Technical Memorandum

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Subject: Current Status of 2007 Base Year Emission Inventory Development

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1.0 INTRODUCTION

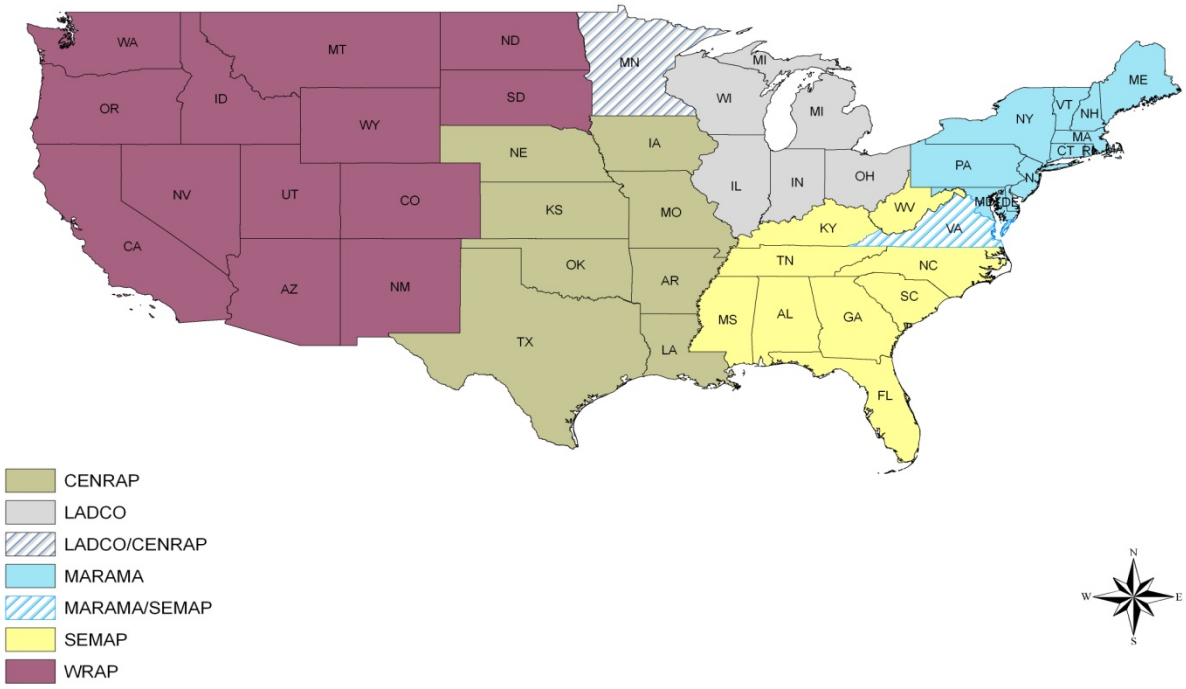
ENVIRON (and its subcontracting team of Eastern Research Group, Inc. [ERG] and Washington University) is assisting the Missouri Department of Natural Resources (MDNR) and Illinois Environmental Protection Agency (IEPA) in developing emissions and air quality modeling inputs and perform quality assurance (QA) and documentation for the next round of ozone and $PM_{2.5}$ State Implementation Plans (SIPs) for the St. Louis area. As part of Task 2b, ERG is focusing on the development of the point, area, and nonroad emissions for the 2007 base year emissions inventory; ENVIRON is addressing the on-road emissions for the 2007 base year emissions inventory. This technical memorandum details the current status of this development.

The 2007 base year emissions inventory relies upon existing emissions data from relevant regional planning organizations (RPOs), the U.S. Environmental Protection Agency (U.S. EPA), and some states. There are seven distinct regions located in the 36 km modeling domain:

- Western Regional Air Partnership (WRAP) region
- Central Regional Air Planning Association (CENRAP) region
- Lake Michigan Air Directors Consortium (LADCO) region
- Southeastern Modeling, Analysis, and Planning (SEMAP) inventory region
- Mid-Atlantic Regional Air Management Association (MARAMA) inventory region
- Canada
- Mexico

The five regions located in the United States are shown in Figure 1. It should be noted that emissions from Minnesota and Virginia appear in the inventories for two different regions. Because QA has not been completed for all regions, it is not clear which inventories will be used for these two states. The current status for each of the seven distinct regions is presented below.

Figure 1. U.S. Inventory Regions



2.0 Western Regional Air Partnership (WRAP)

The Western Regional Air Partnership (WRAP) region consists of 15 Western states. However, for the purposes of this study, AK and HI have been excluded from this analysis, since they do not lie within the CMAQ 36 km modeling domain. The 13 states included in the WRAP dataset are: AZ, CA, CO, ID, MT, ND, NM, NV, OR, SD, UT, WA, and WY. In addition to these states, the WRAP dataset also includes emissions data for some tribal areas within the WRAP region. Since 2007 emissions data were not available for the 2007 base year, point, area, and nonroad emissions data for the WRAP region was developed using U.S. EPA's 2008 National Emissions Inventory (NEI) data.[1]

2.1 WRAP Point Sources

As mentioned above, the WRAP point source data contains emissions data for the 13 WRAP states. The WRAP point source emissions data from the NEI were checked for location details (i.e., is the facility located in the indicated state, using emission release point coordinates and state FIPS in the emissions data record for the particular facility) using Geographical Information System (GIS). The geographic location findings are as follows:

- For 10 states (i.e., AZ, CO, ID, MT, ND, NM, OR, SD, UT, and WA), all emission release points were properly located within their respective states.
- California – Nearly all (i.e., approximately 99.9 percent) of the 82,042 emission release points were properly located in the state. A total of 32 emission release points were not located within the state boundaries (i.e., 29 points in NV, 1 in WA, 1 in Canada, and 1 in the Atlantic Ocean.
- Nevada – A total of 3,529 out of 3,931 emission release points were properly located in the state. The remaining emission release points (i.e., approximately 10 percent) were scattered in various WRAP states (i.e., AZ, CA, CO, NM, and UT) and non-WRAP states (i.e., IL, IN, KS, LA, MO, NE, NJ, OH, OK, TN, and TX).
- Wyoming – Nearly all (i.e., approximately 99.8 percent) of the 2,871 emission release points were properly located in the state. A total of 6 emission release points were not located within the state boundaries (i.e., 2 in Idaho and 1 each in CO, NM, SD, and TX).

In addition to checking the geographic location, the emissions data were also checked to identify any potential outliers (i.e., unusually high emissions, such as several orders of magnitude). No obvious outliers were found in the point source data.

2.2 WRAP Area Sources

The WRAP area source data contains emissions data for the 13 WRAP states. The WRAP area source emissions data from the NEI were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). It should be noted that in the 2008 NEI that two categories previously considered to be nonroad sources (i.e., locomotives and commercial marine vessels) are now considered to be area

[1] *2008 National Emissions Inventory Data, Version 1.5.* U.S. Environmental Protection Agency. Released May 16, 2011. Internet address: http://www.epa.gov/ttn/chief/net/2008inventory.html

sources. No obvious outliers were identified in the WRAP area source emissions data. The highest emissions were identified to be 713,402 tons per year (tpy) of PM_{10} from unpaved road dust in New Mexico. The following state-specific QA findings for completeness were identified:

- Industrial area source fuel combustion – 8 states (CO, MT, ND, OR, SD, UT, WA, and WY) do not have emissions for the industrial area source fuel combustion source categories.
- Commercial/institutional area source fuel combustion – 6 states (CO, MT, ND, OR, WA, and WY) do not have emissions for the commercial/institutional area source fuel combustion source categories.
- Evaporative area sources – 6 states (i.e., MT, ND, OR, SD, WA, and WY) do not have emissions for the graphic arts, industrial surface coatings, degreasing, and autobody refinishing source categories.

2.3 WRAP Nonroad Sources

The WRAP nonroad source data contains emissions data for the 13 WRAP states. The WRAP nonroad source emissions data from the NEI were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). No outliers or other issues have been identified in the WRAP nonroad source emissions data.

2.4 WRAP Data Formatting

All WRAP point, area, and nonroad source emissions data have been obtained, compiled, and checked. However, the WRAP SMOKE-ready IDA format input files have not yet been generated.

3.0 Central Regional Air Planning Association (CENRAP)

The Central Regional Air Planning Association (CENRAP) region consists of 9 states, including: AR, IA, KS, LA, MN, MO, NE, OK, and TX. Some CENRAP states provided state-specific point source emissions data. If state-specific point source emissions data were not available, point source data from U.S. EPA's 2008 NEI were used. In addition, area and nonroad emissions data for the CENRAP region were also obtained from U.S. EPA's 2008 NEI. It should be noted that Minnesota emissions data were also included in the dataset from the Lake Michigan Air Directors Consortium (LADCO) region. Strictly speaking, Minnesota is not a LADCO member state; however, it appears that Minnesota emissions are often included in LADCO modeling efforts. Additional research will be conducted to identify whether the CENRAP Minnesota emissions or the LADCO Minnesota emissions should be used.

3.1 CENRAP Point Sources

At the present time, CENRAP state-specific point source data have been obtained for KS, LA, MO, OK, and TX, but not for AR, IA, MN, and NE. These state-specific point source data were identified as 2007 data; however, some of the file names potentially indicate 2008 data. In addition, the unavailability of the state-specific point source data has not been absolutely confirmed for AR, IA, MN, and NE. Because this confirmation has not been obtained, no QA steps have been carried out

for any of the CENRAP point source data. Necessary QA steps will be conducted in the very near future. If state-specific point source data are, in fact, unavailable for AR, IA, MN, and NE, then point source data from U.S. EPA's 2008 NEI will be used.

3.2 CENRAP Area Sources

The CENRAP area source data contains emissions data for the 9 CENRAP states. The CENRAP area source emissions data from the NEI were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). No obvious outliers were identified in the CENRAP area source emissions data. The following state-specific QA findings for completeness were identified:

- Industrial area source fuel combustion – 3 states (AR, IA, and NE) do not have emissions for the industrial area source fuel combustion source categories. In addition, TX only has natural gas industrial area source fuel combustion.
- Commercial/institutional area source fuel combustion – 3 states (AR, IA, and NE) do not have emissions for the commercial/institutional area source fuel combustion source categories. In addition, TX only has natural gas and LPG commercial/institutional area source fuel combustion.
- Evaporative area sources – 3 states do not have emissions for various solvent evaporative source categories: degreasing (IA, NE, and OK), industrial surface coatings (IA, NE, and OK), autobody refinishing (IA, NE, and OK), graphic arts (IA and NE), and dry cleaning (IA).
- Open burning and fires – AR does not have emissions for the open burning and fire source categories.

3.3 CENRAP Nonroad Sources

The CENRAP nonroad source dataset contains emissions data for the 9 states in the CENRAP region. All the nonroad source emissions data were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). No outliers and/or issues have been identified in the CENRAP nonroad source emissions data.

3.4 CENRAP Data Formatting

As discussed in Section 3.1, the CENRAP point source emissions data have not been finalized pending receipt of all state-specific point source data. Therefore, CENRAP point source data have not been compiled or checked. All CENRAP area and nonroad source emissions data have been obtained, compiled, and checked. However, the SMOKE-ready IDA format input files have not yet been generated for these data.

4.0 Lake Michigan Air Directors Consortium (LADCO)

The Lake Michigan Air Directors Consortium (LADCO) region consists of 5 states, including: IL, IN, MI, OH, and WI. As discussed in Section 3.0, Minnesota emissions data were included in both the

datasets from the CENRAP region and the LADCO region. Additional research will be conducted to identify whether the CENRAP Minnesota emissions or the LADCO Minnesota emissions should be used. The LADCO point, area, and nonroad emissions data were obtained via FTP transmittal.[2]

4.1 LADCO Point Sources

The point source emissions data for LADCO were split into two parts: electricity generating units (EGUs) and Non-EGUs. Both of these point source emissions datasets were checked for location details (i.e., is the facility located in the indicated state, using emission release point coordinates and state FIPS in the emissions data record for the particular facility) using GIS. These datasets were also checked for potential outliers (i.e., unusually high emissions).

Point source emissions data for both EGUs and Non-EGUs were provided for all LADCO states (i.e., IL, IN, MI, MN, OH, and WI) in NIF format. However, complete EGU NIF tables (e.g., EM, CE, SI, EP, ER, etc.) were only available for IN, MI, and MN. For the other three states (i.e., IL, OH, and WI), only the EM and CE tables were provided for EGUs, which means that specific location information was unavailable. As a result, QA steps for EGU emissions data were only conducted for IN, MI, and MN.

The findings from the LADCO point source checks are as follows:

- LADCO point source data have a mix of inventory years – 84.4 percent of the records have an identified year of 2007, but 15.4 percent of the records are for 2008 and 0.2 percent of the records are for 2006.
- Less than 5 percent of the emission release points in any given state were located outside of their respective state boundaries.
- In the MN non-EGU dataset, there were 87 emission records that have an undefined state-county FIPS code of "27777".

4.2 LADCO Area Sources

The LADCO area source data contains emissions data for the 6 states in the LADCO region. The LADCO area source emissions data from the NEI were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). All LADCO area source data had an identified inventory year of 2008. With the exception of MN, no problems were identified with the LADCO region states. The MN-specific issues were related to missing source categories and included the following:

- No gasoline distribution emissions.
- No solvent evaporation categories (e.g., traffic markings, asphalt application, architectural surface coatings, consumer solvents, autobody refinishing, etc.).
- No agricultural categories (e.g., tilling, burning, pesticides, fertilizers, etc.).
- No cattle/livestock categories.
- No structure or vehicle fires.
- No paved/unpaved road dust.

[2] *LADCO 2007 Draft Base C Inventory*. Lake Michigan Air Directors Consortium (LADCO). Downloaded via FTP site on May 23, 2011.

- No wastewater treatment plants.

4.3 LADCO Nonroad Sources

The LADCO nonroad source dataset contains emissions data for the 6 states in the LADCO region. LADCO split their nonroad data into two broad categories: NMIM equipment and marine, air, and rail (MAR). All the nonroad source emissions data were checked for completeness (i.e., emissions have been calculated for all major source categories) and for outliers (i.e., excessively high emissions). All LADCO nonroad source data had an identified inventory year of 2008. The LADCO NMIM data also included emissions for Iowa and Missouri; however, since these are not LADCO states, they are not discussed here. The relevant nonroad findings include the following:

- The MAR emissions data for the LADCO region are all for the year 2002. The start and end dates in the emissions data file received from LADCO are "20020101" and "20021231" respectively.
- In IN and OH, the emissions data State and County FIPS field (5 digit) has missing zeroes between the state and county codes (e.g., "18 1" instead of "18001", and "39 21" instead of "39021") for certain SCCs (i.e., 2275001000, 2275020000, 2275050000, and 2275060000).
- IL – The MAR emissions data do not contain aircraft emissions. In addition, the MAR emissions include ROG and SO_x, instead of VOC and SO_2.
- IN – The MAR emissions include ROG, instead of VOC.
- MI – No recreational or railroad equipment categories were included.
- MN – The MAR emissions data do not contain aircraft emissions.
- OH – The MAR emissions include ROG, instead of VOC.

4.4 LADCO Data Formatting

All LADCO point, area, and nonroad source emissions data have been obtained, compiled, and checked. However, the LADCO SMOKE-ready IDA format input files have not yet been generated.

5.0 Southeastern Modeling, Analysis, and Planning (SEMAP)

The Southeastern Modeling, Analysis, and Planning (SEMAP) inventory region consists of 10 states, including: AL, FL, GA, KY, MS, NC, SC, TN, VA, and WV. It should be noted that Virginia emissions data were also included in the dataset from the Mid-Atlantic Regional Air Management Association (MARAMA). Additional research will be conducted to identify whether the SEMAP Virginia emissions or the MARAMA Virginia emissions should be used.

The SEMAP inventory is currently being developed by the Southeastern States Air Resource Managers (SESARM) and their selected contractor team. The base year 2007 inventory is nearing completion, but is not quite done. The latest communication with SESARM staff indicated the following[3]:

[3]Personal communication with Ron Methier, Southeastern Modeling, Analysis, and Planning (SEMAP) inventory staff. September 7, 2011.

- Point source data are currently being reviewed with expected completion by late September 2011.
- Area source data are awaiting reconciliation with the point source data. The expected completion date is October 7, 2011.
- Nonroad source data are complete, but have not been obtained from SEMAP staff.

6.0 Mid-Atlantic Regional Air Management Association (MARAMA)

The Mid-Atlantic Regional Air Management Association (MARAMA) inventory region includes the states in the Mid-Atlantic/Northeast Visibility Union (MANE-VU) plus the state of Virginia. The inventory region includes the following states: CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, and VT. As discussed in Section 5.0, Virginia emissions data were included in both the datasets from the SEMAP inventory region and the MARAMA inventory region. Additional research will be conducted to identify whether the SEMAP Virginia emissions or the MARAMA Virginia emissions should be used. The MARAMA point, area, and nonroad emissions data were obtained via FTP transmittal.[4]

6.1 MARAMA Point Sources

The point source emissions data for MARAMA were checked for location details (i.e., is the facility located in the indicated state, using emission release point coordinates and state FIPS in the emissions data record for the particular facility) using GIS. These datasets were also checked for potential outliers (i.e., unusually high emissions). The overall MARAMA point source data consisted of a total of 34,308 emission release points, of which 34,078 emission release points are located completely within their respective MARAMA state boundaries. Most of the rest are straddling state boundaries and very few (i.e., less than 10) are outside their respective MARAMA states by a few miles (i.e., 3 to 5 miles). All MARAMA point source emissions data were for the 2007 inventory year.

6.2 MARAMA Area Sources

The MARAMA area source data contains emissions data for the 13 states in the MARAMA inventory region. The MARAMA area source emissions data were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). The following findings were identified:

- Most of the MARAMA area source data have an identified year of 2007 (99.6 percent), but 0.4 percent of the records have a 2009 inventory year.
- MD – No industrial fuel use categories.
- ME – No industrial fuel use categories.
- NH – No residential wood combustion categories.
- NY – Only state with area source utility sector fuel use categories.
- RI – No miscellaneous area fires (forest fires, structure fires, motor vehicle files, and wildfires).

[4] *2007 Emission Inventory for Regional Air Quality Modeling in the Northeast/Mid-Atlantic Region*. Mid-Atlantic Regional Air Management Association (MARAMA). February 27, 2011.

6.3 MARAMA Nonroad Sources

The MARAMA nonroad source dataset is split into four different parts: nonroad, commercial marine vessels, aircraft, and locomotives. All the emissions data were checked for completeness (i.e., emissions have been calculated for all the major source categories) and for outliers (i.e., very high emissions). The nonroad part of the inventory does not contain any data for Virginia. All MARAMA nonroad source data have a 2007 inventory year.

In general, the nonroad, commercial marine vessels, and the aircraft potions of MARAMA's nonroad dataset appear to be acceptable. Some potential QA findings were recorded for the locomotives part:

- There are 6 SCCs (Yard Locomotives, Line Haul – Class I, Line Haul – Class II/III, Passenger, Commuter, and an unknown SCC [2285001005})
- CT – Only state with unknown SCC 2285001005.
- DE – No commuter and passenger line haul emissions.
- DC – No Class II/III line haul emissions.
- MA – No passenger line haul emissions
- ME – No Class I, commuter, and passenger line haul emissions.
- NH – No yard, Class I, commuter, and passenger line haul emissions; only Class II/III line haul emissions.
- NJ – No passenger line haul emissions.
- RI – Contains yard and an aggregated total for all line haul operations (i.e., Class I, Class II/III, passenger, and commuter).
- VT – No yard, commuter, and passenger line haul emissions.
- VA – No commuter line haul emissions.

6.4 MARAMA Data Formatting

All MARAMA point, area, and nonroad source emissions data have been obtained, compiled, and checked. However, the MARAMA SMOKE-ready IDA format input files have not yet been generated.

7.0 Mexico

The 2008 base year emissions for the Mexico portion of the modeling domain were obtained from a 2008 projected emissions inventory previously developed by ERG.[5] The emission source categories for the projected emissions inventory correspond exactly to the original 1999 Mexico National Emissions Inventory (NEI) developed by ERG.[6] Unlike the U.S. regions, ERG has also prepared the on-road motor vehicle emissions for Mexico.

[5] *Mexico National Emissions Inventory, 1999: Final*. Prepared for the Secretariat of the Environment and Natural Resources and the National Institute of Ecology of Mexico by Eastern Research Group, Inc. (ERG), Sacramento, California. October 11, 2006.

[6] *Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030*. Final Report. Prepared for Instituto Nacional de Ecología and the National Renewable Energy Laboratory by Eastern Research Group, Inc. (ERG), Sacramento, California. January 9, 2009.

There are a total of 2,454 municipalities (i.e., county equivalents) in the entire country of Mexico, of which 574 municipalities are located within the modeling domain. This is graphically shown in Figure 2. The state numbers in Figure 2 correspond with the state codes in Table 1.

All municipalities from the following 11 states are located within the modeling domain (i.e., the entire state is within the domain): Aguascalientes, Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo León, Sinaloa, Sonora, Tamaulipas, and Zacatecas.

No municipalities from the following 12 states are located within the modeling domain (i.e., the entire state is outside the domain): Campeche, Colima, Chiapas, Distrito Federal, Guerrero, México, Michoacán, Morelos, Oaxaca, Puebla, Tabasco, and Tlaxcala.

For the following 9 states, some municipalities are located within the modeling domain, while some municipalities are located outside the domain: Guanajuato, Hidalgo, Jalísco, Nayarit, Querétaro, Quintana Roo, San Luis Potosí, Veracruz, and Yucatán.

Visual examination of GIS files containing municipality boundaries was conducted to make a qualitative determination of whether a particular municipality was located inside or outside for those municipalities intersected by the modeling domain boundary. Details regarding which specific municipalities are within the modeling domain are presented in Table 1.

The 2008 Mexico emissions data have already been formatted into SMOKE-ready IDA format input files as part of ERG's previous project.

8.0 Canada

ENVIRON has already obtained base year emissions for Canada. These emissions will be used for this project's base year emissions, so ERG is not independently developing any new emissions for Canada.

Figure 2. Mexico Municipalities Within the 36 km Modeling Domain

Table 1. Mexico Municipalities Within the 36 km Modeling Domain.

State Code	State Name	Number of Municipalities in State	Number of Municipalities in Domain	Municipality Details
01	Aguascalientes	11	11	All municipalities.
02	Baja California	5	5	All municipalities.
03	Baja California Sur	5	5	All municipalities.
04	Campeche	11	0	No municipalities.
05	Coahuila	38	38	All municipalities.
06	Colima	10	0	No municipalities.
07	Chiapas	118	0	No municipalities.
08	Chihuahua	67	67	All municipalities.
09	Distrito Federal	16	0	No municipalities.
10	Durango	39	39	All municipalities.
11	Guanajuato	46	9	Atarjea (11006), Dolores Hidalgo (11014), León (11020), Ocampo (11022), San Diego de la Unión (11029), San Felipe (11030), San Luis de la Paz (11033), Victoria (11043), and Xichú (11045)
12	Guerrero	81	0	No municipalities.
13	Hidalgo	84	1	San Felipe Orizatlán (13046)
14	Jalísco	124	22	Bolaños (14019), Colotlán (14025), Chimaltitán (14031), Encarnación de Díaz (14035), Hostotipaquillo (14040), Huejúcar (14041), Huejuquilla El Alto (14042), Jalostotitlán (14046), Lagos de Moreno (14053), Mexticacan (14060), Mezquitic (14061), Ojuelos de Jalisco (14064), San Juan de los Lagos (14073), San Martín de Bolaños (14076), Santa María de los Angeles (14081), Teocaltiche (14091), Tequila (14094), Totatiche (14104), Villa Guerrero (14115), Villa Hidalgo (14116), Cañadas de Obregón (14117), and Yahualica de González Gallo (14118)
15	México	125	0	No municipalities.
16	Michoacán	113	0	No municipalities.
17	Morelos	33	0	No municipalities.
18	Nayarit	20	18	All municipalities, except Amatlán de Cañas (18003) and Bahia de Banderas (18020).

State Code	State Name	Number of Municipalities in State	Number of Municipalities in Domain	Municipality Details
19	Nuevo León	51	51	All municipalities.
20	Oaxaca	570	0	No municipalities.
21	Puebla	217	0	No municipalities.
22	Querétaro	18	3	Arroyo Seco (22003), Jalpan de Serra (22009), and Landa de Matamoros (22010)
23	Quintana Roo	8	3	Isla Mujeres (23003), Benito Juárez (23005), and Lázaro Cárdenas (23007)
24	San Luis Potosí	58	57	All municipalities, except Tamazunchale (24037).
25	Sinaloa	18	18	All municipalities.
26	Sonora	72	72	All municipalities.
27	Tabasco	17	0	No municipalities.
28	Tamaulipas	43	43	All municipalities.
29	Tlaxcala	60	0	No municipalities.
30	Veracruz	212	14	Citlaltepetl (30035), Chinampa de Gorostiza (30060), Chontla (30063), Ozuluama de Mascareñas (30121), Pánuco (30123), Platón Sánchez (30129), Pueblo Viejo (30133), Tamalín (30150), Tamiahua (30151), Tampico Alto (30152), Tantima (30154), Tantoyuca (30155), Tempoal de Sánchez (30161), and El Higo (30205)
31	Yucatán	106	40	Baca (31004), Bokobá (31005), Buctzotz (31006), Calotmul (31008), Cansahcab (31009), Cenotillo (31012), Conkal (31013), Chemax (31019), Chicxulub Pueblo (31020), Dzemul (31026), Dzidzantún (31027), Dzilam de Bravo (31028), Dzilam González (31029), Dzoncauich (31031), Espita (31032), Hunucmá (31038), Ixil (31039), Mérida (31050), Mocochá (31051), Motul (31052), Muxupip (31054), Panabá (31057), Progreso (31059), Río Lagartos (31061), San Felipe (31065), Sinanché (31068), Sucilá (31070), Suma (31072), Tekal de Venegas (31077), Tekantó (31078), Telchac Pueblo (31082), Telchac Puerto (31083), Temax (31084), Temozón (31085), Tepakán (31086), Teya (31088), Tizimín (31096), Ucú (31100), Yaxkukul (31105), and Yobaín (31106)
32	Zacatecas	58	58	All municipalities.
	Total	2,454	574	