APPENDIX AVAILABLE ON REQUEST

Research Report 133

Characterization of Metals Emitted from Motor Vehicles

Appendix D. Source Profiles: Tire Wear, Brake Housing Dust, and Resuspended Road Dust

James J Schauer et al

Correspondence may be addressed to Dr James J Schauer, Environmental Chemistry and Technology Program, University of Wisconsin, 660 N Park St, Madison WI 53706, *jschauer@engr.wisc.edu*.

Although this document was produced with partial funding by the United States Environmental Protection Agency under Assistance Award R82811201 to the Health Effects Institute, it has not been subjected to the Agency's peer and administrative review and therefore may not necessarily reflect the views of the Agency, and no official endorsement by it should be inferred. The contents of this document also have not been reviewed by private party institutions, including those that support the Health Effects Institute; therefore, it may not reflect the views or policies of these parties, and no endorsement by them should be inferred.

This document was reviewed by the HEI Health Review Committee but did not undergo the HEI scientific editing and production process.

APPENDIX D: TIRE WEAR PROFILES **SAMPLED TIRE DUST, normalized to total mass (mg species / g mass)**

		OC organic carbon		EC elemental C		Na sodium		Mg magnesium		Al aluminum		K potassium		Ca calcium		Fe iron	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**Tire 1**	653.4	34.4	9.31	1.12	0.418	0.033	0.729	0.032	0.324	0.020	0.215	0.015	1.203	0.122	2.894	0.685
PM10	**Tire 2**	708.5	37.7	3.61	0.82	0.099	0.039	0.060	0.031	0.100	0.025	0.065	0.018	0.407	0.146	0.000	0.817
PM10	**Tire 3**	702.8	36.1	4.42	0.88	0.000	0.023	0.015	0.018	0.029	0.015	0.010	0.011	0.037	0.086	0.057	0.486
PM2.5	**Tire 1**	634.9	32.4	4.55	0.79	0.105	0.045	0.080	0.017	0.082	0.054	0.064	0.032	0.000	0.138	1.341	0.069
PM2.5	**Tire 2**	653.4	33.5	3.03	0.80	0.073	0.052	0.018	0.020	0.033	0.063	0.043	0.038	0.000	0.162	0.246	0.074
PM2.5	**Tire 3**	619.3	31.4	3.56	0.78	0.025	0.031	0.000	0.012	0.010	0.037	0.011	0.022	0.000	0.095	0.000	0.044

		Ti titanium		V vanadium		Cr chromium		Mn manganese		Cu copper		Zn zinc		As arsenic		Ru rubidium	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**Tire 1**	0.199	0.032	0.0065	0.0011	0.0705	0.0039	0.1132	0.0054	0.4862	0.1319	0.5869	0.0683	0.0233	0.0073	0.0015	0.0010
PM10	**Tire 2**	0.000	0.039	0.0052	0.0014	0.0083	0.0043	0.0000	0.0063	0.0122	0.1647	0.2290	0.0738	0.0221	0.0086	0.0024	0.0013
PM10	**Tire 3**	0.005	0.023	0.0049	0.0008	0.0077	0.0026	0.0007	0.0037	0.0041	0.0980	0.2788	0.0439	0.0171	0.0051	0.0028	0.0007
PM2.5	**Tire 1**	0.036	0.003	0.0002	0.0004	0.0746	0.0027	0.0153	0.0006	0.1679	0.0066	3.3466	0.0791	0.0000	0.0076	0.0000	0.0005
PM2.5	**Tire 2**	0.004	0.003	0.0007	0.0005	0.0007	0.0028	0.0014	0.0006	0.0615	0.0071	0.2090	0.0826	0.0000	0.0085	0.0007	0.0005
PM2.5	**Tire 3**	0.005	0.002	0.0012	0.0003	0.0000	0.0017	0.0000	0.0003	0.0280	0.0042	0.2443	0.0486	0.0000	0.0050	0.0003	0.0002

		Sr strontium		Mo molybdenum		Ru ruthenium		Rh rhodium		Pd palladium		Ag silver		Cd cadmium		Sb antimony	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**Tire 1**	0.0370	0.0024	0.0066	0.0002	0.000	0.000	0.000	0.000	0.000	0.001	0.108	0.003	0.000	0.000	0.182	0.035
PM10	**Tire 2**	0.0000	0.0030	0.0003	0.0002	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.044
PM10	**Tire 3**	0.0000	0.0018	0.0004	0.0001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026
PM2.5	**Tire 1**	0.0021	0.0004	0.0046	0.0001	0.000	0.000	0.000	0.000	0.000	0.000	0.110	0.001	0.000	0.000	0.013	0.002
PM2.5	**Tire 2**	0.0000	0.0005	0.0002	0.0001	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.002
PM2.5	**Tire 3**	0.0000	0.0003	0.0001	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.001

		Cs cesium		Ba barium		Ce cerium		W tungsten		Pt platinum		Tl thallium		Pb lead		U uranium	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**Tire 1**	0.001	0.001	0.616	0.141	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
PM10	**Tire 2**	0.001	0.001	0.000	0.157	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
PM10	**Tire 3**	0.001	0.001	0.000	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
PM2.5	**Tire 1**	0.000	0.000	0.126	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
PM2.5	**Tire 2**	0.000	0.000	0.001	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
PM2.5	**Tire 3**	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX D: BRAKE WEAR PROFILES

RESUSPENDED BRAKE HOUSING DUST, normalized to total mass (mg species / g mass)

		OC		EC		Na		Mg		Al		K		Ca		Fe		Ti	
		organic carbon		elemental C		sodium		magnesium		aluminum		potassium		calcium		iron		titanium	
SIZE		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**A**	67.5	21.1	28.6	7.5	2.0	0.5	1.1	0.4	1.1	0.3	1.2	0.2	1.0	1.8	61.6	10.6	5.009	0.564
PM10	**B**	113.9	15.0	72.4	7.3	6.2	0.4	3.1	0.2	1.7	0.1	3.3	0.2	26.0	1.5	175.6	9.9	7.747	0.429
PM10	**C**	59.0	8.0	43.9	4.0	4.3	0.3	1.9	0.1	0.5	0.1	1.7	0.1	2.8	0.3	235.2	12.9	3.525	0.195
PM10	**D**	48.8	9.8	53.3	5.1	1.6	0.2	1.1	0.1	0.3	0.1	0.3	0.1	2.2	0.5	171.2	10.4	0.035	0.139
PM10	**E**	102.2	25.1	44.8	8.8	4.8	0.6	2.1	0.4	2.0	0.3	0.6	0.2	2.9	2.0	191.5	16.0	1.283	0.521
PM10	**F**	61.7	32.4	32.9	11.9	1.3	0.9	0.7	0.6	0.7	0.5	0.4	0.4	0.5	3.0	47.7	17.1	0.000	0.806
PM10	**G**	63.3	25.1	30.1	9.0	8.4	0.9	5.3	0.6	1.5	0.4	1.2	0.3	6.0	2.2	352.7	27.2	1.008	0.602
PM10	**H**	105.4	21.7	57.6	8.5	2.2	0.4	1.3	0.3	2.7	0.3	0.9	0.2	22.8	2.2	58.7	8.9	0.160	0.393
PM10	**I**	29.4	7.5	28.3	3.3	1.4	0.2	5.1	0.3	0.3	0.1	0.3	0.1	2.2	0.5	404.9	21.9	0.541	0.142
PM10	**J**	70.3	35.2	36.6	12.9	0.7	0.9	0.5	0.7	2.6	0.6	0.7	0.4	9.6	5.2	46.2	18.4	0.000	0.869
PM2.5	**A**	42.5	34.6	3.6	10.6	0.4	1.4	0.3	0.5	0.4	1.7	0.2	1.0	0.0	4.4	26.9	3.8	2.266	0.286
PM2.5	**B**	141.6	33.4	81.8	13.8	3.4	1.0	3.3	0.5	1.2	1.1	1.7	0.7	14.6	3.3	112.9	13.2	4.655	0.542
PM2.5	**C**	52.6	10.7	28.8	3.6	4.2	0.3	3.0	0.1	0.8	0.4	1.9	0.2	3.2	1.0	351.1	7.5	6.229	0.123
PM2.5	**D**	52.6	13.1	39.9	5.1	1.8	0.4	2.6	0.2	0.5	0.5	0.2	0.3	2.4	1.3	173.6	11.0	0.080	0.027
PM2.5	**E**	40.6	43.3	0.0	13.4	1.6	1.8	2.5	0.7	3.5	2.2	0.1	1.3	0.0	5.6	93.9	10.2	0.921	0.153
PM2.5	**F**	25.0	49.8	0.0	15.7	1.2	2.1	0.4	0.8	0.0	2.6	0.0	1.5	0.0	6.6	110.2	12.2	0.535	0.151
PM2.5	**G**	60.7	36.9	19.9	11.6	7.9	1.6	5.0	0.7	1.3	1.8	1.1	1.1	4.3	4.6	498.8	34.5	2.024	0.162
PM2.5	**H**	142.3	40.6	47.7	12.6	4.9	1.5	4.6	0.6	5.7	1.8	1.3	1.1	47.2	5.2	265.7	14.2	0.844	0.104
PM2.5	**I**	20.3	7.8	4.3	2.3	0.5	0.3	4.2	0.4	0.2	0.4	0.1	0.2	0.8	0.9	334.5	21.1	0.388	0.031
PM2.5	**J**	7.2	55.0	0.0	17.5	3.6	2.4	2.5	0.9	0.7	2.9	1.4	1.7	0.0	7.4	230.9	23.7	0.622	0.167

		V vanadium		Cr chromium		Mn manganese		Cu copper		Zn zinc		As arsenic		Ru rubidium		Sr strontium		Mo molybdenum	
SIZE		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**A**	0.000	0.016	0.068	0.052	0.373	0.079	21.152	2.379	7.473	1.000	0.000	0.103	0.000	0.014	0.210	0.038	0.001	0.003
PM10	**B**	0.012	0.005	0.536	0.032	1.234	0.071	32.459	1.833	14.155	0.812	0.036	0.032	0.013	0.004	0.394	0.023	0.026	0.002
PM10	**C**	0.120	0.007	0.312	0.018	2.881	0.147	3.709	0.360	3.385	0.220	0.001	0.016	0.001	0.002	0.131	0.009	0.014	0.001
PM10	**D**	0.003	0.005	0.233	0.019	1.423	0.088	0.215	0.582	11.526	0.717	0.000	0.030	0.001	0.004	0.048	0.011	0.019	0.001
PM10	**E**	0.000	0.017	0.350	0.060	1.426	0.121	5.761	2.183	3.717	0.991	0.000	0.112	0.000	0.015	0.180	0.040	0.037	0.004
PM10	**F**	0.081	0.027	0.136	0.088	0.251	0.130	0.064	3.377	1.078	1.507	0.217	0.175	0.028	0.023	0.040	0.061	0.020	0.005
PM10	**G**	0.070	0.020	0.456	0.071	2.614	0.194	0.921	2.496	5.616	1.174	0.199	0.130	0.038	0.018	0.219	0.047	0.031	0.004
PM10	**H**	0.041	0.013	0.123	0.043	0.391	0.067	0.442	1.640	0.692	0.734	0.115	0.086	0.000	0.011	0.061	0.030	0.053	0.004
PM10	**I**	0.212	0.012	0.225	0.019	1.706	0.096	0.710	0.581	0.813	0.262	0.071	0.030	0.008	0.004	0.140	0.013	0.027	0.002
PM10	**J**	0.061	0.029	0.166	0.095	0.199	0.139	0.124	3.635	0.239	1.623	0.235	0.189	0.001	0.025	0.034	0.065	0.064	0.007
PM2.5	**A**	0.010	0.011	0.057	0.078	0.122	0.023	9.421	1.182	2.398	2.277	0.084	0.231	0.000	0.008	0.094	0.017	0.001	0.001
PM2.5	**B**	0.020	0.008	0.386	0.066	0.834	0.097	16.281	1.893	7.308	1.661	0.085	0.147	0.004	0.005	0.309	0.037	0.014	0.002
PM2.5	**C**	0.141	0.004	0.451	0.020	2.586	0.028	3.548	0.102	4.907	0.530	0.029	0.054	0.003	0.002	0.208	0.005	0.017	0.000
PM2.5	**D**	0.016	0.003	0.281	0.028	1.385	0.085	0.195	0.063	10.753	0.933	0.039	0.066	0.006	0.002	0.096	0.007	0.019	0.001
PM2.5	**E**	0.019	0.015	0.237	0.106	0.644	0.070	3.667	0.472	1.030	2.890	0.245	0.299	0.018	0.011	0.110	0.020	0.010	0.002
PM2.5	**F**	0.038	0.018	0.062	0.117	0.625	0.071	3.024	0.627	2.362	3.388	0.000	0.347	0.000	0.014	0.078	0.020	0.033	0.004
PM2.5	**G**	0.039	0.012	0.519	0.087	3.752	0.234	3.596	0.309	8.012	2.401	0.000	0.243	0.014	0.012	0.282	0.022	0.044	0.003
PM2.5	**H**	0.047	0.012	0.246	0.080	1.519	0.079	3.619	0.511	2.594	2.300	0.000	0.238	0.000	0.010	0.275	0.019	0.150	0.007
PM2.5	**I**	0.162	0.011	0.119	0.018	1.376	0.085	0.846	0.073	0.295	0.476	0.000	0.049	0.001	0.002	0.101	0.007	0.019	0.001
PM2.5	**J**	0.013	0.019	0.262	0.133	1.222	0.124	5.080	0.855	2.905	3.805	0.000	0.389	0.000	0.015	0.253	0.033	0.225	0.022

		Ru ruthenium		Rh rhodium		Pd palladium		Ag silver		Cd cadmium		Sb antimony		Cs cesium		Ba barium		Ce cerium	
SIZE		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**A**	0.001	0.003	0.000	0.001	0.000	0.009	0.001	0.008	0.000	0.001	10.258	0.822	0.000	0.011	10.010	1.997	0.000	0.000
PM10	**B**	0.000	0.001	0.000	0.000	0.000	0.003	0.000	0.002	0.000	0.000	5.541	0.587	0.000	0.004	19.327	1.197	0.000	0.000
PM10	**C**	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.597	0.089	0.000	0.002	14.704	1.046	0.001	0.000
PM10	**D**	0.000	0.001	0.000	0.000	0.000	0.003	0.002	0.002	0.000	0.000	0.000	0.154	0.000	0.003	4.079	0.603	0.000	0.000
PM10	**E**	0.002	0.003	0.000	0.001	0.000	0.010	0.000	0.008	0.000	0.001	1.450	0.580	0.000	0.012	9.963	2.145	0.000	0.001
PM10	**F**	0.000	0.004	0.004	0.002	0.026	0.016	0.000	0.013	0.001	0.001	0.000	0.896	0.027	0.019	3.836	3.227	0.002	0.001
PM10	**G**	0.000	0.003	0.004	0.002	0.025	0.012	0.000	0.010	0.002	0.001	0.996	0.668	0.031	0.014	16.894	2.625	0.004	0.000
PM10	**H**	0.000	0.002	0.001	0.001	0.000	0.008	0.000	0.006	0.001	0.000	0.000	0.437	0.003	0.009	3.921	1.584	0.001	0.000
PM10	**I**	0.000	0.001	0.001	0.000	0.002	0.003	0.000	0.002	0.001	0.000	0.236	0.155	0.005	0.003	16.784	1.062	0.001	0.000
PM10	**J**	0.000	0.005	0.002	0.003	0.000	0.017	0.000	0.014	0.001	0.001	0.000	0.966	0.011	0.021	3.399	3.475	0.001	0.001
PM2.5	**A**	0.000	0.008	0.000	0.003	0.000	0.007	0.000	0.025	0.000	0.011	2.558	0.316	0.000	0.006	4.790	0.647	0.001	0.003
PM2.5	**B**	0.000	0.005	0.000	0.002	0.000	0.004	0.000	0.016	0.000	0.007	4.707	0.545	0.000	0.004	17.501	2.026	0.003	0.002
PM2.5	**C**	0.000	0.002	0.000	0.001	0.000	0.002	0.000	0.006	0.000	0.003	3.513	0.226	0.000	0.002	18.516	0.228	0.003	0.001
PM2.5	**D**	0.000	0.002	0.000	0.001	0.001	0.002	0.002	0.007	0.000	0.003	0.000	0.016	0.004	0.002	6.809	0.428	0.001	0.001
PM2.5	**E**	0.000	0.010	0.000	0.003	0.000	0.009	0.000	0.031	0.000	0.014	0.898	0.120	0.011	0.009	6.303	0.760	0.006	0.004
PM2.5	**F**	0.018	0.012	0.008	0.004	0.001	0.011	0.012	0.037	0.000	0.017	0.451	0.098	0.000	0.010	6.769	0.843	0.000	0.004
PM2.5	**G**	0.013	0.008	0.009	0.003	0.007	0.008	0.010	0.026	0.000	0.012	1.981	0.136	0.000	0.008	19.903	1.277	0.000	0.003
PM2.5	**H**	0.012	0.008	0.001	0.003	0.000	0.007	0.007	0.025	0.000	0.012	0.473	0.062	0.000	0.007	19.781	1.012	0.000	0.003
PM2.5	**I**	0.003	0.002	0.001	0.001	0.000	0.001	0.002	0.005	0.000	0.002	0.159	0.016	0.000	0.002	11.478	0.715	0.000	0.001
PM2.5	**J**	0.020	0.013	0.002	0.004	0.000	0.011	0.013	0.041	0.000	0.019	0.313	0.100	0.000	0.011	21.373	2.175	0.000	0.005

		W tungsten		Pt platinum		Tl thallium		Pb lead		U uranium	
SIZE		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	**A**	0.002	0.005	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000
PM10	**B**	0.002	0.002	0.000	0.000	0.000	0.000	0.038	0.002	0.000	0.000
PM10	**C**	0.003	0.001	0.000	0.000	0.000	0.000	0.014	0.001	0.000	0.000
PM10	**D**	0.001	0.001	0.000	0.000	0.000	0.000	0.010	0.001	0.000	0.000
PM10	**E**	0.000	0.005	0.000	0.001	0.000	0.001	0.007	0.003	0.000	0.000
PM10	**F**	0.000	0.008	0.001	0.001	0.001	0.001	0.004	0.004	0.000	0.000
PM10	**G**	0.003	0.006	0.001	0.001	0.001	0.001	0.017	0.003	0.000	0.000
PM10	**H**	0.003	0.004	0.000	0.000	0.000	0.000	0.015	0.002	0.000	0.000
PM10	**I**	0.007	0.001	0.000	0.000	0.000	0.000	0.006	0.001	0.000	0.000
PM10	**J**	0.000	0.009	0.000	0.001	0.000	0.001	0.004	0.004	0.000	0.000
PM2.5	**A**	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.000
PM2.5	**B**	0.001	0.002	0.000	0.000	0.000	0.000	0.016	0.012	0.000	0.000
PM2.5	**C**	0.003	0.001	0.000	0.000	0.000	0.000	0.015	0.004	0.000	0.000
PM2.5	**D**	0.001	0.001	0.000	0.000	0.001	0.000	0.008	0.005	0.000	0.000
PM2.5	**E**	0.000	0.003	0.000	0.001	0.002	0.001	0.000	0.023	0.001	0.000
PM2.5	**F**	0.006	0.004	0.000	0.001	0.000	0.001	0.000	0.027	0.000	0.000
PM2.5	**G**	0.008	0.003	0.000	0.000	0.000	0.000	0.005	0.019	0.000	0.000
PM2.5	**H**	0.006	0.003	0.000	0.000	0.000	0.000	0.005	0.019	0.000	0.000
PM2.5	**I**	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000
PM2.5	**J**	0.006	0.004	0.000	0.001	0.000	0.001	0.000	0.031	0.000	0.000

APPENDIX D: RESUSPENDED ROAD DUST PROFILES

RESUSPENDED ROAD DUST, normalized to total mass (mg species / g mass)

		OC		EC		Cl^-		NO_3^-		SO_4^{2-}		NH_4^+		Na		Mg		Al	
SIZE	SAMPLE	organic carbon		elemental C		chloride		nitrate		sulfate		ammonium		sodium		magnesium		aluminum	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	KILBORN SUMMER	91.50	25.91	21.08	5.70	7.15	3.54	0.00	2.06	35.09	17.34	0.00	0.69	7.60	0.99	7.29	0.90	10.85	3.45
PM10	KILBORN WINTER	110.73	18.01	14.62	3.66	72.13	5.26	2.33	1.18	28.73	9.78	0.00	0.39	14.60	1.20	2.24	0.33	0.00	1.82
PM10	HOWELL SUMMER	93.93	13.37	7.97	2.55	12.62	1.57	8.60	0.96	16.74	7.10	0.13	0.29	0.61	0.15	1.44	0.19	0.34	1.36
PM10	HOWELL WINTER	153.29	19.08	16.48	3.73	29.50	2.35	14.39	1.28	29.40	8.25	0.06	0.33	2.48	0.22	3.28	0.29	0.46	1.54
PM2.5	KILBORN SUMMER	79.91	41.80	0.57	9.20	15.22	7.43	6.98	4.44	59.84	36.31	0.00	1.47	3.00	0.73	3.11	0.54	0.00	6.87
PM2.5	KILBORN WINTER	95.21	25.16	12.72	5.19	49.38	5.14	2.08	2.23	38.74	18.37	0.00	0.74	5.58	0.77	-0.14	0.23	0.00	3.45
PM2.5	HOWELL SUMMER	81.70	16.55	10.23	3.23	5.61	2.25	0.00	1.33	22.83	10.97	0.00	0.44	3.67	0.31	13.49	0.94	15.09	2.33
PM2.5	HOWELL WINTER	131.47	27.95	15.72	5.44	19.25	4.00	1.20	2.28	36.53	18.78	0.00	0.76	8.11	0.75	6.86	0.76	2.65	3.56

		K		Ca		Fe		Ti		V		Cr		Mn		Cu		Zn	
SIZE	SAMPLE	potassium		calcium		iron		titanium		vanadium		chromium		manganese		copper		zinc	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	KILBORN SUMMER	10.47	1.34	26.69	3.22	41.44	5.02	3.68	0.45	0.08	0.01	0.38	0.05	0.62	0.07	0.31	0.04	1.47	0.20
PM10	KILBORN WINTER	6.00	0.57	13.64	1.19	12.11	0.91	1.16	0.10	0.03	0.00	0.25	0.02	0.31	0.02	0.27	0.02	0.95	0.08
PM10	HOWELL SUMMER	2.30	1.87	5.61	6.52	3.66	2.93	0.52	0.06	0.02	0.00	0.05	0.00	0.11	0.01	0.06	0.00	0.15	0.04
PM10	HOWELL WINTER	1.81	0.15	10.16	0.89	6.65	0.50	0.52	0.06	0.02	0.00	0.07	0.00	0.10	0.01	0.33	0.02	0.20	0.05
PM2.5	KILBORN SUMMER	4.99	0.64	13.67	1.67	21.65	2.14	2.47	0.29	0.06	0.01	0.29	0.02	0.35	0.03	0.20	0.02	1.27	0.22
PM2.5	KILBORN WINTER	4.32	0.49	4.56	0.89	8.74	0.93	0.82	0.14	0.02	0.01	0.16	0.01	0.20	0.02	0.57	0.04	0.63	0.11
PM2.5	HOWELL SUMMER	15.30	0.90	47.25	3.58	31.52	1.97	3.00	0.19	0.06	0.01	0.42	0.02	0.57	0.03	0.49	0.03	1.08	0.09
PM2.5	HOWELL WINTER	6.91	0.55	26.57	2.28	21.18	1.52	2.05	0.18	0.04	0.01	0.38	0.03	0.37	0.03	0.41	0.03	1.08	0.13

		As		Ru		Sr		Mo		Ru		Rh		Pd		Ag		Cd	
SIZE	SAMPLE	arsenic		rubidium		strontium		molybdenum		ruthenium		rhodium		palladium		silver		cadmium	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	KILBORN SUMMER	0.00	0.00	0.04	0.00	0.23	0.03	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
PM10	KILBORN WINTER	0.00	0.00	0.03	0.00	0.10	0.01	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM10	HOWELL SUMMER	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM10	HOWELL WINTER	0.00	0.00	0.01	0.00	0.05	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
PM2.5	KILBORN SUMMER	0.00	0.00	0.01	0.00	0.13	0.01	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
PM2.5	KILBORN WINTER	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
PM2.5	HOWELL SUMMER	0.01	0.00	0.06	0.00	0.16	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00
PM2.5	HOWELL WINTER	0.01	0.00	0.03	0.00	0.14	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00

		Sb		Cs		Ba		Ce		W		Pt		Tl		Pb		U	
SIZE	SAMPLE	antimony		cesium		barium		cerium		tungsten		platinum		thallium		lead		uranium	
		avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
PM10	KILBORN SUMMER	0.01	0.02	0.00	0.00	0.68	0.08	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.35	0.04	0.00	0.00
PM10	KILBORN WINTER	0.00	0.01	0.00	0.00	0.31	0.02	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.20	0.01	0.00	0.00
PM10	HOWELL SUMMER	0.00	0.01	0.00	0.00	0.10	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
PM10	HOWELL WINTER	0.00	0.01	0.00	0.00	0.13	0.01	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
PM2.5	KILBORN SUMMER	0.00	0.05	0.00	0.00	0.43	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.02	0.00	0.00
PM2.5	KILBORN WINTER	0.00	0.02	0.00	0.00	0.16	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.14	0.01	0.00	0.00
PM2.5	HOWELL SUMMER	0.00	0.01	0.00	0.00	0.55	0.03	0.03	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.22	0.01	0.00	0.00
PM2.5	HOWELL WINTER	0.00	0.02	0.00	0.00	0.44	0.03	0.01	0.00	0.12	0.01	0.00	0.00	0.00	0.00	0.22	0.01	0.00	0.00