Work Authorization 5: Permian Basin Regional Freight and Energy Sector Transportation Plan

Land Use and Freight Technical Memorandum

Prepared by Atkins North America, Inc. and Cambridge Systematics, Inc.

September 2020

Contents

Acronyms v

1.0 Introduction 1
1.1 Methods and Data Overview 2

2.0 Overview of Permian Basin Demographics 4
2.1 Key Population Centers 8
2.2 Population Growth Trends 10
2.3 Population Projections 12

3.0 Industrial Land Uses in the Permian Basin 16
3.1 Permian Basin Key Employment Sectors 16
3.2 Oil and Gas Wells 24
3.3 Oil and Gas Lease Activity 27
3.4 Disposal Wells 30
3.5 Sand Mines 32
3.6 Hazardous Materials 34
3.6.1 Permian Area Hazmat Fixed Facilities 35
3.6.2 Permian Area Hazmat Transportation 39
3.6.3 Liquid Bulk Terminals 50
3.6.4 Crude Oil Refineries 52
3.6.5 Natural Gas Distribution Hubs and Processing Plants 53
3.7 Freight Generators and Receivers 63

4.0 Non-Industrial Land Uses in the Permian Basin 66
4.1 Overall Permian Basin 66
4.2 Midland-Odessa Metropolitan Area 73
4.2.1 Population Growth and Projections 75
4.2.2 Growth Challenges 77
4.3 City of Midland 78
4.4 City of Odessa 83
4.5 Other Population Centers 88
4.5.1 City of Hobbs, NM 88
4.5.2 City of Carlsbad, NM 88
4.5.3 City of Big Spring, TX 91
4.5.4 City of Andrews, TX 93
4.5.5 City of Artesia, NM 95
4.5.6 City of Lovington, NM 95
4.5.7 City of Snyder, TX 97
4.5.8 Town of Pecos City, TX 99
4.5.9 City of Lamesa, TX 101
4.5.10 City of Fort Stockton, TX 101
4.5.11 City of Monahans, TX 101
4.5.12 City of Seminole, TX 102
4.5.13 City of Kermit, TX 102

5.0 Environmental Justice (EJ) Considerations 102

6.0 Local Ordinances Impacting Freight 109

7.0 Distribution of Freight-Intensive Land Uses 111

8.0 Summary and Conclusions 118

Figures

Figure 1: Permian Basin Study Area 5
Figure 2: 2017 Population Ranges by County 7
Figure 3: Permian Basin Key Population Centers 9
Figure 4: Projected Population Change by County* 15
Figure 5: Employment by Organization Within Key Industrial Sector—Mining, Quarrying, and Oil/Gas Extraction, 2017 18
Figure 6: Employment by Organization Within Key Industrial Sector—Retail, 2017 19
Figure 7: Employment by Organization Within Key Industrial Sector—Construction, 2017 20
Figure 8: Employment by Organization Within Key Industrial Sector—Transportation and Warehousing, 2017 21
Figure 9: Employment by Organization Within Key Industrial Sector—Manufacturing, 2017 22
Figure 10: Employment by Organization Within Key Industrial Sector—Agriculture, Forestry, Fishing, and Hunting, 2017 23
Figure 11: Permian Basin Active Oil and Gas Well Count by County, February 2020 26
Figure 12: Oil and Gas Lease Activity by Year from 2005-2020 29
Figure 13: Permian Basin Oil and Gas Leases by Year from 2005 through 2019 30
Figure 14: Permian Basin Disposal Wells 31
Figure 15: Permian Basin Sand Mines 33
Figure 16: Hazmat Classification 34
Figure 17: Tank Trailer Configurations 41
Figure 18: Radioactive and Non-Radioactive Materials Routes for Midland and Odessa, 2019 42
Figure 19: Active Rail Corridors in the Permian Basin, 2019 44
Figure 20: Direct Truck to Rail Transloading 45
Figure 21: Texas Top 5 Hazmat Destinations by Rail 47
Figure 22: Pipelines 48
Figure 23: Energy Transfer Mexico Projects 54
Figure 24: Waha Hub Daily Average Price, 2019-2020 56
Figure 25: Permian Basin Oil- and Gas-Related Processing/Storage Facilities, 2020 62
Figure 26: Freight Generating Businesses, 2015 64
Figure 27: Freight Receiving Businesses, 2015 65
Figure 28: Permian Basin Land Use Cover, 2016 67
Figure 29: Population Centers of 5,000 or more within the Permian Basin, 2017 70

Figure 30: Residential Building Permits by County, 2009-2018 72
Figure 31: Midland-Odessa Metropolitan Area 74
Figure 32: Oil Production by County by Month from January 2000 to September 2019 76
Figure 33: Midland Development Areas 79
Figure 34: Midland 2035 Future Land Use Map 80
Figure 35: Midland 2035 Future Land Use Map 82
Figure 37: Odessa 2035 Future Land Use Map 84
Figure 38: Odessa Thoroughfare Plan 86
Figure 39: Odessa Truck Routes 87
Figure 40: Carlsbad 2040 Future Land Use Scenario 90
Figure 41: City of Big Spring 2030 Future Land Use Map 92
Figure 42: City of Andrews 2042 Future Land Use Map 94
Figure 43: Lovington 2040 Future Land Use/Target Development Area Map 96
Figure 44: City of Snyder 2040 Future Land Use Map 98
Figure 45: West Pecos Initiative Framework Plan 100
Figure 46: Percentage of Low-Income Households by Census Tract (2017) 104
Figure 47: Percentage of Limited English Proficiency Populations by Census Tract (2017) 105
Figure 48: Percentage of Minority Populations by Census Tract (2017) 107
Figure 49: Environmental Justice Index Map, 2017 108
Figure 50: Permian Basin Freight-Intensive Land Uses 113
Figure 51: Permian Basin Freight-Intensive Land Uses and Regional Freight Network 115
Figure 52: Permian Basin Freight-Intensive Land Uses and Environmental Justice Areas 117

Tables

Table 1: Data Sources and Descriptions 2
Table 2: Population by Decade by County in the Study Area 6
Table 3: Population Change by Decade by County in the Study Area 11
Table 4: Projected Population and Population Change by County, 2020-2050 13
Table 5: Permian Basin Employees by Key Industrial Sector, 2017 17
Table 6: Key Industry Employment Located within Midland-Odessa Metropolitan Area, 2017 24
Table 7: Permian Basin Area Fixed Facility Responsible Agencies 36
Table 8: Permian Basin Liquid Bulk Terminal 50
Table 9: Permian Basin Petroleum Refineries 53
Table 10: Texas Gas Processing Plants in the Permian Basin Region 57
Table 11: New Mexico Gas Processing Plants in the Permian Basin Region 60

Table 12: Top Ten Gas Processing Plants by Plant Capacity in the Permian Basin Region 61
Table 13: Population (1990-2017) and Planning Tools for Key Population Centers in the Permian Basin 68
Table 14: Population Change by Decade for Cities with Populations over 5,000..... 69
Table 15: Population and Percent Change by Decade by City in the Midland-Odessa Metropolitan Area 75
Table 16: Legend for Land Use Figures 79
Table 17: Frequently Occurring Ordinances by Population Center 109
Table 18: Freight/Land Use Intensity Scoring Criteria 112

Acronyms

AAR	Association of American Railroads
BBLS	Barrels
BCF	Billion Cubic Feet
bpd	barrels per day
BTS	Bureau of Transportation Statistics
BTU	British Thermal Units
CAGR	compound annual growth rate
CFS	Commodity Flow Survey
DHS	Department of Homeland Security
DOT	U.S. Department of Transportation
EHS	Extremely Hazardous Substance
EIA	U.S. Energy Information Administration
EJ	Environmental Justice
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FM	Farm to Market Road
FMCSA	Federal Motor Carrier Safety Administration
Hazmat	Hazardous Materials
HHS	U.S. Department of Health and Human Services
HIFLD	Homeland Infrastructure Foundation Level Data
ISP	Interim Storage Partners
I-10	Interstate 10
I-20	Interstate 20
LEHD	Longitudinal Employer Household Dynamics
LEP	Limited English Proficiency
LEPC	Local Emergency Planning Committee
LNG	Liquid Natural Gas
LOS	Level of Service
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
NAICS	North American Industry Classification System
NGLs	Natural Gas Liquids
NRC	Nuclear Regulatory Commission
PBLRO	Permian Basin Land and Royalty Owners
PHMSA	Pipeline and Hazardous Materials Safety Administration
PSI	Pounds per Square Inch
RMP	Risk Management Plan
RQ	Reportable Quantity
RV	Recreational Vehicle
SH	State Highway

TCEQ	Texas Commission on Environmental Quality
TDM	Travel Demand Model
THFN	Texas Highway Freight Network
Tier II	Reports for Facilities stored Hazmat above RQ
TIH	Toxic Inhalation Hazard
TM	Technical Memorandum
TPQ	Threshold Planning Quantity
TRI	Toxics Release Inventory
TxDOT	Texas Department of Transportation
UP	Union Pacific Railroad
US	U.S. Highway
WCS	Waste Control Specialists
WTI	West Texas Intermediary

1.0 Introduction

The purpose of this Technical Memorandum (TM) is to analyze the interplay between freight and land use within the Permian Basin region. Freight transportation and surrounding land uses (and land use regulations) can complement or conflict with each other, depending on the type, frequency, and level of interaction. Efficient and effective freight transportation depends on the availability and location of supportive land uses, such as:

- The clustering of raw materials, pickup sites, and delivery locations; and
- Appropriate land use development for truck fueling, parking, and staging.

Freight activity can also impact local land uses in negative ways, particularly residential and commercial development, such as:

- Vehicle noise;
- Freight vehicle interactions with passenger cars, bicycles, and pedestrians on local streets;
- Heavy freight vehicles causing damage to local streets; and
- Noxious or hazardous material conveyance.

The Permian Basin region is unique due to the high volume of energy sector-related freight activity. The magnitude and geographic dispersion of this activity make it difficult to effectively separate any land uses from freight movement. The region also is experiencing a high level of population growth in a short amount of time, creating significant demands for infrastructure, resources, and social services.

Analyzing freight and land use interactions as part of the Permian Basin Regional Freight and Energy Sector Transportation Plan is necessary to understand the distribution of land uses in relation to freight. In addition, this will assist in recommending policies and strategies that improve freight efficiency and effectiveness while minimizing unwelcome interactions between freight and incompatible land uses.

Goods movement is essential to supporting the region's economy and quality of life. However, growth in goods movement activities (from the energy sector or other industrial activity) also gives rise to negative community impacts. In addition to safety and air quality concerns, freight activities can cause excessive noise and vibration along significant goods movement corridors. As population and the energy sector continues to grow and expand throughout the region, so will commercial centers, leading to more widespread dispersion of freight-intensive impacts such as truck traffic.

1.1 Methods and Data Overview

This TM draws on several key data sources, both quantitative and qualitative, to develop a comprehensive picture of the freight land use within the study area. Data items used throughout the TM are summarized in Table 1.

Table 1: Data Sources and Descriptions

Data Item	Description	Source
Oil and Gas Assets	Sand mine locations, active oil wells, active drilling permits, oil and gas leases, water disposal sites, oil and gas processing and storage facilities	Enverus Drillinginfo Database, 2020; Energy Information Administration (EIA), 2018; Texas Railroad Commission
Population	County level population estimates and projections, historical populations for cities of 5,000+	Texas Demographic Center, 2019; The University of New Mexico Geospatial and Population Studies, 2019, U.S. Census Bureau
Environmental Justice Populations	Census tract level distribution of low-income, limited English proficiency (LEP), and minority populations	U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates
Employment by NAICS	Census block level Longitudinal Employer Household Dynamics (LEHD) Origin Destination Employment Statistics (LODES) - 10 labor segment markets defined by NAICS	OntheMap https://onthemap.ces.census.gov consecutive years of data from 2002 to 2017
Freight generators and receivers	Freight generating and freight receiving businesses by tonnage	TRANSEARCH Freight Finder, 2015
Pipelines	The location of pipelines across the state.	TxDOT Freight and International Trade Section, 2019
Railroads	Locations of rail lines by railroad	National Transportation Atlas Database, 2018; TxDOT 2017
Hazardous Materials	Hazardous material shipments and routes, fixed facility regulations, pipeline locations, capacity, liquid terminal locations,	Federal Motor Carrier Safety Administration (FMCSA) National Hazardous Materials Route Registry-by State,

Data Item	Description	Source
	capacity, natural gas processing plants and capacities,	FMCSA Administration National Hazardous Materials Route Registry-by State, Energy Information Administration (EIA), Homeland Infrastructure Foundation Level Data (HIFLD), Environmental Protection Agency (EPA), U.S. Census Commodity Flow Survey (2012), Industry Interviews (May-Sep 2019), Association of American Railroads (AAR), Industry Web Sites.
Land Use	Land cover and future land use maps from local agencies	National Land Cover Database 2016; Municipality comprehensive plans, Interviews

This TM covers the following:

- Historical and projected growth patterns in the region;
- Distribution of industrial activity in the region;
- Current and projected land uses and growth patterns in local agencies within the Permian Basin, including local ordinances affecting freight;
- Land use interaction with the transportation network;
- Community and Environmental Justice (EJ) issues; and
- Key issues, trends, and considerations for land use and freight in the region.

2.0 Overview of Permian Basin Demographics

The Permian Basin is located in western Texas and southeastern New Mexico. The basin is approximately 250 miles wide and 300 miles long, totaling approximately 75,000 square miles.[1] The Permian Basin includes Lubbock, to the north, Midland, to the east, Big Bend National Park to the south, and Lea and Eddy Counties to the west in New Mexico. The Permian Basin is named after the world's thickest deposits of rocks from the Permian geologic period that can be found in the basin. The basin contains the Mid-Continent Oil Field, with more than 7,000 oil fields.[2] Other areas within the greater Permian Basin include the Delaware Basin in the western part of the Permian Basin extending into New Mexico and Midland Basin located in the eastern Permian Basin as shown in **Figure 1**.

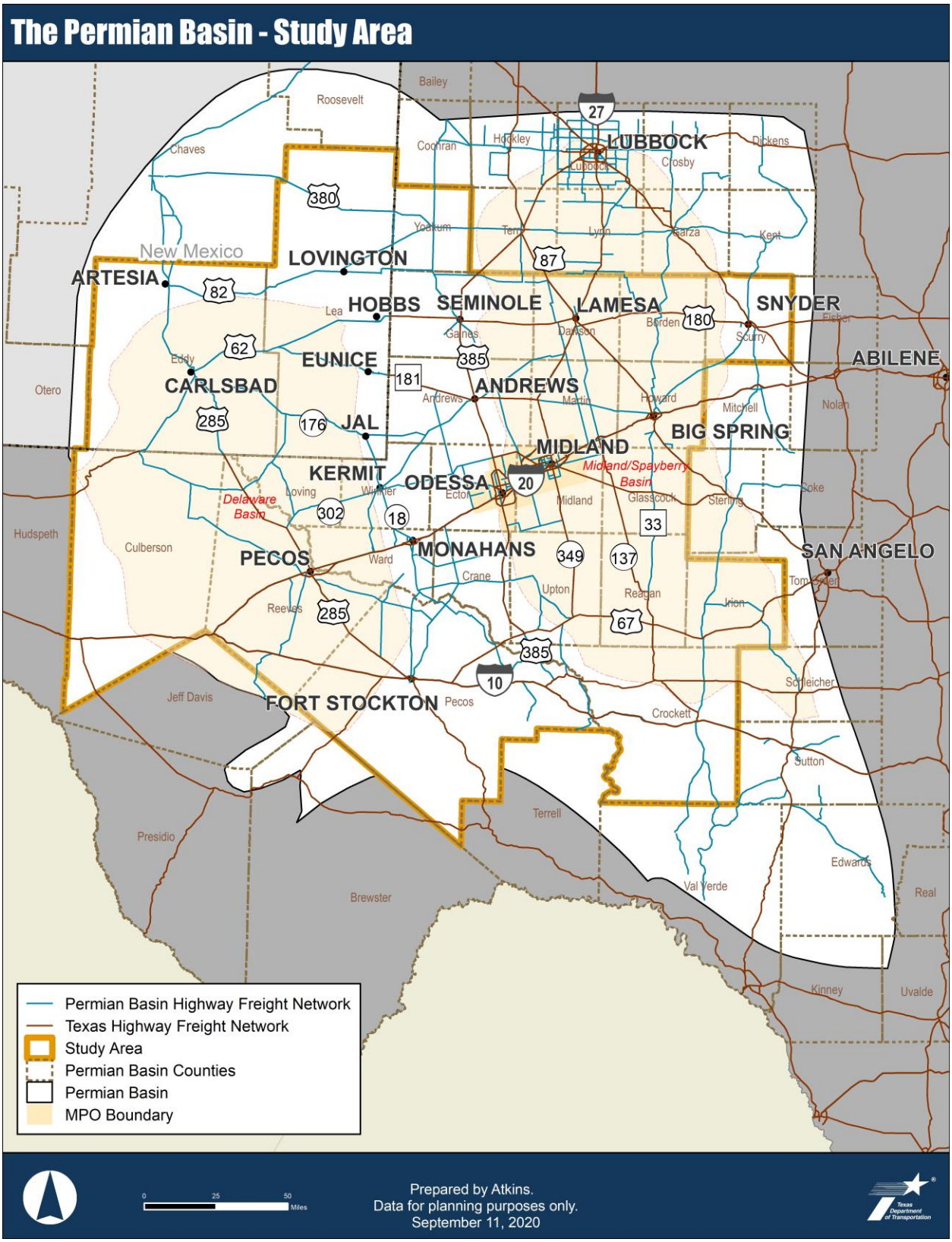
The Permian Basin Regional Freight and Energy Sector Transportation Plan study area is made up of the following Texas counties: Andrews, Borden, Crane, Crockett, Culberson, Dawson, Ector, Gaines, Glasscock, Howard, Irion, Loving, Martin, Midland, Pecos, Reagan, Reeves, Scurry, Upton, Ward, Winkler, and Yoakum. The study area also contains Lea and Eddy counties in New Mexico. See **Figure 1** for a map of the study area. The total population of the study area in 2017 was 639,981, which is a 12 percent increase over 2010.

This section provides detail on Key Population Centers (Section 2.1), Population Growth Trends since 1990 (Section 2.2), and Population Projections (Section 2.3). The population projections extend to 2040 for Lea and Eddy counties in New Mexico and to 2050 for the Texas counties.

[1] Railroad Commission of Texas [RRC], 2019. https://www.rrc.state.tx.us/oil-gas/major-oil-and-gas-formations/permian-basin-information/

[2] Ibid

Figure 1: Permian Basin Study Area



There were approximately 639,981 people and 208,582 households in the Permian Basin study area in 2017. [3,4] **Table 2** shows the population changes in the study area over the last 30 years. **Figure 2** shows population ranges by county in 2017.

Table 2: Population by Decade by County in the Study Area

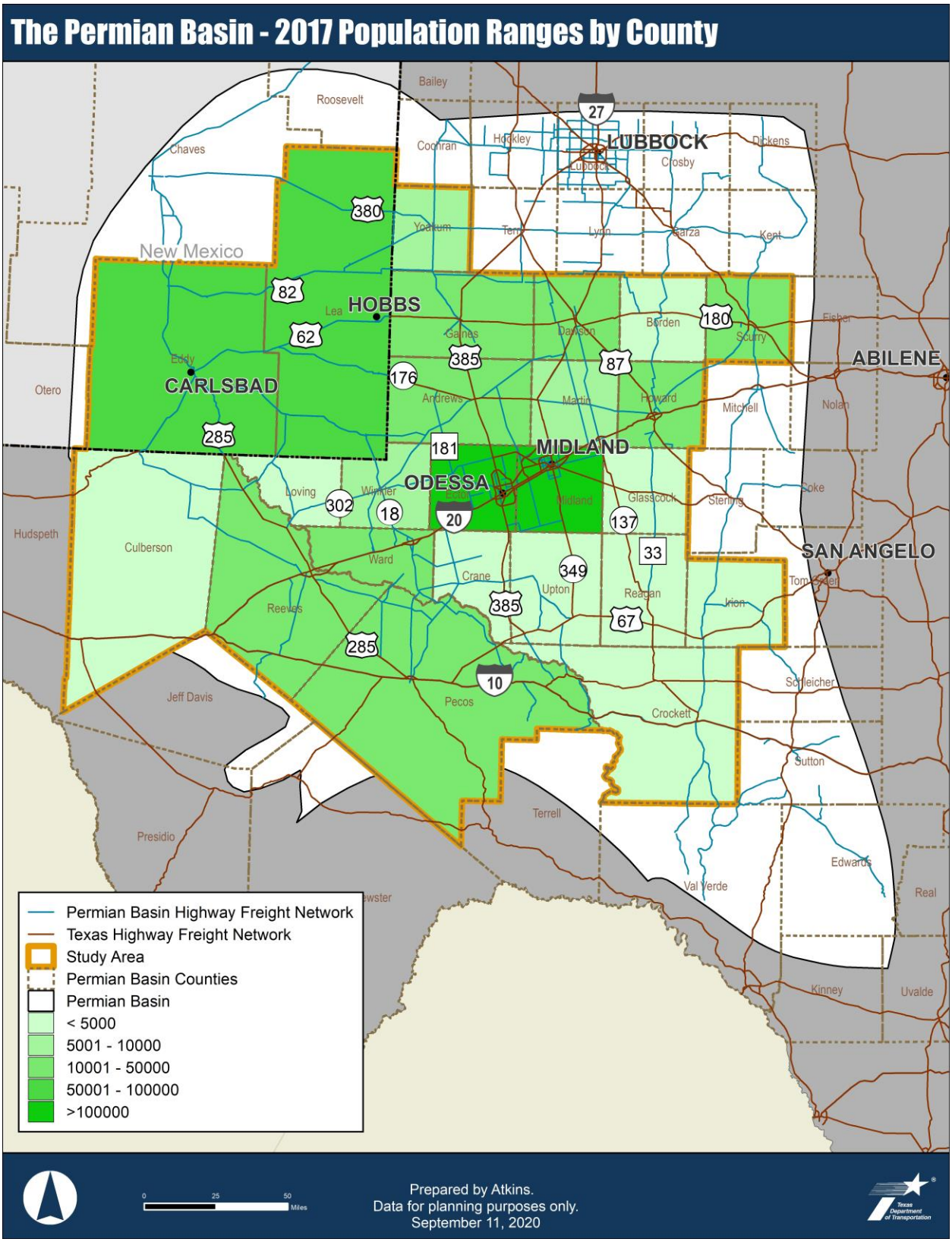
Texas Counties	1990	2000	2010	2017
Andrews	14,338	13,004	14,786	17,631
Borden	799	729	641	668
Crane	4,652	3,996	4,375	4,731
Crockett	4,078	4,099	3,719	3,523
Culberson	3,407	2,975	2,398	2,211
Dawson	14,349	14,985	13,833	12,672
Ector	118,934	121,123	137,130	159,797
Gaines	14,123	14,467	17,526	20,598
Glasscock	1,447	1,406	1,226	1,256
Howard	32,343	33,627	35,012	36,148
Irion	1,629	1,771	1,599	1,523
Loving	107	67	82	81
Martin	4,956	4,746	4,799	5,445
Midland	106,611	116,009	136,872	164,771
Pecos	14,675	16,809	15,507	15,626
Reagan	4,514	3,326	3,367	3,682
Reeves	15,852	13,137	13,783	15,308
Scurry	18,634	16,361	16,921	16,905
Upton	4,447	3,404	3,355	3,618
Ward	13,115	10,909	10,658	11,232
Winkler	8,626	7,173	7,110	7,668
Yoakum	8,786	8,481	7,879	8,589
New Mexico Counties	1990	2000	2010	2017
Lea	55,795	55,511	64,727	69,505
Eddy	48,605	51,658	53,829	56,793
Total	**514,822**	**519,773**	**571,134**	**639,981**

Source: Texas Demographic Center, 2019

[3] Texas State Demographer, 2019 https://demographics.texas.gov/Data/TPEPP/Estimates/

[4] U.S. Census, 2013-2017 American Community Survey 5-Year Estimates – ACS Households and Families

Figure 2: 2017 Population Ranges by County



Source: Texas Demographic Center, 2019

The University of New Mexico, 2019. *Geospatial and Population Studies*. https://gps.unm.edu/pru/estimates

2.1 Key Population Centers

There are several key population centers in the study area. For this TM, key population centers were identified in counties with populations over 50,000. Population data in **Table 2** show that Ector and Midland Counties were the two most populous counties in the study area in 2017. The cities of Odessa and Midland, respectively, are located within these counties as well as the Permian Basin Metropolitan Planning Organization (MPO) planning boundaries. These key population centers are shown on **Figure 3**. Technological advances in hydraulic fracking has led to a huge increase in the amount of oil and natural gas produced in the region, and Odessa and Midland are considered the headquarters for energy production in the area.

Midland and Odessa both contain a mix of residential, civic, commercial, and industrial land uses and are connected by urban development along the Interstate 20 (I-20) corridor. The increase in oil and gas production in the Permian Basin has led to rapid population growth in these cities. The City of Midland Comprehensive Plan and the City of Odessa Master Plan both anticipate future growth to be concentrated in the area between the two cities and to the north, near Andrews County.[5,6]

Lea and Eddy Counties in New Mexico also contain key population centers within the study area, such as Hobbs and Carlsbad, respectively. These two counties are some of the fastest growing counties in the state of New Mexico. While other counties in New Mexico have lost population, both Lea and Eddy counties have grown over the last 20 years. Much of the growth in these areas is also is attributed to the oil and natural gas industries in the Permian Basin.[7]

The areas outside of these population centers are primarily rural, with smaller towns located along roadways in the study area. Additionally, more than 150,000 oil wells and 22,000 gas wells have been permitted and completed throughout the study area.[8]

---

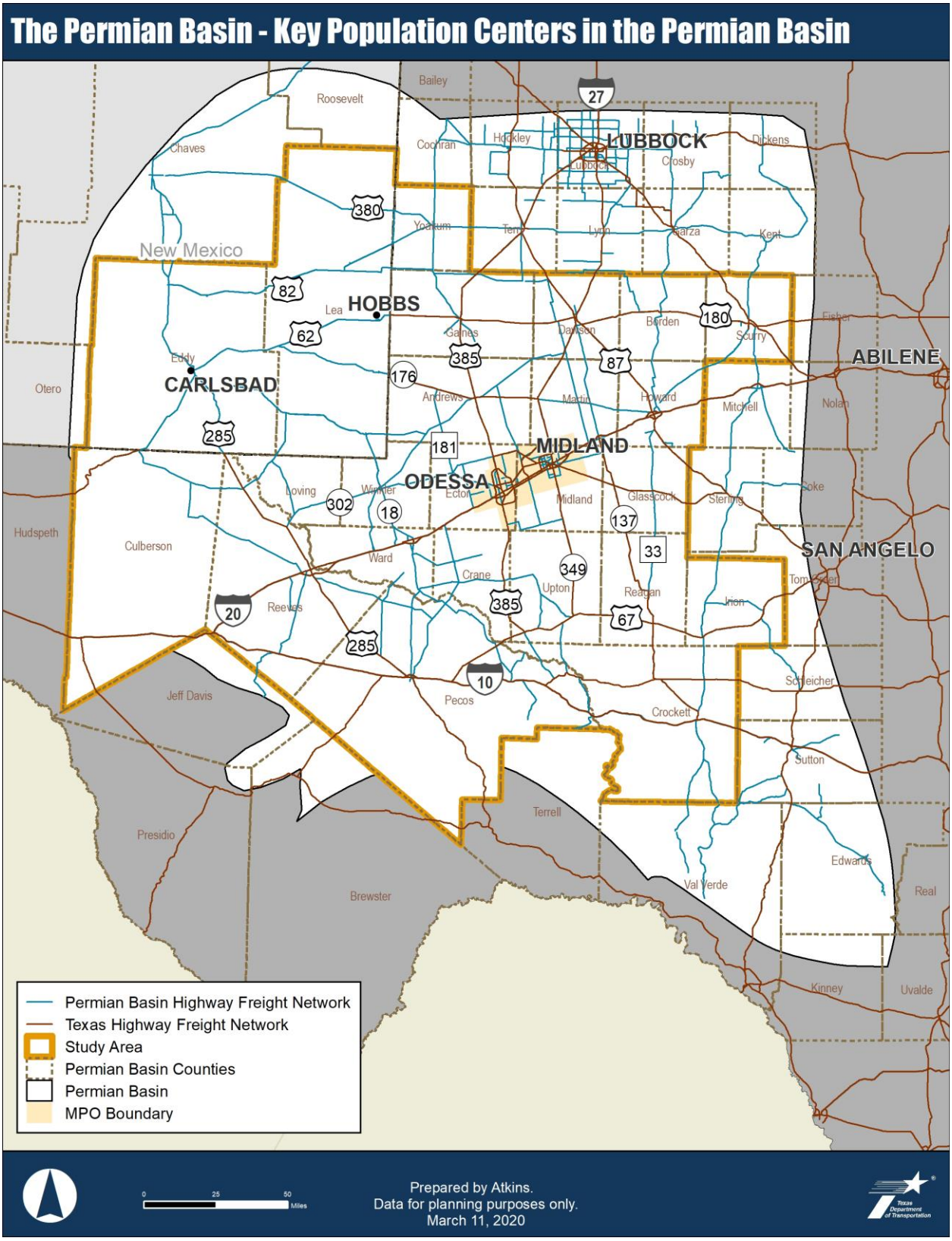
[5] City of Odessa, 2016. *Envision Odessa Comprehensive Master Plan*. https://www.odessa-tx.gov/home/showdocument?id=2953

[6] City of Midland, 2016. *Tall City Tomorrow Comprehensive Plan*. https://www.midlandtexas.gov/532/Tall-City-Tomorrow

[7] Lea County, 2019. https://www.leacounty.net/p/departments/community-development/planning

[8] Railroad Commission of Texas [RRC], 2019

Figure 3: Permian Basin Key Population Centers



2.2 Population Growth Trends

The Permian Basin study area experienced a considerable population increase over the last 30 years. As shown in **Table 3**, the growth rate for the study area has increased every decade since 1990, with the most significant growth occurring since 2010. Between 1990 and 2000, the region's population grew by 1 percent as compared to 12.1 percent between 2010 and 2017. Over the last 20 years, many of the counties that were losing population between 1990 and 2000 started gaining population.

Midland County experienced the largest growth rate within the study area, with a 21.6-percent population increase between 2010 and 2017.[9] Gaines, Andrews, and Ector counties also experienced high levels of population growth during that period. In **Table 3**, below, the counties with growth greater than 10 percent between 2010 and 2017 are shown in green; the counties with the greatest population loss between 2010 and 2017 are shown in orange. Much of the growth is occurring in the largest population centers.

[9] Texas Demographic Center, 2019.

Table 3: Population Change by Decade by County in the Study Area

Texas Counties	1990-2000	2000-2010	2010-2017
Andrews	-9.3%	13.7%	18.3%
Borden	-8.8%	-12.1%	4.8%
Crane	-14.1%	9.5%	6.2%
Crockett	0.5%	-9.3%	-7.2%
Culberson	-12.7%	-19.4%	-8.2%
Dawson	4.4%	-7.7%	-11.1%
Ector	1.8%	13.2%	16.3%
Gaines	2.4%	21.1%	19.1%
Glasscock	-2.8%	-12.8%	1.0%
Howard	4.0%	4.1%	3.1%
Irion	8.7%	-9.7%	-9.0%
Loving	-37.4%	22.4%	-1.2%
Martin	-4.2%	1.1%	11.4%
Midland	8.8%	18.0%	21.6%
Pecos	14.5%	-7.7%	-0.4%
Reagan	-26.3%	1.2%	9.1%
Reeves	-17.1%	4.9%	13.7%
Scurry	-12.2%	3.4%	-2.0%
Upton	-23.5%	-1.4%	8.3%
Ward	-16.8%	-2.3%	5.6%
Winkler	-16.8%	-0.9%	6.1%
Yoakum	-3.5%	-7.1%	9.0%
New Mexico Counties	1990-2000	2000-2010	2010-2017
Lea	-0.5%	16.6%	7.4%
Eddy	6.3%	4.2%	5.5%
Region Average	**1.0%**	**10.0%**	**12.0%**

Source: Texas Demographic Center, 2019
The University of New Mexico, 2019. Geospatial and Population Studies. https://gps.unm.edu/pru/estimates
Green indicates the counties with growth greater than 10 percent between 2010 and 2017
Orange indicates the counties with the greatest population loss between 2010 and 2017

2.3 Population Projections

Population projections for the study area for the next 30 years indicate that the region is expected to experience an even greater increase in growth rates than during the last 30 years. Growth projections were obtained from the Texas State Demographer's Office and the State of New Mexico. Projections for the New Mexico counties are only available through 2040.

Table 4 and **Figure 4** P show that, overall, the study area population will grow by about 27 percent between 2020 and 2030, and by another 31 percent between 2030 and 2040. Between 2020 and 2050 (Texas counties only), the study area population is projected to increase by more than 154 percent. Within **Table 4**, counties expected to at least double in size are shown in green. Counties projected to lose population are shown in orange. In some areas, temporary housing for energy sector employees ("staff camps," discussed further in **Section 4**) has been utilized to address local housing shortages; these residents may not be adequately captured in the growth estimates and/or projections because of the transitory nature of these camps.

Table 4: Projected Population and Population Change by County, 2020-2050

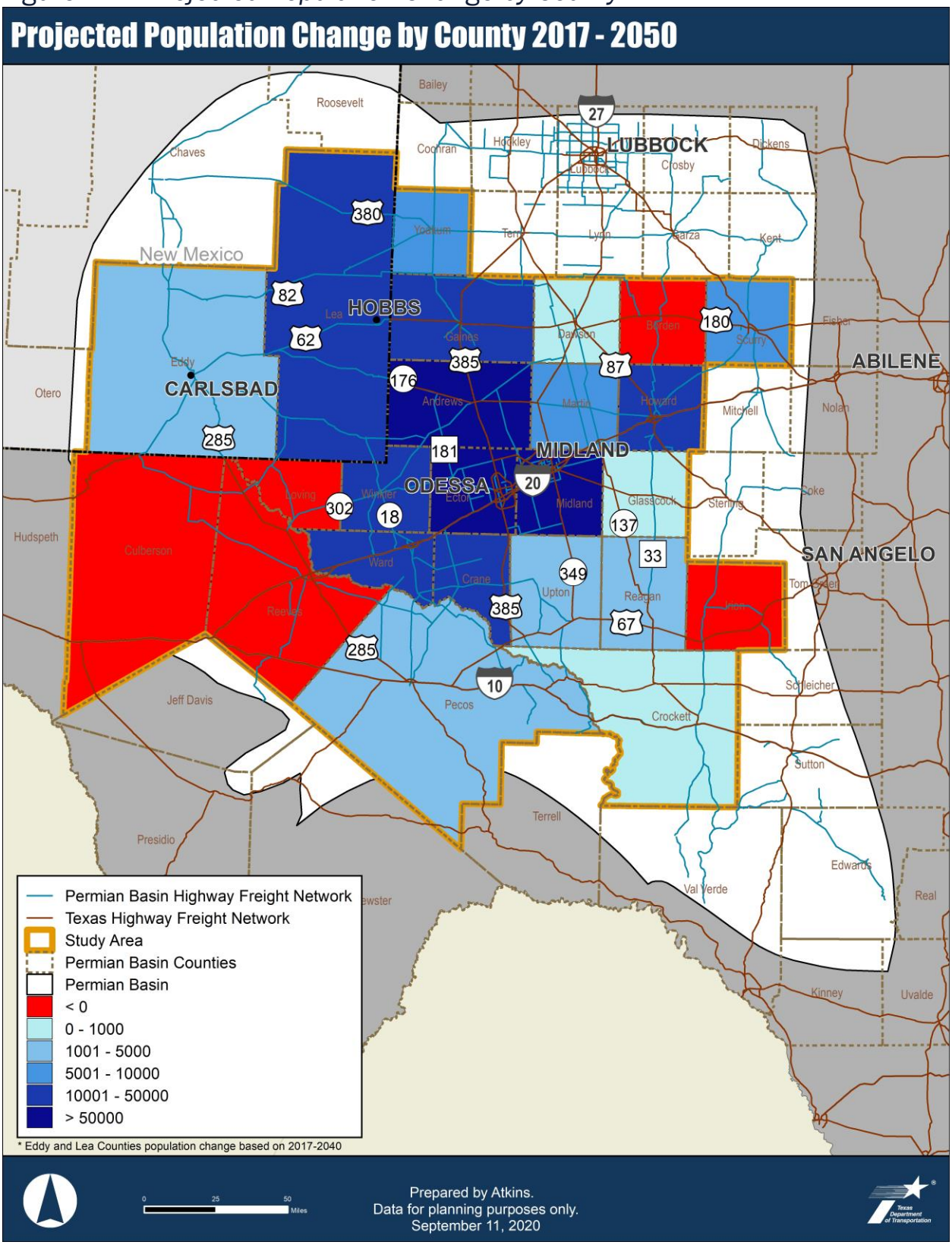
Texas Counties	2020	2030	2040	2050	% change 2020-2050	Population Change 2020-2050
Andrews	22,268	35,750	59,669	100,627	352%	78,359
Borden	685	706	687	663	-3%	-22
Crane	6,209	8,809	12,665	18,418	197%	12,209
Crockett	4,040	4,212	4,209	4,219	4%	179
Culberson	2,245	2,067	1,840	1,590	-29%	-655
Dawson	13,592	13,482	13,422	13,269	-2%	-323
Ector	184,838	255,395	356,876	494,413	167%	309,575
Gaines	22,121	27,880	35,455	45,004	103%	22,883
Glasscock	1,365	1,505	1,555	1,485	9%	120
Howard	41,236	49,372	59,555	71,192	73%	29,956
Irion	1,508	1,463	1,389	1,260	-16%	-248
Loving	92	90	88	77	-16%	-15
Martin	6,044	7,618	9,374	11,695	93%	5,651
Midland	187,362	268,083	390,818	573,085	206%	385,723
Pecos	16,548	17,064	17,466	18,116	9%	1,568
Reagan	4,226	5,253	6,513	8,145	93%	3,919
Reeves	12,610	11,949	11,139	10,459	-17%	-2,151,
Scurry	18,381	20,049	21,673	23,405	27%	5,024
Upton	3,983	4,726	5,551	6,557	65%	2,574
Ward	13,592	18,162	24,633	33,336	145%	19,744
Winkler	9,295	12,460	17,107	23,352	151%	14,057
Yoakum	9,225	11,102	13,169	15,398	67%	6,173
New Mexico Counties	2020	2030	2040	2050	% change 2020-2040	Population Change 2020-2040
Lea	75,784	78,992	81,635	NA	8%	5,851
Eddy	57,913	58,547	58,233	NA	1%	320
Total	**715,162**	**914,736**	**1,204,721**	**1,475,765***	**154%***	**894,300***

Source: Texas Demographic Center, 2019
The University of New Mexico, 2019. *Geospatial and Population Studies* https://gps.unm.edu/pru/projections
* Texas counties only
Green indicates the counties that are projected to double their population by 2050.
Orange indicates that counties that are projected to lose population by 2050

Andrews, Crane, Ector, Midland, Ward, and Winkler counties are all expected to grow by more than 30 percent every decade. As Midland and Odessa continue to grow over the next 30 years, both cities expect much of the new commercial and residential development to expand northward. Starting in 2020, the population of Andrews County is projected to increase by 60 percent every decade until at least 2050, resulting in growth of more than 352 percent between 2020 and 2050. Percentage change between 2020 and 2050 should be viewed with caution, however, as counties with lower total population can appear to experience explosive growth with even small levels of projected change. For example, Crane (pop. 6,200) and Midland (pop. 187,400) counties are both projected to increase by approximately 200 percent between 2020 and 2050; when viewed in terms of actual population increase, however, Crane County is projected to add approximately 12,200 people, while Midland County adds approximately 385,720 people.

Growth is expected mainly in counties with established population centers (**Figure 3**) particularly those surrounding the Midland-Odessa metropolitan area. Of the projected growth in the region (Texas only), 78 percent is located in Midland and Ector counties. Population projections for the Midland and Odessa metropolitan area are discussed in more detail in section 4.2. Several counties—including Borden, Culberson, Dawson, Irion, Loving, and Reeves—are projected to lose population over the next 30 years.

*Figure 4: Projected Population Change by County**



*New Mexico Counties are showing population change from 2017-2040

Source: Texas Demographic Center, 2019

The University of New Mexico, 2019. *Geospatial and Population Studies* https://gps.unm.edu/pru/projections

3.0 Industrial Land Uses in the Permian Basin

This section examines the industrial land uses in the Permian Basin, which both generate and receive freight. These land uses are often incompatible with residential land uses as they often have negative externalities associated with them such as increased noise, truck traffic, and pollution. Employment in industry sectors that generate freight traffic and that have significant concentrations in the region were mapped to get a sense of where the largest businesses/organizations are located. These industries are based on North American Industry Classification System (NAICS) codes and include mining, quarrying, oil/gas extraction, retail, construction, transportation and warehousing, manufacturing, and agriculture, forestry, fishing and hunting. Most of the employment in these industries with the exception of agriculture, forestry, fishing and hunting, which is clustered around the more urbanized areas. The Permian Basin is dominated by the energy sector so this section also looks at the oil and gas industry including active wells, oil and gas lease activity, sand mines, and water disposal sites. Additionally, this section discusses hazardous materials,where they are produced and how they are moved throughout the region, which is an important safety consideration. Lastly, this section examines freight producers and consumers in the region using Transearch Freight Finder data, which provides insight into the location of freight-related businesses and the amount of freight they generate or receive in tonnage.

3.1 Permian Basin Key Employment Sectors

Data on industrial organizations and employment in the region were gathered from OnTheMap, a partnership between the U.S. Census Bureau and all 50 states to collect and track employment information by NAICS codes through unemployment insurance wage data and the Quarterly Census of Employment in Wages. This data set does not account for self-employed workers, the uniformed military, or informal workers (e.g., babysitters, handymen doing small odd jobs, house cleaners, lawn and yard work, etc.) who are not taxed or monitored by the government. This analysis focuses on industrial sectors (a) with significant concentration in the region, and (b) that generate significant amounts of freight traffic. These industrial sectors include:

- Mining, quarrying, oil/gas extraction (NAICS 21);
- Retail (NAICS 44-45);
- Construction (NAICS 23);
- Transportation and warehousing (NAICS 48-49).
- Manufacturing (NAICS 31-33); and
- Agriculture, forestry, fishing, and hunting; (NAICS 11)

Table 5 shows the total number of employees in each key sector within the Permian Basin study area. These numbers represent the companies located within the region, excluding workers in the region whose companies are based outside of the study area.

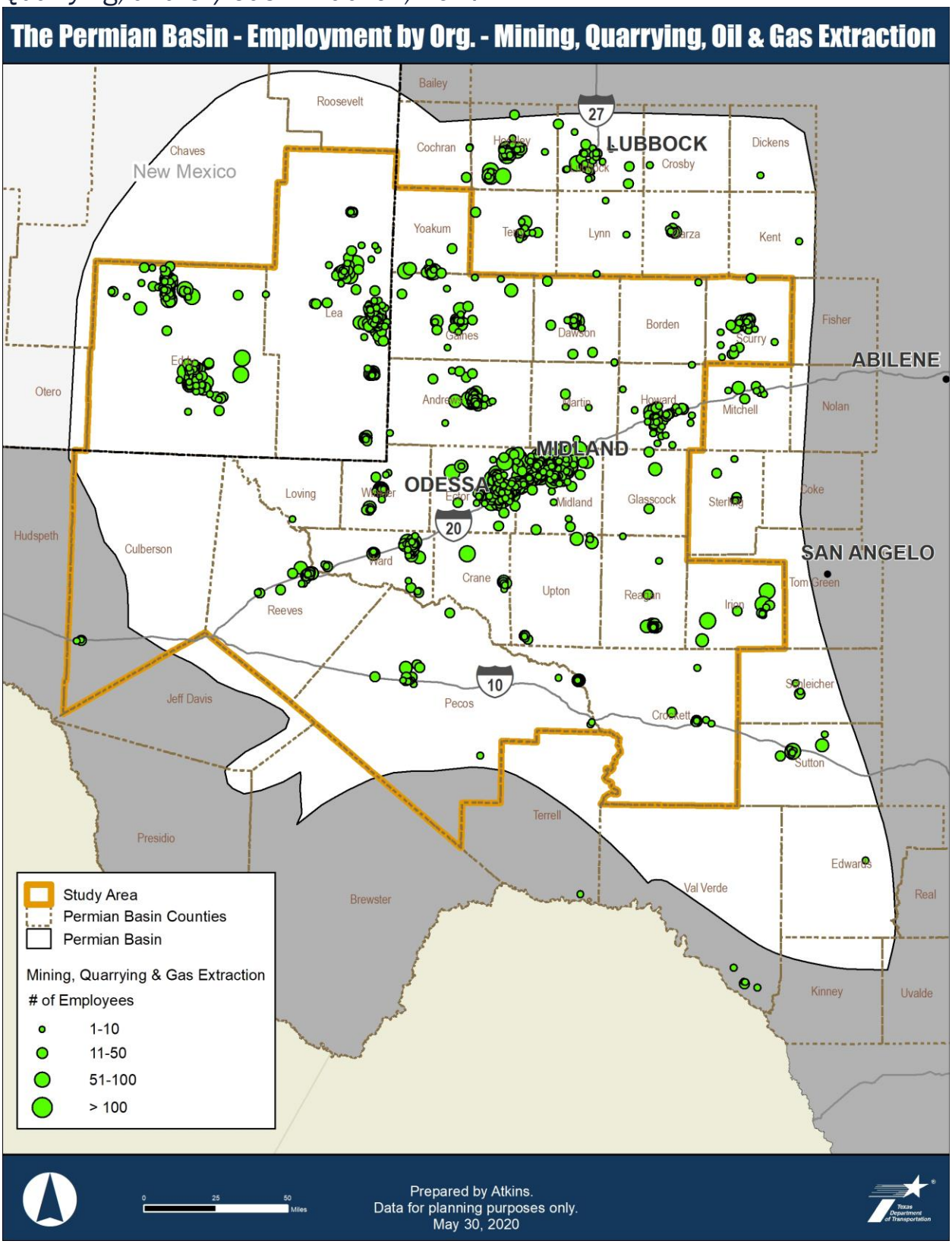
Table 5: Permian Basin Employees by Key Industrial Sector, 2017

Sector	Total Employees in the Study Area
Mining, quarrying, oil/gas extraction	53,491
Retail	26,904
Construction	19,687
Transportation and warehousing	11,716
Manufacturing	10,989
Agriculture, forestry, fishing, and hunting	3,461
Total	**126,248**

Source: OnTheMap, U.S. Census Bureau, 2017

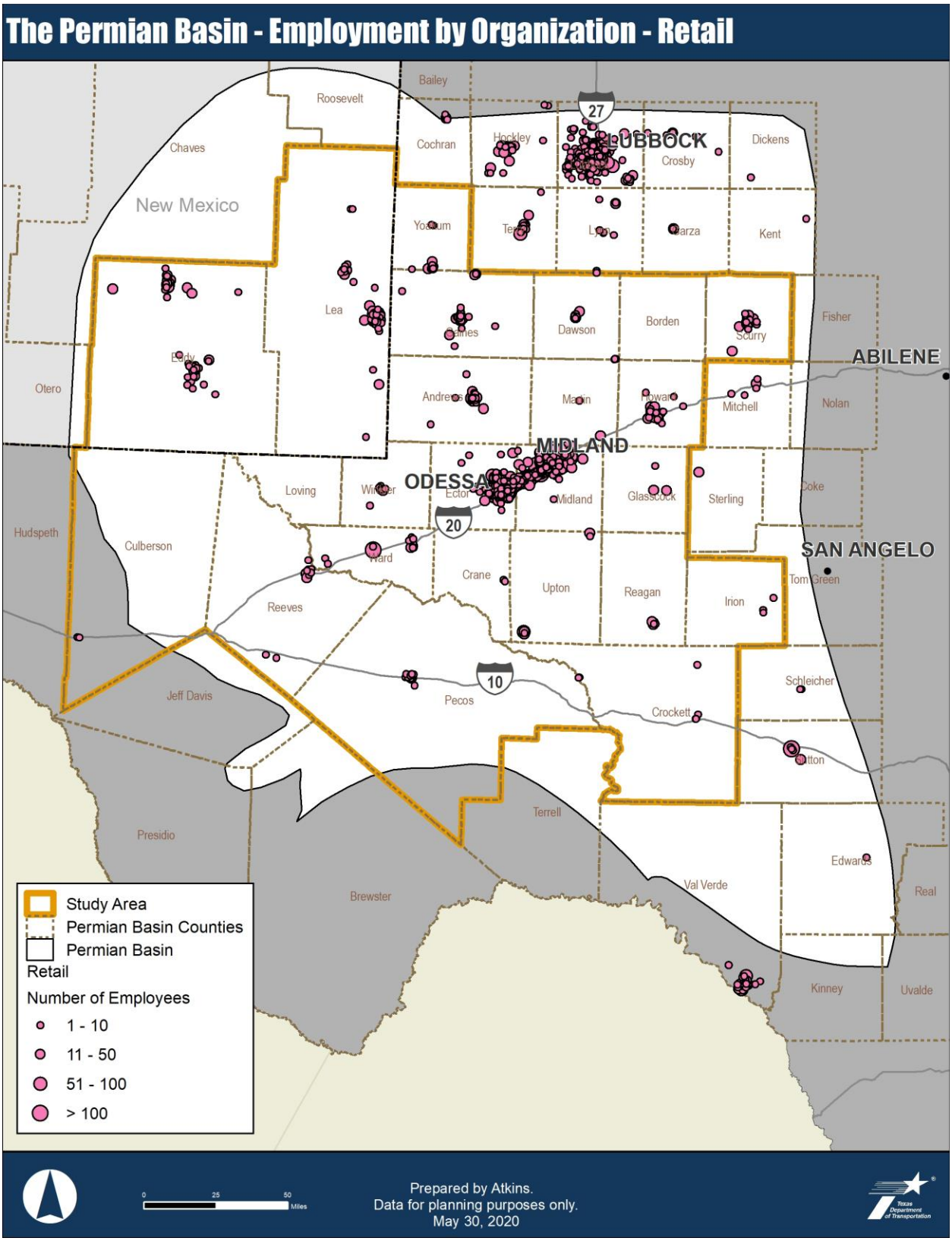
Figures 5 through **10** show the location of organizations within these key sectors, including those based in adjacent/nearby counties. The size of the location markers corresponds to the number of employees within each organization. Oil/gas wells themselves are not displayed on these maps, but the companies associated with their development and maintenance are included. Oil/gas wells are discussed in more detail later in Section 3.2. With the exception of agriculture, forestry, fishing, and hunting, the largest concentration of industrial/commercial activity is unsurprisingly concentrated within the Midland-Odessa metropolitan area. Other notable concentrations are observed in Big Spring, Snyder, Hobbs, and Carlsbad.

Figure 5: Employment by Organization Within Key Industrial Sector—Mining, Quarrying, and Oil/Gas Extraction, 2017



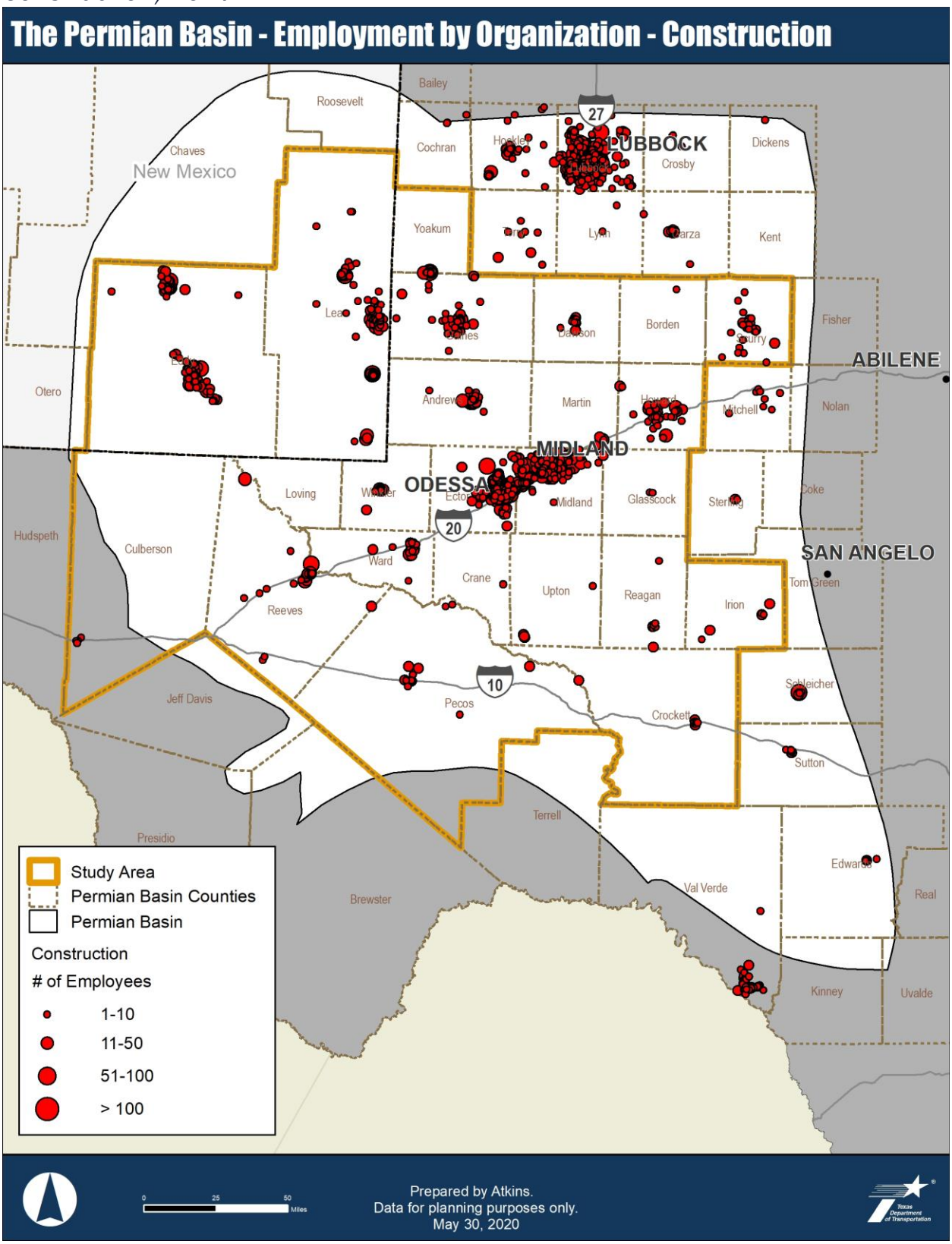
Source: OnTheMap, U.S. Census Bureau, 2017

Figure 6: Employment by Organization Within Key Industrial Sector—Retail, 2017



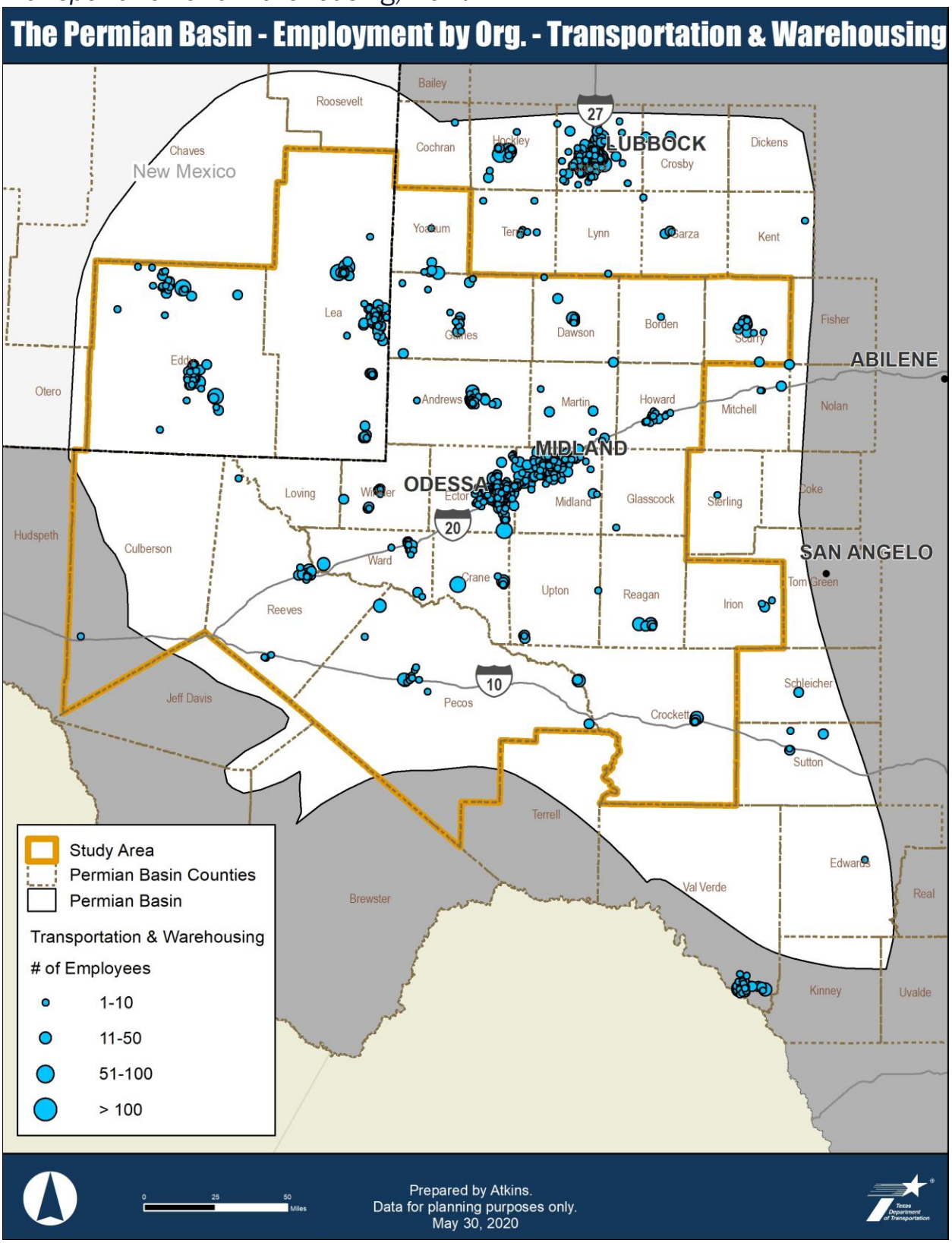
Source: OnTheMap, U.S. Census Bureau, 2017

Figure 7: Employment by Organization Within Key Industrial Sector—Construction, 2017



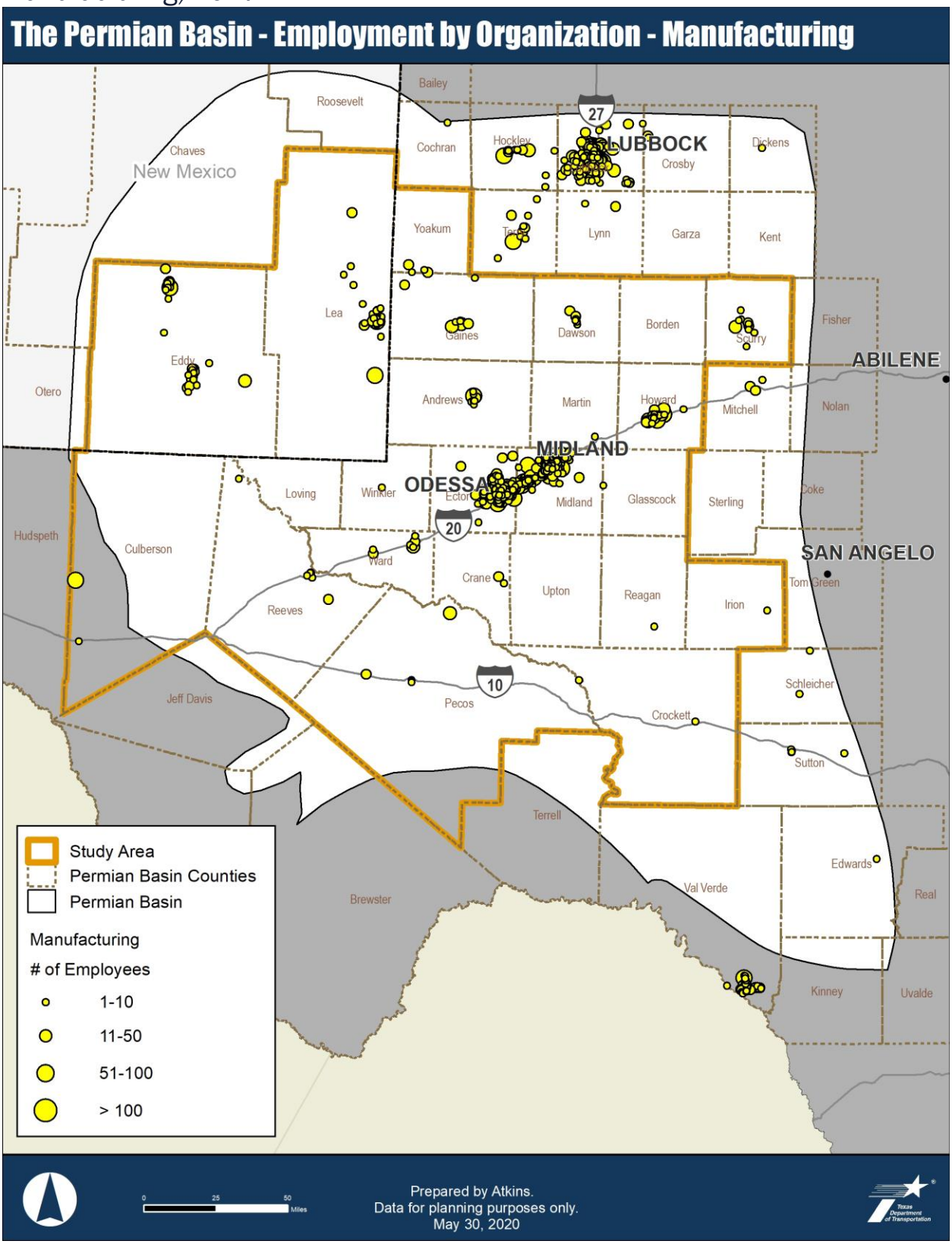
Source: OnTheMap, U.S. Census Bureau, 2017

Figure 8: Employment by Organization Within Key Industrial Sector—Transportation and Warehousing, 2017



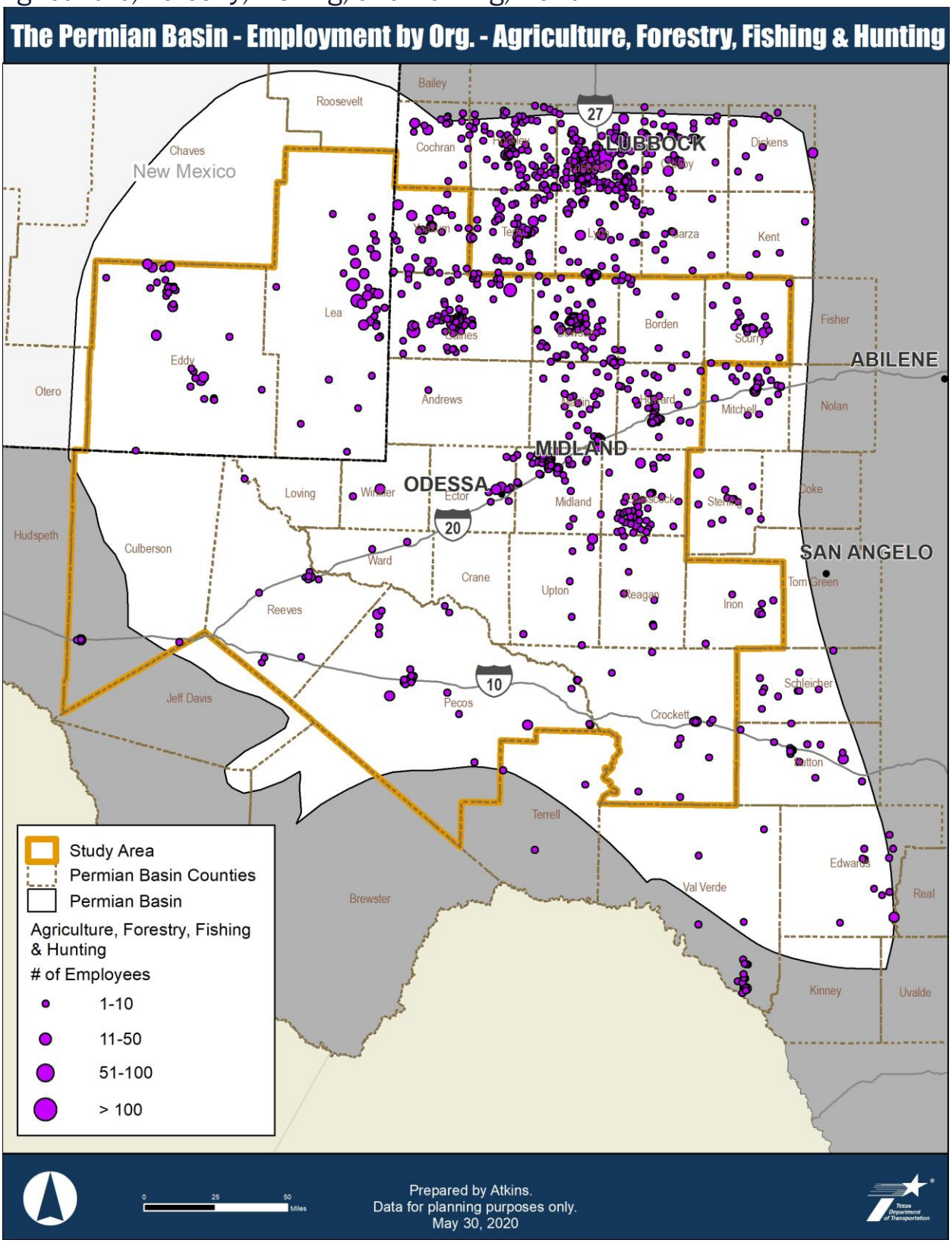
Source: OnTheMap, U.S. Census Bureau, 2017

Figure 9: Employment by Organization Within Key Industrial Sector—Manufacturing, 2017



Source: OnTheMap, U.S. Census Bureau, 2017

Figure 10: Employment by Organization Within Key Industrial Sector—Agriculture, Forestry, Fishing, and Hunting, 2017



Source: OnTheMap, U.S. Census Bureau, 2017

Industries in the mining, quarrying, and oil/gas extraction sector are prevalent throughout the Permian Basin. While many companies are concentrated near large population centers (two-thirds of total companies are located in Midland or Odessa), others are located in more remote areas. For example, **Figure 5** shows several large mining, quarrying, and oil/gas extraction companies are located in Irion County, which has a total population of roughly 1,500 people.

Manufacturing, construction, and transportation/warehousing industries are predominantly concentrated near major population centers, including Midland, Odessa, Hobbs, Carlsbad, Artesia, Big Spring, and Snyder. Retail is highly clustered within population centers, with very little in between population centers. Agricultural operations are scattered throughout the northern portion of the study area, with larger concentrations in Lea County, NM.

Table 6 shows the percentage of employment in the region located within the Midland-Odessa metropolitan area. More than half of total study area employment is located in this metropolitan area.

Table 6: Key Industry Employment Located within Midland-Odessa Metropolitan Area, 2017

Select Industry Sector	Study Area Employees	Employees within Midland-Odessa	Percentage of Study Area Employment within Midland-Odessa
Agriculture, forestry, fishing, and hunting	3,461	267	8%
Construction	19,687	10,933	56%
Manufacturing	10,989	7,239	66%
Mining, quarrying, oil/gas extraction	53,491	30,385	57%
Retail	26,904	15,370	57%
Transportation and warehousing	11,716	6,202	53%
Total	**126,248**	**70,396**	**56%**

Source: OnTheMap, U.S. Census Bureau, 2017

3.2 Oil and Gas Wells

The number of oil and gas wells in the Permian Basin study area has increased steadily in the last several years and significantly over the last decade.[10] **Figure 11** shows the

[10] Texas Railroad Commission

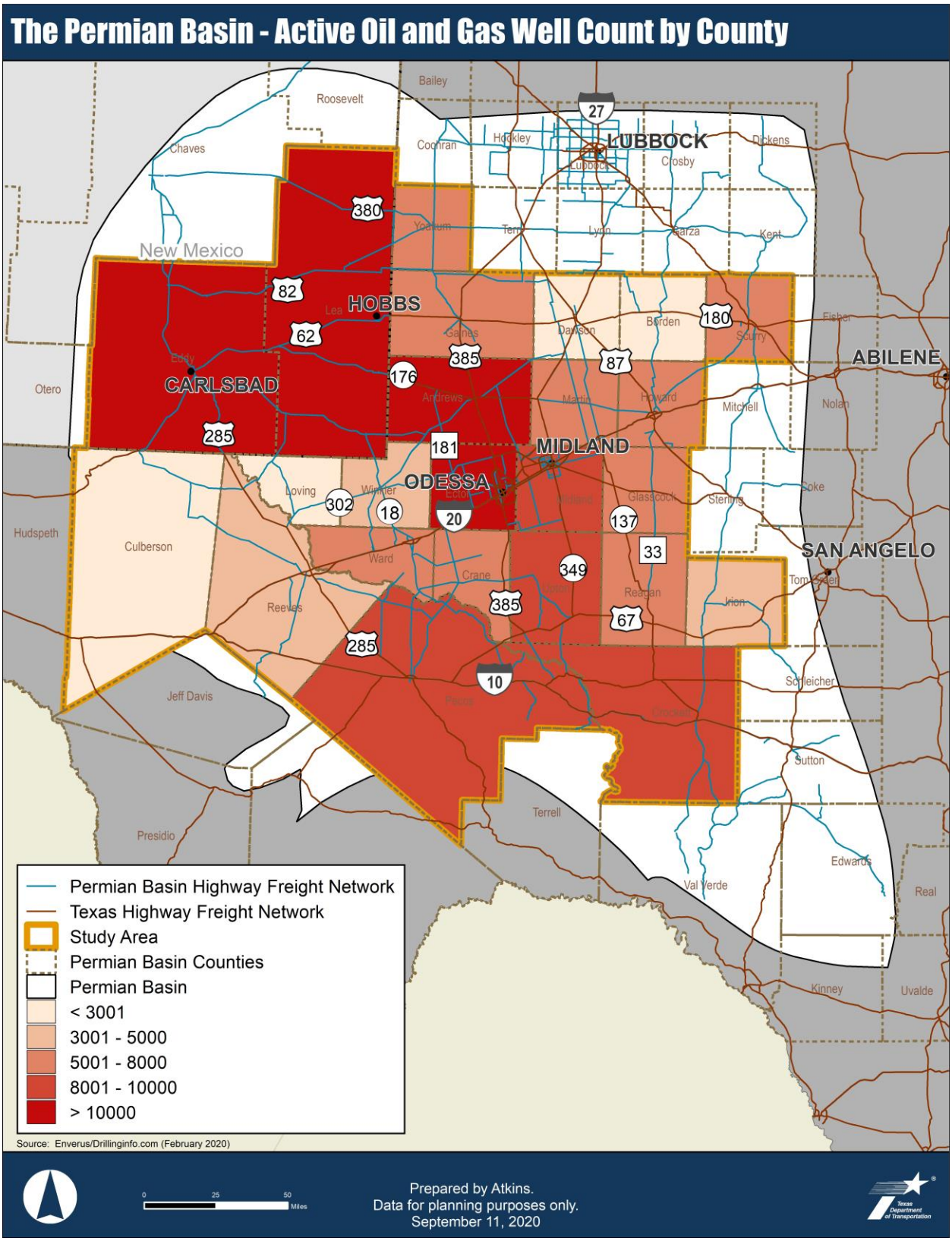
concentrations of active oil and gas wells in the study area. Oil and gas wells are located throughout the Permian Basin, with clustering toward the counties in the center and northwest portion of the study area around Andrews, Ector, Lea, and Eddy counties with large numbers also appearing in Midland, Upton, Pecos, and Crockett counties. New oil and gas well development is anticipated to move toward the Delaware Basin in the western portion of the study area next.[11]

For a typical new development site[12], the process of site preparation, pad construction, rig assembly, drilling/casing, rig disassembly, follow-up site preparation/clean up, and fracturing can generate approximately 4,000 to 7,000 heavy truck trips over 45 to 75 days. However, once the site is in full operation and enters its production phase, truck traffic drops off considerably with only 30 to 50 heavy truck trips over a 20 to 30-day period being generated to serve the site. Heavy truck traffic continues to drop once the site enters its maintenance phase with it generating about 3 to 5 heavy truck trips per day. This process repeats itself as the heavy truck traffic relocates to a new site. These estimated ranges, of course, vary and depend on several factors, but they provide an idea of the intensity of freight activity associated with developing new production sites.

[11] Stakeholder interviews

[12] TxDOT, "Work Authorization 5: Permian Basin Regional Freight and Energy Sector Plan – Stakeholder Outreach Meeting Notes, September 12, 2019," Technical Memorandum, September 20, 2019. The analysis assumes that a typical new development site consists of 1 pad 6 to 8 acres in size, with 6 to 8 wells located on the pad, and an 18,000 foot vertical component to each well.

Figure 11: Permian Basin Active Oil and Gas Well Count by County, February 2020



Source: Enverus/Drillinginfo.com, February 2020

3.3 Oil and Gas Lease Activity

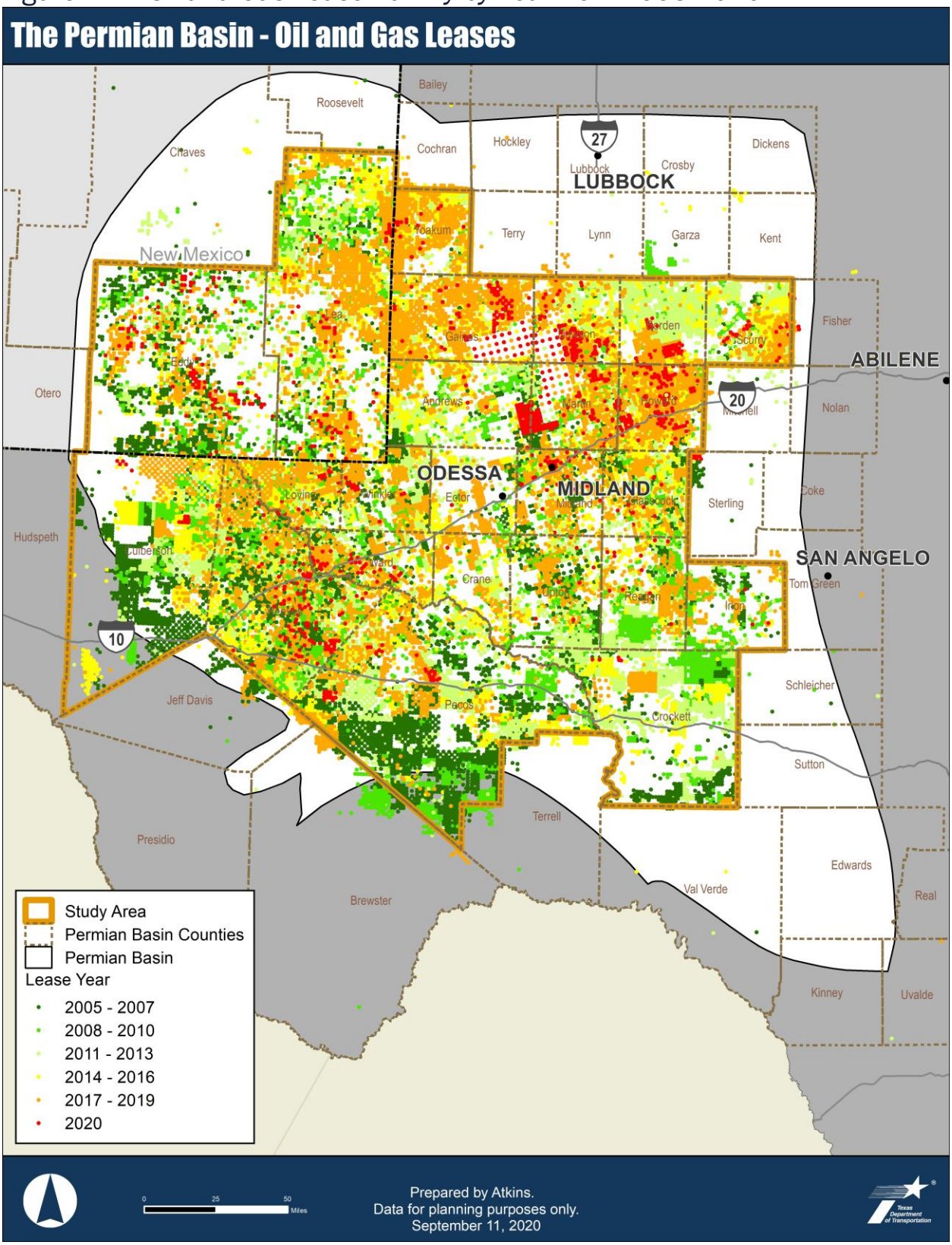
Figure 12 shows oil and gas lease activity by year from 2005 to April 2020. This data includes:

- **Assignment**- the sale, transfer, or conveyance of all or a fraction of ownership interest or rights owned in real estate or other such property. The term is commonly used in the oil and gas business to convey working interest, leases, royalty, overriding royalty interest, and net profits interest.
- **Leases**- a contract between mineral owner (otherwise known as the lessor) and a company or working interest owner (otherwise known as the lessee) in which the lessor grant the lessee the right to explore, drill, and produce oil, gas, and other minerals for a specified primary term and as long thereafter as oil, gas, or other minerals are being produced in paying quantities. This lease gives the lessee a working interest. The oil and gas lease is granted in exchange for a bonus consideration and royalty payments to the lessor.
- **Lease Amendments**- a legal document to modify the terms of the original lease. It allows certain terms to be changed, while leaving the rest of the lease intact and in full effect
- **Lease Extensions**- when the Lessor and/or leasehold owner extended the initial number of years or months defined in an Oil, Gas, and Mineral Lease (primary term) prior to its expiration.
- **Lease Option**- a provision in an oil and gas lease which grants the Lessor and/or the leasehold owner the option to extend the initial number of years or months defined in an Oil, Gas, and Mineral Lease (primary term) prior to its expiration
- **Lease Ratifications**- the act of adopting and confirming all the terms and provisions of an existing Oil, Gas, and Mineral Lease.
- **Memo of Lease**- a contract between a mineral owner (Lessor) and the leasing party (Lessee) outlining the terms of lease in a summarized format.
- **Release of Lease**- a document filed by the leasing party (Lessee) releasing the mineral owner (Lessor) in whole or in part from the binding terms of an existing lease contract.
- **Seismic Memo**- contract wherein the landowner (Grantor) grants to the second party (Grantee) the exclusive right and irrevocable option for a period of time, to enter upon and conduct oil and gas related geophysical operations upon, over, and across the lands, in a summarized format.
- **Seismic Option**- contract wherein the landowner (Grantor) grants to the second party (Grantee) the exclusive right and privilege of conducting all geophysical exploration, seismic or otherwise, while also conveying unto the Grantee the exclusive right and

option to acquire an oil and gas lease covering all or part of the landowner's interest in the land.

There has been significant lease activity throughout the Permian Basin from 2005 through April 2020. Some of the more recent activity has been concentrated in the northeastern part of the study area including Martin, Howard, Dawson, Gaines, Borden and Yoakum counties. Another cluster of recent activity in the last three years occurred in the southwestern portion of the study area including Ward, Loving, Reeves, Eddy and Lea counties. This generally falls within the Midland Basin in the northeast and the Delaware Basin in the southwest, as can be seen on **Figure 1**. This indicates the likelihood of increased truck movement and development activity, within the Delaware and Midland Basins, as new oil and gas wells are established.

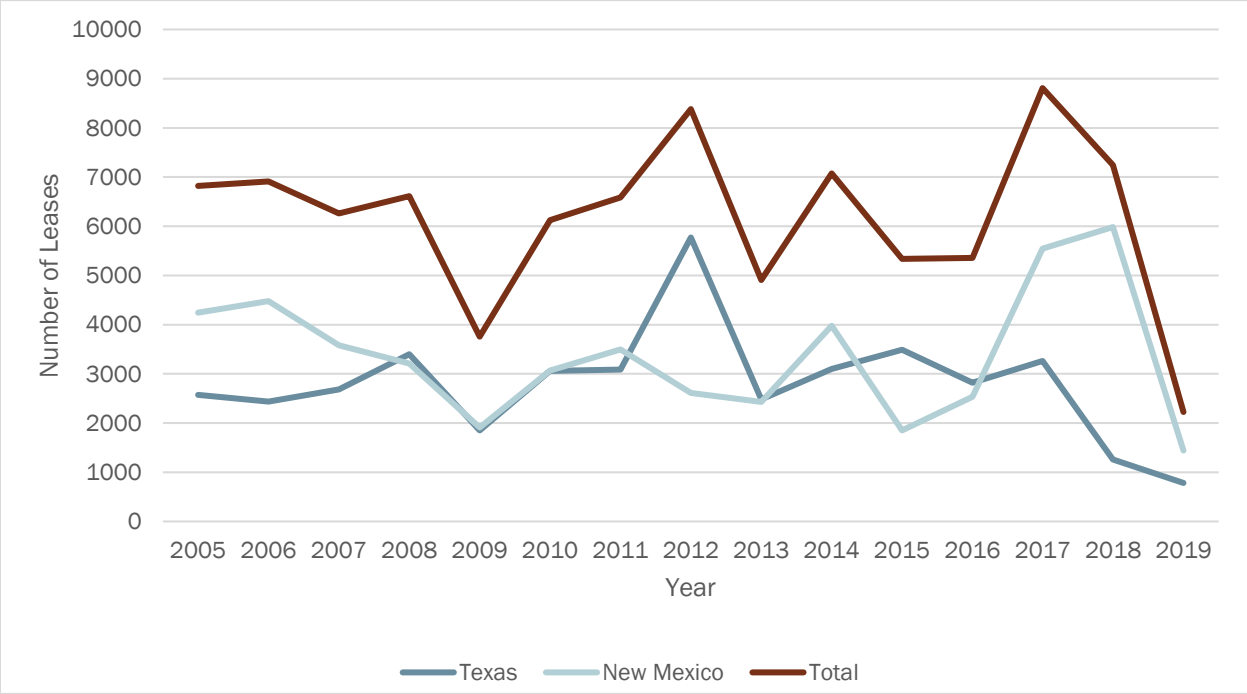
Figure 12: Oil and Gas Lease Activity by Year from 2005-2020



Source: Enverus/Drillinginfo.com, April 2020

The number of oil and gas leases within the study area has fluctuated over the years with peaks in 2012, and 2018 and dips in 2009 and 2013 as shown in **Figure 13**. In 2019, number of oil and gas leases dropped dramatically from over 7,200 in 2018 to just over 2,200. This nearly 70 percent drop in leases corresponded with some of the region's largest energy sector employers laid off workers[13].

Figure 13: Permian Basin Oil and Gas Leases by Year from 2005 through 2019

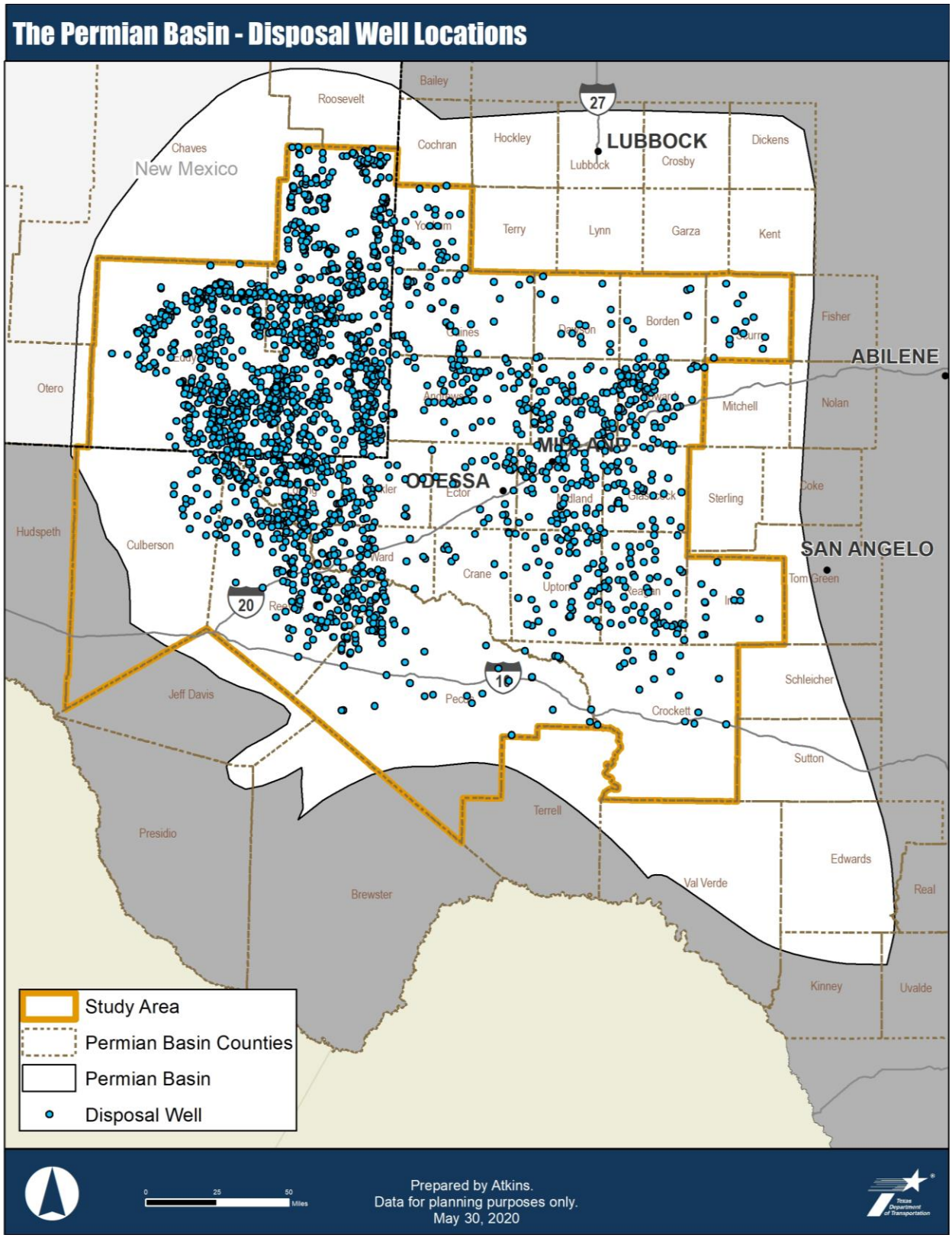


3.4 Disposal Wells

Disposal wells may be used to inject mineralized water produced with oil and gas into underground zones for the purpose of safely and efficiently disposing of the fluid. **Figure 14** shows the locations of disposal wells in the Permian Basin, which shows a large number are located in the western half of the study area, in Eddy and Lea Counties, NM, as well as Loving and Reeves counties in Texas. Trucks are used to transport the produced water to these disposal wells leading to increased truck traffic on nearby roads.

[13] Hiller, J. "U.S. shale producers turn to jobs cuts as investor pressures mount," April 9, 2019, Reuters, Accessed September 24, 2020.

Figure 14: Permian Basin Disposal Wells



Source: Enverus/Drillinginfo.com, April 2020

3.5 Sand Mines

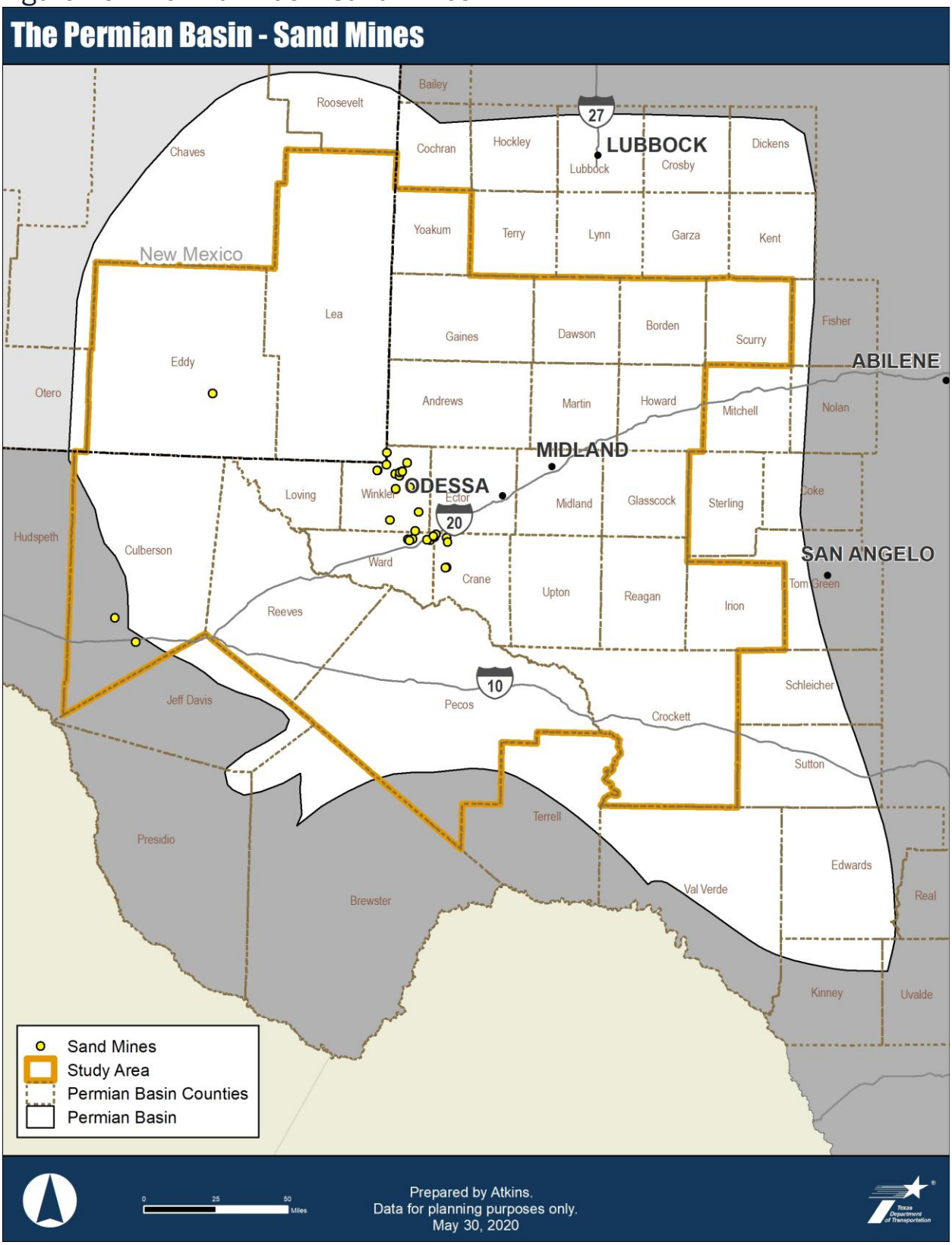
Sand mines are a major generator of truck trips for sand used in fracking. **Figure 15** shows the location of sand mines in the Permian Basin, which are mainly located in Winkler, Ward and Crane Counties. Each mine has an operating capacity between 3,000,000 and 5,500,000 tons of sand annually. The sand or quartz particles are mixed with liquids and forced into a well to prop open fractures in layers of shale that contain oil, natural gas, and natural gas liquids. In the Permian Basin, almost all frac sand is delivered by truck although rail may be used in specific circumstances or for part of the transport between sand mines and well sites. In recent years, locally sourced sand has been used as a method to reduce shipping costs and simplify logistics as the source is closer to production wells. A majority of current oil and gas activity is within a one-hour drive from a sand mine[14].

Each fracking job requires about 20 million pounds of sand or about 400 truckloads (carrying approximately 50,000 pounds of sand).[15] This indicates a huge volume of trucks between frac sand mines and well locations in areas that are frequently without major roads and in many instances roads that were not designed to handle the volume or axle loads of these trucks.

[14] PLG Consulting. Frac Sand Update 2019. *Key Highlights and Analysis From the 4th Annual Frac Sand Industry Update Conference.* https://plgconsulting.com/featured-insights/frac-sand-update-2019/

[15] TxDOT May 2019 Stakeholder Visit Notes—Cudd Energy Services

Figure 15: Permian Basin Sand Mines



Source: TxDOT Odessa District, and Atlas Sand data

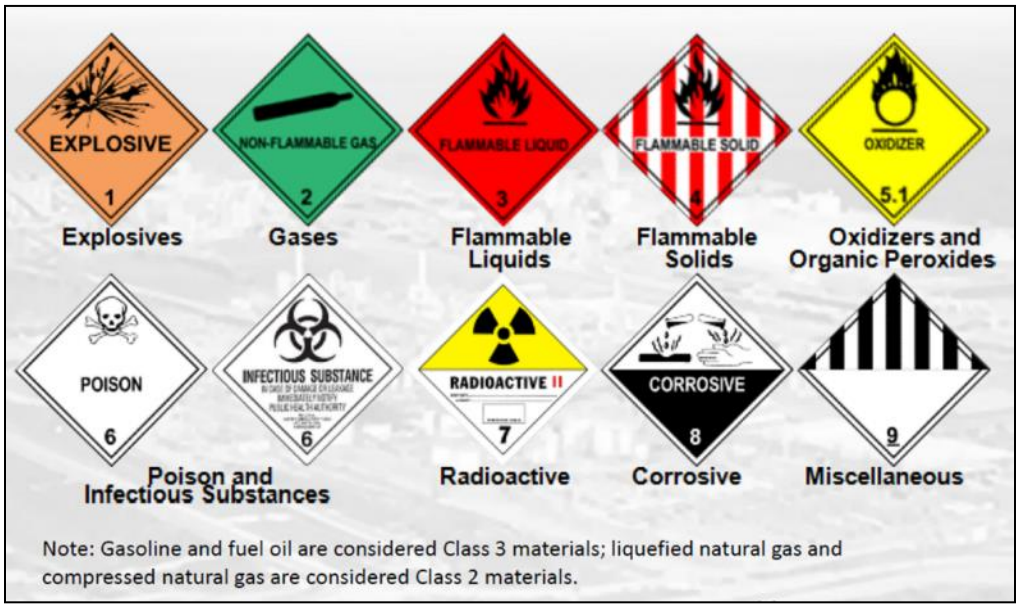
3.6 Hazardous Materials

There are more hazardous materials stored or transported in Texas than any other state, most of which is concentrated along the Gulf Coast. This section describes hazardous materials in the Permian Region to bring context to impacts from commercial and industrial development.

Broadly speaking, the term "hazardous materials," or "hazmat," involves the transport of chemicals and fuels that have one or more hazardous properties. As defined by the U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA), hazardous materials are substances or materials that, when transported for commerce, are capable of posing an unreasonable risk to health, safety, and property.[16]

Through classification procedures, hazardous materials are assigned a hazard class (1 through 9) and, in certain instances, a division. Hazard classes and divisions are categories of hazardous materials based on shared hazards and properties. They include explosives, gases, flammable liquids, flammable solids, oxidizers, toxic substances, radioactive substances, corrosives, and many other sub-categories. This allows for a standard method for communicating material hazards across all sectors of industry and around the world (see **Figure 16**Error! Reference source not found.).

Figure 16: Hazmat Classification



Source: Emergency Response Guidebook (ERG); PHMSA, Transport Canada et al, 2016 edition

Most of the hazardous materials (also known as hazmat) in the Permian Basin are associated with hydrocarbons from the oil and gas industry. These include crude oil and associated natural gas (transported by pipelines), natural gas liquids (NGLs), such as

[16] Title 49 Code of Federal Regulations [CFR] Part 171.

propane, butane, and ethane, (largely transported by rail), refined petroleum, including gasoline, diesel fuel, kerosene, and jet fuel (transported by pipeline and truck), and biofuels for blending, such as ethanol, (transported by rail and truck). Industrial hazmats also present in the Permian Region include chlorine gas for water and waste water treatment, and anhydrous ammonia for fertilization and refrigeration, both of which are transported by rail and truck. Industrial chemicals transported by rail include potassium chloride, sodium carbonate, petrochemical feedstocks, sodium hydroxide, and sulfuric acid.

Sites that handle or manage hazmat generally are incompatible with residential development and may require supplemental monitoring and screening to protect public health. Hazmat storage and transportation is regulated by multiple federal and state agencies. For example, terminals are subject to regulation by the Environmental Protection Agency (EPA) at the federal level and the Texas Commission on Environmental Quality (TCEQ) at the state level. The EPA requires industry to report on the storage, use and releases of hazardous substances to federal, state, and local governments under the Emergency Planning Right to Know Act (EPCRA).[17] The EPA publishes a "List of Lists[18]" of over 1700 chemicals to help facilities handling chemicals determine, for a specific chemical, whether they may be subject to certain reporting requirements. The Cybersecurity and Infrastructure Security Agency, within the Department of Homeland Security, monitor terminals that handle or store certain "chemicals of interest," to comply with Chemical Facility Anti-Terrorism Standards.[19] There are over 300 chemicals of interest, and they are categorized under three main security issues: release, theft or sabotage. They include chemicals such as chlorine gas and ammonium nitrate.

The USDOT Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates above-ground storage tanks and the transportation of hazardous materials via pipeline, rail and truck.

The following subsections present Permian Basin area hazmat fixed facilities, hazmat transportation by mode, liquid bulk terminals, crude oil refineries, and natural gas distribution hubs and processing plants.

3.6.1 Permian Area Hazmat Fixed Facilities

Hazmat Fixed facilities are regulated by the EPA and the TCEQ for industries that store reportable quantities of substances subject to the Emergency Planning and Community

[17] EPCRA requires state and local governments, and Indian tribes to use this information to prepare for and protect their communities from potential risks. See https://www.epa.gov/epcra.

[18] EPA List of Lists: See https://www.epa.gov/epcra/consolidated-list-lists-under-epcracerclacaa-ss112r-august-2020-version.

[19] CISA is one of the 8 agencies (such as FEMA and TSA) within the DHS

Right-to-Know Act (EPCRA), as specified in the EPA's Consolidated List of Lists[20], and are thus regulated by federal and/or state agencies. These facilities also serve as a basis for hazmat transportation origins and destinations both inside and outside the Permian Basin for planning purposes.

Permian Region fixed facilities include petroleum refineries, power generation plants, gas processing facilities, petroleum terminals and other facilities where petroleum products are transported or stored. Some facilities are known as transportation "terminals" which facilitate the flow of crude oil, refined products or NGLs from one transportation system to another (e.g., from pipeline to truck or from one pipeline to another pipeline). While often overlooked, transportation terminals are essential links in the petroleum supply chain. All terminals have storage tanks and infrastructure to facilitate the movement of material into and out of the terminal. Fixed facility infrastructure in the Permian Basin includes:

- Liquid bulk terminals
- Gas pipeline compression stations
- HGL and Product pipeline pumping stations
- Rail track and rail car loading and unloading infrastructure
- Truck racks for loading or unloading tank trucks

Permian Basin Area fixed facilities also have implications for subsequent routing and distribution. Oil and gas production in the Permian Basin serves both local and regional markets, extending to other states and to Mexico. Fixed facilities also include those industries required to file annual Risk Management Plans (RMP) under the Section 112[r] Program, Toxics Release Inventories (TRI) and/or Tier II Reports required by the TCEQ or the EPA (see **Table 7**).

Table 7: Permian Basin Area Fixed Facility Responsible Agencies

Acronym	Description	Responsible Agency
RMP	Risk Management Plan	EPA
TRI	Toxics Release Inventory	TCEQ
Tier II	Tier II Reports	TCEQ

Source: Texas Commission on Environmental Quality (TCEQ) Web Site, accessed April 12, 2019.

3.6.1.1 Risk Management Program (RMP) Facilities

Section 112(r) of the Clean Air Act Amendments requires EPA to publish regulations and guidance for chemical accident prevention at facilities that use certain hazardous substances such as chlorine gas. These regulations and guidance are contained in the RMP

[20] Environmental Protection Agency, https://www.epa.gov/epcra/consolidated-list-lists.

rule which requires facilities that use extremely hazardous substances to develop a Risk Management Plan which:

- identifies the potential effects of a chemical accident,
- identifies steps the facility is taking to prevent an accident, and
- spells out emergency response procedures should an accident occur.

These plans provide valuable information to local fire, police, and emergency response personnel to prepare for and respond to chemical emergencies in their community. Making RMPs available to the public also fosters communication and awareness to improve accident prevention and emergency response practices at the local level.[21]

Under the RMP Rule, facilities are required to file an annual RMP if they store "extremely hazardous substances" (EHS) such as hydrogen fluoride and other flammable substances above a certain threshold planning quantity (TPQ). EPA currently lists 355 chemicals under EHS. These facilities include power generation plants, chemical companies, fuel terminals, water treatment plants, wastewater treatment plants, refineries and gas plants. Exposure to EHS chemicals is a top concern for first responders, and such chemicals include chlorine gas, anhydrous ammonia, ethylene oxide, sulfuric acid and other toxic chemicals and fuels. It is a priority for emergency managers to conduct training and exercises on a regular basis with industry representatives from RMP facilities to coordinate hazmat planning and emergency response.

In the Permian Basin Region, RMP facilities are located in the six high-producing oil and gas counties in the Midland and Delaware Basins, including Martin, Howard, Midland, Glasscock, Upton and Reagan Counties. Additional RMP facilities are located in Ector, Andrews, and Scurry Counties in Texas and Eddy and Lea Counties in New Mexico.

3.6.1.2 Toxics Release Inventory (TRI) Facilities

TRI tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. U.S. facilities in different industry sectors must report annually how much of each chemical is released to the environment and/or managed through recycling, energy recovery and treatment. (A "release" of a chemical means that it is emitted to the air or water or placed in some type of land disposal.)[22] EPA's TRI list includes approximately 650 toxic chemicals and categories. There are 36 industries in Midland and Odessa that filed TRI reports in 2016. These industries included plastics and rubber (60 percent), chemicals (30 percent), chemical wholesalers (5 percent) and petroleum bulk terminals (5 percent). The top five chemicals released included styrene, methanol, toluene, ethylene glycol and glycol ethers.

---

[21] EPA RMP Rule, https://www.epa.gov/rmp/risk-management-plan-rmp-rule-overview.

[22] EPA TRI Program, https://www.epa.gov/toxics-release-inventory-tri-program/what-toxics-release-inventory.

3.6.1.3 Permian Basin Tier II Facilities

Each year the EPA requires organizations and businesses in the U.S. with hazardous chemicals above "reportable quantity" (RQ) to fill out annual Tier II reports. There are approximately 500,000 chemicals that require Tier II reporting including gasoline, diesel, and other chemicals. Typical Tier II facilities include retail gas stations and other industries that store hazardous chemicals and fuels and are located throughout the Permian Basin. TCEQ manages the Tier II Program and coordinates Tier II Report submissions each year in cooperation with the Local Emergency Planning Committees (LEPCs) in the Permian Basin and throughout the state.

Transport of hazardous materials (by any mode) requires supplemental preparation and controls to ensure public safety. In the Permian Basin, oil and gas companies commonly purchase surface rights in conjunction with mineral rights in order to plan for pipeline construction in areas with surface development. Hazardous materials represent 12 percent of all freight tonnage in the US according to the Commodity Flow Survey (CFS), the primary source of publicly available freight data[23]. However, since data on crude oil shipments is not included in the CFS, that percentage is more like 15-20 percent.
In May 2020, The U.S. Nuclear Regulatory commission recommended approving Interim Storage Partners' (ISP) application for a of a nuclear waste storage facility in Andrews County. This facility would store up to 5,000 metric tons of spent nuclear fuel at the proposed site for 40 years with a possible phased expansion to store up to 40,000 metric tons. The nuclear waste would be transported to the site on Midland's railways. A final decision on whether to grant ISP a license will be made after the completion of a final environmental impact statement in 2021.[24] However, the Midland Fasken Oil and Ranch and the Permian Basin Land and Royalty Owners (PBLRO) organization oppose the application and are appealing to the NRC. Opponents claim the Permian Basin and associated fields are not the right location for such a site. If granted, Waste Control Specialists Inc. (WCS) would build an above ground high level nuclear storage facility that would be equipped to take the sum of waste in eight phases. During a nuclear waste accident in a Carlsbad mine in 2014, production in the mine was closed for three years. There are concerns that a similar incident could occur in the Permian Basin and affect the oil industry.[25]

Energy development industries handle hazardous materials throughout their operation, including at fuel storage terminals, crude oil refineries, and gas processing hubs and plants.

---

[23] The Commodity Flow Survey is a joint effort by the Bureau of Transportation Statistics and the U.S. Census Bureau, U.S. Department of Commerce.

[24] Randle, C., May 2020. Midland Reporter Telegram. *NRC recommends approval of nuclear waste site in Andrews County.* https://www.mrt.com/business/oil/article/NRC-recommends-approval-of-nuclear-waste-site-in-15265790.php

[25] Information obtained from PROTECT THE BASIN: an initiative of the Permian Basin Coalition of Land & Royalty Owners and Operators. https://www.protectthebasin.com/about

The location and nature of all of these facilities needs to be considered in determining potential future land use and development

3.6.2 Permian Area Hazmat Transportation

Chemicals and fuels in the Permian Basin are transported by rail, truck, and pipeline. The shipping infrastructure in the region is extensive and highly integrated. Most of the facilities in the Permian Basin support hazmat shipments; of these, all have truck access, some have conveyor systems, many are supported by rail connections, and most have extensive pipeline connections to large-volume production and/or storage facilities within the industrial complexes in Midland, Odessa, Big Springs and Colorado City. This section outlines the broad scope of the system and details the specific chemical shipment characteristics by mode for petroleum products and other hazmat chemicals.

A wide variety of business arrangements support hazmat transportation in the Permian Basin. The pipeline system is a mixture of facility-owned and owner-operated dedicated lines that function alongside lines operated by third-party companies where the product changes ownership at a variety of points in the transfer. Some of the fuel and chemical production companies have highly specialized, dedicated fleets of hazmat trailers, rail cars and pipeline systems, all of which directly support delivery to clients. Other facilities use authorized shippers and haulers to directly distribute oil and gas to clients or deliver chemicals to wholesale distribution companies for further distribution to end-users.

To support this complex system, significant petroleum transportation infrastructure is required to transport crude oil, natural gas, NGLs and chemicals in the Permian Basin. This includes an interconnected network of transportation facilities, including highways, railroads, pipeline and fixed terminal facilities.

It should be noted that in addition to oil and gas products, water, sand and chemicals are needed for the fractionation process as more horizontal wells are drilled to connect the historically vertical wells in the region. This process translates to additional transportation movements by pipeline, railroad and highway facilities.

3.6.2.1 Hazmat by Truck

Highways provide the important network in the Permian Basin to transport crude oil and petroleum products. Using this highway network, trucks deliver a majority of all petroleum fuels on the "last mile" of the supply chain, but in remote production areas that lack pipeline or rail infrastructure, trucks also provide the "first mile" of transportation, hauling crude oil to centralized storage facilities that are connected to rail and pipeline infrastructure. Over the past several years, increasing production in the Permian Basin has put pressure on existing crude gathering and distribution pipeline systems. As the pace of new well construction outstripped the pace of gathering line expansion, trucks filled the gap, transporting crude from the wellhead to gathering terminals or delivering crude directly to local refiners.[26,27] In addition to transporting crude oil and NGLs, trucks are needed to transport produced water to and from well sites and to salt water disposal wells (SWDs) throughout the region. Dealing with produced water often involves trucking long distances to saltwater disposal wells, but producers and midstream companies now are working to develop pipeline networks to reduce transportation costs.

Toxic inhalation hazards (TIH) such as anhydrous ammonia, chlorine gas and sulfur dioxide are also transported by rail or truck in the Permian Basin for use at water and waste water treatment plant and power generation facilities. Anhydrous ammonia may be shipped in rail cars, each containing an average of 35,000 pounds when loaded or by truck in 11,500-gallon tank trailers. Chlorine gas and sulfur dioxide are usually transported in containers by truck in 150-pound or 2,000-pound cylinders. Other chemicals are transported by truck in 55-gallon drums or small totes in box trucks.[28]

Most of the hazmat truck shipments to and from the Permian Basin are local or in-state deliveries. Sulfuric acid is transported in totes of various sizes ranging from 220 to 330 gallons and in 35-ton trailers and chlorine is transported in 150-pound cylinders. Anhydrous ammonia is transported by all modes, but by truck in the Permian Basin in 11,500-gallon quantities and anhydrous hydrogen fluoride is transported in 20-ton tank trucks. Smaller quantities of ethylene oxide and hydrogen sulfide are also transported by motor carrier.

---

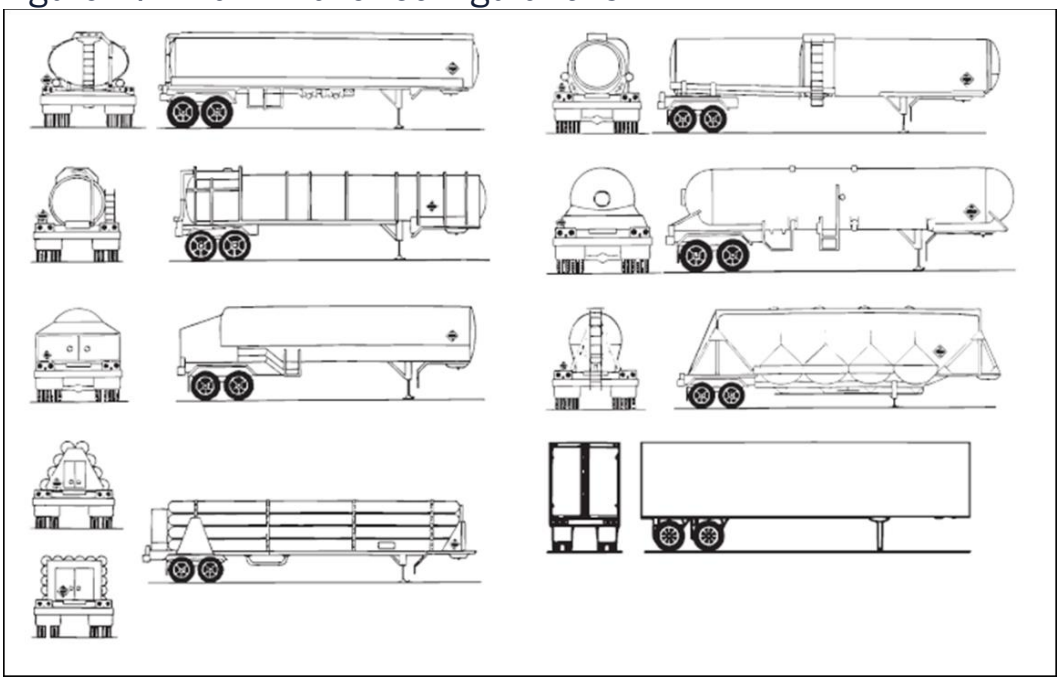
26 Gathering lines are used to transport raw crude oil and natural gas short distances from the wellhead to nearby processing plants (also known as gathering terminals) and storage tanks

27 Interview with AFPM August 2019.

28 David Willauer, TRB Hazmat Committee Chair, Hazmat SME, corroborated in conversations with David Bierling, Texas A&M, September 2019 and May 2020.

Hazmat is transported in many different types of truck trailers, most of which are tank trailers used to transport many different types of chemicals and fuels. Fuel tankers represent the majority of all tank trailers on the road since refined petroleum represents 85 percent of all hazmat truck shipments in the U.S.[29]. Chemical tank trailers are usually temperature controlled. Cryogenic tank trailers are used to transport liquid natural gas (LNG), liquid nitrogen and liquid oxygen. Pressurized tank trailers are used to transport propane, butane and anhydrous ammonia. **Figure 17** illustrates typical DOT Tank Trailer configurations.

Figure 17: Tank Trailer Configurations



Source: Emergency Response Guidebook (ERG), PHMSA, Transport Canada et al, 2016.

Emergency responders are trained to recognize different tank trailer designs to help respond appropriately to hazmat incidents. For example, the oval-shaped profile tank trailers have multiple compartments and are used to transport refined petroleum products from petroleum terminals to retail fuel stations. Refined petroleum fuels represent over 85 percent of all highway hazmat shipments in the U.S.[30] In the Permian Basin, this percentage is likely to be even higher due to the need for more diesel fuel to operate oil rigs, pumping stations and trucks transporting oil and gas products to and from oil and gas wells in the region.

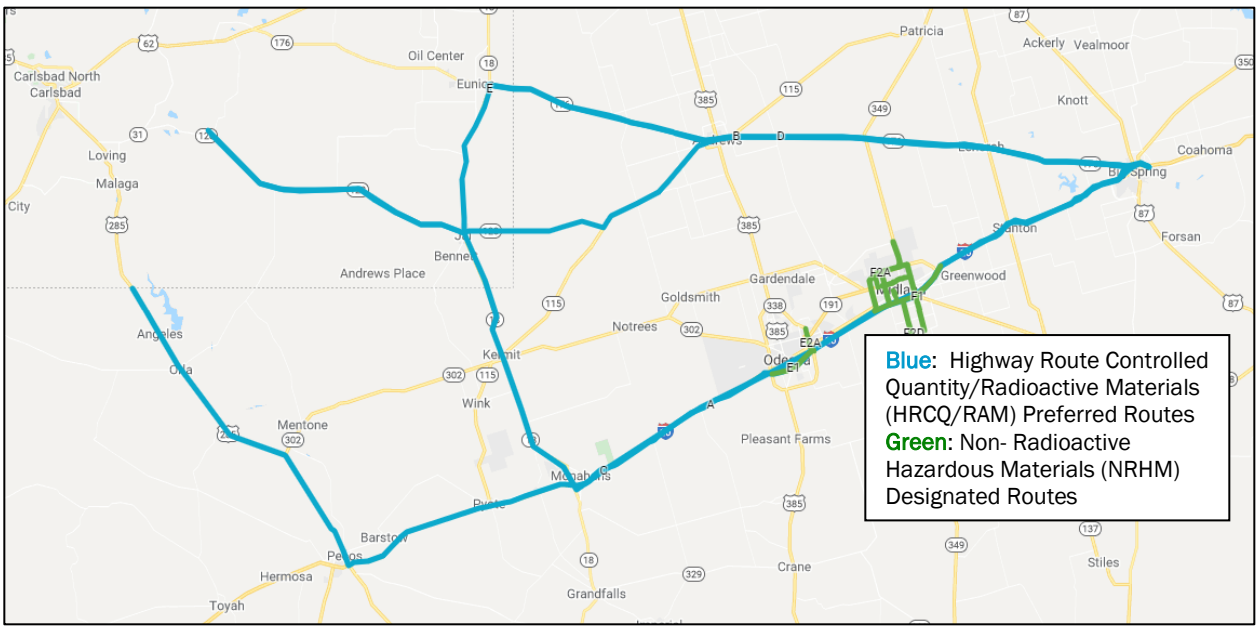
[29] Transportation—Commodity Flow Survey, Bureau of Transportation Statistics and U.S. Census Bureau, 2012 Economic Census

[30] Transportation—Commodity Flow Survey, Bureau of Transportation Statistics and U.S. Census Bureau, 2012 Economic Census

Some truck trailers will contain multiple types of hazmat, and each corresponding placard must be displayed accordingly. This includes dry van trailers with drums of different types of hazmat, or open flatbed trailers with bottles of compressed gases, toxic chemicals or other inhalation hazards.

The Texas Department of Transportation (TxDOT) has established (non-radioactive) hazardous materials routes in Midland and Ector counties to minimize the potential for adverse health impacts. Land use along these routes play a role in determining the safest routes for transporting hazmat. **Figure 18** shows these routes for Midland and Odessa, as well as the region's radioactive materials preferred routes.

Figure 18: Radioactive and Non-Radioactive Materials Routes for Midland and Odessa, 2019



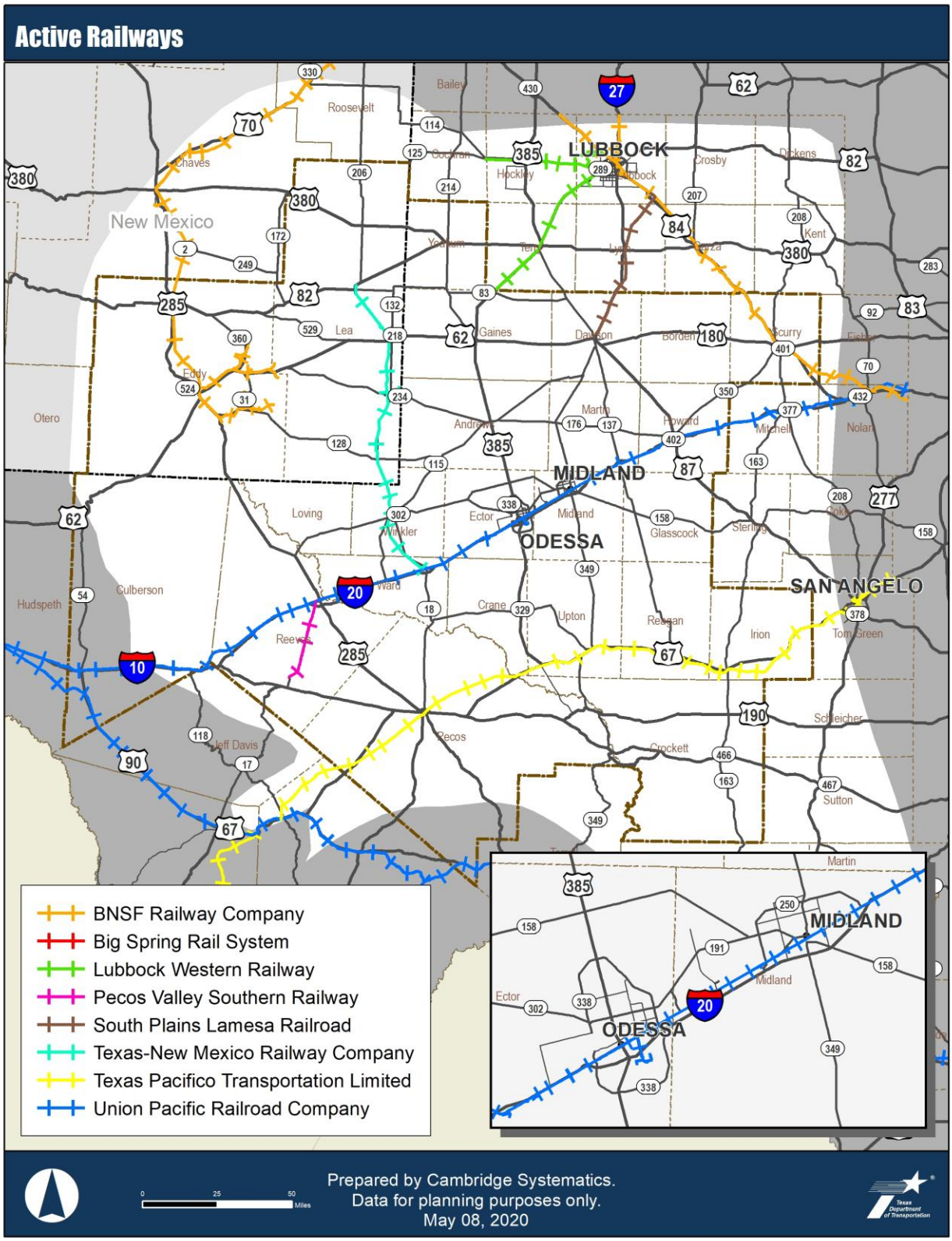
Source: National Hazardous Materials Route Registry - By State, FMCSA https://www.fmcsa.dot.gov/regulations/hazardous-materials/national-hazardous-materials-route-registry-state

3.6.2.2 Hazmat by Rail

The North American rail network provides an extensive and flexible transportation system for refinery and petrochemical feedstocks, as well as finished and intermediate products. Rail infrastructure includes rail cars (tank cars for liquids and gases, and hopper cars for solids, such as plastic resins) and locomotives; rail car loading and unloading facilities; and railway tracks and switchyards.

There are two Class I Railroads (BNSF and UP) and six regional railroads in the Permian Basin as shown in **Figure 19**.

Figure 19: Active Rail Corridors in the Permian Basin, 2019



Source: National Transportation Atlas Database, 2018; Texas Department of Transportation, 2017.

This section describes how freight railroads transport domestic supplies of crude oil, ethanol, and NGLs, including the types of trains and rail cars used. In the decade since the start of the domestic energy revolution, there has been steady growth in the amount of ethanol and crude oil moved by rail, with volumes escalating each year from 2008 to the present.

The Class I railroads operate line-haul trains that typically contain at least 70 cars, and often 100 or more. Trains operating west of the Mississippi River tend to be even longer, sometimes exceeding 120 cars. These line-haul trains may be constructed to provide either "manifest" or "unit" service. Manifest trains have a mixed consist, meaning they move a variety of cargoes in several different car types and for multiple shippers.[31]

When the rail market for crude oil began to develop as the use of hydraulic fracturing technology grew, the service was often provided in manifest trains because of a lack of volume. Many of the new oil-producing fields lacked high-capacity gathering and storage systems, as well as car loading infrastructure. Blocks of railroad tank cars were thus filled on sidings by tank trucks and then scheduled for rail pick up two or three times per week. The transfer from truck to tank car was often made using portable transloader platforms, as shown in **Figure 20**.

Figure 20: Direct Truck to Rail Transloading

Source: TRB, Special Report 235, 2017

Chemicals account for a large share of rail tonnage in the United States and Texas accounting for 35 percent of all tonnage. More than half of all rail chemical tonnage consists of various industrial chemicals, including potassium chloride, sodium carbonate (soda ash), sodium hydroxide (caustic soda), sulfuric acid, urea, and anhydrous ammonia. Plastic materials and synthetic resins—including large quantities of polyethylene, polypropylene, polyvinyl chloride, and similar products—account for more than one-fourth of rail chemical

[31] Safely Transporting Hazardous Liquids and Gases in a Changing U.S. Energy Landscape, Special Report 235, TRB 2017.

tonnage. Most of the remaining tonnage consists of various types of fertilizers and other agricultural chemicals.[32]

Crude oil and refined petroleum, such as gasoline and diesel, typically move by rail when they cannot be moved by pipeline. Certain NGLs such as propane and butane, commonly move by rail, as do heavier, solid or semisolid refined products, such as asphalt, petroleum coke and sulfur. Petrochemical products, such as plastic resins, move by rail as well, as do chemicals needed in the operation of petroleum refineries, such as acids and caustic soda. While biofuels, such as ethanol and biodiesel, can be transported by pipeline, their physical and chemical properties present operational challenges and therefore they are primarily shipped by rail. Ethanol is currently the top hazmat rail commodity by volume in the U.S.[33]

A 2009 TxDOT study on hazardous materials shipments estimated that approximately 35 million tons of hazardous materials were transported on rail lines in the state of Texas in 2005. Of that total, 43 percent of total tonnage originated in Texas, 25 percent terminated in Texas, roughly 20 percent consisted of through movements, and less than 20 percent of total tonnage was internal to the State.[34] While more recent data is being acquired by the State that may be used to update this estimate, the older data does demonstrate the magnitude of hazardous shipments by rail and directional trends that likely still hold true. Since Texas is a primary producer and refiner of petroleum, it is not surprising that petroleum and related products are dominant in internal, originating, or terminating movements. On the contrary, “Freight forwarder traffic” (break-bulk) dominated in through movements. Ethyl alcohol (or ethanol) had the second highest tonnage in through movements and implying that production and consumption of ethanol primarily occurs outside Texas. Chlorine gas tonnage was fourth in terminating movements implying that it is produced outside Texas but used heavily within the state.

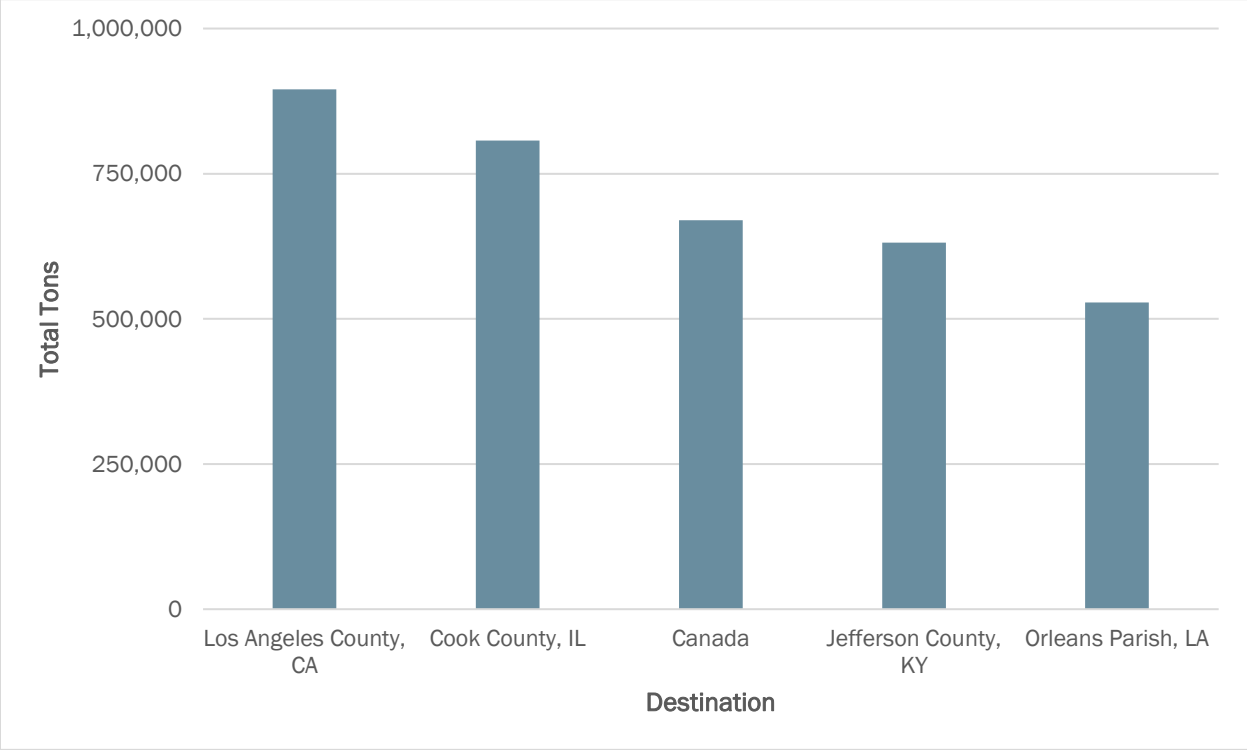
While the State of Texas transports more hazmat than any other state in the U.S., the Permian Basin represents a smaller hazmat profile. For rail hazmat shipments in the Permian Basin, most of the rail movements represent through traffic from Texas to California, as illustrated in **Figure 21,** Top Destination States.

[32] Ascension Parish Hazmat Report, IEM, 2011.

[33] American Association of Railroads, selected Class I rail volume data, STP Waybill Data, 2019.

[34] FHWA, Freight Analysis Framework (FAF4), 2012.

Figure 21: Texas Top 5 Hazmat Destinations by Rail



Source: Warner, Protopapas et al; Texas Transportation Institute, Understanding and Managing the Movements of Hazardous Material Shipments Through Texas Population Centers, 2009.

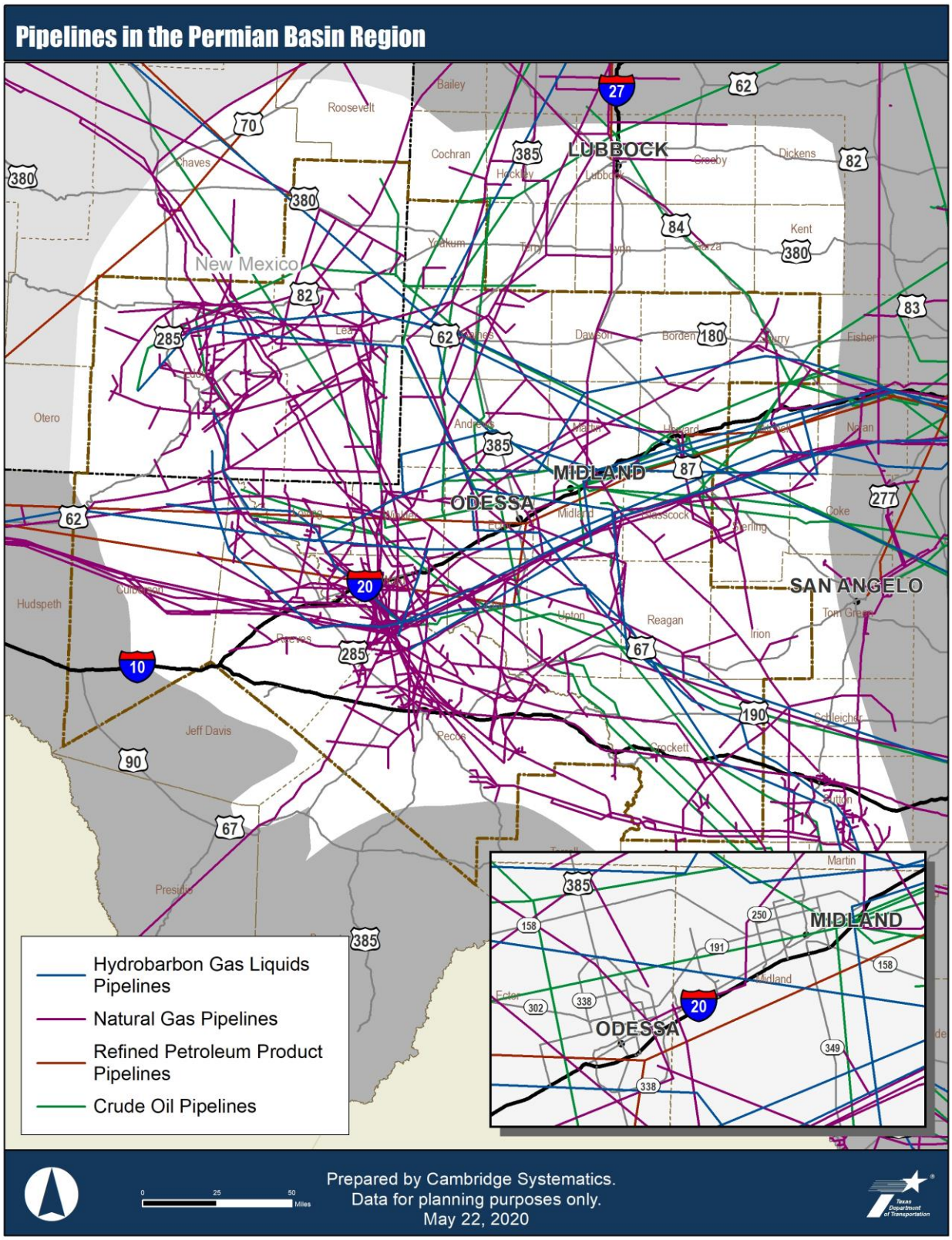
3.6.2.3 Hazmat by Pipeline

There is an extensive pipeline network in the Permian Basin as can be seen in **Figure 22**. Most of these pipelines transport crude oil, natural gas and natural gas liquids.

Crude oil and natural gas are transported by pipeline in upstream gathering and midstream transmission systems. In the case of natural gas, downstream systems of distribution pipelines are also used to deliver the commodity to local distribution companies that serve residential and commercial users.[35]

[35] Natural gas distribution systems consist of mains, which can exceed 20 inches in diameter, and service laterals, often made of plastic, which are usually less than 2 inches in diameter.

Figure 22: Pipelines



Source: U.S. Energy Information Administration, 2020.

While pipelines are among the safest modes for transporting liquids and gases, the nature of the cargo is inherently dangerous. Pipeline failures can pose an immediate threat to people and communities. A failure of a hazmat pipeline relating to the integrated production and distribution system within the Permian Basin would not only pose a significant immediate safety hazard to the lives of community members but would also have a serious impact on operations and production within the whole system. Depending on circumstances of an event, particularly one affecting a number of key primary production facilities and chemicals, a disruption in transportation could cause widespread and costly production disruptions among many facilities in the system.

The three main types of pipelines in this system include collecting, transmission and distribution pipelines. Collection pipelines move product to regional hubs which then connect to storage facilities or terminals.

Gathering systems are used to transport raw crude oil and natural gas short distances from the wellhead to nearby processing plants and storage tanks. These systems usually consist of low-pressure steel lines less than 8 inches in diameter. The raw crude oil that exits gathering lines is usually treated and vented at field plants to remove impurities such as water, sediment, and dissolved gasses (e.g., carbon dioxide and hydrogen sulfide). Likewise, natural gas is transported from the production field in gathering lines to nearby gas-processing plants to extract valuable NGLs and unwanted gases and liquids.

The removal of impurities from the crude oil and natural gas streams is necessary to meet the quality specifications of the midstream transmission pipelines, particularly to prevent corrosion. This initial processing is also necessary to meet the commodity specifications of receiving refineries, utilities, and factories. In the case of natural gas, the NGLs removed at gas processing plants create a third commodity stream that is carried through transmission pipelines to downstream fractionators where NGLs, such as propane, butane, and ethane, are extracted for storage and transportation to end-use markets.

Transmission pipelines carry products from terminals to market hubs, other terminals and processing plants that sell the fuel and other products refined from these resources to customers via distribution pipelines. Many of the transmission pipelines are interstate systems that supply products to the United States and to Mexico. Gas and oil transmission pipelines are made of steel, normally 8 to 48 inches in diameter, and operated at high pressures ranging from 400 to 1,400 pounds per square in (psi). Lines typically run several hundred miles, often accompanied by other lines in shared rights of way. There are also dedicated chemical pipelines that carry synthesis gas, anhydrous ammonia, carbon dioxide, and hydrogen to fractionalization and cracking plants located along the Gulf Coast.

Pipeline capacity for transporting Permian crude has become very constrained and more expensive alternative means of transport has been needed until new pipelines are built. This includes rail and truck shipments. Higher transportation costs mean that West Texas Intermediary (WTI) pricing at Midland needs to be priced lower to compete with other crude oils on the Gulf Coast.

Four main hazardous commodities transported by pipeline include:

1. Crude oil;
2. Natural gas;
3. Natural gas liquids (NGLs); and
4. Refined petroleum products

Other types of pipelines transport smaller volumes of anhydrous ammonia, C02, produced water and chemicals in the Permian Region. More pipeline information is contained in the Regional Freight Needs Assessment Technical Memo.

3.6.3 Liquid Bulk Terminals

Liquid bulk terminals are located at gathering points in oil-producing areas, at major pipeline interconnections, and close to refining hubs. They include bulk terminals to store crude oil or refined products, terminals associated with refineries, asphalt terminals, or smaller breakout tanks containing crude oil, refined products and chemicals.
In the Permian Region there are 19 terminals (**Table 8**) for storing crude oil, refined products, chemicals, asphalt and propane.

Table 8: Permian Basin Liquid Bulk Terminal

Name	City	Type	Commodity	Capacity (in barrels)	Access
Holly Energy Partners	Artesia, NM	Refinery Terminal	Crude, Refined, Asphalt	150,000	Truck, Rail, Pipeline
Alon Usa	Big Spring	Refinery Terminal	Crude, Refined, Asphalt, Chemicals	2,413,000	Truck, Rail Pipeline
Eott Energy Pipeline	Crane	Crude Terminal	Crude	808,000	Pipeline
Plains Pipeline Lp	Hermleigh	Breakout Tanks	Chemicals	1,602,929	Pipeline
West Texas Gulf	Hermleigh	Breakout Tanks	Refined, Chemicals	2,356,705	Pipeline
Centurion Pipeline Lp	Ira	Breakout Tanks	Chemicals	190,000	Pipeline

Name	City	Type	Commodity	Capacity (in barrels)	Access
Mobil Pipeline	Kermit	Breakout Tanks	Chemicals	336,000	Pipeline
Plains Pipeline Lp	Kermit	Breakout Tanks	Chemicals	97,824	Pipeline
Plains Pipeline Lp	Kermit	Breakout Tanks	Chemicals	1,135,857	Pipeline
Plains Pipeline Lp	Mccamey	Breakout Tanks	Chemicals	2,410,581	Pipeline
Centrion Pipeline (Oxy)	Midland	Breakout Tanks	Crude, Chemicals	1,947,000	Pipeline
Chevron Usa Midland	Midland	Bulk Terminal	Chemicals	186,568	Truck, Pipeline
Plains-Mesa	Midland	Breakout Tanks	Crude, Chemicals	1,797,879	Truck, Pipeline
Plains-Midland	Midland	Breakout Tanks	Crude, Chemicals	1,708,288	Truck, Pipeline
Teppco	Midland	Breakout Tanks, Crude	Chemicals	1,206,159	Truck, Pipeline
Magellan Midstream	Odessa	Bulk Terminal	Refined	709,000	Truck, Pipeline
Trojan Pipeline	Seminole	Breakout Tanks	Chemicals	289,000	Pipeline
Kinder Morgan	Wink	Breakout Tanks	Chemicals	603,810	Pipeline
Jal LPG Storage	Jal, NM	Pressurized Tanks	Propane	326,523	Truck, Pipeline

Source: Homeland Infrastructure Foundation Level Data (HIFLD) and Energy Information Administration (EIA)[36]

Liquid terminals containing refined products provide the link between the wholesale and retail fuel marketers. Liquid terminals receive bulk supply by pipeline or, in some remote areas, by rail or truck. The product is stored in above ground tanks until it is delivered by truck to retail outlets and large commercial consumers and distribution companies that supply heating oil and propane to residences and businesses. Liquid terminals containing refined products also typically have infrastructure to support blending biofuels (such as

[36] https://hifld-geoplatform.opendata.arcgis.com/datasets/7841aba67178425cbf33995fc914e2fe_0/data?geometry=-106.039%2C30.983%2C-99.101%2C32.617

ethanol and biodiesel) and additives into finished fuels. The blending takes place "at the rack," which is the overhead rack under which trucks drive to load blended fuel into finished gasoline and other products.

Liquid terminals containing refined fuels are connected by refined product pipelines and products are stored in large tanks at the facility. These terminals generate significant truck traffic since trucks distribute refined products to retail stations and customers. Diesel fuel was in high demand in the Permian Basin because of the number of oil rigs, trucks, pumps, generators, and other machinery required in oil and gas extraction operations.[37] Up until the winter of 2020, these terminals would generate between 300 and 500 trucks/day with higher volumes in summer months and lower volumes in winter months.[38] Liquid terminals also are connected to railroads for transporting ethanol and other products by rail. Refined gasoline is blended with ethanol at the rack before being transported around the region.

3.6.4 Crude Oil Refineries

Crude oil refineries play an important role in the Permian Basin. They process crude oil into refined products such as gasoline, diesel and other distillates. Each refinery is configured to refine a specific grade of crude oil. These facilities are 24/7 operations, usually operating in eight-hour shifts. Refineries are only shut down for scheduled maintenance or major disruptions such as a natural disaster or fire. Refined products are first stored at the terminal in above ground tanks, then transported by pipeline and truck to wholesalers and retailers. Other refineries in Texas use crude oil from the Permian Basin as well, which is why there are currently 13 pipelines transporting crude oil to refineries and export terminals along the Texas Gulf Coast. Permian refineries process crude oil that is transported to the refinery using a combination of gathering pipeline networks and trucks. In the refining process, natural gas liquids (NGLs) such as propane and butane are removed from the crude oil and used for other purposes, such as heating and motor fuel blending and shipped from the refinery to other locations by truck and by rail.

Crude oil refineries in the Permian Basin region are located in Big Spring and El Paso, TX and in Artesia, NM, with a combined production capacity of over 300 barrels per day (bpd). ALON USA owns the refinery in Big Spring, with a capacity of 73,000 bpd. Western Refining Company owns the refinery in El Paso, with a capacity of 135,000 bpd. HollyFrontier[39] own the Navajo Artesia refinery with a capacity of 100,000 bpd (**Table 9**).

---

[37] Interview with American Fuel and Petrochemical Manufacturers (AFPM) staff, August, 2019.

[38] Interview with Tom Byers (Magellan) July 3, 2019.

[39] Holly Energy Partners, L.P. ("HEP") is a Delaware limited partnership formed in early 2004 by HollyFrontier and is headquartered in Dallas, Texas. HEP provides petroleum product and crude oil transportation, terminalling, storage and throughput services to the petroleum industry, including HollyFrontier Corporation subsidiaries. The Partnership, through its subsidiaries and joint ventures, owns and/or operates petroleum product and crude gathering pipelines, tankage and terminals in Texas, New Mexico, Washington, Idaho, Oklahoma, Utah, Nevada, Wyoming and Kansas as well as refinery processing units in Kansas and Utah.

Table 9: Permian Basin Petroleum Refineries

Refinery	City	Company	BPD
Big Spring	Big Spring	ALON USA	73,000
El Paso	El Paso	Western Refining	135,000
Navajo	Artesia, NM	Holly Frontier	100,000

Source: U.S. Energy Information Administration, 2019. *Refinery Capacity Report.* https://www.eia.gov/petroleum/refinerycapacity/refcap19.pdf

Meridian Energy Group recently announced that they will be constructing a full-conversion crude oil refinery in Winkler County. The refinery will have a throughput capacity of approximately 60,000 bpd and will process local crude oil into products for local and regional markets.[40]

Terminal operation is not expected until 2023. In light of the recent capital and energy market volatility due to the impact of the Coronavirus on hydrocarbon demand and resulting short-term oversupply of crude oil, Meridian maintains the refining industry has weathered previous downturns and anticipates there may be a strong demand response that occurs after this period of low market prices.[41]

3.6.5 Natural Gas Distribution Hubs and Processing Plants

The Permian Basin produces natural gas directly from dedicated gas wells and natural gas associated with crude oil production. This section describes the Waha Hub and the 84 natural gas processing plants to process combined gas production from West Texas and Southeast New Mexico.

The Waha Hub, from which natural gas is traded, is also where natural gas is then transported via pipeline in multiple directions. Natural gas "hubs" serve as a central pricing point for a particular network's natural gas. The domestic natural gas marketplace has a highly active spot market where brokers and others buy and sell natural gas. Market participants buy and sell natural gas on a "spot" basis every day at trading points all over the U.S., with the largest trading hub, "Henry Hub," located in Louisiana.[42]

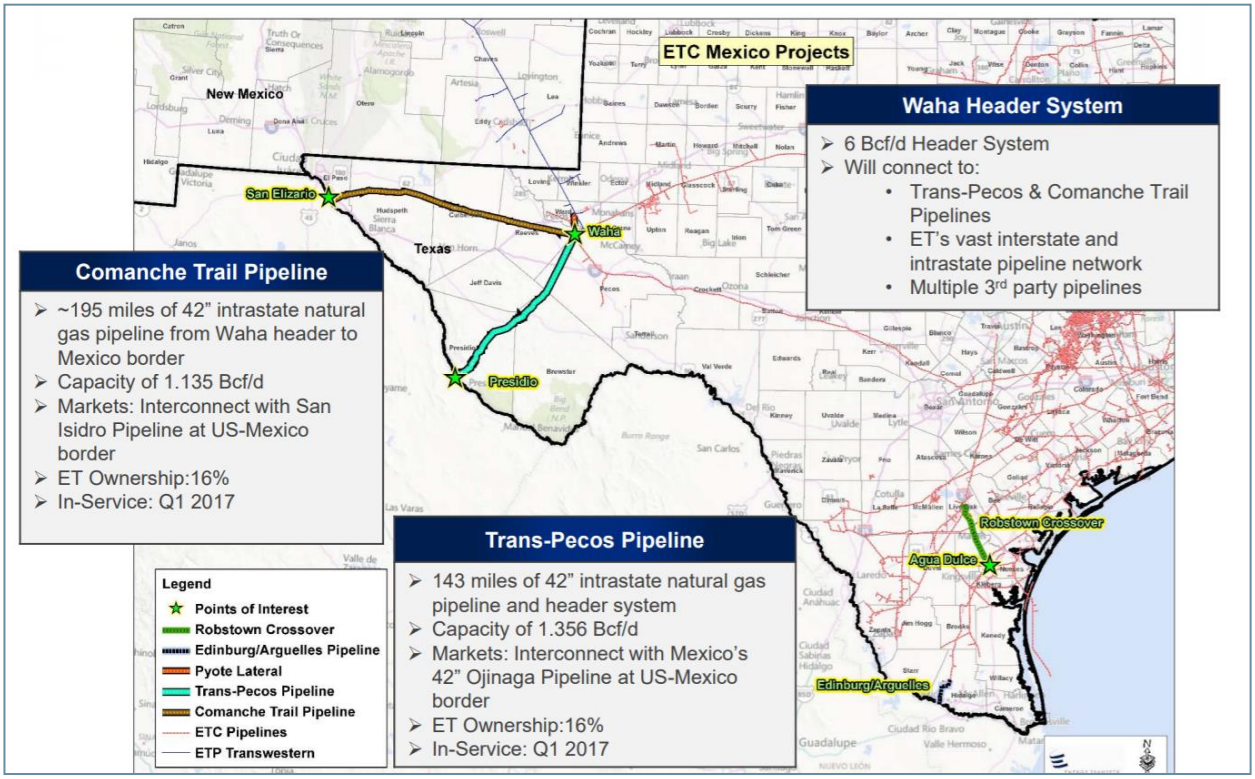
[40] U.S. Energy Information Administration, 2019. *Refinery Capacity Report.* https://www.eia.gov/petroleum/refinerycapacity/refcap19.pdf

[41] Meridian Energy Group Web Site, accessing May 2020 https://meridianenergygroupinc.com/meridian-is-uniquely-positioned/

[42] The Henry Hub is a distribution hub on the natural gas pipeline system in Erath, Louisiana, owned by Sabine Pipe Line LLC, a subsidiary of EnLink Midstream Partners LP, https://en.wikipedia.org/wiki/Henry_Hub

In recent years, the natural gas price at the Waha Hub has often been the lowest in North America for two reasons. First, hydrocarbon production in the Permian Basin has exceeded available takeaway pipeline capacity, and a significant amount of natural gas production in the Permian Basin is associated with oil production. Second, as a result of this market imbalance, producers and marketers have had to compete to transport natural gas in a constrained network, and oil market prices have had a pronounced effect on the Waha Hub price.[43]

Figure 23: Energy Transfer Mexico Projects



Source: RBN Energy, 2019.

[43] EIA, Natural Gas Weekly Update, https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2020/03_19/#jm-overview

The Waha Hub is located in Pecos County, TX, and interconnects with more than a dozen pipelines (including four major interstate pipelines and nine Texas intrastate pipelines) with a combined takeaway capacity of more than 10 billion cubic feet per day (Bcf/d) in 2019. Waha is actually two "hubs," (1) Energy Transfer Partners' (ETP) Waha Header (started in 2017), and (2) the Enterprise Waha Hub, owned by Enterprise Products Partners.[44] These two hubs connecting multiple pipelines are then also connected by a pipeline to provide multiple options for directionality and storage (see Figure 23).

The "Waha-area Header" is a gathering facility where multiple wells are tied in. The Waha Header, located near the Waha Hub, accommodates 6 billion cubic feet per day of natural gas and connects to over 10 different natural gas pipelines. The project was built by a consortium of Carso Energy, MasTec, and Energy Transfer Partners (ETP) for Mexico's Comisión Federal de Electricidad.

In an important recent milestone, Kinder Morgan began operations on the Gulf Coast Express (GCX) in September, 2019. This pipeline now delivers natural gas from the Waha Area to Agua Dulce near the Texas Gulf Coast. The GCX provides approximately 2.0 billion cubic feet per day of incremental natural gas capacity to the Texas Gulf Coast markets, which is helping to relieve existing Permian Basin gas takeaway constraints and reduce natural gas flaring.[45]

Calculations that go into daily gas pricing at Waha Hub comes from numerous sources. For example sources from one trader include deliveries from El Paso Natural Gas into various pipelines, transactions from Southern Union Gas Services; sales from the Regency Energy Partner Waha Gas Processing Plant, deals into the beginning of the Energy Transfer Fuel System; and transactions in and out of the Enstor Waha Storage Hub.[46]

The Waha Hub plays a prominent role in supplying natural gas from the Permian Basin to Mexico, which now relies heavily on natural gas imports as domestic production has

---

[44] Energy Transfer Partners Presentation, March 2019: https://ir.energytransfer.com/static-files/098b295e-6a02-4626-b075-2fdadff8e74b

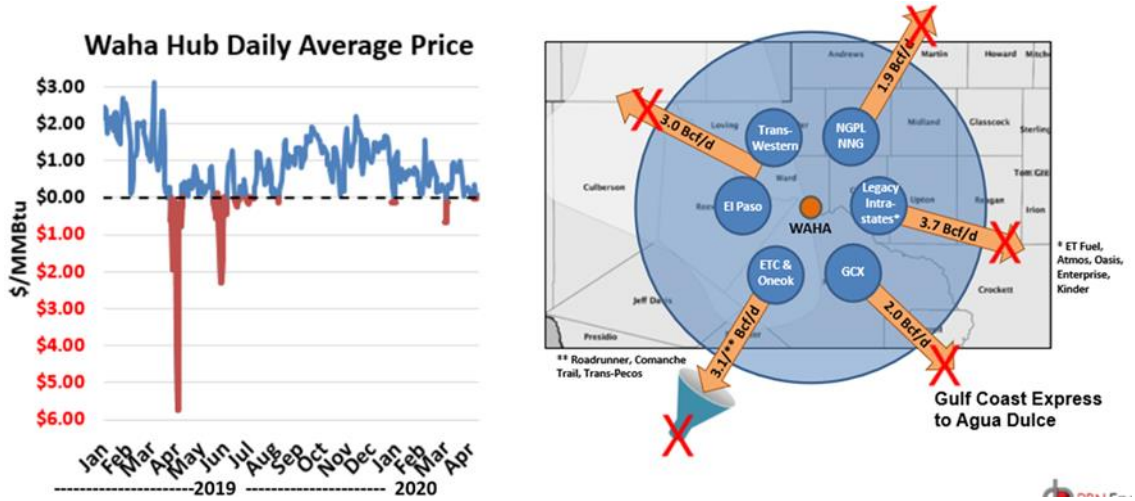
[45] Kinder Morgan Web Site, accessed June 1, 2020: https://ir.kindermorgan.com/news/news-details/2019/Gulf-Coast-Express-Pipeline-Placed-in-Service-Ahead-of-Schedule/default.aspx

[46] Natural Gas Intelligence (NGI): https://www.naturalgasintel.com/data/data_products/daily?region_id=west-texas/se-new-mexico&location_id=WTXWAHA

declined since 2010. In December, 2019, Fermaca's 1.32 Bcf/d La Laguna-Aguascalientes natural gas pipeline launched operations, a key component of the Wahalajara system that brings natural gas from Texas into central Mexico. The Wahalajara system is a group of new pipelines that connects the Waha hub in western Texas to Guadalajara and other population centers in west-central Mexico. The 281-mile pipeline connects into the El Encino-La Laguna pipeline to the north and the Villa de Reyes-Aguascalientes-Guadalajara pipeline to the south, creating a 1,336 mile trunk line that covers seven states in Mexico.[47]

In the Spring of 2019, there was not enough pipeline capacity to move Permian Basin gas to market, resulting in negative prices from the Waha Hub. **Figure 24** shows that natural gas fell below zero in April and June, 2019 and in March of 2020.

Figure 24: Waha Hub Daily Average Price, 2019-2020



Source: RBN Energy, 2019.

Gas processing plants are located throughout the Permian Basin, refining gas for local and regional distribution. An extensive network of gas gathering pipelines are used to transport natural gas to processing plants. Most of these plants also have liquefaction capabilities to store liquid natural gas (LNG) until needed. **Table 10** lists the 51 gas processing plants in West Texas and **Table 11** lists the 20 gas processing plants in Eddy and Lea Counties, New Mexico. Combined, the Permian Basin operates 71 gas processing plants. **Table 12** lists the top ten gas processing plants by capacity within the study area.

[47] Argus Media Report, Dec 2019. https://www.argusmedia.com/en/news/2031472-fermaca-starts-new-gas-export-line-to-mexico

Table 10: Texas Gas Processing Plants in the Permian Basin Region

Plant Name	County Name	Plant Capacity (Bcf/d)	Plant Flow (Bcf/d)	BTU Content	LNG Capacity (Bbls)
Dollarhide Gas Plant	Andrews	56	56	NA	7,000
Midmar West	Andrews	65	41	1,300	640
Cgu Cordona Lake Plant	Crane	10	5	610	443
Block 31 Plant	Crane	41	41	550	718
Targa Sandhills Plant	Crane	180	152	1,230	9,285
Ozona	Crockett	32	9	1,290	648
Ozona Gas Processing Plant	Crockett	120	85	1,160	15,833
Southwest Ozona	Crockett	90	85	1,160	1,429
Goldsmith	Ector	160	165	1,325	9,000
Seminole Gas Processing Plant	Gaines	285	275	1250	10,000
Bearkat Plant	Glasscock	60	40	1,250	4,213
Deadwood Plant	Glasscock	58	29	1,365	2,330
Rebel Plant	Glasscock	200	200	1,300	NA
East Vealmoor Gas Plant	Howard	45	22	1,267	750
Mertzon Plant	Irion	52	49	1,239	7,658
Midmar East	Martin	100	65	1,300	2,500
Riptide Plant	Martin	100	85	1,270	6,600
Sale Ranch Gas Plant	Martin	250	210	1,247	750
Tarzan Gas Plant	Martin	10	9	1,050	1,876
High Plains Plant	Midland	200	171	1,260	837

Plant Name	County Name	Plant Capacity (Bcf/d)	Plant Flow (Bcf/d)	BTU Content	LNG Capacity (Bbls)
Pegasus Plant	Midland	100	60	1,287	42
Roberts Ranch	Midland	70	70	1,100	362
Spraberry Plant	Midland	125	63	1,300	NA
Coyanosa	Pecos	125	100	1,175	97,000
Gomez Plant	Pecos	84	80	950	NA
Tract 75 Gas Plant	Pecos	110	73	300	NA
Waha Plant	Pecos	120	120	1,184	NA
Big Lake Plant	Reagan	200	140	1,150	NA
Midkiff Plant	Reagan	230	220	1,290	833
Arrowhead Plant	Reeves	220	196	1,258	1,850
East Toyah Gas Plant	Reeves	440	300	1,250	4,500
Orla Plant	Reeves	210	160	1,220	1,350
Pecos Bend Gas Processing Plant	Reeves	153	30	1,386	437
Pecos Gas Plant	Reeves	250	120	1,300	2,040
Pecos River Plant	Reeves	30	19	1,248	4,300
Red Bluff Plant	Reeves	220	180	1,220	1,350
Delaware Basin Gas Processing Plant	Reeves	150	150	1,239	NA
Snyder Gasoline Plant	Scurry	90	59	1,300	1,000
Benedum Complex	Upton	360	242	1,278	750

Plant Name	County Name	Plant Capacity (Bcf/d)	Plant Flow (Bcf/d)	BTU Content	LNG Capacity (Bbls)
Crane Gas Plant	Upton	30	25	1,355	NA
Panther Plant	Upton	210	185	1,326	NA
Tippett Plant	Upton	55	50	1,200	7,500
Bone Springs Gas Processing Plant	Ward	120	102	1,250	5,700
MiVida JV Processing Plant	Ward	200	190	1,280	20,000
Halley	Winkler	107	90	1,129	169
Keystone	Winkler	100	100	1,200	500
Cornell Mahoney Gas Plant	Yoakum	50	40	380	2,000
Denver Unit CO2 Recovery Plant	Yoakum	290	279	229	850
WPMT NGL	Yoakum	40	11	891	NA
Wasson ODC Unit CO2 Removal Plant	Yoakum	100	96	NA	4,300
Willard CO2 Recovery Plant	Yoakum	96	94	185	1,500

Source: EIA Natural Gas Survey 2017 https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2017&year2=2017&company=Name

Table 11: New Mexico Gas Processing Plants in the Permian Basin Region

Plant Name	County Name	Plant Capacity (Bcf/d)	Plant Flow (Bcf/d)	BTU Content	LNG Capacity (bbls)
Artesia	Eddy	90	80	1,200	2,573
Carlsbad Chaparral Gas Plant	Eddy	40	23	1,150	NA
Dagger Draw	Eddy	50	35	1,150	NA
Indian Basin Gas Plant	Eddy	300	64	1,260	5,000
Pecos Diamond	Eddy	40	23	1,150	NA
South Carlsbad Dew Point Plant	Eddy	200	50	1,060	1,200
South Eddy Cryo Plant	Eddy	200	200	1,246	NA
Buckeye CO2 Plant	Lea	55	53	230	700
Denton GS Plant	Lea	20	2	1,427	750
East Vacuum Liquid Recovery Plant	Lea	45	24	1,027	1,355
Eunice	Lea	105	95	1,250	4,000
Hobbs Cryogenics Plant	Lea	42	20	1,125	80
Jal #3 Plant	Lea	110	95	1,250	6,680
Linam Ranch	Lea	225	164	1,241	1,400
Maljamar Gas Plant	Lea	150	85	1,200	1,143
Monument Plant	Lea	85	81	1,265	5,357
Red Hills	Lea	275	130	1,150	NA
Saunders Plant	Lea	70	38	1,220	2,286
Targa Midstream Services	Lea	115	100	1,029	713
Zia II Plant	Lea	220	180	1,120	3,950

Source: EIA Natural Gas Survey 2017 https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2017&year2=2017&company=Name

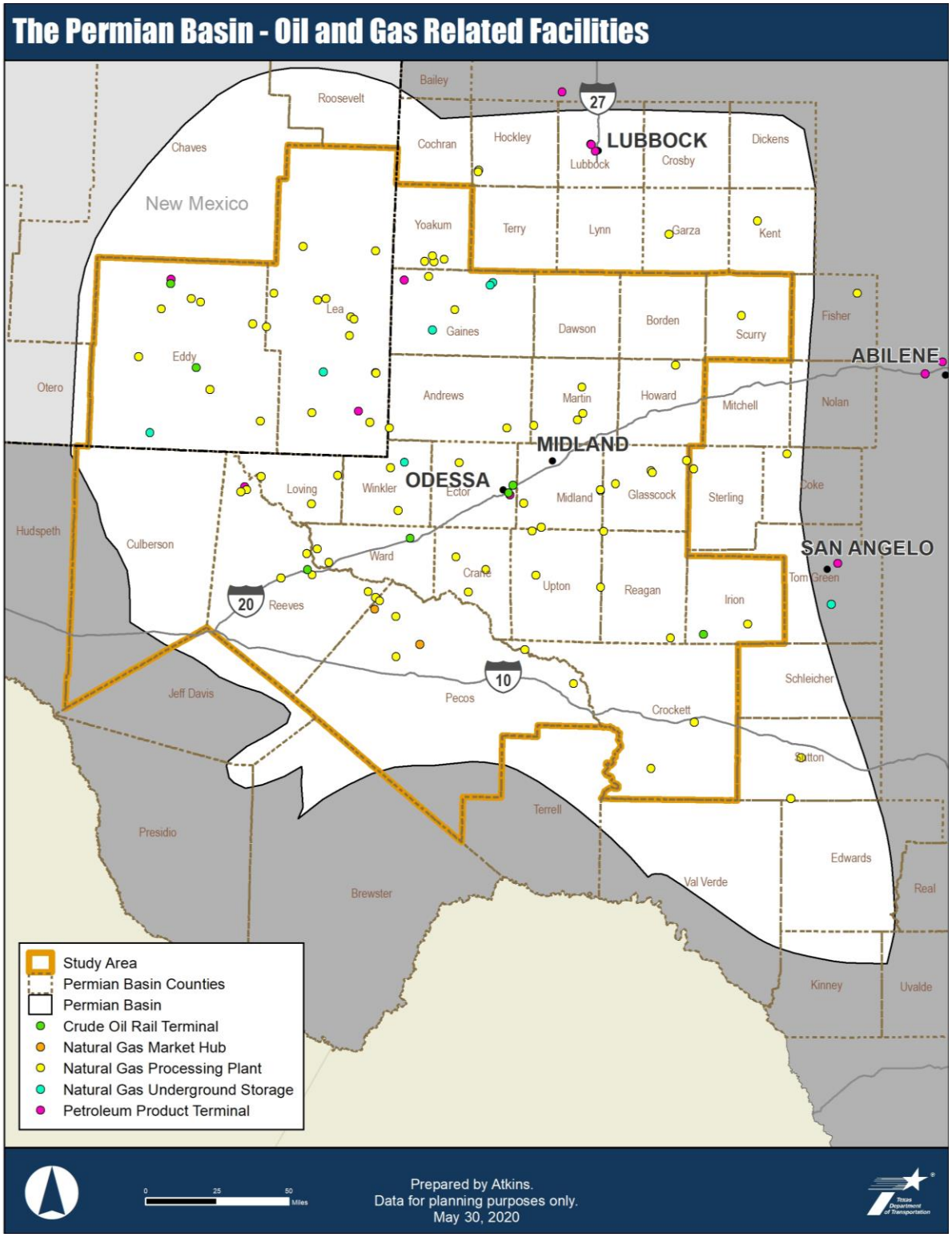
Table 12: Top Ten Gas Processing Plants by Plant Capacity in the Permian Basin Region

Plant Name	County Name	Plant Capacity (Bcf/d)	Plant Flow (Bcf/d)	BTU Content	LNG Capacity (Bbls)
East Toyah Gas Plant	Reeves	440	300	1,250	4,500
Benedum Complex	Upton	360	242	1,278	750
Indian Basin Gas Plant	Eddy	300	64	1,260	5,000
Denver Unit CO2 Recovery Plant	Yoakum	290	279	229	850
Seminole Gas Processing Plant	Gaines	285	275	NA	10,000
Red Hills	Lea	275	130	1,150	NA
Sale Ranch Gas Plant	Martin	250	210	1,247	750
Pecos Gas Plant	Reeves	250	120	1,300	2,040
Midkiff Plant	Reagan	230	220	1,290	833
Linam Ranch	Lea	225	164	1,241	1,400

Source: EIA Natural Gas Survey 2017 https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2017&year2=2017&company=Name

Figure 25 shows the location of oil- and gas-related facilities, such as processing plants, terminals, and major storage facilities based on data from the U.S. Energy Information Administration (EIA). These facilities are located throughout the study area and Texas. They represent assets for the production and distribution of oil and gas, but they also represent potential hazards and can impact what types of land uses can be developed nearby. In addition to these types of facilities, liquid pipelines require pumping stations and gas pipelines require compression stations, which are critical infrastructure for the distribution of oil and gas but are potentially hazardous and need appropriate separation from other infrastructure and development.

Figure 25: Permian Basin Oil- and Gas-Related Processing/Storage Facilities, 2020



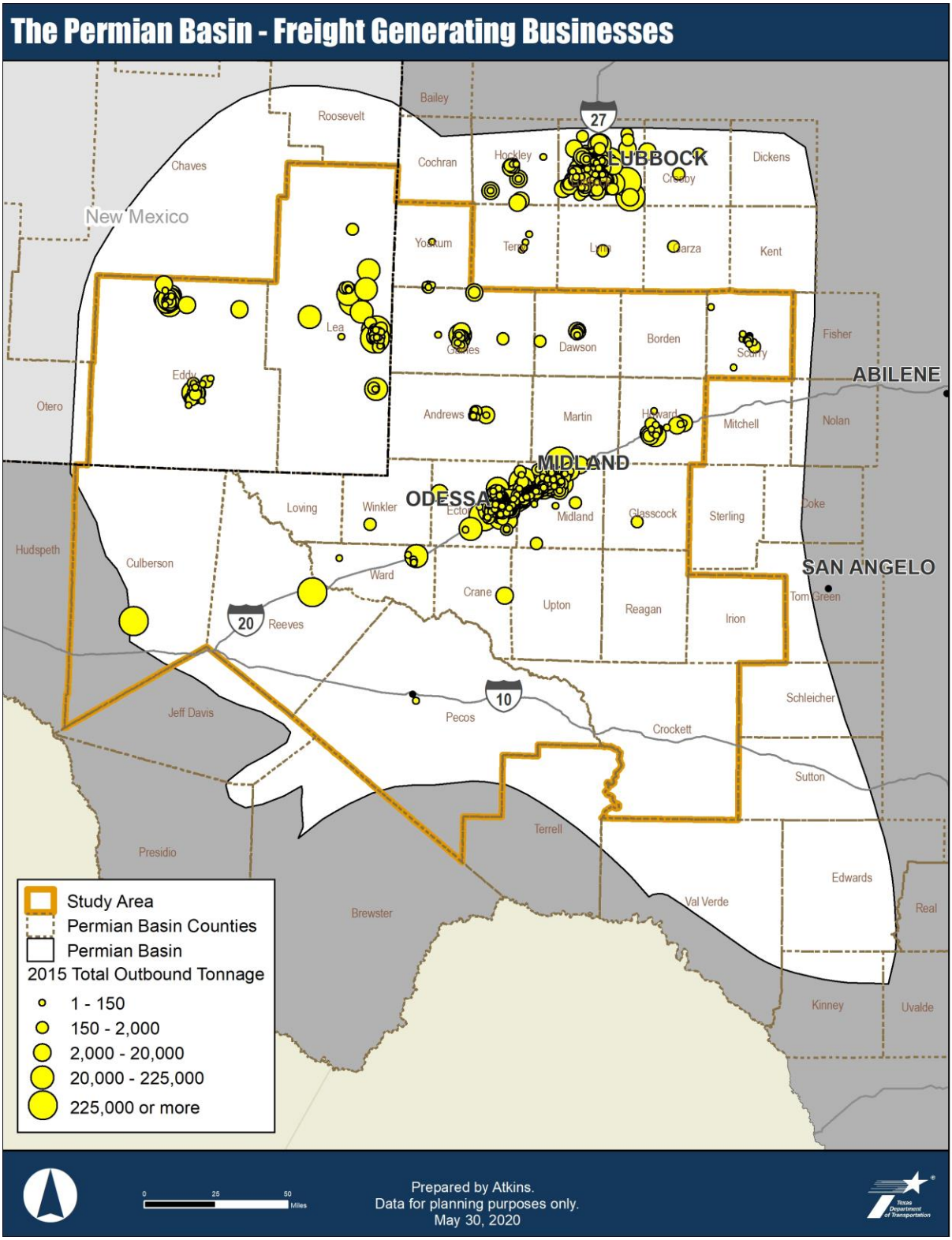
Source: U.S. Energy Information Administration (EIA), 2018-2020. https://www.eia.gov/maps/layer_info-m.php

3.7 Freight Generators and Receivers

This section looks at freight generators and freight receivers within the Permian Basin. Freight generators are businesses that produce freight while freight receivers are businesses that consume freight. IHS Global Insight's TRANSEARCH freight data have a subset of location-specific business data called Freight Finder. Although this is only a sample of businesses generating and receiving freight, it provides insight into the location of freight-related businesses and the amount of the freight they generate or receive in tonnage. **Figure 26** and **Figure 27** show the location of freight-generating and freight-receiving businesses in the study area by tonnage of freight for 2015.

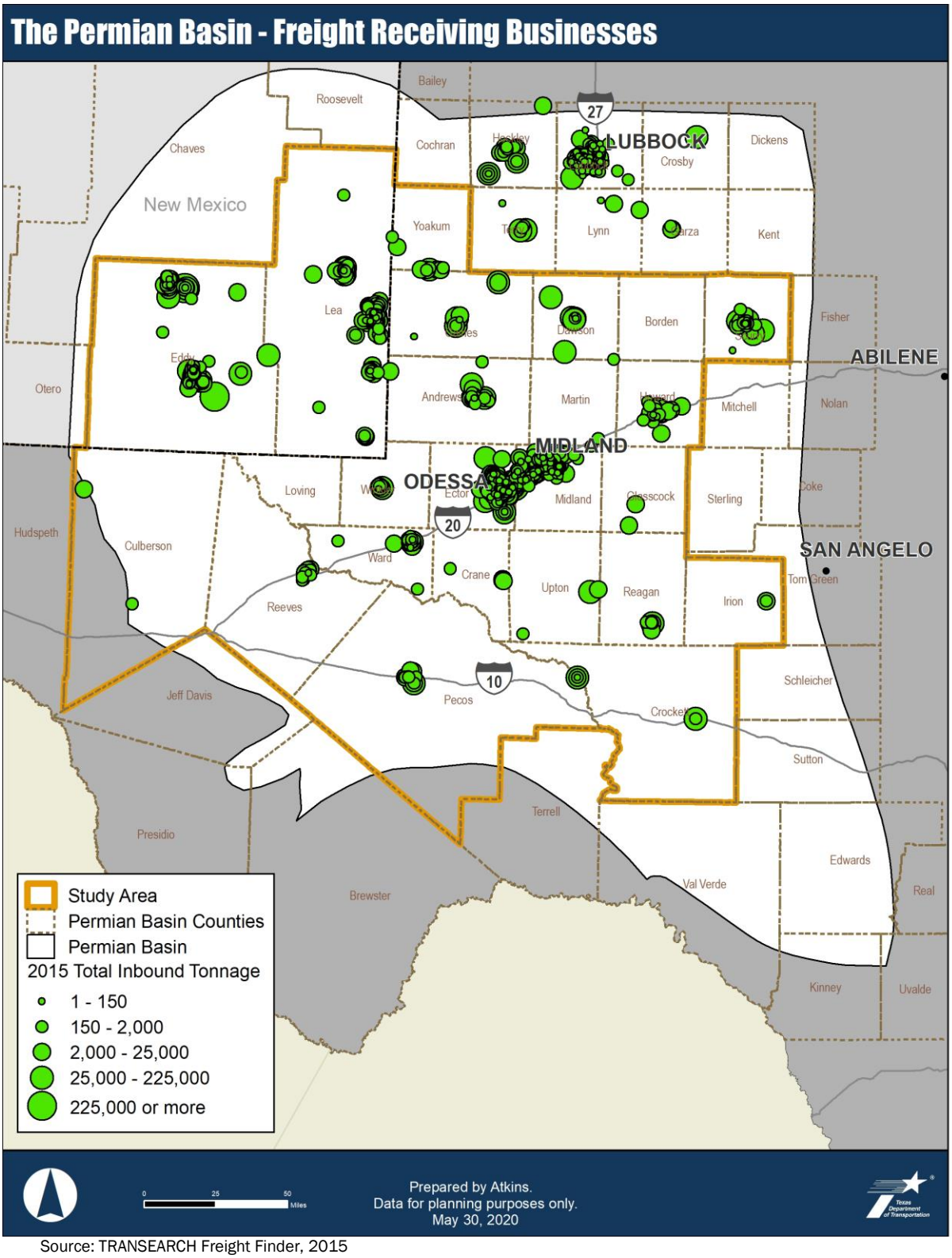
Figure 26 and **Figure 27** show that the dominant freight-generating and freight-receiving businesses from the Freight Finder data are located in or near urban locations and tend to mirror the location of employment in the OnTheMap data discussed in Section 3.1. This may further show that the Freight Finder data are good at capturing the movement of freight to regional distribution centers, but not the shorter distribution trips between those regional distribution centers and the location of oil and gas well production areas.

Figure 26: Freight Generating Businesses, 2015



Source: TRANSEARCH Freight Finder, 2015

Figure 27: Freight Receiving Businesses, 2015



Source: TRANSEARCH Freight Finder, 2015

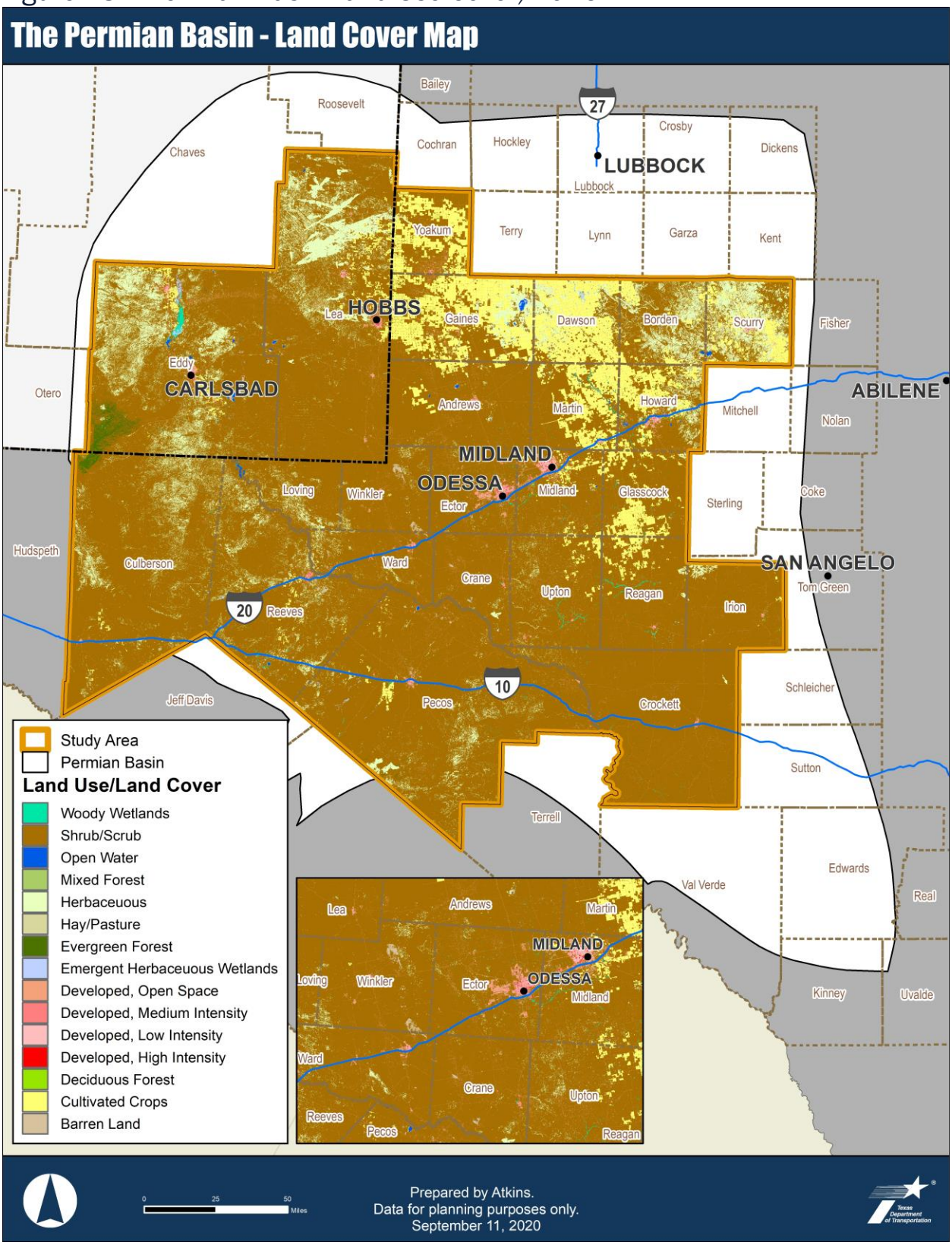
4.0 Non-Industrial Land Uses in the Permian Basin

Industrial land uses are not the only land uses that have an impact on freight movement. People are consumers of freight and identifying residential and commercial land uses can help show where freight is being consumed in the study area and can identify and potential conflict areas or areas of avoidance with freight intensive land uses. This section examines the existing and projected residential and commercial land uses within the Permian Basin, the Midland-Odessa metropolitan area, and cities with populations above 5,000. Cities with populations greater than 5,000 were chosen because they are more likely to have land use plans and because larger populations tend to consume/demand more freight.

4.1 Overall Permian Basin

The overall Permian Basin study area is sparsely populated. As shown in **Figure 28**, using data from the National Land Cover Database (2016), the vast majority of the region is undeveloped shrub/scrub land. Much of this undeveloped area is dotted with energy sector activity, as described in the previous section. Areas of development, predominantly low to medium density, are visible in Midland-Odessa, Big Spring, Hobbs (New Mexico), and several smaller municipalities. Agricultural uses are concentrated in the northern portions of the study area, particularly Gaines and Dawson counties, while a swath of evergreen forest exists in the far western portion of the region, straddling the Texas/New Mexico border.

Figure 28: Permian Basin Land Use Cover, 2016



Source: Multi-Resolution Land Characteristics Consortium. National Land Cover Database, 2016. https://www.mrlc.gov/

While the region is experiencing considerable population growth, the growth is mainly concentrated near existing developed areas with infrastructure, utilities, retail establishments, and social services. This section reviews the current and, if available, future/planned land use for developed areas within the region. The analysis focuses on cities in the region with populations above 5,000. **Table 13** shows the population of each of these cities as well as the type of planning documents/tools prepared by each municipality.

Table 13: Population (1990-2017) and Planning Tools for Key Population Centers in the Permian Basin

City	County	1990 Population	2000 Population	2010 Population	2017 Population	% Change 1990-2017	Comp. Plan?	Zoning Map?
Midland, TX	Midland	89,443	94,996	111,147	131,286	46.8%	X	X
Odessa, TX	Ector	89,699	90,943	99,940	115,930	29.2%	X	X
Hobbs, NM	Lea	29,115	28,657	34,122	32,427	11.4%	X	X
Carlsbad, NM	Eddy	24,952	25,652	26,138	28,774	15.3%	X	X
Big Spring, TX	Howard	23,093	25,233	27,282	28,257	22.4%	X	X
Andrews, TX	Andrews	10,678	9,652	11,088	13,333	24.9%	X	X
Artesia, NM	Eddy	10,610	10,692	11,301	11,842	11.6%		X
Lovington, NM	Lea	9,332	9,471	11,009	11,558	23.9%	X	X
Snyder, TX	Scurry	12,195	10,783	11,202	11,543	-5.3%	X	X
Pecos City, TX	Reeves	12,069	9,501	8,780	9,552	-20.9%		X
Lamesa, TX	Dawson	10,809	9,952	9,422	9,322	-13.8%		X
Fort Stockton, TX	Pecos	8,524	7,846	8,283	8,405	-1.4%	X	X
Monahans, TX	Ward	8,101	6,821	6,953	7,526	-7.1%		X
Seminole, TX	Gaines	6,342	5,910	6,430	7,327	15.5%		
Kermit, TX	Winkler	6,875	5,714	5,708	6,405	-6.8%		

Source: U.S. Census Bureau, 2013-2017. American Community Survey 5-Year Estimates; U.S. Census Bureau, 2006-2010. American Community Survey; U.S Census Bureau, 2000. Total Population.

Table 14 shows the population change by decade for cities with populations over 5,000 within the region, and highlights some of the vitality in the region with many cities experiencing declines in populations from 1990-2000, but then growth from 2000 to 2017.

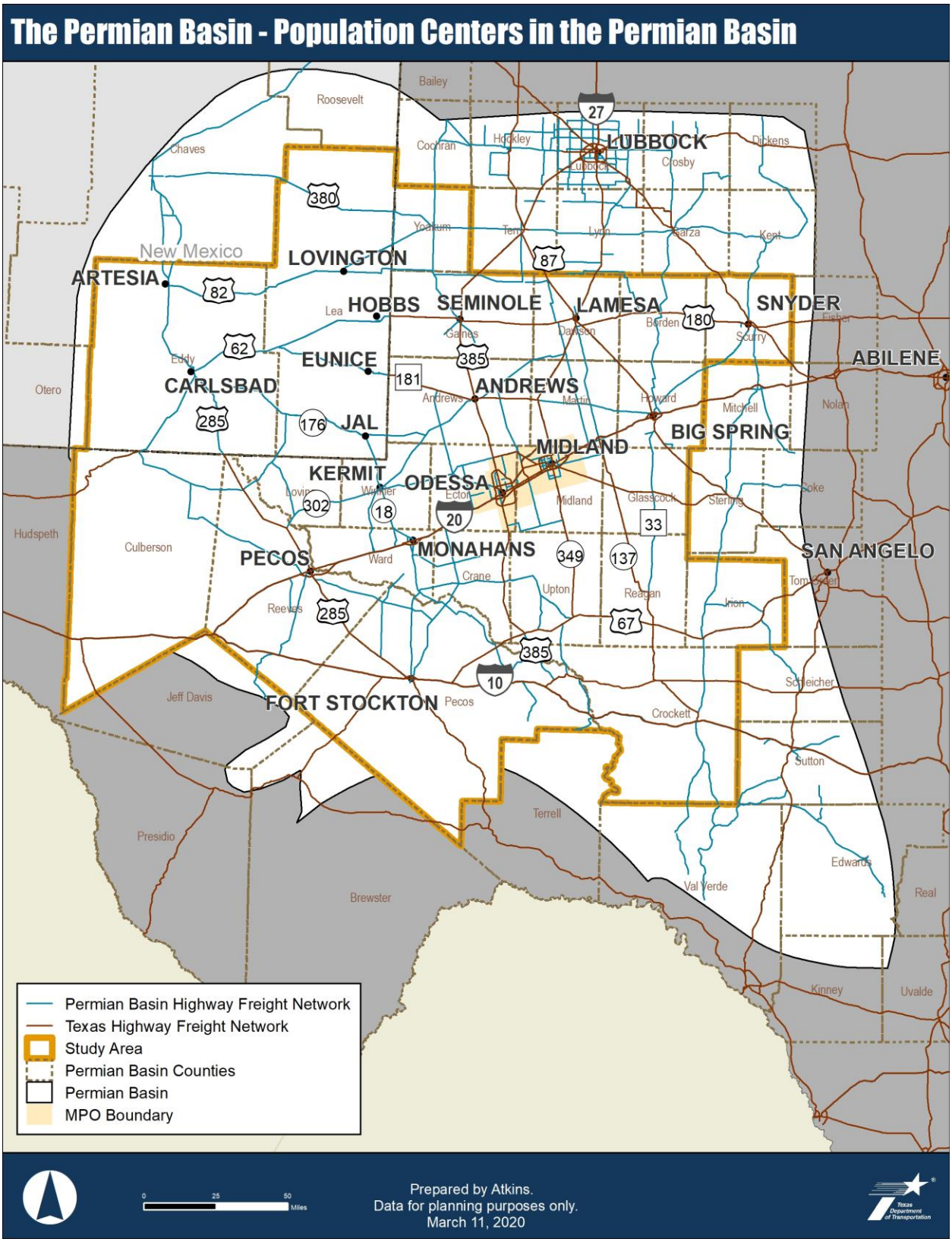
Table 14: Population Change by Decade for Cities with Populations over 5,000

City	County	1990-2000		2000-2010		2010 2017	
		% Change	Absolute Change	% Change	Absolute Change	% Change	Absolute Change
Midland, TX	Midland	6.2%	5,553	17.0%	16,151	18.1%	20,139
Odessa, TX	Ector	1.4%	1,244	9.9%	8,997	16.0%	15,990
Hobbs, NM	Lea	-1.6%	-458	19.1%	5,465	-5.0%	-1,695
Carlsbad, NM	Eddy	2.8%	700	1.9%	486	10.1%	2,636
Big Spring, TX	Howard	9.3%	2,140	8.1%	2,049	3.6%	975
Andrews, TX	Andrews	-9.6%	-1,026	14.9%	1,436	20.2%	2,245
Artesia, NM	Eddy	0.8%	82	5.7%	609	4.8%	541
Lovington, NM	Lea	1.5%	139	16.2%	1,538	5.0%	549
Snyder, TX	Scurry	-11.6%	-1,412	3.9%	419	3.0%	341
Pecos City, TX	Reeves	-21.3%	-2,568	-7.6%	-721	8.8%	772
Lamesa, TX	Dawson	-7.9%	-857	-5.3%	-530	-1.1%	-100
Fort Stockton, TX	Pecos	-8.0%	-678	5.6%	437	1.5%	122
Monahans, TX	Ward	-15.8%	-1,280	1.9%	132	8.2%	573
Seminole, TX	Gaines	-6.8%	-432	8.8%	520	14.0%	897
Kermit, TX	Winkler	-16.9%	-1,161	-0.1%	-6	12.2%	697

Source: U.S. Census Bureau, 2013-2017. American Community Survey 5-Year Estimates; U.S. Census Bureau, 2006-2010. American Community Survey; U.S Census Bureau, 2000. Total Population.

Figure 29 shows the location of these cities within the Permian Basin study area. These cities are further discussed in Section 4.5.

Figure 29: Population Centers of 5,000 or more within the Permian Basin, 2017

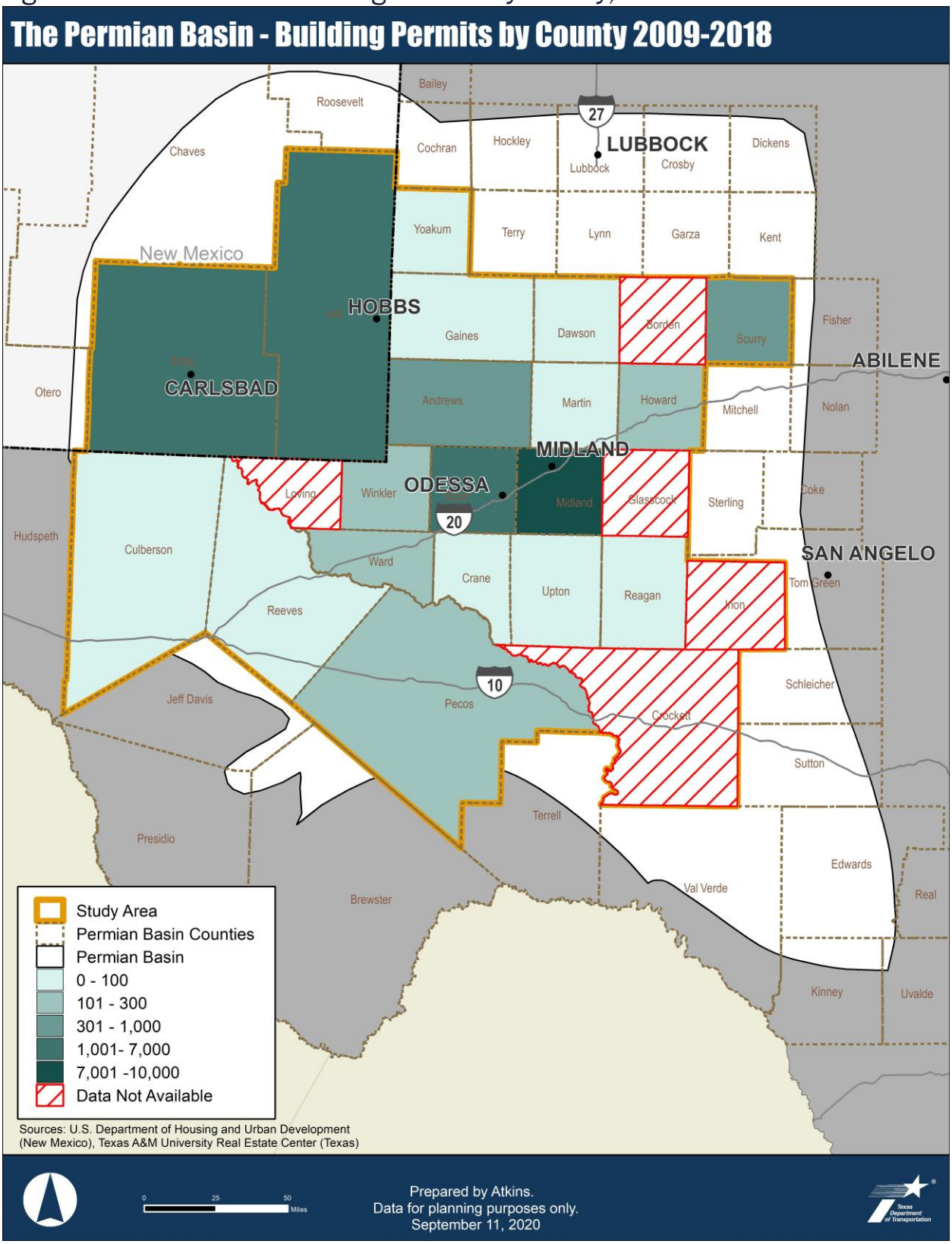


Cities with populations over 5,000 (2017)

Figure 30 shows the distribution of residential building permits across the region for the 10-year period from 2009 through 2018. Midland, Ector, Lea, and Eddy counties, which contain the largest cities in the region, issued more than 1,000 permits each during this period. Residential building permits are an indication of growth and larger populations usually equates to an increased demand for freight. Increased residential buildings and land uses also means that there is less land available for freight land uses and freight and residential land uses are often incompatible. Therefore, freight and residential land uses should not be located adjacent to each other because of some of the negative externalities associated with freight land uses such as increased noise and truck traffic.

The pressures of population growth, combined with the distances workers need to travel to reach their job sites across the region, have led to the development of temporary "staff camp" developments throughout the Permian Basin, particularly for the oil and gas industry. These staff camps provide dormitory-like accommodations and services like meals and laundry. Many staff camps are located near existing population centers, but others occur in more remote locations. Additionally, privately owned Recreational Vehicle (RV) lots house temporary oil and gas workers in the region. The emergence of staff camps and RV lots highlights the need for additional housing in the region.

Figure 30: Residential Building Permits by County, 2009-2018



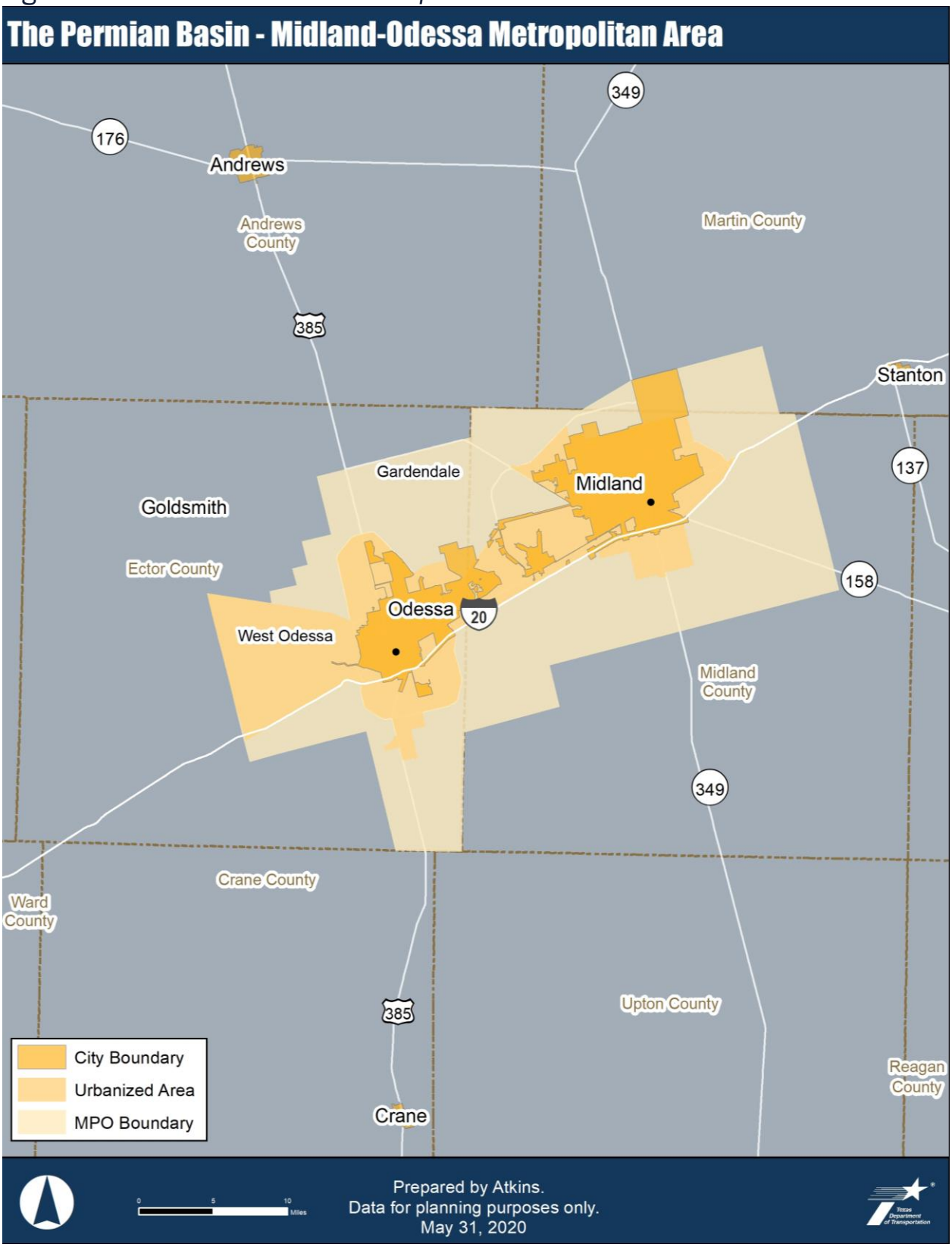
Source: U.S. Department of Housing and Urban Development. State of the Cities Data Service. https://socds.huduser.gov/permits/index.html?

The following sections discuss land uses on a local level, relying on information from city comprehensive plans, land use maps, and zoning ordinances. They cover the Midland-Odessa area as well as several smaller municipalities. While some local plans did specifically mention freight, most did not include designated plans for freight accommodation.

4.2 Midland-Odessa Metropolitan Area

The cities of Midland and Odessa are located approximately 12 miles apart along the I-20 corridor. Connected by I-20, Business Loop 20, and State Highway (SH) 191, growth in development between the two cities has resulted in an interconnected region. The metropolitan area also includes the unincorporated communities of West Odessa and Gardendale. The Permian Basin Metropolitan Planning Organization (MPO) serves as the regional transportation planning agency for the Midland-Odessa Metropolitan Area, which includes considerable portions of Midland and Ector counties, as well as a portion of Martin County. A map of the Midland-Odessa Metropolitan Area is shown in **Figure 31**.

Figure 31: Midland-Odessa Metropolitan Area



Relevant planning efforts that include transportation and/or land use for the Midland-Odessa metropolitan area include:

- The Permian Basin MPO's Forward45 Plan (Metropolitan Transportation Plan), 2019;
- Motor MPO (now Permian Basin MPO) Midessa Land Use Transportation Study, 2014;
- City of Midland Comprehensive Plan, Tall City Tomorrow, 2016;
- Priority Midland Economic Impact Study (Midland Development Corporation), 2019; and
- City of Odessa Comprehensive Plan, Envision Odessa, 2016.

4.2.1 Population Growth and Projections

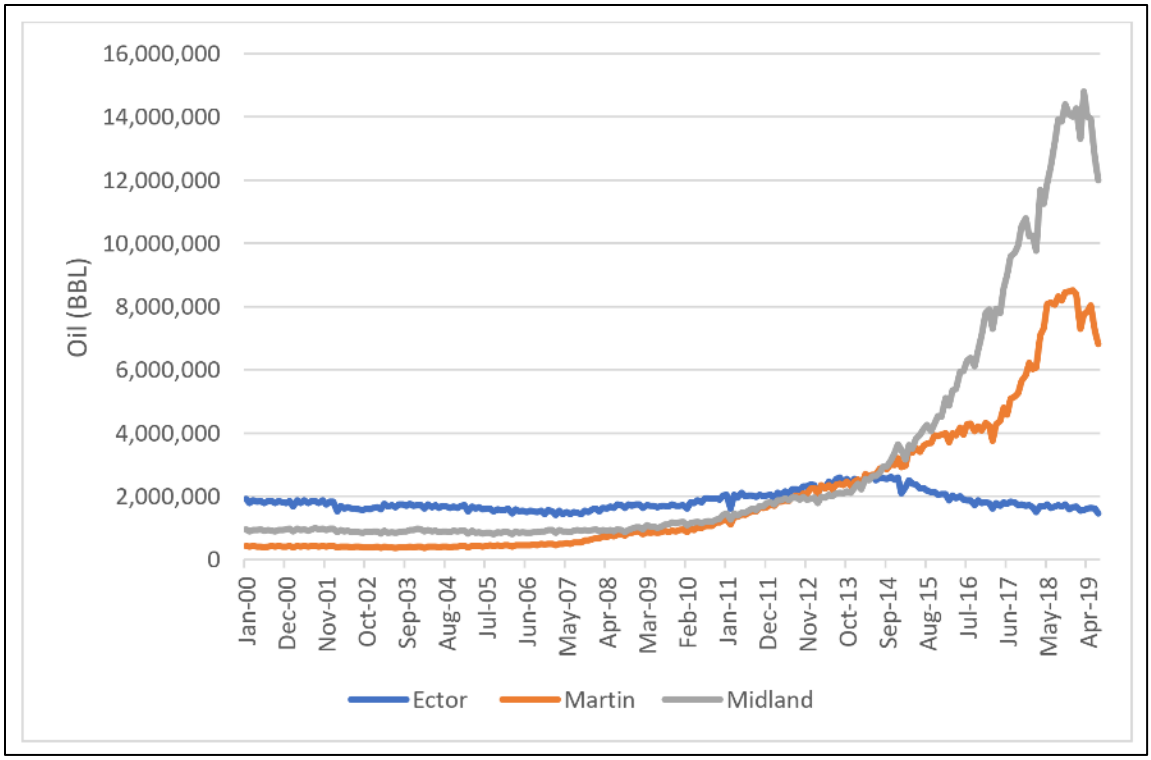
The total population of the Midland-Odessa region was approximately 275,000 as of 2017. **Table 15** shows the population in the region from 1990 through 2017 as well as the percent change by decade. Overall growth in the region increased at a faster pace since 2000; this coincides with the steep increase in oil production during this period (**Figure 32**).

Table 15: Population and Percent Change by Decade by City in the Midland-Odessa Metropolitan Area

City/Area	1990	2000	2010	2017	% Change 1990-2000	% Change 2000-2010	% Change 2010-2017	% Change 1990-2017
Midland	89,443	94,996	111,147	131,286	6.2%	17.0%	18.1%	46.8%
Odessa	89,783	90,943	99,940	115,930	1.3%	9.9%	16.0%	29.1%
West Odessa	16,574	17,799	22,707	25,781	7.4%	27.6%	13.5%	55.6%
Gardendale	1,103	1,197	1,574	1,979	8.5%	31.5%	25.7%	79.4%
Total Region	**193,903**	**204,935**	**235,368**	**274,976**	**5.7%**	**14.9%**	**16.8%**	41.8%

Source: U.S. Census Bureau, 2013-2017. American Community Survey 5-Year Estimates; U.S. Census Bureau, 2006-2010. American Community Survey; U.S Census Bureau, 2000. Total Population.

Figure 32: Oil Production by County by Month from January 2000 to September 2019



Source: Permian Basin MPO Forward45 Plan, 2019.
Oil (BBL) = Oil barrels

The Permian Basin MPO's Travel Demand Model (TDM) assumes the region will have a total population of 427,163 residents by 2045. This is a considerably more conservative estimate than that reported by the Texas Demographic Center, referenced in **Table 4** in **Section 2** above, which predicts a sharp increase between 2040 and 2050 to arrive at an estimate of more than 1 million residents in Midland and Ector Counties (combined) by 2050. The City of Midland's Comprehensive Plan estimates the City's population will rise to 158,000 by 2035, while the City of Odessa's Comprehensive Plan estimates a population of around 140,000 residents by 2035[48,49]; however, these estimates only apply to areas within the city limits. The Priority Midland Economic Impact Study produced by the Perryman Group for the Midland Development Corporation estimates the population of the Midland metropolitan statistical area (MSA) (Midland and Martin Counties) will reach 280,000 by 2030.[50] While the estimates vary, the overall consensus is that the region is growing at a rapid pace.

[48] City of Midland, 2016. *Tall City Tomorrow Comprehensive Plan*. https://www.midlandtexas.gov/532/Tall-City-Tomorrow

[49] City of Odessa, 2016. *Envision Odessa Comprehensive Master Plan*. https://www.odessa-tx.gov/home/showdocument?id=2953

[50] The Perryman Group. 2019. Priority Midland by the Numbers. https://prioritymidland.com/

4.2.2 Growth Challenges

The increasing population is placing heavy demands on the region's supply of housing, amenities, and social services. Issues reported by municipalities and stakeholders in the region include:

- Housing demand exceeds the supply, which leads to increases in housing costs and development of alternative arrangements, such as staff camps, RV parks, etc.
- Investment in community services has not kept pace with population growth. Overcrowded schools and the lack of investment in new schools is further complicated by the issue that the average age of new residents is early 30s, an age that is more likely to have young children. In addition, medical facilities are stretched too thin for the area.
- Lack of workforce available for construction, teaching, law enforcement, and retail jobs slows progress. High salaries for the energy-industry workforce have driven up prices in the area, making it difficult for working-class people to afford the local cost of living. Also, the highly competitive wages and demand for energy-industry employees make employment in other industries less desirable.
- Developer reluctance to build in the area, citing the perception of previous "boom and bust" periods in the region, limits available housing inventory.
- Strain on the transportation network, particularly where energy sector freight traffic conflicts with local/residential traffic, reduces Level Of Service (LOS).
- Near oilfields, conflicts between "surface rights" and underground "mineral rights" affect what types of land uses can be developed. In Texas, whoever owns the mineral rights has the right to use as much of the surface estate as "reasonably necessary" for mineral exploration and production.[51]

Many of these issues are also applicable to the whole Permian Basin study area.

Local agencies, elected officials, major employers, and other key stakeholders in the region are taking a proactive approach to planning and harnessing the economic potential of current growth trends. For example, the Permian Strategic Partnership is a group of energy companies, elected officials, and government agencies formed to tackle local concerns such as education, healthcare, housing, and transportation. Local and regional governments—including the Permian Basin Regional Planning Commission, Permian Basin MPO, and cities of Midland and Odessa—are working closely with TxDOT on transportation planning and the development of this regional freight plan.

[51]Texas A&M Agrilife Extension.Texas Agriculture Law Blog. 2018. *Texas Mineral Owner's Implied Right to Use the Surface*. https://agrilife.org/texasaglaw/2018/11/26/texas-mineral-owners-implied-right-to-use-the-surface/

4.3 City of Midland

The City of Midland is connected to I-20 and SH 349, which are both part of the Texas Highway Freight Network, and help move freight both within the region, and to the entire state. I-20 is also a hazmat route, and there are a few additional roads within Midland that can transport non-radioactive hazardous materials including, Loop 250, SH 349, and north Midkiff Road. A map of the hazmat routes can be found in Section 3.6, **Figure 18**. The Union Pacific (UP) Toyah subdivision rail line also runs through Midland parallel to I-20 and connects the region to the Dallas-Fort Worth metropolitan (DFW) area and on to Memphis.

The Midland Comprehensive Plan, Tall City Tomorrow, was approved in 2016 and includes population projections through 2035. The Plan highlights Midland's unique opportunities and challenges, including rapid population growth, unique environmental features, and how the energy sector affects the city's development.

According to Tall City Tomorrow, residential development historically grew in a contiguous manner radiating to the north, west, and east out of the downtown core. Over the past several years, this growth has moved beyond Loop 250, the ring road around Midland on the north side of I-20. The challenge for the city in the coming years is to ensure that this future growth remains connected to the existing city and is supplied with the services necessary to create vibrant and stable neighborhoods.[52]

Tall City Tomorrow estimates Midland will need to add 622 housing units annually, through 2035, to accommodate demand. The city requires a buffer of 500 feet around all oil wells, which provides significant constraints to development in this oil-rich area.

Figure 33 shows Tall City Tomorrow's Development Area map. The plan anticipates that most of the future development will occur in the "Current Development Area" and the "Northern Development and Drilling (D/D) Area". The SH 349 corridor is likely to serve as the city's northern growth boundary for the next 20 plus years.

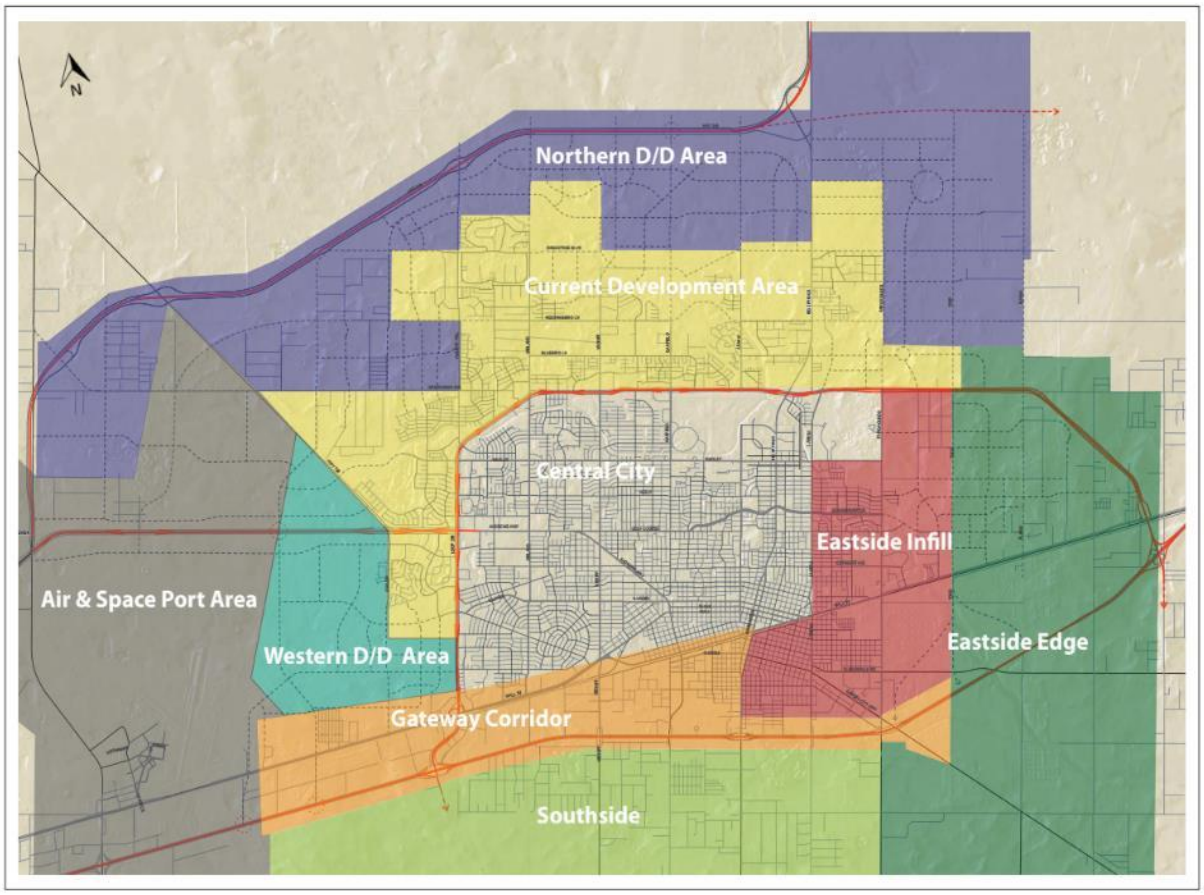
In discussions with City of Midland planning staff, approximately 1,100 single-family homes are currently permitted in the area between Loop 250 and SH 349, in the current development area.

The "Southside Area" is identified as an area where future transportation projects (such as a potential south side loop) may have a substantial impact on growth. While the "Western D/D Area" is near areas of existing development, growth in this area is expected to be slow due to drilling operations as well as expansion of Midland International Air and Space Port

[52] City of Midland, 2016. *Tall City Tomorrow Comprehensive Plan*. https://www.midlandtexas.gov/532/Tall-City-Tomorrow

operations. Growth in the "Eastside Edge" is currently constrained due to lack of water and sewer infrastructure.

Figure 33: Midland Development Areas



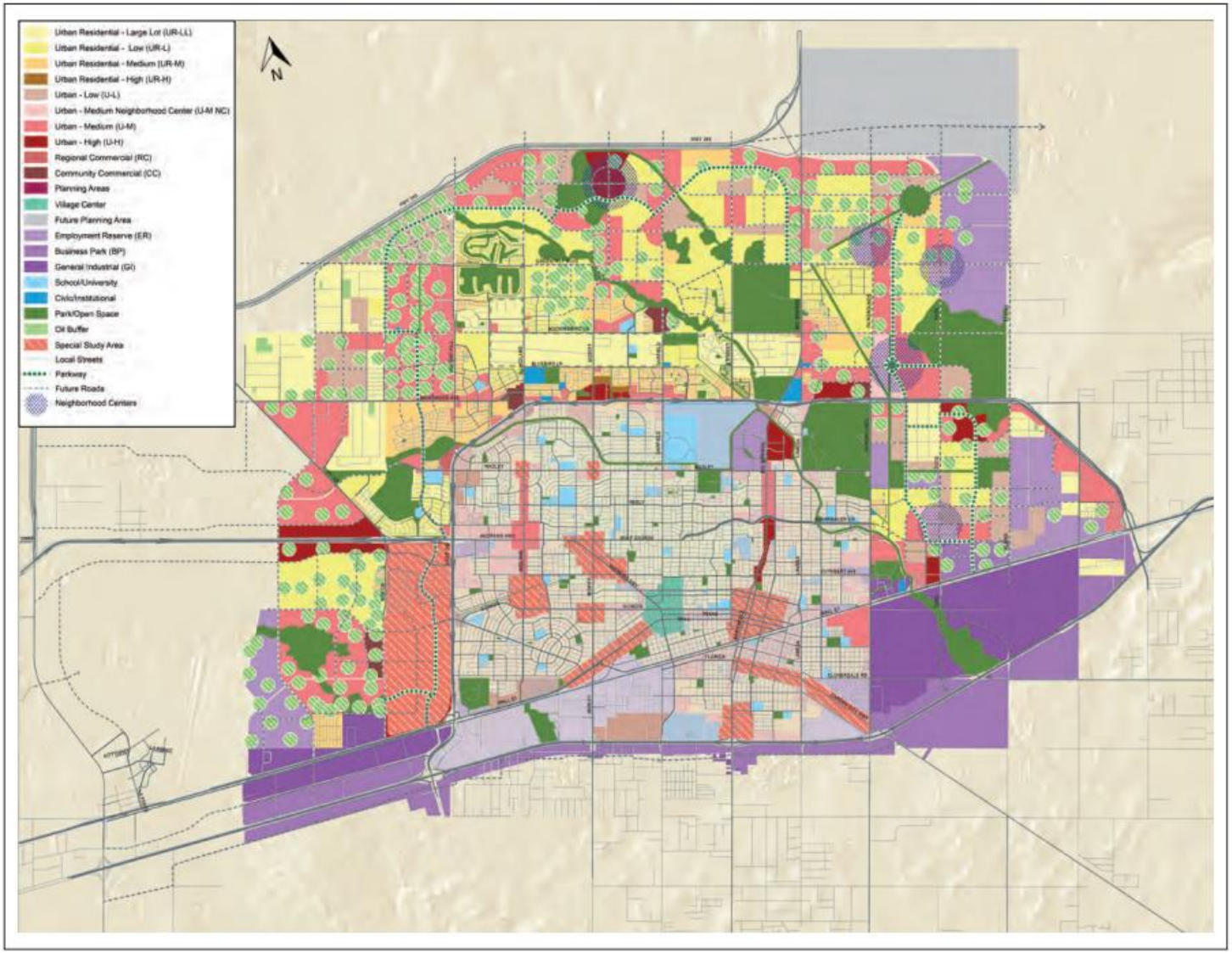
Source: City of Midland, 2016. *Tall City Tomorrow Comprehensive Plan*. https://www.midlandtexas.gov/532/Tall-City-Tomorrow

Figure 34 shows the city's Future Land Use Map. Residential and commercial uses are focused west and north of Loop 250, as far as SH 349. Industrial uses are clustered along the southern portion of the city, along the I-20 and Business 20 corridors. **Table 16** provides the colors that are typically used in land use maps and that can be referenced if the individual map legends in this section and sections 4.4 and 4.5 are hard to read.

Table 16: Legend for Land Use Figures

Color	Typical Land Use
Yellows/Browns	Residential
Reds	Retail and Commercial
Purple	Industrial and Manufacturing
Blue	Institutional and Public
Greens	Recreational
Greys	Transportation

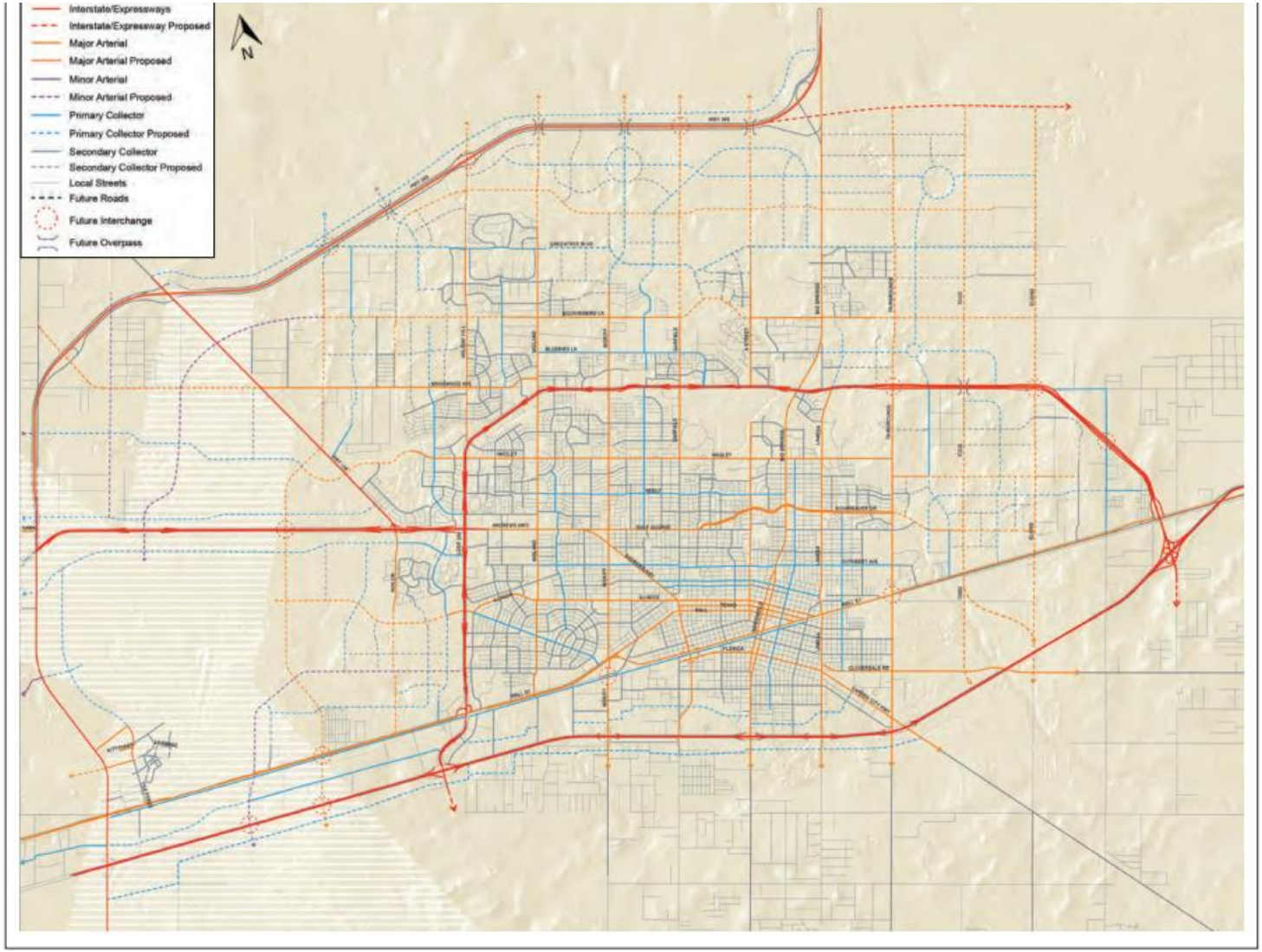
Figure 34: Midland 2035 Future Land Use Map



Source: City of Midland, 2016. *Tall City Tomorrow Comprehensive Plan*. https://www.midlandtexas.gov/532/Tall-City-Tomorrow

Figure 35 shows Tall City Tomorrow's proposed thoroughfare plan, including current and future roadways shown by federal functional classification. One of the key issues is maintaining and improving connectivity in growing areas of the city. The city's system of arterial, collector, and local streets provides solid connectivity within Loop 250; Tall City Tomorrow recommends this pattern should be maintained and continued in growth areas, and these should connect to Loop 250. Midland, like many cities in the region, has a city ordinance requiring commercial vehicles to travel on designated truck routes, avoiding the city center.

Figure 35: Midland 2035 Future Land Use Map



City of Midland, 2016. Tall City Tomorrow Comprehensive Plan. https://www.midlandtexas.gov/532/Tall-City-Tomorrow

Priority Midland is a study commissioned by the Midland Development Corporation, approved in 2019. The purpose of the study is to examine the impacts of the booming petroleum sector on Midland and its surrounding area, including trends in population and employment growth, housing needs, infrastructure, education, health and wellness, and overall quality of place. The study includes detailed projections through 2030, and provides a range of possible outcomes depending on low, baseline, and high oil price scenarios. The study area for Priority Midland encompasses all of Midland and Martin counties, which is a larger area than Tall City Tomorrow, which addresses planning only within the Midland city limits.

Priority Midland includes somewhat more-aggressive population growth scenarios than Tall City Tomorrow. Priority Midland estimates the need for 1,473 new single-family residences and 903 more multi-family residences each year, through 2030, to meet housing demand; even with the report's inclusion of Martin County, this is still a substantially larger estimate than Tall City Tomorrow's estimate of 622 new single-family residences. The need is exacerbated by shortages of workers in the construction industry, given the strong competition for workers within the oil and gas industry.

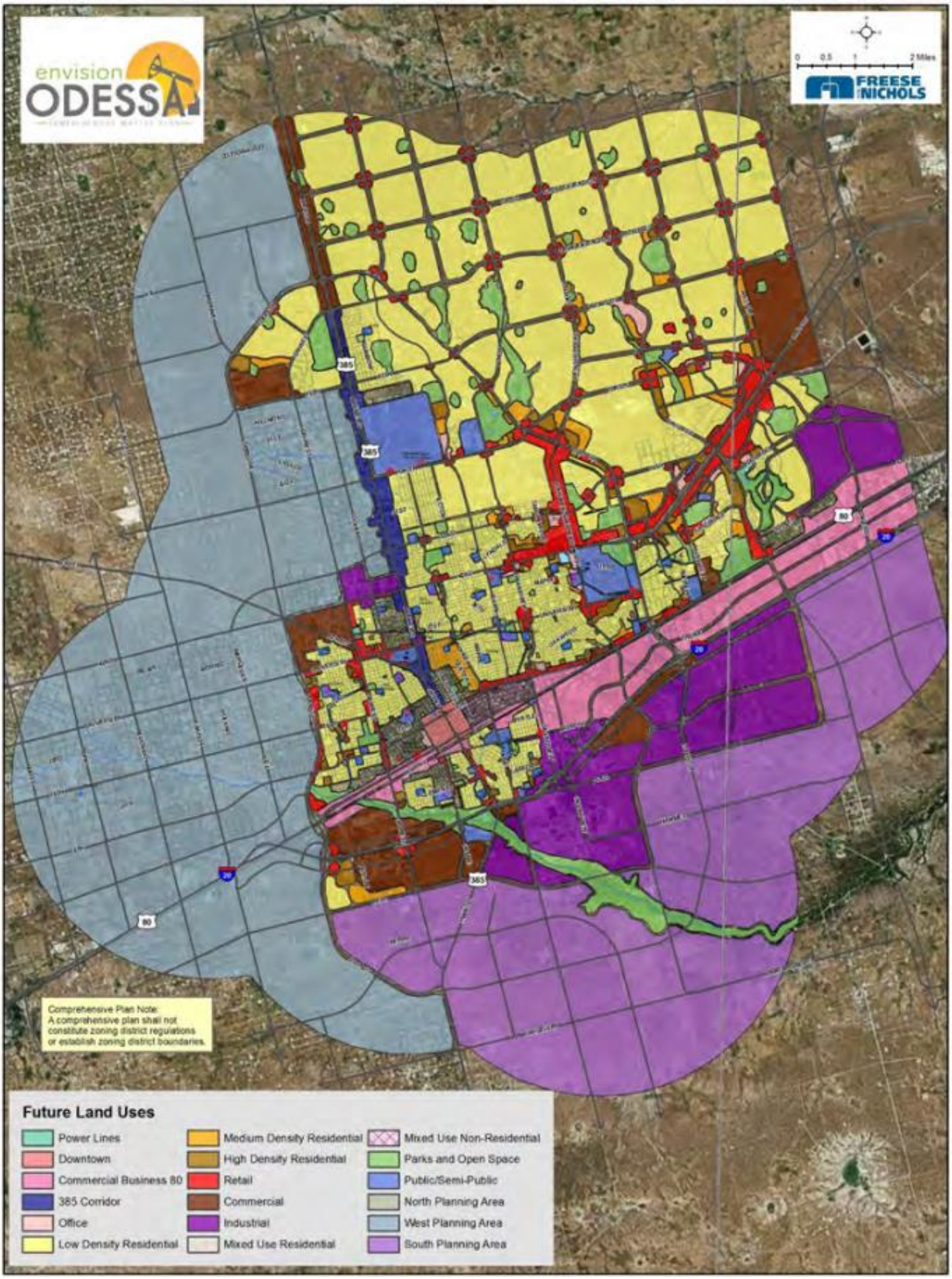
4.4 City of Odessa

The Odessa Comprehensive Plan, Envision Odessa, was approved in 2016. The Plan notes that Odessa has grown due to resurgence of the oil and gas industry. Since 2000, the community has added more than 20,000 new residents, much of that growth occurring during that last five years alone.

Envision Odessa's Future Land Use map is shown in **Figure 36**. The city has proposed northward growth, with new construction (low-density residential) occurring on vacant land in northern and eastern Odessa. As stated in the plan, aging commercial corridors and vacant land within the core of the city present additional opportunities to accommodate growth. Growing inward—one of the core principles of Envision Odessa—will help the city reinvest in the community's core and leverage the region's growth to stabilize and sustain Odessa. To this end, Odessa has identified several potential mixed-use areas within the urban core, which aim to provide more of a traditional, walkable neighborhood alternative to the auto-oriented community, as well as increased densities.

Retail development is concentrated along the SH 191 and Loop 338 corridors, with other commercial pockets along SH 191 and west/southwest of the downtown core. Like Midland, industrial development is planned to expand along the south side of the city, adjacent to I-20 and Business 20.

Figure 36: Odessa 2035 Future Land Use Map



Source: City of Odessa, 2016. *Envision Odessa Comprehensive Master Plan*. https://www.odessa-tx.gov/home/showdocument?id=2953

Envision Odessa specifically mentions the need to accommodate and manage truck traffic. The proposed Thoroughfare Plan is shown as **Figure 37**, and it includes plans for new grade-separated interchanges along Loop 338 around the city. The plan has two policies specifically related to truck traffic, which are quoted below.

- **Policy: Enforce Truck Routes**—Truck traffic is part of our regional economy—the trucking industry employs thousands of people in the oil and gas industry. Truck traffic through our internal roadway system, however, poses many safety threats. Our community must work with local energy companies to ensure that truck routes are enforced by the City and the companies themselves.[53]
- **Policy: Advocate for Grade-Separated Interchanges Along Loop 338**—Odessa continues to grow to the northeast. The new development is increasing congestion along Loop 338. Loop 338 is a designated truck route with heavy truck traffic. Residential and commercial development will increase the likelihood of truck/passenger vehicle collisions. Grade-separated interchanges and Texas Turnarounds (a lane allowing cars traveling on one side of a one-way frontage road to U-turn onto the opposite frontage road) along Loop 338 will decrease the likelihood of serious collisions. Grade-separated interchanges should be considered at Yukon Road, Grandview Avenue, 87th Street, and Andrews Highway (U.S. Highway [US] 385).[54]

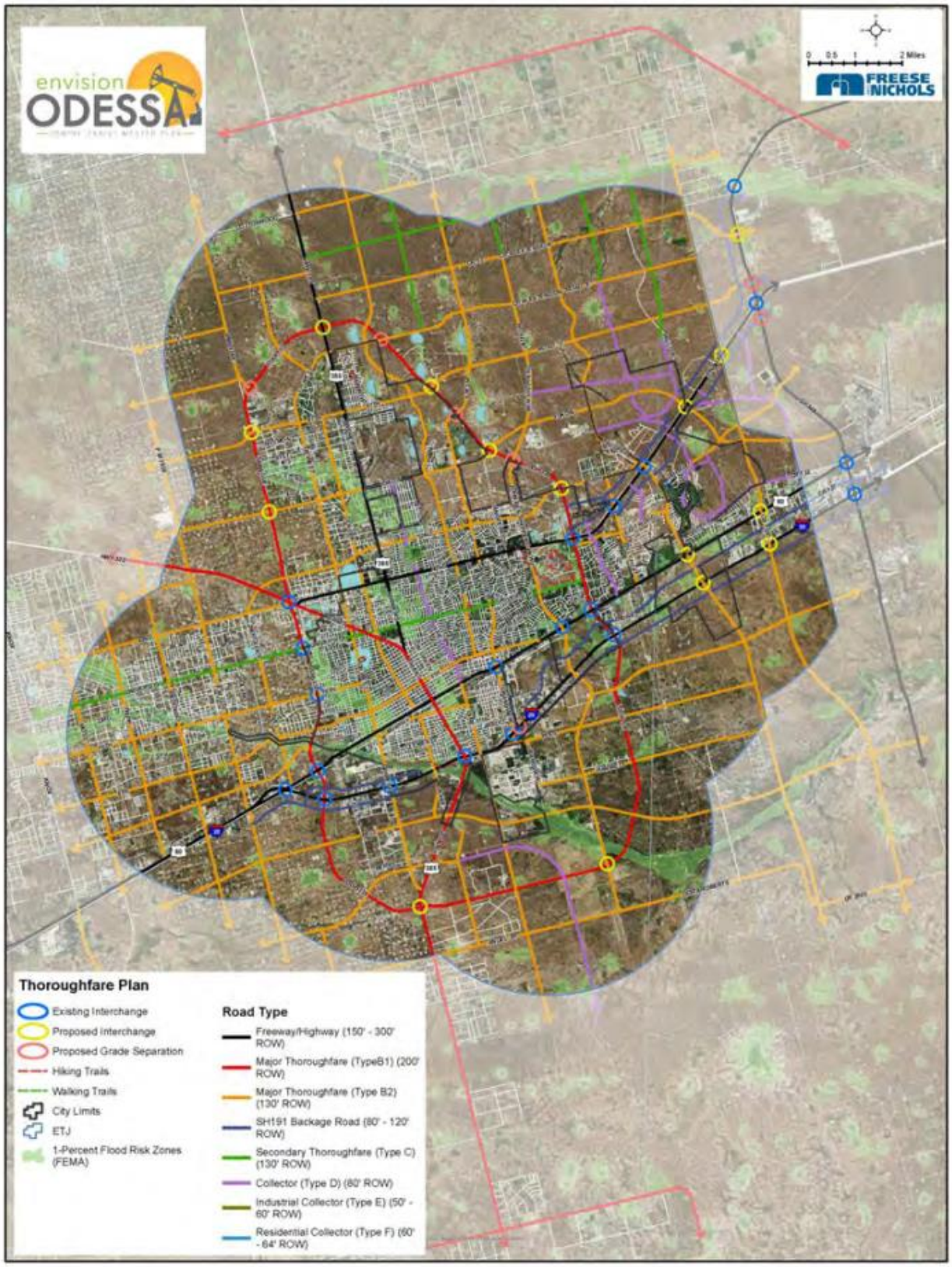
A map of Odessa's designated truck routes is included as **Figure 38**. Through trucks are required to use I-20, Business 20, or the SH 338 loop around the city. Trucks with in-town origins or destinations are permitted to use certain major thoroughfares within the central city. Additionally, I-20 and US 385 are both on the Texas Highway Freight Network (THFN) and I-20 is also a hazmat route. Other non-radioactive hazmat routes in Odessa include portions of SH 338 north of I-20 and Business 20. Similar to Midland, the Union Pacific Toyah subdivision rail line also runs through Odessa parallel to I-20 and connects the region to the Dallas-Fort Worth metropolitan area and on to Memphis.

---

[53] City of Odessa, 2016. *Envision Odessa Comprehensive Master Plan*. P. 63. https://www.odessa-tx.gov/home/showdocument?id=2953

[54] Ibid.

Figure 37: Odessa Thoroughfare Plan



Source: City of Odessa, 2016. *Envision Odessa Comprehensive Master Plan*. https://www.odessa-tx.gov/home/showdocument?id=2953

Figure 38: Odessa Truck Routes

Source: City of Odessa, 2016. *Envision Odessa Comprehensive Master Plan*. https://www.odessa-tx.gov/home/showdocument?id=2953

4.5 Other Population Centers

The other population centers within the region also are impacted by the oil and gas industry, as well as the high volume of freight traffic in the region. Many population centers are projected to grow during the next 30 years, albeit more slowly than the Midland-Odessa metropolitan area, while some are projected to maintain or decrease in population size. This section presents the cities with populations over 5,000, other than Midland and Odessa which were discussed in sections 4.3 and 4.4, in order of decreasing population as shown in Table 13.

4.5.1 City of Hobbs, NM

The City of Hobbs is located in Lea County, due west of Seminole, TX, and approximately three miles west of the Texas/New Mexico border. The city was built at the intersections of US 62 (part of the Permian Basin Highway Freight Network), SH 18, and SH 218. Population in Hobbs held steady, or slightly decreased, between 1970 and 2000. In 2000, the population started to increase again. In 2017, the population of Hobbs was estimated at 32,427, up from 29,161 in 2000, making Hobbs the third most populated city in the Permian Basin study area behind Midland and Odessa.[55] Growth projections for Lea County predict an overall 8-percent increase between 2020 and 2040.

Hobbs' comprehensive plan was prepared in 2004, with projections to 2020; most of the goals and recommendations within the plan pertain to past years. Much of Hobbs' potential for growth is determined by water availability; water is described as Hobbs' most valuable asset due to its arid climate. The plan includes a goal of expanding and diversifying the housing supply and anticipates future development will continue to occur north of the city.[56]

4.5.2 City of Carlsbad, NM

The City of Carlsbad is the county seat of Eddy County at the northern part of the Chihuahuan Desert, and on the edge of the Guadalupe Mountains. The city is located at the intersection of US 62, SH 524, US 285, and SH 216. US 62 and US 285 are both part of the Permian Basin Highway Freight Network. The Carlsbad Caverns National Park, the second most-visited National Park in the state, is a key tourist draw in this area. Between 1980 and 2000, the population of the city remained relatively constant around 25,000. The population has steadily increased since 2000 due in part to the oil production increase in the Permian Basin. According to the U.S. Census Bureau, there were an estimated 28,774 people living in the city in 2017, although the city's comprehensive plan, adopted in 2019, notes the population is considerably higher than Census estimates. The city estimates greater Carlsbad was home to more than 43,000 residents in 2017. The plan includes low (0.5

[55] Ibid

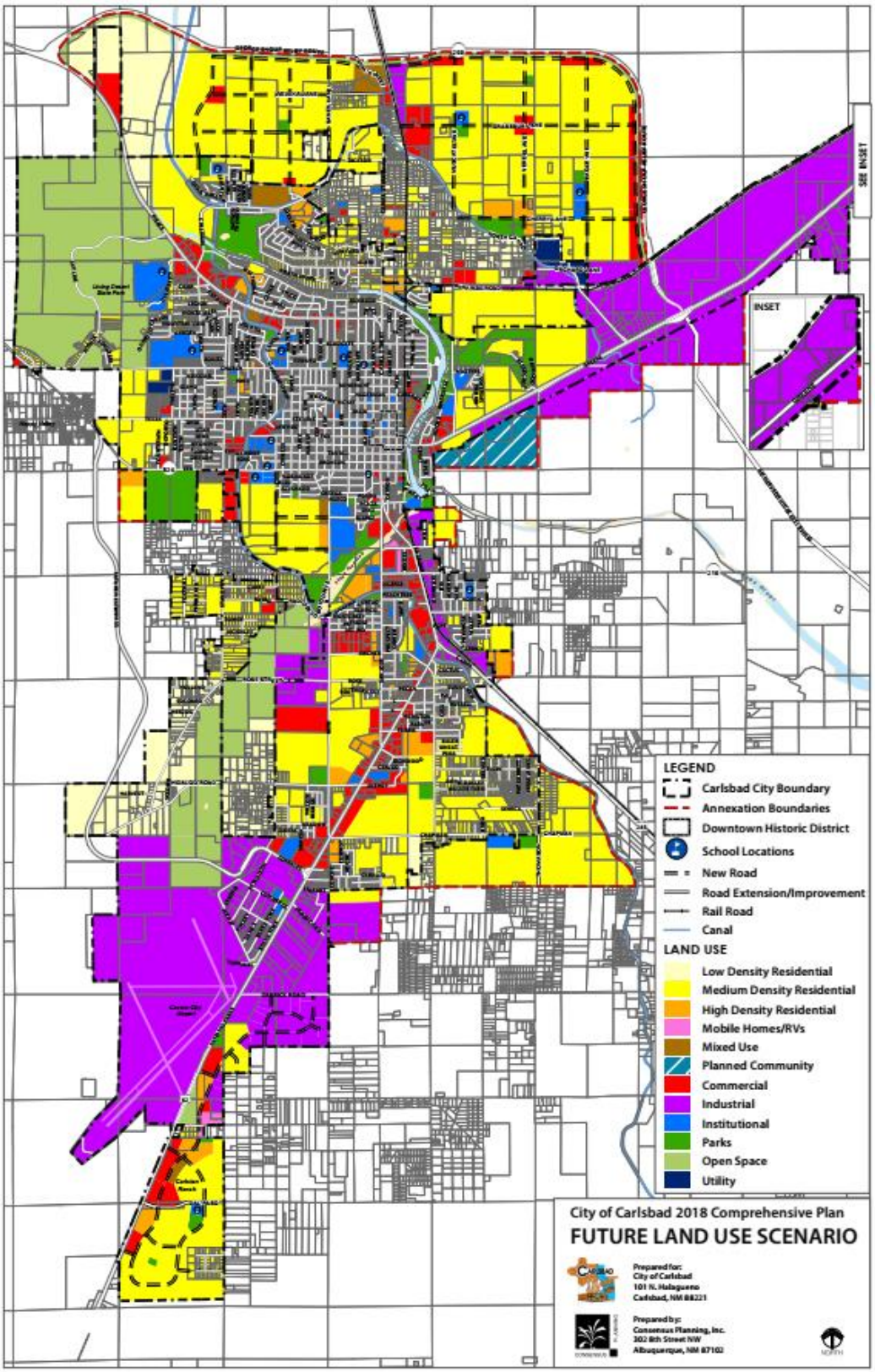
[56] City of Hobbs, 2004. *Hobbs Comprehensive Community Development Plan.* https://www.hobbsnm.org/files/engineering/planning/comprehensive_plan.pdf

percent growth per year), medium (0.75 percent) and high (1 percent) growth scenarios; the medium growth scenario results in a population exceeding 55,000 in 2040.[57]

The City of Carlsbad anticipates annexing approximately 8,652 acres of land around the existing city limits. Most of the areas proposed for annexation are north of the city. The city's Future Land Use Scenario (**Figure 39**) shows future industrial development along East Greene Street and around the Cavern Air Terminal. The scenario also shows commercial uses along highway corridors, and a mix of residential, institutional, and open space throughout the rest of the city.

[57] City of Carlsbad, 2019. *City of Carlsbad Comprehensive Plan.*

Figure 39: Carlsbad 2040 Future Land Use Scenario



Source: City of Carlsbad, 2019. *City of Carlsbad Comprehensive Plan.*

4.5.3 City of Big Spring, TX

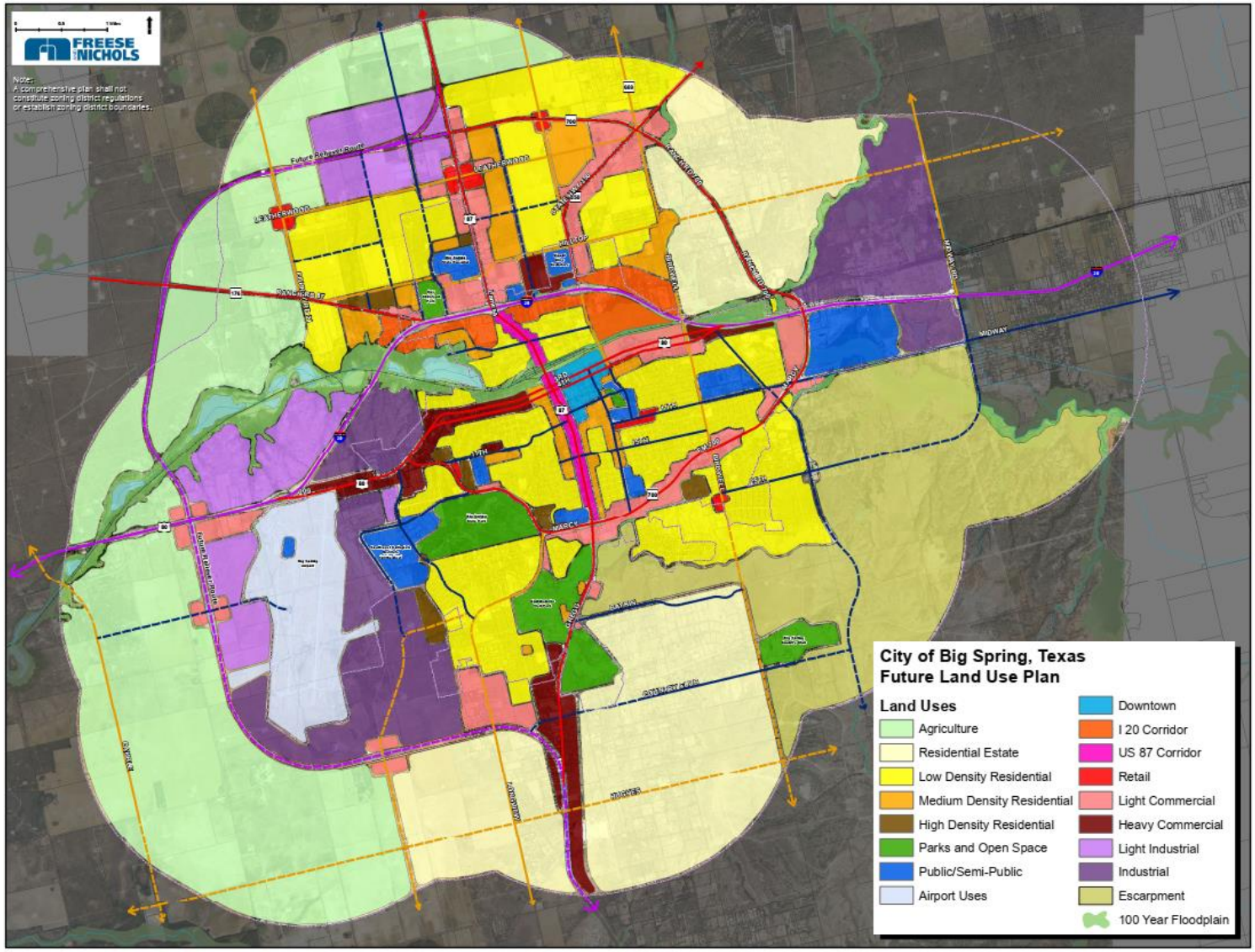
The City of Big Spring is located in Howard County, east of Midland at the intersection of I-20 and US 87. The THFN routes of I-20 and US 87 connect to Big Spring. I-20 and SH 176 are also hazmat routes that connect to the city. The UP rail line that runs parallel to I-20 runs through Big Spring, and UP has a major classification yard in the city. Like many of the communities in the Permian Basin, the city has historically seen periods of rapid growth and slow population decline. Since 1990, the city's population has steadily increased. In 2017, there were approximately 28,257 people living in the city (U.S. Census, 2017), up from 23,093 in 1990. According to the city's 2030 Comprehensive Plan, Big Spring anticipates that its population will continue to grow during the next 20 years at a Compound Annual Growth Rate (CAGR) of 1 percent per year. The city estimates that the population will be approximately 31,000 in 2025 and 34,000 in 2035.[58]

Big Spring's future 2030 land use map is shown in **Figure 40**. The comprehensive plan prioritizes investing in the downtown core, creating a variety of housing types, and developing mixed-use neighborhoods. The plan notes that Big Spring lacks multi-family (apartment) housing types and aims to broaden the mix of housing choices.

The proposed western loop around Big Spring is a four-lane limited access roadway. It is part of the proposed Ports-to-Plains corridor, which is a trade route through Texas that would connect Mexico and Colorado. The western loop would divert heavy truck traffic around Big Spring and is expected to open up areas near McMahon-Wrinkle Airport for new industrial development, particularly manufacturing and warehousing. These types of land uses benefit from access to primary truck routes and trade corridors. The western loop will provide a bypass route for truck traffic. Per **Figure 40**, the city's future land use plan has oriented industrial development along the loop. The purpose of this configuration is to ensure that future retail and commercial activity is located within the core of Big Spring (City of Big Spring, 2016).

[58] The City of Big Spring, 2016. *Big Spring 2030 Comprehensive Plan.* https://www.mybigspring.com/DocumentCenter/View/147/Comprehensive-Plan-Draft-January-20-2016-PDF?bidId=

Figure 40: City of Big Spring 2030 Future Land Use Map



Source: The City of Big Spring, 2016. *Big Spring 2030 Comprehensive Plan.* https://www.mybigspring.com/DocumentCenter/View/147/Comprehensive-Plan-Draft-January-20-2016-PDF?bidId=

4.5.4 City of Andrews, TX

The City of Andrews is the county seat of Andrews County. The city is situated directly north of Odessa along US 385. The THFN routes US 385 and SH 176 connect to Andrews and SH 176 and SH 115 are hazmat routes that connect to the city. Between 1960 and 2000, the total population decreased every decade, but the city started gaining population again in 2000 (City of Andrews, 2013).[59] There were approximately 13,333 people living in the city in 2017 (U.S. Census, 2017)[60]. The population is projected to increase at a CAGR of about 2 percent per year, resulting in a population of about 22,000 in 30 years, an increase of approximately 65 percent.[61]

The City of Andrews Comprehensive Plan, approved in 2013, includes a future land use map (**Figure 41**) that shows residential development extending to the north and commercial development extending to the south and west. US 385 through the city is designated as a "Main Street District," with retail and mixed-use development. Most residential development is proposed as low-density single-family homes, with large-lot "residential estate" development on the outskirts of the city.

The City of Andrews conducted a Truck Reliever Route Study in 2007, with the purpose of developing an outer loop to divert heavy truck traffic associated with the oil and gas industry away from the central city. Designated as Loop 1910 in 2013, the city anticipates that the reliever route will serve as the outer loop of the community for the foreseeable future. The future land use plan (**Figure 41**) has intended for retail to be located at the major intersections along the reliever route.

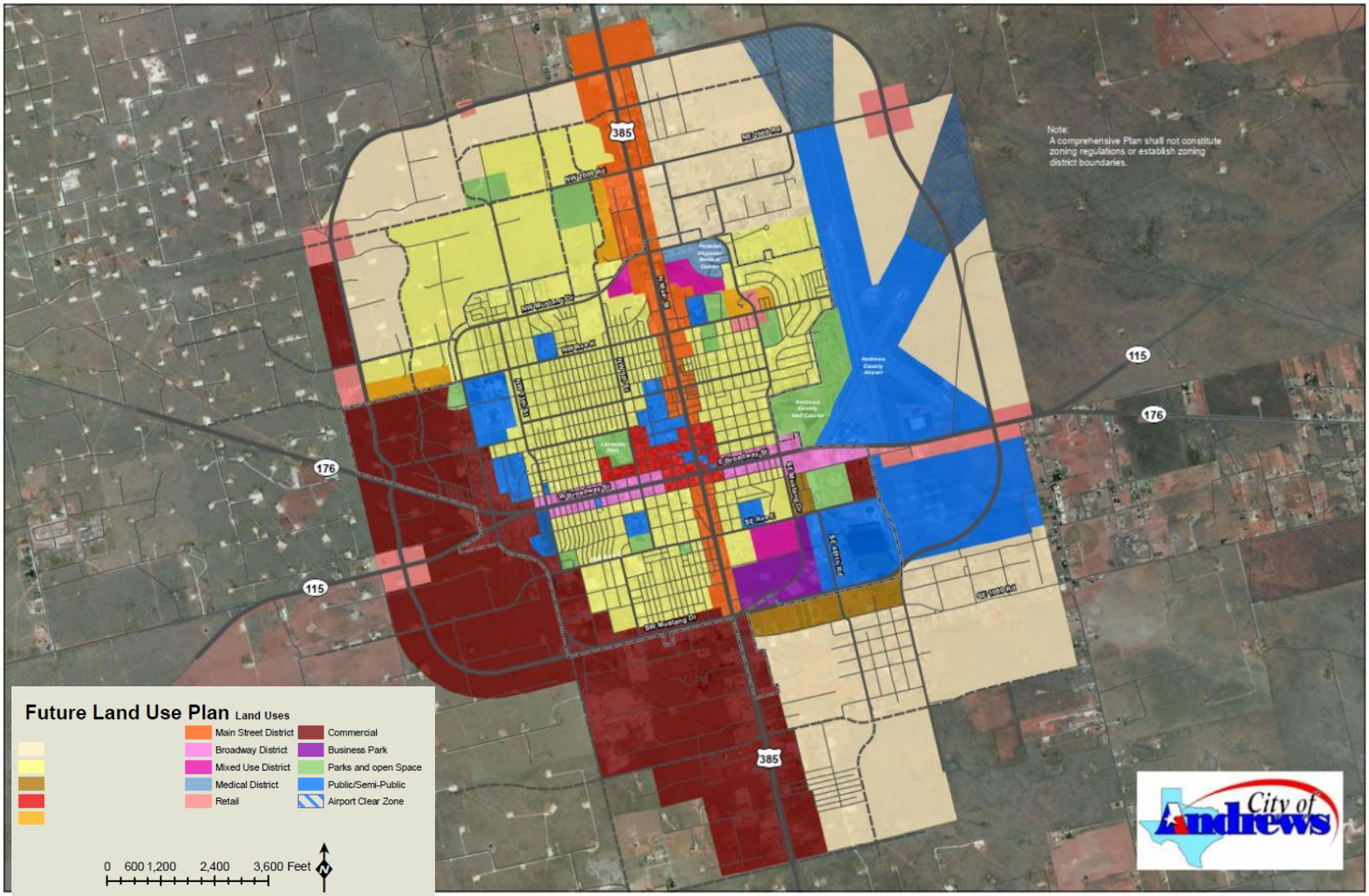
---

[59] City of Andrews, 2013. City of Andrews Comprehensive Plan http://www.cityofandrews.org/Business/Comp_Plan_Andrews_Full_Draft_05_14_13.pdf

[60] U.S. Census Bureau ACS 2017

[61] City of Andrews, 2013. City of Andrews Comprehensive Plan http://www.cityofandrews.org/Business/Comp_Plan_Andrews_Full_Draft_05_14_13.pdf

Figure 41: City of Andrews 2042 Future Land Use Map



Source: City of Andrews, 2013. City of Andrews Comprehensive Plan http://www.cityofandrews.org/Business/Comp_Plan_Andrews_Full_Draft_05_14_13.pdf

4.5.5 City of Artesia, NM

The City of Artesia is located in Eddy County at the intersection of Permian Basin Freight Highway Network Routes US 82 and US 285, approximately 35 miles north of Carlsbad. The city had an estimated population of 11,842 residents in 2017.[62] The current zoning map indicates that commercial land uses are concentrated along the two U.S. highways; heavy industrial land uses are also concentrated along US 285, including the Navajo refinery. Residential and commercial land uses are mixed throughout the remainder of the city.

4.5.6 City of Lovington, NM

The City of Lovington is the county seat of Lea County. The city is located at the intersection of US 82, which is part of the Permian Basin Highway Freight Network, and SH 18, approximately 21 miles northwest of Hobbs. Much like the region as a whole, Lovington's population decreased between 1970 and 2000, but started growing again in the 2000s. The city had a population of approximately 11,558 in 2017, up 23 percent from 9,369 in 2000.[63] The city's comprehensive plan provides low, mid- and high-range growth rates through 2040. The mid-range estimate anticipates that the population will continue to grow at a rate of approximately 1.2 percent each year for a total exceeding 15,000 residents in 2040.[64]

The city's comprehensive plan, approved in 2015, identifies "target development areas" for future growth (**Figure 42**). Residential development is concentrated in the northwest portion of the city, with substantial portions of the target areas located outside the current city boundaries. The Plan also anticipates adding around 600 acres of new industrial land, particularly in the southeast along SH 18. Sections of mixed-use and commercial development are planned for the southern areas of the city, within current city boundaries.

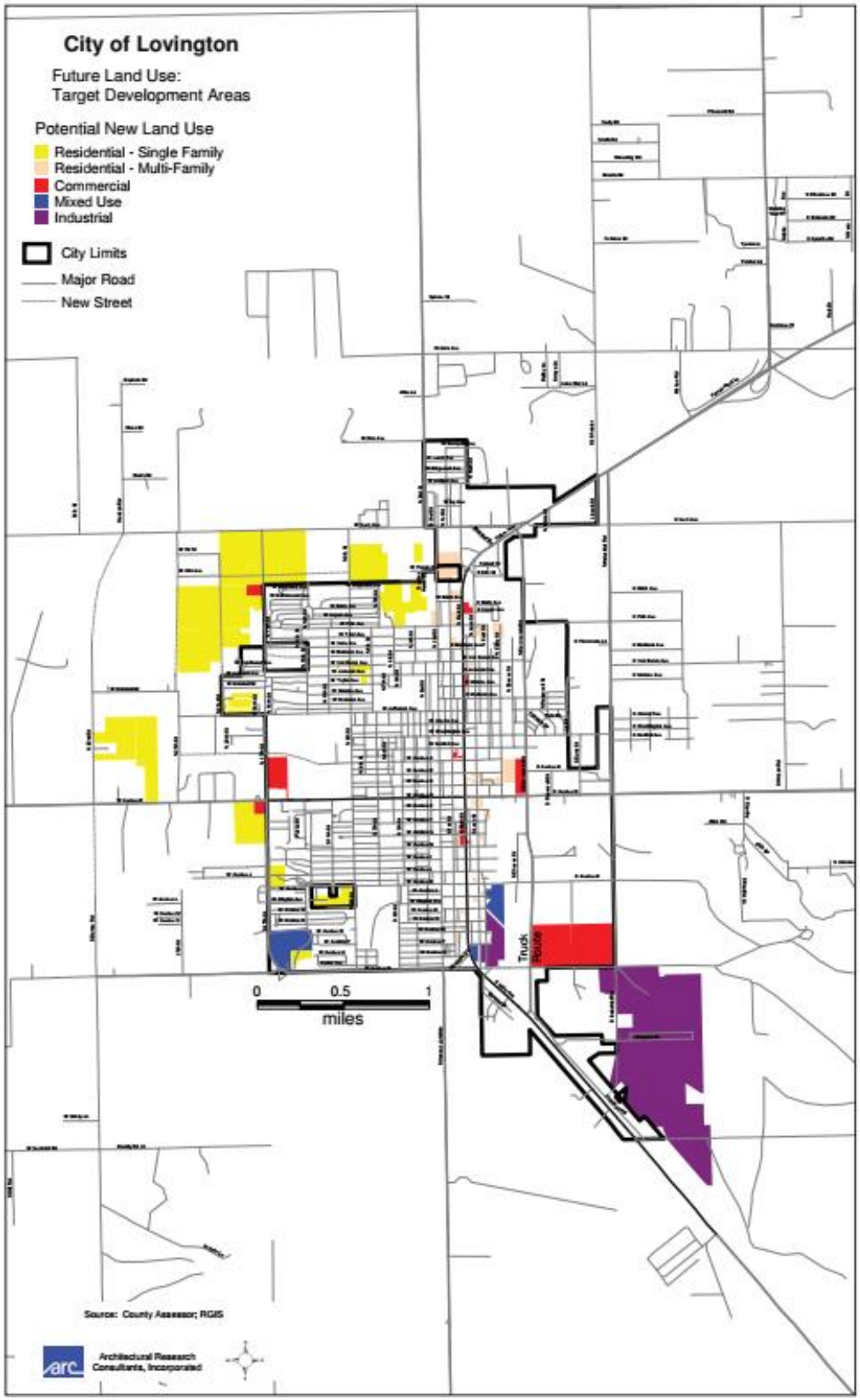
---

[62] U.S. Census Bureau ACS 2017

[63] Ibid

[64] City of Lovington, 2015. *The City of Lovington Comprehensive Plan.* http://www.lovington.org/2015-comprehensive-plan.html

Figure 42: Lovington 2040 Future Land Use/Target Development Area Map



Source: City of Lovington, 2015. *The City of Lovington Comprehensive Plan.* http://www.lovington.org/2015-comprehensive-plan.html

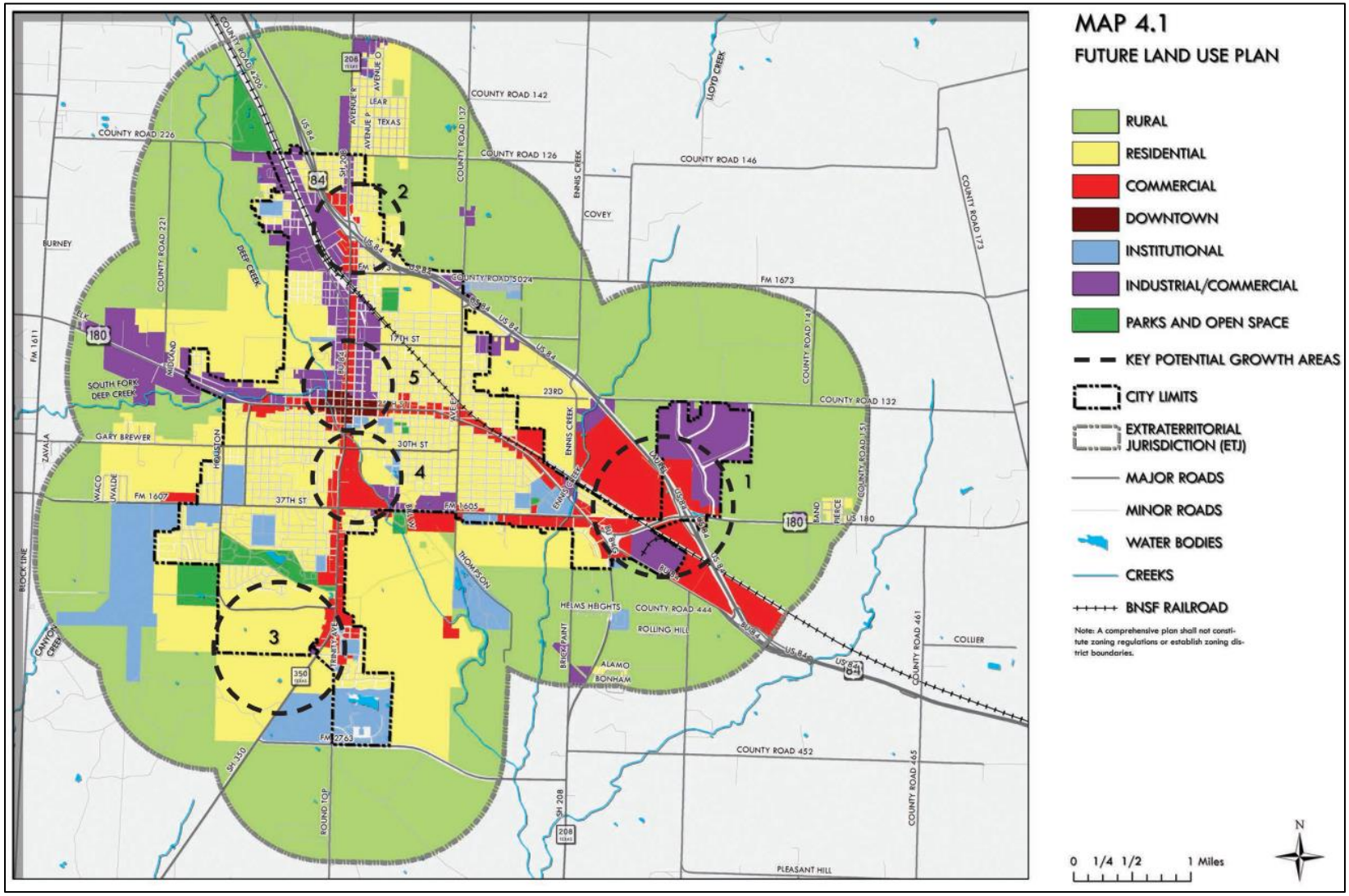
4.5.7 City of Snyder, TX

The City of Snyder is the county seat of Scurry County, located northeast of Big Spring near the edge of the Permian Basin study area. The city sits at the junction of US 180 and US 84, both of which are on the THFN, roughly 20 miles north of I-20.Snyder has experienced varying levels of population growth; between 1950 and 2010, the city's population decreased by 7 percent while the county's population decreased by 26 percent.[65] Recently, the population of the city has increased, likely as a result of the increased oil/gas shale development and the recent growth in wind energy development within the region. In 2017, the city population was 11,543 (U.S. Census, 2017). Population projections within the city's Comprehensive Plan, developed in accordance with the Texas State Demographer, predict a population exceeding 15,000 by 2030, or roughly a 10-percent increase each decade. Some of Snyder's key goals are to attract new growth and investment and make Snyder an attractive place to locate for the region's workforce.

The city has identified five areas for future development and investment: US 180/US 84 Gateway Area 1 will be a commercial and industrial hub; North College Avenue/US 84 Gateway Area 2 is the northern boundary where continued industrial and commercial development is expected; SH 350/Southwest Snyder Gateway 3 is expected to continue to be a growth priority area for residential development; College Avenue/37th Street (Gateway 4) is expected to become a major new commercial, office, residential, and open space center for the city; and Growth Area 5 in central Snyder will continue to develop its influence as a focal point and downtown mixed-use zone. These areas are shown as circles on the future land use plan show in **Figure 43**. The plan also prioritizes incorporating a mix of uses in the central city to create an interesting and dynamic downtown area (City of Snyder, 2017).

[65] City of Snyder, 2017. City of Snyder Comprehensive Plan. https://ci.snyder.tx.us/DocumentCenter/View/1220/City-of-Snyder-Comprehensive-Plan-Adopted-January-9-2017?bidId=

Figure 43: City of Snyder 2040 Future Land Use Map



Source: City of Snyder, 2017. City of Snyder Comprehensive Plan. https://ci.snyder.tx.us/DocumentCenter/View/1220/City-of-Snyder-Comprehensive-Plan-Adopted-January-9-2017?bidId=

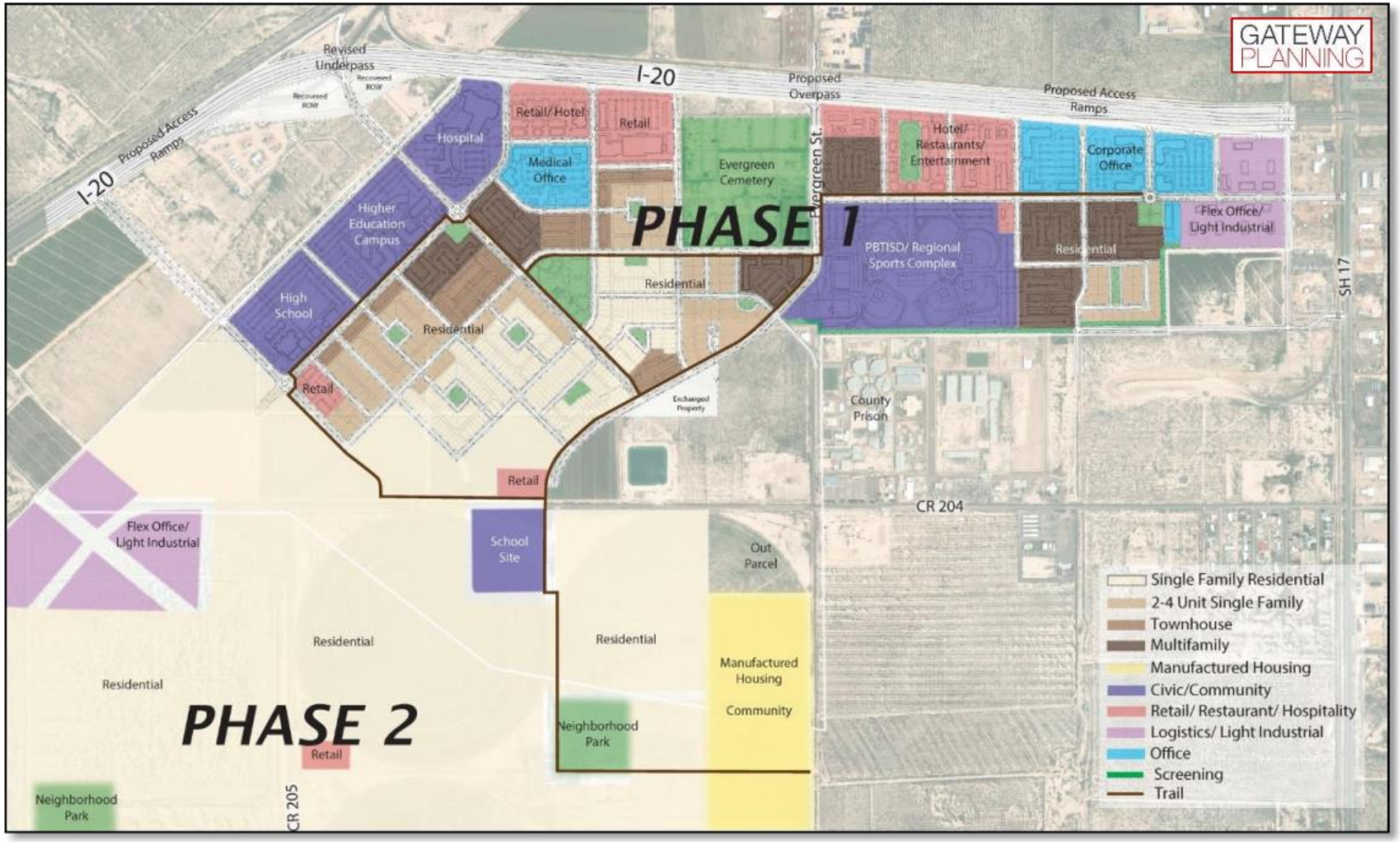
4.5.8 Town of Pecos City, TX

The Town of Pecos City is the county seat of Reeves County. The town is located along I-20 about 74 miles west of Odessa and about 43 miles east of the I-10/I-20 interchange. THFN routes that connect to Pecos include I-20, Business 20 and US 285. The population of Pecos City was about 9,552 in 2017, an increase as comparable to the 2010 and 2000 Census counts of 8,780 and 9,486, respectively.[66] The current zoning map shows that industrial land uses are concentrated west of SH 17 and along the UP railroad in the northern portion of the city. There is a large general retail district around the I-20 and US 285 interchange, along I-20, and along US 285 in the northern portion of the city. There are a mix of single-family, multi-family, and retail zoning districts throughout the rest of Pecos City.

The Town of Pecos City is situated within the energy-rich Delaware Basin, a key hotspot for oil and gas activity, which presents a locational advantage over Midland-Odessa for business and workers focusing on the Delaware Basin. Pecos City is looking to capitalize on that opportunity, developing a Master Plan for growth in West Pecos on more than 3,500 acres of undeveloped property adjacent to I-20. The West Pecos Initiative is proposed to include residential, commercial, tourism, healthcare, and open space uses to attract and retain a diverse workforce (**Figure 44**). According to a recent study developed by the Perryman Group, Pecos City will need 14,000 total housing units by 2023, with nearly 17,000 needed by 2038. These projections differ from the Texas State Demographer's estimates for Reeves County, which predict the county will lose 17 percent of its population by 2050.

[66] U.S. Census Bureau ACS 2017

Figure 44: West Pecos Initiative Framework Plan



Source: West Pecos Initiative, West Pecos Master Plan, 2018

4.5.9 City of Lamesa, TX

The City of Lamesa is in Dawson County, located between Midland and Lubbock at the intersection of US 180 and US 87. THFN routes that connect to Lamesa include US 180, US 87, SH 349 and SH 147. Over the past 20 years, the population of Dawson County has been declining. Between 2010 and 2017, the population had decreased by about 11 percent. There were approximately 9,322 people residing in Lamesa in 2017, and the historic population trends in the county are mirrored in the city. Lamesa has not seen the same growth that other Permian Basin cities have experienced.

The current zoning map shows that heavy industrial uses are primarily concentrated east of US 87. Light industrial and commercial land uses are concentrated along the other highways in the city, and most of the rest of the city is zoned for residential land uses. Population projections are not available for the city, but according to the Texas Demographic Center, Dawson County population is projected to continue to decline with a 2-percent decrease in population by 2050.[67]

4.5.10 City of Fort Stockton, TX

The City of Fort Stockton is located in Pecos County, along Interstate 10 (I-10) at the intersection with US 285, both of which are on the THFN, roughly 50 miles southeast of Pecos City. The population of the city declined between 1980 and 2000, but it increased slowly between 2000 and 2010. The current population of Fort Stockton was about 8,405 people in 2017.[68] The city's Comprehensive Plan, prepared in 2009, projects the local population will continue to increase slowly for a total of 9,854 residents in 2040. Within the Plan, future residential development is anticipated in the area north of I-10, as well as infill development on smaller vacant parcels for moderate-density residential developments.[69]

4.5.11 City of Monahans, TX

The City of Monahans is the county seat of Ward County. The city is situated on the I-20 corridor with Pecos City to the west, Odessa to the east, and Fort Stockton to the south. Most development exists between I-20 and Sealy Avenue/Business 20. There were approximately 7,526 people residing in Monahans in 2017, up slightly from 6,953 in 2010 and 6,821 in 2000.[70] The Monahans Sandhills State Park tourist destination is located about four miles east of the city. The current zoning map shows commercial development concentrated along Sealy Avenue, SH 18, and I-20. The rest of the city is zoned for a mix of commercial and residential land uses. Population projections are not available for

---

[67] Texas Demographic Center, 2019

[68] U.S. Census Bureau ACS 2017

[69] City of Fort Stockton, 2009. *Fort Stockton Comprehensive Master Plan.* https://cityoffortstockton.com/wp-content/uploads/2013/10/CMP6.pdf

[70] U.S. Census Bureau ACS 2017

Monahans, but Ward County (which extends to the west almost as far as Pecos City) is projected to increase to more than 33,000 residents (a 145-percent increase) by 2050.[71]

Monahans is also home to about ten sand mines (see **Figure 15**) which supply sand to much of the energy sector in the Permian Basin. These mines produce heavy truck traffic and need to be considered in future land use decisions so as to minimize negative impacts to incompatible land uses such as residential.

4.5.12 City of Seminole, TX

The City of Seminole is the county seat of Gaines County. The city is located north of Andrews and west of Lamesa at the intersection of US 180, US 385, and US 62, which are all part of the THFN. There were approximately 7,327 people residing in Seminole in 2017, up from 6,430 in 2010 and 5,910 in 2000.[72] The economy in Seminole primarily consists of oil production, agriculture and light steel fabrication. Gaines County is among the top two Counties is Texas for both oil and cotton production.[73]

4.5.13 City of Kermit, TX

The City of Kermit is the county seat of Winkler County, located north of Monahans and about 20 miles north of I-20. In 2017, there were approximately 6,405 people residing in Kermit, up from 5,708 in 2010 and 5,714 in 2000.[74] Kermit is located along SH 302, a heavily used freight traffic route running between Odessa and the Delaware Basin. Many of the sand mines in the region are located near Kermit (see **Figure 15**). These mines produce heavy truck traffic and need to be considered in future land use decisions so as to minimize negative impacts to incompatible land uses such as residential.

5.0 Environmental Justice (EJ) Considerations

In addition to population projections and development plans, EJ considerations play a part in evaluating the interactions between freight and land use in the Permian Basin. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.[75] EJ was introduced into national policy in 1994 by Executive Order 12898. The regulation requires projects to:

- Avoid or mitigate disproportionately high public health, socioeconomic, and environmental effects on low-income and minority populations;

---

[71] Texas Demographic Center, 2019

[72] U.S. Census Bureau ACS 2017

[73] Seminole Economic Development Corporation. http://www.seminoleedc.org/

[74] Ibid

[75] U.S. Environmental Protection Agency. *Environmental Justice*. https://www.epa.gov/environmentaljustice

- Locate and include all potentially impacted communities in the decision-making process; and
- Prevent the denial or lack of receipt of benefits from the process by low-income and minority populations.

This section will review the distribution of low-income, Limited English Proficiency (LEP), and minority populations within the Permian Basin study area within the context of the industrial activity and land uses described above.

Low-income is defined as any census tract with a median household income less than the 2019 U.S. Health and Human Services (HHS) poverty threshold of $25,750 for a family of four.[76] A person who qualifies as a LEP candidate is not fluent in the English language, often because it is not his/her first language.

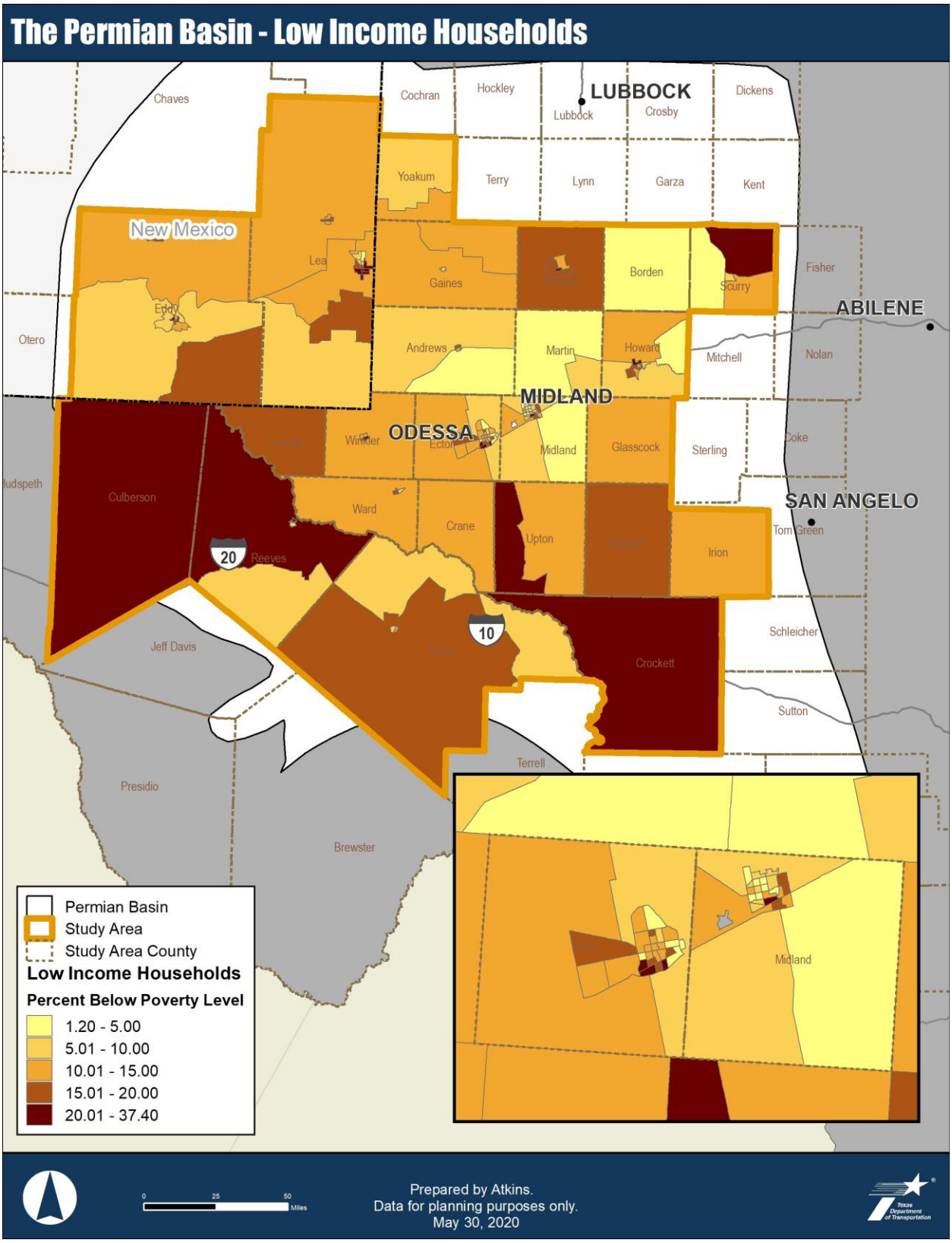
Concentrations of minority populations usually are defined as areas with 50 percent or more minority population. Minority population is a vital aspect of EJ analysis; however, it should be noted that the Latino population within the study area region is high compared to other regions in the United States. The study area as a whole is 41.5 percent minority, inclusive of residents identifying as white with Hispanic descent.

Figure 45 displays the percentage of low-income households by census tract. In many cases, census tracts in sparsely populated areas span entire counties. Culberson, Crockett, and portions of Reeves, Scurry, and Upton counties include higher relative percentages of low-income populations. Within the Midland-Odessa metropolitan area, portions of Odessa and Midland near I-20 and Business 20 exhibit the highest levels of low-income households.

Figure 46 shows concentrations of LEP households. Within most of the study area, approximately 5 percent to 25 percent of households qualify as LEP households. Culberson County and certain areas of Midland near I-20 contain higher numbers of LEP households (greater than 25 percent).

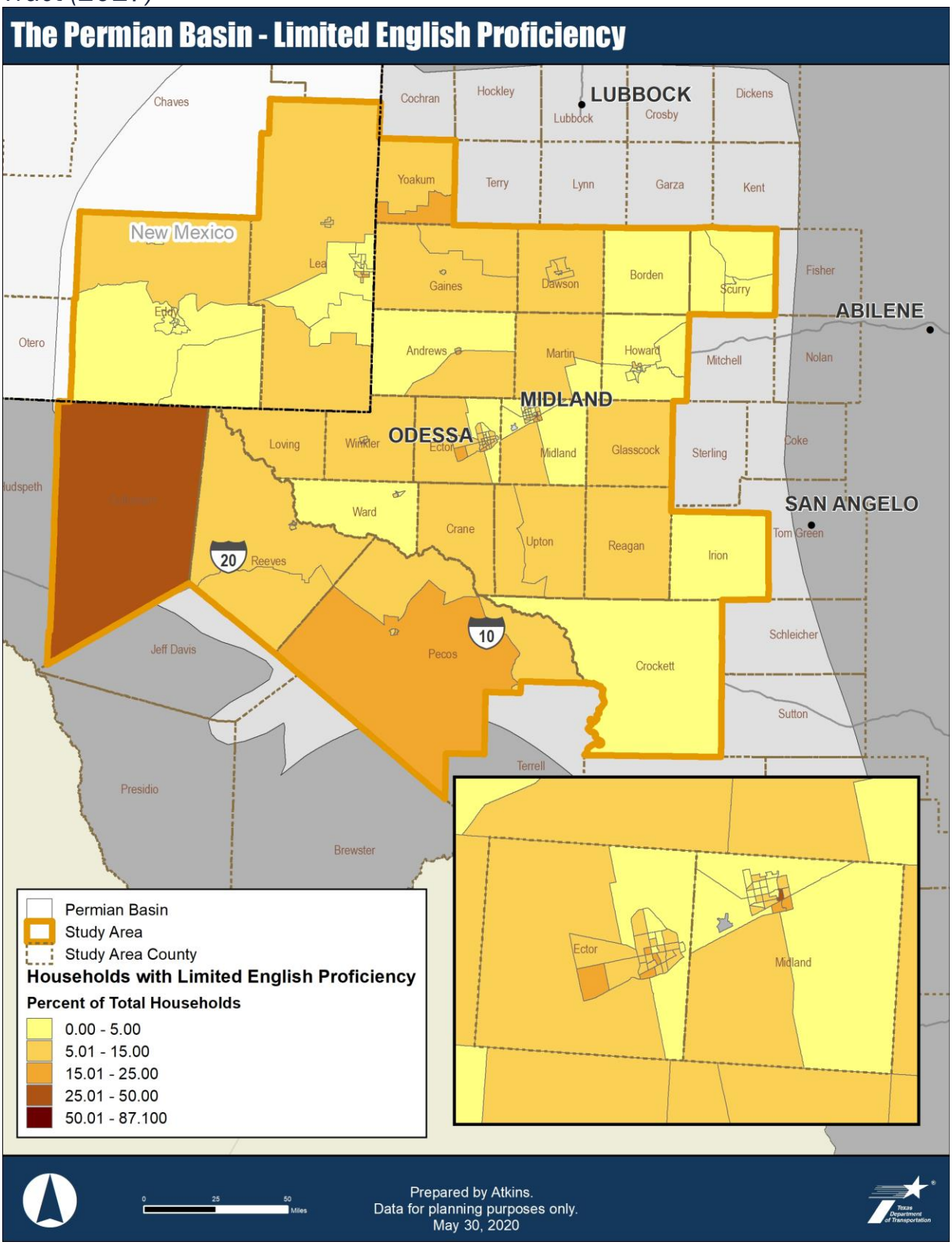
[76]U.S. Department of Health and Human Services. *2019 Poverty Guidelines*. https://aspe.hhs.gov/2019-poverty-guidelines

Figure 45: Percentage of Low-Income Households by Census Tract (2017)



Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates

Figure 46: Percentage of Limited English Proficiency Populations by Census Tract (2017)



Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates

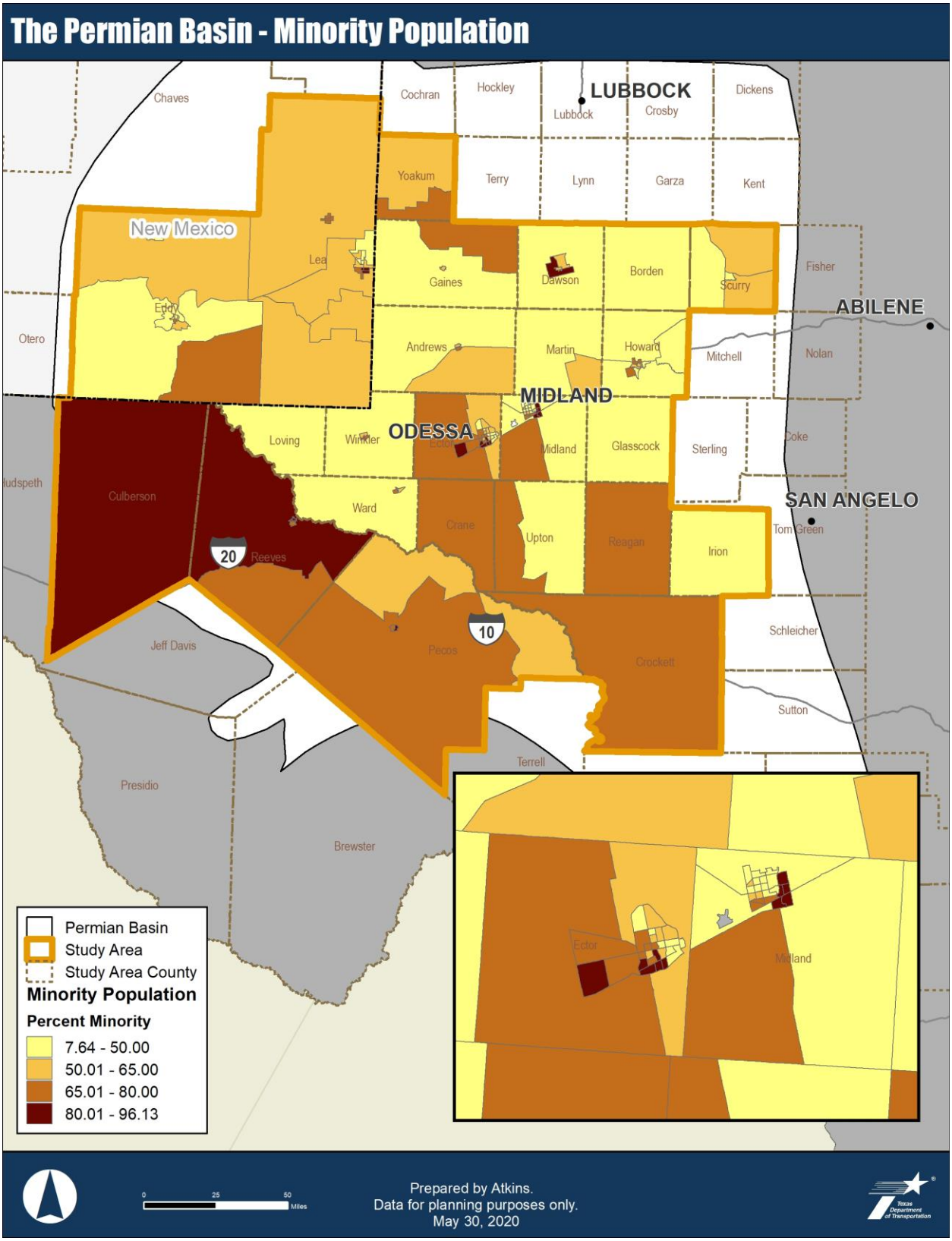
Figure 47 displays the distribution of minority populations across the study area. As mentioned above, the study area as a whole includes greater than 40 percent minority citizens. Only the lowest break on the map (light yellow shade) displays census tracts with less than 50 percent minority populations. These tracts are concentrated in counties ringing the Midland-Odessa metropolitan area. Highest concentrations of minority populations—greater than 80 percent—are found in Culberson County and portions of Reeves County, as well as parts of Midland and Odessa, Lamesa, and Hobbs.

Certain trends stand out among these maps. Culberson and the northern portion of Reeves County show high concentrations of minority and LEP populations. Neither county is densely populated (Culberson had a population of 2,211 in 2017), but Reeves County includes the Town of Pecos City, which has plans to expand in the future. The location of these counties near the prolific Delaware Basin could mean higher levels of freight activity on regional and local roadways.

The low income, LEP, and minority population distribution maps exhibit concentrations within portions of Midland and Odessa, particularly the south and east portion of Midland and the south part of Odessa, near I-20. These areas overlap with future land use plans that designate areas near I-20 for industrial development. Higher levels of freight traffic coincide with industrial development, suggesting potential EJ concerns in these areas of the Midland-Odessa metropolitan area.

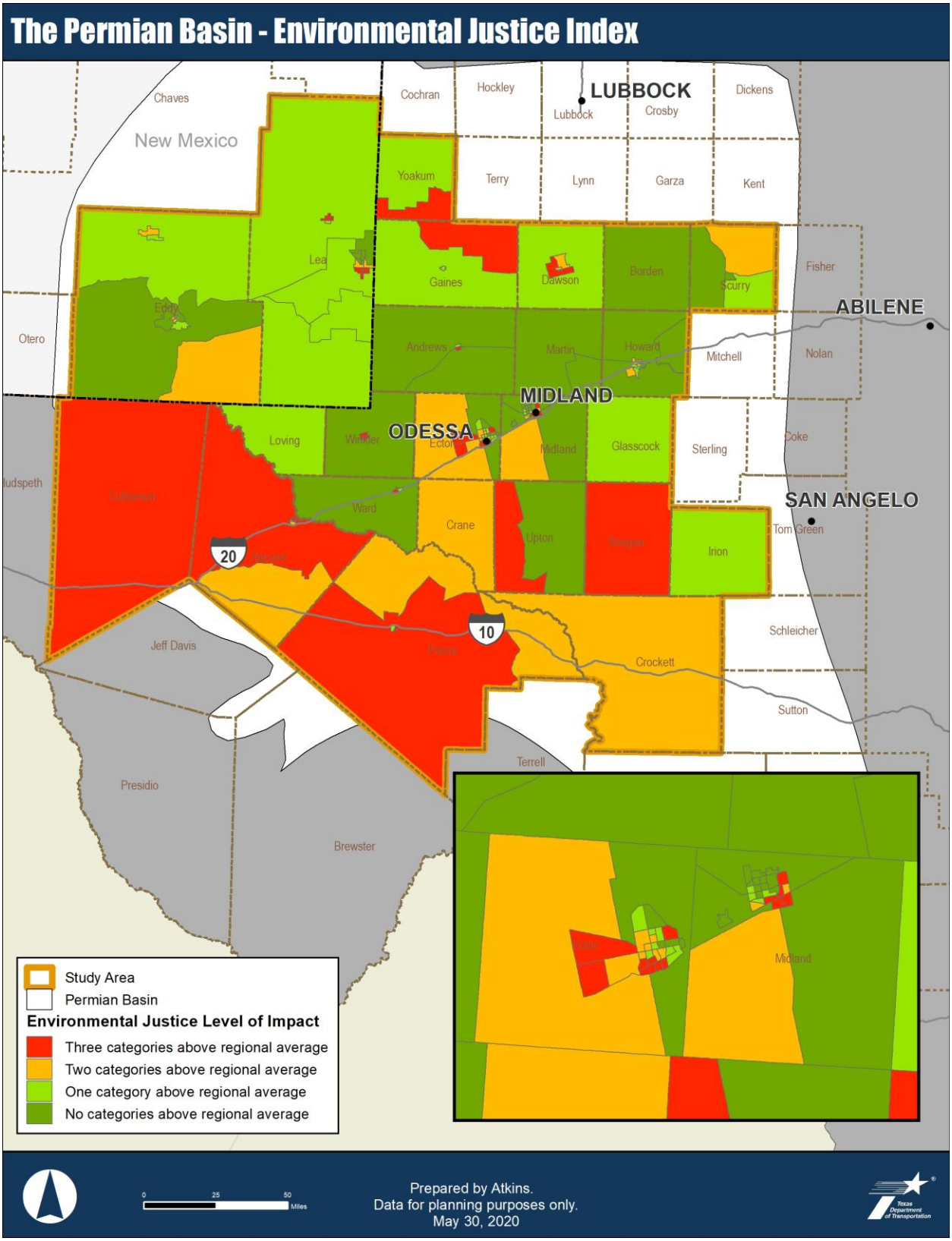
Figure 48 is a composite index map showing census tracts that contain levels of each of the three EJ indicators (low income, LEP, minority) at numbers greater than the regional average. Tracts shown in dark green contain no categories above the regional average; these areas have the lowest potential for disproportionate EJ impacts. Tracts shown in red are above the regional average for all three categories and should be considered the most sensitive from an EJ standpoint. Substantial portions of rural areas rank highly on this index, including Culberson, Reeves, Pecos, and Reagan counties; however, highly developed areas of the Midland-Odessa metropolitan area also contain high levels of low-income, LEP, and minority communities, including areas adjacent to I-20 and portions of West Odessa.

Figure 47: Percentage of Minority Populations by Census Tract (2017)



Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates

Figure 48: Environmental Justice Index Map, 2017



Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates

6.0 Local Ordinances Impacting Freight

Local city codes and ordinances across the study area were reviewed to determine their potential impacts on freight transportation. In most cases, city ordinances did not differ from each other substantially, each dealing with the same types of restrictions and nuisance prohibitions. Certain ordinances pertaining to freight that appeared across the study area include:

- **Prohibition on Commercial Motor Vehicle (CMV) parking within public Right Of Way (ROW)**. There were certain variations on this theme; for example, most ordinances provided caveats for loading/unloading, and some limited restrictions only to residential areas.
- **Truck Routes**. This ordinance appeared most frequently in the study area, where CMVs were required to operate only along routes designated for trucks, except in the limited cases of local pickups or deliveries.
- **Hazmat Routes**. Certain cities designated a subset of truck routes for hazmat transportation.
- **Engine brakes prohibited**. Several cities included ordinances prohibiting the use of engine or "jake" brakes using compressed air, which emit loud noises.

These ordinances are meant to improve safety and quality of life and protect against some of the negative externalities associated with freight.

Table 17 illustrates frequently occurring ordinances for population centers reviewed in Section 4.5.

Table 17: Frequently Occurring Ordinances by Population Center

City/Town	Restrictions/ prohibition on CMV parking on public ROW	Trucks must drive on designated Truck Routes	Trucks with hazardous cargo must drive on designated hazmat routes	Engine/jake brake prohibited
Andrews, TX	X	X		X
Artesia, NM				
Big Spring, TX				X
Carlsbad, NM				X
Fort Stockton, TX	X	X		
Hobbs, NM				
Kermit, TX		X	X	
Lamesa, TX				

City/Town	Restrictions/ prohibition on CMV parking on public ROW	Trucks must drive on designated Truck Routes	Trucks with hazardous cargo must drive on designated hazmat routes	Engine/jake brake prohibited
Lovington, NM	X			
Midland, TX	X	X	X	X
Monahans, TX	X	X		
Odessa, TX	X	X	X	
Pecos City, TX	X	X		
Seminole, TX				
Snyder, TX		X		X

Some city codes include more specific, unique ordinances pertaining to freight, which did not appear commonly across the region. These include:

- **City of Midland** codes include weight restrictions on certain street segments identified in the ordinance. CMVs with a standard load capacity exceeding one ton (loaded or unloaded) are prohibited from driving on identified street segments.
- **City of Lamesa** requires all tank trucks and trailers used for the transportation of liquefied petroleum gases within the city to be constructed and operated as to comply with the regulations approved by the National Board of Underwriters and the National Fire Protection Association.
- **Pecos City** specifies that all oil/gas drilling and production operations shall be conducted in such a manner as to eliminate/minimize dust, noise, vibration, or noxious odors, and shall be in accordance with the best accepted practices.
- **City of Kermit** prohibits noise of such character, intensity, and duration that it substantially interferes with the enjoyment of private homes.
- **City of Hobbs** specifies that all motor vehicles or motorcycles must not be operated on public rights of way at any time when noise from the engine and/or exhaust system is plainly audible at a distance of 50 feet, with the exception of construction or agricultural equipment on the job site or on highways.

All cities studied in the region have noise ordinances. In most cases, noise regulations are general in nature and do not pertain to CMVs in particular, nor do they apply to particular times of day. Frequently occurring noise ordinances that may have a bearing on freight transportation include prohibitions on:

- Frequent sounding of vehicle horns or other signal devices;

- Operation of out-of-repair or otherwise excessively noisy vehicles;
- Exhaust without mufflers;
- Excessive noise associated with loading or unloading vehicles; and
- Excessive noise near schools, hospitals, churches, courts in session, or other sensitive uses.

7.0 Distribution of Freight-Intensive Land Uses

The factors discussed throughout this document (population growth, employment in key industries, distribution of energy sector land uses, etc.) are all components that drive freight demand. The project team developed a methodology to review the levels and distribution of freight-generating land uses, by selecting key criteria and quantifying their intensity across the study area. The Permian Basin Freight and Energy Sector Transportation Plan Steering Committee, a group of local stakeholders advising TxDOT on the regional freight plan, were invited to review the methodology and provide input.

Key criteria were selected based on their relation to freight activity and whether data were readily available. The selected criteria include:

- **Projected population in 2050 (2040 for New Mexico).** This factor recognizes the importance of population centers in generating freight activity. Existing populated areas and their immediate surroundings were identified, and projected growth at a county level was applied to these zones (recognizing that growth is most likely to occur within and adjacent to existing population centers). New Mexico projections are included as far as 2040. (Sources: Texas Demographic Center, 2019, and University of New Mexico Geospatial and Population Studies, 2019)
- **Employment in key industries.** This factor uses employment levels in the key industries discussed above (agriculture/forestry; construction; manufacturing; mining/quarrying/ oil/gas extraction; retail; and transportation/warehousing) to account for levels of high freight-generating industries. (Source: U.S. Census Bureau, OntheMap, 2017)
- **Active oil/gas wells.** Oil/gas wells generate considerable freight traffic, from initial site preparation to eventual extraction and disassembly. When asked which criteria were most important, steering committee members felt this factor warranted additional emphasis. (Source: Enverus/Drillinginfo.com, February 2020)
- **Permits for oil/gas wells.** This factor was included to account for future as well as existing oil/gas wells. The number of approved permits for wells that have not been drilled provides an assumption of where future activity is most likely to occur. (Source: Enverus/Drillinginfo.com, February 2020)

- **Sand mines.** Sand mines in the study area generate large amounts of freight traffic as trucks bring sand for fracking to numerous well sites. (Sources: TxDOT Odessa District and Atlas Sand data)

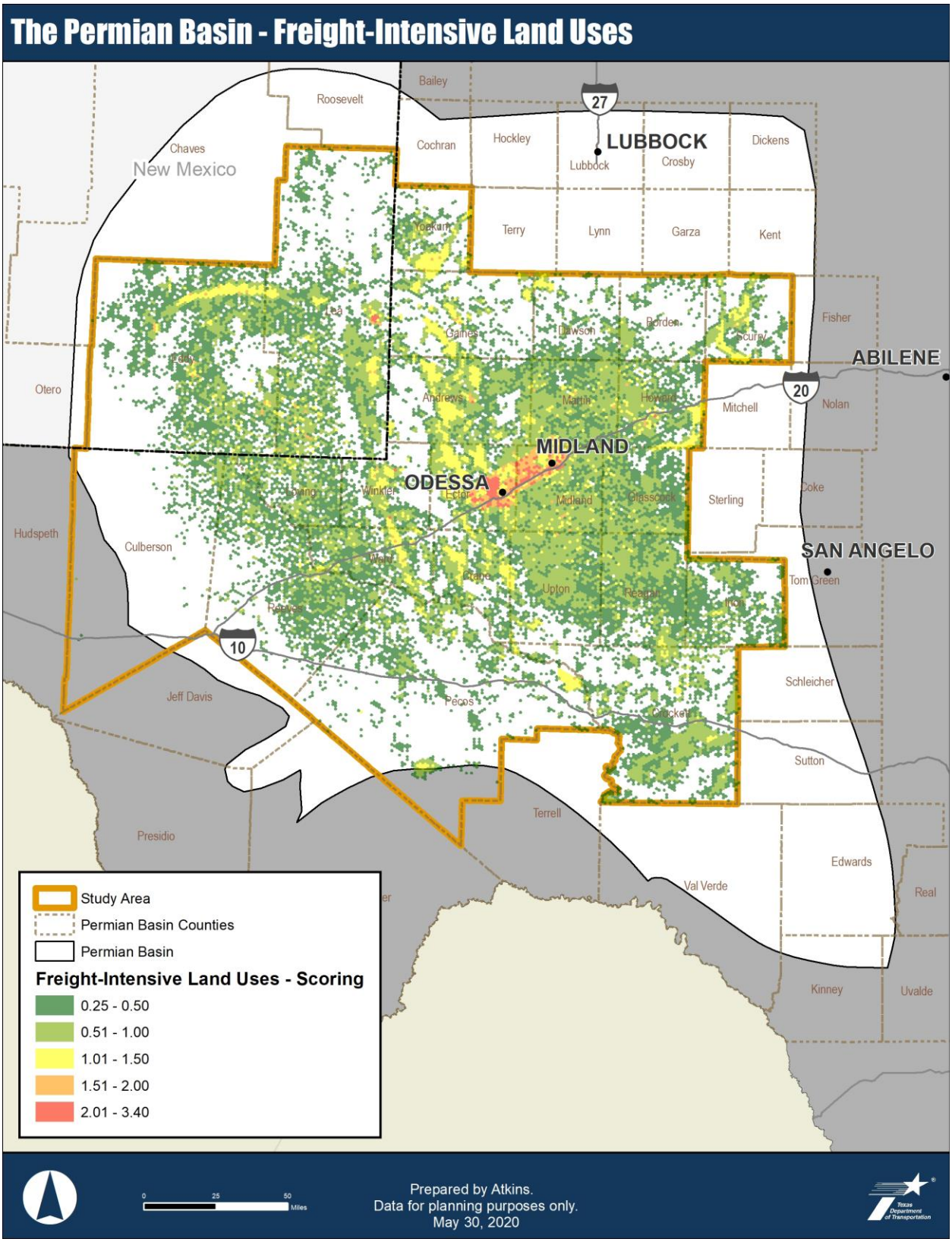
The team divided the study area into an array of 44,022 hexagons with an area of one square mile. Each hexagon then was "scored" based on the presence of the five criteria above within the one-mile area. The scoring process is described **Table 18**. Each hexagon could receive a maximum of one point for each criterion. Based on stakeholder input, the active oil/gas wells received an additional 20-percent weighting (i.e., 1.2 would be the highest possible score for this measure). The highest score any one hexagon could receive would be 5.2 points.

Table 18: Freight/Land Use Intensity Scoring Criteria

	Hexagon Score				
	1	0.75	0.5	0.25	0
Projected Population (total citizens within populated areas and immediate surroundings)	51,000+	25,000–50,099	10,000–24,999	5,000–9,999	< 5,000
Key industry employment (employees per hexagon)	500+	100–499	50–99	10–49	< 10
Active oil/gas wells (per hexagon) (weight + 20%)	26+	11–25	6–10	1–5	0
Approved permits (per hexagon)	15+	10–14	5–9	1–4	0
Sand mines (per hexagon)	1+				0

Figure 49 shows the levels and distribution of freight-intensive land uses across the study area based on the above scoring criteria, with orange and red as the most-intense areas and green as less intense. The Midland-Odessa Metropolitan Area shows the highest intensity, due to a confluence of population, employment, and industrial activity. Other areas of moderate to high intensity occur in bands running north/south, particularly between Odessa and the Andrews area, as well as through Ward and Winkler counties up into Lea County, NM. A similar band of activity occurs east/west across northern Eddy County. The majority of Martin, Howard, Midland, Glasscock, Upton, and Reagan counties show moderate levels of freight intensity. Some levels of activity are present in the Delaware Basin area; the results reflect the presence of wells and permits in the area, but few population or employment centers.

Figure 49: Permian Basin Freight-Intensive Land Uses



In **Figure 50**, the Permian Basin Regional Freight Network was overlaid on the intensity map. In many cases, bands of activity are associated with existing transportation linkages; for example, the band that runs north/south through Monahans, Kermit, and up to Hobbs, NM, roughly follows SH 18, although the portion of SH 18 north of Jal, NM, is not classified as part of the Permian Basin Regional Freight Network. The activity band in northeast Eddy County follows US 82. The area of activity spanning between Odessa and Andrews County is loosely organized around US 385 and Farm to Market Road (FM) 181; however, connectivity is lacking on the western side of this activity cluster between US 62 and I-20.

Figure 50: Permian Basin Freight-Intensive Land Uses and Regional Freight Network

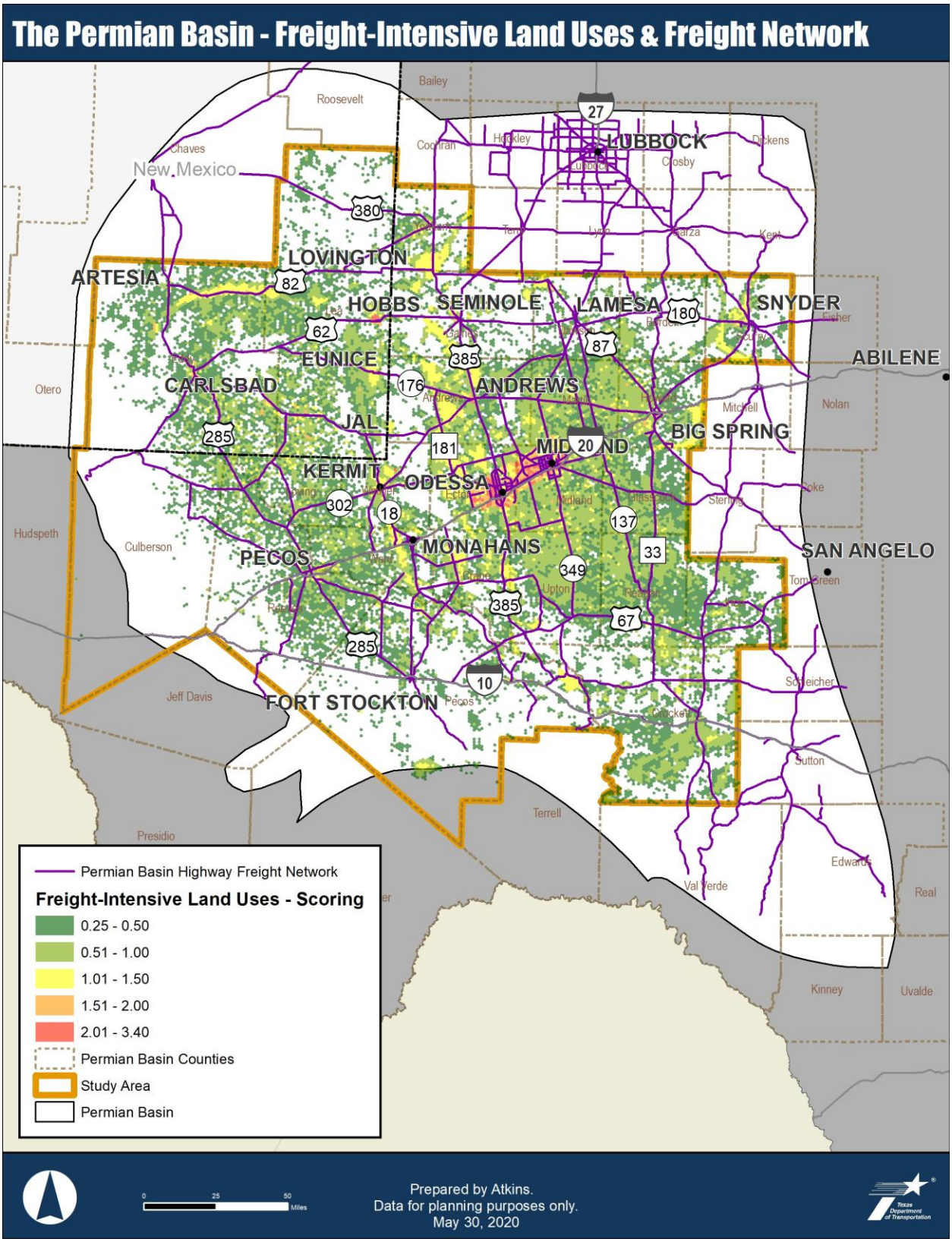
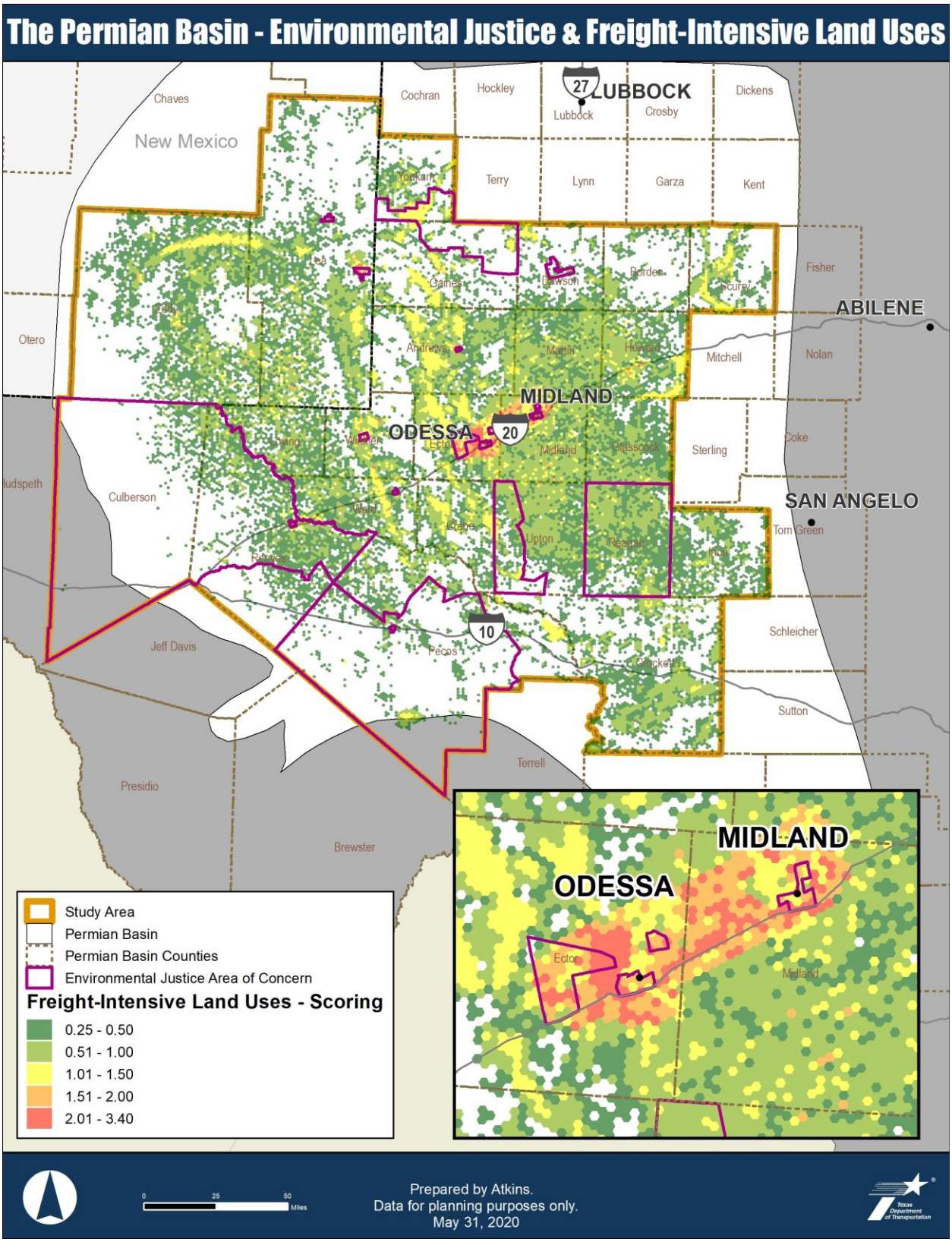


Figure 51 overlays the locations that are above the regional average for the three EJ indicators (low income, LEP, minority) on the intensity map. This provides insight into how these environmental justice communities are impacted by freight-intensive land uses and can help guide future freight-intensive developments to avoid disproportionately impacting areas of high environmental justice populations. **Figure 51** shows that, within the cities of Midland and Odessa, high freight-intensity land uses coincide with concentrated areas of environmental justice populations. Additionally, there are small pockets in Lea County, NM, as well as Andrews and Winkler Counties in Texas, where freight-intensive land uses and EJ populations overlap. The southern part of Yoakum County also contains moderately heavy freight land uses and EJ populations. It is important to try to improve the quality of life and mitigate the impacts—such as increased traffic noise, traffic congestion, and potential night-time disturbances—that these land uses may have on these vulnerable populations.

Figure 51: Permian Basin Freight-Intensive Land Uses and Environmental Justice Areas



8.0 Summary and Conclusions

Land use and freight in the Permian Basin are inextricably linked. As the largest oil and gas producing region in the United States, there are wells and associated infrastructure located throughout the Permian Basin. The Permian Basin economy is energy based, so freight related to the energy industry must be accounted for in all land use planning — accommodation of freight is integral to the well-being of the Permian Basin. Land use and energy development need to be conducted in a coordinated way. The rapid growth in population and employment due to increased energy production creates challenges for providing adequate, affordable, and available housing and community services.

Land use in the Permian Basin involves balancing residential, commercial, and industrial development with oil and gas exploration in the region. Oil and gas production require many truck trips to establish and maintain wells, pipelines, distribution lines, and related infrastructure. The location and intensity of wells, pressure stations, pumps, pipelines, sand mines, water disposal sites, and hazmat sites impact where and what types of land use development are feasible. Land use and energy development need to be conducted in a coordinated way. There should be mechanisms across the region to ensure this coordination takes place, incorporating energy-related companies and governmental entities that regulate and plan for land use and energy exploration.

While integral to the region's economy, the energy industry infrastructure and related trucks bring road congestion and increased deterioration of pavements, noise, pollutants, and sometimes the shipment of hazmat freight. Fracking uses water from local supplies, especially ground water, that cannot at present be restored to potable use and produced water needs to be stored and managed separately. Lack of housing needed for the labor force at oil and gas wells or support services has resulted in "staff camps"— temporary villages with limited services that generally are located away from existing population centers and commercial, institutional, medical, and emergency services.

The benefits and negative impacts of the energy industry in the Permian Basin are not distributed evenly to all areas. The freight activity hotspot map shows relatively high current or expected freight intensity near population centers, especially Midland and Odessa, but also in sparsely populated or remote areas near the location of active wells, sand mines, and areas where permits have been issued for oil and gas well development. These areas of high freight intensity and the roads connecting them are where investments for improving freight movement should focus, both to expedite freight movement and to ameliorate the negative consequences associated with them. The EJ index map shows census tracts of vulnerable populations—low income, minority, and LEP households. These areas and the populations within them should be considered to ensure that energy development and related public infrastructure benefit them and do not place additional burden on their communities.

As the Permian Basin continues to grow it is critical to balance the freight needs of the energy industry with the continued land use development of population centers that support the energy industry.