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Supplementary material for

Wildland fire emission factors in North America: synthesis of existing data, measurement needs and management applications

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Supplementary Appendices

Appendix 1. References used for emissions factor (EF) summaries in the Smoke Emissions Repository Application. The underlying database contains additional references compiled by Lincoln et al. (2014) and others that were not used in EF summaries, generally because they summarized other research and contained redundant values.

1. Akagi SK, Yokelson RJ, Burling IR, Meinardi S, Simpson I, Blake DR, McMeeking GR, Sullivan A, Lee T, Kreidenweis S, Urbanski S, Reardon J, Griffith DWT, Johnson TJ, Weise

DR (2013) Measurements of reactive trace gases and variable O3 formation rates in some South Carolina biomass burning plumes. *Atmospheric Chemistry and Physics* **13**, 1141–1165, www.atmos-chem-phys.net/13/1141/2013/, doi:10.5194/acp-13-1141-2013. (SERA RefID 231)

2. Aurell J, Gullett BK (2013) Emission factors from aerial and ground measurements of field and laboratory forest burns in the southeastern U.S.: $PM_{2.5}$, black and brown carbon, VOC, and PCDD/PCDF. *Environmental Science and Technology* **47**, 8443−8452, dx.doi.org/10.1021/es402101k. (SERA RefID 236)
3. Aurell J, Gullett BK, Tabor D (2015) Emissions from southeastern U.S. Grasslands and pine savannas: comparison of aerial and ground field measurements with laboratory burns. *Atmospheric Environment* **111**, 170-178. http://dx.doi.org/10.1016/j.atmosenv.2015.03.001. (SERA RefID 238)
4. Babbitt RE, Ward DE, Susott RA, Hao WM, Baker SP (1994) Smoke from western wildfires, 1994. In: Proceedings of the 1994 Annual Meeting of Interior West Fire Council, Coeur d'Alene, Idaho. 18 p. (SERA RefID 100)
5. Bertschi I, Buettner K, Charlson R, Fritschen L, Monteith L, Murphy J, Pickford S, Darley E (2003) Trace gas and particle emissions from fires in large-diameter and belowground biomass fuels. *Journal of Geophysical Research* **108(D13)**, 8472. doi.org/10.1029/2002JD002100. https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=1047&context=chem_pubs. (SERA RefID 120)
6. Bovee H, Buettner K, Charlson R, Fritschen L, Monteith L, Murphy J, Pickford S, Darley E (1969) The study of forest fire atmospheric pollution, USFS 4040 (4000) Interim Report 68-1.

86 p. (SERA RefID 4)

7. Burling IR, Yokelson RJ, Akagi SK, Urbanski SP, Wold CE, Griffith DWT, Johnson TJ, Reardon J, Weise DR (2011) Airborne and ground-based measurements of the trace gases and particles emitted by prescribed fires in the United States. *Atmospheric Chemistry and Physics* **11**, 12197–12216, www.atmos-chem-phys.net/11/12197/2011/. doi:10.5194/acp-11-12197-2011. (SERA RefID 171)
8. Burling IR, Yokelson RJ, Griffith DWT, Johnson TJ, Veres P, Roberts JM, Warneke C, Urbanski SP, Reardon J, Weise DR, Hao WM, de Gouw J (2010) Laboratory measurements of trace gas emissions from biomass burning of fuel types from the southeastern and southwestern United States. *Atmospheric Chemistry and Physics* **10**, 11115-11130. doi.org/10.5194/acp-10-11115-2010 https://www.fs.fed.us/rm/pubs_other/rmrs_2010_burling_i002.pdf. (SERA RefID 170)
9. Chen LWA, Moosmüller H, Arnott WP, Chow JC, Watson JG, Susott RA, Babbitt RE, Wold CE, Lincoln, EN, Hao WM (2007) Emissions from laboratory combustion of wildland fuels: emission factors and source profiles. *Environmental Science & Technology* **41**: 4317-4325. doi.org/10.1021/es062364i https://www.fs.fed.us/rm/pubs_other/rmrs_2007_chen_l001.pdf. (SERA RefID 195)
10. Chen LWA, Verburg P, Shackelford A, Zhu D, Susfalk R, Chow JC, Watson JG (2010) Moisture effects on carbon and nitrogen emission from burning of wildland biomass. *Atmospheric Chemistry and Physics Discussions* **10**, 6617-6625. doi.org/10.5194/acp-10-6617-2010 https://www.atmos-chem-phys.net/10/6617/2010/acp-10-6617-2010.pdf. (SERA RefID 180)
11. Clements HB, McMahon CK (1980) Nitrogen oxides from burning forest fuels examined by

thermogravimetry and evolved gas analysis. *Thermochimica Acta* **35**, 133-139. doi.org/10.1016/0040-6031(80)87187-5 https://www.srs.fs.usda.gov/pubs/ja/ja_mcmahon015.pdf. (SERA RefID 142)

12. Clements HB, McMahon CK (1984) A microcombustion method to measure forest fuel emissions. *Journal of Fire Sciences* **2**, 260-275. doi.org/10.1177/073490418400200402 https://www.frames.gov/documents/smoke/serdp/clements_mcmahon_1984.pdf. (SERA RefID 42)
13. Goode JG, Yokelson RJ, Susott RA, Ward DE (1999) Trace gas emissions from laboratory biomass fires measured by open-path Fourier transform infrared spectroscopy: fires in grass and surface fuels. *Journal of Geophysical Research* **104(D17)**, 21237-21245. doi.org/10.1029/1999JD900360 https://www.frames.gov/documents/smoke/serdp/goode_et_al_1999.pdf. (SERA RefID 117)
14. Goode JG, Yokelson RJ, Ward DE, Susott RA, Babbitt RE, Davies MA, Hao WM (2000) Measurements of excess O3, CO2, CO, CH4, C2H4, C2H2, HCN, NO, NH3, HCOOH, CH3COOH, HCHO, and CH3OH in 1997 Alaskan biomass burning plumes by airborne Fourier transform infrared spectroscopy (AFTIR). *Journal of Geophysical Research* **105(D17)**, 22147-22166. doi.org/10.1029/2000JD900287 https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2000JD900287. (SERA RefID 118)
15. Hardy CC, Conard SG, Regelbrugge JC, Teesdale DR (1996) Smoke emissions from prescribed burning of southern California chaparral. USDA Forest Service PNW Research Station, PNW-RP-486. (SERA RefID 157)
16. Hays MD, Geron CD, Linna KJ, Smith ND, Schauer JJ (2002) Speciation of gas-phase and fine particle emissions from burning of foliar fuels. *Environmental Science and Technology*

36, 2281-2295. doi.org/10.1021/es0111683. (SERA RefID 141)

17. Hegg D, Radke LF, Hobbs PV, Rasmussen RA, Riggan PJ (1989) Emissions of some trace gases from biomass fires. 82nd Annual Meeting and Exhibition Anaheim, California, June 25-30, 1989. 14 p. https://www.frames.gov/documents/smoke/serdp/hegg_et_al_1990.pdf [Accessed 22 April 2019] (SERA RefID 63)
18. Hennigan CJ, Miracolo MA, Engelhart GJ, May AA, Presto AA, Lee T, Sullivan AP, McMeeking GR, Coe H, Wold CE, Hao WM, Gilman JB, Kuster WC, de Gouw J, Schichtel BA, Collett JL, Kreidenweis SM, Robinson AL (2011) Chemical and physical transformations of organic aerosol from the photo-oxidation of open biomass burning in an environmental chamber. *Atmospheric Chemistry and Physics* **11**, 7669-7686. doi.org/10.5194/acp-11-7669-2011 https://www.fs.fed.us/rm/pubs_other/rmrs_2011_hennigan_c001.pdf. (SERA RefID 201)
19. Koss AR, Sekimoto K, Gilman JB, Selimovic V, Coggon MM, Zarzana KJ, Yuan B, Lerner BM, Brown SS, Jimenez JL, Krechmer J, Roberts JM, Warneke C, Yokelson RJ, de Gouw J. (2018) Non-methane organic gas emissions from biomass burning: identification, quantification, and emission factors from PTR-ToF during the FIREX 2016 laboratory experiment. *Atmospheric Chemistry and Physics* **18**, 3299-3319. doi.org/10.5194/acp-18-3299-2018 https://www.atmos-chem-phys.net/18/3299/2018/acp-18-3299-2018.pdf. (SERA RefID 242)
20. Liu X, Huey LG, Yokelson RJ, Selimovic V, Simpson IJ, Muller M, Jimenez JL, Campuzano-Jost P, Beyersdorf AJ, Black DR, Butterfield A, Choi Y, Crounse JD, Day DA, Diskin GS, Dubey MK, Fortner E, Hanisco TF, Hu W, King LE (2017) Airborne measurements of western U.S. wildfire emissions: Comparison with prescribed burning and air quality

implications. *Journal of Geophysical Research: Atmospheres* **122**, 6108-6129. doi.org/10.1002/2016JD026315. (SERA RefID 230)

21. McKenzie LM, Hao WM, Richards GN, Ward DE (1994) Quantification of major components emitted from smoldering combustion of wood. *Atmospheric Environment* **28**, 3285-3292. doi.org/10.1016/1352-2310(94)00158-H https://www.frames.gov/documents/smoke/serdp/mckenzie_et_al_1994.pdf. (SERA RefID 102)
22. McKenzie LM, Hao WM, Richards GN, Ward DE (1995) Measurement and modeling of air toxins from smoldering combustion of biomass. *Environmental Science & Technology* **29**, 2047–2054. doi.org/10.1021/es00008a025. (SERA RefID 105)
23. McMeeking GR, Kreidenweis SM, Baker S, Carrico CM, Chow JC, Collett JL, Hao WM, Holden AS, Kirchstetter TW, Malm, WC, Moosmüller H, Sullivan AP, and Wold CE. (2009) Emissions of trace gases and aerosols during the open combustion of biomass in the laboratory. *Journal of Geophysical Research* **114**, D19210. doi:10.1029/2009JD011836 https://www.fs.fed.us/rm/pubs_other/rmrs_2009_mcmeeking_g001.pdf. (SERA RefID 172)
24. Mickler RA, Rorig M, Geron CD, Achtemier GL, Bailey AD, Krull C, Brownlie D (2007) Development and demonstration of smoke plume, fire emissions, and pre-and post-prescribed fire fuel models on North Carolina coastal plain forest ecosystems. In: Proceedings of The Fire Environment - Innovations, Management, and Policy Conference, Destin, Florida, March 26-30, 2007. USDA Forest Service RMRS-P-46CD. pgs 409-426. https://www.fs.fed.us/rm/pubs/rmrs_p046.pdf. (SERA RefID 140)
25. Nance DJ, Hobbs PV, Radke LF (1993). Airborne measurements of gases and particles from an Alaskan wildfire. *Journal of Geophysical Research* **98**, D8, 14873-14882.

doi.org/10.1029/93JD01196
https://www.frames.gov/documents/smoke/serdp/nance_et_al_1993.pdf. (SERA RefID 153)

26. Nelson RM (1982) An evaluation of the carbon balance technique for estimating emission factors and fuel consumption in forest fires. Research Paper SE-231. Asheville, NC: USDA Forest Service, Southeastern Forest Experiment Station. 9 p. https://www.frames.gov/documents/smoke/serdp/nelson_1982.pdf. (SERA RefID 129)
27. Nelson RM, Ward DE (1980) Backfire particulate emissions and Byram's fire intensity. Research Note SE-RN-290. Asheville, NC: USDA Forest Service, Southeastern Forest Experiment Station. 6 p. https://www.frames.gov/documents/smoke/serdp/nelson_ward_1980.pdf. (SERA RefID 26)
28. Patterson EM, McMahon CK (1984) Absorption characteristics of forest fire particulate matter. *Atmospheric Environment* **18**, 2541-2551. doi.org/10.1016/0004-6981(84)90027-1. (SERA RefID 229)
29. Patterson EM, McMahon CK, Ward DE (1986) Absorption properties and graphitic carbon emission factors of forest fire aerosols. *Geophysical Research Letters* **13**, 129-132. doi.org/10.1029/GL013i002p00129 https://www.frames.gov/documents/smoke/serdp/patterson_et_al_1986.pdf. (SERA RefID 53)
30. Radke LF, Hegg DA, Nance JD, Lyons JH, Laursen KK, Ferek RJ, Hobbs PV (1990) Airborne Observations of Biomass Fires. Final Report to the National Institute of Standards and Technology. 131 p. http://carg.atmos.washington.edu/sys/research/archive/biomass_fires.pdf. (SERA RefID 137)
31. Radke LF, Hegg DA, Lyons JH, Brock PV, Weiss RE, Rassussen RA (1988) Airborne measurements on smokes from biomass burning. Pages 411-422 In: Hobbs, Peter V.;

McCormick, M. Patrick, eds. Aerosols and climate. Hampton, VA: A. Deepak Publishing Co. https://www.frames.gov/documents/smoke/serdp/radke_et_al_1988.pdf. (SERA RefID 59)

32. Radke LF, Lyons JH, Hobbs PV, Hegg DA, Sandberg DV, Ward DE (1990) Airborne monitoring and smoke characterization of prescribed fires on forest lands in western Washington and Oregon. General Technical Report, PNW-GTR-251. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 81 p. https://www.frames.gov/documents/smoke/serdp/lawrence_et_al_1990.pdf. (SERA RefID 147)
33. Robertson KM, Hsieh YP, Bugna GC (2014) Fire environment effects on particulate matter emission factors in southeastern U.S. pine-grasslands. *Atmospheric Environment* **99**, 104-111. http://dx.doi.org/10.1016/j.atmosenv.2014.09.058 https://www.sciencedirect.com/science/article/pii/S1352231014007511. (SERA RefID 240)
34. Selimovic V, Yokelson RJ, Warneke C, Roberts JM, de Gouw J, Reardon J, Griffith DWT (2018) Aerosol optical properties and trace gas emissions by PAX and OP-FTIR for laboratory-simulated western US wildfires during FIREX, *Atmospheric Chemistry and Physics* **18**, 2929-2948. https://doi.org/10.5194/acp-2017859. (SERA RefID 243)
35. Simpson IJ, Akagi SK, Barletta B, Blake NJ, Choi Y, Diskin GS, Fried A, Fuelberg HE, Meinardi S, Rowland FS, Vay SA, Weinheimer AJ, Wennberg PO, Wiebring P, Wisthaler A, Yang M, Yokelson RJ, Blake DR (2011) Boreal forest fire emissions in fresh Canadian smoke plumes: C1-C10 volatile organic compounds (VOCs), CO2, CO, NO2, NO, HCN and CH3CN. *Atmospheric Chemistry and Physics* **11**, 6445–6463. doi:10.5194/acp-11-6445-2011 www.atmos-chem-phys.net/11/6445/2011/. (SERA RefID 234)
36. Strand TM, Rorig M, Yedinak K, Seto D, Allwine E, Garcia FA, O'Keefe P, Checan VC,

Mickler R, Clements C, Lamb BK, Thistle H (2013) Sub-canopy transport and dispersion of smoke: A unique observation dataset and model evaluation. Final Report to the Joint Fire Science Program: Project 09-1-04-2, 63 pp. https://www.firescience.gov/projects/09-1-04-2/project/09-1-04-2_final_report.pdf. (SERA RefID 237)

37. Urbanski SP (2013) Combustion efficiency and emission factors for wildfire-season fires in mixed conifer forests of the northern Rocky Mountains, US. *Atmospheric Chemistry and Physics* **13**, 7241–7262. doi:10.5194/acp-13-7241-2013. www.atmos-chem-phys.net/13/7241/2013/. (SERA RefID 239)
38. Urbanski SP, Hao WM, Baker S (2009) Chemical composition of wildland fire emissions. In: Bytnerowicz A., Arbaugh M., Andersen C., Riebau A. 2009. Wildland Fires and Air Pollution. Developments in Environmental Science 8. Amsterdam, The Netherlands: Elesevier. pp.79-108. https://www.fs.fed.us/psw/publications/4451/psw_2009_4451-001_079-108.pdf. (SERA RefID 179)
39. Ward, DE, Hardy CC (1984) Advances in the characterization and control of emissions from prescribed fires. Presented at the 77th Annual Meeting of the Air Pollution Control Association, San Francisco, California, June 24-29, 1984. 32 p. https://www.frames.gov/documents/smoke/serdp/ward_hardy_1984.pdf [Accessed 22 April 2019] (SERA RefID 46)
40. Ward DE, Hardy CC (1989) Emissions from prescribed burning of chaparral. Presented at the 82nd Annual Meeting and Exhibition of the Air and Waste Management Association, Anaheim, California, June 25-30, 1989. 22 p. https://www.frames.gov/documents/smoke/serdp/ward_hardy_1989b.pdf. (SERA RefID 66)
41. Ward DE, McMahon CK, Adams DF (1982) Laboratory measurements of carbonyl sulfide

and total sulfur emissions from open burning of forest biomass. Presented at the 75th Annual Meeting of the Air Pollution Control Association, New Orleans, Louisiana, June 20-25, 1982. 18 p. https://www.frames.gov/documents/smoke/serdp/ward_et_al_1982b.pdf [Accessed 22 April 2019] (SERA RefID 36)

42. Ward DE, Sandberg DV, Ottmar RD, Anderson JA, Hofer GC, Fitzsimmons CK (1982) Measurement of smoke from two prescribed fires in the Pacific Northwest. Presented at the 75th Annual Meeting of the Air Pollution Control Association, New Orleans, Louisiana, June 20-25, 1982. 24 p. (SERA RefID 37)
43. Ward DE, Hardy CC, Ottmar RD, Sandberg DV (1982) A sampling system for measuring emissions from west coast prescribed fires. In: Proceedings of the Annual General Meeting of the Air Pollution Control Association, Pacific Northwest International Section; 1982 November 15-17; Vancouver, BC. 10 p. https://www.frames.gov/documents/smoke/serdp/ward_et_al_1982a.pdf [Accessed 22 April 2019] (SERA RefID 35)
44. Ward DE, Susott RA, Waggoner AP, Hobbs PV, Nance JD (1992) Emission factor measurements for two fires in British Columbia compared with results for Oregon and Washington. In: Proceedings Pacific Northwest International Section of the Air and Waste Management Association Annual Meeting November 11-13, Bellevue, WA. (SERA RefID 94)
45. Ward DE, Hardy CC (1986) Advances in the characterization and control of emissions from prescribed broadcast fires of coniferous species logging slash on clearcut units. Final report, Project EPA DW12390110-0l-3/DOE DE-Al79-83BP12869, on file at Forest Science Laboratory, Seattle, WA. January. (SERA RefID 245)

46. Ward DE, Hardy CC, Sandberg DV, Reinhardt TE (1989) Mitigation of prescribed fire atmospheric pollution through increased utilization of hardwoods, piled residues, and long-needled conifers – Part III – emission characterization. USDA Forest Service, PNW Research Station, IAG-DE-AI179-85BP18509 (PNW-85-423). 110 p. (SERA RefID 244)

47. Weise DR, Ward DE, Paysen TE, Koonce AL (1991) Burning California chaparral- an exploratory study of some common shrubs and their combustion characteristics. *International Journal Wildland Fire* **1** 153-158. doi.org/10.1071/WF9910153 https://www.frames.gov/documents/smoke/serdp/weise_et_al_1991.pdf. (SERA RefID 86)

48. White JD (1987) Emission rates of carbon monoxide, particulate matter, and benzo(a)pyrene from prescribed buring of fine southern fuels. Southeastern Forest Experiment Station Research Note SE-346. 8 p. (SERA RefID 178)

49. Yokelson RJ, Goode JG, Ward DE, Susott RA, Babbitt RE, Wade DD, Bertschi IT, Griffith DWT, Hao WM (1999) Emissions of formaldehyde, acetic acid, methanol, and other trace gases from biomass fires in North Carolina measured by airborne Fourier Transform Infrared Spectroscopy. *Journal of Geophysical Research* **104**, D23: 30109-30125. doi.org/10.1029/1999JD9008. (SERA RefID 133)

Appendix 2: Analysis of variance tests of pollutant emissions factors (EF) categorized by combustion phase (CombPhase), regional vegetation type (regionalVegetationType) and fuel category (fuelCategory). Due to unequal sample sizes and data gaps, tests were not possible for every category by pollutant. Tables 1 and 3 provide definitions of combustion phase, regional vegetation type and fuel category codes.

Carbon dioxide (CO_2)

Combustion Phase
Record Count by Phase

Phase	Freq
F	286
R	20
S	127

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
1005	1567	1641	1613	1704.98	1932.8

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	3564305	1782152.43	136.943	0
Residuals	430	5595950	13013.84	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	-342.124	-404.179	-280.069	0
S-F	-146.196	-174.805	-117.587	0
S-R	195.928	131.384	260.472	0

Regional Vegetation Type Type
ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	4	310605.2	77651.31	2.728	0.029

Residuals	477	13575207.3	28459.55	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
SE pine-N conifer	-68.241	-215.613	79.130	0.711
SE shrub-N conifer	80.059	-103.312	263.430	0.754
W conifer-N conifer	-35.602	-177.765	106.561	0.960
W shrub-N conifer	-37.650	-184.319	109.019	0.956
SE shrub-SE pine	148.301	19.672	276.929	0.015
W conifer-SE pine	32.639	-23.314	88.593	0.500
W shrub-SE pine	30.591	-35.983	97.166	0.717
W conifer-SE shrub	-115.661	-238.288	6.965	0.075
W shrub-SE shrub	-117.709	-245.532	10.114	0.088
W shrub-W conifer	-2.048	-56.123	52.027	1.000

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	7	1277429	182489.87	6.577	0
Residuals	540	14983736	27747.66	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
Grass-Duff	191.464	35.436	347.491	0.005
MC-Duff	205.059	69.439	340.678	0.000
Mixedwood-Duff	208.000	42.993	373.007	0.003
Pine_needles-Duff	91.752	-59.908	243.412	0.592
Pine_under-Duff	240.769	99.095	382.442	0.000
Shrub-Duff	178.557	43.913	313.201	0.002
Slash-Duff	145.914	12.296	279.532	0.021
MC-Grass	13.595	-89.474	116.663	1.000
Mixedwood-Grass	16.537	-122.954	156.027	1.000
Pine_needles-Grass	-99.712	-223.127	23.703	0.216
Pine_under-Grass	49.305	-61.608	160.219	0.878
Shrub-Grass	-12.907	-114.688	88.875	1.000
Slash-Grass	-45.549	-145.969	54.870	0.866
Mixedwood-MC	2.942	-113.272	119.156	1.000
Pine_needles-MC	-113.307	-209.635	-16.978	0.009

Pine_under-MC	35.710	-43.976	115.396	0.873
Shrub-MC	-26.501	-92.890	39.887	0.927
Slash-MC	-59.144	-123.426	5.138	0.097
Pine_needles-Mixedwood	-116.249	-250.836	18.339	0.148
Pine_under-Mixedwood	32.769	-90.457	155.994	0.993
Shrub-Mixedwood	-29.443	-144.517	85.631	0.994
Slash-Mixedwood	-62.086	-175.958	51.786	0.714
Pine_under-Pine_needles	149.017	44.337	253.697	0.000
Shrub-Pine_needles	86.806	-8.144	181.755	0.102
Slash-Pine_needles	54.163	-39.327	147.652	0.646
Shrub-Pine_under	-62.212	-140.225	15.802	0.231
Slash-Pine_under	-94.855	-171.084	-18.626	0.004
Slash-Shrub	-32.643	-94.840	29.554	0.752

Carbon monoxide (CO)

Combustion Phase

Record Count by Phase

x	Freq
F	295
R	29
S	138

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
2.8	59.25	82.38	95.36	122.69	358

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	775559.8	387779.922	300.423	0
Residuals	459	592467.4	1290.779	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	135.664	119.224	152.104	0
S-F	66.845	58.132	75.557	0
S-R	-68.820	-86.076	-51.563	0

Regional Vegetation Type

ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	5	69363.67	13872.73	4.358	0.001
Residuals	547	1741068.28	3182.94	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
SE grass-N conifer	-18.560	-81.755	44.635	0.960
SE pine-N conifer	17.097	-33.824	68.018	0.930
SE shrub-N conifer	-13.232	-76.427	49.963	0.991
W conifer-N conifer	26.594	-23.045	76.234	0.644
W shrub-N conifer	9.595	-41.099	60.290	0.994
SE pine-SE grass	35.657	-7.394	78.708	0.169
SE shrub-SE grass	5.328	-51.717	62.372	1.000
W conifer-SE grass	45.154	3.627	86.682	0.024
W shrub-SE grass	28.155	-14.628	70.939	0.414
SE shrub-SE pine	-30.329	-73.380	12.722	0.335
W conifer-SE pine	9.498	-8.499	27.494	0.658
W shrub-SE pine	-7.501	-28.232	13.229	0.906
W conifer-SE shrub	39.827	-1.701	81.354	0.069
W shrub-SE shrub	22.828	-19.956	65.611	0.648
W shrub-W conifer	-16.999	-34.345	0.347	0.059

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	6	153721.5	25620.256	8.212	0
Residuals	577	1800081.9	3119.726	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
SE grass-N conifer	-18.560	-81.755	44.635	0.960
SE pine-N conifer	17.097	-33.824	68.018	0.930
SE shrub-N conifer	-13.232	-76.427	49.963	0.991
W conifer-N conifer	26.594	-23.045	76.234	0.644
W shrub-N conifer	9.595	-41.099	60.290	0.994
SE pine-SE grass	35.657	-7.394	78.708	0.169

SE shrub-SE grass	5.328	-51.717	62.372	1.000
W conifer-SE grass	45.154	3.627	86.682	0.024
W shrub-SE grass	28.155	-14.628	70.939	0.414
SE shrub-SE pine	-30.329	-73.380	12.722	0.335
W conifer-SE pine	9.498	-8.499	27.494	0.658
W shrub-SE pine	-7.501	-28.232	13.229	0.906
W conifer-SE shrub	39.827	-1.701	81.354	0.069
W shrub-SE shrub	22.828	-19.956	65.611	0.648
W shrub-W conifer	-16.999	-34.345	0.347	0.059

Methane (CH4)

Combustion Phase

Record Count by Phase

x	Freq
F	249
R	20
S	116

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	1.94	3.24	4.51	6.66	24.1

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	2719.959	1359.979	240.955	0
Residuals	382	2156.051	5.644	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	7.409	6.110	8.709	0
S-F	5.136	4.507	5.764	0
S-R	-2.274	-3.627	-0.921	0

Regional Vegetation Type Type

ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	6	611.234	101.872	9.249	0
Residuals	323	3557.755	11.015	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value

SE grass-N conifer	0.132	-4.539	4.803	1.000
SE pine-N conifer	2.441	-1.294	6.176	0.456
SE shrub-N conifer	-0.019	-4.514	4.476	1.000
W conifer-N conifer	2.822	-0.728	6.372	0.220
W duff-N conifer	7.733	2.120	13.347	0.001
W shrub-N conifer	-0.203	-4.009	3.603	1.000
SE pine-SE grass	2.309	-1.086	5.704	0.405
SE shrub-SE grass	-0.151	-4.367	4.066	1.000
W conifer-SE grass	2.690	-0.500	5.881	0.162
W duff-SE grass	7.602	2.208	12.995	0.001
W shrub-SE grass	-0.334	-3.807	3.139	1.000
SE shrub-SE pine	-2.460	-5.608	0.688	0.238
W conifer-SE pine	0.381	-1.139	1.902	0.990
W duff-SE pine	5.292	0.686	9.899	0.013
W shrub-SE pine	-2.644	-4.692	-0.596	0.003
W conifer-SE shrub	2.841	-0.085	5.767	0.063
W duff-SE shrub	7.752	2.511	12.994	0.000
W shrub-SE shrub	-0.184	-3.416	3.048	1.000
W duff-W conifer	4.911	0.453	9.369	0.020
W shrub-W conifer	-3.025	-4.712	-1.337	0.000
W shrub-W duff	-7.936	-12.601	-3.271	0.000

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	8	1109.206	138.651	13.726	0
Residuals	366	3697.066	10.101	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
Duff-CWD	-2.346	-7.165	2.474	0.846
Grass-CWD	-8.974	-13.094	-4.853	0.000
MC-CWD	-5.788	-9.421	-2.155	0.000
Mixedwood-CWD	-7.399	-11.494	-3.305	0.000
Pine_shrub-CWD	-9.293	-14.112	-4.473	0.000
Pine_under-CWD	-8.367	-12.108	-4.627	0.000
Shrub-CWD	-7.939	-11.665	-4.214	0.000

Slash-CWD	-5.874	-9.558	-2.190	0.000
Grass-Duff	-6.628	-10.579	-2.677	0.000
MC-Duff	-3.442	-6.882	-0.003	0.050
Mixedwood-Duff	-5.054	-8.978	-1.130	0.002
Pine_shrub-Duff	-6.947	-11.622	-2.272	0.000
Pine_under-Duff	-6.022	-9.575	-2.468	0.000
Shrub-Duff	-5.594	-9.132	-2.056	0.000
Slash-Duff	-3.528	-7.022	-0.035	0.046
MC-Grass	3.186	0.822	5.549	0.001
Mixedwood-Grass	1.574	-1.452	4.600	0.792
Pine_shrub-Grass	-0.319	-4.270	3.632	1.000
Pine_under-Grass	0.606	-1.919	3.132	0.998
Shrub-Grass	1.034	-1.470	3.538	0.934
Slash-Grass	3.099	0.658	5.541	0.003
Mixedwood-MC	-1.612	-3.930	0.706	0.428
Pine_shrub-MC	-3.505	-6.944	-0.065	0.042
Pine_under-MC	-2.579	-4.191	-0.967	0.000
Shrub-MC	-2.152	-3.729	-0.574	0.001
Slash-MC	-0.086	-1.563	1.390	1.000
Pine_shrub-Mixedwood	-1.893	-5.817	2.031	0.853
Pine_under-Mixedwood	-0.968	-3.451	1.516	0.953
Shrub-Mixedwood	-0.540	-3.001	1.921	0.999
Slash-Mixedwood	1.525	-0.872	3.923	0.555
Pine_under-Pine_shrub	0.926	-2.628	4.479	0.996
Shrub-Pine_shrub	1.353	-2.185	4.891	0.958
Slash-Pine_shrub	3.419	-0.075	6.912	0.061
Shrub-Pine_under	0.428	-1.384	2.239	0.998
Slash-Pine_under	2.493	0.769	4.217	0.000
Slash-Shrub	2.065	0.373	3.758	0.005

Nitrogen oxides (NOx)

Combustion Phase

Record Count by Phase

x	Freq
F	63
R	11
S	17

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.03	1.66	2.67	2.69	3.25	7.6

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	3.291	1.646	0.816	0.446
Residuals	88	177.519	2.017	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	-0.260	-1.367	0.846	0.841
S-F	-0.477	-1.403	0.448	0.439
S-R	-0.217	-1.527	1.093	0.918

Regional Vegetation Type

ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	5	7.825	1.565	0.746	0.592
Residuals	76	159.428	2.098	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
SE grass-N conifer	0.633	-3.232	4.499	0.997
SE pine-N conifer	-0.595	-3.729	2.538	0.994
SE shrub-N conifer	-0.044	-3.711	3.623	1.000
W conifer-N conifer	-0.309	-3.589	2.971	1.000
W shrub-N conifer	0.037	-3.027	3.102	1.000
SE pine-SE grass	-1.229	-3.842	1.385	0.742
SE shrub-SE grass	-0.677	-3.911	2.557	0.990
W conifer-SE grass	-0.943	-3.730	1.845	0.920
W shrub-SE grass	-0.596	-3.127	1.935	0.983
SE shrub-SE pine	0.552	-1.759	2.862	0.982
W conifer-SE pine	0.286	-1.341	1.913	0.995
W shrub-SE pine	0.633	-0.499	1.764	0.579
W conifer-SE shrub	-0.265	-2.771	2.240	1.000
W shrub-SE shrub	0.081	-2.135	2.297	1.000
W shrub-W conifer	0.347	-1.143	1.837	0.984

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	3	76.818	25.606	7.548	0
Residuals	91	308.709	3.392	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
Pine_under-Duff	1.025	-1.085	3.136	0.583
Shrub-Duff	2.726	0.900	4.552	0.001
Slash-Duff	1.655	-0.393	3.703	0.156
Shrub-Pine_under	1.701	0.294	3.108	0.011
Slash-Pine_under	0.630	-1.056	2.315	0.762
Slash-Shrub	-1.071	-2.383	0.241	0.149

Particulate matter (PM)

Combustion Phase

Record Count by Phase

x	Freq
F	44
R	15
S	40

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
2.1	7.15	13.8	14.94	19.65	58.3

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	3025.839	1512.920	20.399	0
Residuals	96	7119.898	74.166	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	13.964	7.834	20.093	0.000
S-F	9.503	5.024	13.982	0.000
S-R	-4.461	-10.668	1.746	0.206

Regional Vegetation Type

ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	4	9210.836	2302.709	11.368	0
Residuals	242	49021.466	202.568	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
SE pine-SE grass	9.832	-29.595	49.259	0.959
SE shrub-SE grass	3.088	-38.403	44.578	1.000
W conifer-SE grass	4.336	-34.937	43.608	0.998
W shrub-SE grass	20.134	-19.381	59.649	0.628
SE shrub-SE pine	-6.744	-21.426	7.938	0.714
W conifer-SE pine	-5.496	-11.532	0.540	0.093
W shrub-SE pine	10.302	2.851	17.753	0.002
W conifer-SE shrub	1.248	-13.014	15.511	0.999
W shrub-SE shrub	17.046	2.130	31.963	0.016
W shrub-W conifer	15.798	9.212	22.384	0.000

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	5	8941.545	1788.309	8.822	0
Residuals	263	53311.565	202.706	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
Mixedwood-Grass	18.800	-14.573	52.173	0.588
Pine_needles-Grass	4.884	-13.346	23.114	0.972
Pine_under-Grass	13.769	-4.292	31.829	0.247
Shrub-Grass	18.040	0.482	35.598	0.040
Slash-Grass	4.861	-12.182	21.904	0.964
Pine_needles-Mixedwood	-13.916	-43.736	15.904	0.763
Pine_under-Mixedwood	-5.031	-34.748	24.685	0.997
Shrub-Mixedwood	-0.760	-30.173	28.654	1.000
Slash-Mixedwood	-13.939	-43.048	15.170	0.742
Pine_under-Pine_needles	8.885	-1.196	18.966	0.119

Shrub-Pine_needles	13.156	4.006	22.306	0.001
Slash-Pine_needles	-0.023	-8.141	8.096	1.000
Shrub-Pine_under	4.272	-4.536	13.079	0.732
Slash-Pine_under	-8.907	-16.637	-1.177	0.014
Slash-Shrub	-13.179	-19.648	-6.710	0.000

Particulate matter less than 2.5 microns ($PM_{2.5}$)

Combustion Phase

Record Count by Phase

x	Freq
F	176
R	15
S	49

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
1.1	8.18	13.08	17.63	22.44	89.95

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	7955.672	3977.836	21.877	0
Residuals	237	43093.974	181.831	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	19.95	11.396	28.505	0.000
S-F	9.50	4.363	14.637	0.000
S-R	-10.45	-19.835	-1.065	0.025

Regional Vegetation Type

ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	4	9727.78	2431.945	9.73	0
Residuals	275	68730.90	249.931	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
SE pine-SE grass	9.449	-2.384	21.282	0.185
SE shrub-SE grass	0.940	-16.783	18.663	1.000

W conifer-SE grass	-4.214	-16.417	7.988	0.878
W shrub-SE grass	4.948	-8.070	17.966	0.835
SE shrub-SE pine	-8.509	-22.752	5.733	0.473
W conifer-SE pine	-13.664	-19.800	-7.527	0.000
W shrub-SE pine	-4.501	-12.131	3.128	0.486
W conifer-SE shrub	-5.154	-19.705	9.396	0.867
W shrub-SE shrub	4.008	-11.233	19.249	0.951
W shrub-W conifer	9.162	0.971	17.353	0.020

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	6	12412.49	2068.748	8.974	0
Residuals	301	69386.90	230.521	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
Grass-Duff	-7.296	-26.811	12.220	0.925
MC-Duff	-5.768	-28.302	16.767	0.988
Mixedwood-Duff	-9.839	-29.814	10.136	0.767
Pine_under-Duff	-0.919	-17.467	15.628	1.000
Shrub-Duff	3.961	-12.659	20.581	0.992
Slash-Duff	-12.690	-29.523	4.143	0.279
MC-Grass	1.528	-17.987	21.043	1.000
Mixedwood-Grass	-2.543	-19.037	13.950	0.999
Pine_under-Grass	6.376	-5.742	18.495	0.707
Shrub-Grass	11.257	-0.961	23.474	0.093
Slash-Grass	-5.394	-17.900	7.111	0.861
Mixedwood-MC	-4.071	-24.046	15.904	0.997
Pine_under-MC	4.848	-11.699	21.396	0.977
Shrub-MC	9.729	-6.891	26.349	0.591
Slash-MC	-6.922	-23.755	9.911	0.886
Pine_under-Mixedwood	8.920	-3.926	21.765	0.379
Shrub-Mixedwood	13.800	0.861	26.739	0.028
Slash-Mixedwood	-2.851	-16.062	10.360	0.995
Shrub-Pine_under	4.880	-1.619	11.379	0.283
Slash-Pine_under	-11.771	-18.796	-4.746	0.000

Slash-Shrub	-16.651	-23.845	-9.457	0.000

Sulphur dioxide (SO2)

Combustion Phase

Record Count by Phase

x	Freq
F	106
R	1
S	18

Summary Statistics

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.64	1.02	1.12	1.42	3.42

ANOVA of Combustion Phase

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CombPhase	2	5.691	2.846	5.929	0.003
Residuals	122	58.555	0.480	NA	NA

Tukey Combustion Phase

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
R-F	1.640	-0.011	3.292	0.052
S-F	0.458	0.039	0.877	0.028
S-R	-1.182	-2.871	0.507	0.225

Regional Vegetation Type

ANOVA of Regional Vegetation Type

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
regionalVegetationType	2	8.189	4.095	15.374	0
Residuals	88	23.437	0.266	NA	NA

Tukey Regional Vegetation Type

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
W conifer-SE pine	0.401	-0.024	0.825	0.068
W shrub-SE pine	-0.257	-0.710	0.196	0.371
W shrub-W conifer	-0.658	-0.945	-0.370	0.000

Fuel Category

ANOVA of Fuel Category

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
fuelCategory	4	10.129	2.532	6.059	0
Residuals	102	42.626	0.418	NA	NA

Tukey Fuel Category

Comparison	Estimate	Conf.low	Conf.high	ADI.p.value
Grass-Duff	-0.465	-1.435	0.504	0.672
MC-Duff	-0.393	-1.090	0.304	0.522
Pine_under-Duff	-0.575	-1.321	0.171	0.212
Shrub-Duff	-1.007	-1.714	-0.299	0.001
MC-Grass	0.072	-0.715	0.860	0.999
Pine_under-Grass	-0.109	-0.940	0.722	0.996
Shrub-Grass	-0.542	-1.338	0.255	0.331
Pine_under-MC	-0.182	-0.668	0.304	0.837
Shrub-MC	-0.614	-1.038	-0.189	0.001
Shrub-Pine_under	-0.432	-0.933	0.069	0.125

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Appendix 3: Supported air pollutants in SERA and EF summaries, including mean, standard deviation (SD), minimum (min) and maximum (max) values in g/kg, excluding outliers. Pollutant Category include: critical air pollutant (CAP), greenhouse gas (GHG), hazardous air pollutant (HAX), toxic air pollutant (TOX). RefID lists source references for each pollutant.

Pollutant	Formula/ Acronym	Molecular weight	N	EF (g/kg)	SD	Min	Max	Category	Ref ID
1,1,2,2-tetrachloroethane	C2H2Cl4	167.838	1	0.01		0.01	0.01	HAP, TOX	236
1,1-dichloro-1-fluoroethane	CH3CClF2	116.944	2	3.25	2.62	1.40	5.10	TOX	230
1,1-difluoroethane	C2H4F2	66.051	2	1.75	0.92	1.10	2.40		230
1,2,3-trimethylbenzene	C9H12	120.195	7	0.04	0.03	0.02	0.09		231, 234
1,2,4-trimethylbenzene	C9H12	120.195	22	0.02	0.03	0.00	0.11	TOX	231, 234, 236, 238
1,2-dichloroethane	C2H4Cl2	98.954	2	3.10	2.83	1.10	5.10	HAP, TOX	230
1,3,5-trimethylbenzene	C9H12	120.195	18	0.01	0.01	0.00	0.05		231, 236, 238
1,3-butadiene	C4H6	54.092	59	0.17	0.15	0.00	0.74	HAP, TOX	171, 230, 231, 234, 236, 238, 243
1,3-dimethylnaphthalene	C12H12	156.228	58	0.02	0.02	0.00	0.13		242
1,4-dichlorobenzene	C6H4Cl2	146.998	1	0.00		0.00	0.00	HAP, TOX	236
1-butyne	C4H6	54.092	7	0.00	0.00	0.00	0.01	HAP, TOX	231
1-chloro-1,1-difluoroethane	C2H3ClF2	100.493	2	2.60	1.84	1.30	3.90	TOX	230
1-heptene	C7H14	98.189	7	0.04	0.03	0.01	0.10		231
1-octene	C8H16	112.216	7	0.04	0.04	0.01	0.12		231
1-pentene	C5H10	70.135	9	0.04	0.03	0.01	0.12		230, 231
2 cyclopenten 1-one	C5H6O	82.102	16	0.13	0.12	0.00	0.52		105, 231
2-(3h)furanone	C4H4O2	84.074	58	0.39	0.30	0.05	1.36		242
2(5h)-furanone	C4H4O2	84.074	7	0.10	0.06	0.01	0.22		105
2,3-dimethylbutane	C6H14	86.178	5	1.28	2.16	0.00	5.00		230, 231
2,5-dimethylfuran	C6H8O	96.129	7	0.10	0.14	0.02	0.41		231

2+3-methylpentane	C6H14		3	4.07	4.09	0.02	8.20		230, 234
2-acetylfuran	C6H6O2	110.112	8	0.04	0.02	0.01	0.06		105
2-butanone	C4H8O	72.107	22	0.10	0.06	0.01	0.29	TOX	231, 234, 236, 238
2-butyl nitrate	C4H9NO3	119.12	2	2.25	0.49	1.90	2.60		230
2-butyne	C4H6	54.092	7	0.00	0.00	0.00	0.01	HAP, TOX	231
2-ethenyl benzofuran	C10H8O	144.173	57	0.02	0.01	0.00	0.06		242
2-ethylfuran	C6H8O	96.129	7	0.02	0.02	0.01	0.07		231
2-ethyltoluene	C9H12	120.195	7	0.01	0.01	0.00	0.03		231
2-furnmethanol	C5H6O2	98.101	5	0.26	0.36	0.01	0.87		105
2-hexanone		100.161	10	0.00	0.00	0.00	0.01		236
2-hydroxy-2H-furan-5-one	C4H4O3	100.073	58	0.05	0.05	0.00	0.29		242
2-methyl-1-butene	C5H10	70.135	6	0.02	0.01	0.01	0.03		231
2-methyl-2-butene	C5H10	70.135	6	0.02	0.01	0.01	0.04		231
2-methylpentane	C6H14	86.178	6	0.01	0.00	0.00	0.01		231
2-methylpropanal	C4H8O	72.107	6	0.02	0.01	0.01	0.04	TOX	231
2-pentyl nitrate	C5H11NO3	133.147	2	5.15	0.07	5.10	5.20		230
2-propanol	C3H8O	60.096	3	0.00	0.00	0.00	0.00		236
3-buten-1-amine	C4H9N	71.123	56	0.00	0.00	0.00	0.01		242
3-ethyltoluene	C9H12	120.195	8	0.07	0.10	0.01	0.29		231, 234
3-furaldehyde	C5H4O2	96.085	10	0.81	0.62	0.01	1.80		105
3-methyl-1-butene	C5H10	70.135	6	0.01	0.00	0.01	0.02		231
3-methyl-2-butanone	C5H10O	86.134	7	0.03	0.04	0.01	0.12		231
3-methyl-2-butyl nitrate	C5H11NO3	133.147	2	3.90	3.96	1.10	6.70		230
3-methyl-3-buten-2-one	C5H8O	84.118	7	0.12	0.18	0.02	0.51		231
3-methylacetophenone	C9H10O	134.178	58	0.04	0.03	0.00	0.13		242
3-methylbutanal	C5H10O	86.134	6	0.03	0.01	0.02	0.05		231
3-methylpentane	C6H14	86.178	7	0.00	0.00	0.00	0.01		231
3-pentyl nitrate	C5H11NO3	133.147	2	4.40	0.00	4.40	4.40		230
4-carene	C10H16	136.238	6	0.05	0.07	0.01	0.17		231
4-ethyltoluene	C9H12	120.195	15	0.01	0.00	0.00	0.02		231, 236

4-methyl-2-pentanone	C6H12O	100.161	10	0.00	0.00	0.00	0.00	HAP, TOX	236
4-pyridone	C5H5NO	95.101	56	0.01	0.01	0.00	0.05		242
5-(hydroxymethyl)-2-furfural	C6H6O3	126.111	57	0.30	0.26	0.02	1.19		242
5-hydroxymethyl-2[3h]-furanone	C5H6O3	114.1	58	0.20	0.18	0.02	0.78		242
5-methyl-2-furaldehyde	C6H6O2	110.112	10	0.18	0.14	0.01	0.50		105
acenaphthene	C12H10	154.212	3	0.00	0.00	0.00	0.00	HAP, TOX	238
acenaphthylene	C12H8	152.196	60	0.01	0.01	0.00	0.04	HAP, TOX	238, 242
acetaldehyde	C2H4O	44.053	65	0.93	0.74	0.13	3.65	HAP, TOX	231, 242
acetamide	C2H5NO	59.068	55	0.04	0.05	0.00	0.26	HAP, TOX	242
acetic acid	C2H4O2	60.052	152	2.06	1.85	0.19	9.28		105, 117, 118, 120, 133, 170, 171, 231, 243
acetic anhydride	C4H6O3	102.089	58	0.09	0.07	0.01	0.39		242
acetol	C3H6O2	74.079	84	0.79	0.60	0.00	2.63		105, 230, 231, 243
acetone	C3H6O	58.08	57	0.36	0.27	0.05	1.05		242
acetonitrile	C2H3N	41.053	76	0.09	0.08	0.00	0.39	HAP, TOX	230, 231, 234, 236, 238, 242
acetylene	C2H2	26.038	282	0.65	0.70	0.04	4.10		63, 117, 118, 120, 137, 153, 170, 171, 172, 179, 230, 231, 234, 242, 243
acrolein	C3H4O	56.064	80	0.70	0.49	0.07	2.49	HAP, TOX	231, 236, 238, 242
acrylonitrile	C3H3N	53.064	80	0.03	0.02	0.00	0.09	HAP, TOX	231, 236, 238, 242
allylamine	C3H7N	57.096	56	0.00	0.00	0.00	0.01		242

alpha-pinene	C10H16	136.238	22	0.05	0.03	0.00	0.12		230, 231, 234, 236, 238
ammonia	NH3	17.031	210	1.34	1.43	0.02	6.60	CAP, TOX	63, 117, 118, 120, 133, 153, 170, 171, 172, 180, 231, 237, 243
ammonium	NH4+	18.039	62	0.08	0.11	0.00	0.51		172, 180, 230
anthracene	C14H10	178.234	3	0.00	0.00	0.00	0.00	HAP, TOX	238
benzaldehyde	C7H6O	106.124	58	0.08	0.06	0.01	0.27		242
benzene	C6H6	78.114	83	0.36	0.26	0.05	1.47	HAP, TOX	230, 231, 234, 236, 238, 242
benzo[a]anthracene	C18H12	228.294	3	0.00	0.00	0.00	0.00	HAP, TOX	238
benzo[a]pyrene	C20H12	252.316	11	0.00	0.00	0.00	0.00	HAP, TOX	178, 238
benzo[b]fluoranthene	C20H12	252.316	3	0.00	0.00	0.00	0.00	HAP, TOX	238
benzo[ghi]perylene	C22H12	276.338	3	0.00	0.00	0.00	0.00	HAP, TOX	238
benzo[k]fluoranthene	C20H12	252.316	3	0.00	0.00	0.00	0.00	HAP, TOX	238
benzofuran	C8H6O	118.135	58	0.04	0.03	0.01	0.17		242
benzoic acid	C7H6O2	122.123	3	0.08	0.07	0.02	0.16		105
benzonitrile	C7H5N	103.124	62	0.02	0.02	0.00	0.10		105, 242
beta-pinene	C10H16	136.238	10	0.19	0.27	0.01	0.72		230, 231, 234
black carbon	BC		114	0.90	0.76	0.00	3.22		236, 238, 243
brown carbon	BrC		19	1.13	0.40	0.66	2.10		236, 238
butadiene hydroxynitrates	C4O4H7N		2	0.01	0.00	0.01	0.02		230
butane	C4H10	58.124	19	0.07	0.06	0.02	0.20		63, 137, 230, 231, 234
butene hydroxynitrates	C4O4H9N		2	0.03	0.01	0.02	0.03		230

butyl acetate	C6H12O2	116.16	1	0.00		0.00	0.00		236
butyraldehyde	C4H8O	72.107	7	0.04	0.03	0.02	0.09	TOX	231
butyric acid	C4H8O2	88.106	5	0.07	0.04	0.04	0.14		105
C4-dihydroxycarbonyls	C4O3H8		2	0.05	0.04	0.02	0.08		230
C4-hydroxydicarbonyls/C5-alkenediols	C4O3H6/C5O2H10		2	0.11	0.02	0.09	0.12		230
camphene	C10H16	136.238	4	0.28	0.32	0.01	0.66		231
carbon dioxide	CO2	44.009	578	1586.57	171.06	828.50	1968.00	GHG	4, 35, 42, 46, 63, 66, 86, 94, 100, 102, 117, 118, 120, 129, 133, 137, 140, 153, 157, 170, 171, 172, 179, 195, 201, 230, 231, 234, 237, 238, 239, 243, 244, 245
carbon disulfide	CS2	76.131	6	0.00	0.01	0.00	0.02	HAP, TOX	236
carbon monoxide	CO	28.01	640	103.51	58.30	2.80	359.00	CAP	4, 35, 36, 37, 42, 46, 63, 66, 86, 94, 100, 102, 117, 118, 120, 129, 133, 137, 140, 153, 157, 170, 171, 172, 178, 179, 180, 195, 201, 230, 231, 234, 237, 238, 239, 243, 244, 245
carbon suboxide	C3O2	68.031	58	0.00	0.00	0.00	0.01		242

carbon tetrachloride	CCl4	153.811	2	0.00	0.00	0.00	0.00	GHG, HAP, TOX	236
carbonyl sulfide	COS	60.07	12	0.15	0.18	0.01	0.51	HAP, TOX	36, 230, 231, 234
chloride	Cl-	35.45	35	0.71	1.21	0.03	5.39		172, 230
chloroethane	C2H5Cl	64.512	2	0.00	0.00	0.00	0.01	HAP, TOX	236
chrysene	C18H12	228.294	3	0.00	0.00	0.00	0.00	HAP, TOX	238
cis-2-butene	C4H8	56.108	9	0.05	0.05	0.01	0.17		230, 231, 234
cis-2-pentene	C5H10	70.135	7	0.01	0.01	0.01	0.04		231
creosol	C8H10O2	138.166	66	0.27	0.26	0.01	1.36		105, 242
crotonic acid	C4H6O2	86.09	5	0.17	0.29	0.03	0.68		105
cumene	C9H12	120.195	15	0.00	0.00	0.00	0.01	HAP, TOX	231, 236, 238
cyclohexane	C6H12	84.162	3	0.00	0.00	0.00	0.00	TOX	236
decanal	C10H20O	156.269	57	0.00	0.00	0.00	0.01		242
diacetyl	C4H6O2	86.09	1	2.10		2.10	2.10		230
dibenz[a,h]anthracene	C22H14	278.354	2	0.00	0.00	0.00	0.00	HAP, TOX	238
dibromomethane	CH2Br2	173.835	2	1.80	0.28	1.60	2.00	TOX	230
dichlorodifluoromethane	CCl2F2	120.908	9	0.00	0.00	0.00	0.01		63, 137, 236
dichloromethane	CH2Cl2	84.927	8	1.05	2.30	0.00	6.50	GHG, HAP, TOX	230, 236
dihydronaphthalene	C10H10	130.19	58	0.03	0.03	0.00	0.17		242
dimethyl disulfide	C2H6S2	94.19	57	0.00	0.00	0.00	0.01		242
dimethyl sulfide	C2H6S	62.13	64	0.00	0.00	0.00	0.02		230, 231, 242
dimethyl trisulfide	C2H6S3	126.25	55	0.00	0.00	0.00	0.00		242
dimethylbenzofuran	C10H10O	146.189	58	0.04	0.03	0.00	0.16		242
d-limonene	C10H16	136.238	22	0.73	1.36	0.01	5.36		231, 236, 238

elemental carbon	EC		54	1.42	1.79	0.00	8.01		172, 180, 238
ethanal nitrate	C2O4H3N		2	2.75	0.21	2.60	2.90		230
ethane	C2H6	30.07	72	0.39	0.19	0.07	1.03		63, 102, 120, 137, 153, 179, 230, 231, 234
ethanol	C2H6O	46.069	76	0.04	0.04	0.00	0.23		231, 234, 236, 238, 242
ethenamine	C2H5N	43.069	58	0.01	0.01	0.00	0.04		242
ethene	C2H4	28.054	258	0.94	0.80	0.11	4.70	TOX	102, 117, 118, 120, 133, 170, 171, 179, 230, 231, 234, 242, 243
ethene hydroxynitrate	C2O4H5N		2	4.26	6.00	0.02	8.50		230
ethyl acetate	C4H8O2	88.106	1	0.00		0.00	0.00		236
ethyl nitrate	C2H5NO3	91.066	2	2.40	1.56	1.30	3.50		230
ethylbenzene	C8H10	106.168	24	0.03	0.02	0.00	0.08	HAP, TOX	230, 231, 234, 236, 238
ethylindene	C11H12	144.217	58	0.02	0.02	0.00	0.10		242
ethylnylpyrrole	C6H6		58	0.00	0.00	0.00	0.01		242
eugenol	C10H12O2	164.204	2	0.07	0.01	0.07	0.08		105
fluoranthene	C16H10	202.256	3	0.00	0.00	0.00	0.00	HAP, TOX	238
fluorene	C13H10	166.223	3	0.00	0.00	0.00	0.00	HAP, TOX	238
formaldehyde	H2CO	30.026	202	1.53	0.92	0.09	4.76	HAP, TOX	117, 118, 120, 133, 170, 171, 231, 234, 242, 243
formamide	CH3NO	45.041	56	0.01	0.01	0.00	0.06		242
formic acid	HCOOH	46.025	187	0.28	0.27	0.00	1.21	TOX	105, 117, 118, 120, 133, 170, 171, 231, 242, 243

furan	C4H4O	68.075	178	0.33	0.34	0.02	1.60	TOX	120, 170, 171, 230, 231, 234, 242, 243
furfural	C5H4O2	96.085	62	0.69	0.45	0.01	2.70		231, 243
gamma-butyrolactone	C4H6O2	86.09	5	0.09	0.05	0.05	0.17		105
glycolaldehyde	C2H4O2	60.052	67	0.60	0.46	0.05	2.54		117, 120, 231, 243
glyoxal	C2H2O2	58.036	58	0.26	0.23	0.00	0.96		242
guaiacol	C7H8O2	124.139	66	0.38	0.38	0.00	1.92		105, 242
heptane	C7H16	100.205	24	0.01	0.01	0.00	0.04		230, 231, 234, 236, 238
hexane	C6H14	86.178	24	0.01	0.01	0.00	0.05	HAP, TOX	230, 231, 234, 236, 238
hydrogen chloride	HCl	36.458	35	0.12	0.16	0.00	0.67		170, 230, 243
hydrogen cyanide	HCN	27.026	185	0.40	0.40	0.01	2.12	HAP, TOX	118, 120, 170, 171, 230, 231, 234, 242, 243
hydrogen peroxide	H2O2	34.014	2	0.60	0.59	0.18	1.02		230
hydrogen sulfide	H2S	34.076	53	0.01	0.01	0.00	0.05		242
hydroperoxy acetone	C3O3H6		2	0.09	0.06	0.04	0.13		230
hydroperoxymethanol	CO3H4	64.04	2	0.19	0.20	0.05	0.33		230
indeno[1,2,3-cd]pyrene	C22H12	276.338	3	0.00	0.00	0.00	0.00	HAP, TOX	238
isoamyl cyanide	C6H11N	97.161	55	0.00	0.00	0.00	0.01		242
isobutane	C4H10	58.124	9	0.01	0.01	0.01	0.03		230, 231, 234
isobutylene	C4H8	56.108	18	0.10	0.04	0.04	0.20		230, 231, 234
isocyanic acid	HNCO	43.025	58	0.53	0.34	0.05	1.57		242
isopentane	C5H12	72.151	9	0.02	0.02	0.01	0.07		230, 231, 234
isoprene	C5H8	68.119	87	0.15	0.15	0.01	0.67	TOX	171, 230, 231, 234, 242
isoprene hydroperoxyaldehydes	C5O3H8		2	0.17	0.01	0.16	0.18		230
isoprene hydroxy hydroperoxides	C5O3H10		2	0.08	0.05	0.04	0.11		230
isoprene hydroxynitrates	C5O4H9N		2	0.02	0.01	0.01	0.02		230

isopropyl nitrate	C3H7NO3	105.093	2	4.55	1.77	3.30	5.80		230
m-, p-xylene	C8H10		18	0.06	0.03	0.01	0.11	HAP, TOX	230, 234, 236, 238
m,p-cresol	C7H8O		9	0.05	0.02	0.01	0.08	HAP, TOX	105
methacrolein	C4H6O	70.091	7	0.04	0.00	0.03	0.04		231, 234
methane	CH4	16.043	449	4.78	3.76	0.00	24.10	GHG	35, 46, 63, 66, 94, 100, 102, 117, 118, 120, 133, 137, 153, 157, 170, 171, 172, 179, 230, 231, 234, 237, 238, 239, 243, 244, 245
methanediol	CH4O2	48.041	58	0.00	0.00	0.00	0.00		242
methanethiol	CH4S	48.103	54	0.01	0.01	0.00	0.07		242
methanimine	CH3N	29.042	57	0.00	0.00	0.00	0.00		242
methanol	CH3OH	32.042	217	1.37	1.25	0.09	6.42	HAP, TOX	105, 117, 118, 120, 133, 170, 171, 230, 231, 234, 242, 243
methenamine	C6H12N4	140.19	3	0.18	0.11	0.06	0.28		105
methyl acetoacetate	C5H8O3	116.116	9	0.23	0.25	0.01	0.77		105
methyl benzeneacetonitrile	C9H9N	131.178	56	0.00	0.00	0.00	0.02		242
methyl benzofuran	C9H8O	132.162	57	0.05	0.04	0.01	0.18		242
methyl benzoic acid	C8H8O2	136.15	58	0.08	0.06	0.01	0.31		242
methyl bromide	CH3Br	94.939	9	0.00	0.00	0.00	0.00	GHG, HAP, TOX	230, 236
methyl chavicol	C10H12O	148.205	57	0.03	0.02	0.00	0.09		242

methyl chloride	CH3Cl	50.485	22	0.02	0.01	0.01	0.05	GHG, HAP, TOX	66, 230, 234, 236, 238
methyl iodide	CH3I	141.939	2	3.70	2.55	1.90	5.50	HAP, TOX	230
methyl methacrylate	C5H8O2	100.117	7	0.00	0.00	0.00	0.01	HAP, TOX	236
methyl naphthalene	C11H10	142.201	58	0.03	0.03	0.00	0.19		242
methyl nitrate	CH3NO3	77.039	2	1.50	0.28	1.30	1.70		230
methyl propanoate	C4H8O2	88.106	58	0.08	0.07	0.01	0.30		242
methyl tert-butyl ether	C5H12O	88.15	1	0.00		0.00	0.00	HAP, TOX	236
methyl vinyl ketone	C4H6O	70.091	8	0.11	0.11	0.02	0.37		231, 234
methyl vinyl ketone/methacrolein hydroxynitrates	C4O5H7N		2	0.02	0.00	0.02	0.02		230
methyl vinyl ketone/methacrolein/crotonaldehyde	C4H6O		2	0.33	0.06	0.29	0.37		230
monoterpenes	C10H16		66	0.99	1.30	0.02	5.43		230, 231, 242
m-xylene	C8H10	106.168	6	0.06	0.03	0.01	0.11	HAP, TOX	231
myrcene	C10H16	136.238	3	0.06	0.05	0.01	0.11		231
naphthalene	C10H8	128.174	75	0.06	0.05	0.00	0.23	HAP, TOX	236, 238, 242
n-decane	C10H22	142.286	4	0.04	0.03	0.01	0.08		231
nitrate	NO3-	62.004	58	0.11	0.11	0.00	0.60		172, 180, 230
nitric oxide	NO	30.006	190	2.13	1.61	0.09	8.10		117, 118, 142, 170, 171, 172, 195, 230, 231, 234, 237, 243
nitrobenzene	C6H5NO2	123.111	58	0.01	0.01	0.00	0.03	HAP, TOX	242
nitroethane	C2H5NO2	75.067	58	0.00	0.00	0.00	0.00		242
nitroethene	C2H3NO2	73.051	58	0.00	0.00	0.00	0.00		242

nitrogen dioxide	NO2	46.005	157	1.15	0.87	0.05	4.80		142, 170, 171, 172, 195, 230, 231, 234, 243
nitrogen oxides	Nox		115	2.96	2.03	0.03	11.29	CAP	37, 63, 140, 142, 153, 170, 171, 180, 201, 230, 231, 237
nitromethane	CH3NO2	61.04	65	0.06	0.04	0.00	0.15	TOX	231, 242
nitrotoluene	C7H7NO2	137.138	55	0.01	0.01	0.00	0.03		242
nitrous acid	HNO2	47.013	164	0.49	0.24	0.04	1.28		170, 171, 231, 242, 243
nitrous oxide	N2O	44.013	9	0.22	0.11	0.04	0.41	GHG	63, 137, 153
nitroxyhydroperoxide/ nitroxyhydroxyepoxide	C5O5H9N		2	0.02	0.00	0.02	0.02		230
nonane	C9H20	128.259	14	0.01	0.01	0.00	0.03		231, 236
nonmethane hydrocarbons	NMHC		112	5.87	4.62	0.00	22.50		35, 46, 94, 157, 244, 245
nonmethane organic compounds	NMOC		10	18.87	14.61	6.78	57.12		231
octane	C8H18	114.232	16	0.01	0.01	0.00	0.03		231, 236
organic aerosol	OA		8	13.90	9.34	5.40	30.90		230, 231
organic carbon	OC		54	18.32	28.41	0.23	137.33		172, 180, 238
orthocresol	C7H8O	108.14	9	0.03	0.01	0.00	0.05	HAP, TOX	105
o-xylene	C8H10	106.168	24	0.02	0.01	0.00	0.04	HAP, TOX	230, 231, 234, 236, 238
ozone	O3	47.997	10	2.17	4.91	-1.25	14.00	TOX	63, 137
particle-bound polycyclic aromatic hydrocarbons	PPAH		8	0.01	0.01	0.00	0.02	HAP, TOX	237
particulate matter < 1µm	PM1		3	26.03	6.15	20.40	32.60		230
particulate matter 10µm	PM10		9	8.70	3.22	3.38	12.90	CAP	140, 157
particulate matter 2.5µm	PM2.5		321	19.83	16.19	1.10	89.95	CAP	46, 66, 100, 120, 140, 141, 157,

									171, 172, 179, 180, 236, 237, 238, 240, 244, 245
particulate matter 2µm	PM2		15	19.13	10.07	5.50	43.80		59, 137
particulate matter 3.5µm	PM3.5		13	16.14	7.86	9.70	37.40		59, 137, 153
particulate matter 48µm	PM48		22	19.97	12.13	4.40	47.90		59, 94, 137
p-cymene	$C_{10}H_{14}$	134.222	3	0.42	0.50	0.00	0.98		231
pentane	C_5H_{12}	72.151	9	0.03	0.01	0.01	0.05		230, 231, 234
peracetic acid	$C_2H_4O_3$	76.051	2	0.24	0.28	0.05	0.44	TOX	230
phenanthrene	$C_{14}H_{10}$	178.234	3	0.00	0.00	0.00	0.00	HAP, TOX	238
phenol	C_6H_6O	94.113	134	0.62	0.57	0.02	3.54	HAP, TOX	105, 120, 231, 242, 243
phenylacetonitrile	C_8H_7N	117.151	56	0.01	0.01	0.00	0.05		242
phenylacetylene	C_8H_6	102.136	58	0.01	0.01	0.00	0.06		242
polychlorinated dibenzofurans	PCDF		14	0.00	0.00	0.00	0.00	HAP, TOX	236
polychlorinated dibenzo-p-dioxins	PCDD		13	0.00	0.00	0.00	0.00	HAP, TOX	236
potassium cation	K^+	39.098	31	0.48	0.50	0.03	2.36		172
propane	C_3H_8	44.097	68	0.14	0.10	0.01	0.54		63, 137, 153, 179, 230, 231, 234
propanone nitrate	$C_3O_3H_5N$		2	4.00	0.71	3.50	4.50		230
propene	C_3H_6	42.081	293	0.61	0.49	0.04	2.42	TOX	63, 120, 137, 153, 170, 171, 172, 179, 230, 231, 234, 236, 238, 242, 243
propene hydroxynitrates	$C_3O_4H_7N$		2	0.02	0.01	0.02	0.03		230
propiolic acid	$C_3H_2O_2$	70.047	58	0.01	0.01	0.00	0.03		242
propiolonitrile	C_3HN	51.048	58	0.00	0.00	0.00	0.00		242

propionaldehyde	C3H6O	58.08	20	0.64	0.41	0.24	2.07	HAP, TOX	230, 231, 234, 236
propionic acid	C3H6O2	74.079	9	0.21	0.14	0.02	0.39		105
propionitrile	C3H5N	55.08	57	0.01	0.02	0.00	0.08		242
propyl nitrate	C3H7NO3	105.093	2	4.45	4.03	1.60	7.30		230
propylbenzene	C9H12	120.195	16	0.01	0.00	0.00	0.01		231, 236
propynal	C3H2O	54.048	58	0.03	0.02	0.00	0.08		242
propyne	C3H4	40.065	62	0.05	0.03	0.00	0.14		179, 230, 231, 234
p-xylene	C8H10	106.168	7	0.04	0.03	0.02	0.09	HAP, TOX	231
pyrene	C16H10	202.256	3	0.00	0.00	0.00	0.00	HAP, TOX	238
pyridine	C5H5N	79.102	5	0.05	0.08	0.01	0.20	TOX	105
pyruvaldehyde	C3H4O2	72.063	3	1.10	0.85	0.30	2.00		105
pyruvic acid	C3H4O3	88.062	58	0.01	0.01	0.00	0.03		242
quinone	C6H4O2	108.096	57	0.09	0.05	0.01	0.25	HAP, TOX	242
salicylaldehyde	C7H6O2	122.123	61	0.06	0.05	0.01	0.28		105, 242
sodium cation	Na+	22.99	15	0.06	0.08	0.00	0.25		172
styrene	C8H8	104.152	80	0.07	0.07	0.01	0.37	HAP, TOX	231, 236, 238, 242
sulfate	SO4(2-)	96.056	35	0.28	0.19	0.01	0.73		172, 230
sulfinylmethanamine	CH3NOS	77.101	57	0.00	0.00	0.00	0.00		242
sulfur dioxide	SO2	64.058	127	1.11	0.72	0.00	3.42	CAP	140, 170, 172, 230, 243
syringol	C8H10O3	154.165	56	0.04	0.03	0.00	0.17		242
terpenes			8	3.40	4.32	0.14	13.35		231
tetrahydrofuran	C4H8O	72.107	10	0.00	0.00	0.00	0.01		236
thiophene	C4H4S	84.136	58	0.01	0.01	0.00	0.05		242
toluene	C7H8	92.141	83	0.23	0.20	0.02	1.12	HAP, TOX	230, 231, 234, 236, 238, 242
total carbon	TC		5	10.06	3.87	7.10	16.00		238

total hydrocarbon	THC		56	8.36	5.30	1.06	21.80		4, 42, 129, 140
total particulate matter	PM		276	19.23	15.45	2.10	77.10		26, 35, 36, 37, 46, 53, 66, 86, 129, 147, 157, 178, 195, 229, 244, 245
trans-2-butene	C4H8	56.108	9	0.06	0.06	0.01	0.21		230, 231, 234
trans-2-pentene	C5H10	70.135	7	0.03	0.02	0.01	0.08		231
trimethylamine	C3H9N	59.112	56	0.00	0.00	0.00	0.01		242
vanillin	C8H8O3	152.149	66	0.14	0.13	0.00	0.60		105, 242
vinyl acetate	C4H6O2	86.09	21	0.34	0.25	0.03	1.00	HAP, TOX	105, 236, 238
vinyl acetylene	C4H4	52.076	58	0.05	0.04	0.01	0.19		242
vinyl chloride	C2H3Cl	62.496	2	0.00	0.00	0.00	0.00	HAP, TOX	236
vinyl guaiacol	C9H10O2	150.177	58	0.15	0.16	0.01	0.84		242
vinylpyridine	C7H7N	105.14	58	0.00	0.00	0.00	0.02		242
water	H2O	18.015	55	0.66	0.39	0.09	1.63		242
xylenes	C8H10		10	0.08	0.03	0.04	0.13	HAP, TOX	236

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