

section 3: geography and demographics

3.1 – regional geography

Located midway between Dallas and Austin on IH-35, Waco is centrally located in the region known as the ‘Heart of Texas.’ The Waco Urbanized Area, as identified by the US Census Bureau, encompasses approximately 91 square miles and an estimated population of 186,293 as of the year 2017.

In order to account for future growth and activities that impact mobility within the urbanized area, the MPO studies a much larger area when developing the Metropolitan Transportation Plan. This area is referred to as the Waco Metropolitan Area and it is coextensive with McLennan County, Texas. The Waco Metropolitan Area encompasses 1,037 square miles and in 2017 had an estimated population of 251,259 (US Census, American Community Survey). Map 1.1 shows both the Waco Urbanized Area and the Waco Metropolitan Area.

3.1.1 – physical geography

The Waco Metropolitan Area is located at the confluence of the Brazos and Bosque Rivers. The Brazos River roughly bisects McLennan County into two equal parts. The North, Middle and South Bosque Rivers enter the Metropolitan Area from the north, northwest and west respectively and flow into Lake Waco and then form the Bosque River. These rivers create significant natural barriers across the Waco Metropolitan Area.

The Waco Metropolitan Area is relatively flat and without much change in relief despite being bisected by the Balcones Fault system. The highest point within the region is 962 feet above sea level at a point northwest of Crawford and the lowest point is 349 feet above sea level along the Brazos River at the McLennan / Falls County Line. Elevation and severe slopes generally do not create significant natural barriers within the Waco Metropolitan Area.

Most of the Waco Metropolitan Area lies within the Blackland Prairie region of Texas. Broad grasslands within fertile soils containing a large amount of clay characterize this region. Although this clay is

beneficial for agriculture, it is problematic for road construction as these clays will experience a significant amount of swelling when wet and will shrink significantly when dry. The resulting shrinking and swelling often significantly reduce the useful life of pavements within the Metropolitan Area.

3.1.2 – climate and natural hazards

The climate of Waco can best be described as moderate. The National Oceanic and Atmospheric Administration (NOAA) classifies Waco’s climate as humid subtropical. Winters are generally mild with temperatures occasionally dropping below freezing and rarely experiencing ice or snow. Summers are hot with high temperatures often rising above 100 degrees Fahrenheit. Rainfall typically is concentrated during the spring with much drier conditions during summer and early fall. The mild climate of the Waco Region makes bicycle and pedestrian travel modes more appealing to a larger segment of the population. Although the summers can be quite hot, the uncomfortable temperatures usually occur between 12:00 noon and 7:00 PM, which does not impose significant restrictions on these modes of travel. Table 3.1 provides an overview of 30-year averages for seasonal climatological data.

table 3.1 – waco 30 year climatological data: 1989-2018

Season	Average High Temp*	Average Low Temp*	Average Precipitation (inches)
Winter (Jan to Mar)	69.1	35.8	8.4
Spring (Apr to Jun)	83.2	62.4	10.89
Summer (Jul to Sep)	89.5	74.2	6.78
Fall (Oct to Dec)	75	41.9	9.92
Annual	79.2	53.6	35.99

*Average seasonal temperature over 30-year period
Source: National Weather Service, NOAA Online Weather Data (NOWData)

natural hazards and disasters

The Waco Metropolitan Area is situated in the transition zone between the Gulf Coastal Plain and the Southern Great Plains. This region is characterized by seasonal conflicts between warm, moist airmasses coming from the Gulf of Mexico and cold, continental polar airmasses coming from Canada and the Northern Great

Plains. These conflicts are most typical during the period from March through June although the region can experience similar conditions during the months of October and November. These conflicts of airmasses may sometimes result in severe weather conditions characterized by heavy rainfall, damaging straight line winds, large hail and occasional tornadoes. Fortunately damage from winds, hail and tornadoes are infrequent and rarely result in more than temporary disruptions to normal transportation system operations. Heavy rainfall, on the other hand, is a more frequent occurrence, can occur over a very large geographic region, and can result in a longer term closure of important transportation facilities.

The Waco Metropolitan Area can also be impacted by hurricanes and other tropical weather systems making landfall along the Texas Gulf Coast. These events are fortunately infrequent and due to the region’s position approximately 200 miles inland, these systems generally have minimal wind impacts by the time they reach Waco. These tropical systems, however, often bring very significant amounts of rainfall and can have similar or more severe flooding impacts compared to the severe weather experienced by the springtime or late fall clash of airmasses.

At the opposite extreme of flooding, the Waco Metropolitan Area has a long history of periodic drought which can have their own set of impacts to the transportation system. McLennan County’s expansive clay soils contract significantly during periods of drought, and without proper road base preparation, can cause permanent pavement damage. In addition, the resulting soil movements can sometimes cause underground utilities to shift which in rare circumstances result in the breakage of water, sewer or natural gas lines. These disruptions, in turn lead to the closure of adjacent roadways.

During periods of drought a frequent hazard are grass fires from dry or dead vegetation. Of particular concern are fires that result from railroad operations as these are sometimes in very rural areas that are difficult for fire agencies to access. The fires themselves rarely result in significant damage to transportation facilities. The primary threat to transportation operations are the reduced visibilities from smoke that may extend over a large area and cause impacts many miles from the fire zone. The McLennan County Office of Emergency Management (OEM) coordinates responses to fire and other emergencies that cross jurisdictional boundaries. The OEM notifies

appropriate agencies, such as the Texas Department of Transportation (TxDOT) and the Department of Public Safety (DPS), when visibilities may become a threat to specific roadways.

Since snow and ice are rare occurrences, there is little need for the use of salt to de-ice roads. The result is less wear and tear on pavement surfaces and bridge structures as compared to areas with significant icing. This also results in a somewhat older motor vehicle fleet as vehicle bodies are less prone to rust and corrosion. This has potentially negative consequences for air quality and carbon emissions as newer vehicles are nearly always more fuel efficient and comply with stricter vehicle emission standards than their older counterparts.

The Waco Metropolitan Area has no history of significant impacts from earthquakes, tsunamis, meteor strikes, avalanches or volcanic activity including ash dust from distant volcanic eruptions.

3.1.3 – existing land use

Much of the Waco Metropolitan Area can be described as rural in character. The majority of the urbanized uses are concentrated in a relatively small area in the center of the county. In 2017, roughly 80% of land in McLennan County was used for either agricultural purposes or was considered forested. Of the land considered ‘developed,’ nearly 69% was devoted to residential uses. See Tables 3.2 and 3.3 for summaries of land uses within McLennan County. This information is also depicted on Maps 3.1 and 3.2.

table 3.2 – 2017 land use percentages by category

Category	Acres	Percent of County
Agricultural	472,258	69.6%
Forested / Wooded / Marsh	72,318	10.7%
Residential	42,682	6.3%
Highway Right of Way	28,485	4.2%
Water	18,649	2.7%
Vacant / Undeveloped	10,243	1.5%
Surface Mining	8,960	1.3%
Parks / Recreational Areas	5,506	0.8%
Industrial	5,982	0.9%
Commercial	3,399	0.5%
Other Development	10,040	1.5%

table 3.3 – 2017 developed land uses

Category	Percent of Developed Uses
Residential	68.7%
Industrial	9.6%
Commercial / Office	5.5%
All Other Development	16.2%

The relatively flat and well-drained soils that promote agriculture, however, are also very easy to develop into residential subdivisions. This, when combined with a favorable property tax structure, have contributed to significant levels of urban sprawl. Since 2005, agricultural land uses have decreased from 72.3% of McLennan County to 69.6%. While a small percentage of this decline is due to marginally productive lands being returned to forested land cover, the vast majority of this decline is due to encroachment of developed land uses.

Unlike development prior to 2013, new growth has been constructed at a somewhat higher density of developed acres per person than previously (see Table 3.4). This is a welcome trend in that higher densities require less support infrastructure:

transportation, utilities, schools, public services, etc. As such, the cost of providing these needs is subsequently also significantly less. In addition, higher densities make non-automotive modes more of a viable transportation option for those who are either unable to physically operate or unable to afford an automobile. Despite this most recent trend, the Waco Metropolitan Area continues to use significantly more developed land to support each person than most other metropolitan areas in the United States.

table 3.4 – change in developed acres per person since 2013

Developed Acres per Person 2013	Developed Acres per Person 2017	Percent Change	Acres per Person for New Development
0.363	0.341	-6.1%	0.314

Of greater concern than the density of new developments is the location. Slightly more than half of new residential acreage is found in areas considered rural in 2013. Locations of new commercial, office and industrial developments, however, were primarily in suburban context areas (see Table 3.5). This trend further exacerbates an already problematic disconnect between where the region’s residents live and where they work, go to school, shop and perform all other activities of life. The resulting distances between various land uses forces residents of these new developments to use an automobile to perform any task. In addition, many of the developments furthest from the urban core also have the highest average age, many from retiring baby boomers. The concern is that as these retirees age, their ability to utilize an automobile declines resulting in a significant increase in demand for very limited rural public transportation services. Section 3.3.4 describes in greater detail the distribution of elderly citizens within the Waco Region. When looking at all developed land uses, more than 93% of new development was physically located outside of the urban core despite one-eighth of all land in the urban core being classified as vacant (12.6% of total land area). See Map 3.3 for the change in developed land uses between 2013 and 2017 and Map 3.5 for the grouping of urban, suburban, and rural traffic analysis zones (TAZ).

table 3.5 – location of new developed land uses by TAZ grouping: 2013 to 2017

Land Uses	Urban TAZ	Suburban TAZ	Rural TAZ
Residential	5.8%	40.5%	53.7%
Commercial / Office	12.9%	74.2%	12.9%
Industrial	8.6%	52.9%	38.5%
Other Development*	3.9%	64.4%	31.7%
All Development	6.8%	46.8%	46.3%

*Does not include landfills, surface mining or right of way.

3.1.4 – forecasted land use

In 2005, the Waco MPO contracted with Wilbur Smith Associates (WSA) to identify future land-use patterns for the Waco Region for the year 2030, in a report titled, ‘Future Land Use Study for McLennan County.’ Three scenarios were identified in the report: 1.) A ‘trend scenario’ assuming no significant changes in land use or transportation policies, with development patterns similar to those observed between 1995 and 2005; 2.) ‘Alternative Scenario 1,’ resulting in most new development occurring within the urbanized area and as little as 5% assigned to areas beyond, and 3.) ‘Alternative Scenario 2,’ resulting in most new development occurring within the current urbanized area, but with as much of 20% of the future growth assigned to cities and towns outside of the urbanized area.

Since the study’s completion in 2005, development has closely resembled the study’s ‘trend scenario,’ with the majority of residential development occurring in very low density developments in areas previously classified as rural. Most commercial, industrial and office developments are projected to be concentrated within suburban or urban areas, generally adjacent to or in close proximity of existing expressway or principal arterials roadways.

3.2 – demographics

To support development of the regional travel demand model, MPO staff collects population, employment and income information by traffic analysis zone (TAZ) for the years 2015 and 2045. This information is also useful to assess which areas within the region

are growing, declining and how those trends may change in the future. Relative to US census tracts, TAZ geography is significantly smaller, which provides a more detailed assessment of growth trends. This information is then used by MPO staff to identify future transportation infrastructure and service needs. For more information regarding the travel demand model, refer to section 5.1.2.

Regarding all other current demographic information, MPO staff utilizes data from the US Census American Community Survey at the census tract level geography. While census tracts sometimes cover very large geographic areas, census data at smaller geography levels is generally unreliable with unacceptably high margins of error. As a result, using smaller census geographies may lead to incorrect assessments of socio-economic conditions.

3.2.1 – 2015 population

According to US Census estimates, McLennan County experienced a 4.5% increase in population between 2010 and 2015. Suburban traffic analysis zones (TAZs) contain the majority of the population within the MPO study area and have experienced most of the regional growth between 2010 and 2015. Table 3.6, Charts 3.1 and 3.2, and Map 3.4 show the population changes between 2010 and 2015 within the Waco Metropolitan Area, by TAZ.

table 3.6 – population trends since 2010 by traffic analysis zone

Geography	2010 Population	2015 Population	Change	Percent Change	Percent of Regional Growth
Urban Zones	85,556	87,044	1,488	1.7%	14.1%
Suburban Zones	98,924	106,811	7,887	8.0%	74.8%
Rural Zones	50,426	51,590	1,164	2.3%	11.0%
McLennan County	234,906	245,445	10,539	4.5%	100.0%

Source: MPO Staff estimates using US Census 2015 McLennan County population

A trend of concern is the continued population growth of unincorporated areas. These areas have few development restrictions and lower property taxes, and have inadequate transportation infrastructure to accommodate this growth. Additionally, these areas are also developed at very low densities (one to two housing units per acre or less) resulting in greater centerline mile requirements for highway infrastructure and also makes these areas unfeasible for transit service. Conversely, many areas within the urban core have excess highway capacity and housing unit densities appropriate for mass transit. The third guiding principal of this plan is to increase usage of the underutilized highway infrastructure and mass transit (refer to Section 2.1).

chart 3.1 – percent population change: 2010 to 2015

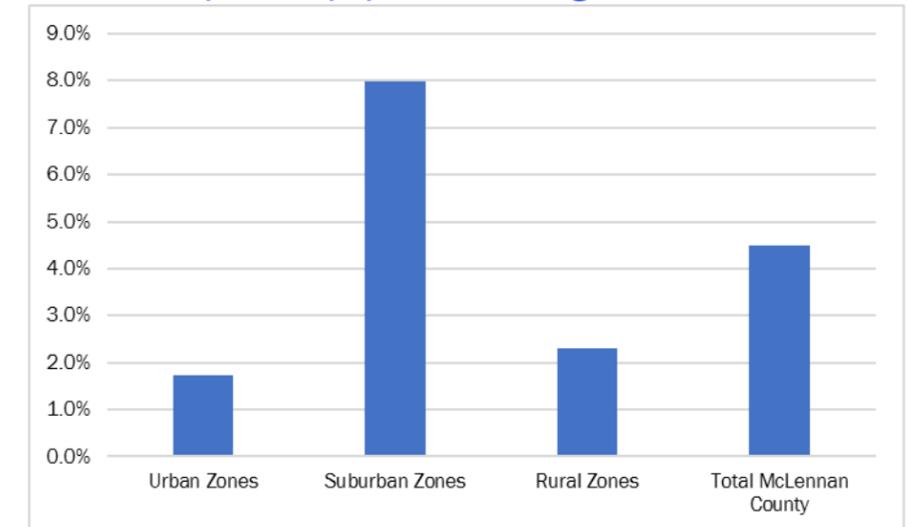
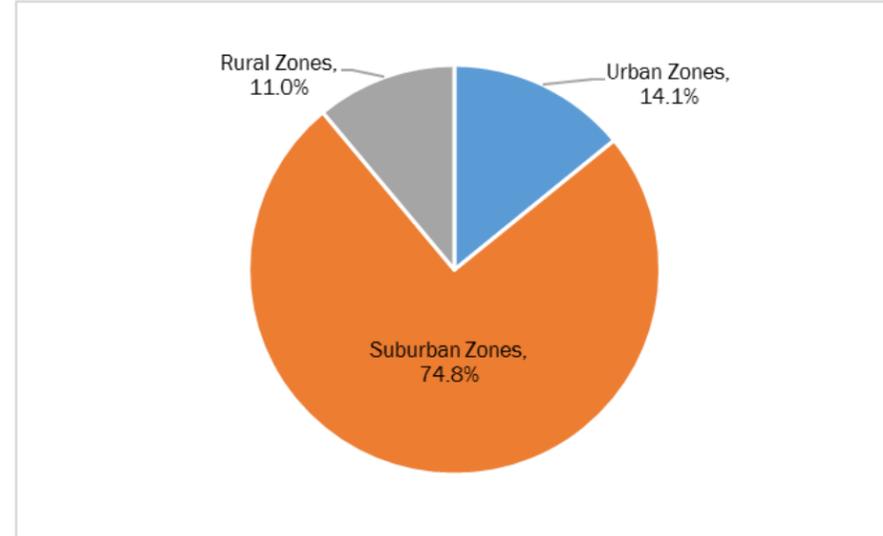


chart 3.2 – percent of metropolitan growth: 2010 to 2015



3.2.2 – 2045 population forecast

MPO staff developed population forecasts for the year 2045 in order to support the MPO’s travel demand model. By the year 2045, the population of McLennan County is forecasted to grow by 24.9% (61,089 people). In the same timeframe, the State of Texas is expected to experience a 60.5% population growth (according to the Texas Demographic Center). Table 3.7, Chart 3.3, and Map 3.6 show the projected population change for McLennan County for the period of 2015-2045 by traffic analysis zone classification.

The land use trend report prepared by WSA included a ‘Trend Scenario,’ which assumes that population distribution will closely follow trends observed between 1990 and 2010. This MTP assumes that this observed trend will continue at least through 2030. As such, it is expected that there will be continued impact to the transportation network creating significantly more demand for highway infrastructure within the suburban and unincorporated areas. Because of the nature of suburban development, it’s expected that nearly all residents within these high-growth zones would utilize an automobile for most, if not all, trip purposes. With anticipated transportation revenues projected to be at a significant underinvestment scenario (see Section 6 for revenue forecast), the population distribution projected under the Trend Scenario is considered unsustainable as the region will be unable to address the increased mobility demand within the newly developing zones.

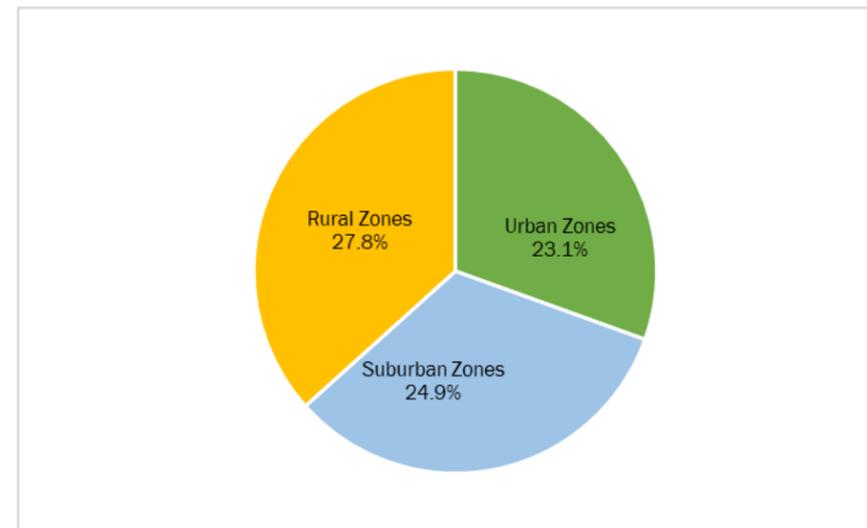
After 2030, several efforts from MPO stakeholders forecasted a gradual change in land use distribution to become somewhat more urbanized with higher population and employment densities in the urban core. Despite this, suburban and exurban growth is expected to continue through the MTP planning horizon.

table 3.7 – population forecasts for 2045 by traffic analysis zone

Geography	2015 Population	Forecasted 2045 Population	Change	Percent Change	Percent of Regional Growth
Urban Zones	87,044	107,169	20,125	23.1%	32.9%
Suburban Zones	106,811	133,445	26,634	24.9%	43.6%
Rural Zones	51,590	65,920	14,330	27.8%	23.5%
McLennan County	245,445	306,534	61,089	24.9%	100.0%

Source: MPO Staff forecasts using Texas Demographic Center McLennan County population forecast.

chart 3.3 – forecasted percent change in population: 2015 to 2045



3.2.3 – 2015 employment

The MPO staff reviewed the distribution of regional employment as a method of identifying the destination end points for regional trips. Since travel patterns vary depending upon business activities, the analysis breaks out employment by retail, service, basic (manufacturing or industrial), and educational sectors.

MPO staff estimated the Waco Metropolitan Area labor force at 106,466 for 2015, which is a 6% increase from 2010. In general terms, employment follows population, although the appearance of employment centers lag behind the residential development. As of 2016, most employment (91.6%) is concentrated within urban and suburban TAZs. With that said, nearly all employment growth from 2010 to 2015 (96.1%) has occurred in suburban TAZs. Table 3.8 shows how regional employment has changed since 2010 by TAZ classification. Map 3.7 shows employment change by traffic analysis zone.

table 3.8 – employment trends for the waco metropolitan area: 2010-2015

Geography	2010 Employment	2015 Employment	Change	Percent Change	Percent of Regional Growth
Urban Zones	52,273	52,347	74	0.14%	1.2%
Suburban Zones	39,367	45,135	5,768	14.7%	96.1%
Rural Zones	8,821	8,984	163	1.8%	2.7%
McLennan County	100,461	106,466	6,005	6.0%	100.0%

Source: MPO Staff Estimates

Employment location, unlike population, tends to be clustered in certain areas due to zoning restrictions and the need for more robust municipal infrastructure than residential development (highways, water, sewer, storm drainage, etc.). MPO staff have identified seven primary clusters of employment activity, which in 2015 employed over half of the workforce within McLennan County

(see Table 3.9 and Chart 3.4). The territories covered by these clusters can be viewed on Map 3.8.

cluster 1 – downtown waco / baylor university

Downtown Waco, once the center of economic activity for the metropolitan area, remains a major center of employment with almost 10% of McLennan County’s workforce. Employment in downtown includes services such as finance, government, law offices and accounting firms. Downtown has several retail and restaurant establishments, as well as entertainment venues that serve residents, downtown employees, tourists, and Baylor University students. Baylor University, with 17,000 students and 2,900 employees, lies just east of IH-35 and significantly contributes to the activity within downtown. Baylor is the largest single employer in the region.

Loft apartment construction has picked up momentum and significantly increased the permanent residential population of downtown. This increase in population has attracted Baylor University students and young professionals. Industrial uses, which were concentrated along the Union Pacific railroad tracks, have generally moved out of downtown in favor of industrial parks near Loop 340.

cluster 2 – texas state technical college

The Texas State Technical College (TSTC) campus, located approximately seven miles north of downtown Waco, serves 4,200 students with 800 employees. The campus is also the location of many aviation-related industries, the largest of these is L-3 Communications with approximately 750 employees.

cluster 3 – bellmead / lacy-lakeview

The intersection of IH-35 and Loop 340 / Lake Shore Drive continues to attract a significant amount of new development as a result of the Bellmead industrial and commercial park, northeast of the intersection, and the redevelopment of the shopping center northwest of the intersection. Most of the employment within this cluster is either retail or basic sector. Between 2010 and 2015, this cluster gained an estimated 1,131 jobs.

cluster 4 – north valley mills drive

Valley Mills Drive has historically been a strong cluster of retail and commercial activity. However, in the past decade, new retail centers along State Highway 6 and Hewitt Drive have contributed to a slow decline of retail activity along this corridor. This cluster, however, continues to represent a significant center of commercial development and retail workforce employment.

cluster 5 – richland / north highway 6

The development of Richland Mall and relocation of Providence Hospital to the Highway 6 corridor in the late 1970s and 1980s have continued to attract many retail and service sector developments to the corridor. Since 2005, some of the retail employment has been siphoned off to the Central Texas Marketplace located within the marketplace / industrial cluster. Providence Hospital and associated services, with approximately 2,300 employees, represents one of the largest concentrations of employment within the region. In the recent past, due to the number of employees, this cluster was considered a de Facto central business district for the region. With the increasing shift of employment to more suburban locations observed since 2010, it is difficult to define a specific central business district for 2015.

cluster 6 – marketplace / industrial

The Texas Central Industrial Park is located southwest of the IH-35 interchange with West Loop 340 and represents the largest area devoted to industrial development within the Waco Urbanized Area. Central Texas Marketplace, which opened in 2003, has also created a significant cluster of retail employment. Some of the retail previously located in the vicinity of Richland Mall (cluster 5) has relocated to this cluster, however, much of the retail activity is new to the region. This cluster has experienced the highest growth in employment (26%) since 2010.

cluster 7 – hewitt / west waco

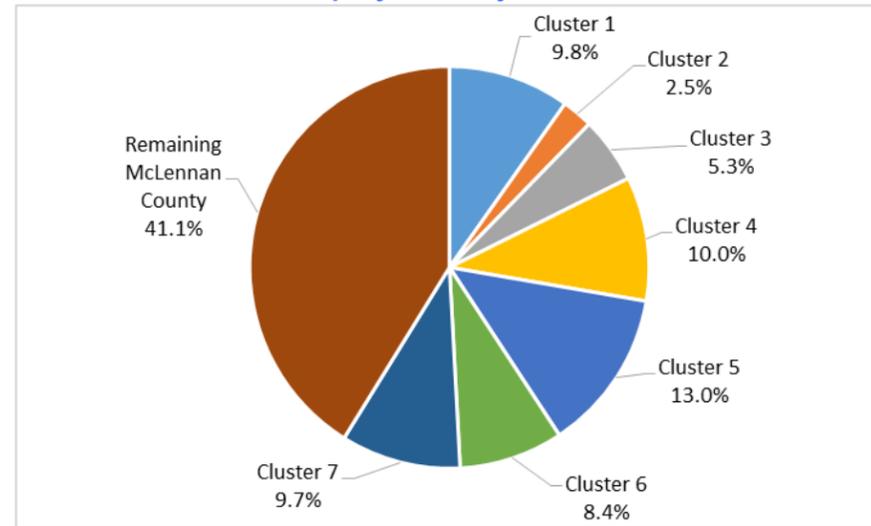
This cluster has, since 2000, become a major center of retail, service, and basic employment activity following the significant residential growth in the corridor since 1990. This cluster also has the highest concentration of basic employment out of the seven employment clusters. In addition, the growth of the Midway Independent School District (ISD) campuses have added significant educational employment to the corridor.

table 3.9 – 2015 workforce employment by cluster

Geography	Total Employment (2015)	Percent of McLennan County Workforce	Change in Total Employment from 2010
Cluster 1 – Downtown Waco / Baylor University	10,467	9.8%	-2.2%
Cluster 2 – Texas State Technical College	2,678	2.5%	-9.1%
Cluster 3 – Bellmead / Lacy-Lakeview	5,681	5.3%	+24.9%
Cluster 4 – North Valley Mills Drive	10,652	10.0%	-4.3%
Cluster 5 – Richland / N Hwy 6	13,876	13.0%	+3.9%
Cluster 6 – Marketplace / Industrial	8,975	8.4%	+26.0%
Cluster 7 – Hewitt / West Waco	10,332	9.7%	+11.6%
Total All Clusters	62,661	58.9%	+6.1%
Remaining McLennan County	43,805	41.1%	+5.8%
Total McLennan County Workforce	106,466	100.0%	+6.0%

Source: MPO Staff Estimates

chart 3.4 – 2015 employment by cluster



Source: MPO Staff estimates

3.2.4 – 2045 forecasted employment

Total employment is anticipated to closely approximate the population growth during the planning period. The result is an estimated county employment total of 133,101 in 2045. Employment location is expected to closely follow the patterns of population growth, a trend observed nationally. In 2045, about 51.8% of all McLennan County employment is expected to be located within one of the seven employment clusters (compared to 58.9% in 2015). Based upon recent trends, the service and special generator employment sectors are anticipated to significantly increase their share of the workforce relative to other sectors. Basic employment is anticipated to significantly reduce its share of the workforce and decline between 2015 and 2045. Retail employment is expected to decline in most cluster areas, and experience only a very small increase in employment by 2045. All clusters are expected to gain employment, with the exception of Cluster 4 (North Valley Mills Drive), which is expected to experience a 5.8% decline in employment.

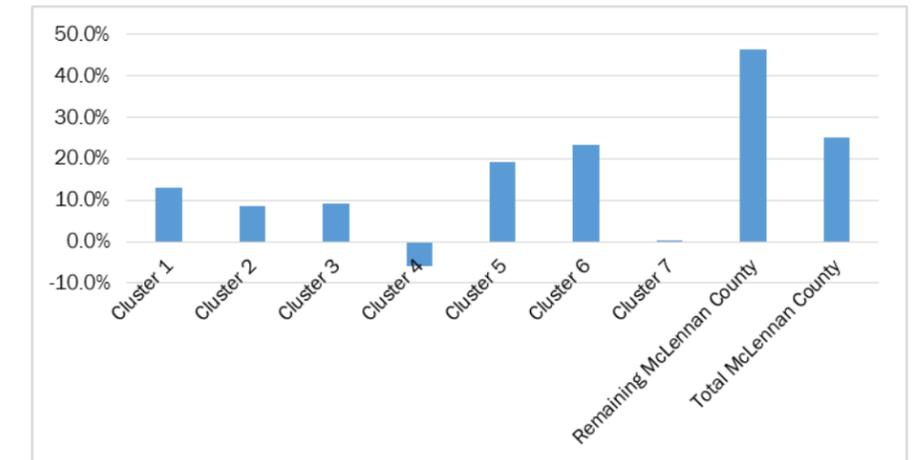
Table 3.10 and Chart 3.5 show the projected change in employment distribution between the years 2015 and 2045 by types of census tract. Map 3.9 shows the projected employment changes by traffic analysis zone.

The projected employment for 2045 represents two continuing challenges in addressing regional mobility: 1.) For those with limited or low incomes, employment opportunities continue to move into suburban areas, thus increasing regional reliance on the automobile for employment and 2.) Employment location is projected to continue to be located in areas with limited infrastructure to support the resultant increases in traffic volume.

table 3.10 – forecasted workforce employment by cluster: 2045

Geography	Forecasted 2045 Employment	Percent of McLennan County Workforce	Change in Total Employment from 2015
Cluster 1 – Downtown Waco / Baylor University	11,820	8.9%	+12.9%
Cluster 2 – Texas State Technical College	2,910	2.2%	+8.7%
Cluster 3 – Bellmead / Lacy-Lakeview	6,195	4.7%	+9.0%
Cluster 4 – North Valley Mills Drive	10,037	7.5%	-5.8%
Cluster 5 – Richland / N Hwy 6	16,530	12.4%	+19.1%
Cluster 6 – Marketplace / Industrial	11,084	8.3%	+23.5%
Cluster 7 – Hewitt / West Waco	10,367	7.8%	+0.3%
Total All Clusters	68,943	51.8%	10.0%
Remaining McLennan County	64,158	48.2%	46.5%
Total McLennan County Workforce	133,101	100.0%	25.0%

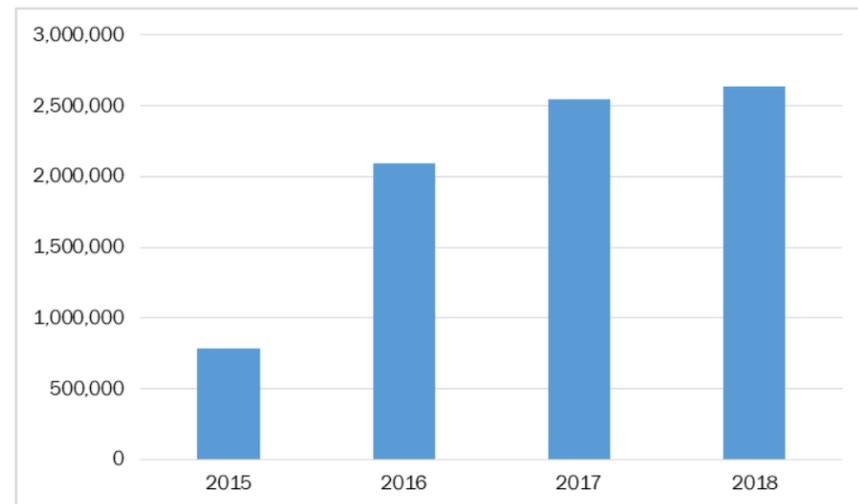
chart 3.5 – forecasted change in employment by cluster: 2015-2045



3.2.5 – travel and tourism

Waco has been a destination for visitors since cowboys herded longhorn cattle across the Brazos River on its famed Suspension Bridge on their trek north along the Chisholm and Shawnee Trails in the 1870s. Tourism has been a significant driving economic factor in the Waco Metropolitan Area and is trending upward as over 2.6 million tourists visited Waco in 2018 (see Chart 3.6). Many of these visitors came to Waco for the Magnolia experience, to sample tasty treats during the Texas Food Truck Showdown, to cheer on the 'Baylor Nation' and enjoy many other local attractions. The Waco Mammoth National Monument welcomed guests from all 50 states, three US territories and over 54 foreign countries. Demand for hotel rooms continues to grow; the Waco Convention and Visitors Bureau reports that Waco was ranked first for hotel occupancy in Texas in 2018, with an occupancy rate of 73.1%.

Chart 3.6 – attendance at waco tourist attractions: 2015-2018



Source: Waco Convention and Visitors Bureau

In calendar year 2018 there were seven venues that attracted over 50,000 guests, including:

- Magnolia Market at the Silos
- Cameron Park Zoo
- Mayborn Museum Complex
- Dr Pepper Museum
- Waco Mammoth National Monument
- Texas Ranger Hall of Fame and Museum
- Waco Tourist Information Center

The Waco Region also hosts over 200 community races, special events and festivals each year. Key events include:

- Magnolia’s Silobration
- Magnolia’s Spring at the Silos
- Silo District Marathon
- Greater Waco Chamber’s Food Truck Showdown

- Waco Wonderland
- Heart O’ Texas Fair and Rodeo
- Margarita & Salsa Festival
- Baylor University Homecoming
- Southwestern Region Little League and Softball Tournament
- Starburst Junior Golf Classic
- Brazos Nights
- Fourth on the Brazos
- Heart of Texas Air Show
- Waco Cultural Arts Fest
- Homestead Heritage Fall Fair
- Ironman 70.3 Waco Triathlon

In addition, Baylor University hosts several dozen academic and athletic events throughout each school year that bring visitors to Waco. Home football and basketball games impact the local economy and transportation system. Up to 45,000 fans attend each Baylor University home football game, and each home basketball game averages approximately 6,500 fans. Map 3.10 shows the location of the more significant venues attracting tourists to the Waco Metropolitan Area.

MPO staff regularly coordinates with representatives in the local tourism industry to further understand tourists’ needs and tourism trends in order to integrate planning strategies to support area attractions and further enhance economic vitality. The number of visitors to key area attractions and annual events are tracked to assess efficiencies and deficiencies in access, parking and wayfinding. The MPO coordinates with tourism representatives, local governments and local agencies to address deficiencies and to anticipate operational impacts to the transportation system.

Both visitors and local residents choosing to attend the many attractions and special events throughout the Waco Region primarily travel by private automobile and can have a significant impact on traffic during the duration of each event. The area’s largest attractions are located within a 7-square mile area centered

on downtown Waco and Cameron Park along the banks of the Brazos River. The most sizable special events also take place here. Due to the concentrated number of tourists in this zone, foot traffic between attractions and parking opportunities must be considered by local agencies. The Waco Convention and Visitors Bureau (which includes many member cities in McLennan County), TxDOT, the City of Waco, Baylor University, the Waco Transit System (Waco Transit), McLennan County, and the MPO work together to implement traffic and emergency management plans to address operational issues that may arise, and to communicate helpful information to visitors.

To address daily impacts of tourism, area agencies have identified parking opportunities and implemented public transportation shuttles and on-street wayfinding programs. Information is published and promoted through appropriate various agency brochures, maps, websites and social media. Waco Transit operates the Silo District Downtown Trolley, the LaSalle-Circle Shuttle, and the Baylor (game-day) Tailgater Shuttle to circulate visitors between attractions, shopping and restaurant venues, sporting events, hotels and parking facilities. Automobile, motorcoach, tour bus and school bus parking availability is identified and publicized. These opportunities, processes and programs are reviewed continually in order to address evolving need.

To address the impacts of major special events, area agencies have worked together to develop and implement traffic control and emergency operations plans. Area police and fire response teams coordinate with event staff and agency officials to manage circulation via street closures, lane restrictions, signal control, and to address emergency situations when required.

3.3 – title VI analysis

A primary goal of the Waco MPO is to ensure that the transportation needs of all people are met and that no one population group must endure a disproportional share of the burdens in meeting those needs. In order to accomplish this goal, the Waco MPO performs an analysis of its plans and programs to assess the mobility needs of traditionally underrepresented groups, and assess the potential impacts of proposed projects upon these groups. The following discussion quantifies the traditionally underrepresented groups and describes their distribution within the Waco Metropolitan Area.

3.3.1 –race, ethnicity, and poverty

Executive Order (EO) 12898 requires recipients of federal funding to identify and address disproportionate health or environmental effects on minority and low-income populations. This requirement is also referred to as environmental justice (EJ) policy. Title VI of the 1964 Civil Rights Act states that “no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or otherwise be subject to discrimination under any program or activity that is a recipient of federal financial assistance.” Simply stated, if an organization (such as the MPO) receives federal funds, it cannot use those funds in any way that would unfairly treat a person differently from other people.

Within the Waco area, EJ populations include Black and Hispanic minority populations, and low-income populations. As shown in Table 3.11 below, within McLennan County, the Black population is roughly 14% and the Hispanic population is just over 25%. Blacks and Hispanics predominantly reside within urban census tracts. In addition, a higher-than-average number of Black residents live in the Mart area, and a higher-than-average number of Hispanic residents live in the McGregor area.

table 3.11 – population by protected population group: 2013-2017

Geography	Percent Non-Hispanic Black	Percent Hispanic	Percent Non-Hispanic White	Percent Non-Hispanic Other
Urban Census Tracts	24.2%	40.8%	32.2%	2.8%
Suburban Census Tracts	10.5%	20.0%	64.8%	4.6%
Rural Census Tracts	4.7%	11.6%	81.7%	2.0%
McLennan County	14.2%	25.6%	56.7%	3.5%

Source: US Department of Commerce: Bureau of the Census – American Community 5-Year Estimate 2013-2017

McLennan County is above the state average for persons living below the census defined poverty level (\$12,060 for an individual in 2017) and below the state average for per capita income. Among McLennan County census tracts, poverty rates vary widely from 0% to 76.5%. Urban census tracts have the highest poverty rate at 32.5%, compared to average poverty rates of 14.2% in suburban census tracts, and 8.8% in rural census tracts. See Table 3.12 for per capita income and poverty rates.

The tracts with extreme poverty generally correlate well with a lack of access to automobiles (see Section 3.3.3). As income decreases, the ability to afford an automobile also decreases. The result is that these areas are more heavily dependent upon public transportation and bicycle/pedestrian facilities than other segments of the population. An additional challenge is that many of the same areas with low incomes and high poverty are also the same areas identified as EJ-protected zones for Black and Hispanic populations. This provides a further emphasis for the public transportation recommendations identified in section 7. Map 3.11 shows the median household income in McLennan County and Map 3.12 depicts the distribution of poverty by census tract.

table 3.12 – poverty and income statistics: 2013-2017

Geography	Average Per Capita Income	Percent Living in Poverty
Urban Census Tracts	\$16,006	32.5%
Suburban Census Tracts	\$27,547	14.2%
Rural Census Tracts	\$20,097	8.8%
McLennan County	\$24,273	19.3%
State of Texas	\$28,985	16%

Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

limited english proficiency

The MPO monitors information published by the US Census regarding persons who speak English less than ‘very well’ and which languages they speak, and provides certain services in languages most likely to be needed within the Waco Region. As defined within Executive Order 13166, LEP persons are those who do not speak English as their primary language and have limited ability to read, speak, write or understand English. Waco MPO’s Limited English Proficiency (LEP) Plan identifies the strategies the MPO staff undertakes to ensure that LEP populations are able to participate in the transportation planning process and understand how transportation decisions impact their lives. The LEP plan also outlines how the MPO can identify a person who may need language assistance, the ways in which assistance may be provided, staff training that may be required, and how to notify LEP persons that assistance is available. As of 2019, the MPO regularly provides Spanish translation for written meeting notices and comment cards, and offers Spanish translation at public meetings upon request. Map 3.13 shows the percent of native Spanish speakers who speak English less than ‘very well’ in McLennan County by census tract.

3.3.2 – travel time analysis

In order to estimate whether the existing transportation system meets the goals of Title VI of the Civil Rights Act and Executive Order 12898, the MPO staff performed an analysis of commuting travel times by travel mode, and the prevalence of different travel

modes among EJ protected census tracts and non-EJ protected census tracts. For purposes of this analysis 'Protected' includes census tracts with populations of Non-Hispanic Blacks, Hispanics, or persons in poverty, greater than the McLennan County average. Map 3.14 identifies the EJ-protected census tracts used within this analysis.

MPO staff compared average commuting travel time across different travel modes. The results of this comparison are shown in Table 3.13 and Chart 3.7. On average, only 3% of single-occupancy one-way automobile trips were greater than 60 minutes. In comparison, roughly one-third of one-way public transit trips were greater than 60 minutes. For example, a public transit trip between EJ-protected zones on the north side of the Waco Urbanized Area and several of the more significant regional centers of employment (near Hwy 6 and Loop 340) can take up to 90 minutes one-way. In addition, urban public transportation fixed-route service within McLennan County only operates between 5:15 AM and 7:15 PM on weekdays, and 6:15 AM and 8:15 PM on Saturdays. There is no public transit service on Sunday. Map 3.15 shows mean one-way travel time by census tract.

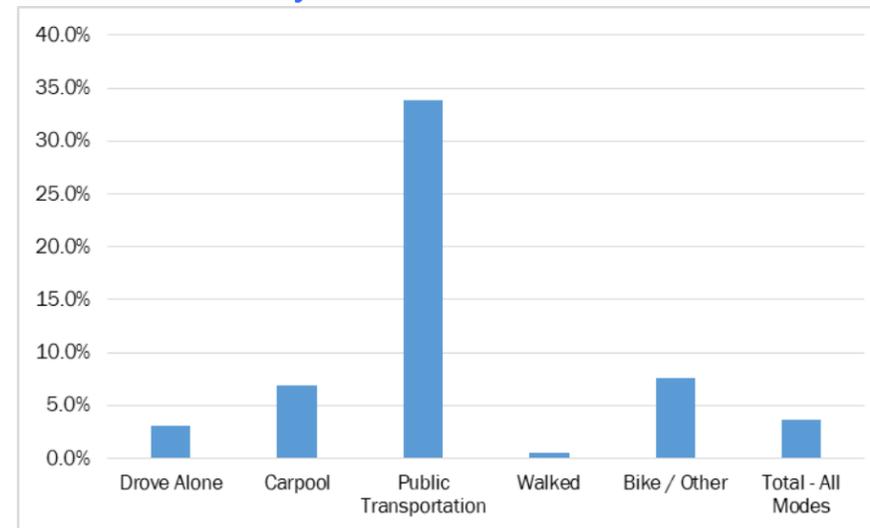
As shown in Chart 3.8, residents of EJ-protected census tracts are more likely to rely on public transit, walking, or biking/other modes than non-EJ protected census tracts. However, both EJ and non-EJ protected zones still primarily rely on single-occupancy vehicle trips for commuting purposes. Automobile affordability is discussed in Section 3.3.3.

table 3.13 – mclennan county commute travel time by mode

Mode	Percent of Total	Less than 20 minutes	20 to 60 minutes	Greater than 60 minutes
Drove Alone	85.5%	61.2%	35.7%	3.0%
Carpool	11.1%	56.8%	36.3%	6.9%
Public Transportation	0.5%	34.6%	31.5%	33.8%
Walked	1.7%	84.0%	15.4%	0.5%
Biked / Other	1.3%	58.2%	34.2%	7.6%
Total All Modes	100%	61.0%	35.4%	3.6%

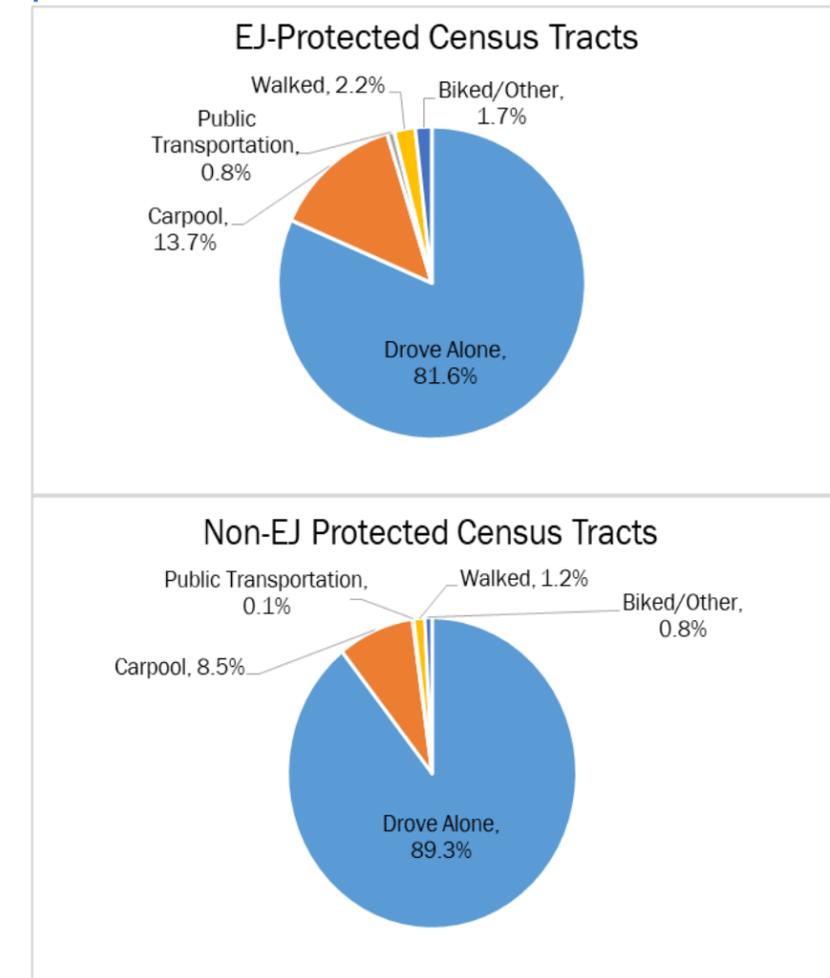
*Workers age 16 or older
Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

chart 3.7 – percent of workers with travel times greater than 60 minutes by mode: 2013 -2017



*Workers age 16 or older
Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

Chart 3.8 –travel mode comparison between environmental justice protected census tracts and non-protected census tracts*



*Workers age 16 or older
Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

3.3.3 – automobile availability and affordability

Approximately 6.5% of households in the Waco Region (and 11% within the urban census tracts) do not have access to an automobile, as compared to 5.5% statewide (see Table 3.14). Map 3.16 shows the percent of occupied housing units with no automobile access by census tract. Within McLennan County, access to automobiles is well correlated to income and poverty

status. Owning and operating an automobile is expensive. An inexpensive car can still cost about \$5,000 to \$7,000 per year; these costs include the initial purchase, registration, insurance, maintenance, fuel and in some cases parking. This can place a significant burden on a family, especially families that are living at or near the poverty level. Chart 3.9 provides an example of monthly expenses for a family of four living at the census-defined poverty level. A family that is able to rely on public transit, instead of owning a personal vehicle, has significantly more monthly income to spend on groceries, healthcare, clothing, and any other items. However, as discussed in Section 3.3.2, the drawback of relying on public transit alone is a potentially significant increase in travel time.

Another way to measure automobile affordability is to combine housing and transportation costs and compare this to median household income. A combined housing and transportation percentage of less than 50% is generally considered affordable. Table 3.15 provides an estimated 'affordability index' for households in urban, suburban, and rural census tracts, and McLennan County as a whole. In urban census tracts, 30.6% of the population is living at 100% to 200% of the federal poverty level. Households at one to two times the federal poverty level are often financially vulnerable to an unexpected expense, such as a major car repair. Map 3.17 shows the percent of individuals living below 200% of the federal poverty level by census tract.

table 3.14 – occupied housing units with no automobiles: 2013-2017

Geography	Percent of Occupied Housing Units with No Vehicles Available
Urban Census Tracts	11%
Suburban Census Tracts	5%
Rural Census Tracts	3%
McLennan County	6.5%
State of Texas	5.5%

Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

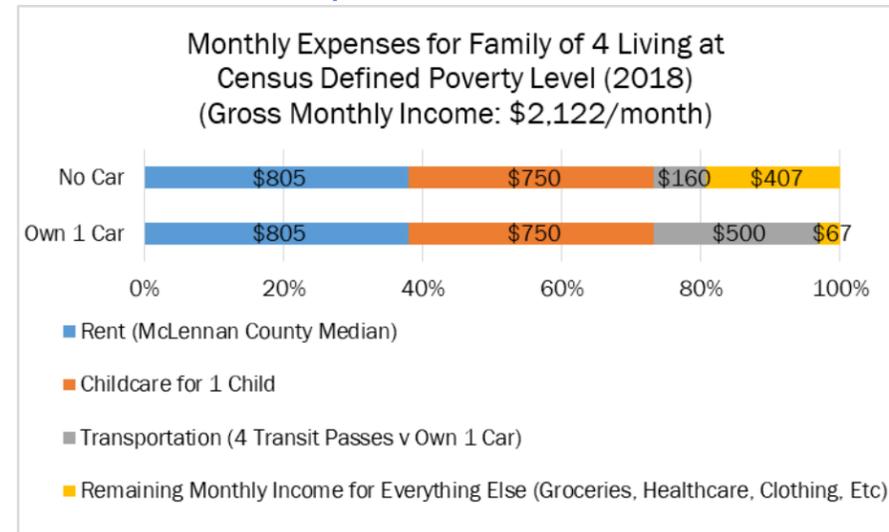
table 3.15 – affordability index and poverty: 2013-2017

Geography	Median Rent	Median Household Income	Affordability Index (Monthly)*	Percent Living in Poverty	Percent Living between 100% and 200% of Poverty Level
Urban Census Tracts	\$732	\$30,150	\$1,256	32.5%	30.6%
Suburban Census Tracts	\$832	\$61,240	\$2,551	14.2%	18.9%
Rural Census Tracts	\$812	\$61,240	\$2,551	8.8%	19.6%
McLennan County	\$805	\$46,262	\$1,927	19.3%	23%

*50% of gross monthly household income.

Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

chart 3.9 – comparison of monthly household expenses: automobile ownership vs. no automobile



Source: US Department of Commerce: Bureau of the Census – American Community Survey 2013-2017 and 2018, and Waco MPO Staff Estimates

3.3.4 – elderly population and ambulatory disabilities

High concentrations of elderly within the metropolitan area are strongly correlated with the presence of either assisted living facilities, nursing facilities, or retirement communities. Seven out of eight census tracts with more than 20% of persons over age 65 have one or more of these facilities. Many nursing home or assisted living residents have limited ability to independently move from location to location, the definition of ambulatory difficulty. The level of independent mobility varies depending upon the type of care being provided. Nursing homes provide 24-hour care, thus independent mobility is extremely limited to non-existent. Assisted living facilities, however, provide varying degrees of care and persons may have significant ability to move from location to location, although this population is generally more transit dependent than the population as a whole. Map 3.18 shows the distribution of persons age 65 or older in McLennan County and Map 3.19 indicates how persons with ambulatory difficulty are dispersed throughout the county by census tract.

Rural census tracts in McLennan County have the highest percentage of residents over the age of 65, and a higher-than-State average of residents with ambulatory difficulty. The dispersion of transit-dependent individuals into very low density / rural areas, highlights a growing need for rural transportation services. See Table 3.16 for the distribution of elderly population and people with ambulatory difficulty within McLennan County.

table 3.16 – elderly population and persons with ambulatory difficulty: 2013-2017

Geography	Percent Over Age 65	Percent with Ambulatory Difficulty
Urban Census Tracts	9.4%	7.3%
Suburban Census Tracts	15.5%	6.6%
Rural Census Tracts	17.3%	7.3%
McLennan County	13.6%	7%
State of Texas	11.7%	6%

Source: US Department of Commerce: Bureau of the Census – American Community Survey 5-Year Estimate 2013-2017

3.4 – environmental constraints

The Fixing America's Surface Transportation (FAST) Act requires an accounting of potential environmental mitigation activities which may be necessary as a result of impacts imposed by the transportation system upon the environment. Specific activities are usually identified as part of the development of an Environmental Impact Statement (EIS) or Environmental Assessment (EA), typically performed during the design phase of a project. The identification of potential environmental impacts during the planning process has consistently been identified as a method to expedite the environmental review process and to move projects towards construction faster. This consideration would have a two-fold effect: 1.) Projects with significant environmental impacts would be identified sooner, allowing policy makers to better weigh the benefits of the project against these impacts as well as the anticipated delays from potential mitigation of these impacts, and 2.) Projects with little or no significant impacts can develop more quickly as an accounting of these impacts has been made prior to the design phase.

Analysis of potential environmental constraints focused on five general categories: 1.) Hazardous material storage areas or generation facilities, 2.) Lands identified as part of Section 4(f) of the 1966 Transportation Act, 3.) Land use takings, 4) air quality, and 5) climate change and greenhouse gases. Generally speaking, recommended alignments or proposed right-of-way boundaries have not been identified at the long-range planning level, thus the MPO staff has chosen to evaluate projects based upon the chance that mitigation for one or more factors may be necessary as the project develops.

A 'likely' chance is defined as a feature being located within 250 feet of the centerline of an existing highway and for new construction on a new alignment, a 'likely' chance is defined as a feature being located within 500 feet of the center of the corridor. A 'somewhat likely' chance is applied when it appears that a design alternative could be implemented which completely avoids impacting a feature within the 250 or 500 foot 'likely' zone. Such an instance would be where a project could avoid a feature by acquiring right of way completely from one side of the existing right of way. A 'not likely' chance is defined as no features exist within the 250 or 500 foot 'likely' zone. See Appendix B for the project

evaluation criteria scores for each project, based on potential 'likely' or 'somewhat likely' impacts.

3.4.1 – hazardous materials

The Texas Commission on Environmental Quality (TCEQ) issues permits for businesses or individuals that generate, store or transport materials that could be hazardous to human health. These locations do not necessarily represent places with soil or ground water contamination; however, the acquisition of these sites may require special procedures that would significantly increase the right-of-way and site preparation costs for proposed projects.

3.4.2 – 4F lands

4F refers to Section 4(f) of the Federal Transportation Act of 1966 which identifies several land uses that federal aid transportation projects must avoid impacting unless no other feasible alternative exists. If a significant impact were necessary upon one or more 4F lands, a mitigation of those impacts would be necessary to offset any impacts, usually at a very high cost. Lands included within Section 4(f) are wetlands (as classified by the US Army Corps of Engineers), wildlife and waterfowl refuges, historic or religious sites and park or recreation areas.

In McLennan County, the only areas officially classified as a wetland are lakes or other permanent water features. However, the 100-year flood plain does represent riparian habitats in McLennan County that provide unique habitats for wildlife and waterfowl not found elsewhere in the county. This is in large part because most other lands in the county are developed or used for agricultural purposes. Therefore, the MPO has decided to use the 100-year flood plain, as defined by the Federal Emergency Management Agency (FEMA), as a substitute for wetlands in our analysis of potential environmental mitigation activities. All officially defined wetlands within McLennan County are included within the 100-year flood plain.

There are no officially designated wildlife or waterfowl refuges located within McLennan County. With that said, however, several endangered or threatened species have been identified within the county and potential habitats for these species exist throughout the county. One of the challenges with this form of analysis is that the Texas Parks and Wildlife Department usually does not reveal specific locations of endangered or threatened species habitats

within a public forum for fear of some type of disturbance or destruction by humans. Therefore, the MPO has chosen to identify all highway projects requiring additional right-of-way and with a rural component as having a 'somewhat likely' impact on endangered or threatened species habitat.

3.4.3 – land use takings

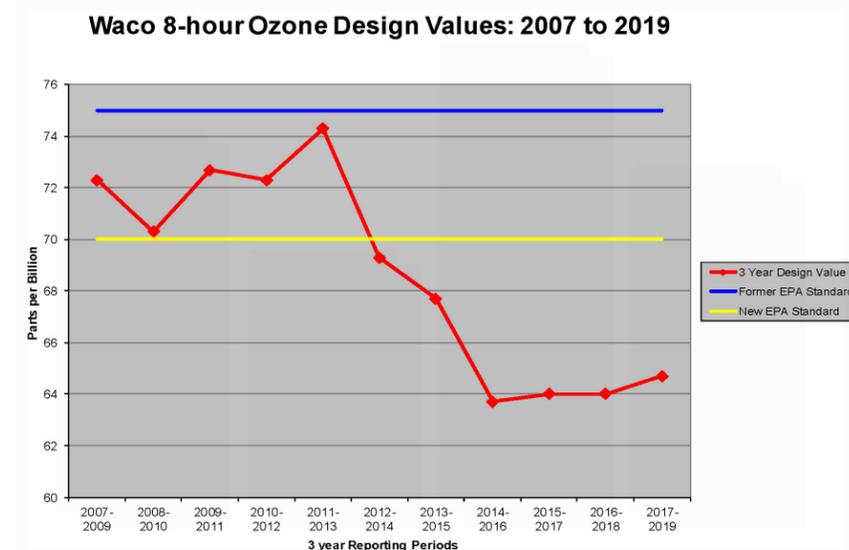
Although partly accounted for within the right-of-way costs, this analysis provides some information regarding potential impacts to the built or human environment. One part of the analysis is the identification of the number of residential or commercial / industrial structures within the 250 or 500 foot 'likely' zone. This provides some approximate quantification of impacts to the built environment.

3.4.4 – air quality

The Waco area has one air quality monitoring site, Waco Mazanec C1037, which is monitored by TCEQ. As of calendar year 2019, the Waco Metropolitan Area is considered to be in attainment for all air pollutants by the Environmental Protection Agency (EPA). Periodically, the Waco air quality monitoring site records 8-hour ozone concentrations that approach the National Ambient Air Quality Standards (NAAQS) standard of 0.070 parts per million (ppm). See Chart 3.10 for the recorded trend of 8-hour ozone concentrations in the Waco Metropolitan Area.

Tropospheric, or ground-level ozone, is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC). This happens when pollutants, such as those emitted by cars and other sources, chemically react in the presence of sunlight. Ozone is most likely to reach unhealthy levels on hot sunny days in urban environments, but can still reach high levels during colder months. See Section 1.3.3 for more information on the Clean Air Act and MPO Attainment Status.

chart 3.10 –8-hour ozone design values: 2007 to 2019



Source: Texas Commission on Environmental Quality - Current and historical measurements of ozone air pollution in Texas: Four Highest Eight-Hour Ozone Concentrations

3.4.5 – climate change and greenhouse gasses

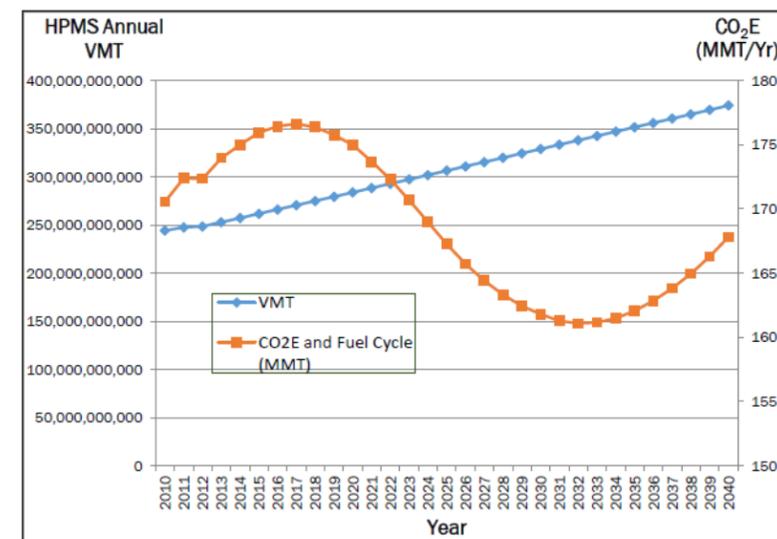
The transportation sector is the second largest source of greenhouse gas (GHG) emissions, contributing 26% of all GHG emissions in the US and 34.5% of all GHG emissions in Texas in the year 2014. The majority of transportation GHG emissions result from the combustion of petroleum-based products (e.g., gasoline) in personal and commercial vehicles, trains, ships, and airplanes. Carbon dioxide (CO₂) is the largest component of these GHG emissions. According to TxDOT’s 2018 Statewide On-Road Greenhouse Gas Emissions Analysis and Climate Change Assessment report, in 2014, approximately 76% of transportation emissions in Texas were due to on-road emissions.

In Texas, GHG emissions are predicted to peak in 2017 and reach a low in 2032. The peak emission reductions would be achieved by 2032 as later model-year vehicles enter the Texas fleet, and older vehicles are phased out. In this situation, technology reduces emissions more than vehicle miles traveled (VMT) increases it. However, once 2012–2025 model-year vehicles have saturated the fleet, GHG emissions begin to increase again as VMT increases (see Chart 3.11).

Future on-road GHG emissions may be affected by: 1) the results of federal policy including tailpipe and fuel controls, 2) market forces that may alter vehicle technology and purchase (such as electric vehicle manufacturing and sales), 3) individual choice decisions regarding commute options, 4) reductions that can be achieved through traffic system management operation and/or demand management, and 5) technological advancements that may alter the transportation system and associated emissions.

Other potential impacts of climate stressors on the state of Texas’ transportation system include, but are not limited to, flooding, precipitation (including stormwater runoff rates), sea level rise, storm surge, extreme heat and drought, changes to wet/dry seasonal patterns, and extreme weather events.

chart 3.11 – texas vehicle miles traveled and annual carbon dioxide equivalent on-road and fuel-cycle emissions trends



Data Sources: For VMT, population and on-road CO₂ emissions: (TCEQ 2015)
To obtain fuel-cycle emissions, TxDOT multiplied the statewide annual emissions by 1.27 (EPA fuel-cycle factor is 27% of on-road emissions). TxDOT used the following for the million metric ton conversion (annual tons/1.10231131092 metric tons/U.S. tons)/1,000,000.

HPMS = highway performance monitoring system; VMT = vehicle miles traveled; CO₂E=carbon dioxide equivalent, MMT= million metric tons

Source: TxDOT, 2018, Statewide On-Road Greenhouse Gas Emissions Analysis and Climate Change Assessment

3.4.6 – analysis of potential environmental impacts

Projects considered for inclusion in the MTP were evaluated to determine the potential environmental impact, either positive or negative. See Section 7 for a discussion of how projects were evaluated and selected, and Appendix B for the project evaluation criteria. As a general rule, most projects will require some review of underground storage tank location and floodplain / wetlands impacts as most projects of any length will encounter these features. With the possible exception of interstate and some highway projects, which will require more significant reviews due to length and adjacent development, most other projects will generally avoid significant environmental impacts.