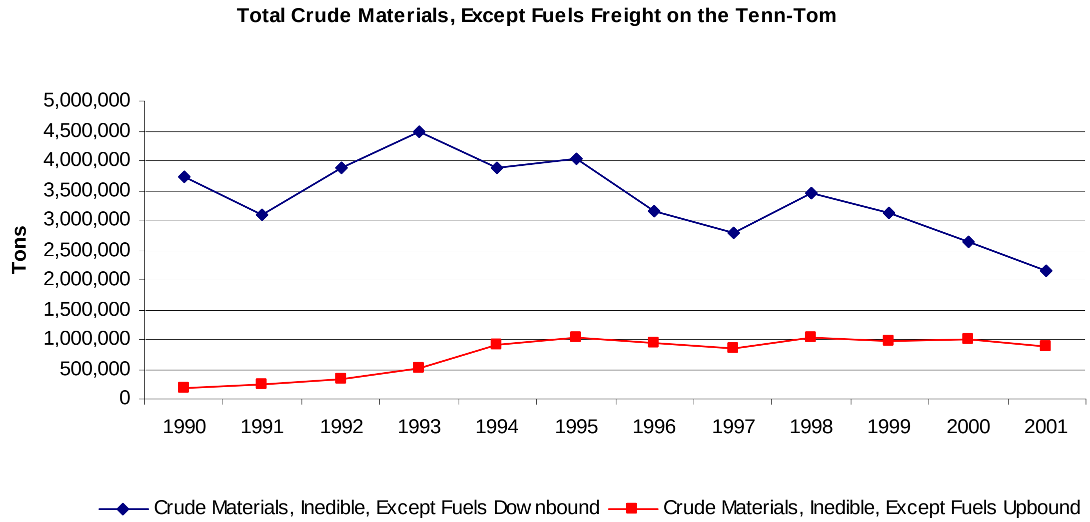
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-78



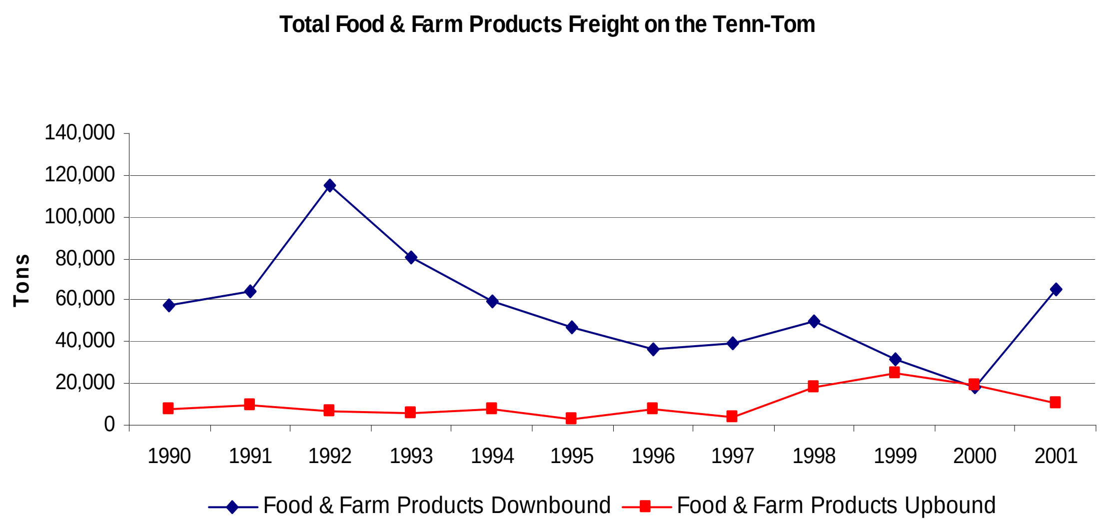
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-79



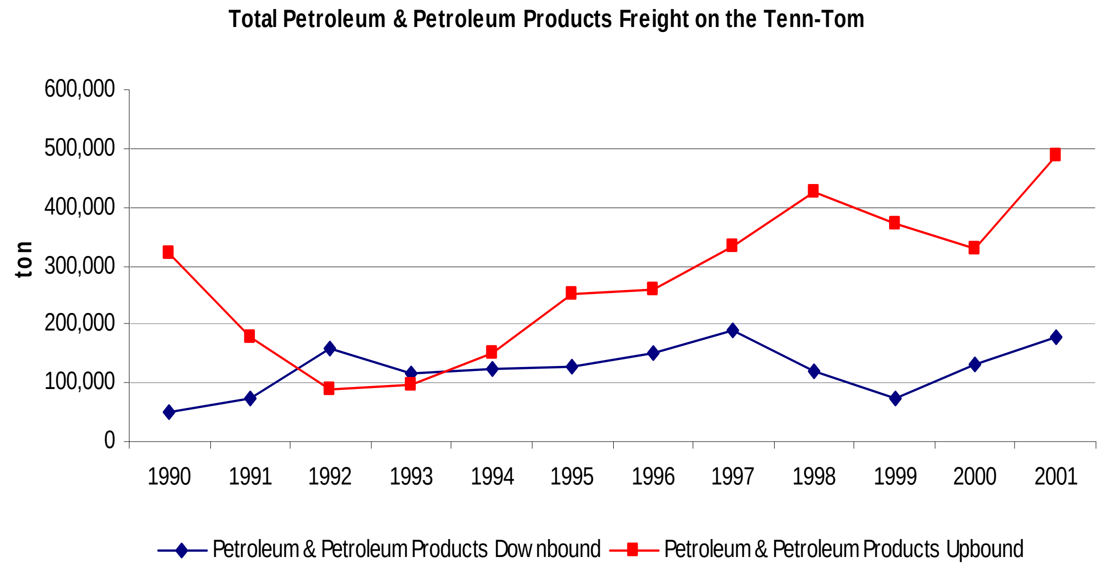
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-80



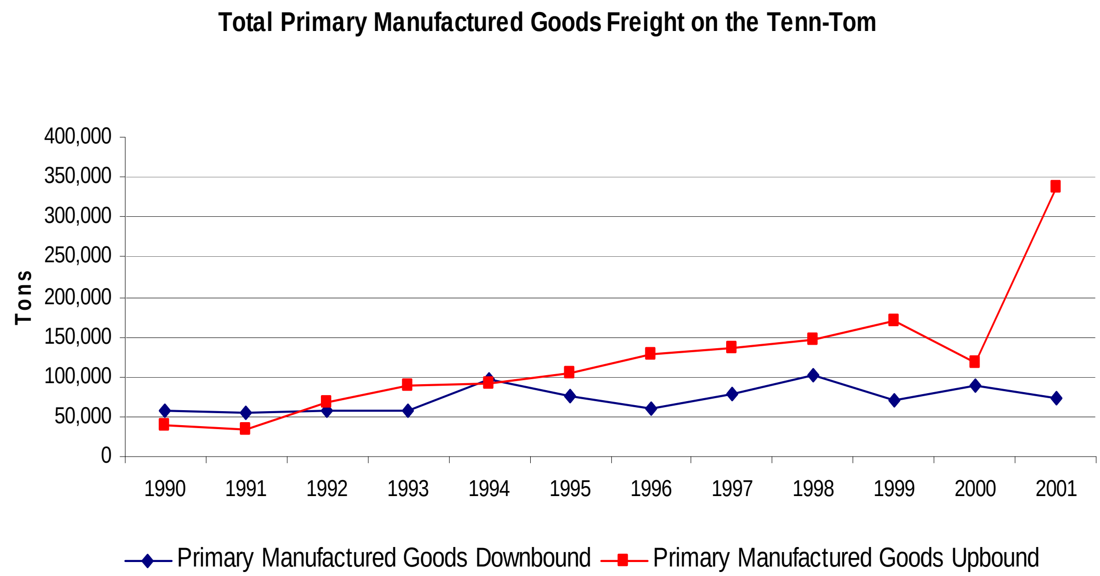
Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-81



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

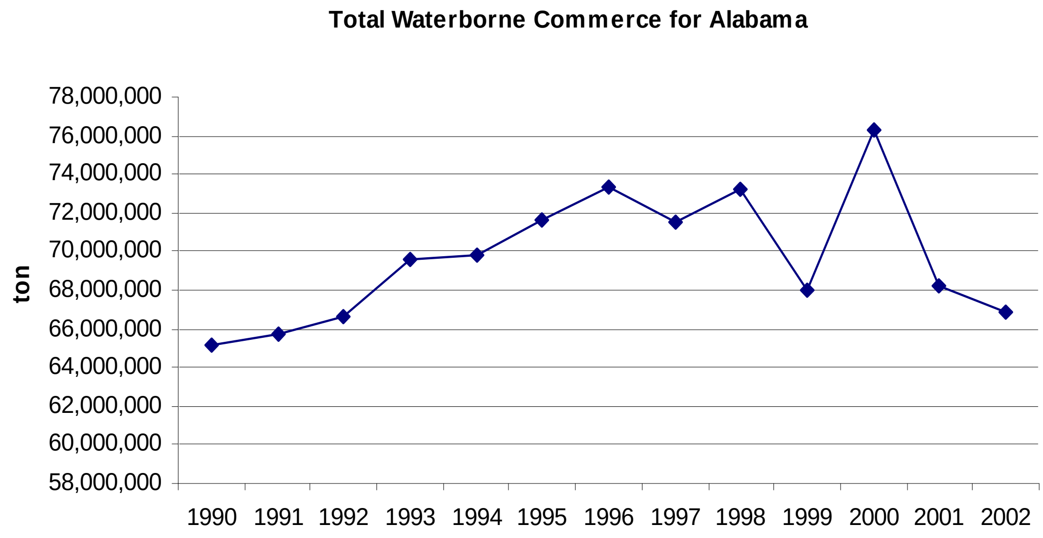
Figure 2-82



Source: Army Corps of Engineers, compiled by the University of Alabama in Huntsville Office for Economic Development

Figure 2-83

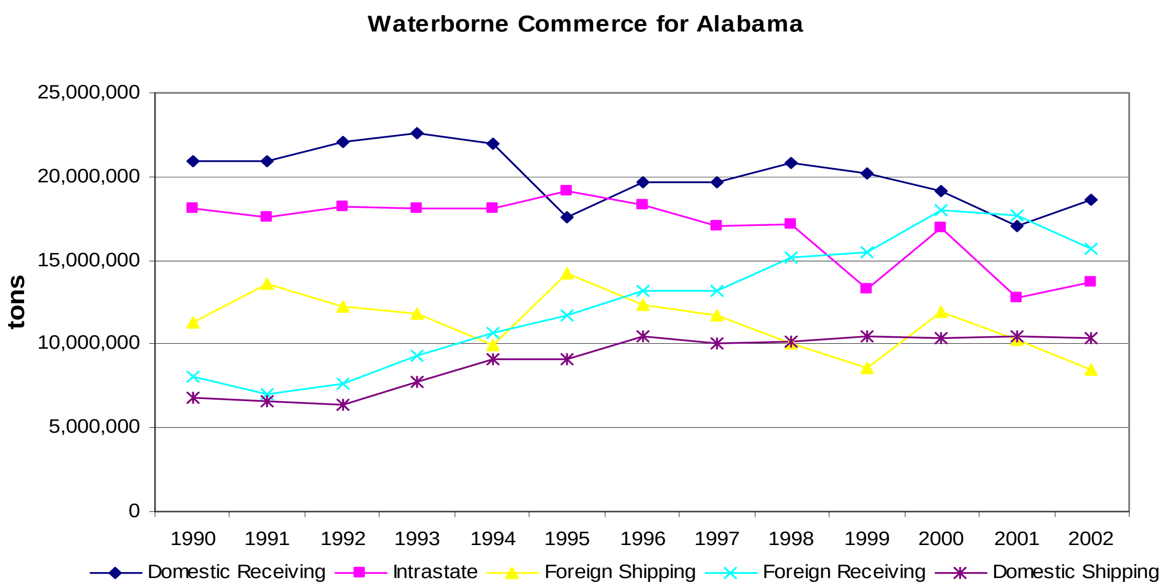
The main components of waterborne commerce for Alabama are Domestic Shipping, Domestic Receiving, Foreign Shipping, Foreign Receiving, and Intrastate. Total waterborne commerce for Alabama steadily increased from 1990-1991 and 1994-1996. In 1999 total waterborne commerce sharply declined and then peaked in 2000 at approximately 76.3 million tons (Figure 2-84).



Source: Army Corps of Engineers

Figure 2-84

Although tonnage for domestic receiving exhibited much variation throughout 1990-2002, it was the main driver of water commerce in Alabama. According to Figure 2-85, Foreign Receiving showed a continuous increase for the period 1990-2002. Foreign Receiving was approximately 8.0 million tons in 1990 and 15.6 million tons in 2002. Domestic shipping showed steady increases for the period 1993-1997, and then stayed within the range of 10.2-10.5 million tons for the period 1998-2002. Foreign shipping showed marked increases and decreases for the period 1990-2002.



Source: Army Corps of Engineers

Figure 2-85

There are some areas within the waterways of Alabama that have experienced extreme drops in waterborne commerce in the past decade. In several areas, most recently in the Coosa River, the depth of the river cannot be maintained at the required 9' clear depth to allow continuous flow of product on the river. The Apalachicola, Chattahoochee, and Flint (ACF) River System is another of those systems that has experienced an extreme drop in waterborne commerce. Barge traffic on the Apalachicola-Chattahoochee-Flint River system has declined about 10% annually since 1990 (Figure 2-86). River traffic dropped dramatically in the late 1990's with fewer than 200 barges a year using the waterways. The estimated average cost per ton-mile from 1995-98 was 14.1 cents, almost 24 times more than the cost on the Upper Mississippi River (.597 cents). In 2001 barge traffic plummeted with only 30 barges using the entire river system. During the last full year shipping freight by barge took place, each trip cost taxpayers between $30,000 and $60,000. [5] There are significant disagreements between stakeholders as to the necessity for commerce use of the waterway versus the environment and recreational uses. As a result, the last barge company on the Apalachicola ceased operations in the spring of 2002.

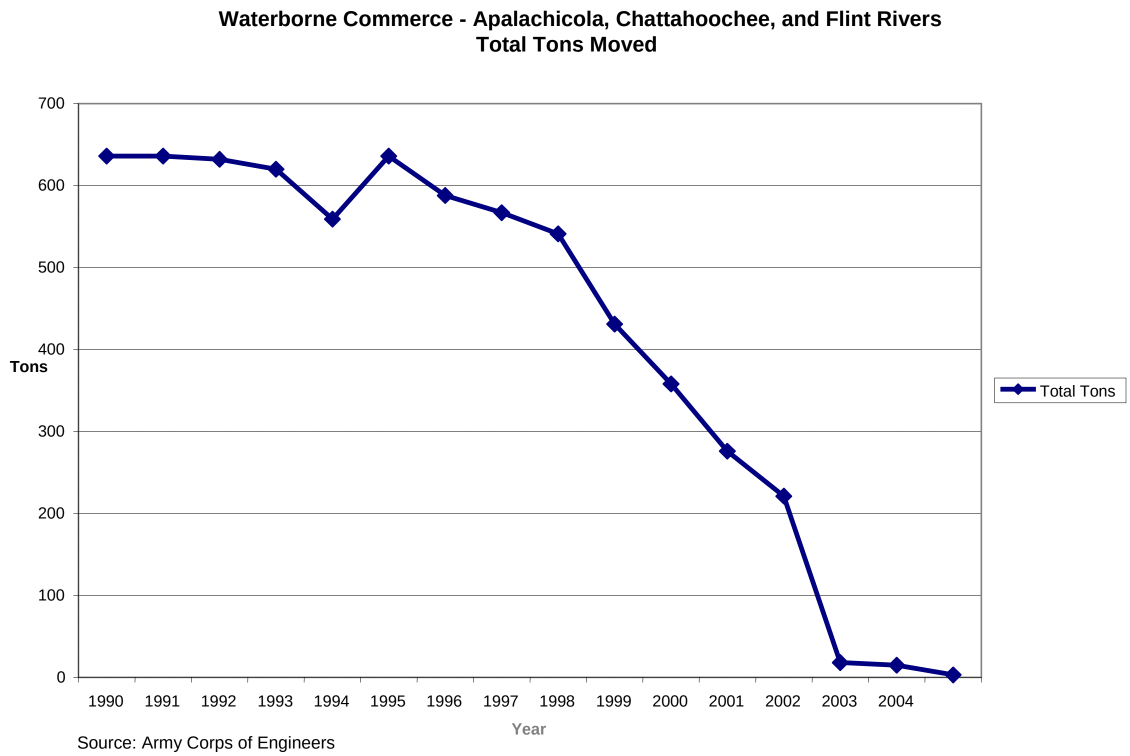
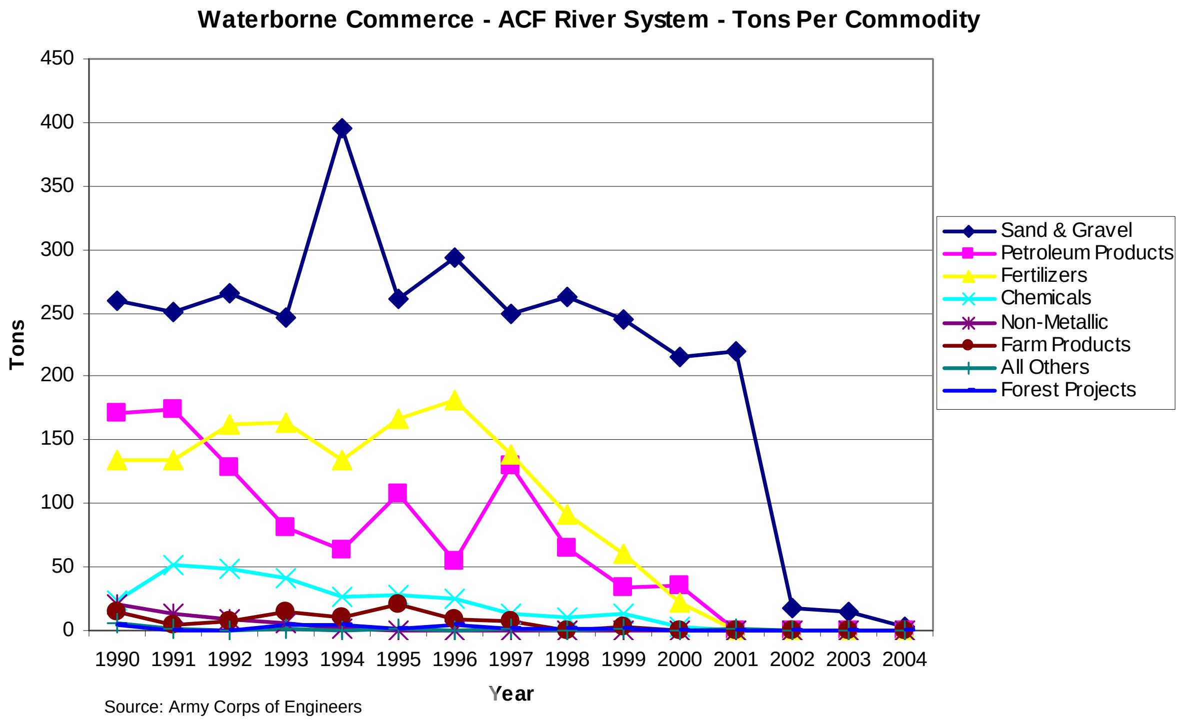


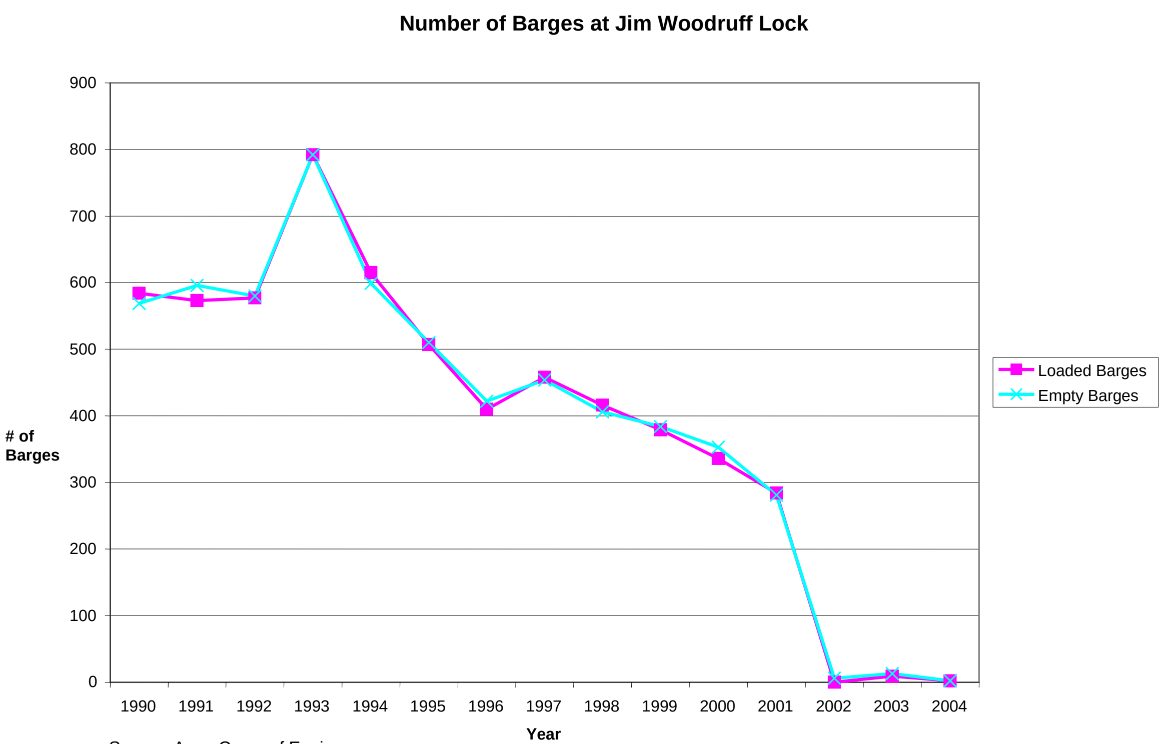
Figure 2-86

Sand and Gravel was the commodity with the largest volume of shipments on the ACF River System. The second largest volume of shipments varied between Petroleum Products and Fertilizers. Forest Products, Farm Products, and Non-Metallic Industry shipments were fairly low for the period 1990-2000. By 2001 out of all industries listed in Figure 2-87, only Sand and Gravel show recorded shipments on the ACF River System.



Source: Army Corps of Engineers

Figure 2-87



Source: Army Corps of Engineers

Figure 2-88

The total number of barges (Loaded and Empty) moving through Jim Woodruff Lock remained fairly constant from 1990-1992. Total number of barges peaked in 1993 at 1,584 barges (Loaded: 792; Empty: 792) and declined in the periods 1994-1996 and 1998-2002. Figure 2-88 shows in some instances total number of loaded barges equal to or almost equal to empty barges.

The inland waterway borne commerce is very much tied to the activity of the Alabama Sate Docks at the Port of Mobile. The Port of Mobile is one of the largest bulk ports in the U.S. and bulk products are often the type of products shipped via the navigable inland waterways.

2.4 Seaports

The Port of Mobile is a strategic link in the transportation infrastructure of the state and region. In 2000, the Port of Mobile was ranked 13th out of the top 150 U.S. ports in terms of tonnage moved in a study by the U.S. Army Corp of Engineers.[6] The Port of Mobile has been a major component of the bulk shipping industry for many years and the Alabama State Port Authority is currently executing a plan to develop Choctaw Point, a container port operation capable of handling 250,000 to 300,000 TEU's (Twenty Foot Equivalent Units, a container) annually. This would be at a minimum a 500% increase from the 50,000 TEU's handled today. The Port of Mobile is in position to become a major player in the container freight business in addition to being a major port for bulk materials, but the port must overcome cost and delivery obstacles to succeed. This success, though, will result in an issue of how to move the freight out of the Mobile area in such a way as to not cause traffic congestion that eventually impedes economic growth.

The Port of Mobile also contains one of the largest coal terminals in the country and is a strategic partner in the power generation industry that supports a significant portion of Alabama and surrounding states. Southern Company, one of the port's largest import customers, expressed a desire to double the amount of import coal coming through the McDuffie Island Coal Terminal operation at the Port of Mobile to use in the generation of electrical power in the region. The current throughput of coal is about 12 million tons. As part of this effort, UAH worked with the Alabama State Port Authority to develop a plan for productivity improvement to reach the desired import goal. To achieve this goal, the Port of Mobile will need to develop a culture of continuous improvement within an environment where this kind of thinking has not been supported in the past. The Alabama State Port Authority has taken steps in that direction. The McDuffie Island Coal Terminal is well on its way to becoming the preeminent coal handling facility in North America.

There has been commerce in and out of the Port of Mobile since the early part of the 17th Century. The current navigation channel maintained by the U.S. Army Corps of Engineers provides safe navigational depth of 45 feet from the Gulf of Mexico to the mouth of the Mobile River. The 45-foot channel serves the McDuffie Island Coal Terminal located at the mouth of the river. The channel then becomes 40 feet deep and proceeds north to the Cochrane/Africatown Bridge passing over the Bankhead and Wallace tunnels. The Mobile River, on which the Alabama State Docks facilities are located, is formed some 45 miles north of the city with the joining of the Alabama and Black Warrior/Tombigbee Rivers. The Mobile River also serves as the gateway to international commerce for the Tennessee/Tombigbee Waterway. In the southern edge of Mobile Bay, access is gained to the Intercoastal Waterway as it makes its way from St. Marks, Florida, to Brownsville, Texas.

Beginning with the expansion of the cotton trade in the 1800's, the Port of Mobile has been a major participant in America's waterborne commerce and has contributed to the region's and the nation's economic well being. The Port operates as a self-supporting enterprise agency of the Executive branch of state government.

Total tonnage for the Port of Mobile for the period 1991-2002 was approximately 605.3 million tons compared to 2.0 billion tons at the Port of Houston. The Port of Mobile ranks fourth on the basis of total tonnage for the period 1991-2002 when compared to the list of southern ports shown on Figure 2-89 and 6th in Average Annual Growth (Figure 2-90).

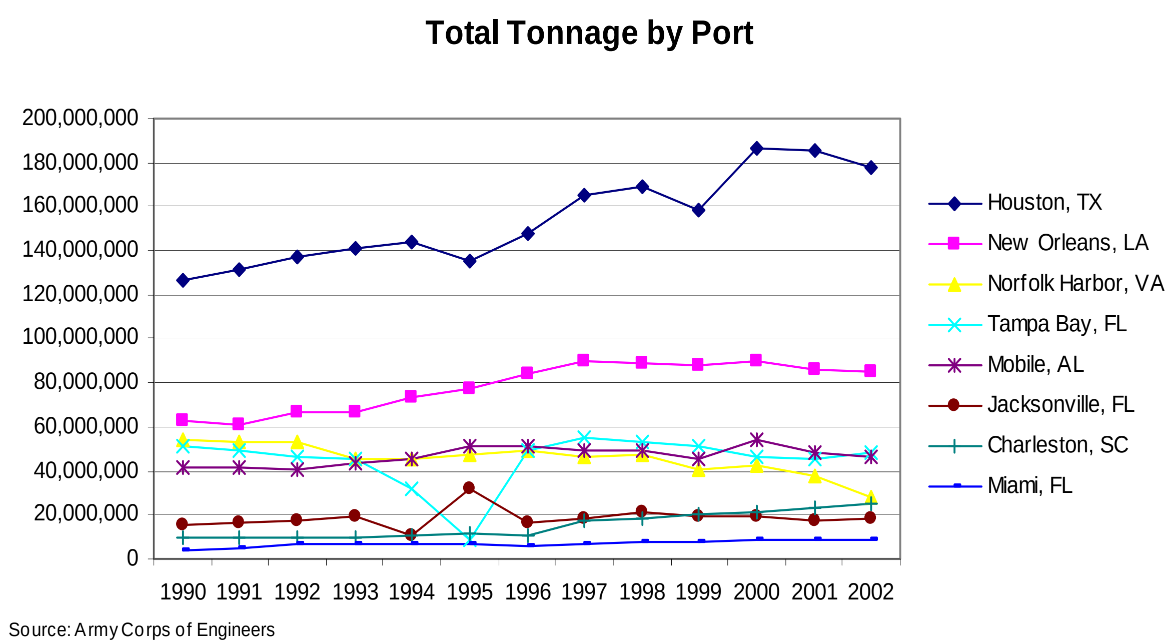


Figure 2-89

In intermodal container freight shipping, the Port of Mobile handles between 50k to 60k TEU's (Twenty Foot Equivalent Units – containers) annually. The completion of Choctaw Point in 2006 will increase the container capacity of the dock from 250k to 300k TEU's annually.

The largest commodity handled by the Port is coal (Figure 2-91). The McDuffie Island Coal Terminal is one of the largest coal handling port facilities in the world. McDuffie's main customer for coal services is the Southern Company, which has requested that the McDuffie Coal Terminal double the coal imported through the facility from 8 million tons to 16 million tons. The McDuffie Island Coal Terminal was established in 1976 as an export facility, and still exports approximately 4 million tons annually.

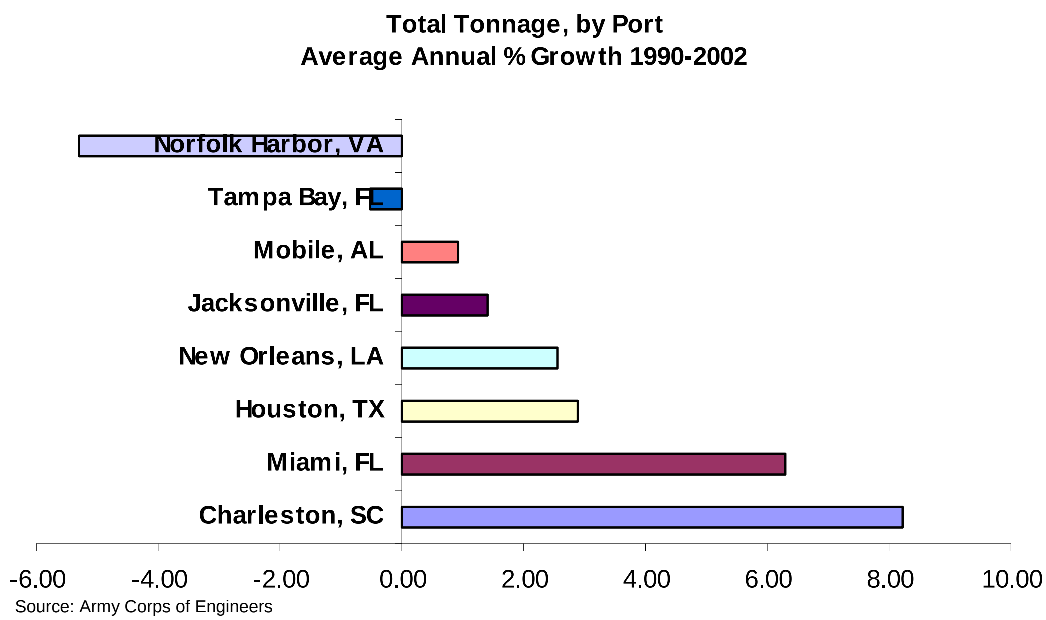


Figure 2-90

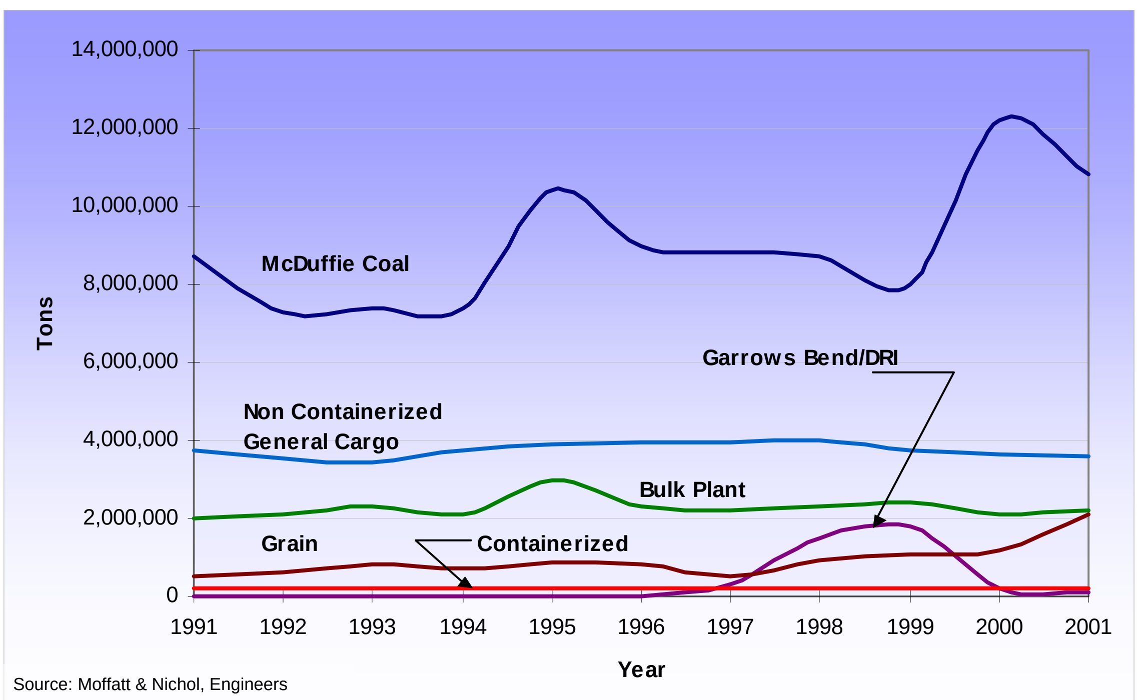


Figure 2-91
Port of Mobile Cargo Throughput 1991 to 2001 (tons)

2.5 Airways

Air freight data for the period 1993-2002 was obtained from the U.S Department of Transportation, Bureau of Transportation Statistics. Huntsville, Birmingham, Montgomery and Mobile all have freight air facilities with Huntsville being an international port of entry. Of these, only Huntsville has shown significant growth in the volume of freight with a percentage annual growth rate of 30.2% from 1993 to 2002.

Air freight is often considered the transportation mode of last resort due to the perceived cost of shipment. Air cargo tends to be utilized for high cost, low weight products and components. Several actions are happening that may bring the cost of airfreight down to the level where more manufacturers will consider it as a viable alternative. Pemco Aviation in Dothan, Alabama has been working with a customer on converting Boeing 737's into 737 QC's which consists of installing a large door in the place of the personnel door and rails on the floors. Freight can be moved into and out of the plane on those rails and pallets of seats can also be installed quickly into the plane. Air transportation companies in the Far East are using the planes to fly passengers during the day, and then change the plane over in 30 minutes to fly cargo at night. By managing their airplane resources in this manner, the companies are able to get better utilization out of the equipment and lower the cost of freight shipments.

The increased security since 9/11/01 has caused some delay in importing shipments through customs. Even with this increased security, the Port of Huntsville has a daily flight nonstop from Europe and has recently initiated weekly flights to Asia.

Air freight data for the period 1993-2002 was obtained from the U.S Department of Transportation, Bureau of Transportation Statistics. Total air freight for the state is shown in Figure 2-92. There are four freight airports in Alabama with Mobile recently opening BFM as a regional freight airstrip. Huntsville/Madison County International Airport is by far the busiest in terms of flights and volume of product shipped (Figure 2-93). The Port of Huntsville consists of the International Airport and a rail/highway intermodal center.

Total International Freight volume steadily increased for the period 1995-2002 (Figure 2-94). Total international freight volume for 1993 was 7,053 tons and rose to 82,741 tons in 2002. Figure 2-95 shows the components of International freight volumes for Alabama. For the period 1996-2002 tons of international air-freight entering Alabama (international origin) was greater than air-freight leaving Alabama (international destination). In 2002 international air-freight origin and destination was fairly equal with international origin and destination being 41,612 and 41,129 tons respectively.

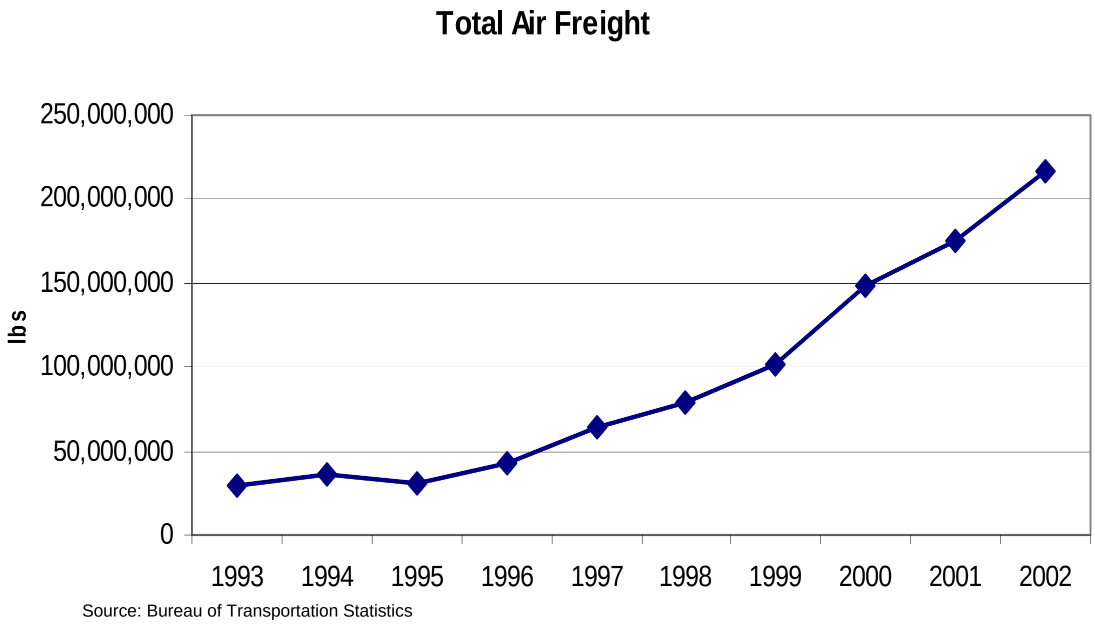


Figure 2-92
Total Air Freight in Alabama

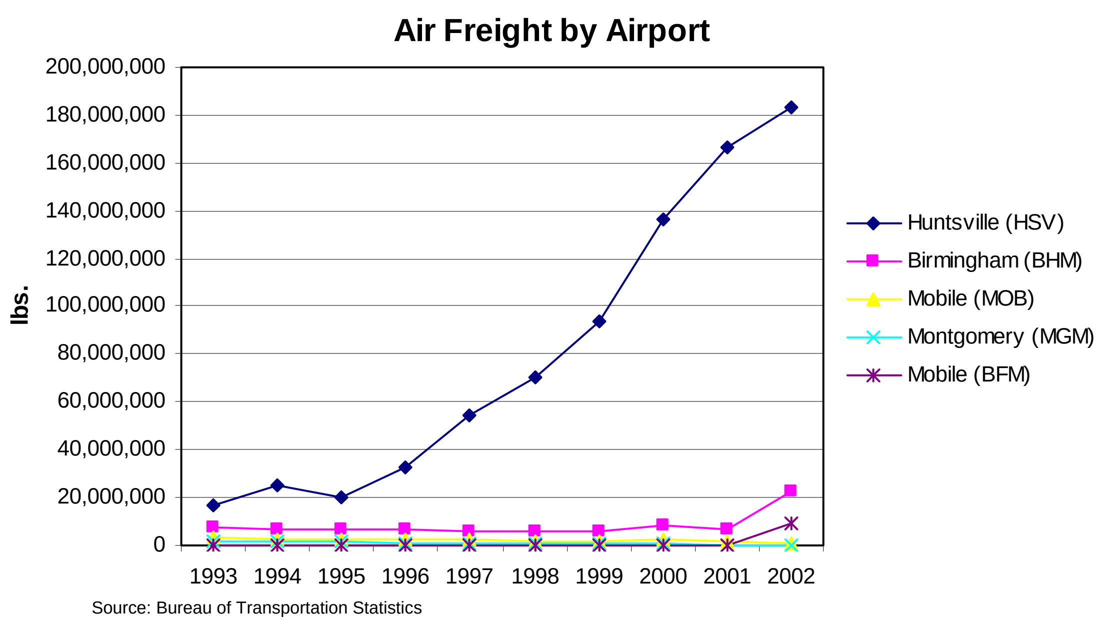


Figure 2-93

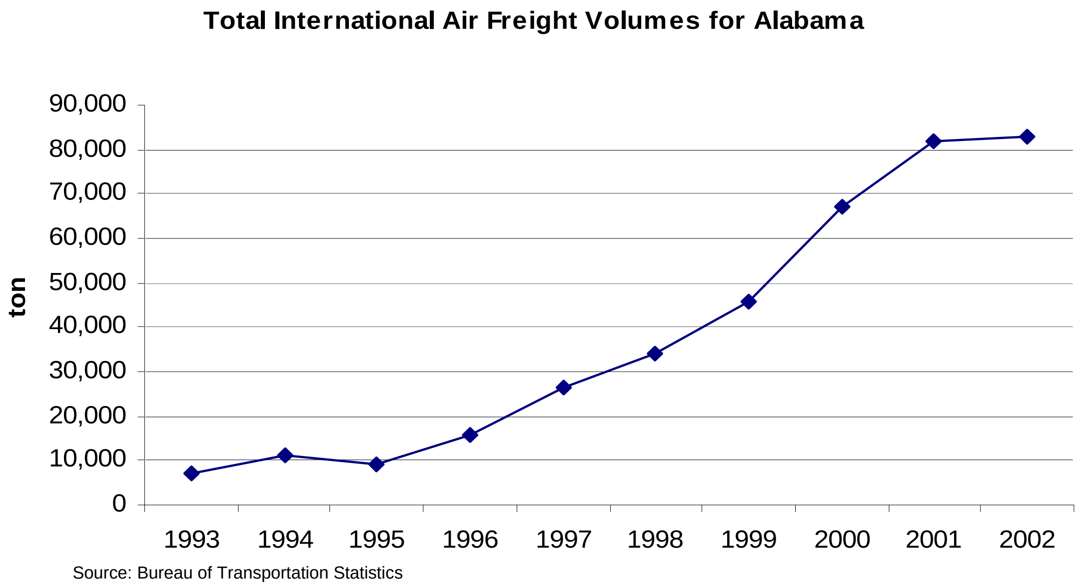


Figure 2-94

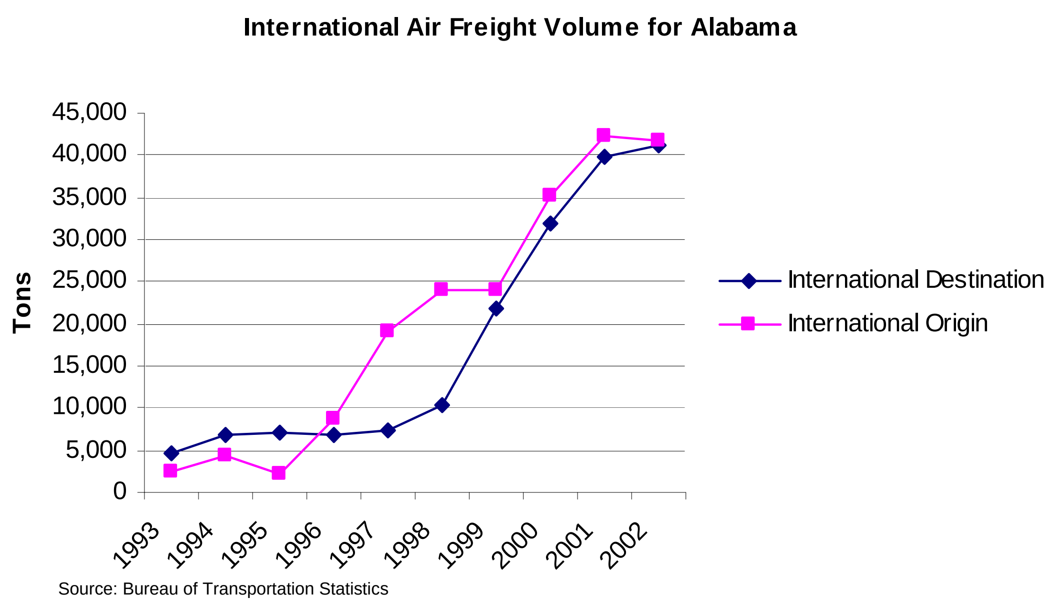
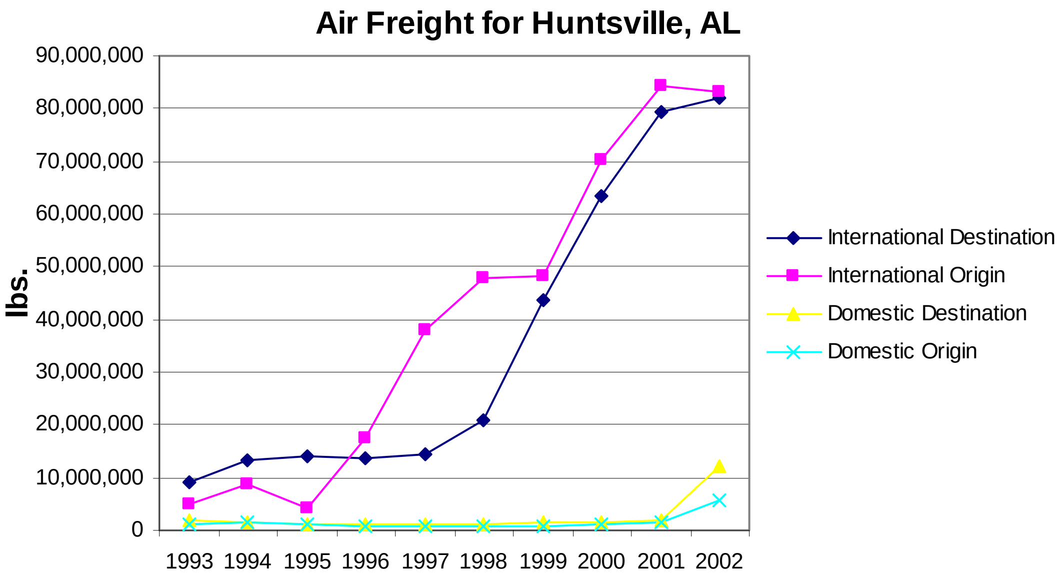


Figure 2-95

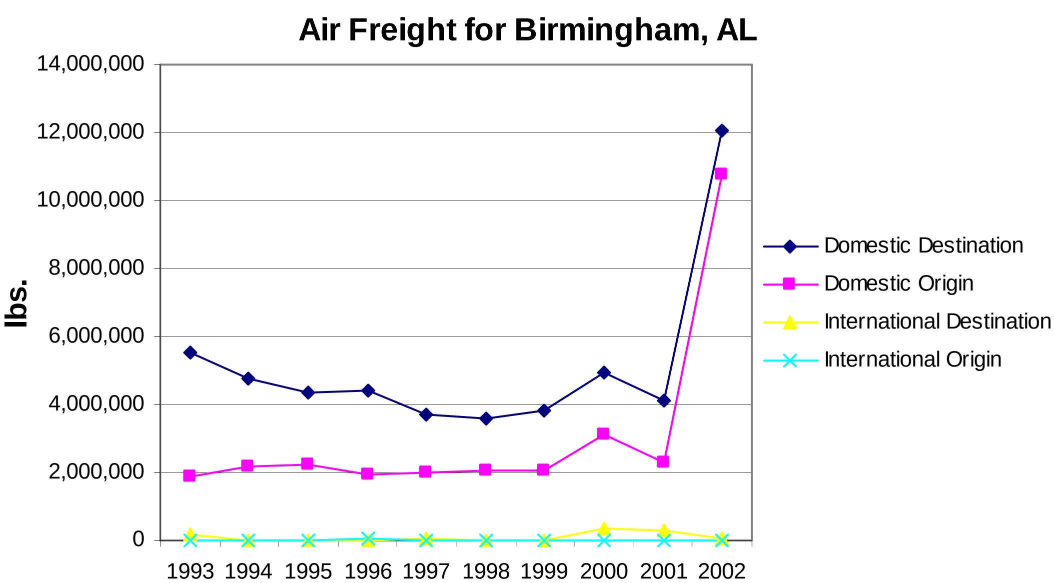
Figure 2-96 shows the components of air freight in Huntsville, Alabama. The largest components for this area are international origin and destination. International air-freight entering Huntsville rose sharply during the periods 1996-1998 and 2000-2001. Air freight leaving Huntsville for international destinations also rose sharply for the period 1998-2001. Air freight with domestic origin and destination remained fairly the same for the period 2001-2002.



Source: Bureau of Transportation Statistics

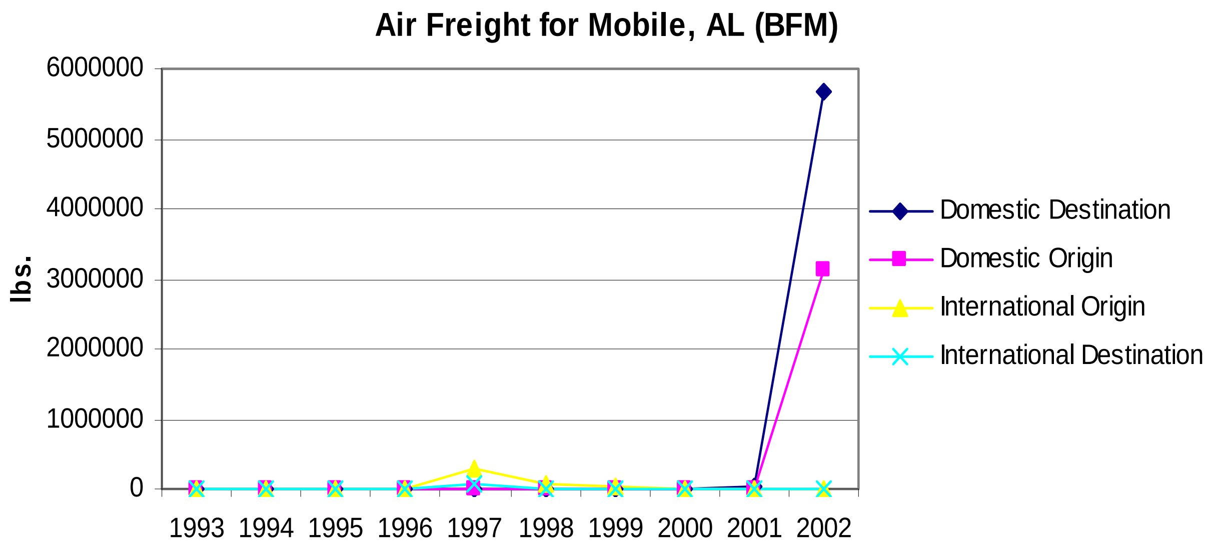
Figure 2-96

Figures 2-97 to 2-99 present components of air freight for other regions in Alabama



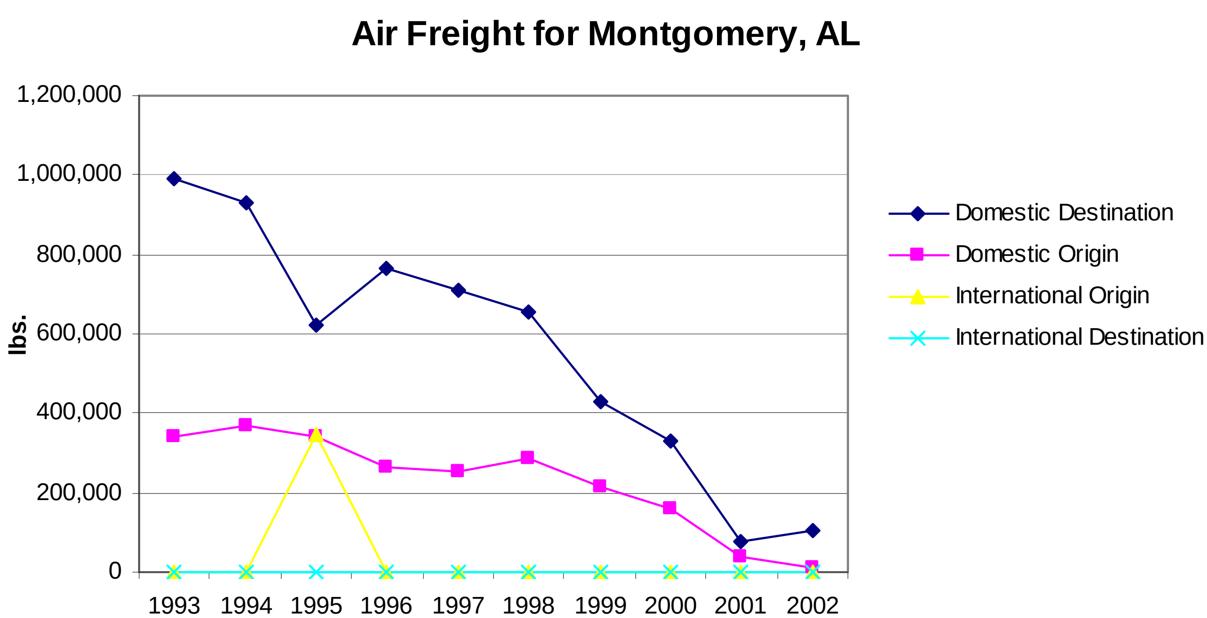
Source: Bureau of Transportation Statistics

Figure 2-97



Source: Bureau of Transportation Statistics

Figure 2-98



Source: Bureau of Transportation Statistics

Figure 2-99

2.6 Intermodal

Intermodal freight activity is the act of exchanging freight between two or more modes of freight transportation. The majority of this activity takes place between railroad and truck, typically at an inland site, or between ocean going vessel and either train or truck at a seaport. Although there have been discussions about using container on barge as a method to move freight inland, waterborne commerce entities in Alabama have yet to embrace the idea.

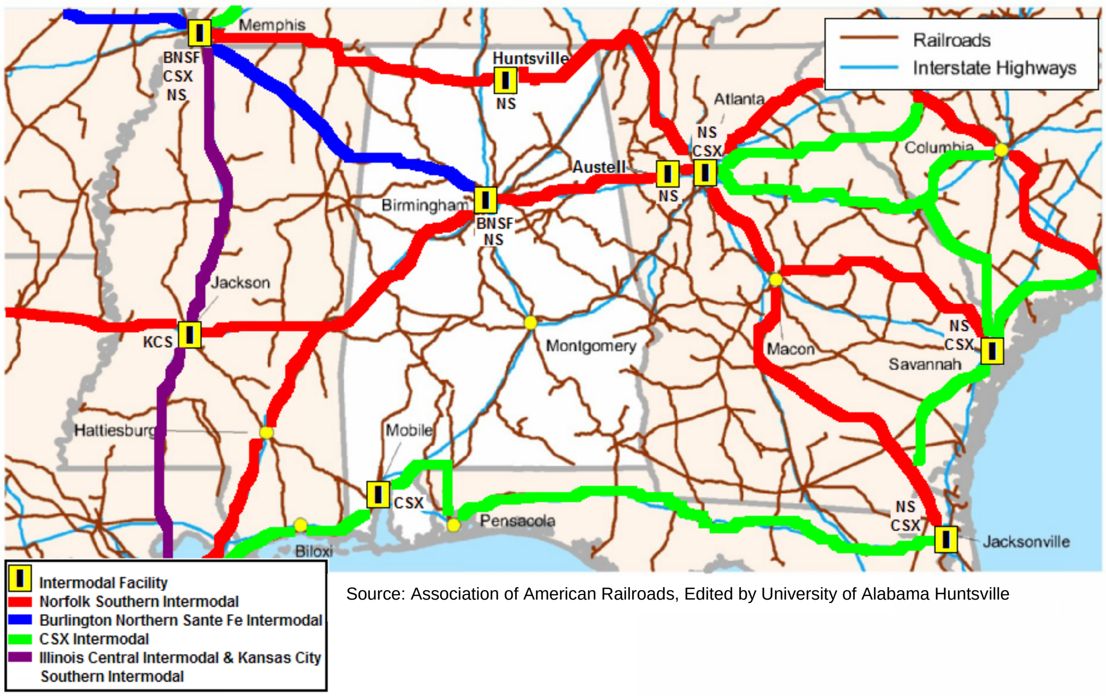
The four primary Class-1 railroads in the United States each operate their own defined intermodal systems. These systems consist of intermodal terminals at or near major container seaports and inland intermodal terminals, which are typically at or near major population centers. The railroads serve these terminals using dedicated intermodal trains, traveling along lanes designated for intermodal traffic. These lanes are generally established based on density of container volume and the ability to accommodate the double-stacking of containers. Some rail lanes may not be amenable to double-stack trains, due to low overpass clearances or low tunnel heights.

The eastern portion of the U.S., generally east of the Mississippi River, with some exceptions, is served primarily by the Norfolk-Southern (NS) railroad and the CSX railroad. The western portion of the U.S., generally west of the Mississippi River, with some exceptions, is served primarily by the Burlington Northern Santa Fe (BNSF) railroad and the Union Pacific (UP) railroad. While the eastern railroads do cooperate with the western railroads on moving intermodal freight across the country, there is also fierce competition between the railroads, particularly where they serve the same geographic areas.

International containers, arriving at U.S. seaports, are transported inland via both truck and rail. Trucks generally deliver containers within a 200-mile radius of the seaport. Rail is generally used to move containers to inland points beyond 200 miles of the seaports. Once the containers arrive at a designated inland terminal, trucks will then deliver the containers, generally within a 200-mile radius of the inland terminal. The process is reversed for containers moving to the seaports for export. The radius distance is not a set number. Exceptions to this distance frequently occur due to many variables.

Domestic containers and rail trailers move from point to point within the U.S. Domestic intermodal freight is typically used for long-haul situations, in excess of 500 miles. Once the containers arrive at a destination terminal, trucks will then deliver the containers, generally within a 100-mile radius of the terminal. The domestic service radius of an intermodal terminal is generally less than the international radius, due to competition with over-the-road truck rates.

Presently there are three primary intermodal rail terminals located in Alabama, each served by a different Class-1 railroad. Huntsville is served by Norfolk-Southern; Birmingham is served by BNSF; and Mobile is served by CSX. Additionally, Norfolk-Southern operates a small intermodal terminal in Birmingham to exclusively serve the Mercedes-Benz plant in Vance, AL. Both Huntsville and Mobile are served by eastbound and westbound intermodal train service. Birmingham is the eastern-most terminus for the BNSF railroad. Therefore, there is no eastbound intermodal train service from the BNSF terminal in Birmingham (Figure 2-100).



Source: Association of American Railroads, Edited by University of Alabama Huntsville

Figure 2-100
Intermodal Railroads and Facilities in Alabama and the Southeast

Due to the fact that Mobile, at present, is not a major container port, the railroads hold that there is not sufficient container volume to justify a north-south intermodal rail connection between Mobile and Birmingham and/or Mobile and Huntsville. Both CSX and Norfolk-Southern have rail lines extending from Mobile into central and north Alabama. However, the viability of those rail lines, being usable for intermodal rail traffic, would have to be determined by the individual railroads. CSX does not have an intermodal terminal in either Birmingham or Huntsville and Norfolk-Southern will usually utilize their intermodal hub terminal, in Austell, GA, to link Mobile to Huntsville. Mobile, with the planned development of the Choctaw Point container terminal, intends to become a major container seaport on the Gulf coast. Current projections call for the Choctaw Point terminal to be operational by fourth quarter of 2006. The projected volume for Choctaw Point is between 250,000 and 300,000 containers annually which will be a minimum increase of 500% from the current volumes of around 50,000 containers.[7] Mobile is served by 5 Class 1 railroads; Norfolk Southern, CSX, BNSF, Illinois Central (Owned by Canadian National RR, CN) and Kansas City Southern. Any combination of these five, or all five could potentially serve Choctaw Point.

Even though the Port of Huntsville has access to rail, air and highway modes of transportation, the intermodal nature of the freight dictates the modes of delivery. Freight will typically transfer from truck to rail and truck to air. Very seldom does a product transfer from air to rail or rail to air due to the weight and delivery time requirements. Air freight will carry high value, low weight, time definite delivery items and rail will carry high weight, lower cost, non-time sensitive materials.

The International Intermodal Center (IIC), at the Port of Huntsville, is owned and operated by the Huntsville/Madison County Airport Authority (HMCAA). The IIC operates as a private, intermodal rail ramp for the Norfolk Southern (NS) railroad and is situated on approximately 50 acres of airport land with direct access to the NS main line and the US Interstate System. The yard is composed of four parallel tracks, able to accommodate forty-four 100 ft. rail cars; 1200 feet of additional ramp track, 6,200 feet of lead track and 3,600 feet of storage track. The yard is a combination terminal and depot with a parking capacity of 1,200 wheeled units (TOFC), space for 548 stacked loads and 576 stacked empty units. Lifts are generated by a 45-ton rail mounted gantry crane (RMG) and a 45-ton rubber-tire gantry crane (RTG) supported by various hosting equipment. The IIC currently maintains a small pool of chassis consisting of 20’ and 40’ equipment available for daily rental. The IIC presently employs 14 full-time (including the IIC Director) and 2 part-time HMCAA employees. The IIC is used by approximately twenty steamship lines, of which a dozen constitute 90% of the business. Due to a recent expansion, the IIC can now accommodate up to 114,000 lifts per year, with an increase in storage capacity to over 2,300 units.

The IIC ramp serves a concentric catchments area of approximately 150 miles. Intermodal containers of overseas origin are railed via the NS from the East Coast seaports of Savannah and Charleston. From the West Coast seaports, containers destined for Huntsville are railed via the Union Pacific (UP) and Burlington Northern Santa Fe (BNSF) railroads to Memphis; where they connect with the NS and proceed from there to Huntsville and points east. The IIC also ships and receives domestic rail containers and trailers, via certain designated lanes. The IIC began operations in December 1986. The first full year of operation, 1987, the IIC performed 11,847 rail lifts. Since 1987, rail lift volume has increased 131% to 27,423 lifts, performed in 2003. 2002 and 2003, have been record volume years for the IIC, with 26,502 lifts and 27,423 lifts, respectively (Figure 2-101). Currently the lift volume mix is approximately 85% international and 15% domestic.

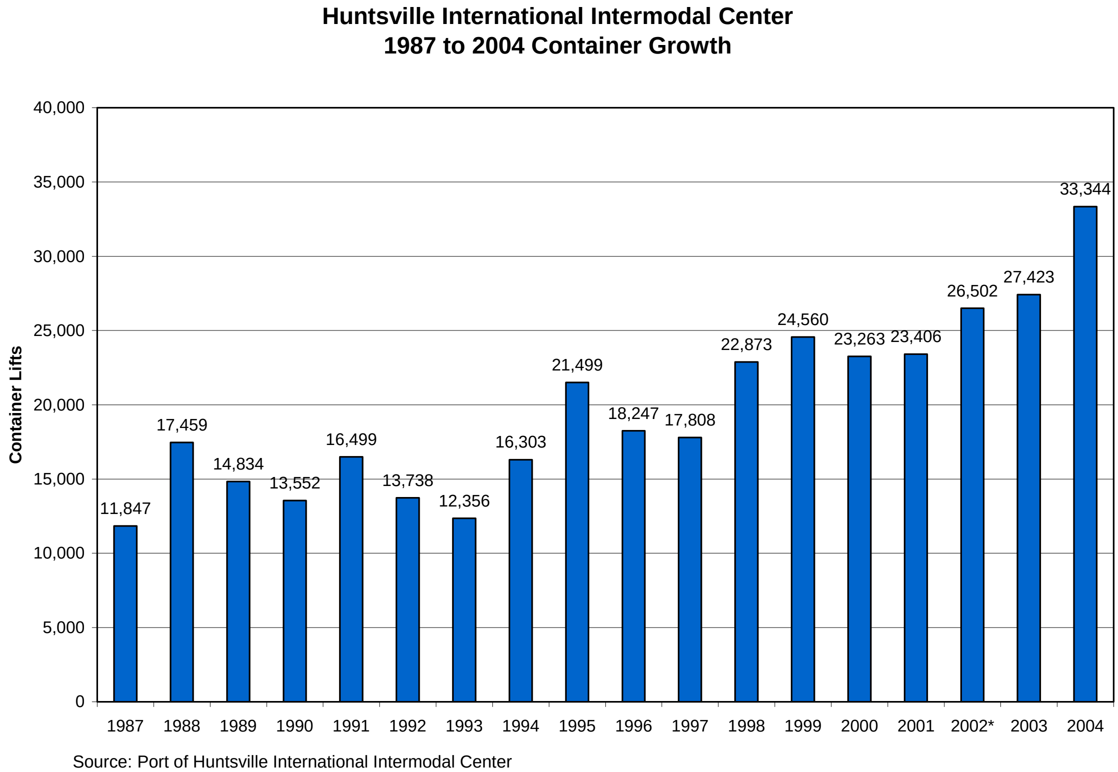


Figure 2-101

Due to recent expansion and upgrades of their intermodal facility, completed in 2004, the Port of Huntsville has capacity to handle up to 100,000 containers annually, approximately three times the volume experienced in 2004.

The characteristics of the intermodal freight industry typically follow a given set of guidelines, as mentioned earlier. In these guidelines trucks generally deliver containers within a 200-mile radius of the seaport, while rail is generally used to move containers to inland points beyond 200 miles of the seaports. In a domestic container movement, rail will be utilized to move freight in long-haul situations, in excess of 500 miles. Once the domestic containers arrive at a destination terminal, trucks will then deliver the containers, generally within a 100-mile radius of the terminal. Using these guidelines, the current competitive situation in Alabama can be seen in Figure 2-102. If a circle with a 200 mile diameter is drawn from each intermodal facility located in Alabama, it is quickly recognized that trucking competes with rail in almost every market. The flexibility of truck freight transportation in the state requires intermodal rail compete from a price standpoint without the container volume to offset costs. Therefore, container lanes are not designated due to low volume and competition from truck freight.

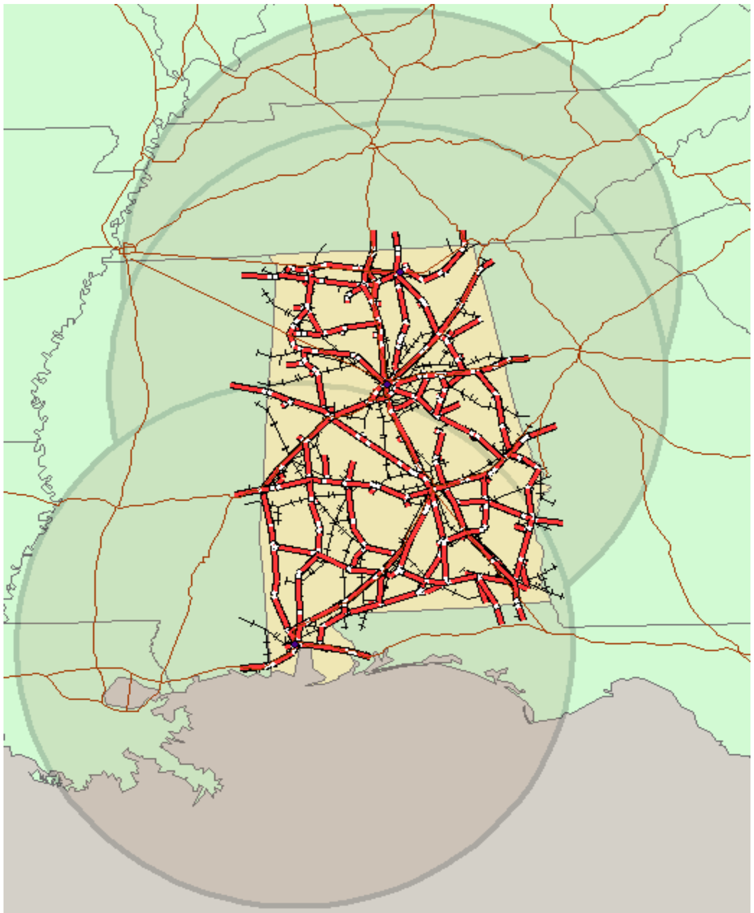


Figure 2-102
Rail & Highway Network – 200 Mile Radius Around Intermodal Facilities

Other competitive issues that the intermodal infrastructure stakeholders in Alabama will have to deal with are the fact that the Port of Huntsville is “sandwiched” between two major intermodal gateways, Memphis and Atlanta. Therefore, some steamship lines may prefer to consolidate their equipment at the major gateways rather than position equipment at a lower volume facility. Some steamship lines prefer to truck their containers into Alabama from the East coast ports of Charleston and Savannah to improve equipment utilization. By trucking the containers in the steamship line can cut up to three days off of the cycle time for a container, thus turning the equipment faster. This same situation could occur in Mobile.

<u>Conclusions</u>

Research by the Federal Highway Administration indicates that if the freight system within the U.S. continues to rely on trucks and highways, the demand for freight transportation over the next two decades will far outpace the available infrastructure capacity.[8] Intermodal freight movement offers an efficient and socially beneficial alternative, but there are many obstacles to overcome before manufacturers in the U.S. will be persuaded to change their current behavior.

In this chapter we have investigated the current state of transportation infrastructure in Alabama. There are problems, such as deterioration of bridges and roadways which must be dealt with along with opportunities to seize upon to move Alabama towards becoming a Freight Gateway to Mid-America. In the next chapter we will research the population trends and makeup of the state and how historical and current dynamics are establishing the future requirements for economic growth.

3. Population

Understanding the infrastructure in Alabama was the first step to the development of an integrated systemic approach to infrastructure planning for dynamic economies in transition. The second important factor to understand is the population of the state and how historical and current dynamics are establishing the future requirements for economic growth.

Population trends do have an effect on the economy and infrastructure of a region. Economic activity needs population to grow. A growing economy attracts population, thus creating a cycle of growth and prosperity. The opposite is also true. An economy in decline will lose population as people leave the region to look for opportunity elsewhere, thus creating a downward spiral from which it is very difficult to pull out. The transportation infrastructure in a region is either an enabler or restrictor of growth. The presence of infrastructure is not necessarily a stimulus for growth, but the lack of infrastructure can extinguish growth.

Population growth in Alabama has lagged behind the southeast and the nation for the past two decades, as can be seen in Figure 3-1.

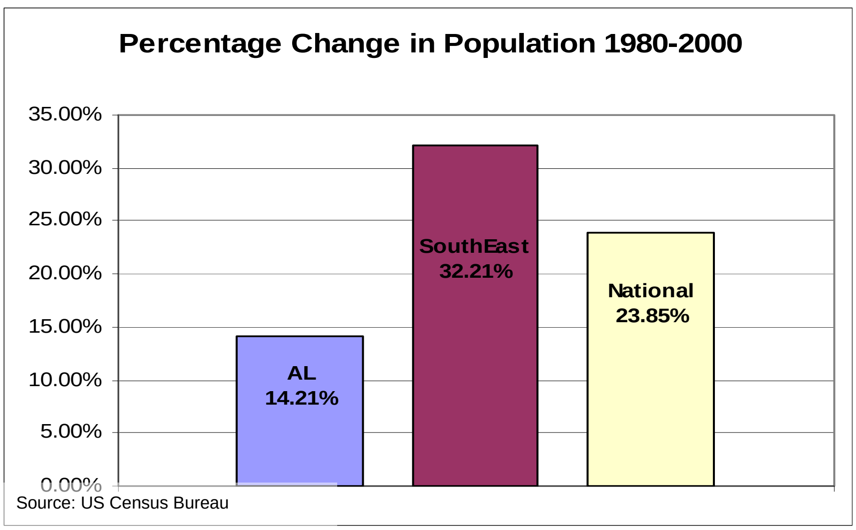


Figure 3-1
Relative Population Growth: Alabama, Southeast, and U.S. (1980 to 2000)

The population and labor force data used in the following charts was obtained from the Department of Industrial Relations and the Census Bureau. Figure 3-2 is a map of the southeastern United States that indicates which states are growing the fastest. The same information is shown for labor force in Figure 3-3.

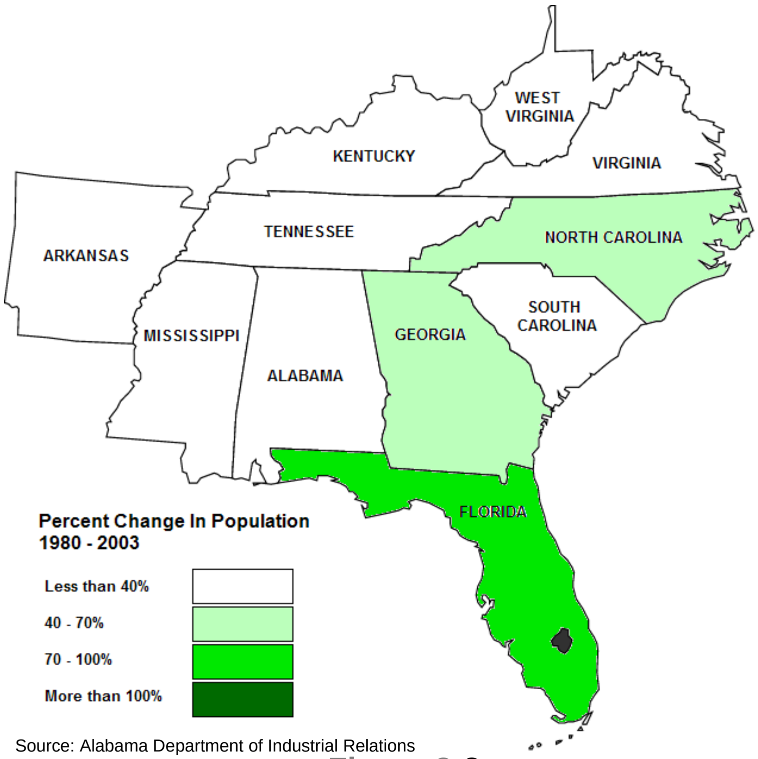


Figure 3-2

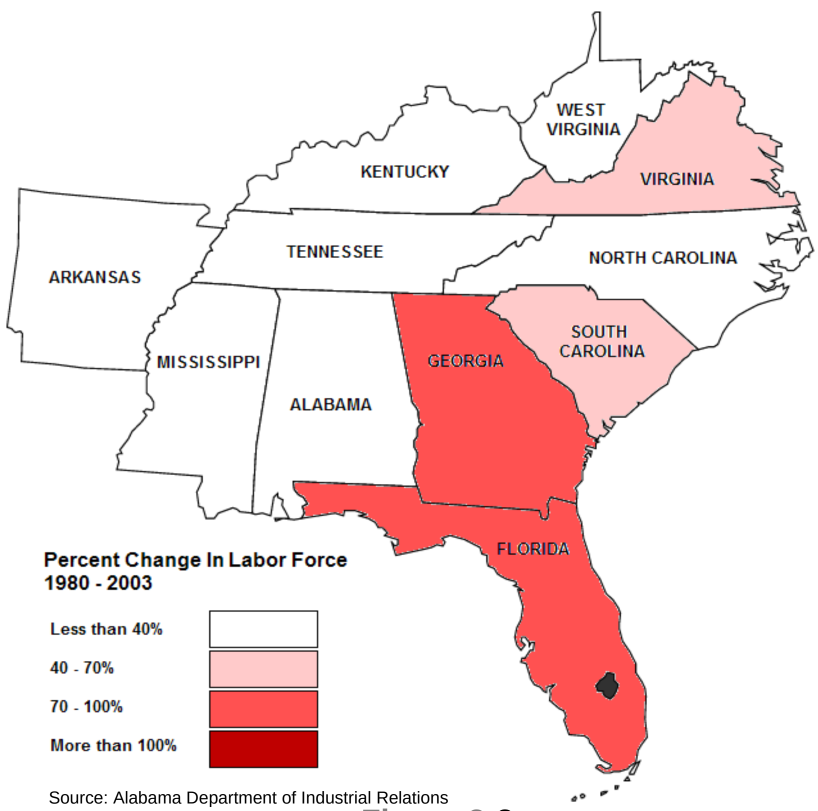


Figure 3-3

The nine Transportation Planning regions used by AL DOT were chosen for this analysis. Figure 3-4 shows the counties that make up each region. Figures 3-5 and

3-6 show the percent change in population and labor force for the nine regions. In Figure 3-5 you can see that region 8 is the only region that experienced a decline in population and regions 1 and 9 had the strongest growth. Figure 3-6 also shows regions 1 and 9 having the strongest growth in percent change in labor force.

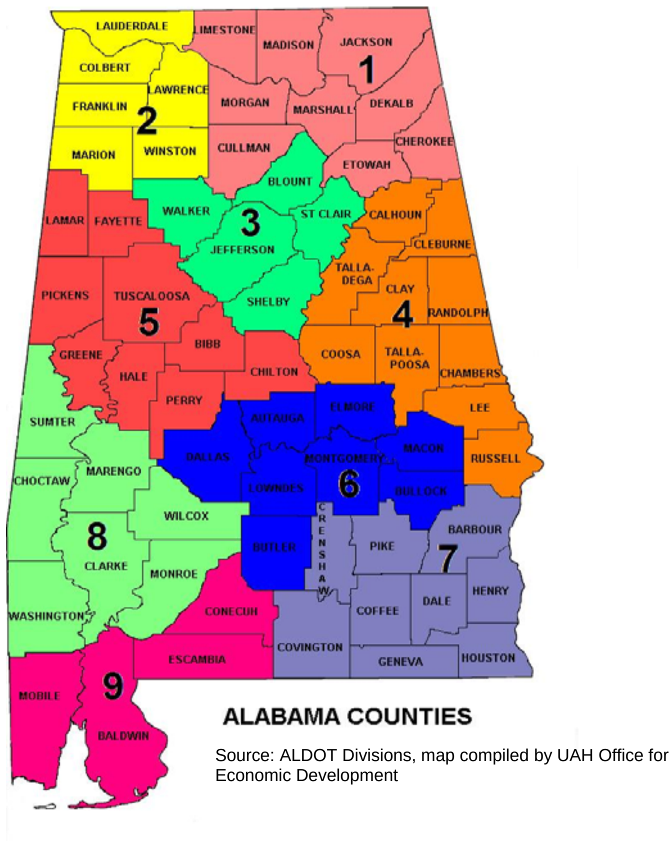


Figure 3-4

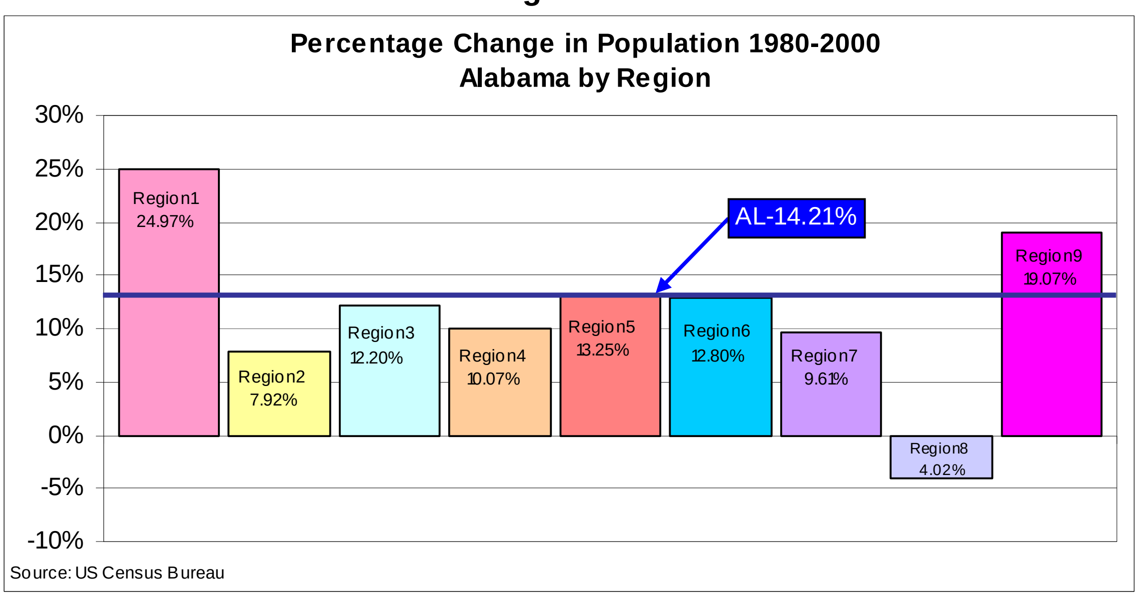


Figure 3-5

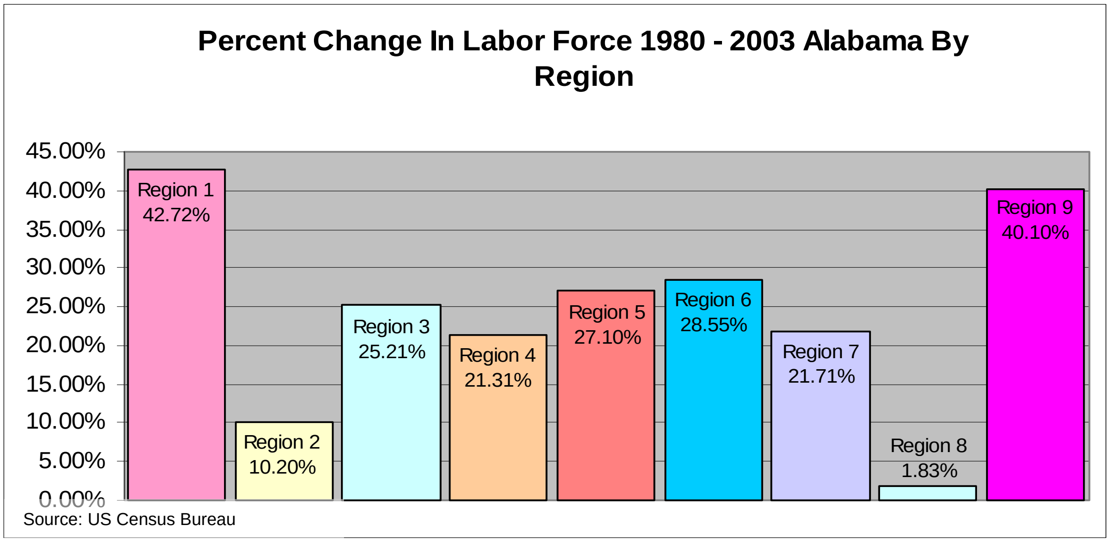


Figure 3-6

Research into the population growth and trends in Alabama yields evidence that the population in the state is aging. The percentage of 0 to 4, 5 to 17 and 18 to 24 year olds in every region of Alabama declined between 1980 and 2000. Age groups 25 to 44, 45 to 64 and 65 to 84 all increased during the same time period, see Figure 3-7. If this trend continues to its logical end, the ability to maintain, much less grow, the economy of Alabama will be severely hindered.

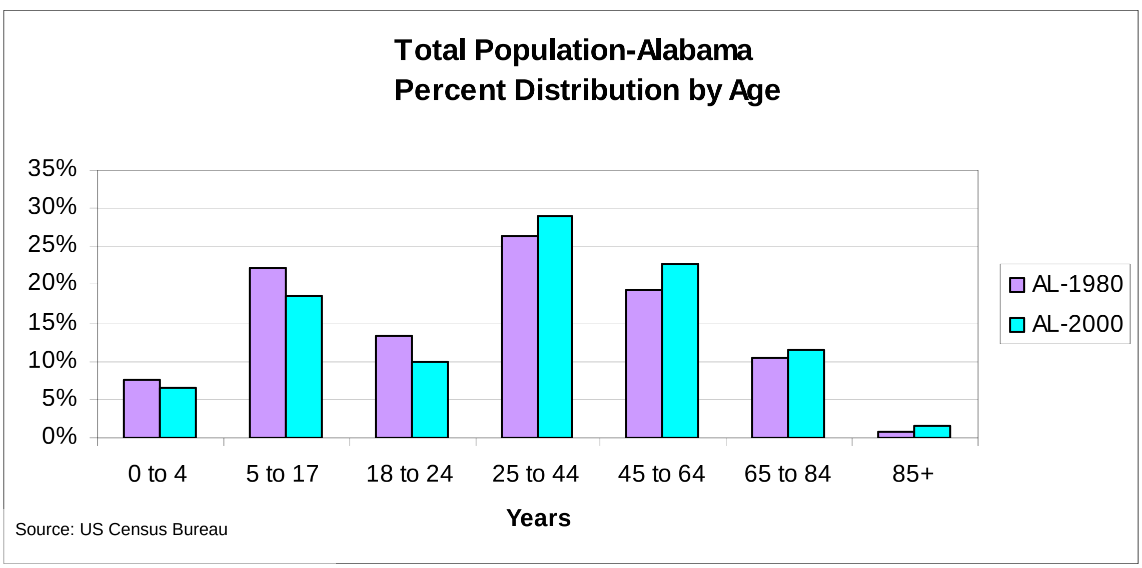


Figure 3-7
Total Population – Alabama, Percent Distribution by Age

Figures 3-8 through 3-16 show the percent change in population for each region. It is interesting to note that all nine regions experienced a decline in population in the 18 – 24 year old age group.

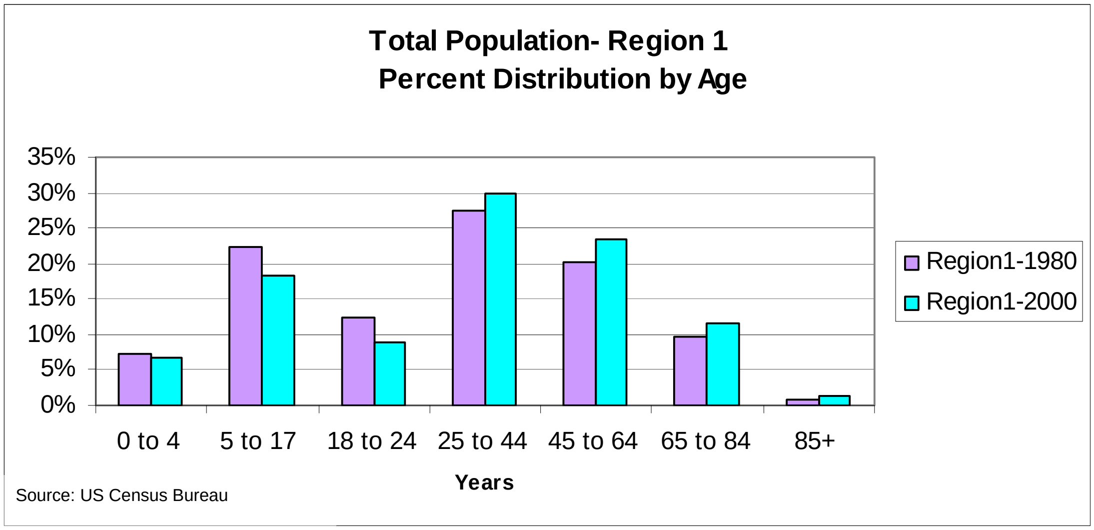


Figure 3-8

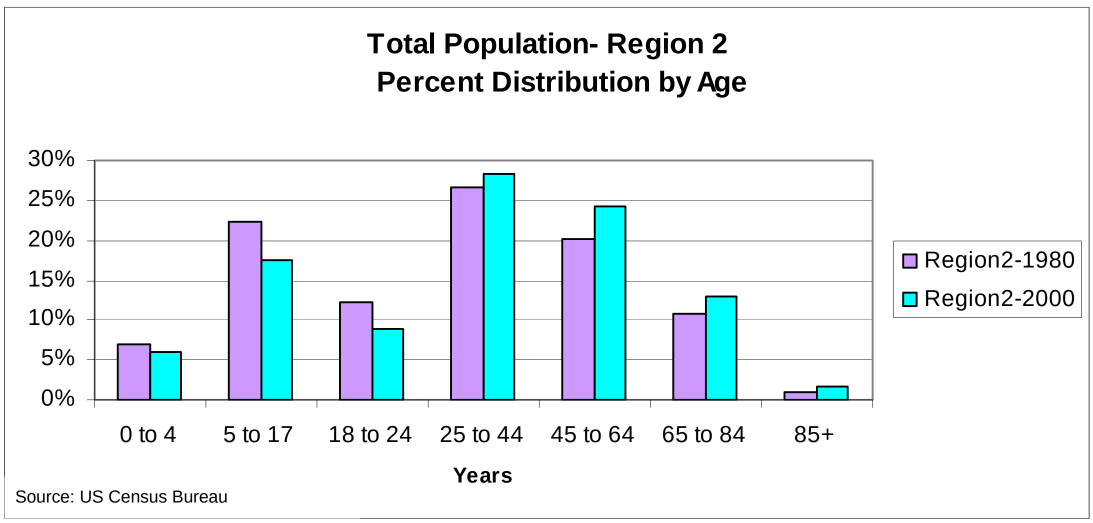


Figure 3-9

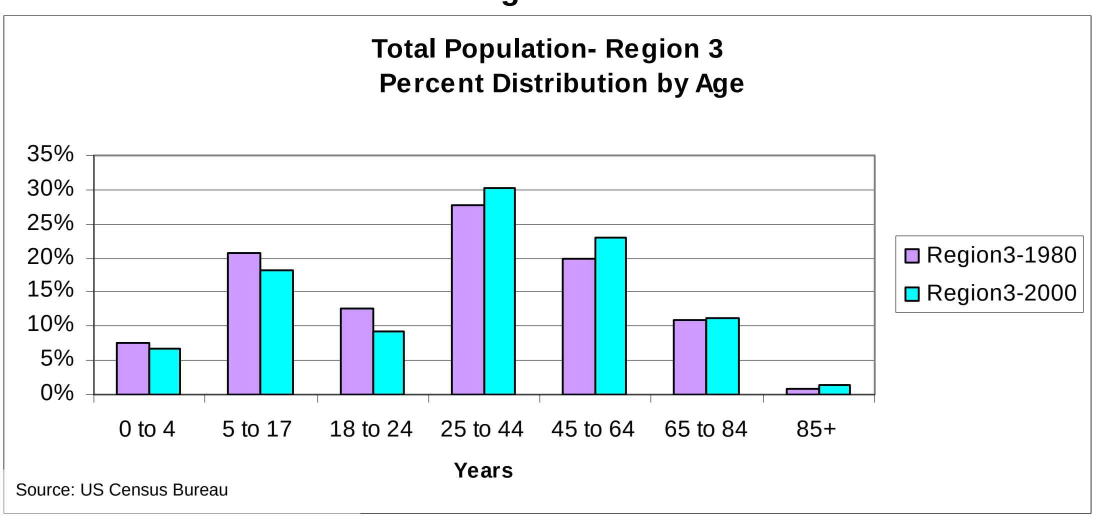


Figure 3-10

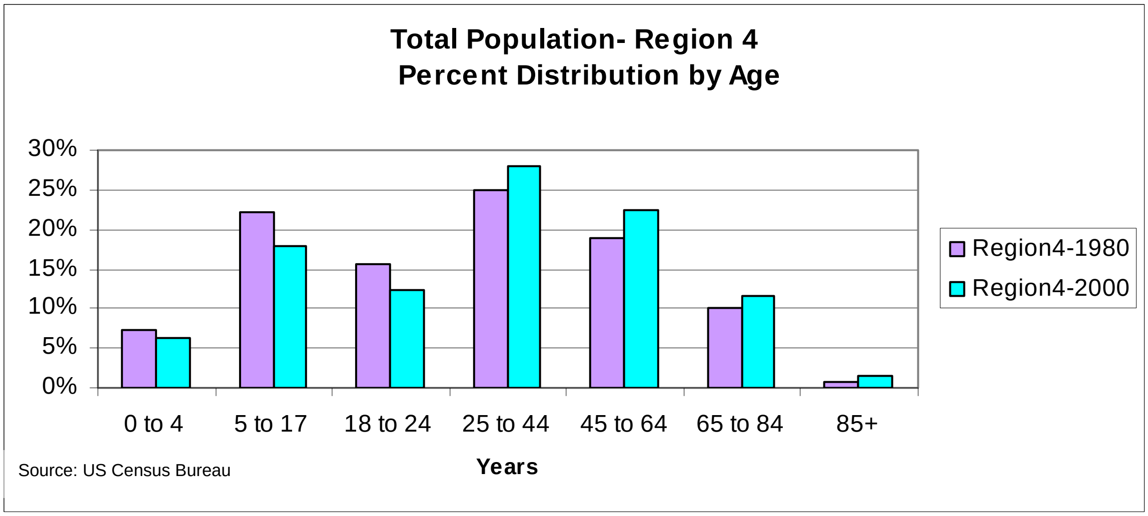


Figure 3-11

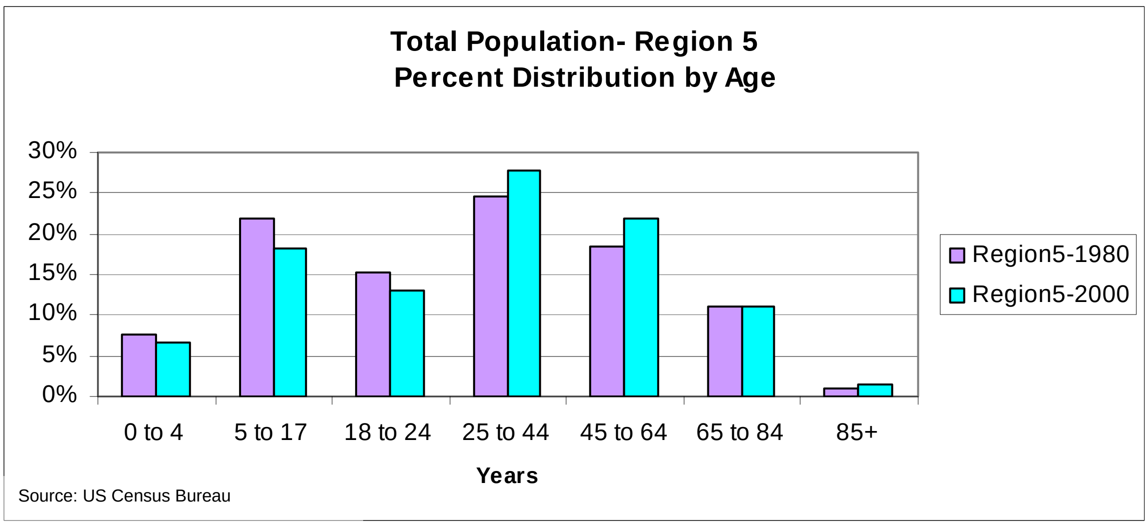


Figure 3-12

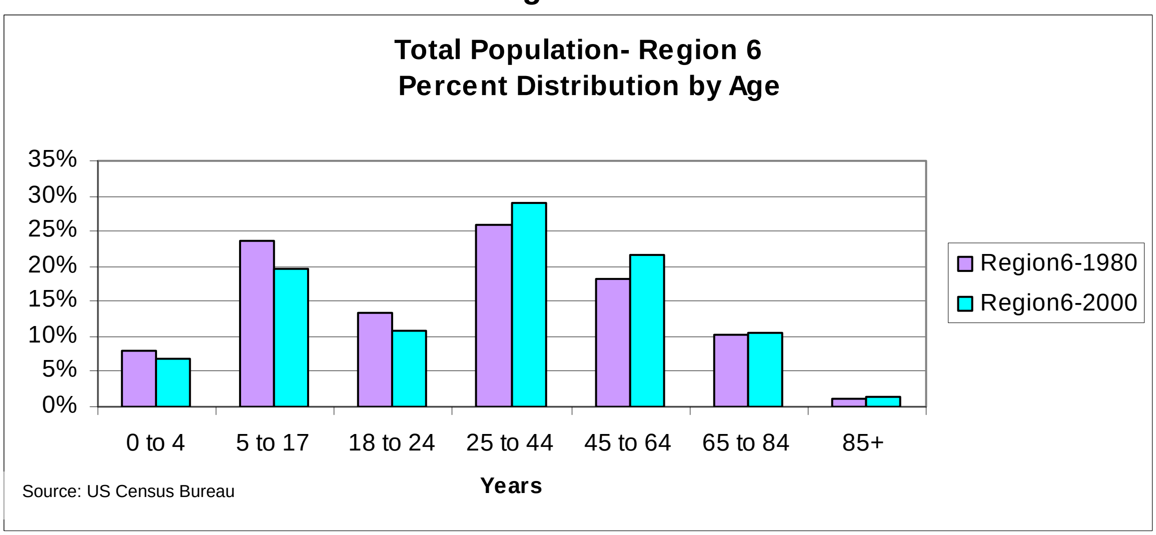


Figure 3-13

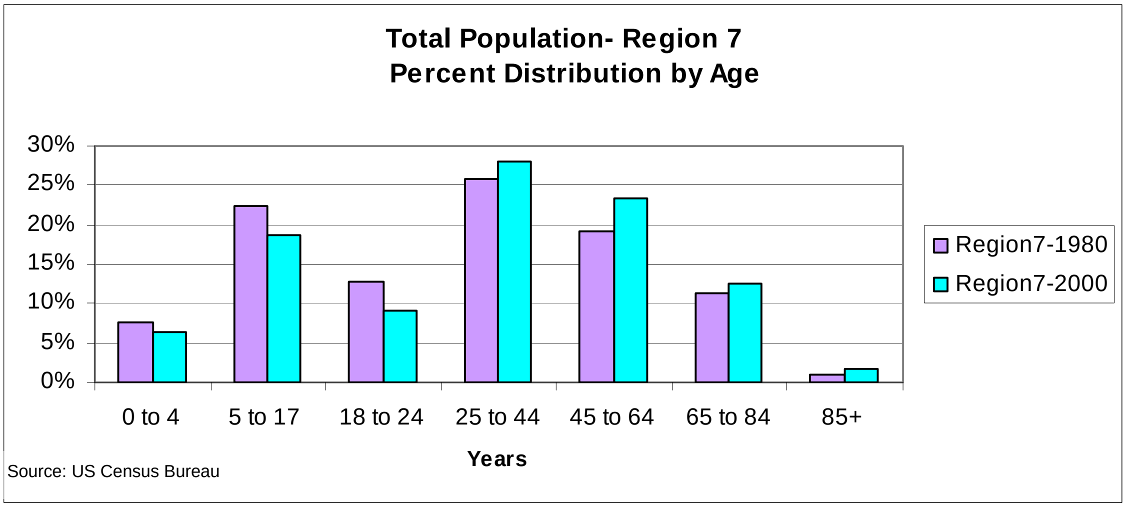


Figure 3-14

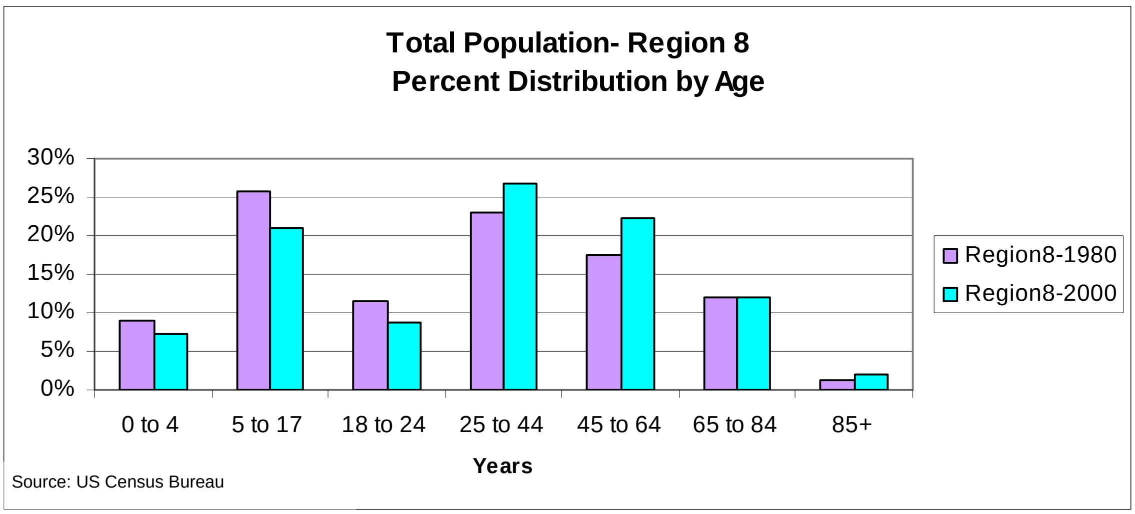


Figure 3-15

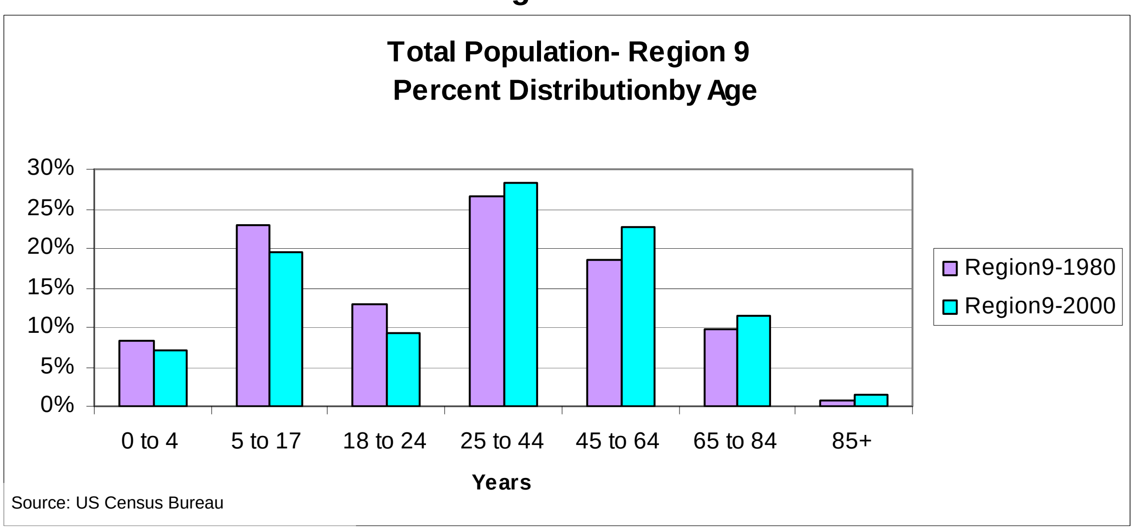


Figure 3-16

Figures 3-17 through 3-19 show the percent change in population and labor force for Region 1. Each region's percent change is broken down into the counties that make up that region. All nine regions are depicted in the same format in Figures 3-20 through 3-43.

Figure 3-17

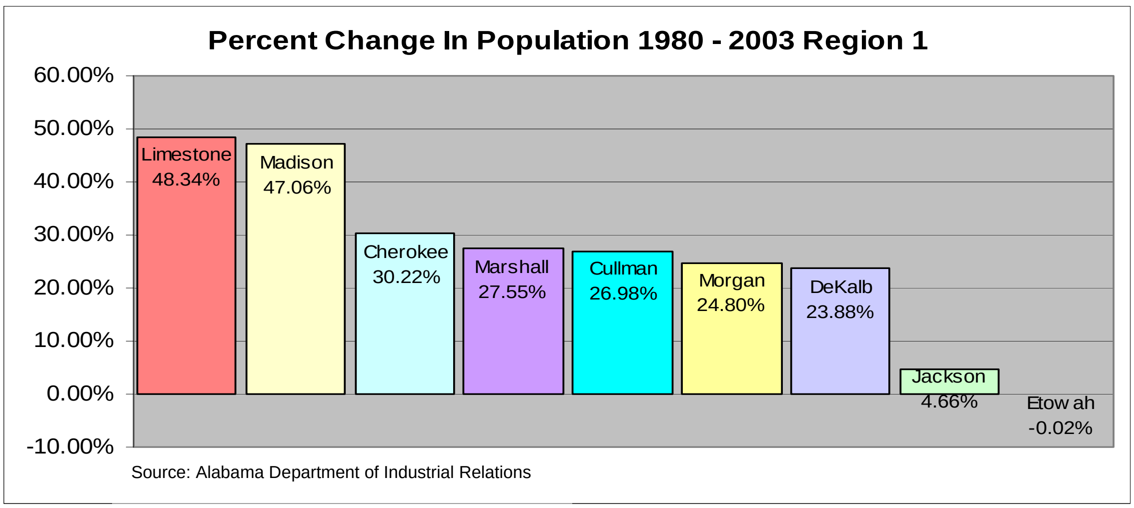


Figure 3-18

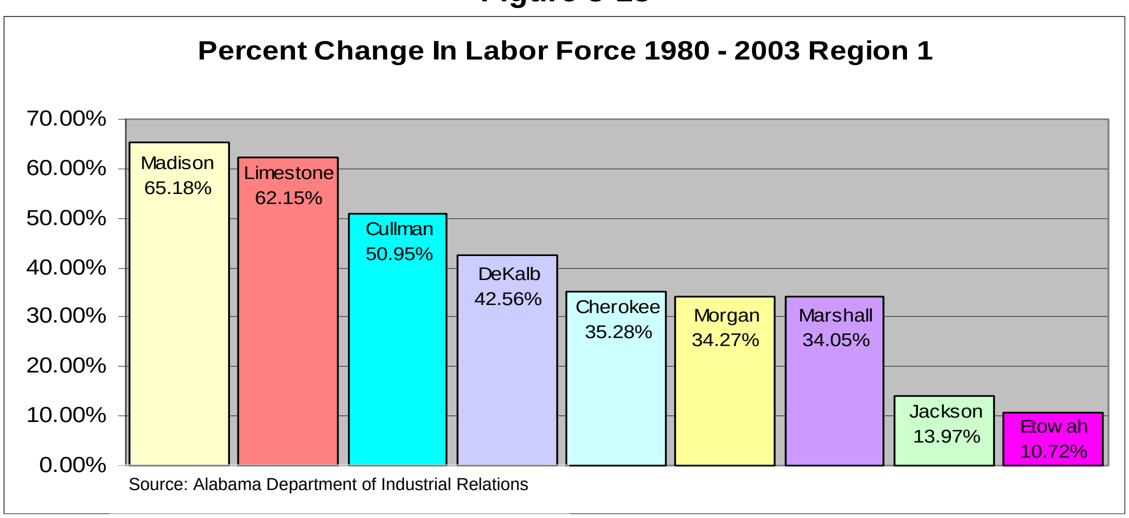


Figure 3-19

Figure 3-20

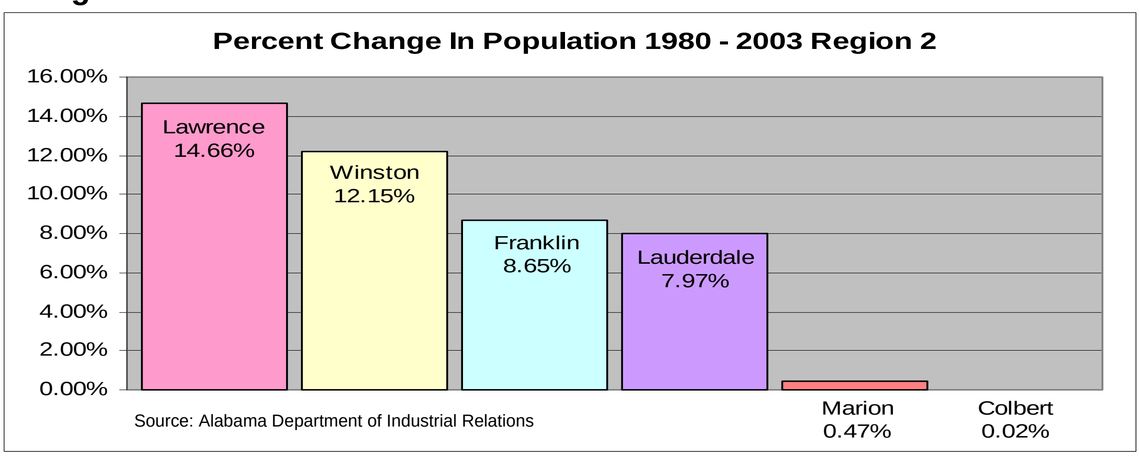


Figure 3-21

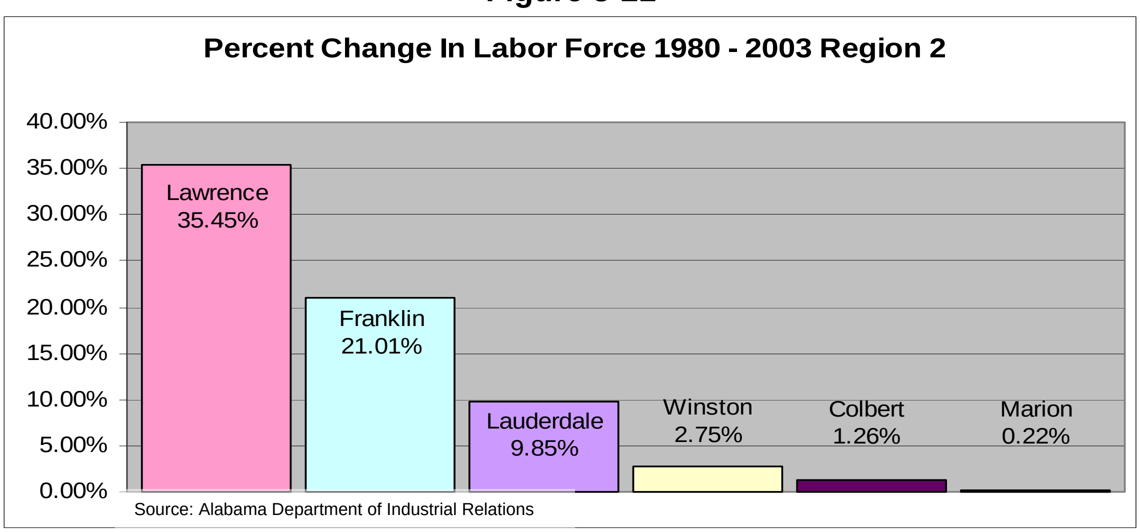


Figure 3-22

In Region 3, Shelby County experienced tremendous growth with a 140% percent change in population (Figure 3-24) and a 179% percent change in labor force (Figure 3-25). Also interesting to note is Jefferson County had a negative percent change in population (Figure 3-24).

Figure 3-23

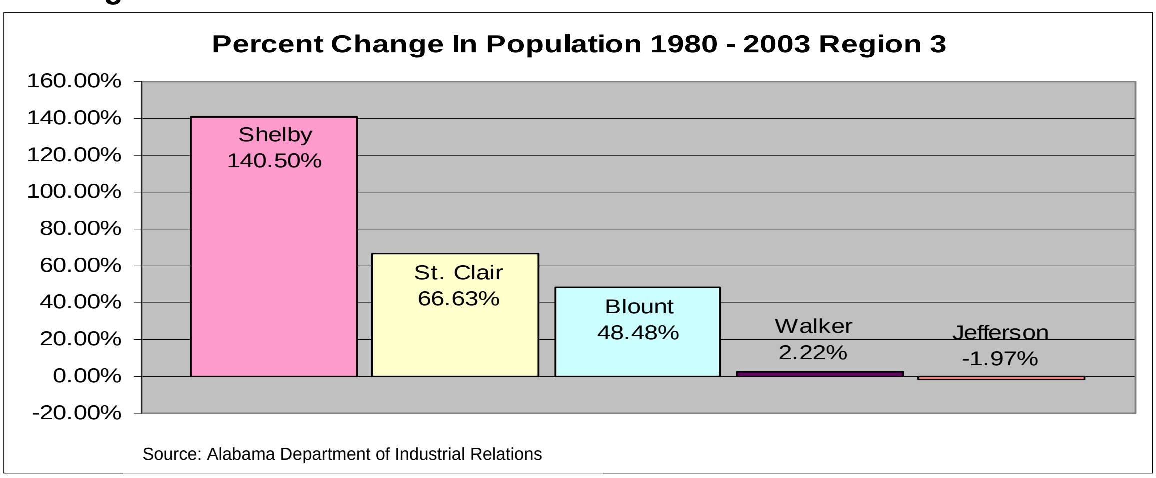


Figure 3-24

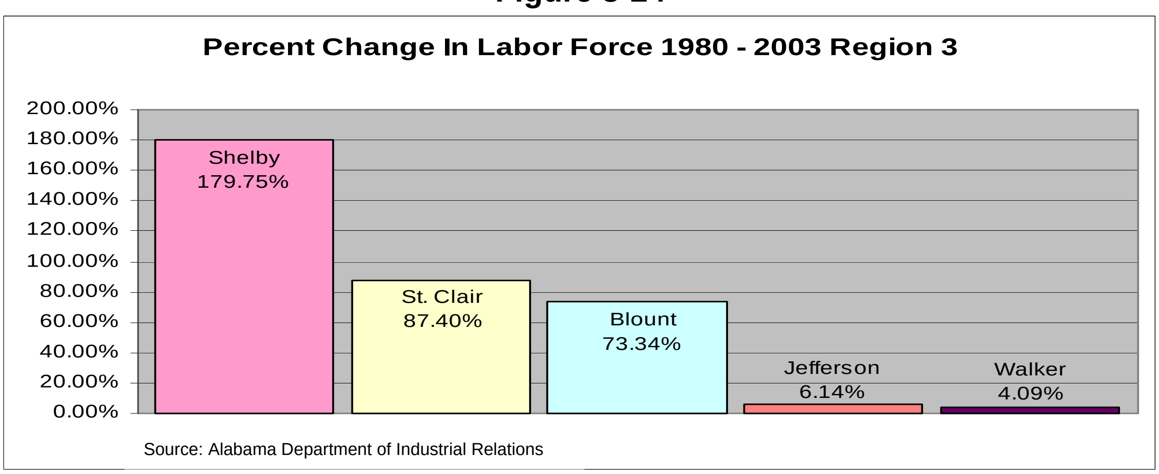


Figure 3-25

Lee County, in Region 4 experienced significant growth in both the percent change in population (56%) and the percent change in labor force (63%).

Figure 3-26

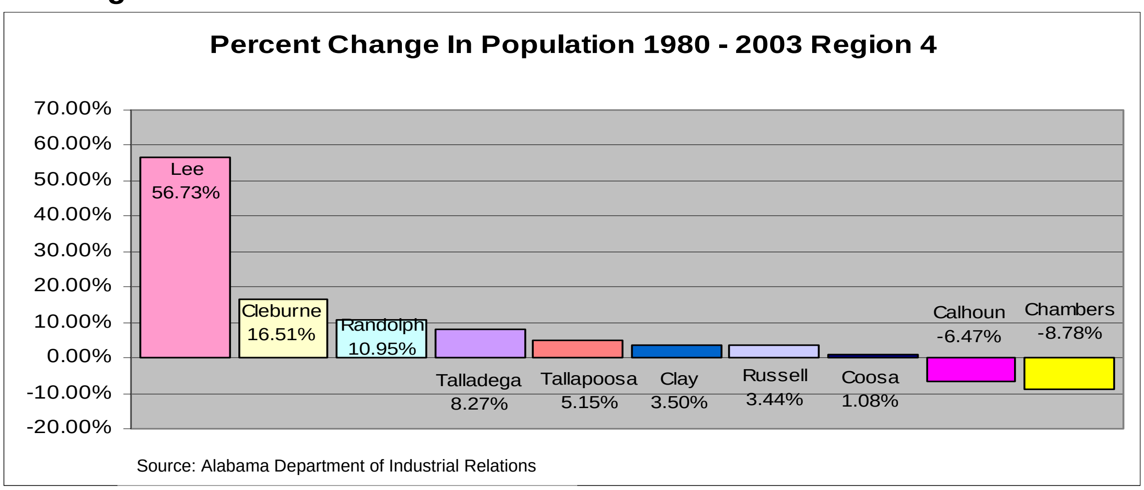


Figure 3-27

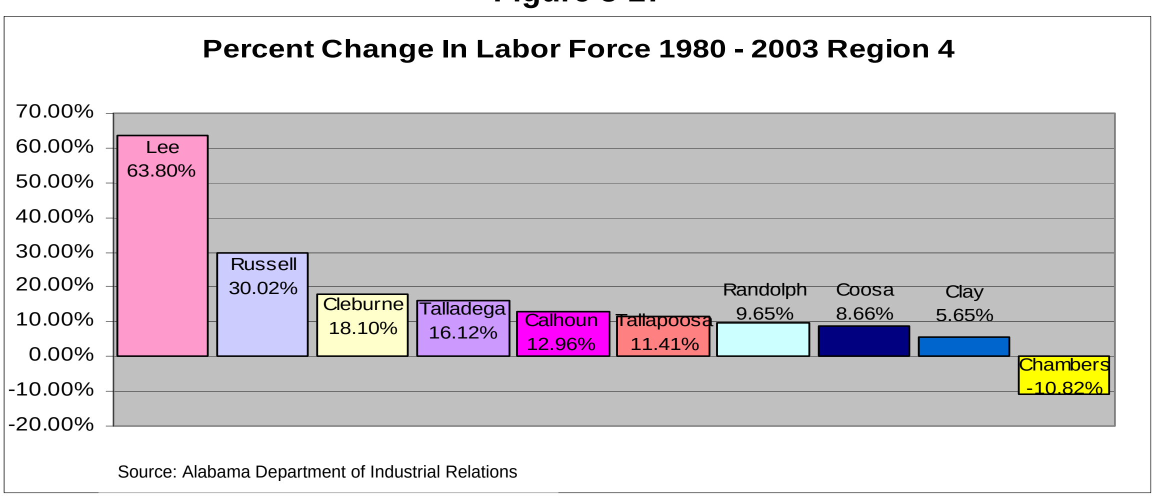


Figure 3-28

Figure 3-29

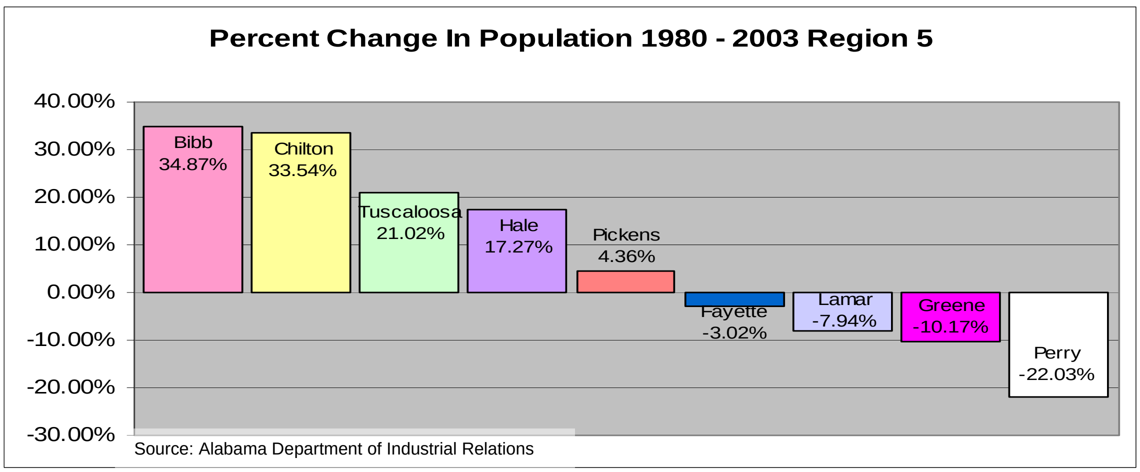


Figure 3-30

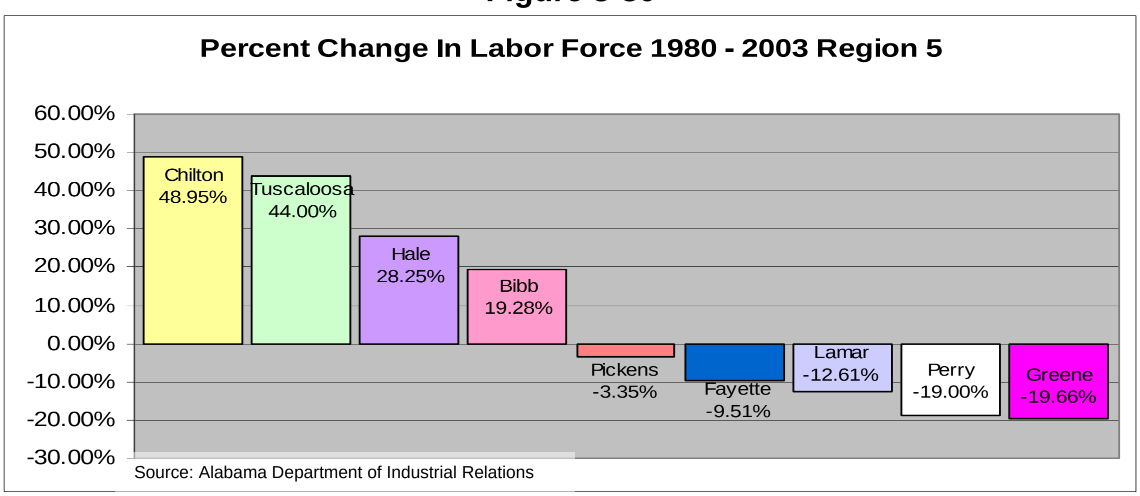


Figure 3-31

Figure 3-32

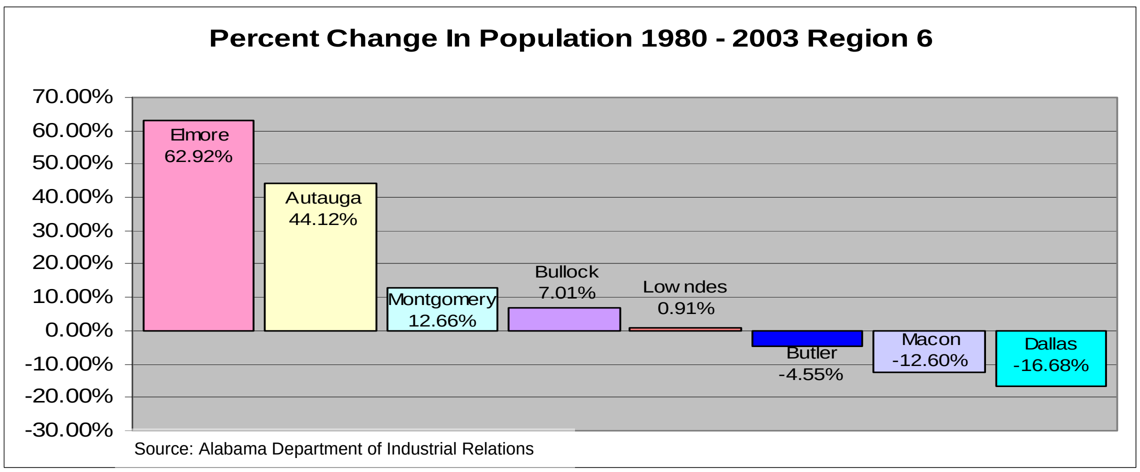


Figure 3-33

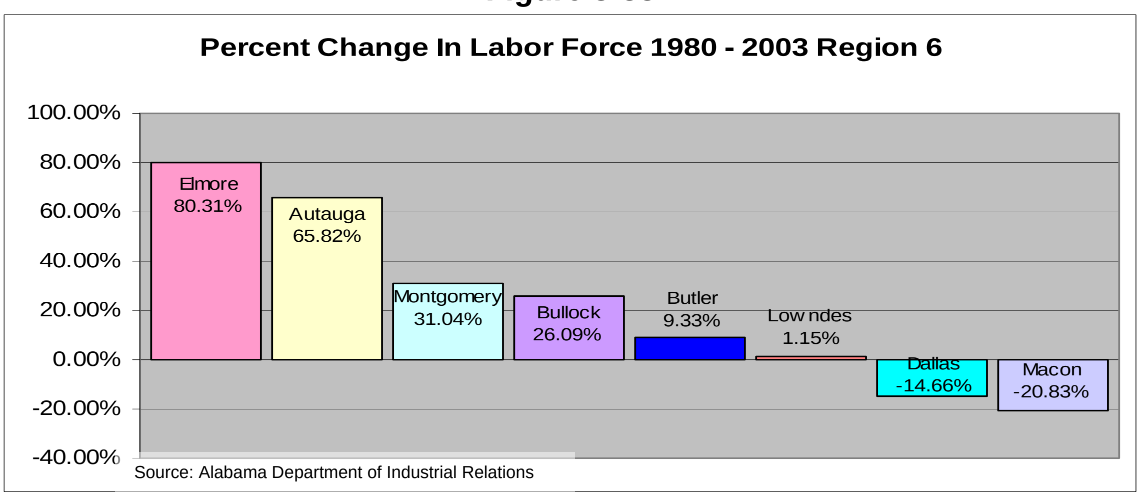


Figure 3-34

Figure 3-35

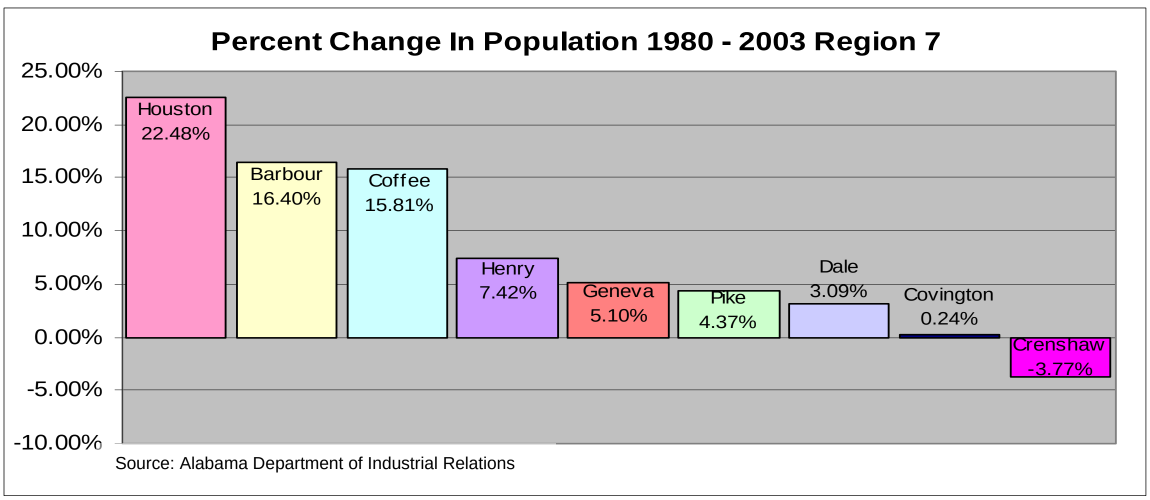


Figure 3-36

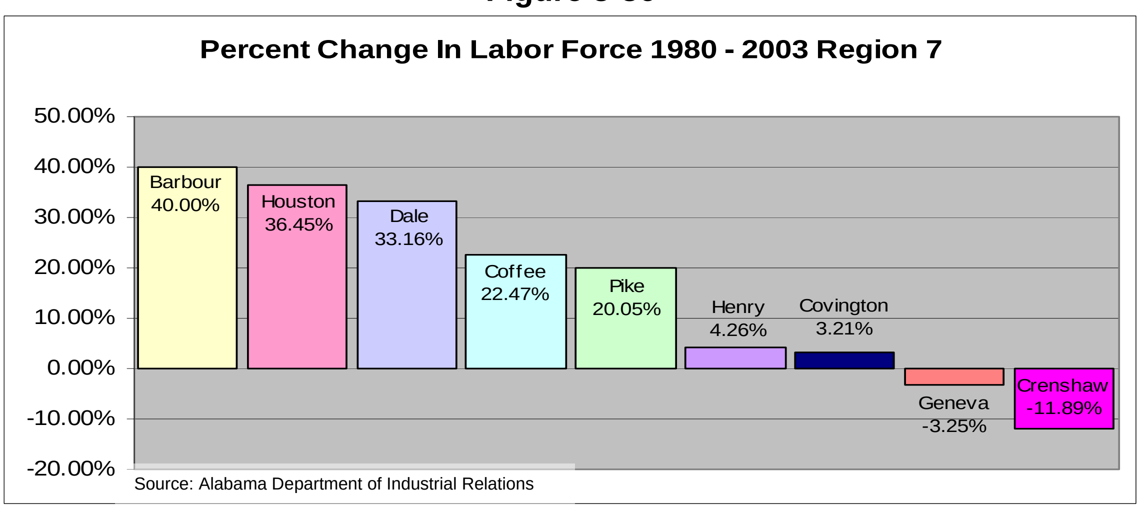


Figure 3-37

Region 8, shown in Figures 3-39 and 3-40 show the most negative changes of all regions with more than half the counties experiencing a decline in both population and labor force.

Figure 3-38

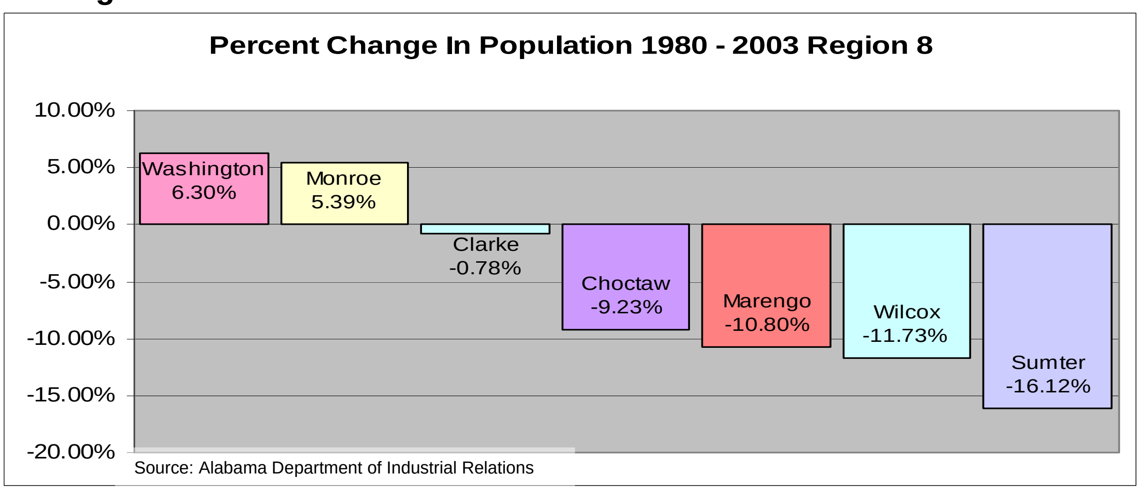


Figure 3-39

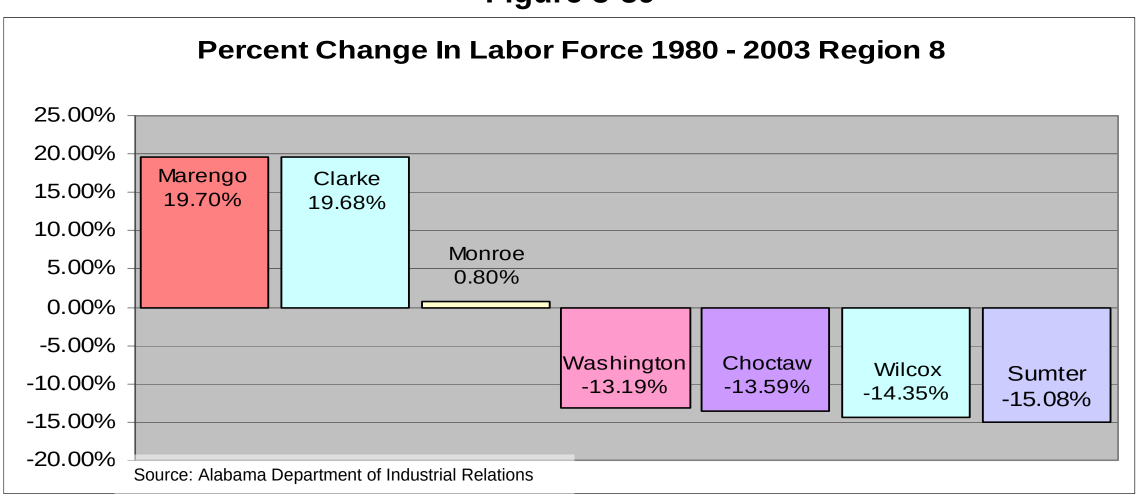


Figure 3-40

In Region 9, Baldwin County experienced significant growth with a percent change in population of 93% and a percent change in labor force of 132%.

Figure 3-41

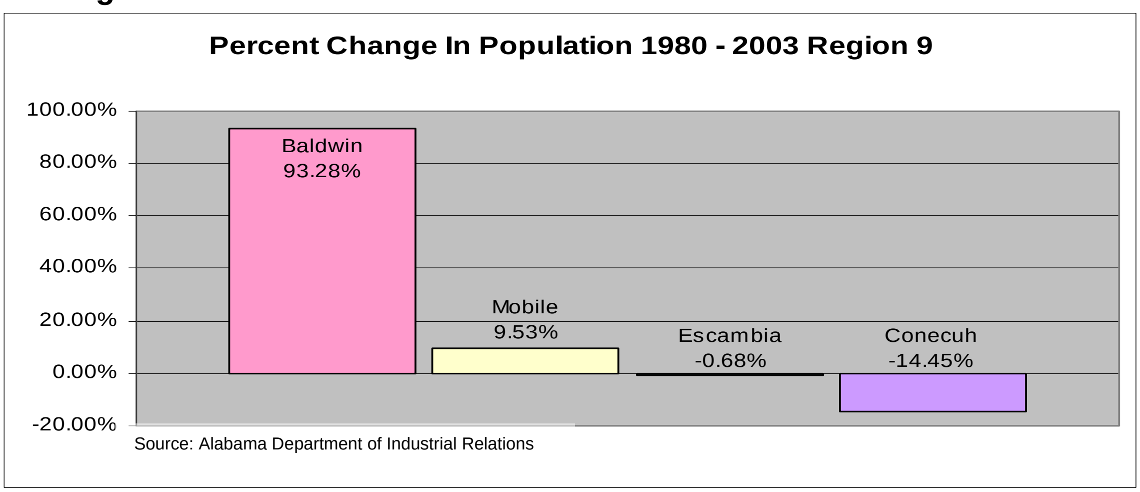


Figure 3-42

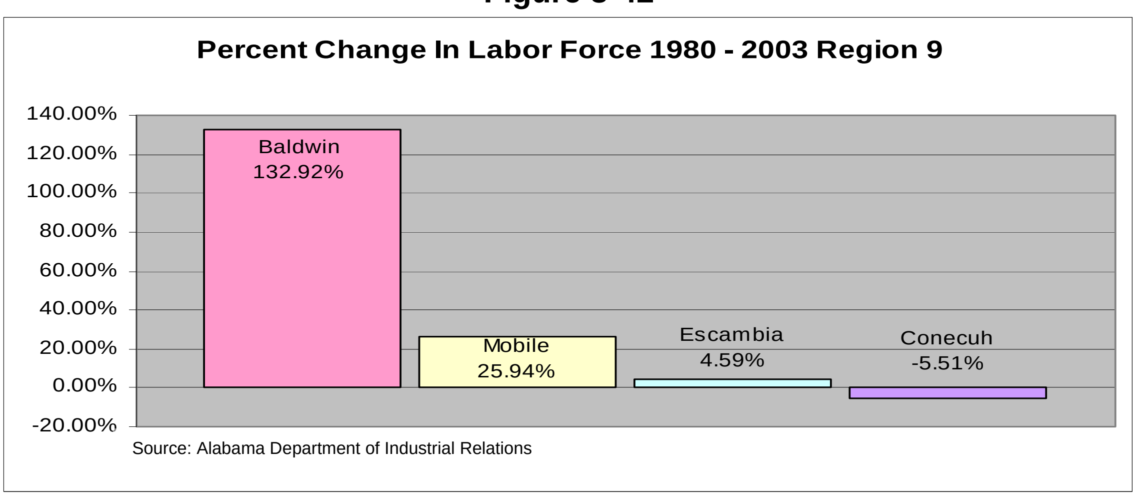
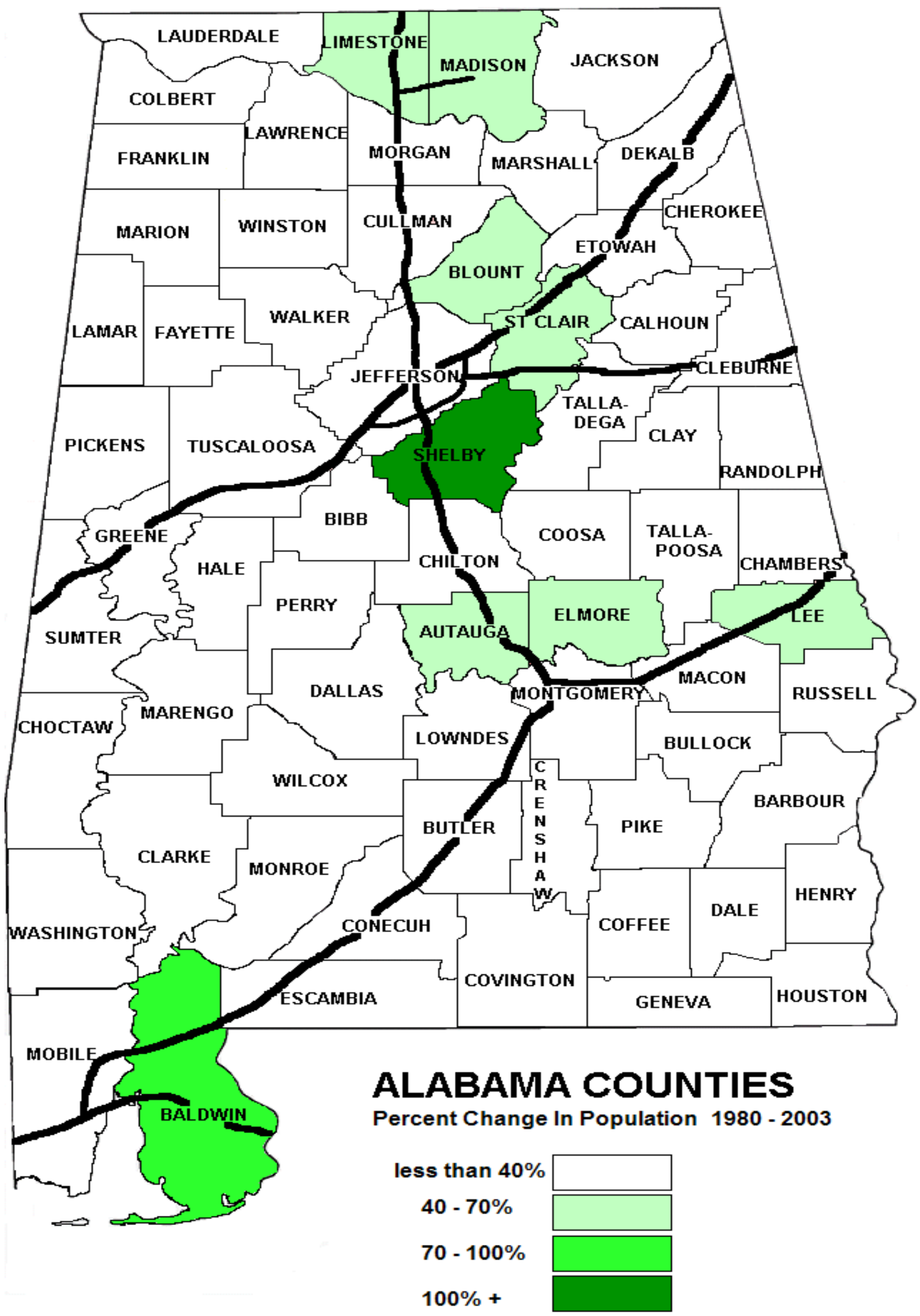


Figure 3-43

Figures 3-44 and 3-45 are maps of Alabama that show the counties that are experiencing the largest percent changes in population and labor force. From the maps we can tell that the counties experiencing the most growth are those located along the major interstates. This, in turn increases congestion on those major transportation arteries. Population tends to increase economic activity, which tends to increase freight requirements. The growing economy, then, increases the attraction for additional population.



Source: Alabama Department of Industrial Relations

Figure 3-44

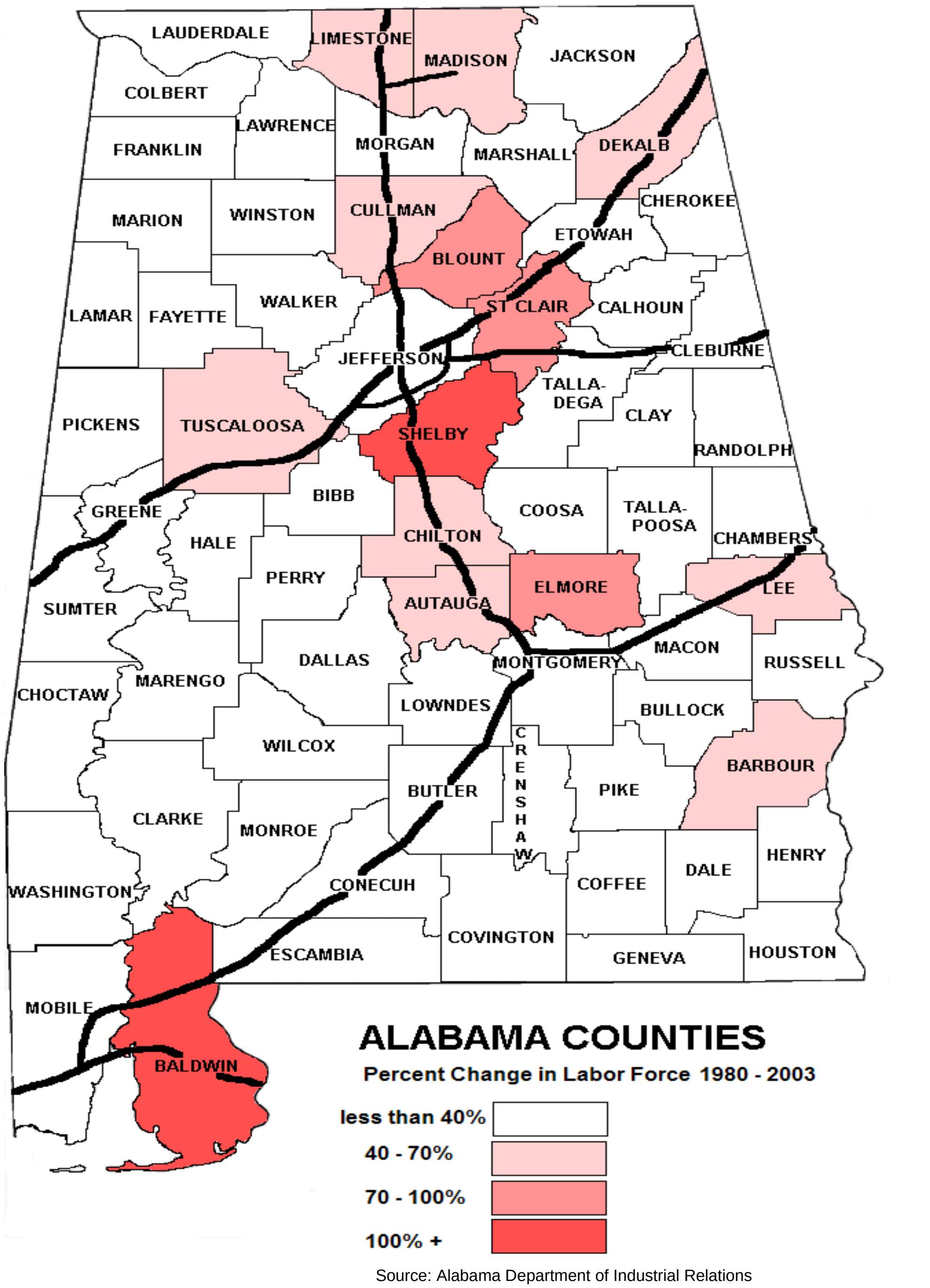

LAUDERDALE
LIMESTONE
MADISON
JACKSON
COLBERT
LAWRENCE
MORGAN
MARSHALL
DEKALB
FRANKLIN
MARION
WINSTON
CULLMAN
BLOUNT
ETOWAH
CHEROKEE
LAMAR
FAYETTE
WALKER
ST CLAIR
CALHOUN
JEFFERSON
CLEBURNE
PICKENS
TUSCALOOSA
TALLA-
DEGA
CLAY
SHELBY
RANDOLPH
GREENE
BIBB
COOSA
TALLA-
POOSA
HALE
CHILTON
CHAMBERS
PERRY
ELMORE
LEE
SUMTER
AUTAUGA
DALLAS
MACON
MONTGOMERY
RUSSELL
MARENGO
CHOCTAW
LOWNDES
BULLOCK
WILCOX
CRENSHAW
BARBOUR
BUTLER
PIKE
CLARKE
MONROE
HENRY
DALE
WASHINGTON
CONECUH
COFFEE
COVINGTON
ESCAMBIA
GENEVA
HOUSTON
MOBILE
BALDWIN
ALABAMA COUNTIES
Percent Change in Labor Force 1980 - 2003
less than 40%
40 - 70%
70 - 100%
100% +
Source: Alabama Department of Industrial Relations

Figure 3-45

3.1 Rural Alabama

According to the 2000 census, there are 55 counties (out of 67) with less than 100,000 people in residence.[1] Alabama is predominately a rural state. In rural areas, infrastructure needs are not necessarily related to transportation. In the broader definition of infrastructure which would include education, employment opportunities, commerce, financial resources, in addition to transportation, it may be that some of these factors are more needed than transportation facilities. To this end, urban transportation planning methods are inadequate for use due to the significant weights given to population and economic activity. Sustainable economic momentum is a basic premise in urban transportation planning but rural transportation planning must be capable of predicting sudden changes in economic activity. Trend analysis will not suffice. Rural Alabama is not lacking in the amount of attention being paid to the unique set of problems in that region. In 2004 there were not less than 16 different Black Belt Initiatives underway to address workforce and economic development issues in this rural and economically depressed area of the state. Coordination and policy directives seem necessary to ensure that the rural regions initiatives provide value added assistance for the investment made.

Rural areas were formerly considered to be areas with a core population of less than 50,000, while municipalities with populations over 50,000 were considered urban. New Urban Influence Codes developed by the Office of Management and Budget in 2003, classify two types of urban areas – urbanized areas and urban clusters.[2] Urbanized areas contain an urban nucleus of 50,000 or more people. The nucleus may be a city, or it may be a grouping of residents in an area with a population density of 1,000 persons per square mile. Urban clusters are territories built up around small towns and cities, and have at least 2,500 but less than 50,000 persons.

Rural areas, by the new classification, are all territories outside of urbanized areas and urban clusters. The U.S. rural population was 21% in 2000 according to the Economics Research Service of the U.S. Department of Agriculture.[3]

According to researchers at Auburn University, 45 of Alabama's 67 counties can be considered rural, that is, the counties which are not classified as Metropolitan Statistical Areas. Thirty percent of Alabama's population is rural. "Beyond the Interstate: The Crisis in Rural Alabama" identifies several gaps which leave rural Alabama at the bottom of quality of life indicators.[4] Fourteen of fifteen counties with double-digit unemployment are rural. Nine of ten counties with the highest population over 65 are rural. Fourteen of fifteen counties with the lowest SAT scores are rural. And the rural counties have the lowest median family income.

A large portion of rural Alabama is classified as an area named "The Black Belt". There are several definitions for the Black Belt differing by their bases, for example, on soil characterization, level of poverty, or percentage African-American population. For the purposes of our analysis, we have taken the broadest possible definition of a

Black Belt, which covers 19 counties, shown in Figure 3-46. The 19 counties were identified based on the University of Alabama Institute for rural health research.

Figure 3-46
19 Black Belt Counties

Rural Alabama, and particularly the Black Belt, is an area known for its depressed and distressed economic climate. High unemployment, low family incomes, and slim chances for economic development have plagued these areas for generations. Many studies have been conducted documenting the poverty in the Black Belt, but few have been followed up with investments to alleviate the distress.

The initial project approach was to use a survey instrument developed by the University of Alabama in Huntsville Office for Economic Development for modeling the impact of predicted increases in manufacturing-related traffic on Alabama highways. The model could be used to predict future highway expansion requirements. The survey asked for information such as current and predicted truck and rail volumes, and asked questions such as “what transportation improvements would enhance your business?” By utilizing the transportation survey with major manufacturers in Dallas, Perry, Sumter, Hale, Marengo and Greene counties, we planned to describe the role of infrastructure in bringing economic development to the rural areas, particularly the Black Belt. However, after surveying 20 companies and 3 industrial development specialists it was clear that transportation issues were not the greatest barriers to company growth or job growth. Industry issues such as replacement products by competitors for the paper industry, or international outsourcing for the textile/apparel industry and workforce development issues were identified as the greatest barriers to economic development.

Generally, the transportation needs identified were secondary barriers to business success. The most common response to the question "what are your transportation issues" was that rural companies have a hard time getting contract haulers to make frequent stops at Black Belt manufacturing locations. Of the companies surveyed, most indicated that their customers were willing to wait on slower delivery schedules that result from infrequent contract hauler schedules. However, if the product delivery requirements were urgent, customers would be willing to pay a shipping premium to entice a truck company to go outside its normal route. The rural companies did not estimate that they lost business due to these scheduling issues, or that improved road conditions would lead to better scheduling. The lack of routing of trucks through rural areas has more to do with the fact that the volumes to be transported are so low that the areas do not warrant more frequent routing, than with the condition of the roads or needs for additional infrastructure. The answer to increasing truck volumes would be to increase current business and attract new business so that contract haulers can make efficient runs. Specific transportation improvement requests from the manufacturers included completing the full four lanes for Highway 80, expand I-85 from Montgomery to the Mississippi state line, improve the Port of Epes, and make better use of the Tennessee-Tombigbee Waterway.

Still seeking to identify the transportation related issues affecting economic development in the Black Belt, the project evolved into the following parts:

- Literature Review of corridor studies for roads in the Black Belt.
- Gap Analysis of Economic Development in the Black Belt vs. Economic Development Statewide.
- Gap analysis between local Black Belt transportation planning and state implementation of projects.
- Study of corridor development and rural planning methods in Florida and Georgia.
- Potential for job creation through transportation related industries.

Although the absence of infrastructure presents a barrier to economic development, infrastructure without accompanying workforce development will not yield significant economic development. Policy directives for a state department of transportation seem necessary to elevate attention to rural infrastructure investment. This points to an urgent need for training rural citizens for living wage jobs, or potentially jobs that would supplement a farming income, since many of today's small farmers are surviving at subsistence levels.

Beyond workforce development, there is the issue of the current condition of public education in the Black Belt. Potential employers have a disincentive to locate in areas where relocating employees would be dissatisfied with the educational offerings. Much adult workforce development could be made more efficient if the adults had a solid early educational background, resulting in improved life skills levels.

The complex nature of the many factors affecting economic development indicates that a comprehensive economic development strategy would be much more effective in producing entrepreneurship opportunities and employment opportunities than would a stand-alone infrastructure investment. Thus the role of infrastructure in bringing economic development to rural Alabama is to augment a comprehensive economic development plan, which also includes workforce development.

The outcome of this analysis was the development of some alternative approaches. At one time during 2004 there were at least 16 different Black Belt Initiatives ongoing in Alabama. It is recognized that this area of Alabama holds some particular problems that must be addressed in order for all Alabamians to participate in the new economy. It is quite evident that coordination needs to take place to make sure that the resources being applied to the problems are spent in the best way possible with little or no duplication of effort. Some actions to try to achieve positive results could be:

- Work with ALDOT to determine the feasibility of a rural transportation planning department. Conduct an organizational assessment to identify how such a department would fit into the existing (or new) structure.
- Identify the key steps needed to establish a state policy on rural transportation planning, using the Georgia and Florida models. Identify potential champions in the Alabama State Legislature to garner support for a rural initiative.
- Conduct a feasibility study of a rural intermodal center that would encourage entrepreneurship, job creation, and wealth creation in the Black Belt. Job training for the intermodal center would add the vital element of workforce development to the infrastructure investment. Such an intermodal center as a public/private partnership could be an excellent opportunity for federal and state infrastructure investment.

<u>Conclusion</u>

Population in Alabama is growing, but especially in counties along interstate highways. This reflects the spread from urban areas, the flight from rural areas as well as developments in industrial growth. The next chapter examines the structure of economic activity in Alabama.

4. Economic Activity

The third of the interrelated factors in Figure 1-1 to be considered is economic activity. Traffic and freight shipments arise from a complicated interaction of population, industry mix, geography, and the availability of multiple modes of transportation and shipping. The investigation of future traffic, and freight shipments, demand a deep understanding of an area's economic and industrial base. The concept of industry clusters, developed by the Institute for Strategy and Competitiveness at the Harvard Business School, offers a sound and innovative approach to assessing and analyzing current and likely future industry mix.[1] This assessment of industry clusters then becomes a foundation for analysis of traffic and freight shipments.

4.1 Industry Clusters

A *Cluster* refers to a group of interrelated companies and institutions in a specific discipline which are located within the same economic region or geographic area. As an example, the California wine cluster is composed not only of vineyards, growers, wineries and processing facilities, but also includes irrigation technology, harvesting equipment, fertilizer, pesticides, herbicides, winemaking equipment, bottles, labels, UC Davis, and the Wine Institute.[2] This cluster is illustrated in Figure 4-1.[3] In addition, as noted in the figure, the wine cluster overlaps with the tourism and food clusters offering opportunities for joint growth and development.

Clusters typically include end product or service companies, suppliers of specialized inputs, components, machinery, specialized services, financial institutions, and firms in related industries. Many clusters also include universities and other institutions providing specialized training, education, and research as well as trade associations. It is important to reemphasize that clusters cut across traditional industry classifications. This type of business environment encourages innovation and increases productivity. Clusters increase the level of competitiveness and cooperativeness between firms. Firms located within an economic region form synergies in order to benefit from both similarities and complementarities of its neighboring firms. These synergies can be formed within a cluster or between clusters. A cluster allows firms within an economic region to develop relationships in order to share valuable resources with relative ease. These factors allow a regional economy to flourish and achieve a high level of prosperity. On the other hand, however, it must be noted that cluster growth is accompanied by growth in traffic, freight shipments, and often highway congestion. Indeed, congestion is often cited as a key threat to on-going cluster growth and evolution. Nevertheless, much of a region's economic development can be explained using the cluster point of view, and as a corollary, much of a region's traffic can be analyzed utilizing clusters.

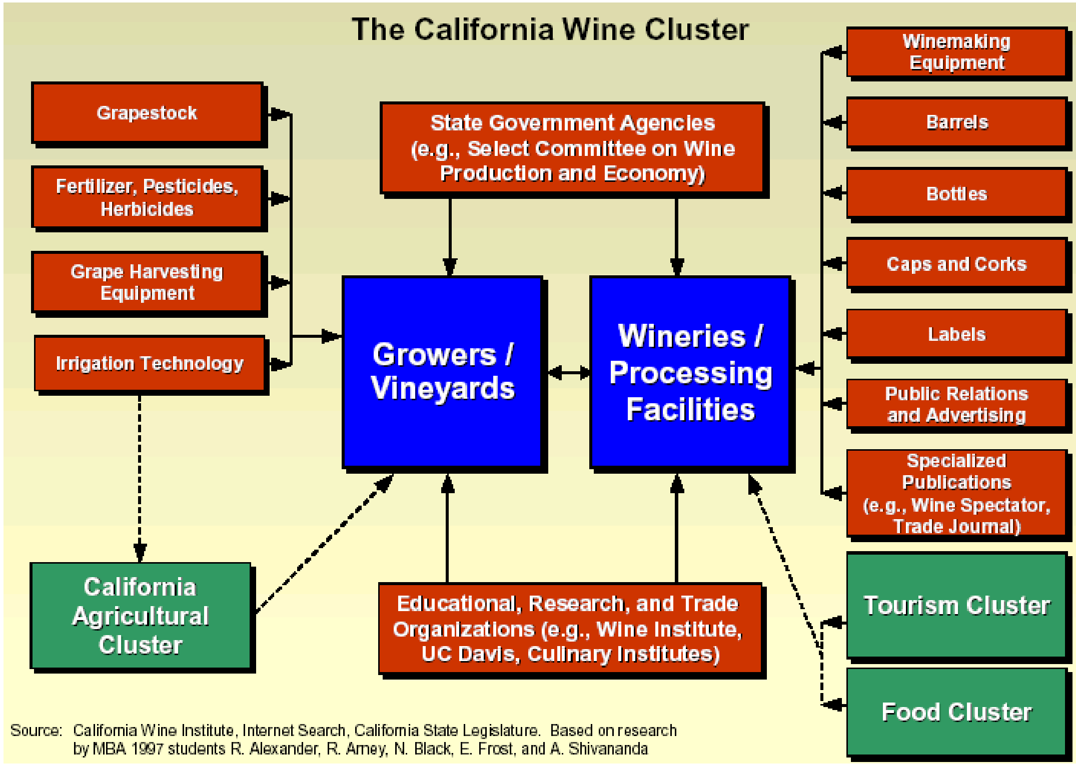


Figure 4-1

From this point of view, economic and industry development can arise from the birth of a new cluster or the growth of an existing cluster. The automotive cluster is a new cluster in Alabama that has emerged from the initial anchor firm, Mercedes Benz. With the arrival of Mercedes, first, second, and third tier suppliers began to locate and grow in Alabama. Subsequently, Honda opened a vehicle assembly plant and additional suppliers moved to Alabama. The Hyundai plant was another addition, causing the growth of the automotive cluster to continue. Clusters can also develop and grow from overlapping, related clusters. This growth arises at an intersection or an overlap between clusters. A cluster overlap occurs when a particular cluster is complimented by another cluster outside of its industry. For example, the aerospace cluster in Huntsville and North Alabama has contributed to the growth and development of the communications equipment cluster and the information technology cluster. These overlaps show that the skills, assets, and knowledge base from one cluster may be used to support another cluster in some manner. This type of relationship allows for coordination between different industries and fosters economic development.

Figure 4-2 presents an overview of the major industry clusters as developed by the Harvard Business School and illustrates, first, the overlapping nature of clusters, and second, the somewhat natural groupings of clusters.[4] Several implications are readily apparent from Figure 4-2. First, traditional industry clusters for Alabama including textiles, apparel, forest products, and agricultural products have no or very little overlap with other clusters. Thus, if these clusters decline, as they have over the past decade, the impact is significant because the skills, knowledge base, and other resources are essentially single use. There is little, to no, cluster overlapping. The assets in these clusters, be they human, equipment, or knowledge, are not easily used in other areas. On the other hand, emerging clusters in Alabama such as automotive, information technology, and production technology have significant overlap and potential for growth and innovation.

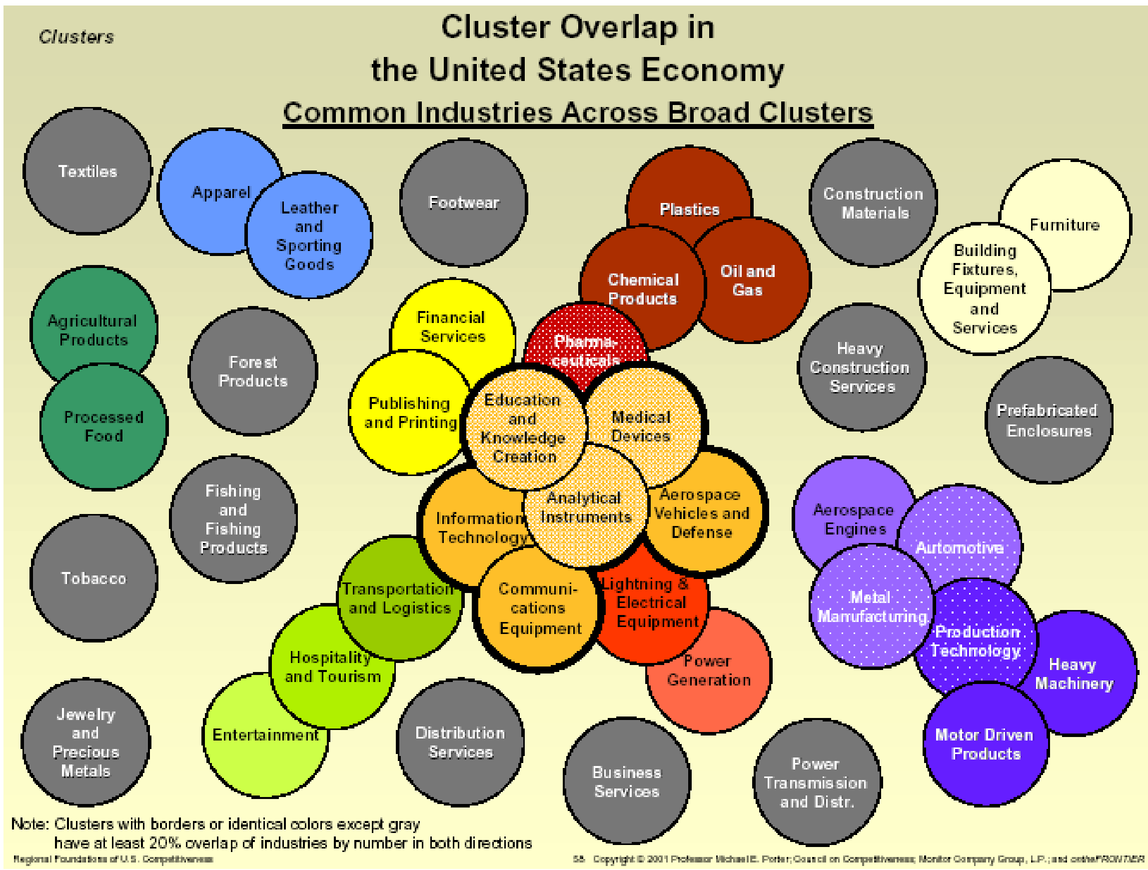


Figure 4-2

This chapter presents cluster employment, job creation, job loss and cluster overlap for the economy of Alabama. The employment data is shown for both clusters and major subclusters. The subcluster employment is presented for the major clusters of the regions. The chapter begins with the state as a whole, by showing the state's cluster employment for the year 2001, job creation and loss for the years 1990-2001, cluster overlap for the year 2001, and subcluster employment. After the state overview, the data is more finely subdivided by presenting the aforementioned indicators for the economic areas in the state, which include the Huntsville economic area, the Birmingham economic area, the Montgomery economic area, the Mobile economic area, and the Dothan economic area. Finally, the data is shown in even finer detail, through the state's metropolitan areas (MSA's). The MSA's include, Huntsville, Birmingham, Montgomery, Mobile, Dothan, Anniston, Decatur, Florence, Tuscaloosa, Auburn-Opelika, and Gadsden.

Before the data is presented, however, it needs to be noted that the clusters referred to in this report are “traded” clusters. The Harvard Business School defines a traded cluster as “traded industries that sell products and services across economic areas, so they are concentrated in the specific regions where they choose to locate production, due to the competitive advantages afforded by these locations. Employment levels in traded industries thus vary greatly by region, and have no clear link to regional population levels.” [5]

State of Alabama
Total Employment by Cluster, 2001

Cluster	Employment
Business Services	51,811
Heavy Construction Services	32,863
Financial Services	27,742
Metal Manufacturing	26,884
Textiles	25,010

Source: Industry Cluster Analysis for Alabama

Table 4-1

State of Alabama
Job Creation by Subcluster, 2001

Cluster	Subcluster	Employment
Business Services	Computer Programming	13,965
Hospitality & Tourism	Accommodations & Related Services	13,671
Construction Services	Final Construction	13,120
Business Services	Management Consulting	11,906
Financial Services	Insurance Products	11,384
Metal Manufacturing	Metal Steel Mills & Foundries	11,357
Education & Knowledge Creation	Educational Institutions	10,283
Automotive	Automotive Parts	10,007
Financial Services	Depository Institutions	8,214

Source: Industry Cluster Analysis for Alabama

Table 4-2

Employment in Alabama

In 2001, Alabama’s total employment was 1,620,592, which was 1.41% of National Employment. Alabama’s average wages in 2001 were $27,861 -vs- $34,669 for the US, or 19.64% below the national average. Average wage growth per year in Alabama was 3.82% -vs- 4.41% for the US.[6] As shown in Table 4-1 and Figure 4-3, Alabama's 3 largest clusters were business services, heavy construction services, and financial services. As shown in Table 4-2 Alabama's three largest subclusters were computer programming, accommodations and related services, and final construction.

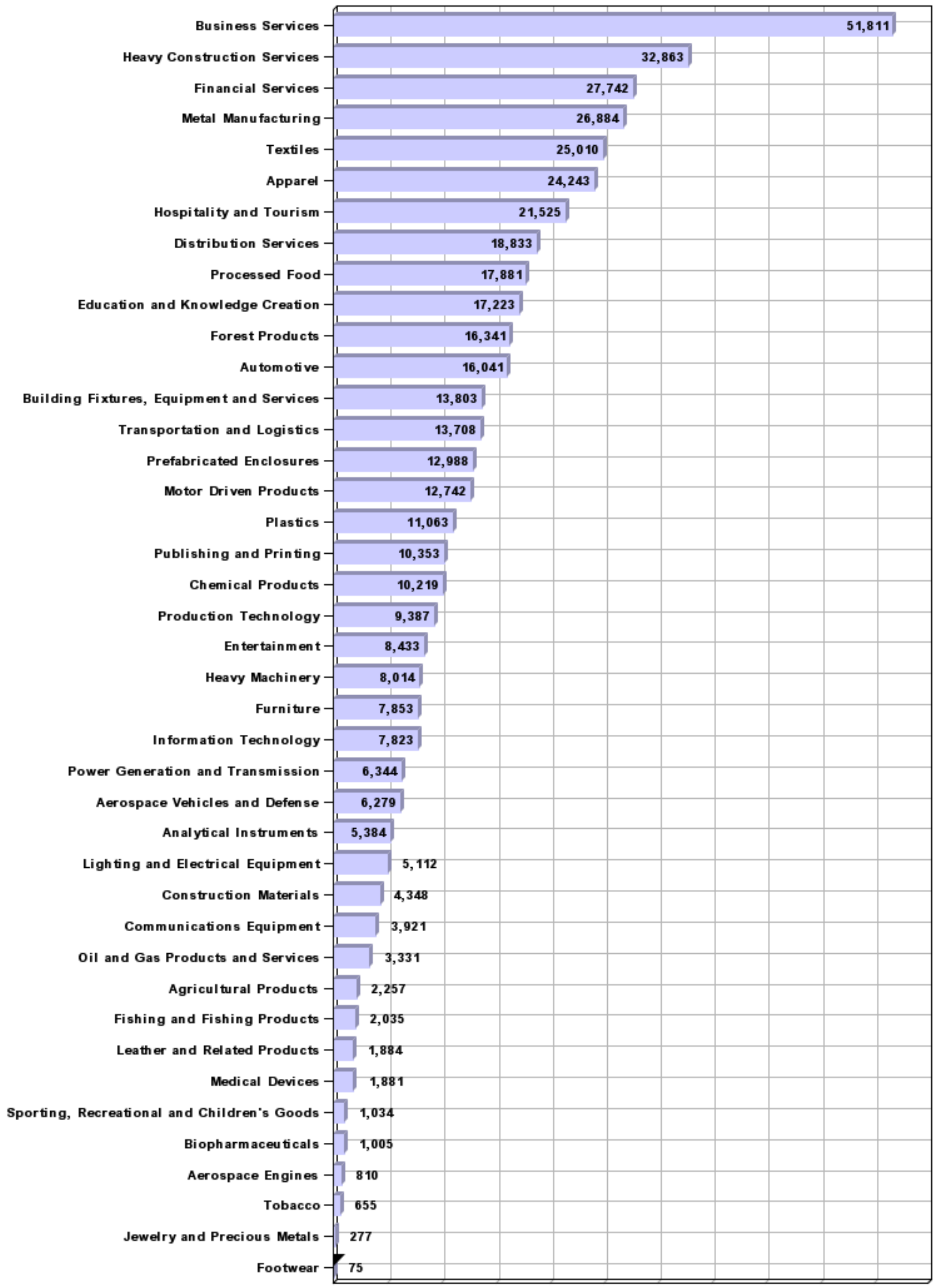
Job Creation/Loss in Alabama

Alabama's employment growth from 1990-2001 was 1.90%, while the U.S. average was 2.10%. As Figure 4-4 shows, the clusters which experienced the largest growth over this time were the business services cluster gaining about 21,000 jobs, the education and knowledge creation cluster, gaining about 8,000 jobs, and the hospitality and tourism cluster, gaining about 7,000 jobs. Figure 4-4 also shows that Alabama's largest job loss from 1990-2001 occurred in the apparel cluster with a loss of about 31,000 and textiles clusters with an estimated job loss of about 10,000. Current employment in these industries is vulnerable.

Cluster Overlap and Potential for Growth in Alabama

Figure 4-5 shows the largest 15 clusters for the state of Alabama. As Figure 4-5 shows, Alabama has some areas of overlap between its major clusters. The first grouping includes financial services and education and knowledge creation. Another grouping includes the transportation and logistics and hospitality and tourism clusters. A third grouping occurs between the metal manufacturing and automotive clusters. These overlaps show the industries that would be good candidates for growth and development for the state. These industries are good candidates because some of the necessary support base is already in place to support the growth of industries already existing in the state or industries that do not already exist in the state that are related to the overlapping clusters.

State of Alabama
Total Employment by Traded Cluster, 2001



Source: Industry Cluster Analysis for Alabama

Figure 4-3

State of Alabama
Job Creation by Traded Cluster, 1990-2001

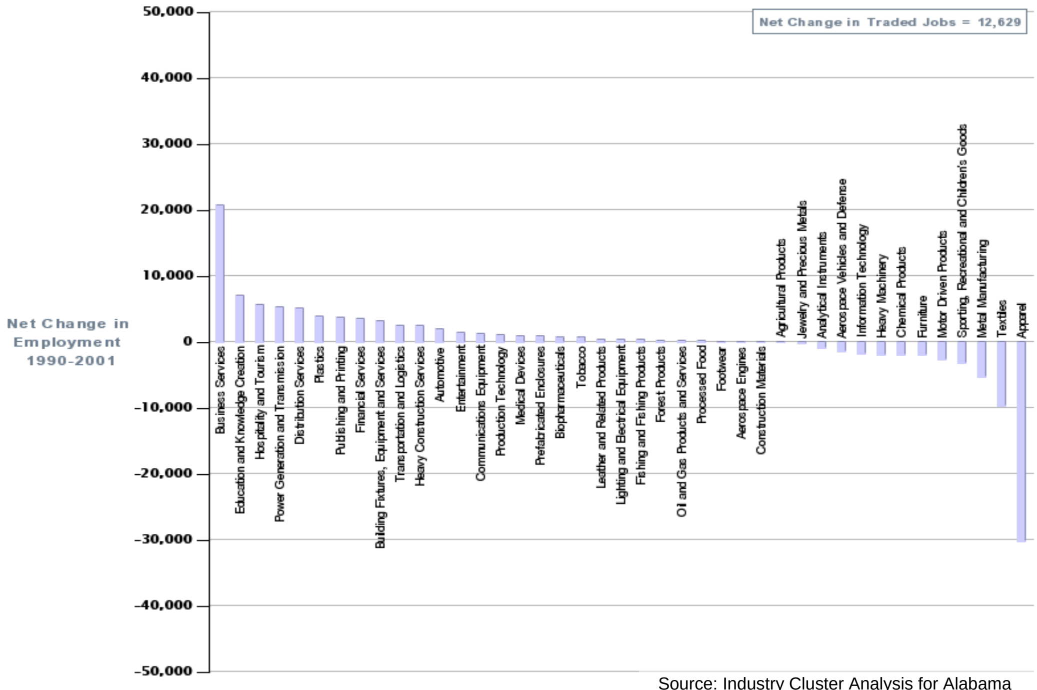


Figure 4-4

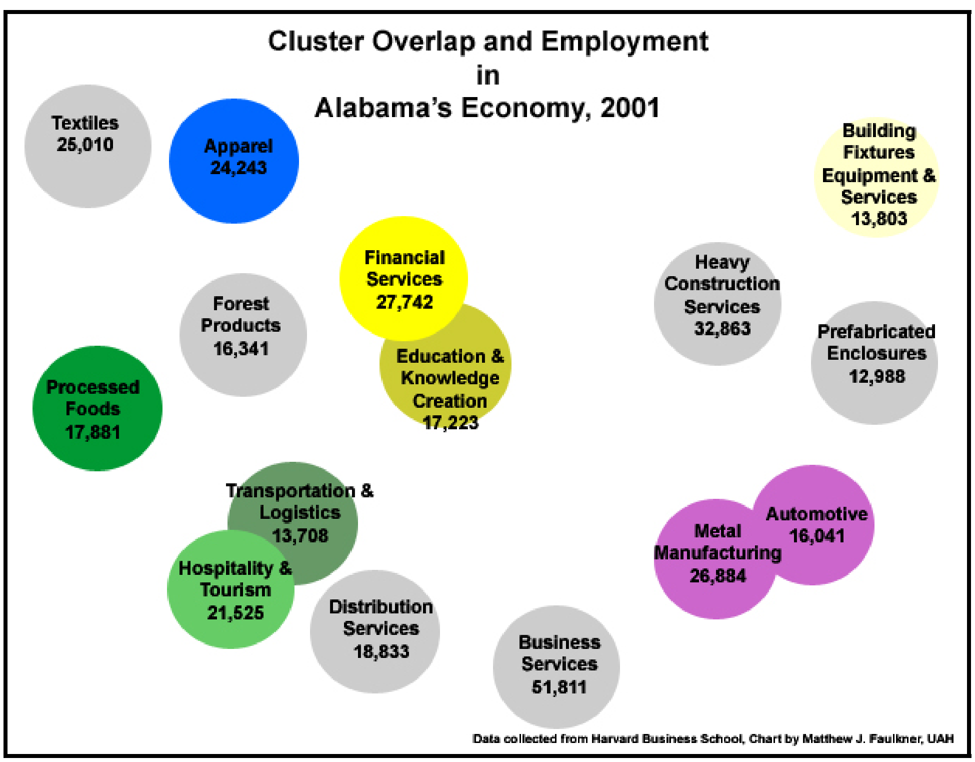
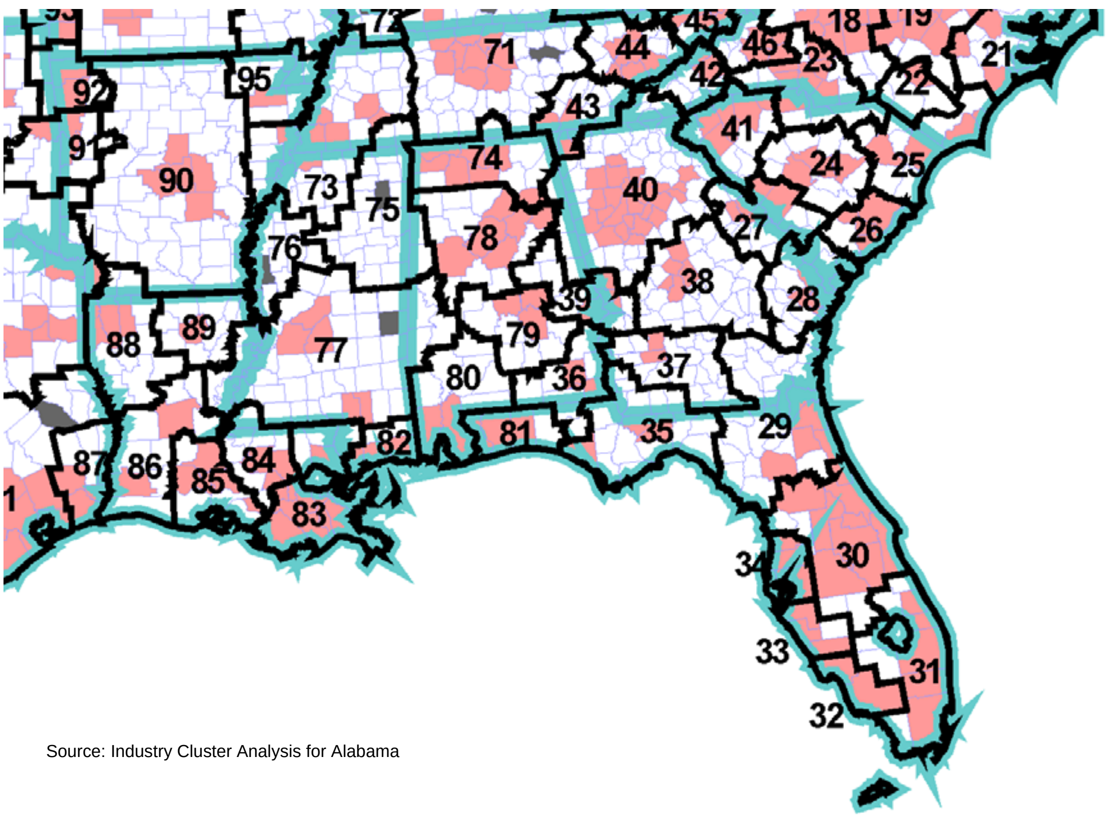


Figure 4-5

The following charts contain data for the economic and metropolitan areas in Alabama. Economic areas encompass all Alabama counties, rural and urban; therefore, they cover a larger area than the metropolitan areas. Metropolitan areas (MSA's) encompass primarily urban counties. Table 4-3 shows the counties included within the economic areas, while Table 4-4 shows the counties included within the MSA's.

Figure 4-6 shows the economic areas for Alabama and other southeastern states.



Source: Industry Cluster Analysis for Alabama

Figure 4-6
Economic Areas

Counties Located in Alabama Economic Areas

Economic Area	Counties
Birmingham, AL	Bibb, Blount, Calhoun, Chilton, Cullman, Fayette, Hale, Jefferson, Marion, St. Clair, Shelby, Talladega, Tuscaloosa, Walker, Winston
Dothan, AL-FL-GA	Barbour, Coffee, Covington, Dale, Geneva, Henry, Houston, Holmes (FL), Washington (FL), Quitman (GA)
Huntsville, AL-TN	Colbert, Dekalb, Etowah, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, Morgan, Lincoln (TN)
Mobile, AL	Baldwin, Clarke, Conecuh, Escambia, Mobile, Monroe, Washington, Wilcox
Montgomery, AL	Autauga, Bullock, Butler, Crenshaw, Dallas, Elmore, Lowndes, Montgomery, Perry, Pike

Table 4-3

Counties Located in Alabama Metropolitan Areas

Metropolitan Area	Counties
Anniston, AL	Calhoun
Auburn-Opelika, AL	Lee
Birmingham, AL	Blount, Jefferson, St. Clair, Shelby
Decatur, AL	Lawrence, Morgan
Dothan, AL	Dale, Houston
Florence, AL	Colbert, Lauderdale
Gadsden, AL	Etowah
Huntsville, AL	Limestone, Madison
Mobile, AL	Baldwin, Mobile
Montgomery, AL	Autauga, Elmore, Montgomery
Tuscaloosa, AL	Tuscaloosa

Table 4-4

Figures 4-7 through 4-11 present the major clusters and employment for the five economic regions within Alabama.

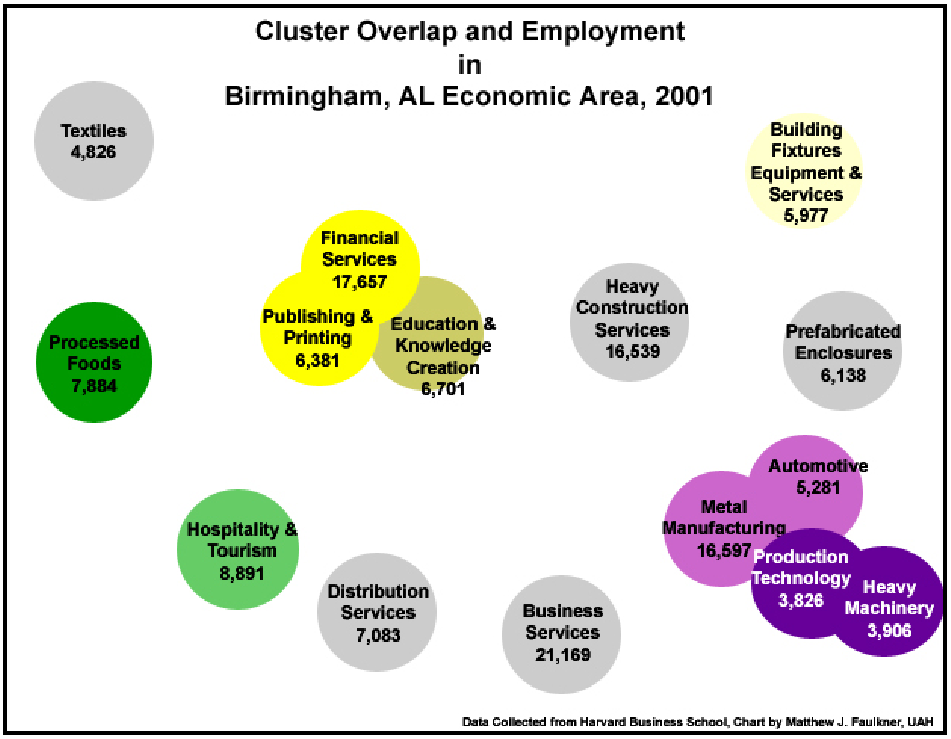


Figure 4-7

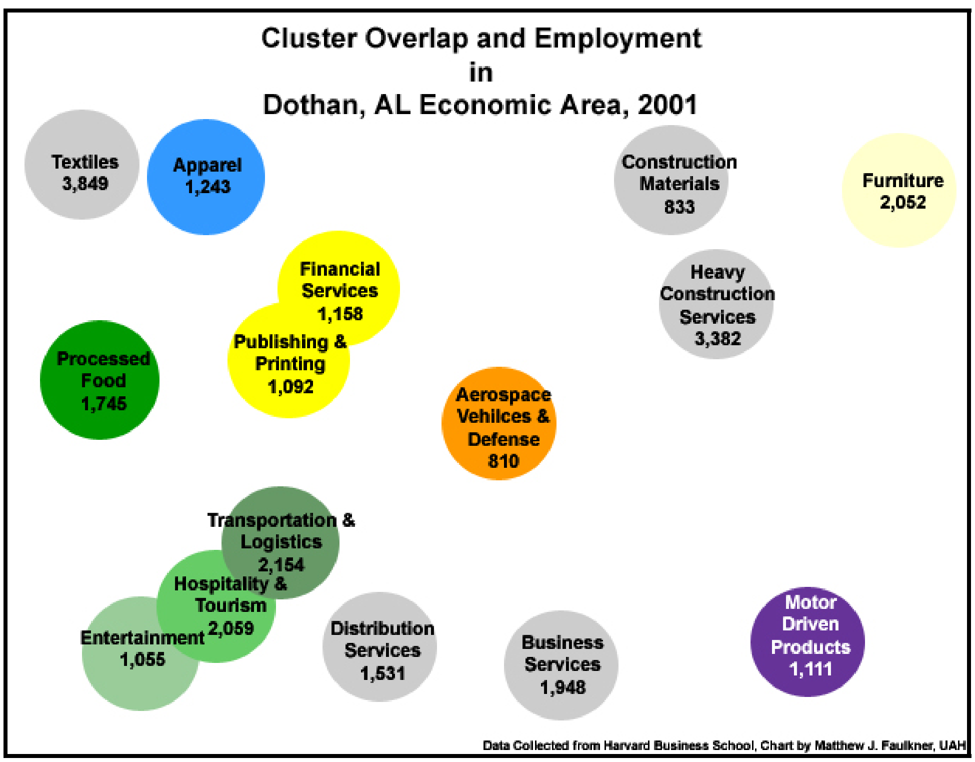


Figure 4-8

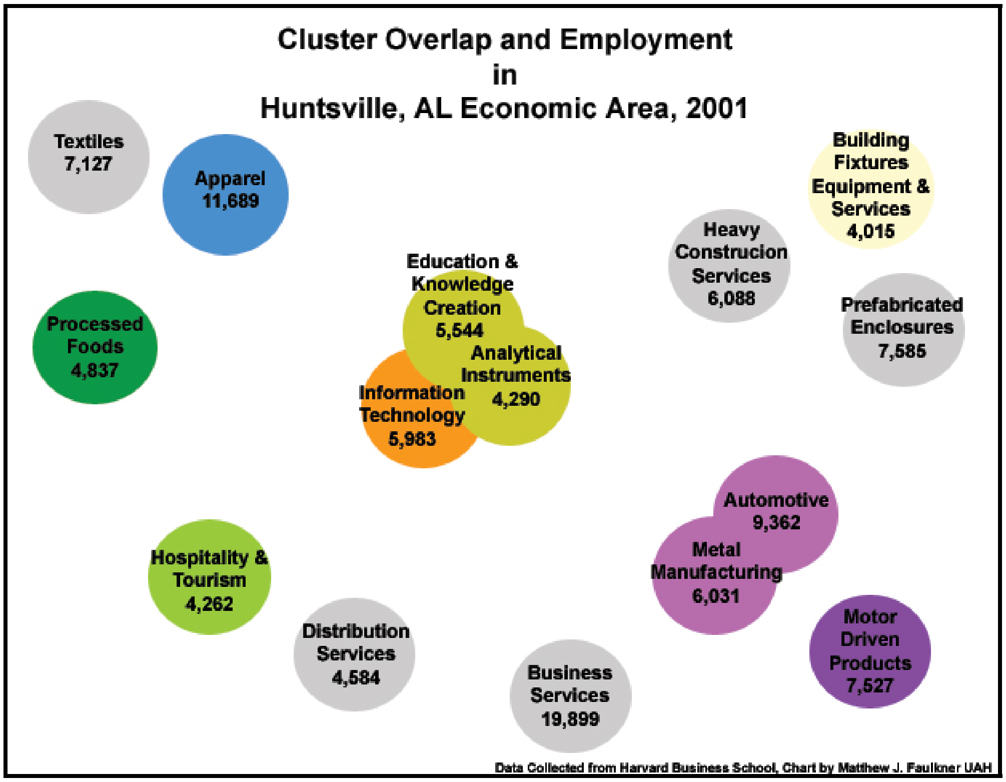


Figure 4-9

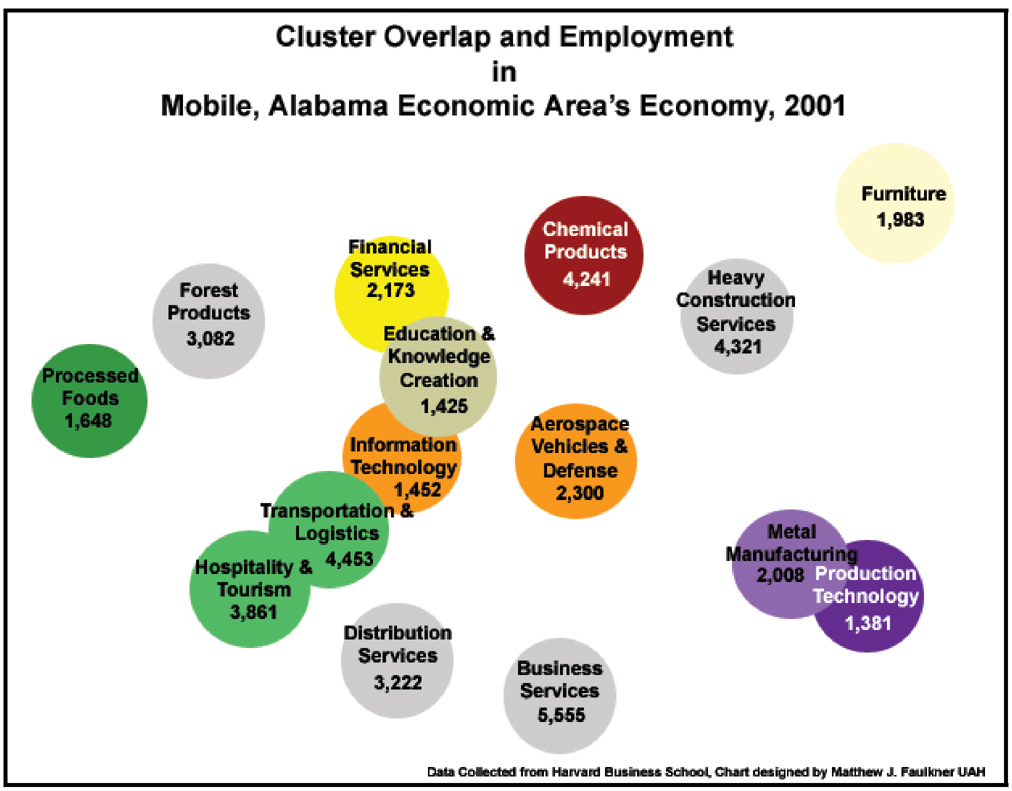


Figure 4-10

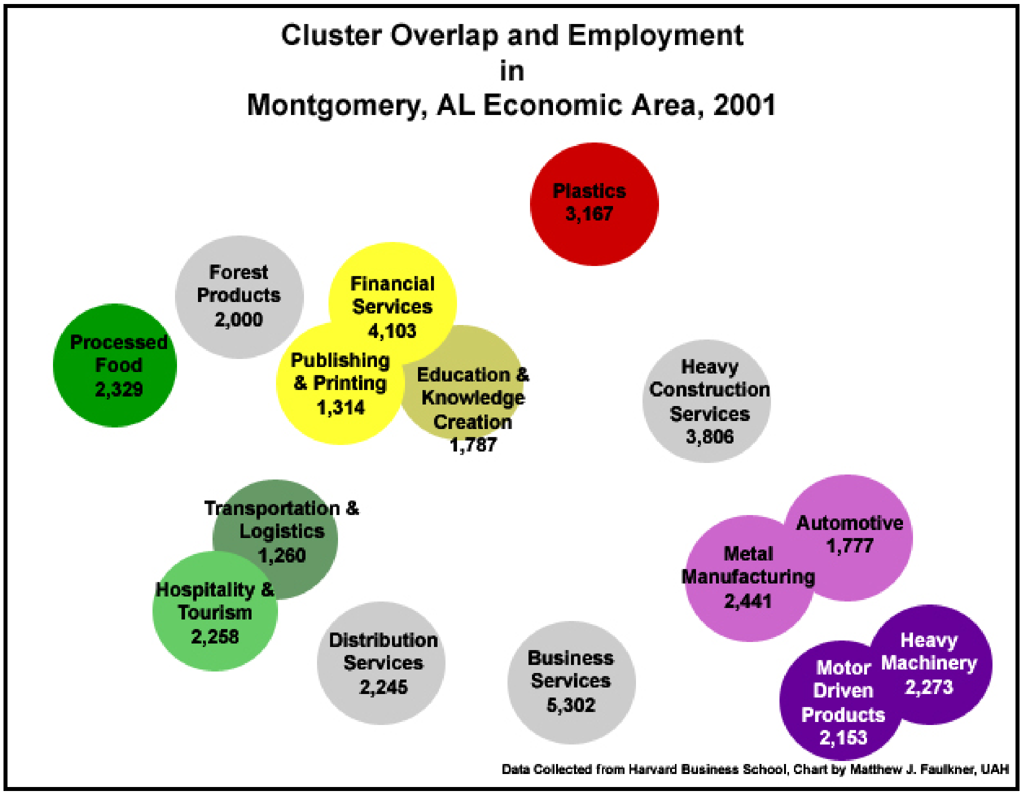


Figure 4-11

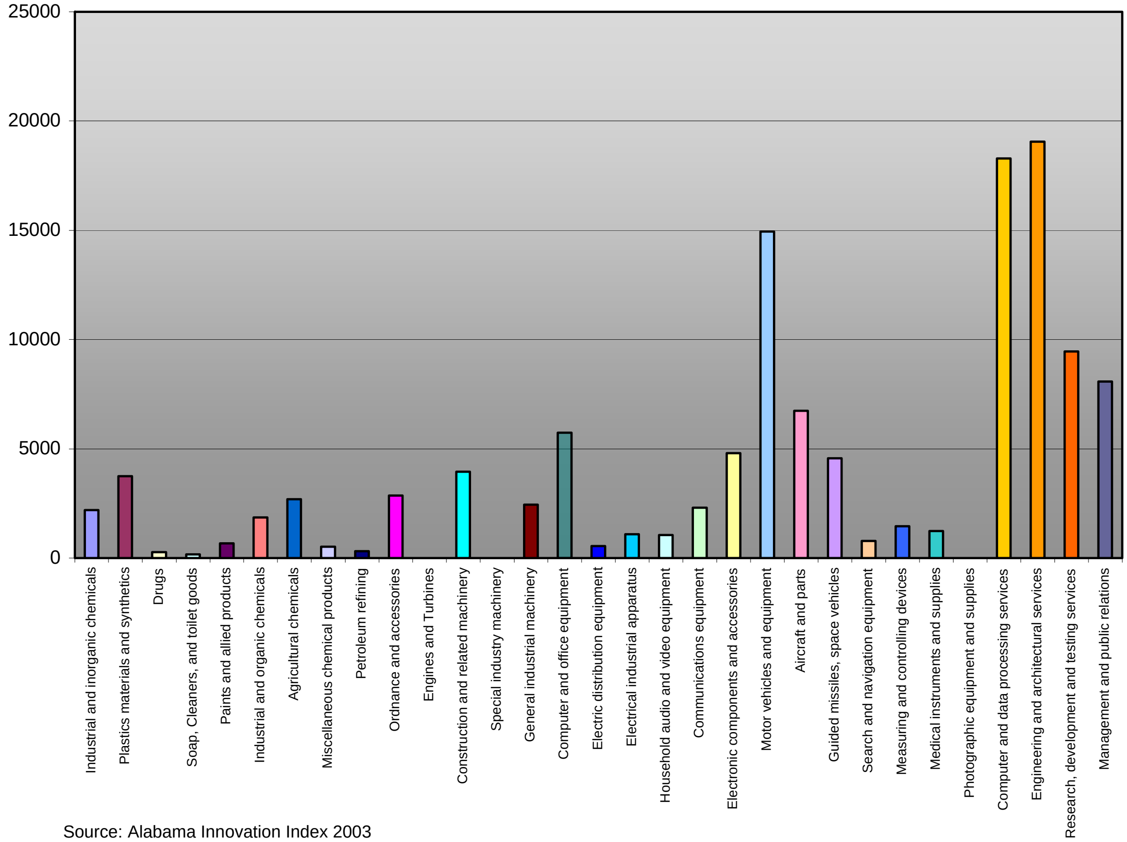
The major clusters for the eleven metropolitan areas in Alabama are presented in Table 4-5 below.

	Decatur	**Florence**	**Huntsville**	
1	Prefabricated Enclosures	Apparel	Business Services	
2	Forest Products	Prefabricated Enclosures	Automotive	
3	Motor Driven Products	Metal Manufacturing	Information Technology	
4	Textiles	Automotive	Education and Knowledge Creation	
5	Metal Manufacturing	Business Services	Analytical Instruments	
	Anniston	**Gadsden**	**Tuscaloosa**	**Birmingham**
1	Metal Manufacturing	Motor Driven Products	Heavy Construction Services	Business Services
2	Heavy Construction	Business Services	Motor Driven Products	Financial Services
3	Textiles	Metal Manufacturing	Automotive	Metal Manufacturing
4	Prefabricated Enclosures	Heavy Construction Services	Plastics	Heavy Construction Services
5	Furniture	Publishing and Printing	Business Services	Hospitality and Tourism
	Auburn-Opelika	**Dothan**	**Mobile**	**Montgomery**
1	Motor Driven Products	Transportation and Logsitics	Business Services	Business Services
2	Automotive	Hospitality and Tourism	Transportation and Logistics	Finanical Services
3	Business Services	Business Services	Heavy Construction Services	Heavy Construction Services
4	Heavy Construction Services	Motor Driven Products	Chemical Products	Motor Driven Products
5	Textiles	Heavy Construction Services	Hospitality and Tourism	Plastics

Source: Industry Cluster Analysis for Alabama

Table 4-5

Another means of identifying areas of strength is to examine employment by SIC Codes. (Figure 4-12).



Source: Alabama Innovation Index 2003

Figure 4-12
High Tech Employment in Alabama for 2000

In summary, the interaction among regional assets such as population, transportation infrastructure, and mix of industry is just as important to understanding demands on the transportation system(s) as recognizing the existence of these assets. The dynamics of how regional assets are utilized impacts the demand for transportation infrastructure. Transportation planning can be improved by considering the mix or clusters of industry in a particular region. Cluster models go beyond just recognizing the presence of an industry. Clusters, by definition, are built upon interactions between industries in a geographic location. It is in these interactions that transportation services enable or inhibit economic growth. Further efforts to improve transportation planning models should consider the presence and size of industry clusters as well as how these clusters utilize transportation infrastructure within a geographic region.

Source: Alabama Innovation Index 2003

4.2 Industry Surveys

4.2.1 Manufacturing Transportation Surveys

Two particular industry clusters in Alabama, the automotive and aerospace industries, were of significant interest to this research due to the size of the clusters and/or the rate of growth the industry has experienced in recent history. Face-to-face discussions with representatives of companies in Alabama's major industry clusters revealed not only the differences and similarities among companies but also within clusters of industry. It became increasingly obvious that the size of a particular industry cluster was at least as, if not more, important than the size of the largest company in the cluster. For example, the relatively new (10 years or so) and rapidly growing automotive cluster in Alabama is making a noticeable difference in Alabama's economy and in the commercial shipments on Alabama's highways.

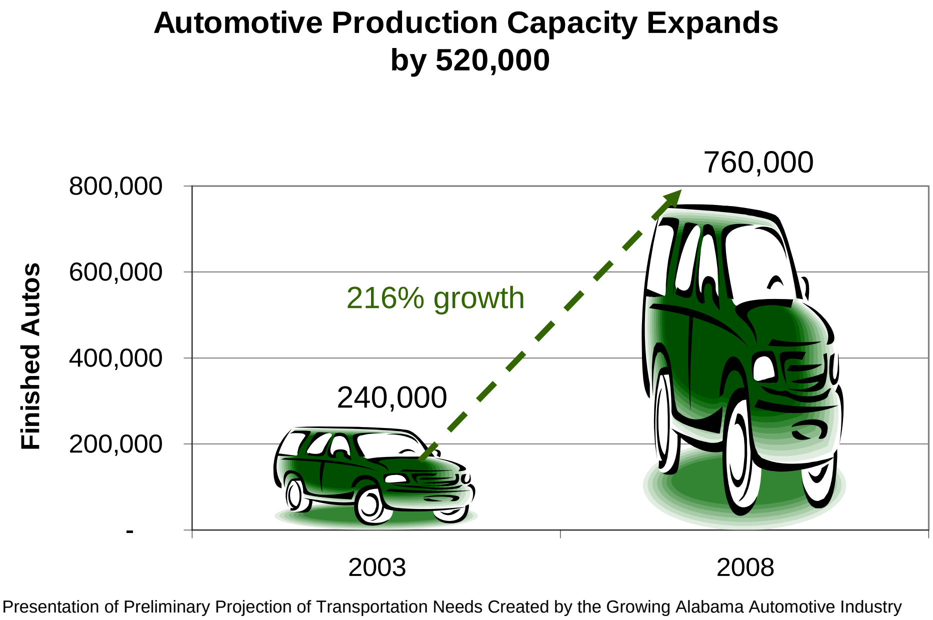


Figure 4-13

The automotive industry in Alabama is continuing to grow and thrive as production of finished vehicles in the state increases, as shown in Figure 4-13. The automotive industry has provided high wage jobs and employment growth to the state during a time in which several traditional industries have been in decline. This welcome growth brings with it transportation infrastructure issues such as traffic congestion, that will have to be addressed. This industry will continue to put a strain on the transportation infrastructure as production increases and shipping volume due to Just-In-Time manufacturing requirements escalate. The brand-named original equipment manufacturer (OEM) assembly plants, Mercedes, Honda, Hyundai, and Toyota (engines), attract the most attention, but it is the suppliers to these plants that generate the majority of the shipments. Most (96%) of these just-in-time, just-in-sequence shipments are carried by truck (Figure 4-14). The data collected from the industry surveys, shows that on average for each truck shipment originating from or terminating at the OEM plant, 3.5 truck shipments occur in the supply chain (first, second, or third-tier).

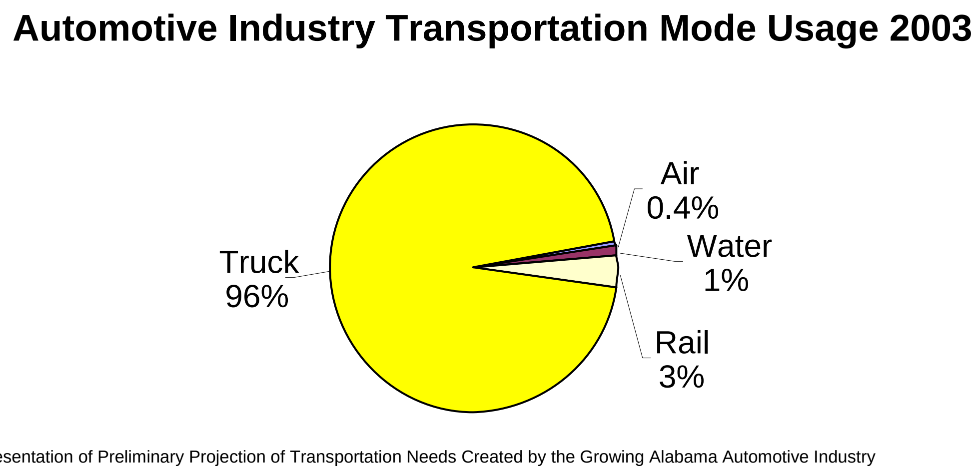


Figure 4-14

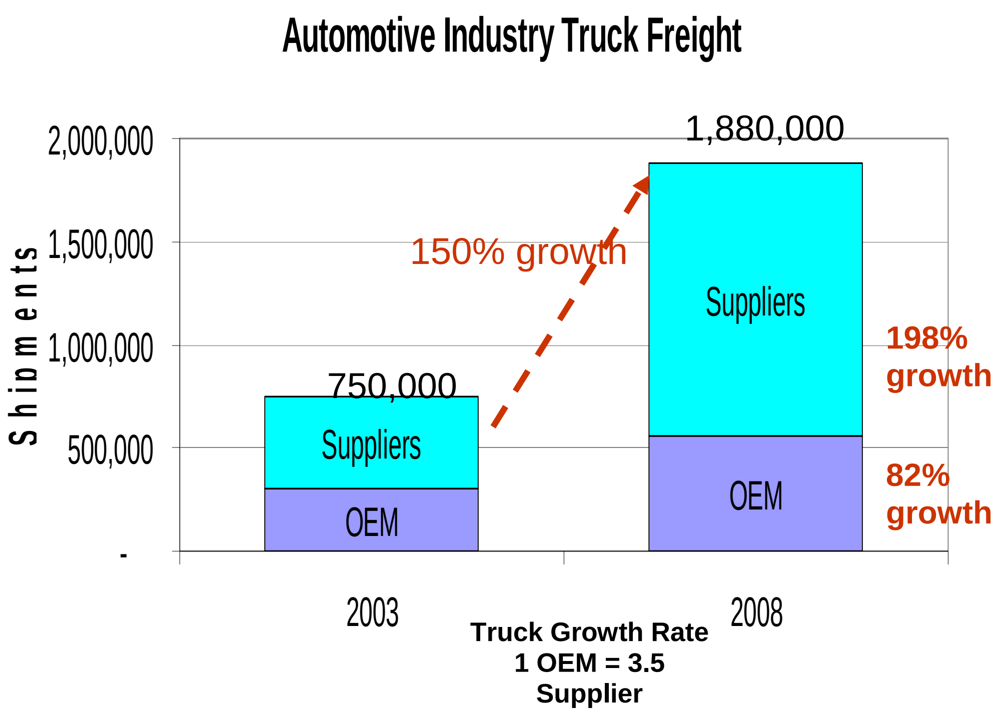


Figure 4-15

The impact on road infrastructure in Alabama will certainly be noticed as annual automotive truck shipments grow by 150% from 750,000 in 2003 to 1,880,000 by 2008 (see Figure 4-15).[7] In any given hour of the business day, there are approximately 156 trucks carrying automotive freight on Alabama roads. The survey indicated that this average will grow to 392 per hour by 2008. Unfortunately, most of this growth will occur in the region of the state where road capacities are reached or exceeded regularly during normal business hours. In Figure 4-16 the automotive companies in Alabama are shown by the county the company resides in along with the projected (highlighted) areas where the ALDOT capacity guidelines will be exceeded by 2008. Coupled with other truck freight flowing within and through Alabama, significant congestion may result in the locations where industries can least afford the delay.

Automotive Companies In Alabama

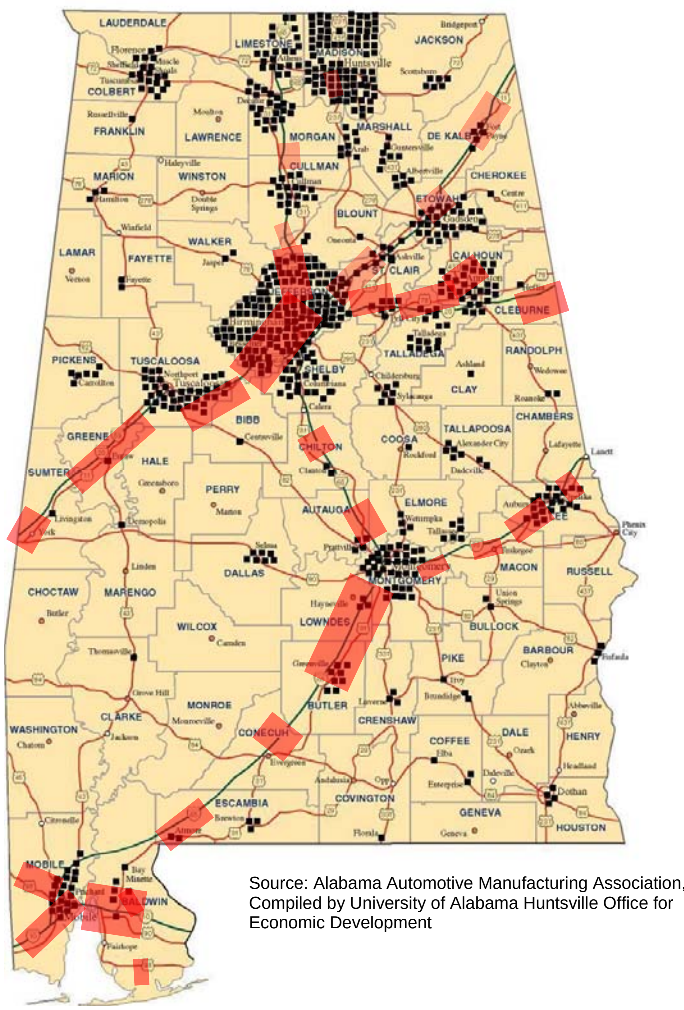
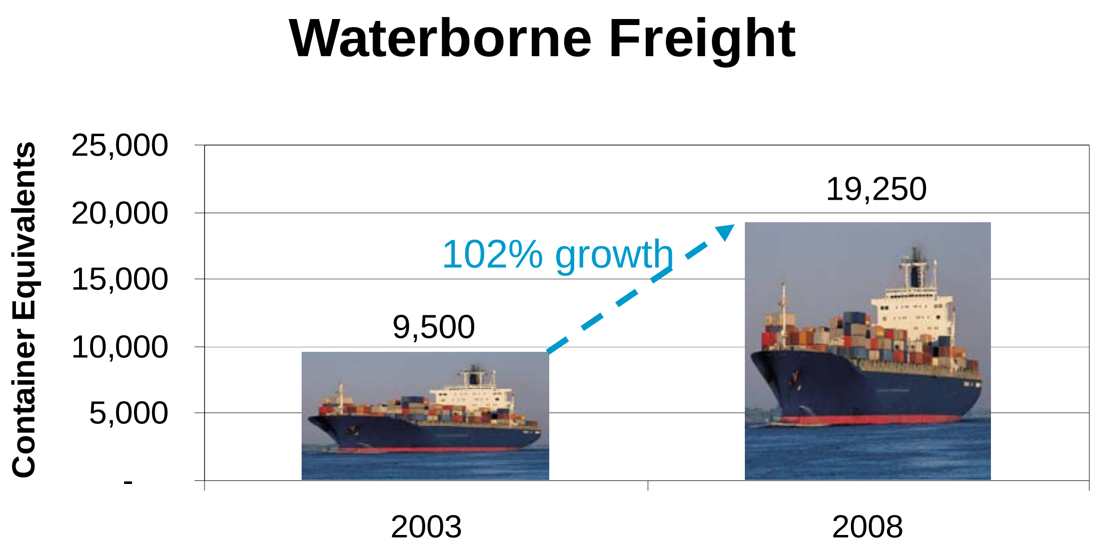


Figure 4-16
Highlighted Area of Automotive Industry Concentration and Congested Facilities

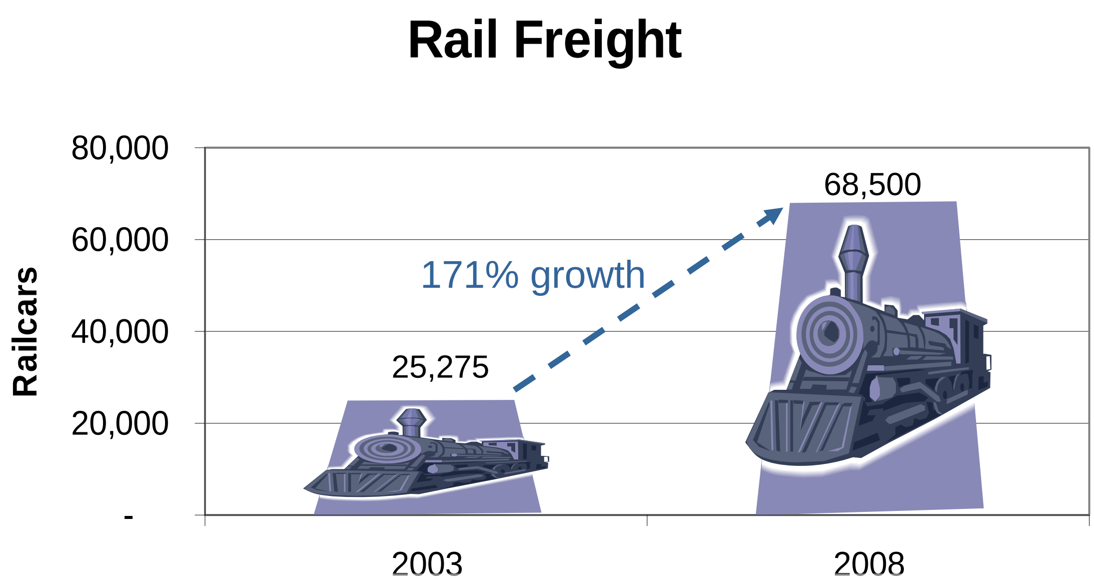
Other modes of automotive freight transportation will grow as the number of autos assembled in Alabama reaches planned capacity of 760,000 per year in

2008. Growth in waterborne freight (Figure 4-17), and rail freight (Figure 4-18) will noticeably impact available capacity. A large portion of the finished vehicles leave the state by way of the railroad carriers. The air freight from the automotive cluster may exceed the anticipated growth (Figure 4-19) if the other modes of transportation cannot meet the expanded demands of suppliers and assembly plants.



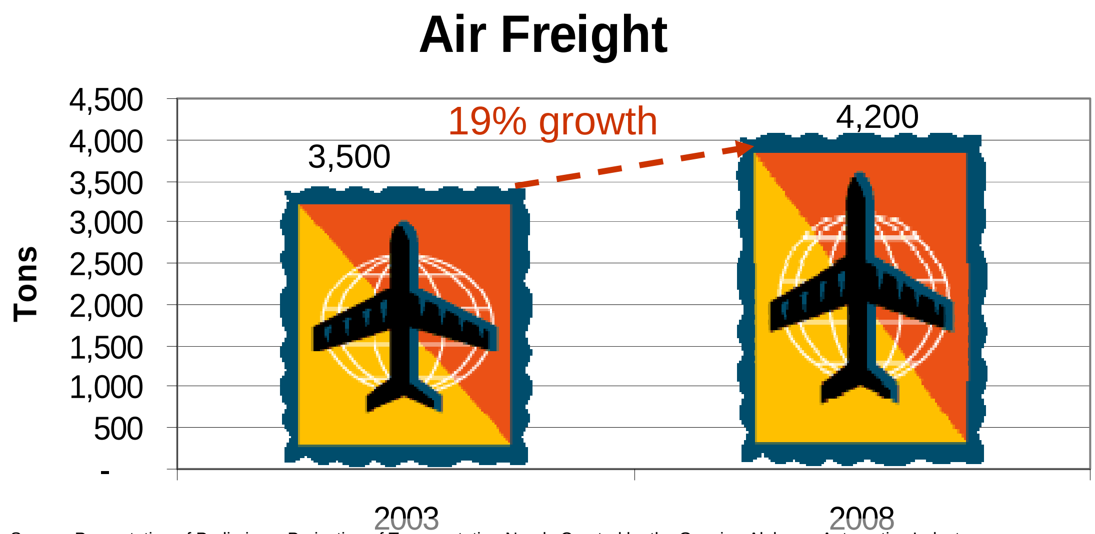
Source: Presentation of Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry

Figure 4-17
Growth in Waterborne Freight Due to Automotive Production



Source: Presentation of Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry

Figure 4-18
Growth in Rail Freight Due to Automotive Production



Source: Presentation of Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry

Figure 4-19
Growth in Air Freight Due to Automotive Production

The aerospace industry in Alabama has had a significant presence in the state for over 40 years. Discussions with numerous aerospace executives during the interviews clarified that there are two distinct types of aerospace industries in Alabama; military/space and commercial sectors. Most of the freight moved by the aerospace companies surveyed has a domestic origin and destination. For comparison, 94% of the tonnage and 97% of the truck (LTL & bulk) shipments is domestic freight versus 6% or less freight is originating or terminating outside of the United States.[8] Based on the responses to the survey, international outsourcing by Alabama's aerospace industries has not significantly impacted aerospace manufacturing in the state. Only by examining both aerospace sectors and the sub-clusters, was a relevant understanding of the industry possible.

Alabama aerospace companies primarily use seven modes of transportation. In terms of weight, rail moves the most freight. However based on number of shipments, truck is the most popular mode of moving aerospace materials and products. Specifically, these were the modes of transportation identified by the survey:

- Air
- Rail
- River
- Ocean – bulk
- Ocean – container
- Truck – bulk
- Truck – container & LTL

For illustration purposes, the freight modes are segmented into shipments that are measured in tons (tons) and shipments that are tracked in loads, partial loads, and containers (units). Further review of domestic and international cargo shows that rail moves 91% of the domestic tonnage. River freight is second at 8%. Truck freight (charted in units) is split between bulk and LTL. See Figures 4-20 and 4-21.

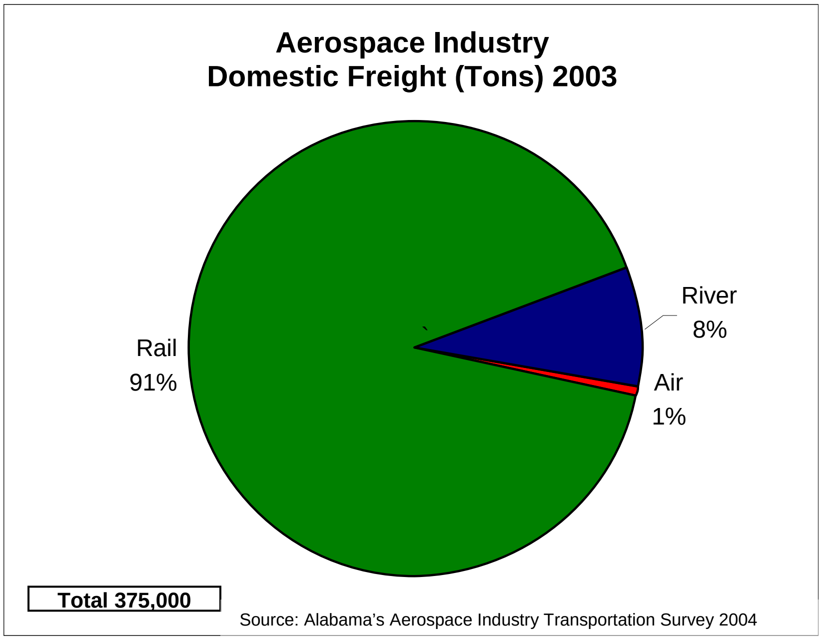


Figure 4-20

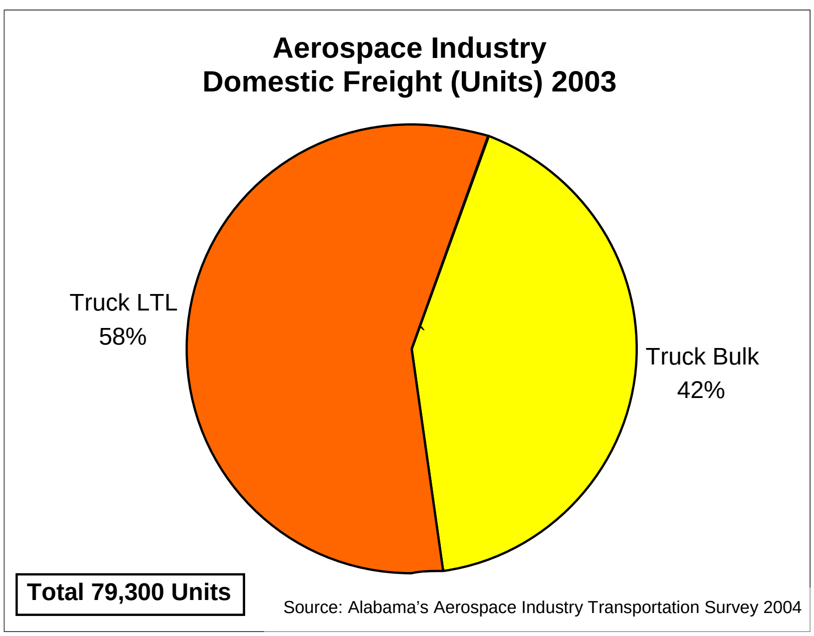


Figure 4-21

For international cargo, ocean freight is the mode of choice for aerospace. For shipments measured by weight, ocean bulk freight is used 98% of the time. Air freight accounted for 2% and rail less than 1% of the shipments in 2003. See Figure 4-22.

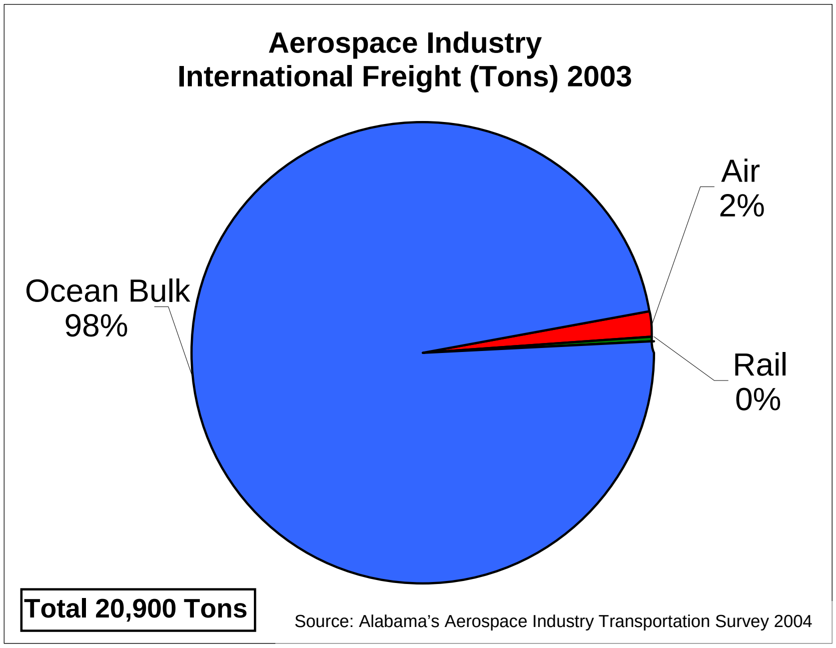


Figure 4-22

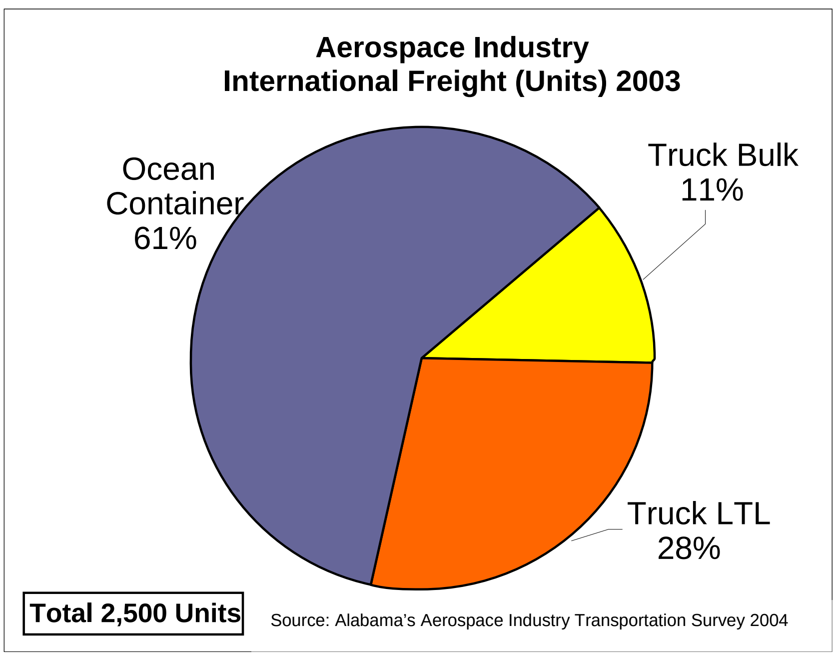


Figure 4-23

For international shipments charted in units, ocean containers are used 61% of the time with truck LTL (less than trailer load) at 28% and truck bulk (truck load) 11% (Figure 4-23). Canada and Mexico are both popular destinations for Alabama aerospace industries' products which accounts for the strong share of the freight handled by truck.

Companies participating in the survey were asked to project the changes in their freight transportation volumes for 5 years (2008) and 10 years (2013). In almost all companies, freight volumes are expected to increase for inbound and/or outbound shipments.

Domestic air freight is projected to see the largest percentage increase by 2008 (44%) and by 2013 (86%) from the 2003 levels. Domestic truck bulk (truck loads) is anticipated to increase almost as much in percentage terms from 2003 with a 34% increase by 2008 and a 67% increase by 2013. Figures 4-24 and 4-25. The truck modes (bulk and LTL) transport much more cargo than is moved by air freight. Due to the heavy use of trucks, demands for transportation infrastructure from the aerospace industries will be from the truck shipments.

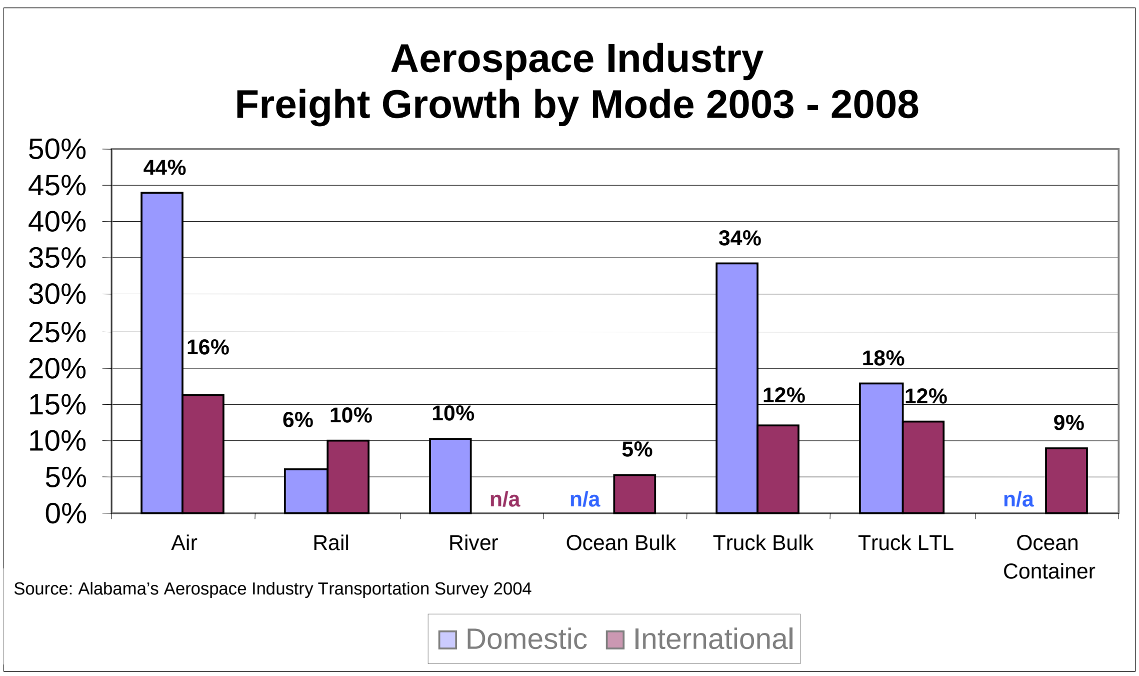


Figure 4-24

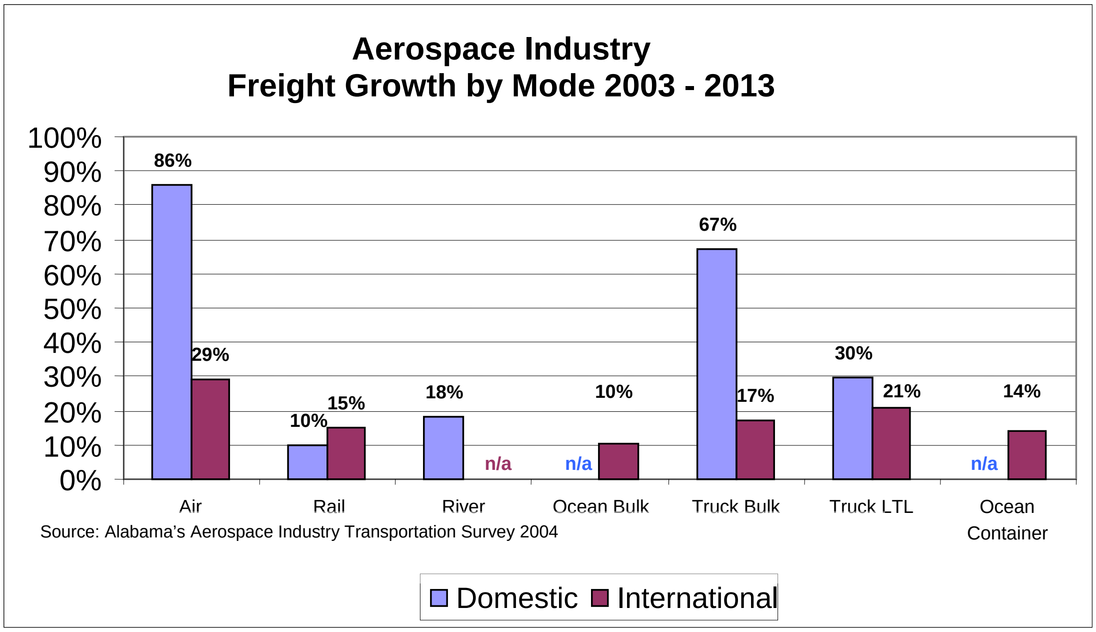


Figure 4-25

The Alabama aerospace manufacturing industry is as dependent on the transportation infrastructure as any manufacturing industry in the state. The ability to meet the growing transportation needs of this industry will impact the success of Alabama in retaining existing and attracting new companies to the state. Given the relatively high quality and high value of the jobs in the aerospace industry, it will be essential to the economy that transportation infrastructure resources are allocated in the proper proportions between maintenance and expansion. The 2002 Aerospace Industries Survey found that aerospace accounted for 139,601 jobs (direct and indirect) and $6.16 billion in payroll (direct and indirect jobs).[9] Aerospace companies depend most heavily on highway infrastructure but rail, water, and air transportation are also very important to the future of Alabama's aerospace industry.

Another interesting fact that developed from the interview discussions with transportation managers was that Alabama manufacturing companies in general are primarily focused on their current (short-term) business needs. Future business forecasts are either not being shared or not being incorporated into the transportation department information of the company. Only by connecting the inputs from executive-levels with transportation department information, can reasonable forecasts for industry clusters be made. This disconnect between the board-room and loading dock suggests that transportation information gathered through traditional channels may not be sufficient in planning for the transportation infrastructure of tomorrow. Understanding, that although Alabama companies compete in a global economy, it is the domestic shipping and the preference for truck shipment by these companies that will drive transportation forecasts for the foreseeable future.

An additional finding is that there is an imbalance of trade between Alabama and other states that appears to affect the available capacity of over the road trucks to move products of Alabama manufacturers. Over the road truck operators seem to hold the opinion that if they deliver a load to an Alabama company they will return home empty, making the operators reluctant to make the initial delivery to Alabama companies. The manufacturers in Alabama complain that they cannot find trucks to move their products when needed within and outside of the state. Adding into this situation the new hours-of-service (HOS) rules on truckers, the available trucking capacity is even more constrained creating a supply-demand imbalance. The fact that these two positions are held simultaneously would indicate that there is a communication issue between the freight service providers and their customers.

4.2.2 Automotive Industry Survey

Automotive manufacturing in Alabama continues to grow, with 86,674 employees and generating nearly $3.3 billion in payroll. Of these jobs 31,197 were located at automotive manufacturing plants (Figure 4-26). These jobs support another 55,477 jobs created in the rest of the economy as a result of purchases by the industry and its employees. Total jobs grew at a rate of 3.5 percent from 2002 to 2003 while payroll grew at 8.9 percent over the same time period. That growth in payroll exceeded growth in jobs indicates workers are benefiting from higher salaries. [10]

Researchers with the Office for Economic Development at the University of Alabama in Huntsville (UAH) surveyed 207 automotive manufacturing plants in the state to mark the industry's status and measure activities during the previous year. Data was collected via a mail survey, an online survey, emails and telephone calls. Of these 207 plants, 32 established a presence in Alabama during 2003. Most of these new plants are in an early startup stage. Twenty-four existing Alabama plants became part of the industry with sales to the industry in 2003. Seven automotive manufacturing plants closed their doors last year.

Besides a growth trend, the study revealed automotive manufacturing is expanding into new areas of the state. This is evident when the state is divided roughly into four regions from north to south, with Region 1 in the northern quadrant and Region 4 in the southern quadrant. Jobs grew at just over 20 percent from 2002-2003 in Regions 3 and 4 (Figure 4-26). Plant floor space in Region 3 grew at an annual rate of 20 percent. Regions 3 and 4 garnered 20 of the 32 plants new to Alabama last year.[11] These new plants should be in full production in the next few years, giving rise to growth in employment in these regions. Additionally, seven new counties, Bullock, Coffee, Crenshaw, Elmore, Lauderdale, Lowndes and Macon were added to the list of counties with automotive manufacturing plants; six of these counties are in Regions 3 and 4.

Industry Growth in Jobs

Region	2002	2003	Change
1	13,805	12,365	-10.4%
2	10,396	11,633	+11.9%
3	3,290	3,965	+20.5%
4	2,676	3,234	+20.9%
Statewide	30,180	31,197	+3.4%
Plants	162	207	

Source: Alabama's Automotive Manufacturing Industry Report 2003

Figure 4-26

Region 2, home to Mercedes Benz in Tuscaloosa and Honda in Talladega, saw a 12 percent increase in jobs, a 43 percent increase in plant floor space and the addition of nine new supplier plants. Tuscaloosa County ranked number one with Madison County second in total automotive industry employment. Talladega County ranked number three in terms of overall state automotive industry jobs. Region 1 decreased in jobs and plant floor space by 10 percent. The closing of Madison County's Goodyear Dunlop plant was largely responsible for the losses. Madison County moved from first to second in automotive manufacturing employment (Table 4-6). [12]

Top Six Counties Ranked by Automotive Jobs

County	Rank 2003	Rank 2002	Jobs 2003	Jobs 2002	Change 2002-2003	Percent Change
Tuscaloosa	1	2	5,291	4,980	+311 jobs	+6.2%
Madison	2	1	4,207	5,595	-1,388 jobs	-24.8%
Talladega	3	3	4,002	3,209	+793 jobs	+24.7%
Limestone	4	4	2,885	2,876	+9 jobs	0.3%
Etowah	5	5	2,026	2,133	-107 jobs	-5.0%
Lee	6	6	2,011	1,866	+145 jobs	+7.8%

Source: Alabama's Automotive Manufacturing Industry Report 2003

Table 4-6

AMINA

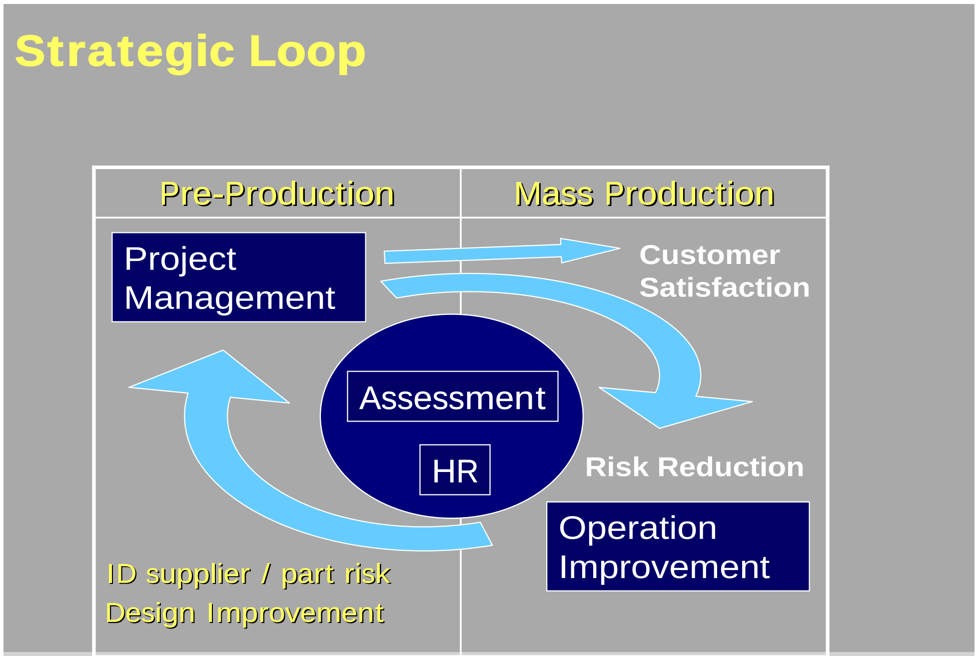
The Alabama Automotive Manufacturers Association (AAMA) organized the Automotive Manufacturing Improvement Network of Alabama (AMINA) to assist participating Alabama automotive suppliers in becoming lean enterprises and meet industry requirements for quality, cost, delivery, management and continuous improvement (Figure 4-27). The goals of the network are to help participants share continuous improvement techniques, and meet Original Equipment Manufacturers (OEM) requirements to achieve system certification to the ISO/TS 16949:2002 integrated management system standard.

AMINA was originally established with first tier suppliers to Mercedes Benz in Vance, Alabama and a supplier to Honda in Lincoln, Alabama. During initial meetings between AMINA and personnel from the Office for Economic Development (OED) at the University of Alabama in Huntsville (UAH) it was agreed that a plan to expand AMINA beyond the original group was desirable. A plan for expansion of the organization was developed that included the division of the state into sections and identification of a chair for each of the sections. This was implemented in October of 2004. The following is a description of the organization as it stands at the end of 2004. AMINA has established three sections:

- Central Alabama Section (formed in 2002)
    - Participating Companies
        - Mercedes-Benz U.S. International, Inc. Tuscaloosa, AL
        - ISE Innomotive Systems U.S., Inc. Tuscaloosa, AL
        - Johnson Controls, Inc. Cottondale, AL
        - Ogihara America Corporation Birmingham, AL
        - Oris Automotive Parts Alabama, Ltd. Bessemer, AL
        - Stahlschmidt & Maiworm USA Inc Auburn, AL
        - ZF Lemforder Corporation Tuscaloosa, AL

- North Alabama Section (formed in 2004)
    - Participating Companies
        - Honda Manufacturing of Alabama, LLC Lincoln, AL
        - AGC Automotive Americas
        - Delphi Saginaw Athens, AL
        - HiSAN, Inc. Scottsboro, AL
        - International Diesel of Alabama, LLC
        - Toyota Motor Manufacturing Alabama, Inc.
        - Triana Industries, Inc. Madison, AL
        - TS Tech Alabama, LLC

- South Alabama Section (formed in 2004)
    - Participating Companies
        - Hyundai Motor Manufacturing Alabama, LLC
        - T&W Assembly



Source: Toyota: Strengthen the Team to Succeed, Presentation by Sig Huber, Manager, TMMNA, Alabama Automotive Manufacturers Association, October 2004, Birmingham, AL

Figure 4-27
Strategic Supply Chain Loop

4.2.3 Aerospace Survey

The purpose of this research was to provide information to support the growth and development of the aerospace industry in Alabama. A letter from Governor Bob Riley endorsing the survey was mailed to over 400 companies. An online version of the survey was also available. Non-respondents to the initial mailing were contacted several times in a variety of ways including mailing, phone calls and emails.

Two hundred three (203) companies reported on their year 2002 activities. We estimate that the 203 respondent companies represent at least 90% of Alabama's aerospace industry employees and include at least 95% of companies with more than 250 employees. Information on federal government aerospace employment and payroll in Alabama was obtained from Public Affairs Offices at Redstone Arsenal, Maxwell/Gunter AFB and Fort Rucker.

Alabama's private sector aerospace industry is made up of seven sectors (Figure 4-28):

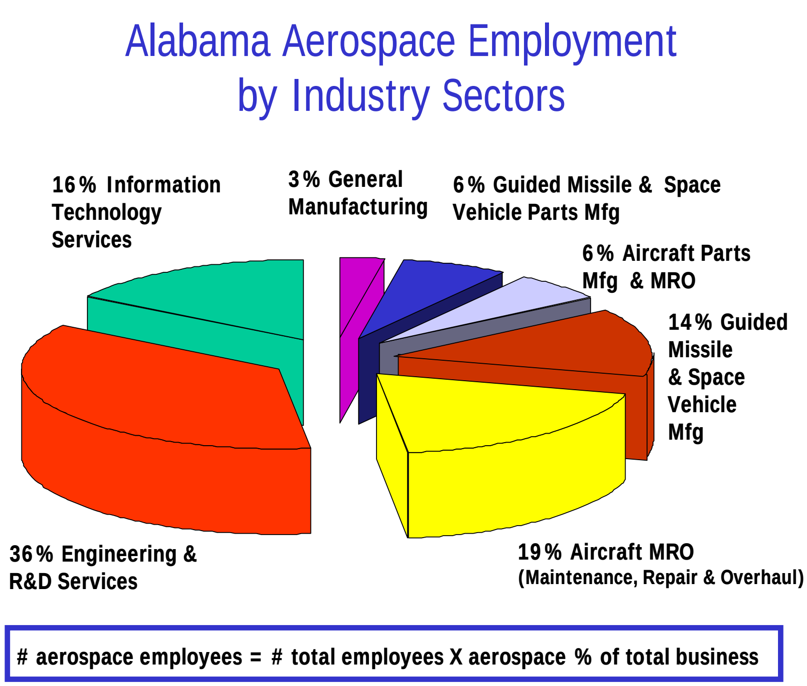
- General manufacturing (3% of private sector aerospace jobs)
- Missile and space vehicle parts manufacturing (6% of private sector aerospace jobs)
- Aircraft parts manufacturing (6% of total private sector jobs)
- Missile and space vehicle manufacturing (14% of private sector aerospace jobs)

- Aircraft maintenance, repair and overhaul (MRO) (19% of private sector aerospace jobs)
- Engineering and R&D services (36% of private sector aerospace jobs)
- Information technology services (16% of private sector aerospace jobs).[13]

Fourteen of Alabama counties had 100 or more aerospace jobs. Ninety-nine percent of all private sector aerospace jobs were in these 14 counties (Figure 4-29).

- Region 1 (Madison, Morgan and Cullman counties) employed 66.7% of all the private sector aerospace workers in the state.
- Region 2 (Calhoun, Jefferson and Talladega counties) accounted for 5.7% of private sector aerospace jobs.
- Region 3 (Dallas and Montgomery counties) had 8% of the state's private sector aerospace jobs.
- Region 4 (Dale, Pike, Coffee, and Houston counties) accounted for 12.3% of private sector aerospace
- Region 5 (Baldwin and Mobile counties) had 6.7% of the state's private sector aerospace jobs.[14]

Private sector aerospace companies in Alabama employed 36,253 individuals and federal aerospace installations in Alabama employed another 36,799 workers for a total state aerospace direct workforce of 73,032 in 2002.



Source: Aerospace Industry Report 2002

Figure 4-28

When the multiplier effect is taken into account, Alabama's aerospace industry created an additional 66,569 multiplier or indirect jobs. In total, direct and multiplier jobs in the private and federal aerospace sectors accounted for 139,601 jobs in Alabama in 2002 (Table 4-7).

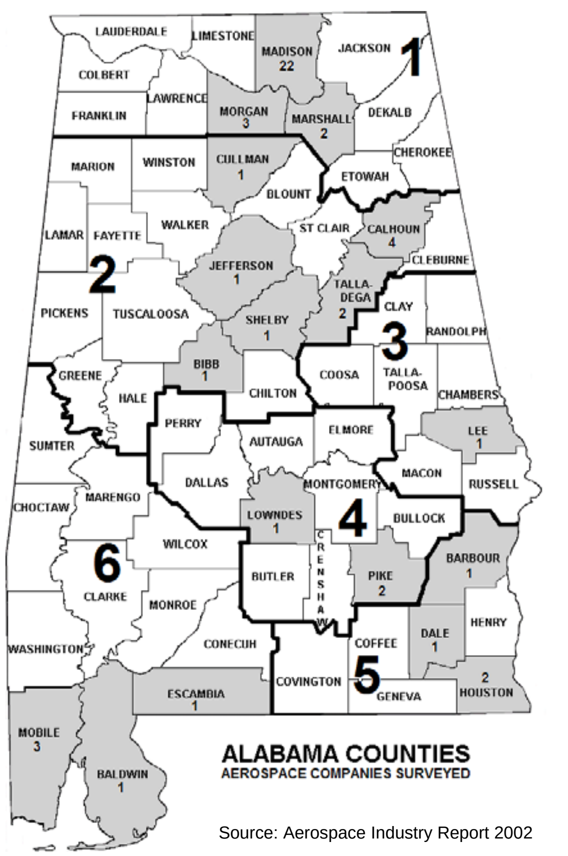
Alabama's Aerospace Jobs in 2002

	Direct Jobs	**Multiplier Jobs**	**Total Jobs**
Private Sector	36,253	47,223	83,476
Federal Aerospace	36,779	19,346	56,125
Totals	**73,032**	**66,569**	**139,601**

Source: Aerospace Industry Report 2002

Table 4-7

Additionally, Alabama's aerospace industry employed a highly skilled and well-educated workforce. Of the total workforce, 23% were employed as production workers and another 34% were degreed professional in science and engineering fields.[15]



Source: Aerospace Industry Report 2002

Figure 4-29

Regions and Companies Surveyed

Total direct payroll for Alabama's aerospace private sector workers amounted to $1.98 billion in 2002 while federal sector aerospace workers earned a total of $1.68 billion. The aerospace direct payroll for the state in 2002 amounted to $3.66 billion. When the payroll associated with multiplier jobs is added to the direct payroll, the payroll associated with Alabama aerospace industry swells to $6.16 billion (Table 4-8).

Alabama's Aerospace Payroll in 2002

	Direct Payroll	**Multiplier Payroll**	**Total Payroll**
Private Sector	$ 1.98 B	$ 1.60 B	$ 3.58 B
Federal Aerospace	$ 1.68 B	$ 0.90 B	$ 2.58 B
Totals	**$ 3.66 B**	**$ 2.49 B**	**$ 6.16 B**

Source: Aerospace Industry Report 2002

Table 4-8

The aerospace industry is a large and critical component of the Alabama economy. The industry provides thousands of well paying jobs to Alabama citizens and pumps billions of dollars into the state economy. At a time when jobs are being lost in apparel, textiles, pulp and paper, plastics and chemicals, the aerospace industry is a bright spot with substantial growth opportunities for the future.

<u>Conclusions</u>

Manufacturing companies in Alabama are projecting greater need for trucking services at a time when the availability is already under strain and roads are at or over capacity in many areas. Maintenance and capital improvements are lagging behind demand and a change in funding for the foreseeable future is not expected. This situation is not going to correct itself and pressure on the infrastructure of the state to support economic growth will continue to grow.

In summary, the benefits of examining transportation data through the lens of the appropriate industry cluster are evident whether an industry is growing (automotive), stable (aerospace), or declining (apparel, textiles). Longstanding industries in a region are important but relying too heavily on data from these familiar companies may yield inadequate transportation planning. Enhancing the systems for transportation planning should include information beyond the transportation data channels. Planning must incorporate methods of associating data within and across industry clusters. In the next chapter, an analytical tool for transportation demand analysis is developed and utilized to project future infrastructure congestion.

5. Transportation Demand Model

Modeling freight transportation and predicting future growth in freight transportation has been performed with limited success in this country. Modeling intermodal, statewide freight transportation is an important part of understanding and predicting the transportation infrastructure needs in a region. The Transportation Equity Act for the 21st Century (TEA-21) supported the development of statewide models through identified transportation planning factors, specifically stated "to enhance the integration and connectivity of the transportation system, across and between modes throughout the State, for people and freight".[1]

The primary reason the forecasting of freight movements has been ineffective is that the current state-of-the-practice is focused on examining historical growth, then forecasting the historical growth trends into the future, essentially utilizing the notion that previous growth is a good predictor of future growth. Unfortunately, this model of freight prediction is limited with respect to the facts that freight growth trends do not follow historical trends and growth in freight transportation is generated by large, independent events that require a multitude of factors to come together in a symbiotic fashion.

Growth in freight transportation occurs when a new facility is opened, not as a gradual process. A roadway or rail-line that has been experiencing limited freight movement will see an abrupt increase in transportation after the construction of a manufacturing plant or timber processing facility. The development of facilities that will be instrumental in affecting the amount of freight transportation on roadways and rail lines occur when a specific set of external factors are in place to foster the development of such facilities. These factors include the economy, level of productivity, industry clusters in the area, and economies of scale associated with production. It is the combination of discrete freight generating events and external factors that limit the effectiveness of trend line analysis for freight forecasting.

To improve freight forecasting methodologies, this research effort attempted to utilize urban transportation planning models as a tool to model statewide freight transportation. These models, used in almost every metropolitan area in the country, take input levels of transportation demand (in the form of trips produced from one area and trips attracted to another area) and transportation supply (in the form of roadways available to accommodate the trips) and predict future traffic volumes on city streets. The output of these models are used to identify current deficiencies in the transportation system, and with forecasted population and employment data, to identify future transportation system deficiencies that will arise at a specified horizon year. The advantage these models have over trend line forecasting is that the model inputs can be adjusted for discrete events, or sudden changes in employment and/or changes in the transportation network.

Initially, the model inputs were developed following the traditional approach in an urban model. First, a network was developed to represent the facilities of interest (facilities where the future level of transportation demand, measured in volume, were determined). For our model, both a highway network and rail network were developed. Secondly, relationships between common economic and population factors were developed from the freight transportation survey conducted as part of the research effort and discussed in Chapter 4. The relationships focused the amount of transportation need, or the demand for transportation, which was expected as a function of the employment of the company, with unique relationships developed for individual industries reviewed during the survey. After defining the relationships, a projected demand for transportation services could be generated with knowledge of the industry employment for a county and overall county population. When applying the software for performing a run of the urban transportation planning model, the supply side input networks and demand side transportation needs are combined to determine the traffic volume, or freight flow, expected on the individual roadway or rail line facilities in the network.

5.1 Building the Model

The modeling aspect of this project began with a task initially described as a Logistics Model for Alabama. In order to eventually produce a logistics model of Alabama, the project was divided into phases. The first phase was to develop an accurate understanding of the current reality of freight transportation in the state using a modeling approach based upon the traditional four-step urban transportation planning process. This required preparation of a highway infrastructure network model. The Alabama specific network used counties as traffic zones. The roadways were attributed with distance, capacity (using Alabama Department of Transportation recommended values), and speed.

The purpose of this portion of the larger project was to develop a model that accurately reflects the current state of Alabama's infrastructure and allows for predictive analysis of the impact that relocating or developing industries would have on the state's freight transportation network. The model was built using the tool TRANPLAN which can be employed to determine the expected effect of industry growth on the local transportation infrastructure. The data for the model was developed from published government sources and the freight transportation survey described in Chapter 4. Regression analysis was performed to study the relationships between industry size and type and the resulting freight flow. As freight flow was a primary focal point for this work, a statistical analysis was performed on the relationship between freight flow and the industries located in Alabama to determine the overall county freight movement. The specific tasks performed were: data collection, definition of a relationship between industry and freight flow, network development, and assignment of traffic. Traffic was assigned to the Alabama specific network using the socio-economic data for the counties in Alabama and equilibrium assignment algorithm. The trips were determined using the relationships developed for freight flow from the survey information and personal travel characteristics. The model utilizes input data described in Table 5-1.

Alabama Dept. of Transportation • Traffic flow on interstates and highways • Railroad maps with company rail line designation	**Federal Highway Administration** • Traffic flow on interstates and highways • Historical traffic growth
Private Industry Sources • CSX Intermodal • Norfolk Southern Intermodal • BNSF Intermodal • Moffit and Nichols – Choctaw Point Report	**Survey of Alabama Manufacturers** • Freight by mode • Freight projections (5 & 10 yr) • Employment • Origin and destination
Dept. of Geography University of Alabama • Maps of Alabama	**American Association of Railroads** • Freight carried on Alabama railways
Bureau of Transportation Statistics • Air Freight data by airport • Commodity flow survey	**Army Corp of Engineers** • River borne commerce for Alabama • Freight by port

Table 5-1
Model Data Sources

The network was developed using GIS data for Interstates facilities, United States Highways and Alabama State Highways within the CUBE/VIPER environment. There were two separate networks developed, one focusing on the national highway infrastructure and one focusing on Alabama specific roadways. The national level network identified individual states as traffic zones, while the Alabama specific network used counties as traffic zones. The roadways were attributed with distance, capacity (using Alabama Department of Transportation recommended values), and speed. The networks are shown in Figures 5-1 and 5-2. The national model was developed to predict flows passing into Alabama and through Alabama. To accomplish this, a model was developed that used the states as the natural zones for the production and attraction of freight. To add realism to the model and to reduce bias for the selection of single roadways, states in close proximity to Alabama that have multiple highways connections were sub-divided into smaller zones, with the freight movements distributed to the new sub-state zones based on population. An example of this division can be found in Mississippi, where the state has been divided into three sub-state zones to account for freight movements from south Mississippi entering Alabama on Interstate 10, central Mississippi entering Alabama on Interstate 20/59, and northern Mississippi entering Alabama on U.S. Highway 72.

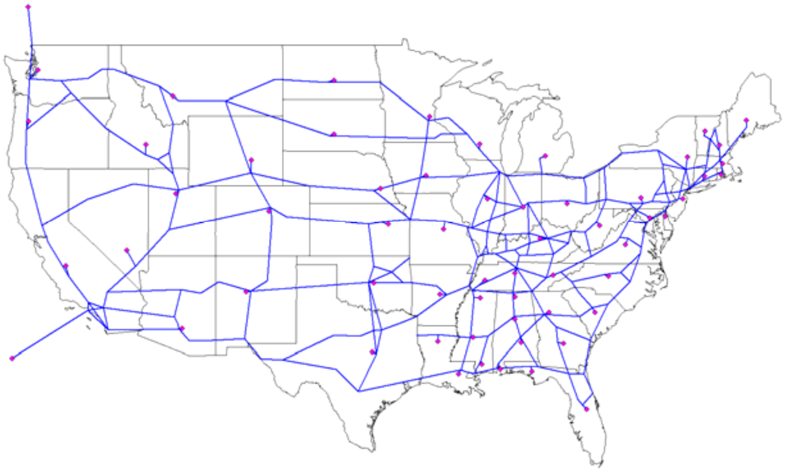


Figure 5-1
U.S. Highway Infrastructure

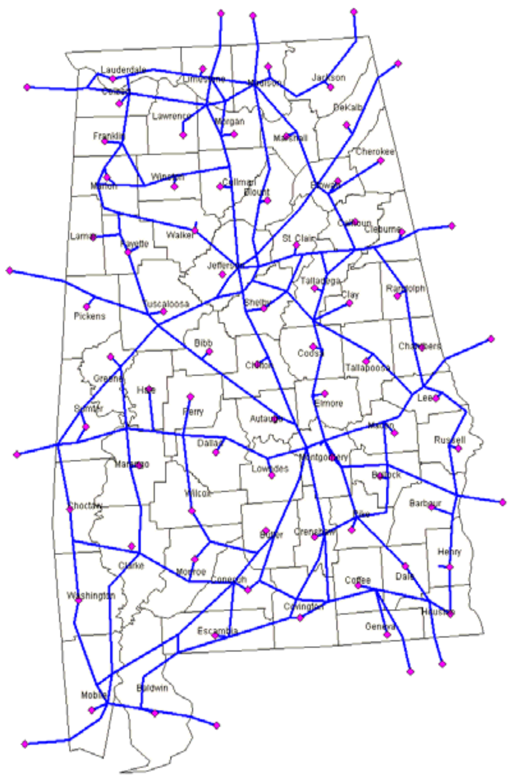


Figure 5-2
Alabama Highway Model Network

The traffic was assigned to the national network using freight flow information from the Commodity Flow Survey and an all-or-nothing assignment algorithm. Traffic was assigned to the Alabama specific network using the socio-economic data for the counties in Alabama and equilibrium assignment algorithm. The trips were determined using the relationships developed for freight flow from the survey information and personal travel characteristics adapted from the Virginia statewide model, as a personal travel survey was not conducted as a component of this project. The assignment of the Alabama network is shown in 5-3.

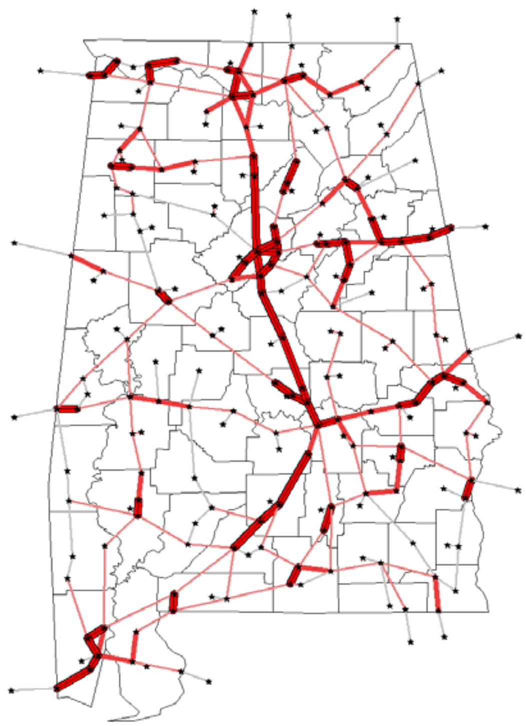


Figure 5-3
Alabama Traffic Assignment

5.2 Model Output and Conclusions

The model was used to predict future traffic levels and congestion in 2008 based upon historical growth rate of traffic in Alabama over the last 15 years. The current highway model has several important constraints and limitations. Freight flow in the current demand model, is based on averages and traffic flows and are assigned at a fixed rate so variation in demand that is evident in everyday activity is not considered. The model uses employment as the main characteristic of freight generation which does not take productivity improvement, a major indicator of an improving economy, into consideration. The current model does not incorporate endogenous changes in mode choice.

The congestion of a highway is a measure of the number of vehicles using the highway (the traffic volume) and the maximum number of vehicles the highway was designed to handle (the highway capacity). Capacity of a highway is determined by the geometric design (curve segments), the terrain, traffic composition (cars vs. trucks) and reasonable driver expectations (safe following distance, reasonable speed, general comfort levels, etc.). The table below displays maximum hourly passenger car volumes per hour-per lane expected by highway type.

Maximum Passenger Cars per Hour, per Lane	**Facility Description**
2200	Interstate
1800	6 lane State Route
1800	4 lane State Route
1600	2 lane State Route

Table 5-2

According to the Alabama Department of Transportation (ALDOT), the formula to calculate ***daily capacity*** for a highway is:

$$\frac{\text{(Maximum Passenger cars per hour per lane) X (Number of lanes)}}{\text{Percent Daily Traffic Appearing in the Peak Hour}}$$

The formula for calculating the ***daily volume*** for a highway is:

Daily Volume = AADT + TADT

AADT is defined as the Annual Average Daily Traffic on a highway. TADT is defined as the Truck Average Daily Traffic (AADT * percentage of trucks on highway). The volume of traffic using the highway is adjusted for the impact trucks have on the available capacity of a highway due to the length, acceleration and deceleration characteristics, and general driver reaction. This method is used since all data is taken in terms of passenger vehicles.

The volume to capacity ratio is a standard measure used to quantify congestion. A volume to capacity ratio of 0.75 or greater in a rural area and 0.90 in an urban area indicates a deficient condition (congestion) on that segment of highway, according to ALDOT specifications. The difference in deficiency condition ratios between urban and rural areas is based on driver expectation of congestion. In an urban area travelers expect higher volumes and will tolerate more congested roadways.

The data used to determine volume to capacity ratios on Alabama highways were obtained from the (ALDOT) traffic count database. There are alternative ways to calculate a highway daily capacity and daily volume, however, the ALDOT methodology was selected for simplicity and to maintain consistency with ALDOT forecasting methods.

The Figures 5-4 through 5-8 are output charts from the model. Figures 5-4 and 5-5 indicate current and forecasted traffic volumes compared to true capacity and ALDOT congestion guidelines for Interstates I-20 and I-65. Note that, in both charts, there are areas where current volumes exceed the available ALDOT facility capacity guidelines. Using the forecasted volume created by including specific cluster growth knowledge, the area at or over capacity greatly expands by 2008.

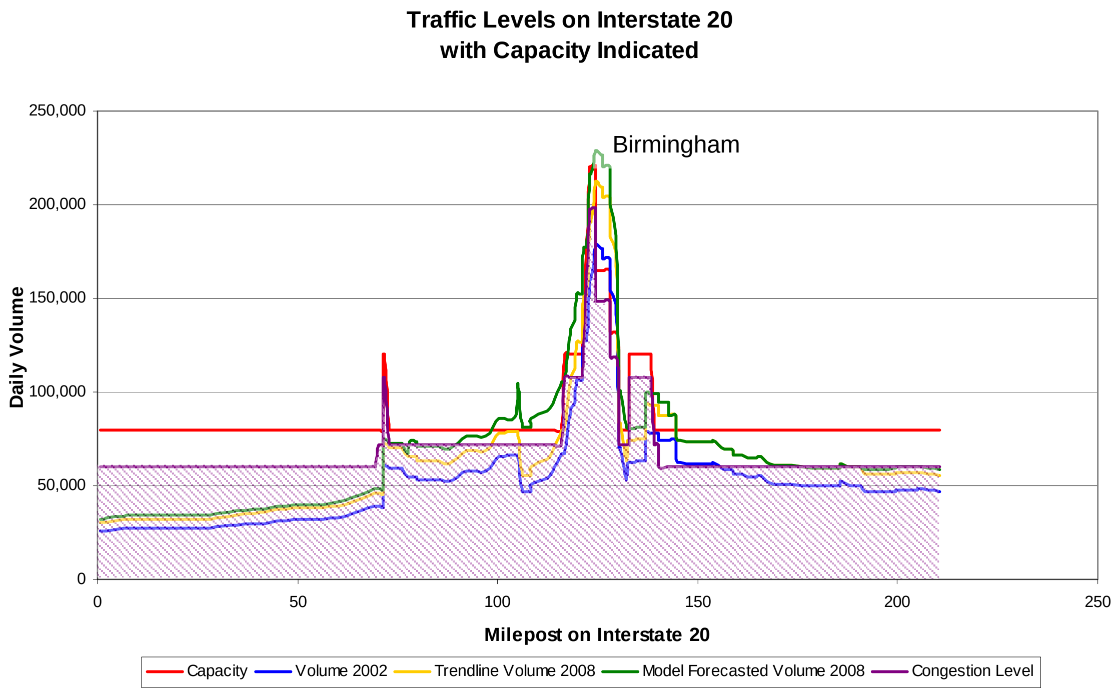


Figure 5-4

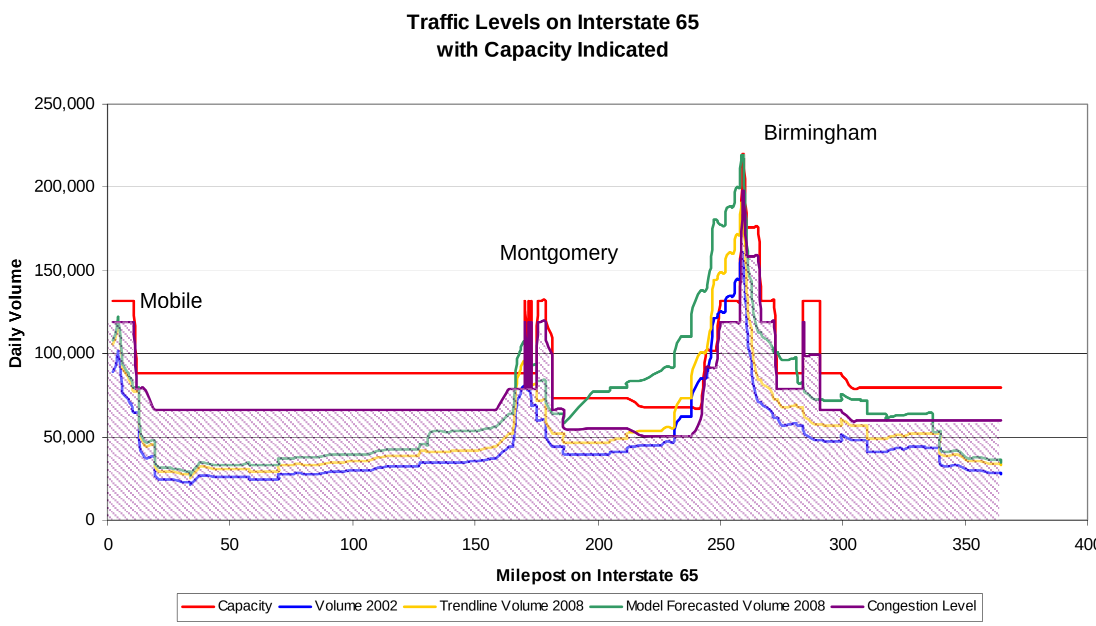


Figure 5-5

The major advantage this modeling methodology provided was the ability to develop future scenarios that were reflective of discrete events where the demand for transportation services would change. For example, the development of a new manufacturing plant in a specific county could be input to the model as a change in employment, which would be reflected as a change in demand for transportation services on that county. The model would then be able to predict the future transportation requirements and allow the user to identify deficiencies in the infrastructure that might need to be addressed to ensure the growth scenario identified is brought to fruition. An example of this is a demonstration utilizing the highway network and the specific growth anticipated in the automotive and aerospace industries in Figures 5-6 through 5-8. Figure 5-6 shows the 2002 levels of congestion on the highway network. In Figure 5-6, the total miles of road considered as congested by the ALDOT capacity guidelines is 455.

Congested Locations 2002
Alabama DOT Volumes

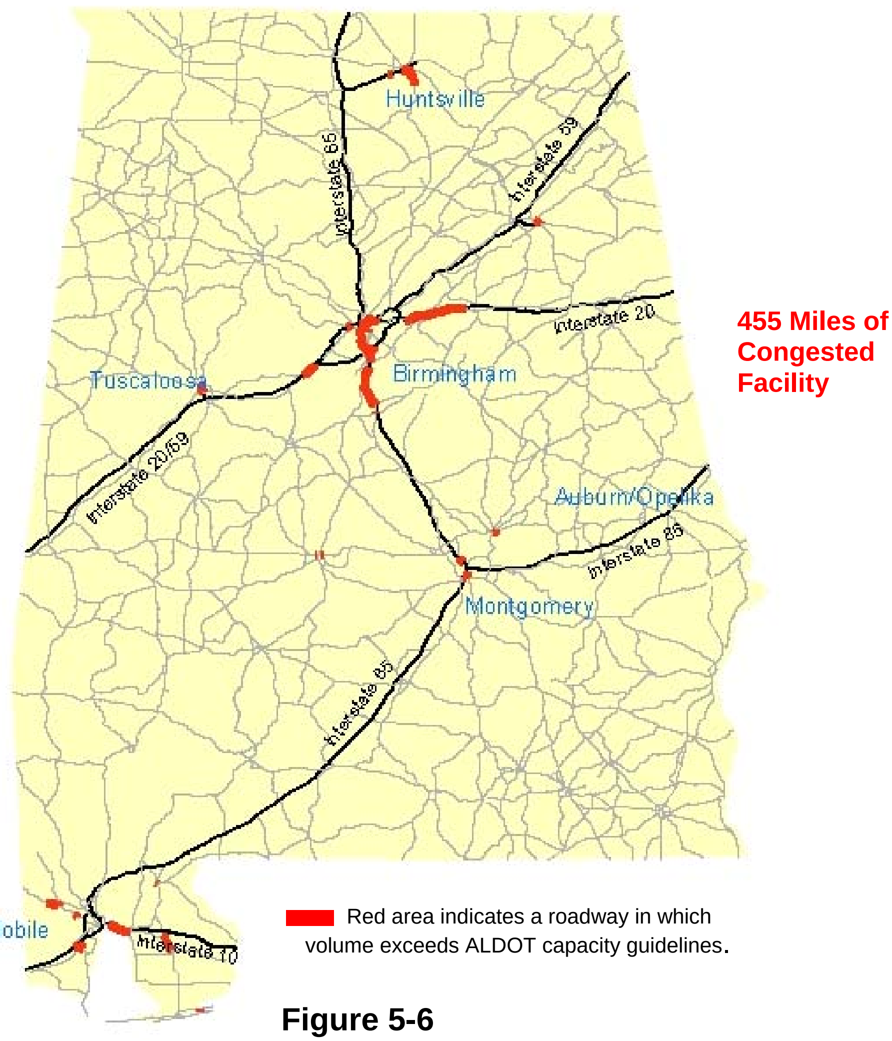


Figure 5-6

Figure 5-7 shows anticipated congestion in 2008 assuming historical economic growth rates, and Figure 5-8 presents the much greater congestion in 2008 arising from the automobile and aerospace industry clusters over the next several years. In Figure 5-7 the total miles of congested roadway is projected to be 1035, a 128% increase over 2002.

Congested Locations 2002
Alabama DOT Volumes

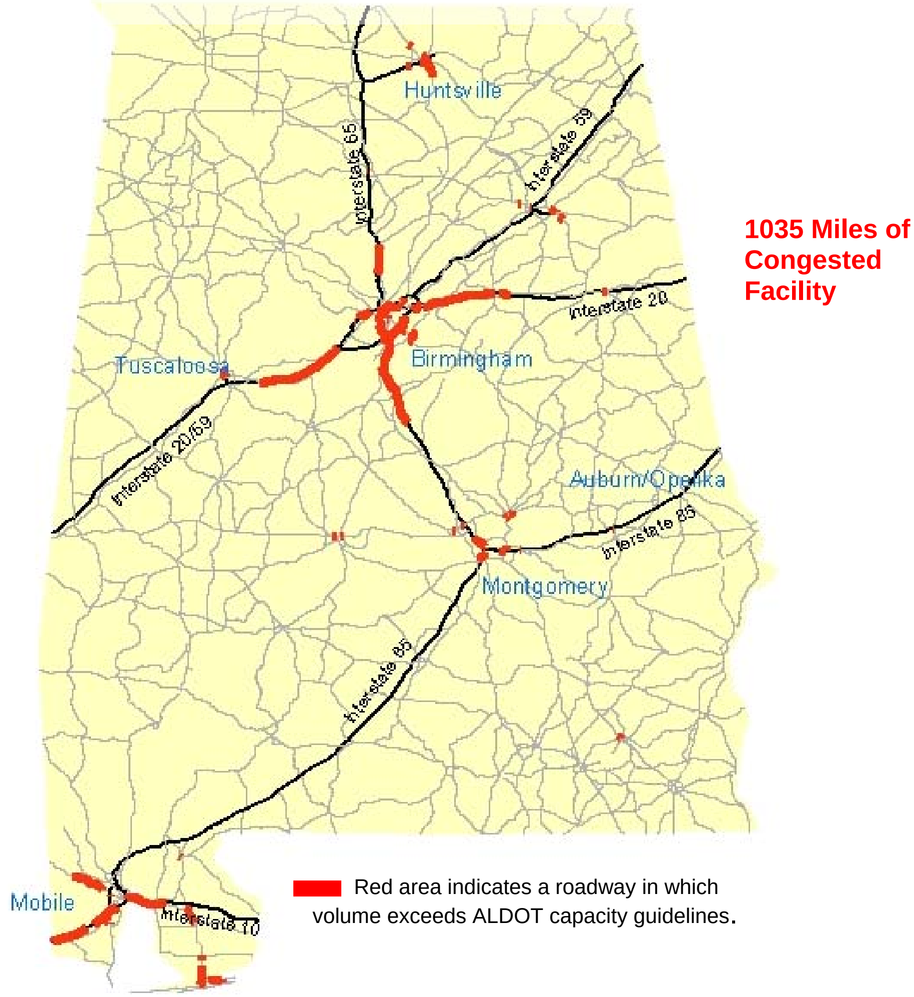
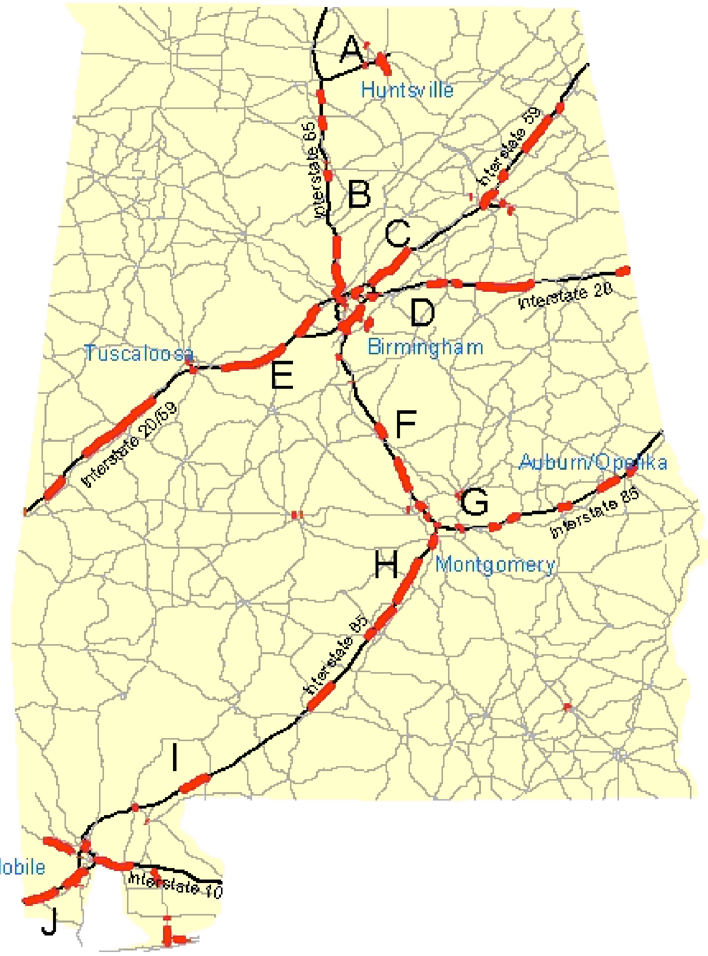


Figure 5-7
Forecast Using Historical Trend Analysis

In Figure 5-8, the total miles of roadway congested is projected to be 1760 miles. This forecast predicts a growth in congested roadways of 287% over 2002. Additionally, the inclusion of specific cluster knowledge in traffic forecasting identified 70% more congested roadway than the historical trend forecasting method (Table 5-2).

Year	Model Methodology	Miles of Congested Highway
2002	Actual Volume of Traffic	455
2008	Historical Trend Analysis Forecast	1035
2008	Industry Cluster Knowledge of Growth Projections	1760

Table 5-3
Model Output of Congested Highway Miles



Map Location	2002 AADT	2008 AADT Historical Trend Forecast	% Increase from 2002 Using Trend Line Forecast	2008 AADT Forecast with Specific Cluster Growth	% Increase from 2002 Using Industry Cluster Analysis
A	57,121	67,842	18.8%	78,577	37.6%
B	48,901	58,080	18.8%	73,494	50.3%
C	29,680	35,251	18.8%	52,885	78.2%
D	61,773	73,367	18.8%	79,853	29.3%
E	53,117	63,087	18.8%	71,112	33.9%
F	43,591	51,773	18.8%	82,589	89.5%
G	84,332	100,148	18.8%	137,207	62.7%
H	34,427	40,942	18.9%	52,735	53.2%
I	26,082	30,978	18.8%	33,165	27.2%
J	53,729	63,814	18.8%	65,314	21.6%

Figure 5-8
2008 Volume to Capacity Ratios with Automotive and Aerospace Cluster Information Included

The construction of the traffic demand model brought forth several observations. First, forecasting traffic based on historical rates and growth is going to leave the state unprepared to deal with infrastructure demands shown in Figures 5-7 and 5-8. In these two depictions of model output, historical growth was applied to Figure 5-7 and knowledge based on specific industry characteristics and growth was applied to Figure 5-8. If traditional methods were used to plan, as shown in Figure 5-7, a severe lack of capacity would develop with little or no warning from the forecasting tools. It is quite apparent that a traffic plan established for a 128% increase in congested roadway would be inadequate for an actual increase of 287%.

An additional issue with forecasting tools comes from the source of data used to prepare the forecast. Traditional freight forecasting models utilize employment and SIC or NACIS codes to calculate freight generated. This method of forecasting does not take into consideration the productivity improvements implemented by a company to improve the competitiveness of the organization. Productivity improvement can result in an increase in production with the same number of employees or the same production with fewer employees. In either instance the traditional forecasting methods will understate the freight requirements. This leads to the realization that employment and industry codes are not adequate predictors of freight need generation in a region.

Another finding from the modeling effort was that the lead time to add capacity to Alabama's transportation infrastructure is often longer than the time period by which the infrastructure will be at, and over, capacity. There needs to be substantial effort made to investigate alternatives to building capacity.

Conclusions

Output from the modeling effort indicates that a capacity issue is looming on Alabama interstate highways. Figures 5-9 through 5-13 suggests that a significant portion of each major interstate in Alabama will experience congestion in the next 5 years. It is important to start now to address these coming issues.

One of the primary uses for the transportation model is to predict changes in the transportation network that would result from industries either relocating to Alabama or developing within the state. The main factors affecting the network are assumed to be the volume of incoming and outgoing freight, the mode or modes of transportation utilized, and the origin or destination of the freight. Data from the industries surveyed can be used to forecast these parameters for future developing industries. These predictive relationships will be of particular interest to local communities seeking to attract new industries. In addition to the traditional analysis on the local economy, a detailed transportation analysis can be done to determine the effect of various types of industries on the local, existing infrastructure. Communities could then target those industries that would create economic growth and have the least amount of negative impact on the local transportation infrastructure.

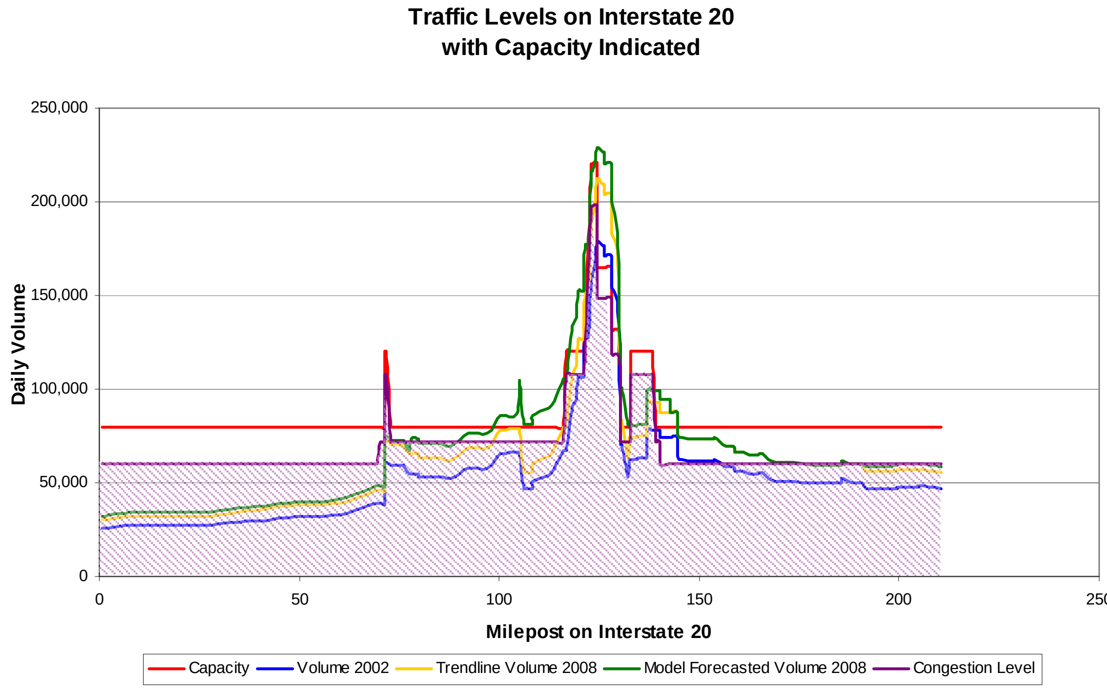


Figure 5-9
Traffic Levels on Interstate 20 With Capacity Indicated

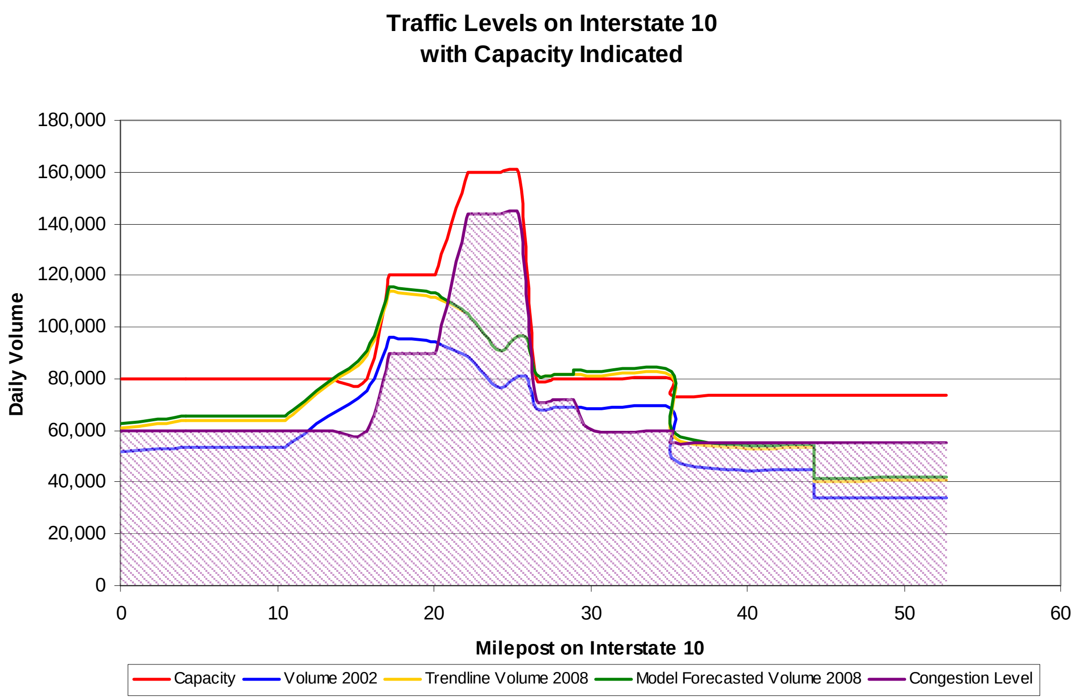


Figure 5-10
Traffic Levels on Interstate 10 With Capacity Indicated

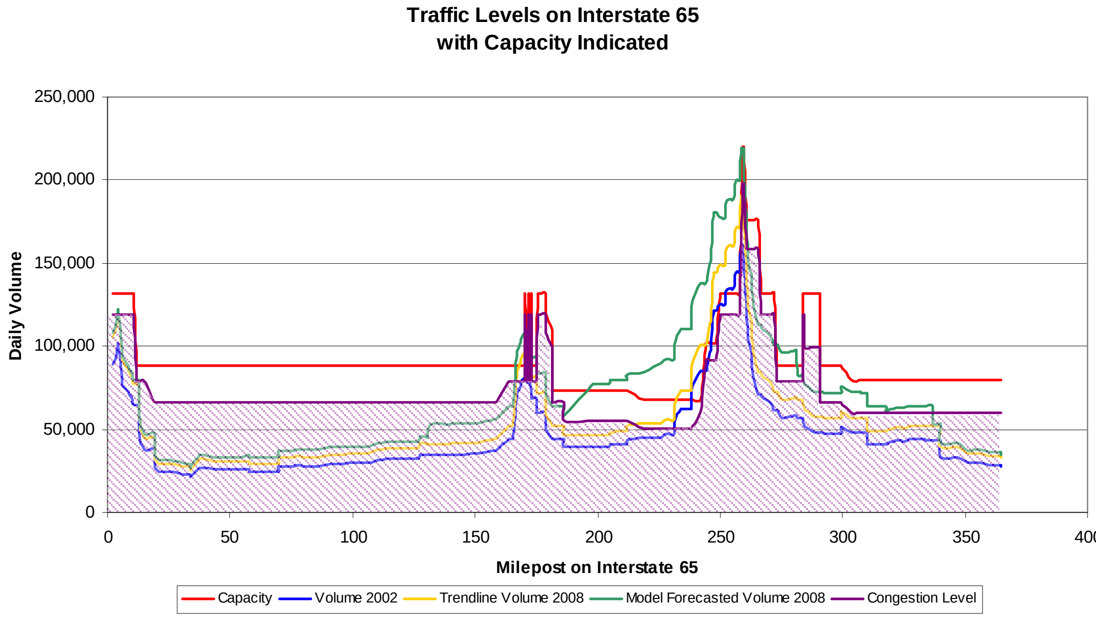


Figure 5-11
Traffic Levels on Interstate 65 With Capacity Indicated

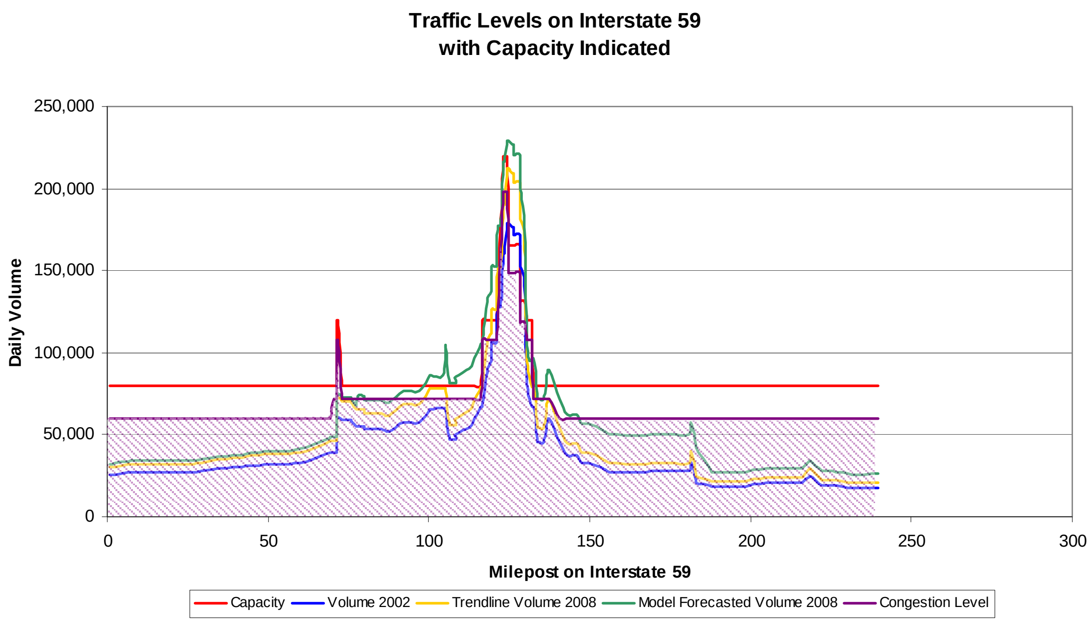


Figure 5-12
Traffic Levels on Interstate 59 With Capacity Indicated

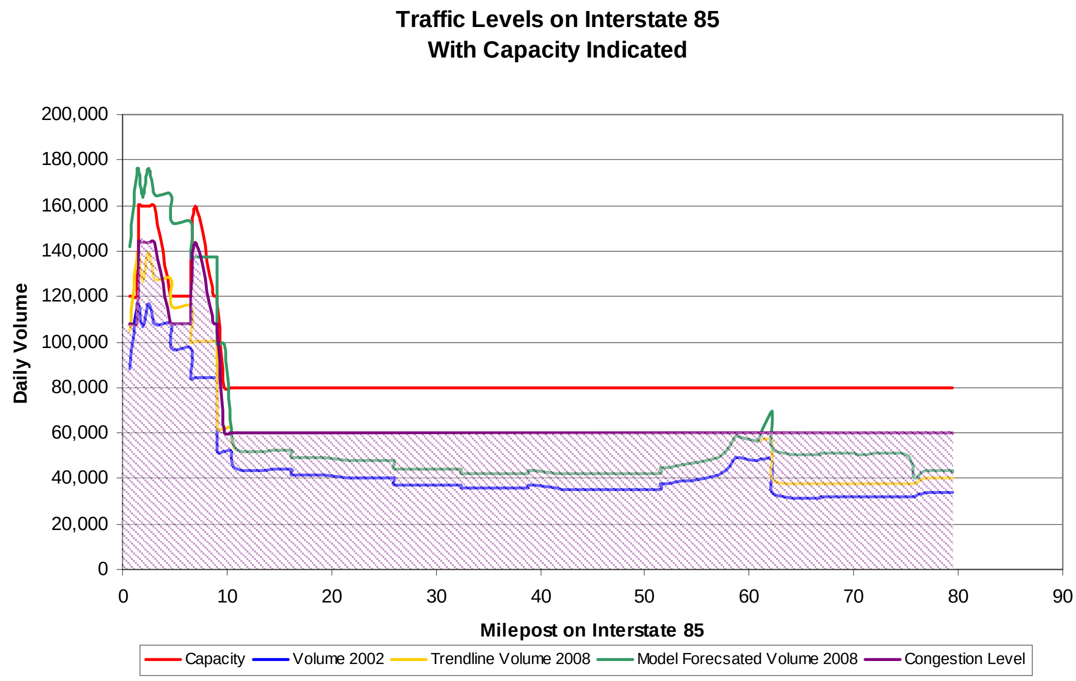


Figure 5-13
Traffic Levels on Interstate 85 With Capacity Indicated

The ability to forecast and model freight transportation is important to understanding the relationship between infrastructure and economic activity. The data collected and model presented here is an important first step to assisting decisions makers in addressing the needs of businesses and understanding how transportation infrastructure decisions can improve or discourage a cohesive business environment. Future efforts must include examining the business data to determine how transportation infrastructure decisions affect travel mode. The existing forecasting tool only examines the effect of the freight moving to and from a specific business. It does not incorporate the “trickle down” effect a new industry would have on the local economy. Extensions of this model would need to incorporate a multiplier to include the increase of transportation related to the growth of the local economy stemming from the new industry.

The application of the urban transportation planning model provided a tool to improve the ability to forecast freight transportation needs in the state. The model proved superior to the trend line analysis because of the ability to account for plant openings and discrete changes in the industrial landscape of the state. However, the model was limited in its ability to incorporate the entire universe of economic and social changes that influence freight transportation. The future improvements to the model need to focus on obtaining a better understanding of the relationships between productivity and freight transportation needs, and ultimately, understanding the universe of external factors that cause industry growth and development.

6. Conclusions and Recommendations

Alabama infrastructure requires substantial financial resources for improvement and maintenance. It is imperative that funding for the Alabama Department of Transportation be increased to meet the needs of future economic growth. With the problems and opportunities facing Alabama, it is especially important that funding be preserved and not diverted from ALDOT for non-transportation related projects as frequently happens.

Insights and revelations as to the true nature of freight and transportation modes were made during the course of this research. Freight movement by truck on Alabama highways in continuing to grow, railroads are filling their capacity, air freight is growing and waterborne freight is declining.

The automotive industry relies heavily on trucking as the preferred method of freight movement and there are no indications that this preference is going to change. Figure 6-1 shows the location of automotive companies in Alabama. Of note is the clustering of the automotive industry along interstates, major highways and around urban areas, contributing to the congestion in those areas.

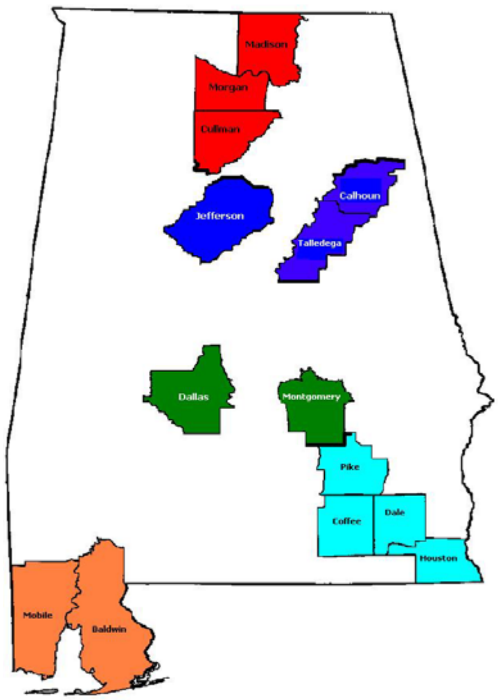
Automotive Companies In Alabama

Source: Alabama Automotive Manufacturing Association, Compiled by University of Alabama Huntsville Office for Economic Development

Figure 6-1

Automotive Companies in Alabama

The Aerospace industry in Alabama is composed of two distinct types: military/space and commercial sectors. These two components are distinct in terms of the workforce required, facilities and freight requirements. In its current configuration, the aerospace industry does not put undue strain on the transportation infrastructure in the state. Most of the aerospace industry freight is domestic in origin and destination, with the volume of freight being low relative to other industry clusters. The aerospace industry growth seems to be focused in the counties that already contain aerospace companies and is not expanding throughout the rest of the state (Figure 6-2).



Region #1
(Madison, Morgan, Cullman Counties)
66.7% of total aerospace jobs in the state
Region #2
(Calhoun, Jefferson, Talladega Counties)
5.7% of total aerospace jobs in the state
Region #3
(Montgomery, Dallas Counties)
8.0% of total aerospace jobs in the state
Region #4
(Dale, Pike, Coffee, Houston Counties)
12.3% of total aerospace jobs in the state
Region #5
(Mobile, Baldwin Counties)
6.7% of total aerospace jobs in the state
Rest of State
<1% of total aerospace jobs in the state

Source: Alabama Aerospace Industry 2002: Industry Survey Report

Figure 6-2
Counties with Aerospace Companies

In performing this research it was observed that most industries are not pursuing alternative modes of freight transportation. In almost all instances, the mode of freight transportation is focused on optimizing the freight movement within the mode rather than optimizing the “system” of freight movement. Since the different modes of transportation do not work together to efficiently move freight through the system, the result is a less than optimized movement of product from manufacturer to customer. The metrics and incentives for the different modes of freight movement do not currently provide incentive for freight modes to work together for the most efficient and effective movement of freight. Adding to the pressure on the system is the increase in international transportation that has come as a result of NAFTA.

Congestion is a reality in Alabama today and will become a greater part of the life of Alabamians in the near future. Figure 6-3 is a graph indicating the capacity of Interstate 65 with lines showing 2002 actual volumes by mile, a 2008 forecasted volume based on historical trends and a 2008 forecast constructed with specific knowledge of the automotive and aerospace clusters growth incorporated. As the chart shows, the amount of I-65 where volume is greater than capacity will continue to grow, causing slow commutes, extended delivery times and greater pressure for Just-In-time deliveries.

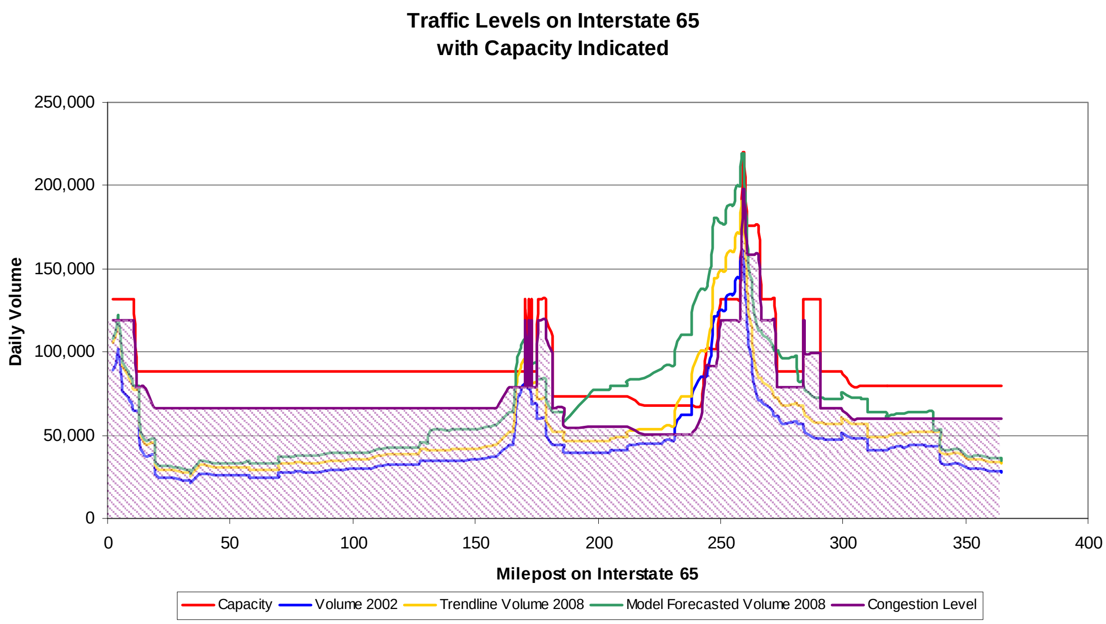


Figure 6-3

During the construction of the traffic demand model several observations were made. One of the first revelations was that forecasting traffic based on historical rates and growth is going to leave the state unprepared to deal with the infrastructure demands. This can be seen on Figure 6-4 where historical growth was applied to the chart on the left and knowledge based on specific industry characteristics and growth was applied to the chart on the right. If traditional methods were used to plan, severe congestion would develop with little or no warning from the forecasting tools.

An additional issue with forecasting tools comes from the source of data used to prepare the forecast. Traditional freight forecasting models utilize employment and SIC or NACIS codes to calculate freight generated. This method of forecasting does not take into consideration the productivity improvements that a company implements to improve the competitiveness of the organization. This can result in an increase of production with the same number of employees or the same production with fewer employees. In either instance the traditional forecasting methods will understate the freight requirements. This leads to the realization that employment and industry codes are not adequate predictors of freight need generation in a region. The better the data is that can be included in the model, the better the model will be able to replicate reality.

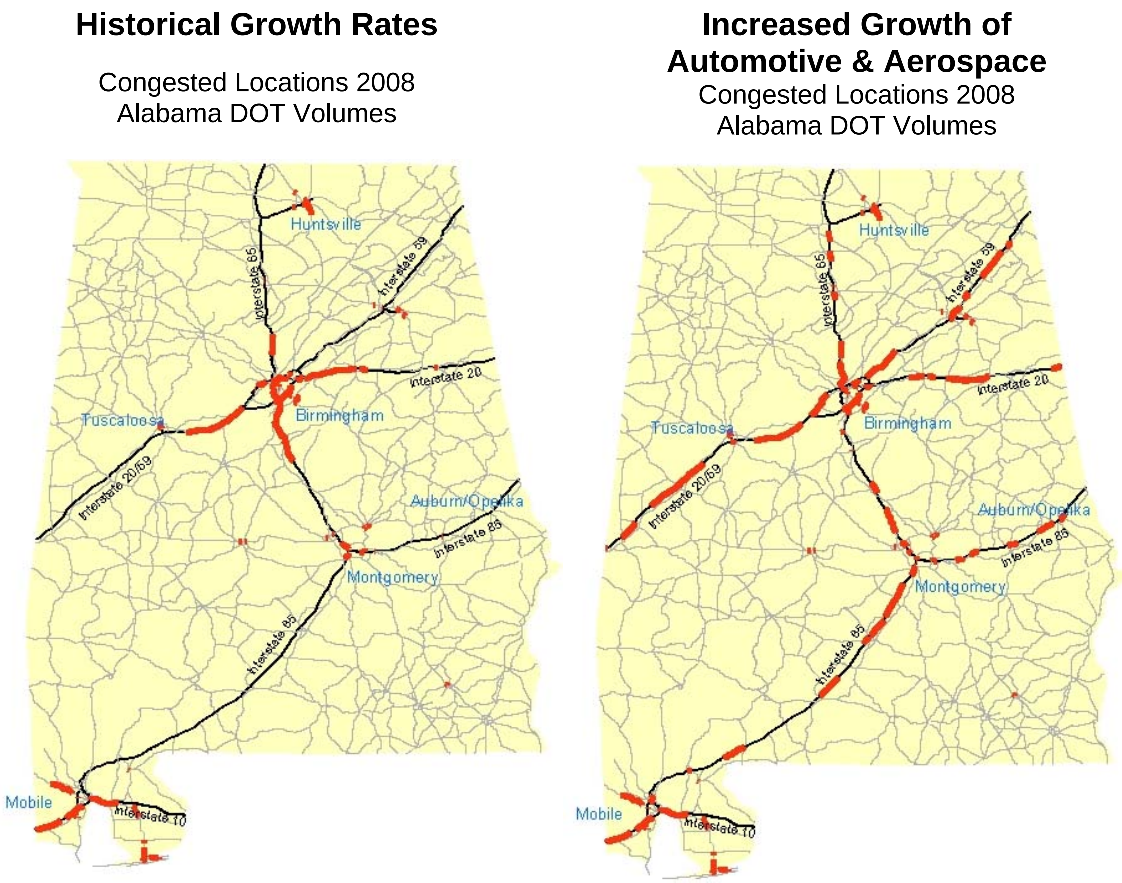


Figure 6-4

An additional finding from the modeling effort in this research was that the lead time to add capacity to Alabama's transportation infrastructure is longer than the lead time when the infrastructure will be at, and over, capacity. It is not going to be possible from a physical or fiscal standpoint to build our way out of the coming traffic congestion problems. There has not been sufficient effort made to investigate alternative answers to building capacity.

The Port of Mobile is positioning itself to be a major player in the container freight business in addition to being a major port for bulk materials. The issue is going to be how to move the freight out of the Mobile area in such a way as to not cause significant traffic congestion that eventually impedes economic growth. The waterways in Alabama are very underutilized. There seems to be a belief by the waterway shipping enterprises that it is not possible to support a Just-In-Time manufacturing environment with inland waterway shipping. There is not currently a Third Party Logistics (3PL) service provider that works using the waterways of Alabama as the preferred mode of transportation. Alabama has abundant natural resources in the Port of Mobile and the inland waterway system but has not yet been able to fully utilize them to enhance economic growth.

The railway system in Alabama is extensive yet it lacks a north-south intermodal track. With all north-south rail designated for merchandise, it can take longer for a container to get from Mobile to Huntsville than it takes a container to get from Long Beach, California to Huntsville. To designate a track as intermodal, the railroads want assurance of a certain amount of freight (usually 50 to 70 containers per day) but manufacturers want the assurance of intermodal time definite delivery before they will commit to the freight volume. The railroads are currently functioning at their believed capacity, and have no incentive to increase that capacity. The situation is a model Catch-22.

Alabama is in a unique position to benefit from an increase in the globalization of trade. But to take full advantage of this opportunity, it is important that a systems approach be taken in the evaluation and understanding of the transportation infrastructure. By evaluating and acting on the transportation network as a functioning, interacting system, Alabama can become the Freight Gateway to Mid-America.

An initial part of understanding how this system functions is to discover the freight characteristics related to industry clusters and how those clusters generate freight. This information should be used to develop a freight forecasting tool that is specific to the clusters located in a region. The information used to fuel the forecasting tool will have to include the ratio at which supplier shipments are generated per shipment to the final assembly location.

It is important that the understanding of the industry clusters developed during the course of this research be continued and enhanced. The automotive and aerospace industries are vital parts of the Alabama economy and periodic surveys will be necessary to stay abreast of the growth and impact. This process should be expanded to include additional industry clusters in the state. Not only is an understanding of the growth of the industry important but additional information specific to industry clusters can be acquired and used to enable growth.

To better understand the transportation needs of particular industries it is also important to identify the manufacturing characteristics of companies in an industry cluster. Whether the company is involved in mass production or one of a kind prototype production will have an effect on the freight the manufacturer generates. Discovering the factors that contribute to the choice of transportation mode will be needed to develop educational tools and incentives to encourage producers to ship products on less utilized modes. To become the Freight Gateway to Mid-America, Alabama will need to develop non-infrastructure solutions such as traffic flow controls, accident clearing, more efficient cargo movement planning and scheduling. To manage the freight network as the gateway to middle America it will be necessary to develop an appropriate set of metrics for measuring system performance.

Rural areas of the state pose a particular set of problems to be addressed. As the research team found in surveying manufacturers in rural Alabama, the infrastructure needed in these areas cannot be judged in the same manner as infrastructure needs in metropolitan areas of the state. The feasibility of establishing a rural transportation planning department should be evaluated with the Alabama Department of Transportation. This would require an organizational assessment that will identify how such a department would fit into the existing or new structure. A project to identify key steps needed to establish a state policy on rural transportation planning using Georgia and Florida state models should be undertaken. To generate the momentum needed to make this type of change will require potential champions in the state legislature to push rural policy initiatives to be identified and educated in the merits of the proposal.

The key to economic development in rural Alabama is the development of entrepreneurial activity that aligns with the strengths of the region. This research recommends that a feasibility study of a rural intermodal center that would utilize the resources of waterways, rail and highways to efficiently and effectively facilitate the movement of freight into and from Mid-America be conducted and a plan for development of the idea be implemented. This idea will put to use the available workforce and bring job creation and wealth creation to an area of Alabama that desperately needs such an infusion of hope.

The ports in Alabama will need to create a culture of continuous improvement within an environment where this kind of thinking has not been supported in the past. Both the Alabama State Port Authority and the Huntsville Madison County Airport Authority have taken steps in that direction. The Port of Mobile, McDuffie Island Coal Terminal is well on its way to becoming the preeminent coal handling facility in North America. The Intermodal facility in Huntsville has the plan and the facilities and operations in place to become one of the largest and most efficient operations in the country. These efforts should be fully funded and supported by the state and the management of the respective organizations. A study of the waterways in Alabama should be initiated to determine the efficiency and operating constraints of the waterway lock and dam system and the operating parameters by which it is managed.

The key to creating an Alabama transportation infrastructure that is the destination of choice for shippers of product is to fully develop a system dynamics model by which decisions can be simulated and returns on the proposed changes be evaluated. This model would use many of the items described above and take into account the variability of real world actions. Some specific recommendations are:

Establish Freight Demand Functions Based Upon Industry Clusters

The forecasting of freight traffic is commonly performed by estimating truck traffic as a percentage of a forecast for overall traffic flow. The percentage of truck traffic used in the forecast is calculated by randomly sampling a segment of overall highway traffic. This is a very indirect method for forecasting freight and essentially separates the forecast from the specifics of the underlying industry and any specific changes or growth in the industry mix. A direct freight forecast based upon industry economic activity offers an improvement to the forecast based upon a percentage of overall traffic flow. This project would establish a more direct relationship between the major traded industry clusters in a region and the freight traffic generated as a result of that cluster activity. Both gross cluster product and the number of cluster employees should be investigated as indicators of cluster economic activity in the relationships for forecasted freight traffic. The result will be a methodology to build a forecast based upon the traded cluster makeup of the region and the ability to more accurately forecast demand on the infrastructure created by economic growth and industry recruitment.

Impact of Modern Supply Chain Strategies on Freight Traffic

Many industries in the U.S. are heavily focused on reducing waste, improving efficiencies and increasing return on assets. Supply chain strategies are increasingly being used to achieve these goals. For example, excess inventory is a waste and an unnecessary financial asset. Companies are increasingly turning to Just-In-Time delivery in order to reduce inventories. The frequent deliveries, often multiple times a day for large assembly plants, increases truck traffic on a daily basis. Similarly, demand for precise deliveries often results in less than truck load deliveries, again increasing truck traffic. On the other hand, vendor managed inventory facilities located in close proximity to manufacturing facilities, reduces inventory owned by the manufacturer as well as reducing traffic flow. A project to develop a multi-stage (customer, distributor, manufacturer, first, second and third tier suppliers) system dynamics model of the supply chain should be undertaken. The model would be used to develop estimates for truck traffic based upon alternative supply chain and inventory management policies including JIT (just-in-time) and VMI (vendor managed inventory). The result will be used in the development of an Alabama Transportation Infrastructure Model and a long-term system dynamics model.

Develop an Intermodal Traffic Simulation Model for Alabama

The highway traffic model developed in 2004 calculated a deterministic “snapshot” of average traffic flow during a day. Peak traffic flows were estimated based upon ratios to average flow. The model incorporated no interrelationships between modes of shipping, i.e., truck, rail, air or water. The Alabama Transportation Infrastructure Model (ATIM) will overcome many of the limitations of the earlier model. The proposed model would be a discrete simulation that will create traffic flows over a twenty-four hour day. Automobile traffic and truck traffic will be independently calculated and used to simulate overall traffic flows. The model should also incorporate dynamics between modes of shipping. The ATIM would be stochastic in that it would incorporate the random variation inherent in transportation systems as well as the complex interactions of how freight moves over the transportation network and through intermodal connector points.

The ATIM could be used to estimate how changes in the network or changes in utilization of network components will impact the performance of the overall transportation system and effectively communicate the expected performance of system investment alternatives through powerful visualization and animation presentations. ATIM outputs would include the transportation mode freight movement by system segment and time of day, the ability to perform "What-If" scenarios that can be compared to determine cost/benefit analysis and the ability to highlight problem areas by time of day providing an understanding peak demand system needs.

Figure 6-5 shows the relationships between the major components of the ATIM which would be used to "model" transportation in Alabama. The discrete simulation tool could be used to model the transportation network for Alabama, simulate the vehicle routing in the state, identify most likely near term choke points at Freight Gateways in Alabama's transportation network, evaluate opportunities and limitations for barge and rail shipment of containers, and generate performance measures for the Alabama transportation infrastructure. The ATIM would also provide input to the system dynamics model of Alabama infrastructure.

Relationships Between Major Components of the ATIM

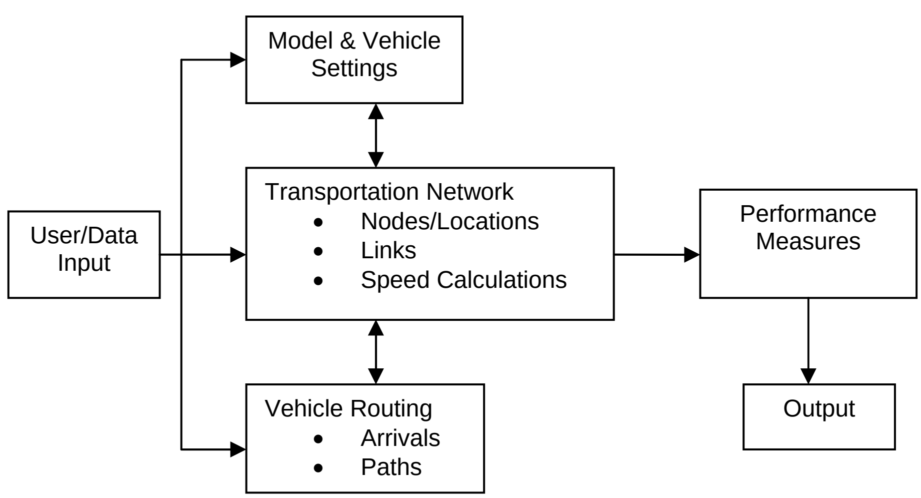


Figure 6-5

Determine the Infrastructure Requirements of Targeted Industry Clusters

This project would determine the infrastructure requirements of targeted industry clusters and develop economic payback models of improvement scenarios. Identify interrelationships among specific cluster growth rates and input factors (tax and incentive policy, shipping requirements, workforce needs, etc.). This would also provide information to the system dynamics model of Alabama infrastructure.

Analyze the Dynamics of Changing Freight Mode

It is necessary to understand and examine the factors that cause a company to review and change their existing mode of shipping freight. The key variables that influence a company to switch freight modes would be incorporated into model equations. Delays, constraints, and limitations to intermodal shifts should be identified. The result of this project would provide input components to the system dynamics model of Alabama infrastructure.

Development of Preliminary System Dynamics Model of the Alabama Transportation Infrastructure

The highway traffic model developed in 2004 provided a calculated average snapshot of highway traffic for a day for the interstate and secondary highways of Alabama. Alternative assumptions for economic growth could be used to generate snapshots of future congestion. This model, however, did not show variation during the day nor did it include other forms of transportation and shipping. The ATIM model described above would simulate all forms of shipping and transportation during a twenty four hour day. This would allow investigation of peak congestion and impacts of network and infrastructure improvements. Neither of these models however has the ability to examine the long-term interaction between a state's economy and the transportation infrastructure. These dynamics are influenced by several long-term feedback loops that interact, influence, and in many ways determine the evolution of a state's well being. One positive feedback loop is the dominant loop identified for cluster growth: as a cluster grows, support resources such as workforce, knowledge base, etc. also increase, thereby supporting continued growth of that cluster. Silicon Valley, Boston and Austin are often cited as examples of cluster growth. On the other hand, traffic congestion is often cited as a constraint to cluster growth. This negative loop arises from cluster growth leading to traffic and congestion and thus inhibiting future industry growth. Another set of dynamic interrelationships involve growth, tax revenues, and future infrastructure improvements to ease congestion. Policies affecting transfer of freight from truck to rail or water can also have multiple impacts through the various relationships, both on highway traffic and the economy. In this project a preliminary system dynamics model that will quantify these interrelationships and develop long-term outlooks for the Alabama economy based on alternative investments in infrastructure will be developed.

In the USDOT strategic plan the following statements can be found:

"Americans have built a vast and highly productive network of transportation assets based on the strengths of individual modes – air, marine, highway, transit and rail. Now, our challenge is to become the architects of the future blending these separate constituencies into a single, fully coordinated system – one that connects and integrates the individual modes in a manner that is at once safe, economically efficient, equitable, and environmentally sound."[1]

"By the year 2020, U.S. foreign trade in goods is expected to grow by more than half its current tonnage. Major congestion that now occurs in and around marine ports and terminals at specific points and times will increase. DOT must have new policies and programs in place to be prepared for this projected increase in trade."[2]

During the conduct of this research by the Office for Infrastructure, Logistics and Transportation at UAH, the truth of the statements from the DOT Strategic Plan were made evident. To manage the effect of increased global trade, Alabama and the rest of the U.S., must begin to look at the movement of freight as a system of interconnected resources that can be flexible and efficient enough to move freight when it needs to be moved, to where it needs to be taken and at a cost that can sustain the network and not add unnecessary expense.

7. References

Executive Summary

1. Hutcheson, Jim, Gregory A. Harris, and Jeff Thompson. "Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry." Alabama Automotive Industry Association Quarterly Meeting. Huntsville, May 20, 2004.

2. "Intermodalism: Moving America's People and Goods." *Subcommittee on Highways and Transit,* June 18, 2002. <http://www.house.gov/transportation/highway/06-18-02/06-18-02memo.html> (23 February 2005).

3. "Alabama Transportation Profile." *Bureau of Transportation Statistics,* 2002. <http://www.bts.gov/publications/state_transportation_profiles/alabama/pdf/entire.pdf>.

4. *Traffic AADT Database.* Montgomery: Alabama Department of Transportation, 2002. Database on CD-ROM.

5. "Railroad Service in Alabama." *Association of American Railroads,* 2002. <http://www.aar.org/PubCommon/Documents/AboutTheIndustry/RRState_AL.pdf?states=RRState_AL.pdf>.

6. *Alabama Transportation Profile*.

7. "Air Carrier Statistics (Form 41 Traffic)." *Intermodal Transportation Database, Bureau of Transportation Statistics,* 2004. <http://www.transtats.bts.gov/Tables.asp?DB_ID=110&DB_Name=Air%20Carrier%20Statistics%20%28Form%2041%20Traffic%29&DB_Short_Name=Air%20Carriers>.

8. Brown, Thomas R., Anthony B. Hatch. "The Value of Rail Intermodal to the U.S. Economy." *Association of American Railroads,* September 19, 2002. <http://www.aar.org/pubcommon/documents/govt/brown.pdf >.

9. "Annual Estimates of the Population for Counties of Alabama." *Population Division, U.S. Census Bureau*, April 9, 2004. <http://www.census.gov/popest/counties/tables/CO-EST2003-01-01.pdf>.

10. Killingsworth, William R., and Matthew J. Faulkner. *Industry Cluster Analysis For Alabama.* Huntsville: University of Alabama Huntsville Office for Economic Development, November 21, 2003.

11. *Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry.*

12. Spann, Mary S. *Alabama Aerospace Industry 2002: Industry Survey Report.* Montgomery: Alabama Department of Economic and Community Affairs, September 2002.

13. “U.S. Department of Transportation Strategic Plan 2003 – 2008.” *U.S. Department of Transportation,* September 2003. <http://www.dot.gov/stratplan2008/strategic_plan.htm#_Toc52257027>.

Chapter 1

1. Hutcheson, Jim, Gregory A. Harris, and Jeff Thompson. "Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry." Alabama Automotive Industry Association Quarterly Meeting. Huntsville, May 20, 2004.

2. “Intermodalism: Moving America’s People and Goods.” *Subcommittee on Highways and Transit,* June 18, 2002. <http://www.house.gov/transportation/highway/06-18-02/06-18-02memo.html> (23 February 2005).

3. Killingsworth, William R., and Matthew J. Faulkner. *Industry Cluster Analysis For Alabama.* Huntsville: University of Alabama Huntsville Office for Economic Development, November 21, 2003.

Chapter 2

1. “Railroad Service in Alabama.” *Association of American Railroads,* 2002. <http://www.aar.org/PubCommon/Documents/AboutTheIndustry/RRState_AL.pdf?states=RRState_AL.pdf>.

2. “Alabama Transportation Profile.” *Bureau of Transportation Statistics,* 2002. <http://www.bts.gov/publications/state_transportation_profiles/alabama/pdf/entire.pdf>.

3. Ibid.

4. Army Corps of Engineers. Interview by author, July 28, 2004, Huntsville. Phone Conversation.

5. “What's At Stake! Help Protect America's Water Resources.” *National Wildlife Federation,* March 16, 2004. <http://action.nwf.org/campaign/water20040316/explanation>.

6. *Alabama Transportation Profile.*

7. "Alabama State Port Authority: Development Master Plan Choctaw Point Terminal." Mobile, AL: Moffatt & Nichol Engineers, May 2002.

8. "U.S. Department of Transportation Strategic Plan 2003 – 2008." *U.S. Department Of Transportation,* September 2003. <http://www.dot.gov/stratplan2008/strategic_plan.htm#_Toc52257027>

Chapter 3

1. "Annual Estimates of the Population for Counties of Alabama." *Population Division, U.S. Census Bureau*, April 9, 2004. <http://www.census.gov/popest/counties/tables/CO-EST2003-01-01.pdf>.

2. Stanley, Karen, and Lauren Jennings. "The Role of Infrastructure on Economic Development in Rural Alabama." Huntsville: University of Alabama Huntsville Office for Economic Development, January 2005.

3. Ibid.

4. Ibid.

Chapter 4

1. Killingsworth, William R., and Matthew J. Faulkner. *Industry Cluster Analysis For Alabama.* Huntsville: University of Alabama Huntsville Office for Economic Development, November 21, 2003.

2. Ibid.

3. Porter, Michael E. "Clusters and Regional Competitiveness: Recent Learnings." International Conference on Technology Clusters. Montreal, November 7, 2003.

4. Ibid.

5. Killingsworth, William R., and Matthew J. Faulkner. *Industry Cluster Analysis For Alabama.* Huntsville: University of Alabama Huntsville Office for Economic Development, November 21, 2003.

6. Ibid.

7. Hutcheson, Jim, Gregory A. Harris, and Jeff Thompson. "Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry." Alabama Automotive Industry Association Quarterly Meeting. Huntsville, May 20, 2004.

8. Harris, Gregory A., Jim Hutcheson, Lauren Jennings, and Jeff Thompson. “Alabama’s Aerospace Industry Transportation Survey 2004.” Huntsville: University of Alabama Huntsville Office for Economic Development, November 2004.

9. Spann, Mary S. *Alabama Aerospace Industry 2002: Industry Survey Report.* Montgomery: Alabama Department of Economic and Community Affairs, September 2002.

10. Spann, Mary S., Gregory A. Harris, and Laura A. Lee. *Alabama’s Automotive Manufacturing Industry 2003: Employment, Growth and Opportunities.* Huntsville: Alabama Automotive Manufacturing Association, June 2004.

11. Ibid.

12. Ibid.

13. *Alabama Aerospace Industry 2002: Industry Survey Report.*

14. Ibid.

15. Ibid.

Chapter 5

1. Anderson, Michael D., Rajeev Seetharam, and Alisha D. Youngblood. *A Demand Model for Intermodal Travel in the State of Alabama.* Huntsville: Huntsville Simulation Conference, October 20, 2004.

Chapter 6

1. “U.S. Department of Transportation Strategic Plan 2003 – 2008.” *U.S. Department Of Transportation,* September 2003. <http://www.dot.gov/stratplan2008/strategic_plan.htm#_Toc52257027>

2. Ibid.

8. Appendices

Reports

Alabama's Aerospace Industry Transportation Survey 2004
http://www.uaheconomicdevelopment.org/pdfs/28.pdf

Alabama Aerospace Industry 2002: Industry Survey Report
http://www.uaheconomicdevelopment.org/pdfs/27.pdf

Alabama's Automotive Manufacturing Industry 2003: Employment, Growth and Opportunities
http://www.uaheconomicdevelopment.org/pdfs/32.pdf

Industry Cluster Analysis for Alabama

Automotive Manufacturing Improvements Network of Alabama (AMINA) 2004 Report
http://www.uaheconomicdevelopment.org/pdfs/30.pdf

A Demand Model for Intermodal Travel in the State of Alabama
http://www.uaheconomicdevelopment.org/pdfs/37.pdf

The Role of Infrastructure on Economic Development in Rural Alabama
http://www.uaheconomicdevelopment.org/pdfs/40.pdf

Presentations

Alabama's Aerospace Industry 2002
http://www.uaheconomicdevelopment.org/pdfs/29.pdf

Alabama Automotive Manufacturing Industry 2003: Preliminary Projection of Transportation Needs Created by the Growing Alabama Automotive Industry
http://www.uaheconomicdevelopment.org/pdfs/33.pdf

Alabama's Automotive Manufacturing Industry 2003: Employment, Growth and Opportunities
http://www.uaheconomicdevelopment.org/pdfs/20.pdf

Transportation Infrastructure in Alabama: Meeting the Needs for Economic Growth