Texas: Dallas/Fort Worth and Houston-Galveston-Brazoria

Intended Area Designations for the 2015 Ozone National Ambient Air Quality Standards (NAAQS) Technical Support Document (TSD)

1.0 Summary

This technical support document (TSD) describes the EPA's intent to designate the Dallas/Fort Worth (DFW) and Houston-Galveston-Brazoria (HGB) areas in Texas as nonattainment for the 2015 ozone National Ambient Air Quality Standards (NAAQS). The intended attainment/unclassifiable designation for El Paso and Hudspeth Counties are addressed in the multi-state El Paso-Las Cruces TX-NM TSD that is included in the docket for this action.

On October 1, 2015, the EPA promulgated revised primary and secondary ozone NAAQS (80 FR 65292; October 26, 2015). The EPA strengthened both standards to a level of 0.070 parts per million (ppm). In accordance with Section 107(d) of the Clean Air Act (CAA), whenever the EPA establishes a new or revised NAAQS, the EPA must promulgate designations for all areas of the country for that NAAQS. The EPA must complete this process within 2 years of promulgating the NAAQS, unless the Administrator has insufficient information to make the initial designations decisions in that time frame. In such circumstances, the EPA may take up to 1 additional year to complete the designations.

Under CAA section 107(d), states were required to submit area designation recommendations to the EPA for the 2015 ozone NAAQS no later than 1 year following promulgation of the standards, i.e., by October 1, 2016. Tribes were also invited to submit area designation recommendations. On September 30, 2016, Texas ("the State") submitted to EPA its recommendations for nonattainment counties. On August 23, 2017, the State submitted updated recommendations.[1] The State's recommended counties for each nonattainment area are for the 2015 ozone NAAQS based on air quality data from 2013-2015 and 2014-2016 are identified in column 2 of Table 1 (below).

After considering the State's recommendations and based on the EPA's technical analysis as described in this TSD, the EPA does not intend to modify the State's recommendation for the Dallas/Fort Worth, TX and Houston-Galveston-Brazoria, TX areas. The EPA intends to designate the areas listed in Table 1 (below), as nonattainment for the 2015 ozone NAAQS. Under the CAA, the EPA must designate an area nonattainment if it has an air quality monitor that is violating the standard or if the area has sources of emissions that are contributing to a violation of the NAAQS in a nearby area. Detailed descriptions of the intended nonattainment boundaries for these areas are found in the supporting technical analysis for each area in Section 3 of this TSD. The EPA intends to designate as attainment/unclassifiable all other counties in the State where the agency has received complete information and that were not previously designated as attainment/unclassifiable in the November 6, 2017 action discussed below. As noted above, El Paso and Hudspeth Counties are more thoroughly address in the El Paso-Las Cruces TX-NM TSD.

Table 1. Texas's Recommended Nonattainment Areas and the EPA's Intended Designated Nonattainment Areas for the 2015 Ozone NAAQS

[1] All the state and tribal recommendations submitted to EPA are available at https://www.epa.gov/ozone-designations/2015-ozone-standards-state-recommendations.

Area	Texas's Recommended Nonattainment Counties[2]	EPA's Intended Nonattainment Counties
Dallas/Fort Worth, TX	Collin County Dallas County Denton County Ellis County Johnson County Kaufman County Parker County Rockwall County Tarrant County Wise County	Collin County Dallas County Denton County Ellis County Johnson County Kaufman County Parker County Rockwall County Tarrant County Wise County
Houston-Galveston-Brazoria, TX	Brazoria County Chambers County Fort Bend County Galveston County Harris County Liberty County Montgomery County Waller County	Brazoria County Chambers County Fort Bend County Galveston County Harris County Liberty County Montgomery County Waller County

On November 6, 2017 (82 FR 54232; November 16, 2017), the EPA signed a final rule designating most of the areas the State did not recommend for designation as nonattainment as attainment/unclassifiable.[3] EPA explains in section 2.0 the approach it is now taking to designate the remaining areas in the State.

The EPA will designate all tribes in accordance with two guidance documents issued in December 2011 by the EPA Office of Air Quality Planning and Standards titled, "Guidance to Regions for Working with Tribes during the National Ambient Air Quality Standards (NAAQS)) Designations Process,"[4] and "Policy for Establishing Separate Air Quality Designations for Areas of Indian Country."[5] There are no tribal lands in the areas recommended as nonattainment by the State.

2.0 Nonattainment Area Analyses and Intended Boundary Determination

The EPA evaluated and determined the intended boundaries for each nonattainment area on a case-by-case basis, considering the specific facts and circumstances of the area. In accordance with the CAA section 107(d), the EPA intends to designate as nonattainment the areas with the monitors that are violating the 2015 ozone NAAQS and nearby areas with emissions sources (i.e., stationary, mobile, and/or area sources) that contribute to the violations. As described in the EPA's designations guidance for the 2015 NAAQS (hereafter referred to as

[2] Hood County was recommended as nonattainment in the State's September 30, 2016 submittal, but was recommended as attainment in the State's updated submittal dated August 23, 2017. See a more detailed discussion in Section 3.1, below.
[3] In previous ozone designations and in the designation guidance for the 2015 ozone NAAQS, the EPA used the designation category label Unclassifiable/Attainment to identify both areas that were monitoring attainment and areas that did not have monitors but for which the EPA had reason to believe were likely attainment and were not contributing to a violation in a nearby area. The EPA is now reversing the order of the label to be Attainment/Unclassifiable so that the category is more clearly distinguished from the separate Unclassifiable category.
[4] https://www.epa.gov/sites/production/files/2016-02/documents/ozone-designation-tribes.pdf
[5] https://www.epa.gov/sites/production/files/2016-02/documents/indian-country-separate-area.pdf

the "ozone designations guidance"[6] after identifying each monitor indicating a violation of the ozone NAAQS in an area, the EPA analyzed those nearby areas with emissions potentially contributing to the violating area. In guidance issued in February 2016, the EPA provided that using the Core Based Statistical Area (CBSA) or Combined Statistical Area (CSA)[7] as a starting point for the contribution analysis is a reasonable approach to ensure that the nearby areas most likely to contribute to a violating area are evaluated. The area-specific analyses may support nonattainment boundaries that are smaller or larger than the CBSA or CSA.

On November 6, 2017, the EPA issued attainment/unclassifiable designations for approximately 85% of the United States and one unclassifiable area designation.[8] At that time, consistent with statements in the designations guidance regarding the scope of the area the EPA would analyze in determining nonattainment boundaries, EPA deferred designation for any counties in the larger of a CSA or CBSA where one or more counties in the CSA or CBSA was violating the standard and any counties with a violating monitor not located in a CSA or CBSA. In addition, the EPA deferred designation for any other counties adjacent to a county with a violating monitor. The EPA also deferred designation for any county that had incomplete monitoring data, any county in the larger of the CSA or CBSA where such a county was located, and any county located adjacent to a county with incomplete monitoring data.

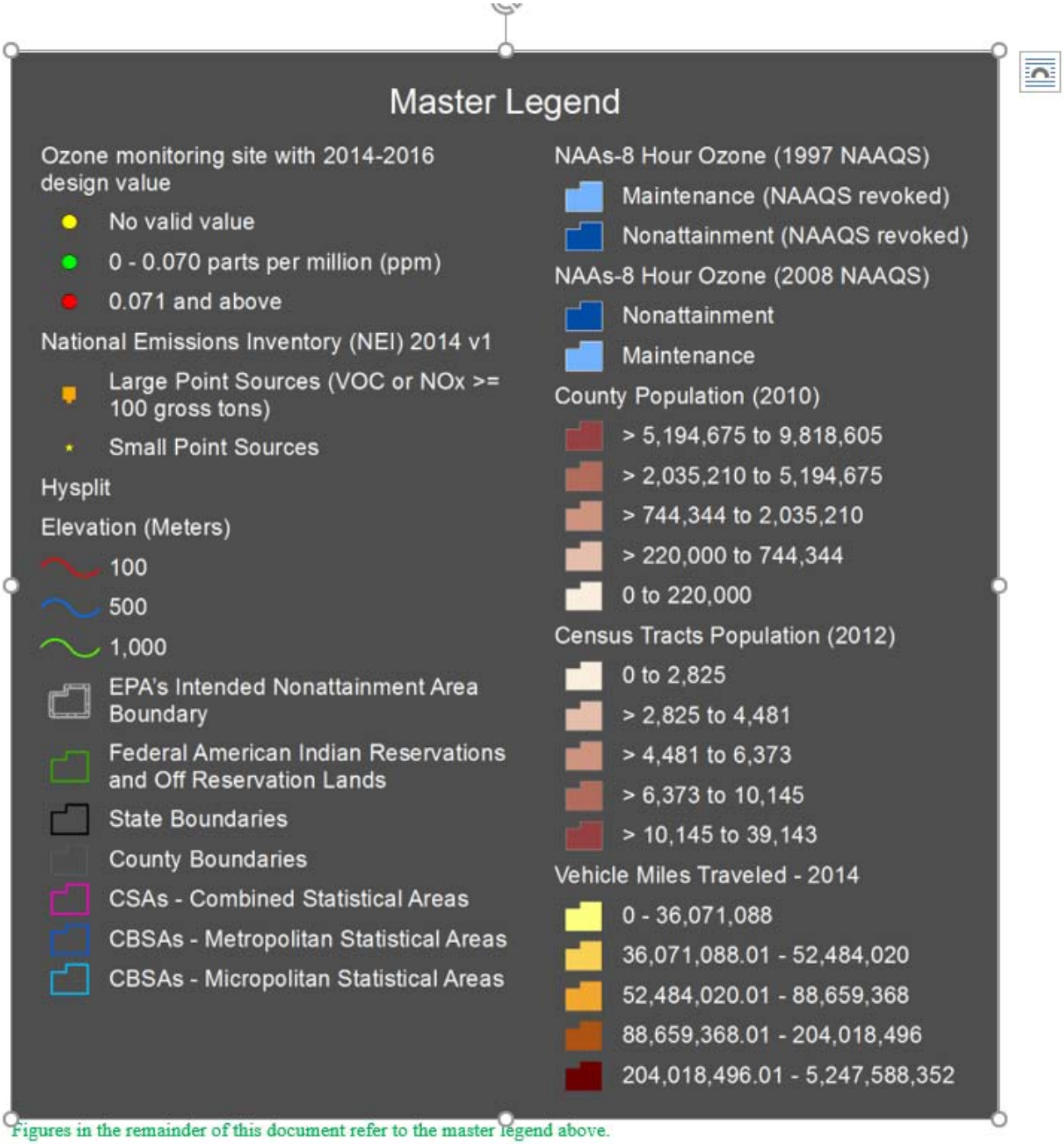
The EPA is proceeding to complete the remaining designations consistent with the designations guidance (and EPA's past practice) regarding the scope of the area EPA would analyze in determining nonattainment boundaries for the ozone NAAQS as outlined above. For those deferred areas where one or more counties violating the ozone NAAQS or with incomplete data are located in a CSA or CBSA, in most cases the technical analysis for the nonattainment area includes any counties in the larger of the relevant CSA or CBSA. For counties with a violating monitor not located in a CSA or CBSA, EPA explains in the 3.0 Technical Analysis section, its decision whether to consider in the five-factor analysis for each area any other adjacent counties for which EPA previously deferred action. We intend to designate all counties not included in five-factor analyses for a specific nonattainment or unclassifiable area analyses, as attainment/unclassifiable. These deferred areas are identified in a separate document entitled "Intended Designations for Deferred Counties and Partial Counties

[6] The EPA issued guidance on February 25, 2016 that identified important factors that the EPA intends to evaluate in determining appropriate area designations and nonattainment boundaries for the 2015 ozone NAAQS. Available at *https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs*

[7] Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/www/metroareas/metrodef.html. The Office of Management and Budget (OMB) adopts standards for defining statistical areas. The statistical areas are delineated based on U.S. Census Bureau data. The lists are periodically updated by the OMB. The EPA used the most recent July 2015 update (OMB Bulletin No. 15-01), which is based on application of the 2010 OMB standards to the 2010 Census, 2006-2010 American Community Survey, as well as 2013 Population Estimates Program data.

[8] Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards published on November 16, 2017(82 FR 54232).

Not Addressed in the Technical Analyses." which is available in the docket.



Figures in the remainder of this document refer to the master legend above.

3.0 Technical Analyses

This technical analysis identifies the area with monitors that violate the 2015 ozone NAAQS. It also provides EPA's evaluation of these areas and any nearby areas to determine whether those nearby areas have emissions sources that potentially contribute to ambient ozone concentrations at the violating monitors in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In developing this technical analysis, the EPA used the latest data and information available to the EPA (and to the states and tribes through the Ozone Designations Mapping Tool and the EPA

Ozone Designations Guidance and Data web page).[9] In addition, the EPA considered any additional data or information provided to the EPA by states or tribes.

The five factors recommended in the EPA's guidance are:

1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

3.1 Technical Analysis for the Dallas/Fort Worth Area

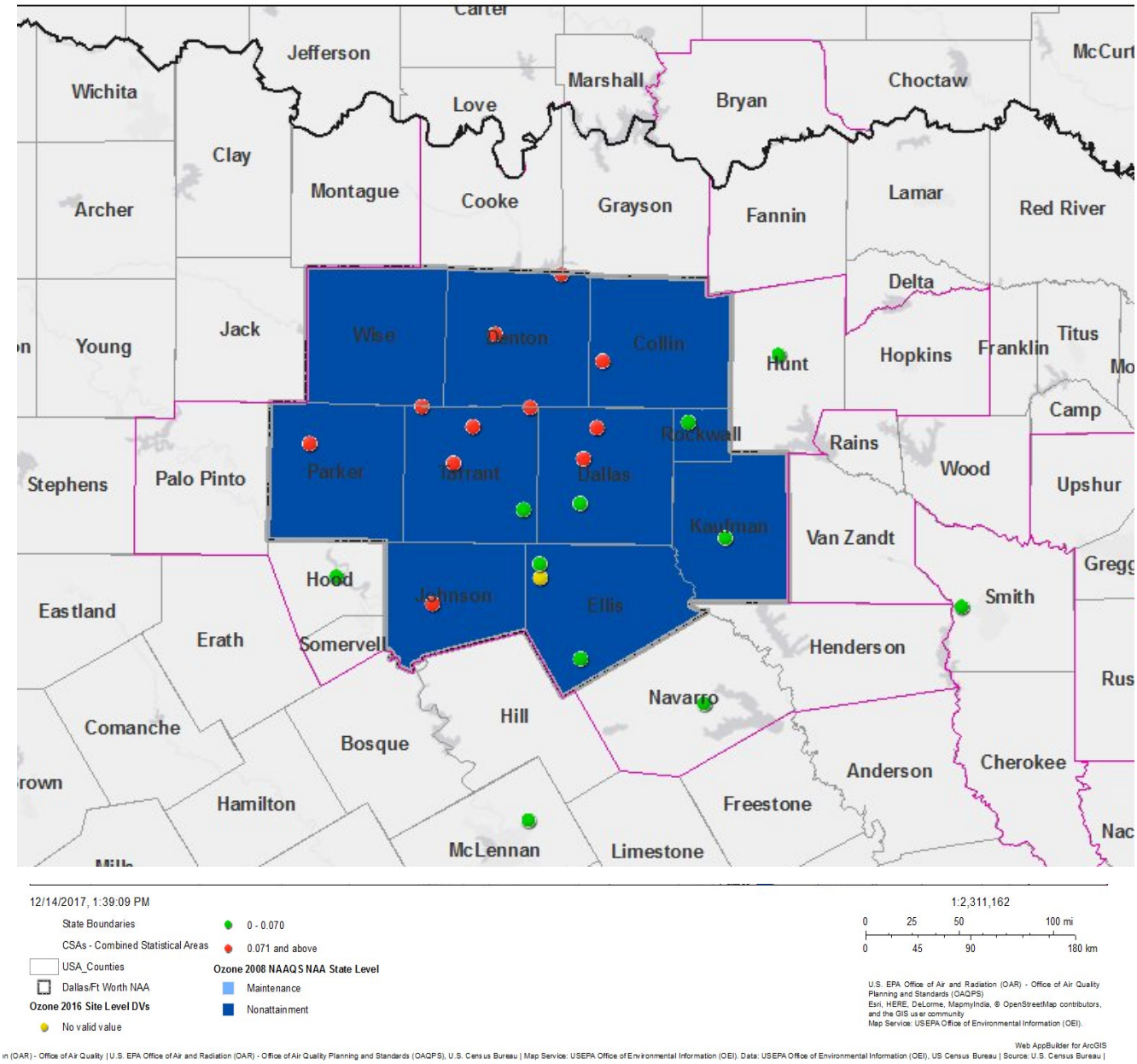
The Core Based Statistical Area (CBSA) is known as Dallas-Fort Worth-Arlington, TX and includes 13 counties: Collin, Dallas, Denton, Ellis, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, Somervell, Tarrant, and Wise counties. The Combined Statistical Area (CSA) is known as Dallas-Fort Worth, TX-OK and includes these 13 counties, plus six more Texas counties: Cooke, Grayson, Henderson, Hopkins, Navarro, and Palo Pinto, plus Bryan County, Oklahoma. Sixteen of these 20 counties either include a violating monitor or border a county with a violating monitor. These 20 counties are shown in Figure 1 below and we refer to these 20 counties as the area of analysis.

Figure 1 shows the EPA's intended nonattainment boundary within the area of analysis. The map also shows the location of the ambient air quality monitors, county and other jurisdictional boundaries, and the 2008 ozone NAAQS nonattainment boundary.

For purposes of the 1997 ozone NAAQS, the following whole counties within the area of analysis were designated nonattainment: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant. For purposes of our previous designations under the 2008 ozone NAAQS, these same 9 counties, plus all of Wise County, were designated nonattainment. The EPA intends to designate these same 10 counties as nonattainment for the 2015 ozone NAAQS and does not intend to modify the State's recommendation.

[9] The EPA's Ozone Designations Guidance and Data web page can be found at *https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.*

Figure 1. EPA's Intended Nonattainment Boundaries for the Area of Analysis



The EPA must designate as nonattainment any area that violates the 2015 ozone NAAQS and any nearby areas that contribute to the violation in the violating area. Collin, Dallas, Denton, Johnson, Parker and Tarrant counties have monitors in violation of the 2015 ozone NAAQS, therefore these counties are included in the intended nonattainment area. The following sections describe the five factor analysis EPA used to determine whether additional counties should be included as part of the nonattainment area based on contributions to the violating monitors. While the factors are presented individually, they are not independent. The weight-of-evidence of the five factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

Factor 1: Air Quality Data

The EPA considered 8-hour ozone design values in parts per million (ppm) for air quality monitors in the DFW area based on data for the 2014-2016 period (i.e., the 2016 design value). This is the most recent three-year period with fully-certified air quality data. The design value (DV) is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.[10] The 2015 NAAQS are met when the DV is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations.[11] The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone DVs. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule[12] are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the DV for the county or area is determined by the monitor with the highest valid DV. The presence of one or more violating monitors (i.e. monitors with DVs greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the most recent DVs violate the NAAQS, and examined historical ozone air quality measurement data (including previous DVs) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing DV data generally include State and Local Air Monitoring Stations that are operated in accordance with 40 CFR part 58, appendix A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible for comparison to the NAAQS, subject to the requirements given in the EPA's March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248). There is a SPM in Bryan County that is moved every two years and thus, is not eligible for comparison to the ozone NAAQS for designation purposes.[13]

The 2014-2016 DVs for counties in the area of analysis are shown in Table 2 below.

[10] The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.
[11] The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.
[12] The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance.*
[13] The 8-hour primary ozone NAAQS is met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, See 40 CFR 50.19. Data from two nearby sites may be combined into a single site data record for the purpose of calculating a valid design value. See 40 CFR 50, Appendix U. However, the monitor in Bryan County was moved to Johnston County, which is northwest of Bryan County and outside of the CSA, and therefore not likely to be representative of the same air mass. Thus it is not appropriate to combine the data records.

Table 2. Air Quality Data (all values in ppm)*

County**	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Bryan (Oklahoma)	No	400130380	**N/A**			
Collin	Yes	480850005	**0.074**	0.074	0.077	0.073
Cooke	No	No monitor	N/A			
Dallas	Yes	481130069	0.071	0.066	0.080	0.069
		481130075	**0.072**	0.070	0.079	0.067
		481130087	0.064	0.063	0.068	0.062
Denton	Yes	481210034	**0.080**	0.077	0.088	0.076
		481211032	0.076	0.075	0.079	0.075
Ellis	Yes	481390016	0.063	0.062	0.068	0.060
		481391044	0.062	0.060	0.066	0.060
Grayson	No	No monitor	N/A			
Henderson	No	No monitor	N/A			
Hood	No	482210001	0.069	0.073	0.073	0.063
Hopkins	No	No monitor	N/A			
Hunt	No	482311006	0.060	0.062	0.062	0.058
Johnson	Yes	482510003	**0.072**	0.071	0.073	0.072
Kaufman	Yes	482570005	0.061	0.062	0.064	0.057
Navarro	No	483491051	0.061	0.060	0.064	0.060
Palo Pinto	No	No monitor	N/A			
Parker	Yes	483670081	**0.073**	0.072	0.079	0.068
Rockwall	Yes	483970001	0.066	0.066	0.071	0.061
Somervell	No	No monitor	N/A			
Tarrant	Yes	484390075	0.072	0.073	0.078	0.067
		484391002	0.074	0.079	0.079	0.066
		484392003	0.073	0.074	0.076	0.070
		484393009	**0.075**	0.073	0.079	0.075
		484393011	0.065	0.065	0.069	0.061
Wise	Yes	No monitor	N/A			

* The highest design value in each county with a violating monitor is indicated in bold type.
** All counties are in Texas, unless otherwise noted.
N/A means that the monitor did not meet the completeness criteria described in 40 CFR, part 50, Appendix U, or no data exists for the county.

One or more monitors in Collin, Dallas, Denton, Johnson, Parker and Tarrant counties show a violation of the 2015 ozone NAAQS, therefore these counties are included in the intended nonattainment area. A county must also be designated nonattainment if it contributes to a violation in a nearby area. Each county without a violating monitor that is located in the area of analysis has been evaluated based on the weight-of-evidence of the five factors and other relevant information to determine whether it contributes to the nearby violation. EPA also notes that, in addition to the violating monitors in Collin, Dallas, Denton, Johnson, Parker and Tarrant counties, five other counties have one or more ambient monitors that are meeting the ozone NAAQS. Within the area of

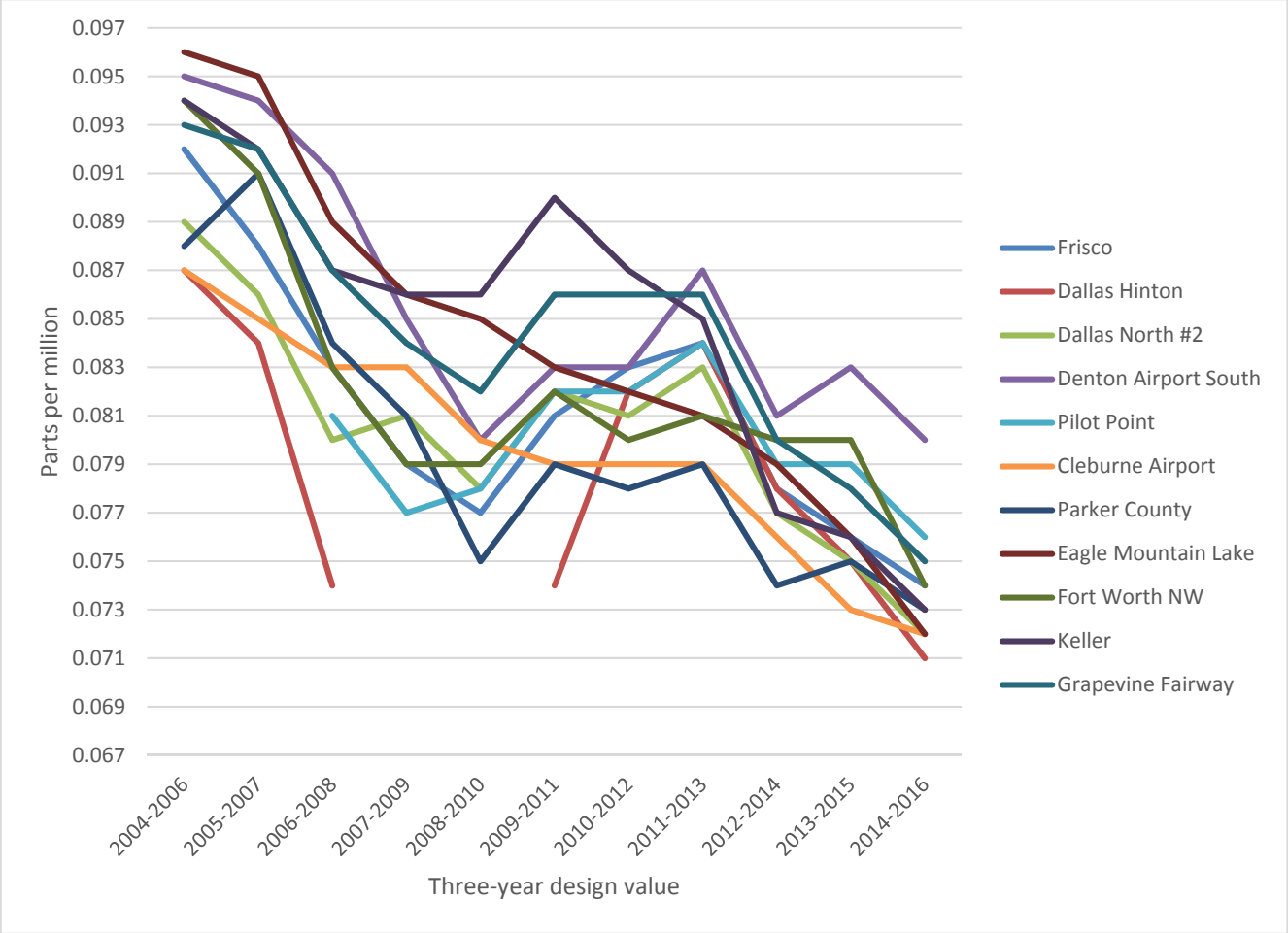
analysis, Bosque, Cooke, Fannin, Grayson, Hill, Jack, Palo Pinto, Somervell and Wise counties do not have ozone monitoring sites.[14]

Figure 1, shown previously, identifies the intended nonattainment area, the CSA boundary and the violating monitors. Table 2 identifies the DVs for all monitors in the area of analysis and Figure 2 shows the historical trend of DVs for the violating monitors. As indicated on the map, there are a total of 19 monitors in the area of analysis and 11 are in violation of the 2015 ozone NAAQS. The violating monitors are located in Collin, Dallas, Denton, Johnson, Parker and Tarrant counties. The "Frisco" monitor in Collin County has a DV of 74 ppb and is in the southwest quadrant of the county, within a residential area in the City of Frisco. The two violating monitors in Dallas County are 1) the "Hinton" monitor with a DV of 71 ppb, located in a commercial area about 4.5 miles northwest of the downtown Dallas area; and 2) the "Dallas North 2" monitor with a DV of 72 ppb, located in a residential area about 10 miles north of the downtown Dallas area. The "Dallas Redbird Executive Airport" monitor has a DV of 64 ppb and is located about 8 miles south-southwest of the downtown Dallas area on the west side the Dallas Executive Airport. The two violating monitors in Denton County are 1) the "Denton Airport South" monitor with a DV of 80 ppb, located about 1.5 miles west of the City of Denton and less than a half mile north of the Denton Airport; and 2) the "Pilot Point" monitor with a DV of 76 ppb, located in a rural area of the county, less than half a mile south of the Cooke, Denton, and Grayson County lines, just east of Lake Ray Roberts (this is the northern-most monitor in the DFW area). The four violating monitors in Tarrant County are 1) the "Grapevine Fairview" monitor with a DV of 75 ppb, located near the southeast end of Grapevine Lake, about 4.5 miles north of the Dallas-Fort Worth International Airport and almost on the Denton County line; 2) the "Keller" monitor with a DV of 73 ppb, located in a residential area about 3 miles west of Keller; 3) the "Eagle Mountain Lake" monitor with a DV of 72 ppb, located near the northeast end of Eagle Mountain Lake and less than a half mile south of the Wise County line; and 4) the "Fort Worth Northwest" monitor with a DV of 74 ppb, located near the southern edge of the Meacham International Airport. The "Arlington Municipal Airport" monitor in Tarrant County has a DV of 65 ppb and is located at the southeast end of the Arlington Municipal Airport The monitor in Parker County has a DV of 73 ppb and is in a rural area about 9.5 miles northwest of Weatherford (this is the western-most monitor in the DFW area). The monitor in Johnson County (the "Cleburne Airport" monitor) has a DV of 72 ppb and is on the southwest side of the Cleburne Regional Airport, about 2.5 miles west of Cleburne. The monitors in six counties within the area of analysis are meeting the 2015 ozone standard: In Hunt County the "Greenville" monitor has a DV of 60 ppb; in Rockwall County the "Rockwall Heath" monitor has a DV of 66 ppb; in Kaufman County, the monitor has a DV of 61 ppb; in Navarro County the "Corsicana" monitor has a DV of 61 ppb; in Ellis County the "Midlothian OFW" monitor has a DV of 63 ppb and the "Italy" monitor has a DV of 62 ppb; and in Hood County the "Granbury" monitor has a DV of 69 ppb.

Figure 2 below illustrates the trend in ozone design values since 2006 at the monitors in the area of analysis that are currently violating the 2015 ozone standard. For design values between 2010 and 2011, nearly every violating monitor in the area of analysis has experienced intermediate increases in ozone levels, but the overall trend for the monitors in this area is a decrease in ozone levels since 2006. The monitor with the highest current design value in the area of analysis, i.e., the design value monitor, which in this case is the Denton Airport South monitor, is decreasing by an average of 1.5 ppb per year.

[14] As described above, the monitor in Bryan County, OK is a SPM and is not eligible for comparison to the ozone NAAQS for designation purposes.

Figure 2. Three-Year Design Values for Violating Monitors (2006-2016).



EPA intends to designate as nonattainment the areas with the monitors that are violating the 2015 ozone NAAQS: Therefore, Collin, Dallas, Denton, Johnson, Parker, and Tarrant counties are included in EPA's intended nonattainment area for the 2015 ozone NAAQS.

Factor 2: Emissions and Emissions-Related Data

The EPA evaluated ozone precursor emissions of nitrogen oxides (NOx) and volatile organic compounds (VOC) and other emissions-related data that provide information on areas contributing to the violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For each county in the area of analysis, the EPA examined the magnitude of large sources (NOx or VOC emissions greater than 100 tons per year (tpy)) and small point sources and the magnitude of county-level emissions reported in the NEI.[15] These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations. Table 3 below

[15] These data do not include biogenic VOC emissions.

provides a county-level emissions summary of NOx and VOC emissions for the area of analysis considered for inclusion in the intended Dallas/Fort Worth nonattainment area.

Table 3. Total County-Level NOx and VOC Emissions

County*	State Recommended Nonattainment?	Total NOx (tpy)	Total VOC (tpy)
Dallas	Yes	41,673	44,695
Tarrant	Yes	33,079	38,600
Collin	Yes	12,341	13,136
Denton	Yes	11,059	16,033
Wise	Yes	10,789	12,777
Ellis	Yes	10,087	5,551
Navarro	No	5,918	3,881
Johnson	Yes	5,683	7,688
Kaufman	Yes	5,391	3,013
Hunt	No	4,876	2,922
Parker	Yes	4,693	6,190
Grayson	No	4,521	6,205
Cooke	No	3,343	6,792
Bryan County, Oklahoma	No	2,812	2,187
Hood	No	2,711	2,575
Henderson	No	2,652	3,843
Hopkins	No	2,517	1,726
Palo Pinto	No	2,382	4,035
Rockwall	Yes	1,611	1,728
Somervell	No	435	583
	Area wide:	168,573	184,160

* All counties are in Texas, unless otherwise noted.

In addition to reviewing county-wide emissions of NOx and VOC in the area of analysis, the EPA also reviewed emissions from large and small point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. The locations of the large and small point sources are shown in Figure 3 below.

Figure 3. Large and Small Point Sources in the Area of Analysis

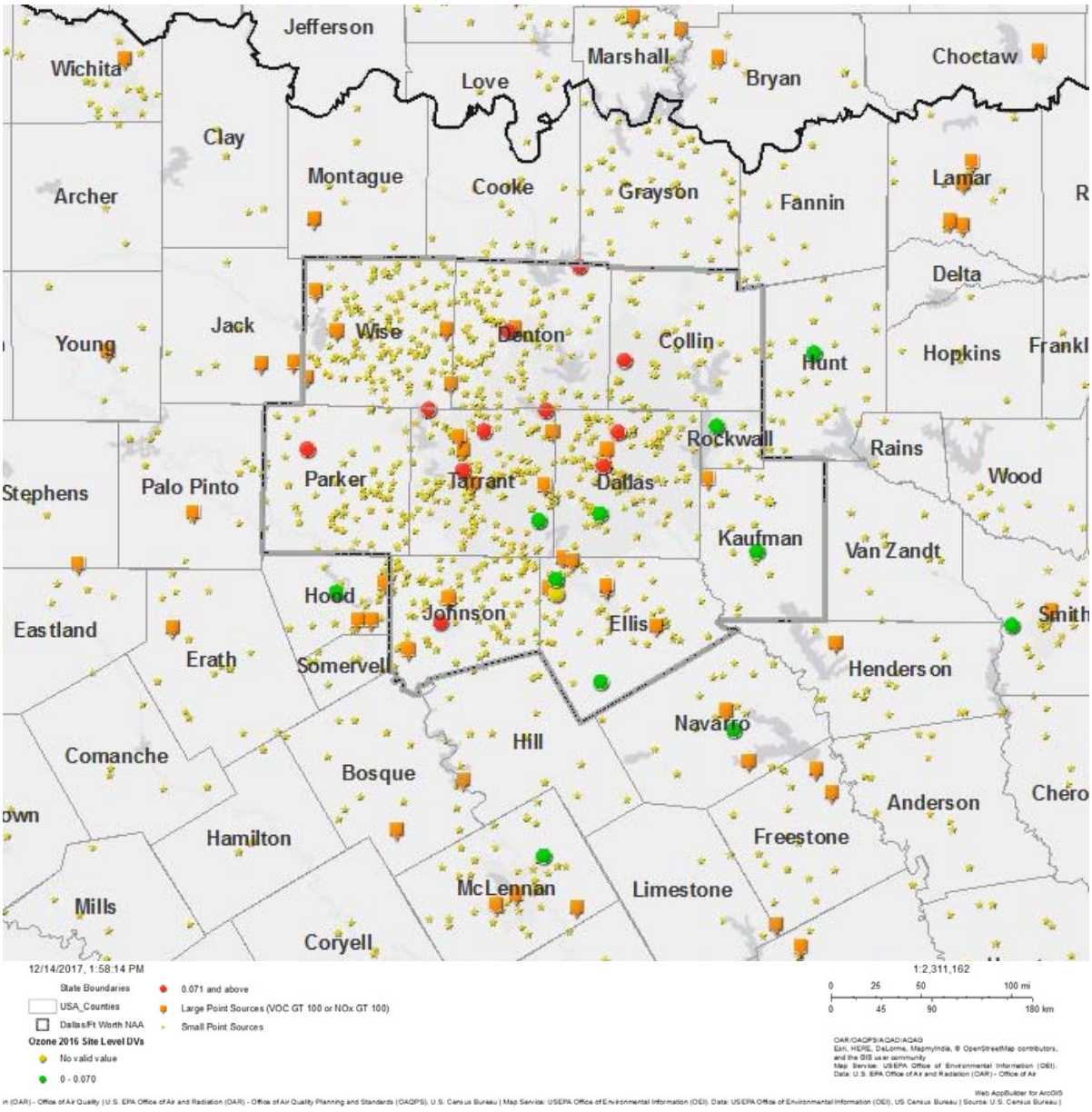


Figure 3 shows that small point sources are ubiquitous, though more concentrated in the area of analysis. There are fewer large point sources and several counties (Somervell, Parker, Rockwall, Colin, Hunt, Cooke, and Grayson) within the area of analysis have no large point sources. Two counties within the area of analysis are characterized by having the highest emissions of NOx and VOC, which exceed 33,000 tpy: Dallas and Tarrant. Four counties in the area of analysis are characterized by emissions of NOx between 10,000 and 13,000 tpy: Collin, Denton, Wise and Ellis. Collin, Denton and Wise have emissions of VOC between 12,000 and 16,000 tpy. Navarro, Johnson, Kaufman, Hunt, Parker and Grayson Counties emit greater than 4,000 tpy of NOx. Ellis, Johnson, Parker, Grayson and Cooke Counties emit greater than 5,000 tpy of VOC. The remaining counties are characterized by comparatively lower emissions, in the range of 400 to 3,300 tpy of NOx and 600 to 3,900 tpy of VOC.

Population density and degree of urbanization

In this part of the factor analysis, EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include emissions of NOx and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NOx and VOC emissions that may contribute to violations of the NAAQS. Table 4 below shows the population, population density, and population growth for each county in the area of analysis. Figure 4 contains a county-level density map of the area of analysis.

Table 4. Population and Growth*

County**	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population 2010-2015	Population % change 2010-2015
Dallas	Yes	2,368,139	2,553,385	2931	185,246	8
Tarrant	Yes	1,809,034	1,982,498	2296	173,464	10
Collin	Yes	782,341	914,127	1087	131,786	17
Denton	Yes	662,614	780,612	889	117,998	18
Ellis	Yes	149,610	163,632	175	14,022	9
Johnson	Yes	150,934	159,990	221	9,056	6
Parker	Yes	116,927	126,042	140	9,115	8
Grayson	No	120,877	125,467	135	4,590	4
Kaufman	Yes	103,350	114,690	147	11,340	11
Rockwall	Yes	78,337	90,861	715	12,524	16
Hunt	No	86,129	89,844	107	3,715	4
Henderson	No	78,532	79,545	91	1,013	1
Wise	Yes	59,127	62,953	70	3,826	7
Hood	No	51,182	55,423	132	4,241	8
Navarro	No	47,735	48,323	48	588	1
Bryan (Oklahoma)	No	42,416	44,884	50	2,468	6
Cooke	No	38,437	39,229	45	792	2
Hopkins	No	35,161	36,223	47	1,062	3
Palo Pinto	No	28,111	27,895	29	-216	-1
Somervell	No	8,490	8,739	47	249	3
	Area wide:	6,817,483	7,504,362	481	686,879	10

* U.S. Census Bureau population estimates for 2010 and 2015; see www.census.gov/data.html.
** All counties are in Texas, unless otherwise noted.

The Dallas-Fort Worth area is a large metropolitan area with a total population of approximately 7.5 million people. The 2015 Census data indicate that the majority of the population in the area of analysis reside in Dallas, Tarrant, Collin, Denton, Ellis, Johnson, Parker, Grayson, Kaufman and Rockwall counties - each of these counties is characterized by population counts in excess of 100,000 people and population densities greater than 100 people per square mile.[16]

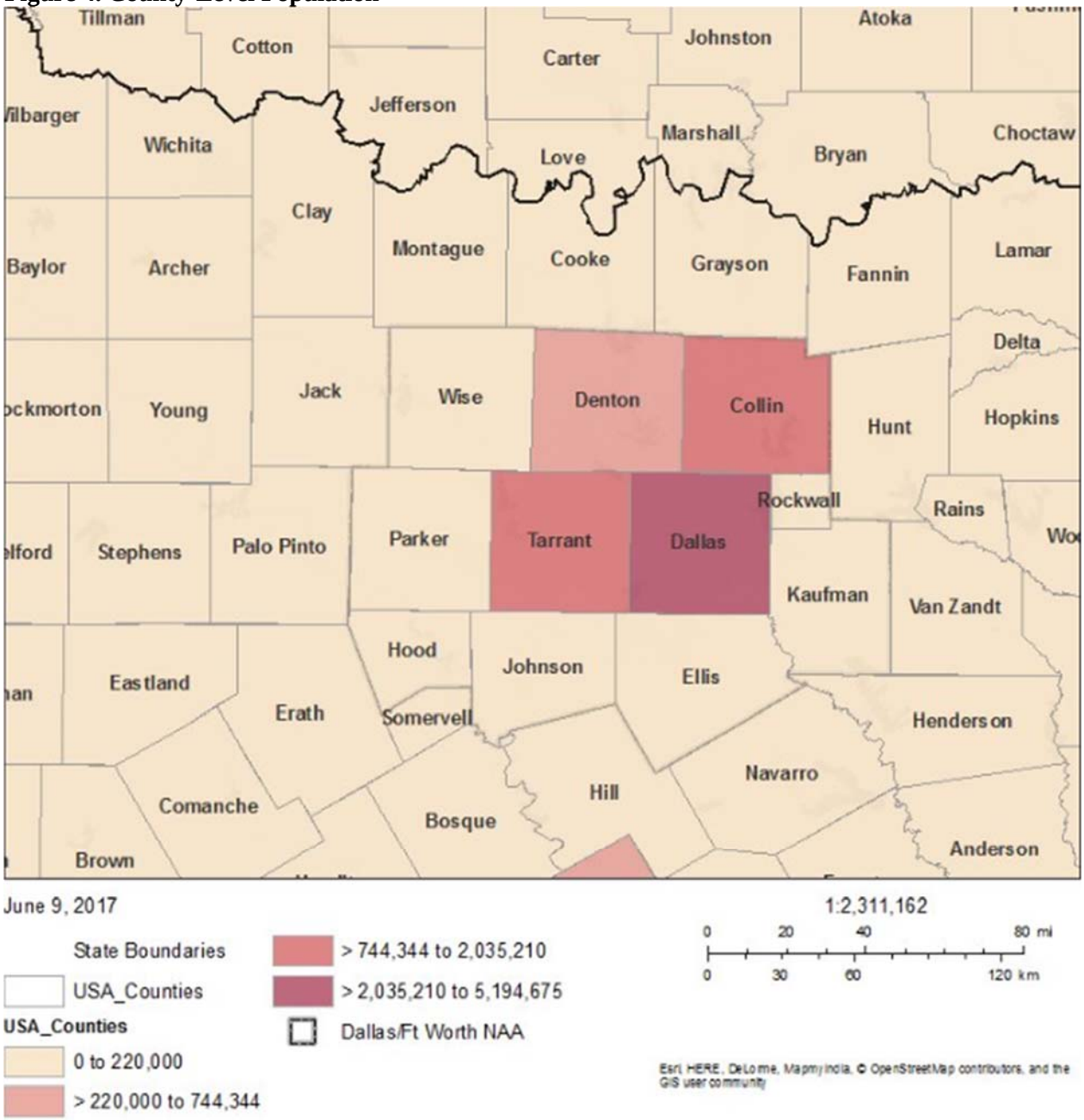
[16] The population of Rockwall County is less than 100,000, but the population density is 715.

Dallas and Tarrant Counties have the highest populations and are the most densely populated counties in the area of analysis. Dallas County has nearly 2.6 million people and a population density of 2,931 people per square mile, and Tarrant County has nearly 2 million people and a population density of 2,296 people per square mile. Collin and Denton counties also have relatively large populations and are also densely populated - each has more than 700,000 people and a population density exceeding 800 people per square mile. While Rockwall County ranks 10th in terms of population, with just over 90,000, it ranks fifth in population density with 715 people per square mile. This is not surprising considering that Rockwall is the smallest County geographically in the area of analysis.

There are nine counties in the area of analysis with populations ranging between 55,000 and 164,000 people: Ellis, Grayson, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, and Wise. Of these, Wise and Henderson Counties are among the lowest populations (62,953 and 79,545, respectively) and have population densities of 70 and 91 people per square mile, respectively. The remaining seven counties have comparatively higher population densities ranging from 107 to 221 people per square mile.

From 2010 to 2015, the four most populated counties in the area of analysis experienced population growth in excess of 100,000 people and had among the highest percentage population change: Dallas (185,246 people or 8%), Tarrant (173,464 people or 10%), Collin (131,786 people or 17%), and Denton (117,998 people or 18%). Population growth in all of the remaining counties was less than 15,000 people. However, eight of the remaining counties had population increases greater than 5%: Rockwall (12,524; 16%), Kaufman (11,340; 11%), Ellis (14,022; 9%), Parker (9,115; 8%), Hood (4,241; 8%), Wise (3,826; 7%), Johnson (9,056; 6%), and Bryan (2,468, 6%). Two other counties with populations over 50,000 had population increases of 4%: Grayson and Hunt. The remaining six counties are predominantly rural, with populations below 50,000 and each had less than 4% population change.

Figure 4. County-Level Population



Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents and the total vehicle miles traveled (VMT) for each county in the area of analysis.[17] In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or high number of commuters is generally an integral part of an urban area. High VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population and/or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area and thus, could indicate that the associated area source

[17] The VMT data are available from the NEI (see https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei). See also https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.

and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census Bureau for the area of analysis. [18] Table 5 below shows the traffic and commuting pattern data, including total VMT for each county, number of residents who work in each county, and the number and percent within each county that commute to counties with violating monitors. Unless otherwise noted, the data in Table 5 are 2014 data.

Table 5. Traffic and Commuting Patterns

County*	State Recommended Nonattainment?	2008 Total VMT (Million Miles)	2014 Total VMT (Million Miles)	VMT Growth 2008 to 2014 (percent)	County Residents Who Work	Number Commuting to or Within Counties with Violating Monitor(s)	Percentage Commuting to or Within Counties with Violating Monitor(s)
Dallas	Yes	26,625	25,401	-5%	1,075,478	962,986	89.5
Tarrant	Yes	16,741	16,147	-4%	861,575	770,380	89.4
Collin	Yes	6,198	7,883	27%	423,478	377,467	89.1
Denton	Yes	5,507	6,343	15%	372,251	333,946	89.7
Ellis	Yes	1,893	2,553	35%	75,222	43,286	57.5
Kaufman	Yes	1,548	2,167	40%	51,404	31,595	61.5
Johnson	Yes	1,432	1,870	31%	69,256	56,436	81.5
Parker	Yes	1,280	1,680	31%	52,250	43,379	83.0
Hunt	No	1,046	1,623	55%	35,720	13,811	38.7
Grayson	No	1,364	1,190	-13%	50,777	17,892	35.2
Wise	Yes	969	1,097	13%	25,643	11,954	46.6
Rockwall	Yes	676	838	24%	40,904	26,004	63.6
Navarro	No	801	809	1%	20,752	5,388	26.0
Henderson	No	768	727	-5%	26,875	4,432	16.5
Cooke	No	636	682	7%	17,241	6,134	35.6
Hopkins	No	608	576	-5%	14,203	1,798	12.7
Hood	No	443	573	29%	22,787	9,228	40.5
Palo Pinto	No	397	382	-4%	9,822	2,692	27.4
Bryan, OK	No	460	602	31%	16,186	522	3.2
Somervell	No	121	98	-19%	3,783	1,316	34.8
	Total:	69,513	73,239	5%	3,265,607	2,720,646	83.3

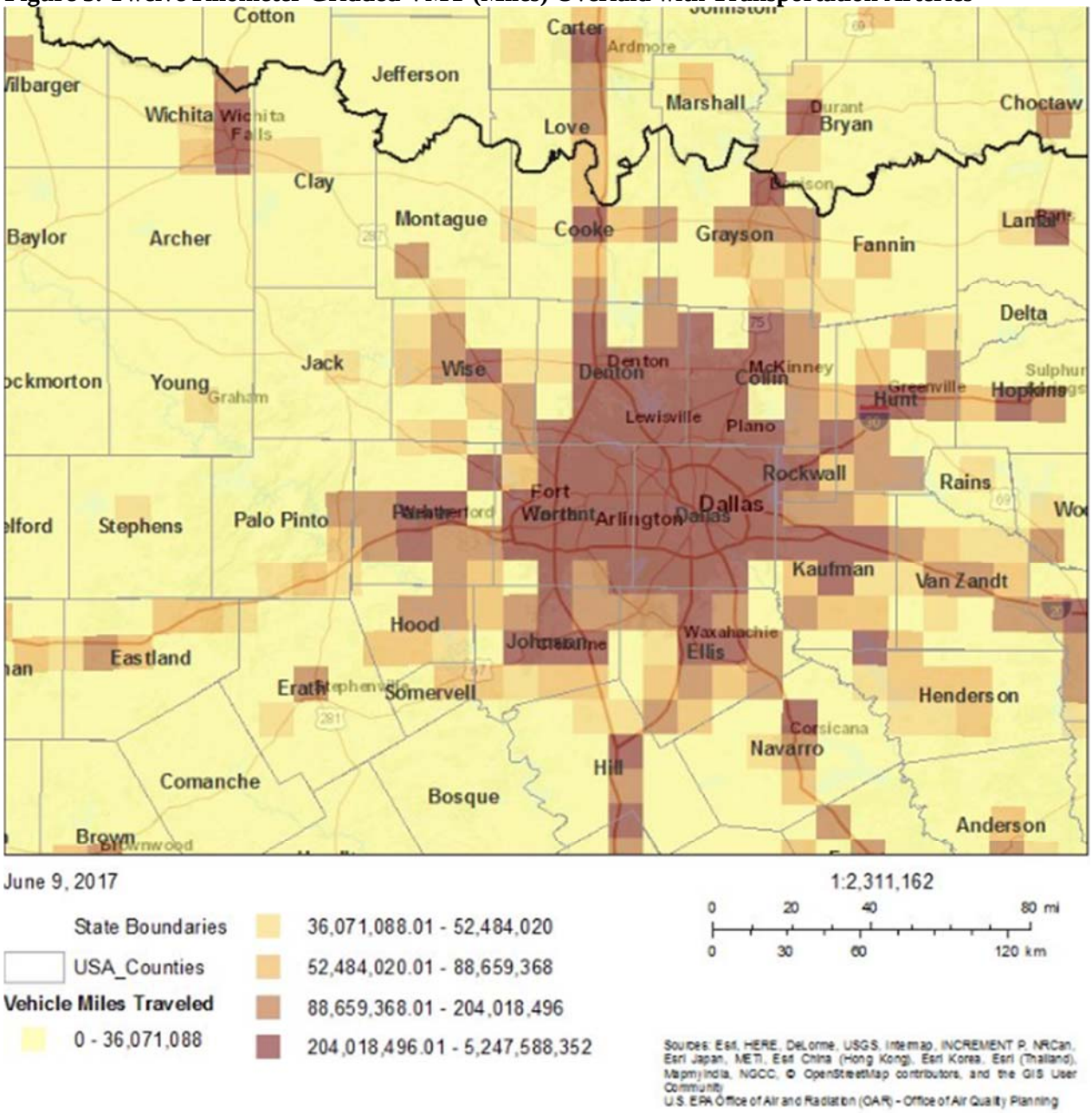
* All counties are in Texas, unless otherwise noted. Counties with a monitor violating the NAAQS are shown in bold.

To show traffic and commuting patterns, Figure 5 below overlays 12-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.[19] The data for Figure 5 are the 12-kilometer gridded 2014 VMT in the Ozone Mapping Tool.

[18] The worker data can be accessed at: http://onthemap.ces.census.gov/.

[19] Twelve kilometers is equivalent to 7.44 miles.

Figure 5. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



VMT in the area of analysis traveled a total of approximately 73 billion miles during calendar year 2014. Four counties in the area (Collin, Dallas, Denton, and Tarrant) each have total VMT for calendar year 2014 in excess of 6 billion miles. Dallas and Tarrant Counties have the highest total VMT of approximately 25 and 16 billion miles, respectively. An additional seven counties have 2014 VMT in the range of one to 2.5 billion miles: Ellis, Grayson, Hunt, Johnson, Kaufman, Parker, and Wise Counties.

Thirteen of the 20 counties in the area of analysis had an increase in VMT for the period from 2008 - 2014.[20] For eight of these counties the VMT growth from 2008-2014 was at least 24 percent: Rockwall (24%), Collin (27%), Hood (29%), Bryan, Johnson, and Parker Counties (31%), Ellis County (35%), Kaufman County (40%), and Hunt County (55%).[21] Denton and Wise Counties had approximately 15 and 13 percent VMT growth,

[20] To calculate VMT growth we compared VMT from the 2008 and 2014 NEIs.

[21] While Hood and Bryan Counties experienced high growth in VMT, both counties have VMT of 460 million or less, which are among the lowest VMT rates in the area of analysis.

respectively, and Cooke and Navarro Counties had approximately 7 percent or less VMT growth. Tarrant and Dallas Counties had a decrease in VMT growth, of approximately 4 and 5 percent, respectively.

The four counties with the highest number of commuters also have the highest percentage of commuters to or within counties with the violating monitors: Collin, Dallas, Denton, and Tarrant, each at 89 percent. These four counties also have violating monitors. Five counties have more than 50% of their workers commuting to or within counties with the violating monitors: Ellis (58%), Kaufman (62%), Rockwall (64%), Johnson (82%), and Parker (83%) and of these. Johnson and Parker Counties have violating monitors. Close to half (47%) of the workers who live in Wise County commute to counties with the violating monitors. For Cooke, Grayson, Hood, Hunt, Navarro, Palo Pinto, and Somervell Counties, approximately 26% to 41% of their workers commute to the counties with violating monitors. Less than 18% of the workers who live in Henderson and Hopkins Counties commute to counties with the violating monitors. Only three percent of the workers who live in Bryan County commute to the counties with the violating monitors.

Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources in the area. EPA conducted analyses to better understand the area's meteorological transport conditions using the National Oceanic and Atmospheric Administration Hybrid Single Particle Lagrangian Integrated Trajectory Model (NOAA HYSPLIT or HYSPLIT). The HYSPLIT model yields an estimate of the path an air mass has traveled before reaching a monitor at a specific location and time. Specifically, the model provides the centerline of the probable path. By evaluating these estimates of where an air mass has traveled before reaching a monitor where an exceedance has occurred, one can consider what potential areas and emission sources could have contributed to the exceedance. The EPA evaluated 2014-2016 HYSPLIT trajectories at 100, 500, and 1000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figures 6a – 6f below show the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8 hour values that exceed the 2015 ozone NAAQS) for the violating monitors.

Figure 6a. HYSPLIT Back Trajectories for the Violating Monitor in Parker County

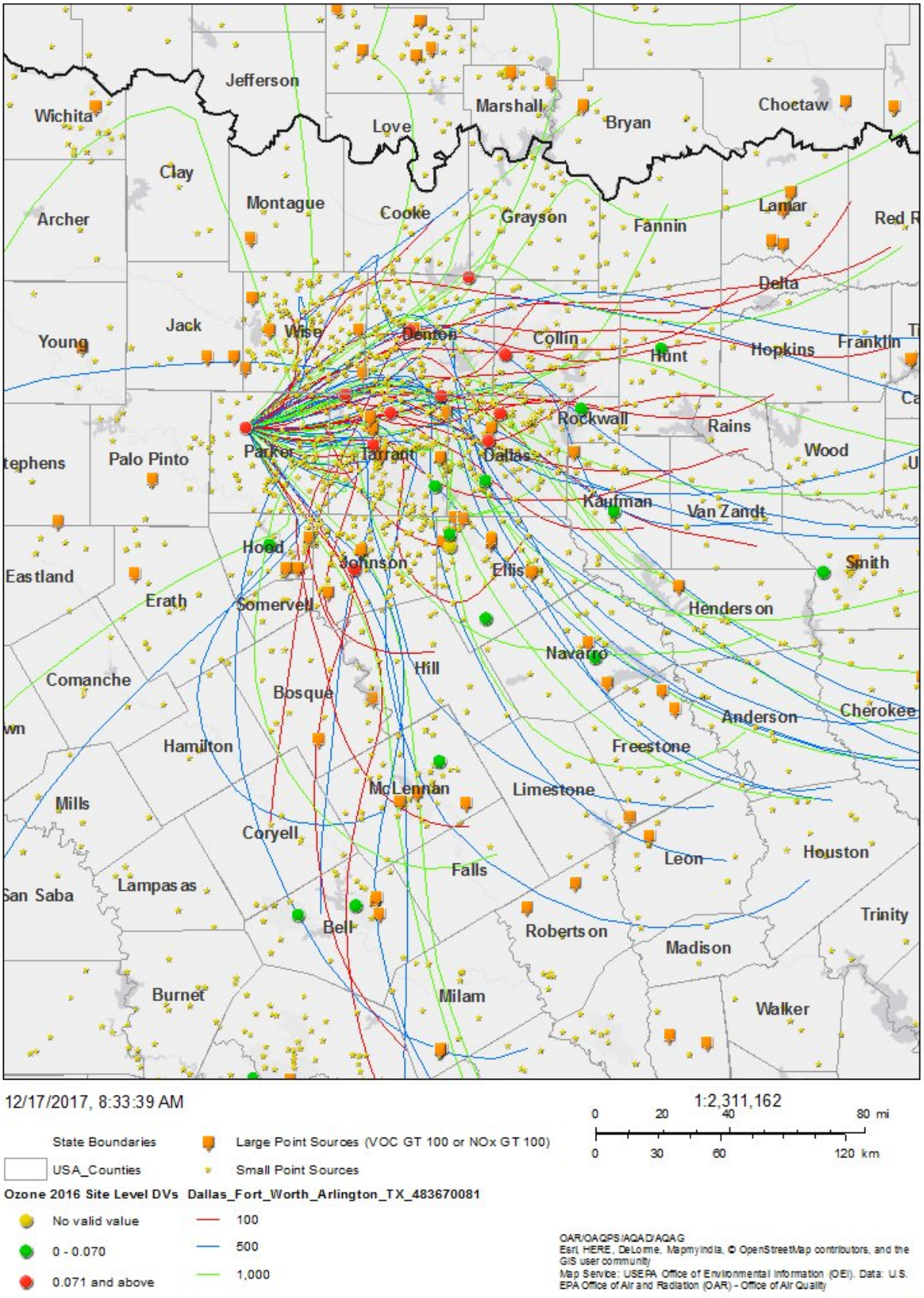


Figure 6b. HYSPLIT Back Trajectories for the Violating Monitor in Johnson County

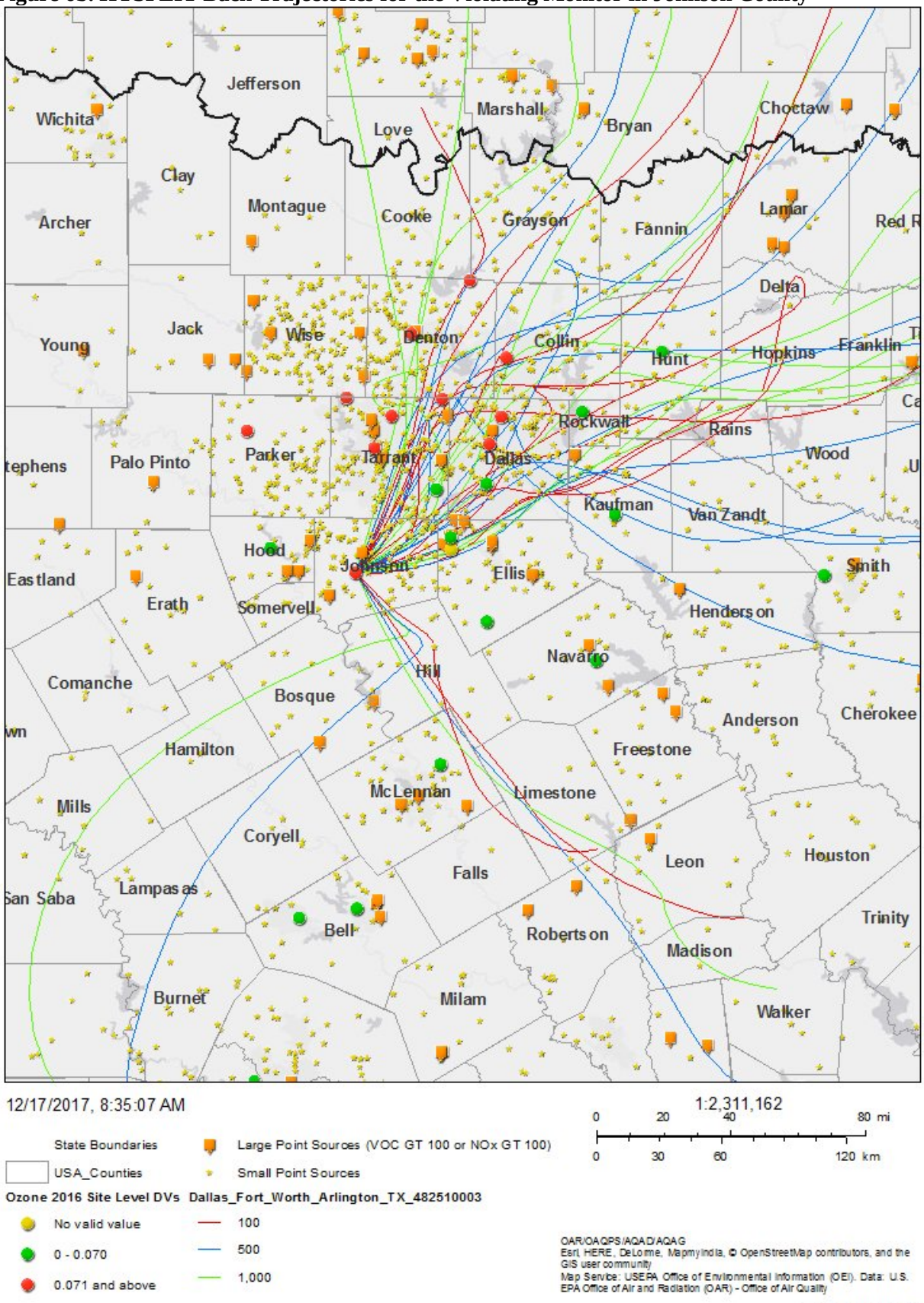
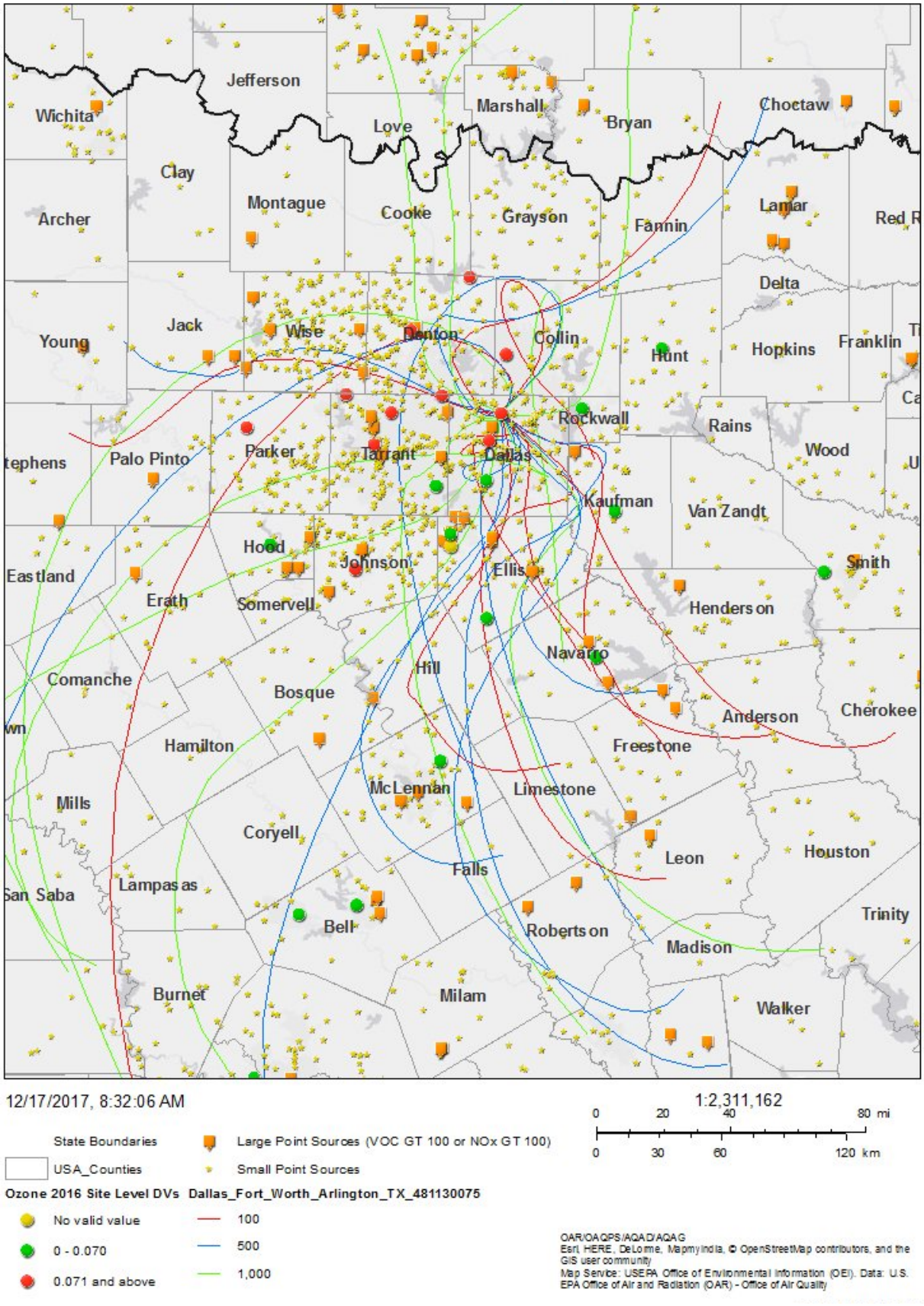
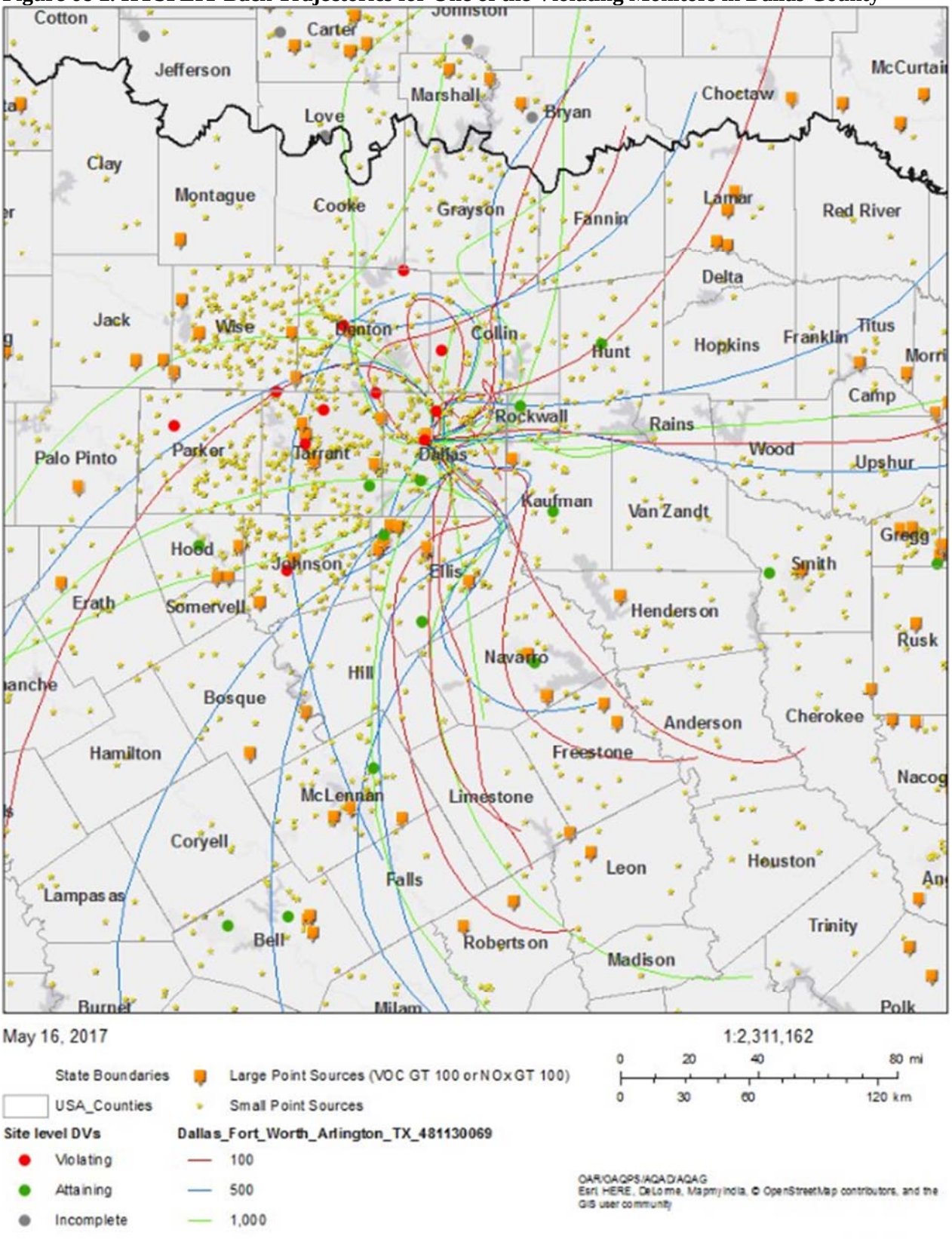


Figure 6c-1. HYSPLIT Back Trajectories for One of the Violating Monitors in Dallas County[22]



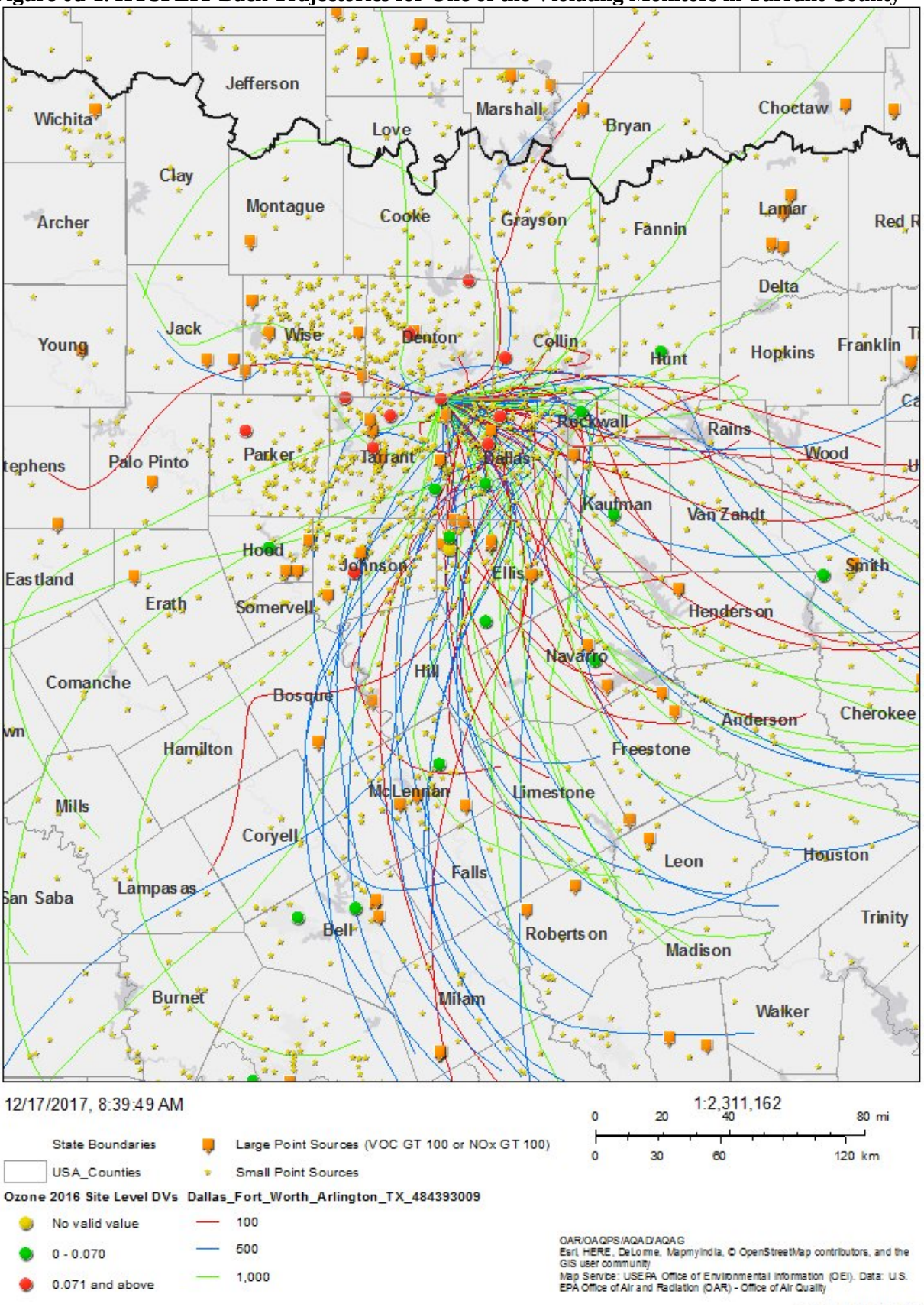
[22] This is the Dallas North #2 monitor - it has the higher ozone DV of the two violating monitors in Dallas County.

Figure 6c-2. HYSPLIT Back Trajectories for One of the Violating Monitors in Dallas County[23]



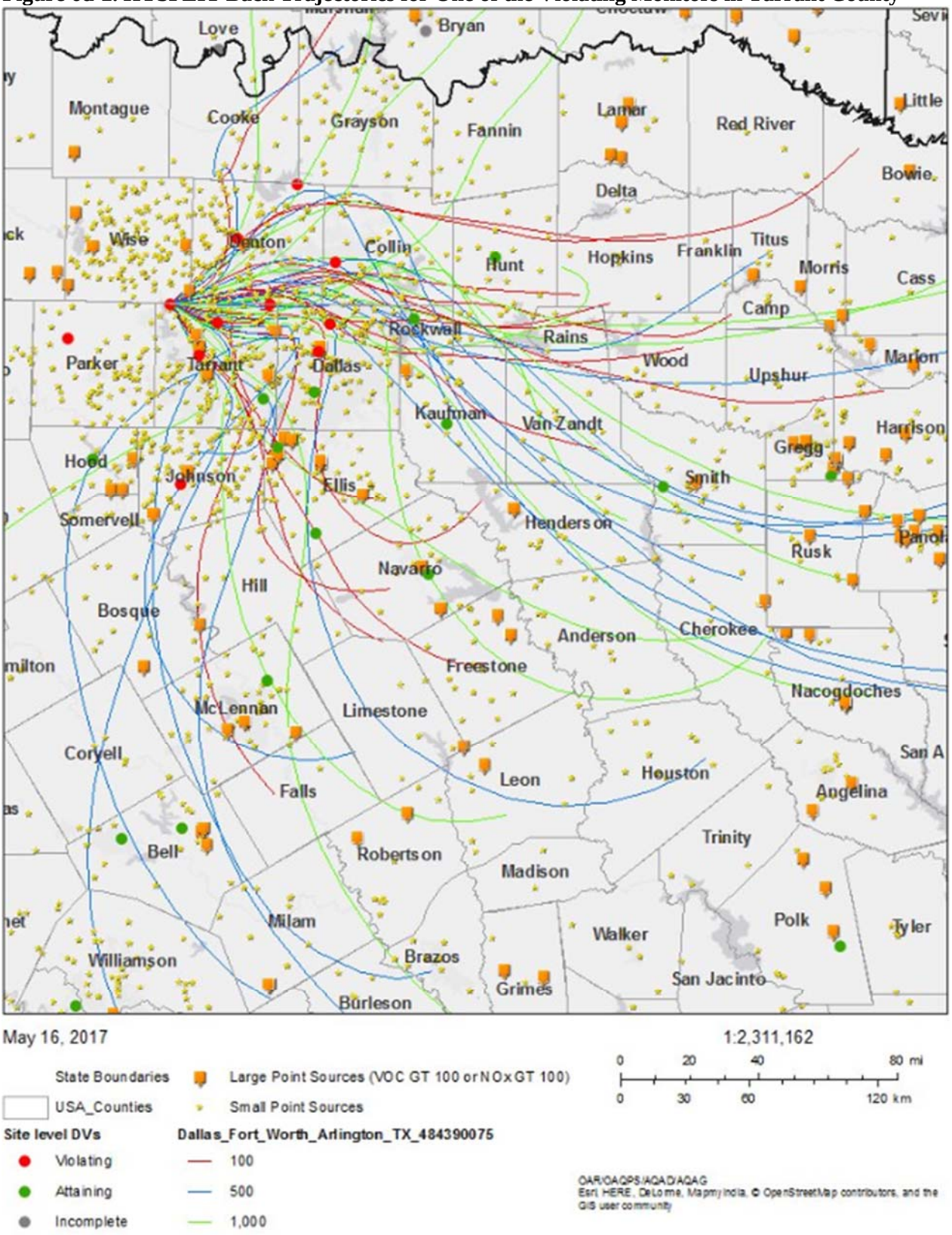
[23] This is the second of two violating monitors in Dallas County and is known as the Dallas Hinton monitor.

Figure 6d-1. HYSPLIT Back Trajectories for One of the Violating Monitors in Tarrant County[24]



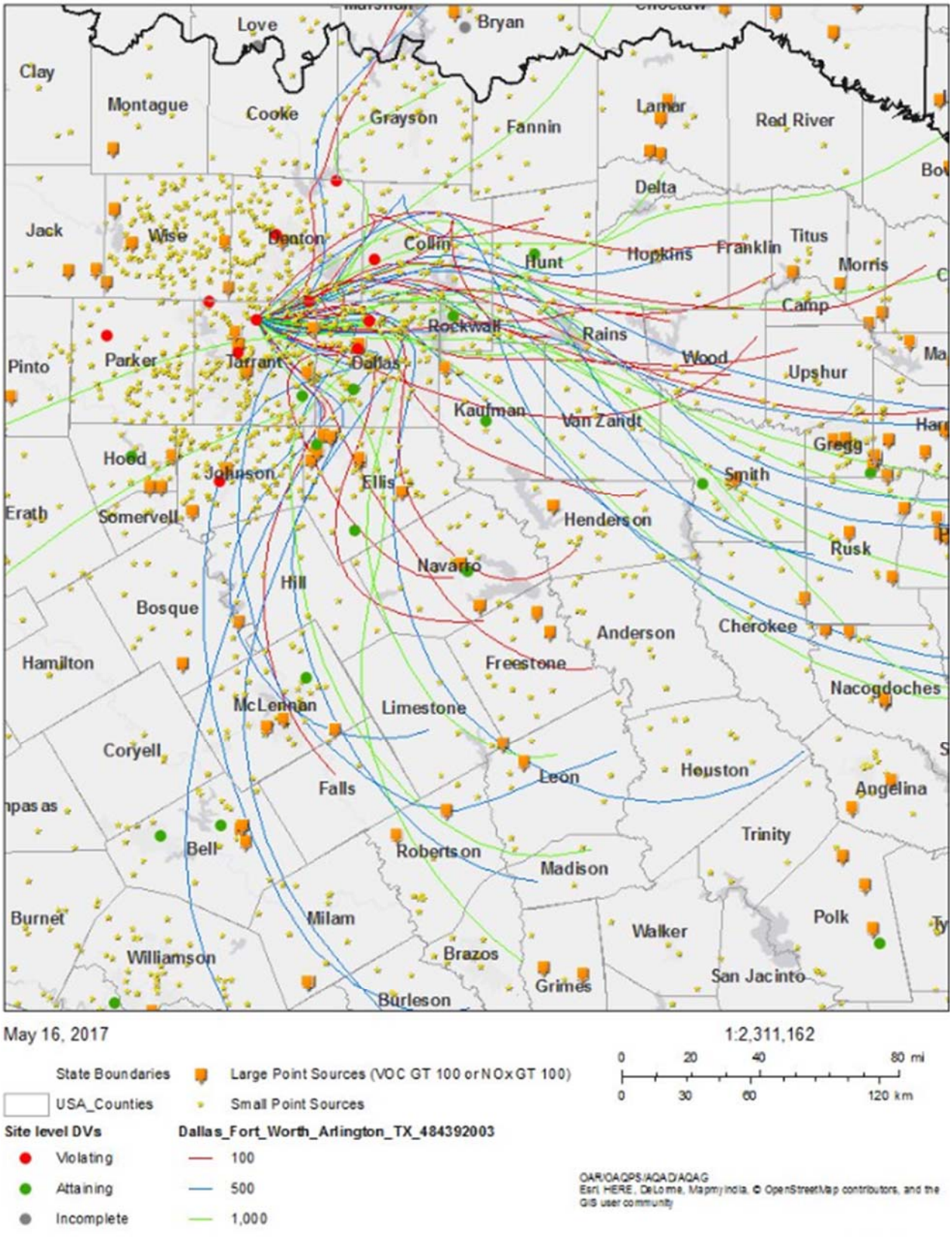
[24] This monitor at Grapevine Fairway has the highest ozone design value of the 4 violating monitors in Tarrant County.

Figure 6d-2. HYSPLIT Back Trajectories for One of the Violating Monitors in Tarrant County[25]



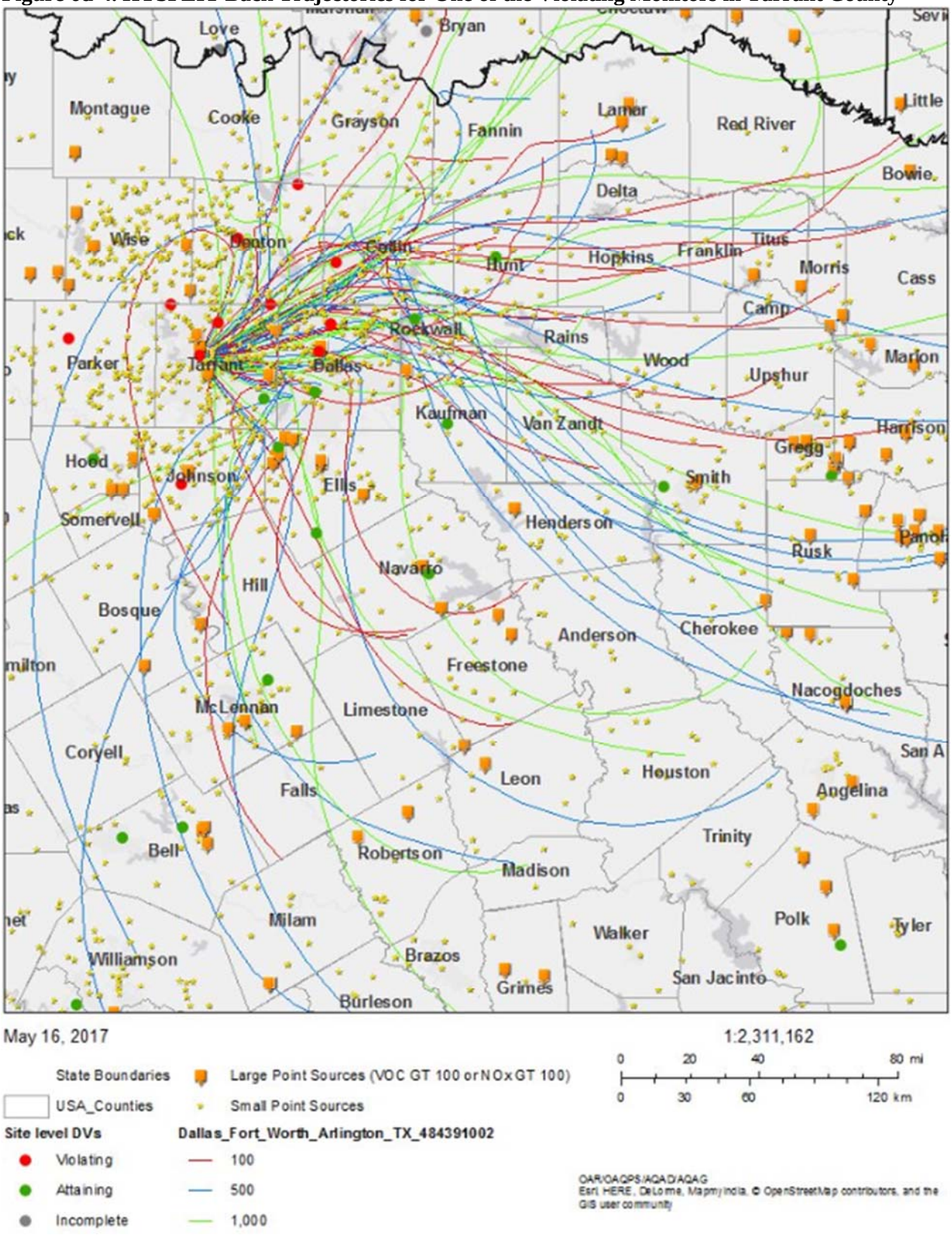
[25] This is the second of four violating monitors in Tarrant County and is known as the Eagle Mountain Lake monitor.

Figure 6d-3. HYSPLIT Back Trajectories for One of the Violating Monitors in Tarrant County[26]



[26] This is the third of four violating monitors in Tarrant County and is known as the Keller monitor.

Figure 6d-4. HYSPLIT Back Trajectories for One of the Violating Monitors in Tarrant County[27]



[27] This is the fourth of four violating monitors in Tarrant County and is known as the Fort Worth Northwest monitor.

Figure 6e. HYSPLIT Back Trajectories for the Violating Monitor in Collin County

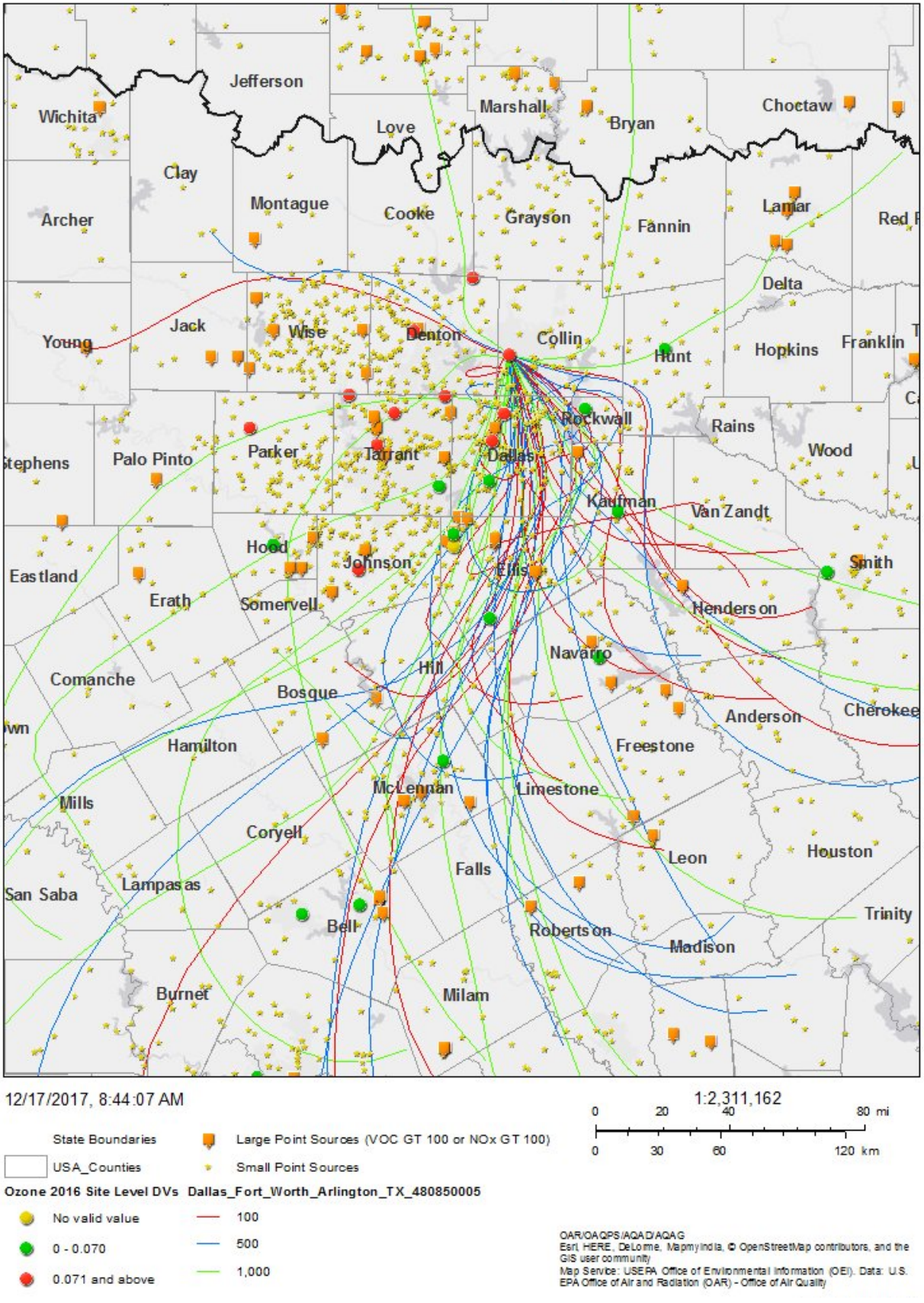
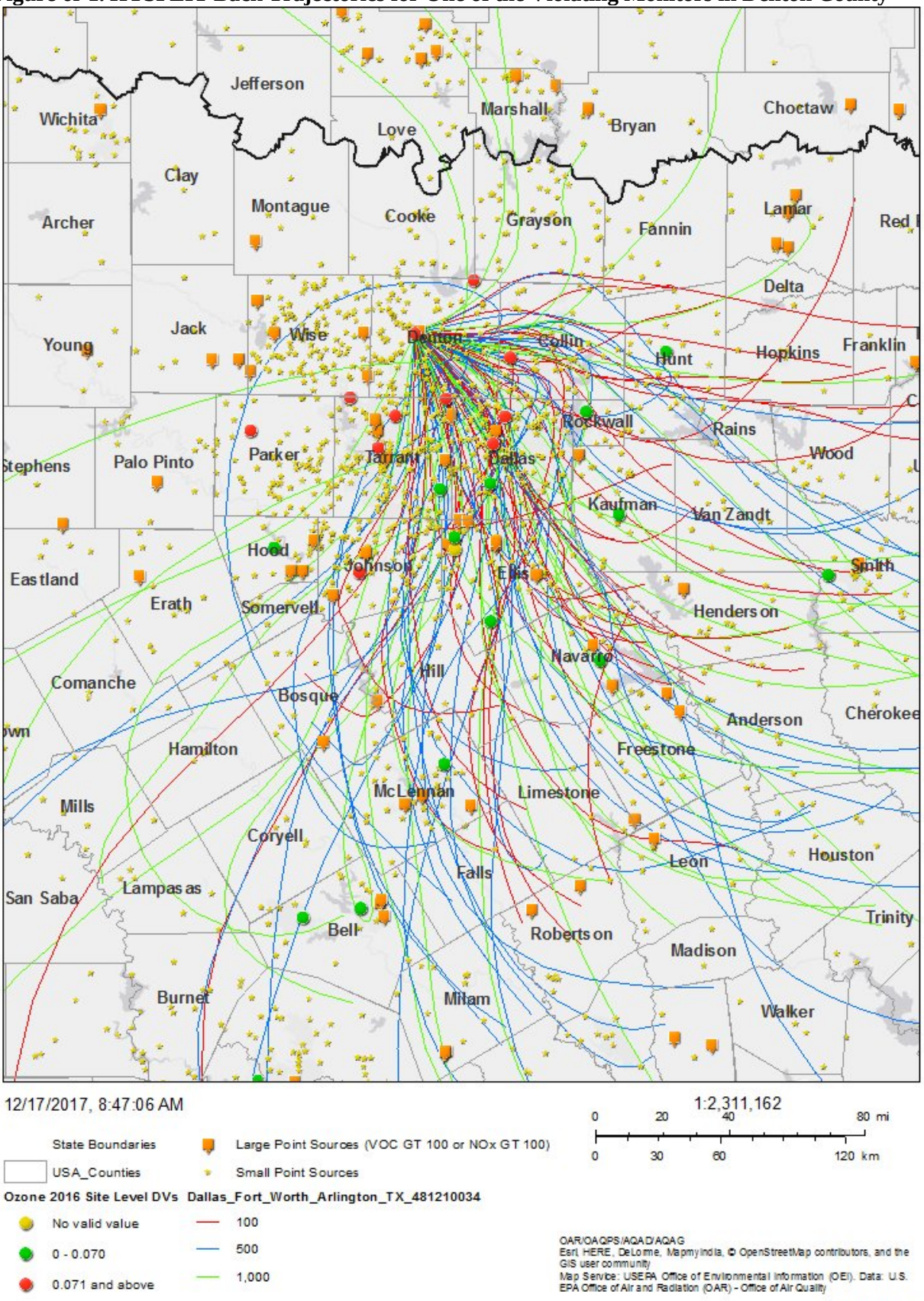
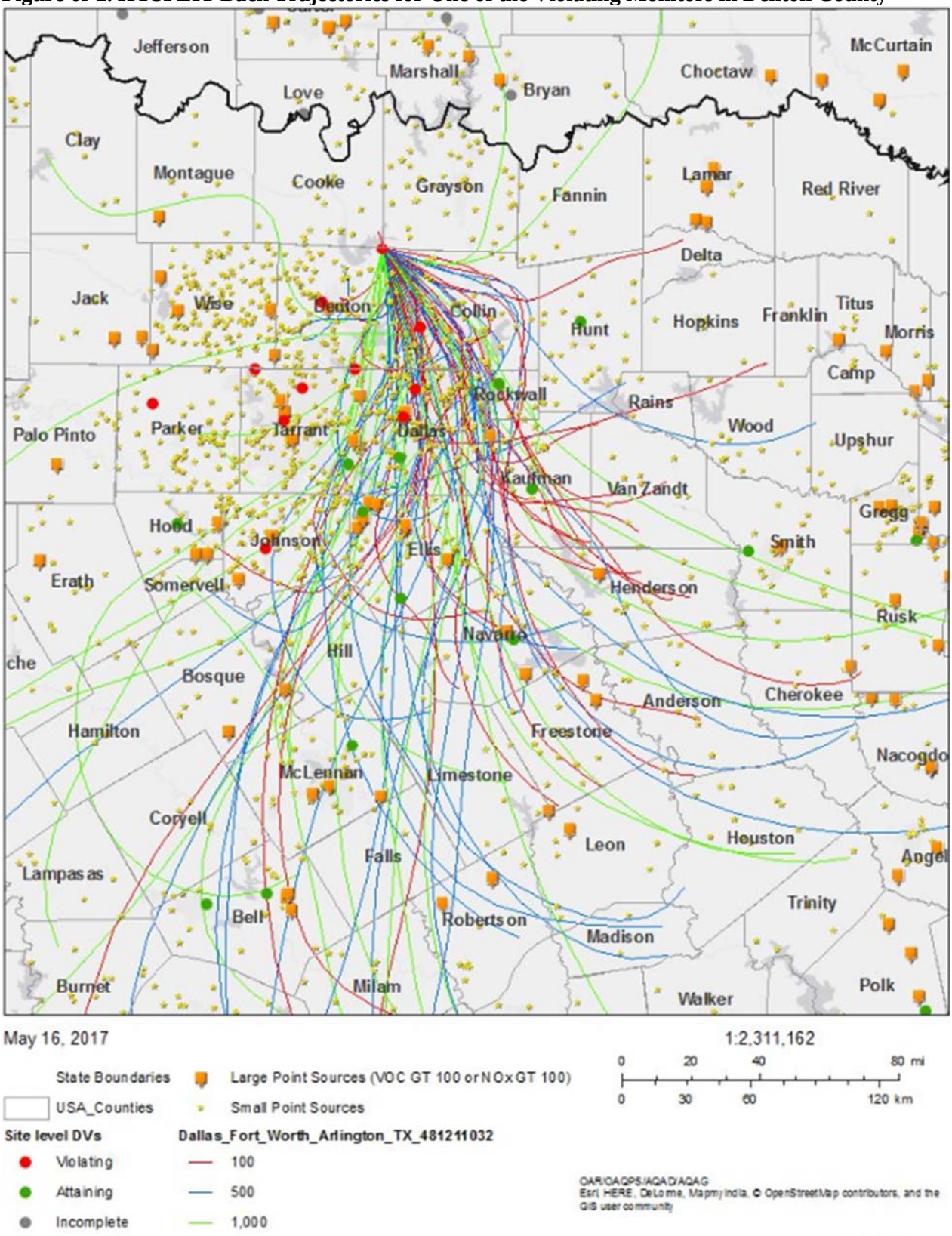


Figure 6f-1. HYSPLIT Back Trajectories for One of the Violating Monitors in Denton County[28]



[28] This is the Denton Airport South monitor – it has the higher ozone DV of the 2 violating monitors in Denton County.

Figure 6f-2. HYSPLIT Back Trajectories for One of the Violating Monitors in Denton County[29]



[29] This is the second of two violating monitors in Denton County and is known as the Pilot Point monitor.

Most of the HYSPLIT back trajectories show air movement from the east, southeast, and south, with several exceptions, as described here: the HYSPLIT maps for Parker County and three of the Tarrant County monitors (Figures 6a, 6d-2, 6d-3, and 6d-4) show winds predominantly from the east on days when those monitors exceeded the 2015 ozone NAAQS; the HYSPLIT maps for Denton County and one of the Tarrant County monitors (Figures 6f and 6d-1) show winds predominantly from the east, southeast, and south on days when those monitors exceeded the 2015 ozone NAAQS; the HYSPLIT map for Johnson County (Figure 6b) shows winds predominantly from the northeast on days when that monitor exceeded the 2015 ozone NAAQS; the HYSPLIT map for Collin County (Figure 6e) shows winds predominantly from the south on days when that monitor exceeded the 2015 ozone NAAQS; and the HYSPLIT maps for the two Dallas County monitors (Figures 6c-1 and 6c-2) show back trajectories from nearly every direction on days when those monitors exceeded the 2015 ozone NAAQS.

We also note where the HYSPLIT maps show an absence of back trajectories toward the violating monitors: there are no back trajectories showing air flow from Palo Pinto County to the monitor in nearby Parker County on days when that monitor exceeded the 2015 ozone NAAQS (Figure 6a); there is no air flow from Hood County to the monitor in nearby Johnson County on days when that monitor exceeded the 2015 ozone NAAQS (Figure 6b); and there is no air flow from Grayson County to the monitor in nearby Collin County on days when that monitor exceeded the 2015 ozone NAAQS (Figure 6e).

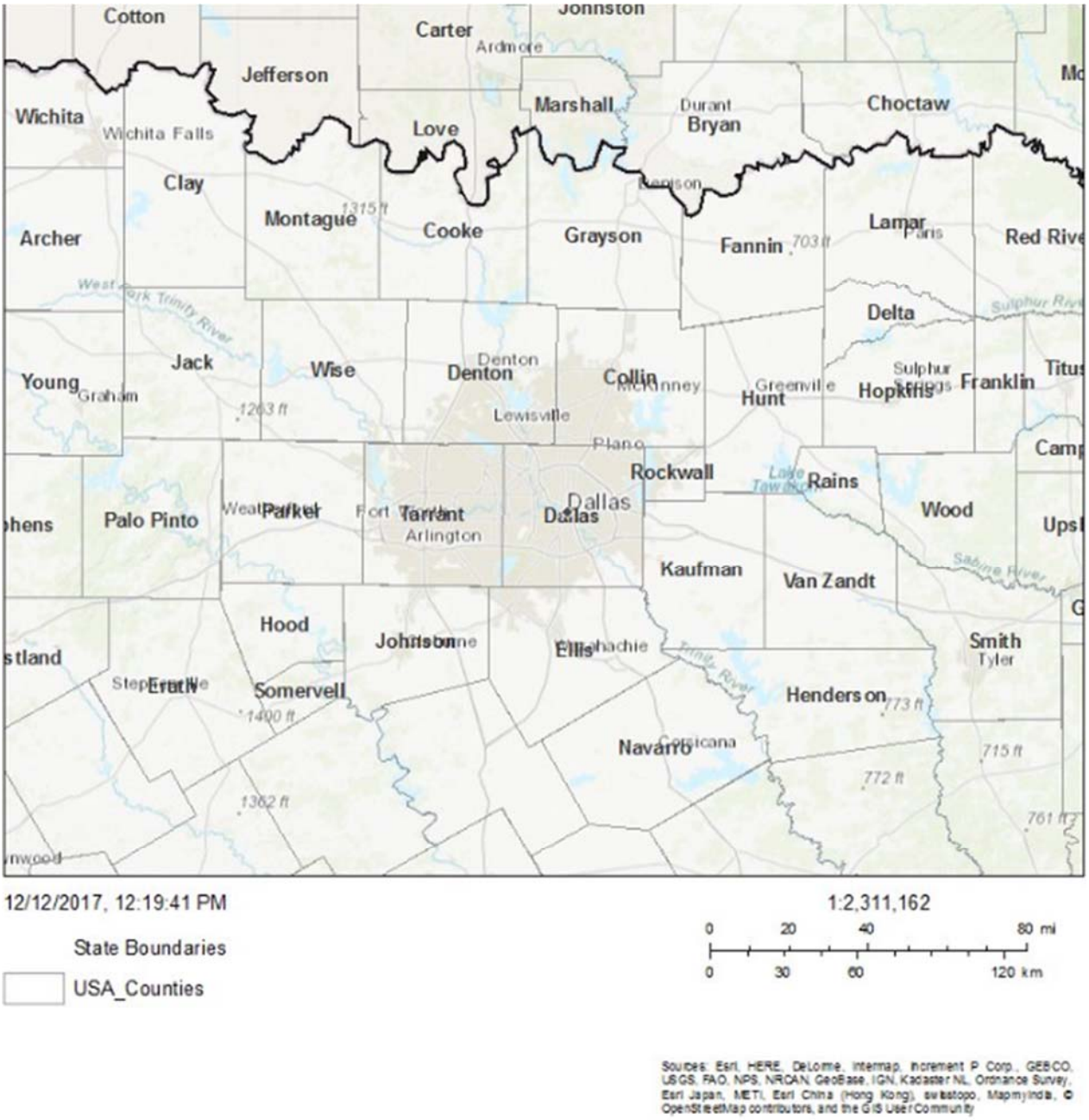
A more detailed discussion of this factor is provided in the conclusion section below.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA evaluated the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area. Figure 7 below illustrates that the DFW area does not have geographical or topographical features that limit air pollution transport within its air shed. Therefore, this factor did not add consequence in this evaluation.

Figure 7. Topographic Illustration of the Physical Features



Factor 5: Jurisdictional boundaries

Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the intended nonattainment area, EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to: counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

The DFW area has a previously established nonattainment boundary associated with the 2008 ozone NAAQS, consisting of these 10 counties: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant and Wise. The State recommended the same 10-county boundary for the 2015 ozone NAAQS. The boundary recommended by the State falls within the boundary of the metropolitan planning organization (MPO).[30] The MPO in this area is the North Central Texas Council of Governments and they provide, among other services, transportation planning, and mobile source emission reduction programs and policies. The State does not have jurisdiction in Indian country and the area of analysis does not include Indian country.

Conclusion for the Dallas/Fort Worth Area

Based on the assessment of factors described above, EPA does not intend to modify the State's recommendation that the following counties be included as part of the Dallas/Fort Worth nonattainment area because they have air quality monitors that indicate a violation of the 2015 ozone NAAQS and/or because they are contributing to a violation in a nearby area: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties. These are the same counties that were designated as nonattainment for the 2008 ozone NAAQS.

The air quality monitors in Collin, Dallas, Denton, Johnson, Parker and Tarrant Counties are violating the 2015 ozone NAAQS based on the 2014-2016 DVs and thus, these counties are included in the nonattainment area.

Ellis County ranks among the highest in NOx emissions (6th), population and VMT (5th), and nearly 60% of workers living in Ellis County commute to one or more of the counties with violating monitors in the area of analysis. Examination of HYSPLIT illustrates that back trajectories to the violating monitors in nearby Dallas, Tarrant, and Johnson Counties passed over large point sources in Ellis County prior to reaching such monitors (see Figures 6b, 6c-1, 6c-2, and 6d-4 above).

Wise County ranks among the highest in NOx (5th) and VOC (5th) emissions in the area of analysis, has over 1 billion VMT and nearly 50% of workers living in Wise County commute to the one or more counties with violating monitors. Examination of back trajectories shows that trajectories to the violating monitors in nearby Johnson County passed over numerous large and small point sources in Wise County before reaching such monitors (see Figure 6a above). One of the back trajectories loops back on itself within Wise County, potentially giving the air mass more opportunity to gather emissions before reaching the violating monitor.

Rockwall County has the 5th highest population density in the area of analysis, more than 800 million VMT, and more than 63% of workers living in Rockwall County commute to the counties with violating monitors. Examination of back trajectories indicates trajectories through Rockwall County before reaching the violating monitors in nearby Collin and Dallas counties (see Figures 6c-1, 6c-2, and 6e above). Rockwall County does not have large point sources and many of the back trajectories pass through counties with higher emissions before and after passing through Rockwall County (see Figures 6c-1 and 6e above), however, because of its high population density (over 700 people per square mile) and commuter traffic contribution, Rockwall County is an integral part of the urban area within the area of analysis and is contributing area and mobile source NOx and VOC emissions to the nearby violating monitors.

Kaufman County has the 4th highest percentage of population growth (11%) and the 6th highest VMT (over 2 billion) in the area of analysis, and more than 61% of workers living in Kaufman County commute to the counties with violating monitors. Examination of back trajectories shows air flow through Kaufman County before reaching the violating monitors in nearby Dallas counties (see Figures 6c-1 and 6c-2). Kaufman County has one large point source and many of the back trajectories pass through counties with higher emissions before

[30] The MPO is a federally mandated and federally funded transportation policy-making organization in the United States that is made up of representatives from local government and governmental transportation authorities.

and after passing through Kaufman County (see Figures 6c-1 and 6c-2 above). However, because of its population growth and commuter traffic contribution, Kaufman County is an integral part of the urban area within the area of analysis and is contributing area and mobile source NOx and VOC emissions to the nearby violating monitors.

The EPA does not intend to modify the State's recommendation to designate Hood County as attainment/unclassifiable for the 2015 ozone NAAQS. Hood County ranks among the lowest regarding VMT (3rd lowest), VOC (5th lowest) and NOx (6th lowest) emissions, and population (7th lowest) within the area of analysis. Examination of back trajectories shows some trajectories do pass through Hood County prior to reaching the violating monitor in nearby Parker County (see Figure 6a above). However, these same trajectories subsequently pass through counties with much higher emissions, VMT, and population. In one example, a trajectory passes through Hood, then through Tarrant, Denton, and Wise Counties before reaching the violating monitor. Another trajectory passes through Hood, then through Johnson and Tarrant Counties, and finally over numerous small point sources in Parker County before reaching the violating monitor in Parker County. In comparison to Hood County, Tarrant County emits 12 to 15 times more NOx and VOC and Denton and Wise Counties emit 4 to 6 times more NOx and VOC; Tarrant County has about 28 times more VMT, Denton County has about 11 times more VMT, and Wise County has almost twice the VMT; and workers that commute from Tarrant to Parker County are 7 times the number that commute from Hood to Parker County. There are three other trajectories that flow through Hood County to the violating monitor in Parker County - one of these back trajectories passes through other counties in the southeast, including McLennan County, which emits almost 4 times more NOx (9,897 tpy) and about 2.5 times more VOC (6,432 tpy) than Hood County. The other two pass through counties multiple counties further south and flow over large and small point sources before reaching Hood County. Examination of back trajectories shows that air does not flow through Hood County before reaching the violating monitor in nearby Johnson County (see Figure 6b above). For these reasons, we believe Hood County does not contribute to violations at the nearby monitors and we do not intend to designate Hood County as nonattainment.

The EPA does not intend to modify the State's recommendation to designate Grayson County attainment/unclassifiable for the 2015 ozone NAAQS. Grayson County has no large point sources to potentially contribute emissions and is among the lowest in NOx (9^{th}) and commuter data (7^{th}) within the area of analysis. Within the area of analysis, examination of back trajectories shows three parcels of air that flow through Grayson County prior to reaching one of the violating monitors in nearby Denton County (see Figure 6f-1 above) and one parcel of air that flows through Grayson County before reaching the other violating monitor in Denton County (Figure 6f-2 above). However, all of these trajectories pass through at least half of Collin and Denton Counties prior to reaching one of the violating monitors (Figure 6f-1). In comparison to Grayson County, Collin and Denton Counties have 6 to 7 times more population, 5 to 6 times more VMT, and 2 to 3 times more NOx and VOC emissions. Examination of back trajectories shows that air does not pass through Grayson County prior to reaching the violating monitor in nearby Collin County (Figure 6e above).

The EPA does not intend to modify the State's recommendation to designate Hunt County attainment/unclassifiable for the 2015 ozone NAAQS. Hunt County has no large point sources to potentially contribute emissions and is among the lowest in VOC emissions (6^{th}) and commuter data (9^{th}) in the area of analysis. Examination of back trajectories shows that three parcels of air flow through Hunt County prior to reaching the violating monitor in nearby Collin County (see Figure 6e above). None of the trajectories originate in Hunt County. All of these trajectories flow across nearly the entire southern section of Collin County before reaching the violating monitor in comparison to Hunt County, Collin County has 10 times more population 5 times more VMT and 2.5 to 4.5 times more in NOx and VOC emissions.

The EPA does not intend to modify the State's recommendation to designate Cooke County as attainment/unclassifiable for the 2015 ozone NAAQS. Cooke County also has no large point sources to potentially contribute emissions and is among the lowest in NOx emissions (8^{th}), population (4^{th}), VMT (6^{th}) and commuter data (8^{th}) in the area of analysis. Examination of back trajectories shows three parcels of air flow through Cooke County prior to reaching the violating monitors in nearby Denton County (see Figures 6f-1 and 6f-2 above). However, two of the trajectories do not originate in Cooke County and these trajectories both dip deeply into Denton County, passing over numerous small point sources in Denton County before reaching the violating monitor. The trajectory that originates in Cooke County flows past the violating monitor in Denton County in a wide arch to the center of Denton County, then reverses direction and flows in a wider arch back to the violating monitor. In comparison to Cooke County, Denton County emits 2 times more NOx and 3 times more VOC, has 9 times more VMT, 20 times more population, and fewer than 36% of workers residing in Cooke County commute to the counties with the violating monitors.

The EPA does not intend to modify the State's recommendation to designate Bryan, Henderson, Hopkins, Navarro, Palo Pinto, and Somervell counties as attainment/unclassifiable for the 2015 ozone NAAQS. Within the area of analysis, these six counties ranked comparatively low for some or all of the evaluated factors: all have less than 5,000 tpy in VOC emissions; all but Navarro have less than 5,000 tpy in NOx emissions; all but Henderson have the lowest populations and population densities, all but Bryan experienced three percent or less in population growth from 2010 to 2015; all have among the lowest VMT; and all experienced negative VMT growth from 2008 to 2014. In addition, these six counties have the fewest commuters to the counties with violating monitors. Finally, analysis of back trajectories shows that on days when monitors exceeded the standard, there was no air flow from Palo Pinto or Somervell to the violating monitors (Figures 6a and 6b above), and while there are limited trajectories over Henderson, Hopkins, Navarro and Bryan coupled with the relatively low emissions and population, we believe these counties do not contribute to violations at the nearby monitors and we do not intend to designate such counties as nonattainment.

Therefore, in conclusion of our review and analyses of the five factors for the counties in the area of analysis, we do not intend to modify the State's recommendation that the Dallas/Fort Worth nonattainment area for the 2015 ozone standard be comprised of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise counties.

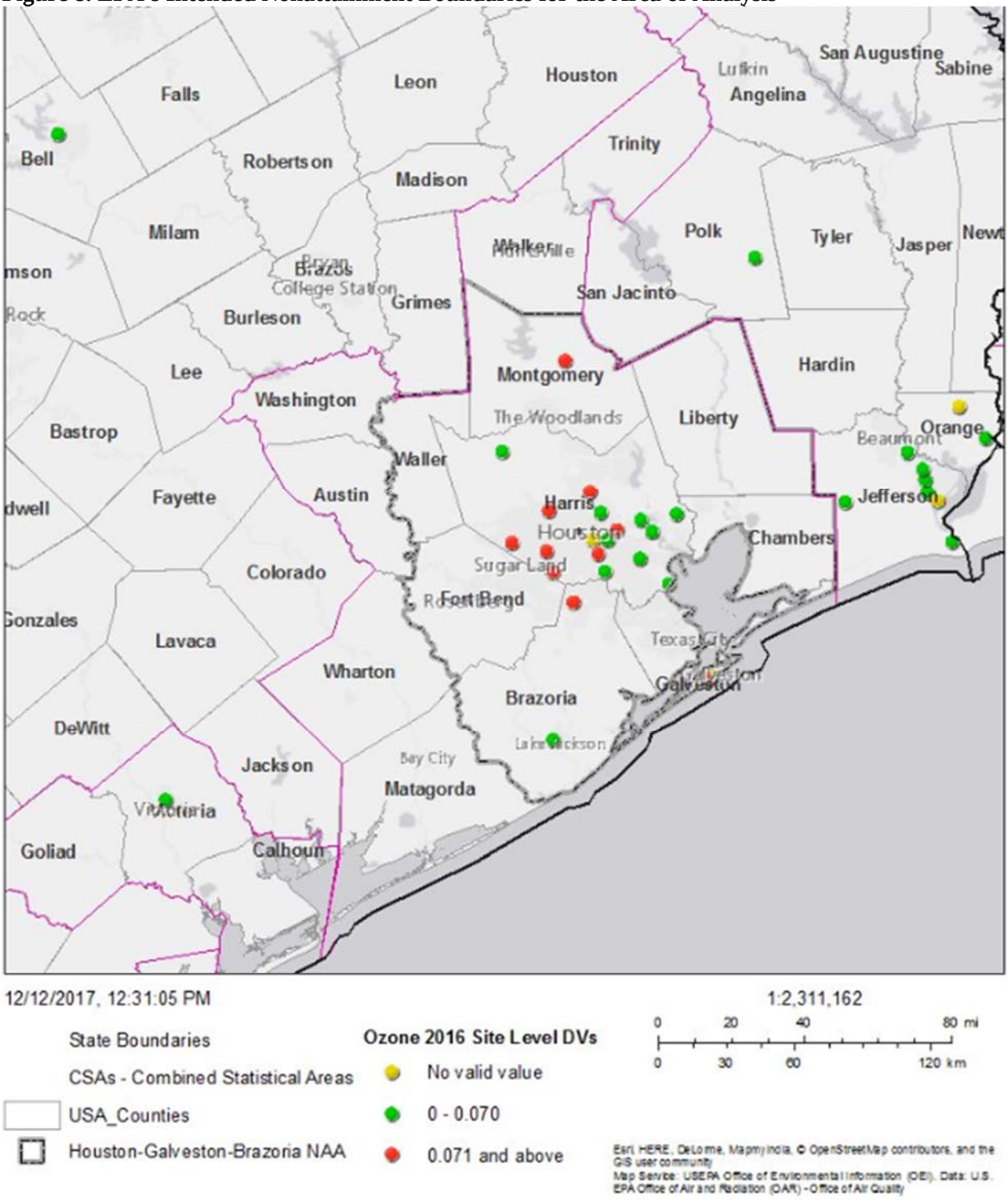
3.2 Technical Analysis for the Houston-Galveston-Brazoria Area

The Core Based Statistical Area (CBSA) is known as Houston-The Woodlands-Sugar Land and includes nine counties: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller. These nine counties, plus the five counties of Matagorda, Trinity, Walker, Washington, and Wharton, are included in the Combined Statistical Area (CSA) known as Houston-The Woodlands. These 14 counties are shown in Figure 8 below and we refer to these 14 counties as the area of analysis.

Figure 8 shows the area of analysis and EPA's intended nonattainment boundary within the area of analysis. The map also shows the location of the ambient air quality monitors, counties, the CSA boundaries and the 2008 ozone NAAQS nonattainment boundaries.

For purposes of both the 1997 and 2008 ozone NAAQS, the following whole counties within the area of analysis were designated nonattainment: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller. The EPA and does not intend to modify the State's recommendation to designate these same eight counties as nonattainment for the 2015 ozone NAAQS.

Figure 8. EPA's Intended Nonattainment Boundaries for the Area of Analysis



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Brazoria, Galveston, Harris and Montgomery Counties have monitors in violation of the 2015 ozone NAAQS, therefore these counties are included in the intended nonattainment area. The EPA determined that Chambers, Fort Bend, Liberty and Waller Counties contribute to the violating area. The following sections describe the weight of evidence five factor analysis. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers the

interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

Factor 1: Air Quality Data

The EPA considered 8-hour ozone design values (DVs) in ppm for air quality monitors in the Houston-Galveston-Brazoria area based on data for the 2014-2016 period (i.e., the 2016 DV). This is the most recent three-year period with fully-certified air quality data. The DV is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.[31] The 2015 NAAQS are met when the DV is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations.[32] The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone DVs. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule[33] are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the DV for the county or area is determined by the monitor with the highest valid DV. The presence of one or more violating monitors (i.e. monitors with DVs greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the most recent DVs violate the 2015 ozone NAAQS, and examined historical ozone air quality measurement data (including previous DVs) to understand the nature of ozone ambient air quality in the area. Eligible monitors for providing DV data generally include State and Local Air Monitoring Stations that are operated in accordance with 40 CFR part 58, appendix A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes.[34]

The 2014-2016 DVs for counties in the area of analysis are shown in Table 6 below.

[31] The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.
[32] The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.
[33] The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance.*
[34] All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible for comparison to the NAAQS, subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

Table 6. Air Quality Data (all values in ppm)[a]

County	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Austin	No	No monitor	N/A			
Brazoria	Yes	480391004	**0.075**	0.071	0.086	0.069
		480391016	0.064	0.061	0.065	0.066
Chambers	Yes	No monitor	N/A			
Fort Bend	Yes	No monitor	N/A			
Galveston	Yes	481671034	**0.076**	0.071	0.084	0.074
Harris	Yes	482010024	**0.079**	0.068	0.095	0.074
		482010026	0.068	0.064	0.081	0.061
		482010029	0.069	0.063	0.078	0.067
		482010046	0.067	0.062	0.078	0.062
		482010047	0.074	0.064	0.091	0.069
		482010051	0.071	0.067	0.079	0.067
		482010055	0.075	0.067	0.080	0.078
		482010062	0.065	0.065	0.073	0.057
		482010066	0.076	0.070	0.079	0.079
		482011017	0.069	0.067	0.077	0.065
		482010416	0.072	0.066	0.087	0.065
		482011015	0.065	0.059	0.079	0.059
		482011034	0.073	0.066	0.088	0.067
		482011035	0.069	0.058	0.084	0.065
		482011039	0.067	0.063	0.077	0.062
		482011050	0.070	0.065	0.083	0.064
Liberty	Yes	No monitor	N/A			
Matagorda	No	No monitor	N/A			
Montgomery	Yes	483390078	**0.072**	0.072	0.073	0.071
Trinity	No	No monitor	N/A			
Walker	No	No monitor	N/A			
Waller	Yes	No monitor	N/A			
Washington	No	No monitor	N/A			
Wharton	No	No monitor	N/A			

[a] The highest design value in each county with a violating monitor is indicated in bold type.
N/A – in this case, no data exists because there is no eligible (regulatory) monitor.

One monitor in Brazoria, Galveston, and Montgomery counties and seven monitors in Harris County show a violation of the 2015 ozone NAAQS, therefore these counties are included in the intended nonattainment area. A county must also be designated nonattainment if it contributes to a violation in a nearby area. Each county within the area of analysis has been evaluated based on the weight-of-evidence of the five factors and other relevant information to determine whether it contributes to the nearby violation. EPA also notes that Harris County also has nine ambient monitors that are meeting the ozone NAAQS. Within the area of analysis, Chambers, Fort Bend, Grimes, Liberty, Matagorda, San Jacinto, Walker, Waller and Wharton counties do not have ozone monitoring sites.

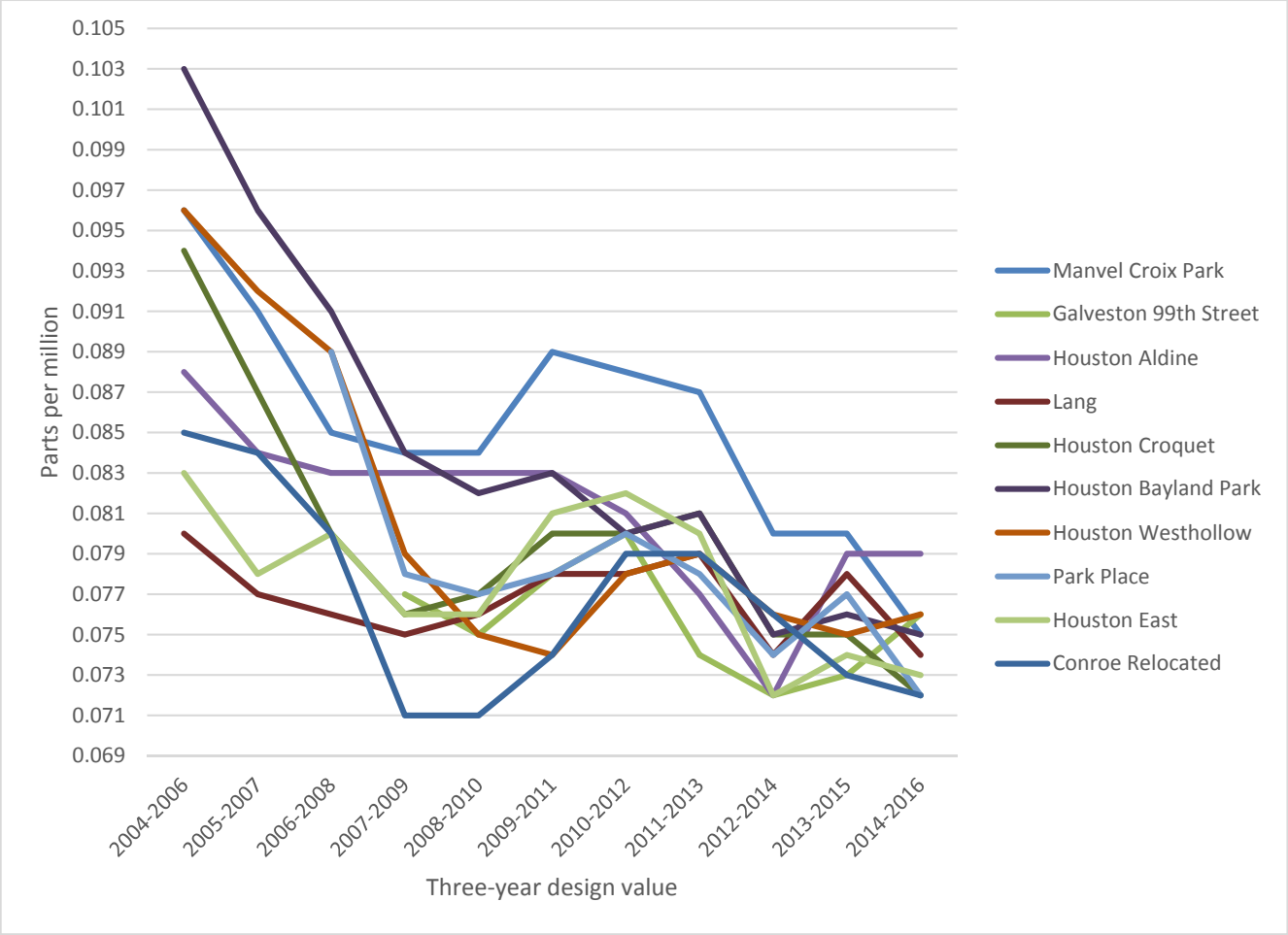
Figure 8 above identifies the Houston-Galveston-Brazoria intended nonattainment area, the CSA boundary and the violating monitors. Table 6 above identifies the DVs for all monitors in the area of analysis and Figure 9 below shows the historical trend of DVs for the violating monitors. As indicated on Figure 8, there are a total of

20 monitors and 10 are in violation of the 2015 ozone standard. The violating monitors are located in Brazoria, Galveston, Montgomery and Harris Counties. The violating monitor in Brazoria County has a DV of 75 ppb and is located about 5 miles south of the Beltway[35] and west of highway 288. Brazoria County also has a monitor with a DV of 64 ppb located in Lake Jackson, about one mile west of highway 288. The violating monitor in Galveston County has a DV of 76 ppb and is located near the southwest edge of the Scholes International Airport on Galveston Island. The violating monitor in Montgomery County has a DV of 72 ppb and is located at the Lone Star Executive Airport in Conroe. Harris County has 7 violating monitors inside the Beltway and one outside the Beltway. The violating monitor which is outside the Beltway is about 16.5 miles west-southwest of the downtown Houston area. Inside the Beltway, the northern-most violating monitor is about 3.5 miles south-southeast of Houston Intercontinental Airport; heading in a clockwise direction, the next violating monitor is about 8.5 miles east of the downtown Houston area and south of I-10; the next is about 6.5 miles southeast of the downtown Houston area, south of I-610 and west of I-45; the next is about 11.5 miles south-southwest of the downtown Houston area; the next is about 9.5 miles southwest of the downtown Houston area; and the last violating monitor inside the Beltway is about 9 miles northwest of the downtown Houston area and south of highway 290. There are 9 monitors in Harris County that are meeting the 2015 ozone standard and one is located in the northwest quadrant of the County, less than a mile south of Grand Parkway, with a DV of 69 ppb. The other 8 monitors are located on the east side of the County: the monitor on North Wayside Drive has a DV of 67 ppb and is about 1.5 miles north of loop 610; the monitor in Galena Park has a DV of 69 ppb and is located about half a mile east of loop 610; the monitor on Monroe Road has a DV of 65 ppb and is located about 2 miles west of I-45 and less than 2 miles north of the Beltway; the monitor on Sheldon Road has a DV of 68 ppb is about 2 miles east of the Beltway and about 1.5 miles north of I-10; the monitor near the northwest corner of Brown Memorial Field has a DV of 67 and is about 1.5 miles east of the Beltway and less than a half mile east of Red Bluff Road; the monitor at the northern tip of San Jacinto State Park has a DV of 65 ppb and is about 4 miles east of the Beltway and about 2 miles south of I-10; the eastern-most monitor has a DV of 69 ppb and is off of Garth and East Wallisville Roads, about 1.25 miles north of I-10; and the monitor in the southeastern-most quadrant of the County has a DV of 70 ppb and is about 1.5 miles northeast of Seabrook, near the western edge of Galveston Bay.

Figure 9 below illustrates the trend in ozone design values since 2006 at the monitors in the area of analysis currently violating the 2015 ozone NAAQS. Figure 9 shows that there has been fluctuation in which monitor records the highest ozone DVs and the northern-most monitor in Harris County (Houston Aldine) has the highest ozone DV (79 ppb) for 2014-2016. In 2011, Figure 9 shows there have been upticks in most of the violating monitors. The overall trend since 2006 is a gradual decrease in ozone levels, with the design value monitor (Houston Aldine) decreasing by an average of 0.9 ppb per year.

[35] The Beltway is also known as the Sam Houston Thruway and it encircles the City of Houston.

Figure 9. Three-Year Design Values for Violating Monitors (2006-2016).



EPA intends to designate as nonattainment the areas with the monitors that are violating the 2015 ozone NAAQS: Brazoria, Montgomery, Galveston, and Harris Counties are included in EPA's intended nonattainment area for the 2015 ozone NAAQS.

Factor 2: Emissions and Emissions-Related Data

The EPA evaluated ozone precursor emissions of nitrogen oxides (NOx) and volatile organic compounds (VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For each county in the area of analysis, the EPA examined the magnitude of large sources (NOx or VOC emissions greater than 100 tons per year) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

Table 7 below provides a county-level emissions summary of NOx and VOC (in tpy) emissions for the area of analysis.

Table 7. Total County-Level NOx and VOC Emissions

County	State Recommended Nonattainment?	Total NOx (tpy)	Total VOC (tpy)

Harris	Yes	85,180	100,518
Galveston	Yes	14,939	12,028
Brazoria	Yes	12,811	15,542
Fort Bend	Yes	12,693	11,876
Montgomery	Yes	8,122	12,956
Chambers	Yes	5,267	26,892
Matagorda	No	3,647	7,167
Wharton	No	3,614	5,747
Liberty	Yes	3,302	6,522
Austin	No	2,684	2,106
Walker	No	2,524	2,301
Waller	Yes	1,946	1,815
Washington	No	1,838	2,233
Trinity	No	767	3,121
	Area wide:	159,334	207,703

Our review of emissions of NOx and VOC in the area of analysis includes emissions from large point sources. The location of these sources, together with the other four factors, can help determine the nonattainment boundaries. The locations of the large and small point sources are shown in Figure 10 below.

Figure 10. Large and Small Point Sources in the Area of Analysis.

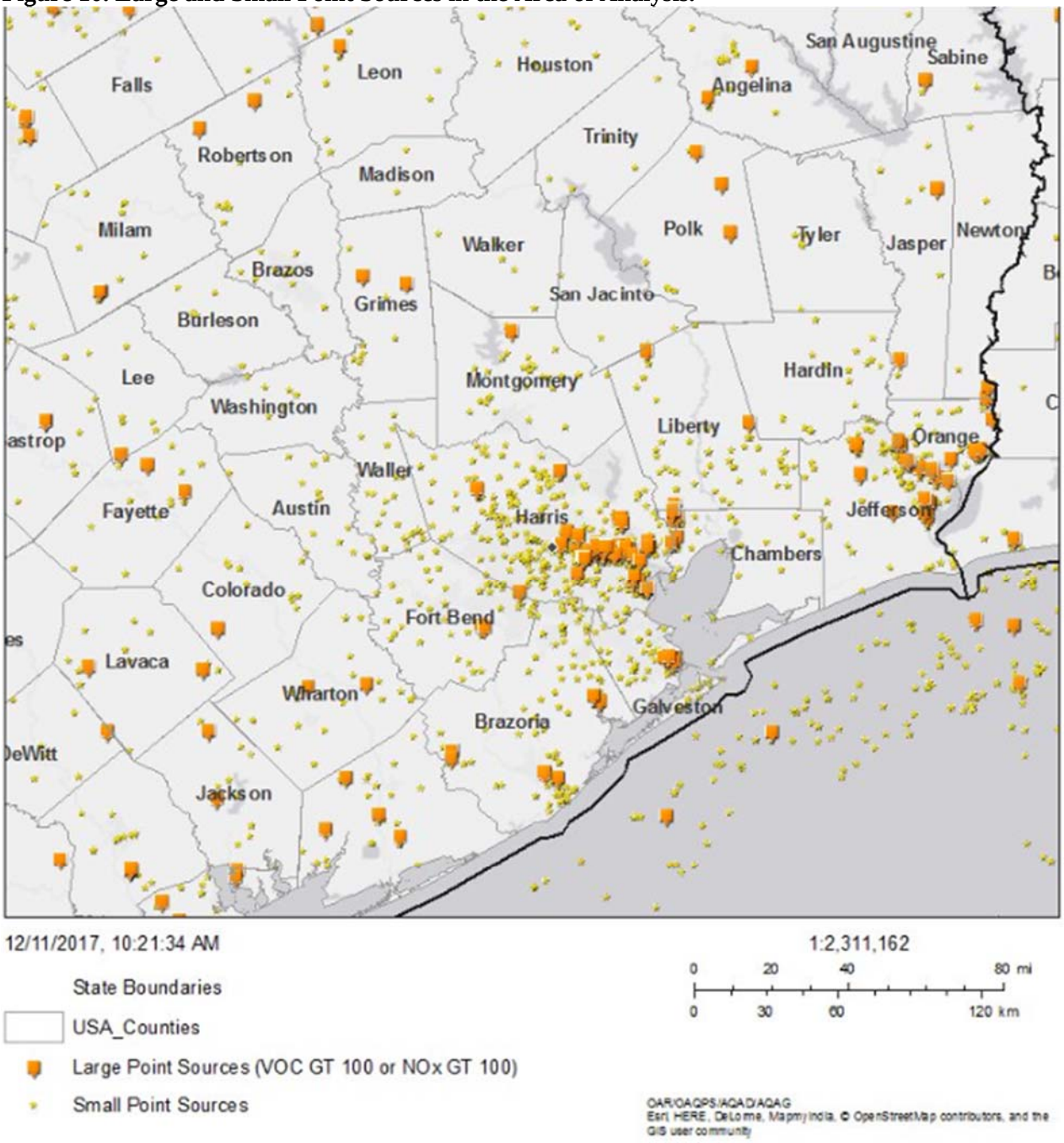


Figure 10 shows that small point sources are ubiquitous, though more concentrated the central portion of the area of analysis, in particular Harris and Galveston Counties. There are fewer large point sources than small point sources and several counties within the area of analysis have no large point sources. We note the cluster of large point sources in Harris County Five counties in the area of analysis are characterized by comparatively high emissions of NOx, which exceed 10,000 tpy: Brazoria, Fort Bend, Galveston, and Harris. Harris County emits the most NOx - about 85,000 tpy - and the other three counties emit between approximately 12,000 and 15,000 tpy. Montgomery County emits about 8,000 tpy in NOx and the remaining counties are characterized by comparatively lower emissions, in the range of 800 to 5,000 tpy.

Six counties in the area of analysis are characterized by comparatively high emissions of VOC, which exceed 11,000 tpy: Brazoria, Chambers, Fort Bend, Galveston, Harris, and Montgomery. Harris County emits the most

VOC (about 100,000 tpy), Chambers emits about 27,000 tpy and the other four counties emit between approximately 12,000 and 16,000 tpy. Wharton, Liberty and Matagorda counties have emissions of VOC in the range of 5,000 to 7,000 tpy. The remaining counties are characterized by comparatively lower emissions, in the range of 1,800 to 2,300 tpy.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include emissions of NOx and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NOx and VOC emissions that may contribute to violations of the NAAQS. Table 8 below shows the population, population density, and population growth information for each county in the area of analysis. Figure 11 contains a county-level density map of the area of analysis.

Table 8. Population and Growth

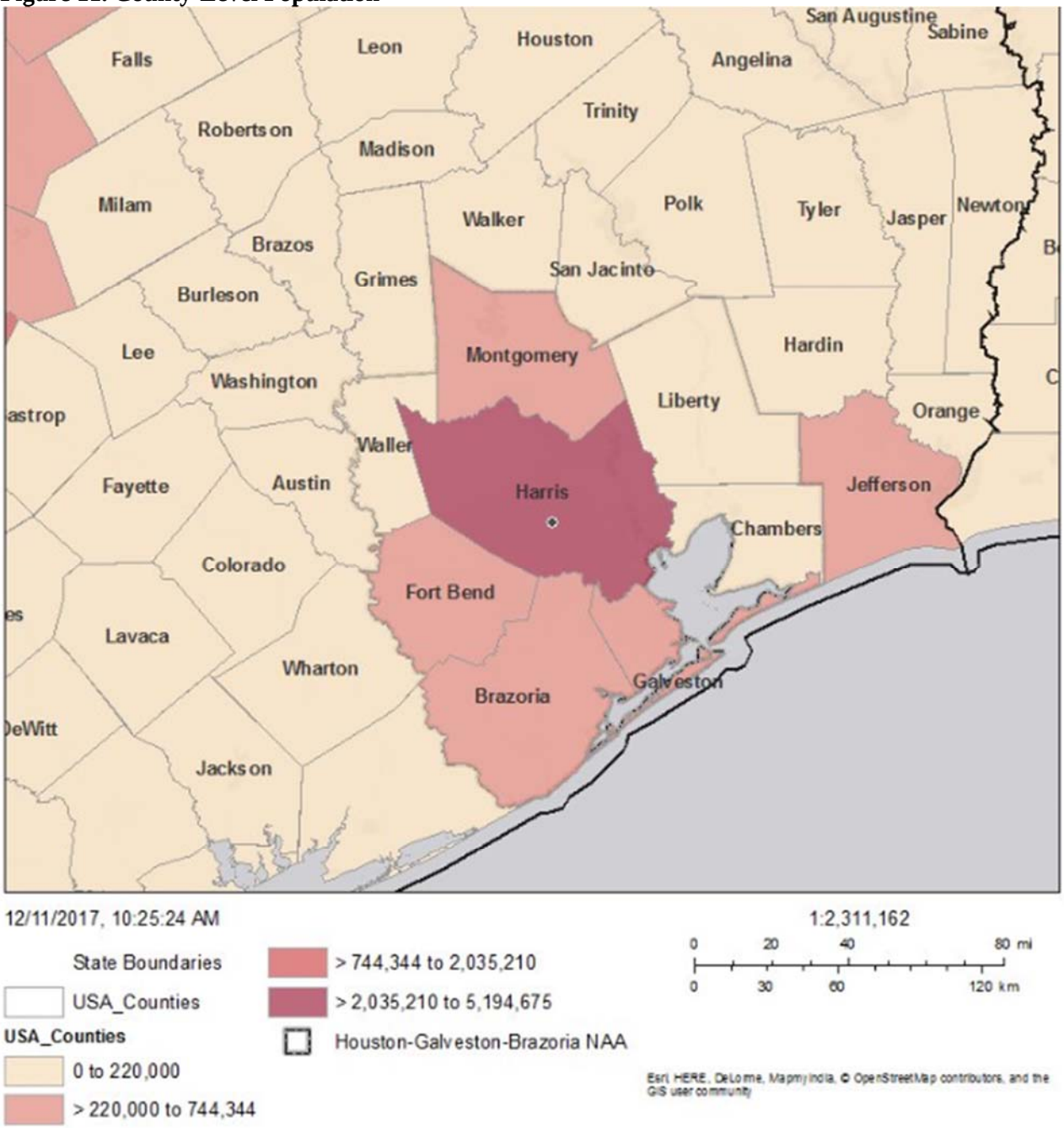
County	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Harris	Yes	4,092,459	4,538,028	2664	445,569	11
Fort Bend	Yes	585,375	716,087	831	130,712	22
Montgomery	Yes	455,746	537,559	516	81,813	18
Brazoria	Yes	313,166	346,312	255	33,146	11
Galveston	Yes	291,309	322,225	852	30,916	11
Liberty	Yes	75,643	79,654	69	4,011	5
Walker	No	67,861	70,699	90	2,838	4
Waller	Yes	43,205	48,656	95	5,451	13
Wharton	No	41,280	41,486	38	206	1
Chambers	Yes	35,096	38,863	65	3,767	11
Matagorda	No	36,702	36,770	33	68	0
Washington	No	33,718	34,765	58	1,047	3
Austin	No	28,417	29,563	46	1,146	4
Trinity	No	14,585	14,402	21	-183	-1
	Area wide:	6,114,562	6,855,069	547	740,507	12

Source: U.S. Census Bureau population estimates for 2010 and 2015. See www.census.gov/data.html.

The 2015 Census data indicate that the majority of the population within the area of analysis resides in the counties of Brazoria, Fort Bend, Galveston, Harris, and Montgomery - each of these counties is characterized by population counts in excess of 300,000 people and population densities greater than 200 people per square mile. The remaining counties are characterized by lower populations ranging from approximately 14,000 to 80,000 and population densities ranging from 21 to 95 people per square mile.

From 2010 to 2015, Fort Bend and Montgomery Counties experienced the highest percent change in population, with increases of 22% and 18%, respectively. Waller County experienced a 13% increase in population growth during the same period. Harris County experienced the highest absolute population change of over 445,000, which is approximately 11% more than in 2010, and Brazoria, Galveston, and Chambers also grew by about 11% during the same period. Liberty County grew by 5%, Walker and Austin Counties grew by 4%, Washington County grew by 3% and Wharton County grew by 1% during the same period. The remaining counties in the area of analysis experienced zero or negative population growth from 2010 to 2015.

Figure 11. County-Level Population



Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total vehicle miles traveled (VMT) for each county in the area of analysis.[36] In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban

[36] The VMT data are available from the NEI (see https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei). See also https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.

perimeter may signify increasing integration with the core urban area, and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated 2014 worker data collected by the U.S. Census Bureau for the counties in the area of analysis.[37] Table 9 shows the traffic and commuting pattern data, including total VMT for each county, number of residents who work in each county, number of residents that work in each county, and the percent of residents working in counties with violating monitors.

Table 9. Traffic and Commuting Patterns

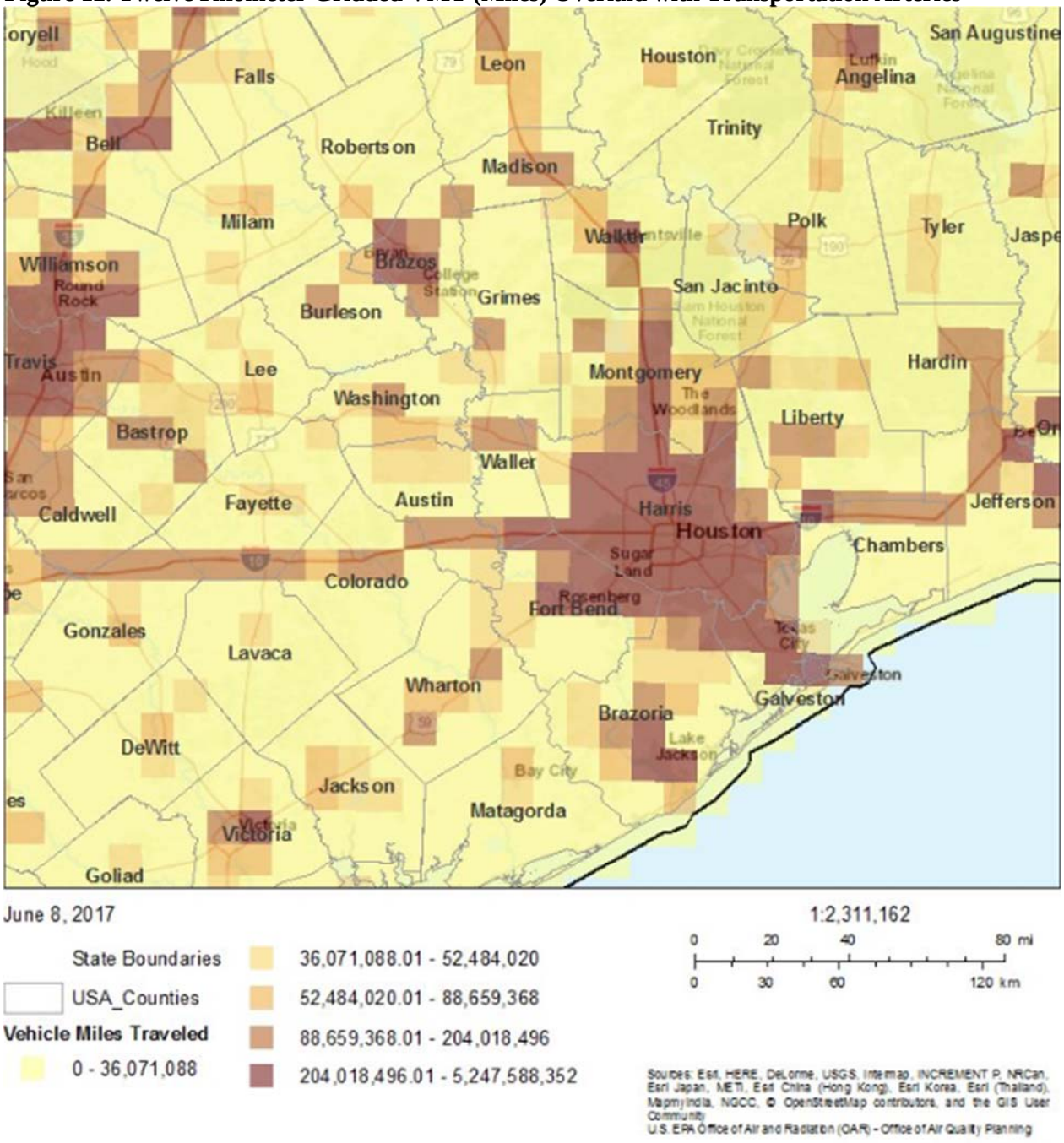
County	State Recommended Nonattainment?	2008 Total VMT (Million Miles)	2014 Total VMT (Million Miles)	VMT Growth 2008 to 2014 (percent)	Number of County Residents Who Work	Number Commuting to or Within Counties with Violating Monitor(s)	Percentage Commuting to or Within Counties with Violating Monitor(s)
Harris	Yes	40,379	40,481	0.3%	1,874,608	1,597,010	85.2
M**ontgomery**	Yes	3,982	4,517	13.4%	218,136	179,612	82.3
Fort Bend	Yes	3,339	3,652	9.4%	308,462	205,064	66.5
Brazoria	Yes	2,263	2,281	0.8%	149,107	126,362	84.7
Galveston	Yes	2,210	2,127	-3.8%	138,998	121,866	87.7
Chambers	Yes	935	969	3.6%	20,624	13,419	65.1
Walker	No	944	881	-6.7%	21,308	5,883	27.6
Liberty	Yes	865	812	-6.1%	35,507	21,005	59.2
Waller	Yes	759	760	0.2%	17,991	10,099	56.1
Wharton	No	690	657	-4.7%	22,012	7,120	32.3
Austin	No	542	520	-4%	15,420	5,457	35.4
Washington	No	515	454	-11.8%	16,692	3,382	20.3
Matagorda	No	343	316	-7.9%	18,892	7,660	40.5
Trinity	No	137	133	-2.9%	5,402	1,249	23.1
	Total:	57,902	58,559	1.1%			

Counties with a monitor(s) violating the NAAQS are indicated in bold.

To show traffic and commuting patterns, Figure 12 (below) overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.

[37] The worker data can be accessed at: http://onthemap.ces.census.gov/.

Figure 12. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



Commuters in the area of analysis traveled a total of over 58 billion miles during calendar year 2014. The greatest VMT is concentrated around major highways in the counties of Harris, Montgomery, and Galveston. Harris County accounts for a large portion of that – over 40 million miles. Four other counties in the area of analysis (Montgomery, Fort Bend, Brazoria and Galveston,), each have total VMT for calendar year 2014 in excess of 2 billion miles. Wharton, Waller, Liberty, Walker and Chambers have VMT ranging from 650 to 970 million, respectively, Austin County has 520 million, Washington County has over 450 million, Matagorda has over 300 million and Trinity has the lowest VMT (over 100 million).

Montgomery County experienced double-digit growth in VMT from 2008 – 2014 (+13.4%), followed by Fort Bend County (+9.4%).[38] Chambers, Brazoria, Harris and Waller counties all saw growth in VMT during this

[38] To calculate VMT growth we compared VMT from the 2008 and 2014 NEIs.

period, but to a lesser extent Chambers County (+3.6%), Brazoria County (+0.8%), Harris County (+0.3%), and Waller County (+0.2%). The remaining counties within the area of analysis experienced negative growth in VMT, ranging from (-2.9%) to (-11.8%).

The four counties in the area of analysis with the highest percentage of commuters to or within counties with violating monitors are the those with the violating monitors: Galveston (88%), Harris and Brazoria (both 85%), and Montgomery (82%). In addition, 56% to 67% of workers living in Waller, Liberty, Chambers and Fort Bend counties commute to the counties with the violating monitors. Over 40% of workers living in Matagorda County commute to the counties with the violating monitors. A range of 20% to 35% of workers living in the remaining counties commute to the counties with the violating monitors.

Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources in the area. EPA conducted analyses to better understand the area's meteorological transport conditions using the National Oceanic and Atmospheric Administration Hybrid Single Particle Lagrangian Integrated Trajectory Model (NOAA HYSPLIT or HYSPLIT). The HYSPLIT model yields an estimate of the path an air mass has traveled before reaching a monitor at a specific location and time. Specifically, the model provides the centerline of the probable path. By evaluating these estimates of where an air mass has traveled before reaching a monitor where an exceedance has occurred, one can consider what potential areas and emission sources could have contributed to the exceedance. The EPA evaluated 2014-2016 HYSPLIT trajectories at 100, 500, and 1000 meters AGL that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figures 13a – 13j show the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8 hour values that exceed the 2015 ozone NAAQS) for the violating monitors.

Figure 13a. HYSPLIT Back Trajectories for the Violating Monitor in Montgomery County

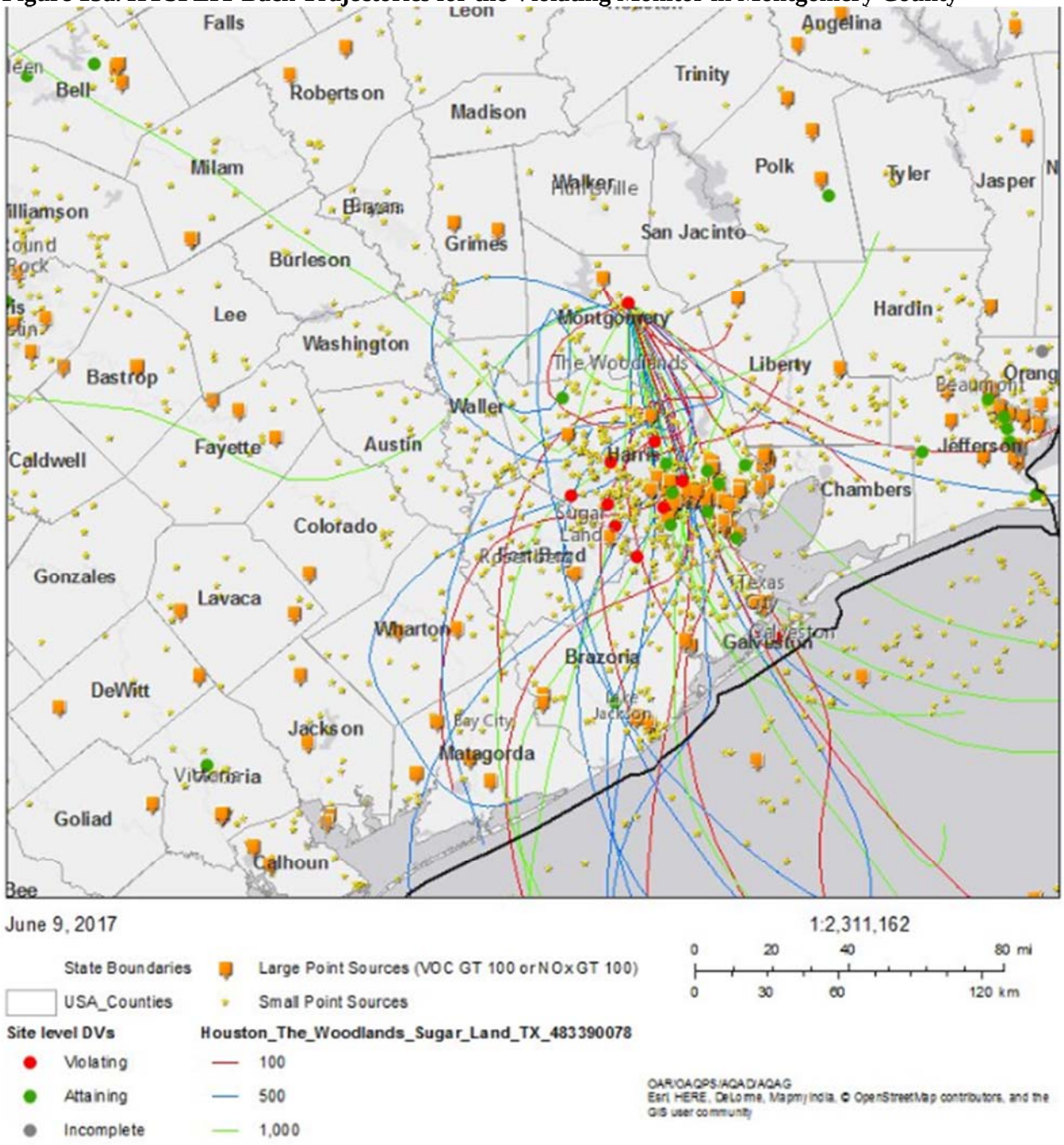


Figure 13b. HYSPLIT Back Trajectories for the Violating Monitor in Brazoria County

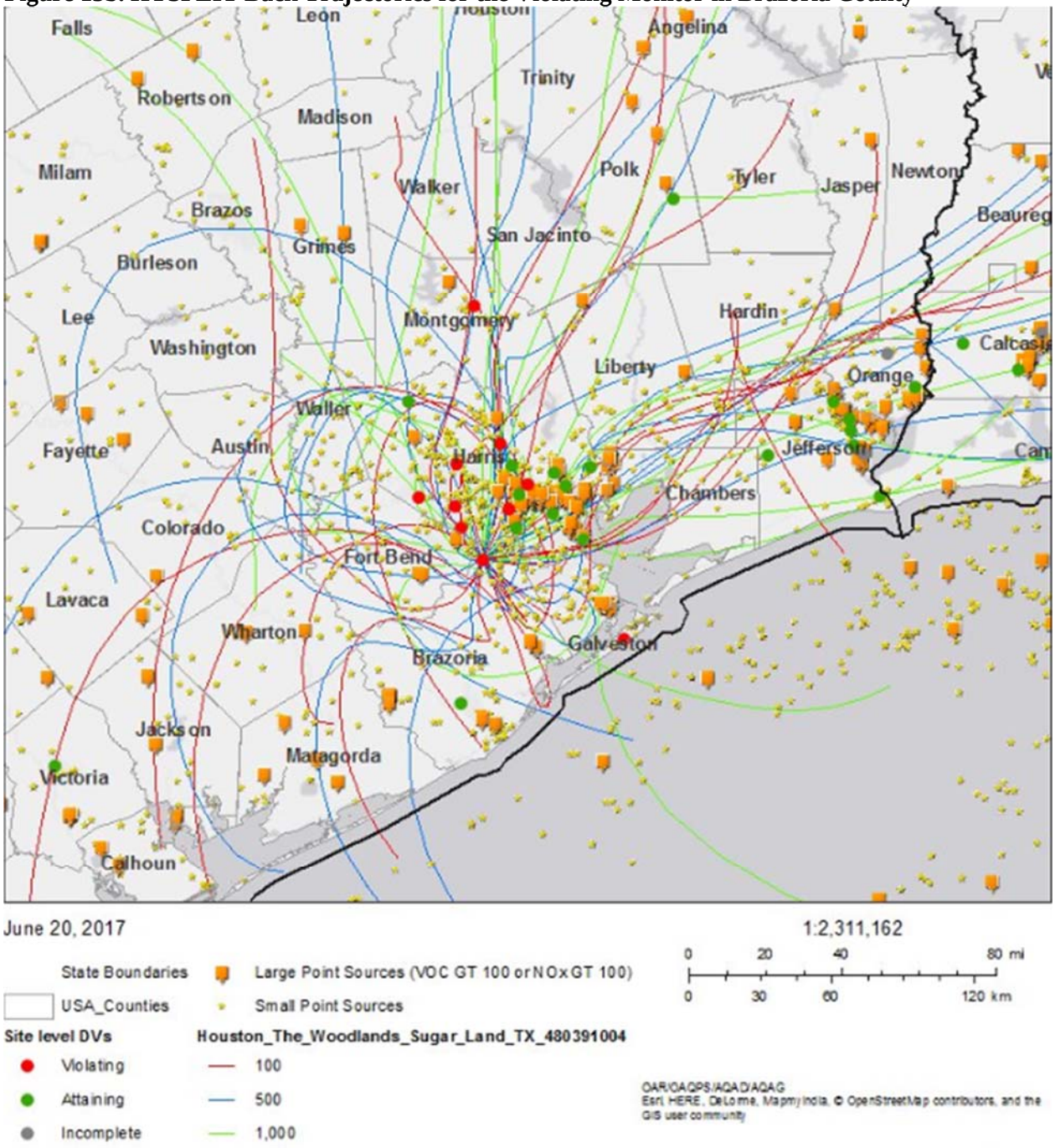


Figure 13c. HYSPLIT Back Trajectories for the Violating Monitor in Galveston County

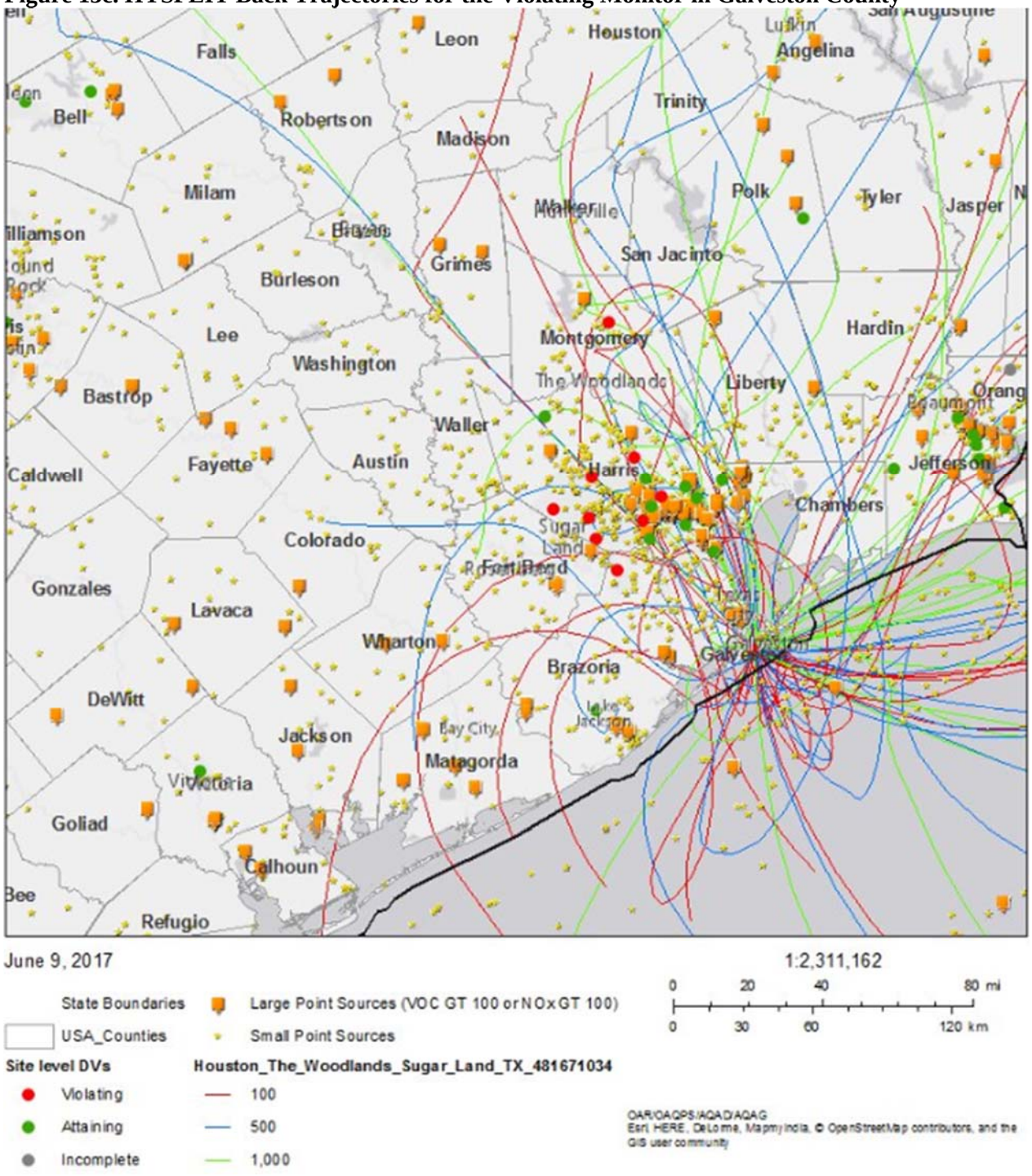
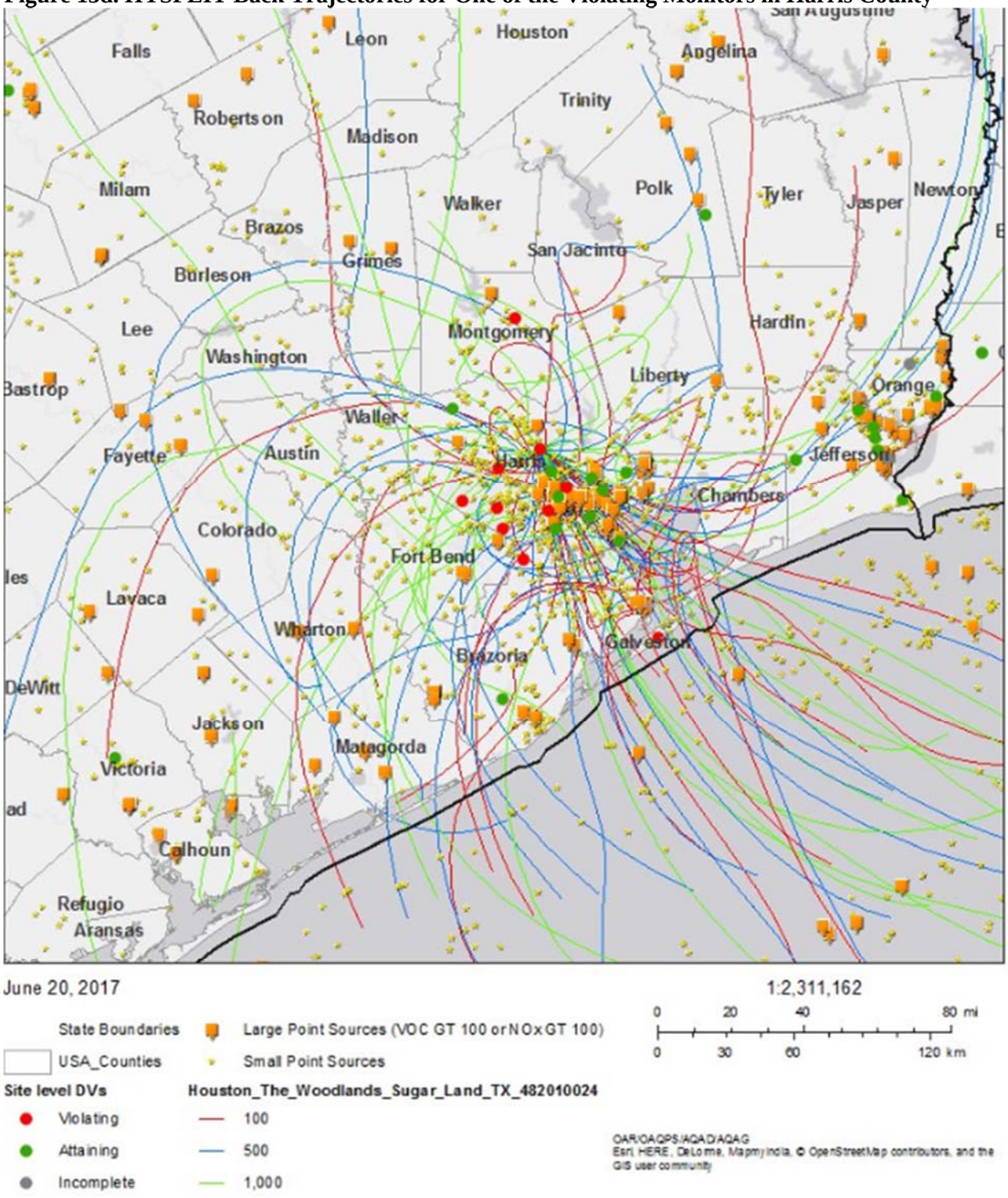
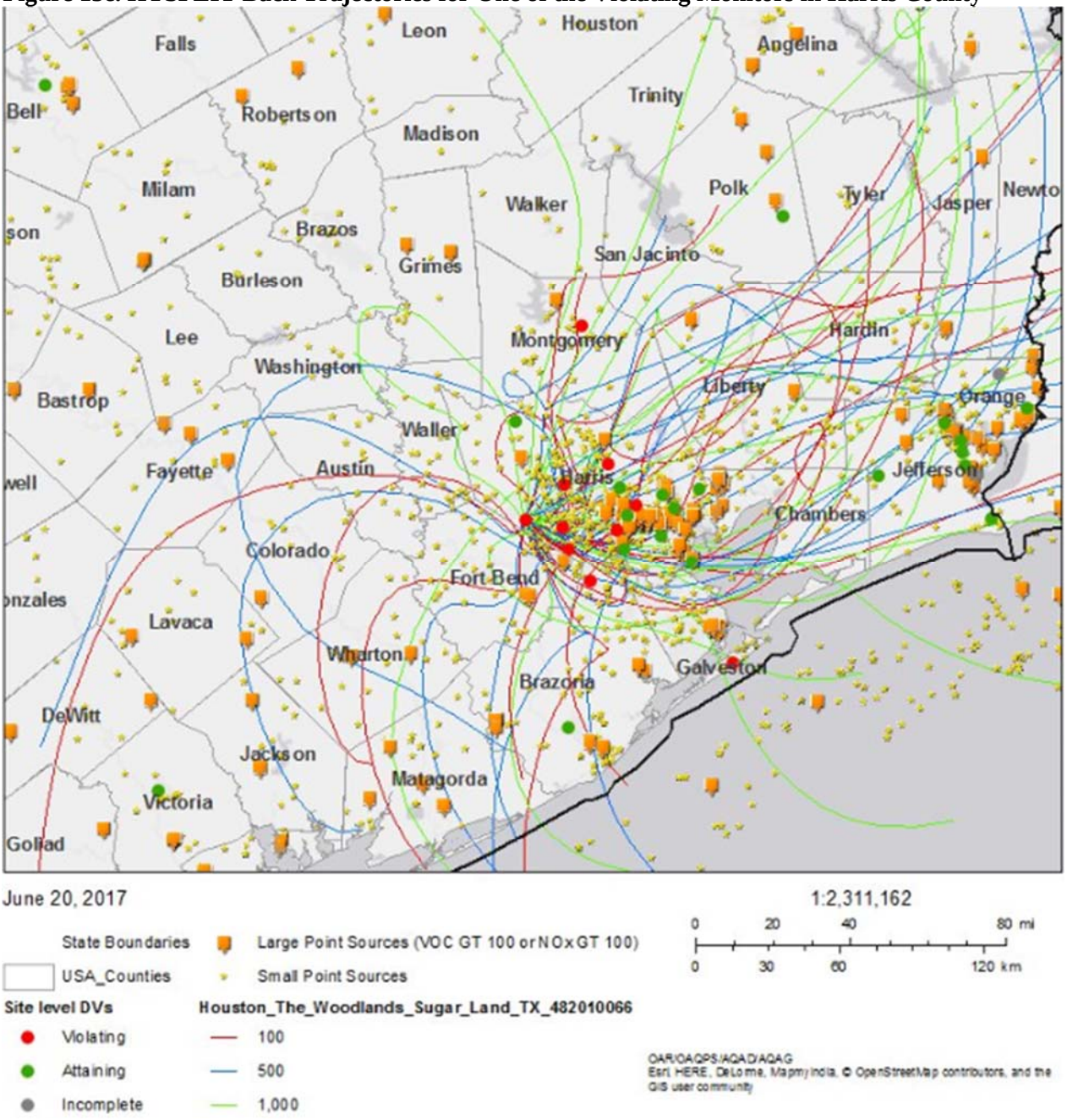


Figure 13d. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[39]



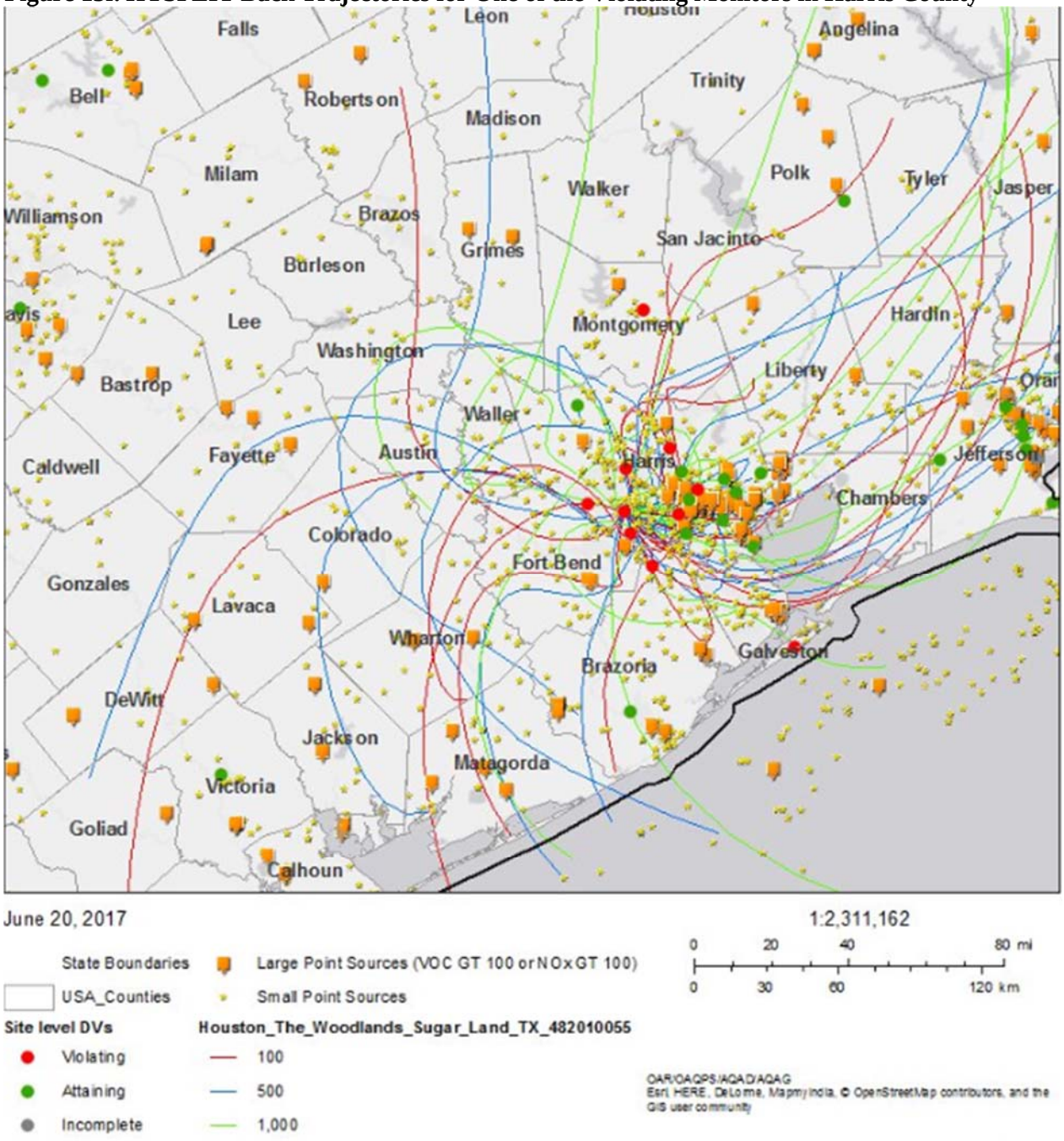
[39] This is the Houston Aldine monitor, which has the highest design value of the seven violating monitors in Harris County.

Figure 13e. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[40]



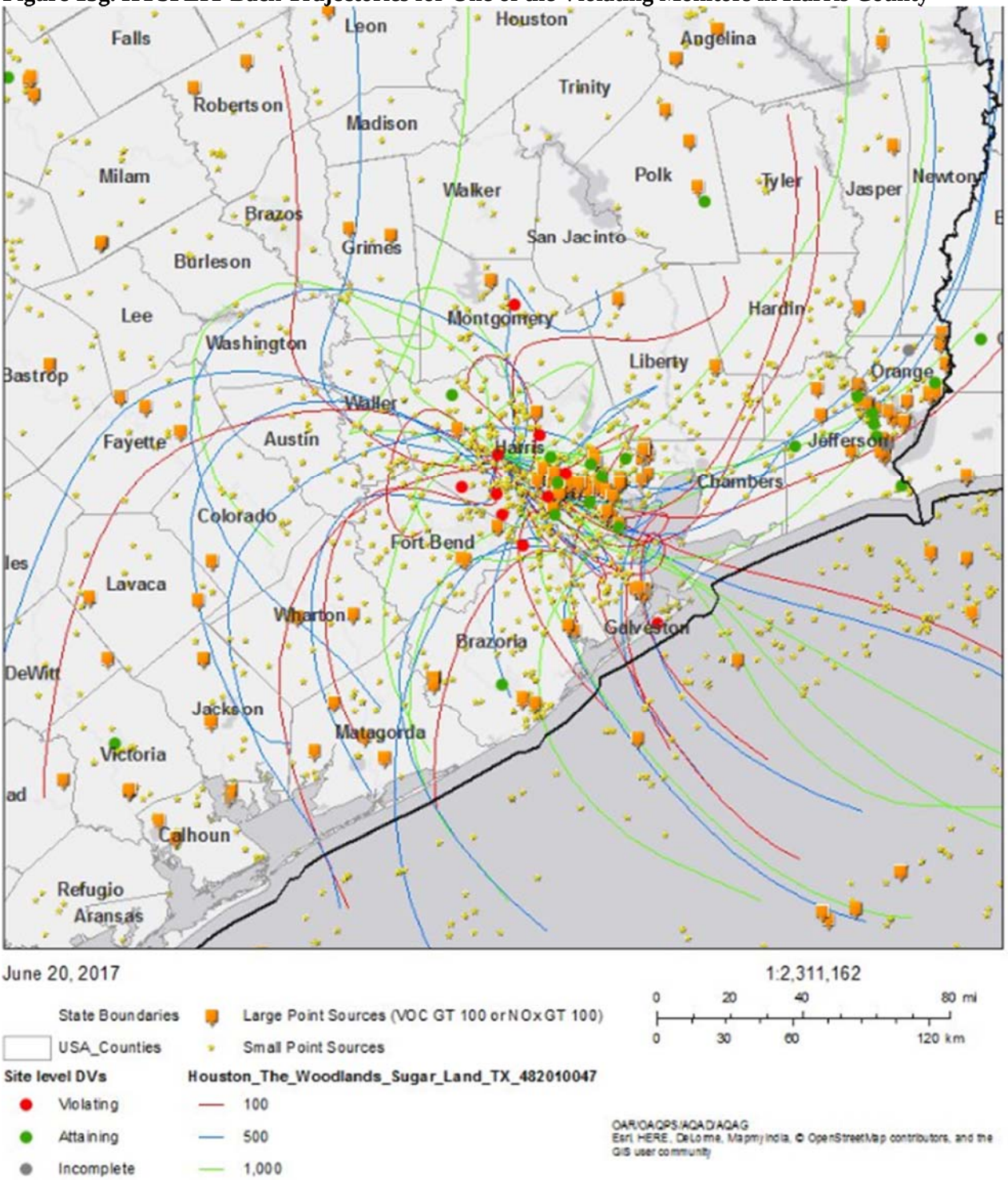
[40] This is the Westhollow monitor, which has the second highest design value of the seven violating monitors in Harris County.

Figure 13f. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[41]



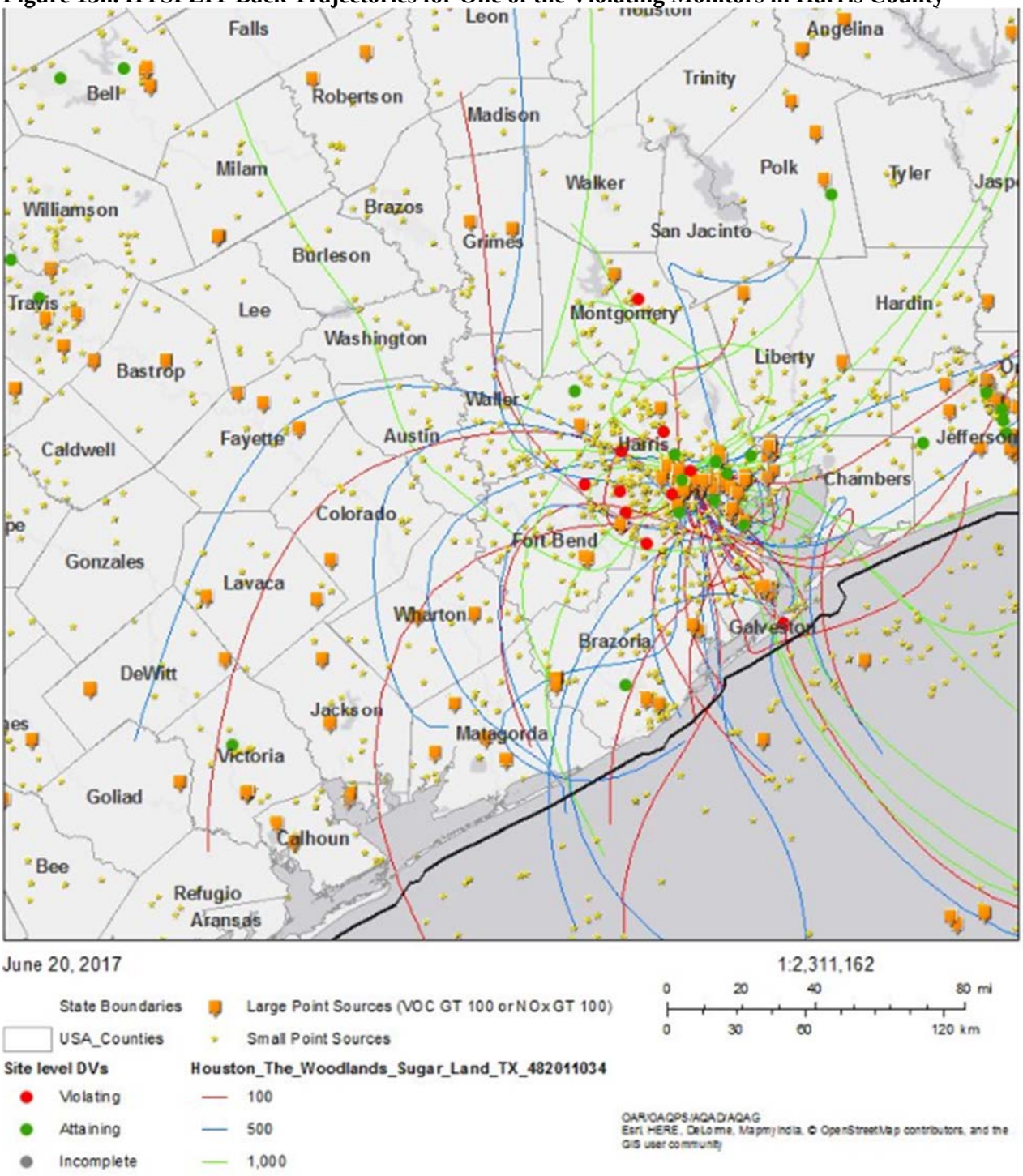
[41] This is the Bayland Park monitor, which has the third highest design value of the seven violating monitors in Harris County.

Figure 13g. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[42]



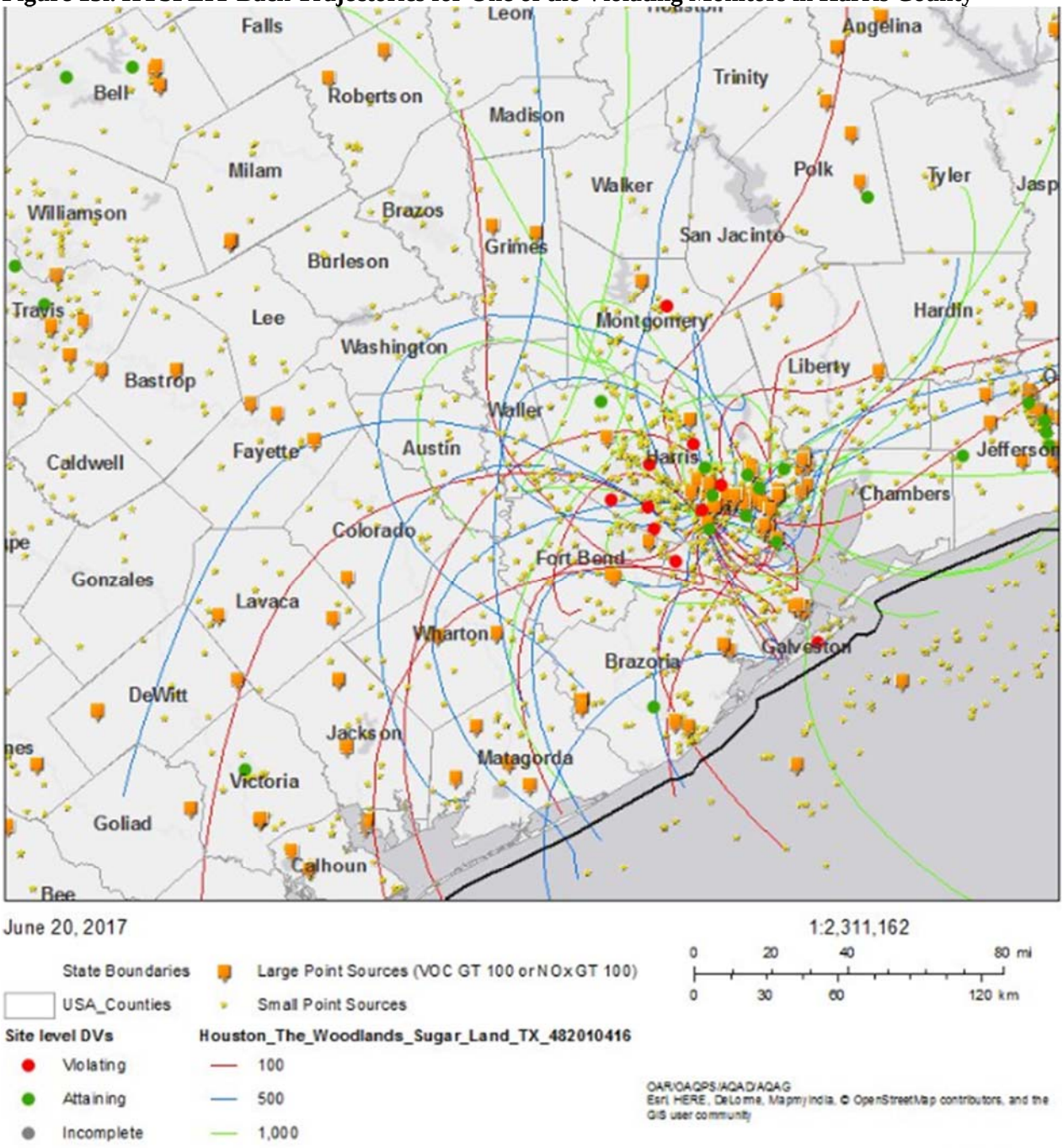
[42] This is the Lang monitor, which has the fourth highest design value of the seven violating monitors in Harris County.

Figure 13h. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[43]



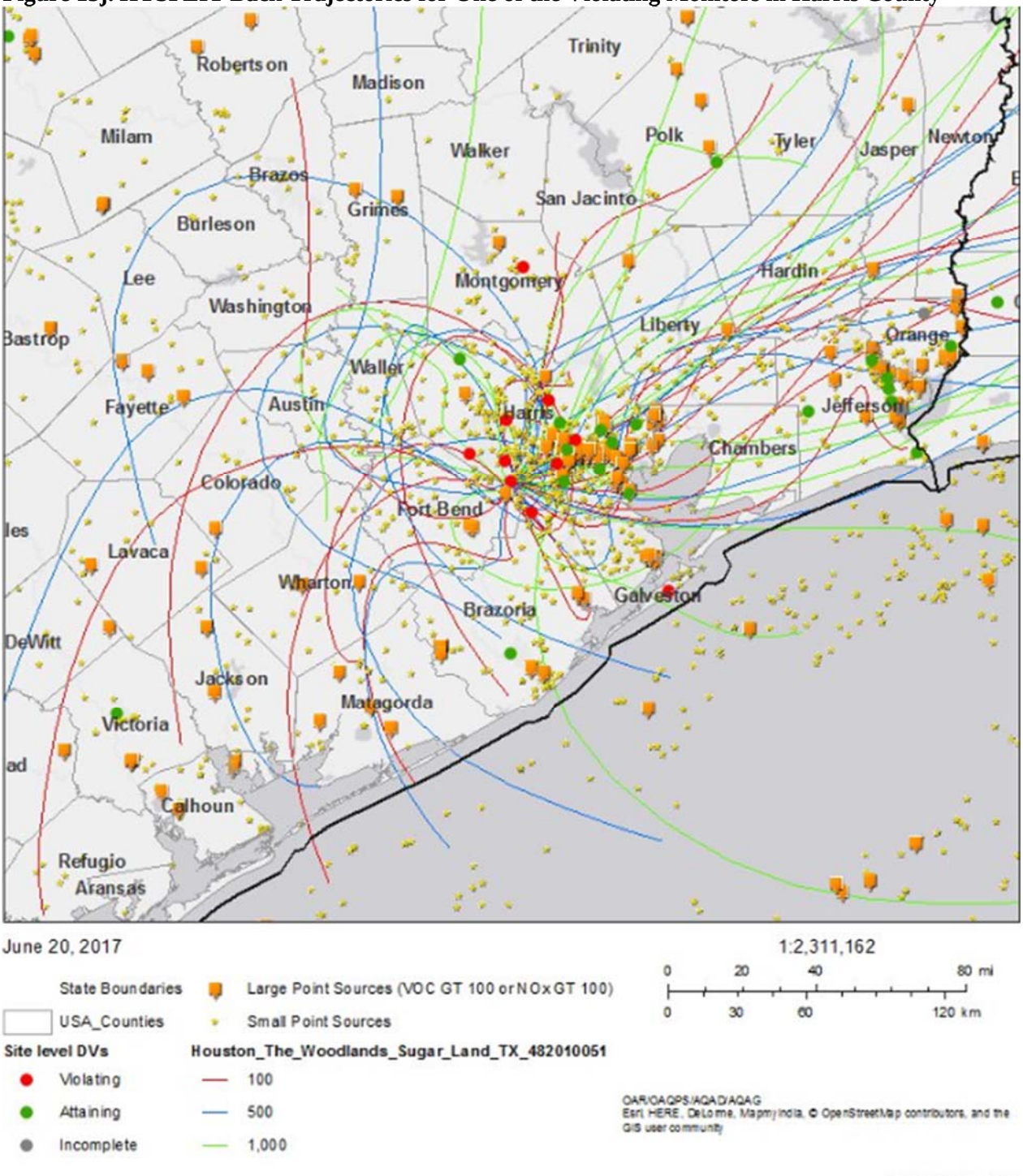
[43] This is the Houston East monitor, which has the fifth highest design value of the seven violating monitors in Harris County.

Figure 13i. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[44]



[44] This is the Park Place monitor, which has the sixth highest design value of the seven violating monitors in Harris County.

Figure 13j. HYSPLIT Back Trajectories for One of the Violating Monitors in Harris County[45]



The HYSPLIT data show back trajectories predominantly from the south-southeast to the violating monitor in Montgomery County (see Figure 13a). We see back trajectories predominantly from the east and southeast to the violating monitor in Harris County (Figure 13e). However, most of the back trajectories come from nearly every direction to the violating monitors (Figures 13b – 13j).

[45] This is the Houston Croquet monitor, which has the lowest design value of the seven violating monitors in Harris County.

We also note the HYSPLIT maps show an absence of back trajectories from Walker County to the violating monitor in nearby Montgomery County on days when that monitor exceeded the 2015 ozone NAAQS (Figure 13a).

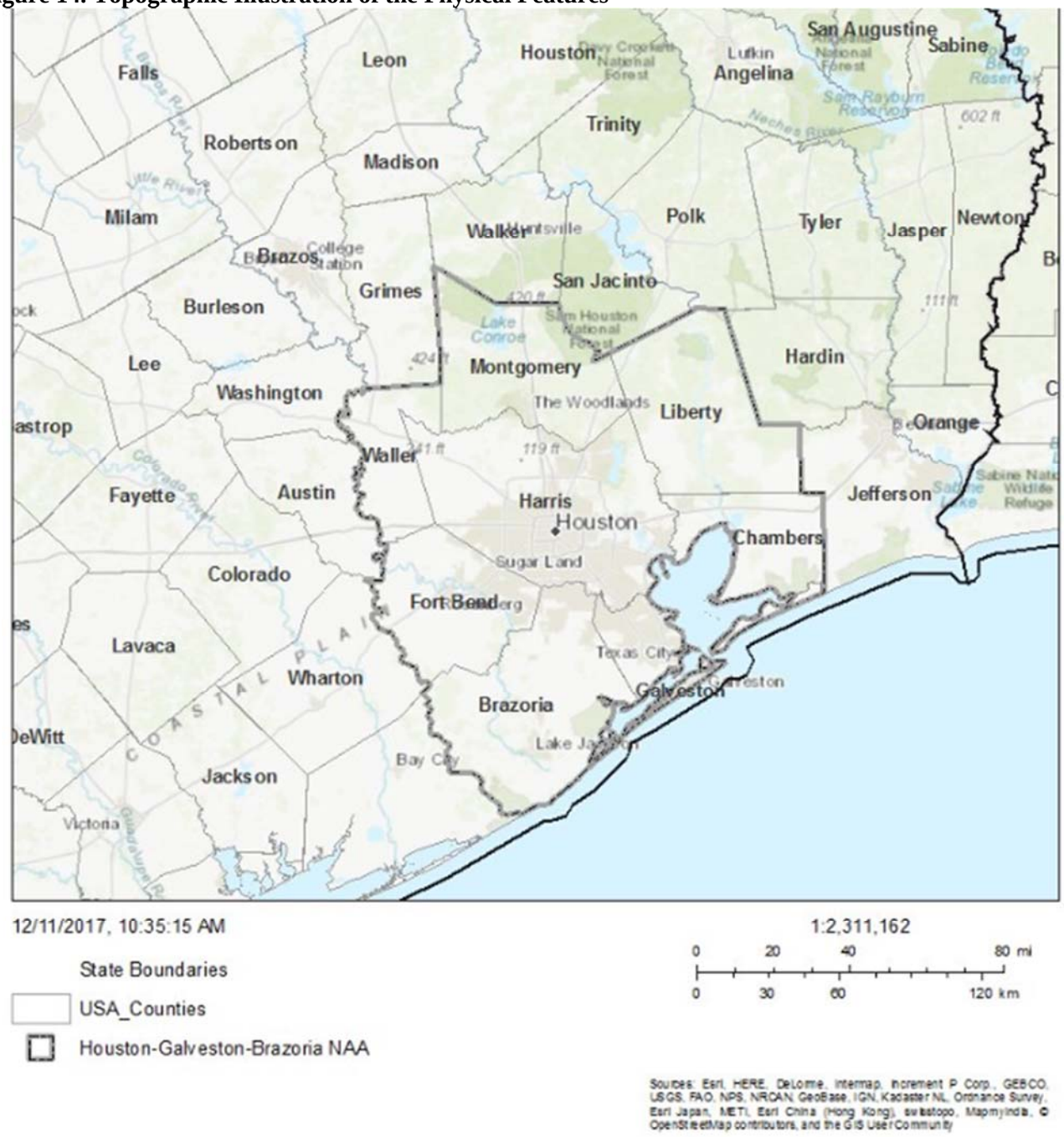
A more detailed discussion of this factor is provided in the conclusion section below.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA used geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area of analysis. Figure 14 below illustrates that the area does not have any geographical or topographical features significantly limiting air pollution transport into or within its air shed. Therefore, this factor did not provide data relevant for determining the appropriate nonattainment area boundary.

Figure 14. Topographic Illustration of the Physical Features



Factor 5: Jurisdictional boundaries

Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the intended nonattainment area, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to: counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting

the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

The area of analysis has previously established nonattainment boundaries associated with the 1997 and 2008 8-hour ozone NAAQS. The 1997 and 2008 8-hour ozone nonattainment area boundaries encompassed all of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties. Texas recommended that the nonattainment boundary for the 2015 ozone NAAQS be the same eight counties designated as nonattainment for the 1997 and 2008 ozone NAAQS. The boundary recommended by the State falls within the CSA boundary and within the boundary of the MPO, which in this area is the Houston-Galveston Area Council. The State does not have jurisdiction in Indian country and the area of analysis does not include Indian country.

Conclusion for the Houston-Galveston-Brazoria Area

Based on the assessment of factors described above, EPA does not intend to modify the State's recommendation that the following counties be included as part of the Houston-Galveston-Brazoria ozone nonattainment area because they have air quality monitors that indicate a violation of the 2015 ozone NAAQS, and/or because they are contributing to a violation in a nearby area: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties. These are the same counties that were included in the Houston-Galveston-Brazoria nonattainment area for the 2008 ozone NAAQS.

The air quality monitors in Brazoria, Galveston, Harris, and Montgomery Counties are violating the 2015 ozone NAAQS based on the 2014-2016 DVs, thus these counties are included in the nonattainment area.

The EPA does not intend to modify the State's recommendation to include Chambers, Fort Bend, Liberty and Waller Counties in the nonattainment for the 2015 ozone NAAQS based on contribution to air quality at one or more of the violating monitors. Chambers County is among the highest regarding VOC (2^{nd}) and NOx (6^{th}) emissions, VMT (6^{th}), and commuter data (6^{th}) in the area of analysis. Examination of the HYSPLIT data show back trajectories through Chambers County to the violating monitors in nearby Galveston and Harris Counties (see Figures 13c– 13j).

Fort Bend County is among the highest regarding NOx (4^{th}) and VOC (6^{th}) emissions, population statistics (2^{nd}) and traffic data (5^{th}) in the area of analysis. Examination of the HYSPLIT data show back trajectories through Fort Bend County to the violating monitors in nearby Brazoria and Harris Counties (see Figures 13b and 13d – 13j).

Liberty County has moderately high VOC emissions (8^{th}) and traffic data (7^{th}) in the area of analysis. The commuting patterns show 59% of workers in Liberty County commute to a county with a violating monitor showing that Liberty is well-integrated into those areas. Examination of the HYSPLIT data show back trajectories through Liberty County to the violating monitors in nearby Montgomery and Harris Counties (see Figures 13a, 13d – 13f, 13i, and 13j). In at least three instances, the trajectory originated in Liberty County (see Figures 13a, 13h, and 13i).

Waller County has comparatively high commuter/traffic data (8^{th}) with 56% of workers commuting to a county with a violating monitor showing that Waller is well-integrated into those areas. Waller has the third lowest NOx and the lowest VOC emissions within the area of analysis but moderately high population growth (13% from 2010 to 2015). Examination of the HYSPLIT data show back trajectories through Waller County to the violating monitors in nearby Montgomery and Harris Counties (see Figures 13a, and 13d – 13j).

The EPA does not intend to modify the State's recommendation to designate the remaining counties in the area of analysis as attainment/unclassifiable. In the area of analysis, Walker County is among the lowest in NOx and VOC emissions (4th lowest) and contributes the 3rd lowest percentage of commuters to the counties with violating monitors. Examination of the HYSPLIT data show there are no back trajectories from Walker County to the violating monitor in nearby Montgomery County on days when that monitor exceeded the 2015 ozone NAAQS (Figure 13a).

Within the area of analysis, Wharton County is comparatively low in NOx (7th lowest) and VOC (6th lowest) emissions, population (6th lowest), VMT (5th lowest), and contributes the 4th lowest percentage of commuters to the counties with violating monitors. Examination of the HYSPLIT data show four back trajectories that flow through Wharton County to the violating monitor in nearby Brazoria County on days when that monitor exceeded the 2015 ozone NAAQS (Figure 13b). However, one of the trajectories flows through the center of Fort Bend County before reaching the violating monitor and another trajectory flows through the centers of Fort Bend and Brazoria Counties. In comparison to Wharton County, Fort Bend County has 3.5 times more NOx emissions, 2 times more VOC emissions and commuters to the counties with violating monitors, 17 times more population, and 5.5 times the VMT. Two other trajectories that originate in Wharton County flow through Waller and Harris Counties before reaching the violating monitor. In comparison to Wharton County, Harris and Brazoria Counties have 3 to 24 times more NOx and VOC emissions, 3.5 to 62 times more VMT, and 8 to 99 times more population.

Matagorda County is not proposed for inclusion in the nonattainment area for the 2015 ozone NAAQS. Within the area of analysis, Matagorda County is among the lowest in VOC emissions (8th lowest), population (4th lowest), and VMT (2nd lowest). Examination of the HYSPLIT data show three back trajectories that flow through Matagorda County to the violating monitor in nearby Brazoria County on days when such monitor exceeded the 2015 ozone NAAQS (Figure 13b). However, these trajectories flow through the center of Brazoria County before reaching the violating monitor. In comparison to Matagorda County, Brazoria County has 2 to 3.5 more NOx and VOC emissions, 7 times more VMT, and 9 times more population.

Austin, Trinity, and Washington also rank low for most of the factors. In the area of analysis, Trinity County ranks the lowest for every emission source except VOC, where it is the 5th lowest. In the area of analysis, Washington and Austin are among the lowest in NOx (2nd and 5th lowest) and VOC (2nd and 3rd lowest) emissions, population (3rd and 2nd lowest), and VMT (3rd and 4th lowest), respectively. Examination of HYSPLIT data (Figures 13a-13j) shows few back trajectories passing through these counties compared to other counties in the area of analysis. Figure 13a shows no back trajectories through Trinity County before reaching the violating monitor in Montgomery County, but back trajectories pass through Trinity County before reaching the violating monitors in Brazoria, Galveston and Harris Counties (Figures 13b, 13c, 13e, and 13i). However, the trajectories through Trinity County also pass through Montgomery County before reaching the violating monitors and in comparison, Montgomery County emits four times more VOC and 10 times more NOx than Trinity County. The trajectories that pass through Harris, Liberty and Chambers Counties gather pollutants from those counties before reaching the violating monitor in Galveston County (Figure 13c).

Figures 13a - 13j show back trajectories pass through Austin County before reaching the violating monitors in the area of analysis. However, the trajectories through Austin County also pass through Fort Bend County before reaching the violating monitors in Galveston and Harris Counties (Figures 13b, 13c, 13e, 13f, 13i, and 13j) and in comparison, Fort Bend County emits almost 5 times more NOx and almost 6 times more VOC than Austin County. The trajectories through Austin County also pass through Waller County before reaching the violating monitors in Montgomery and Harris Counties (Figures 13a, 13d, 13g, and 13h) and in comparison to Austin County, Waller County has 75% higher population, 46% more VMT, and contributes nearly twice the commuters to the counties with violating monitors.

Figures 13a, 13b, and 13c - 13j show back trajectories pass through Washington County before reaching the violating monitors in the area of analysis. However, the trajectories through Washington County also pass through Fort Bend County before reaching the violating monitors in Brazoria and Harris Counties (Figures 13b, 13f, 13h, and 13j) and in comparison to Washington County, Fort Bend emits almost 7 times more NOx, 5 times more VOC, has 20 times more population, 8 times more VMT, and 60 times more commuters to the counties with violating monitors. The trajectories through Washington County also pass through Waller County before reaching the violating monitors in Montgomery and Harris Counties (Figures 13a, 13d, 13e, and 13g) and in comparison to Washington County, Waller County has 40% more population, 65% more VMT, and 3 times the commuters to the counties with violating monitors. The trajectories through Washington County also pass through Montgomery County before reaching the violating monitor in Harris County (Figure 13i) and in comparison to Washington County, Montgomery County emits four times more NOx, five times more VOC, has 15 times more population, 9 times more VMT, and 53 times more commuters to the counties with violating monitors.

Therefore, in conclusion of our review and analyses of the five factors for the counties in the area of analysis, we do not intend to modify the State's recommendation that the Houston-Galveston-Brazoria nonattainment area for the 2015 ozone standard be comprised of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties.