CADDO PARISH REGIONAL WATER/UTILITY DISTRICT
Master Plan
FINAL REPORT
Phase III Development and Evaluation of Future Growth Scenarios
Caddo Parish
Shreveport, Louisiana

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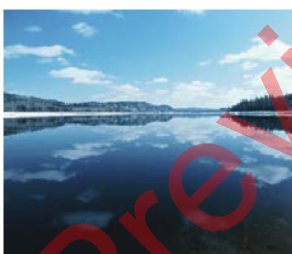

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Phase III Development and Evaluation of Future Growth Scenarios

1.0 *Introduction*

The Regional Water/Utility Master planning process is based on many factors. Each of these must be understood before recommendations for future plans can be made. Phases I and II covered the details of the available water resources and existing water facilities. This phase will cover the elements which impact future growth and will analyze the various scenarios which can be used to calculate future water demand.

This section will analyze the impacts of land use, historical water use data, economic growth, transportation corridors and the most significant determinate, population growth, to estimate future water demands for Caddo and Bossier Parish.

1.1 Population Growth

Population projections are utilized by a variety of organizations and provide data which offers many applications. A few examples are provided in the following list.

1. The health care industry utilizes projections to identify areas with heavy growth in elderly population.
2. The commercial industry uses projections to identify a particular customer base.
3. Population projections can be used by economic development groups to identify elements related to job demand.
4. State and local governments use population projections for planning and funding of services, such as, water, wastewater and other utilities.

The importance of demographic trends can be expressed on a global, national and local level. Population growth can impact the earth's natural ability to supply food, a nation's ability to provide education, and a parish's requirement for infrastructure improvements. Population growth estimates are often used to justify the planning of projects such as roads, subdivisions, parks, shopping centers and utility improvements. One key element in successfully sustaining growth is assuring that adequate water resources are available to meet future demands. Population projections form the foundation upon which future water demands can be estimated.

Although it is difficult to predict future population growth, the most accurate estimation can be obtained through recognizing patterns within a population's growth history. Often these patterns can be expressed in the form of economic variables. It is possible to estimate future demographics based on an analysis of past trends and economic expectations for the future. When applied appropriately, these methods produce valuable future population estimates which can be used for the successful planning of water resources (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

1.2 Parish Expansion

Over the past few years, Caddo and Bossier Parishes have benefited from economic growth mainly due to the oil and gas industry. These parishes were selected into the top ten in national economic development rankings, in part, because of growth in the energy, tourism, technology and research industries. Their growth has surpassed that which was experienced in the remainder of the state. In particular, recent development of the Haynesville Shale play has spurred economic growth.

1.3 Water Demand

Along with growth comes an increase in demand, for example, some public water systems in these parishes are operating at maximum capacity. It is very difficult to precisely predict the quantity of water demanded by a particular population because there are so many variable factors which affect water consumption. Geographic location, population quantity and density, climatologic circumstances, government programs and regulations, and economic conditions are just some of the factors which can impact water consumption. This phase will provide the required quantitative data to allow for the proper planning of future waterworks improvement projects.

The future water demand for this study was calculated with the projected populations based on a per capita usage multiplied by the population of the area served. Multipliers were then utilized to determine a conservative projected water demand.

1.4 Adjustments for Unforeseen Events

It should be noted that while the population projections reflect past trends and expected future events, it is complex and difficult to forecast the effects of new unforeseen events. These events might impact the growth rates and directly influence the water demand. The projections used should be periodically reviewed for the applicability of assumptions and adjusted as required to account for additional events which might cause variations in the population.

2.0 *Scope Phase III*

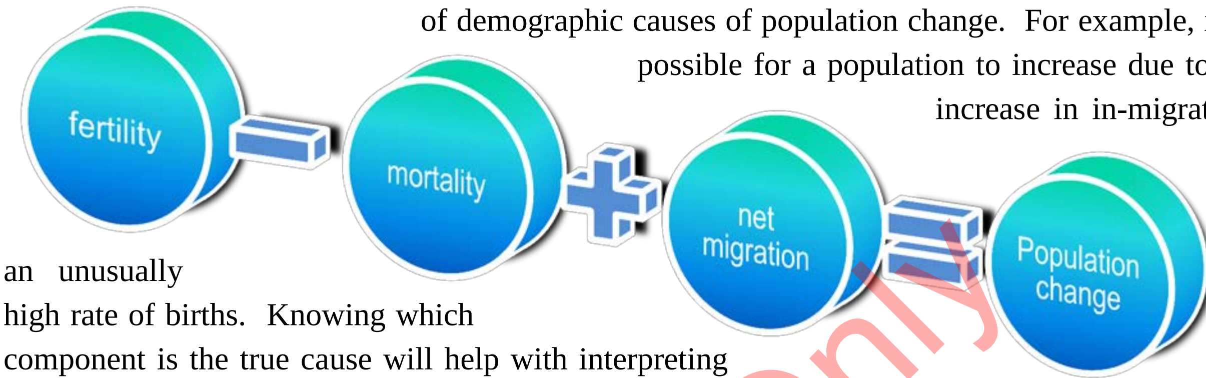
This phase will identify and evaluate a set of alternatives that will quantify the required water resources to meet future growth. Past population growth and historic events which may be the cause of noticeable variations in the population will be described. A detailed description of the components of population change and determinates will be provided. Census data for the components of population change will be noted and implemented into the final population projection calculations. Available data sources for population projections and water demand will be documented and reviewed for possible utilization in this study. The proposed interstate corridors will be evaluated for economic growth and the population projections adjusted as required to accommodate the expected increase in in-migration and development.

The existing comprehensive Master Plans for both parishes will be analyzed for potential utilization in final calculations and conservative approaches will be applied to determine the projected water demand.

The details for the projection calculations as well as any associated assumptions are clearly stated to allow for the determination of any required revisions and adjustments as unforeseen future events unfold.

In addition to determining the required future water demand, this phase will explore the existing land use and identify principles to promote smart growth and efficient utilization of water resources.

3.0 *Components of Population Change*



Fertility, mortality and migration are the three basic components of population change. A population increases due to births and in-migration; and a population declines due to deaths and out-migration. It is beneficial to separate these components when producing population projections for a variety of reasons. Distinguishing the components allows for the identification of demographic causes of population change. For example, it is possible for a population to increase due to an increase in in-migration or an unusually high rate of births. Knowing which component is the true cause will help with interpreting the data. It is also useful to separate these components because they can vary differently in response to changes to economic, social, political, cultural, medical, environmental and other factors that affect population change. Also, the components vary based on location and have varying trends with time. The separation of the components can assist in determining population turbulence due to unique events which is critical in determining if adjustments should be made to the historical data before calculating trends. Before population projections can be made, each of the three components as well as their determinants must be analyzed and understood.

3.1 Fertility

Table 3-1
Total Number of Births

	Caddo	Bossier
1970	4858	1616
1975	4244	1433
1980	4999	1549
1985	5160	1630
1990	4368	1473
1995	3582	1372
2000	3839	1534
2005	3627	1630
2010	3858	1636

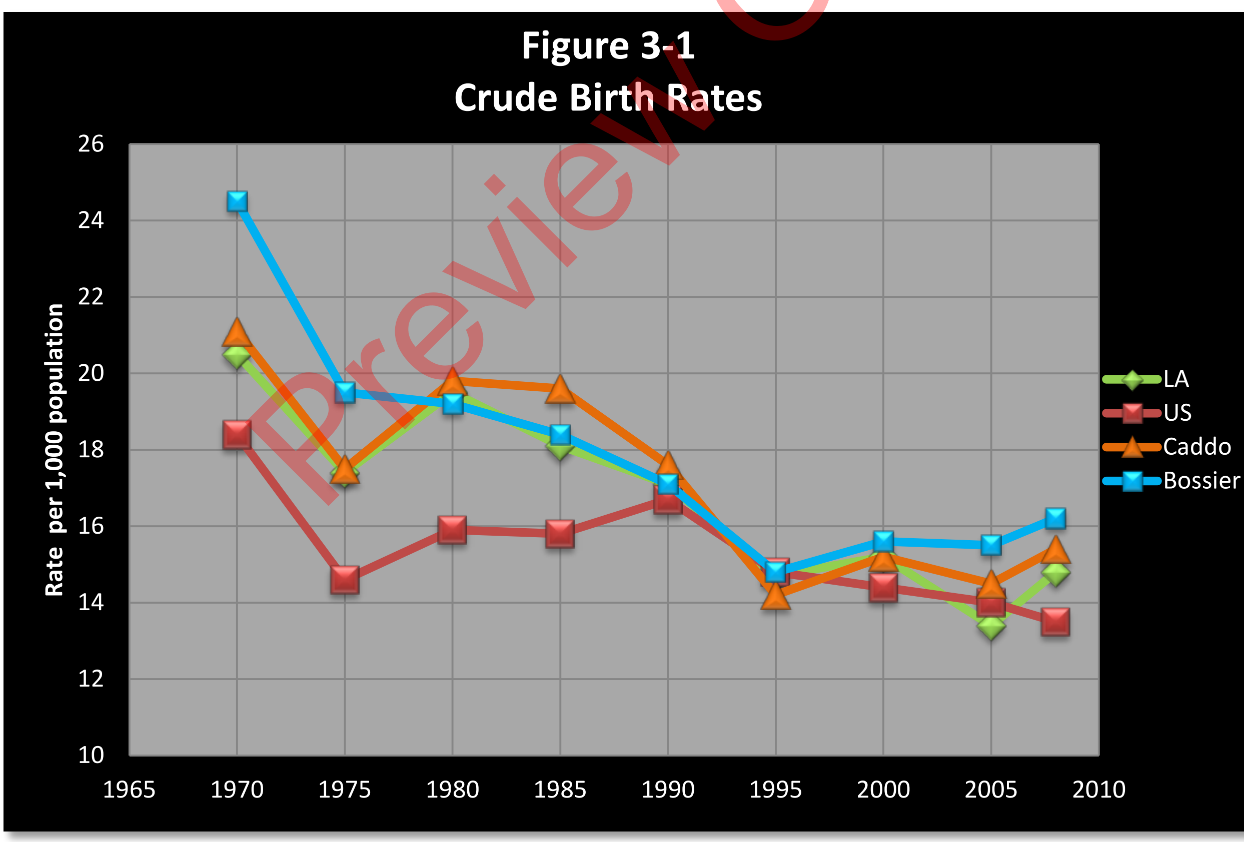
Source: US Census data

Fertility as it relates to demographics is the production of offspring. Fertility depends on cultural, biological, social, economic and psychological factors. These factors can impact the choice of when to have children and how many. Knowledge about the factors which impact this personal choice is extremely important in the attempt to predict the fertility rate.

Over the last two centuries, fertility rates have declined in high-income countries such as the United States. This is in part due to the availability and effectiveness of contraceptives, the increased roles of women in the workplace and the higher cost and lower economic benefits of having children (Stanley K. Smith, Jeff Tayman and David Swanson. 2001). The number of births for Caddo and Bossier Parishes are shown in Table 3-1. This table shows that Caddo and Bossier parishes' birth rates follow the US trends.

There are numerous ways to measure fertility rates. Some of the most common are crude birth rate, general fertility rate, age-specific birth rate (ASBR), total fertility rate and child-woman ratio. Each type is based on the number of live births at a geographic location and the population of that area. The numerator is the number of births and the denominator is the total population or the population of a particular age, sex, or other characteristic group.

The crude birth rate is typically calculated by dividing the number of births during a year by the midyear population. It is then multiplied by 1,000 to reflect the number of births per 1,000 persons. The historic crude birth rates for Caddo and Bossier Parishes show an overall decline in the number of births per 1,000 persons, which is reflective of typical trends in the US and Louisiana. The trends for both the US, Louisiana, Caddo and Bossier Parishes are shown in Figure 3-1 (Louisiana Department of Health and Hospitals. 2008).



Source: Louisiana Vital Statistic Reports 2008 and 1997, Department of Health and Hospitals

The crude birth rate as a method for measuring fertility has its limitations because it does not consider the age-sex structure of a population. Births typically only occur among females between the ages of 15 and 44. Therefore, the composition of a population as it relates to this demographic characteristic is of great importance in relation to the number of births. There are other measures of fertility which account for the differences in age and sex characteristics: general fertility rate, ASBR, and the total fertility rate.

The general fertility rate is equal to the number of births divided by the number of females in their prime childbearing years (ages 15 - 44). The ASBR is determined by dividing the number of births in a particular age group by the total number of females in that age group. The total fertility rate is the sum of all of the individual ASBRs. Each of these rates can be expressed in terms of births per 1,000 by multiplying by 1,000.

3.2 Mortality

Table 3-2
Total Number of Deaths

	Caddo	Bossier
1970	2322	434
1975	2362	482
1980	2477	559
1985	2549	536
1990	2547	609
1995	2615	683
2000	2631	776
2005	2712	845
2010	2594	912

Source: US Census data

Mortality is the occurrence of deaths in a population. Mortality changes primarily based on the population's standard of living, advances in medicine, public health and science. It can vary based on economic elements; low-income people generally have higher mortality rates than high-income people. Education can also impact mortality even when adjustments are made for differences in income.

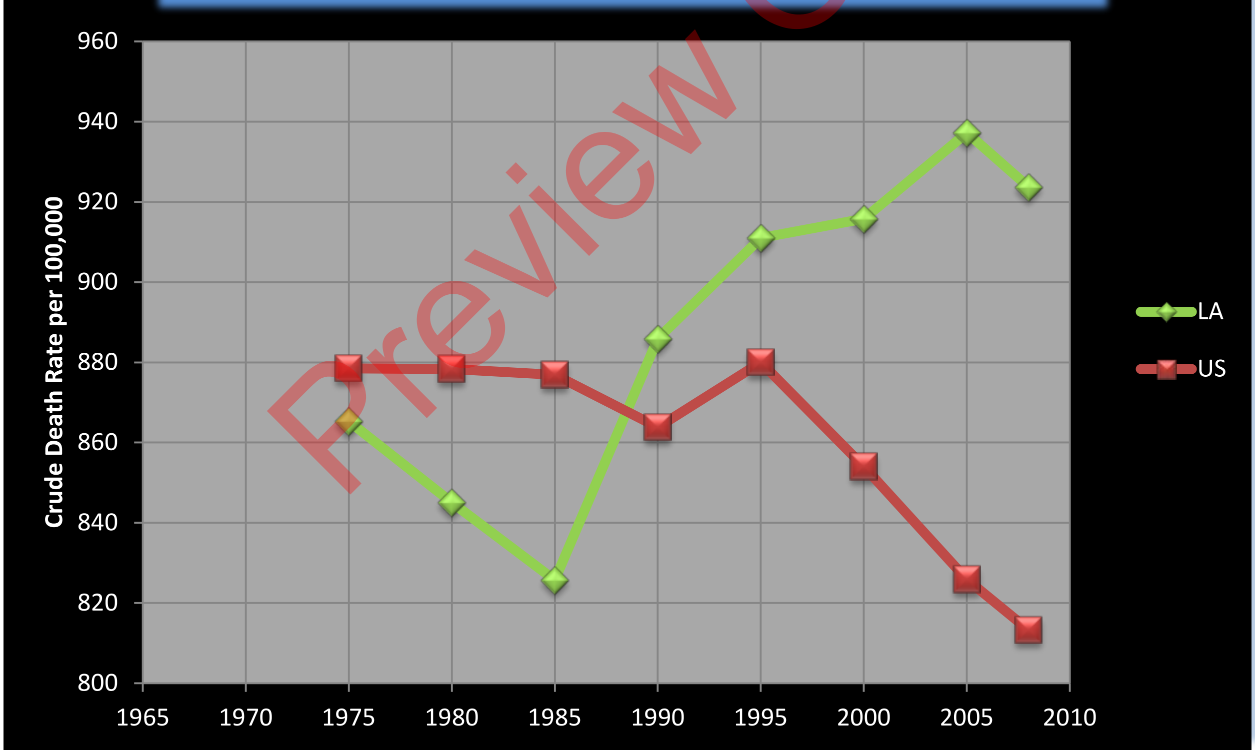
During the last two centuries, the mortality rate has declined considerably in high-income countries including the United States. In addition, they have declined in low and middle-income countries during the last 50 years. Mortality rates vary among race, ethnic, and socioeconomic groups (Stanley K. Smith, Jeff Tayman and David Swanson. 2001). The total number of deaths for Bossier and Caddo Parishes are provided in Table 3-2. The data shows that the death rates have remained relatively constant over the years with a slight increase which is contrary to what the nation's trends have been in the past and what would typically be expected. This rate may be a reflection of how health trends vary with geographic regions but additional analysis is required to understand why the rate has increased instead of decreased over time.

There are numerous methods for measuring mortality. Two methods are age-specific death rate (ASDR) and the crude death rate (CDR). An ASDR is the number of deaths of persons between a particular age range divided by the midyear population of persons between that age range. The

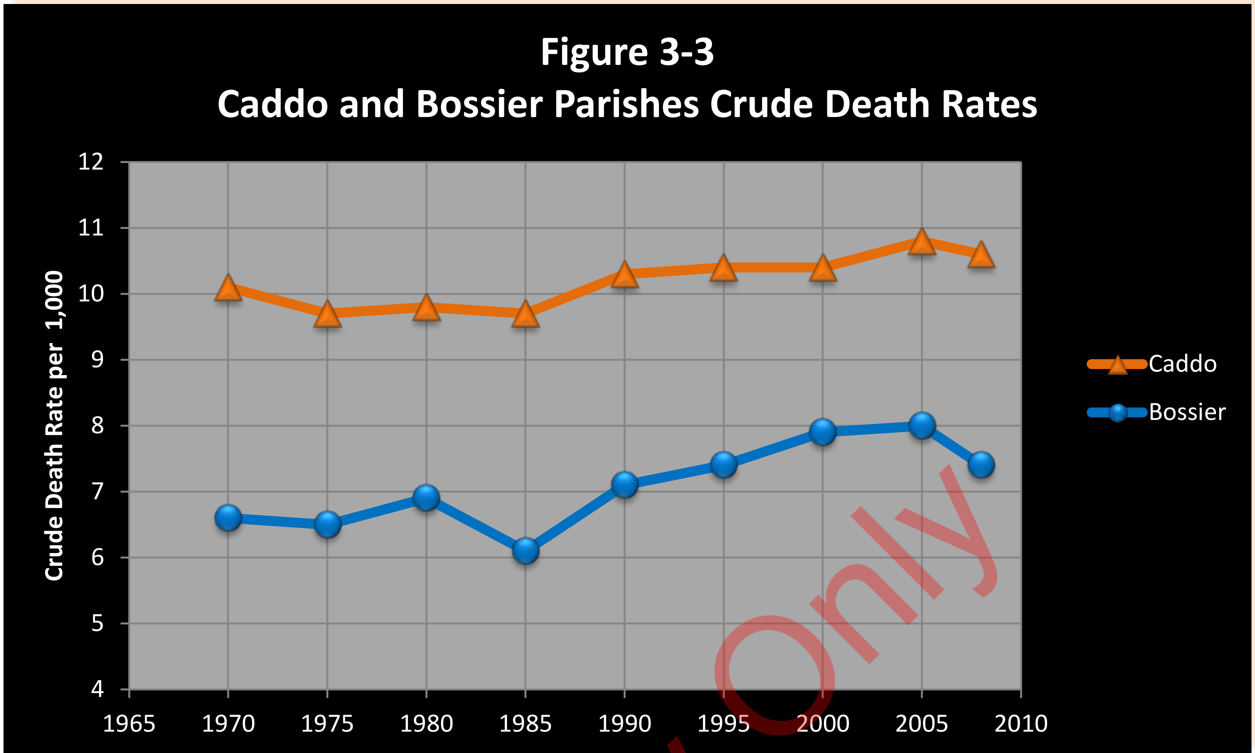
CDR is normally calculated by dividing the number of deaths during a year by the midyear population. This number is then multiplied by 1,000 to represent the number of deaths per 1,000 persons.

Since the 1990's, Louisiana's CDR has risen steadily while the US's CDR has remained stable. Caddo and Bossier Parish CDRs have also risen since the 1990's but Bossier Parish's has risen at a steeper rate than Caddo Parish's. A comparison between the crude death rates of the US and Louisiana are provided in Figure 3-2. Caddo and Bossier Parishes CDRs are provided in Figure 3-3. The CDR trends for Caddo and Bossier Parishes, while contradictory to national trends, appear to be in accordance with Louisiana's trends. There is a reduction in 1985 and a peak in 2005. Overall, there is a trend of increased death while the death rates for the United States follow more of a steady decline over the years.

Figure 3-2
Louisiana and United States Crude Death Rates



Source: Louisiana Vital Statistic Reports 2008 and 1997, Department of Health and Hospitals



Source: Louisiana Vital Statistic Reports 2008 and 1997, Department of Health and Hospitals

When comparing the CDRs for different populations, it is sometimes beneficial to account for the differences in population distribution. This can help provide a better understanding about what may be causing the CDRs to be higher or lower than expected. One method, which can be used to compensate for this, is to use adjusted rates also known as standardized rates. These rates adjust for differences in age, race or sex which can increase or decrease the likelihood of death in populations. The most commonly used adjusted rates are age-adjusted rates because age is the most significant characteristic related to disease and death. An area which attracts a large number of retirees is more likely to have higher crude death rate than an area with a larger amount of young families. The age-adjusted rates can be used to compensate for these differences in the distribution of age groups and allow for a comparison of different populations (Louisiana Department of Health and Hospitals. 2008).

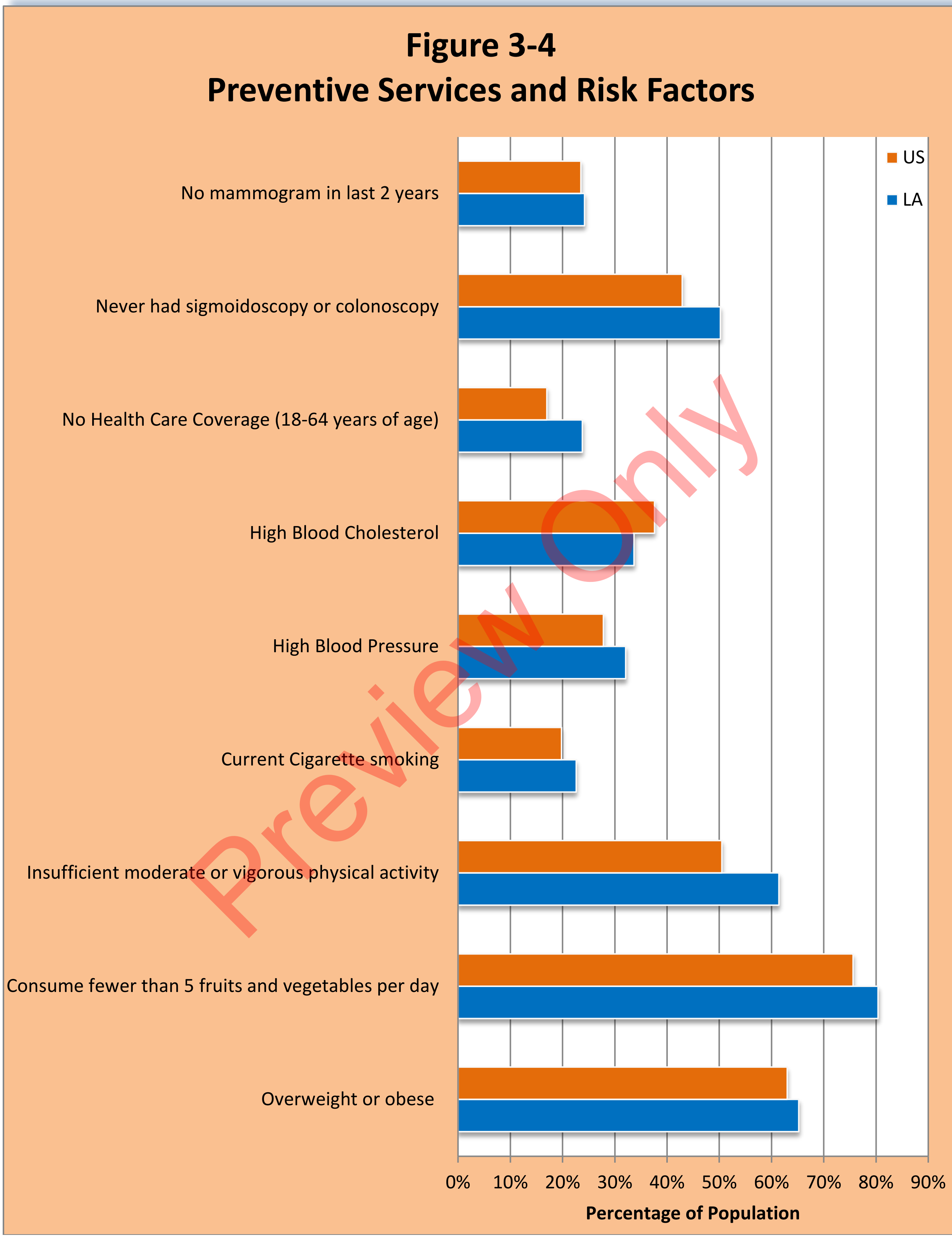
Table 3-3 provides the age-adjusted rate for Louisiana's ten leading causes of death. This table shows that Louisiana's age-adjusted rate is higher than the national age-adjusted rate for each cause of death. This is reflective of the fact that Louisiana is one of several southern states which have been historically recognized as having high age-adjusted death rates. This also means that Louisiana's higher death rates are not due to the population's age distribution.

Table 3-3
Age Adjusted Death Rates

Deaths	Louisiana	US
Age-Adjusted Death Rate per 100,000 (US 2000 standard population)	922	758.7
Age-Adjusted Death Rate for Leading Causes of Death		
Diseases of the Heart	227.8	186.7
Malignant Neoplasms (Cancer)	201.4	175.5
Cerebrovascular Diseases (Stroke)	46.2	40.6
Accidents	53.3	38.6
Diabetes Mellitus	29.6	21.8
Chronic Lower Respiratory Diseases	42.6	44.0
Alzheimer's Disease	30.7	24.4
Nephritis, Nephrotic Syndrome, and Nephrosis	26.5	14.8
Influenza and Pneumonia	19.9	17.0
Septicemia	18.4	11.1

Source: Louisiana Vital Statistic Report 2008, Department of Health and Hospitals

The high death rates are due mainly to lifestyle factors. High tobacco use, poor nutrition, lack of physical activity, high obesity rates, underuse of preventative services, and lack of health care are all reasons why Louisiana residents have such high death rates (Department of Health and Human Services and CDC. 2008). Figure 3-4 provides a comparison between the preventive services and risk factors for Louisiana verses the United States. These life style factors also help explain why Caddo and Bossier Parishes' death rates, which follow Louisiana's, are contrary to what would be expected based on national trends.



Source: Department of Health and Human Services and CDC.

3.3 Net Migration

Migration is the change in an individual's residence from one country, place, or locality to another. It only refers to change in usual residence which would exclude short-term travel such as work, vacation, visits to family and friends or business trips. Some factors which effect mobility are wage rates, unemployment rates, cost of living, amenities, age, education, occupation, family connections and marital status (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

Two terms which are commonly used to describe measures of migration data are gross migration and net migration. Gross migration is the total number of migrants into or out of an area. Net migration is the difference between the two. The net migration for Caddo and Bossier Parishes is shown in Table 3-4.

Table 3-4
Net Migration

Year	Caddo	Bossier
1995-2000	- 10640	2459
2005-2009	-1807	3166
2010-2011	189	1449

Source: US Census and American Community Survey

Migration is a complex concept with determinates that are difficult to define and predict. Even the method of choice utilized to measure migration can be subjective when determining the treatment of distance traveled by migrants, time interval covered, geographic boundaries crossed and defining the distinction between temporary and permanent moves. These issues can present complications when it comes to analyzing the determinates of migration (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

The fertility and mortality rates are typically stable but migration is the most instable out of the three components of population change. Migration is also the most difficult component to predict.

An individual's age greatly influences their mobility. Children usually live with their parents without control over where they live, when they move and where they relocate. Their mobility depends entirely on their parents' wishes. However, young adults have more control over their mobility and will normally relocate for college, career opportunities or marriage. They have a high rate of mobility. Once a person becomes married, typically moves are less frequent but can occur due to changes in job status, neighborhood characteristics, family size and economic conditions. When a person reaches retirement age, additional moves may occur in the hopes of locating a better climate or communities with additional amenities. When a person ages further, they may make final moves due to declining health or sometimes the death of a spouse (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

The mobility rates by age for Caddo and Bossier Parishes and Louisiana are shown in Figure 3-5. They are similar in that the peak is in the 5 - 17 age group and a significant portion of moves take place between the ages of 25 to 54. The declining number of moves as the population gets older is also noticeable in this figure.

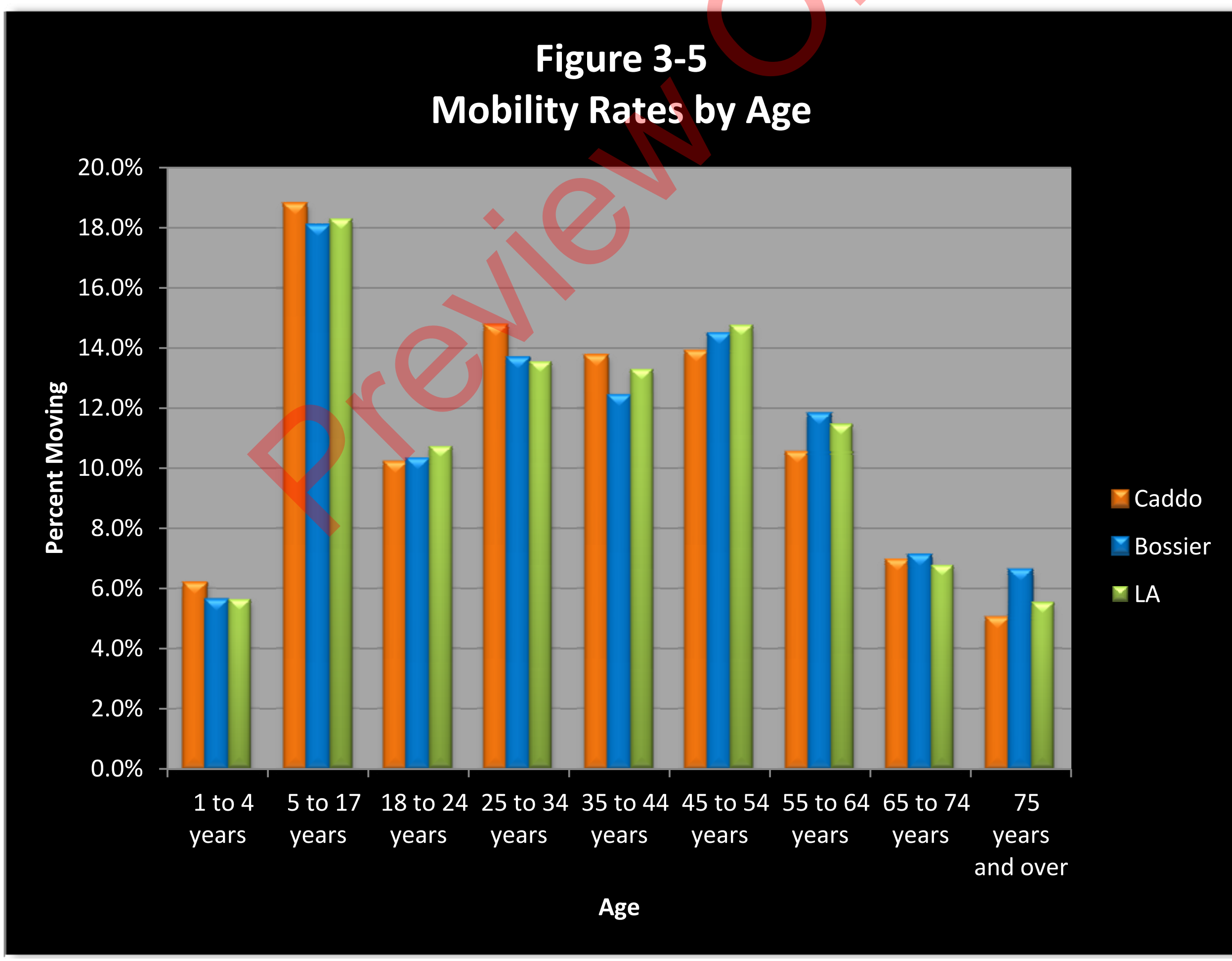


Figure 3-5
Mobility Rates by Age

Source: 2006-2010 American Community Survey 5-Year

There are two methods for determining why people move. One method is to survey migrants about their reasons for moving. One survey of interstate migrants found that they cited employment-related factors as the major reason for moving for more than 50% of the migrant population interviewed under the age of 50. For participants over the age of 65, employment only accounted for a very small portion of the moves. Instead, climate was cited as a major reason for moving by participants between the ages of 50 - 64 but less than 15% of participants aged under 50 mentioned this as a reason for moving (Stanley K. Smith, Jeff Tayman and David Swanson. 2001). The results of this analysis indicate that a population's age distribution can impact the overall reasons for moving and the net migration for the area. Figure 3-6 shows the reasons for intercounty/interparish moves based on the US Census Bureau, current Population Survey for 2011.

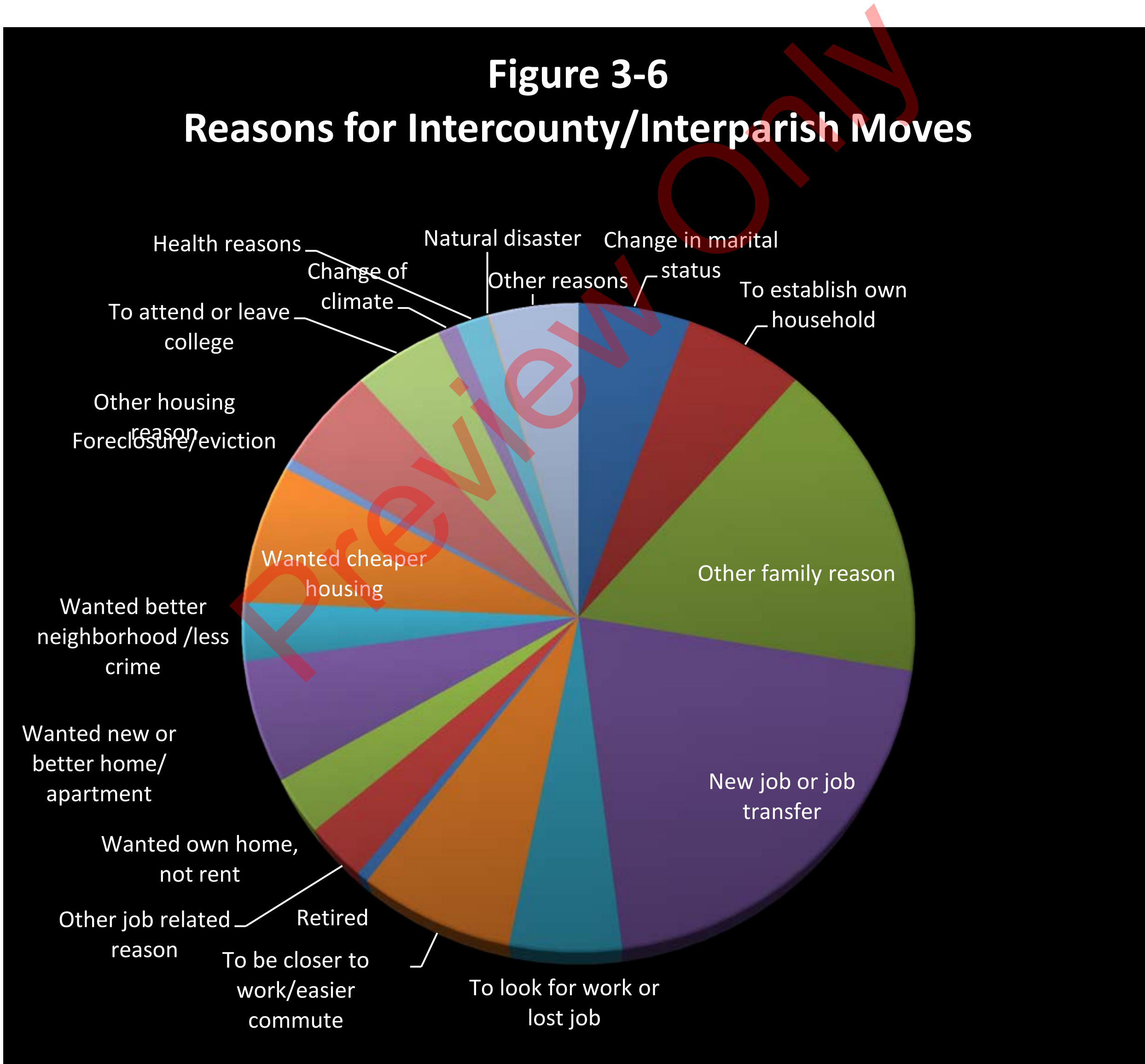


Figure 3-6
Reasons for Intercounty/Interparish Moves

Source: 2011 US Census

The second method for determining why people move is to deduce motives from statistical analyses. This method determines associations between the characteristics of migrants and their reasons for moving. The characteristics considered are generally age, education, marital status and regional characteristics. Past trends have shown that age is a major indicator of mobility. It has also been noticed that people with more education move more often than those with less and being married greatly reduces mobility.

Recently, most of the migration for Caddo and Bossier Parishes are residents moving from Caddo to Bossier Parish. According to a local area demographer, most of the recent movement between Caddo Parish and Bossier Parish is a result of employment from the Haynesville Shale natural gas play and construction. This Phase will consider historical migration data as well as known future employment opportunities and transportation improvements to calculate the projected migration for Caddo and Bossier Parishes.

4.0 *Historic and Current Economic and Demographic Conditions*

4.1 The United States Census Population Data

The Decennial Census (Census) is the most recognized and widely used source for demographic data in the United States. It was first completed in 1790 and is required by the constitution to count the entire population of the country. The results of the census are used to determine a state's congressional representation and electoral boundaries for local and state governments.

> *"Today, the Decennial Census, the Economic Census and the American Community Survey give Congress and community leaders the information they need to make informed decisions…A census tells us not only about our past, but it can help us prepare for our future."*
>
> *Source: US Census Bureau*

It has been expanded over the years as the importance of statistical data related to demographics and economic trends were recognized. The type of questions asked by the US Census Bureau has evolved over time to meet the requirements of the nation. Currently, the Census gathers information on hundreds of topics which include, but are not limited to, economic, agricultural, demographic, geographic, housing, and education. The Census serves as a critical source for planners and policy makers.

The American Community Survey (ACS) is an annual national survey completed by the US Census Bureau which provides demographic, housing, social and economic data each year. It provides information on the mobility/migration of residents for the US, states, metropolitan areas, and geographical areas which meet minimum population sizes for the survey year. It samples a small percentage of the population and is intended to assist communities by providing them with useful data for planning their investments and services. These surveys date back to the year 2000 and continue to the present.

The ACS replaced the long form data of the census and differs from the Decennial Census data in that it provides information about how the nation lives while the Decennial Census focuses on the number of people who live in the United States. The following sections will analyze the historic population data obtained from census data. In later sections, census data will be utilized to approximate future population.

4.2 The Birth of Two Parishes

Currently, Caddo and Bossier Parishes are two of 64 parishes within the State of Louisiana. However, when the state was originally created, neither parish existed. Caddo Parish was formed in 1838 from Natchitoches Parish and Bossier Parish was formed in 1843 from Claiborne Parish. At the time Bossier Parish was created, Louisiana was only divided into a total of 43 parishes. Figure 4-1 shows the historical parish boundaries. Each parish's creation date corresponds with the dates of available US Decennial Census population data. Population data is available for Caddo and Bossier Parishes dating as far back as the 1840's and the 1850's respectively.

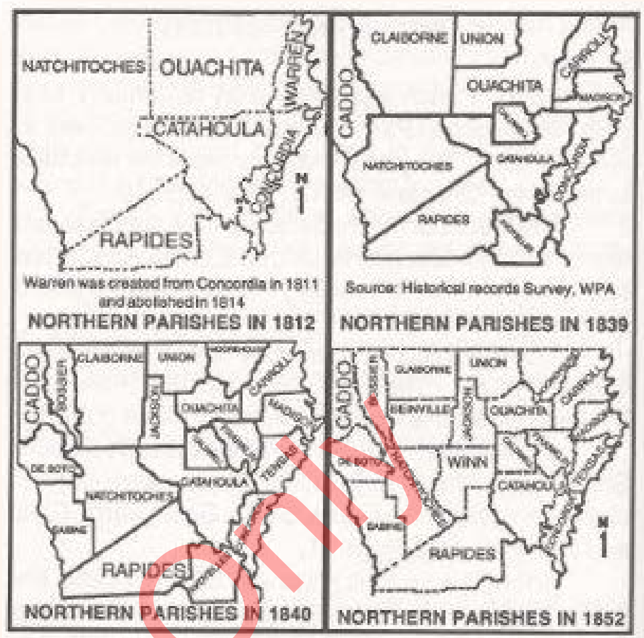


Figure 4-1

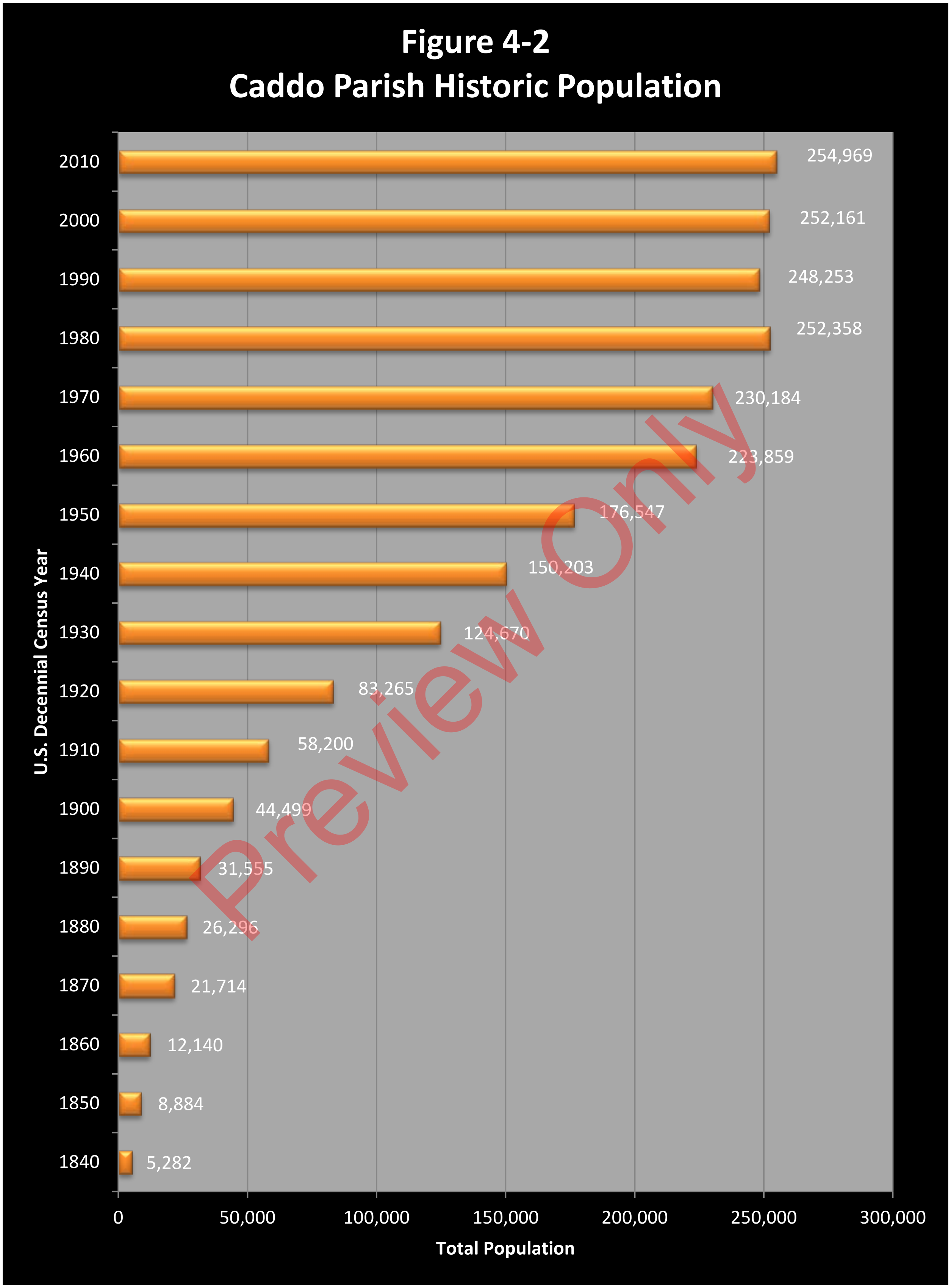
Historical Parish Boundaries

At this time, the parishes had enough residents to justify the creation of a new parish. This was also around the time of the Great Western Migration. Many people were moving to Texas and other new territories because of generous land grants. This is argued by some to be the cause of such late development in this area. "Caddo Parish didn't begin until 1837, some 30 years after it had begun in other parts of Louisiana and the adjoining states of Texas and Arkansas" (Sam Collier, 2007). However, others believe this migration to be the source of the population increase which led to the parishes' creation.

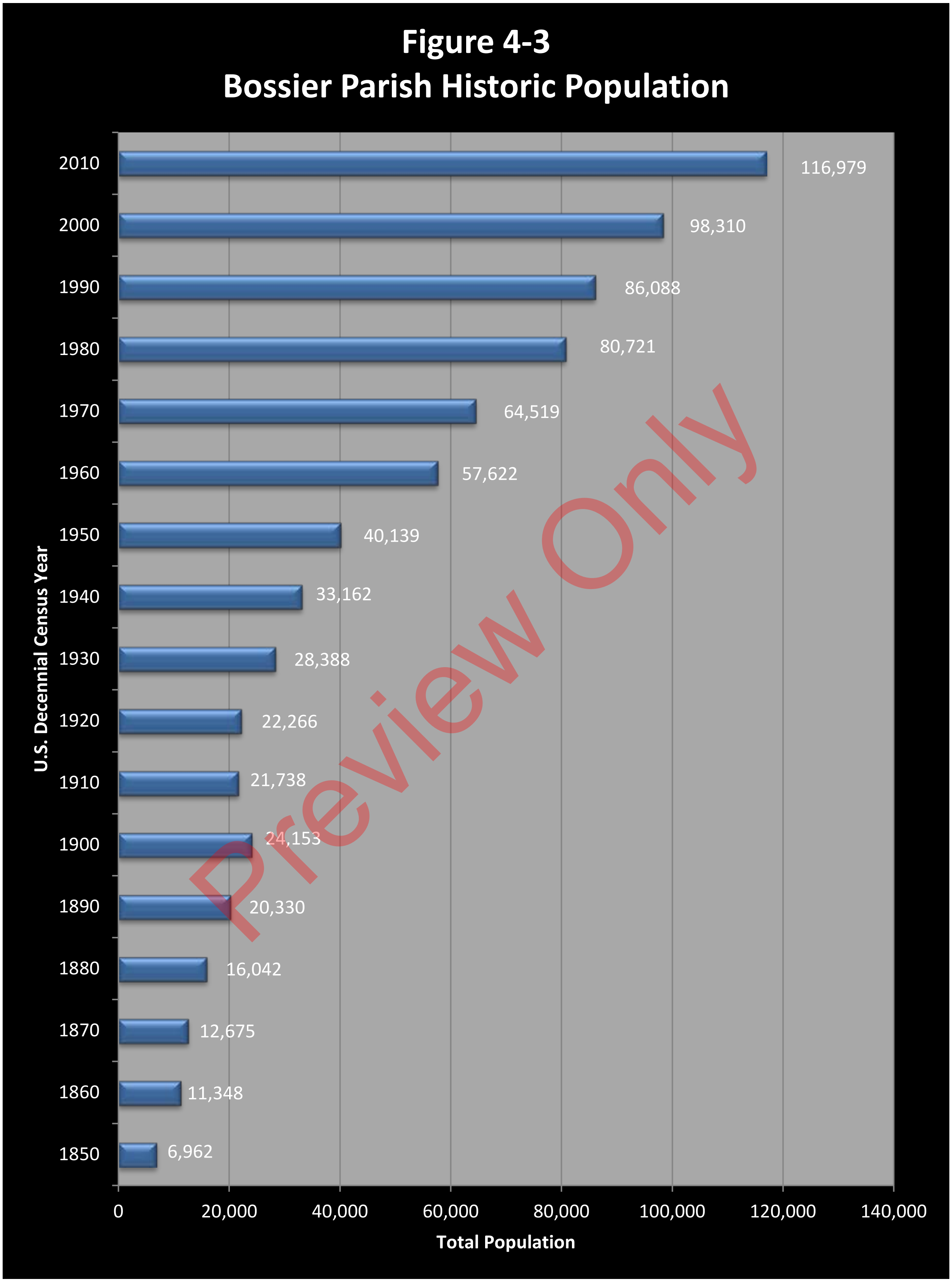
> *"Many families traveling westward to Texas and other new territories changed their plans after viewing the countryside with fertile land, abundant forest, and meandering bayous.*
>
> *Source: Louis Stinson, Bossier City History*

4.3 Historic Population Growth

Since their creation, the populations of Caddo and Bossier Parishes have experienced historic population growth. At the time of their creation, Caddo Parish experienced the second largest growth rate and Bossier experienced its highest growth rate. Over the years, these two parishes have enjoyed benefits from cotton crops, massive demands for timber, connectivity along the Red River and railroad network, the oil boom, Barksdale Air Force Base and even more recently, the exploding riverboat and gaming industry. Caddo and Bossier Parishes' populations have increased at an average decennial rate of about 15% and 13% respectively. However, these long term averages disguise variations in the population growth for both Parishes throughout these years. Figures 4-2 and 4-3 show the total population growth for each parish from the point of their creation through the most recent decennial census. The following section provides an explanation of historic events which may have led to the variations in population growth for each parish over the years since they were created.



Source: US Census



Source: US Census

4.3.1 The early 1800's – Cotton is King

Immediately after their creation, Caddo and Bossier Parishes received substantial population growth as they benefited from the connectivity provided by river transportation. The Red River provided growth and prosperity for the area as settlers surged the two parishes. Many of the original settlers in these parishes were wealthy plantation owners, who brought increased employment as warehouses, stores, cotton gins and sawmills were required to support the growing industry. In addition, steamboat traffic increased as the goods required transportation. The Red River was considered a "Louisiana trade highway second in importance only to the Mississippi," as it "rapidly populated the drained swamplands of north Louisiana" (Viola Carruth. 1970).

This immediate growth in population is reflected in the percentage growth shown in Figures 4-2 and 4-3 for Caddo Parish in the 1840's and Bossier Parish in the 1850's.

4.3.2 The Civil War and Reconstruction Era

The Civil War brought slightly different experiences for Caddo Parish when compared to Bossier Parish during the 1860's. Caddo Parish was one of the only regions in northern Louisiana which was spared from the destitution associated with the war. It was during this decade that Caddo Parish's maximum population growth rate was obtained. Since its creation, Caddo Parish had benefited from its large cotton plantations and during the war, Shreveport became the capital of the Confederate Louisiana with the fall of New Orleans. "Its citizens were not forced to endure the hunger and hardships which were known in other sections" (Viola Carruth. 1970).

A Civil War Capital

The first daily newspaper in Shreveport, the Natchitoches *Union*, printed its first issue in the early 1860's. In it was a description of Shreveport which reflects the prosperity experienced throughout Caddo Parish and reflects the contrast seen in the growth for Caddo versus Bossier Parish during that period.

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"Shreveport has become the most thriving business city in North Louisiana. It is admirably situated for trade, commanding some of the most flourishing agricultural regions of Texas. It is connected with New Orleans by the Red River and about to be connected with the Mississippi by the Vicksburg and Texas Railway, a branch of which already extends some distance into Texas."

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Early 1860's
Judge Charles A. Bullard

In the 1870's, the River Parishes of north Louisiana, like much of the south, were devastated by the Reconstruction. Farms, roadways, and governmental buildings were destroyed. The cost of the war efforts was tremendous. The economic infrastructure suffered and many men died leaving their remaining family members impoverished. The lower annual growth rate for Caddo Parish reflects how the Parish suffered at this time even though it did continue to grow (Viola Carruth. 1970). Bossier Parish managed to prosper to some degree; although it also experienced some suffering during this time (Clifton Cardin. 1999).

4.3.3 The late 1800's

In the 1880's and 1890's, Caddo Parish experienced an increase in wealth and prosperity due to the completion of the north-east Pacific Railroad. The completion of this railroad allowed for the shipping of massive amounts of timber to the north and east. These gains are reflected in the percentage growth numbers for this time (Viola Carruth. 1970).

Bossier Parish population grew but at a reduced rate during this time until the 1900's when it experienced its first decline in population growth since the parish was created. While there does not appear to be any noted causes in the parish's history, the 1900's was the time period for several events which might have impacted the economy of the Parish at this time. The Panic of 1901 was the first stock market crash in the New York Stock Exchange which was followed by the 1902-04 recession. There was also the Panic of 1907 which led to the creation of the Federal Reserve System.

4.3.4 The early 1900's – the Century Begins with a Boom

The discovery of oil in Caddo and Bossier Parish in 1904 (Samuel Touchstone. 1998) and 1908 (Clifton Cardin. 1999), respectively, marked the beginning of the next big boom. This major economic event brought more manufacturing, road building, and people which can be noticed in the growth trends from 1910's to 1920's for Bossier Parish and from 1900's to 1920's for Caddo Parish.

4.3.5 The 1930's – a period of Great Depression

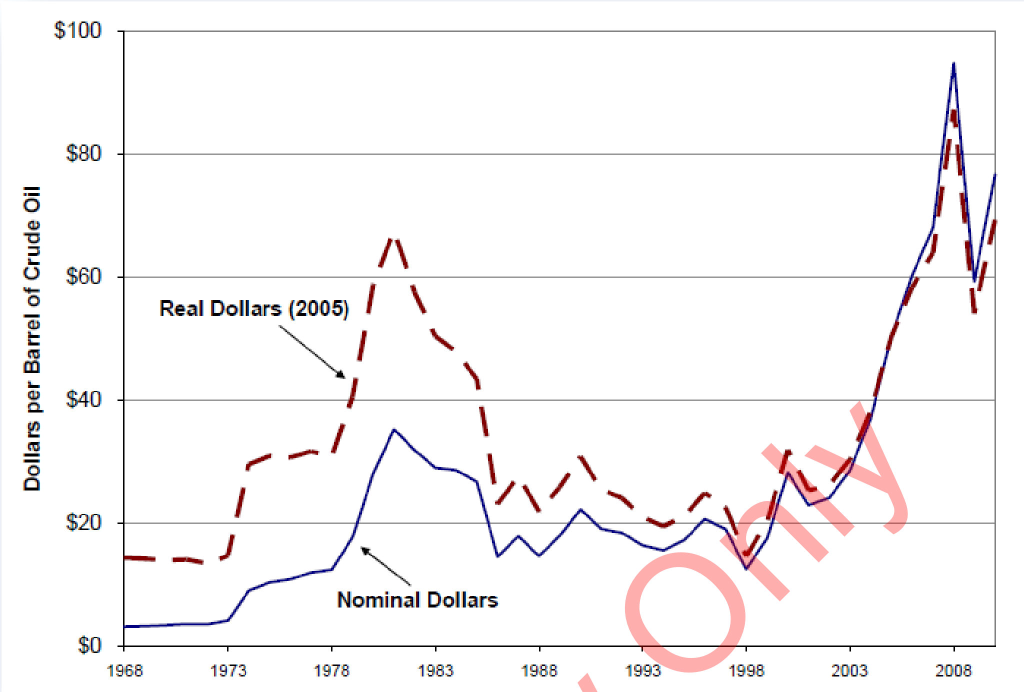
The October 20, 1929 stock market crash marked the beginning of the Great Depression and a time of great suffering to the nation. While the effects were felt all over the nation including northwest Louisiana, Caddo and Bossier Parishes did fare better than many regions. A reduction in the population growth rate can be noticed during this time but it is not as drastic as it might have been were it not for several events, which included the construction of Barksdale Air Force Base (Barksdale AFB), the Shreveport Municipal Airport, and the discovery of the Rodessa gas field (Viola Carruth. 1970). In addition, they made a rapid recovery which is evident in the percentage growth rates for the decades which followed.

From the very beginning, Barksdale AFB brought growth to the area. Its construction injected $2.65 million into the local economy and employed between 900 and 1,100 construction workers (Caddo Parish Sheriff Reading Room website. 1999). Barksdale AFB experienced many mission changes which required expansions during the 1940's and 1950's. Both Caddo and Bossier Parish experienced population growth but Bossier Parish experienced its second highest percentage growth during this period which was likely a direct result of the expansions at Barksdale AFB. By 1949, there were 8,500 people at Barksdale AFB with a payroll of two million (Clifton Cardin. 1993). When compared to Bossier Parish's population of approximately 33,000 according to the US Census, it is clear how significant Barksdale's AFB impact was on the area.

4.3.6 The 1960's and 1970's

Each parish continued to experience slow growth in the 1960's, but the 1970's brought a significant increase in the populations of both Caddo and Bossier Parishes. This could have been due to the booming oil industry and the soaring prices of oil as it changed into an expensive energy source. This rise in oil prices was due to an interruption of supply as the members of the Organization of Petroleum Exporting Countries (OPEC) embargoed shipments of oil to the US in support of Israel during the Yom Kipur War in 1973-1974. The resulting shortages combined with domestic controls the US placed on the price of oil led to the quadrupling of oil prices and long lines at gas stations (Congressional Research Service. 2012). Figure 4-4 shows the long-term trends of crude oil in current dollars and deflated dollars.

Figure 4-4
Nominal and Real Cost of Crude Oil to Refiners, 1968-2010



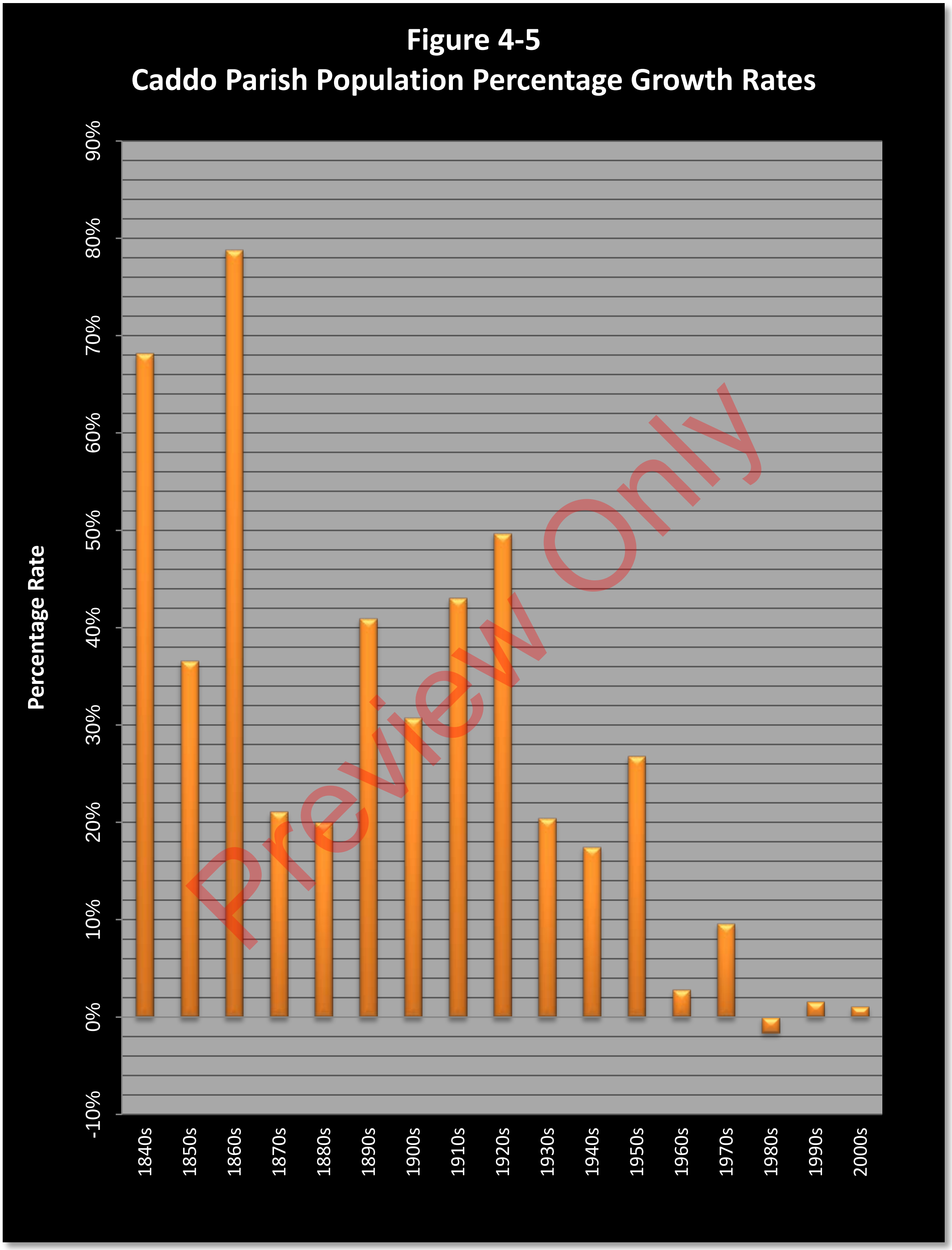
Source: Congressional Research Service

4.3.7 The 1980's – "Oil Glut"

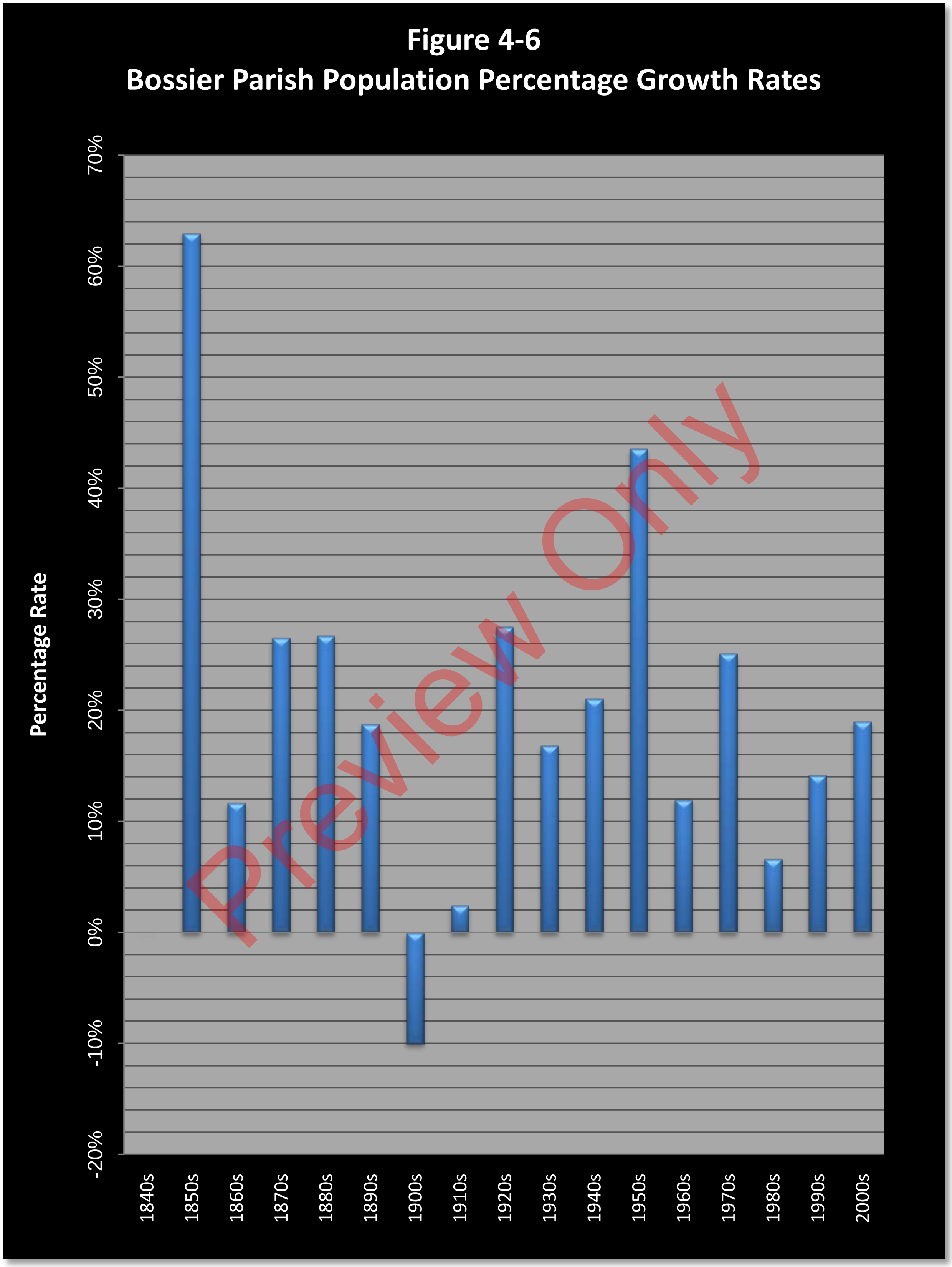
In the 1980's, the global crash of the oil industry created a depression in Louisiana. The drop in oil prices caused a drop in tax revenues which caused a suspension of government-funded activity which equaled to jobs lost. The oil prices collapsed because of a decrease in demand and excess production capacity. The recession of 1980 impacted both Caddo and Bossier Parish but the impact on Caddo Parish is most visible in the population decline. It was during this period that Caddo Parish saw its first loss in population since its creation.

4.3.8 The 1990's to the present

The 1990's and the 2000's have been periods of slow population growth in part due to the weak economy. This is especially true for Caddo Parish. Recently, Bossier Parish has grown at a much larger rate than Caddo Parish which may be attributed in part to increased construction. Bossier Parish passed a $70 million bond issue in 2004 for the construction of three new schools and renovations of existing schools (US Department of Housing and Urban Development. 2006). In addition, these growths may be the result of the production from the Haynesville Shale, the opening of the Louisiana Boardwalk, the Cyber Innovation Center, StageWorks of Louisiana, Millennium Studios and several riverboat casinos.

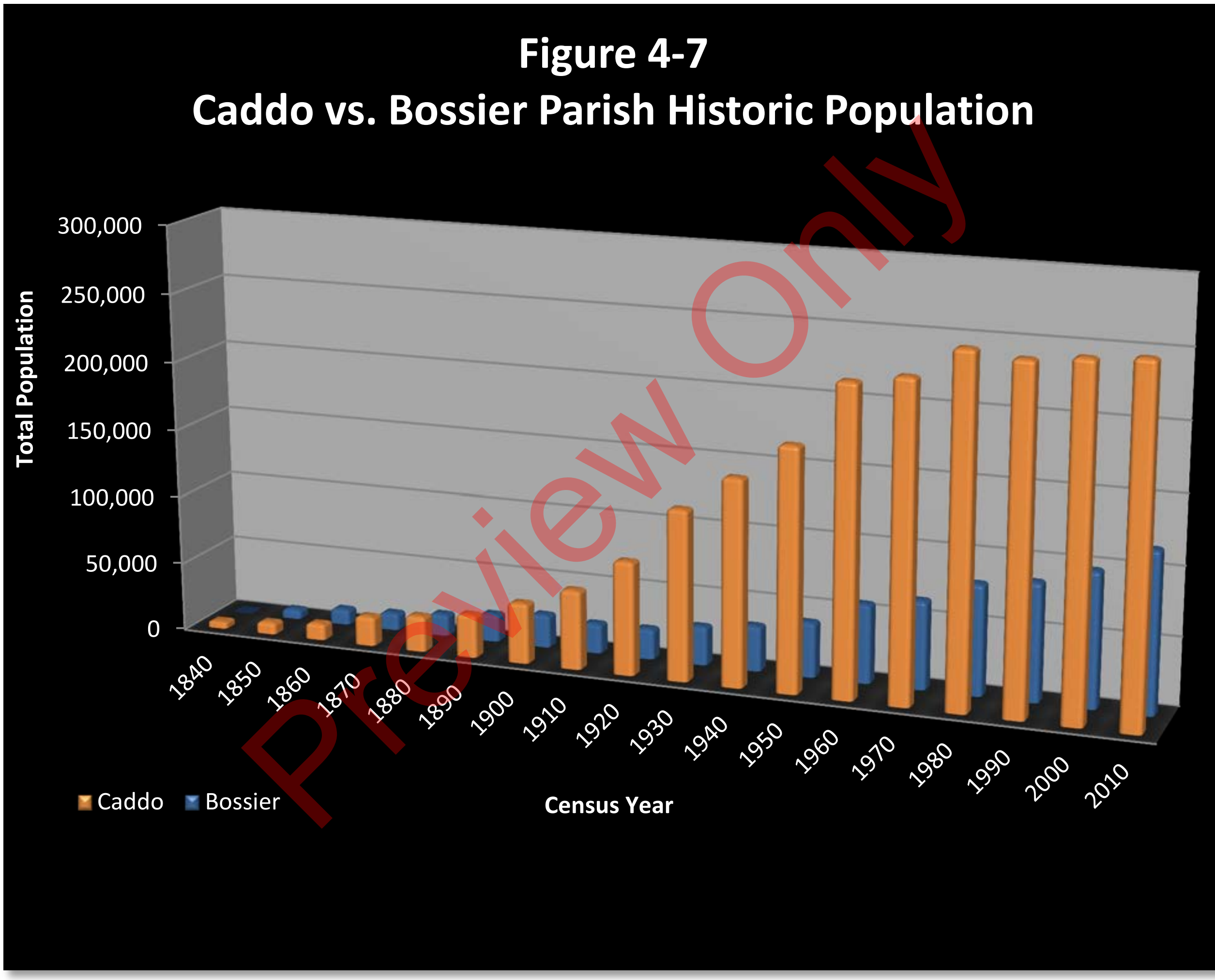


Source: US Census



Source: US Census

Figure 4-7 shows a comparison of Caddo and Bossier Parishes historic total population. Recent trends show that Caddo Parish saw a loss in population in the 1980's but recovered in the 1990's. In contrast, Bossier Parish has not seen a loss in population since the 1900's. In addition, the percentage of growth in Caddo Parish has declined from 1990 to 2000 while percentages for Bossier Parish have increased since 1980. Although Bossier Parish has seen more population growth over the past few decades, the total population of Caddo Parish has consistently been greater than the total population of Bossier Parish.



Source: US Census

4.4 Community Historic Population Growth

The US Census provides population data for several communities within Caddo and Bossier Parishes. These communities are labeled in the census data as places within the state of Louisiana and are defined as a concentration of population either legally bounded as an Incorporated Place or identified as a Census Designated Place (CDP). Incorporated Places are defined by the US Census as a type of governmental unit incorporated under state law as a city, town, borough or village and having legally prescribed limits, powers, and functions. CDP are statistical entities comprising a densely settled concentration of population that is not within an incorporated place but is locally identified by a name. CDP are delineated with the assistance of state and local officials and the Census Bureau.

There are seventeen (17) communities within Caddo and Bossier Parishes combined which were recognized by the US Decennial Census in the year 2000 and eighteen (18) in the year 2010. Lakeview is the only place which was not recognized for both Decennial Censuses.

The communities' population data can be useful in determining which portions of the parish are experiencing the greatest growth. In addition, this data can assist in projecting future trends. Based on the percent change in population growth, Blanchard, Greenwood, Haughton, Eastwood and Bossier City are some of the communities experiencing the most population growth between 2000 and 2010. The community data for 2000 and 2010 (excluding Lakeview) are provided in Table 4-1 in the order of population percentage change.

Table 4-1
US Census Community Data for 2010 and 2000

Name	2010	2000	percent change
Blanchard	2899	2050	41.4%
Greenwood	3219	2458	31.0%
Haughton	3454	2792	23.7%
Eastwood	4093	3374	21.3%
Bossier City	61315	56461	8.6%
Red Chute	6261	5984	4.6%
Shreveport	199311	200145	-0.4%
Belcher	263	272	-3.3%
Benton	1948	2035	-4.3%
Mooringsport	793	833	-4.8%
Plain Dealing	1015	1071	-5.2%
Gilliam	164	178	-7.9%
Vivian	3671	4031	-8.9%
Rodessa	270	307	-12.1%
Ida	221	258	-14.3%
Oil City	1008	1219	-17.3%
Hosston	318	387	-17.8%

While the percentage change of population is useful in gaging the amount of growth, water demand is calculated based on the total population. Considering this, it is also necessary to consider the total change in population when analyzing the growth of these communities. Figure 4-8 presents information on the total population growth for each of the places which US Census data is available for both 2000 and 2010.


Figure 4-8
Total Population Growth for Communities
from 2000 to 2010
Bossier City
Blanchard
Greenwood
Eastwood
Haughton
Red Chute
Belcher
Gilliam
Ida
Rodessa
Mooringsport
Plain Dealing
Hosston
Benton
Oil City
Vivian
Shreveport
-1000
0
1000
2000
3000
4000
5000
Preview Only

5.0 *Population Projections*

5.1 Population Projection Methods

There are various methods of projecting population. Some of the most common methods are defined below:

1. Trend Extrapolation Methods are based on past trends and assume that the future demographic developments can be derived from past population trends. This can be simple, linear extrapolation, or complex, ARIMA time series models. This method is frequently used in econometrics. The weakness of this method is the lack of accounting for events which affect the demographics. For example, changes in business development.
2. Cohort-Component Method considers the estimated projected births, deaths and net migration when determining the projected population. This method is the most frequently used for population projections and is the method used by the US Census Bureau for population projections.
3. Structural Models are based on historical demographic variables as well as other variables which could cause a change in projections. There are numerous types of structural models which can range in complexity and number of variables required. The most frequently used types of structural models for local populations projections are economic-demographic and urban systems models.

For this analysis, the Cohort-Component Method was used to complete the population projection calculations. This method was chosen because it is widely used, highly respected and provides flexibility for adjustments due to a variety of events. In addition to the Cohort-Component Method, the result of a structural model was applied to adjust the population for the expected impacts of new interstate expansion. Existing population projections completed by others will be extended with the use of trend extrapolation methods and the most conservative approximation will be used to calculate the water demand.

5.2 Approaches to Projecting the Components of Population Change

5.2.1 Fertility

One approach to projecting fertility rates is to hold the age-specific birth rate (ASBR) constant through the projection horizon. The ASBR is determined by dividing the number of births to females in a given age group by the number of females in that age group. Normally the ASBR is used for the most recent year which data is available. This is a justifiable approach because it is unlikely that these rates will vary greatly. The stabilization of fertility rates in the US over a period of time is justification for the use of a constant rate (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

Another approach is to extrapolate the ASBRs based upon historical trends. This is useful in societies where the birth rates have changed at a steady rate and will continue to change at this rate in the future. This can be used in countries which are experiencing demographic transitions in fertility rates.

Time series techniques can also be used to project births without consideration to ASBR. This technique can disregard the age structure of the population and even the total size of the population. This approach is useful for short-range projections (less than five years).

This study projected fertility by holding the ASBR for 2010 constant which, as previously mentioned, is a justifiable approach.

5.2.2 Mortality

Mortality rates are easier to predict than fertility rates. One example can be found in the twentieth century which brought a slow steady drop in mortality rates but saw great fluctuation in the fertility rates. There are two approaches which can be used in projecting the mortality rates for a population. The simplest approach is to assume the rate will continue unchanged which works best for short projection horizons of less than ten years. For longer projection horizons, it is typically best to assume that mortality rates will continue to fall. However, the rates in this study area have historical values which have remained relatively stable in recent years. Therefore, the mortality rate will be held constant.

5.2.3 Migration

There are multiple ways to predict migration data. Models can be created based on in- and out-migration data or the historical net migration data only can be projected.

There are two common models which can be used to project migration data in cohort-component models. The first method is the migrant pool model which utilizes the in-migration and out-migration historical data without consideration of the places of origin and destination of the migrant. The second method is a multi-regional model and requires the in- and out-migration data for each place to be considered. This second method uses data which covers only migrants to and from specific places.

A more simplified approach is to extrapolate the historical net migration data for the most recently available time periods. This can be done by developing an equation that fits the trend in a given variable population. By assuming that the trends will continue or adjustments may be made if a change in the net migration trends are expected.

The migration data for this study was projected using a multi-regional model with consideration of the in and out migration for each parish.

5.3 Sources of Population Projections

5.3.1 Existing Community Plans/Studies for Caddo and Bossier Parishes

There are a number of community studies and plans which have been generated to analyze portions of Caddo and Bossier Parishes' future growth and provide guidance for new development. Some of these studies have completed economic and demographic projections which were reviewed for potential suitable use in this analysis. These projections originate from various sources and utilize differing methodology. Each projection has merit for its intended uses, but none were ideally suited in isolation for the purposes of this analysis. A summary of each of these sources are provided in the following list and details about the review process for each alternative economic and demographic forecasting technique is provided in Table 5-4.

1. Shreveport-Caddo 2030 Master Plan (2010 MP)
   A master plan was prepared by Goody Clancy and Associates, Inc. for the Shreveport Metropolitan Planning Commission (MPC) of Caddo Parish and was adopted on December 1, 2010. This study assumed that the Shreveport-Caddo community would experience an increase in population growth and indicated three scenarios for this growth based on benchmark rates of job growth for 2030. (Scenario 1, 116,441; Scenario 2, 118760; Scenario 3, 134,297) The plan assumed that investments would be made and initiatives implemented to attract growth. This plan used the 2009 job to population ratio to estimate what the population would be in 2030 based on the benchmark rates of growth.

2. Water and Wastewater Infrastructure Plan (1999)
   This plan was prepared by Black and Veatch, LLP and Aillet, Fenner, Jolly and McClelland for the City of Shreveport Department of Water and Sewerage. It utilized population projections prepared by the Louisiana Population Data Center (LPDC) at Louisiana State University. The populations from this study are shown in Table 5-1.

Table 5-1
Projected Populations for Shreveport and Caddo Parish

	2000	2005	2010	2015	2020	2025	2030
Caddo	250,000	257,625	265,483	273,580	281,924	290,523	299,384
Shreveport	200,000	206,100	212,386	218,864	225,539	232,418	239,507

3. Bossier Comprehensive Land Use and Development Plan (2003)
   This plan was completed by Wilbur Smith, Associates and is an official public document which provides guidance for growth and economic development in the MPC Planning Area. This document has been adopted by the Bossier City-Parish Metropolitan Planning Commission, City of Bossier City Council and Bossier Parish Police Jury. The target year for this report is 2020. It projected the past population (from 1990 to 2000) forward by use of three methods: exponential, linear regression and geometric. The exponential approach assumes a constant rate of growth. The linear regressions approach is a straight line approach which gives a rate of growth which declines with time. The geometric curve assumes an increased rate of growth. The final population used in these calculations was a blend of geometric and exponential methods. The result was a growth rate of approximately 13%. Table 5-2 shows the calculated populations from this plan.

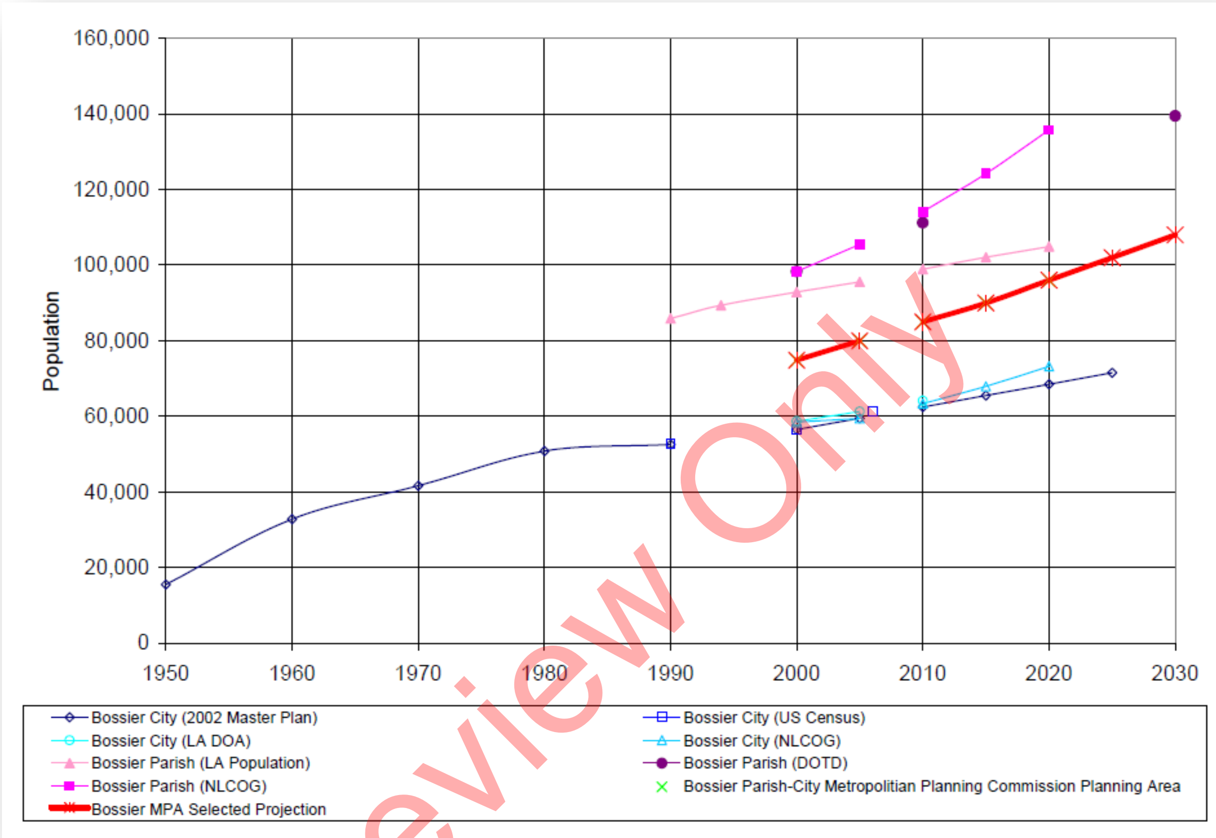
Table 5-2
Population Projection

	2010	2020
Bossier MPC Planning Area	85,000	96,000

4. A Water System Improvement Plan (2008)
   This plan was prepared by Camp Dresser McKee (CDM) for the City of Bossier City's Public Utilities Department. The plan utilized population projections completed by the Metropolitan Planning Commission for 2005 through 2020 and extended the projections to 2030 with the use of a 6 percent growth rate. A graph from this study which shows the projected population is shown in Figure 5-1.

Figure 5-1

Population Projections for Bossier City



5. Barksdale AFB Air Force Base Joint Land Use Study (2009)
   This study was completed under a contract with the Bossier City-Parish Metropolitan Planning Commission and with financial support from the Office of Economic Adjustment, Department of Defense. The partners for this study were Bossier Parish, Caddo Parish, the Cities of Bossier, Benton, Haughton and Shreveport. The purpose of the study was to create a community-based method for the formulation of solutions which address land use issues surrounding the military installation. Since the study was adopted, the community appointed a Barksdale AFB retiree to the Bossier City Zoning Board. This study did not complete an independent population projection calculation. Instead, it references the projections completed in the Bossier City Comprehensive Plan.

6. The National Cyber Research Park Overlay District Guidelines (date unknown)
   These guidelines were created to serve as a guide for growth within the Bossier City's National Cyber Research Park Planned Development Overlay District. According to the Bossier City Code of Ordinances, overlay districts allow for additional requirements to be placed on general zoning districts. These guidelines protect residents in the National Cyber Research Park and encourage a campus like environment for future development. While this guide is useful for the future growth and land development, it did not provide any population projection data.

7. Greenwood, Louisiana Comprehensive Master Plan (2007)
   This plan was prepared by the Coordinating and Development Corporation (CDC) for the Town of Greenwood. It provides population projections based on previous population estimates provided at the website of city-data.com which indicated a growth rate of +5.2% from 2000 to 2004. The historic and projected populations which were indicated in this plan are shown in Table 5-3.

Table 5-3
Projected Population of Greenwood

2000	2004	2008	2012	2016	2020
2,458.00	2,587.00	2,722.00	2,863.00	3,012.00	3,169.00

   This plan also referenced an *Assessment of Existing Water Supply and Wastewater treatment Facilities for the Town of Greenwood Caddo Parish*, dated April 2006, by BALAR Engineers & Surveyors. This study also provided population projections which are show in Table 5-4.

Table 5-4
Projected Population of Greenwood

2011	**2016**	**2026**
3,450.00	4,100.00	5,375.00

8. Blanchard Utilities 2010 Annual Report (2011)
   This report was prepared by the staff of Blanchard Utilities and provides general information about upgrades to the system and new equipment purchased during the year. It also provides information about different maintenance programs the utility system has implemented. This report did not provide any population data.

Table 5-5
Summary of Existing Alternative Community Projection Data

Source	Geographic Detail	Planning Horizon	Variables Projected	Projection Method	Comments
Shreveport-Caddo Master Plan	Shreveport	2030	Population	Benchmark Scenarios	Not for entire parish; short planning horizon
*Water and Wastewater Infrastructure Plan**	Shreveport and Caddo Parish	2030	Population	*	short planning horizon; older dataset used for projections
Bossier Comprehensive Land use and Development Plan	Bossier City	2020	Population	13 % growth rate	Not for entire parish; short planning horizon
Water System Improvement Plan	Bossier City	2030	Population	6% growth rate	Not for entire parish; short planning horizon
*Barksdale AFB Joint Land Use Study**	Bossier City	2020	Population	13 % growth rate	Not for entire parish; short planning horizon
Greenwood Comprehensive Master Plan	The Town of Greenwood	2020 ; 2026	Population	5.2% growth rate; Reference others	Not for entire parish; short planning horizon

*This plan only referenced population projections completed by others.

5.3.2 Sub-state Population Projections

5.3.2.1 Louisiana Department of Administration - 2007

Most states develop sub-state population projects for use in local planning studies and to assist policy makers. This type of project is outside of the statistical database completed by the US Census Bureau. Louisiana sub-state population projections were completed in 2007 by Mr. Troy Blanchard, Associate Professor of Sociology at Louisiana State University, for the Louisiana Department of Administration, Office of Electronic Services, Louisiana State Data Center. These projections provide population data through the year 2030 (Troy Blanchard, 2007).

The parish projections were completed for three population scenarios: high, middle and low population scenarios. It was recommended that the middle series be used for population scenarios through 2030 for most parishes. The high or low series were provided as alternatives for variations in net migration (Troy Blanchard, 2007). The net migration assumptions utilized for each of the three population scenarios are as follows:

- Middle Series – assumes the rate of migration experienced between 2000-2005 will remain constant through 2030
- Low Migration Series – the rate of migration through 2030 will be half of what was experienced between 2000-2005
- High Migration Series – the rate of migration through 2030 will be one and one-half of what was experienced between 2000-2005

These projections utilize birth and death rates based on vital statistics data from 2000-2004 and hold the rates at a constant. The projections were adjusted for the impacts of Hurricanes Katrina and Rita (Troy Blanchard, 2007). The results of the middle series for these projections are summarized in Table 5-6.

Table 5-6
Louisiana Department of Administration Parish Population Projections

	2005	2010	2015	2020	2025	2030
Caddo	250,470	247,970	244,650	240,880	236,610	231,790
Bossier	105,430	112,470	119,660	126,780	134,010	141,350

These projections approximated that the 2010 populations for Caddo and Bossier Parishes would be 247,970 and 112,470 respectively. According to the US Census 2010 data, the actual populations for these parishes were 254,969 for Caddo Parish and 116,979 for Bossier Parish. This represents a difference of approximately 7,000 for Caddo Parish and 4,500 for Bossier Parish, which correlates to a percentage increase of 2.7% and 3.9% for Caddo and Bossier Parishes, respectively.

5.3.2.2 Louisiana Statewide Transportation and Infrastructure Plan - 2008

The review and status report for the Louisiana Statewide Transportation Plan was completed by Wilbur Smith, Associates for the Louisiana Department of Transportation and Development in 2008. This plan provides a blueprint for investment into transportation infrastructure and also provided parish-level population projections in an effort to determine the future traffic volumes which yield future transportation needs. The projections shown in this plan were developed by Woods and Poole Economics. They complete annual population projections for every state, region, county and Metropolitan and Micropolitan Area in the United States.

These projections estimated that the 2010 population for Caddo and Bossier Parishes would be 257,106 and 111,227, respectively. This represents an over estimation of approximately 2,100 for the 2010 Caddo Parish population and an under estimation of approximately 5,700 for Bossier Parish. This is a percentage difference of approximately -0.8 % and 4.9% for Caddo and Bossier Parishes respectively.

This plan also provided 2030 populations projections. They were estimated to be 273,595 and 139,499 for Caddo and Bossier Parishes respectively.

5.4 Approach to Population Projection Calculations

In order to effectively evaluate the future water demand for Caddo and Bossier Parishes, adequate population projections are necessary. It was determined that independent population projection calculations should be completed for this study because the existing studies either utilized census data which is no longer the most current, had geographic boundaries which were smaller than the parish level, or did not project to the desired target year. However, the sub-state projections completed by Mr. Troy Blanchard in 2007 and Woods and Poole in 2008 were extended to the 2035 projection horizon and compared to the calculations for this study. The largest projected population totals would be utilized for the final water demand calculations.

The demographic projection approach adopted for this effort was the Cohort-Component Method. This method projects the three components of population change separately for each birth cohort (person born in a given year). A cohort is a group of people who experience a common demographic event at a particular time. The Cohort-Component projects the population by age (usually five year age groups) and gender.

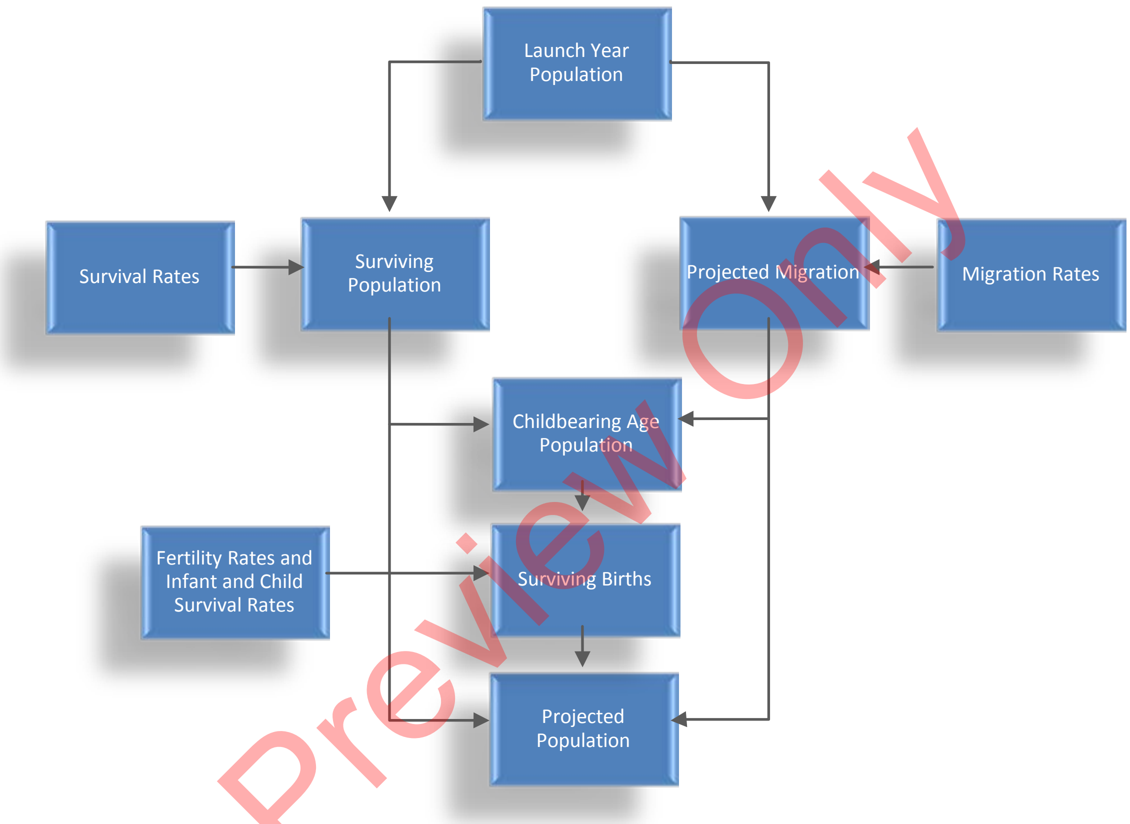
Since the 1940's, the Cohort-Component Method has been the projection method utilized by the US Census Bureau. Surveys also show that it is the method of choice for state projections; 89% of states which make state level projections use this method. In addition, it is commonly used for county and sub-county level projections (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

This study calculated the estimated population based on five-year age groups. 2010 was used as the launch year along with five target years: 2015, 2020, 2025, 2030 and 2035. A detailed discussion of this process is provided in the sections which follow. The methods utilized in this study closely follow those presented by Stanley K. Smith, Jeff Tayman and David Swanson in 2001.

5.5 Unadjusted Population Projection Calculations

The Cohort-Component Method requires four steps to be calculated in the following sequence: Mortality, Migration, Fertility and the Final Projection. The amount of the launch year population who will survive to the target year is determined, followed by the calculations for net migration. The number of births is approximated based on the total number of females who are of childbearing age. These three components are combined to result in the total population for the target year. Figure 5-2 shows the process involved in the Cohort-Component Method. In the sections which follow, a detailed description is provided for each of the four steps and equations for each of the variables are shown.

Figure 5-2
Overview of Cohort-Component Method



Source: Stanley K. Smith, Jeff Tayman and David Swanson. 2001

5.5.1 Step 1 - Mortality Calculations

This step determines the number of people who are living during the launch year and who will survive to the target year. This is calculated by multiplying the base year population by the survival rate for each age group. Survival rates indicate the probability of surviving from one age group into another. The survival rates can be calculated from life tables. Life tables are used to measure mortality, survivorship and the life expectancy of a population at varying ages. These tables show the probability of a person at a certain age dying before they reach another exact age. Life tables have six basic functions which are listed below:

1. Portion dying ($_nq_x$) – The probability of dying between the ages of x and x+n. This function represents the portion of persons in the cohort who are alive at the beginning of the indicated age interval (x) who will die before reaching the end of that age interval (x+n).

2. Number surviving (l_x) – the number of persons who survive to specific age (x) out of the beginning cohort of 100,000 live births. 100,000 is the typical total number of births assumed for the hypothetical cohort of newborn babies, who are subject to the age-specific mortality rates on which the table is based.

3. Number dying ($_nd_x$) – The number of persons who would die within the indicated age interval (x to x+n) out of the total number of persons alive at the beginning of the interval.

4. Person-years lived during an age interval ($_nL_x$) - The number of person-years that would be lived within the indicated age interval (x to x+n). For example, consider a cohort between the ages of 30-35. If 96,000 persons reach the age 20 and 95,000 survive to age 35, the total person years would be (95,000 x5 = 475,000 person-years) and the 594 who die would live varying periods of time, averaging approximately 2 ½ years (1000 x 2.55 = 2,550 person-years).

5. Total person-years yet to be lived (T_x) – The summed total of person-years lived during this and all following age intervals.

6. Life expectancy (e_x) – The average number of years remaining for a person who survives to the beginning of the indicated age interval.

Life tables are typically based on age-specific death rates for a three-year time period, generally around a census taking. They are prepared every ten years. For example, the census for year 2000 would be used as the base population for the age-specific death rates for 1999, 2000, and 2001. The life tables utilized for this study were for the state of Louisiana, US Decennial Life Tables for 1989-91 which were completed by the Centers for Disease Control and Prevention/Nation Center for Health Statistics. The decennial life tables are the only source for State life expectancy data available at the National Center for Health Statistics. These tables appeared to be the most current available for the State of Louisiana. These life tables are based on age-specific death rates for the period 1989-91. Data from the 1990 census were used to calculate the death rates occurring in the three-years 1989-91 (Department of Health and Human Services and CDC. 2008).

Life tables are classified as two types: unabridged and abridged. These two types of life tables differ by the age intervals in which the data is presented. An unabridged life table has survival information for every single year of age spanning from birth to the last applicable age. An abridged life table has survival information which is provided for age groups (US Department of Commerce. 1971.). Common intervals for abridged life tables are five and ten years. Both types of tables are useful for projections but it is recommended that the life table age groups match the projection intervals. This analysis used the information from a US Decennial unabridged life table to create a five-year abridge life table which was used to calculate the survival rates for Caddo and Bossier Parishes. Table 5-7 shows the resulting abridged life table which was utilized in this study to calculate the survival rates.

Table 5-7
Abridge Life Table for Louisiana

	Probability of dying between ages x to x+n	Number surviving to age x	Number dying between ages x to x+n	Person-years lived between ages x to x+n	Total number of person - years lived above age x	Number of years remaining
	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	^0e_x
Under 5 years	0.01116	100000	1113	495422	7,428,337	74.28
5 to 9 years	0.00115	98887	114	494124	6,932,914	70.11
10 to 14 years	0.00139	98773	138	493600	6,438,790	65.19
15 to 19 years	0.00454	98635	447	492177	5,945,190	60.27
20 to 24 years	0.00707	98188	691	489270	5,453,013	55.54
25 to 29 years	0.00777	97496	755	485599	4,963,743	50.91
30 to 34 years	0.00836	96742	807	481742	4,478,143	46.29
35 to 39 years	0.01068	95936	1019	477252	3,996,400	41.66
40 to 44 years	0.01522	94916	1436	471205	3,519,149	37.08
45 to 49 years	0.02268	93481	2102	462473	3,047,944	32.60
50 to 54 years	0.03398	91380	3065	449693	2,585,471	28.29
55 to 59 years	0.05098	88316	4411	431183	2,135,779	24.18
60 to 64 years	0.07695	83905	6261	404714	1,704,596	20.32
65 to 69 years	0.1161	77644	8607	367732	1,299,881	16.74
70 to 74 years	0.17568	69037	11307	318010	932,149	13.50
75 to 79 years	0.26486	57729	13758	255066	614,139	10.64
80 to 84 years	0.40297	43971	15091	182217	359,073	8.17
85 years and over	0.60686	28879	13767	108802	176,854	6.12

The survival rates are calculated based on two columns in the life table, ${}_nL_x$ and T_x. The survival rates for this study were computed for five-year intervals using the calculated abridged life table for the state of Louisiana shown in Table 5-7. The equation typically used to calculate the survival rates for persons up to the oldest age group is shown below:

$${}_5S_x = {}_5L_{x+5} / {}_5L_x$$

Where,

${}_5S_x$ = the survival rate between the ages of x and x+5
${}_5L_{x+5}$ = the number of person-years lived between the ages of x+5 and x+10
${}_5L_x$ = the number of person-years lived between the ages of x and x+5

It is standard practice to use a slightly different equation to calculate the survival rates for persons in the oldest age group because it is an open-ended group. This equation replaces L values with T values as follows:

$$S_x = T_{x+5} / T_x$$

Where,

S_x = survival rate after age x
T_{x+5} = the total persons lived after age x+5
T_x = the total persons lived after age x

It is worth mentioning that the survival rates for ages 0-1 are often calculated separately from children aged 1-4 to account for the high rates of mortality in the first year of life. This distinction was less important in this study because these projections will not be used for detailed analyses of mortality. The calculated survival rates used for this study are shown in Table 5-8.

Table 5-8
Calculated Survival Rates

Age in years 2010	Survival Rate
Under 5 years	0.99738
5 to 9 years	0.99894
10 to 14 years	0.99712
15 to 19 years	0.99409
20 to 24 years	0.99250
25 to 29 years	0.99206
30 to 34 years	0.99068
35 to 39 years	0.98733
40 to 44 years	0.98147
45 to 49 years	0.97237
50 to 54 years	0.95884
55 to 59 years	0.93861
60 to 64 years	0.90862
65 to 69 years	0.86479
70 to 74 years	0.80207
75 to 79 years	0.71439
80 to 84 years	0.59710
85 years and over	0.49253

Once the survival rates were determined, the population surviving to the target year was calculated using the following equation:

$${}_nSURVP_{x+z,t} = {}_nP_{x,l} \ \text{x} \ {}_nS_x$$

Where,

x = the youngest age in the age group
n = the number of years in the age group
z = the interval between the launch and target years
t = the target year
l = the launch year
SURVP = the surviving population
P = the population
S = the probability of surviving for z or more years

The projections of surviving population for Caddo and Bossier Parishes are shown in Table 5-10 through Table 5-14 on pages 5-19 through 5-23.

5.5.2 Step 2 - Migration Calculations

Once the surviving population has been determined, the next step is to calculate the in-migration and out-migration. This study applied the migration rates to the base-year populations which is an acceptable practice. The in-migration rates are equal to the number of in-migrants divided by the base year population for the parish under consideration. The out-migration rates are equal to the number of out-migrants divided by the base year population for the parish under consideration. These equations are expressed below.

$$ {}_{n}INMIG_{x+z,\, l\ to\ t} = {}_{n}P_{x,\, l} \ \text{x} \ {}_{n}INMIGRATE_{x,\, l\ to\ t} $$
$$ {}_{n}OUTMIG_{x+z,,\, l\ to\ t} = {}_{n}P_{x,\, l} \ \text{x}\ OUTMIGRATE_{x,\, l\ to\ t} $$

where,

P	= the population of the area to be projected
INMIG	= the projection of in-migrants
INMIGRATE	= the z-year in-migration rate
OUTMIG	= the projection of out-migrants
OUTMIGRATE	= the z-year out-migration rate
x	= the youngest age in the age group
n	= the number of years in the age group
t	= the target year
l	= the launch year
z	= the interval between the launch and target years

The aforementioned methods for projecting migration have only been for domestic (or internal) migration. Domestic migration represents the moves which take place within the same country. International migration results when a move takes place from one country to another. Domestic migration has the greatest impact on population growth and demographic change for most state and local populations (Stanley K. Smith, Jeff Tayman and David Swanson. 2001). This has also proven to be true for Caddo and Bossier Parishes. For example, the 2010 census shows that international migration represents less than 3% of each of the parishes' total movers.

For this study the international migration was included in the in-migration numbers only. There was no deduction made for out-migration. This results in a slightly more conservative projected population estimate.

The calculated unadjusted in-migration and out-migration totals are shown in Table 5-10 through Table 5-14 on pages 5-19 through 5-23.

5.5.3 Step 3 - Fertility Calculations

After migration was approximated, a projection for the number of births was completed. In addition, the impact of mortality and migration on the youngest age group was calculated. The females of childbearing age (the at-risk female population) was multiplied by the projected ASBRs. This calculation was computed for each female age group and summed to determine the total number of births. Historic proportions were used to allocate the births into male and female categories. The final step was to calculate the population surviving from this group to the target year, which will result in the population for the youngest age group.

Members of the female population will age during the projection interval which causes them to pass from one age group to another. It is assumed that these female members will spend on average half of the projection interval in one age group and half in the next higher age group. In order to accommodate for this aging process, the ASBRs are adjusted. The adjusted ASBR is equal to the average of the two age groups rates(Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

Some members of the female population will also die during the projection interval. It is assumed that these females members who die live through half of the projection interval. To account for this, the launch populations are reduced by one-half of the deaths that are expected during the time interval (Stanley K. Smith, Jeff Tayman and David Swanson. 2001).

Adjustments are then made for migration. The female in-migrants are added into the at-risk population and the female out-migrants are subtracted. The equations for the fertility calculations are shown below:

$${}_{n}ADJASBR_{x,t} = ({}_{n}ASBR_{x,t} + {}_{n}ASBR_{x+5,t})/2$$
$${}_{n}ATRISKFP_{x,t} = {}_{n}FP_{x,l} - (0.5 \text{ x } {}_{n}FD_{x,\, l \text{ to } t}) + ({}_{n}FINMIG_{x+z.,\, l \text{ to } t}) - ({}_{n}FOUTMIG_{x+z,\, l \text{ to } t})$$
$${}_{n}B_{x,\, l \text{ to } t} = {}_{n}ADJASBR_{x,\, t} \text{ x } {}_{n}ATRISKFP_{x,\, t}$$
$$B_{l \text{ to } t} = \sum {}_{n}B_{x,\, l \text{ to } t}$$
$$MB_{l \text{ to } t} = B_{l \text{ to } t} \text{ x } PCTM$$
$$FB_{l \text{ to } t} = B_{l \text{ to } t} - MB_{l \text{ to } t}$$
$${}_{n}M_{0,\, t} = MB_{l \text{ to } t} \text{ x } {}_{n}MS_{0}$$
$${}_{n}F_{0,t} = FB_{l \text{ to } t} \text{ x } {}_{n}FS_{0}$$

Where,

ASBR	= age-specific birth rate
ADJASBR	= adjusted age-specific birth rate
ATRISKFP	= at-risk female population
FP	= female population
FD	= female deaths
FINMIG	= the projection of female in-migrants
FOUTMIG	= the projection of female out-migrants

B	= the projection of total births
MB	= the projection of male births
PCTM	= the proportion of births that are male
FB	= the projection of female births
$_nM_{0,t}$	= the male population projection in the youngest age group
$_nMS_0$	= the male infant and child survival rate
$_nF_{0,t}$	= the female population projection in the youngest age group
$_nFS_0$	= the female infant and child survival rate
x	= the youngest age in the age group
n	= the number of years in the age group
t	= the target year
l	= the launch year
z	= the interval between the launch and target years

The results of the calculations are shown in the first row of Table 5-10 through Table 5-14 on pages 5-19 through 5-23 for the youngest age group in each parish.

5.5.4 Step 4 - Final Projection Calculations

Once the mortality, migration and fertility projections were completed, the final projections were calculated. This process combines the results from each of these projections for all but the youngest age group. The youngest age group is equal to the surviving births calculated based on the fertility projection calculations only. The equation used to calculate the population for all age groups is as follows:

$$_nP_{x+z,t} = {}_nSURVP_{x+z,t} + {}_nINMIG_{x+z,l\ to\ t} - {}_nOUTMIG_{x+z,\ l\ to\ t}$$

where,

P	= the population of the area to be projected
INMIG	= the projection of in-migrants
OUTMIG	= the projection of out-migrants
SURVP	= the surviving population
x	= the youngest age in the age group
n	= the number of years in the age group
t	= the target year
l	= the launch year
z	= the interval between the launch and target years

The population projection calculations based on each planning horizon is shown in Table 5-10 through Table 5-14 on pages 5-19 through 5-23. The total population calculated utilizing the aforementioned methods is summarized in Table 5-9 and will be referenced throughout this study as the unadjusted population totals. An analysis of how these totals compare to population projections completed by others will be provided in later sections in this phase.

Table 5-9

Unadjusted Parish Population Totals		
Year	Caddo	Bossier
2015	260,720	122,360
2020	265,490	127,340
2025	268,990	132,360
2030	271,340	137,750
2035	273,160	143,760

Table 5-10
2015 Population Calculation Table

Age in years 2015	2015 Population Surviving		2010 to 2015 Deaths		2010 to 2015 In-Migration		2010 to 2015 Out-Migration		Total 2015 Population	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
Under 5 years	19,702	9,789	11	5	-	-	-	-	19,702	9,789
5 to 9 years	17,812	8,645	47	23	625	1,309	1,597	1,045	16,840	8,909
10 to 14 years	17,407	8,483	18	9	836	1,087	935	532	17,308	9,038
15 to 19 years	16,875	8,128	49	24	812	1,043	908	511	16,780	8,661
20 to 24 years	17,754	7,662	105	46	1,661	1,245	1,581	946	17,833	7,962
25 to 29 years	18,112	8,341	137	63	2,518	1,639	2,252	1,536	18,378	8,444
30 to 34 years	18,636	9,314	149	75	1,897	1,117	1,635	1,368	18,898	9,064
35 to 39 years	16,248	8,044	153	76	1,657	966	1,428	1,183	16,477	7,828
40 to 44 years	15,009	7,693	193	99	775	810	630	636	15,155	7,867
45 to 49 years	14,484	7,236	273	137	753	767	612	602	14,625	7,401
50 to 54 years	16,711	8,025	475	228	739	536	522	635	16,928	7,926
55 to 59 years	17,702	7,615	760	327	794	516	560	611	17,935	7,520
60 to 64 years	16,088	6,379	1,052	417	480	306	371	366	16,196	6,319
65 to 69 years	12,791	5,328	1,286	536	394	264	305	316	12,880	5,276
70 to 74 years	8,875	3,807	1,388	595	133	97	116	175	8,893	3,729
75 to 79 years	6,304	2,876	1,556	710	102	79	89	142	6,318	2,813
80 to 84 years	4,655	1,989	1,861	795	39	17	255	-	4,439	2,006
85 to 89 years	3,088	1,060	2,083	716	31	11	202	-	2,916	1,071
90 years and over	2,380	728	2,453	750	29	9	189	-	2,220	737

Note: Migration is not calculated for the age group under five years.

Table 5-11
2020 Population Calculation Table

Age in years 2020	2020 Population Surviving		2015 to 2020 Deaths		2015 to 2020 In-Migration		2015 to 2020 Out-Migration		Total 2020 Population	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
Under 5 years	19,301	9,745	11	5	-	-	-	-	19,301	9,745
5 to 9 years	19,651	9,763	52	26	690	1,478	1,762	1,180	18,578	10,061
10 to 14 years	16,822	8,900	18	9	808	1,140	903	558	16,728	9,482
15 to 19 years	17,258	9,012	50	26	831	1,157	928	566	17,161	9,602
20 to 24 years	16,681	8,610	99	51	1,561	1,399	1,486	1,063	16,756	8,946
25 to 29 years	17,699	7,902	134	60	2,461	1,553	2,201	1,455	17,959	8,000
30 to 34 years	18,232	8,377	146	67	1,856	1,005	1,600	1,230	18,488	8,152
35 to 39 years	18,722	8,980	176	84	1,909	1,079	1,645	1,320	18,985	8,738
40 to 44 years	16,268	7,729	209	99	840	814	683	639	16,426	7,903
45 to 49 years	14,874	7,721	281	146	773	818	628	643	15,019	7,897
50 to 54 years	14,220	7,196	404	205	629	481	444	569	14,405	7,108
55 to 59 years	16,232	7,600	697	326	728	515	514	610	16,446	7,506
60 to 64 years	16,834	7,059	1,101	462	502	338	389	405	16,948	6,992
65 to 69 years	14,716	5,741	1,480	577	453	284	351	340	14,819	5,686
70 to 74 years	11,138	4,563	1,742	713	167	116	146	209	11,160	4,470
75 to 79 years	7,133	2,991	1,760	738	116	82	101	148	7,148	2,925
80 to 84 years	4,513	2,009	1,804	803	38	17	247	-	4,304	2,026
85 to 89 years	2,651	1,198	1,789	808	27	12	174	-	2,504	1,210
90 years and over	2,530	890	2,607	917	31	-	201	-	2,360	890

Note: Migration is not calculated for the age group less than five years.

Table 5-12
2025 Population Calculation Table

Age in years 2025	2025 Population Surviving		2020 to 2025 Deaths		2020 to 2025 In-Migration		2020 to 2025 Out-Migration		2025 Population	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
Under 5 years	18,717	10,045	10	5	-	-	-	-	18,717	10,045
5 to 9 years	19,250	9,720	51	26	676	1,472	1,726	1,175	18,200	10,017
10 to 14 years	18,559	10,051	20	11	892	1,288	996	630	18,454	10,708
15 to 19 years	16,679	9,455	48	27	803	1,214	897	594	16,585	10,074
20 to 24 years	17,059	9,546	101	57	1,596	1,551	1,519	1,178	17,136	9,918
25 to 29 years	16,630	8,879	126	67	2,312	1,745	2,068	1,635	16,874	8,989
30 to 34 years	17,817	7,936	143	64	1,814	952	1,563	1,165	18,067	7,723
35 to 39 years	18,316	8,076	172	76	1,867	970	1,609	1,187	18,574	7,859
40 to 44 years	18,745	8,627	241	111	968	909	787	714	18,926	8,822
45 to 49 years	16,121	7,757	304	146	838	822	681	645	16,278	7,934
50 to 54 years	14,604	7,679	415	218	646	513	456	608	14,794	7,585
55 to 59 years	13,812	6,816	593	293	619	462	437	547	13,995	6,731
60 to 64 years	15,436	7,045	1,010	461	460	338	356	404	15,540	6,979
65 to 69 years	15,399	6,353	1,549	639	475	315	367	376	15,507	6,292
70 to 74 years	12,815	4,917	2,004	769	193	125	167	226	12,840	4,816
75 to 79 years	8,951	3,585	2,209	885	145	98	126	177	8,970	3,506
80 to 84 years	5,106	2,090	2,041	835	43	18	280	-	4,869	2,107
85 to 89 years	2,570	1,210	1,734	816	26	12	168	-	2,427	1,222
90 years and over	2,395	1,034	2,468	1,066	29	-	190	-	2,234	1,034

Note: Migration is not calculated for the age group under five years.

Table 5-13
2030 Population Calculation Table

Age in years 2030	2030 Population Surviving		2025 to 2030 Deaths		2025 to 2030 In-Migration		2025 to 2030 Out-Migration		2030 Population	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
Under 5 years	18,491	10,751	10	6	-	-	-	-	18,491	10,751
5 to 9 years	18,668	10,019	49	26	655	1,517	1,674	1,211	17,650	10,325
10 to 14 years	18,181	10,006	19	11	874	1,282	976	628	18,078	10,661
15 to 19 years	18,401	10,677	53	31	886	1,371	990	671	18,297	11,377
20 to 24 years	16,487	10,015	98	60	1,542	1,627	1,468	1,236	16,561	10,406
25 to 29 years	17,008	9,844	129	74	2,365	1,934	2,115	1,812	17,257	9,966
30 to 34 years	16,740	8,917	134	71	1,704	1,070	1,469	1,309	16,975	8,678
35 to 39 years	17,899	7,651	168	72	1,825	919	1,573	1,125	18,151	7,445
40 to 44 years	18,339	7,759	235	100	947	817	770	642	18,516	7,935
45 to 49 years	18,576	8,659	351	163	965	918	784	721	18,756	8,856
50 to 54 years	15,828	7,714	450	219	700	516	494	610	16,034	7,620
55 to 59 years	14,185	7,273	609	312	636	493	449	583	14,372	7,182
60 to 64 years	13,135	6,318	859	413	392	303	303	362	13,224	6,258
65 to 69 years	14,120	6,341	1,420	638	435	314	337	376	14,219	6,279
70 to 74 years	13,410	5,441	2,097	851	202	138	175	250	13,436	5,330
75 to 79 years	10,299	3,863	2,542	953	167	106	145	191	10,321	3,778
80 to 84 years	6,408	2,505	2,562	1,001	54	21	351	-	6,111	2,526
85 to 89 years	2,908	1,258	1,962	849	29	13	191	-	2,746	1,271
90 years and over	2,296	1,111	2,366	1,145	28	-	182	-	2,142	1,111

Note: Migration is not calculated for the age group under five years.

Table 5-14
2035 Population Calculation Table

Age in years 2035	2035 Population Surviving		2030 to 2035 Deaths		2030 to 2035 In-Migration		2030 to 2035 Out-Migration		2035 Population	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
Under 5 years	18,880	11,770	10	6	-	-	-	-	18,880	11,770
5 to 9 years	18,443	10,723	48	28	647	1,623	1,654	1,296	17,436	11,050
10 to 14 years	17,631	10,314	19	11	847	1,322	947	647	17,532	10,989
15 to 19 years	18,026	10,630	52	31	868	1,365	970	668	17,924	11,327
20 to 24 years	18,189	11,310	108	67	1,702	1,837	1,620	1,396	18,270	11,751
25 to 29 years	16,437	10,328	124	78	2,285	2,029	2,044	1,901	16,678	10,456
30 to 34 years	17,120	9,887	137	79	1,743	1,186	1,502	1,452	17,361	9,621
35 to 39 years	16,817	8,597	158	81	1,715	1,033	1,478	1,264	17,054	8,366
40 to 44 years	17,921	7,351	230	94	926	774	752	608	18,094	7,517
45 to 49 years	18,173	7,788	343	147	944	825	767	648	18,350	7,965
50 to 54 years	18,238	8,611	518	245	807	576	569	681	18,475	8,506
55 to 59 years	15,374	7,306	660	314	689	495	487	586	15,577	7,215
60 to 64 years	13,489	6,741	882	441	402	323	311	387	13,580	6,678
65 to 69 years	12,016	5,686	1,208	572	370	282	287	337	12,099	5,631
70 to 74 years	12,296	5,430	1,923	849	185	138	161	249	12,320	5,319
75 to 79 years	10,777	4,275	2,659	1,055	175	117	152	211	10,800	4,181
80 to 84 years	7,373	2,699	2,948	1,079	62	23	404	-	7,031	2,722
85 to 89 years	3,649	1,508	2,462	1,018	37	15	239	-	3,447	1,523
90 years and over	2,407	1,173	2,480	1,209	29	-	191	-	2,246	1,173

Note: Migration is not calculated for the age group under five years.

6.0 *Transportation and Growth*

History has proven the impact that transportation can have on the growth of population and economic development. From the rivers, to the rail systems, and more recently the highway networks, each of these has been used as critical transportation routes. Their impacts have been evident in the locations and growth of countless urban cities and even the expansion of previously rural communities. These historic trends continue to be evident today. Traditionally, it has been assumed that highway expansion leads to population growth and studies have been conducted which support this assumption (Lichter, D.T. and G.V. Fuguitt. 1980). The impacts due to proposed transportation improvements were considered and applied to the population projection calculations in this study. The section that follows presents information on the existing and proposed transportation infrastructure for Caddo and Bossier Parishes. Following this section is a discussion on how this information was applied to the population projection calculations.

6.1 Existing Transportation Infrastructure

Caddo and Bossier Parishes enjoy the benefits of being located at the crossroads of several existing and proposed major US Interstates. Interstate-20 runs west and east from Interstate-10 in southwest Texas and terminates at the intersection with Interstate-95 in Florence, South Carolina. It provides connectivity to Fort Worth and Dallas, Texas; Atlanta and Augusta, Georgia; and Columbia, South Carolina. The existing Interstate-49 corridor extends in a north-south direction from Interstate-10 in Lafayette, Louisiana to Interstate-20 in Shreveport, Louisiana. The proposed segment of Interstate-49 would extend this connectivity as far north as Kansas City, Missouri (Providence Engineering and Environmental Group, LLC. February 2010). The proposed Interstate-69 will extend from US Highway 171 near Stonewall, Louisiana to

Figure 6-1
Transportation Infrastructure Map

Interstate-20 near Haughton, Louisiana (Michael Baker Jr., Inc. 2005).

Caddo and Bossier Parishes also have several US Highways which provide additional access to the area. Highway 71 runs north-south which begins at the intersection with US Route 190 between Port Barre and Krotz Springs, Louisiana. It's most northern terminus is located at the US and Canadian border in International Falls, Minnesota. Highway 79 runs in a northeast-southwest diagonal direction beginning north of Austin, Texas at Interstate-35. Its northern terminus is located at US 68/ KY 80 duplex in Russellville, Kentucky.

In addition to the aforementioned transportation corridors, Interstate-220 forms a partial loop around the cities of Shreveport and Bossier. It is an east-west bypass route which begins at the western intersection with Interstate-20, north of the Shreveport Regional Airport in western Shreveport. It runs in a northeastern direction over Cross Lake, crosses the Red River north of the Shreveport Downtown Airport where it then crosses into the northern portion of Bossier City. It continues east and ends where it curves south and intersects with Interstate-20.

Figure 6.1 shows the existing and proposed transportation corridors.

6.1.1 Interstate Expansion in Caddo and Bossier Parish

In December 1991, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was signed into law by President George H. W. Bush. It required the development of High Priority Corridors on the National Highway System (NHS) and Congress identified twenty-one transportation corridors which would improve the safety and efficiency of travel and commerce and promote economic development. Interstate-49 and Interstate-69 were two corridors designated as nationally important by Congress.

6.1.1.1 Interstate-49 North Extension

Interstate-49 (I-49) North Extension is a new four-lane fully controlled highway corridor connecting Interstate-220 in Shreveport to the Arkansas state line which is proposed by the Louisiana Department of Transportation and Development (LADOTD), in conjunction with the Federal Highway Administration (FHWA). This project is located in Caddo Parish and will have a direct impact on the following communities (Providence Engineering and Environmental Group, LLC. 2010):

Shreveport	Blanchard	Mooringsport
Dixie	Oil City	Belcher
Gilliam	Vivian	Hosston
Mira	Rodessa	Ida

This proposed highway extends approximately 36 miles and has interchanges at Louisiana Highway 168, Mira-Myrtis Road, Louisiana Highway 2 near Hosston, US Highway 71 between Hosston and Gilliam, Louisiana Highway 530 west of Belcher, Louisiana Highway 169, Louisiana Highway 173 and Louisiana Highway 1.

According to a May 31, 2012 *Shreveport Times* article, the construction for four out of eleven of the highway's segments have been completed, five are currently under construction and two are planned to go out for bids prior to 2012. The Public Information Officer for LADOTD has indicated that the entire corridor is planned for completion by 2016.

6.1.1.2 Interstate-69 US171 to I-20

The Interstate-69 (I-69) project is a new four-lane fully controlled highway corridor connecting US Highway 171 near the Town of Stonewall, Desoto Parish and Interstate-20 near the town of Haughton. This project is a collective effort between LADOTD and the FHWA. It will extend approximately 35 miles and cross the Parishes of Bossier, Caddo and DeSoto. This project will directly connect the following communities:

Indianapolis	Evansville	Memphis
Shreveport/Bossier City	Houston	Lower Rio Grande Valley

6.2 Population Adjustments for Transportation Expansion

It has been established that access to interstate systems have impacts on economic growth and net migration at the county level. While some have argued that population growth precedes highway expansion, studies still show an advantage for county growth where interstates are constructed even when adjustments are made for the growth prior to the highway expansion (Lichter, D.T. and G.V. Fuguitt. 1980).

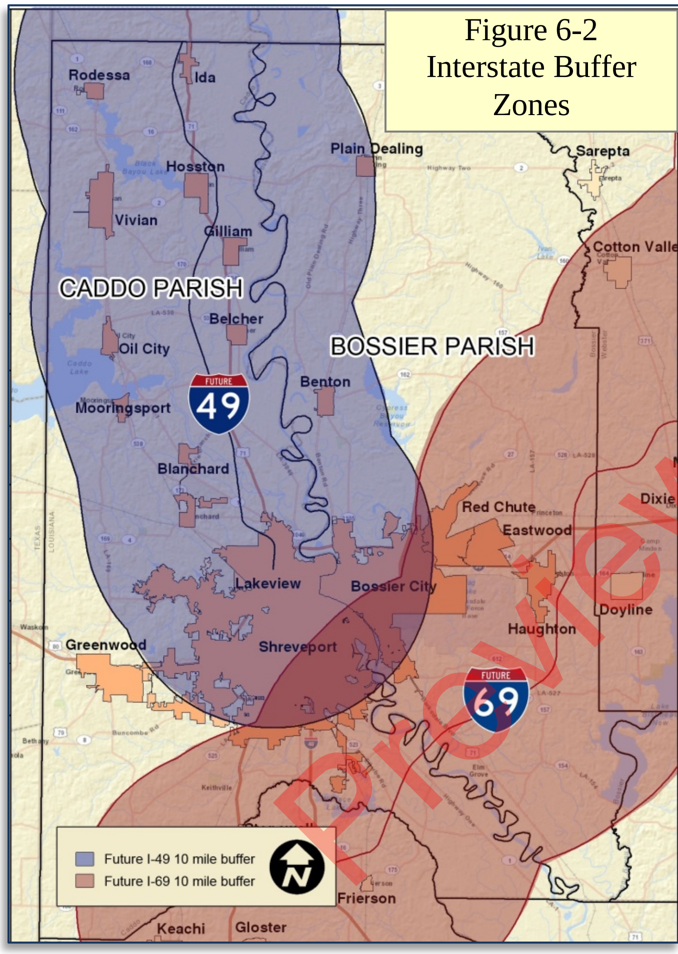


Figure 6-2 Interstate Buffer Zones

It has also been shown that there is a modest relationship between highway expansion and population growth among legally defined parish subdivisions, also known as minor civil divisions (MCDs), within 10-20 miles of the interstate system. As mentioned in the previous sections, there is planned construction for interstates (I-49 and I-69) within both Caddo and Bossier Parishes. Studies show that a 10% increase in a city's initial interstate highway system can result in about a 1.5% increase in its employment over a 20-year period (Gilles Duranton and Matthew Turner. 2011). This study accounted for increased employment due to interstate growth by adjusting the in-migration for communities located within ten miles of the proposed interstate highways. Figure 6-2 shows the communities which are located within a 10 mile buffer of the proposed I-49 and I-69 corridors. The population projections for these communities were adjusted based on the expected increase in employment. The calculations for these adjustments are outlined in the following portion of this report.

Before the calculations could be completed, several assumptions were required to fill data gaps and to insure a logical procedure for completing the calculations. The assumptions for these calculations are as follows:

Assumptions:

1. **Each community will have an increase in population based on their respective parish's increase in interstate construction.**
2. **The percentage of the parish's labor force represented by each community is equal to the percentage of the parish's population for 2010 represented by each community.**
3. **The new employment will be provided to in-migrants instead of existing residents.**
4. **Each new employee will bring additional in-migrants equal to the average household size to the community.**
5. **The total increase for the 20 year period will be obtained at projection year 2035 and the incremental increase will be at a constant rate.**

The lengths of existing and proposed interstates were determined utilizing GIS mapping and the percentage increase of interstate highway length for each parish was calculated. The total increase in employment for each parish was determined based on the 1.5% per 10% interstate growth. The community's increase in employment would be based on the results of this calculation which determined the employment percentage increase to be 16% for Caddo Parish and 23% for Bossier Parish. This employment percentage increase is only applied to the portion of the parish's population each community represents.

The employment rate is equal to the number employed divided by the labor force. The percentage each community represented of their parish's 2010 labor force was determined by multiplying the parish's labor force by the percentage each community represents of their parish's 2010 population. The increase in the number of people employed in each community was determined by multiplying the community's labor force by their parish's employment percentage increase. According to the 2010 US Census Bureau data, the average household size is 2.44 persons for Caddo Parish and 2.54 persons for Bossier Parish. The total employed was multiplied by the average household size to determine the estimated total in-migration due to the increase in interstate highway. The results of these calculations are shown in Table 6-1.

Table 6-1
Community In-Migration due to Interstate Construction

Community In-Migration Due to Interstate Growth in Caddo Parish					
Community Name	**2010**	**% of 2010 Caddo Pop**	**Total Increase in # employed by 2035**	**Total In-Migration by 2035**	**5-yr Incremental Increase**
Belcher	263	0.10%	19.2	46.9	11.7
Blanchard	2899	1.14%	211.7	516.7	129.2
Gilliam	164	0.06%	12.0	29.2	7.3
Hosston	318	0.12%	23.2	56.7	14.2
Ida	221	0.09%	16.1	39.4	9.8
Lakeview CDP	948	0.37%	69.2	169.0	42.2
Mooringsport	793	0.31%	57.9	141.3	35.3
Oil City	1008	0.40%	73.6	179.6	44.9
Shreveport	199311	78.17%	14557.7	35520.7	8880.2
Vivian	3671	1.44%	268.1	654.2	163.6
Rodessa	270	0.11%	19.7	48.1	12.0
	Total	**82.31%**	**15328.6**	**37401.8**	**9350.5**

Community In-Migration Due to Interstate Growth in Bossier Parish					
Community Name	**2010**	**% of 2010 Bossier Pop**	**Total Increase in # employed by 2035**	**Total In-Migration by 2035**	**5-yr Incremental Increase**
Benton	1948	2%	213.1	541.3	135.3
Bossier City	61315	52%	6708.3	17039.2	4259.8
Eastwood	4093	3%	447.8	1137.4	284.4
Haughton	3454	3%	377.9	959.9	240.0
Plain Dealing	1015	1%	111.0	282.1	70.5
Red Chute	6261	5%	685.0	1739.9	435.0
	Total	**67%**	**8543.2**	**21699.8**	**5424.9**

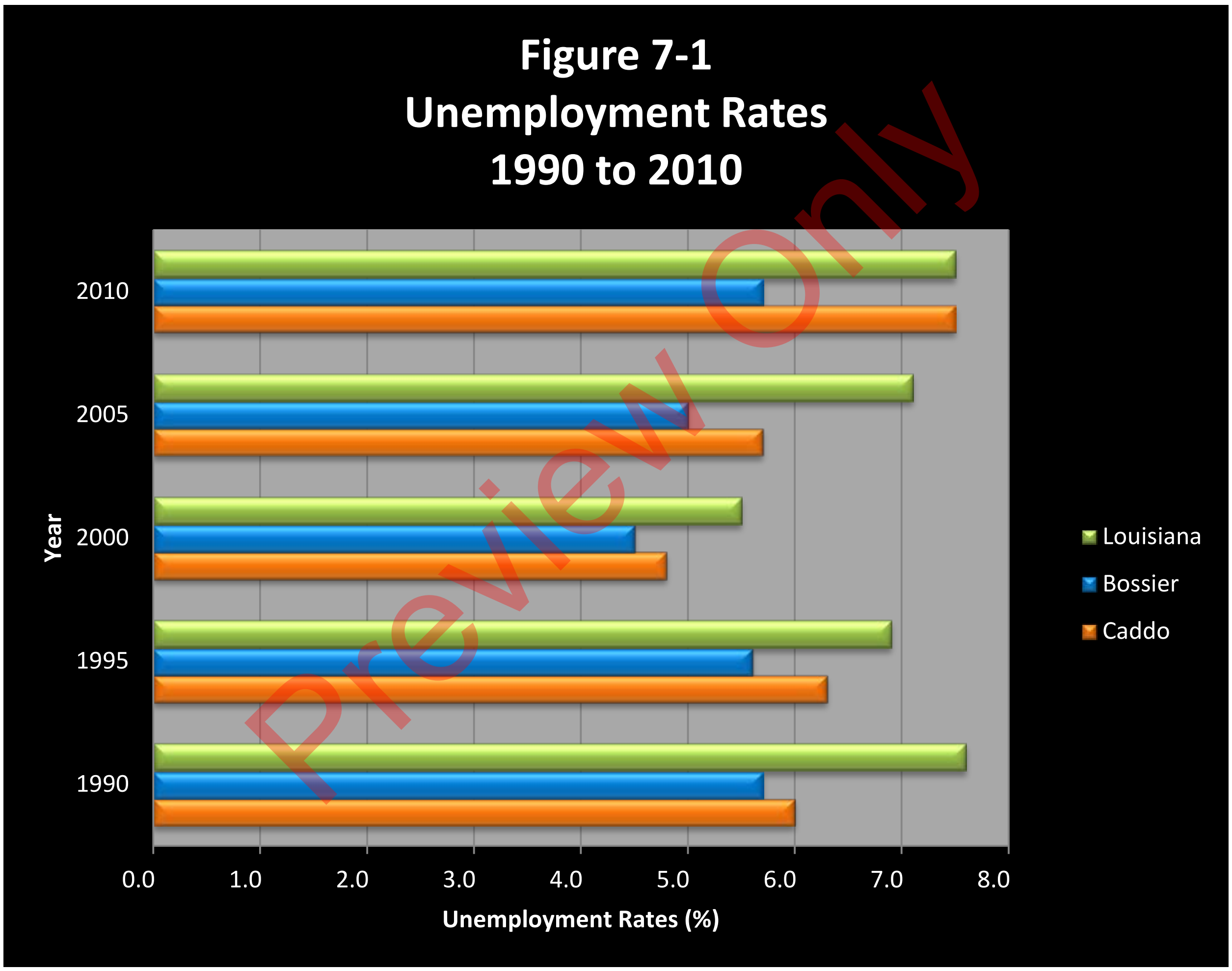
The total calculated 5-year incremental increase for these communities was added to the in-migration for each parish's projected population to produce population totals adjusted for interstate growth. The results of this calculation are shown in Tables 6-2

Table 6-2

Adjusted Parish Population Totals		
Year	Caddo	Bossier
2015	270,700	128,050
2020	285,530	138,990
2025	299,150	150,190
2030	311,650	161,960
2035	323,640	174,560

7.0 *Economic Development and Employment*

It is acceptable practice to adjust the projected population based on expected new employment, especially if the projected employment contradicts past trends. The following section documents some of the top historic and existing employers to establish regional trends. The future employment opportunities are then reviewed, followed by a discussion on the possible application of the data to the calculated population projections.



Source: US Bureau of Labor Statistics

7.1 Historic and Current Employment

Caddo and Bossier Parishes have enjoyed a history full of growth in employment and economic development. These parishes are the economic and healthcare center for northwest Louisiana, east Texas and southwest Arkansas (US Department of Housing and Urban Development. 2006).

The largest employer in northwest Louisiana, Barksdale AFB, (according to the North Louisiana Economic Partnership web site) is located within the limits of these two parishes employing approximately 8,655 people. Considering the above, it is no surprise that they have had unemployment rates which are typically lower than the rates historically experienced within the State of Louisiana (see Table 7-1). The Bureau of Economic Analysis formally recognized the area's growth when they ranked Shreveport-Bossier 9th nationally for gross domestic product growth according to the Cyber Innovation Centers website (www.cyberinnovationcenter.org).

7.1.1 Employment in the 1990's

In the 1990's, Caddo and Bossier Parishes were still feeling the impacts of the poor economy of the 1980's. Collectively, they experienced a loss of 3,300 workers between 1990 and 1993 but from 1993 through 1996, the labor force and resident employment increased by approximately 9,400 and 8,600 employees. This period of growth is due to the gambling industries which, for the first time, played a critical role in employment in this area. It was approximated in 2006 that they employed 8,300 workers. In the late 1990's, the growth in the labor force appeared to level off but resident employment continued to increase. These employment increases were due to growths in the educational, healthcare, professional, business services, retail trade and construction sectors. From 1990 to 1999, the unemployment rate declined from 5.9 to 4.1 percent.

7.1.2 Current Employment

In the 2000's, this growth continued. The annual resident employment in these parishes increased from 2000 to 2005 at a rate equal to the annual gains of the 1990's. The average unemployment rate remained unchanged through 2005 (US Department of Housing and Urban Development. 2006). In the late 2000's, growth continued in the region greatly due to the activity of the Haynesville Shale (Dr. Loren C. Scott and Associates. April 2010). The leading employers according to the North Louisiana Economic Partnership website (www.nlep.org) are shown in Figure 7-2. The sections which follow outline some of the larger employers within the parishes as well as the economic impacts of the Haynesville Shale activities.

Figure 7-2
Leading Employers in Caddo and Bossier Parish 2010-2011

Caddo Parish

- State of Louisiana Civil Service
- Caddo Parish School Board
- LSU Health Sciences Center
- Willis Knighton Health System
- City of Shreveport
- Christus Schumpert Health System
- U.S. Support Company
- Overton Brooks VA Medical Center
- Eldorado Resort Casino
- Libbey Glass, Inc
- The Arc of Caddo-Bossier
- Caddo Parish Sheriff's Office
- Gorman Group/Tango Transport, Inc.

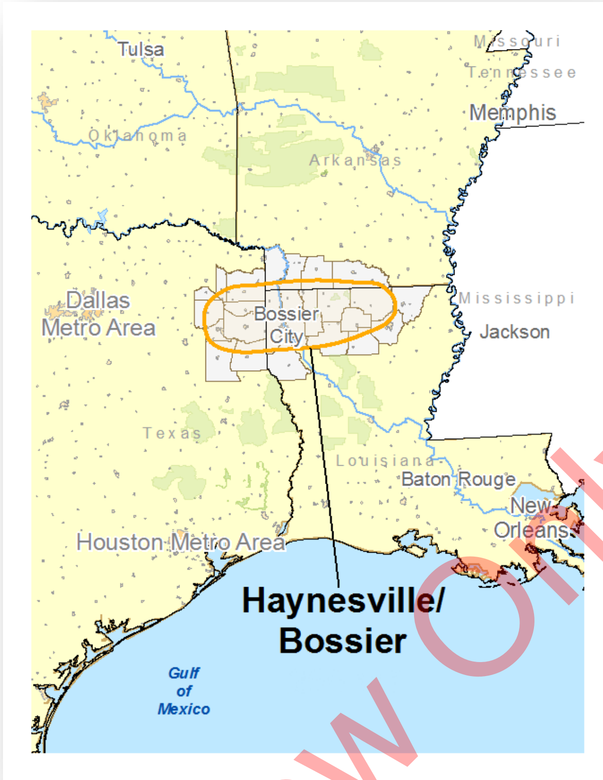
Bossier Parish

- Barksdale Air Force Base
- Bossier Parish School Board
- Harrah's Horseshoe Cosino & Hotel/Harrah's Louisiana Downs
- State of Louisiana Civil Service
- Willis Knighton Health System
- City of Bossier City
- Diamond Jack's Casino Resort
- Boomtown Casino
- Bossier Parish Community College
- Haliburton energy Services
- Wal-Mart Supercenter- Airline Drive
- Northwest Supports &Services Center
- Cellxion, LLC

7.1.3 Haynesville Shale

The Haynesville Shale, sometimes referenced as the Haynesville/Bossier Shale, is a rock formation located in northwestern Louisiana, southwestern Arkansas and eastern Texas. It covers an area of about 9,000 square miles and is located at depths of 10,500 to 13,000 feet below the ground surface. Its average thickness is 200 to 300 feet and it is estimated that there is as much as 251 trillion cubic feet of natural gas in the formation. Caddo and Bossier Parishes are two of six total parishes which make up the most active exploration and production areas. It has been estimated to be the largest onshore natural gas find in the US (LDNR. 2011). There was an increase of over 32,000 jobs, $2.4 billion in new business sales was generated, and $3.9 billion in household earnings was created within Louisiana in 2008 due to activities related to the Haynesville Shale (Dr. Loren C. Scott and Associates. April 2010).

Figure 7-3
Haynesville Shale Location Map



Source: Ground Water Protection Council and All Consulting, 2009

While geologists have known about the Haynesville Shale for many years before the play, it was not until 2008 that the technological advances and the rise in gas prices made the extraction of the natural gas economical. The projected economic impact of the Haynesville Shale activity is provided in Table 7-1.

Table 7-1
Projected Economic Impact of Haynesville Shale Activities: 2012-14

Year	Business Sales	Household Earnings	Jobs
2012	$11,281,082,402	$2,872,718,682	69,424
2013	$10,580,655,696	$2,694,525,036	62,883
2014	$10,580,655,696	$2,694,525,036	60,637

Source: Economic Impact of the Haynesville Shale on the Louisiana Economy

7.1.4 Barksdale Air Force Base

Barksdale AFB was founded in 1933 and is the largest employer in Bossier Parish. (The Coordinating and Development Corporation. 2012). It first served as a training facility for fighter crews in the 1930's. In the 1940's it was used to train A-20 and B-24 bombardment groups and in 1946 it became part of the Strategic Air Command. It is now the home of the B-52 bomber and the only B-52H combat crew training school in the United States. It is located within the Shreveport-Bossier City Metropolitan Area on a 22,000- acre property (Barksdale Air Force Base Joint Land Use Study. January 2009).

7.1.5 LSU Health Sciences Center-Shreveport

LSU Health Sciences Center-Shreveport is the largest single employer in Caddo Parish. It employs approximately 6,390 employees and is part of the LSU System (Goody Clancy and Associates, Inc. Adopted December 1, 2010). According to their web site (http://www.lsuhscshreveport.edu/AboutUs/FactsataGlance1.aspx), the Health Sciences Center generates over $500 million in revenue and has an economic impact of over $1 billion. The campus consists of Schools of Medicine, Allied Health Professions and Graduate Studies.

7.2 Future Economic and Demographic Scenarios

7.2.1 The Louisiana Economic Outlook for 2012-2013

The Louisiana Economic Outlook for 2012-2013 was released in October, 2011 which offered economic forecasts for eight of Louisiana's largest metropolitan areas. Shreveport-Bossier Metropolitan Statistical Area (MSA) was one of the areas included in the 2011 Outlook. It was projected that the closure of the GM plant would have a negative impact on the area's growth but that the coming years would still bring jobs to the area. Shreveport-Bossier MSA was projected to gain 1500 jobs (+0.9 percent) in 2012 and 2100 jobs (+1.2 percent) in 2013.

7.2.2 Margaritaville Casino & Resort

Margaritaville is a casino resort which is currently under construction near the Louisiana Boardwalk in Bossier City. The grand opening is scheduled for the summer of 2013 according to the company's website (www.margaritavillebossiercity.com) and has been projected to create an estimated 1,200 to 1,500 positions and 700 construction jobs. It has been projected that the City of Bossier will collect over $4 million due to growth and over $2 million in occupancy taxes associated with this development according to a July 2, 2012 article by the *Bossier Press-Tribune*.

7.2.3 InterTech Science Park

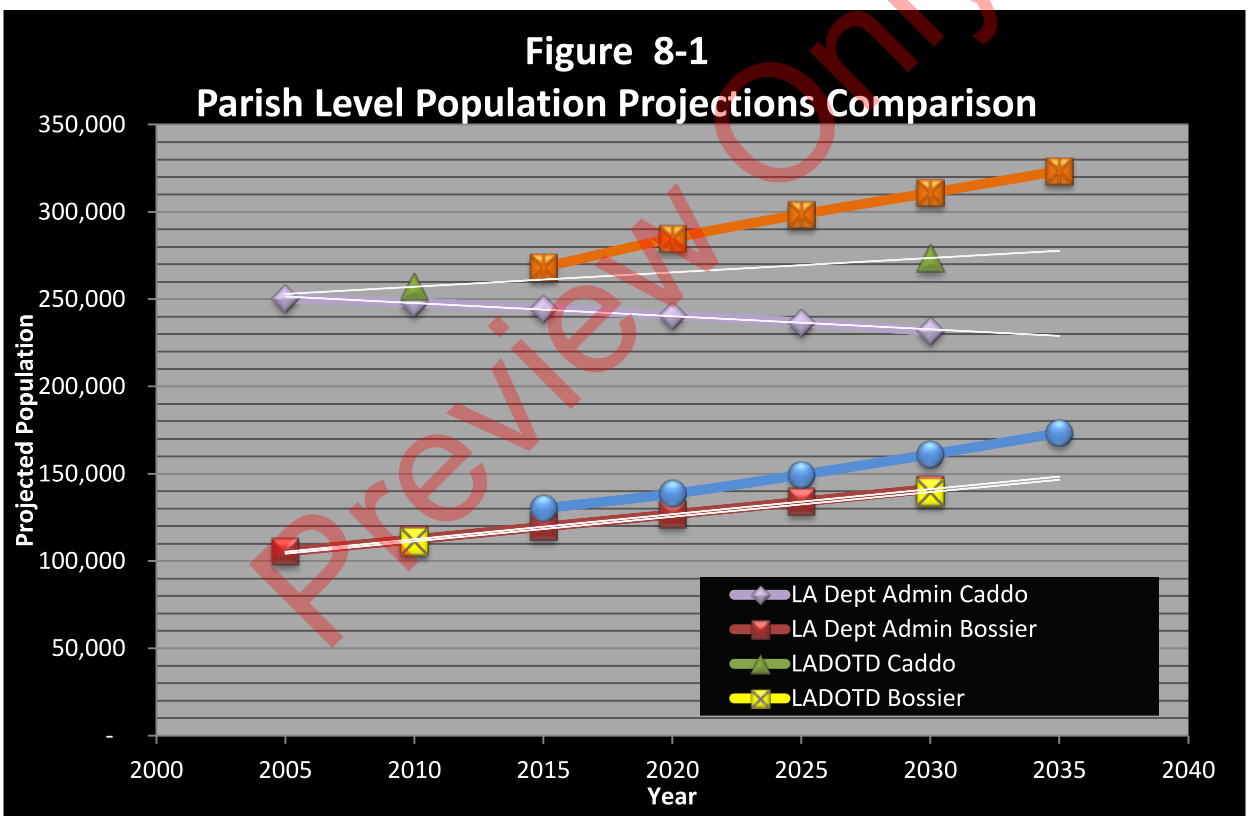
A plan for the development of InterTech Science Park was completed in 1997 and was implemented in 1998. It requires approximately 25 years for full build-out and is estimated to generate 6,000 new jobs. Once the plan is completed, the park will feature a technology-commercial building space, hotel, convention center, retail and restaurant space and a 16-acre residential subdivision (US Department of Housing and Urban Development. 2006).

7.3 Analysis of Economic Development and Employment

A comparison of the past employment trends and projected employment for Caddo and Bossier Parishes indicate that additional population adjustments due to employment are not warranted. The Haynesville Shale activities have been credited with over 4,000 direct jobs and over 50,000 indirect jobs. The projected impacts of the Haynesville Shale activities on employment show over 111,000 jobs for 2010 which decreases to approximately 60,600 in 2014 (Dr. Loren C. Scott and Associates. April 2010). This 2010 activity would have been already reflected in the in-migration rates used to calculate the initial population projections. The jobs created in association with the Haynesville Shale are large enough to accommodate the expected new employment through the projection horizon for this study. Consequently, it would be excessive to adjust the population projections for future employment.

8.0 *Comparison of Projected Populations*

As mentioned in earlier sections of this report, there are two other sources for parish projection estimates: the Louisiana Department of Administration (completed by Mr. Troy Blanchard) and the Louisiana Statewide Transportation Infrastructure Plan. The results of these projections are represented graphically with associated trendlines (shown in white) which have been linearly extrapolated to the year 2035 for comparison with the calculations completed in this study. A graphical comparison of the adjusted projections for this study and population projections completed by The Louisiana Department of Administration and the Louisiana Statewide Transportation Infrastructure Plan clearly show that the estimated population for this study will lead to the greatest projected population. Each population projection is shown in Figure 8-1.



Some of the differences between the population projections completed in other studies versus the projections for this study are likely due to the utilization of different datasets. For example, the projections completed by others use migration data collected prior the Haynesville Shale play but this study utilized Census data which include the impacts of the Shale play. Consequently, a drastic increase in the in-migration would be expected in association with the number of jobs created even though all of the studies were completed with similar projection methods.

It is desired to utilize justifiable data which will result in a conservative estimate for the projected water demand. Accordingly, it was determined that the population projections completed for this study should be used for the future water demand calculations.

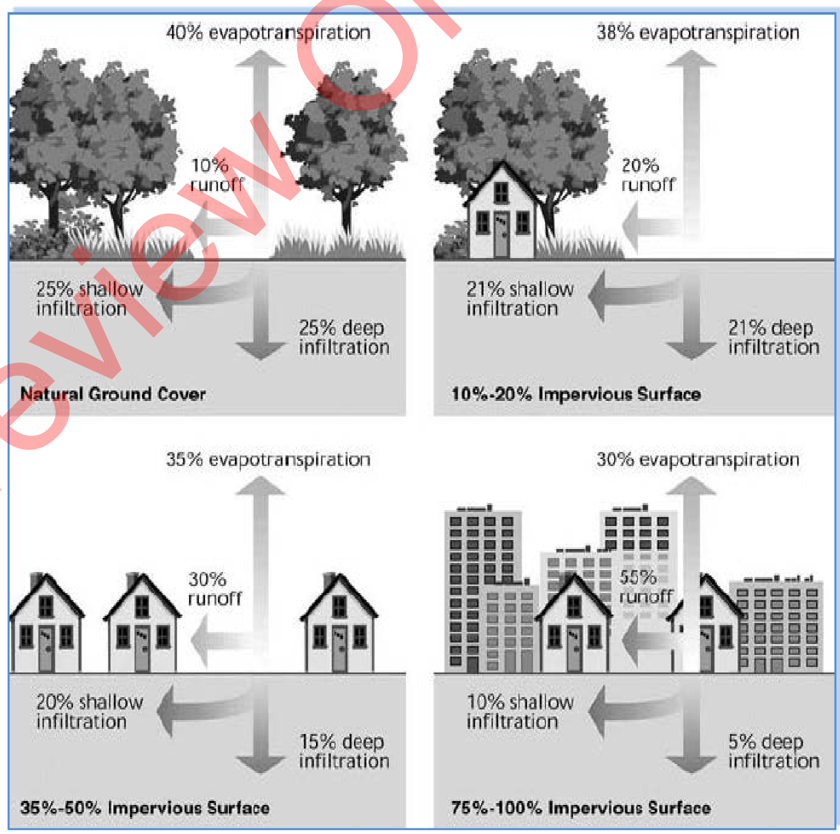
9.0 *Land Use and Development*

9.1 Development Impacts on the Water Resources

Development in areas which were previously undeveloped can impact the quantity of water absorbed through the soil, evaporated and runoff into nearby water bodies or drainage systems. As the amount of impervious cover increases, the amount of water which is absorbed through the soil to recharge aquifers decreases which can negatively affect drinking water supplies and stream baseflows. The construction of developments frequently requires the use of compacted soils which have decreased filter rates than the in-situ soils. These effects are illustrated in Figure 9-1

Undeveloped drainage areas have the natural ability to control the amount of pollutants which discharge to our water resources. Surface runoff in undeveloped areas is slower than the runoff rate of developed areas, therefore allowing for increased rates of soil infiltration. After being discharged into the stream, the runoff mixes with the carbon sediments and nutrients of the stream which undergoes natural processes making the water beneficial to the ecosystems downstream. These drainage areas form a balanced natural filtration system which often cannot be found in current development trends.

Figure 9-1
The Impacts of Impervious Cover on the Hydrologic Cycle



Source: EPA

Development has a direct impact on drainage areas and how they function. Surface runoff is increased which reduces the time to filter the precipitation before reaching water resources. This can decrease water quality as detention is reduced and the amount of water infiltrated into the soil. In addition, development can increase flooding, streambead erosion and sedimentation.

Even the construction activities can impact water quality as sediments and construction materials drain to nearby water bodies. Once construction is complete, the natural land cover is replaced with paved roadways, drives, parking, roof tops and other impervious materials. These are some of the reasons it is desirable to limit the amount of land which is impacted due to new development and the amount of impervious cover.

9.2 Land Use

There are many challenges that regions face in meeting the water demand for future growth, such as the cost associated with maintaining and replacing existing systems and the cost of constructing new facilities to meet the demand of new developments. Regions like Caddo and Bossier Parishes must also address issues related to water shortages associated with drought. The location of development as well as how the land is developed can greatly impact the quality, cost, availability, and demand of water. Increased development densities can minimize the impacts to regional water quality issues. Higher-density development produces less stormwater runoff and less impervious cover than low-density development for the same amount of development (EPA. 2006). The cost of water is impacted by the lot size and distance of development from the treatment plant. It costs more to serve dispersed large lots because of the increased size of distribution system required to connect the water source to the user and increased usage due to watering of larger lawns (EPA. 2004).

While population only grew approximately 15%, urban land area in the contiguous 48 states almost quadrupled from 18.6 million acres to 74 million acres between 1954 and 1997.

Source: EPA

Many utility systems are low on funding. This leads to maintenance being postponed and suspensions of required replacements. While facing these issues with funding, some still direct funds towards supplying water resources to new developments which lack the planning and design principles associated with the protection and proficient use of water resources. Water facility rates are often not in pace with the cost associated with the supply cost and frequently fail to promote conservation during peak usage (EPA. 2004).

In fact, some regions draft zoning regulations with the intent of encouraging low-density development because of a belief that this type of development has fewer impacts on water quality. It has been shown in past studies that a watershed becomes impaired at 10 % impervious and the level of impairment increases with the percent of impervious area. As a result, some local ordinances have been adopted which establish site-level imperviousness limits and delineate boundaries for established low-density development (EPA. 2006.)

The logic behind low-density development neglects several important factors. These are outlined in the following list.

1. The larger lawns associated with low-density developments do not provide the same rate of infiltration as undeveloped open spaces because of soil compaction requirements during construction.

2. The amount of impervious area created by a house can vary greatly by design (multi-story or single-story), size of driveways and roadway infrastructure.

3. Low density developments require more impervious infrastructure. The impervious area from roadways and drives required for larger residential lots can create a higher percentage of impervious area for the drainage area than high-density developments.

The EPA tested the theories of low-density developments and impervious areas by modeling the stormwater impacts from three different development densities which were reflective of the different zoning practices in communities. The amount of pollutants which reach a water body can be closely related to the quantity of runoff generated. The results of the study showed that low-density development does not necessarily protect water resources and at times can actually be counterproductive. It concluded that high-density development should be considered as a policy which could better protect the environment than low-density development (EPA. 2006).

9.3 Smart Growth

Smart growth is a planning principal associated with development of urban areas which encourages concentrated growth in compact walkable urban centers. Smart growth can provide the framework to help guide community, local and state policymakers as well as planners and developers on how and where to grow with minimal impact to the environmental resources. Many of the principles of smart growth work collectively with water efficiency and quality.

Smart growth can reduce water demand, improve system efficiency and prevent urban sprawl with the utilization of existing water systems. Smart growth encourages compact building design which reduces water usage due to large lots, promotes walkable neighborhoods which reduces the pollution due to vehicles, preserves open spaces which decreases the impervious land cover, directs development towards existing communities which reduces the requirement for new infrastructure, and makes development decisions predictable and cost effective (EPA. 2004).

Figure 9-2
Smart Growth Principles

1. Mix land uses
2. Take advantage of compact building design
3. Create a range of housing opportunities and choices
4. Create walkable neighborhoods
5. Foster distinctive, attractive communities with a strong sense of place
6. Preserve open space, farmland, natural beauty, and critical environmental areas
7. Strengthen and direct development towards existing communities
8. Provide a variety of transportation choices
9. Make development decisions predictable, fair and cost effective
10. Encourage community and stakeholder collaboration in development decisions

Source: Smart Growth Network and International City/County Management Association

9.3.1 Origins of Smart Growth

In 1996, the Smart Growth Network was formed from national organizations with members concerned about the impacts of dispersed development patterns on communities. Residents faced increased commute times and traffic log because retail centers, office buildings and schools were located too far from residential developments to allow for more pollution friendly forms of transportation. Existing infrastructure was abandoned while public funds were directed towards expansions outside of the community's core (Smart Growth Network and International City/County Management Association. 2002).

9.3.2 Principles of Smart Growth

The Smart Growth Network created ten basic principles for smart growth after examining common characteristics of existing successful communities and they are listed in Figure 9-2 (EPA. 2006). The following page provides details for the application of these principles towards water resource conservation.

Smart Growth and Water Resource Efficiency and Quality

While there are countless economic, community development, quality of life and environmental benefits which have been documented as results of the implementing these principles, this study will focus on those which specifically relate to water resources and demand.

Mixed Land Uses

This principle promotes that commercial, residential, recreational, educational and other land uses be developed in communities at proximities which allow for access by bicyclists and pedestrians. The benefits to our water resources are reductions in the amount of automobile pollution and reduced water demand due to high density developments. In addition, there is an overall reduction in the amount of impervious area.

Compact Building Design

This principle is founded on the logic that growth can be completed utilizing methods which expand vertically instead of horizontally. This can be accomplished with the use of multistory building and parking structures. This type of development benefits water resources in that it can reduce the impacts on undeveloped land and reduce the quantity of water which is used to water lawns.

Walkable Neighborhoods

This principle believes that communities can be constructed so that walking is an alternative mode of access to destinations. This principle reduces the impacts to the environment by reducing the pollution from automobiles which benefits both water and air quality. Many pedestrian friendly improvements involve landscaping which reduces the amount of impervious cover.

Transportation Options

This principle promotes offering multimodal transportation options to residents. This helps reduce pollution to the water resources. It also prevents traffic congestion and provides viable options of transportation for densely developed areas.

Develop Existing Areas

This principle promotes utilizing existing infrastructure and structures at the city's core instead of rebuilding new facilities along the outer portions of the city limits. This principle is good for water supply issues because it often utilizes existing water distribution lines and treatment facilities. This type of development allows for maintenance activities to be completed which otherwise might suffer due to required demand outside of the city's core.

Preserving Open Space

In order to maintain water quality at regional levels it is necessary to implement this principle. Large open spaces can reduce the rate of runoff and provide for natural filtration. In addition to ecological benefits, these open spaces can provide recreational opportunities and general improvements to residents' quality of life.

Source: EPA

9.4 Existing Land Use

The previous section discussed details on how land use and development can impact the efficiency of water resources as well as water demand. This section presents the current land use for Caddo and Bossier Parishes based on USGS land use categories.

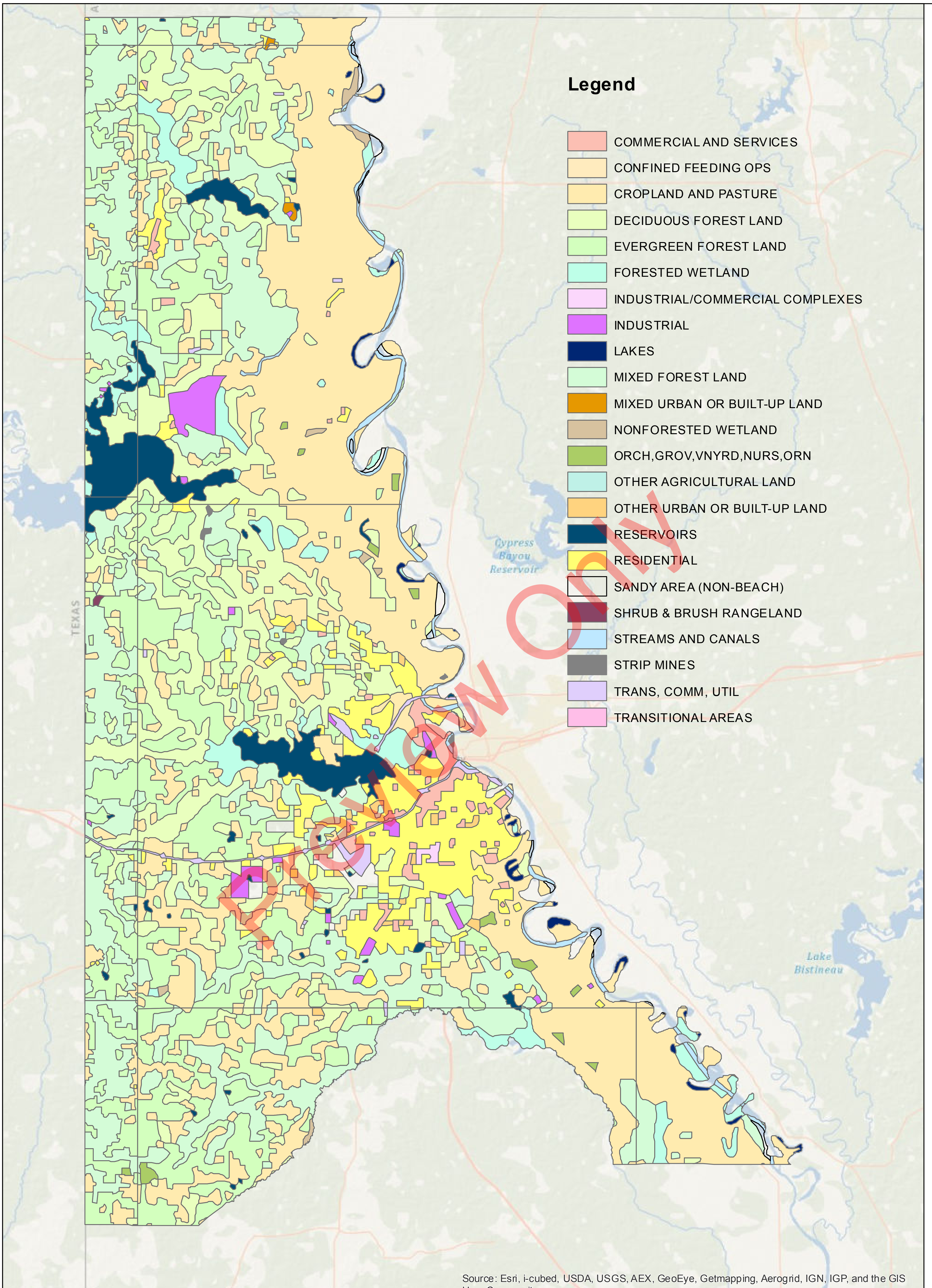
9.4.1 Caddo Parish Existing Land Use

According to the USGS GIS land use data, forest lands make up the largest land use group of Caddo Parish (at 307,111 Ac when deciduous, evergreen and mixed forest land are combined). The second largest land use group is cropland and pasture. The smallest land use group is commercial and other services. A land use map for Caddo Parish is provided in Figure 9-3 on page 9-7.

9.4.2 Bossier Parish Existing Land Use

According to the USGS GIS land use data, forest land also make up the largest land use group for Bossier Parish (at 387,066 Ac. when mixed, deciduous and evergreen forest are combined). The second largest group is cropland and pasture. The smallest land use group is confined feeding, a type of agricultural land group, at 45 Ac. A land use map for Bossier Parish is provided in Figure 9-4 on page 9-8.

Considering the land use data, both Caddo and Bossier Parishes have a unique opportunity to steer future development down a path which protects the remaining critical ecological sites and promotes the efficient usage of the existing water resources. A significant percentage of each parish appears to be undeveloped based upon the above data which allows for proactive policy changes to be implemented for new development. While the land use regulations and policies for Shreveport and Bossier City make moves in the right direction, additional benefits could be gained by expanding this approach to other regions within each parish.



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CADDO PARISH

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Figure 9-3
CADDO PARISH LAND USE MAP
Page 9-7

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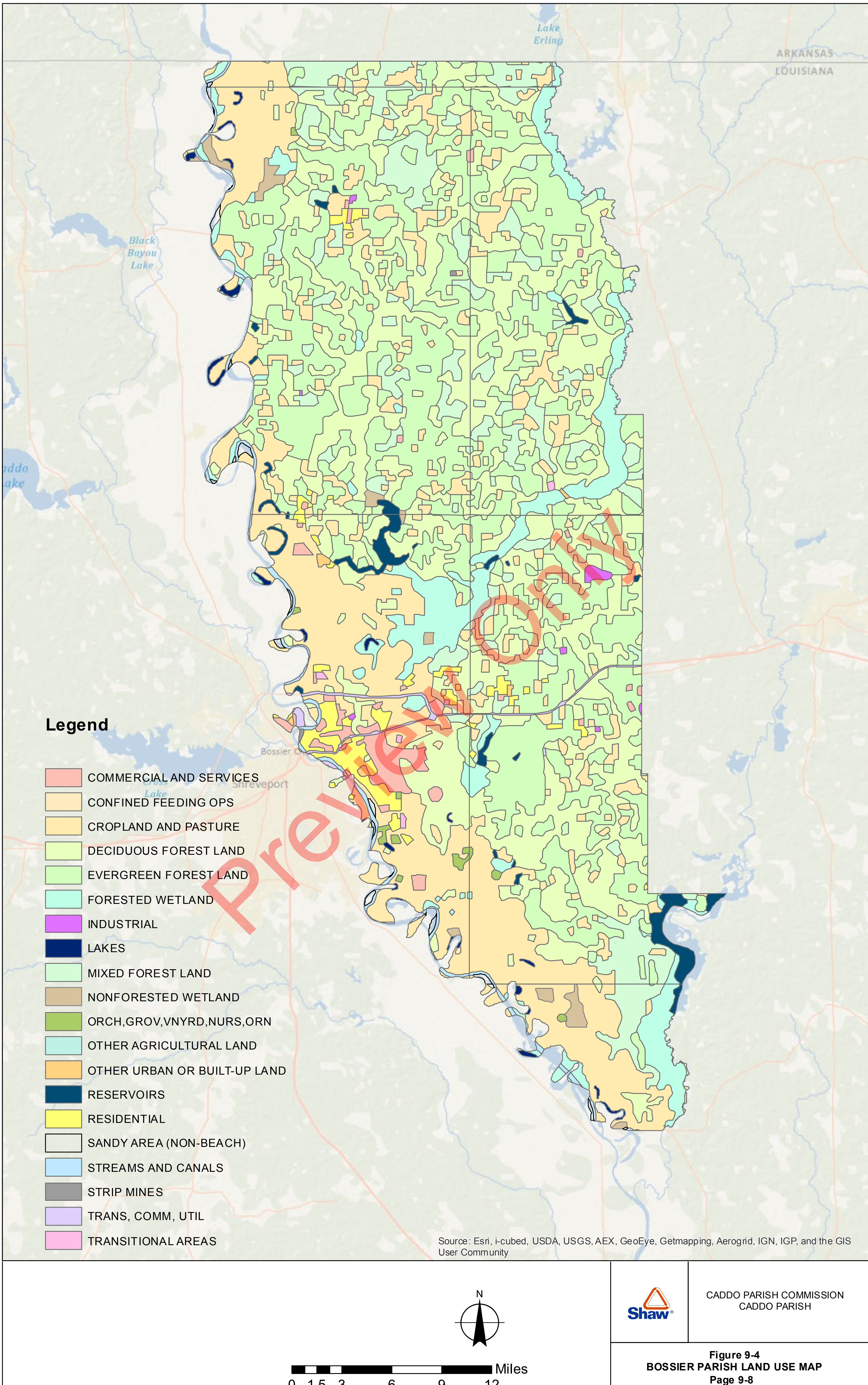

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CADDO PARISH COMMISSION
CADDO PARISH

Figure 9-4
BOSSIER PARISH LAND USE MAP
Page 9-8

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10.0 *Water Demand*

10.1 Methods for Calculating Water Demand

There are various methods for estimating the future water demand and three are summarized below:

- **Extrapolation Method -** uses past data to predict water use. As mentioned in the population projection method section, it can be done by using various types of equations but for water demands it typically requires a minimum of 10-20 years of data. This method, while easy to apply, was not utilized for this study because it does not allow for easy adjustments due to the impacts of population growth.
- **Land Use Type -** future demand is projected by customer category. For example, it can be projected by residential, industrial and commercial. This method requires billing data and demographic data and projected growth all by customer category. This method was not utilized because of data gaps.
- **Per Capita Use -** future demand is determined by multiplying the future population by the per capita use. This method requires population projections and data on historical or current demand. This is a commonly used method and was used to calculate future water demand in this study.

10.2 Peak Water Demand

Water demand can vary seasonally and diurnally. The winter demands are typically lower and summer demands are the highest. The maximum daily demands are usually in the morning or near mid-day. Peaking factors are often utilized to account for these variations. They are typically approximated and result in multiple types of demands which differ by duration. The foundation for all water demand calculations which require the usage of peaking factors is typically found in the average annual daily demand. This variable is usually defined in terms of gallons per day capita and represents the annual average number of gallons used by each person each day. It is calculated by taking the total annual water demand divided by both the population served and 365 days. The peak water system factors and their resulting demands are a critical tool for the evaluation of water demands (Michael R. Lindeburg, PE. 2006). Two types of peak water demands required in this study are the maximum day demand and maximum hour demand.

The *maximum day demand* is the highest daily water use rate during the year. This demand is determined by multiplying the annual average day demand by the maximum day peaking factor.

The *maximum hour demand* is the highest hourly water use rate during the year. It is obtained by multiplying the annual average day demand by the maximum hour demand factor.

10.3 Sources of Water Demand Projections

Several studies have been completed which examine the water demand for major municipalities within Caddo and Bossier Parishes. In addition, there is a source available for parish-level demands. In the sections which follow, the available data is presented and analyzed for potential utilization in this study.

10.3.1 Community Plans/Studies for Caddo and Bossier Parishes' Water Demand

A couple of the community studies mentioned in earlier sections of this report contain information related to water demand. Summaries of each are presented below:

1. City of Shreveport Department of Water and Sewerage (1999) Water and Wastewater Infrastructure Plan, Black & Veatch, LLP and Aillet, Fenner, Jolly & McClelland. This study provided water demand projections based on a per capita water use of 190 gallons per capita per day (gpcd) in 1998 and with an increase of 1 gpcd through the year 2030. The peak for the maximum day peaking factor was 1.8 and maximum hour was 2.9.

2. Bossier Comprehensive Land Use and Development Plan (2003), Wilbur Smith, Associates. This study provided water demand which was presented in a past study, Hydraulic Analysis and Master Plan for Bossier City Water System, dated April 2002. The projected demands from this study are shown in Table 10-1.

Table 10-1
Summary of Bossier City Water Demand Projections

	Average Day Demand (MGD)	Average Month Demand (MGD)	Population Served
2000	9.36	15.03	56,461
2025	14.25	22.8	71,517

3. Bossier City Water System Improvement Plan (2008), CDM. This study provided water demand projections up to year 2028. It should be noted that the water demand projections from this study were approximately 15% higher than previous demands because of the impacts of the dry and hot climate conditions. These calculations used maximum month to average day peaking factors which was 1.65 and the maximum day to average day peaking factor was 2.20. This study used a per capita water use of 180 gpcd. The historical and projected water use from this study is shown in Table 10-2.

Table 10-2
Historical and Projected Water Demand
(million gallons per day)

Year	Average Day Demand (MGD)	Max Month Demand (MGD)	Max Day Demand (MGD)
1995	7.3	10.5	15.3
1996	6.9	8.2	12.5
1997	8.4	10.6	16.0
1998	10.1	14.8	16.0
1999	9.5	15.5	20.0
2000	9.6	15.0	21.0
2001	9.5	12.3	16.0
2002	9.5	12.5	16.0
2003	10.5	13.7	16.2
2004	10.7	13.8	18.1
2005	13.0	17.7	23.0
2010	13.8	22.8	30.4
2015	14.7	24.2	32.3
2020	15.5	25.6	34.2
2025	16.4	27.0	36.1
2028	17.3	28.5	38.0

Similar to the rationale utilized in the analysis of the population projections, it was determined that these community water demand calculations would not be the optimal choice because the geographical boundaries do not match the requirements of this study.

10.3.2 Parish-Level Water Demand

The Louisiana Department of Transportation and Development, in cooperation with the US Geological Survey, produces *Water Use in Louisiana* reports which provide data on parish water withdrawals for surface and groundwater. This data has been reported at five-year increments since 1960. A summary of the historic public water withdrawal totals are provided in Table 10-3. A more detailed presentation of information on the historic and current water withdrawals for Caddo and Bossier Parishes is located in Section 4.0 of Phase I.

Table 10-3
Historic Public Water Withdrawals
(MGD)

Year	Caddo	Bossier
2010	47.33	12.39
2005	51.61	12.4
2000	48.02	11.73
1995	33.33	10.23
1990	39.11	8.81

10.4 Water Demand Calculations

The *Water Use in Louisiana* reports also provide information which can be utilized to calculate the per capita public supply withdrawals for each parish. The averages of the per capita withdrawals for 1990 to 2010 were used for the projection of the water demands in this study with the assumption that they would remain at these levels through the target year. The historical per capita withdrawals are shown in Table 10-4.

Table 10-4
Bossier and Caddo Parishes' Historic per Capita Public Water Withdrawals

	Bossier	Caddo
Year	(gpcd)	(gpcd)
2010	125.20	201.99
2005	140.83	223.29
2000	148.49	216.36
1995	135.60	147.22
1990	117.14	159.42

The projected demand for this study was determined utilizing 140 gpcd withdrawals for Bossier Parish and 190 gpcd withdrawals for Caddo Parish, which is approximately the average of the historical withdrawals. The calculations for the projected water demands are shown in Table 10-5. Only the adjusted future demands were used to calculate water demand for this study.

The maximum daily and maximum hourly demands were calculated with the use of demand multipliers. Table 10-5 presents several typical multipliers. This study used 2.0 for the maximum daily demand and 2.9 for the maximum hourly demand. These factors are within the range of acceptable values and multipliers used in the previously mentioned studies.

Table 10-5
Typical Peaking Factors

Period of Usage	Peaking Factor
Maximum daily	1.8 to 2.8
Maximum hourly	2.5 to 4.0

Source: Water Distribution System Handbook

The projected water demand calculations are provided in Table 10-6 on page 10-5.

Table 10-6
Projected Water Demand Calculations

Year	Adjusted Population		Per Capita (gpcd)		Annual Average Day (MGD)		Maximum Day (MGD)		Maximum Hour (MGD)	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
2015	270,700	128,050	190	140	51.3	17.9	102.7	35.9	148.9	52.0
2020	285,530	138,990	190	140	54.2	19.5	108.3	38.9	157.0	56.4
2025	299,150	150,190	190	140	56.7	21.0	113.5	42.1	164.5	61.0
2030	311,650	161,960	190	140	59.1	22.7	118.2	45.3	171.4	65.8
2035	323,640	174,560	190	140	61.4	24.4	122.8	48.9	178.0	70.9

Based on** ***Water Use in Louisiana 2010

11.0 *Conclusions*

This phase evaluated past population growth for both Caddo and Bossier Parishes and calculated projected populations based on past trends with some consideration of current conditions. The method utilized for these projections was the Cohort-Component Method, which estimates population growth based on fertility, mortality and migration. The results of the initial population projection calculations were called the unadjusted populations and they are shown in Table 11-1.

Table 11-1
Unadjusted Parish Population Totals

Year	Caddo	Bossier
2015	260,720	122,360
2020	265,490	127,340
2025	268,990	132,360
2030	271,340	137,750
2035	273,160	143,760

Potential growth scenarios were then evaluated for possible implementation into the population projection process. These scenarios were based on proposed transportation growth, economic development and employment. It was determined that the growth in employment due to interstate expansion should only be utilized to adjust the projected population because the employment associated with other activities could easily be addressed with the past trends related to the Haynesville Shale play. The adjusted populations due to transportation growth are shown in Table 11-2.

Table 11-2
Adjusted Parish Population Totals

Year	Caddo	Bossier
2015	270,700	128,050
2020	285,530	138,990
2025	299,150	150,190
2030	311,650	161,960
2035	323,640	174,560

An analysis of parish population projections completed by Louisiana Department of Administration and shown in the Louisiana Statewide Transportation Infrastructure Plan revealed that the adjusted population projection calculations completed under this study were the most conservative and therefore would be utilized for the water demand calculations.

Water demand was calculated for maximum day and hour using peaking factors of 2.0 and 2.9 respectively. The annual average day totals were determined using 190 gpcd and 140 gpcd for Caddo and Bossier Parishes respectively. The water demand calculations are shown in Table 11-3.

Table 11-3
Parish Water Demand Projections

Year	Annual Average Day (MGD)		Maximum Day (MGD)		Maximum Hour (MGD)	
	Caddo	Bossier	Caddo	Bossier	Caddo	Bossier
2015	51.3	17.9	102.7	35.9	148.9	52.0
2020	54.2	19.5	108.3	38.9	157.0	56.4
2025	56.7	21.0	113.5	42.1	164.5	61.0
2030	59.1	22.7	118.2	45.3	171.4	65.8
2035	61.4	24.4	122.8	48.9	178.0	70.9

The information obtained in this phase will assist in determining the required future yields needed for Caddo and Bossier Parishes' water resources. The next phase, Phase IV: Feasibility Watershed Analysis, will compare the allowable yields of the water resources to the projected demands calculated in this phase.

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