Gorge Emission Inventory Report

I. Background

The Emission Inventory (EI) work is part of the Gorge Air Quality Study, which is designed to provide an assessment of the causes of visibility impairment in and around the Columbia River Gorge National Scenic Area. There are three key ways we learn about AQ: through monitoring, modeling and emission inventory. This document is a high level summary describing what an EI is, how it fits into the Gorge technical study, and provides information on sources and pollutants that contribute to air quality in the Gorge.

II. Purpose of an Emission Inventory

An emissions inventory is important for a number of reasons. An emission inventory is an itemized list of emission estimates for sources of air pollution in a given area for a specified time period. Present and future year inventories are critical components of air quality planning and modeling. The emissions inventory helps to assess the level of pollutants released into the air from various sources. For example, based on the types and amounts of emissions it can be used to develop an understanding of the sources that may impact the Scenic Area. These sources may come from both man-made and natural sources.

Secondly, the emissions inventory is used to conduct air dispersion modeling. The air dispersion model is considered to be performing well when it can simulate actual monitored air concentrations that have already occurred. The better a model simulates the past, the better the confidence of predicting future-year scenarios and any resulting strategy development.

One other purpose of an emission inventory is to get an estimate of future air quality. This is done by using growth assumptions from various aspects of our lives. This includes things like estimating what future population growth will be, how much driving will be occurring (vehicle miles traveled (VMT)), and economic growth to make a prediction of what future emissions will be. Depending on the category, emissions will either increase or decrease based on population habits, industry growth or slowdown, and environmental conditions such as increased wildfires. The EI is a catalog of the best estimate of current emissions, and a good prediction of what is likely to happen in the future. Additionally, because of the complex chemistry, meteorology, and air movement that occurs in the Gorge area, there are a number of different factors that can translate emissions into air quality impacts. Therefore, judging any source category’s contribution to impairment may require that we evaluate emissions and the impacts from chemical and meteorological conditions.

III. How was the Gorge EI Developed?

A. Emission Inventories Used in the Gorge EI

i. U.S. EPA - National Emissions Inventory (NEI)

Emissions inventories have been critical for the efforts of state, local and federal agencies to attain and maintain the National Ambient Air Quality Standards (NAAQS) that EPA has established for criteria pollutants such as ozone, particulate matter, and carbon monoxide. In the past, mobile, area and biogenic emission inventories have been completed as needed to support activities such as nonattainment/maintenance planning efforts or as time and resources allowed. Point source inventories have been developed each year by the state and local agencies and submitted to EPA for major sources annually. Beginning in 2002 state and local agencies were required to submit emissions information to EPA as part of the National Emissions Inventory (NEI). These emission inventories include information about point, area, on-road mobile, nonroad, and natural sources. EPA compiles the information and adds emissions category data that may not have been submitted, such as fugitive dust. Agencies then review and comment on the revised inventory, EPA makes further revisions, and a final NEI is available for use. The most current inventory data available was used for modeling and haze assessment purposes for the Scenic Area.

ii. WRAP EI

The Western Regional Air Partnership (WRAP) is an organization composed of state, federal, and tribal governments formed to address the federal regional haze rules and other air quality issues in the western U.S. The air quality agencies in Oregon and Washington participate regularly in the Emissions Forum of the WRAP. WRAP developed an emissions inventory for the 14 Western states based on EPA's final 2002 NEI, and used it as the WRAP 2002 "base year" inventory from which it could project future year emissions for 2008, 2013, and 2018 for regional haze purposes.

B. Gorge Project EI

To run an air dispersion model, specific timeframes must be selected in order to create and compare modeling output information to observed monitoring results. This helps create a "base case" modeling output to confirm that the "base case" scenario simulates actual monitored air concentrations that have already occurred. The better a model simulates the past (base case), the better the confidence of predicting future-year scenarios.

The Gorge Technical Team decided that air quality monitoring would take place from July 2003 through February 2005, therefore the emissions inventory estimate needed to be developed for 2004 in order to quantify the emissions in the air that the air monitors would be sampling. The Gorge Technical Team selected 2004 as the "base year" because the emissions information could be input to a model and the output concentrations compared to actual 2004 monitoring data conducted in the Gorge. The "base-year" emissions inventory (EI) was created to document actual emissions occurring in the airshed. For the "future year" comparison, the Team selected 2018 because the WRAP EI was already projected to that year. It allowed for the Gorge modeling to tie in with the WRAP regional modeling for visibility and regional haze.

The Gorge Technical Team reviewed the collected monitoring data. Two summertime (July and August 2004) and two wintertime (Feb 2004 and Nov. 2004) episodes were initially identified for further study based on the monitoring data and analysis presented in the Columbia River Gorge Haze Gradient Study and Causes of Haze in the Gorge (CoHaGo) reports. Because of limited funding, only one wintertime and one summertime episode could be modeled. August and November 2004 were chosen because of the greatest visibility impairment and emissions inventory availability. Additionally, for the purposes of looking at the emission inventory and in performing quality assurance on the model, two specific days were chosen within the modeling episodes. For the August and November events, a specific day was chosen (August 18 and November 12). These days were chosen as "representative" days that would be indicative of conditions for either the summertime or wintertime event.

i. Creating the 2004 EI

Using the 2002 WRAP EI as the foundation, Oregon and Washington provided 2004 annual emissions data for point sources and selected area sources, as point sources are required to report their emissions each year. For the remaining area sources, Oregon and Washington took the 2002 submitted emissions data and grew the emissions to 2004. Information on the basis and methodology for the emissions growth process from 2002 to 2004 is detailed in the 2004 Gorge Emissions Inventory for Modeling report (DEQ, 2006). For nonroad mobile sources Oregon and Washington ran EPA's nonroad model to generate daily emissions. To make comparisons for the episode days the inputs for the model had to be specific to the episode.

However, because most of the emissions were calculated on an annual basis, these emissions needed to be adjusted to reflect seasonal, daily, and hourly emissions to correlate the information to the selected "representative" episode days. Oregon and Washington generated annual county emissions estimates which are processed with a commonly used software package called SMOKE (Sparse Matrix Operator Kernel Emissions) that distributes the emissions data to specific hours of a day, days of a month, and months of the year based on accepted time profiles of the activities that generated the emissions. For example, residential use of lawnmowers occurs more in the evening than the day during the week, but more during the weekend than the weekday, and more between May through October than in December and January. This type of "temporal profile" is established for each source of emissions in the inventory. The SMOKE processing system also uses land type (residential, forest, agricultural) to assign the emissions to certain areas of the county. For example, home heating/cooling and lawnmower use are located in residential areas and farm tractor emissions are placed in agricultural areas. These two activities allow the technical team to disperse the annual emissions estimate to a representative day in August and November for the purposes of examining the data sampled at the monitors and to evaluate the visibility in 2004 and 2018.

ENVIRON (the modeling contractor to the air agencies) estimated the 2004 on-road mobile emissions by running MOBILE 6 within the air dispersion model using model inputs provided by Oregon and Washington. This provided hourly and daily emissions information. On-road mobile emissions are typically characterized as motor vehicles. For the remaining emissions categories where the states could not provide updated 2004 inventory information, Alpine Geophysics (a modeling subcontractor to the air agencies) took the 2002 WRAP inventory and filled those data gaps by growing the emissions to 2004.

Further adjustments to the 2004 inventory were made, including reducing the calculated particulate matter emissions from residential wood smoke and increasing ammonia emissions from agricultural operations. For more detailed information on how the adjustments were calculated, please see the Gorge Modeling Report.

This 2004 emissions inventory was used as one of the inputs to the CAMx dispersion model. The dispersion model was used to simulate the conditions that the year of monitoring recorded for the two chosen episodes. The model is run in an iterative fashion until it represents the monitored data with a known degree of uncertainty. These uncertainty parameters are discussed in detail in the modeling report.

ii. Creating the 2018 EI

When WRAP developed the 2018 EI, it projected its 2002 “base year” inventory. Emissions from various source categories were evaluated and adjusted accordingly to reflect an appropriate inventory of emissions. Various growth factors were used to estimate future year emissions. These included population growth, economic forecasts, increases in motor vehicle travel (vehicle miles traveled, or VMT) and permitted emissions for major industrial sources. The VMT growth assumptions for on-road mobile reflect the region’s local travel forecast. Industry emissions were grown based on EPA’s Economic Growth and Analysis System (EGAS) model.   The WRAP also factored in emissions reductions expected from EPA rules, such as the Best Available Retrofit Technology (BART) rule for some of the BART sources, but it did not include power plants. For a detailed description of how WRAP grew the emissions inventory, please refer to the WRAP Point and Area Source Emissions Projections for the 2018 Base Case Inventory (January 2006). Additionally, some sources were held constant as emissions were not expected to change over time.

In assembling the 2018 EI for the Gorge air quality study, information was used from the WRAP 2018 inventory. Adjustments were made to the 2018 WRAP inventory to incorporate expected impacts from EPA rules that had been promulgated since WRAP developed its 2018 inventory. Alpine Geophysics also corrected errors found in the WRAP 2018 inventory to make it more consistent with local conditions.

IV. What are the Pollutants of Concern?

A good emission inventory (EI) is necessary to understand impacts to air quality, perform source attribution, and evaluate alternative emission reduction scenarios. Each pollutant or compound has a unique set of characteristics that contribute to visibility impairment. The higher the concentration of the pollutants, the more visibility is impaired. Air monitoring on bad visibility days shows the main pollutants impacting the Gorge are: organic carbon, nitrates, and sulfates. These pollutants all have the ability to scatter light, which affects visibility. The sulfates and nitrates are formed from sulfur oxides (SOx) and oxides of nitrogen (NOx), which are products of fossil fuel combustion (coal burning power plants, automobiles, smelters, industrial boilers, and refineries). Ammonia plays a key role in the air chemistry that forms sulfates and nitrates. Sources typically associated with ammonia emissions include livestock farming, application of fertilizer, and microbiological degradation (bacteria). Organic carbon comes from smoke (such as wildfires and woodsmoke) and elemental carbon also comes from combustion activities (such as vehicle engine exhaust). Particulate matter is comprised of both organic and elemental carbon; particulate matter is often further defined in various sizes such as PM2.5 (particulate matter less than 2.5 microns in diameter).

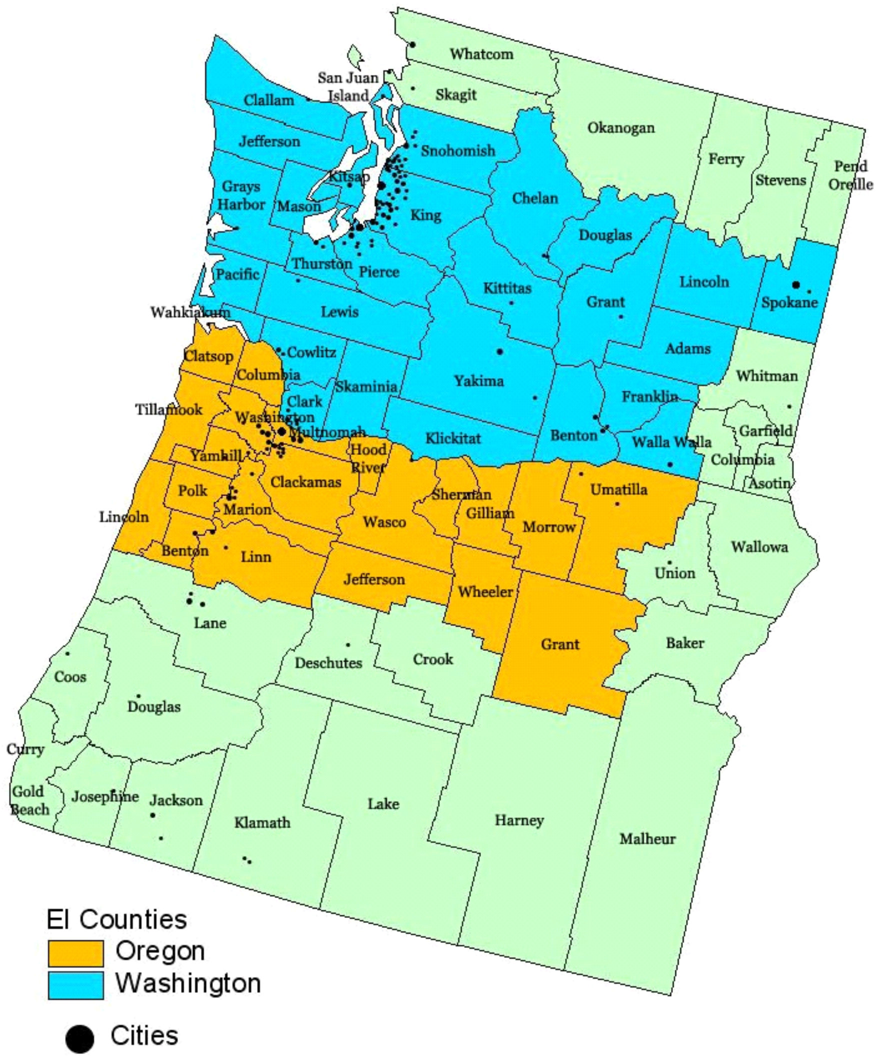
An emission inventory including SOx, NOx, NH3, VOC, and speciated primary PM is needed for the Gorge. This includes emissions from all potential source types affecting the Scenic Area – point sources (e.g., industry), mobile sources (e.g., vehicles, ships, trains, aircraft, diesel vehicles), area sources (e.g., woodstoves, outdoor burning, paint and solvent use, agriculture), and natural sources (e.g., emissions from sources such as vegetation and volcanic activity).

V. EI Areas

Based on information presented in the Causes of Haze in the Columbia Gorge Report the long range transport of visibility impairing pollutants is in the East to West direction in the winter and the West to East direction in the summer. Emissions generated outside the 4-km modeling domain are accounted for through initial and boundary conditions emissions. CAMx employs multiple numerical algorithms that track the horizontal transport of pollutants generated outside of the EI domain. For modeling, a suitable geographic domain must be selected to characterize conditions. Once the domain is chosen, the emissions inventory is compiled for that modeling domain.

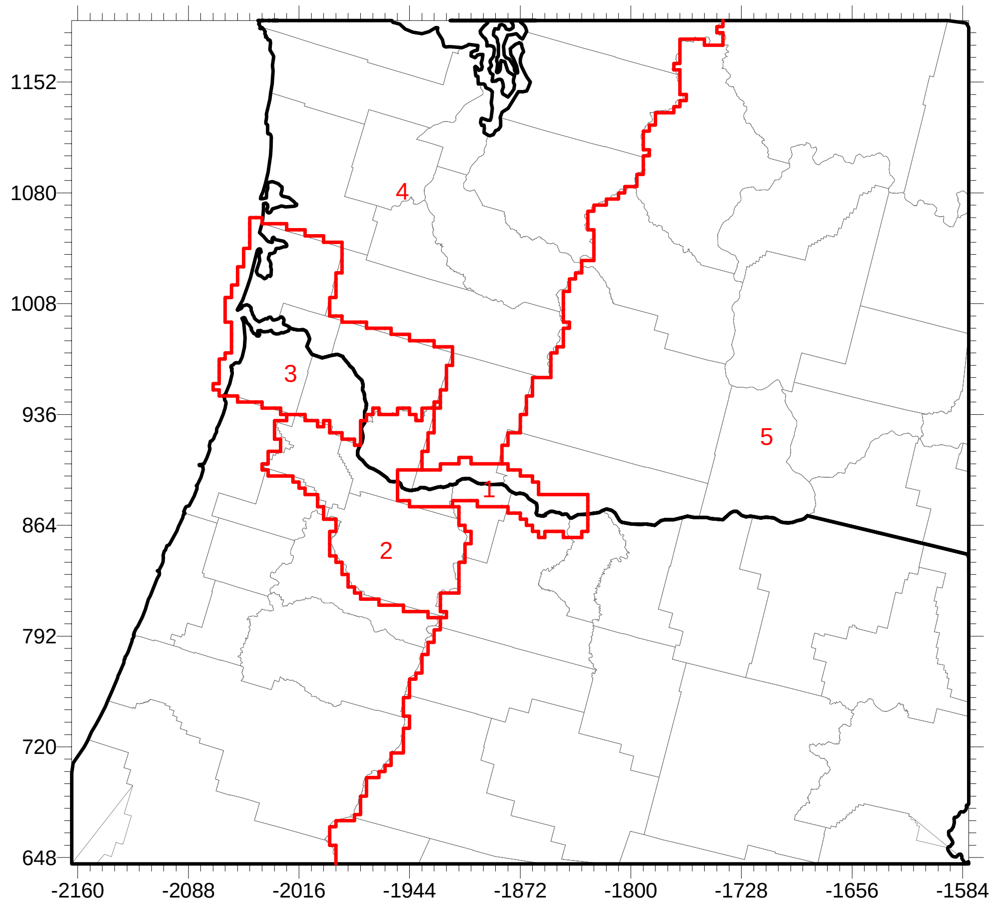
The Gorge Technical team selected a modeling domain to capture what could be affecting conditions in the Gorge. The area included in the emission inventory was focused within a 4-km (6.44 mile) grid modeling area, encompassing most of Washington and Oregon. Twenty-eight counties in Washington and twenty-four counties in Oregon were determined to be most likely to influence visibility in the Scenic Area, and therefore, a comprehensive inventory was performed for the counties highlighted below in blue or yellow.

Figure x. Counties Studied



VI. Overview of Emissions by PSAT Region

In order to obtain a better understanding of source contribution from specific areas, a modeling tool was employed. The CAMx PSAT (PM Source Apportionment Technology) tool could attribute sulfate, nitrate, organics, and primary particulates to regions within the Gorge. This information can be used to better identify what specific emissions are coming from different regions affecting the Gorge. For example, it provides a snapshot of what emissions are coming from the Portland metropolitan area, what emissions are coming from an area specifically within the Columbia River Gorge, and what the contributions of these emissions are. The Technical Team divided up the Gorge modeling area into 5 regions, as shown in Figure x. Region 1 encompasses the Gorge Scenic Area, Region 2 - metropolitan Portland and surrounding areas, Region 3 – areas directly northwest of the central Gorge area, Region 4 – all other areas west of the Gorge area, and Region 5 – all other areas east of the Gorge area. Both 2004 and 2018 emissions were calculated for these areas using the PSAT modeling tool.



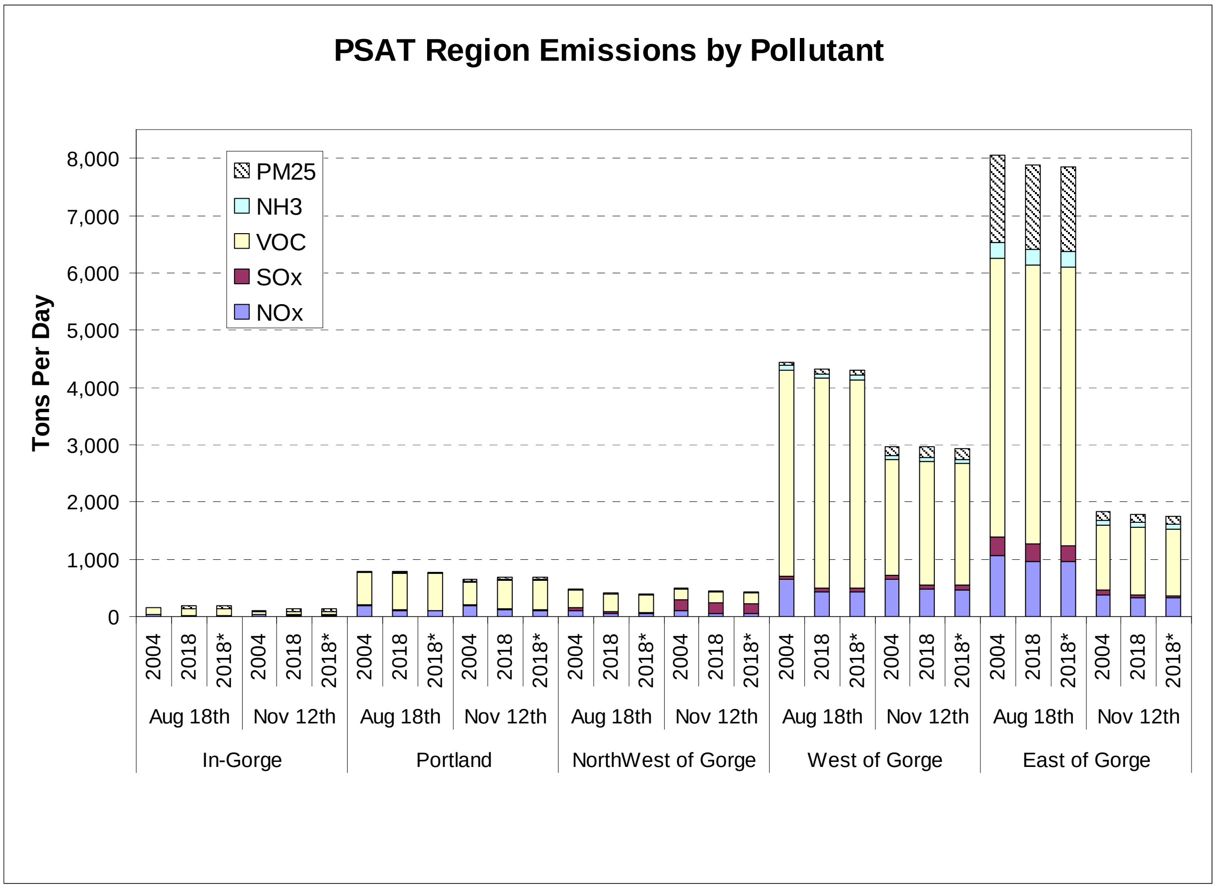
Source Region Map - 4km domain
1. In-Gorge
2. Portland
3. NorthWest of Gorge
4. West of Gorge
5. East of Gorge

(LCP Definition: -97, 40, 45, 33)

Figure x. Modeling domain map of the Columbia River Gorge air quality area

To help gain a better understanding of source contribution from the various regions in the Gorge modeling area, Figure x shows the emissions by pollutant distributed amongst the five PSAT regions. The areas "West of Gorge" and "East of Gorge" have high pollutant contributions, primarily due to the larger area that it encompasses. For example, emissions from the Puget Sound area (Seattle) are included in "West of Gorge" emissions.

Figure x



These emissions in Figure x reflect both natural and anthropogenic sources, however, for the purposes of discussing identifying sources that can be addressed as part of a Gorge visibility strategy, this section details the anthropogenic source contribution for all the pollutants combined. Information on the natural source contribution by pollutant is discussed in Section VI.

A. In-Gorge Source Contributions

The In-Gorge area (Region 1) comprises of the immediate Columbia Gorge Scenic Area including parts of Multnomah, Hood, Wasco, and Sherman counties in Oregon and Skamania, Klickitat, and Clark counties in Washington.   The source categories were determined by identifying all the anthropogenic source categories that were contributing to In-Gorge emissions. DEQ identified and grouped these categories according to similar category groupings (e.g. the agricultural source category consists of nonroad – agricultural, fertilizer operations, and orchard heaters, etc.), the amount of emissions for each category, and source categories of interest. For further information on how the anthropogenic emission source categories were grouped, please refer to Appendix A.

Figure x shows source contributions for August 18, 2004, Region 1: In Gorge. The “Other” source category includes emissions from degreasers, commercial food preparation, dry cleaning, fugitive dust, household solvent use, and graphic arts, etc.

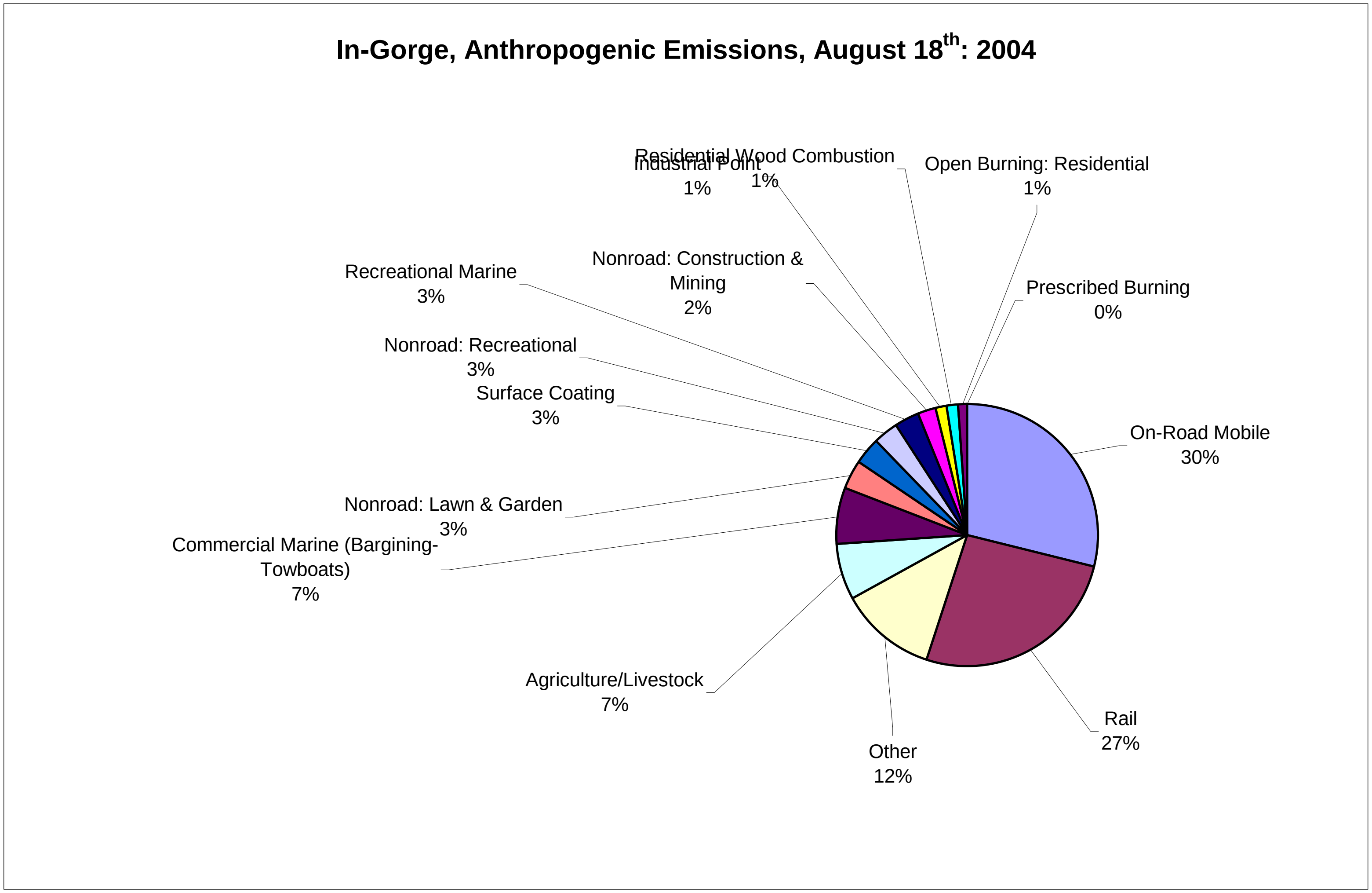


Figure x shows source contributions for August 18, 2018, Region 1 – In Gorge. The “Other” source category includes emissions from lawnmowers, degreasers, commercial food preparation, dry cleaning, fugitive dust, household solvent use, and graphic arts, etc.

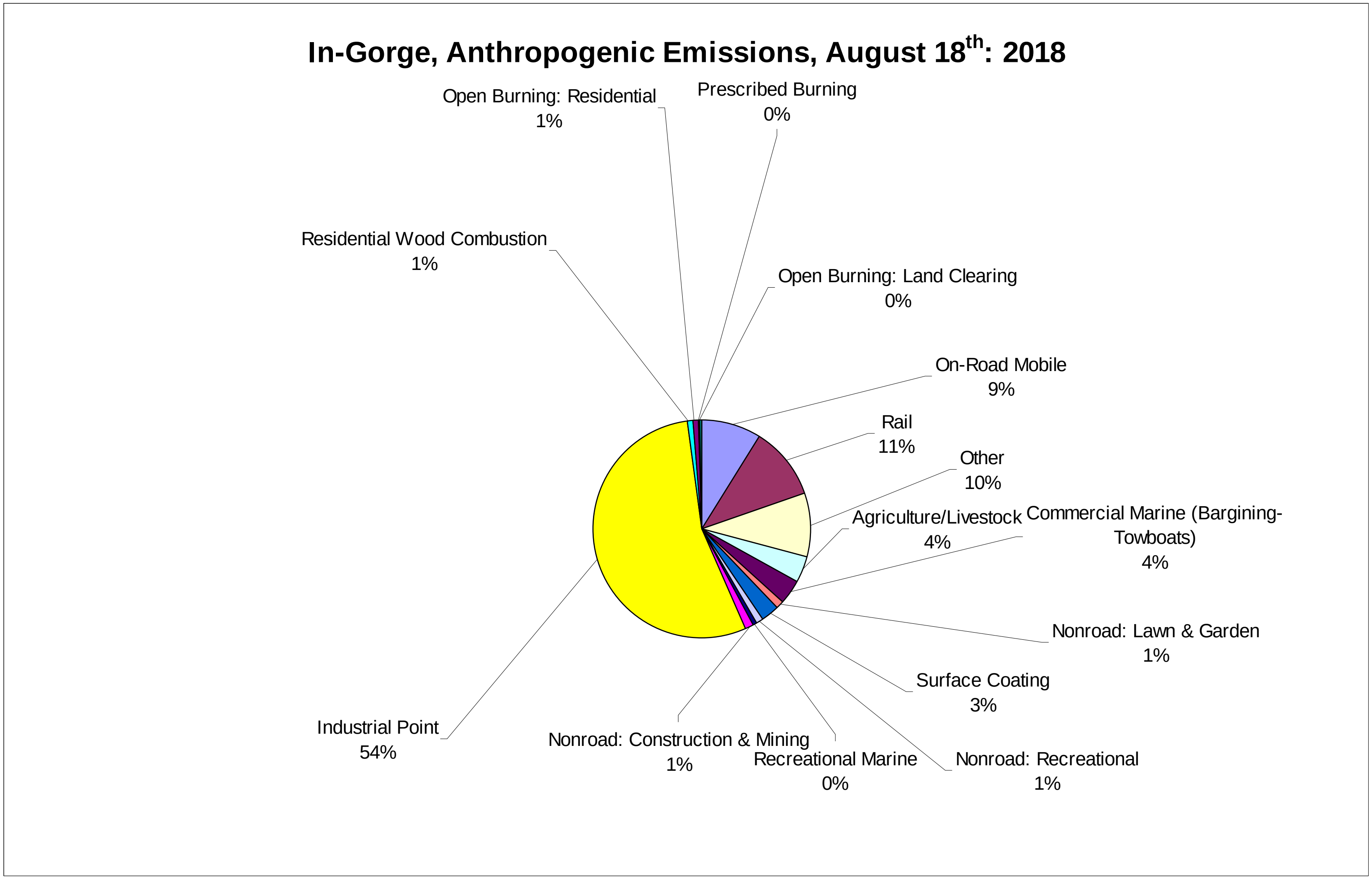


Figure x shows a comparison of source categories (man-made sources only) from August 18, 2004 to August 18, 2018. This is for In-Gorge sources only. From the chart, on-road mobile emissions decrease by 50% (14 tons/day to 7 tons/day) as a result of EPA rules for vehicle engines and ultra low-sulfur fuel. The ultra low sulfur fuel rules went into effect in 2007, resulting in a decreased amount of sulfur that is allowed in fuel, for nonroad equipment, locomotives, and marine vessels. Rail emissions also decrease by 25% (12 tons/day to 9 tons/day) due to EPA's ultra low-sulfur fuel regulations. Industrial point sources show a 4500% increase in emissions (1 ton/day to 45 tons/day). These growth assumptions were based on EPA's Economic Growth and Analysis System growth factor model (EGAS). WRAP utilized this model when making the 2018 EI projections for industry. The "other" source category also shows growth from 2004 to 2018, primarily due to expected increases in household solvent use and degreasing.

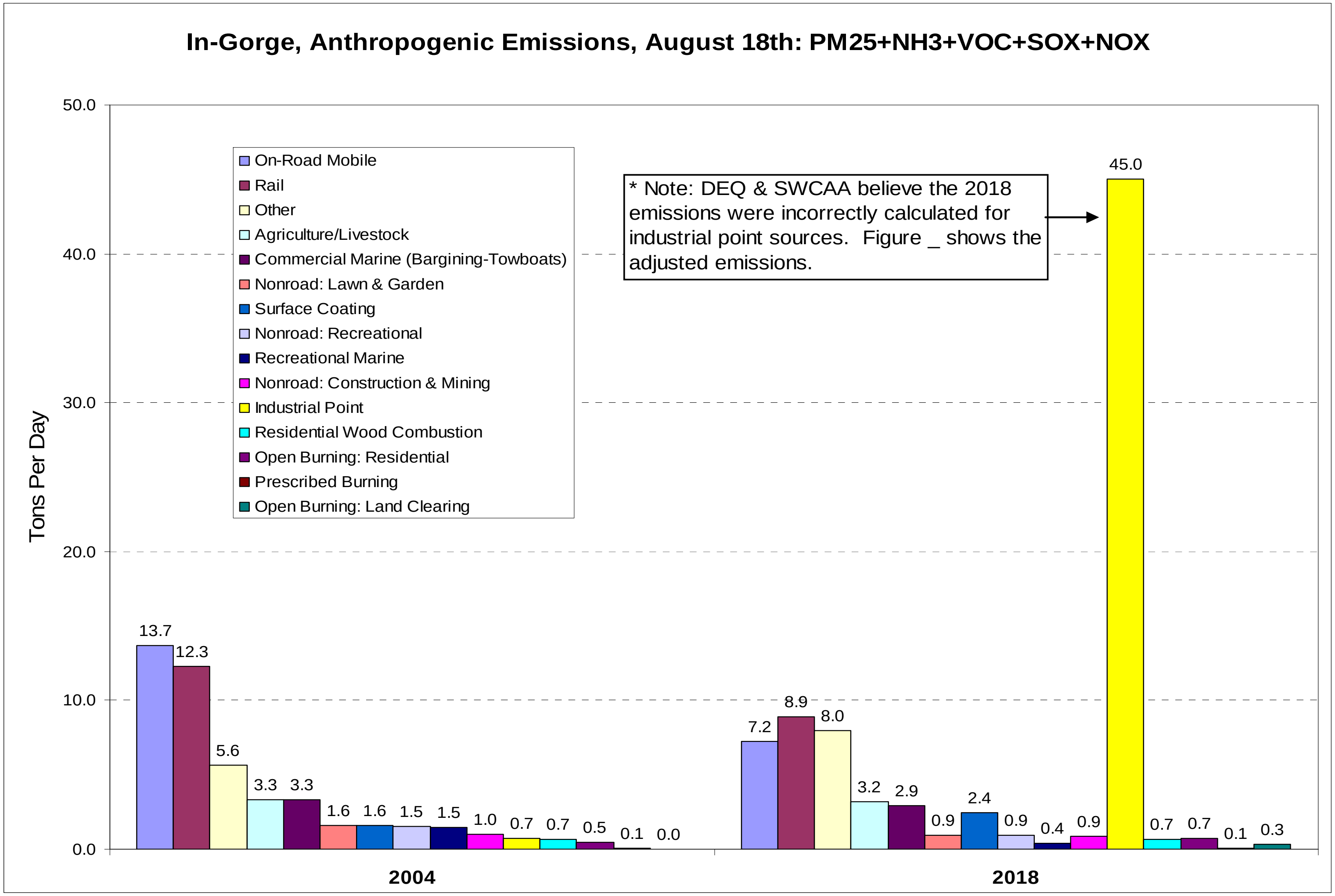


Figure x shows source contributions for November 12, 2018, Region 1 – In Gorge. The "Other" source category includes emissions from lawnmowers, degreasers, commercial food preparation, dry cleaning, fugitive dust, household solvent use, and graphic arts, etc.

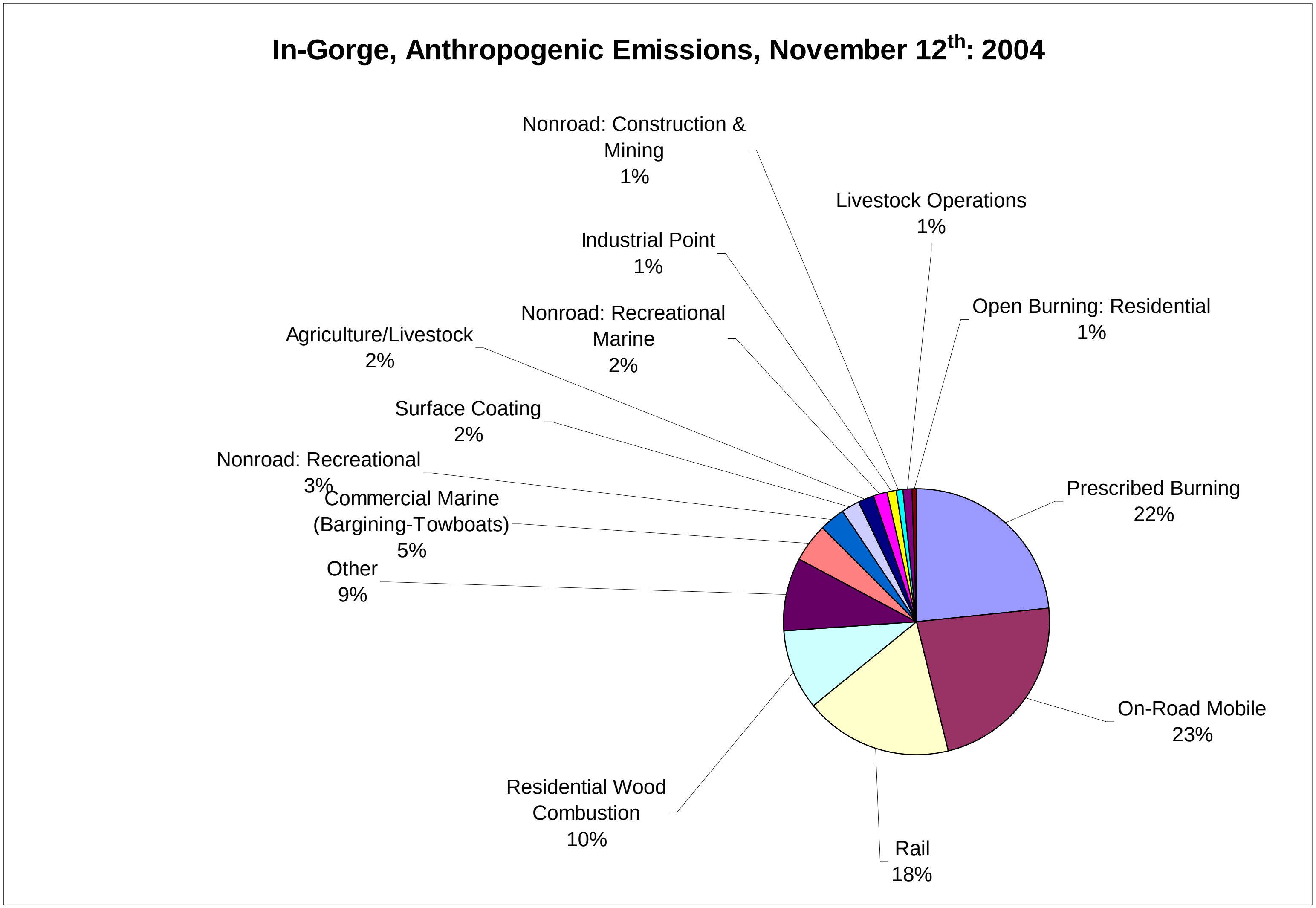


Figure x shows source contributions for November 12, 2018, Region 1 – In Gorge. The “Other” source category includes emissions from lawnmowers, degreasers, commercial food preparation, dry cleaning, fugitive dust, household solvent use, and graphic arts, etc.

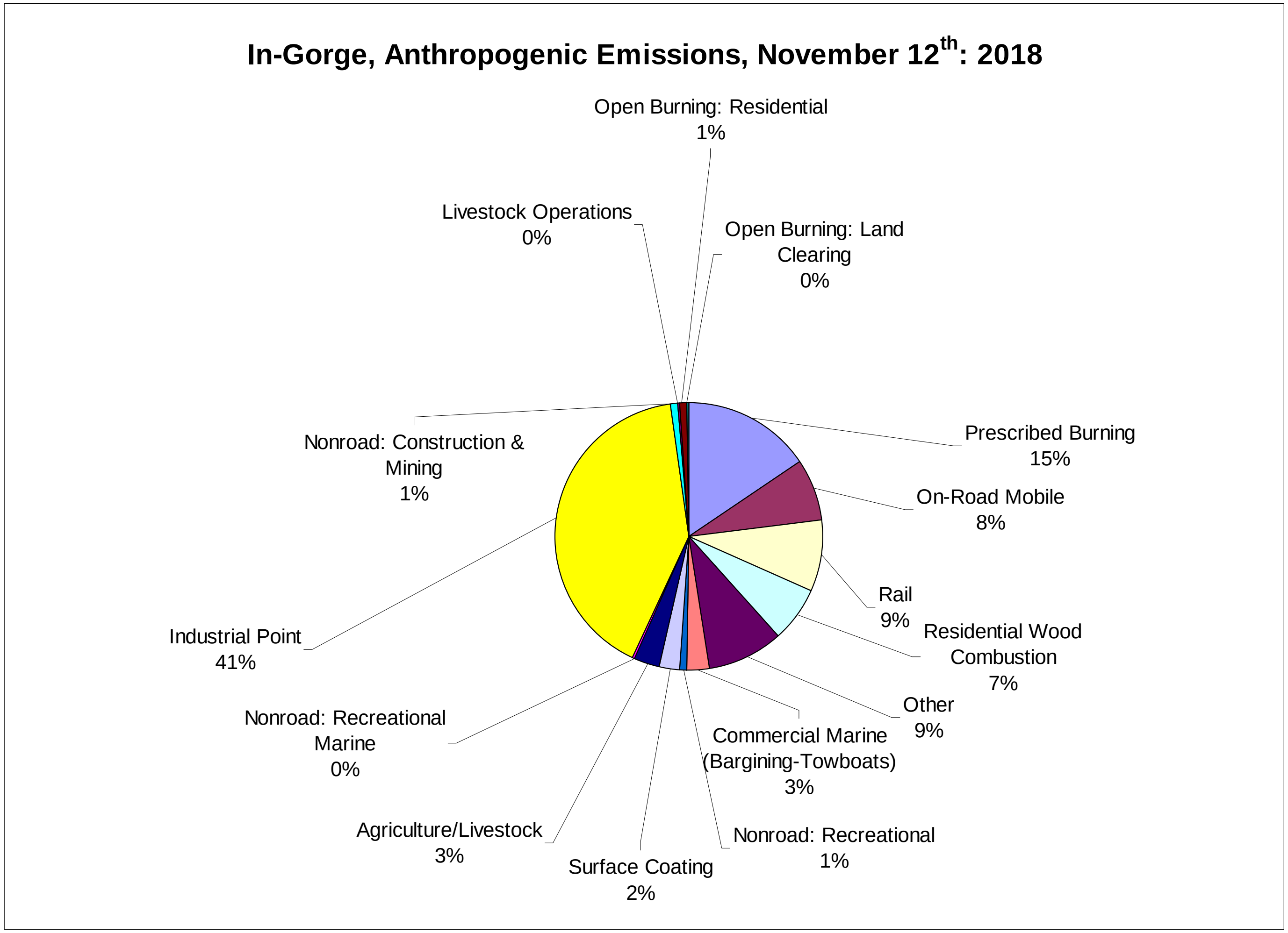
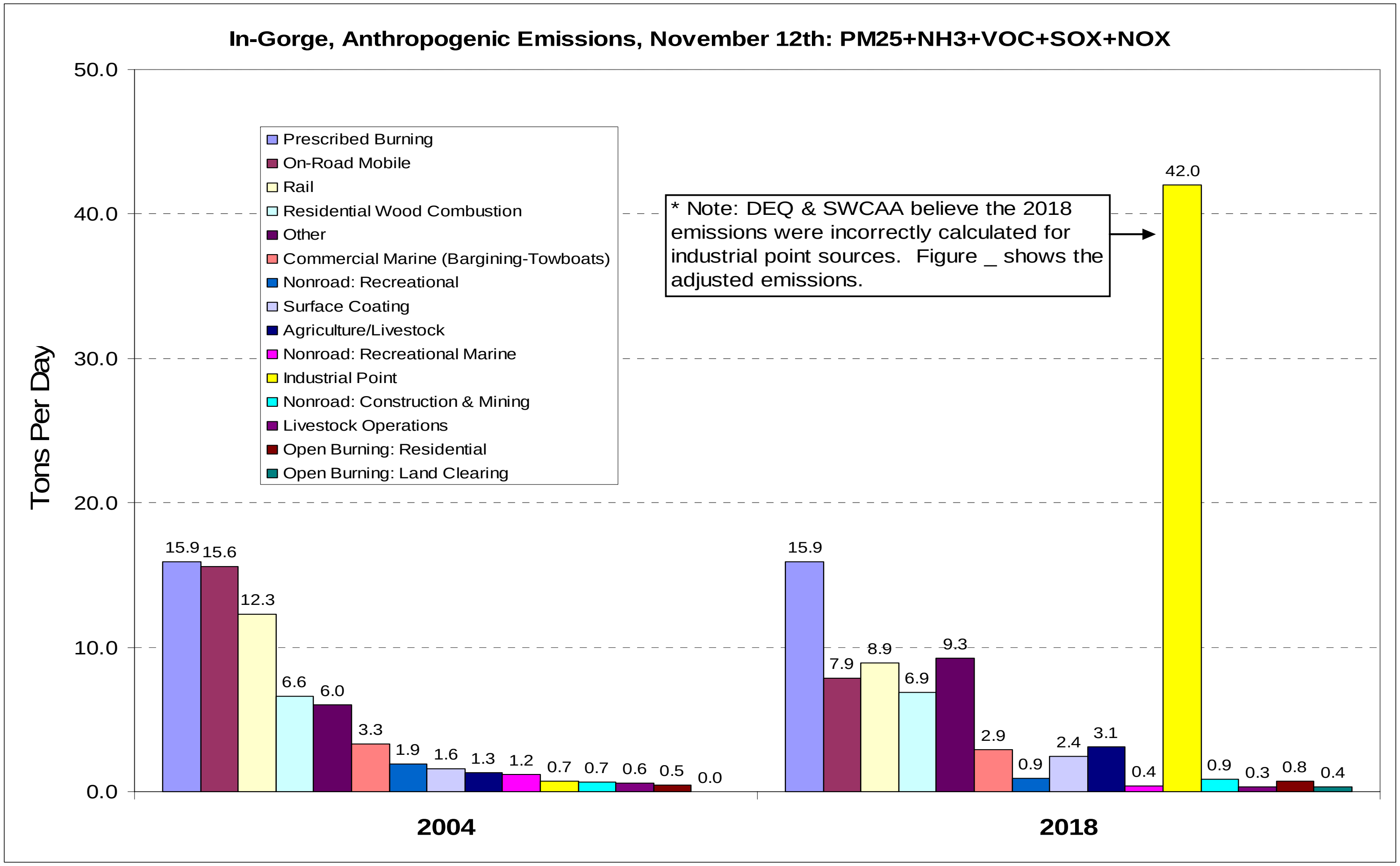


Figure x shows a comparison of man-made sources for November 12, 2004 and 2018. On-road mobile emissions decrease by 50% (16 tons/day to 8 tons/day) and rail emissions decrease by 25% (12 tons/day to 9 tons/day) due to EPA's ultra low sulfur fuel rules. The ultra low sulfur fuel rules went into effect in 2007, resulting in a decreased amount of sulfur that is allowed in fuel, for nonroad equipment, locomotives, and marine vessels. Industrial point sources show a 4200% increase in emissions (1 ton/day to 42 tons/day). These growth assumptions were based on EPA's Economic Growth and Analysis System growth factor model (EGAS). WRAP utilized this model when making the 2018 EI projections for industry. Agricultural emissions show an increase 300% (1 ton/day to 3 tons/day), due to a projected increase in livestock operations. The "other" source category also shows growth from 2004 to 2018, primarily due to expected increases in household solvent use and lawn and garden use.



B. Portland Source contributions

The Portland area (Region 2) comprises metropolitan Portland area including Vancouver, Washington. As with the In-Gorge source category emissions, the source categories were determined by identifying all the anthropogenic source categories that contribute to Portland area emissions. DEQ identified and grouped these categories according to similar category groupings (e.g. the agricultural source category consists of nonroad – agricultural, fertilizer operations, and orchard heaters, etc.), the amount of emissions for each category, and source categories of interest. For further information on how the anthropogenic emission source categories were grouped, please refer to Appendix x.

Figure x shows source contributions for August 18, 2004, Region 2: Portland. “Miscellaneous Area Sources” source category is a combination of solvent applications, including graphic arts, and industrial uses. The “Other” source category includes emissions from fugitive dust, fuel storage, and aircraft emissions.

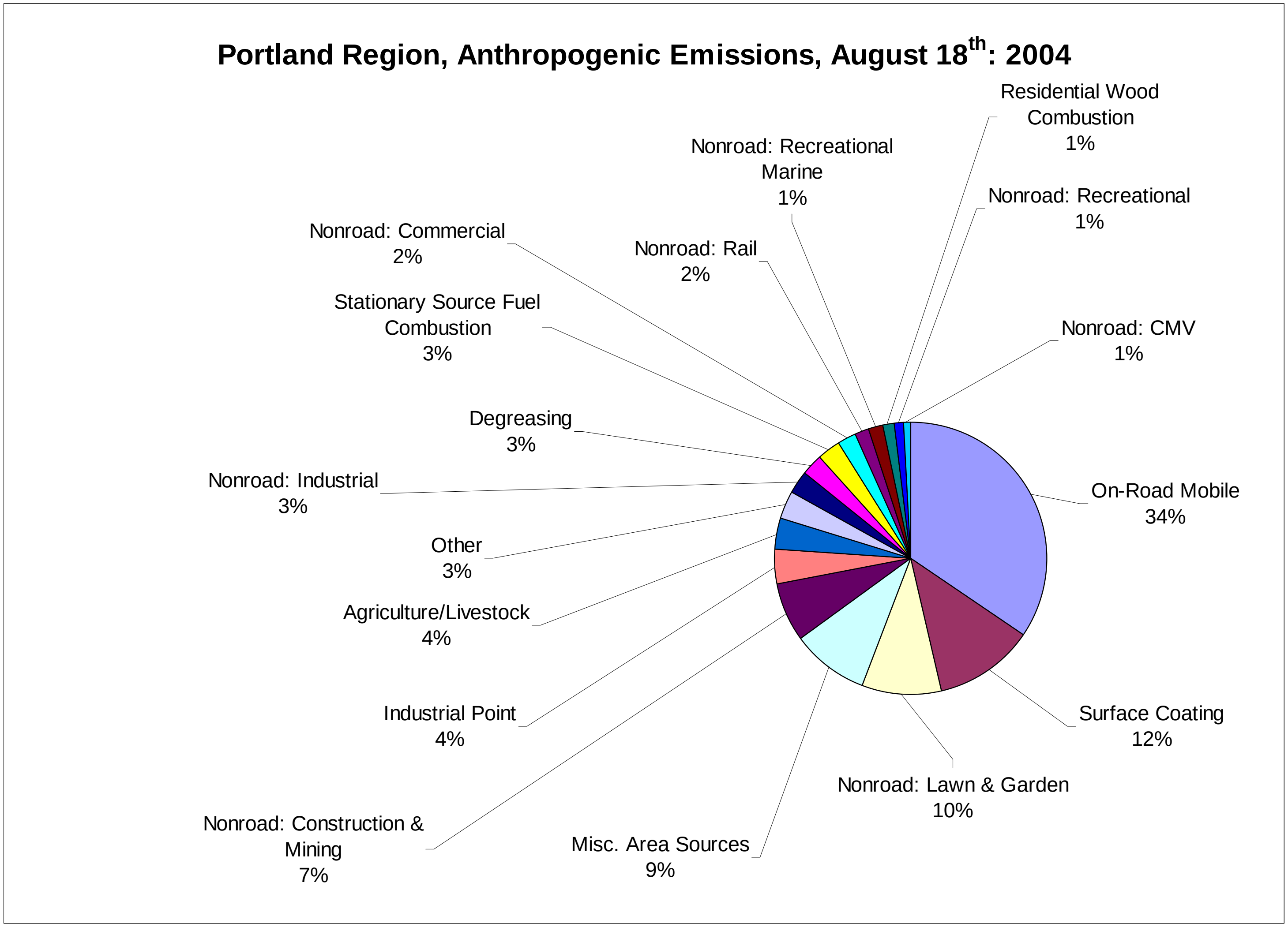


Figure x shows source contributions for August 18, 2018, Region 2: Portland. The category groupings are the same as what was used for August 2004.

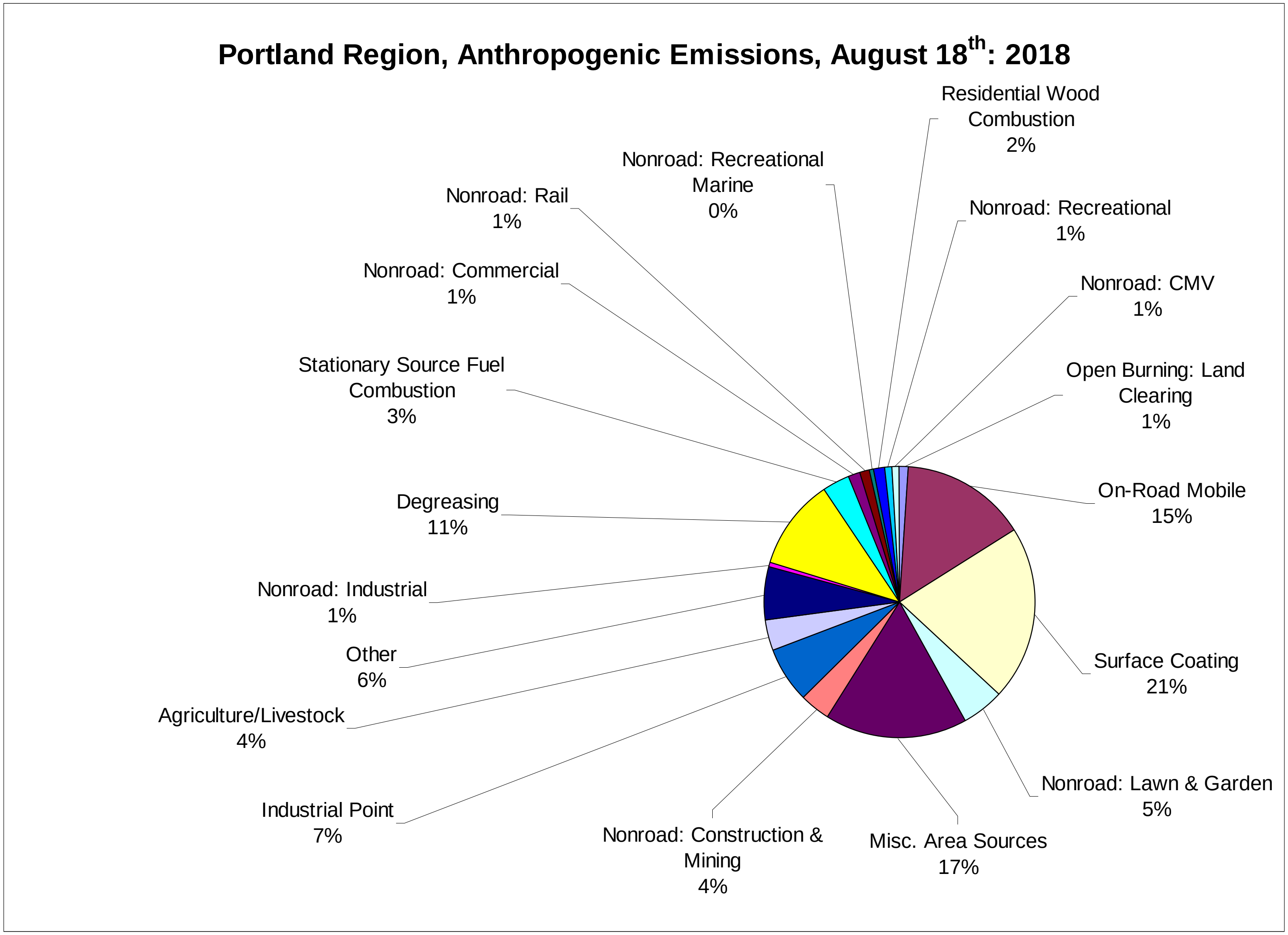


Figure x shows a comparison of man-made sources for August 18, 2004 and 2018. On-road mobile emissions decrease by 57% (172 tons/day to 75 tons/day) and nonroad: construction and mining emissions decrease by 50% (35 tons/day to 18 tons/day) due to EPA's ultra low sulfur fuel rules. The ultra low sulfur fuel rules went into effect in 2007, resulting in a decreased amount of sulfur that is allowed in fuel, for nonroad equipment, locomotives, and marine vessels. Surface coating sources show a 170% increase (60 tons/day to 103 tons/day), miscellaneous area sources increase by 184% (45 tons/day to 83 tons/day), and degreasing emissions increase by 415% (13 tons/day to 54 tons/day) all due to population growth estimates. Industrial point sources show a 157% increase in emissions (21 ton/day to 33 tons/day). These growth assumptions were based on EPA's Economic Growth and Analysis System growth factor model (EGAS). WRAP utilized this model when making the 2018 EI projections for industry. The "other" source category also shows growth from 2004 to 2018, primarily due to expected increases in dry cleaning use, emissions increases in commercial food preparation, and fuel storage and transport.

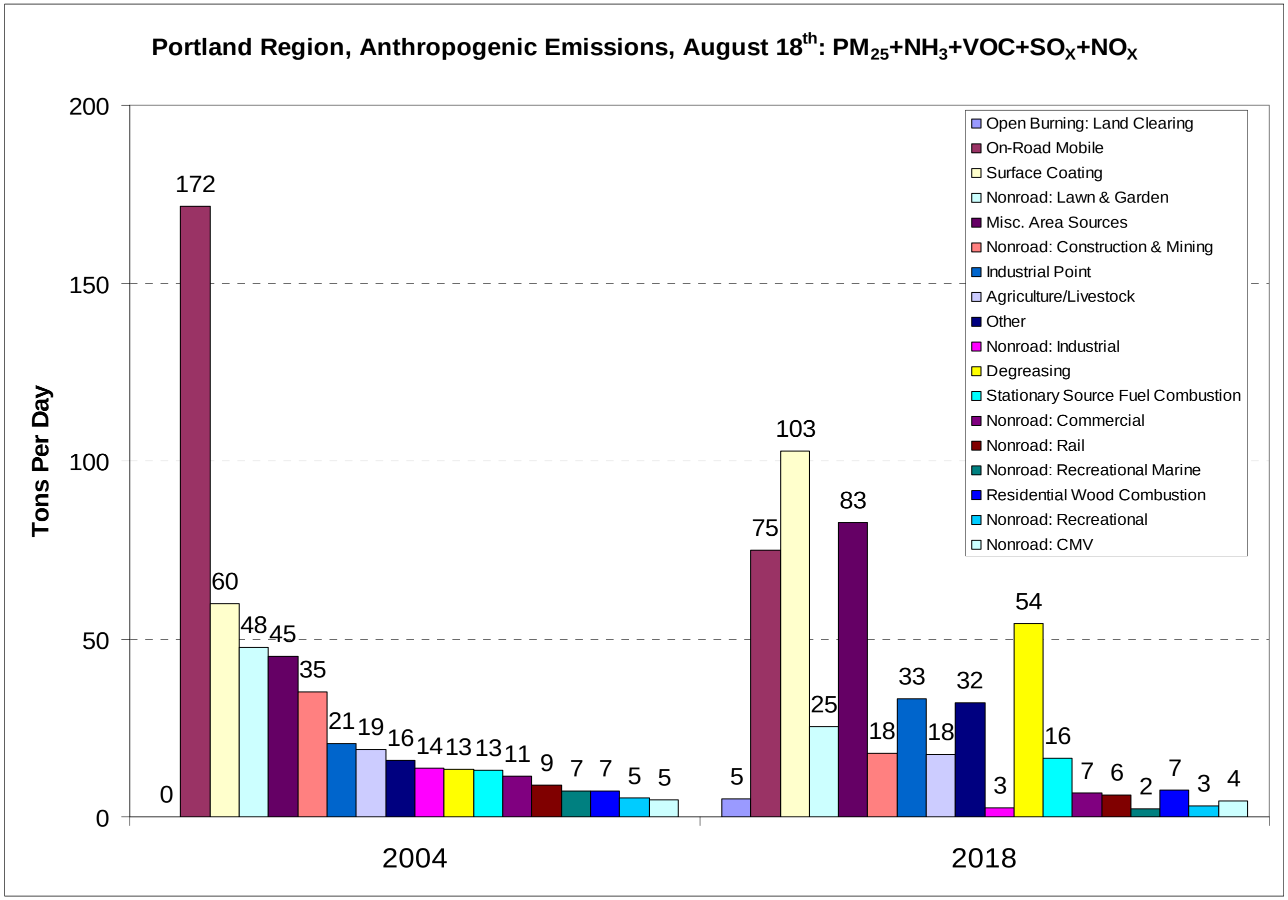


Figure x shows source contributions for November 12, 2004, Region 2 – Portland. The "Other" source category includes emissions from commercial food preparation, fuel storage and transport, prescribed burning, and aircraft emissions. "Miscellaneous Area Sources" are graphic arts, commercial and industrial solvent use including degreasing.

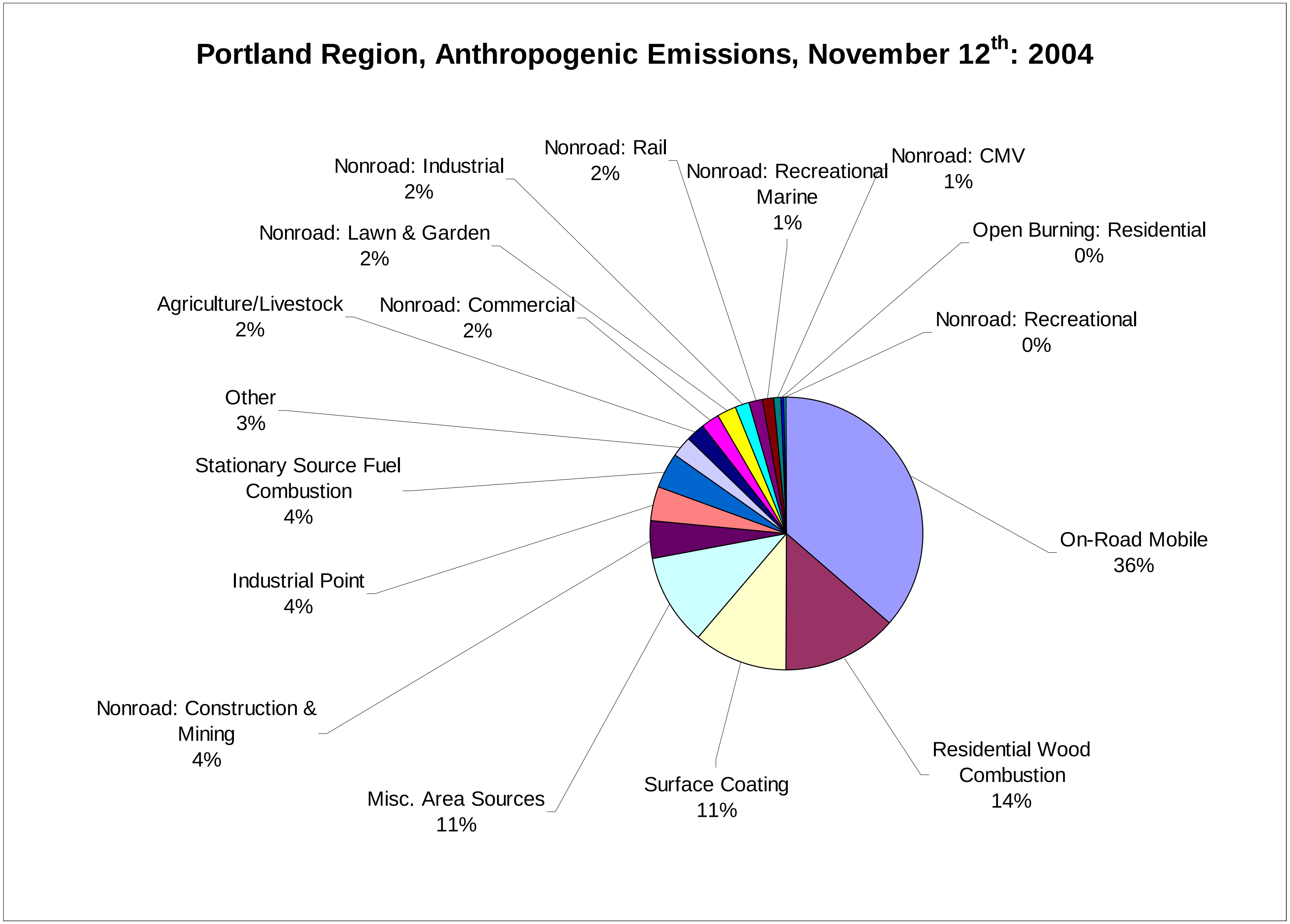


Figure x shows source contributions for November 12, 2018, Region 2 - Portland. The source category groupings are the same as above.

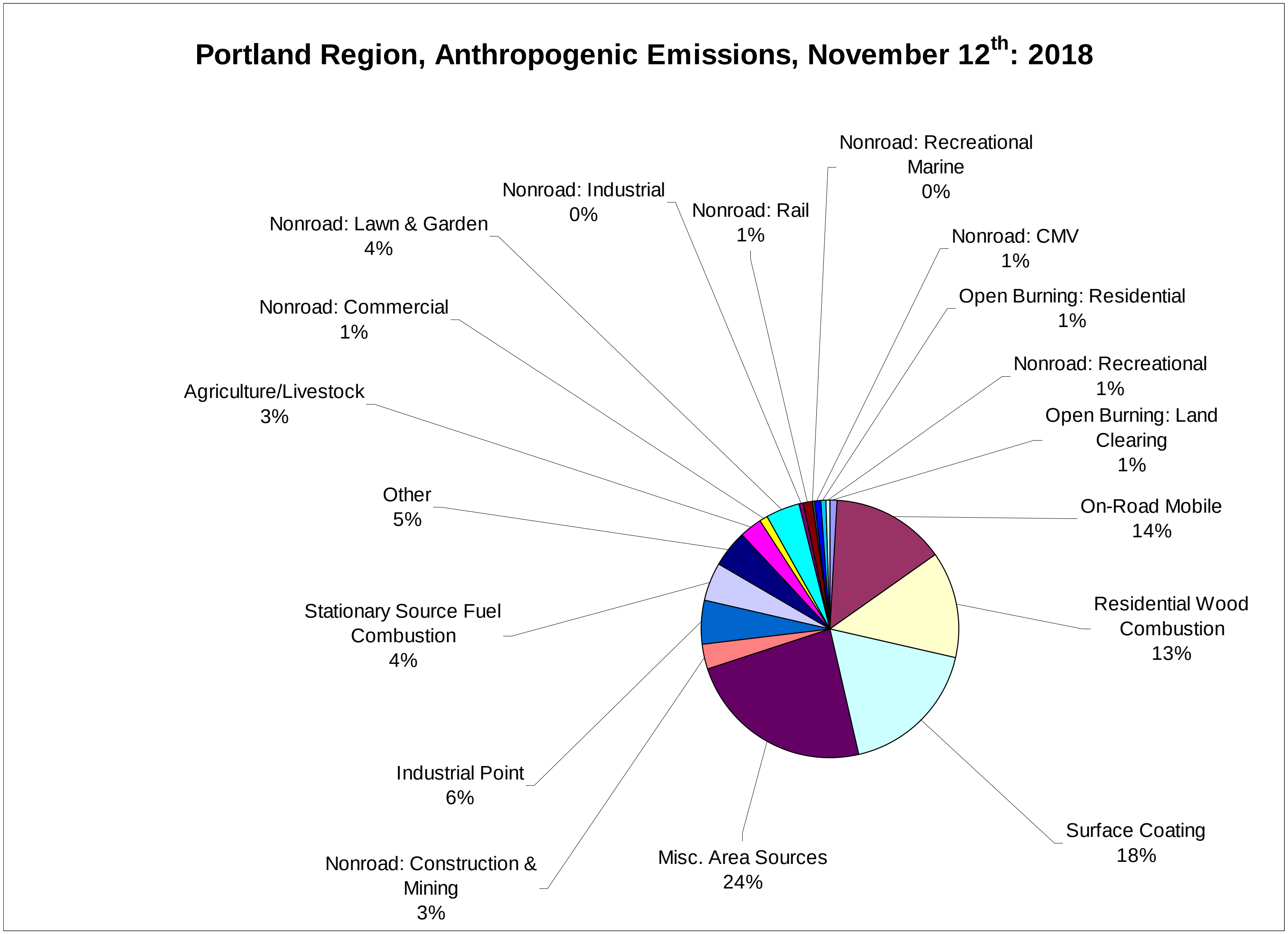
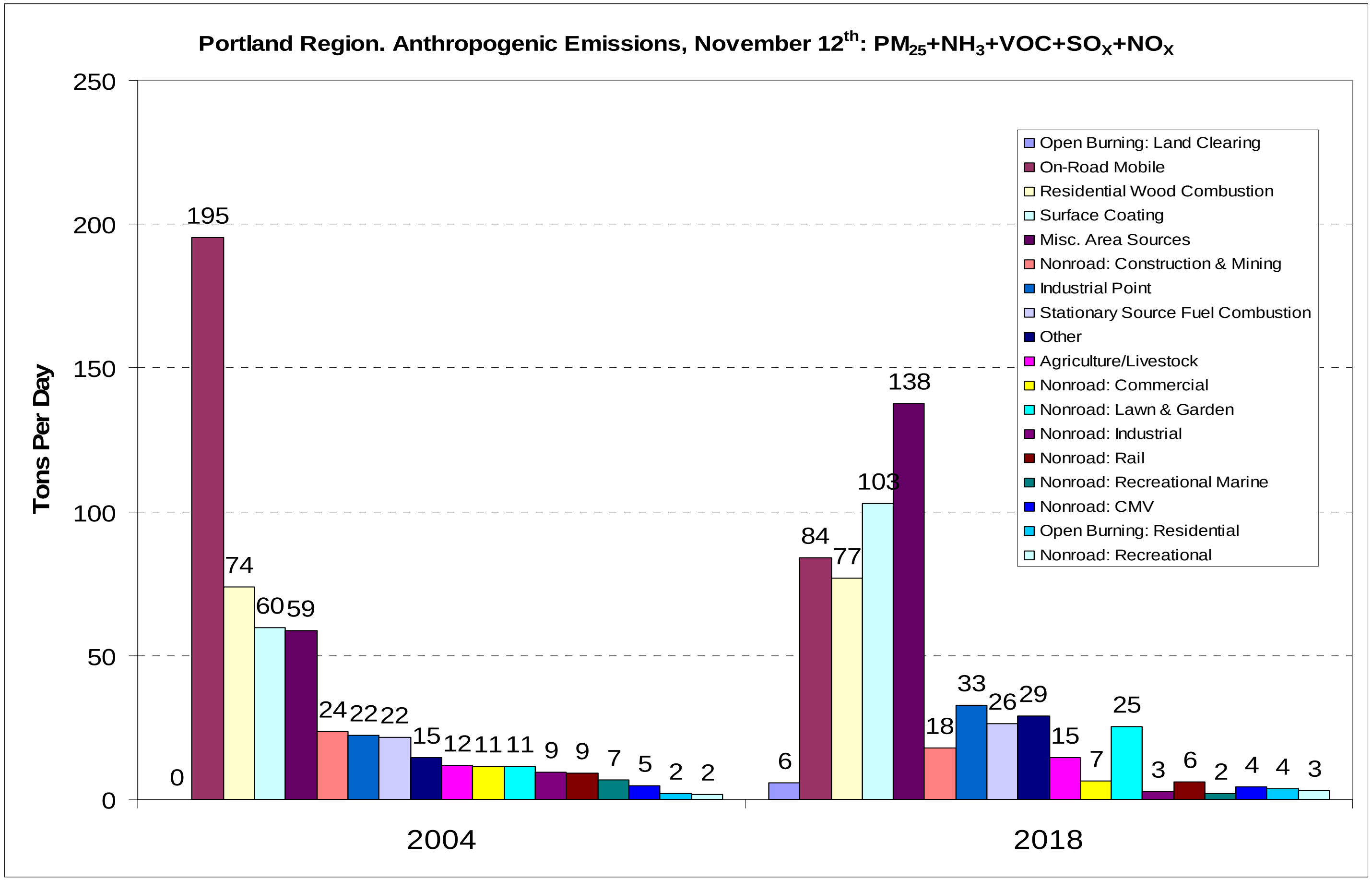


Figure x shows a comparison of man-made sources for August 18, 2004 and 2018. On-road mobile emissions decrease by 57% (195 tons/day to 84 tons/day) due to EPA's ultra low sulfur fuel rules. Surface coating sources show a 170% increase (60 tons/day to 103 tons/day), miscellaneous area sources increase by 233% (59 tons/day to 138 tons/day) all due to population growth estimates. Industrial point sources show a 157% increase in emissions (22 tons/day to 33 tons/day). These growth assumptions were based on EPA's Economic Growth and Analysis System growth factor model (EGAS). The "other" source category also shows growth from 2004 to 2018, primarily due to expected increases in commercial food preparation and fuel storage and transport. Residential wood combustion stays relatively constant throughout (74 tons/day to 77 tons/day).



C. Northwest of Gorge Source Contribution

The Northwest of Gorge area (Region 3) comprises the area just northwest of metropolitan Portland. This consists of Clatsop and Columbia counties in Oregon and Pacific, Wahkiakum, and Cowlitz counties in Washington. As with the In-Gorge source category emissions, the source categories were determined by identifying all the anthropogenic source categories that contribute to the Northwest of Gorge area emissions. DEQ identified and grouped these categories according to similar category groupings (e.g. the agricultural source category consists of nonroad – agricultural, fertilizer operations, and orchard heaters, etc.), the amount of emissions for each category, and source categories of interest. For further information on how the anthropogenic emission source categories were grouped, please refer to Appendix x.

Figure x shows source contributions for August 18, 2004, Region 3: Northwest of Gorge.   The “Other” category emissions include nonroad: logging, lawn & garden, solvent use, and prescribed burning.

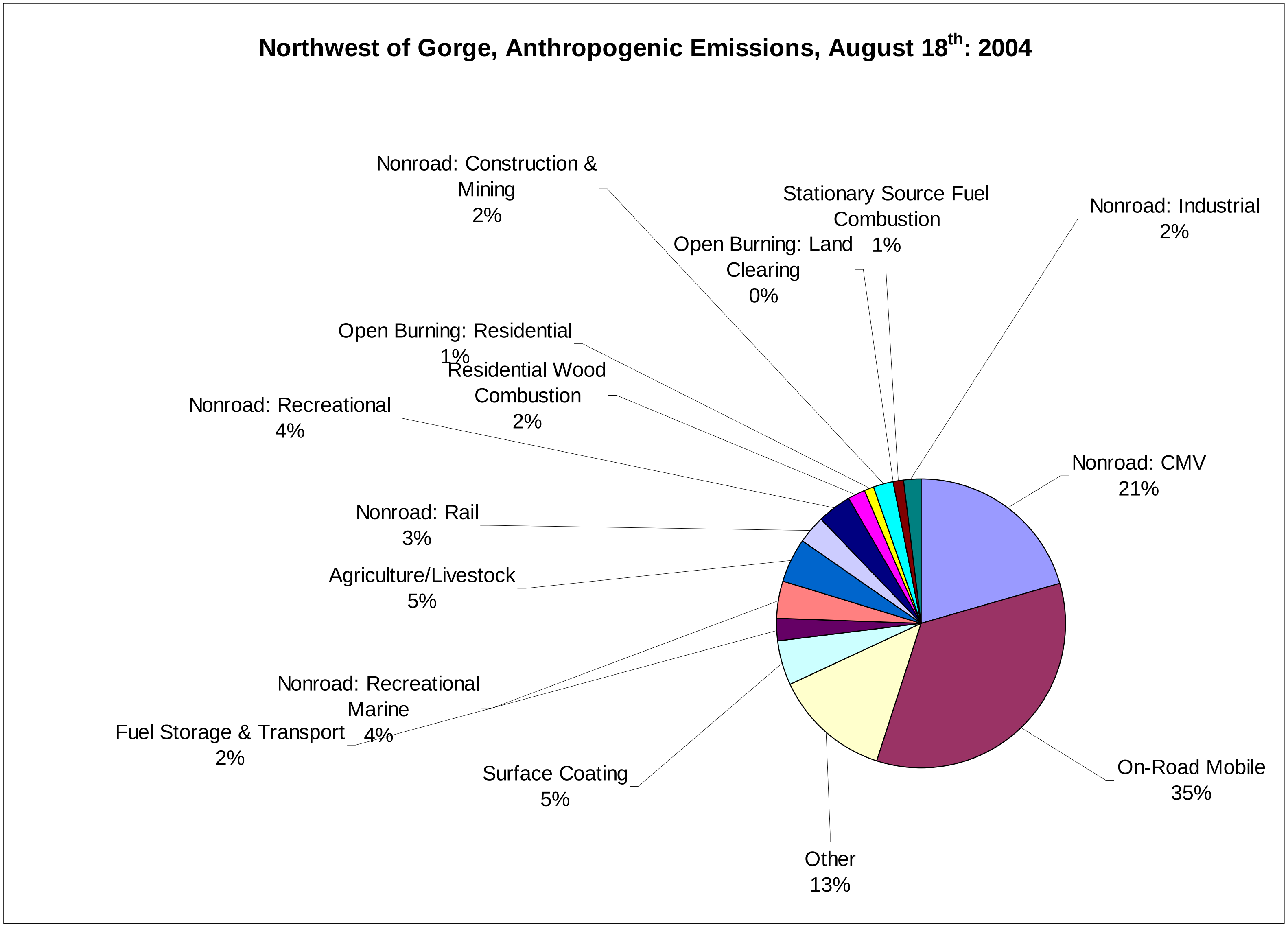


Figure x shows source contributions for August 18, 2018, Region 3: Northwest of Gorge. The source category groupings are the same as above.

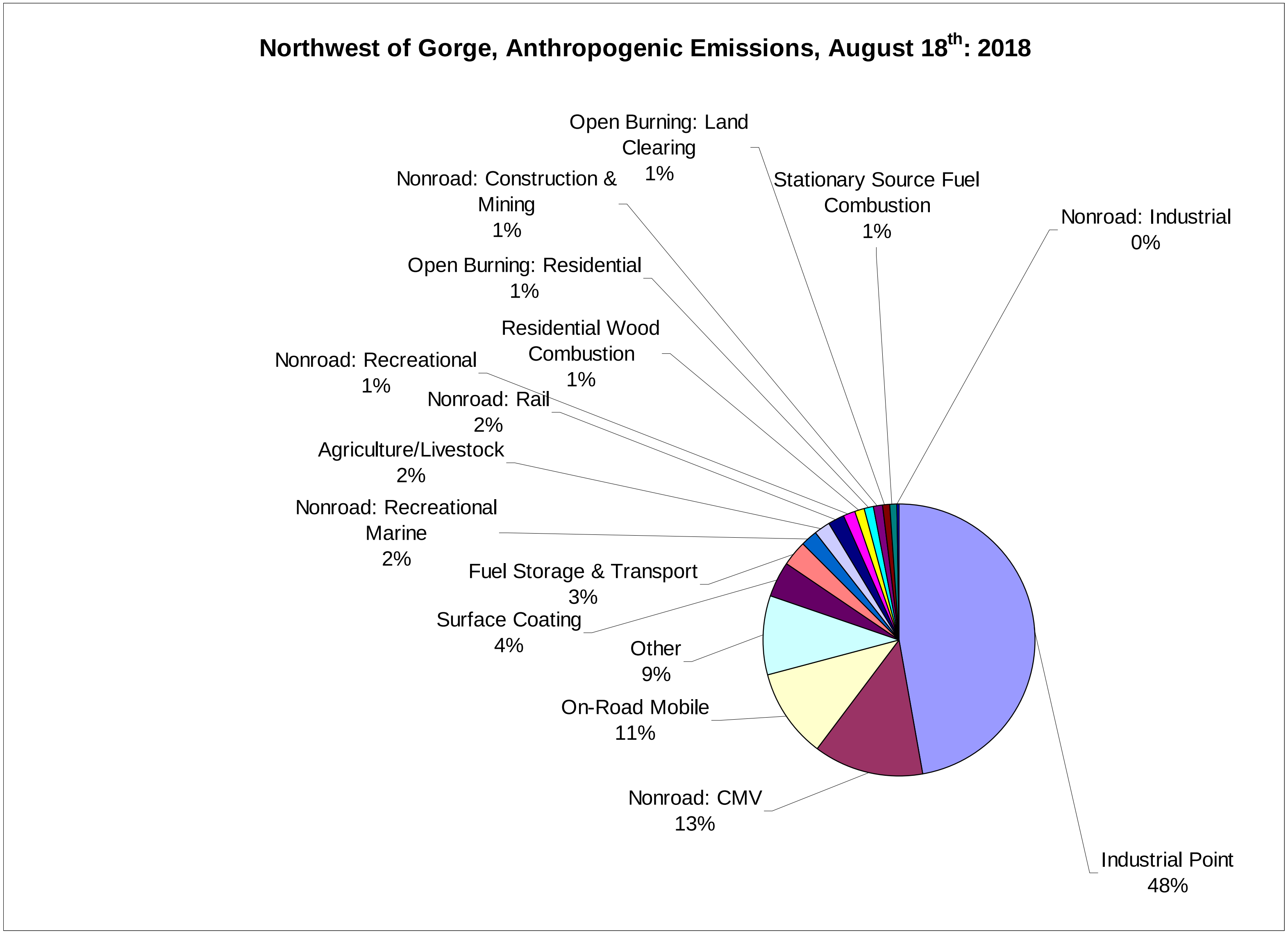


Figure x shows a comparison of source categories (man-made sources only) from August 18, 2004 to August 18, 2018. This is for Northwest of Gorge sources only. From the chart, industrial point emissions decrease by 45% (128 tons/day to 71 tons/day). The Gorge Technical Team discovered one of the industrial point sources, which is located in the "West of Gorge" area had its 2004 emissions incorrectly attributed to the Northwest of Gorge area. In 2018, however, its emissions were correctly attributed to its correct location in the "West of Gorge" area. As a result, the industrial point source emissions for 2004 in this region are higher than they should be and why there is a decrease in emissions from 2004 to 2018. On-road mobile emissions decrease by 50% (31 tons/day to 16 tons/day) due to EPA's ultra low sulfur fuel rules. Nonroad commercial marine vessels remain relatively constant from 2004 to 2018.

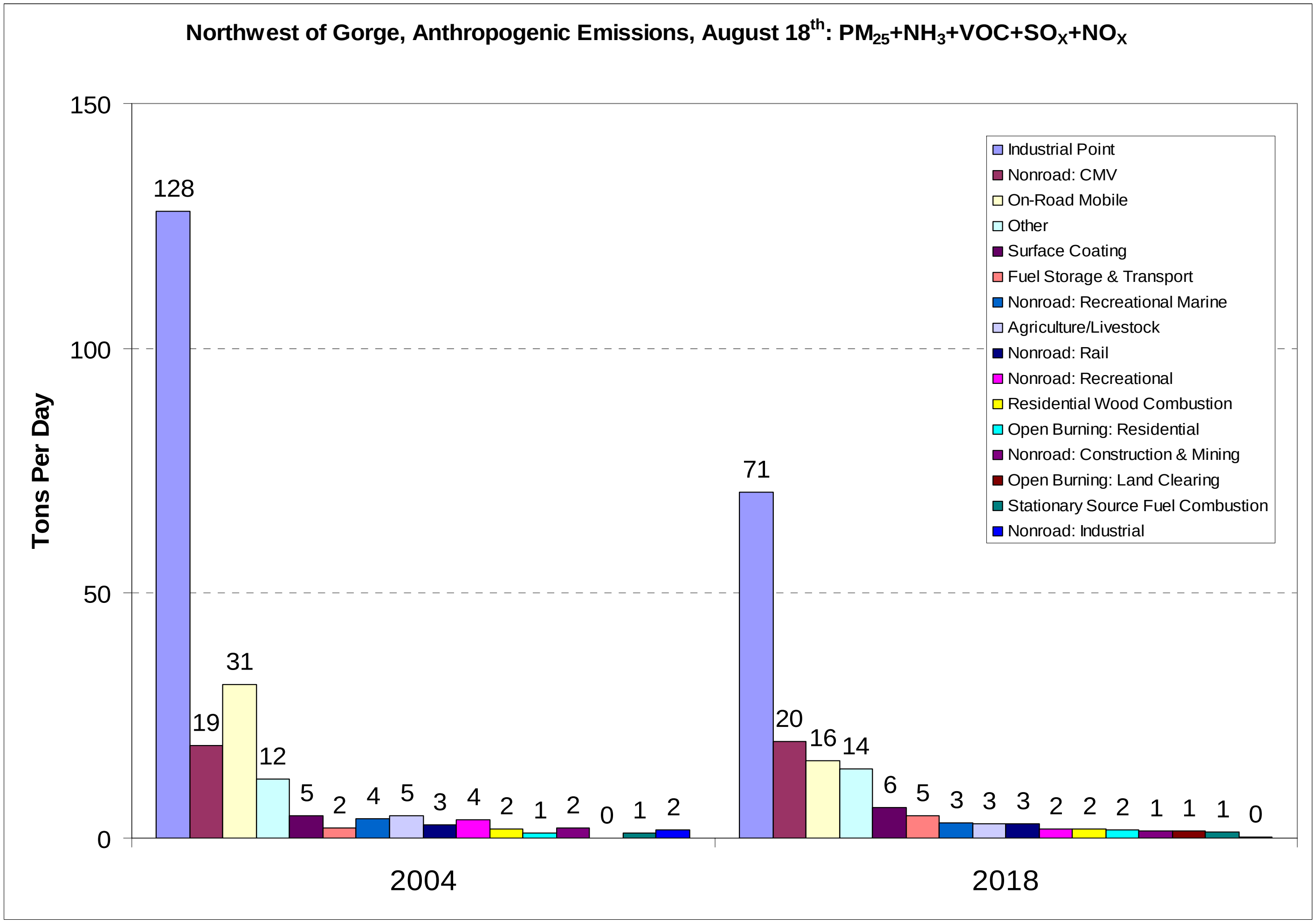


Figure x shows source contributions for November 12, 2004, Region 3 – Northwest of Gorge. The "Other" source emissions come from solvent use and nonroad logging sources, etc.

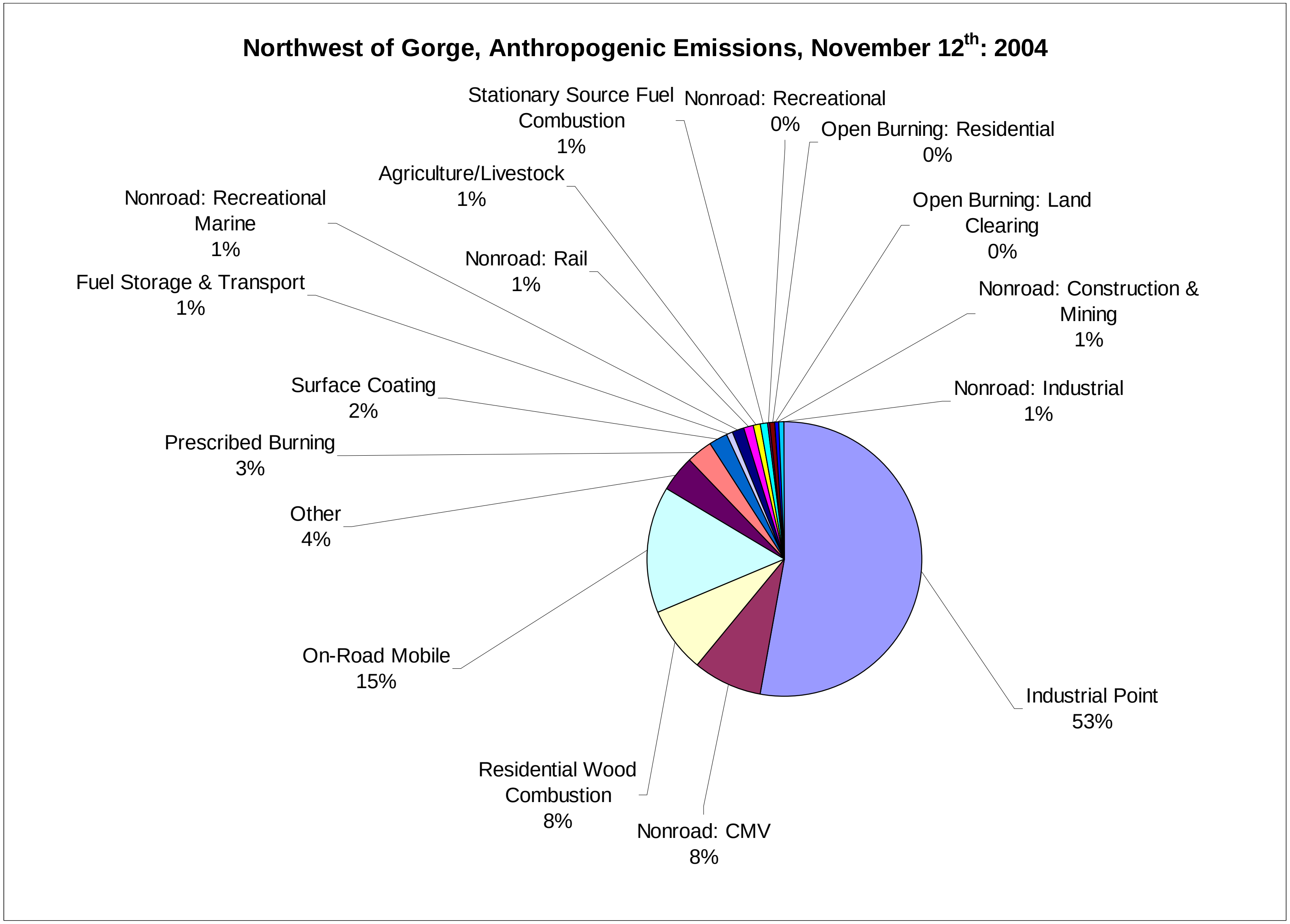


Figure x shows source contributions for November 12, 2018, Region 3 – Northwest of Gorge. The source category groupings are the same as above.

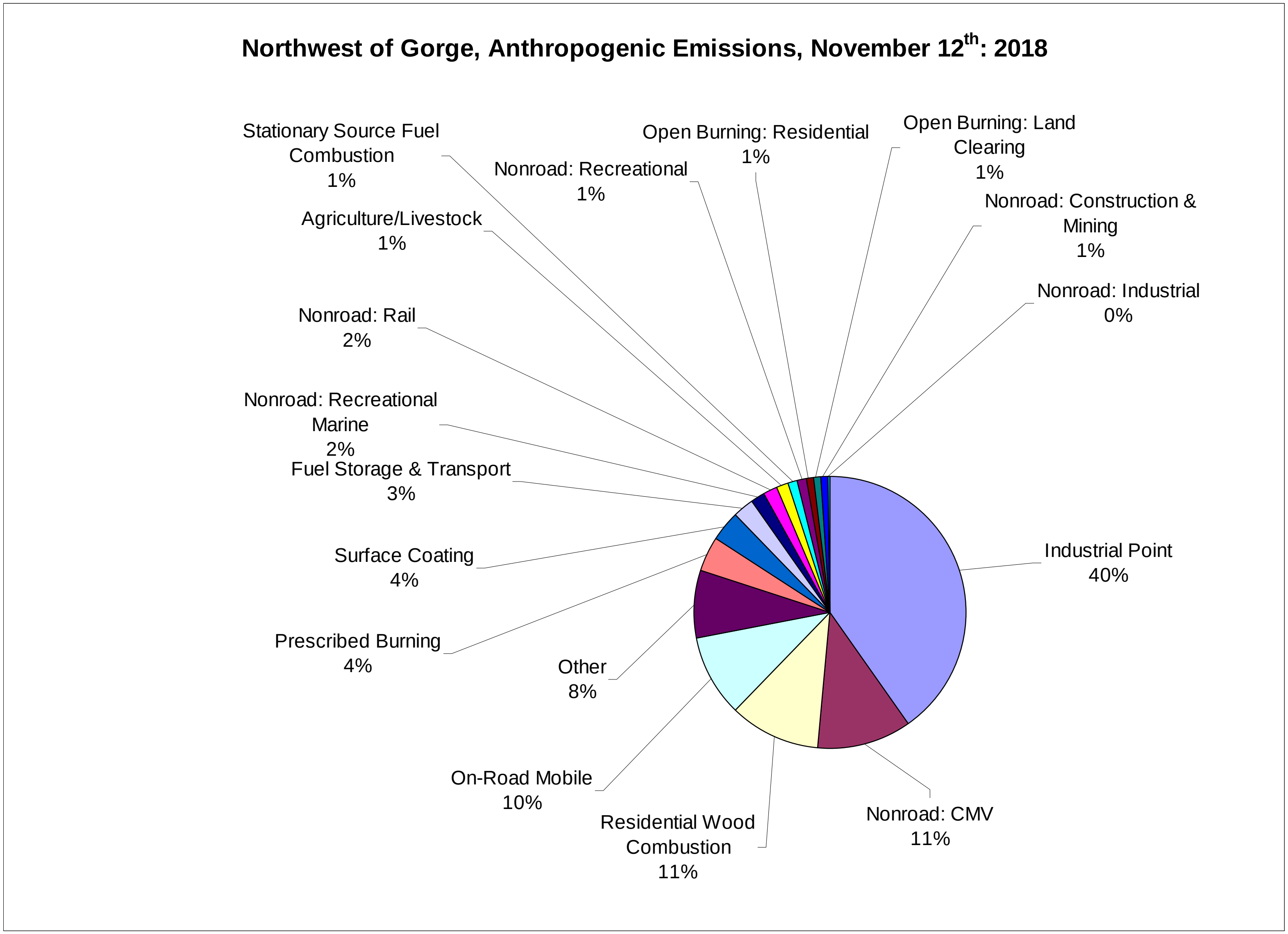
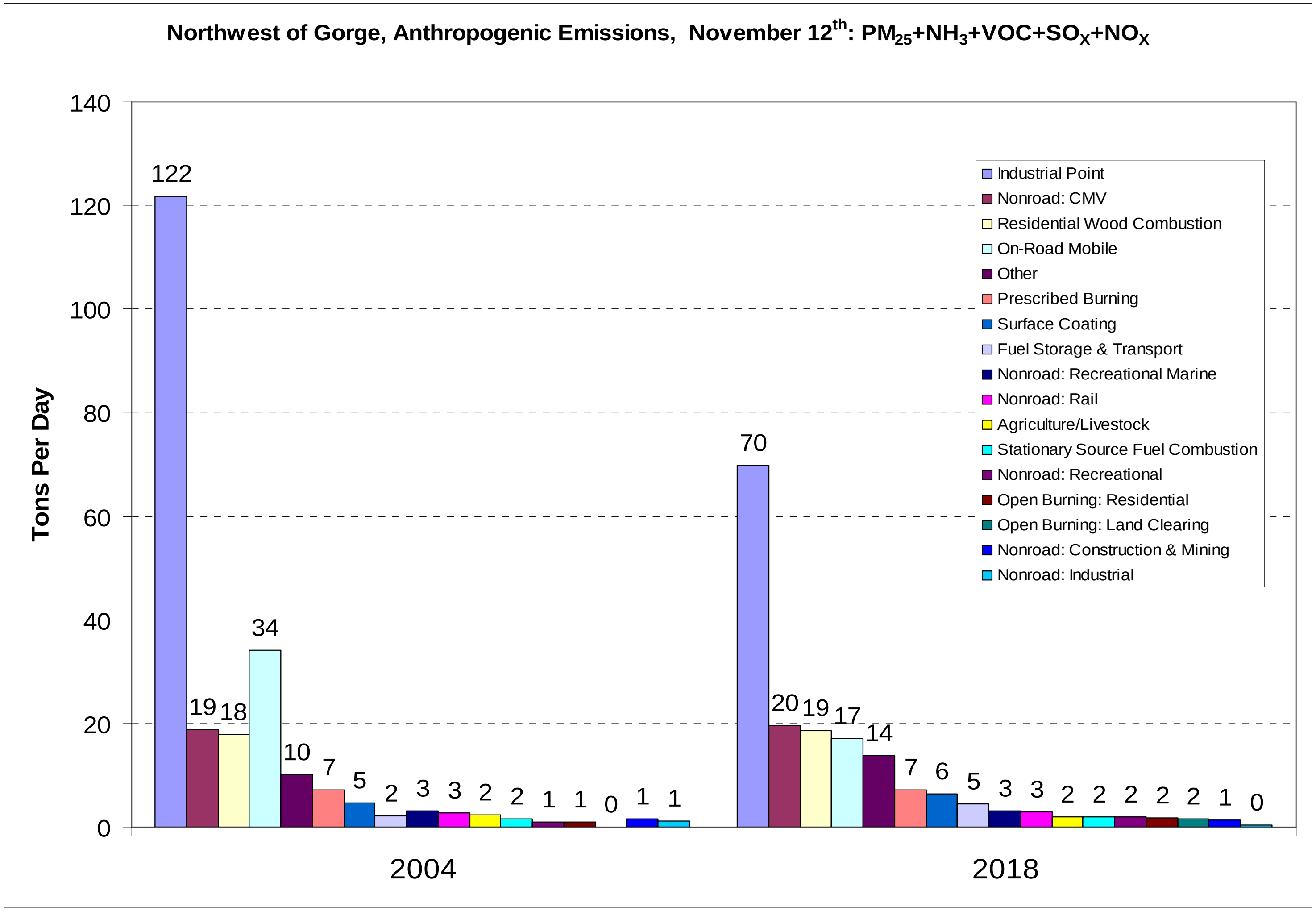


Figure x shows a comparison of source categories (man-made sources only) from November 12, 2004 to November 12, 2018. This is for Northwest of Gorge sources only. From the chart, industrial point emissions decrease by 45% (122 tons/day to 70 tons/day) as a result of the misreporting of emissions for one of industrial point sources, as described in Figure x. On-road mobile emissions decrease by 50% (34 tons/day to 17 tons/day) due to EPA's ultra low sulfur fuel rules. Nonroad commercial marine vessels and residential wood combustion remain relatively constant from 2004 to 2018. The "other" source category also shows some growth from 2004 to 2018, primarily due to expected increases in solvent use and degreasing.



D. West of Gorge Source Contribution

The West of Gorge area (Region 4) comprises all other areas west of the Cascades. As with the In-Gorge source category emissions, the source categories were determined by identifying all the anthropogenic source categories that contribute to West of Gorge area emissions. DEQ identified and grouped these categories according to similar category groupings (e.g. the agricultural source category consists of nonroad – agricultural, fertilizer operations, and orchard heaters, etc.), the amount of emissions for each category, and source categories of interest. For further information on how the anthropogenic emission source categories were grouped, please refer to Appendix x.

Figure x shows source contributions for August 18, 2004, Region 4: West of Gorge. The “Other” source emissions are comprised of dry cleaning, commercial food preparation, and nonroad logging, etc. “Misc. Area Sources” emissions consist of solvent use from households, industry, and commercial activity.

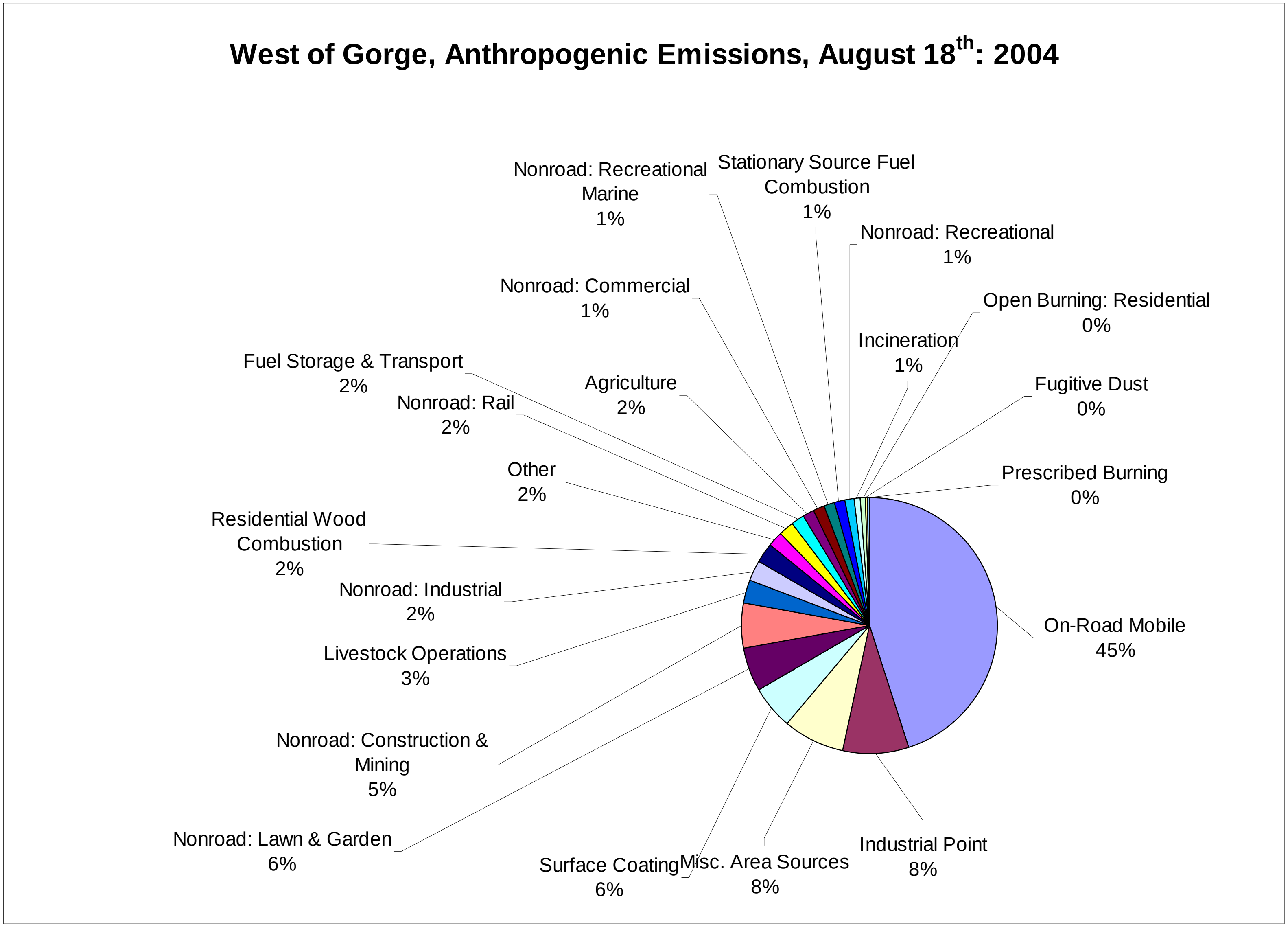


Figure x shows source contributions for August 18, 2018, Region 4: West of Gorge.   The source category groupings are the same as above.

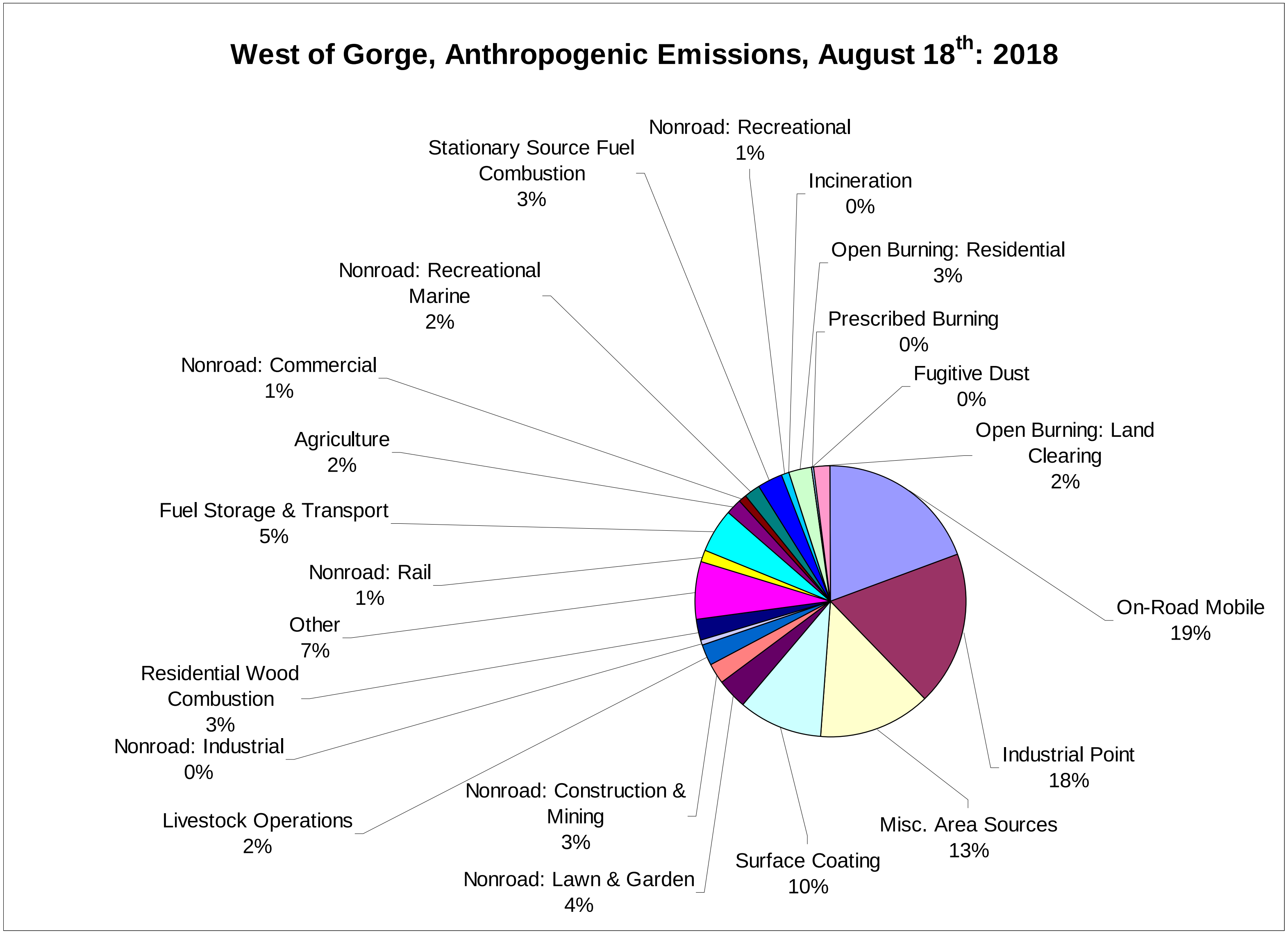


Figure x shows a comparison of source categories (man-made sources only) from August 18, 2004 to August 18, 2018. This is for West of Gorge sources only. On-road mobile emissions decrease by 71% (709 tons/day to 283 tons/day) and nonroad: construction and mining emissions decrease by 55% (86 tons/day to 39 tons/day), and nonroad industrial – such as forklifts – decrease by 82% (38 tons/day to 7 tons/day) due to EPA's ultra low sulfur fuel rules. From the chart, industrial point emissions increase by 206% (130 tons/day to 268 tons/day) based on WRAP's use of growth assumptions using EPA's Economic Growth and Analysis System growth factor model (EGAS). Nonroad lawn and garden decreased 43% due to improvements in engine manufacturing (89 tons/day to 51 tons/day). The "other" source category also shows some growth from 2004 to 2018, primarily due to increases in dry cleaning and commercial food preparation. As the population increases, categories that are contingent upon population increase also show an increase in emissions including fuel storage and transport, stationary fuel source combustion, residential and land clearing open burning.

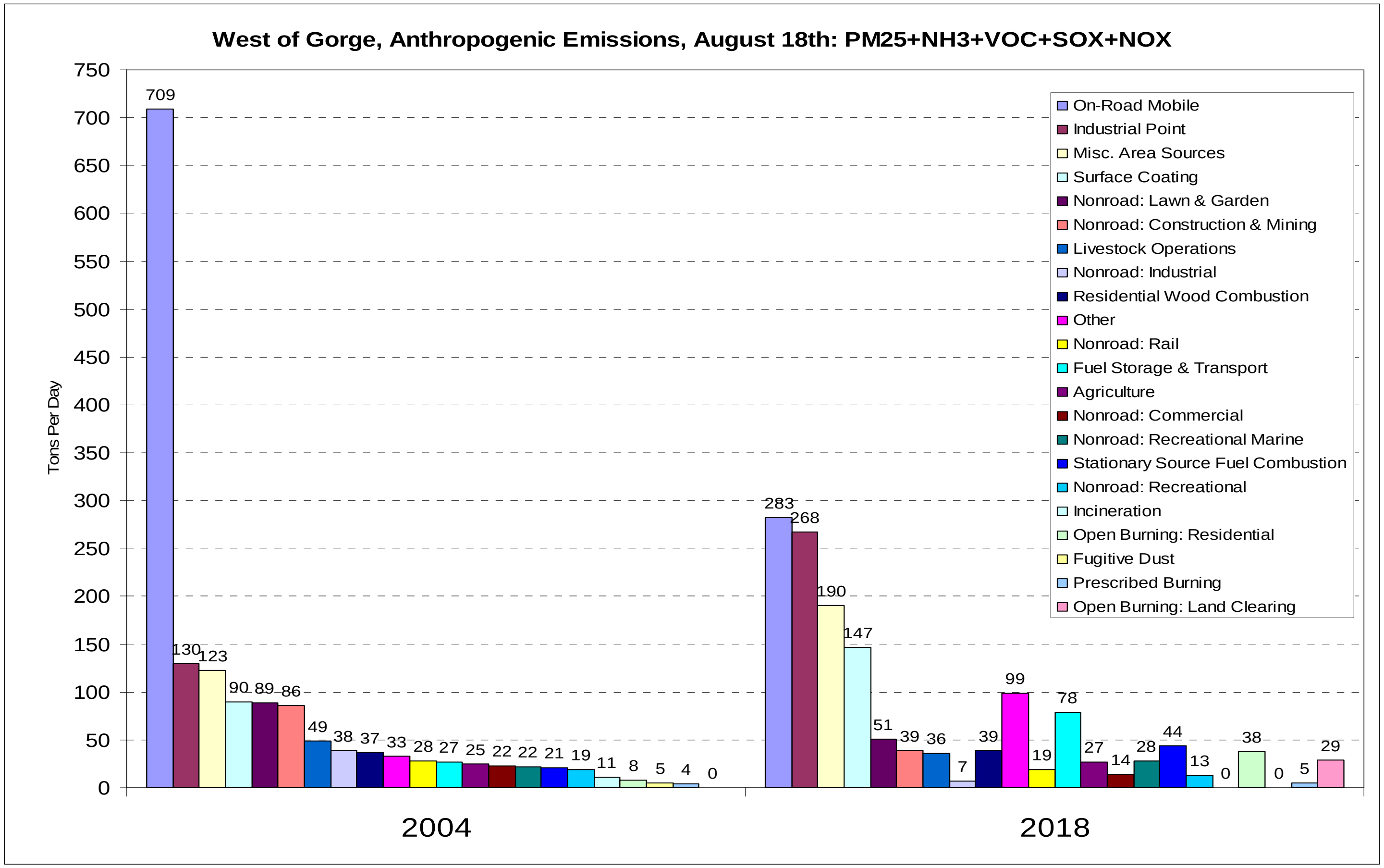


Figure x shows source contributions for November 12, 2004, Region 4 –West of Gorge. "Other" source category emissions include sewage treatment, drycleaners, and commercial food preparation. "Misc. Area Sources" emissions include solvent use from household, commercial, and industrial activity.

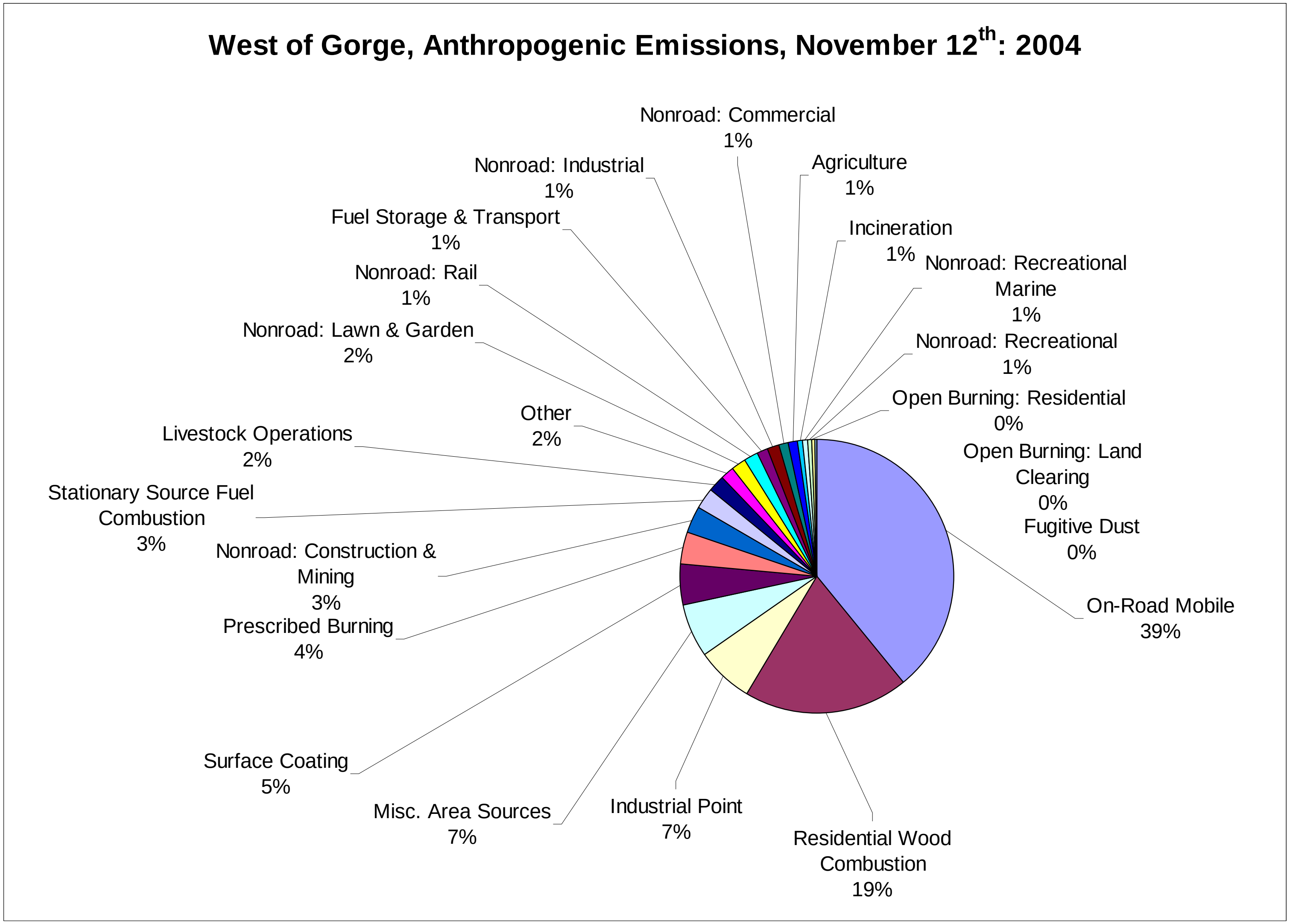


Figure x shows source contributions for November 12, 2018, Region 4 - West of Gorge. The source category groupings are the same as above.

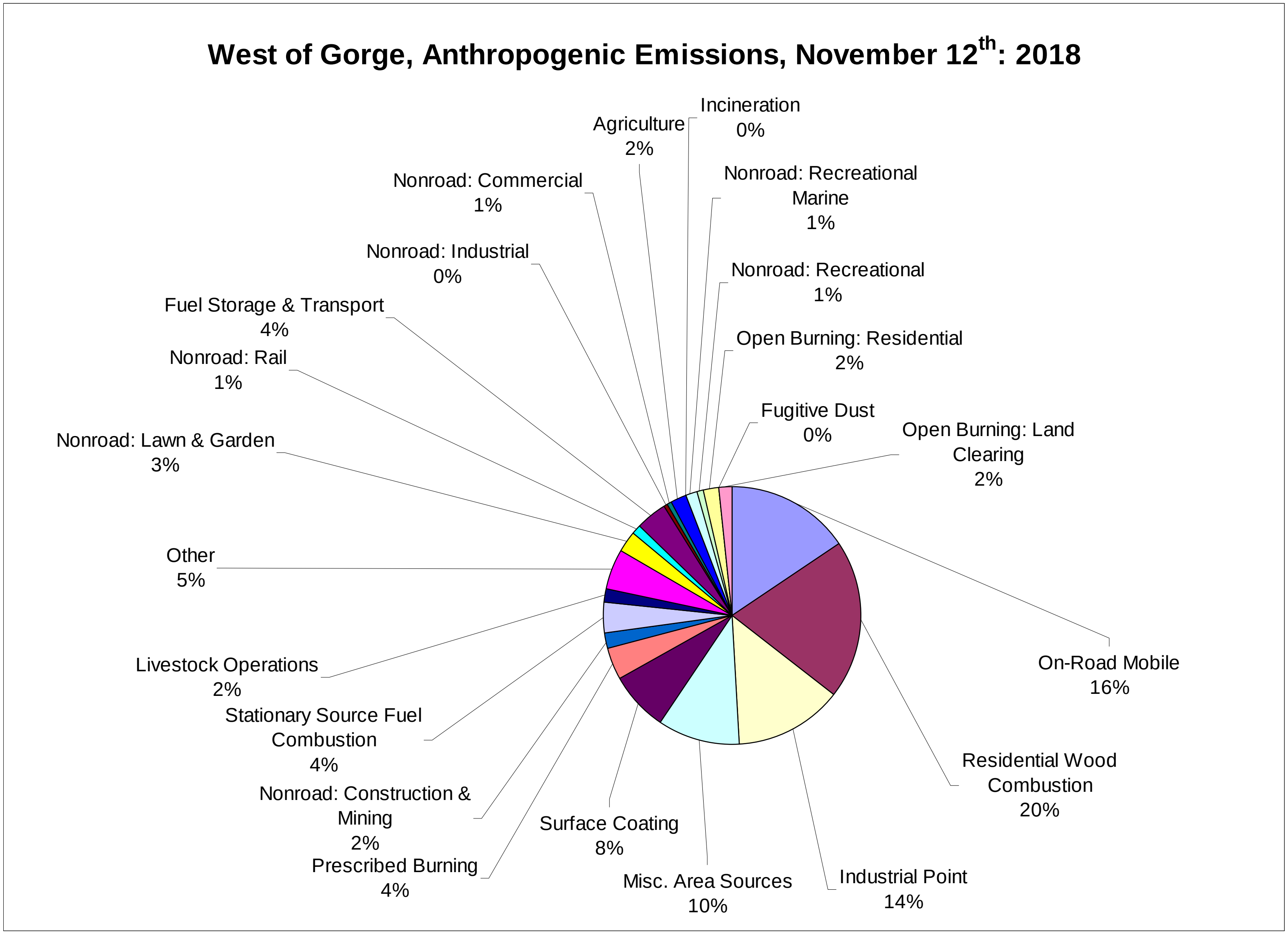
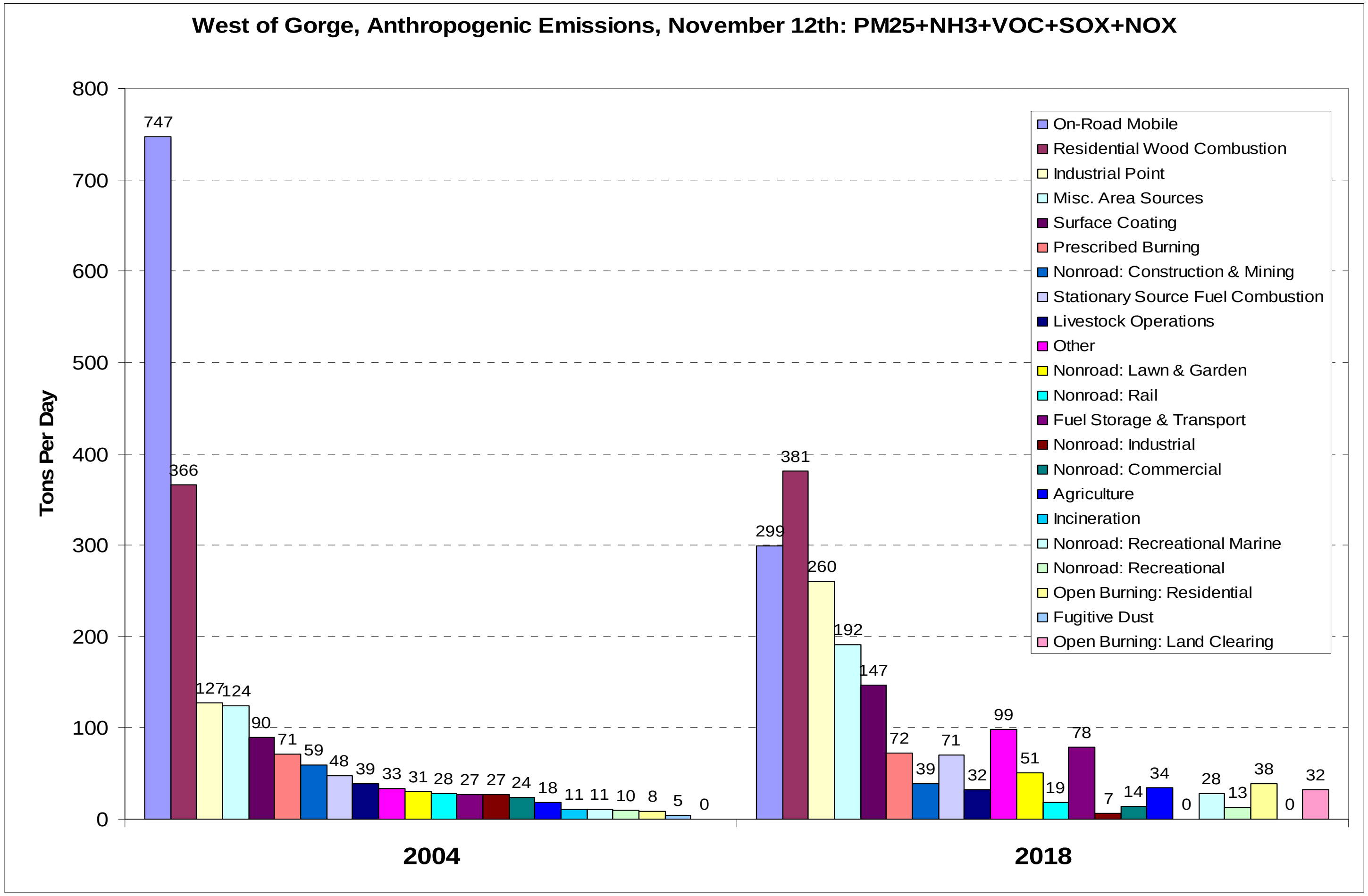


Figure x shows a comparison of source categories (man-made sources only) from November 12, 2004 to November 12, 2018. This is for West of Gorge sources only. On-road mobile emissions decrease by 60% (747 tons/day to 299 tons/day) and nonroad: construction and mining emissions decrease by 34% (59 tons/day to 39 tons/day due to EPA's ultra low sulfur fuel rules. From the chart, industrial point emissions increase by 204% (127 tons/day to 260 tons/day) based on WRAP's use of growth assumptions using EPA's Economic Growth and Analysis System growth factor model (EGAS). The "other" source category also shows some growth from 2004 to 2018, primarily due to increases in dry cleaning and commercial food preparation. As the population increases, categories that are contingent upon population increase also show an increase in emissions including fuel storage and transport, stationary fuel source combustion, residential wood burning, and residential and land clearing open burning.



E. East of Gorge Source Contribution

The East of Gorge area (Region 5) comprises all other areas east of the Cascades. As with the In-Gorge source category emissions, the source categories were determined by identifying all the anthropogenic source categories that contribute to East of Gorge area emissions. DEQ identified and grouped these categories according to similar category groupings (e.g. the agricultural source category consists of nonroad – agricultural, fertilizer operations, and orchard heaters, etc.), the amount of emissions for each category, and source categories of interest. For further information on how the anthropogenic emission source categories were grouped, please refer to Appendix x.

Figure x shows source contributions for August 18, 2004, Region 5: East of Gorge. The "Other" category emissions include landfills, sewage plants, and incineration, etc. In this chart, "Livestock operations" is its own category, separate from "Agriculture" emissions.

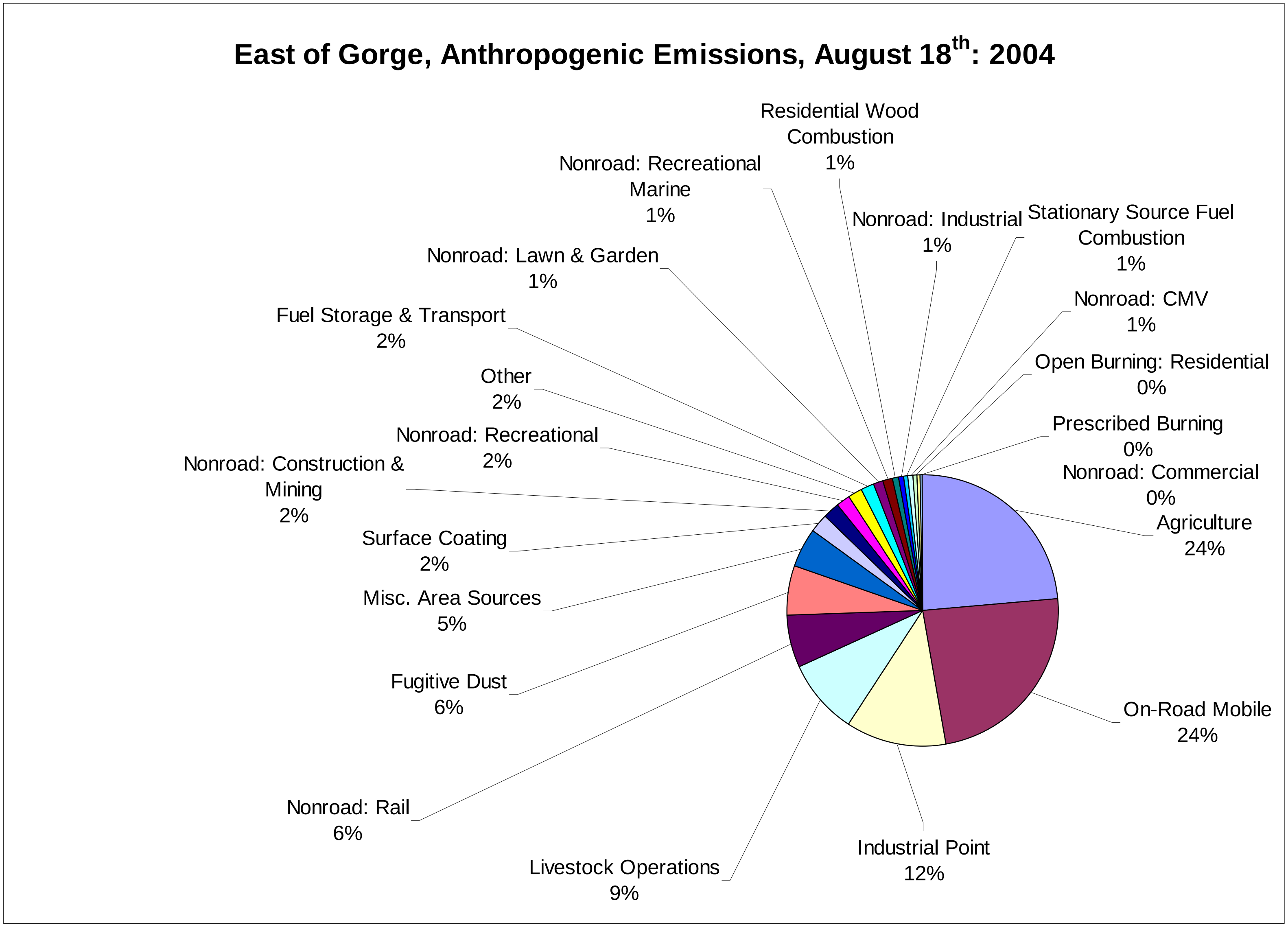


Figure x shows source contributions for August 18, 2018, Region 5 - East of Gorge. The source category groupings are the same as above.

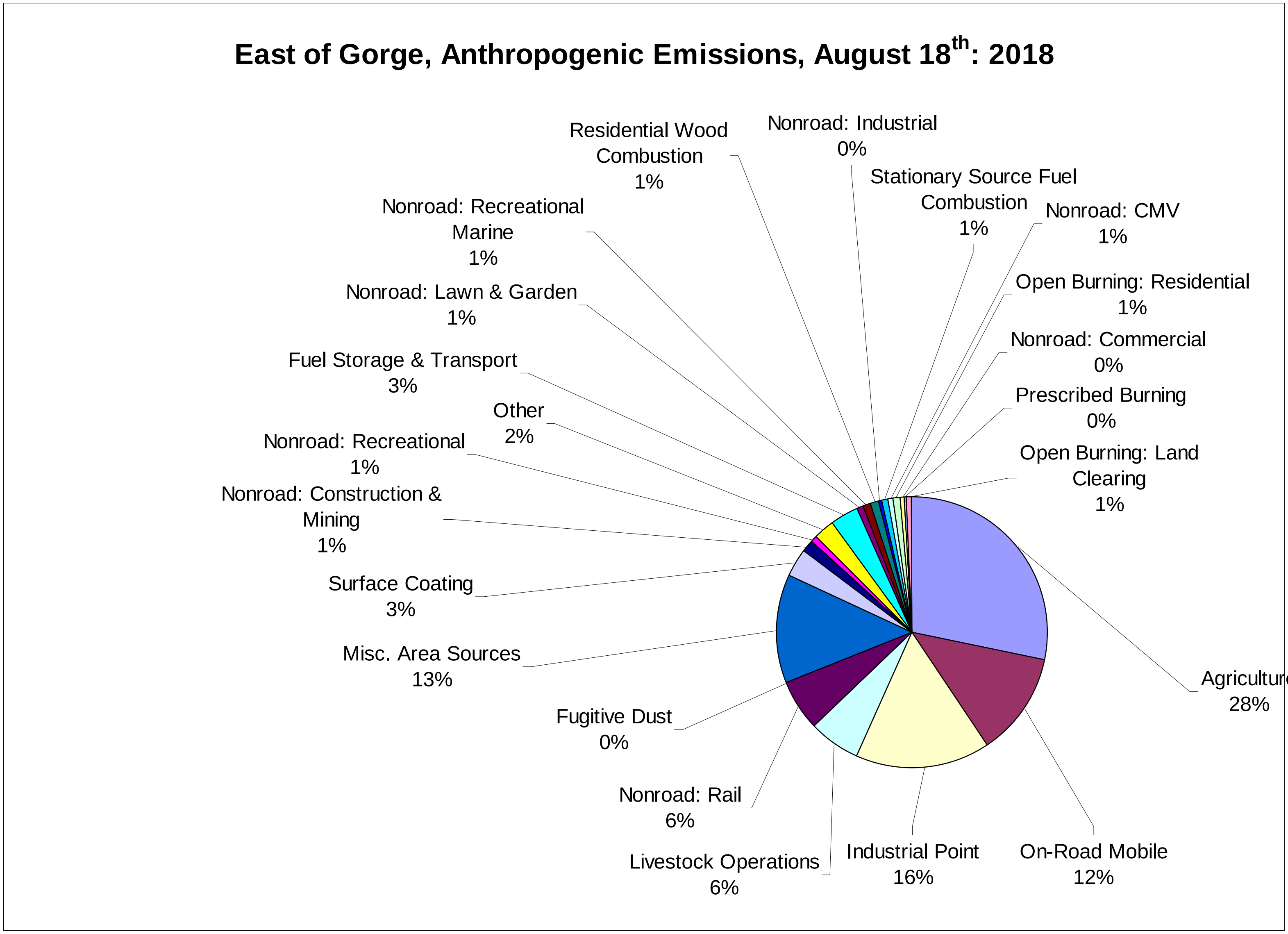


Figure x shows a comparison of source categories (man-made sources only) from August 18, 2004 to August 18, 2018. This is for East of Gorge sources only. On-road mobile emissions decrease by 58% (220 tons/day to 93 tons/day) due to EPA's ultra low sulfur fuel rules. Industrial point emissions and agriculture emissions remain constant. Fugitive dust emissions are nonexistent in 2018, potentially as a result of an EI error. The "other" source category also shows some growth from 2004 to 2018, primarily due to emissions increases in landfills and sewage treatment. As the population increases, categories that are contingent upon population increase also show an increase in emissions including fuel storage and transport, miscellaneous area sources, and stationary fuel source combustion.

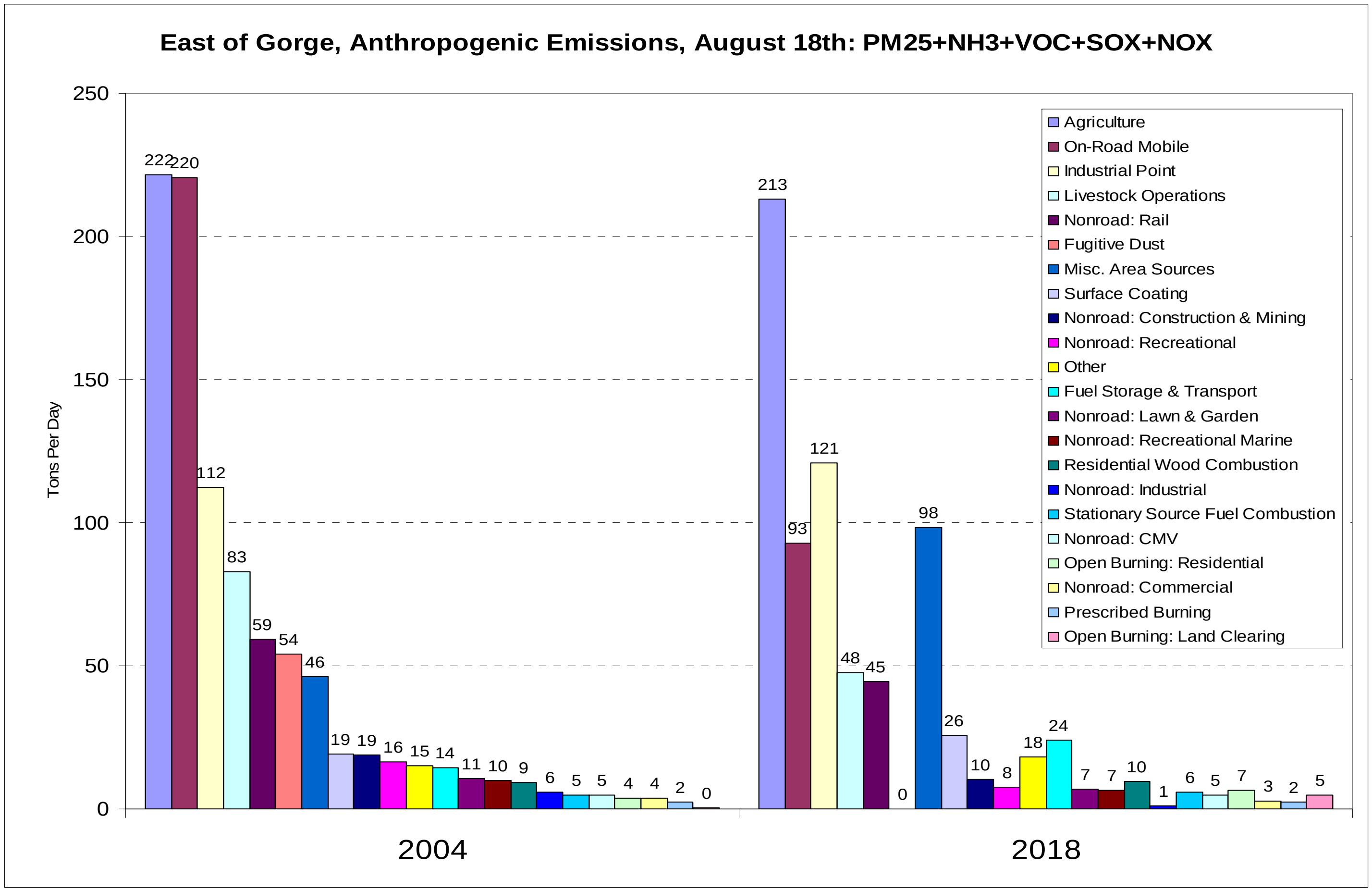


Figure x shows source contributions for November 12, 2004, Region 5: East of Gorge. The “Other” category emissions include landfills, sewage plants, and incineration, etc. In this chart, “Livestock operations” is its own category, separate from “Agriculture” emissions.

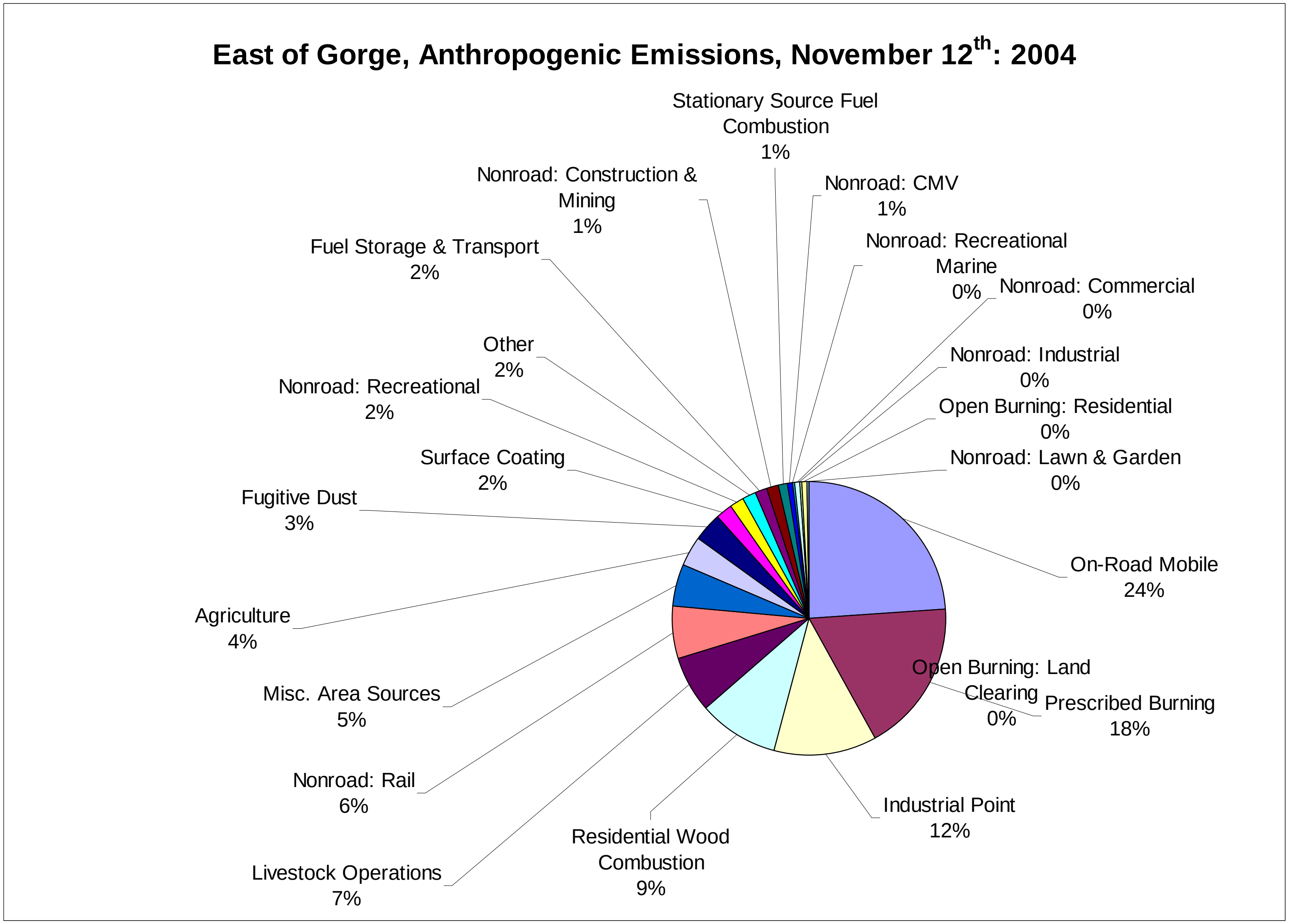


Figure x shows source contributions for November 12, 2018, Region 5 - East of Gorge. The source category groupings are the same as above.

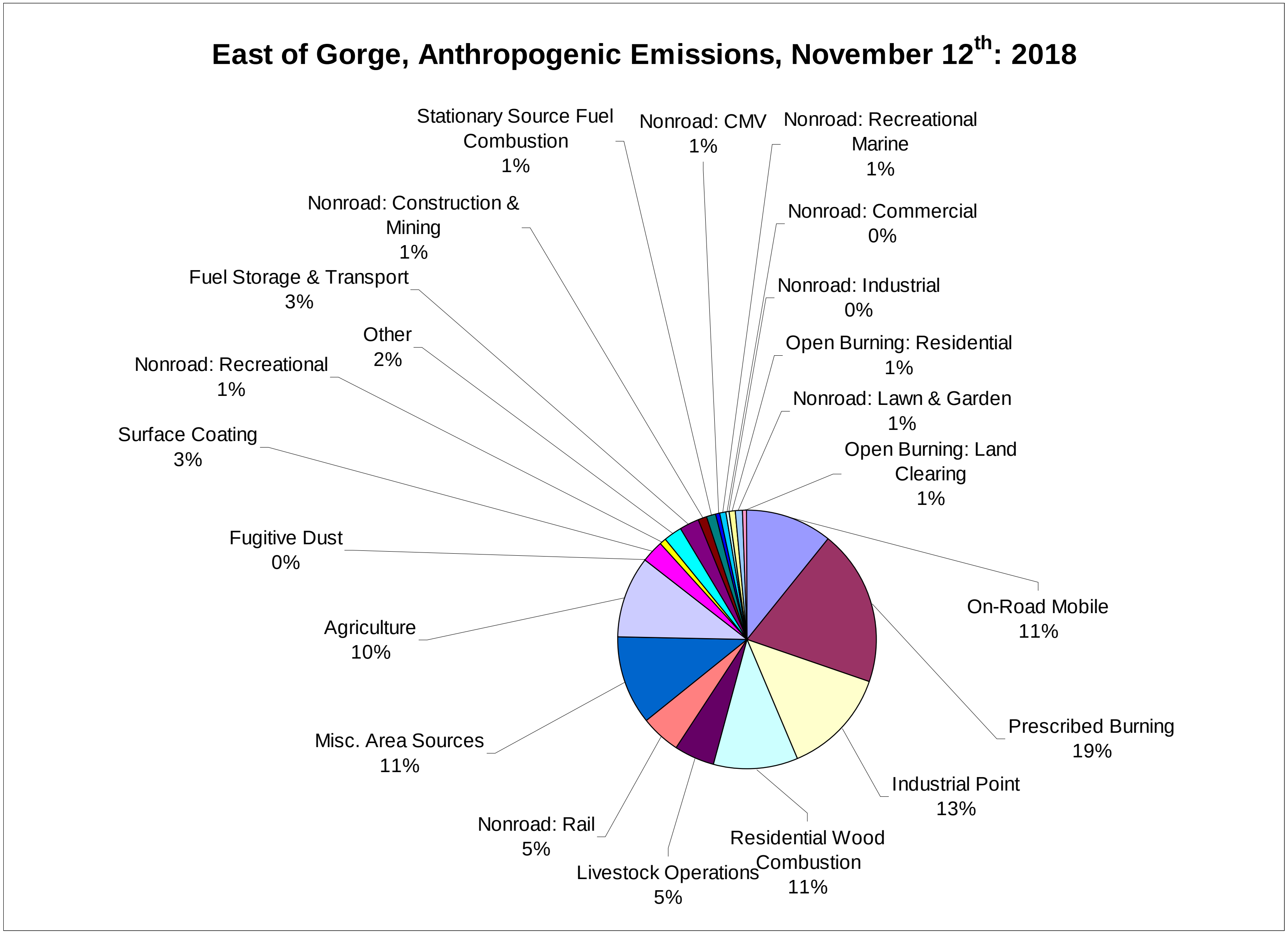
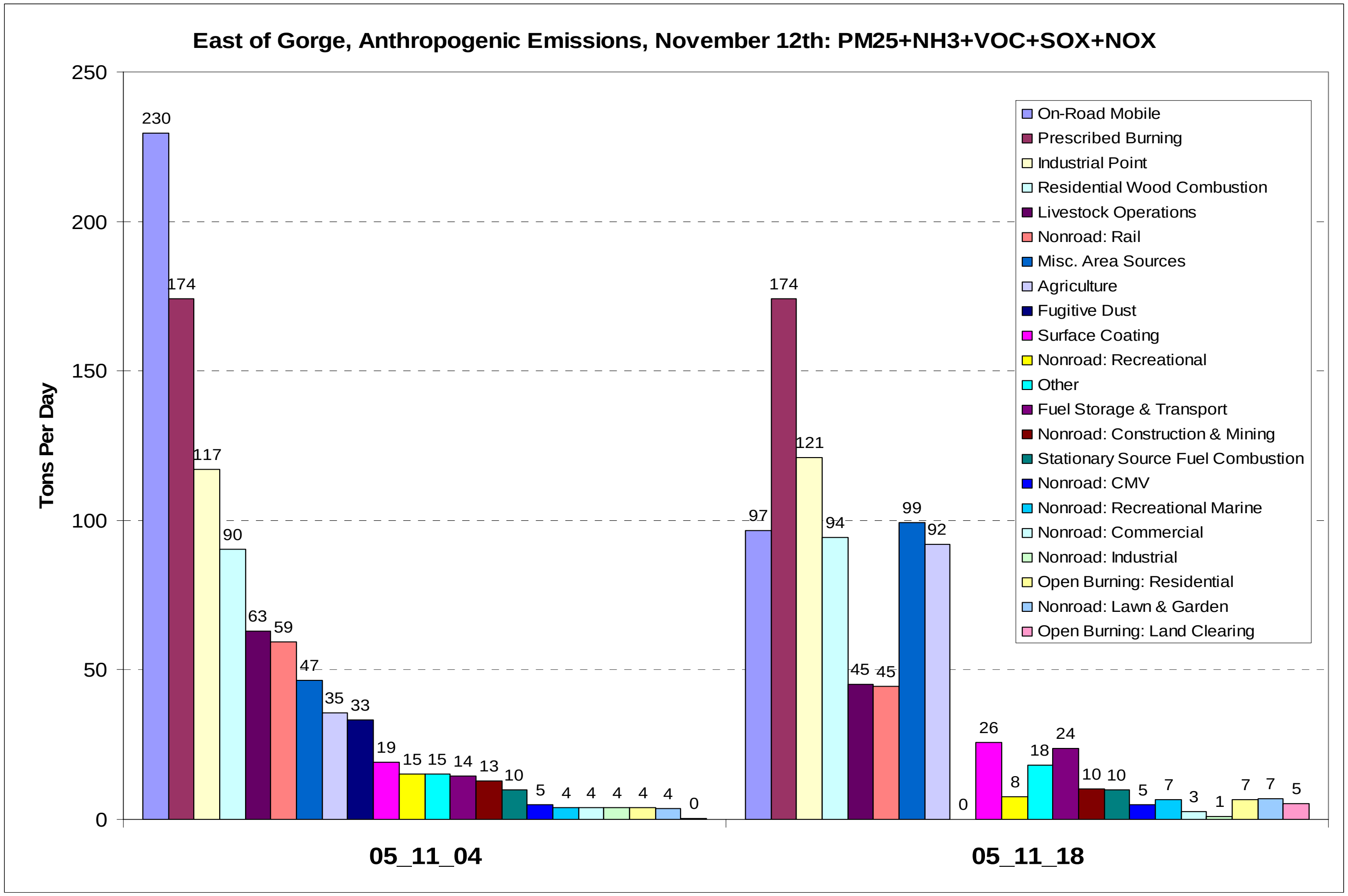
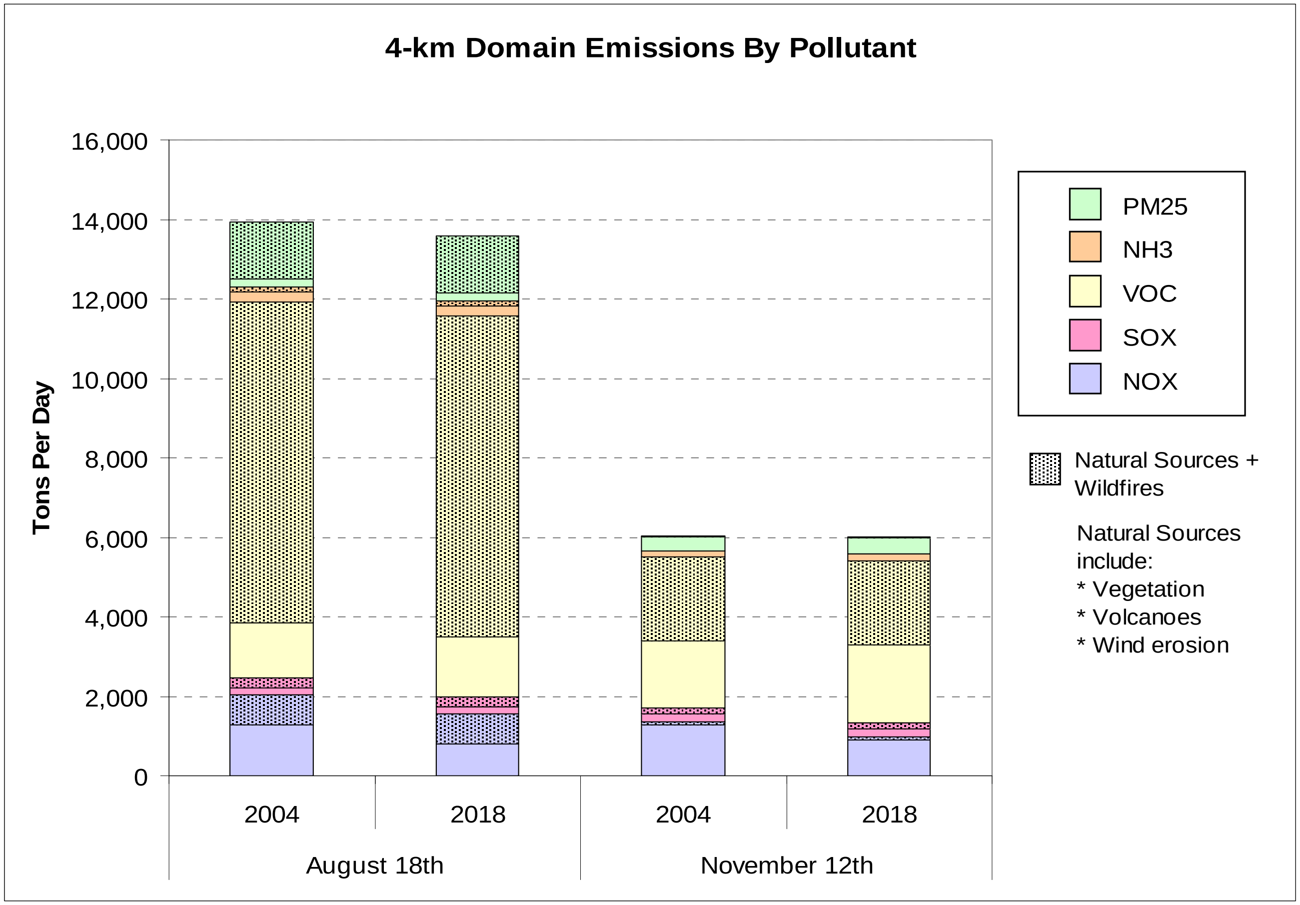


Figure x shows a comparison of source categories (man-made sources only) from November 12, 2004 to November 12, 2018. This is for East of Gorge sources only. On-road mobile emissions decrease by 58% (230 tons/day to 97 tons/day) due to EPA's ultra low sulfur fuel rules. Prescribed burning, industrial point emissions and residential wood combustion emissions remain constant. Fugitive dust emissions are nonexistent in 2018, potentially as a result of an EI error. Agriculture emissions increase as well, but it could be due to a temporal EI error. As the population increases, categories that are contingent upon population increase also show an increase in emissions including miscellaneous area sources.



VII. Domain Emissions by Pollutant

Figure x provides an overall snapshot of pollutant emissions for the two specific episodes modeled. It shows the amount, in tons, per pollutant of what is being emitted over the modeling domain. The chart compares the August 2004 (base case) to August 2018 (future year) emissions and also shows the November base case and future year emissions. In the August and November episodes, VOC has the highest amount of emissions. For example, in August 2004, while VOC emissions are 4.5 times greater (9,460 tons/day VOC) than the next highest pollutant emissions (2,045 tons/day NOx), VOC does not have as much an effect on visibility conditions as other pollutants, such as NOx or SOx. PM2.5 and NH3 are similar to VOC, in that for visibility issues, NOx and SOx are more likely to cause visibility impairment. The graph also shows the comparison of natural sources vs. other sources for all the pollutants in the modeling domain. Natural sources include vegetation, volcanoes, and wind erosion. For example, the August 2004 episode shows 13,930 tons/day of emissions. Of that, 76% (10,651 tons/day) comes from natural sources and wildfires. The remaining 24% (3,279 tons/day) come from man-made sources. In August 2018, the contribution from natural sources increases, at 78% (10,651 tons/day) and with man-made sources contributing 12% (2,933 tons/day). For the November 2004 episode, it shows 6,047 tons/day of emissions. Natural emissions are 39% (2,347 tons/day) and man-made emissions are 61% (3,700 tons/day). In November 2018, the contributions from natural emissions 39% (2,347 tons/day) and man-made emissions 61% (3,659 tons/day) remain constant.


4-km Domain Emissions By Pollutant
Tons Per Day
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2004
2018
2004
2018
August 18th
November 12th
PM25
NH3
VOC
SOX
NOX
Natural Sources + Wildfires
Natural Sources include:
* Vegetation
* Volcanoes
* Wind erosion

A. SOX

The following graphs show the distribution of SOx emissions over the modeling domain. For the August 18, 2004, Figure x shows the breakdown of natural vs. man made SOx sources for the whole domain. SOx is only 3% of the pollutant contribution for the domain, and of that natural sources are 59% of the SOx contribution and man-made sources comprise 41%. The charts are further distributed to show the composition of SOx natural sources and man-made sources. Wildfires are the sole contributor (100%) to the natural source component of SOx. For all the man-made sources, point sources contribute 24% of the total SOx emissions. Coal fired boilers are 38% of the man-made source pie, but contribute only 15% of the total SOx emissions. Nonroad sources (26%) contribute 10% of SOx emissions over the entire domain.

SOx Emissions (Domain)– August 18, 2004

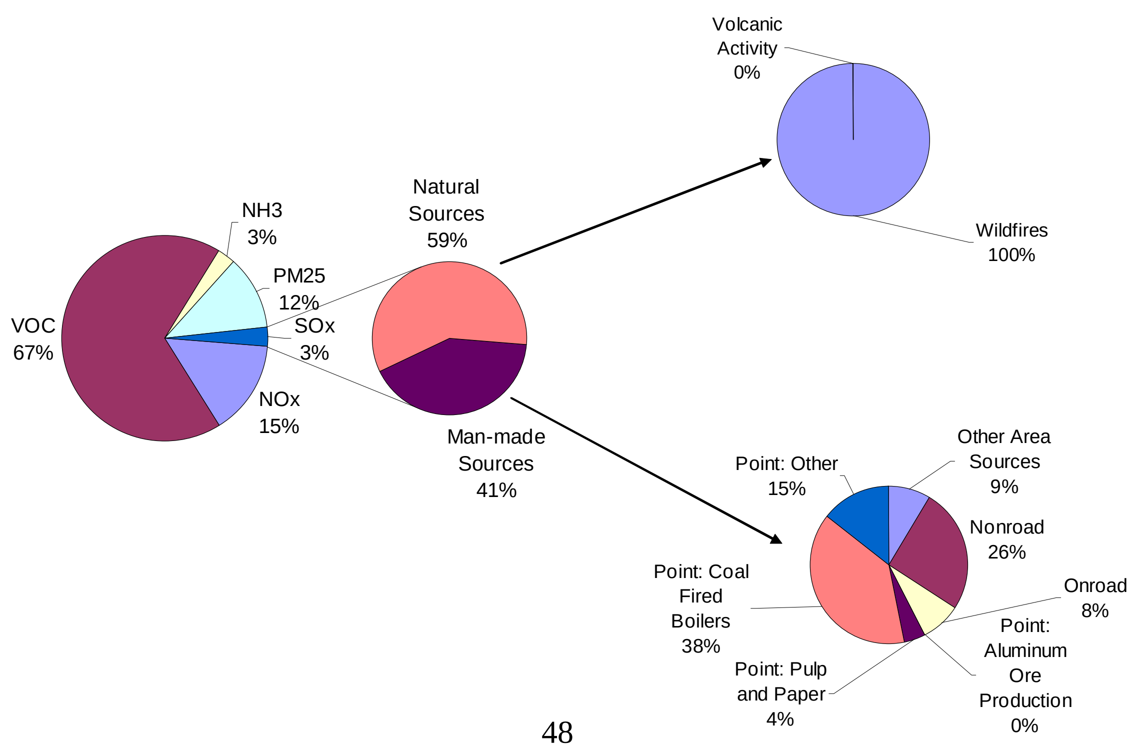
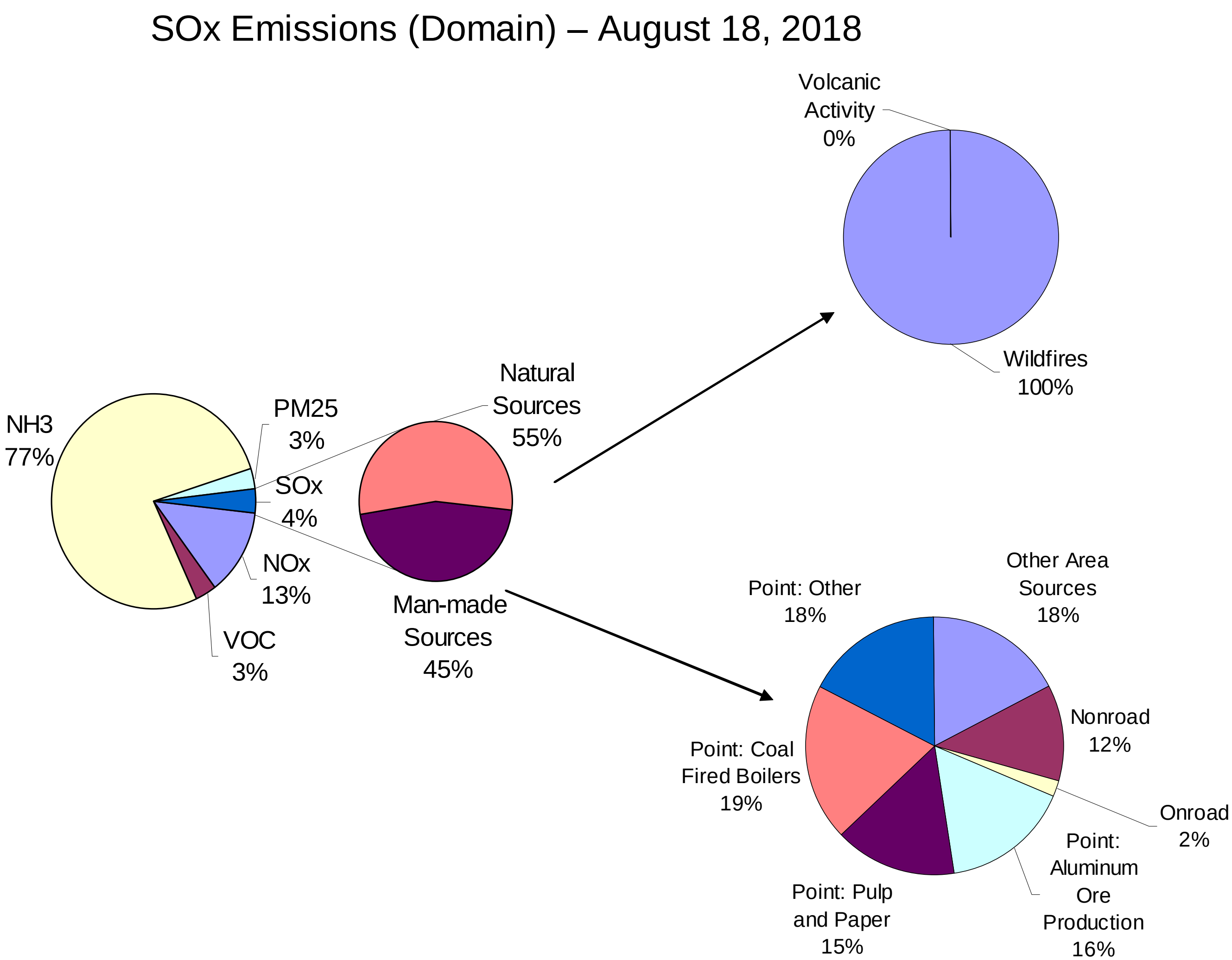
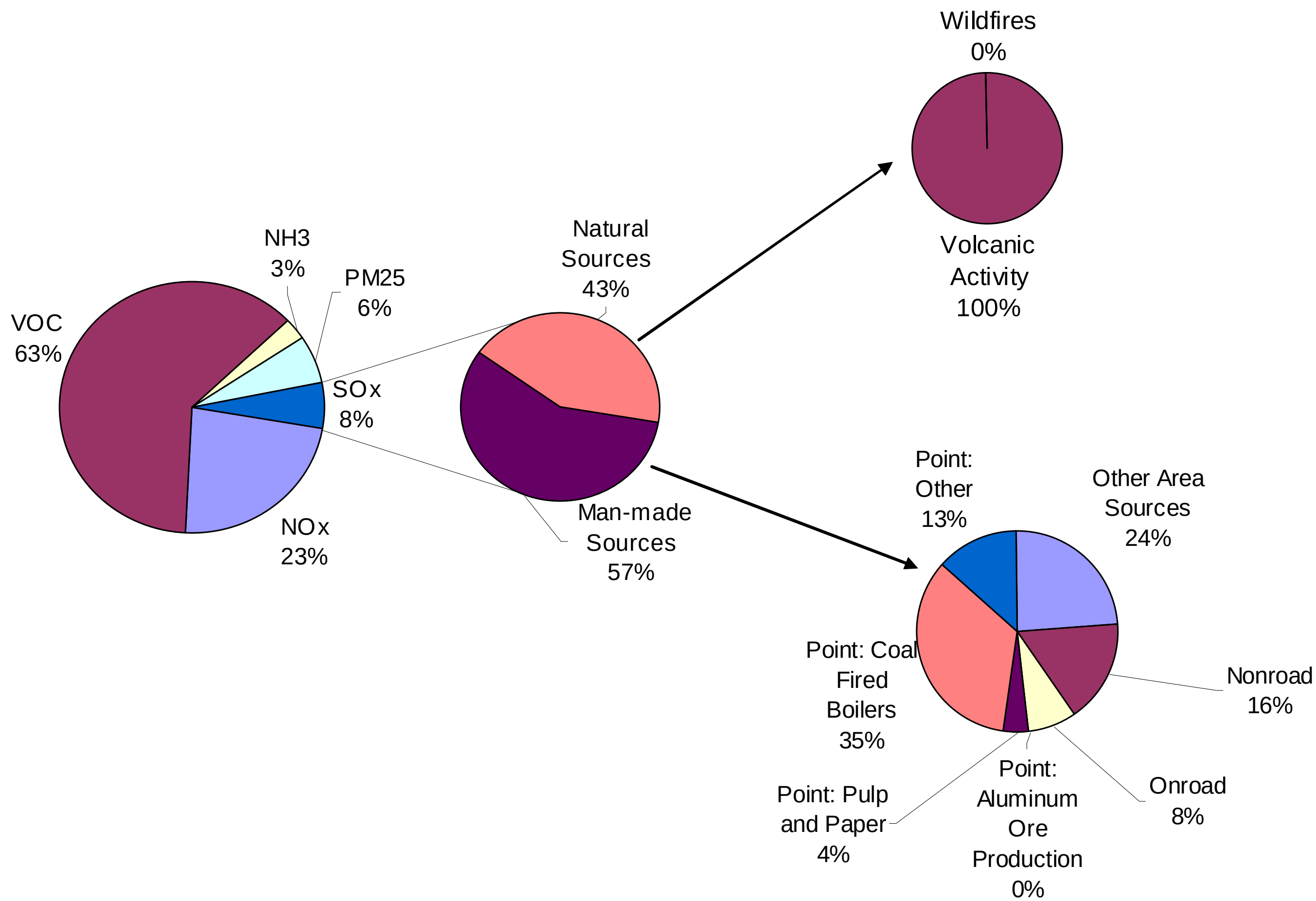


Figure x shows the breakdown of natural vs. man-made SOx sources for the August 18, **2018** episode. SOx emissions are 12% of the pollutant emissions for the whole domain, with natural sources comprising the majority of that contribution (55%) and man-made sources contributing 45%. Wildfires are the sole contributor (100%) to the natural source component of SOx. For all the man-made sources, point sources contribute 28% of the total SOx emissions. Coal fired boilers contribute 8% of the total SOx emissions and other area sources contribute 10% of SOx emissions over the entire domain.

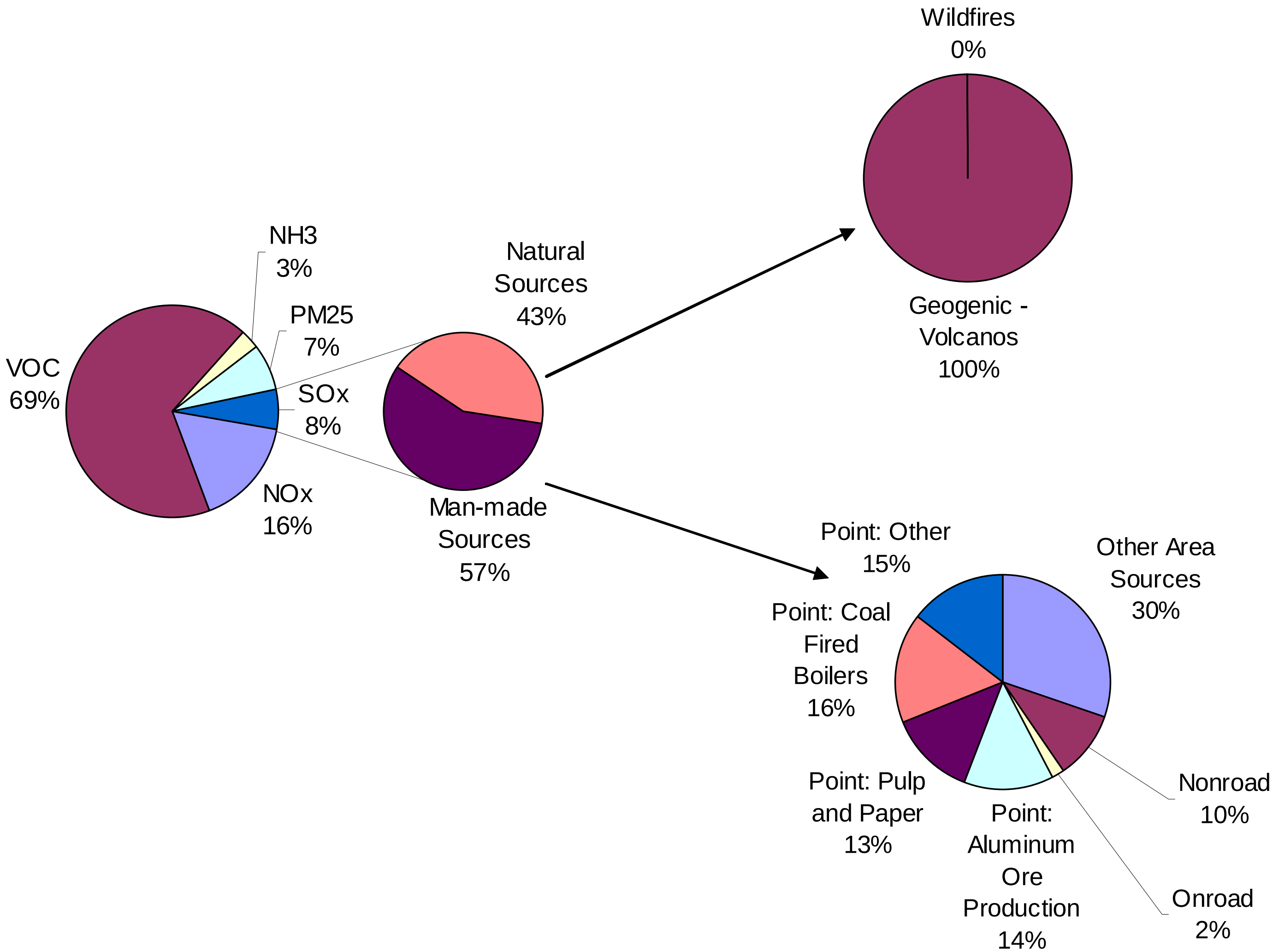


Need to fill in descriptions from this point on.

SOx Emissions (Domain) – November 12, 2004

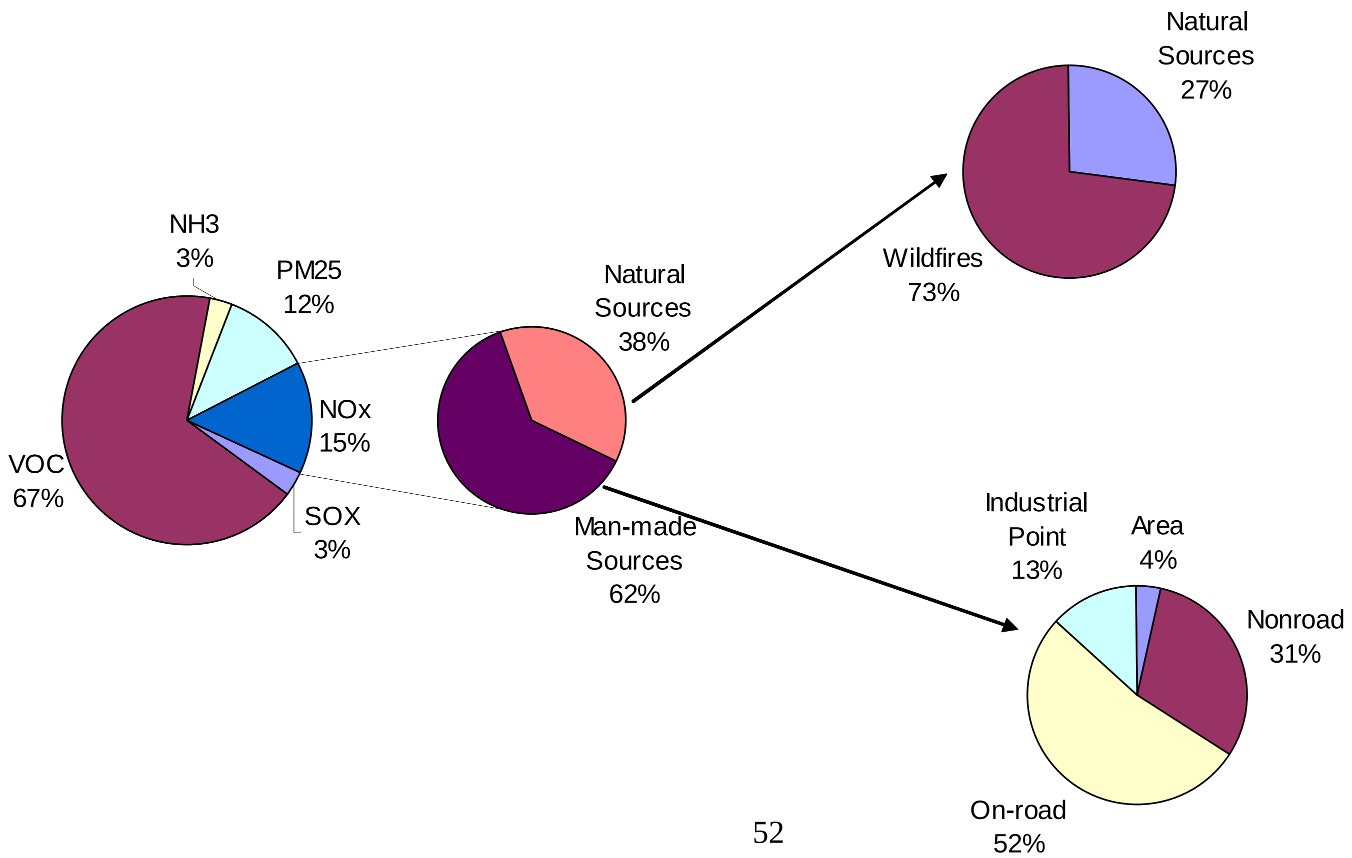


SOx Emissions (Domain) – November 12, 2018

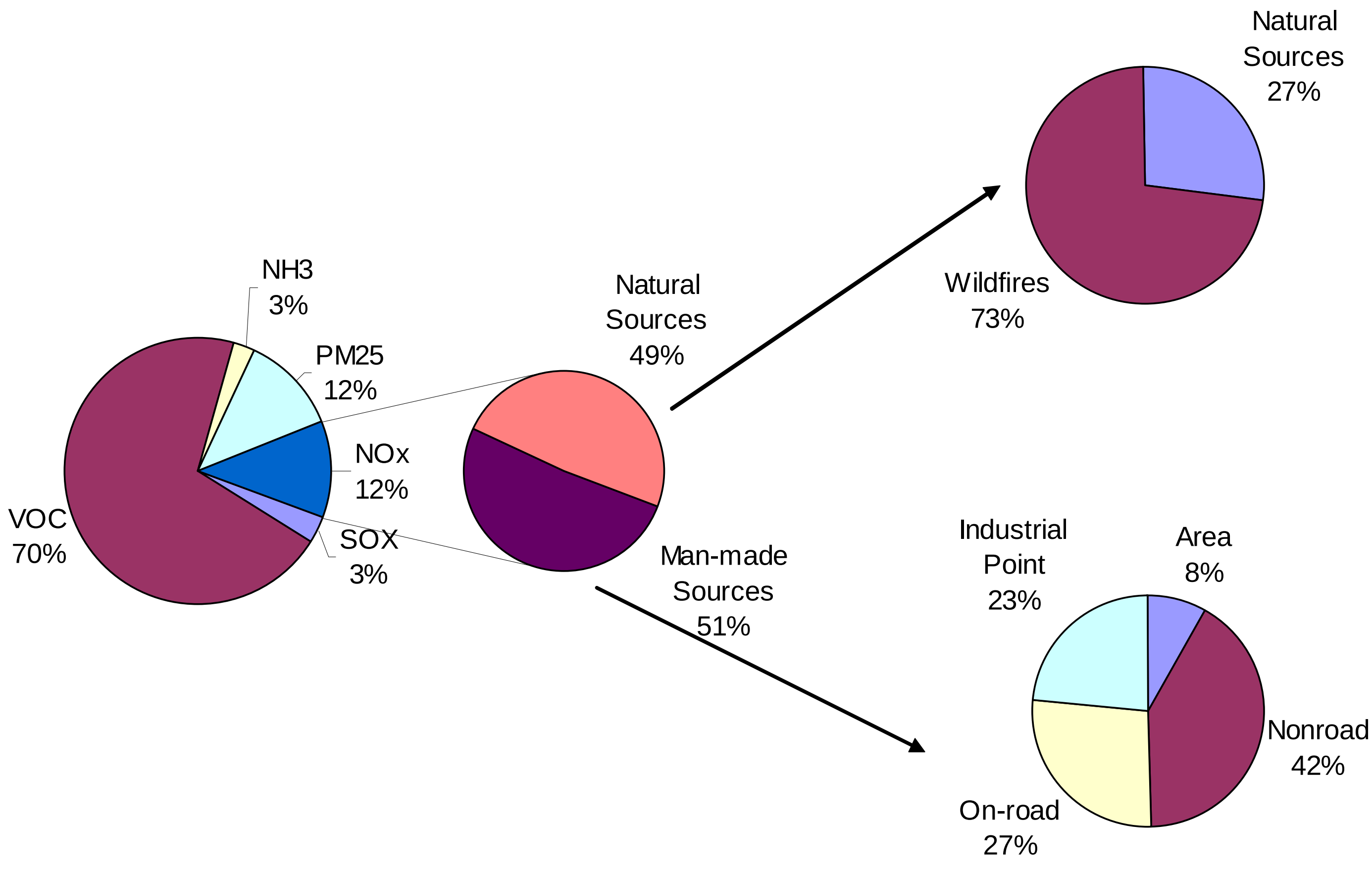


B. NOx

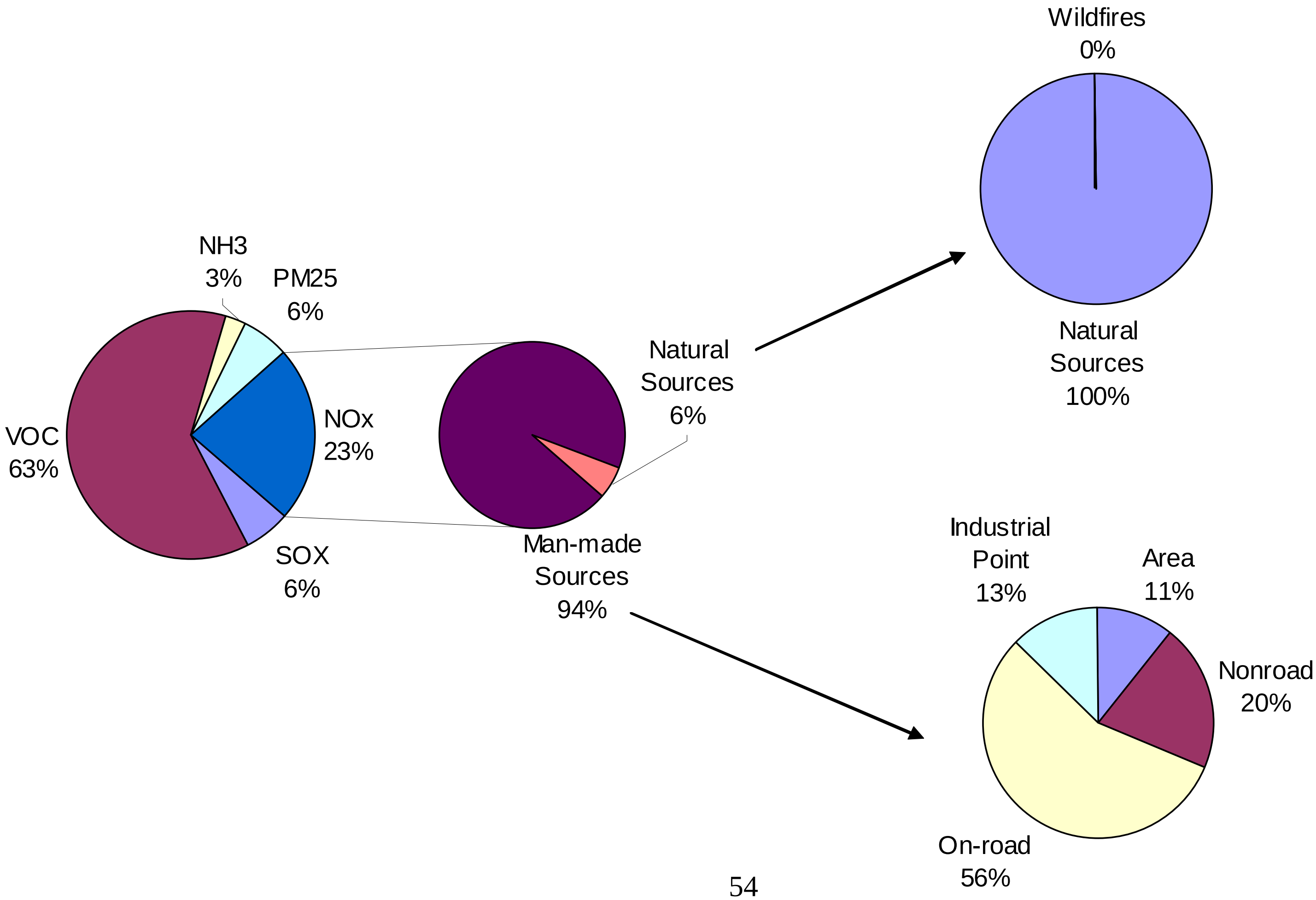
NOx Emissions (Domain) – August 18, 2004



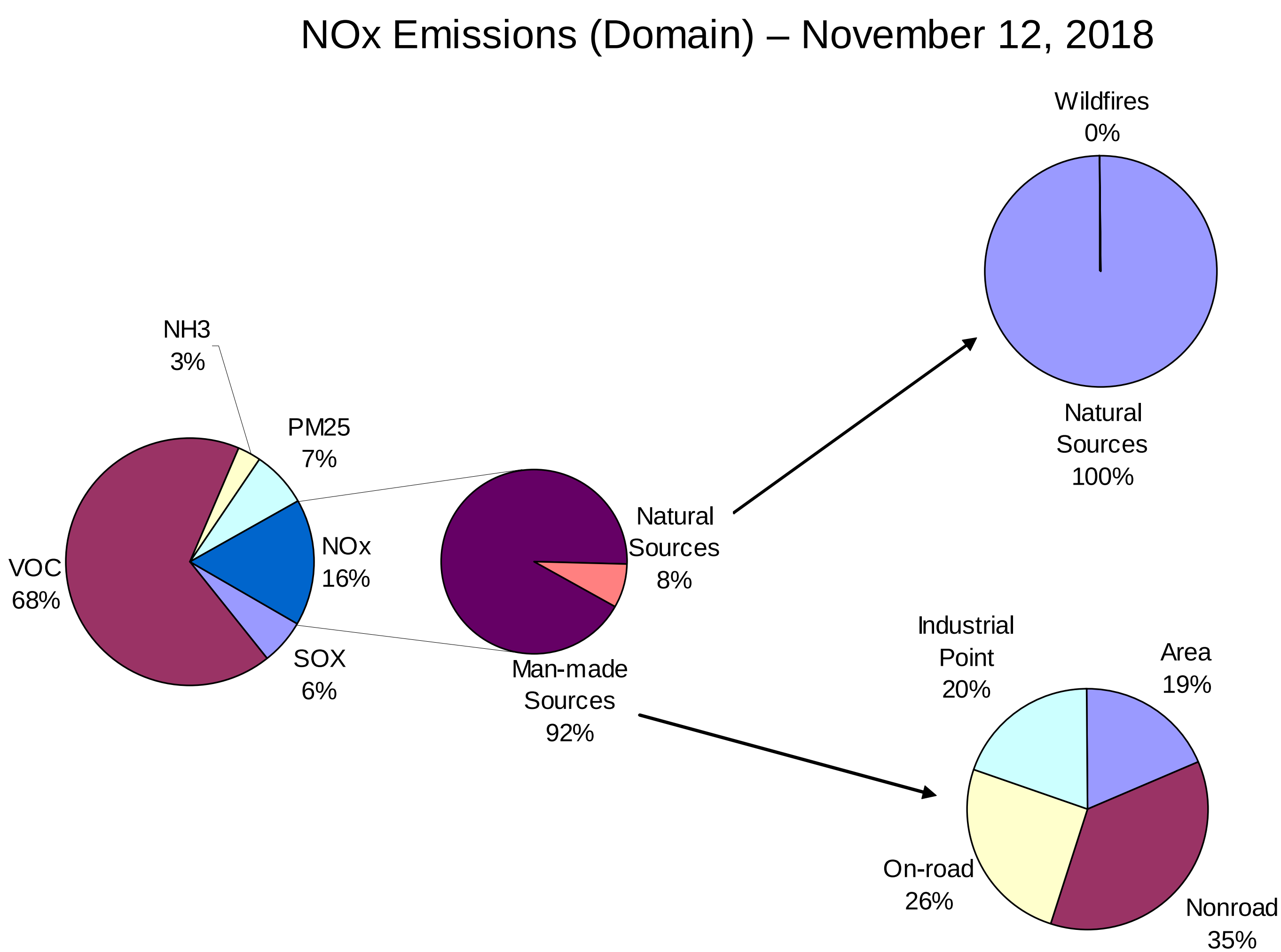
NOx Emissions (Domain) – August 18, 2018



NOx Emissions (Domain) – November 12, 2004

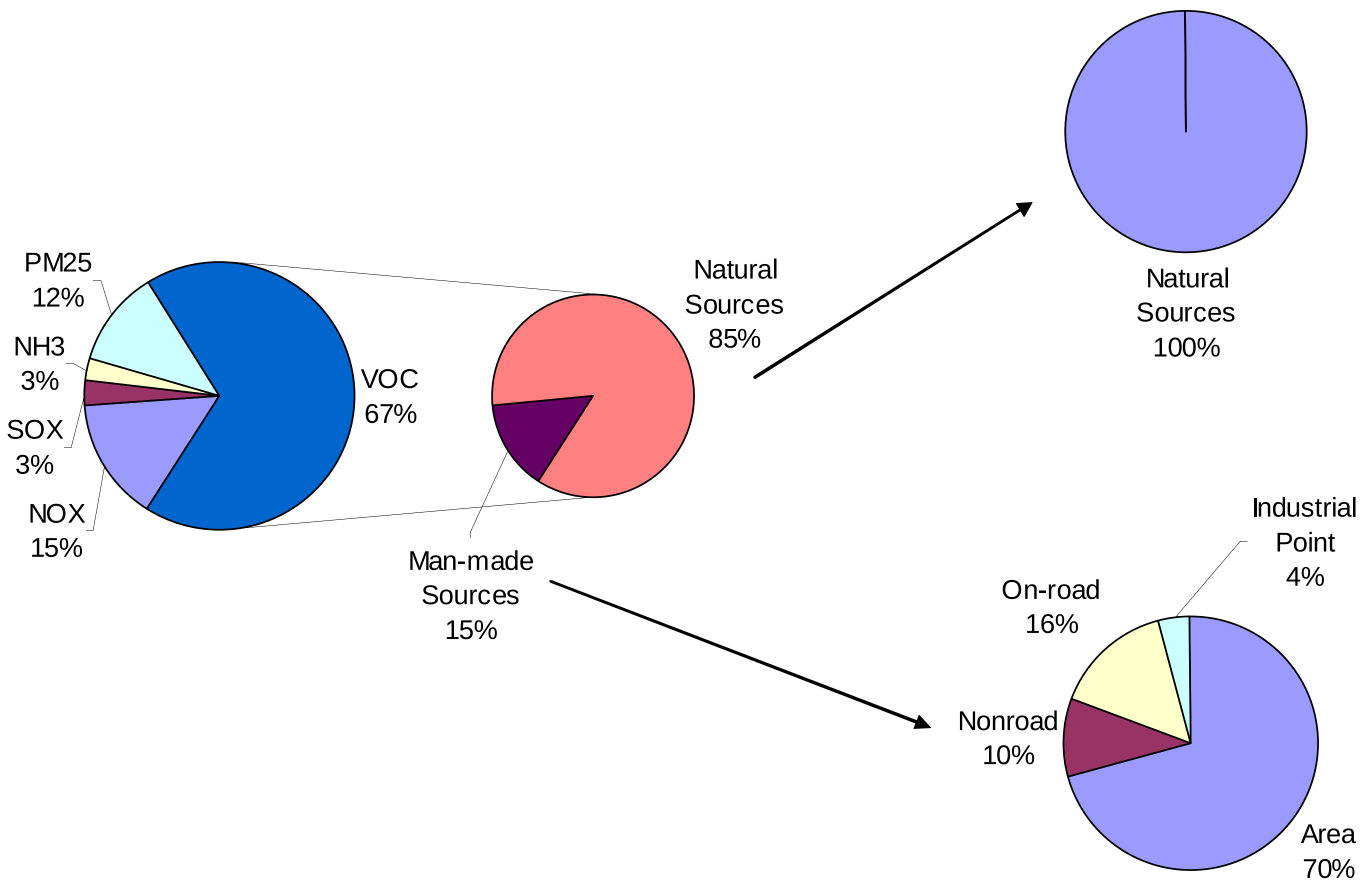


NOx – November 2018

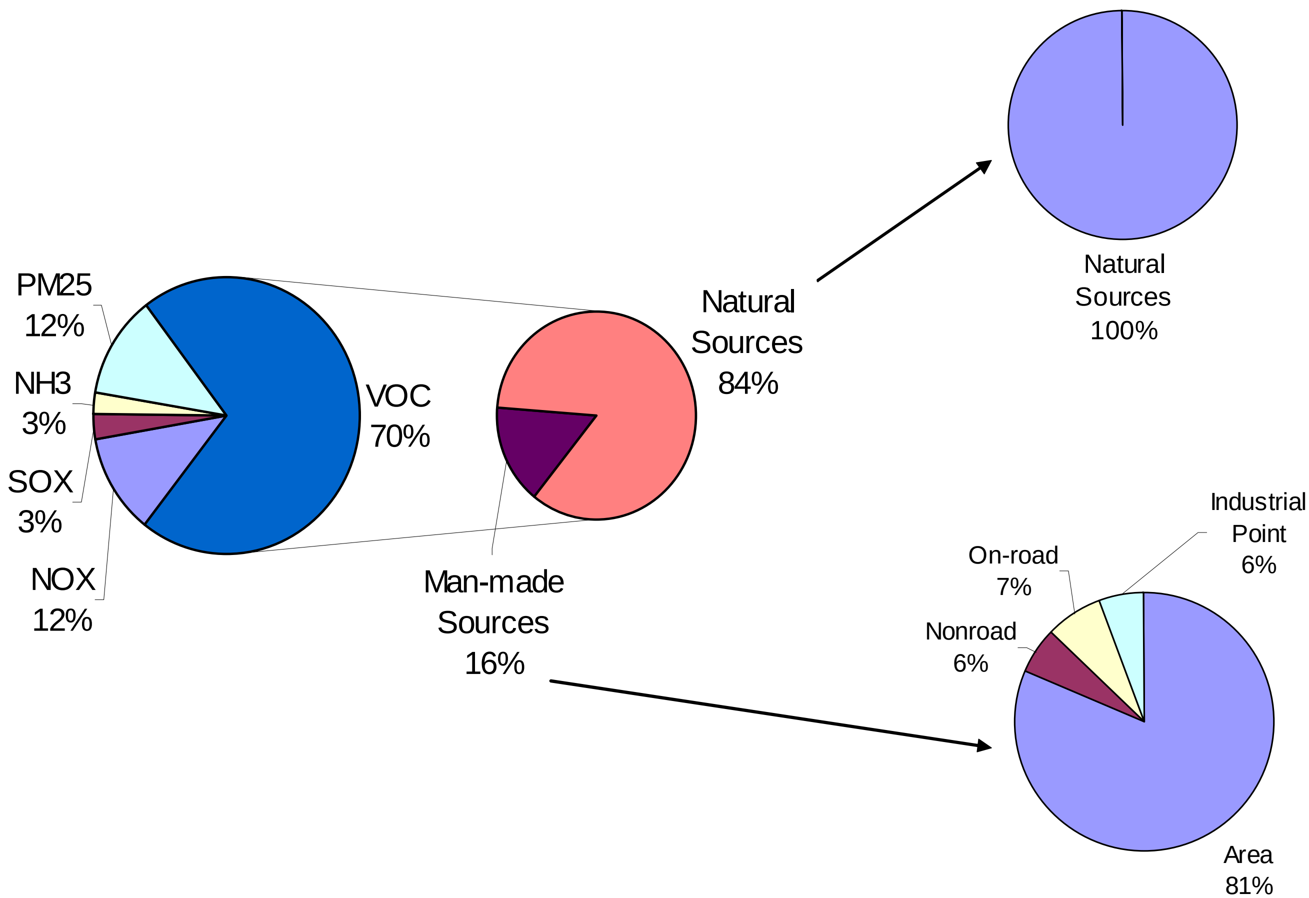


C. VOC

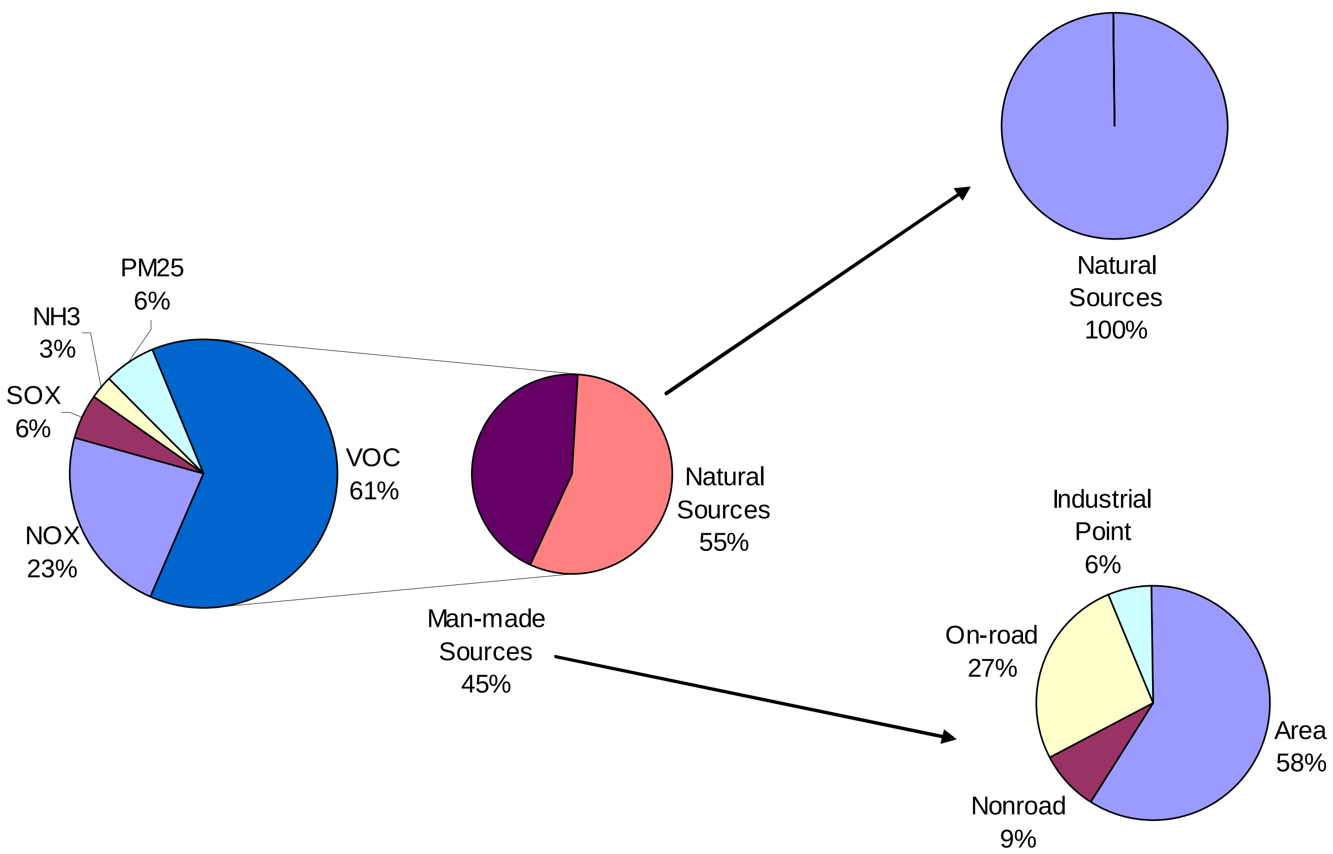
VOC Emissions (Domain) – August 18, 2004



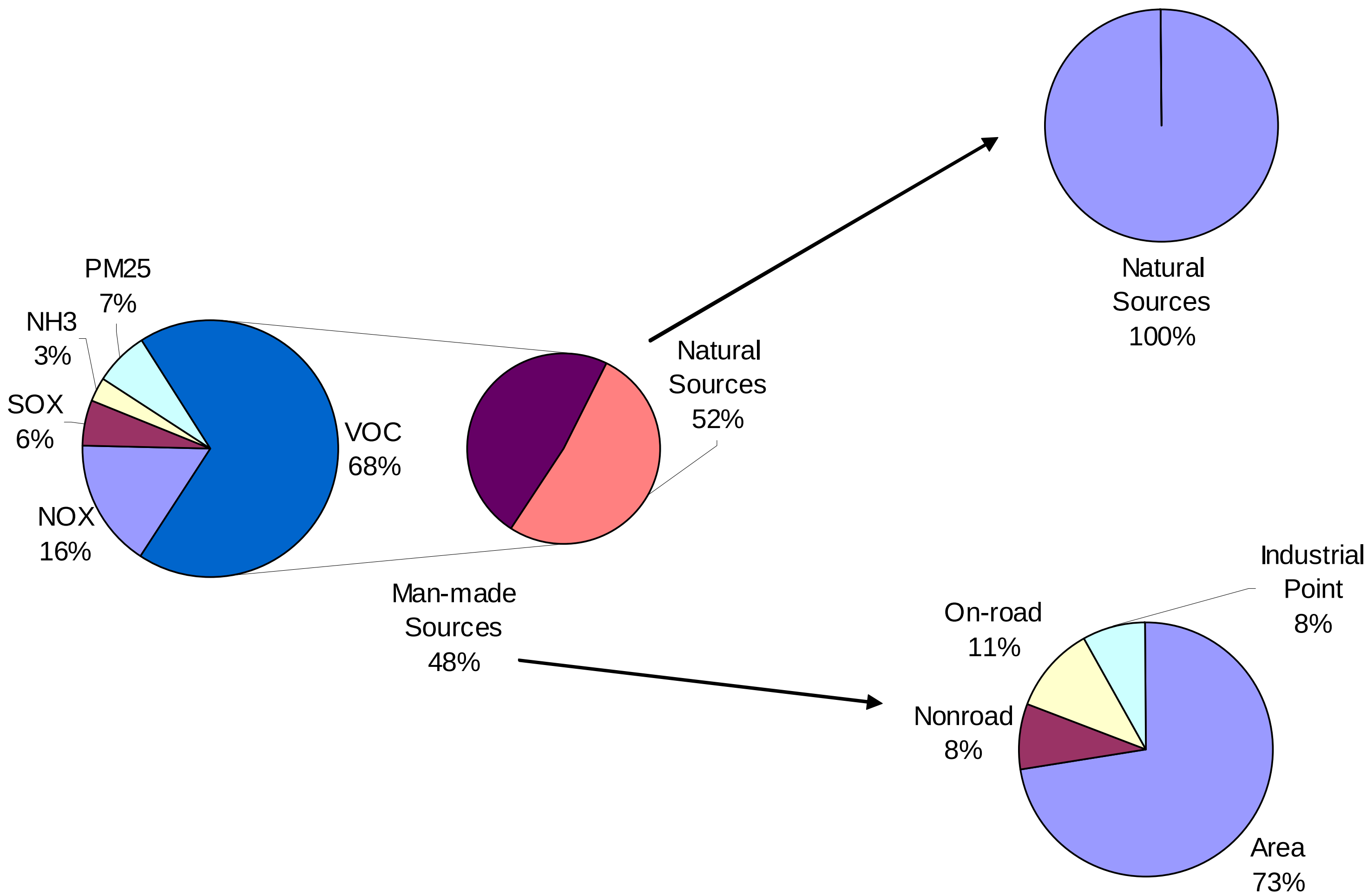
VOC Emissions (Domain) – August 18, 2018



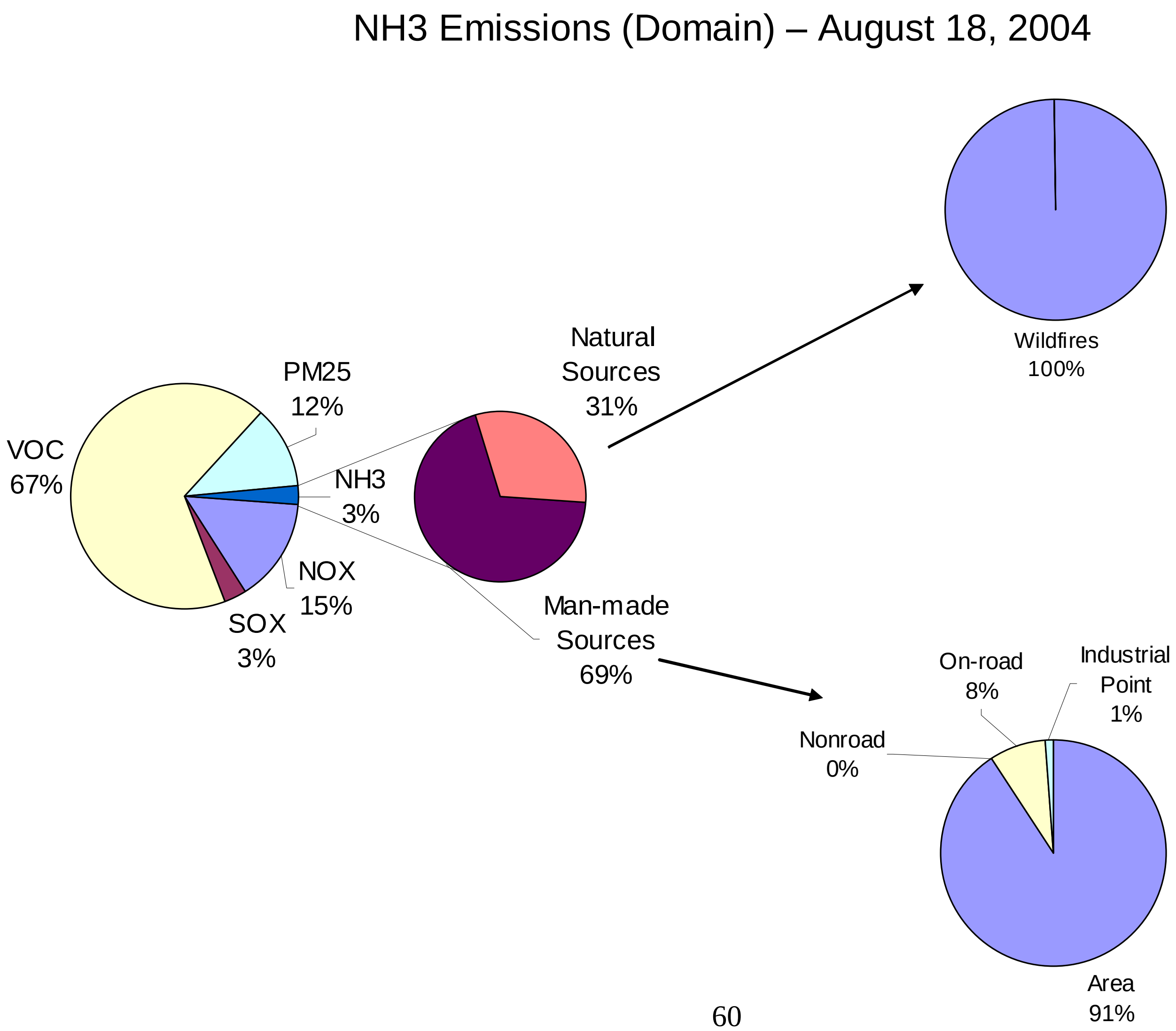
VOC Emissions (Domain) – November 12, 2004



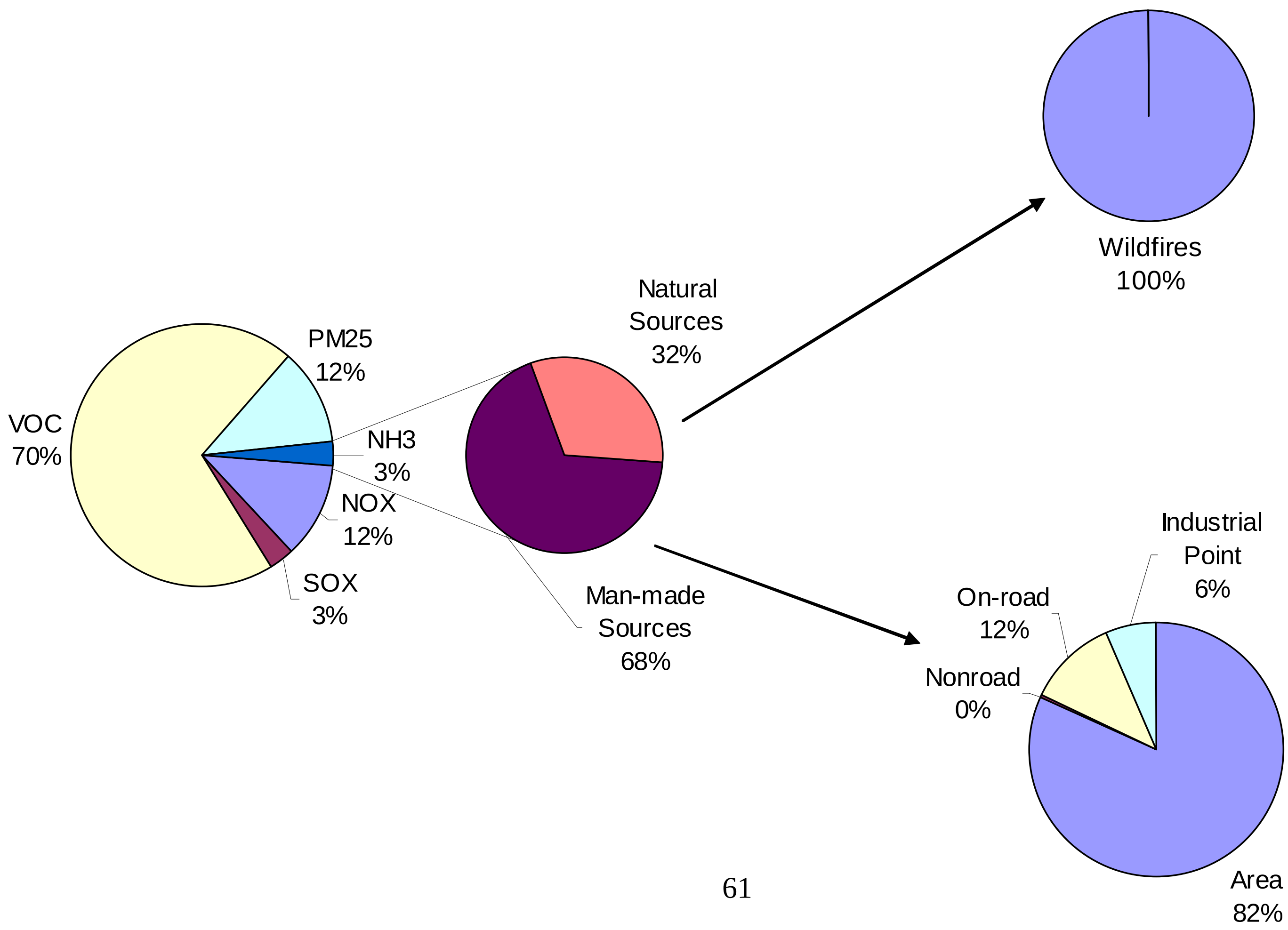
VOC Emissions (Domain) – November 12, 2018



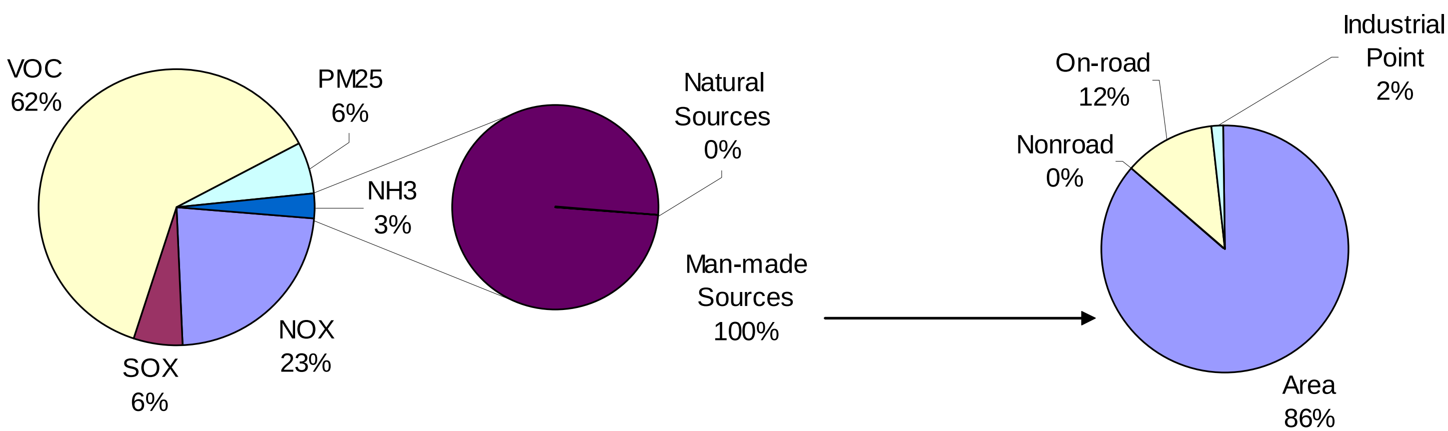
D. NH3


NH3 Emissions (Domain) – August 18, 2004
VOC
67%
PM25
12%
NH3
3%
NOX
15%
SOX
3%
Natural
Sources
31%
Man-made
Sources
69%
Wildfires
100%
On-road
8%
Industrial
Point
1%
Nonroad
0%
Area
91%

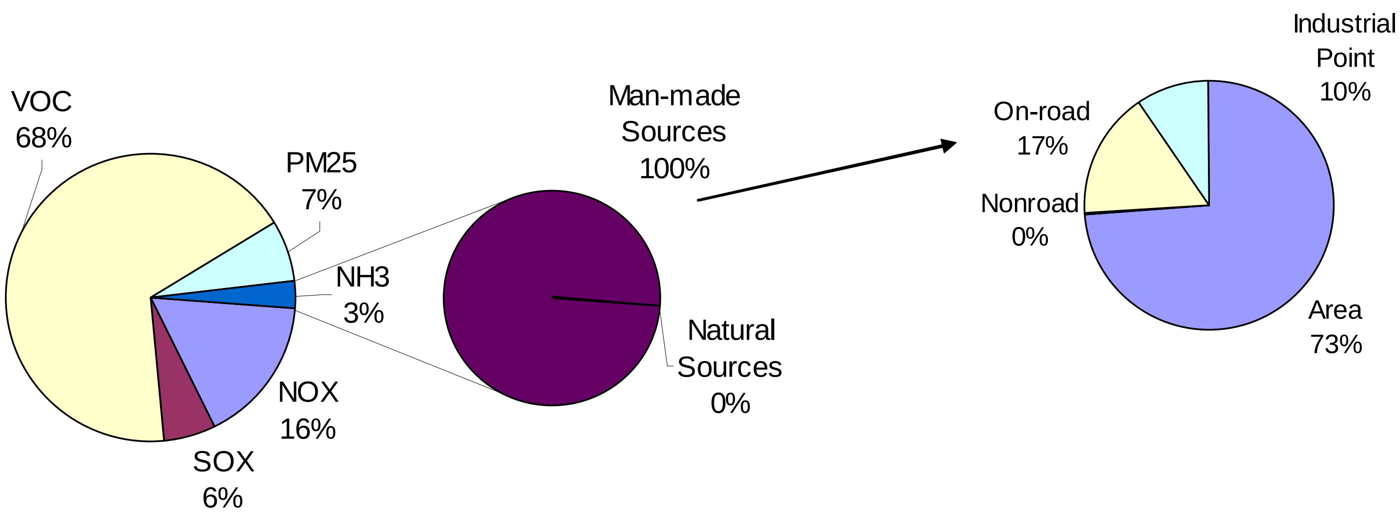
NH3 Emissions (Domain) – August 18, 2018



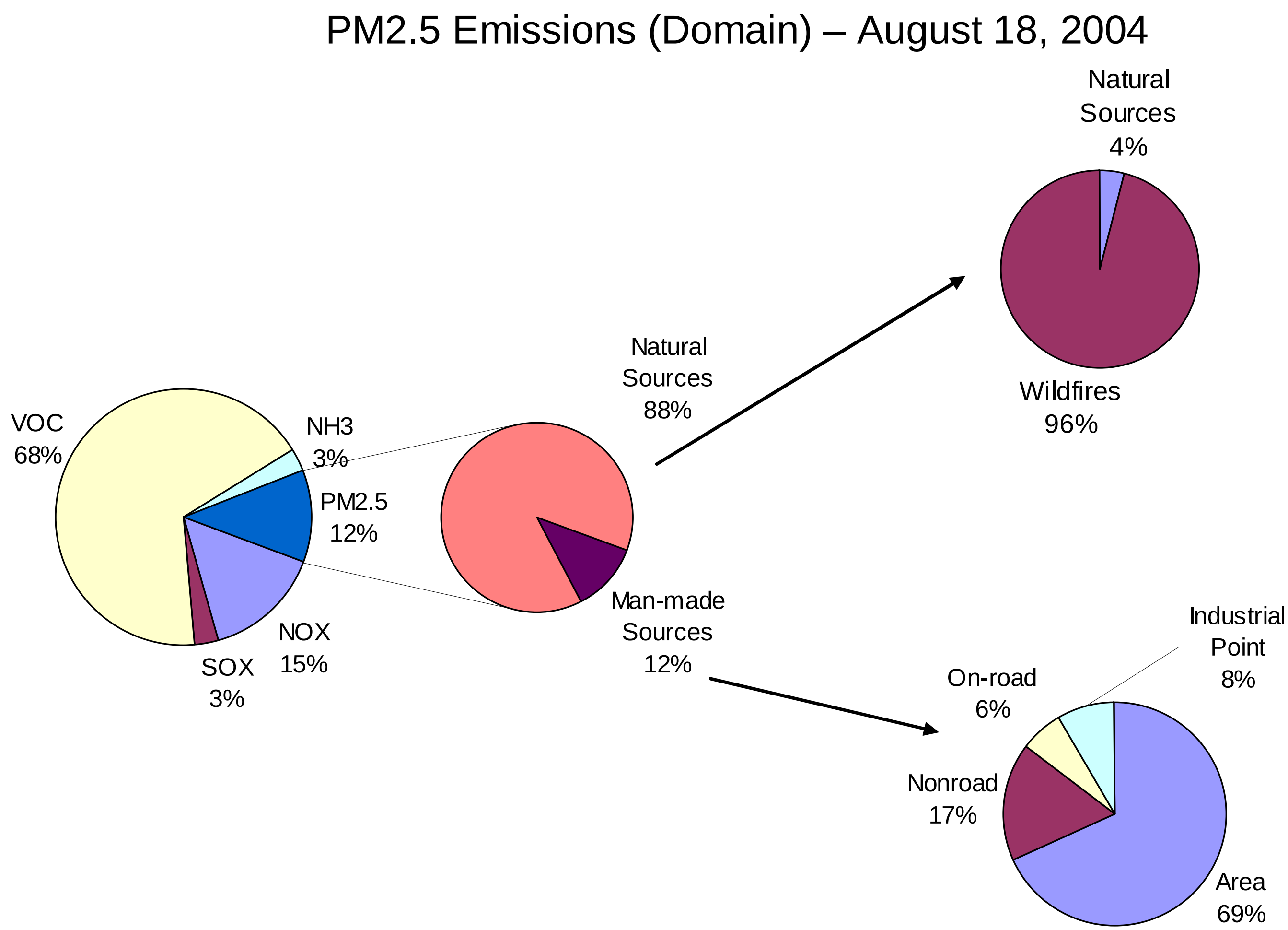
NH3 Emissions (Domain) – November 12, 2004



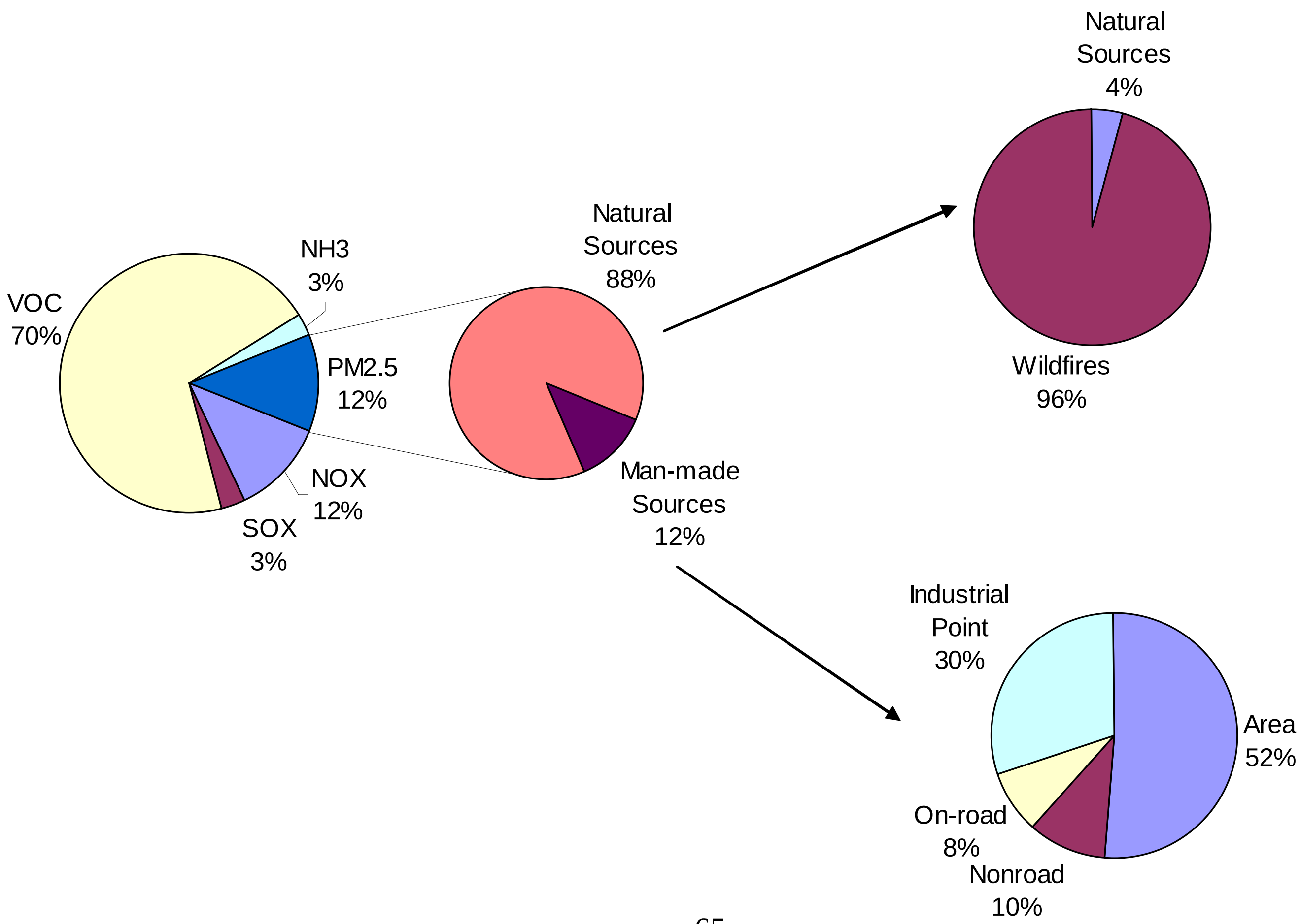
NH3 Emissions (Domain) – November 12, 2018



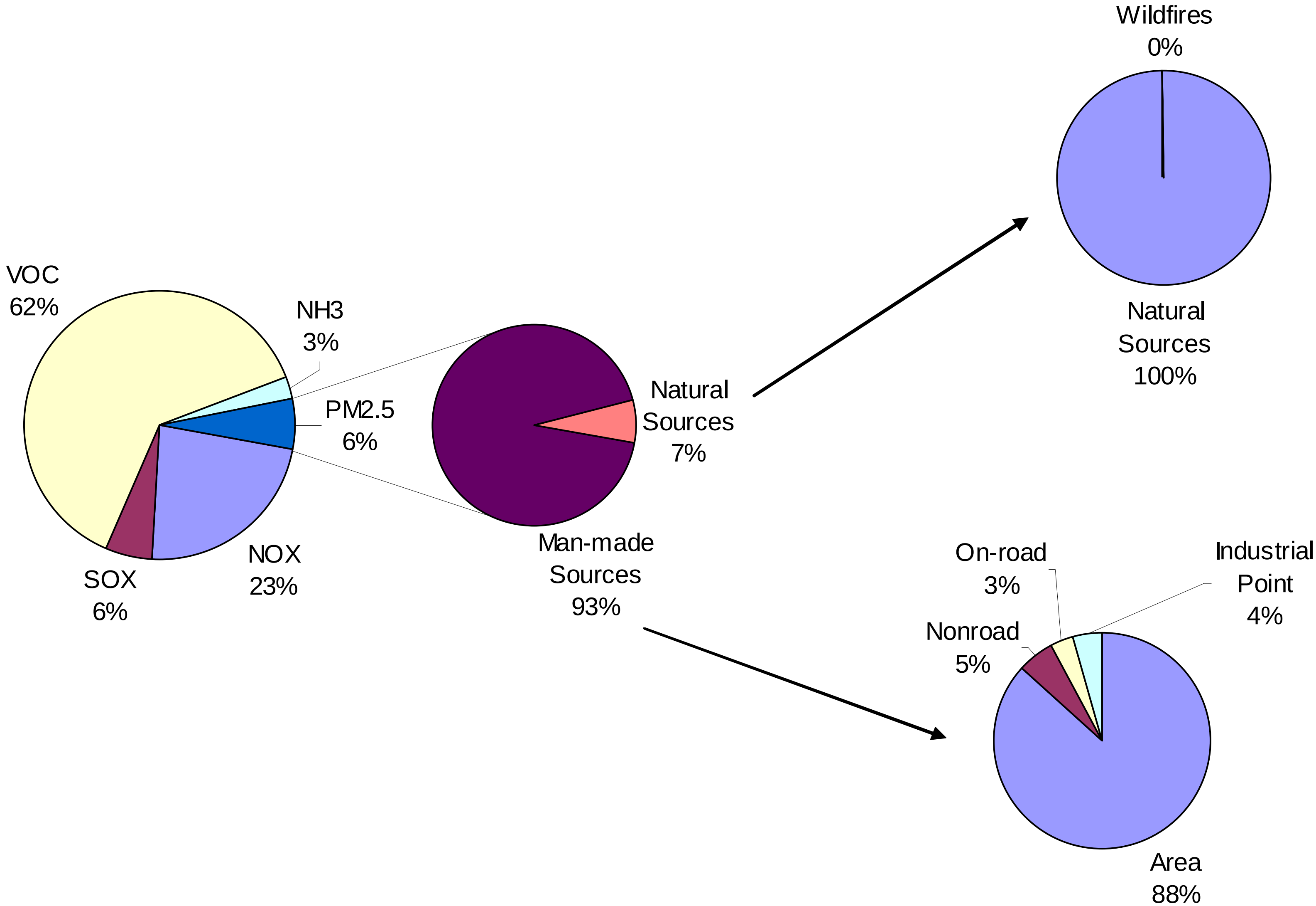
E. PM2.5


PM2.5 Emissions (Domain) – August 18, 2004
VOC
68%
NH3
3%
PM2.5
12%
NOX
15%
SOX
3%
Natural
Sources
88%
Man-made
Sources
12%
Natural
Sources
4%
Wildfires
96%
Industrial
Point
8%
On-road
6%
Nonroad
17%
Area
69%

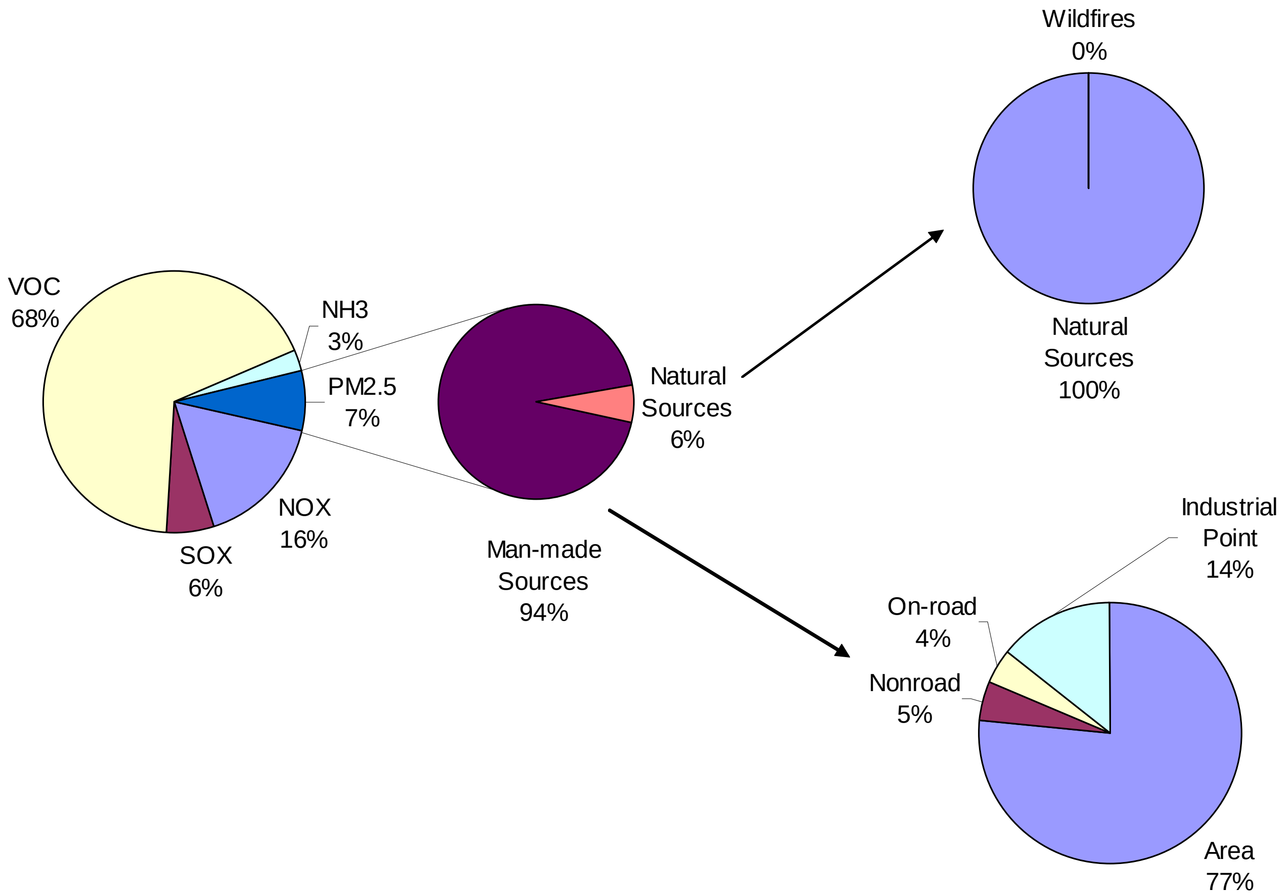
PM2.5 Emissions (Domain) – August 18, 2018



PM2.5 Emissions (Domain) – November 12, 2004



PM2.5 Emissions (Domain) – November 12, 2018



APPENDIX A

In-Gorge Emissions

		----- Aug 18 -----				----- Nov 12 -----	
Group	Category	2004	2018	Group	Category	2004	2018
Agriculture/Livestock	Fertilizer Application	0.92	0.92	Agriculture/Livestock	Fertilizer Application	0.33	0.33
Agriculture/Livestock	Livestock Operations	0.99	0.44	Agriculture/Livestock	Nonroad: Agricultural	0.15	1.43
Agriculture/Livestock	Nonroad: Agricultural	1.21	1.43	Agriculture/Livestock	Open Burning: Agricultural	0.52	0.65
Agriculture/Livestock	Open Burning: Agricultural	0.11	0.15	Agriculture/Livestock	Orchard Heaters	0.35	0.72
Agriculture/Livestock	Orchard Heaters	0.11	0.21	Commercial Marine (Barging-Towboats)	Nonroad: CMV	3.30	2.90
Commercial Marine (Barging-Towboats)	Nonroad: CMV	3.30	2.90	Industrial Point	Industrial Point	0.70	42.00
Industrial Point	Industrial Point	0.71	45.01	Livestock Operations	Livestock Operations	0.62	0.34
Nonroad: Construction & Mining	Nonroad: Construction & Mining	0.99	0.87	Nonroad: Construction & Mining	Nonroad: Construction & Mining	0.68	0.87
Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	1.62	0.92	Nonroad: Recreational	Nonroad: Recreational	1.92	0.92
Nonroad: Recreational	Nonroad: Recreational	1.50	0.92	Nonroad: Recreational Marine	Nonroad: Recreational Marine	1.16	0.40
On-Road Mobile	On-Road Mobile	13.70	7.25	On-Road Mobile	On-Road Mobile	15.57	7.88
Open Burning: Land Clearing	Open Burning: Land Clearing	--	0.32	Open Burning: Land Clearing	Open Burning: Land Clearing	--	0.36
Open Burning: Residential	Open Burning: Residential	0.46	0.75	Open Burning: Residential	Open Burning: Residential	0.47	0.76
Other	Area: Misc. Industrial	0.25	0.36	Other	Area: Misc. Industrial	0.25	0.36
Other	Commercial Food Preparation	0.07	0.07	Other	Commercial Food Preparation	0.07	0.07
Other	Degreasing	0.37	1.21	Other	Degreasing	0.38	1.23
Other	Drycleaning	0.01	0.05	Other	Drycleaning	0.01	0.05
Other	Fuel Storage & Transport	0.62	0.82	Other	Fuel Storage & Transport	0.62	0.82
Other	Fugitive Dust	0.43	0.00	Other	Fugitive Dust	0.33	0.00
Other	Graphic Arts	0.51	0.79	Other	Graphic Arts	0.51	0.79
Other	Incineration	0.09	0.00	Other	Incineration	0.09	0.00
Other	Misc. Area Sources	0.33	0.41	Other	Misc. Area Sources	0.33	0.41
Other	Misc. Non-Industrial Solvent Utilization	1.63	3.14	Other	Misc. Non-Industrial Solvent Utilization	1.65	3.18
Other	Municipal (non-TV) Landfills	0.22	0.32	Other	Municipal (non-TV) Landfills	0.22	0.32
Other	Nonroad: Aircraft & Aircraft Refueling	0.04	0.04	Other	Nonroad: Aircraft & Aircraft Refueling	0.04	0.04
Other	Nonroad: Airport GSE	6E-05	7E-04	Other	Nonroad: Airport GSE	6.E-05	7.E-04
Other	Nonroad: Commercial	0.27	0.16	Other	Nonroad: Commercial	0.27	0.16
Other	Nonroad: Diesel	0.01	--	Other	Nonroad: Diesel	0.01	--
Other	Nonroad: Industrial	0.36	0.08	Other	Nonroad: Industrial	0.25	0.08
Other	Nonroad: Logging	0.06	0.01	Other	Nonroad: Lawn & Garden	0.33	0.92
Other	POTWs	0.06	0.09	Other	Nonroad: Logging	0.06	0.01
Other	Stationary Source Fuel Combustion	0.27	0.41	Other	POTWs	0.06	0.09
Other	TSDFs	3E-03	5E-03	Other	Stationary Source Fuel Combustion	0.56	0.73
Prescribed Burning	Prescribed Burning	0.06	0.06	Other	TSDFs	3.E-03	5.E-03
Rail	Nonroad: Rail	12.27	8.93	Prescribed Burning	Prescribed Burning	15.91	15.91
Recreational Marine	Nonroad: Recreational Marine	1.46	0.40	Rail	Nonroad: Rail	12.27	8.93
Residential Wood Combustion	Residential Wood Combustion	0.65	0.68	Residential Wood Combustion	Residential Wood Combustion	6.63	6.89
Surface Coating	Surface Coating	1.57	2.43	Surface Coating	Surface Coating	1.56	2.43
Totals		**47.2**	**82.6**			**68.2**	**103.0**

Portland: Anthropogenic Emissions: Cumulative Percentages

		— Aug 18 —				— Nov 12 —	
Group	Category	2004	2018	Group	Category	2004	2018
Agriculture/Livestock	Fertilizer Application	1.76	1.76	Agriculture/Livestock	Fertilizer Application	0.69	0.69
Agriculture/Livestock	Livestock Operations	13.58	11.67	Agriculture/Livestock	Livestock Operations	9.71	8.75
Agriculture/Livestock	Nonroad: Agricultural	3.28	3.97	Agriculture/Livestock	Nonroad: Agricultural	0.40	3.97
Agriculture/Livestock	Open Burning: Agricultural	0.04	0.04	Agriculture/Livestock	Open Burning: Agricultural	0.56	0.58
Agriculture/Livestock	Orchard Heaters	0.17	0.19	Agriculture/Livestock	Orchard Heaters	0.58	0.65
Degreasing	Degreasing	13.26	54.21	Industrial Point	Industrial Point	22.31	32.84
Industrial Point	Industrial Point	20.57	33.22	Msc. Area Sources	Area: Msc. Industrial	12.82	15.49
Msc. Area Sources	Area: Msc. Industrial	12.83	15.49	Msc. Area Sources	Degreasing	13.42	54.85
Msc. Area Sources	Graphic Arts	8.21	35.02	Msc. Area Sources	Graphic Arts	8.21	35.02
Msc. Area Sources	Msc. Area Sources	3.87	4.46	Msc. Area Sources	Msc. Area Sources	3.87	4.46
Msc. Area Sources	Msc. Non-Industrial Solvent Utilization	20.22	27.70	Msc. Area Sources	Msc. Non-Industrial Solvent Utilization	20.43	27.95
Nonroad: CMV	Nonroad: CMV	4.64	4.49	Nonroad: CMV	Nonroad: CMV	4.64	4.49
Nonroad: Commercial	Nonroad: Commercial	11.45	6.57	Nonroad: Commercial	Nonroad: Commercial	11.50	6.57
Nonroad: Construction & Mining	Nonroad: Construction & Mining	35.13	17.92	Nonroad: Construction & Mining	Nonroad: Construction & Mining	23.64	17.92
Nonroad: Industrial	Nonroad: Industrial	13.71	2.60	Nonroad: Industrial	Nonroad: Industrial	9.42	2.60
Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	47.54	25.38	Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	11.46	25.38
Nonroad: Rail	Nonroad: Rail	9.02	6.02	Nonroad: Rail	Nonroad: Rail	9.02	6.02
Nonroad: Recreational	Nonroad: Recreational	5.24	3.08	Nonroad: Recreational	Nonroad: Recreational	1.55	3.08
Nonroad: Recreational Marine	Nonroad: Recreational Marine	7.27	2.14	Nonroad: Recreational Marine	Nonroad: Recreational Marine	6.90	2.14
On-Road Mobile	On-Road Mobile	171.64	74.97	On-Road Mobile	On-Road Mobile	195.18	83.92
Open Burning: Land Clearing	Open Burning: Land Clearing	–	4.96	Open Burning: Land Clearing	Open Burning: Land Clearing	–	5.65
Other	Commercial Food Preparation	0.41	11.51	Open Burning: Residential	Open Burning: Residential	1.89	3.84
Other	Drycleaning	0.21	4.75	Other	Commercial Food Preparation	0.41	11.51
Other	Fuel Storage & Transport	3.08	4.66	Other	Drycleaning	2.E-01	5.E+00
Other	Fugitive Dust	2.62	0	Other	Fuel Storage & Transport	3.08	4.66
Other	Incineration	1E+00	5E-01	Other	Fugitive Dust	2.46	0
Other	Municipal (non-TV) Landfills	0.37	0.53	Other	Incineration	1.E+00	5.E-01
Other	Nonroad: Aircraft & Aircraft Refueling	3.21	3.68	Other	Municipal (non-TV) Landfills	0.37	0.53
Other	Nonroad: Airport GSE	0.00	0.11	Other	Nonroad: Aircraft & Aircraft Refueling	3.21	3.68
Other	Nonroad: Diesel	0.87	–	Other	Nonroad: Airport GSE	0.00	0.11
Other	Nonroad: Logging	0.30	0.34	Other	Nonroad: Diesel	0.87	–
Other	Open Burning: Residential	1.83	3.76	Other	Nonroad: Logging	0.31	0.34
Other	POTWs	0.89	1.32	Other	POTWs	0.89	1.32
Other	Prescribed Burning	0.33	0.33	Other	Prescribed Burning	1.13	1.13
Other	TSDFs	3E-01	4E-01	Other	TSDFs	0.30	0.43
Residential Wood Combustion	Residential Wood Combustion	7.21	7.50	Residential Wood Combustion	Residential Wood Combustion	73.99	76.95
Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	13.18	16.33	Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	21.58	26.15
Surface Coating	Surface Coating	59.81	102.69	Surface Coating	Surface Coating	59.73	102.78
Totals		**499.4**	**494.3**			**538.1**	**581.7**

Northwest of Gorge: Anthropogenic Emissions: Tons Per Day

		----- Aug 18 -----				----- Nov 12 -----	
Group	Category	2004	2018	Group	Category	2004	2018
Agriculture/Livestock	Fertilizer Application	0.87	0.87	Agriculture/Livestock	Fertilizer Application	0.15	0.15
Agriculture/Livestock	Livestock Operations	3.03	1.34	Agriculture/Livestock	Livestock Operations	2.05	1.20
Agriculture/Livestock	Nonroad: Agricultural	0.64	0.66	Agriculture/Livestock	Nonroad: Agricultural	0.08	0.66
Agriculture/Livestock	Open Burning: Agricultural	0.00	0.00	Agriculture/Livestock	Open Burning: Agricultural	0.00	0.00
Agriculture/Livestock	Orchard Heaters	0.00	0.00	Agriculture/Livestock	Orchard Heaters	0.00	0.00
Fuel Storage, Transport, Refueling	Fuel Storage, Transport, Refueling	2.08	4.55	Fuel Storage, Transport, Refueling	Fuel Storage, Transport, Refueling	2.08	4.55
Industrial Point	Industrial Point	127.91	70.71	Industrial Point	Industrial Point	121.84	69.74
Nonroad: Commercial Marine	Nonroad: Commercial Marine	18.87	19.66	Nonroad: Commercial Marine	Nonroad: Commercial Marine	18.87	19.66
Nonroad: Construction & Mining	Nonroad: Construction & Mining	2.15	1.44	Nonroad: Construction & Mining	Nonroad: Construction & Mining	1.47	1.44
Nonroad: Industrial	Nonroad: Industrial	1.70	0.30	Nonroad: Industrial	Nonroad: Industrial	1.17	0.30
Nonroad: Rail	Nonroad: Rail	2.63	2.86	Nonroad: Rail	Nonroad: Rail	2.63	2.86
Nonroad: Recreational	Nonroad: Recreational	3.65	1.90	Nonroad: Recreational	Nonroad: Recreational	1.04	1.90
Nonroad: Recreational Marine	Nonroad: Recreational Marine	4.04	3.01	Nonroad: Recreational Marine	Nonroad: Recreational Marine	3.04	3.01
On-Road Mobile	On-Road Mobile	31.44	15.85	On-Road Mobile	On-Road Mobile	34.15	17.10
Open Burning: Land Clearing	Open Burning: Land Clearing	--	1.37	Open Burning: Land Clearing	Open Burning: Land Clearing	--	1.57
Open Burning: Residential	Open Burning: Residential	0.94	1.71	Open Burning: Residential	Open Burning: Residential	0.96	1.73
Other	Area: Misc. Industrial	2.12	2.92	Other	Area: Misc. Industrial	2.12	2.92
Other	Commercial Food Preparation	0.17	0.28	Other	Commercial Food Preparation	0.17	0.28
Other	Degreasing	0.74	1.93	Other	Degreasing	0.75	1.95
Other	Drycleaning	0.04	0.10	Other	Drycleaning	0.04	0.10
Other	Fugitive Dust	0.32	0.00	Other	Fugitive Dust	0.28	0.00
Other	Graphic Arts	0.35	0.71	Other	Graphic Arts	0.35	0.71
Other	Incineration	0.46	0.01	Other	Incineration	0.46	0.01
Other	Misc. Area Sources	8.E-01	7.E-01	Other	Misc. Area Sources	0.83	0.74
Other	Misc. Non-Industrial Solvent Utilization	2.00	3.21	Other	Misc. Non-Industrial Solvent Utilization	2.02	3.23
Other	Municipal (non-TV) Landfills	0.00	0	Other	Municipal (non-TV) Landfills	0.00	0.00
Other	Nonroad: Aircraft & Aircraft Refueling	1.E-01	2.E-01	Other	Nonroad: Aircraft & Aircraft Refueling	0.13	0.16
Other	Nonroad: Airport GSE	0.00	0.00	Other	Nonroad: Airport GSE	0.00	0.00
Other	Nonroad: Commercial	0.48	0.33	Other	Nonroad: Commercial	0.49	0.33
Other	Nonroad: Diesel	0.00	--	Other	Nonroad: Diesel	0.00	--
Other	Nonroad: Lawn & Garden	2.03	1.42	Other	Nonroad: Lawn & Garden	0.38	1.42
Other	Nonroad: Logging	1.69	1.53	Other	Nonroad: Logging	1.73	1.53
Other	POTWs	0.24	0.35	Other	POTWs	0.24	0.35
Other	Prescribed Burning	0.55	0.55	Other	TSDFs	0.00	0.00
Other	TSDFs	0.00	0.00	Prescribed Burning	Prescribed Burning	7.24	7.24
Residential Wood Combustion	Residential Wood Combustion	1.80	1.87	Residential Wood Combustion	Residential Wood Combustion	17.85	18.56
Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	1.06	1.34	Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	1.63	1.97
Surface Coating	Surface Coating	4.59	6.31	Surface Coating	Surface Coating	4.61	6.30
Totals		**219.6**	**150.0**	**Totals**		**230.9**	**173.7**

West of Gorge: Anthropogenic Emissions: Tons Per Day

		----- Aug 18 -----	
Group	Category	2004	2018
Agriculture	Fertilizer Application	7.88	7.88
Agriculture	Nonroad: Agricultural	16.15	18.77
Agriculture	Open Burning: Agricultural	0.13	0.15
Agriculture	Orchard Heaters	0.46	0.47
Fuel Storage, Transport, Refueling	Fuel Storage, Transport, Refueling	27.09	78.44
Fugitive Dust	Fugitive Dust	5.27	0.00
Incineration	Incineration	11.20	0.20
Industrial Point	Industrial Point	129.76	267.78
Livestock Operations	Livestock Operations	49.30	35.86
Misc. Area Sources	Area: Misc. Industrial	23.07	35.17
Misc. Area Sources	Degreasing	16.67	63.03
Misc. Area Sources	Graphic Arts	14.37	32.53
Misc. Area Sources	Misc. Area Sources	16.23	13.00
Misc. Area Sources	Misc. Non-Industrial Solvent Utilization	52.60	46.67
Nonroad: Commercial	Nonroad: Commercial	22.48	14.25
Nonroad: Construction & Mining	Nonroad: Construction & Mining	86.03	38.72
Nonroad: Industrial	Nonroad: Industrial	38.43	6.61
Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	88.60	51.21
Nonroad: Rail	Nonroad: Rail	28.19	18.51
Nonroad: Recreational	Nonroad: Recreational	18.68	12.99
Nonroad: Recreational Marine	Nonroad: Recreational Marine	21.58	27.71
On-Road Mobile	On-Road Mobile	708.94	282.64
Open Burning: Land Clearing	Open Burning: Land Clearing	0.09	28.50
Open Burning: Residential	Open Burning: Residential	7.79	38.14
Other	Commercial Food Preparation	7.77	10.49
Other	Drycleaning	7.61	11.31
Other	Municipal (non-TV) Landfills	1.32	1.86
Other	Nonroad: Aircraft & Aircraft Refueling	0.72	7.98
Other	Nonroad: Airport GSE	0.68	0.34
Other	Nonroad: Commercial Marine	0.41	48.80
Other	Nonroad: Diesel	0.02	--
Other	Nonroad: Logging	6.79	6.47
Other	Placeholder	0.22	--
Other	POTWs	7.54	11.20
Other	TSDFs	0.14	0.21
Prescribed Burning	Prescribed Burning	4.35	4.78
Residential Wood Combustion	Residential Wood Combustion	37.30	38.79
Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	21.03	43.94
Surface Coating	Surface Coating	89.78	146.69
Totals		**1,576.7**	**1,452.1**

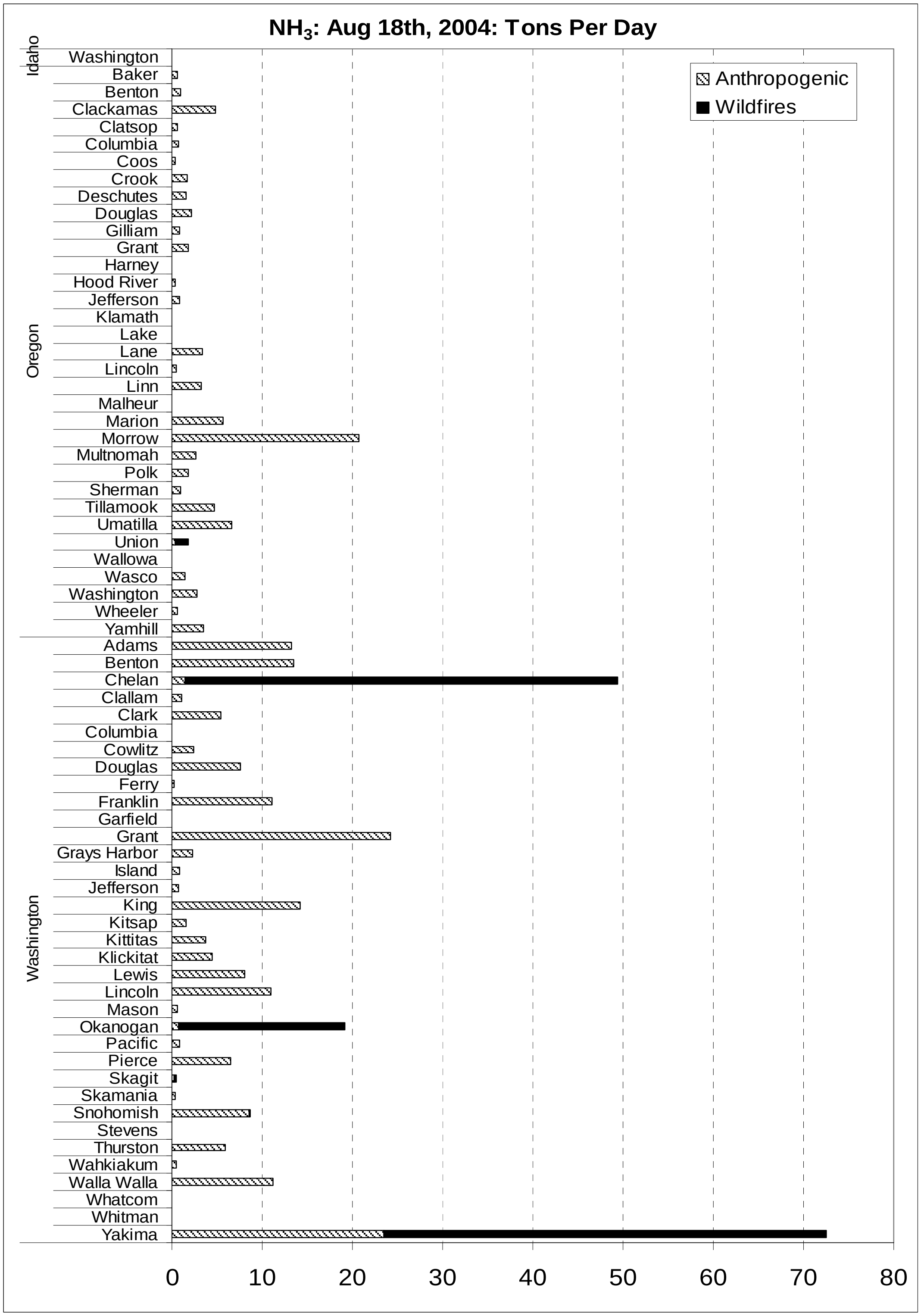
		----- Nov 12 -----	
Group	Category	2004	2018
Agriculture	Fertilizer Application	1.95	1.95
Agriculture	Nonroad: Agricultural	2.52	18.77
Agriculture	Open Burning: Agricultural	12.13	12.17
Agriculture	Orchard Heaters	1.55	1.57
Fuel Storage, Transport, Refueling	Fuel Storage, Transport, Refueling	27.09	78.44
Fugitive Dust	Fugitive Dust	4.85	0.00
Incineration	Incineration	11.20	0.20
Industrial Point	Industrial Point	127.37	259.81
Livestock Operations	Livestock Operations	38.65	31.88
Misc. Area Sources	Area: Misc. Industrial	23.07	35.17
Misc. Area Sources	Degreasing	16.87	63.78
Misc. Area Sources	Graphic Arts	14.37	32.53
Misc. Area Sources	Misc. Area Sources	16.23	13.00
Misc. Area Sources	Misc. Non-Industrial Solvent Utilization	53.15	47.04
Nonroad: Commercial	Nonroad: Commercial	23.53	14.25
Nonroad: Construction & Mining	Nonroad: Construction & Mining	58.96	38.72
Nonroad: Industrial	Nonroad: Industrial	26.57	6.61
Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	30.64	51.21
Nonroad: Rail	Nonroad: Rail	28.19	18.51
Nonroad: Recreational	Nonroad: Recreational	9.82	12.99
Nonroad: Recreational Marine	Nonroad: Recreational Marine	10.57	27.71
On-Road Mobile	On-Road Mobile	746.65	298.57
Open Burning: Land Clearing	Open Burning: Land Clearing	0.10	32.48
Open Burning: Residential	Open Burning: Residential	8.13	38.35
Other	Commercial Food Preparation	7.77	10.49
Other	Drycleaning	7.61	11.31
Other	Municipal (non-TV) Landfills	1.32	1.86
Other	Nonroad: Aircraft & Aircraft Refueling	0.71	7.98
Other	Nonroad: Airport GSE	0.69	0.34
Other	Nonroad: Commercial Marine	0.41	48.80
Other	Nonroad: Diesel	0.02	--
Other	Nonroad: Logging	6.93	6.47
Other	Placeholder	0.22	--
Other	POTWs	7.54	11.20
Other	TSDFs	0.14	0.21
Prescribed Burning	Prescribed Burning	71.01	72.49
Residential Wood Combustion	Residential Wood Combustion	366.00	380.64
Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	47.98	70.60
Surface Coating	Surface Coating	89.84	146.72
Totals		**1,902.3**	**1,904.8**

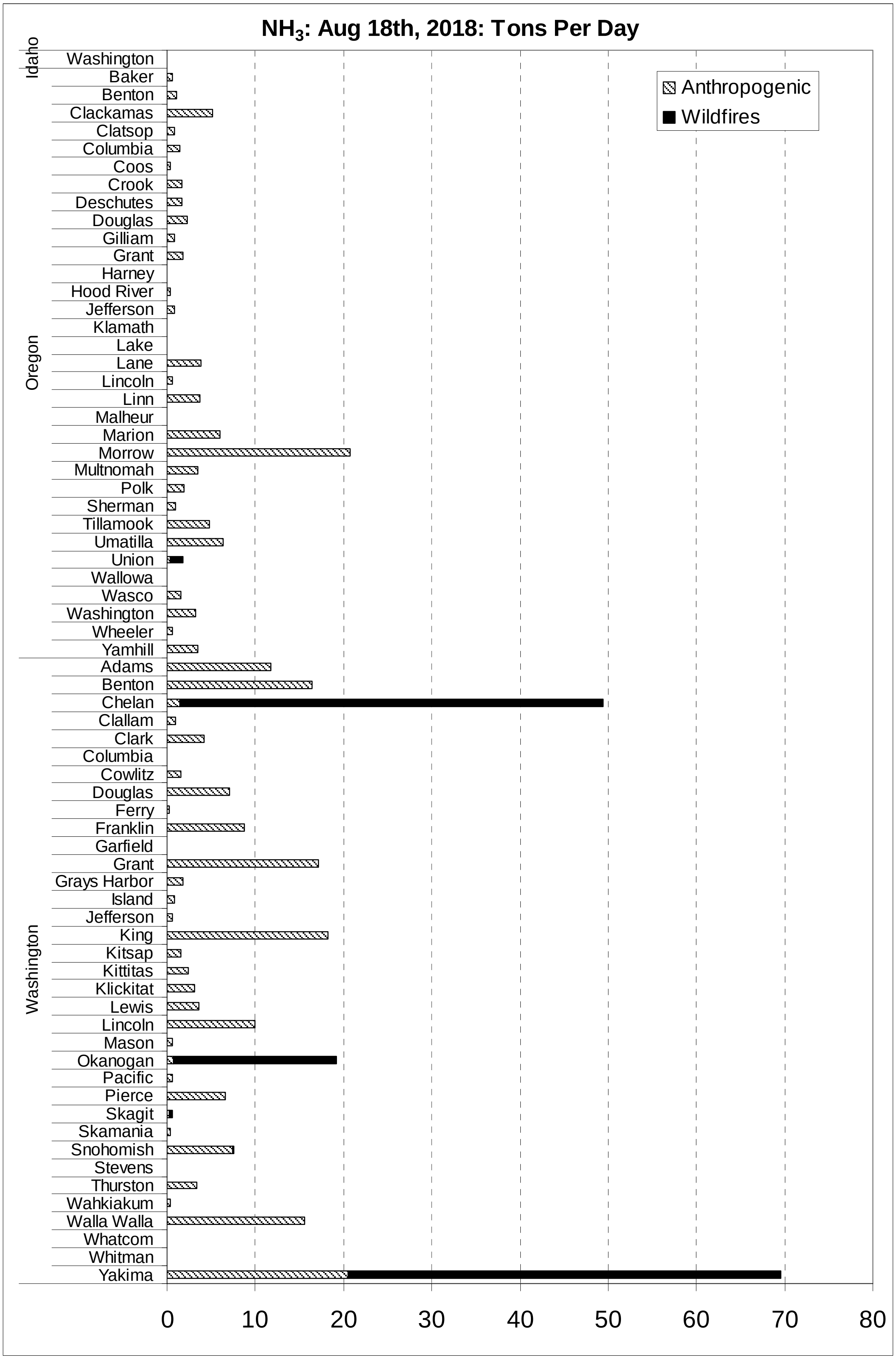
East of Gorge: Anthropogenic Emissions: Tons Per Day

		----- Aug 18 -----				----- Nov 12 -----	
Group	Category	2004	2018	Group	Category	2004	2018
Agriculture	Fertilizer Application	79.52	79.52	Agriculture	Fertilizer Application	13.78	13.78
Agriculture	Nonroad: Agricultural	79.49	71.15	Agriculture	Nonroad: Agricultural	14.33	71.15
Agriculture	Open Burning: Agricultural	62.36	62.35	Agriculture	Open Burning: Agricultural	6.71	6.67
Agriculture	Orchard Heaters	0.20	0.10	Agriculture	Orchard Heaters	0.67	0.34
Fuel Storage, Transport, Refueling	Fuel Storage, Transport, Refueling	14.46	23.90	Fuel Storage, Transport, Refueling	Fuel Storage, Transport, Refueling	14.46	23.90
Fugitive Dust	Fugitive Dust	54.12	0.00	Fugitive Dust	Fugitive Dust	33.24	0.00
Industrial Point	Industrial Point	112.44	121.04	Industrial Point	Industrial Point	117.01	120.90
Livestock Operations	Livestock Operations	82.85	47.60	Livestock Operations	Livestock Operations	63.02	45.35
Misc. Area Sources	Area: Misc. Industrial	10.10	14.59	Misc. Area Sources	Area: Misc. Industrial	10.10	14.59
Misc. Area Sources	Degreasing	3.86	18.74	Misc. Area Sources	Degreasing	3.90	18.96
Misc. Area Sources	Graphic Arts	2.60	3.44	Misc. Area Sources	Graphic Arts	2.60	3.44
Misc. Area Sources	Misc. Area Sources	7.92	7.37	Misc. Area Sources	Misc. Area Sources	7.92	7.37
Misc. Area Sources	Misc. Non-Industrial Solvent Utilization	21.83	54.26	Misc. Area Sources	Misc. Non-Industrial Solvent Utilization	22.07	54.79
Nonroad: Commercial Marine	Nonroad: Commercial Marine	4.93	4.85	Nonroad: Commercial Marine	Nonroad: Commercial Marine	4.93	4.85
Nonroad: Commercial	Nonroad: Commercial	3.82	2.63	Nonroad: Commercial	Nonroad: Commercial	3.99	2.63
Nonroad: Construction & Mining	Nonroad: Construction & Mining	18.91	10.37	Nonroad: Construction & Mining	Nonroad: Construction & Mining	12.70	10.37
Nonroad: Industrial	Nonroad: Industrial	5.67	1.08	Nonroad: Industrial	Nonroad: Industrial	3.97	1.08
Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	10.66	6.84	Nonroad: Lawn & Garden	Nonroad: Lawn & Garden	3.66	6.84
Nonroad: Rail	Nonroad: Rail	59.36	44.54	Nonroad: Rail	Nonroad: Rail	59.37	44.54
Nonroad: Recreational	Nonroad: Recreational	16.42	7.61	Nonroad: Recreational	Nonroad: Recreational	15.18	7.61
Nonroad: Recreational Marine	Nonroad: Recreational Marine	9.90	6.55	Nonroad: Recreational Marine	Nonroad: Recreational Marine	4.03	6.55
On-Road Mobile	On-Road Mobile	220.39	92.70	On-Road Mobile	On-Road Mobile	229.61	96.60
Open Burning: Land Clearing	Open Burning: Land Clearing	0.21	4.73	Open Burning: Land Clearing	Open Burning: Land Clearing	0.23	5.39
Open Burning: Residential	Open Burning: Residential	3.83	6.66	Open Burning: Residential	Open Burning: Residential	3.90	6.75
Other	Commercial Food Preparation	1.10	1.56	Other	Commercial Food Preparation	1.10	1.56
Other	Drycleaning	0.93	1.54	Other	Drycleaning	0.93	1.54
Other	Incineration	1.51	0.37	Other	Incineration	1.51	0.37
Other	Municipal (non-TV) Landfills	7.80	11.19	Other	Municipal (non-TV) Landfills	7.80	11.19
Other	Nonroad: Aircraft & Aircraft Refueling	0.75	0.82	Other	Nonroad: Aircraft & Aircraft Refueling	0.74	0.82
Other	Nonroad: Airport GSE	0.02	0.01	Other	Nonroad: Airport GSE	0.02	0.01
Other	Nonroad: Diesel	0.00	--	Other	Nonroad: Diesel	0.00	--
Other	Nonroad: Logging	1.54	0.39	Other	Nonroad: Logging	1.57	0.39
Other	Placeholder	0.01	--	Other	Placeholder	0.01	--
Other	POTWs	1.49	2.21	Other	POTWs	1.49	2.21
Other	TSDFs	0.00	0.00	Other	TSDFs	0.00	0.00
Prescribed Burning	Prescribed Burning	2.41	2.41	Prescribed Burning	Prescribed Burning	174.24	174.24
Residential Wood Combustion	Residential Wood Combustion	9.15	9.52	Residential Wood Combustion	Residential Wood Combustion	90.48	94.20
Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	4.95	5.99	Stationary Source Fuel Combustion	Stationary Source Fuel Combustion	9.83	9.76
Surface Coating	Surface Coating	19.08	25.64	Surface Coating	Surface Coating	19.06	25.63
Totals		**936.6**	**754.3**	**Totals**		**960.2**	**896.4**

APPENDIX B

County Charts of Emissions

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Washington
Washington
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Benton
Clackamas
Clatsop
Columbia
Coos
Crook
Deschutes
Douglas
Gilliam
Grant
Harney
Hood River
Jefferson
Klamath
Lake
Lane
Lincoln
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Malheur
Marion
Morrow
Multnomah
Polk
Sherman
Tillamook
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Wheeler
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Ferry
Franklin
Garfield
Grant
Grays Harbor
Island
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Klickitat
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Pierce
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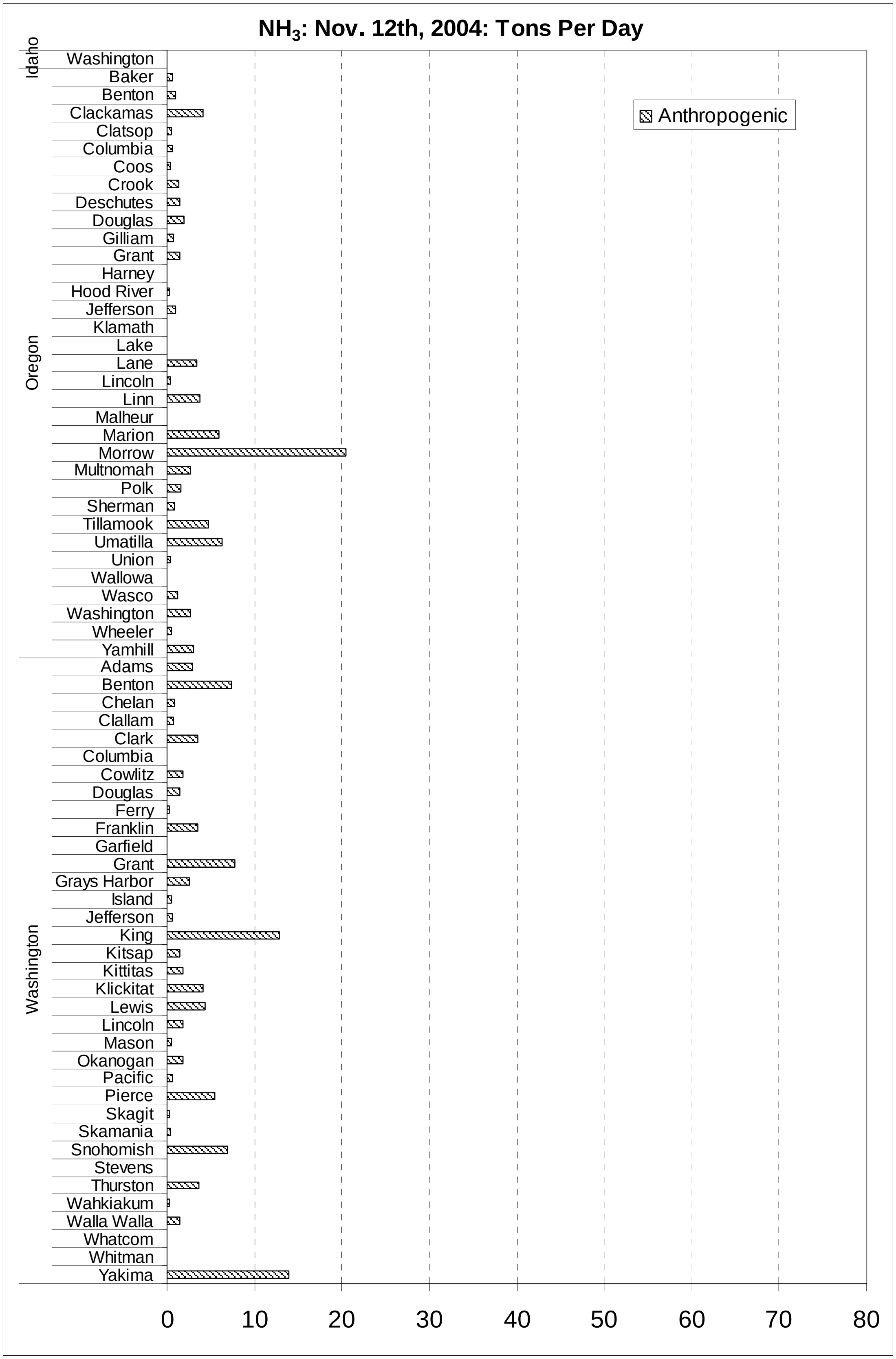
NH3: Nov. 12th, 2004: Tons Per Day
Anthropogenic
Idaho
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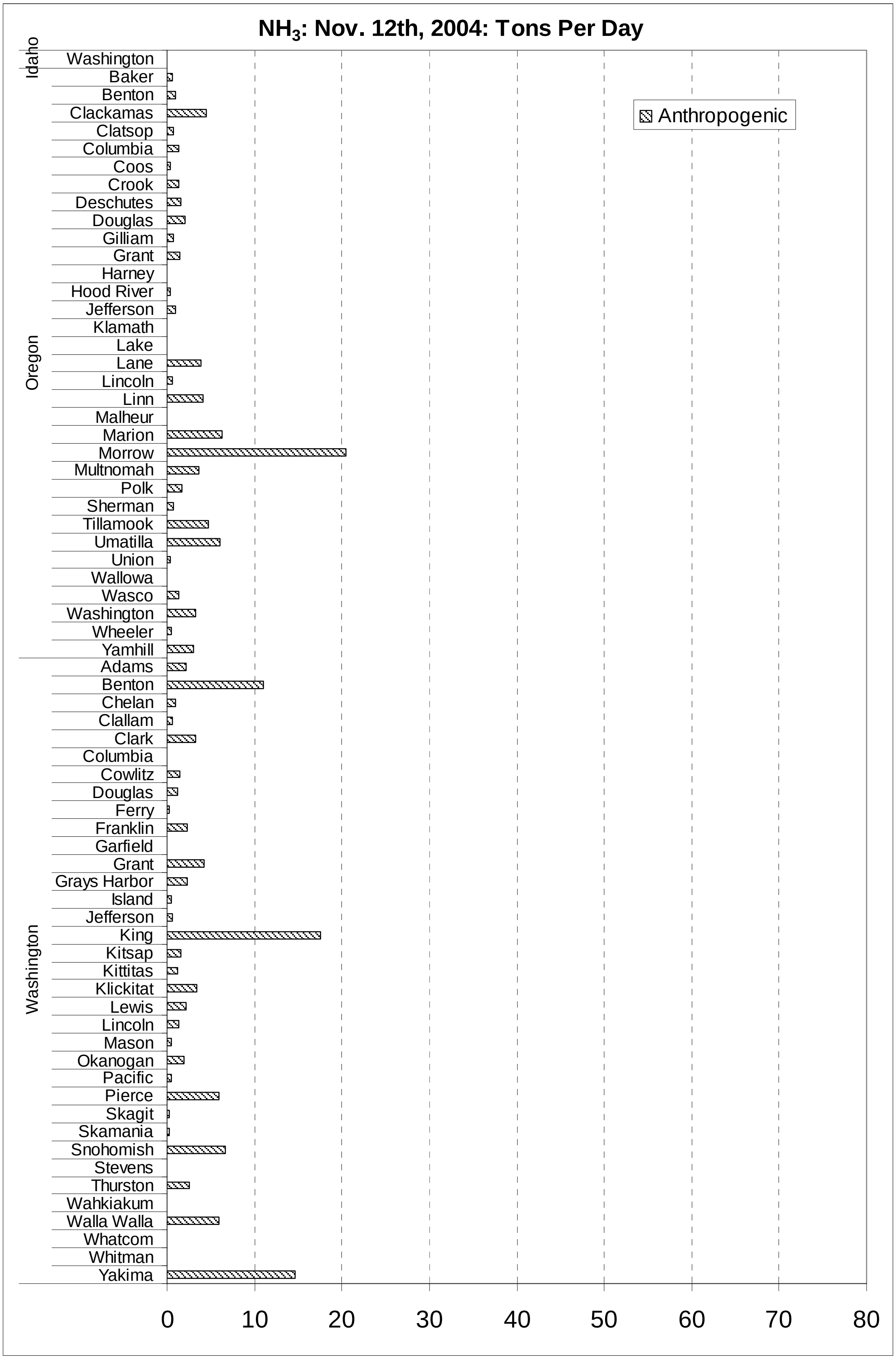

NH3: Nov. 12th, 2004: Tons Per Day
Anthropogenic
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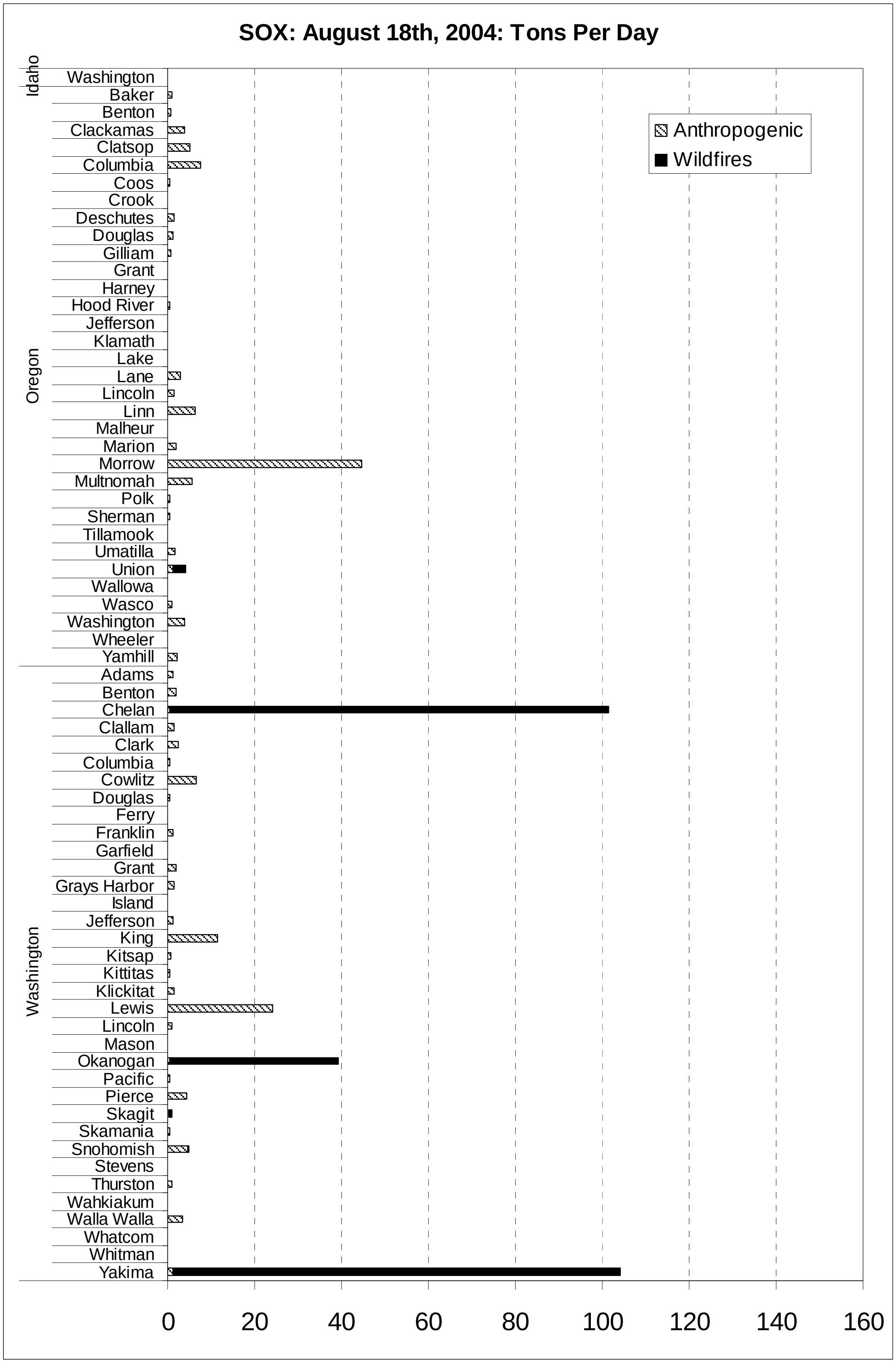
SOX: August 18th, 2004: Tons Per Day
Anthropogenic
Wildfires
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Deschutes
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Multnomah
Polk
Sherman
Tillamook
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Washington
Wheeler
Yamhill
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Adams
Benton
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Columbia
Cowlitz
Douglas
Ferry
Franklin
Garfield
Grant
Grays Harbor
Island
Jefferson
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Klickitat
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Lincoln
Mason
Okanogan
Pacific
Pierce
Skagit
Skamania
Snohomish
Stevens
Thurston
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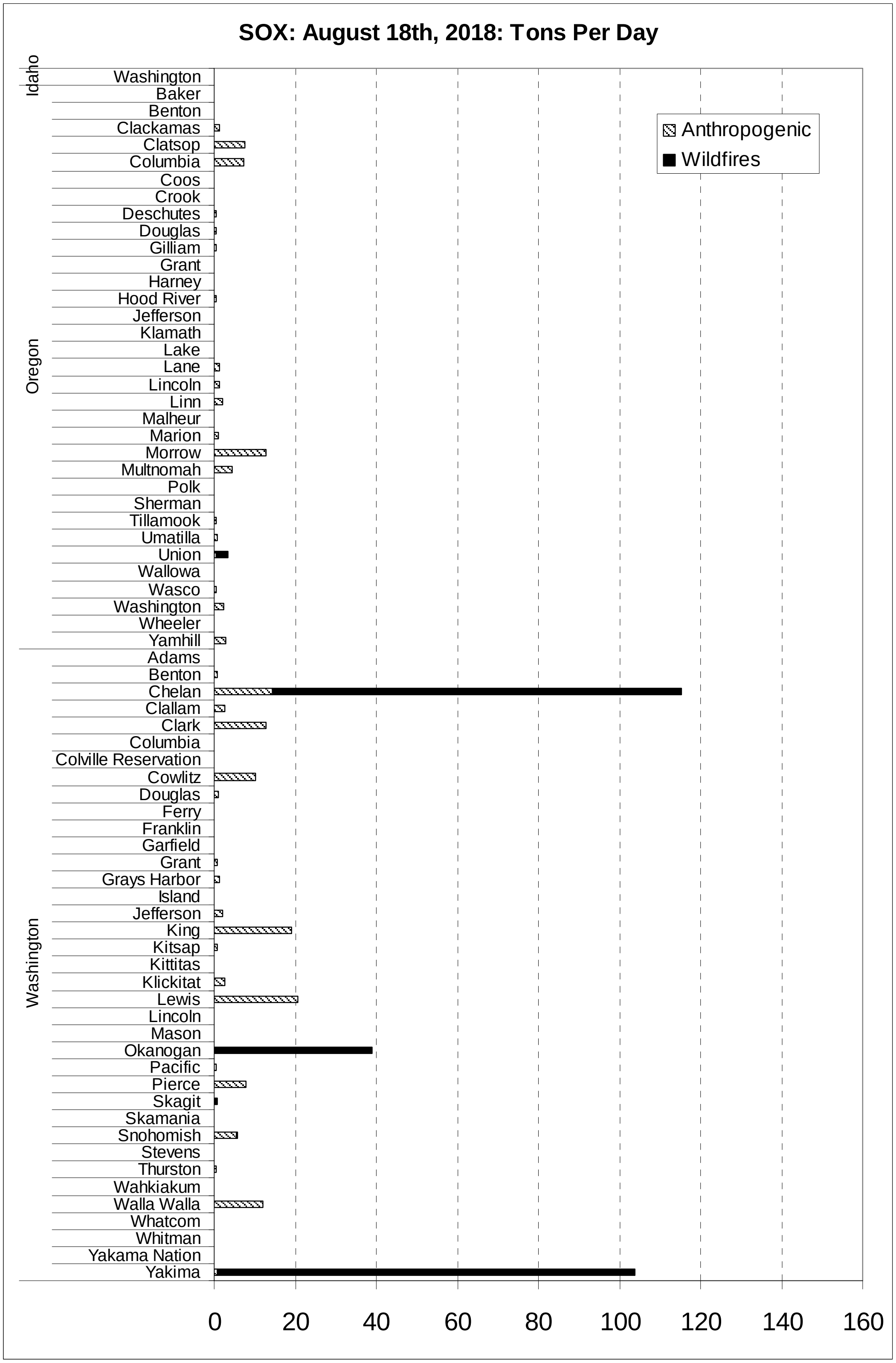
SOX: August 18th, 2018: Tons Per Day
Idaho
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Douglas
Gilliam
Grant
Harney
Hood River
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Umatilla
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Wasco
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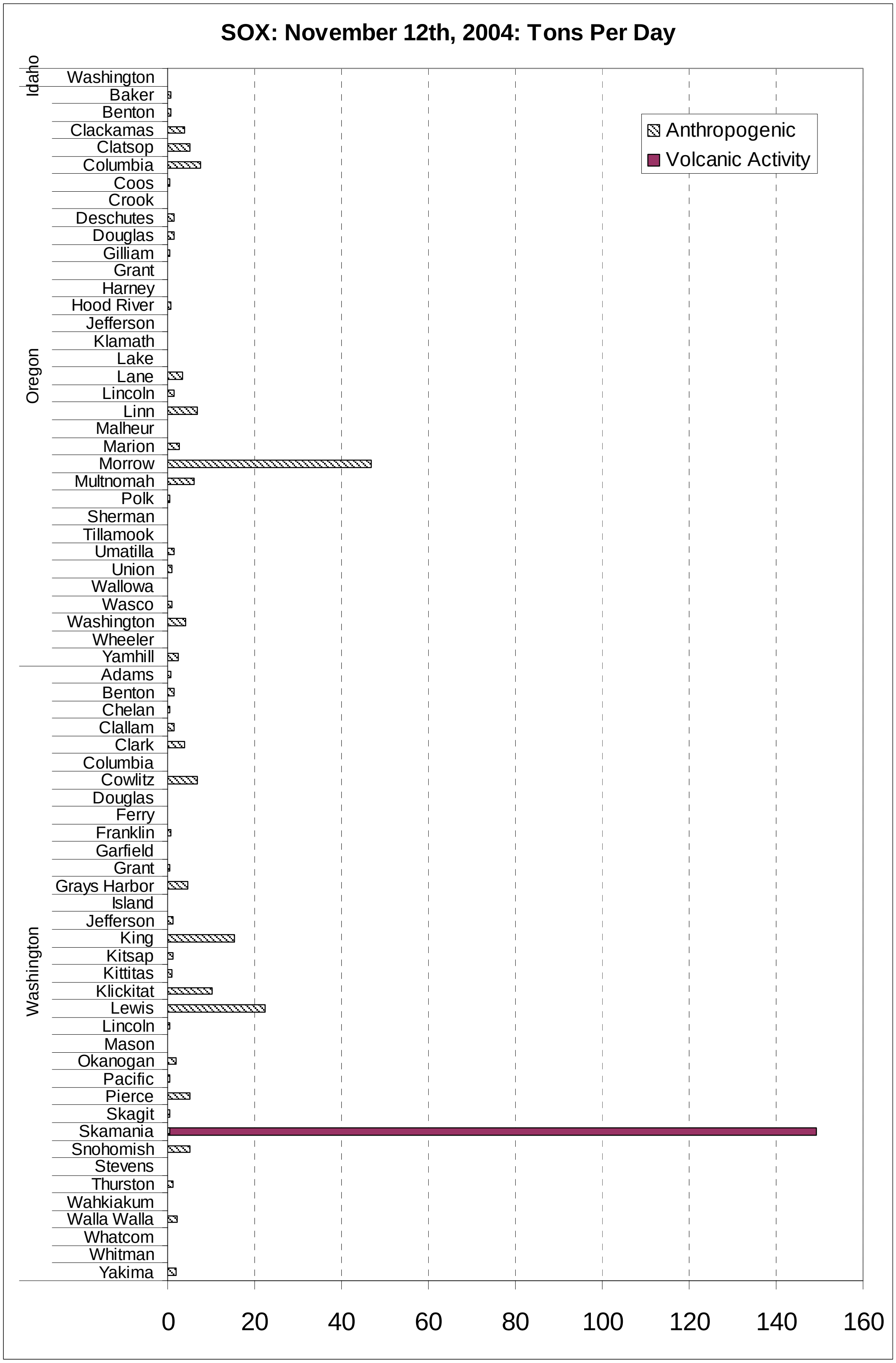
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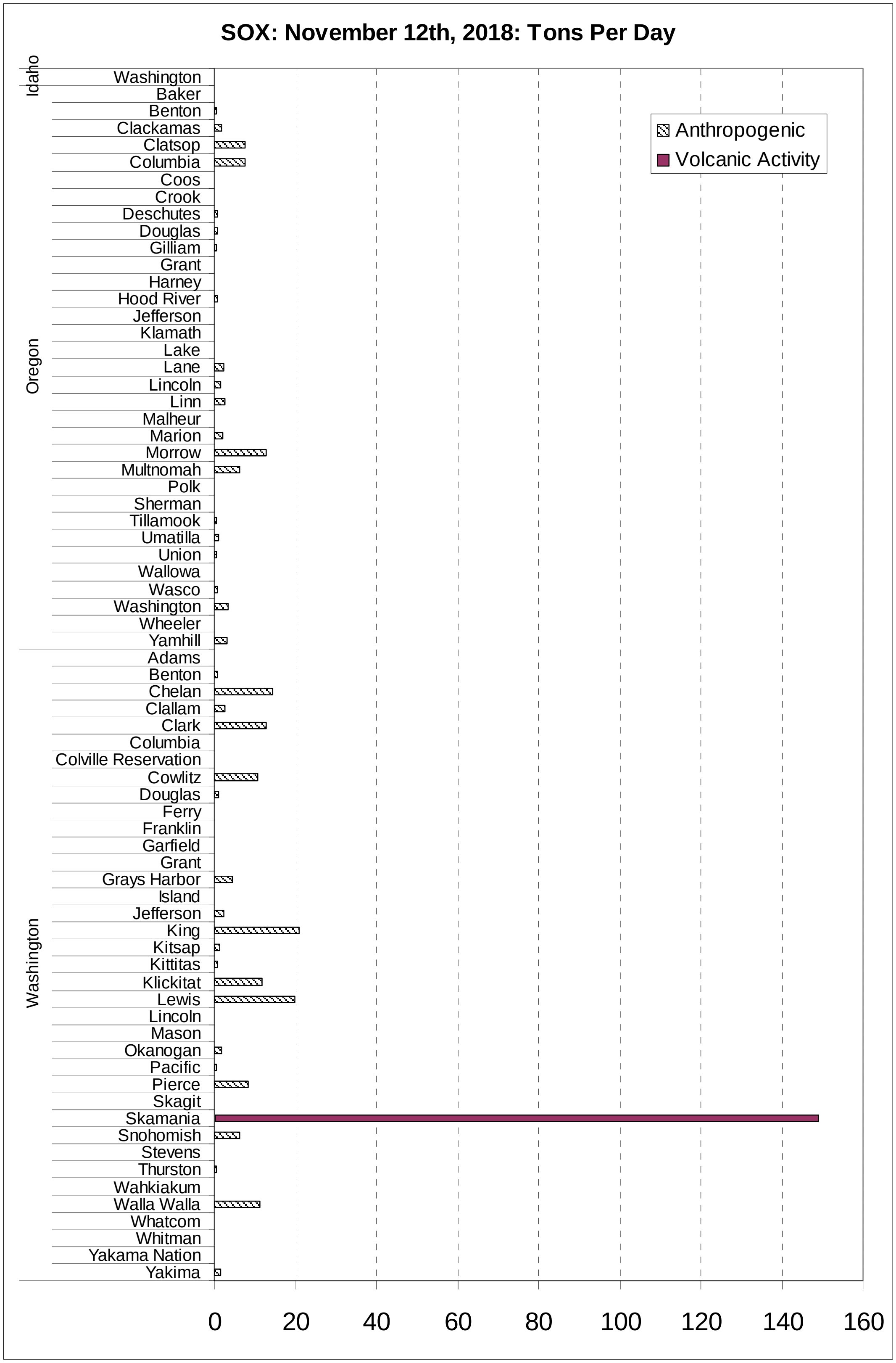
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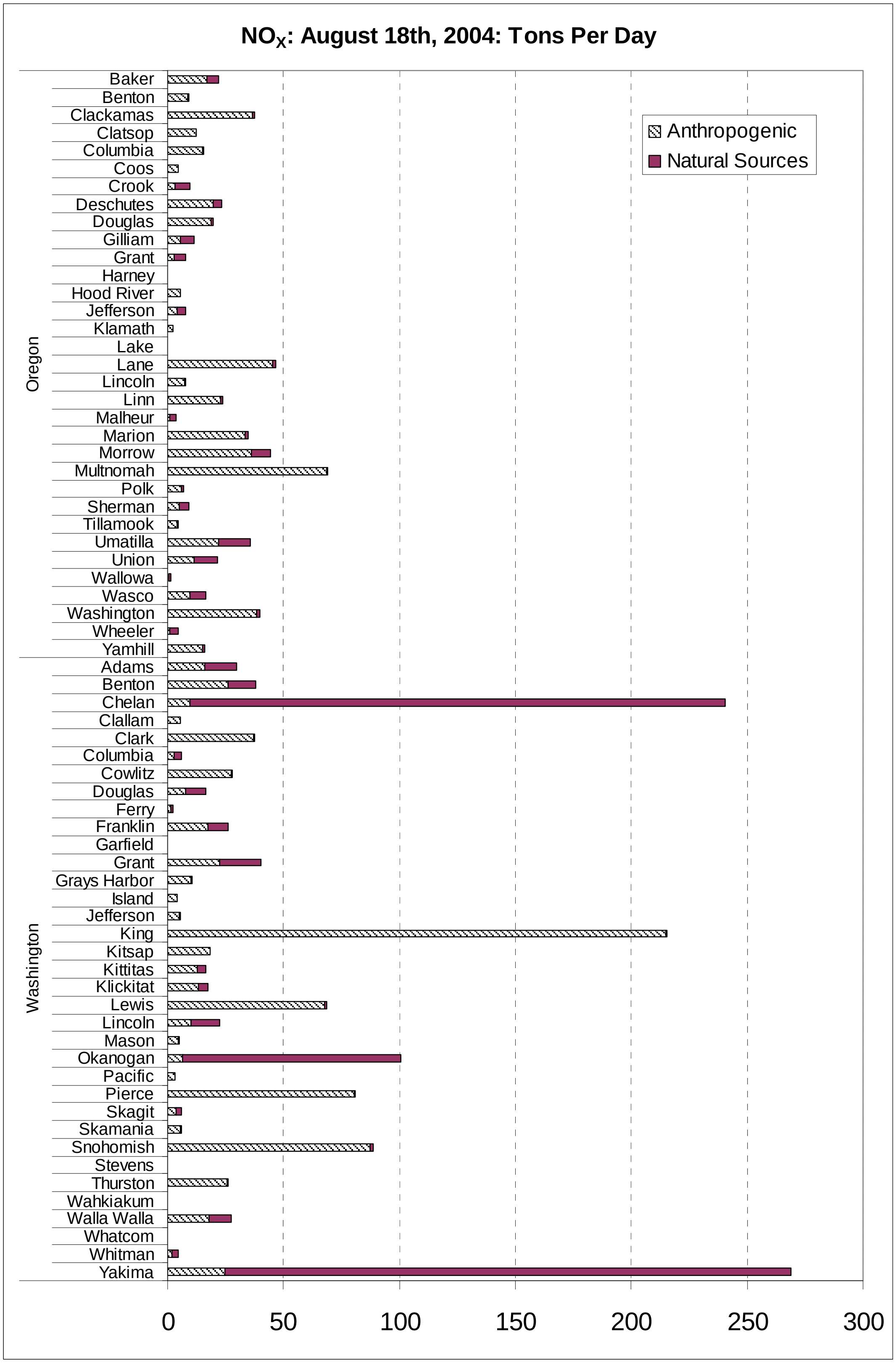
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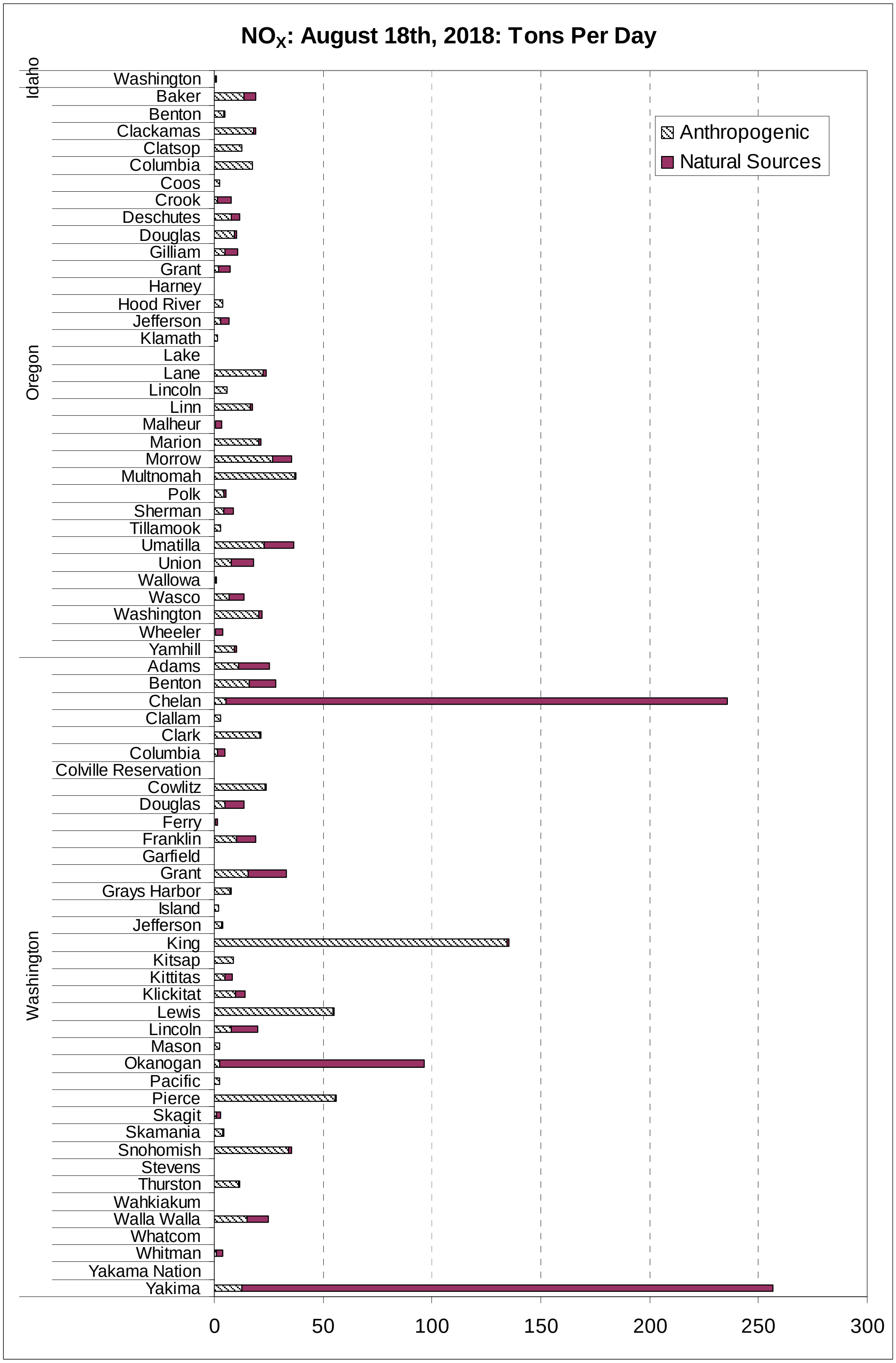
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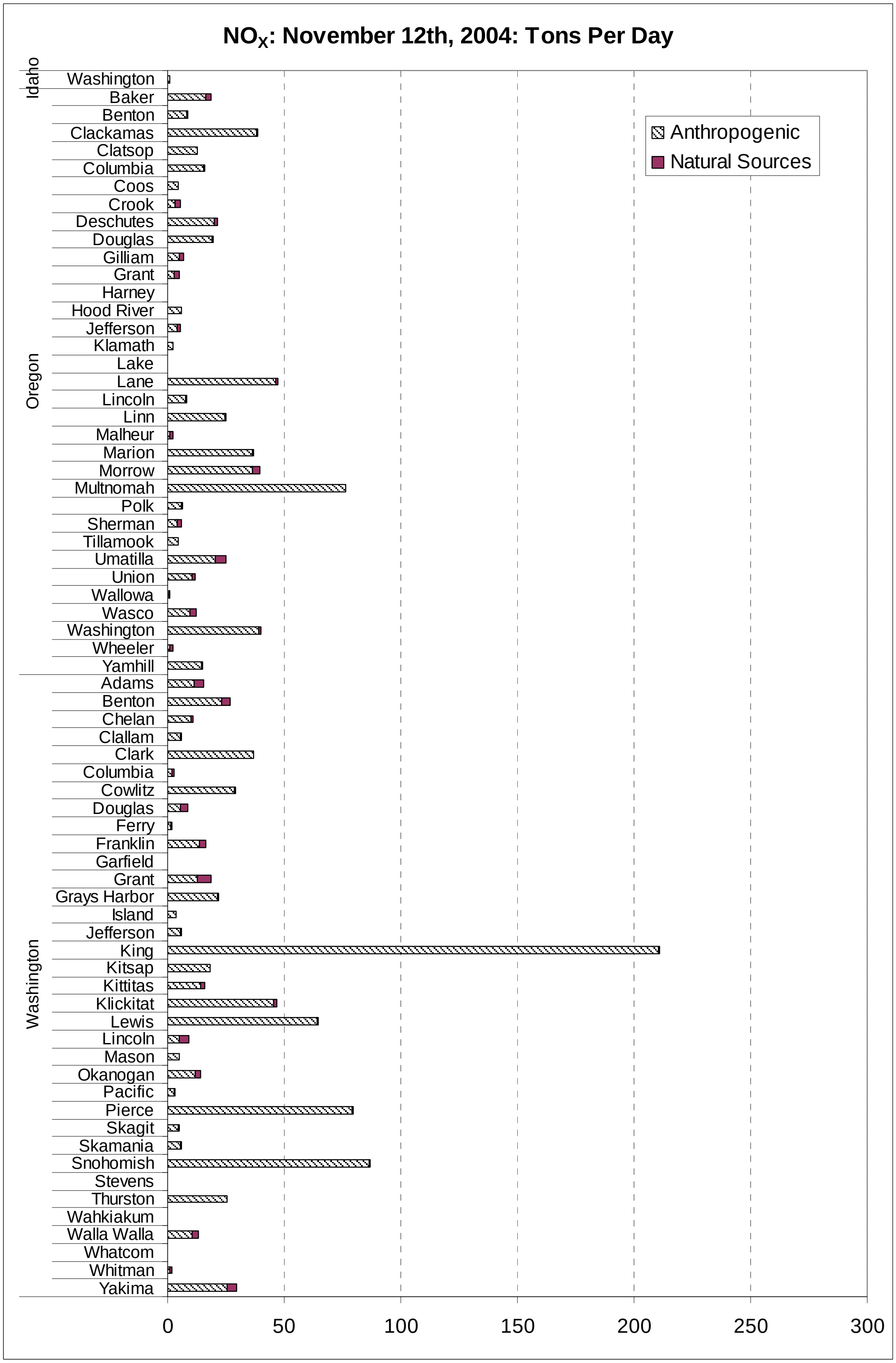

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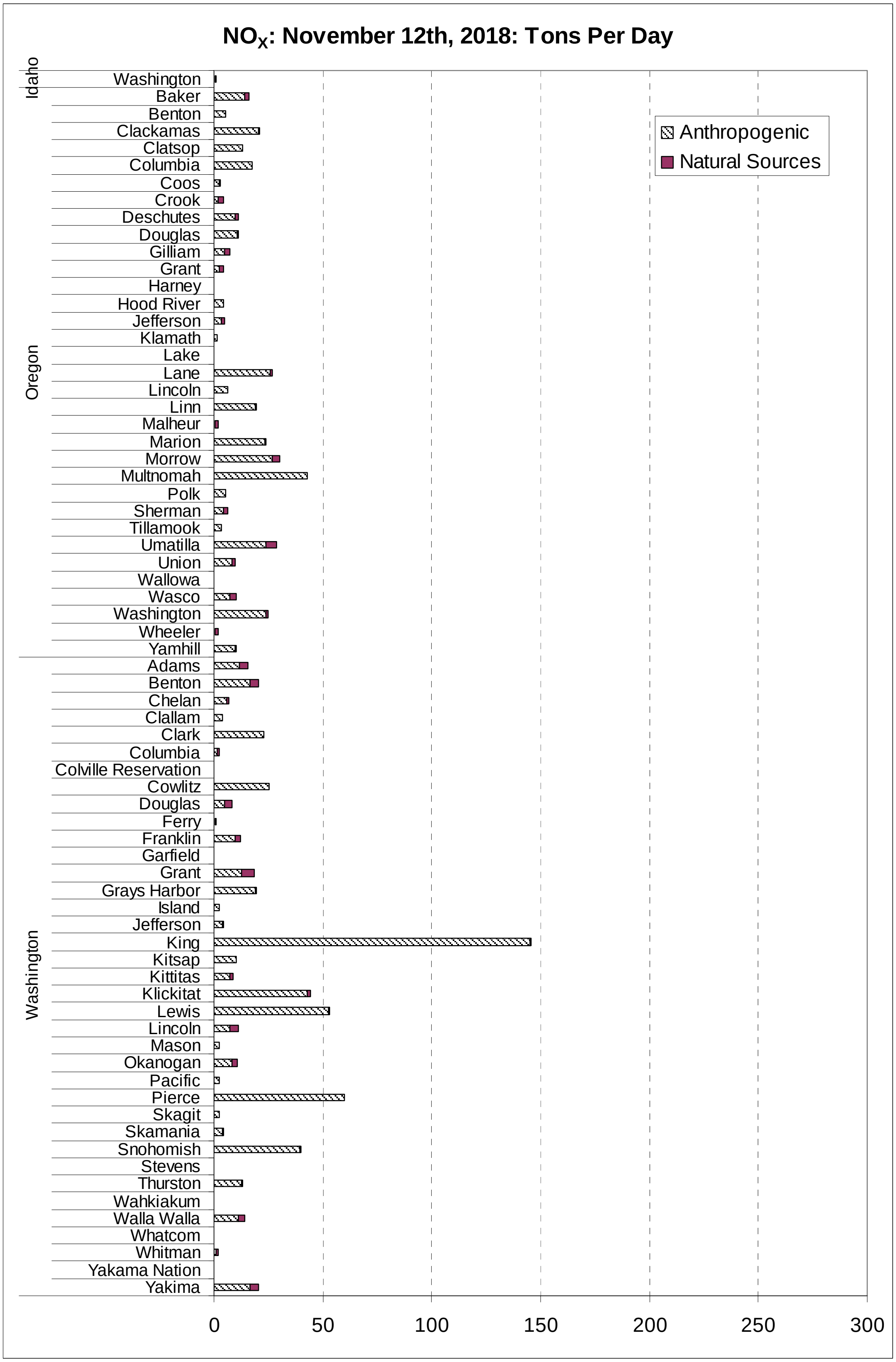
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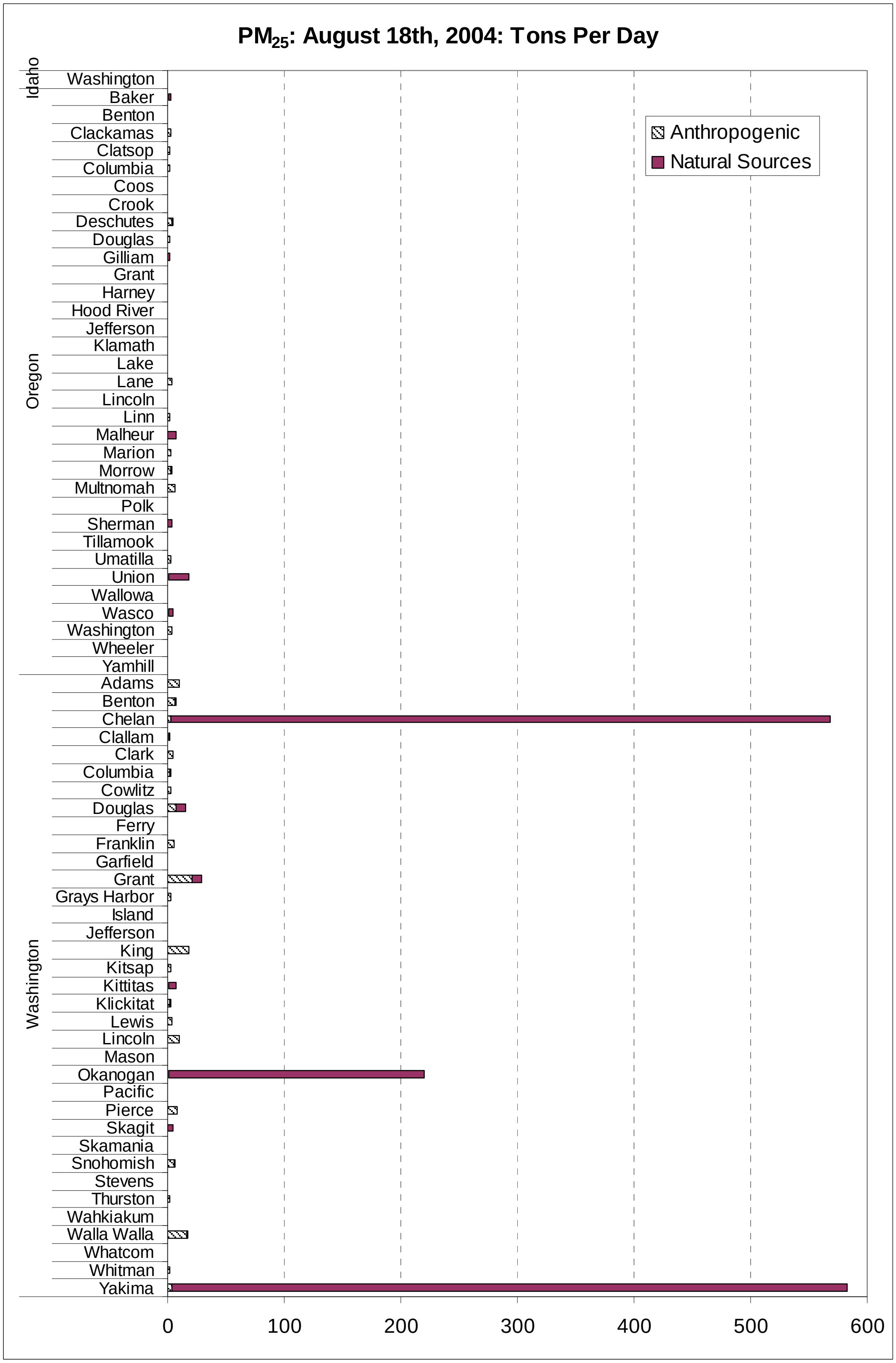
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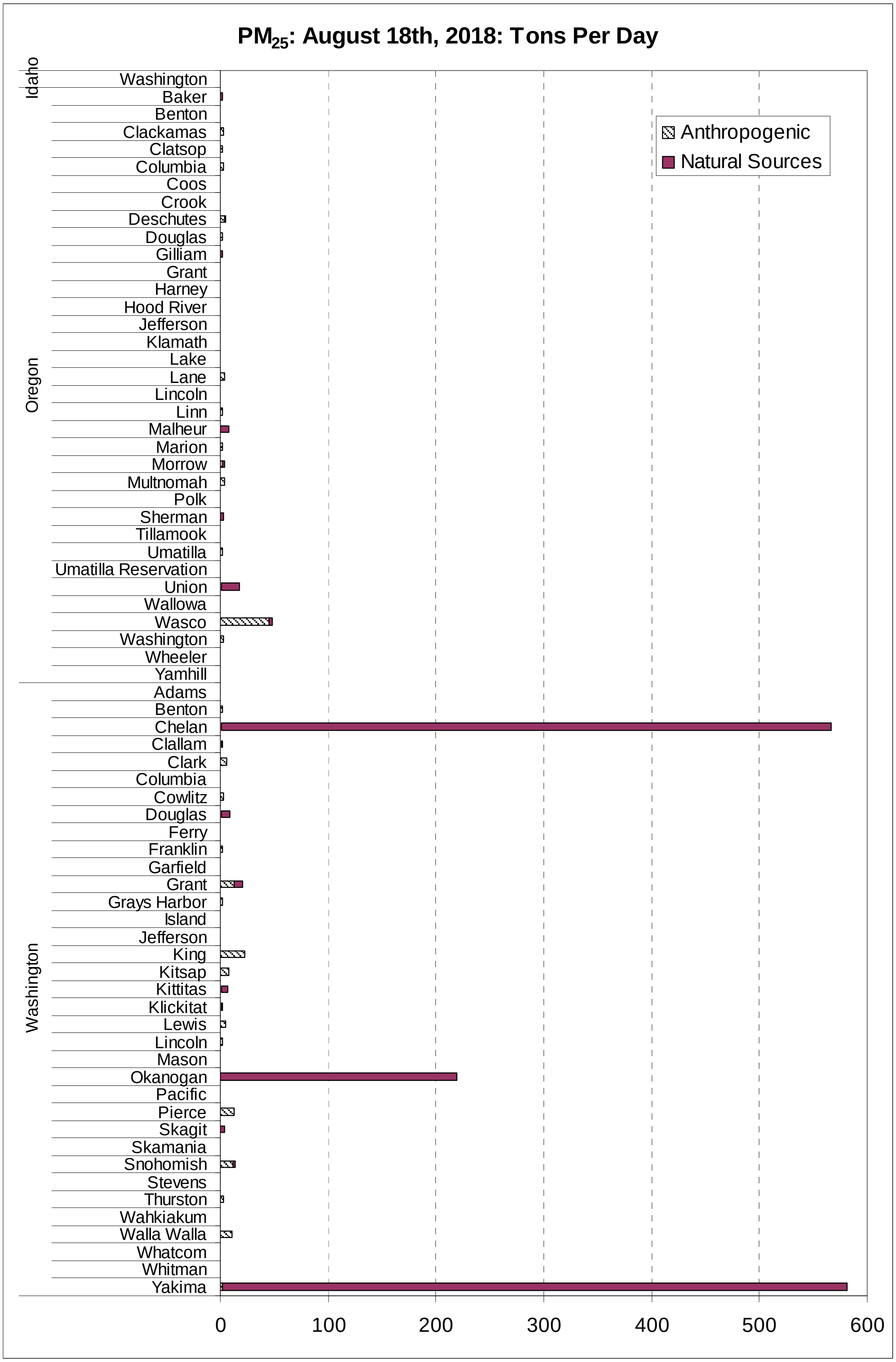
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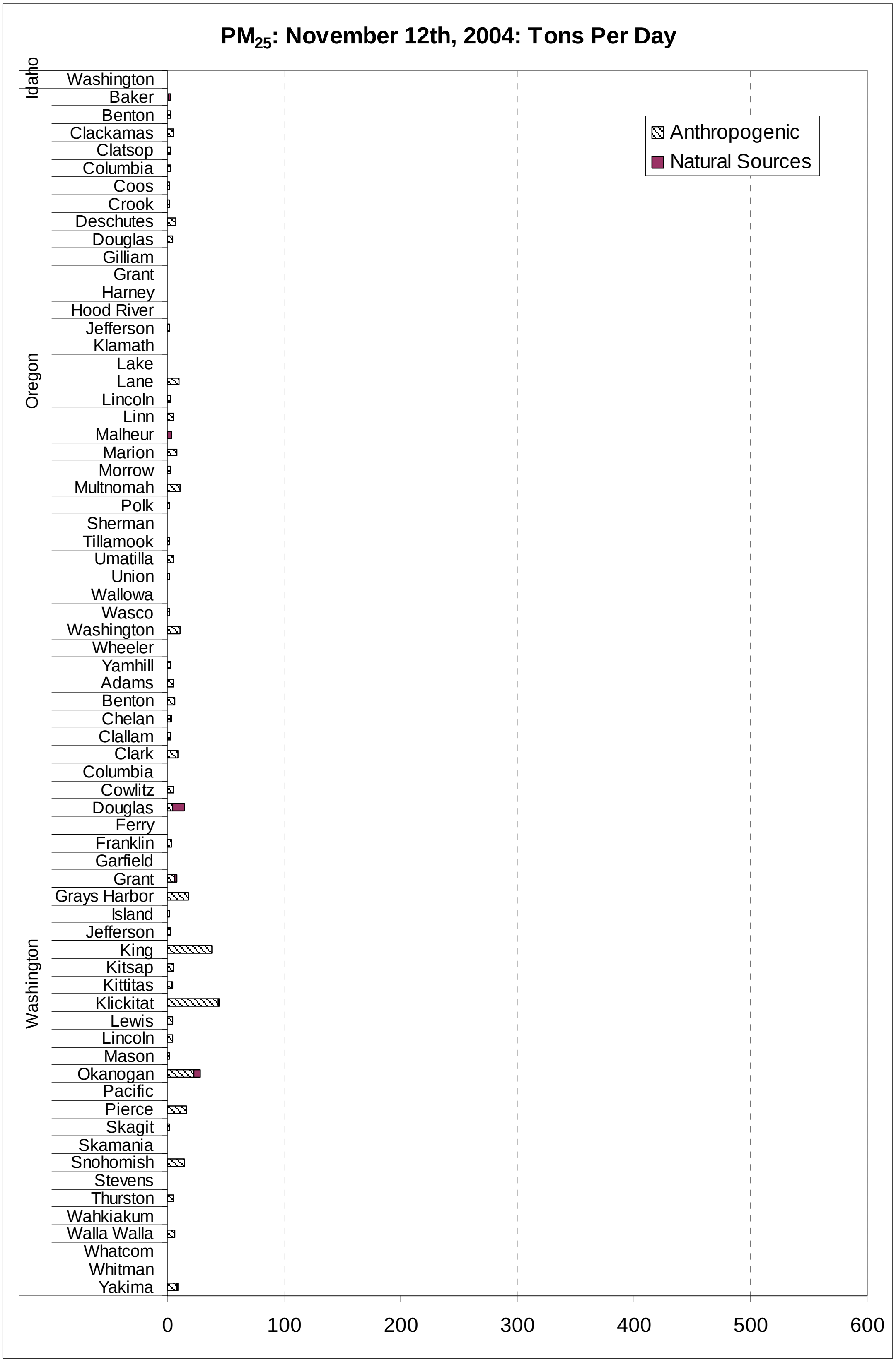

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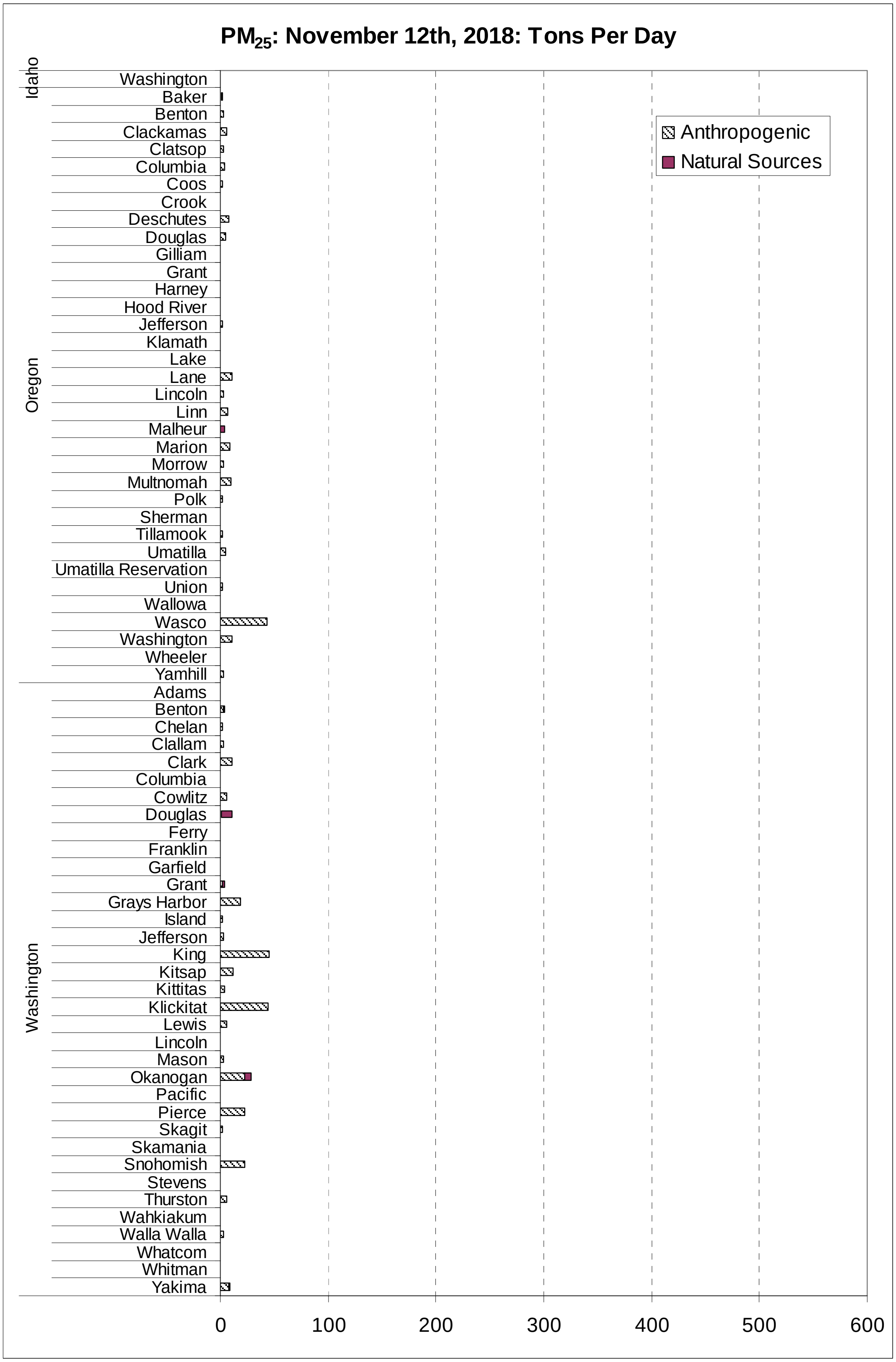

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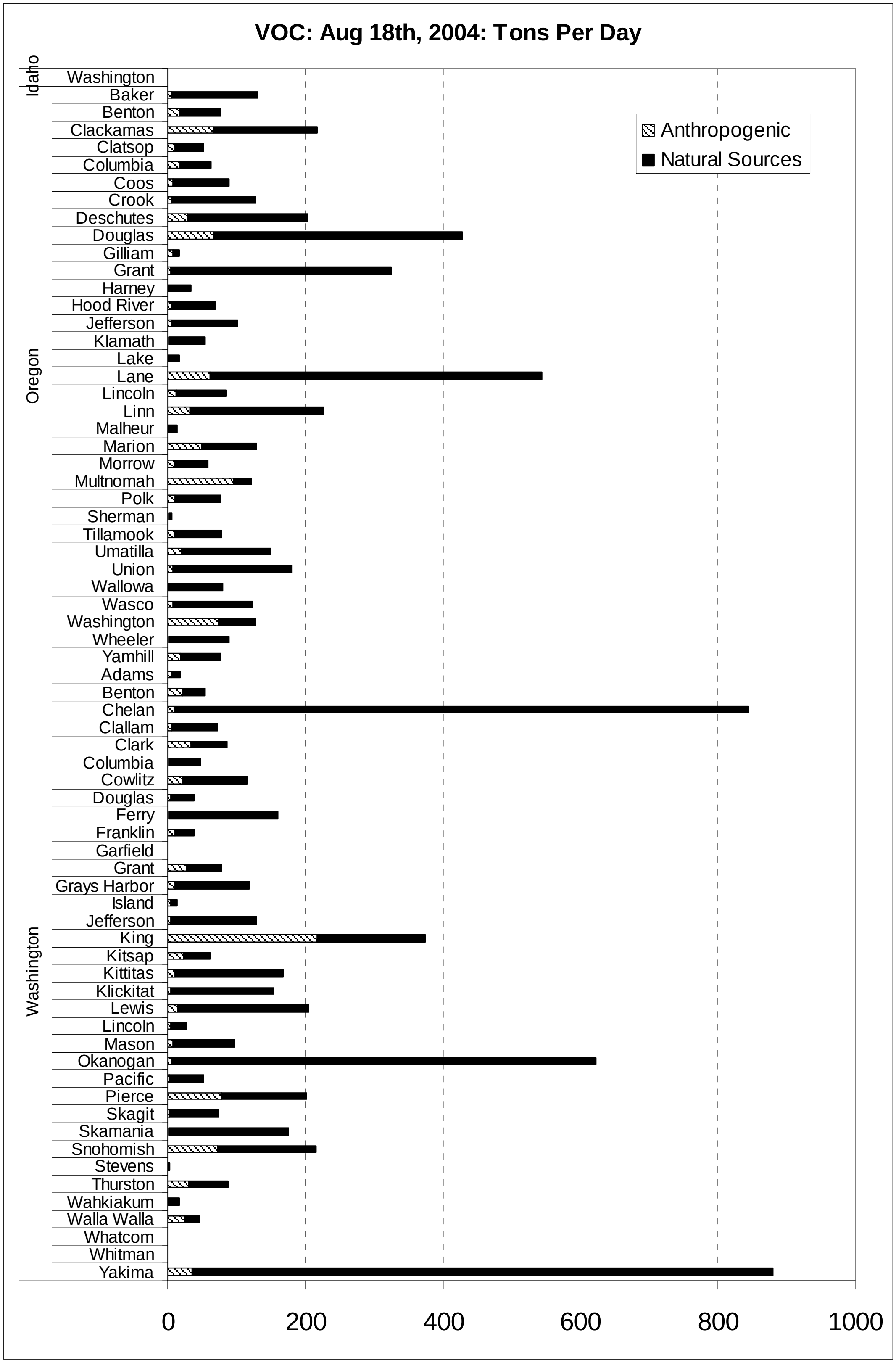

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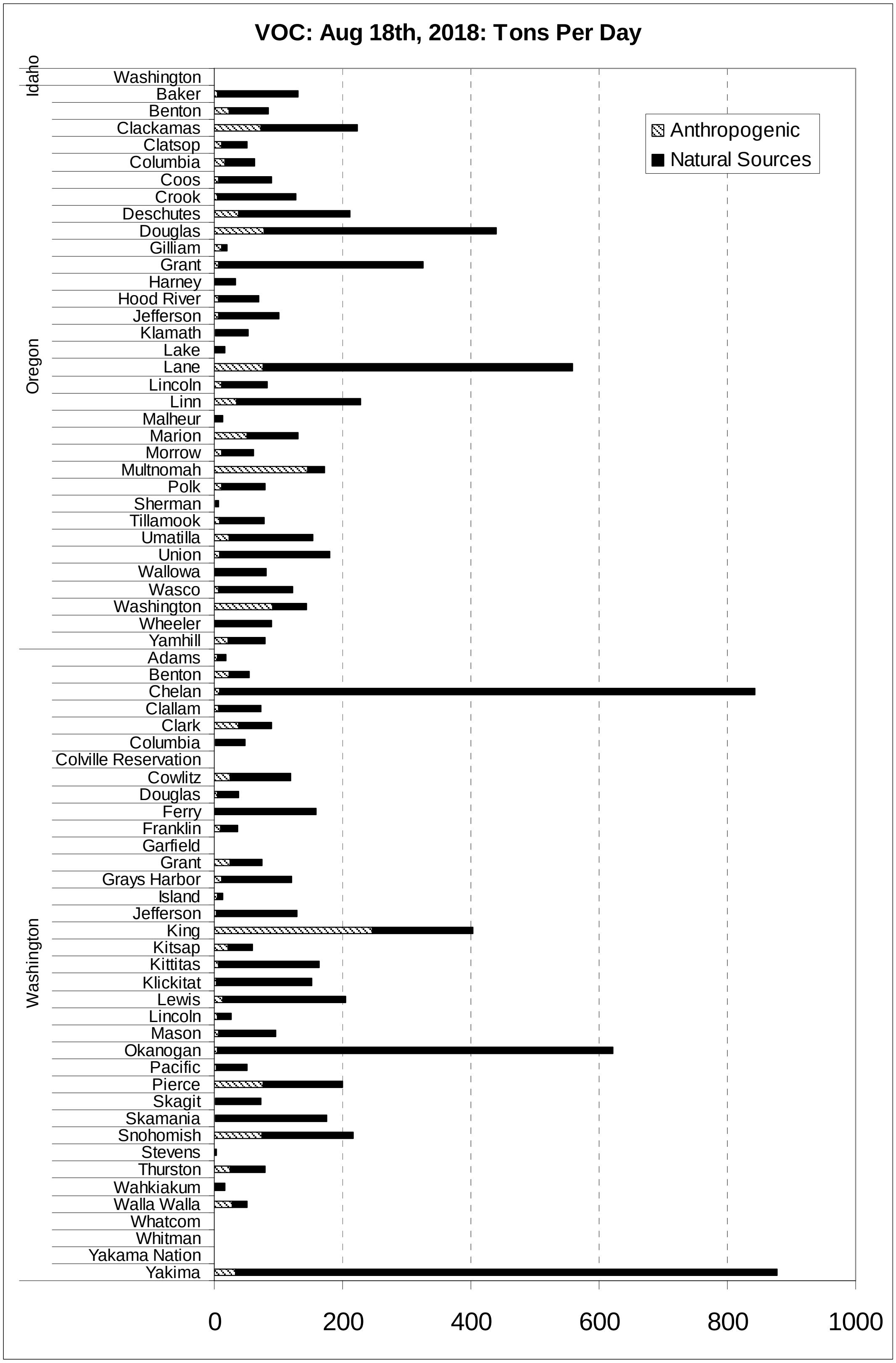
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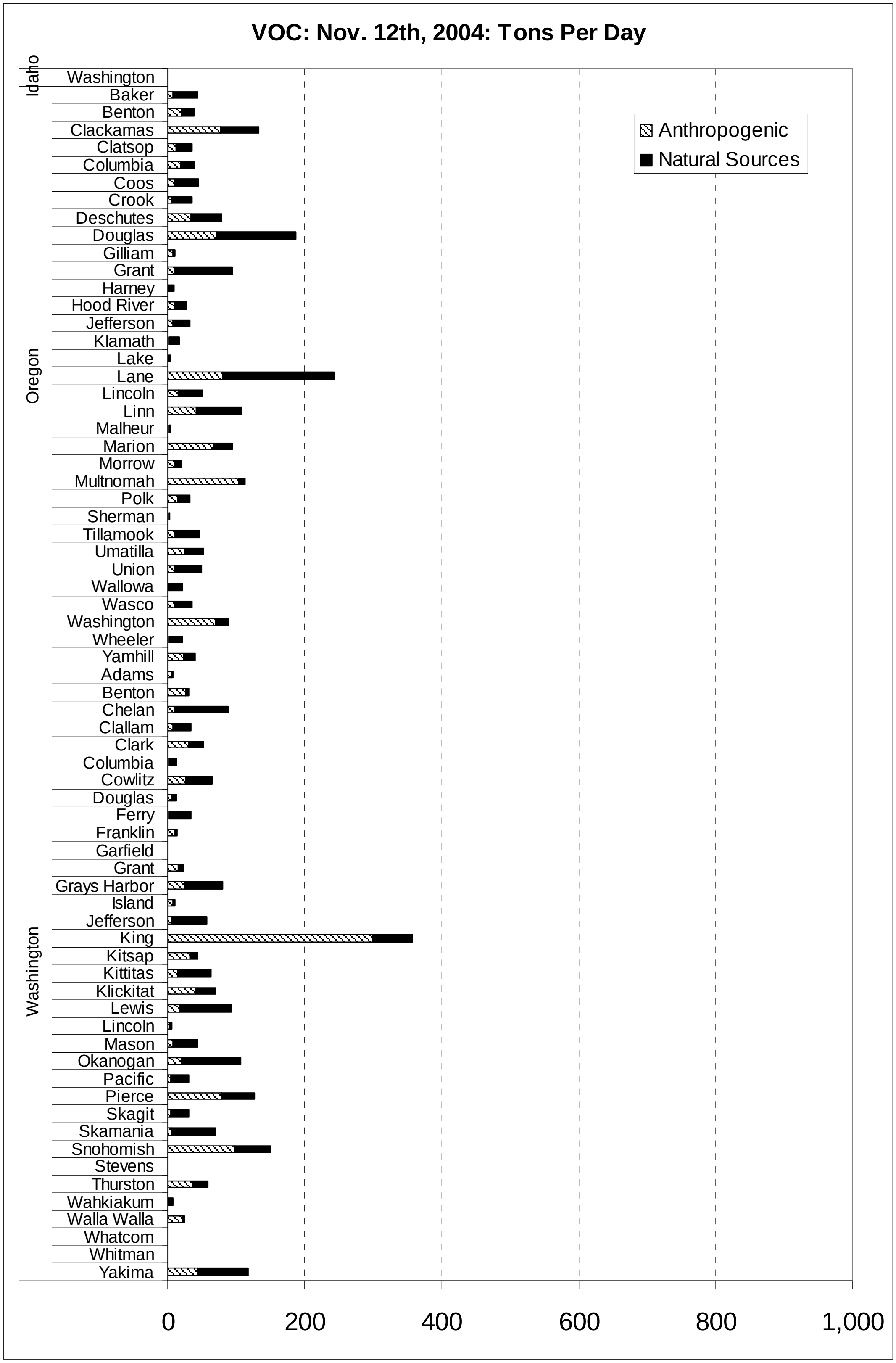
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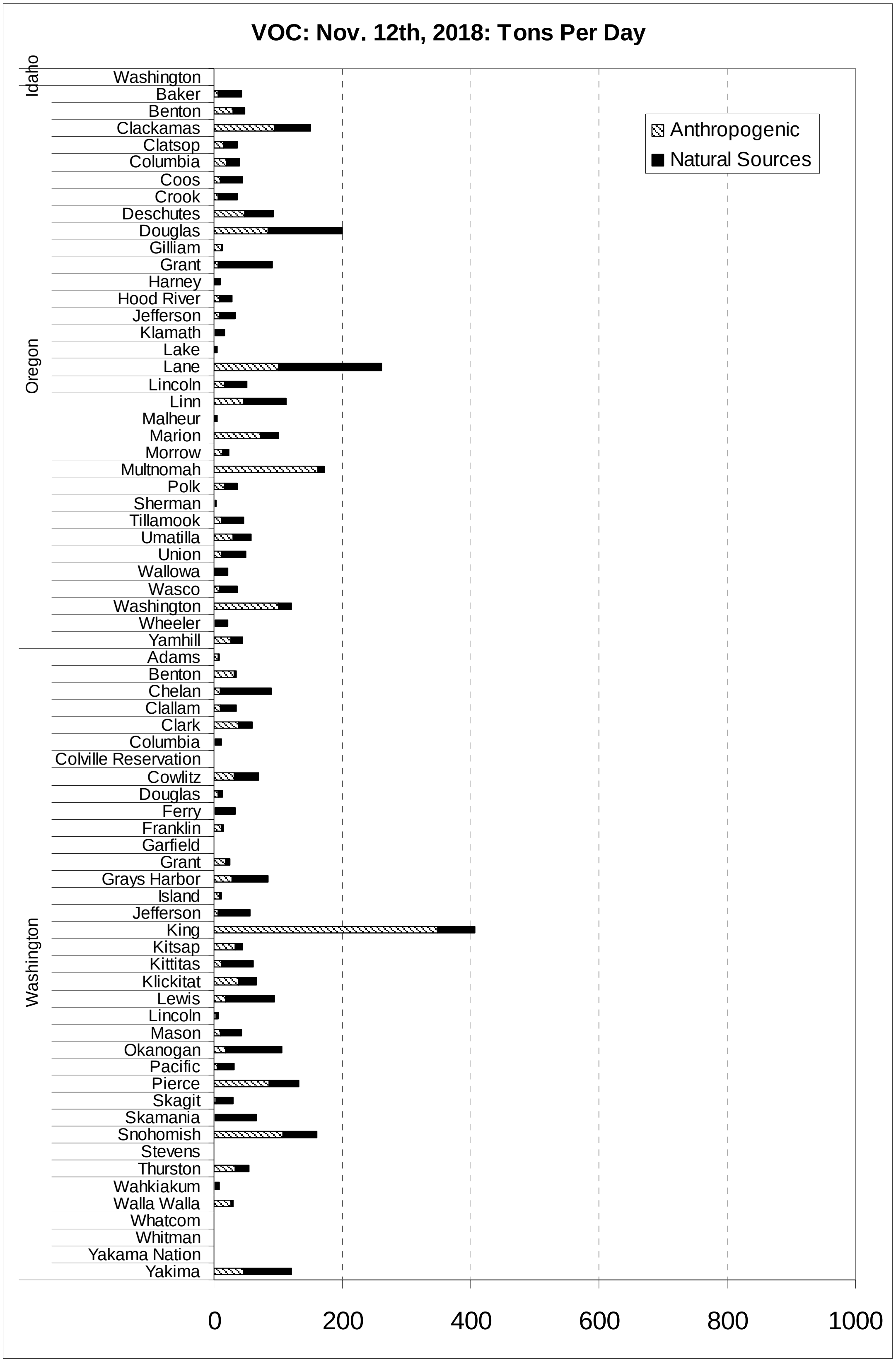
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