Appendix A
Concentrations of Hazardous Air Pollutants
Loudon, Loudon County, Tennessee
November 15, 2003 –December 24, 2005

The table is continued for 10 pages, with 2 pages for each time period.

Hazardous Air Pollutants, Loudon County, Tennessee, November 15, 2003 – April 9, 2004

Compound (ppbv)	11/5/2003	11/17/2003	11/29/2003	12/11/2003	12/23/2003	1/4/2004	1/16/2004	1/28/2004	2/9/2004	2/21/2004	3/4/2004	3/22/2004	3/28/2004	4/9/2004
Canister Results														
1,1,1-Trichloroethane	0.03													
1,1,2,2-Tetrachloroethane														
1,1,2-Trichloroethane														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,2,4-Trichlorobenzene														
1,2,4-Trimethylbenzene	2.26	0.17							0.08	0.08	0.14	0.06	0.12	
1,2-Dibromoethane														
1,2-Dichloroethane														
1,2-Dichloropropane														
1,3,5-Trimethylbenzene	0.81									0.04	0.05		0.04	
1,3-Butadiene	0.05													
Acetonitrile	116.85	294.00	192.81	67.79	237.35	*Note		*Note	*Note	*Note	*Note	*Note	*Note	*Note
Acetylene	0.56	2.63	0.69	0.87	1.12	0.36		0.6	0.96	0.77	1.11	0.74	0.69	0.52
Acrolein (Added New July 2005)														
Acrylonitrile														
Benzene	0.49	0.68	0.19	0.24	0.27	0.19		0.22	0.27	0.24	0.34	0.19	0.27	0.2
Bromochloromethane														
Bromodichloromethane														
Bromoform														
Bromomethane	0.02													
Carbon Tetrachloride	0.08				0.07			0.09	0.06	0.07	0.09		0.08	0.08
Chlorobenzene														
Chloroethane	0.30													
Chloroform	0.18									0.04				0.11
Chloromethane	0.65	0.53	0.48	0.49	0.52	0.57		0.51		0.67	0.51	0.56	0.51	0.5
Chloromethylbenzene														
Chloroprene														
cis-1,2-Dichloroethylene														
cis-1,3-Dichloropropene														
Dibromochloromethane														
Dichlorodifluoromethane	0.47	0.56	0.61	0.55	0.57	0.57		0.49	0.5	0.59	0.48	0.55	0.49	0.47
Dichloromethane	0.12													
Dichlorotetrafluoroethane														
Ethyl Acrylate														

Hazardous Air Pollutants, Loudon County, Tennessee, November 15, 2003 – April 9, 2004, continued

Compound (ppbv)	11/5/2003	11/17/2003	11/29/2003	12/11/2003	12/23/2003	1/4/2004	1/16/2004	1/28/2004	2/9/2004	2/21/2004	3/4/2004	3/22/2004	3/28/2004	4/9/2004
Ethyl tert-Butyl Ether														
Ethylbenzene	0.47	0.15						0.04	0.06	0.06	0.13	0.04	0.09	
Hexachloro-1,3-Butadiene														
m,p-Xylene	2.27	0.46		0.15	0.12			0.1	0.16	0.14	0.34	0.12	0.24	0.12
m-Dichlorobenzene														
Methyl Ethyl Ketone		1.37	0.87	0.90	0.71	1.21			4.7	1.07	10.8	0.85	1.3	1.1
Methyl Isobutyl Ketone	15.06										0.3		0.11	
Methyl Methacrylate														
Methyl tert-Butyl Ether														
n-Octane	1.67										0.09			
o-Dichlorobenzene														
o-Xylene	1.03	0.22						0.05	0.07	0.07	0.14	0.06	0.11	0.05
p-Dichlorobenzene	0.04													
Propylene	0.59	0.98	0.13	0.25	0.25	0.11		0.21	0.3	0.21	0.39	0.21	0.31	0.19
Styrene	0.46	0.48						0.1		0.05	0.48	0.12	0.08	
tert-Amyl Methyl Ether														
Tetrachloroethylene	0.03													
Toluene	6.00	1.31	0.30	0.50	0.48	0.46		0.31	0.4	0.3	0.73	0.19	0.49	0.27
trans-1,2-Dichloroethylene														
trans-1,3-Dichloropropene														
Trichloroethylene														
Trichlorofluoromethane	0.62	0.23	0.27	0.42	0.27	0.31		0.24	0.25	0.3	0.26	0.26	0.23	0.23
Trichlorotrifluoroethane	0.09	0.23	0.19	0.19	0.22					0.11	0.15	0.09		0.13
Vinyl Chloride														
Cartridge Results														
2,5-Dimethylbenzaldehyde	0.07	0.07	0.06	0.03	0.04	0.038	0.067	0.07	0.025	0.036		0.008	0.007	0.016
Acetaldehyde	3.27	4.06	2.12	1.27	3.49	4.71	2.68	1.47	2.66	2.48	3.45	1.26	4.59	2.98
Acetone	0.02	0.05	0.31	7.51	4.08	1.17	8.56	7.88	6.77	6.04	2.2	8.05	2.18	5.67
Benzaldehyde	0.49	0.47	0.13	0.10	0.19	0.317	0.193	0.103	0.185	0.236	0.457	0.122	0.346	0.222
Butyr/Isobutyraldehyde	0.79	1.76	5.06	4.46	3.27	1.34	6.09	3.46	4.94	3.87	2.59	3.33	1.72	3.57
Crotonaldehyde	0.19	0.10	0.04	0.03	0.05	0.071	0.039	0.09	0.057	0.057	0.095	0.047	0.092	0.073
Formaldehyde	33.36	40.00	13.86	11.81	17.73	30.8	12.3	6.26	14.4	18.9	27.4	10.1	23.9	16.8
Hexaldehyde	3.82	4.45	1.31	1.13	2.70	3.2	1.93	0.882	2.26	2.45	2.93	0.961	2.72	1.76
Isovaleraldehyde	0.16	0.06	0.13		0.35	0.122	0.029	0.09	0.044		0.159	0.016	0.071	
Propionaldehyde	0.02	0.02	0.005	0.07	0.22	0.302	0.282	0.121	0.216	0.211	0.254	0.141	0.443	0.268
Tolualdehydes	0.65	1.04	0.58	0.30	0.64	0.789	0.282	0.054	0.267	0.372	0.272	0.103	0.274	0.303
Valeraldehyde	1.45	1.18	0.32	0.24	0.61	0.77	0.445	0.213	0.514	0.606	0.76	0.273	0.789	0.534

Hazardous Air Pollutants, Loudon County, Tennessee, April 18 – September 12, 2004

Compound (ppbv)	4/18/2004	4/21/2004	5/3/2004	5/15/2004	5/27/2004	6/8/2004	6/19/2004	7/2/2004	7/14/2004	7/26/2004	8/7/2004	8/19/2004	8/31/2004	9/12/2004
Canister Results														
1,1,1-Trichloroethane														
1,1,2,2-Tetrachloroethane														
1,1,2-Trichloroethane														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,2,4-Trichlorobenzene														
1,2,4-Trimethylbenzene														
1,2-Dibromoethane	0.08	0.09	0.09	0.09	0.09	0.09	0.22	0.21	0.14	0.13	0.14	0.2	0.14	0.16
1,2-Dichloroethane														
1,2-Dichloropropane														
1,3,5-Trimethylbenzene														
1,3-Butadiene							0.06	0.06	0.04			0.07	0.04	0.05
Acetonitrile														
Acetylene	1.17	2.43	2.65	1.05	1.89	1.28	*Note	*Note	*Note	*Note	*Note	*Note	*Note	*Note
Acrolein (Added New July 2005)	0.6	0.42	0.51	0.52	0.39	1.27	0.32		0.36	0.49	0.48	0.8	0.56	0.85
Acrylonitrile														
Benzene		0.26					0.33			0.38				
Bromochloromethane	0.42	0.39	0.31	0.27	0.28	1.11	0.4	0.46	0.29	0.27	0.17	0.45	0.45	0.36
Bromodichloromethane														
Bromoform														
Bromomethane														
Carbon Tetrachloride														
Chlorobenzene	0.1	0.07	0.09	0.07	0.09	0.09	0.1	0.08	0.07	0.11	0.09	0.11	0.1	0.11
Chloroethane														
Chloroform										0.15		0.13		
Chloromethane	0.14			0.15	0.07	0.15	0.04	0.04	0.05	0.04		0.06		0.05
Chloromethylbenzene	0.53	0.5	0.51	0.66	0.69	0.67	0.68	0.94	0.68	0.93	0.7	0.71	0.62	0.71
Chloroprene														
cis-1,2-Dichloroethylene														
cis-1,3-Dichloropropene														
Dibromochloromethane														
Dichlorodifluoromethane														
Dichloromethane	0.49	0.49	0.5	0.53	0.58	0.54	0.65	0.76	0.62	0.84	0.75	0.72	0.72	0.78
Dichlorotetrafluoroethane						0.12				0.14	0.12		0.76	
Ethyl Acrylate										0.03				

Hazardous Air Pollutants, Loudon County, Tennessee, April 18 – September 12, 2004, continued

Compound (ppbv)	4/18/2004	4/21/2004	5/3/2004	5/15/2004	5/27/2004	6/8/2004	6/19/2004	7/2/2004	7/14/2004	7/26/2004	8/7/2004	8/19/2004	8/31/2004	9/12/2004
Ethyl tert-Butyl Ether	0.06	0.09	0.08	0.06	0.08	0.1	0.16	0.15	0.1	0.09	0.08	0.15	0.12	0.12
Ethylbenzene														
Hexachloro-1,3-Butadiene	0.16	0.22	0.19	0.14	0.17	0.25	0.52	0.43	0.28	0.26	0.18	0.39	0.28	0.3
m,p-Xylene														
m-Dichlorobenzene	0.67	2.81	4.19	1.18	5.87	3.22	4.32	5.14	6.32	7.59	1.16	3.15	1.77	2.25
Methyl Ethyl Ketone		0.2	0.14		0.24	0.23	0.21	0.4	0.35	0.25		0.54	0.4	0.42
Methyl Isobutyl Ketone														
Methyl Methacrylate								0.23			0.27			
Methyl tert-Butyl Ether		0.14			0.09		0.12	0.14	0.11	0.09		0.16		0.08
n-Octane														
o-Dichlorobenzene	0.07	0.1	0.09	0.07	0.07	0.11	0.21	0.18	0.12	0.11	0.09	0.16	0.13	0.14
o-Xylene														
p-Dichlorobenzene	0.17	0.16	0.36	0.25	0.29	0.4	0.35		0.22	0.29	0.48	0.41	0.18	0.32
Propylene	0.06	0.05	0.14	0.09	0.13	0.29	0.11	0.08	0.12	0.06		0.28	0.21	0.06
Styrene														
tert-Amyl Methyl Ether														
Tetrachloroethylene	0.56	0.87	0.63	0.4	0.58	0.98	1.07	1.01	0.68	0.57	0.31	0.97	0.83	0.72
Toluene														
trans-1,2-Dichloroethylene				0.11										
trans-1,3-Dichloropropene														
Trichloroethylene	0.23	0.23	0.24	0.29	0.29	0.23	0.34	0.4	0.3	0.4	0.39	0.33	0.5	0.36
Trichlorofluoromethane	0.18	0.19	0.17		0.16	0.15		0.1	0.15	0.12	0.15	0.18	0.16	0.18
Trichlorotrifluoroethane														
Vinyl Chloride														
Cartridge Results					0.002				0.009	*				
2,5-Dimethylbenzaldehyde	2.78	2.13	0.518	1.58	1.48	1.86	0.712	1.28	1.01	*	1.07		0.709	1.32
Acetaldehyde	1.39	0.67	1	0.735	0.595	0.708	0.468	0.32	0.584	*	1.1		0.432	0.598
Acetone	0.064	0.039	0.02	0.058	0.051	0.123	0.046	0.026	0.038	*	0.021		0.04	0.014
Benzaldehyde	0.169	0.124	0.071	0.113	0.092	0.113	0.089	0.081	0.105	*	0.109		0.069	0.086
Butyr/Isobutyraldehyde	0.064	0.069	0.027	0.309	0.356	0.5	0.594	0.281	0.565	*	0.258		0.377	0.325
Crotonaldehyde	2.54	2.05	0.715	2.66	3.1	3.39	2.98	2.28	3.14	*	2.61		2.7	2.52
Formaldehyde	0.16	0.072	0.031	0.073	0.049	0.061	0.049	0.037	0.047	*	0.056		0.026	0.04
Hexaldehyde	0.123	0.075	0.006	0.053	0.026	0.049	0.021	0.032	0.023	*	0.014			0.029
Isovaleraldehyde	0.125	0.063	0.052	0.109	0.083	0.133	0.094	0.119	0.137	*	0.118		0.107	0.091
Propionaldehyde	0.033	0.017	0.021	0.043	0.043	0.02	0.048	0.024	0.026	*	0.042		0.015	0.025
Tolualdehydes	0.064	0.041	0.022	0.04	0.027	0.038	0.033	0.03	0.031	*	0.032		0.019	0.026
Valeraldehyde														

Hazardous Air Pollutants, Loudon County, Tennessee, September 24, 2004 – February 27. 2005

Compound (ppbv)	9/24/2004	10/18/2004	10/30/2004	11/5/2004	11/11/2004	11/23/2004	12/5/2004	12/17/2004	12/29/2004	1/10/2005	1/22/2005	2/3/2005	2/15/2005	2/27/2005
Canister Results														
1,1,1-Trichloroethane														
1,1,2,2-Tetrachloroethane														
1,1,2-Trichloroethane														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,2,4-Trichlorobenzene														
1,2,4-Trimethylbenzene	0.14	0.09	0.1	0.21	0.09	0.11	0.08	0.09	0.14	0.11	0.08	0.11	0.09	0.16
1,2-Dibromoethane														
1,2-Dichloroethane														
1,2-Dichloropropane														
1,3,5-Trimethylbenzene	0.06			0.06		0.07	0.06		0.04	0.05	0.04		0.04	0.05
1,3-Butadiene	0.07			0.09	0.06						0.07			
Acetonitrile		*Note	*Note		*Note									
Acetylene	1.71	0.44	0.62	2.14	0.89	0.86	1.56	1.76	1.49	1.13	1.01	1.08	0.67	1.13
Acrolein (Added New July 2005)														
Acrylonitrile														
Benzene	0.57	0.2	0.34	0.55	0.28	0.28	0.6	0.59	0.69	0.53	0.44	0.48	0.41	0.93
Bromochloromethane														
Bromodichloromethane														
Bromoform														
Bromomethane														
Carbon Tetrachloride	0.1	0.12	0.07	0.09	0.06	0.07	0.12	0.07	0.08	0.09	0.09	0.08	0.09	0.12
Chlorobenzene														
Chloroethane														
Chloroform	0.17				0.15		0.06		0.1	0.08				
Chloromethane	0.62	0.74	0.75	0.73	0.48	0.47	0.55		0.49	0.5	0.5	0.51	0.59	0.69
Chloromethylbenzene														
Chloroprene														
cis-1,2-Dichloroethylene														
cis-1,3-Dichloropropene														
Dibromochloromethane														
Dichlorodifluoromethane	0.73	0.7	0.42	0.67	0.47	0.45	0.67	0.52	0.49	0.51	0.52	0.51	0.56	0.64
Dichloromethane				0.16						0.1	0.09	0.14		
Dichlorotetrafluoroethane														
Ethyl Acrylate														

Hazardous Air Pollutants, Loudon County, Tennessee, September 24, 2004 – February 27. 2005, continued

Compound (ppbv)	9/24/2004	10/18/2004	10/30/2004	11/5/2004	11/11/2004	11/23/2004	12/5/2004	12/17/2004	12/29/2004	1/10/2005	1/22/2005	2/3/2005	2/15/2005	2/27/2005
Ethyl tert-Butyl Ether														
Ethylbenzene	0.13	0.09	0.07	0.23	0.07	0.09	0.11	0.09	0.12	0.08	0.07	0.09	0.06	0.13
Hexachloro-1,3-Butadiene														
m,p-Xylene	0.35	0.16	0.15	0.46	0.17	0.24	0.22	0.19	0.25	0.17	0.12	0.17	0.12	0.26
m-Dichlorobenzene														
Methyl Ethyl Ketone	0.45	0.39	1.33		0.73	0.33	0.36	0.51	0.92	0.9	0.4	0.42	0.37	0.63
Methyl Isobutyl Ketone		1.27	0.35		0.19	0.14			0.18	0.24			0.23	
Methyl Methacrylate														
Methyl tert-Butyl Ether	0.09													
n-Octane		0.06	0.06	0.09										
o-Dichlorobenzene														
o-Xylene	0.15	0.08	0.07	0.21	0.08	0.11	0.12	0.11	0.14	0.11	0.08	0.09	0.07	0.14
p-Dichlorobenzene														
Propylene	0.55	0.32	0.24	1.1	0.41	0.39	0.59	0.53	0.68	0.41	0.35	0.33	0.24	0.6
Styrene	0.5	0.07	0.05	0.09	0.39	0.61	0.13	0.12	0.23	0.28	0.06	0.24	0.25	0.24
tert-Amyl Methyl Ether														
Tetrachloroethylene				0.06										
Toluene	0.74	0.46	0.46	2.61	0.41	0.5	0.48	0.55	0.75	0.55	0.62	0.63	0.43	0.74
trans-1,2-Dichloroethylene														
trans-1,3-Dichloropropene														
Trichloroethylene														
Trichlorofluoromethane	0.33	0.44	0.18	1.49	0.24	0.25	0.34	0.23	0.24	0.24	0.26	0.32	0.23	0.27
Trichlorotrifluoroethane	0.14	0.09	0.1	0.09	0.11	0.09	0.1		0.1	0.13	0.1	0.12	0.11	0.11
Vinyl Chloride														
Cartridge Results														
2,5-Dimethylbenzaldehyde											**			
Acetaldehyde	1.53	1.34	1.87	1.43	0.943	0.367	1.21	2.14	1.21	0.818	**	0.374	0.661	1.49
Acetone	0.768	0.479	0.358	1.28	0.548	0.701	1.51	2.44	1.64	1.06	**	1.21	1.03	2.62
Benzaldehyde	0.061	0.045	0.025	0.02	0.086	0.03	0.018	0.048	0.036	0.025	**	0.014	0.078	0.04
Butyr/Isobutyraldehyde	0.107	0.114	0.102	0.071	0.119	0.05	0.104	0.138	0.107	0.09	**	0.051	0.06	0.131
Crotonaldehyde	0.284	0.074	0.076	0.018	0.034	0.016	0.064	0.04	0.059	0.033	**	0.014	0.02	0.063
Formaldehyde	2.75	1.32	1.61	1.17	0.989	0.601	1.19	1.56	1.61	1.22	**	0.378	1.01	1.8
Hexaldehyde	0.04	0.052	0.033	0.018	0.031	0.015	0.033	0.055	0.033	0.021	**	0.015	0.018	0.036
Isovaleraldehyde	0.03	0.065	0.053	0.023	0.071		0.031	0.058		0.018	**		0.025	0.016
Propionaldehyde	0.095	0.084	0.061	0.03	0.06	0.039	0.1	0.141	0.129	0.084	**	0.051	0.062	0.155
Tolualdehydes	0.039	0.04	0.015	0.013	0.02	0.013	0.028	0.049	0.037	0.014	**	0.008	0.014	0.036
Valeraldehyde	0.034	0.03	0.026	0.025	0.023	0.01	0.02	0.033	0.023	0.02	**	0.01	0.015	0.025

Hazardous Air Pollutants, Loudon County, Tennessee, March 11, 2005 – August 26, 2005

Compound (ppbv)	3/11/2005	3/23/2005	4/4/2005	4/16/2005	4/28/2005	5/10/2005	5/22/2005	6/15/2005	6/27/2005	7/9/2005	7/21/2005	8/2/2005	8/14/2005	8/26/2005
Canister Results														
1,1,1-Trichloroethane										0.02	0.02	***	0.02	0.03
1,1,2,2-Tetrachloroethane											0.03	***		
1,1,2-Trichloroethane												***		
1,1-Dichloroethane												***		
1,1-Dichloroethene												***		
1,2,4-Trichlorobenzene												***	0.03	
1,2,4-Trimethylbenzene	0.07	0.11	0.15		0.13	0.21			0.15	0.11	1.03	***	0.11	0.2
1,2-Dibromoethane												***		
1,2-Dichloroethane											0.03	***		
1,2-Dichloropropane												***		
1,3,5-Trimethylbenzene					0.04	0.07			0.06	0.03	0.3	***	0.03	0.05
1,3-Butadiene					0.06					0.04	0.16	***	0.02	0.04
Acetonitrile	*Note	*Note			0.37						3.45	***		
Acetylene	0.83	0.93	1.46	1.33	1.03	1.2	0.67	0.34	0.75	1.09	2.95	***	0.89	0.86
Acrolein (Added New July 2005)											0.98	***		
Acrylonitrile												***		
Benzene	0.31	0.42	0.49	0.36	0.31	0.54	0.32	0.19	0.38	0.35	0.89	***	0.25	0.4
Bromochloromethane											0.11	***		
Bromodichloromethane												***		
Bromoform												***		
Bromomethane										0.01	0.02	***	0.01	0.04
Carbon Tetrachloride		0.1	0.1		0.1	0.1	0.1	0.14	0.09	0.1	0.09	***	0.13	0.09
Chlorobenzene											0.05	***		
Chloroethane										0.05	0.02	***	0.02	0.02
Chloroform			0.1	0.07	0.05	0.21	0.06		0.09	0.06	0.22	***	0.07	0.06
Chloromethane	0.59	0.74	0.59	0.64	0.73	0.65	0.7	0.53	0.74	0.66	0.9	***	0.9	0.7
Chloromethylbenzene												***		
Chloroprene												***		
cis-1,2-Dichloroethylene												***		
cis-1,3-Dichloropropene												***		
Dibromochloromethane												***		
Dichlorodifluoromethane	0.57	0.62	0.53	0.64	0.67	0.64	0.63	0.77	0.61	0.59	0.9	***	0.76	0.61
Dichloromethane	0.14	0.1	0.1		0.19	0.09				0.08	1.15	***	0.09	0.15
Dichlorotetrafluoroethane										0.02	0.08	***		0.02
Ethyl Acrylate												***		

Hazardous Air Pollutants, Loudon County, Tennessee, March 11, 2005 – August 26, 2005, continued

Compound (ppbv)	3/11/2005	3/23/2005	4/4/2005	4/16/2005	4/28/2005	5/10/2005	5/22/2005	6/15/2005	6/27/2005	7/9/2005	7/21/2005	8/2/2005	8/14/2005	8/26/2005
Ethyl tert-Butyl Ether												***		
Ethylbenzene	0.06	0.09	0.17	0.13	0.29	0.2	0.12		0.14	0.12	1.5	***	0.12	0.19
Hexachloro-1,3-Butadiene												***		
m,p-Xylene	0.17	0.27	0.41	0.32	0.86	0.47	0.27	0.1	0.32	0.26	4.51	***	0.27	0.43
m-Dichlorobenzene												***	0.01	
Methyl Ethyl Ketone			0.63	0.67	0.34	0.27	0.37			1.23	3.15	***		1.3
Methyl Isobutyl Ketone					0.11					0.07	0.96	***		0.2
Methyl Methacrylate											0.08	***		
Methyl tert-Butyl Ether										0.06		***		
n-Octane					0.12						0.13	***		0.05
o-Dichlorobenzene												***	0.01	
o-Xylene	0.06	0.11	0.19	0.14	0.43	0.21	0.11	0.04	0.16	0.12	1.22	***	0.13	0.2
p-Dichlorobenzene					0.06	0.11				0.05	0.38	***	0.06	0.05
Propylene	0.25	0.33	0.46	0.43	0.43	0.47	0.22	0.14	0.39	0.55	1.12	***	0.4	0.46
Styrene		0.2	0.09	0.11	0.37	0.16			0.24	0.14	1.85	***	0.05	0.12
tert-Amyl Methyl Ether												***		
Tetrachloroethylene											0.6	***		0.03
Toluene	0.34	0.51	1.48	1.05	3.02	1.25	0.87	0.2	1.02	0.91	22.8	***	0.79	1.71
trans-1,2-Dichloroethylene												***		
trans-1,3-Dichloropropene												***		
Trichloroethylene											0.23	***	0.02	0.02
Trichlorofluoromethane	0.27	0.3	0.26	0.3	0.31	0.31	0.27	0.38	0.29	0.28	0.49	***	0.41	0.29
Trichlorotrifluoroethane	0.11	0.1	0.08	0.09	0.09	0.1	0.08	0.14	0.14	0.09	0.08	***	0.13	0.14
Vinyl Chloride					0.04						0.02	***		0.01
Cartridge Results														
2,5-Dimethylbenzaldehyde	0.01													
Acetaldehyde	0.769	0.53	2.28	1.65	0.79	2	0.999	1.15	1.36	1.15	1.34	1.5	0.816	1.64
Acetone	0.969	0.939	2.1	2.06	0.996	1.41	0.816	0.711	0.428	0.759	0.028	0.784	0.685	0.638
Benzaldehyde	0.02	0.019	0.051	0.053	0.064	0.087	0.036	0.024	0.072	0.052	0.031	0.1	0.016	0.023
Butyr/Isobutyraldehyde	0.008	0.056	0.21	0.158	0.074	0.158	0.088	0.083	0.088	0.112	0.102	0.117	0.057	0.094
Crotonaldehyde	0.017	0.012	0.038	0.033	0.031	0.15	0.298	0.541	0.591	0.596	0.672	0.592	0.534	0.429
Formaldehyde	0.641	0.68	1.87	1.83	0.941	2.81	2.31	3.12	3.4	3.87	3.93	4.05	2.51	2.48
Hexaldehyde	0.067	0.016	0.076	0.06	0.033	0.085	0.035	0.031	0.052	0.038	0.023	0.039	0.035	0.069
Isovaleraldehyde	0.079	0.028	0.087	0.054	0.012	0.078	0.024		0.06	0.049	0.094	0.044	0.022	0.054
Propionaldehyde	0.058	0.052	0.108	0.161	0.081	0.18	0.094	0.111	0.107	0.136	0.107	0.136	0.097	0.139
Tolualdehydes	0.016	0.012		0.023	0.015	0.044	0.031	0.059	0.143	0.039	0.037	0.033	0.038	0.024
Valeraldehyde	0.012	0.026	0.063	0.045	0.025	0.058	0.024	0.027	0.03	0.035	0.036	0.038	0.025	0.033

Hazardous Air Pollutants, Loudon County, Tennessee, September 7, 2005 – December 24, 2005

Compound (ppbv)	9/7/2005	9/9/2005	9/19/2005	10/4/2005	10/13/2005	10/25/2002	11/6/2005	11/18/2005	11/30/2005	12/12/2005	12/24/2005	Average
Canister Results												
1,1,1-Trichloroethane	***		0.03	0.02	***	0.03	0.02	0.03	0.02	0.03		0.03
1,1,2,2-Tetrachloroethane	***				***							0.03
1,1,2-Trichloroethane	***				***							
1,1-Dichloroethane	***				***							
1,1-Dichloroethene	***				***							
1,2,4-Trichlorobenzene	***		0.05		***	0.07		0.02				0.04
1,2,4-Trimethylbenzene	***		0.14	0.07	***	0.04	0.05	0.09	0.04		0.07	0.18
1,2-Dibromoethane	***				***							
1,2-Dichloroethane	***				***							0.03
1,2-Dichloropropane	***				***							
1,3,5-Trimethylbenzene	***		0.04	0.02	***	0.02	0.02	0.02	0.02	0.01	0.02	0.07
1,3-Butadiene	***		0.04	0.04	***	0.02	0.02	0.05	0.03	0.02	0.08	0.05
Acetonitrile	***				***						0.24	65.95
Acetylene	***		0.87	0.95	***	0.35	0.61	0.9	0.54	0.64	1.79	0.93
Acrolein (Added New July 2005)	***				***	0.43				0.45		0.62
Acrylonitrile	***				***							0.32
Benzene	***		0.42	0.43	***	0.15	0.21	0.32	0.21	0.19	0.4	0.38
Bromochloromethane	***				***							0.11
Bromodichloromethane	***				***							
Bromoform	***				***							
Bromomethane	***		0.01	0.02	***	0.01	0.01	0.01	0.01		0.01	0.02
Carbon Tetrachloride	***		0.11	0.13	***	0.09	0.09	0.12	0.09	0.12	0.11	0.09
Chlorobenzene	***				***							0.05
Chloroethane	***		0.02	0.02	***	0.01	0.01	0.01	0.01		0.01	0.06
Chloroform	***		0.28	0.2	***	0.05	0.03	0.04	0.09	0.03	0.06	0.10
Chloromethane	***		0.63	0.81	***	0.53	0.63	0.54	0.56	0.65	0.63	0.63
Chloromethylbenzene	***				***							
Chloroprene	***				***							
cis-1,2-Dichloroethylene	***				***							
cis-1,3-Dichloropropene	***				***							
Dibromochloromethane	***				***							
Dichlorodifluoromethane	***		0.61	0.71	***	0.61	0.57	0.75	0.62	0.81	0.76	0.61
Dichloromethane	***		0.07	0.15	***	0.04	0.09	0.05	0.09	0.13	0.07	0.17
Dichlorotetrafluoroethane	***		0.02	0.02	***	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Ethyl Acrylate	***				***							

Hazardous Air Pollutants, Loudon County, Tennessee, September 7, 2005 – December 24, 2005, continued

Compound (ppbv)	9/7/2005	9/9/2005	9/19/2005	10/4/2005	10/13/2005	10/25/2005	11/6/2005	11/18/2005	11/30/2005	12/12/2005	12/24/2005	Average	
Ethyl tert-Butyl Ether	***				***								
Ethylbenzene	***		0.13	0.08	***	0.04	0.06	0.08	0.05	0.04	0.08	0.14	
Hexachloro-1,3-Butadiene	***		0.03		***	0.03		0.01		0.02	0.02	0.02	
m,p-Xylene	***		0.32	0.16	***	0.09	0.12	0.2	0.1	0.09	0.19	0.35	
m-Dichlorobenzene	***				***	0.02		0.02				0.02	
Methyl Ethyl Ketone	***			0.75	***					0.09		1.90	
Methyl Isobutyl Ketone	***		0.04		***			0.06				0.85	
Methyl Methacrylate	***				***							0.08	
Methyl tert-Butyl Ether	***				***							0.16	
n-Octane	***		0.04		***	0.06	0.03		0.02	0.14	0.03	0.16	
o-Dichlorobenzene	***		0.02		***	0.01						0.01	
o-Xylene	***		0.16	0.08	***	0.05	0.06	0.1	0.05	0.04	0.09	0.15	
p-Dichlorobenzene	***		0.04	0.03	***	0.03	0.02	0.03	0.02	0.01	0.02	0.06	
Propylene	***		0.41	0.46	***	0.18	0.11	0.58	0.29	0.26	0.74	0.38	
Styrene	***		0.44	0.25	***	0.08	0.04	0.11	0.09	0.03	0.05	0.21	
tert-Amyl Methyl Ether	***				***								
Tetrachloroethylene	***		0.02	0.03	***	0.01			0.02		0.01	0.09	
Toluene	***		1.02	0.65	***	0.36	0.46	0.62	0.42	0.36	0.65	1.17	
trans-1,2-Dichloroethylene	***				***								
trans-1,3-Dichloropropene	***				***							0.11	
Trichloroethylene	***		0.02		***		0.01	0.02			0.01	0.05	
Trichlorofluoromethane	***		0.29	0.35	***	0.27	0.27	0.38	0.33	0.4	0.36	0.33	
Trichlorotrifluoroethane	***		0.15	0.12	***	0.14	0.09	0.13	0.11	0.16	0.17	0.13	
Vinyl Chloride	***				***							0.02	
Cartridge Results													
2,5-Dimethylbenzaldehyde	***				***							0.03	Avg since
Acetaldehyde	***		1.48	1.21	***	0.324	1.52	1.41	0.543	0.598	1.35	1.62	4/18/04 1.24
Acetone	***		1.07	1.22	***	0.722	1.02	1.61	1.36	0.746	0.01	1.73	
Benzaldehyde	***		0.095	0.092	***	0.017	0.021	0.039	0.023	0.015	0.032	0.09	
Butyr/Isobutyraldehyde	***		0.121	0.112	***	0.036	0.139	0.121	0.066	0.062	0.244	0.84	
Crotonaldehyde	***		0.402	0.255	***	0.017	0.055	0.04	0.025	0.019	0.118	0.18	Avg since
Formaldehyde	***		3.32	2.62	***	0.524	1.91	0.954	0.895	0.754	1.48	6.11	4/18/04 2.02
Hexaldehyde	***		0.099	0.086	***	0.021	0.059	0.036	0.016	0.025	0.034	0.57	
Isovaleraldehyde	***				***		0.083	0.056		0.023	0.04	0.06	
Propionaldehyde	***		0.142	0.154	***	0.042	0.121	0.11	0.074	0.062		0.12	
Tolualdehydes	***		0.044	0.046	***	0.027	0.024	0.047	0.013	0.022	0.022	0.12	
Valeraldehyde	***		0.041	0.039	***	0.01	0.028	0.017	0.015	0.019	0.032	0.17	

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Appendix B

Additional Data on Sources of Environmental Pollution

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Toxic Release Inventory (TRI)

The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990.

TRI data are collected in the first year, analyzed in the second year, and then released the following year. That means that all TRI data are least 2 years old when available. Sometimes the most recent data set will be 3 years old as extra time is necessary to produce particular statistics. Year 2001 TRI data presented by Scorecard (*www.scorecard.org*) and year 2002 data compiled with Tri-Explorer (TRI 2004a) were used in compiling the data presented here. Unless noted, “releases” refers to total on- and off-site disposal or other releases, such as wells, RCRA landfills, fugitive air emissions, point source air emissions, land treatment, surface water discharges, publicly owned treatment works (POTWs), solidification, waste water treatment, storage, land disposal, surface impoundments, and transfers to waste brokers for disposal.

The TRI Program has given the public unprecedented direct access to toxic chemical disposal or other release and other waste management data at the local, state, regional, and national level. Use of this information can enable the public to identify potential concerns, gain a better understanding of potential risks, and work with industry and government to reduce toxic chemical use, disposal or other releases and the risks associated with them. When combined with hazard and exposure data, this information can allow informed environmental priority-setting at the local level.

Federal, state, and local governments can use the data to compare facilities or geographic areas, to identify hot spots, to evaluate existing environmental programs, to more effectively set regulatory priorities, and to track pollution control and waste reduction progress. TRI data, in conjunction with demographic data, can help government agencies and the public identify potential environmental justice concerns. Industry can use the data to obtain an overview of the disposal, release, and other management of toxic chemicals, to identify and reduce costs associated with toxic chemicals in waste, to identify promising areas of pollution prevention, to establish reduction targets, and to measure and document progress toward reduction goals. Public availability of the data has prompted many facilities to work with communities to develop effective strategies for reducing environmental and potential human health risks posed by disposal or other releases and other waste management of toxic chemicals.

While TRI provides the public, industry, and state and local governments an invaluable source of key environmental data, it has some limitations that must be considered when using the data. TRI data reflect chemical management practices, not exposures of the public to those chemicals. The data are generally not sufficient by themselves to determine exposure or to calculate potential adverse effects on human health and the environment. TRI data can be used to identify areas of potential concern. TRI data, in conjunction with other information, can be used as a starting point in evaluating exposures. The determination of potential risk depends upon many factors, including the toxicity of the chemical, the fate of the chemical in the environment, the locality, and the human and other populations that are exposed to the chemical after its disposal or release.

Key factors to consider when using the data include:

- Toxicity varies among the covered chemicals; data on the amounts of the chemicals present alone are inadequate to reach conclusions or formulate policy;
- The presence of a chemical in the environment must be evaluated along with the potential and actual exposures and the route of exposures, the chemical's fate in the environment, and other factors, before any statements can be made about potential risks associated with the chemical or a release;
- Many options for managing production-related wastes are subject to stringent technical standards and exacting state and federal regulatory oversight;
- Regulatory controls apply to many of the releases reported that are production related; reporting facilities must comply with environmental standards and also report residual releases; and
- Some reporters send chemicals off-site in waste to be managed at specialized waste management facilities that are also reporters; adjustments must be made to avoid double counting (TRI 2004b).

Even with expanded industry coverage since the 1998 reporting year, TRI does not address all sources of disposal or other releases and other waste management activities of TRI chemicals. Although the EPA has expanded the number of industries that must report and has added persistent, bioaccumulative, toxic (PBT) chemicals to the section 313 list of toxic chemicals, the program does not cover all sources of TRI chemicals or any sources of non-TRI chemicals. Although TRI is successful in capturing information on a significant portion of toxic chemicals currently being used by covered industry sectors, it does not cover all toxic chemicals or all industry sectors. In addition, even within covered SIC codes, facilities that manage listed TRI chemicals but do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report even though they may release toxic chemicals into the environment. Thus, while the TRI includes 93,380 reports from 4,379 facilities for 2002, the 4.79 billion pounds of on-and off-site disposal or other releases reported represent only a portion of all toxic chemical disposal or other releases nationwide. The TRI does not include data on toxic emissions from cars and trucks, nor from the majority of sources of releases of pesticides, volatile organic compounds, fertilizers or from many other non- industrial sources.

Also, while many facilities base their TRI emissions on monitoring data, others report estimated data, as the program does not mandate monitoring. Various estimation techniques can be used when monitoring data are not available, and EPA has published estimation guidance for the regulated community. Variations between facilities can result from the use of different estimation methodologies. These factors should be taken into account when considering data accuracy and comparability.

The following table lists the TRI chemicals released into the air in Loudon County as reported in the 2002 TRI data. Fugitive emissions are those not caught by a capture system, that is, they are not point sources.

Toxic Release Inventory (TRI) On-site and Off-site Reported Disposed of or Otherwise Released Total Chemicals (in pounds) for Facilities in All Industries, Loudon County, Tennessee, 2002.			
Facility & Chemicals	**Fugitive Air Emissions**	**Point Source Air Emissions**	**Total On- & Off-site Disposal or Other Releases**
Tate and Lyle	**42,971**	**390,121**	**433,435**
Acetaldehyde	40,600	53,720	94,325
Benzo (GHI) Perylene	0	3	3
Dioxin and Dioxin-Like Compounds	0	0.0004	0.0004
Hydrochloric Acid (1995 & after “Acid Aerosols” only)	5	249,270	249,275
Hydrogen Fluoride	0	30,168	30,168
Lead Compounds	0	55	65
Mercury Compounds	0	2	25
Methanol	2,200	22,000	24,205
n-Hexane	166	0	166
Nitrate Compounds	0	0	300
Polycyclic Aromatic Compounds	0	40	40
Sulfuric Acid (1994 & after “Acid Aerosols” only)	0	34,863	34,863
Acupowder TN LLC	**27,651**	**250**	**28,151**
Copper	27,580	0	27,830
Manganese	71	250	321
IMCO Recycling	**0**	**2,200**	**112,213**
Aluminum (Fume or Dust)	0	2,200	112,200
Copper	NA	NA	NA
Dioxin and Dioxin-like Compounds	0	0.001	0.1
Lead	0	0	13
Manganese	NA	NA	NA
Kimberly-Clark	**NA**	**NA**	**NA**
Ammonia	NA	NA	NA
Malibu Boats West Inc.	**76,614**	**51,076**	**127,690**
Styrene	76,614	51,076	127,690
Strongwell	**27,055**	**485**	**27,540**
Styrene	27,055	485	27,540
Viskase Corp	**90,000**	**2,201,142**	**2,291,539**
Carbon Disulfide	90,000	2,170,000	2,260,000
Hydrochloric Acid (1995 & after “Acid Aerosols” only)	0	31,000	31,000
Lead Compounds	0	142	539
Vytron Corp	**0**	**250**	**1,650**
Di(2-Ethylhexl)Phthalate	0	250	1,650
Yale Security INC	**45**	**45**	**7,981**
Chromium Compounds	10	10	3,103
Copper Compounds	10	10	860
Lead Compounds	5	5	89
Nickel Compounds	10	10	3,092
Zinc Compounds	10	10	837

The following table ranks producers in the order of total annual fugitive and point source air emissions based on 2002 TRI data. The next table presents these industries in the order of total on- and off-site disposal or other releases.

Rank Order TRI Fugitive and Point Source Air Emissions (in pounds) for All Chemicals, Facilities in All Industries, Loudon County, Tennessee, 2002.

Rank Order in Loudon County	Facility	Fugitive + Point Source Air Emissions
1	Viskase Corporation	2,291,142
2	Tate and Lyle	433,092
3	Malibu Boats West Inc.	127,690
4	Acupowder TN LLC	27,901
5	Strongwell	27,540
6	IMCO Recycling	2,200
7	Vytron Corp	250
8	Yale Security INC	90
9	Kimberly-Clark	NA

Rank Order TRI Total On-site and Off-site Reported Disposal of or Otherwise Released Total Chemicals (in pounds) for Facilities in All Industries, Loudon County, Tennessee, 2002.

Rank Order in Loudon County	Facility	Fugitive + Point Source Air Emissions
1	Viskase Corporation	2,291,539
2	Tate and Lyle	433,435
3	Malibu Boats West Inc.	127,690
4	IMCO Recycling	112,213
5	Acupowder TN LLC	28,151
6	Strongwell	27,540
7	Yale Security Inc.	7,981
8	Vytron Corp	1,650
9	Kimberly-Clark	NA

Four of the industries in Loudon County rank in the Top 100 TRI chemicals released directly to Tennessee air. These companies and their statewide rank are listed in the following table.

Industries in Loudon County in the Top 100 TRI chemical emissions to the air in Tennessee, 2001.

Rank in Tennessee	Facility	Total Pounds of TRI Chemicals Released to Air
10	Viskase Corporation	2,268,148
28	Tate and Lyle	530,784
57	Acupowder TN LLC	155,542
68	Malibu Boats West Inc.	112,736

Waste Water

Most area industries pre-treat their industrial discharges and send the treated wastes to either the Tellico Reservoir Development Agency (TRDA) Sewage Treatment Plant (STP) or the Loudon STP. Both treatment plants have valid National Pollutant Discharge Elimination System (NPDES) permits. The TRDA STP discharges to the Little Tennessee River at mile 16.1, while the Loudon STP discharges into Watts Bar Lake at Tennessee River mile 591.6. Kimberly-Clark Corporation has an industrial NPDES permit for discharge to the Tennessee River at river mile 589.7. Kimberly-Clark is in compliance with its permit limits. Viskase Corporation has an NPDES permit, although it has no discharge. In November 2003 the Knoxville News Sentinel published a notice that ArvinMeritor Corporation, Praxair Corporation, and Continental Carbonics Corporation were "in significant noncompliance for chronic and technical review criteria violations of the Loudon Sewer Use Ordinance . . . for all of 2003" (Lutrell 2003).

Hazardous Waste

Loudon County has no Superfund National Priorities List (NPL) sites, nor any known hazardous waste generator sites (Resource Conservation and Recovery Act (RCRA)) that are contaminated. One hazardous waste generator (RCRA) site in Lenoir City is undergoing remediation. An NPL site is generally larger than a state superfund site and has more potential to expose local communities to toxic chemicals. Lenoir City Car Works and Greenback Industries are two state superfund sites in Loudon County.

Water Quality Issues

Several streams, rivers, and reservoirs in Loudon County fail to meet State water quality standards. These are listed in the Final 2002 303(d) List, published by TDEC, Division of Water Pollution Control, along with the cause for not meeting standards and the source of each pollutant not meeting standards. In 2002, two water-bodies were delisted, that is, taken off the list. See the next table for details.

Year 2002 303(d) List of Streams and Lakes That Are Water-Quality Limited [1]. Loudon, County, Tennessee. (TDEC Division of Water Pollution Control 2004)

River Basin	Waterbody	Cause for listing/delisting	Source of pollutant/comments
Upper Tennessee	Upper Watts Bar Reservoir	PCBs in sediment Dissolved oxygen	Fishing advisory due to PCBs. Provides habitat for the federally listed fish [2], snail darter (Percina tanasi) and the following mussels: orange-foot pimpleback pearly mussel Plethobasus cooperianus) and pink mucket pearly mussel (Lampsilis abrupta). Upstream impoundment
Upper Tennessee	Mud Creek	Pathogens	Pasture Grazing
Upper Tennessee	Greasy Branch	Pathogens	Pasture Grazing
Upper Tennessee	Pond Creek	Pathogens/nutrients	Pasture Grazing
Upper Tennessee	Sweetwater Creek	Siltation	Channelization/pasture grazing/land development
Upper Tennessee	Sweetwater Creek (delisted)	Priority Organics/Arsenic/ Copper/Chromium	The contaminated sediment was removed from the stream near a CERCLA cleanup site. The implementation of this control strategy has eliminated the source of priority organics, copper, and chromium. (The stream will remain listed for siltation.)
Upper Tennessee	Fort Loudon Reservoir	PCBs in sediment	Fishing advisory due to PCBs.
Upper Tennessee	Fort Loudon Reservoir (delisted)	Urban Runoff/ Storm Sewers	Original listing was in error
Upper Tennessee	Town Creek	Habitat alteration	Pasture grazing/land development/hydromodification
Upper Tennessee	Steekee Creek	Habitat alteration	Pasture grazing
Upper Tennessee	Floyd Creek	Siltation/Pathogens	Pasture grazing
Upper Tennessee	Cloyd Creek	Siltation/Habitat alteration/Pathogens	Pasture grazing/livestock in stream
Little Tennessee	Tellico Reservoir	PCBs in sediment	Fishing advisory-PCBs in catfish. The Tellico River was habitat for the federally listed snail darter (Percina tanasi). However, there are no records of this species post-impoundment.
Little Tennessee	Fork Creek	Nitrates/Siltation/ Pathogens	Pasture grazing
Little Tennessee	Baker Creek	Pathogens	Pasture grazing

[1] *does not meet one or more standards*
[2] *either threatened or endangered*

Appendix C

Hazardous Air Pollutants Not Identified as Chemicals of Concern

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Acetonitrile

Acetonitrile is used as a starting material for the production of nitrogen-containing compounds as well as for extraction of fatty acids from fish liver oils, oils from other animals, and vegetable oils. It is widely used in industrial settings as a solvent and in many other industrial processes [HSDB]. Acetonitrile is a component of environmental tobacco smoke; the concentration is estimated to be about 7.0 micrograms per cubic meter ($\mu g/m^3$) (Miller 1998). Chronic inhalation exposure of humans to acetonitrile results in cyanide poisoning from metabolic release of cyanide after absorption. The major effects consist of those on the central nervous system (CNS), such as headaches, numbness, and tremor.

EPA has derived a Reference Dose (RfC) for acetonitrile of60 $\mu g/m^3$ or 36 parts per billion (ppb) based on the no observed adverse effect level (NOAEL) in mouse subchronic and chronic inhalation studies [IRIS]. This level is expected to be safe for a lifetime exposure. The RfC is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. EPA has assigned acetonitrile as a class D carcinogen, not classifiable as to human carcinogenicity. There is an absence of human evidence and the animal evidence is equivocal.

The mean concentration of acetonitrile measured at the HAPs monitor in Loudon was 1.75 ppb for analysis of samples taken on April 18, April 21, May 3, May 15, May 27, June 8, and July 26, 2004. Sampling and analysis for this chemical has been difficult. Acetonitrile was used in the manufacture of the cartridge and subsequently bled into the canister, adding acetonitrile that was not present in the ambient air to the sample for analysis. This occurred with the sampling device in Dickson County, which was bought at the same time as the device used in Loudon County. The problem has also appeared in the equipment used in Kingsport. Because the sampling results are not reliable, no statements can be made about the health hazard since concentrations are unknown.

Acetylene

Acetylene is a simple asphyxiant. Inhalation of 100,000,000 parts per billion (ppb) may cause a slightly intoxicating effect. There is no evidence that repeated exposure to tolerable levels has any deleterious effects on health. Chronic systemic inhalation causes readily reversible changes which disappear after end of exposure (HSDB).

The mean concentration of acetylene measured at the HAPs monitor in Loudon was 0.88 ppb from November 15, 2003 through December 23, 2004. There should be no health hazard to exposure to this level of acetylene.

Aldehydes

All the aldehydes possess anesthetic properties, but this is obscured by their highly irritant action on the eyes & mucous membranes of the respiratory tract.

Benzaldehyde

Benzaldehyde is used as a chemical intermediate in the manufacture of dyes, odorants, and flavoring chemicals. It is also used directly as a flavoring agent for artificial cherry and almond flavors and as a solvent for oils, resins, and cellulose fibers (HSDB). Benzaldehyde is released to the environment in emissions from combustion processes such as gasoline and diesel engines, incinerators and wood burning. It is formed in the atmosphere through photochemical oxidation of toluene and other aromatic hydrocarbons. It occurs naturally in various plants. If released to the atmosphere, benzaldehyde has a half-life of about 29.8 hours. Rain can remove benzaldehyde from the air. If released to soil or water, the major degradation pathway is expected to be biodegradation.

Occupational exposure to benzaldehyde occurs through inhalation of vapor and dermal contact. Benzaldehyde's use as a flavoring agent and its natural occurrence in many foods will expose the general population through oral consumption. The general population is also exposed to benzaldehyde through its occurrence in ambient air (HSDB). Inhalation of concentrated vapor may irritate the eyes, nose, and throat, especially when in a liquid form. Prolonged contact with the skin may cause irritation, but no other adverse health outcomes are known.

Concentrations of benzaldehyde found in ambient outdoor and indoor air range from 0.1 ppb to 15.6 ppb in the U.S (HSDB).

The mean concentration of benzaldehyde measured at the HAPS monitor in Loudon was 0.13 ppb from November 15, 2003 through December 23, 2004. This level of benzaldehyde is not expected to present a health hazard.

Butyraldehyde and Isobutyraldehyde

Butyraldehyde and isobutyraldehyde are transparent, colorless liquids with an extremely sharp, pungent odor and fruity taste. It is used as in the manufacture of rubber accelerators, synthetic resins, solvents, and plasticizers, as well as a synthetic flavoring in foods. Isobutyraldehyde is used in the synthesis of cellulose esters, perfumes, flavors, gasoline additives, and amino acids and is used as a food additive permitted for direct addition to food for human consumption as a synthetic flavoring substance. Isobutyraldehyde is emitted into the atmosphere by combustion sources and occurs naturally in foods; it is also emitted into the atmosphere by plants. Isobutyraldehyde will be degraded in the atmosphere with a half-life between 2.5 hours and 14.6 hours. Butyraldehyde will degrade in 16.4 hours (HSDB).

Occupational exposure to butyraldehyde and isobutyraldehyde may occur through inhalation and dermal contact. Monitoring data indicate that the general population may be exposed to isobutryaldehyde through consumption of food (since it occurs naturally in many foods) and consumption of drinking water. People may be exposed to butyraldehyde in ambient air. While butyraldehyde and isobutyraldehyde can be irritating to the skin and eyes, they are not associated with any significant or long term adverse health effects.

Concentrations of butyraldehyde found in ambient air range from 0.15 ppb to 7.3 ppb in the U.S (HSDB).

The mean concentration of butyraldehyde and isobutyraldehyde measured at the HAPS monitor in Loudon was 1.38 ppb from November 15, 2003 through December 23, 2004. This is not expected to be a health hazard.

Crotonaldehyde

The general population may be exposed to crotonaldehyde through inhalation of tobacco smoke, gasoline and diesel engine exhausts, and wood combustion.

Atmospheric source of crotonaldehyde include exhausts from both gasoline and diesel engines. It was present at concentrations ranging from 100-1,330 ppb in automobile exhaust gas. Six sites along US Highway 70 near Raleigh, North Carolina, during May 1983 (collection of samples from 7:30-8:30 AM) had crotonaldehyde at concentrations ranging from 2.17-3.71 percent of total carbon collected. Forty-six in-use light-duty gasoline vehicles were monitored for total aldehyde levels and non-methane hydrocarbon concentrations; under conditions of congested city driving crotonaldehyde was 4.19% of the total carbon measured. Under conditions of commuter traffic, crotonaldehyde was 3.53% of the total carbon measured; under rush-hour expressway driving conditions, this compound represented 3.12% of the total carbon measured. Crotonaldehyde was present at 0.12% and 0.03% by weight of total organic gas emissions for non-catalyst and catalyst gasoline engine exhaust, respectively. In addition, crotonaldehyde concentrations of 6-116 milligrams per kilogram (ppb) were detected in emissions from wood burning fireplaces. A wood fireplace emitted from non-detectable levels to 23 mg crotonaldehyde per minute. Sidestream smoke from burning cigarettes contained 280 ug crotonaldehyde per cigarette (HSDB).

Occupational exposure via inhalation and dermal contact is possible at sites of its commercial production and use.

As a strong lacrimatory agent, crotonaldehyde can irritate tissues of the nose, pharynx, and larynx. In addition, no other adverse health consequences are known.

The mean concentration of crotonaldehyde measured at the HAPS monitor in Loudon was 0.155 ppb from November 15, 2003 through December 23, 2004. This is not expected to present a health hazard.

2,5-Dimethylbenzaldehyde

No information available.

The mean concentration of 2,5-dimethylbenzaldehyde measured at the HAPS monitor in Loudon was 0.04 ppb from November 15, 2003 through July 26, 2004. This aldehyde was measured sporadically and is not expected to present a health hazard.

Hexaldehyde

Hexaldehyde (also called hexanal) is a colorless liquid with a characteristic fruity odor on dilution. It is reported to be found naturally in apple, strawberry, camphor oil, tea extracts, tobacco leaves, eucalyptus globulus, dwarf pine, bitter orange, coffee, cocoa, lemon, and orange. Hexaldehyde is released to the environment through various waste streams from its production and use as a food additive (flavor ingredient), in organic synthesis of plasticizers, rubber chemicals, dyes, synthetic resins, and insecticides, and in perfumery (at low concentrations). If released to the atmosphere, hexaldehyde will exist in the vapor phase and will be degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 13 hours. Hexaldehyde is also degraded in the atmosphere by reaction with nitrate radicals with an estimated half-life of 3.4 years. The general population will be exposed to hexaldehyde via inhalation of ambient air, ingestion of food and drinking water, and dermal contact with vapors, food and other products containing it. Occupational exposure may be through inhalation and dermal contact (HSDB). The vapor is irritating the eyes, nose, and throat. It has been measured in diesel exhaust at 200 ppb.

Hexaldehyde has been found in ambient air in Europe, ranging from 0.11 ppb to 1.75 ppb (HSDB).

The mean concentration of hexaldehyde measured at the HAPS monitor in Loudon was 0.957 ppb from November 15, 2003 through July 26, 2004. This is not expected to present a health hazard.

Isovaleraldehyde

Isovaleraldehyde may be released to the environment through its production and use as a flavoring, in perfumes, in pharmaceuticals, and in synthetic resins. If released to the atmosphere, isovaleraldehyde will exist in the vapor phase. Vapor-phase isovaleraldehyde is degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 14 hours.

The general population will be exposed to isovaleraldehyde via inhalation of ambient air, ingestion of food and drinking water, and dermal contact with vapors, food, and other products containing isovaleraldehyde. Occupational exposure may be through inhalation and dermal contact with the compound (HSDB).

Isovaleraldehyde occurs naturally in orange, lemon, eucalyptus, and other oils. It is a component of exhaust of internal combustion engines.

Isovaleraldehyde has been found in air at average concentrations of 0.22 ppb on a busy street in Stockholm, 0.04 ppb on another busy street in Stockholm, 0.05 ppb at a small island in Stockholm, 0.04 on a calm street in Stockholm, and 0.05 ppb at a recreation area, 12 km from Stockholm.

The mean concentration of isovaleraldehyde measured at the HAPS monitor in Loudon was 0.07 ppb from November 15, 2003 through December 23, 2004. This concentration is not expected to present a health hazard.

Propionaldehyde

Propionaldehyde's production and use in the manufacture of propionic acid, plastics, rubber chemicals, and as a disinfectant and preservative may result in its release to the environment through various waste streams. Propionaldehyde is released to the atmosphere via the combustion of wood, gasoline, diesel fuel, and polyethylene. Municipal waste incinerators can release it to ambient air (HSDB).

The vapor may cause respiratory irritation but is not a strong enough irritant of eyes or respiratory tract to be considered significant factor in smog.

Propionaldehyde has been found in concentrations ranging from 0.2 ppb to 39.9 ppb in ambient air in the U.S. (HSDB).

The mean concentration of propionaldehyde measured at the HAPS monitor in Loudon was 0.13 ppb from November 15, 2003 through December 23, 2004. This level is not expected to present a health hazard.

Tolualdehydes

Tolualdehyde, also known as methylbenzaldehyde, may be released to the environment through various waste streams through its production and use in perfumes and as flavoring agents. It is degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 20 hours. Tolualdehyde was listed in the 1980 VOCs database update with 2 reported occurrences; one measurement of urban air at a concentration of 0.132 ppbv and one source-dominated measurement giving a concentration of 0.006 ppbv (HSDB).

The mean concentration of tolualdehydes measured at the HAPS monitor in Loudon was 0.187 ppb from November 15, 2003 through December 23, 2004. This is not expected to present a health hazard.

Valeraldehyde

Valeraldehyde, also known as pentanal, is a natural product and is emitted into the atmosphere by plants and microorganisms and from animal wastes and forest fires. It may also be released to the environment during its production, use as a chemical intermediate, and during its transport, storage and disposal. Anthropogenic sources include emissions from gasoline, diesel, turbine engines, burning logs, and some building products, such as carpet-covered pressed board and polyurethane-coated plywood.

In the atmosphere, valeraldehyde will react with photochemically-produced hydroxyl radicals. It's half-life resulting from its reaction with hydroxyl radicals is 13.5 hr. Direct photolysis is also expected to be an important degradative process in the atmosphere. However, valeraldehyde's rate of direct photolysis is unknown. The general population may be exposed to valeraldehyde in both indoor and outdoor air via inhalation and by ingesting food in which it naturally occurs.

Valeraldehyde is a mild eye irritant.

The mean concentration of valeraldehyde measured at the HAPS monitor in Loudon was 0.267 ppb from November 15, 2003 through December 23, 2004. The level of valeraldehyde is not expected to present a health hazard.

Chloromethane

Chloromethane (also known as methyl chloride) is a clear, colorless gas. It has a faint, sweet odor that is noticeable only at levels which may be toxic. It is heavier than air and is extremely flammable. It also occurs naturally, and most of the chloromethane that is released to the environment (estimated at up to 99%) comes from natural sources. Chloromethane is always present in the air at very low levels. Most of the naturally occurring chloromethane comes from chemical reactions that occur in the oceans or from chemical reactions that occur when materials like grass, wood, charcoal, and coal are burned. It is also released to the air as a product of some plants or from rotting wood.

In addition to natural sources, chloromethane was manufactured as a refrigerant, but refrigerators no longer use chloromethane because of its toxic effects. It was also used as a foam-blowing agent and as a pesticide or fumigant. A working refrigerator that is more than 30 years old may still contain chloromethane, and may be a source of high-level exposure. Today, nearly all commercially produced chloromethane is used to make other substances, mainly silicones (72% of the total chloromethane used). Other products that are made from reactions involving chloromethane include agricultural chemicals (8%), methyl cellulose (6%), quaternary amines (5%), and butyl rubber (3%). These production processes yield very little or no residual choromethane emissions. It is, however, found as a pollutant in municipal waste streams from treatment plants and industrial waste streams as a result of formation or incomplete removal. There are also some manufacturing processes for vinyl chloride that produce small volumes of chloromethane as impurities in the vinyl chloride end product.

If the levels are high enough (over a million times the natural levels in outside air), even brief exposures to chloromethane can have serious effects on the nervous system, including convulsions, coma, and death. Some people have died from breathing chloromethane that leaked from refrigerators in rooms that had little or no ventilation. Most of these cases occurred more than 30 years ago, but this kind of exposure could still happen if you have an old refrigerator that contains chloromethane as the refrigerant. Exposure to chloromethane can also harm your liver and kidney, or have an effect on your heart rate and blood pressure. If you work in an industry that uses chloromethane to make other products, you might be exposed to levels that could cause symptoms resembling drunkenness and impaired ability to perform simple tasks (ATSDR 1998).

It is not known whether chloromethane can cause sterility, miscarriages, birth defects, or cancer in humans. The Department of Health and Human Services (DHHS) has not classified chloromethane for carcinogenic effects. The International Agency for Research on Cancer (IARC) calls chloromethane a Group 3 compound, which means it cannot be determined whether or not it is a carcinogen because there is not enough human or animal data. EPA considers chloromethane possibly carcinogenic to humans (i.e., Group C) based on limited evidence of carcinogenicity in animals.

ATSDR has derived an Environmental Media Evaluation Guide (EMEG) for chronic exposure to chloromethane of 50 ppb.

The mean concentration of chloromethane measured at the HAPS monitor in Loudon was 0.61 ppb from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to these concentrations.

Ethylbenzene

Ethylbenzene is a colorless liquid that smells like gasoline. You can smell ethylbenzene in the air at concentrations as low as 2,000 parts of ethylbenzene per billion parts of air by volume (ppb). It evaporates at room temperature and burns easily. Ethylbenzene occurs naturally in coal tar and petroleum. It is also found in many products, including paints, inks, and insecticides. Gasoline contains about 2% (by weight) ethylbenzene. Ethylbenzene is used primarily in the production of styrene. It is also used as a solvent, a component of asphalt and naphtha, and in fuels. In the chemical industry, it is used in the manufacture of acetophenone, cellulose acetate, diethylbenzene, ethyl anthraquinone, ethylbenzene sulfonic acids, propylene oxide, and α-methylbenzyl alcohol. Consumer products containing ethylbenzene include pesticides, carpet glues, varnishes and paints, and tobacco products. In 1994, approximately 12 billion pounds of ethylbenzene were produced in the United States.

Ethylbenzene is most commonly found as a vapor in the air. This is because ethylbenzene moves easily into the air from water and soil. Once in the air, other chemicals help break down ethylbenzene into chemicals found in smog. This breakdown happens in less than 3 days with the aid of sunlight.

Releases of ethylbenzene into these areas occur from burning oil, gas, and coal and from discharges of ethylbenzene from some types of factories. The median level of ethylbenzene in city and suburban air is about 0.62 parts of ethylbenzene per billion parts (ppb) of air. In contrast, the median level of ethylbenzene measured in air in country locations is about 0.01 ppb. Indoor air has a higher median concentration of ethylbenzene (about 1 ppb) than outdoor air. This is because ethylbenzene builds up after you use household products such as cleaning products or paints.

At certain levels, exposure to ethylbenzene can harm your health. People exposed to high levels of ethylbenzene in the air for short periods have complained of eye and throat irritation. Persons exposed to higher levels have shown signs of more severe effects such as decreased movement and dizziness. No studies have reported death in humans following exposure to Ethylbenzene alone. However, evidence from animal studies suggests that it can cause death at very high concentrations in the air (about 2 million times the usual level in urban air).

Whether or not long-term exposure to ethylbenzene affects human health is not known because little information is available. Short-term exposure of laboratory animals to high concentrations of ethylbenzene in air may cause liver and kidney damage, nervous system changes, and blood changes. The link between these health effects and exposure to ethylbenzene is not clear because of conflicting results and weaknesses in many of the studies. Also, there is no clear evidence that the ability to get pregnant is affected by breathing air or drinking water containing ethylbenzene, or coming into direct contact with ethylbenzene through the skin. Two long-term studies in animals suggest that ethylbenzene may cause tumors. One study had many weaknesses, and no conclusions could be drawn about possible cancer effects in humans. The other, a recently completed study, was more convincing, and provided clear evidence that ethylbenzene causes cancer in one species after exposure in the air to concentrations greater than 740,000 ppb that were approximately 1 million times the levels found in urban air. At present, the federal government has not identified ethylbenzene as a chemical that may cause cancer in humans. However, this may change after consideration of the new data (ATSDR 1999b).

EPA's reference concentration for chronic exposure to ethylbenzene in air is 230 ppb and ATSDR's environmental media evaluation guide for an intermediate exposure is 1,000 ppb. The mean concentration of ethylbenzene measured at the HAPS monitor in Loudon was 0.11 ppb from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to these concentrations.

Fully halogenated chlorofluorocarbons (CFCs)

Fully halogenated chlorofluorocarbons (CFCs) were scheduled for production phase-out in 1987 by the Montreal Protocol. Although originally scheduled for 50% production phase-out by the year 2000 in developed countries, the worsening ozone depletion has forced acceleration of the CFC phase-out (HSDB).

Dichlorodifluoromethane

Dichlordifluoromethane is a refrigerant (Freon 12), an aerosol propellant, and a foaming agent that has not been manufactured in the U.S. since 1995. This compound does not react with photochemically produced hydroxyl radicals, ozone molecules or nitrate radicals in the troposphere. This compound will gradually diffuse into the stratosphere above the ozone layer where it will slowly degrade due to direct photolysis from UV-C radiation and contribute to the catalytic removal of stratospheric ozone. Due to its long atmospheric residence time, the general population is exposed to dichlorodifluoromethane through inhalation of ambient air (HSDB).

The mean concentration of dichlorodifluoromethane measured at the HAPS monitor in Loudon was 0.58 ppb from November 15, 2003 through December 23, 2004.

Trichlorofluoromethane

Trichlorofluoromethane was used as a solvent, fire extinguisher, chemical intermediate, blowing agent. It was known as Freon 11. It's aerosol propellant use was banned in the US on December

15, 1978. Trichlorofluoromethane has been identified in emissions from volcanoes. Trichlorofluoromethane is very stable in the troposphere having a half-life of 52-207 yr. As a result of its stability, it is transported long distances and its concentration is fairly uniform around the globe away from known sources. The only major sink for trichlorofluoromethane is its slow diffusion into the stratosphere where photolysis occurs & subsequent reactions which destroy ozone (HSDB).

The mean concentration of trichlorofluoromethane measured at the HAPS monitor in Loudon was 0.34 ppb from November 15, 2003 through December 23, 2004.

Trichlorotrifluoroethane

Trichlorotrifluoroethane exists as two isomers: 1,1,1-trichloro-2,2,2-trifluoroethane, known as Freon FT, and 1,1,2-trichloro-1,2,2-trifluoroethane, known as chlorofluorocarbon (CFC). Freon FT was mostly used as a refrigereant, while CFC 113 was mostly used as a solvent, although it has refrigerant applications (HSDB).

The mean concentration of trichlorotrifluoromethane measured at the HAPS monitor in Loudon was 0.14 ppb from November 15, 2003 through December 23, 2004.

No public health hazard is expected from CFC's measured at the HAPs monitor in Loudon County.

Methyl Ethyl Ketone (2-Butanone)

Methyl ethyl ketone (MEK), also known as 2-butanone, is a colorless liquid with a sweet, but sharp odor. MEK is manufactured in large amounts for use in paints, glues, and other finishes because it rapidly evaporates and will dissolve many substances. It will quickly evaporate into the air. MEK is often found dissolved in water or as a gas in the air. MEK is also a natural product made by some trees and is found in some fruits and vegetables. The exhausts of cars and trucks release MEK into the air. MEK is usually found in the air, water, and soil of landfills and hazardous waste sites.

Serious health effects in animals have been seen only at very high concentrations of MEK. These high concentrations are not expected in the usual use of MEK or in the vicinity of hazardous waste sites. Studies in animals have shown that MEK does not cause serious damage to the nervous system or the liver, but mice that breathed low levels for a short time had temporary behavioral effects. MEK alone does not have serious effects on the liver or nervous system, but it can cause other chemicals to become more harmful to these systems (ATSDR 1992a).

ATSDR's reference concentration for exposure to MEK in air is 1,700 ppb. The mean concentration of MEK measured at the HAPS monitor in Loudon was 2.41 ppb from November 15, 2003 through December 23, 2004. No adverse health effects are expected from exposure to this level of MEK in air.

1,2,4-Trimethylbenzene

1,2,4-Trimethylbenzene is used as a sterilizing agent for catgut and as an intermediate in the manufacture of trimellitic anhydride, dyes, pharmaceuticals, and pseudocumidine. It's chief industrial use is as solvent and paint thinner. 1,2,4-trimethylbenzene is found in coal and gasoline and is a natural product in some foods (HSDB).

Concentrations of 1,2,4-trimethylbenzene have been found in ambient and indoor air in the U.S. and Europe ranging from not detected to 15 ppb (HSDB).

The mean concentration of 1,2,4-trimethylbenzene measured at the HAPS monitor in Loudon was 0.12 ppb from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to this level of 1,2,4-trimethylbenzene.

Propylene

Propylene is used in the manufacture of polypropylene, alcohol, synthetic glycerol, acrylonitrile, propylene oxide, heptene, cumene, polymer gasoline, acrylic acid, vinyl resins, synthetic rubber, and as an aerosol propellant.

Some sources of propylene are biological in origin; it is a component of garlic essential oils, European fir, Scots pine, natural gases, and it is released by germinating beans, corn, cotton, and pea seeds. Propylene is released to the atmosphere in emissions from the combustion of gasoline, coal, wood and refuse. The most probable route of human exposure to propylene is by inhalation of contaminated air.

Propylene was detected at a concentration range of 7-32 ppbV in Los Angeles, California, air during Sept 29-Nov 13, 1981. Average monthly concentrations of propylene ranged from 1.1 to 15.3 ppbV in atmospheric samples taken at Deonar, India, in 1985. Concentrations in ambient air samples have been found to vary diurnally and with wind direction. Ground-level concentrations of propylene in urban air samples collected in several US cities ranged from 4 to 17 ppb (geometric mean), whereas concentrations in rural surface air samples from six domestic sites ranged from <0.5 to 3.0 ppb (geometric mean) (HSDB).

The mean concentration of propylene measured at the HAPS monitor in Loudon was 0.37 ppb from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to these levels of propylene.

Styrene

In the United States, styrene is produced principally by the catalytic dehydrogenation of ethylbenzene. Styrene is used predominantly in the production of polystyrene plastics and resins. Some of these resins are used for construction purposes such as in insulation or in the fabrication of fiberglass boats. Styrene is also used as an intermediate.in the synthesis of materials used for ion exchange resins and to produce copolymers such as styrene-acrylonitrile (SAN), acrylonitrile-butadiene-styrene (ABS), and styrene-butadiene rubber (SBR). Consumer products made from styrene-containing compounds include packaging, electrical, and thermal insulation materials, pipes, automotive components, drinking tumblers, other food-use utensils, and carpet backing. The Food and Drug Administration (FDA) permits styrene to be used as a direct additive for synthetic flavoring and an indirect additive in polyester resins, ion-exchange membranes, and in rubber articles (5% by weight maximum) intended for use with foods.

Styrene has been detected among the natural volatile components of roasted filberts, dried legumes, fried chicken, nectarines, and Beaufort cheese. Styrene may also enter foods by migration from polystyrene food containers and packaging materials. Concentrations of styrene measured in yogurt packaged in polystyrene containers ranged from 5.5 to 150 µg /L. Mean levels of styrene in foods packaged in plastic in the United Kingdom ranged from <1 to 180 µg /kg. Similar concentrations of styrene were detected in other dairy products packaged in polystyrene containers.

The principal route of styrene exposure for the general population is probably by inhalation of contaminated indoor air. Mean indoor air levels of styrene have been reported in the range of l-9 µg/m3 (0.2-2 ppb), attributable to emissions from building materials, consumer products, and tobacco smoke. Occupational exposure to styrene by inhalation is the most likely means of significant exposure. The highest potential exposure is probably in the reinforced plastics industry and polystyrene factories. Exposure may also be high in areas near major spills.

The most commonly reported adverse health effects from exposure to styrene include subjective symptoms of central nervous system depression and irritation of the eyes and upper respiratory tract. Epidemiological and clinical studies on workers have demonstrated that inhalation exposure to styrene may cause alterations of central nervous system function. The symptoms are typical of central nervous system depression, and appear to be the most sensitive end point for styrene exposure via the inhalation route. High levels (800,000 ppb) produced immediate muscular weakness, listlessness, drowsiness, and impaired balance within minutes of exposure. Exposures to levels in the range of 50,000-200,000 ppb have resulted in a number of signs and symptoms, including impairment of balance and coordination, altered reaction times, sensory neuropathy, impaired manual dexterity, headaches, nausea, mood swings, malaise, and decrement in concentration. Some neurological effects, as evidenced by altered EEGs, occur at exposure levels as low as 25,000 to 31,000 ppb (ATSDR 1992).

ATSDR has established an EMEG of 60 ppb (60 ppb) for chronic, long-term exposure to styrene in air by the general population. EPA has established an RfC of 1000 $\mu g/m^3$ (235 ppb). EPA considers styrene to be a possible carcinogen based on the availability of no human data and limited animal data.

The average concentration of styrene measured at the HAPS monitor in Loudon was 0.19 ppb from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to these levels of styrene.

Toluene

Toluene is a clear, colorless liquid with a distinctive smell. It is a good solvent (a substance that can dissolve other substances). It is added to gasoline along with benzene and xylene. Toluene occurs naturally in crude oil and in the tolu tree. It is produced in the process of making gasoline and other fuels from crude oil, in making coke from coal, and as a by-product in the manufacture of styrene. Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. It is disposed of at hazardous waste sites as used solvent or at landfills where it is present in discarded paints, paint thinners, and fingernail polish. You can begin to smell toluene in the air at a concentration of 8,000 parts of toluene per billion parts of air (ppb), and taste it in your water at a concentration of between 40 and 1,000 ppb.

People may be exposed to toluene from many sources, including drinking water, food, air, and consumer products. They may also be exposed to toluene through breathing the chemical in the workplace or during deliberate glue sniffing or solvent abuse. Automobile exhaust also puts toluene into the air. People who work with gasoline, kerosene, heating oil, paints, and lacquers are at the greatest risk of exposure. Printers are also exposed to toluene in the workplace. Because toluene is a common solvent and is found in many consumer products, persons can be exposed to toluene at home and outdoors while using gasoline, nail polish, cosmetics, rubber cement, paints, paintbrush cleaners, stain removers, fabric dyes, inks, adhesives, carburetor cleaners, and lacquer thinners. Smokers are exposed to small amounts of toluene in cigarette smoke.

The toluene level in the air outside homes is usually less than 1,000 ppb in cities and suburbs that are not close to industry. The toluene inside houses is also likely to be less than 1,000 ppb. The amount of toluene in food has not been reported, but is likely to be low. Traces of toluene were found in eggs that were stored in polystyrene containers containing toluene.

People are probably exposed to only about 300 micrograms (µg) of toluene a day, unless they smoke cigarettes or work with toluene-containing products. People who smoke a pack of cigarettes per day, add another 1,000 µg to their exposure. People who work in places where toluene-containing products are used can be exposed to 1,000 milligrams of toluene a day when the average air concentration is 50,000 ppb and they breathe at a normal rate and volume (ATSDR 2000).

ATSDR's chronic EMEG for exposure to toluene in air is 80 ppb, while EPA's reference dose for chronic exposure is 107 ppb. The average concentration of toluene measured at the HAPS monitor in Loudon was 0.80 ppb from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to these levels of toluene.

Xylenes

In this report, the terms xylene, xylenes, and total xylenes will be used interchangeably. There are three forms of xylene in which the methyl groups vary on the benzene ring: metaxylene, ortho-xylene, and para-xylene (m-, o-, and p-xylene). These different forms are referred to as isomers. The term total xylenes refers to all three isomers of xylene (m-, o-, and p-xylene). Mixed xylene is a mixture of the three isomers and usually also contains 6-15% ethylbenzene. Xylene is also known as xylol or dimethylbenzene. Xylene is primarily a synthetic chemical. Chemical industries produce xylene from petroleum. Xylene also occurs naturally in petroleum and coal tar and is formed during forest fires. It is a colorless, flammable liquid with a sweet odor.

Xylene is one of the top 30 chemicals produced in the United States in terms of volume. It is used as a solvent (a liquid that can dissolve other substances) in the printing, rubber, and leather industries. Along with other solvents, xylene is also used as a cleaning agent, a thinner for paint, and in varnishes. It is found in small amounts in airplane fuel and gasoline. Xylene is used as a material in the chemical, plastics, and synthetic fiber industries and as an ingredient in the coating of fabrics and papers. Isomers of xylene are used in the manufacture of certain polymers (chemical compounds), such as plastics.

Xylene evaporates and burns easily. Xylene does not mix well with water; however, it does mix with alcohol and many other chemicals. Most people begin to smell xylene in air at 80-3,700 parts of xylene per billion parts of air (ppb) and begin to taste it in water at 530-1,800 ppb. Xylene very quickly evaporates into the air from surface soil and water. Xylene stays in the air for several days until it is broken down by sunlight into other less harmful chemicals.

People may come in contact with xylene from a variety of consumer products, including cigarette smoke, gasoline, paint, varnish, shellac, and rust preventives. Breathing vapors from these types of products can expose persons to xylene. Indoor levels of xylene can be higher than outdoor levels, especially in buildings with poor ventilation. Skin contact with products containing xylene, such as solvents, lacquers, paint thinners and removers, and pesticides may also expose people to xylene.

Besides painters and paint industry workers, others who may be exposed to xylene include biomedical laboratory workers, distillers of xylene, wood processing plant workers, automobile garage workers, metal workers, and furniture refinishers also may be exposed to xylene. Workers who routinely come in contact with xylene-contaminated solvents in the workplace are the population most likely to be exposed to high levels of xylene.

The ATSDR chronic EMEG for total xylenes is 100,000 ppb. The average concentration of xylenes measured at the HAPS monitor in Loudon was 0.30 ppb for meta- and para-xylenes and 0.14 ppb for ortho-xylene from November 15, 2003 through December 23, 2004. No public health hazard is expected from exposure to these levels of xylenes.

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Appendix D

Diseases Included in Assessment of Hospital Discharge Death, and Cancer Incidence Data Loudon County, Franklin County, and Tennessee.

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Diseases included in assessment of hospital discharge data, death data, and cancer incidence data for Loudon County, Franklin County, and Tennessee.

ICD-9CM & ICD-9 Codes	ICD-10 Codes	Disease Groups
147	C11	Nasopharynx Malignant Neoplasms
153	C18	Colon Malignant Neoplasms
154	C19-C20	Rectum Malignant Neoplasms
155	C22	Liver Malignant Neoplasms
160	C31	Sinus Malignant Neoplasms
161	C32	Larynx Malignant Neoplasms
162, except 162.0	C34	Bronchus and Lung Neoplasms
162.0	C33	Trachea Malignant Neoplasms
170	C40-C41	Bone Malignant Neoplasms
174-175	C50	Breast Malignant Neoplasms
179,182	C54-C55	Uterine Malignant Neoplasms
180, 181, 185	C51-C53, C57, C58	Other Female Reproductive Malignant Neoplasms
183	C56	Ovary Malignant Neoplasms
185	C61	Prostate Malignant Neoplasms
188	C67	Bladder Malignant Neoplasms
189	C64-C65	Kidney Malignant Neoplasms
191	C71	Brain Malignant Neoplasms
193	C73	Thyroid Malignant Neoplasms
204.0	C91.0	Leukemia, Acute Lymphoid
204.1-204.9	C91, C91.1-C91.9	Leukemia, Lymphoid
205.0	C92.0	Leukemia, Acute Myeloid
205.1-205.9	C92, C92.1-92.9	Leukemia, Myeloid
206.0	C93.0	Leukemia, Acute Monocytic
206.1-206.9	C93, C93.1-C93.9	Leukemia, Monocytic
207-208	C94-C95	Leukemia, all other and unspecified types
358.0	G70	Myasthenia Gravis
401,403	I10, I12	Hypertension, Primary
402,404	I11,I13	Hypertension, Secondary
410-414	I20-I25	Heart Diseases of Ischemic nature
415-429	I26-I51	Heart Disease of Other types
460-466	J01-J06, J20-J22	Acute Upper respiratory Infection (URI)
470-478	J30-J39	Chronic Rhinitis and Sinusitis (R&S)
480-482	J12-J18	Pneumonia
490-491	J40-J42	Chronic Bronchitis
492	J43	Emphysema
493	J45-J46	Asthma
494-496	J44, J47	Chronic Obstructive Pulmonary Disease (COPD)
500-506,508	J60-J68	Non-food (NF) Pneumoconioses
511	J90, J92, J94	Pleurisy
512,514-519	J70, J80-J84,J93, J96,J98	Other Diseases of the Respiratory System (DRS)

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Appendix F

Discussion of

Individual Cancers and Other Diseases

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Bronchus and Lung Cancer

Using data from the TCR, bronchus and lung cancer rates were statistically higher for Loudon County females, males, and both sexes combined when compared to Franklin County and Tennessee rates. In addition, females had statistically higher rates than Tennessee when using hospital in-patient data and males had a statistically higher rate than Tennessee when comparing hospital in-patient and out-patient data and from mortality data. Males in Loudon County also had a higher rate than Franklin County using in-patient hospital data. Comparison of hospital in-patient data showed an increased rate for Loudon County compared to Franklin County for both sexes combined.

For bronchus and lung cancer, Loudon County ranked number 9th in the state for females, 17th males, and 9th both sexes combined using data from the TCR. The numbers of bronchus and lung cancers are large enough to provide stable rates, with little variance.

Leukemia

Rates of leukemia in Loudon County are generally unremarkable when compared to rates in Franklin County and Tennessee, except for myeloid leukemia, either chronic or unspecified. For both sexes combined, the rate in Loudon County is significantly lower than the rate in Franklin County for in-patient data and deaths and lower than the rate in Tennessee for in-patient and outpatient hospital data and for deaths. For females the rate in Loudon County is significantly lower than Franklin County rate for in-patient hospital data and for deaths and is significantly lower than the Tennessee rate for all four databases. For males, the rate in Loudon County is significantly lower than the rate in Franklin County for in-patient hospital data and is significantly lower than the rate in Tennessee for in-patient and out-patient hospital data. There are too few cases in the TCR for statistical analysis.

Acute myeloid leukemia, associated with benzene exposure, is not significantly different from Franklin County or Tennessee for females, males, or both sexes combined for any databases.

Nasopharyngeal Cancer

Formaldehyde has been shown to have some relationship to nasopharyngeal cancer, but this relationship is currently uncertain and under investigation by the U.S. EPA and the National Cancer Institute. The rate of nasopharyngeal cancer is of interest in Loudon because of the uncertainty related to both air concentrations of and toxicity information about formaldehyde.

The numbers of cases in Loudon and Franklin Counties are extremely low, making valid statistical comparisons impossible.

Liver Cancer

The liver is the site of toxic effects for many chemicals. Liver cancer is associated with exposure to high levels of carbon tetrachloride. The rates are not significantly different when compared to rates in Franklin County and Tennessee. However, frequencies are very low, making statistical interpretations difficult at best.

Prostate Cancer

According to data in in-patient and out-patient hospital records and in mortality records, the rate of prostate cancer in Loudon County is not significantly different from the rate in Franklin County. Data from TCR indicates that Loudon County has a significantly higher incidence of prostate cancer than the rates in Franklin County and Tennessee. The rate of prostate cancer from in-patient hospital data in Loudon County is significantly greater than the rate in Tennessee. The age distributions of cases in Loudon and Franklin Counties and in Tennessee are not appreciably different. The cases are fairly evenly distributed across populated areas in Loudon County. According to TCR data Loudon County ranks 3rd for incidence of prostate cancer, but ranks 25th in deaths from prostate cancer.

Breast Cancer, Ovarian Cancer, Uterine and Other Female Reproductive Cancers

The rate of breast cancer in Loudon County is significantly higher than the rates for Franklin County and Tennessee when using data from the TCR. However, the rates using data from in-patient and out-patient records and mortality records are not significantly different.

The rate of ovarian cancer in Loudon County is significantly higher than the rates in Franklin County and Tennessee, using data from in-patient and out-patient hospital records. The rates derived from mortality records and TCR are not significantly different even though Loudon County ranks 6th in ovarian cancer using TCR data.

The rate of uterine cancer is not significantly different in Loudon County compared to the rates in Franklin County and Tennessee, using in-patient and out-patient data and mortality data. The rate is significantly higher using data from the TCR. Loudon County ranks 7th in uterine cancer incidence using data from the TCR.

The only significance difference for other reproductive cancers is that the death rate in Loudon County is higher than the death rate in Franklin County.

Other Respiratory Diseases

Asthma is of great interest in Loudon. Unfortunately, this is a difficult disease for which to obtain reliable data. EEP suspects that many cases of childhood asthma are missed. If children are seen by a private physician who is able to keep their asthma under control, all datasets will miss these cases. For females, males, and both sexes combined, Loudon County shows no statistical differences when compared to Franklin County and Tennessee.

The rates of chronic bronchitis are elevated in Loudon County compared to Franklin County and Tennessee for some datasets, but not all. Using out-patient data, females, males, and both sexes combined have significantly higher rates of chronic bronchitis compared to Franklin County and Tennessee. In-patient hospital data shows increases for Loudon County females, males, and both sexes combined compared to Tennessee. The death rate for Loudon County females was elevated in comparison to Franklin County females.

Using out-patient data, Loudon county females ranked 23th, males ranked 25th, and both sexes combined ranked 23rd. Using in-patient data, Loudon County females ranked 42nd, males ranked 25th, and both sexes combined ranked 23rd.

The data for acute respiratory infections are particularly difficult to interpret. Mostly, there are no significant differences between Loudon and Franklin Counties and Tennessee, although some diseases are significantly greater and some significantly less. No clear pattern emerges from the data for chronic obstructive pulmonary disease, emphysema, pneumoconiosis caused by external factors, pleurisy, pneumonia, and other respiratory diseases.

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Appendix H
Detailed Methods of Data Analysis

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In order to analyze health outcome data in a meaningful way, EEP selected a comparison county. Counties considered for selection included peer counties identified by the Community Health Status Indicators (CHSI) Project, sponsored by the Health Resources and Services Administration (HRSA). The Community Health Status Reports for this project list Franklin, Coffee, Jefferson, and Loudon Counties as peer counties; EEP believes that Franklin County is the best match for Loudon County for this project (HRSA 2000) because Franklin and Loudon counties have similar demographic compositions but differ with respect to the concentration of industries present with Franklin County having fewer industries.

Mortality data from Health Information Tennessee (HIT)

Initially, EEP reviewed health statistics data found on the Department of Health HIT site (http://www.tennessee.gov/health) for the years 1990 through 2002 to compare the top 10 causes of death between Loudon and Franklin Counties and all of Tennessee. This data consisted of rates adjusted to the age distribution of the 2000 U.S. standard population and are given per 100,000 people. The Tennessee population projections used by the Tennessee Department of Health for rate calculations were prepared by the University of Tennessee using direct methods. While this results in more accurate projections than those obtained through the indirect methods employed by the US Census Bureau, use of these projections will give slightly different disease rates. Such rates, however, more readily consider regional circumstances and thus, is our preferred approach. In addition, coding for the various causes of death presented at the HIT site, excludes some conditions that may be of interest in this particular assessment and should be noted:

- The codes for diseases of the heart exclude hypertension;
- The codes for cerebrovascular diseases exclude diseases of the arteries, arterioles, and capillaries;
- The codes for chronic lower respiratory diseases exclude acute upper respiratory infections, respiratory conditions due to external agents (such as asbestosis), and pulmonary and pleural diseases.

To determine if the rates for the leading causes of death in Loudon County significantly differ from Franklin County and Tennessee over time, EEP completed two sample, one-tailed and two-tailed, student t-tests, in the statistical analysis program SAS™, using six different hypotheses for testing. This method has been employed by the CDC under similar circumstances (http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5101a1.htm). For these evaluations, EEP defined statistical significance as a p-value of 0.05 or less. The six hypotheses are detailed below.

7. Loudon County age-adjusted rate is significantly different from that of Franklin County (two-tailed t-test)
8. Loudon County age-adjusted rate is significantly higher that of Franklin County (one-tailed t-test)
9. Loudon County age-adjusted rate is significantly lower that of Franklin County (one-tailed t-test)
10. Loudon County age-adjusted rate is significantly different from that of Tennessee (two-tailed t-test)
11. Loudon County age-adjusted rate is significantly higher that of Tennessee (one-tailed t-test)

12. Loudon County age-adjusted rate is significantly lower that of Tennessee (one-tailed t-test)

Detailed analysis of health outcome data

In order to more thoroughly understand disease trends with respect to the air emissions under consideration and community concerns about respiratory and heart-related illnesses, additional analyses were performed on records of Tennessee residents for the 41 specific diseases listed in Appendix D. Data available about these diseases includes: 1) death certificate information from 1990 through 2003; 2) in-patient hospital discharge data from 1997 through 2003; 3) out-patient hospital discharge data from 1998 through 2003 with 2003 data being provisional; and 4) Tennessee Cancer Registry (TCR) incidence case data from 1991 through 2000. Although available, out-patient hospital discharge data from 1997 was excluded because only one of two hospitals in Franklin County provided out-patient data for that year, leading to substantial underreporting for the year 1997. It is also important to note that prior to 2000, hospitals reported emergency room visits and out-patient ambulatory surgeries, but only reported 23-hour observations at their discretion. Thus, increases in disease frequencies for 2000-2003 may in part be due to increased reporting. Finally, hospital discharge data does not include information about disease incidence observed outside of the hospital setting such as non-hospital clinics and private physician offices. Rather, it only provides a snap shot of illnesses severe enough to result in hospitalization. While this misses the window of opportunity to prevent illness at the earliest possible stage, it is the only information we have available about the non-cancer morbidity experience of Loudon County, Franklin County and Tennessee residents.

For evaluation purposes, the underlying cause of death for each death record was determined. Likewise, the primary cancer diagnosis among cancer incidence cases provided by the TCR was identified. Within the hospital discharge system, however, a patient may have up to nine diagnoses for each hospital visit. All nine diagnostic fields were reviewed for each year of available data. This is a much more conservative approach than considering only the first diagnosis listed. Because we know we are missing nonhospital visits and were concerned about underreporting, we chose this approach to develop a more thorough understanding of disease morbidity.

Since it is possible for a hospital patient to be seen multiple times in one year, we took additional data management measures to identify duplicate patients by isolating records with identical demographic information. The patient's hospital record number, scrambled social security number, date of birth, race, sex, and county of residence were taken into account for this purpose. For example, if a Tennessee resident utilizes a Tennessee hospital five times for asthma in 2000 and three times for ischemic heart disease in 2000, one asthma patient and one ischemic heart disease patient will be counted for 2000 accordingly. If that same Tennessee resident utilizes a Tennessee hospital an additional four times for asthma in 2001, he or she will also be counted as one asthma patient in 2001. Groups of multiple diagnoses and co-morbidities were not considered in this analysis. Finally, considering differences in data quality and time frames, in-patient data was analyzed independently from out-patient data. That being the case, it is possible for one individual to be both and in-patient and out-patient for the same conditions in any given year.

After determining the number of patients seen at least once for each of the 41 diseases evaluated, disease rates for Loudon County, Franklin County, and the state of Tennessee were calculated using population estimates provided by the Tennessee Division of Health Statistics that are routinely used for other analyses. This readily allows comparison of results of these analyses to other reports produced by the Division of Health Statistics. These same population data were also used to calculate death rates and cancer incidence rates for each year that data were available. As stated earlier, use of these population projections may result in slightly different rates than those obtained from using US Census Bureau population data but we feel they more accurately depict local conditions. All rate calculations and statistical tests of difference were performed using the statistical computer software, SAS™. The median age and age range for each of the diseases evaluated were also calculated in SAS™.

Discussion of Data Limitations

Mortality records for the years indicated (1990 through 2003) are complete and reliable. As mentioned above, hospital data may miss some cases of disease if the person saw a private physician at his/her office not associated with a hospital or if the hospital clinic chooses not to report. However, reporting from area hospitals is required by law and is generally good. In-patient hospital data is more reliable and complete than out-patient data for the years 1997 through 2003 for two primary reasons. First, longer stays provide additional opportunities to obtain more complete information. Secondly, the higher costs associated with in-patient hospitalization increases interest in cost recovery, which requires more detailed patient information. In both instances, diagnoses are not verified. Diagnoses for the TCR incidence data are verified but case identification is only about 80% complete. This problem is compounded by the fact that some types of cancer may be reported more thoroughly than others. For example, more aggressive cancers with shorter survival likelihoods may be missed as incidence cases and only captured as mortality events. The important thing to remember when interpreting the health outcome results is that none of the four data sources are perfect; each has its strengths and weaknesses. Furthermore, lifestyle and occupational history information does not accompany any of the health data reviewed. For these reasons, analysis of the data can be used as indicators of statistically significant rate differences, but not as definitive conclusions about the health status of a county or community. A summary of data limitations follows.

<u>Death Data Limitations:</u>
1) These are the most accurate of the data sources considered.
2) It is possible that some non-military-related deaths of Tennessee residents occurring abroad are not captured.
3) Additional efforts are not made to verify diagnoses.

<u>TCR Incidence Limitations:</u>
1) TCR reports these data to be approximately 80% complete but diagnoses are verified.
2) No attempts were made to distinguish diagnoses originating in Tennessee from those originating outside of Tennessee, i.e., information about the duration of current residence and previous residence(s) are not available.
3) No attempts were made to distinguish current conditions from resolved conditions.

Hospital Data Limitations:
1) These data exclude all health care encounters at private clinics and other non-hospital facilities as well as self-treatment. Said another way, these data reflect illnesses severe enough to require some form of hospitalization. They are not likely to reflect early detection of disease or the entire disease experience of any one county or the state of Tennessee.
2) In spite of the efforts taken to identify unique patients, missing or incorrect information for some records may have prevented the complete detection of duplicate patients. Likewise, such errors make it possible for a person to be counted as a resident of more than one county in any given year.
3) No attempts were made to verify diagnoses reported in the hospital records with laboratory results or other information.
4) No attempts were made to distinguish diagnoses originating in Tennessee from those originating elsewhere.
5) No attempts were made to distinguish current conditions from resolved conditions.
6) This only includes data from Tennessee hospitals. It does not include data from hospitals in other states that Tennessee residents go to for care.
7) The hospital discharge system is a financial billing system; it is not intended to track health outcomes even though it is commonly used that way. Because it is a billing system, additional information to better understand health experiences may not be available.

Rate Calculations and Formulas for the draft Loudon Public Health Assessment
The draft Loudon Public Health Assessment released for public comment included mean disease rates for all years in which data was available. The reason for this was to address the community question: Do the disease rates for Loudon County differ significantly over time when compared to Franklin County and the state of Tennessee? Given the data limitations, the statistical method that most appropriately targets this question is the student t-test where variance among annual rates is taken into account. This method calculates a mean rate from annual disease rates and compares how annual disease rates differ from the mean. It also calculates a p-value to indicate how significant differences from the mean are. The formula used to calculate mean rates is:

$$Mean\ Rate = \left[\sum \left(\frac{Total\ Number\ of\ Events\ for\ a\ Specific\ Year}{Total\ Population\ for\ a\ Specifc\ Year} \times 100{,}000 \right) \right] \div Number\ of\ Years$$

This approach has been employed under similar circumstances elsewhere (http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5101a1.htm).

Rate Calculations and Formulas for the Final Loudon Public Health Assessment
From comments received at the public meeting and during the comment period, two other questions arose about the health data. The first question was: Why were mean rates used instead of crude rates? Crude rates can sometimes be more sensitive to changes in population structure than mean rates so in response to these questions we have added crude rates to the final report. The second question was: Relatively speaking, how does the health experience differ between Loudon County, Franklin County and the state of Tennessee? While this seems similar to the initial question raised, it is less concerned with change over time and more interested in broader, big picture, differences. To address this question, we also added crude relative risk ratios (more properly referred to as rate ratios under these circumstances) to the final analyses. The formulas used for these tasks are:

$$\text{Crude Rate} = \frac{\text{Total Number of Events for all Years}}{\text{Total Population for all Years}} \times 100{,}000$$

$$\text{Rate Ratio} = \frac{\dfrac{\text{Total Number of Events for all Years for Area 1}}{(\text{Total Population for all Years for Area 1}) - (\text{Total Number of Events for all Years for Area 1})}}{\dfrac{\text{Total Number of Events for all Years for Area 2}}{(\text{Total Population for all Years for Area 2}) - (\text{Total Number of Events for all Years for Area 2})}}$$

Age-adjusted Rates

For these analyses, age-adjusted rates were not the primary comparisons used for two main reasons. First, when the number of events is small, rates tend to be unstable. In fact, the National Center for Health Statistics considers rates based on frequencies less than 20 to generally be unstable and recommends such rates to be interpreted with caution (McCandless and Oliva, 2003, NAHDO 2004). While the goal of age-adjusted rates is to allow for comparisons between populations independent of age structure, problems resulting from unstable rates can be amplified, especially if the age distribution of a population has undergone changes in specific age groups that adjustment procedures fail to capture adequately. Under such circumstances, one may falsely conclude little difference exists when that may not be the case or vice versa. This problem is sometimes reflected in larger confidence intervals for age-adjusted rates and rate ratios in comparison to crude rates and rate ratios, making interpretations more difficult rather than expanding knowledge of the situation at hand. In addition, if the age proportions used to adjust rates do not adequately reflect the age distribution of the population under study, age-adjusted rates may be further biased. For example, if the age distribution of the population under study is much younger than the average US 2000 population, which is generally the standard used in age-adjustment, disease rates may falsely appear to be much higher than the true community experience and therefore, crude rates may be more meaningful. Similarly, if the age distribution of the population understudy is much older than the average US 2000 population, disease rates may falsely appear to be much lower than the true community experience and crude rates may once again be more meaningful.

With this health assessment, we are faced with the fact that the number of events for many of the health issues we reviewed are below 20. Crude rates, which are subject to the same stability problems as age-adjusted rates, reflect the magnitude of a community's health experience. In this health assessment, we felt it was important to capture that magnitude. Here, the small number of events for many health issues may make age-adjustment an additional source of confusion rather than clarity, especially when trying to understand experiences across health issues. To minimize biased interpretations, rather than present age-adjusted rates for some health issues and crude rates for others, we felt it would be less confusing to present the more conservative, crude rates for all. Such an approach provides us with a more common ground to identify issues warranting further investigation. However, we did calculate age-adjusted rates for all health outcomes and take them into consideration. To minimize confusion, we maintained the age-adjusted rate information separately and did not incorporate it with the crude and mean rate information.

Secondly, the comparison population used in this assessment, Franklin County, was chosen because it has a very similar age distribution to Loudon County. That being the case, adjusting rates for two populations with very similar age proportions does not offer further explanation of rate differences. As stated earlier, to provide information about the magnitude of impact that age may have on disease experiences, especially those with frequencies less than 20, we have included the median age and age range for each of the diseases analyzed in the final report as we did in the draft report.

Finally, since rates for all cancers ranked Loudon County as the highest in Tennessee with respect to mean rates and second highest with respect to crude ranks, we took an extra careful look at the impact of age-adjustment on cancer rates for all counties in Tennessee. These are presented separately in Appendix G. The formula used to calculate age-adjusted rates is:

$$\text{Age-Adjusted Rate} = \sum \left[\text{Age Proportion} \left(\frac{\text{Total Number of Events for all Years for Specific Age Group}}{\text{Total Population for all Years for Specifc Age Group}} \times 100{,}000 \right) \right]$$

The age groups and corresponding proportions used for this formula and used by the Tennessee Department of Health, Division of Health Statistics routinely, are:

AGE GROUP	AGE RANGE	US 2000 proportion
1	Less than 1	0.013818
2	1-4	0.055317
3	5-14	0.145565
4	15-24	0.138646
5	25-34	0.135573
6	35-44	0.162613
7	45-54	0.134834
8	55-64	0.087247
9	65-74	0.066037
10	75-84	0.044842
11	85 and older	0.015508

Appendix I

Community Concerns

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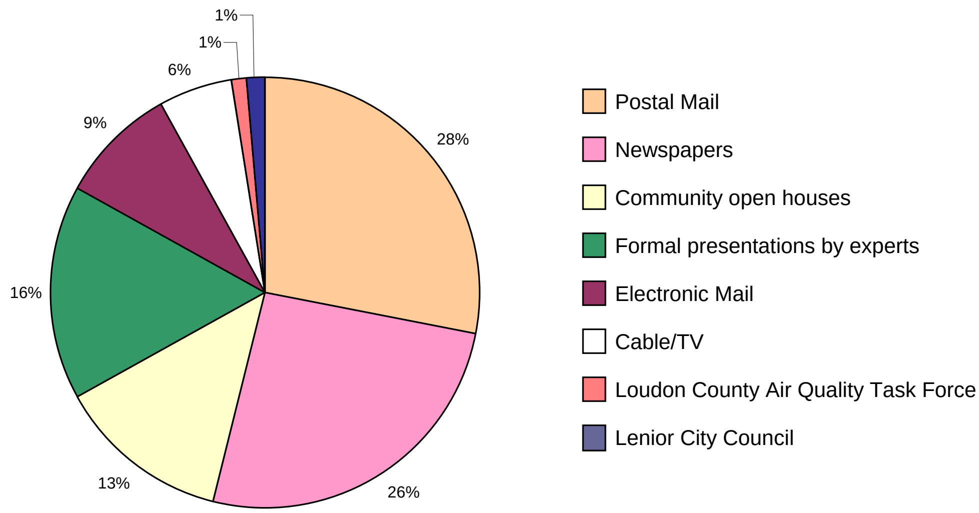
Fifteen percent of residents have children living with them. Loudon is home to many retirees who mentioned that although children are not living in their home, grandchildren come to visit often, some for extended stays. Children's health is a main focus of concern. This will be discussed more thoroughly in the next section, Community Concerns.

As shown in the following figure, most people want to receive information about the Loudon Public Health Assessment process by mail and in newspapers. The preferred newspapers are the Village Connection, the Loudon News- Herald, and the Knoxville News Sentinel.

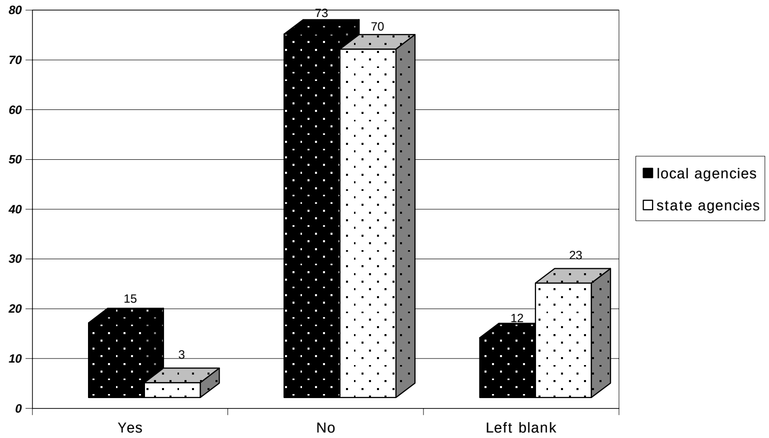
Figure 2. Percentage of respondents wishing to receive information by various means. Loudon County Open House. July 14 and 15, 2004.



An overwhelming majority of respondents wanted information about the chemicals that have been found in the air in Loudon (90%), information on health outcomes such as asthma (88%), and information about how people may come into contact with those chemicals (73%).

When asked if they felt that governmental agencies were responding appropriately to concerns about environmental health in their community, most people said no. Respondents provided some more descriptive information about their concerns and governmental agencies which can be found in the next section, Community Concerns.

Fig. 3. Appropriateness of local and state governmental response to community concerns. Loudon County Open House. July 14 and 15, 2004.



Community Concerns

During the public open house Wednesday, July 14, and Thursday, July 15, 2004 we asked people two open-ended questions. These were:

- What are your main concerns about potential environmental health issues in Loudon?
- Are there any other environmental concerns or comments you would like to provide?

Separating environmental and health concerns is a difficult task because it is well known that a community's environment directly affects that community's health. As well, a community's health directly affects their environment. Since there were so many overlaps of concerns listed by respondents, we fused these concerns together in this section. This section describes the various community concerns that were identified to EEP and a summary of EEP's evaluation. Many concerns were repeated by several community members. Themes were catalogued with subheadings. The concerns/questions are detailed first, followed by the EEP response in *italics*.

Community Concern #1: Air pollution

a. Community members expressed great concern regarding air pollution. They had questions regarding the origin of the pollution. A member of the community asked about the cause of increased haziness, possibly coming from Ohio. There are strong beliefs that the air is getting worse, and that Loudon is one of the most polluted areas in the United States. Residents were concerned about Loudon's Toxic Release Inventory status.

b. Specific health concerns that were identified during the open house include various respiratory symptoms and diseases: pneumonia, asthma, coughing, bronchitis, emphysema, allergies, trouble breathing, and chronic pulmonary obstructive disease. Many community members were concerned that asthma rates are higher in Loudon than in other areas. Community members identified childhood, adult-onset, and exercised-induced asthmas as being more prevalent in the community than elsewhere. One citizen's concern was that odors and air pollution lead to extreme coughing. Other citizens are concerned with year- round bronchitis.

Some residents stated that, since they moved to Loudon, they are now taking more medicines for allergies. Another citizen believes that his/her allergies are due to environmental contaminants. Another concern expressed is that pollution is acting in synergy with local allergens, causing worse symptoms than either trigger alone.

Some citizens state that they have trouble breathing or that on some days they “can’t breathe.” Some say that breathing the air is irritating. One citizen is concerned that the air is more difficult to breath than 20 years ago. A couple mentioned that when they drive through town, they take shorter breaths. Now that the HAPs monitor is in place, several citizens are concerned about what they are breathing. One person is uncomfortable breathing air that has an odor. Another community concern is that employees at the plants are required to wear respirators while local citizens work outside breathing the same pollutants as the industrial workers. Specific questions are:

- Does Loudon have increased risk for asthma and other respiratory diseases?
- Are these respiratory health problems related to air pollution in Loudon?
- Is air pollution related to heart disease?
- Do the workers at the plants wear masks around the same contaminants Loudon residents are breathing?

Loudon does not seem to have an increased rate of respiratory diseases, except for some measures of bronchus and lung cancer and consistent measures for chronic rhinitis and sinusitis. Air pollution in Loudon County may have some relationship to these problems, but it is impossible to assign causation to any particular source. Elevated levels of particulate matter may be related to heart disease (EPA 2004c, Park 2005, Brook 2004).

The Knoxville Regional Early Action Compact (EAC), which included Loudon County, was created to find solutions to lower ozone levels so that compliance with the new ozone standards would be attained. In addition, Loudon County was designated as likely to be in non-attainment of the new $PM_{2.5}$ standards. Both the Knoxville Regional EAC and the Loudon County Air Quality Task Force are working to lower ozone and $PM_{2.5}$ emissions. It is likely that sources of ozone and particulate matter from a variety of sources may have public health implications. See the section on Public Health Implications for more detail.

Workers in industrial settings often wear masks, or respirators, when their jobs require them to be exposed to high levels of chemicals, such as when they must stand near a heated source where vapors are likely to be high. These same high levels of chemicals would not be present everywhere within an industrial facility. The ambient air in Loudon does not contain levels of chemicals, found within certain sections of industrial plants, which are at levels of concern.

Other diseases/symptoms that people were concerned about include:

- Myasthenia Gravis
- Sinusitis
- Sleeping problems
- Headaches

Both Loudon and Franklin Counties reported too few cases of myasthenia gravis for meaningful statistical analysis.

Comparison of health outcome data showed elevated rates of chronic rhinitis and sinusitis in Loudon County for out-patient and in-patient data for females, males, and both sexes combined.

No information was available about the frequency of sleeping problems and headaches.

For total TRI releases to the environment, Viskase is the largest emitter in Loudon County. Viskase releases more than four times the amount of total TRI chemicals compared to A. E. Staley, the second largest Loudon County emitter. Vikase released 2,291,142 pounds of TRI chemicals into the air in 2002. A. E. Staley released 433,092 pounds of TRI chemicals in 2002. Acupowder and Malibu Boats West, Inc. released 27,901 and 127,690 pounds, respectively. In Tennessee, there are 95 counties. Four of the industries in Loudon County rank in Top 100 TRI chemicals in Tennessee released directly to the air. These companies and their statewide rank for 2001 are listed in the following table. Viskase ranked tenth, almost entirely because of their carbon disulfide emissions. A. E. Staley ranked 28th due in large part to hydrochloric acid emissions. Acupowder reported mostly copper releases. Malibu Boats' emission was styrene.

Industries in the top 100 TRI chemical emissions to the air in Tennessee, 2001.

Rank in TN	Facility Name and Address	Total Pounds of TRI Chemicals Released to Air
10	VISKASE CORP. OF AMERICA 106 Blair Bend Dr, Loudon	2,268,148
28	A. E. STALEY MFG. CO. 198 Blair Bend Dr, Loudon	530,784
57	ACUPOWDER TN L.L.C. 6621 Hwy 411 S, Greenback	155,542
68	MALIBU BOATS WEST INC. 5075 Kimberly Way, Loudon	112,736

Scorecard, developed by the Environmental Defense Fund, does not list any Loudon industries as in the top 100 air emitters in the nation. However, the Tennessee Valley Authority (TVA) steam plant at Kingston is ranked as number 23 for air releases. Loudon County is not listed as one of top counties for air pollution from HAPs, $PM_{2.5}$, ozone, or the air quality index (AQI). Scorecard ranks areas based on the maximum AQI recorded. The AQI gives a single summary characterization of air quality. The AQI converts the measured pollutant concentrations of five criteria air pollutants in a community's air to a numerical scale of 0 to 500. The intervals on the AQI scale relate to the severity of potential health effects posed by air pollution levels. Levels above an AQI of 100 are considered unhealthful. Loudon County was not listed in the top 21 counties in Tennessee for AQI in 2001.

Community Concern #2: Specific chemicals

Community members wanted to know if they are being exposed to the following specific chemicals, and, if so, what is the exposure doing to their health:

- Arsenic
- Carbon Disulfide

- Formaldehyde
- Acetonitrile - Is it there or not there?
- Acetaldehyde

The answers to this question are found in the sections describing the HAPs, Health Outcome Data, Public Health Implications, Conclusions, and Appendices, except for arsenic. We have no information on the levels of arsenic in the air in Loudon County.

Community Concern #3: Sensitive populations

Community members were concerned about sensitive populations in their community, namely children and older adults.

a. Community members expressed great concern about the level of childhood respiratory diseases, including asthma, in Loudon. It was suggested that we interview school teachers and a local pediatrician to learn more about these concerns. At the open house we received anecdotal information that children had written essays saying that the air in Loudon stinks and that teachers had brought children inside during recess because of acute health problems caused by air pollution. Residents are concerned that children in the community live near industrial sites. Residents said that schools and parks were in close proximity to polluting industries. Some community members are grandparents whose grandchildren come for frequent visits, and they wanted to know if these children are safe. Specific questions are:

- Will you talk with the pediatrician about his health concerns?
- Could the health effects from air pollution be more harmful to these groups- children and elderly?
- Are children safe even if their schools are in close proximity to industry?

During his 24 years of practice in Loudon, the pediatrician believes he has seen a 30% rise in the asthma incidence in Loudon County. He realizes this is the same as the national trend in urban areas, but is most concerned because Loudon is a rural county, rather than an urban center. He stated that the number of new cases of asthma has increased, rather than the severity of existing cases. He attributes the fact that cases are not more severe to the increasing effectiveness of new treatment modalities. He could think of no other symptoms or diseases in children that have increased in his practice.

In an attempt to verify the anecdotes about recess, staff met and talked with school nurses because school nurses have a better knowledge than teachers of the overall health of a school. Our contact information was given to the nurses, and they were encouraged to distribute the information freely to any school employee who wished to talk with us or submit comments. Although the nurses did not believe they have a higher level of asthmatic students than other schools, they do believe that poor air quality is negatively affecting the health of their student populations. One nurse said that she sees fewer asthma cases on days when exercise and play happens inside rather than outdoors. We were unable to verify or deny the anecdotal information further.

Analysis of in-patient and out-patient hospital data and mortality data show no significant differences in rates of asthma in Loudon County compared to Franklin County and to Tennessee.

Although asthma rates were not elevated, the rates of in-patient and out-patient chronic rhinitis and sinusitis are elevated in Loudon County compared to the rates in Franklin County and Tennessee.

While it is possible that concentrations of HAPs at the schools could possibly be as high as concentrations at the monitoring station on an annual basis, the wind direction during the day is usually toward the northeast, not toward the schools. The winds generally change direction at night, so night time is when the winds from the industrial parks would blow toward the schools. Children should be safe at the schools in Loudon. See the answer for community concern #1.

b. Many community members are retirees who have chosen Loudon as their place of retirement. These community members had concerns that the pollution in Loudon would be more harmful to them in their older age. They had questions related to exercising outdoors, especially in the morning when the odors seem to be worse. They also had concerns that the elderly may be more vulnerable to the effects of pollution.

Many of people who retired and then moved to Loudon County live in Tellico Village which is approximately three to eight miles from Town of Loudon industries. Concentrations of HAPS are expected to be lower than at the monitoring station. It is highly unlikely that people living or exercising in Tellico Village would be adversely affected by the HAPs. See the discussion in the Public Health Implications section.

The lowest reported odor threshold for acetaldehyde and formaldehyde are 2.8 ppb and 20 ppb, respectively (Haz-Map), so it is likely that the odor from acetaldehyde and formaldehyde would be detected near the HAPs monitor. Occasionally, winds out of the northwest could transport emissions from Blair Bend Industrial Park to the Tellico Village area. Winds from the northwest (including north north west and west north west) occur approximately 9% to 15% of the time each month, with velocities ranging from calm conditions to about 25 miles per hour for very short periods. Modeling predicted that, if winds are coming from the northwest, the maximum 1-hour concentration of acetaldehyde could be as high as 11 ppb in the Tellico Village area. It is unlikely that 11 ppb acetaldehyde in air for short periods would cause lasting adverse health effects since 5 ppb is not expected to cause adverse health effects for a lifetime exposure.

Community Concern #4: Cancer and carcinogens

Community members were concerned that there are higher rates of cancer in Loudon and that the HAPs monitor has detected carcinogens, substances that causes cancer. A member of the community compared the data on formaldehyde from the HAPs monitor to EPA comparison values and noted that the monitoring levels were averaging ten times EPA's standards for safety. Throat and skin cancers were mentioned specifically by some residents. Specific questions were:

- Are there known carcinogens being released into the air?
- What are the harmful effects of those?
- Has Loudon had more cancer than other places due to these carcinogens?

Some of the chemicals measured at the HAPs monitor are known carcinogens and some are suspected of causing cancer. See the toxicologic discussion of the chemicals. The concentrations found seem to be within the range of concentrations found in other locations in the U.S. and around the world. Please note the discussion about the public health implications of benzene, carbon tetrachloride, acetaldehyde, and formaldehyde.

Community Concern #5: Burning sensations and irritations

Several Loudon citizens complained of burning sensations and irritations in the eyes, throat, nose, mucous membranes, tongue, and lungs. One resident specifically mentioned air pollution from Viskase as a trigger to his throat burning. Community members were concerned about their lungs burning when they breathe. The concern was that local air pollution might be causing these problems.

When aldehydes are breathed at fairly high concentrations (parts per million range), they are highly irritant to the eyes and mucous membranes of the respiratory tract. Most of the aldehydes measured at the monitoring station were found at extremely low concentrations. Acetaldehyde was found at somewhat higher concentrations, but still below the level at which irritant properties would be expected. The highest concentration of acetaldehyde measured was 4.71 ppb, with an average of 2.34 ppb. The reported concentration that causes eye irritation in a sensitive person is 25,000 ppb (HSDB).

The sampling and analysis for formaldehyde is more complex. Initially formaldehyde was found at levels averaging 19.8 ppb (range, 6.26 to 40 ppb). After April 9, 2004, the measured concentrations dropped significantly, with an average of 2.54 ppb (range, 0.715 to 3.39 ppb). However, all these concentrations are below levels at which irritation is expected.

Community Concern #6: Odor & the quality of life

Community members had several concerns related to the odors in Loudon. Some community members said they stop working or playing outdoors when the odor is bad. Some have ceased working outside altogether. A community member explained that he had no health complaints, but that odor is a quality of life issue. A member of the community wondered whether the bad odor outside meant more dangerous air. This community member jogs in the morning hours, when odor is more prevalent. According to citizen reports, on less windy days, the odor is worse. Specific questions are:

- If the odor is bad, does that mean the air is more hazardous?
- Are any of the odors harmful?

Strong and pungent odors do not necessarily mean that the air is more harmful. There are several pollutants that have no odor that could be harmful and others that have a strong odor that are not. Unpleasant odors in ambient air certainly impinge on the enjoyment people can obtain from working, exercising, and playing outdoors. Because the odors have more than one likely origin, it is difficult to know whether a stronger odor is necessarily more hazardous. At the very least, strong outdoor odors lower the quality of life for people living in those conditions.

According to the American Lung Association (ALA), "Exercise makes us more vulnerable to health damage from these pollutants. We breathe more air during exercise or strenuous work. We draw air more deeply into the lungs. And when we exercise heavily, we breathe mostly through the mouth, bypassing the body's first line of defense against pollution, the nose." There are actions that can be taken to reduce risk to air pollution. The ALA suggests the following:

- *Do train early in the day or in the evening.*
- *Do avoid midday or afternoon exercise, and avoid strenuous outdoor work, if possible, when ozone, smog, or other pollution levels are high.*
- *Do avoid congested streets and rush hour traffic; pollution levels can be high up to 50 feet from the roadway.*
- *Do make sure teachers, coaches and recreation officials know about air pollution and act accordingly.*
- *Most important, do be aware of the quality of the air you breathe! This information can be found by reviewing the Air quality Index. This is available online, through local agencies and the EPA (www.state.tn.us/environment/apc/ozone/ozoneforecast.php).*
- *Don't take air pollution lightly.*
- *Don't engage in strenuous outdoor activity when local officials issue health warnings.*

Community Concern #7: Monitoring and testing:

Community members were concerned about monitoring and testing the air and water. They said that results from the HAPs monitor appeared troublesome, and they want more HAPs monitors installed. A member of the community wanted the monitor to test for more air emissions, such as fine particles. A citizen is concerned that the data from the monitor has been edited. One person wanted more testing for specific chemicals in the water; another noted that Tennessee does not test for many harmful air and water impurities. Another wants to know when tests are being done, who is doing them, the results, and how the results are used. Specific questions are:

- What is the HAPs monitor testing?
- What do the results mean?
- Is there a way to get more air and water monitoring?

When a laboratory is sent the canister and cartridge on which the HAPs were monitored, the laboratory does the analyses. As part of any analytical chemistry procedures, raw results are adjusted to account for things like dilution, to calculate the area under the curve, and to give meaningful, accurate results.

Data on acetonitrile was found to be unreliable because of acetonitrile contamination within the sampling equipment. This problem is not unique to Loudon and has been found elsewhere, in Tennessee and in other states.

It is up to TDEC to decide if more HAPs monitors can be placed in Loudon County. The HAPs monitoring program is part of an EPA program to measure ambient concentrations of a subset of the 188 HAPs listed by EPA. The goal of the national-scale assessment is to identify those air toxics which are of greatest potential concern, in terms of contribution to population risk. The *results will be used to set priorities for the collection of additional air toxics data (e.g., emissions data and ambient monitoring data).*

Talking with the Knoxville Field Office, 888-891-8332, is the best way to ask for more monitoring of all environmental media and to find out when samples will be taken.

Community Concerns #8: Emissions from industry

Community members were concerned about the air emissions from area industries. Community members voiced concerns that industries in Loudon are not using new technology or best practices to reduce pollution/emissions. Another member indicated that nanotechnology would produce smaller particulate matter, but this could cause more harm.

Most of the community had comments specific to Tate and Lyle (A.E. Staley). Many community members expressed concern that Tate & Lyle was given a permit to pollute more. One community member claimed that the permit submitted had used the same data twice. Another community member wondered why other alcohol plants do not smell so badly- was it the coal? Other community members want them to use an oxidizer or the better technology that this company utilizes at other plants. A community member asked how the new plant will affect air quality.

Community members were concerned about the emissions from Viskase. A community member explained that new plants are able to reduce more hydrogen sulfide than the current practices at Viskase.

Many people were concerned about increasing levels of pollution from coal-fired power plants to the west and from TVA.

Other community members were concerned about the ash and sawdust that lands on their personal property.

Specific questions are:

- Are there fewer restrictions for pollution in Loudon than other places?
- If pollution is exceeding levels illegally, then why are industries not being fined?
- How can we continue to recruit industry when we live in an environment that is limited?
- Are industries in Loudon using best practices to reduce air emissions?
- What are appropriate emission standards for formaldehyde and acetaldehyde

Environmental laws to regulate industry have been established by the federal government. These laws are enforced by the US Environmental Protection Agency (EPA) and by state government when their programs have met certain standards. These laws include, but are not limited to, those in the Clean Air Act, Clean Water Act, and the Resource Conservation and Recovery Act (RCRA). Additional laws or rules may be passed by state or local governments. The Tennessee Department of Environment and Conservation permits, regulates, and enforces environmental laws and rules for the state government.

Changing the laws would require new Legislative action. Changes would be met with scrutiny from government, lobbyists, interest groups, and concerned citizens. The law making process is typically slow and difficult. Yet, many believe that the environmental laws benefit all Americans. The laws cover many aspects of environmental compliance; yet not every situation, nor every chemical, is covered in the laws.

A list of the enforcement actions taken by TDEC and/or EPA are included in the presentation of each Title V and conditional major company. Refer to the discussion that begins on page 7. The Department of Health does not enforce environmental laws. We partnered with TDEC to gain this information. To date, our Loudon County environmental public health investigation has been aided by TDEC with supporting documents, data, and verbal assistance. We believe our working relationship among the government agencies to be both positive and protective.

Industries are currently under action or are voluntarily beginning to meet new standards. No one knows the most appropriate emission standards for formaldehyde and acetaldehyde. See the discussion of the chemicals and the public health implications section.

Community Concern #9: Air Modeling

Community questions about the air modeling by UTK involve several subsets of concerns:

1. the proximity of schools to sources of air pollution and predicted concentrations of HAPs at the schools,
2. the discrepancy between modeled acetaldehyde concentrations and actual measured concentrations,
3. the differences in risks to children,
4. the differences in risk to children exposed to a mixture of formaldehyde and acetaldehyde, and
5. the meaning of $1x10^{-6}$ risk.

1. The air modeling results indicate that the predicted annual concentrations of acetaldehyde at the schools on Roberts Road (Loudon Elementary and Fort Loudon Middle) are about the same as at the air monitoring station. The concentrations predicted at the Steekee and Mulberry Street Schools (Steekee Elementary and Loudon High School) are about three times lower than at the air monitoring station. These predictions are based on wind speed and direction data collected at McGee Tyson airport for 1990. The terrain along the Tennessee River at Loudon can influence local wind speeds and direction and introduce uncertainty in the modeling results.

It is likely that the annual concentrations of acetaldehyde occurring at the four schools in downtown Loudon may be very similar to those measured at the air monitoring site. Children are at school around eight hours during the day. Measured wind roses and modeling results both show that wind directions in East Tennessee are bi-modal with prevailing winds out the southwest during the day and out of the northeast at night. It is primarily night-time winds that would transport emissions from industries in the Industrial Parks toward the schools, while winds during the day will likely transport emissions toward the northeast (Miller 2004).

2. The modeling analysis was primarily to predict particulate matter concentrations from several sources in the area. The acetaldehyde modeling was performed to predict maximum annual concentrations and 1-hour maximum concentrations for estimating odor levels due to emissions from Tate and Lyle. Predictions of concentrations of other HAPs were not made. The highest annual average concentration of acetaldehyde predicted was 6.6 ppb at a receptor 0.5 kilometer north of Tate and Lyle. The predicted maximum 24-hour average concentration at the monitoring station was 8 ppb, while the predicted annual average at the monitoring station was 0.7 ppb. Actual measurements for eight months of data are a maximum 24-hour average of 4.7 ppb and an eight-month average of 2.34 ppb.

Comparisons of predicted concentrations (ppb) of acetaldehyde to measured concentrations (ppb) of acetaldehyde at the air monitoring station, Loudon, Loudon County, Tennessee.

	Maximum 24-Hour Concentration at the monitor	Annual Average Concentration at the monitor	Maximum Annual Average Concentration at the highest receptor
Predicted concentrations	8 ppb	0.7 ppb	6.6 ppb (0.5 km north of Tate & Lyle)
Measured concentrations	4.7 ppb [1]	2.34 ppb [1]	Not applicable

[1] *From November 15, 2003 through July 26, 2004*

Modeling for predicted maximum one-hour and maximum annual concentrations of acetaldehyde was documented in "The Loudon Air Quality Study" (Miller et al. 2003). Modeling for maximum 24-hour concentration and annual average concentration of acetaldehyde was performed on March 24, 2004, at the request of APC for comparison to measurements at the monitoring station (Miller, personal communication). The later modeling was performed only for 1990 year meteorological data since it was the highest of the results for 5 years of modeling.

Modeling is not exact; the model makes predictions based on the modeler's estimate of the value and statistical distribution of variables in the complex equations used in the model. One of the major variables is the contribution to acetaldehyde concentrations from other sources, such as from vehicular emissions. No one knows the percentage contribution to total acetaldehyde concentrations from Tate and Lyle, exhaust from diesel and gasoline vehicles, and other unknown sources. See the Discussion on page 13.

3. While there are many studies of adults occupationally exposed to formaldehyde and exposed under acute, controlled conditions, data regarding the toxicological properties of formaldehyde in children are limited. Nevertheless, the same types of effects that occur in adults are expected to occur in children (e.g., damage in portal-of-entry tissues at exposure levels that exceed tissue detoxification mechanisms). Symptoms expected to occur in children include eye, nose, and throat irritation from exposure to airborne concentrations between 400 and 3,000 ppb. Given the water-soluble and reactive nature of formaldehyde and the apparent ubiquity of rapid cellular metabolism of formaldehyde, it is expected that the irritant effects of formaldehyde would be restricted in children, as in adults, to portals-of-entry, although no information was located comparing rates of formaldehyde metabolism in children's tissues with rates in adult *tissues, either in humans or animals. The developing fetus or nursing infant would be expected to be protected from exposure to formaldehyde (via inhalation, oral, and dermal contact) by the pregnant or breast-feeding mother. Studies of animals exposed during pregnancy to formaldehyde in air, in the diet or by gavage, or on the skin have found no distinct or consistent effects on fetal development, even at exposure levels that produced severe maternal toxicity.*

Two studies provide suggestive evidence that children may be more sensitive than adults to the irritant properties of airborne formaldehyde. However, additional research is necessary to confirm or discard the hypothesis that children may be more susceptible than adults to the irritant effects of formaldehyde and to understand the mechanistic basis of this possible difference (ATSDR 1999a).

No information was found that addressed the issue of sensitive populations for exposure to acetaldehyde.

4. No one knows very much about the toxicity of mixtures. EPA has established an RfC for acetaldehyde of 9 µg/m^3 *based on based on the no observed adverse effect level (NOAEL) for degeneration of olfactory epithelium in rats. ATSDR has established a MRL of 8 ppb for chronic-duration inhalation exposure (365 days or more) to formaldehyde. The MRL is based on a minimal lowest observed adverse effect level (LOAEL) for histological changes in nasal tissue specimens from a group of 70 workers employed for an average 10.4 years (range 1–36 years) in a chemical plant that produced formaldehyde and formaldehyde resins for impregnating paper. Since the health endpoints for both chemicals are essentially the same, a safe assumption is that the toxicity of these chemicals may be additive.*

So far the average 24-hour concentration of acetaldehyde is 1.62 ppb, below the RfC, but above the 1 in a million cancer risk value. The average 24-hour concentration of formaldehyde is 6.11 ppb, below the MRL, but above the 1 in a million cancer risk value. In April 2004 the measured concentrations of formaldehyde changed dramatically; at this point the reason is not known. Concentrations between November 15, 2003, and April 9, 2004 ranged from 6.26 ppb to 40 ppb, with an average of 19.8 ppb. Concentrations between April 18, 2004, and December 24, 2005, range from 0.378 ppb and 4.05 ppb, with an average of 2.02 ppb. This later average concentration is below the ATSDR MRL, but above the 1 in million cancer risk value.

5. If a chemical is a probable or known human carcinogen, EPA derives a cancer risk value for that chemical. EPA uses data from animal studies (and human epidemiology studies, if they are available) to extrapolate from high doses with known carcinogenic end points to very low doses using complex models. EPA assumes there is no threshold; that is, any exposure will result in some risk of cancer. This is an assumption that is valid is some cases and not in others, but for most chemicals we lack sufficient data to know the validity of the assumption. EPA then uses one of several models to determine the slope of the 95% upper confidence level of the extrapolated response at low concentrations. This derived slope factor is the number that represents the theoretical risk of excess cancer from exposure to the chemical in question. It is important to note that the cancer risk value is a statistically-derived number representing an upper 95% confidence level of a theoretical straight line predicting an extra cancer in one million people, *when the background lifetime risk of cancer is about one in two for men and one in three for women.*

Community Concern #10: Other environmental concerns

Community members had environmental concerns other than air pollution. These included:

- Power lines
- Meth Labs
- Far fewer hummingbirds than several years ago
- Open fires, land clearing, and burning.
- Adverse effects on soil by the air pollution in the long term
- Water quality of the area lakes
- The number of fish advisories
- Long term effects of air pollution on the water quality
- Time to clean up Loudon
- Traffic
- TVA
- Herbicide use
- Bottle law

There were many comments about traffic in the area. These are detailed below.
Loudon is located in a high interstate traffic area near the confluence of I-40 and I-75 where there are many diesel trucks releasing heavy exhaust. Lenoir City has lots of truck traffic as well. Residents of Loudon identified that older cars are generally more polluting. Some support auto exhaust checks while others voiced they opposed these checks. There has been growth in Loudon County and more people mean more automobiles and boats as well as construction equipment to build new properties. Specific routes of traffic were identified by community members. A resident explained that Loudon was part of AAA's 321 route to the Smokies. Another community member suggested that the "Blue Route" (40.2 miles, from I-75 near Lenoir City to I-75 by the Clinch River near Lake City) was needed.

Specific questions are:

- What can we do about the traffic and emissions from vehicles?
- Is TVA in compliance?

Traffic: The Knoxville Region Early Action Compact (EAC) will address all issues related to ozone and $PM_{2.5}$ compliance. This will include solutions for portion of non-attainment related to traffic and emissions from vehicles. In Loudon County the Loudon County Air Quality Task Force is, also, addressing these issues. See the answer to Community Concern #1.

Bottle Law: A few years ago, the Tennessee Department of Environment and Conservation (TDEC) conducted a telephone survey to determine what environmental issues Tennesseans were most concerned about. Litter was one of the most frequent complaints. Recycling is tremendously beneficial to the environment. Recycling is an industry; recycling rates are connected to the price paid for materials. At this time, aluminum and cardboard prices are stable in the marketplace. However, glass and plastic are worth very little in the market. Glass *is heavy, messy, and must be sorted by color. Plastic is too light-weight and bulky to transport efficiently. Because the market is not favorable for recycling, some recycling rates are low. This translates potential recyclables into trash. Trash is worthless and often gets tossed out to become litter. Several states have bottle bills that collect surcharges on recyclable materials. At this point in time, there is almost zero discussion about a bottle bill for Tennessee, even though litter is recognized as a big problem by a majority of Tennesseans.*

The Knoxville Environmental Assistance Center (1-888-891-8332) has staff who will gladly share information with you about the following issues:

- *Adverse effects on soil by the air pollution in the long term*
- *Water quality of the area lakes*
- *The number of fish advisories*
- *Long term effects of air pollution on the water quality*
- *Meth Labs*
- *Open fires, land clearing, and burning*

In addition, the Region 4 Office of the Tennessee Wildlife Resources Agency (1-800-332-0900) has information about wildlife in Tennessee and about fish advisories. The Division of Natural Heritage, Bureau of Conservation, TDEC (615-532-0431), has information about biological diversity in Tennessee. The Tennessee Department of Agriculture (1-800-628-2631) has information about herbicide spraying. EEP (615-741-7247) has information on a variety of environmental issues, such as power lines. EEP will bring information about these topics to our next public meeting.

Community Concerns #11: People with no health concerns; claim of over response

Some community members attended the open house to express that they have no health concerns and are pleased with the local and state agencies. One community member endorses Staley's expansion and believes the air quality and water quality are good. One community member was concerned that state agencies are over responding to only a few community members.

Whether a citizen feels that state agencies are doing too little or too much, the Tennessee Department of Health hopes that the Public Health Assessment process will be advantageous to all citizens. Community Right-to-Know is a cornerstone of environmental protection. The efforts of the Tennessee Department of Environment and Conservation have led to a better understanding of what chemicals are in Loudon County air. This Public Health Assessment aims to interpret the data for all audiences. Our goal is to effectively meet the needs of the diverse Loudon County communities. Throughout the process, some citizens will feel that government is too involved while other citizens will feel that government is still not doing enough.

Community Concern #12: Environment and the economy

Community members were concerned about their growing economy and the environment. Some of their statements included:

- Jobs should not trade off for clean air.
- Local government more interested in tax base than public health.

- A cleaner environment does not equal fewer jobs.
- Bad press will deter new residents.
- There is too much emphasis on jobs and not enough on health care cost.

Two specific questions/comments are:

- How could our economy be affected if Loudon has tighter environmental restrictions?
- What is the evidence that economic well-being is not in danger from taking care of the environment?

There are opinions on both sides of the environment versus economy argument. Within this document, we cannot provide evidence of one argument being better in Loudon County. However, there are many examples in which working for a healthy environment has made industry more viable. Policy makers and government planners should understand the connections between environmental health and environmental cleanliness and should consider the many options available in today's world marketplace. It is up to local governments, with community input, to determine how best to balance a healthy economy with a healthy environment.

Many large industries recognize the importance of good air quality and a clean environment for attracting and keeping their workers. Typically better air conditions will favor new industries coming in because they can more easily get their air permits approved. In addition, large industries that do not require an air permit may want to locate to an area with a high quality living and working environment.

Loudon County is already in an ozone non-attainment area. Since air-borne pollution reductions are necessary to meet ozone standards, new industries need to be careful about their emissions. Industries interested in attracting working families are typically hesitant about poor air quality areas as well as the local community. Maintaining clean air might lead to a smaller number of industries that need smokestacks to operate or to those industries doing a better job of limiting their emissions.

Community Concerns #13: Dissatisfaction with agencies

Community members identified government agencies as ineffective, unwilling to help, denying an evident problem, and apathetic. Although community members have complained for years, community members feel agencies have done little to help.

On the local level community members are concerned that any action taken now would be too little, too late. Some feel that there has been a lot of talk, but no action. A member of the community was concerned that the local agencies have tried to prevent a health study. Several did not know what the local agencies were doing. Another thought that the local agencies may be over responding to some complaints.

On the state level some general concerns included:

- Agencies have denied access to information,
- Although many requests have been made, nothing is being done
- State agencies cater to businesses

- The state needs a change of attitude
- Some community members did not know what the state agencies are doing in Loudon.

The Tennessee Department of Health does not know what information citizens feel has been withheld. That said, we have not had problems accessing the information we needed in creating this Public Health Assessment. We hope that our involvement will be witnessed as a positive action and be an instrument of positive change.

Comments specific to TDEC:

- TDEC has lied to the community
- Ignored the community's concerns
- Appears to be more interested in paperwork than helping the community
- Sends people out to investigate complaints, but unless they see it with their own eyes, nothing is done.

The Department of Health is a separate agency from TDEC. We have no complaints with their willingness to provide us the information we have requested, nor can we speak on their behalf. We did, on the behalf of the citizens of Loudon County, present the community's concerns to them.

On the federal level a community member called an agency in Atlanta and was told that it would take three years for them to be able to do anything. The community member believes she will be dead by then.

Specific questions are:

- What are the agencies doing about improving our environment?
- What can be regulated?

Only three communities in the 95 counties of Tennessee have had on-going air monitoring. This project, a venture between the Tennessee Department of Environment and Conservation and the US Environmental Protection Agency, was designed to identify the amount of hazardous air pollutants present in Loudon County. Furthermore, TDEC requested our assistance in evaluating the data to ensure that the public health was protected.

Air emissions from large industrial sources are regulated. Environmental operating permits are required before smokestacks can be used. Permitted industries have mandatory reporting or inspection requirements to meet.

Automobile emissions are currently not regulated. In some Tennessee Counties, an automobile emissions testing program is used. This type of program requires that automobiles operate efficiently to minimize the air pollution they can create. The Knoxville Region Early Action Compact (EAC) is working to provide solutions to predicted non-attainment of new ozone and particulate matter standards.

Other air emissions such as from wood burning stoves and fireplaces, leaf burning, and trash burning are not regulated by federal or state law. Some local regulations may be in place to *minimize their environmental impact. Still other sources of air pollution, such as the chemicals that are blown in by the wind from other counties or other states, are not regulated.*

Community Concern #14: Loudon's future

Concerns about Loudon include:

- Loudon is becoming unfit for human habitation.
- Loudon has lost its hospital.
- There seems to be increased illness in our community.
- Emergency preparedness in case of an industrial accident.

Specific questions are:

- Will Loudon continue to be a livable city?
- Are there plans in case of an emergency at a plant?
- Are there enough masks to protect citizens if there is an emergency at a plant and hazardous chemicals are released?

EEP's understanding is that Loudon's hospital is still in existence as part of the Covenant network. The most outstanding finding of EEP's investigation of health outcome data is that Loudon County has a higher rate of chronic rhinitis and sinusitis than Franklin County or Tennessee. EEP did not see an increased rate of asthma in Loudon County, but asthma is most likely under-reported, especially for children whose asthma is under good control.

See the discussions of health outcome data, public health implications, and the discussion for information on the health of the community.

After several industrial accidents, workers and communities in several states demanded information on hazardous materials. Public interest and environmental organizations around the country accelerated demands for information in the mid-1980's on toxic chemicals being released "beyond the fence line" -- outside of the facility. Against this background, the Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted in 1986.

EPCRA's primary purpose is to inform communities and citizens of chemical hazards in their areas. Sections 311 and 312 of EPCRA require businesses to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires EPA and the States to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public in the Toxics Release Inventory (TRI). In 1990 Congress passed the Pollution Prevention Act which required that additional data on waste management and source reduction activities be reported under TRI. The goal of TRI is to empower citizens, through information, to hold companies and local governments accountable in terms of how toxic chemicals are managed.

EPA compiles the TRI data each year and makes it available through several data access tools, including the TRI Explorer and Envirofacts. There are other organizations which also make the data available to the public through their own data access tools, including Unison Institute *which puts out a tool called "RTKNet" and Environmental Defense which has developed a tool called "Scorecard."*

The TRI program has expanded significantly since its inception in 1987. The Agency has issued rules to roughly double the number of chemicals included in the TRI to approximately 650. Seven new industry sectors have been added to expand coverage significantly beyond the original covered industries, i.e. manufacturing industries. Most recently, the Agency has reduced the reporting thresholds for certain persistent, bioaccumulative, and toxic (PBT) chemicals in order to be able to provide additional information to the public on these chemicals.

The Loudon County Emergency Management Agency is responsible for working with local industries to plan for disasters. Loudon County has a comprehensive Emergency Operations Plan which was approved by the Tennessee Emergency Management Agency. Any citizen may view the plan at the Loudon County Emergency Management Agency, 12680 Highway 11 West, Suite 5, Lenoir City or make an appointment to talk with the Director, Gordon Harless (865-988-0175). The public is invited and encouraged to attend the Loudon County Emergency Management Planning Committee meetings.

Appendix J

Response to Comments on the Initial / Public Comment Release Draft Public Health Assessment

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Many comments were received about the public release Loudon County Hazardous Air Pollutants Public Health Assessment. Comments were submitted in writing. In addition to comments collected during the public meeting, comments were sent via letter, fax, and email. If a comment required a change or addition to the document, that change or addition was made in the document. If a comment did not result in a change to the document, it is addressed here in Appendix J. Common comments were grouped; some comments were summarized.

Many of the same comments were received during the availability session held in Loudon in July 2004. Please read Appendix I, Community Concerns, for more detailed answers to these comments.

Comment 1:

In the collection of public comments, there were several individuals who had questions concerning data. Some people asked about access to data while others presented their own calculations using various data sources.

Answer 1:

These comments will be responded to using an approach that a citizen could repeat themselves using Air Quality System data available from the U.S. Environmental Protection Agency Internet site via http://www.epa.gov/air/data/index.html.

First, the data sets that were utilized in the Public Health Assessment: Loudon County HAPs, Loudon County, Tennessee included:

Hazardous Air Pollutants (HAPs) data: This data is collected every 12 days from a monitor near the Blair Bend Industrial Park. Data collection is part of the U.S. EPA Urban Air Toxics Monitoring Program (UATMP). The monitor collects samples that are sent to a scientific laboratory for analytical analysis. This was the key data set utilized in the health assessment. The data was provided to Environmental Epidemiology from the Division of Air Pollution Control. Data collected between November 15, 2003 and May 22, 2005, were used in the health assessment.

The EPA UATMP has released a summary report for their air monitoring sites through the end of calendar year 2003. This report is available online. Some people who provided comments on the health assessment mentioned this report. It can be viewed with Adobe Acrobat Reader at http://www.epa.gov/ttn/amtic/files/ambient/airtox/2003doc.pdf via the Internet. Keep in mind, that only 5 HAPs measurements were collected in 2003 for Loudon County.

Tennessee Cancer Registry (TCR) data: The Tennessee Cancer Registry collects data for cancer incidence. The cancer data must be reviewed for accuracy and certified for use. Currently, only a limited number of years have data available. Some of the TCR data is available on the Internet via http://www2.state.tn.us/health/TCR. Note that Environmental Epidemiology was able to use a larger data set than what is currently publicly available. Private health care providers' data were not available for use. Remember the TCR data used in *the detailed analysis of health outcome data represents years 1991-2000, whereas the data from the TDH/TCR Web site represents years 1997-2000.*

Tennessee Death Certificate data: the Office of Policy, Planning and Assessment, Health Statistics reviews death certificates to gather information on why Tennesseans died. Death certificates can list multiple causes of death such that cancer survivors that die from a non-cancer reason can still be recorded as having cancer. Data represents the years 1990-2003.

Tennessee Hospital In-patient data: the Office of Policy, Planning and Assessment, Health Statistics gathers data about in-patient hospital visits. Data represents years 1997-2003.

Tennessee Hospital Out-patient data: The Office of Policy, Planning and Assessment, Health Statistics gathers data about out-patient hospital visits. Data represents years 1998-2001.

Environmental Regulatory data: The Tennessee Department of Environment and Conservation (TDEC) is responsible for maintaining environmental regulatory standards and laws. TDEC can issue a Notice of Violation (NOV) to a company as an enforcement action. These NOVs are formal procedures that may include financial penalties. A review of TDEC files for companies in Loudon County was performed to understand their environmental track records.

Toxic Release Inventory (TRI) data: The EPA requires industries to self report quantities of potentially harmful chemical releases to the environment. TRI data is available online via http://www.epa.gov/tri; note data is presented two years after it is reported. TRI data for Loudon County is presented in Appendix B. TRI data can be useful in that it ties chemical releases to a particular industry. TRI data represent self-reported estimates and not true "end of pipe" or "top of smokestack" emissions.

Scientific Literature data: Although not a data set of numbers in a spreadsheet, the scientific literature was an important collection of information used in preparing this health assessment. Toxicological Profiles prepared by the federal Agency for Toxic Substances and Disease Registry (ATSDR), as listed in the References section, are great summaries of what is known about a particular chemical based on research studies, accidents, and laboratory experiments. Other reputable scientific journals can also be a source of useful environmental data. These research-based studies can be used to compare Loudon County to other geographic areas.

Analyzing Publicly Available Data

In addition to the above sources of information, the EPA has AirData that can be downloaded and reviewed by anyone. The data is available for many years for several hundred monitoring sites across the United States. The Internet URL is http://www.epa.gov/air/data. The following exercise will use data generated from the AirData for 2003 and 2004 (HAPs data is available for these years). A limited amount of 2005 data has been certified and made available, but without a complete data set comparisons to the previous years' data should not be made.

The data provided has many characteristics including: number of observations, four highest values recorded during the year, mean of all values measured, monitor location, and the reason for the monitor. It is important to note the values presented in the downloadable data. The analytical results are in parts per billion based on carbon (ppbC). The health assessment presented all data in parts per billion by volume (ppbV). To convert, the ppbC value needs to be divided by the number of carbon atoms present in the molecule. Acetaldehyde values need to be divided by 2, formaldehyde, carbon disulfide, and carbon tetrachloride values divided by 1, and benzene values divided by 6. It is important to note the number of observations. In other words, how many measurements of the chemical are contained within the data set. With more observations available the air quality data should be more representative of the average local conditions near the monitoring site. A few monitors measure air parameters frequently and skew the overall observation number upward. This does not affect the quality of the concentration data as the average of the means was used allowing the multiple measurements to only count once in the statistic presented and normalizing the data to follow a normal distribution.

AirData Acetaldehyde

After downloading the data, sorting fields, and performing some simple statistics, a table like the one below can be produced from the EPA UATMP AirData for the chemical acetaldehyde. The table includes the ppbC, converted ppbV, and number of times acetaldehyde was observed. Calendar years 2003 and 2004 are presented. Notice that only 5 values for acetaldehyde are included in the 2003 data for Loudon County. As stated in the health assessment, there is skepticism in the earliest monitoring data for cartridge samples.

Considering all of the data available, the mean value reported for all 45 acetaldehyde measurements at the Loudon County monitor of 1.79 ppb is not that much different than the 1.43 ppb and 1.31 ppb of acetaldehyde measured across the United States in 2003 and 2004, respectively. Furthermore, from the AirData, only the acetaldehyde measurements that were collected for background purposes were considered. The Loudon County HAPs data, collected April 21 through May 22, 2005, had a mean of 1.28 ppb acetaldehyde compared to the annual average background values of 1.75 ppb in 2003 and 1.34 ppb in 2004. The acetaldehyde concentration measured in Loudon County air is not elevated compared to other areas in the United States. Therefore, the health assessment conclusion that no apparent public health hazard from acetaldehyde in air as measured at the HAPs monitor is supported.

Acetaldehyde			
	ppbC	*ppbV*	*# Obs*
Annual average 2003	*2.87*	*1.43*	*11745*
Annual average 2004	*2.62*	*1.31*	*10025*
Loudon mean 2003	*5.68*	*2.84*	*5*
Loudon mean 2004	*3.53*	*1.76*	*31*
Loudon PHA mean		*[R] 1.79*	*46*
Loudon PHA ≤Apr 9, 2004		*2.89*	*14*
Loudon PHA >Apr 9, 2004	*2.72*	*1.28*	*32*
Average Backgrounds 2003	*3.50*	*1.75*	*[NY] 1037*
Average Backgrounds 2004	*2.67*	*1.34*	*[NY] 813*
NY = number of observations includes many measurements from a Queens County New York monitor R = reported value in the Loudon County HAPs health assessment			

<u>AirData Carbon Disulfide</u>

According to the Toxic Release Inventory (TRI) data, Loudon County ranks high for carbon disulfide emissions in Tennessee. Viskase is known to use two railcars of carbon disulfide per week. Even though carbon disulfide was not part of the urban air toxics monitoring, it was apparent that measurements of carbon disulfide in Loudon County were important. Nineteen carbon disulfide measurements were collected between March 28, 2004, and June 13, 2005.

The mean carbon disulfide value in Loudon County was 14.4 ppb. This value is higher than the annual averages of 0.35 ppb in 2003 and 0.40 ppb in 2004 reported by sites across the U.S.A. It is likely that the local emissions of carbon disulfide into Loudon County air are elevating the value in comparison to other areas in the United States. The amount of carbon disulfide measured in Loudon County air is still far below the 300 ppb ATSDR health guideline. The no apparent public health hazard conclusion is supported when investigating carbon disulfide using the AirData.

Carbon Disulfide			
	ppbC	ppbV	# Obs
Annual average 2003	0.35	0.35	3399
Annual average 2004	0.40	0.40	2636
Loudon mean 2003	NR	NR	0
Loudon mean 2004	NR	NR	0
Loudon PHA mean	6.2	[R] 6.2	6
Loudon PHA ≤Apr 9, 2004	6.3	6.3	2
Loudon PHA >Apr 9, 2004	6.1	6.1	4
Average Backgrounds 2003	NE	NE	1
Average Backgrounds 2004	NE	NE	2
NE = not enough background samples were collected to determine this value NR = none reported; Loudon monitoring data for carbon disulfide not in AirData R = reported value in the Loudon County HAPs health assessment			

<u>AirData Formaldehyde</u>

Formaldehyde is perhaps the most complex HAP discussed in the health assessment. The formaldehyde measurements from the HAPs monitor up to April 9, 2004, averaged 19.8 ppb over 14 observations. This value was above health guidelines. Measurements thereafter were much less. The reason for the change in the data is unknown, though maintenance to the monitor is being considered. The more recent average formaldehyde concentration was 1.84 ppb as measured over 32 observations. This value is less than the annual averages in 2003 of 3.49 ppb and 2004 of 3.39 ppb for all sites reporting to AirData. Sites reporting only background concentrations, had average background formaldehyde concentrations of 3.14 ppb in 2003 and 2.20 ppb in 2004. Recent formaldehyde measurements at the Loudon County HAPs monitor are consistent with normal levels of formaldehyde measured in the U.S.

Formaldehyde			
	ppbC	ppbV	# Obs
Annual Average 2003	3.49	3.49	[C] 17807
Annual Average 2004	3.39	3.39	[C] 18478
Loudon mean 2003	23.36	23.36	5
Loudon mean 2004	6.58	6.58	31
Loudon PHA mean	9.17	[R] 9.17	46
Loudon PHA ≤Apr 9, 2004	19.8	19.8	14
Loudon PHA >Apr 9, 2004	2.07	2.07	32
Average Backgrounds 2003	3.14	3.14	[NY] 972
Average Backgrounds 2004	2.20	2.20	[NY] 786
C = observations include many measurements from a Chicago, Illinois monitor NY = observations include many measurements from Queens County, New York monitor R = reported value in the Loudon County HAPs health assessment			

AirData Benzene

Benzene levels measures in Loudon County air at the HAPs monitor are lower than values reported at other air monitoring sites in the U.S. The annual averages for benzene measured at sites in 2003 and 2004 were a bit higher than in Loudon County. Also, 32 monitoring sites setup for general/background samples in 2003 and 39 sites in 2004 showed slightly higher background levels of benzene in other parts of the U.S.A., supporting the health assessment conclusion of no apparent public health hazard.

Benzene			
	ppbC	ppbV	# Obs
Annual Average 2003	2.53	0.421	121,988
Annual Average 2004	2.43	0.405	125,567
Loudon mean 2003	2.05	0.342	4
Loudon mean 2004	2.24	0.373	31
Loudon PHA mean	2.3	[R] 0.39	48
Average Backgrounds 2003	3.14	0.523	[TX] 3716
Average Backgrounds 2004	2.43	0.406	8,644

TX = observations include many measurements from Port Aurthor, Texas monitor
R = reported value in the Loudon County HAPs health assessment

AirData Carbon Tetrachloride

The reported mean of carbon tetrachloride concentrations measured at the Loudon County HAPs monitor was 0.09 ppb. This is equal to the 2003 annual average of 0.09 ppb and a bit lower than the 2004 annual average of 0.12 ppb reported for other U.S. sites. AirData annual averages for carbon tetrachloride general/background air samples were 0.10 ppb in 2003 and 0.11 pbb in 2004, supporting the conclusion of no apparent health hazard.

Carbon Tetrachloride			
	ppbC	ppbV	# Obs
Annual Average 2003	0.09	0.09	[P] 10,985
Annual Average 2004	0.12	0.12	10,026
Loudon mean 2003	0.06	0.06	4
Loudon mean 2004	0.08	0.08	31
Loudon PHA mean	0.09	[R] 0.09	41
Background 2003	0.10	0.10	1,317
Background 2004	0.11	0.11	1,573

P = observations include many measurements from a Providence, Rhode Island monitor
R = reported value in the Loudon County HAPs health assessment

When the publicly available EPA AirData was downloaded and statistically analyzed, the conclusions for the public release Loudon County Hazardous Air Pollutants Public Health Assessment were supported. In large, Loudon County air is similar to other areas in the U.S.A.

Comment 2:

"The statement, 'Since health endpoints for both chemicals are essentially the same, a safe assumption is that the toxicity of these chemicals may be additive' (referring to formaldehyde and other aldehydes), is generally accepted dogma when data are absent describing multiple chemical effects. However, there are a few references that indicate there is a competitive binding to the trigeminal nerve (common receptor) for formaldehyde, acrolein, and acetaldehyde. So although the additivity assumption may still hold true for more chronic endpoints, it appears not to be the case for acute endpoints."

Other people were concerned that nothing specific was presented about quantifying risks from the mixture of chemicals.

Answer 2:

Several research papers were found addressing the issue of the additivity of health effects from mixtures of formaldehyde and acetaldehyde from inhalation. In the most applicable paper, (Cassee 1996) a measure called the RD50 was used to calculate competition for the trigeminal nerve receptor (site of sensory irritation) of mixtures. The RD50 is a statistically derived concentration which reduces the respiratory rate by 50%. The RD50 for formaldehyde ranges from 4.7 to 13.7 ppm (or 4,700 to 13,700 ppb). When levels of these mixtures are inhaled in the RD50 range, there is competition for the receptor and the total health effect is less than predicted from additivity models. According to the same article, "at concentrations much lower than the RD50, a competition model will result in similar results as predicted by dose-addition of equidoses of each compound." (Cassee 1996). The concentrations of formaldehyde and acetaldehyde ranged from less than 1 ppb to around 3 ppb, respectively, using data since April 9, 2004. These concentrations found in Loudon are well below the RD50. Competition would not be expected for the receptor site. Additive effects would be expected.

In addition to formaldehyde and acetaldehyde, there are other aldehydes and chemicals in the Loudon air that may compete for the trigeminal nerve receptor site. These chemicals are at very low levels, but when mixed together may have a more pronounced health effect. Whether the total effect of the mixture is truly additive or competitive cannot be predicted, but the effect may be greater than effects from any individual HAP.

Comment 3:

More than one commenter confused the public health assessment with an EPA-style risk assessment. The two assessments are very different in format and purpose.

Answer 3:

A risk assessment is an analysis that uses information about toxic substances at a site to estimate a theoretical level of risk for people who might be exposed to these substances, usually over a life-time. Risk assessments, prepared by EPA and other agencies, are used to determine if levels of toxic substances at hazardous waste sites pose an unacceptable risk as defined by regulatory standards and requirements. The risk assessment helps regulatory officials make management decisions, such as hazardous site cleanup strategies that will ensure overall protection of human health and the environment.

Risk assessments often are conducted without considering actual exposure. Conservative safety margins are built into a risk assessment analysis to ensure protection of the public for a life-time and for sensitive populations. Therefore, people will not necessarily become sick even if they are exposed to materials at higher dose levels than those estimated by the risk assessment. A risk assessment makes sure all members of the public will be protected from a theoretical risk.

While a public health assessment does not measure the actual health effects that hazardous substances have on people, the assessment does consider actual past, present, or future exposures. The health assessor reviews site-related environmental data and detailed toxicological information about substances at a site or, in the case of Loudon County, about the HAPs measured at the monitor. The assessor derives an estimated dose of the substances to which people in the community might be exposed (concentrations of HAPs at the monitor for Loudon); then these doses are compared with health comparison values (regulatory standards, ATSDR guidelines, WHO guidelines, etc.). Even if the exposure levels are greater than health comparison values, a public health hazard does not necessarily exist. The mechanism of action of the chemicals, dose-response relationships, data from human epidemiologic studies, how people are exposed, and the length and frequency of exposure are all considered in making a determination about hazard to public health from actual or potential exposures.

Since a public health assessment is not an analytical epidemiologic study, usually no relationships can be established between exposure data and health outcome data. In Loudon County, some signs of upper respiratory irritation were found that could possibly have a relationship to mixtures of chemicals, especially aldehydes, but because public health assessments are not designed to show causation, EEP cannot say that the mixture of chemicals measured at the HAPs monitor caused the upper respiratory irritation. The conclusions of an assessment, which are based on the professional knowledge and judgment of the health assessment team, address the likelihood that persons living near a site with hazardous substances were exposed, are being exposed, or might be exposed at some future time to harmful levels of hazardous substances from the site.

Health outcome data are used to give a snap-shot of the health of the community using datasets that are available. No new health data are generated, as would happen in an epidemiologic study. Because the environmental data and the existing health outcome data do not usually overlap in time and no personal exposures are known, causation cannot be established.

A health assessment draws conclusions about exposures to toxic substances and whether the *exposures are likely to lead to illness. Recommendations are made about ways to protect public health. For example, recommendations might be made for the elimination or reduction of harmful exposures, or that some critical, missing data is obtained to assist the evaluation. It could also recommend a more rigorous health investigation be conducted.*

The public health assessment is neither a medical evaluation of individuals nor a rigorous health study of populations (an analytical epidemiology study). It is not a statement about establishing or meeting regulatory standards. The assessor does not determine cleanup levels or the best methods for cleanup or treatment. The public health assessment can be used by risk managers, along with other reports and research, to make decisions. The purpose of the public health assessment is not to make management decisions or to draw conclusions in the absence of data. A risk assessment investigates and evaluates the theoretical effects of hazardous waste both on people and the environment for regulatory purposes. A public health assessment only considers effects to people for public health purposes.

Comment 4:

Use of non-cancer guidelines is not an appropriate basis for an analysis of total risk which includes cancer risk as well as non-cancer risk.

Answer 4:

The reasons for using the non-cancer guidelines is discussed in detail in the Discussion section for acetaldehyde and formaldehyde. Both acetaldehyde and formaldehyde seem to cause cancer at much higher levels than those measured at the HAPs monitor. The concentrations at which a promoter of cancer would enhance carcinogenicity of another chemical would be at least as large as the threshold cancer risk concentrations (tolerable concentration). The World Health Organization's tolerable concentration for acetaldehyde is 0.3 mg/m^3 (167 ppb), and its guideline for formaldehyde in ambient air is 0.1 mg/m^3 (81 ppb), as compared to the average concentration of 1.84 ppb measured after April 9, 2004.

Comment 5:

"Use of generalized anecdotal assertions, instead of available, empirical data, is not appropriate documentation for risk or exposure levels to children and the elderly."

Answer 5:

EEP examined toxicological data and literature for children and the elderly for HAPs; unfortunately not much age-specific data is available. EEP believes that its conclusions about no apparent health hazard for acetaldehyde, formaldehyde, benzene, carbon tetrachloride, and carbon disulfide are applicable for all people of all ages.

Comment 6:

“The mission statement of the TN Dept of Health states it is charged with protecting the health of the public. . . Loudon County is ranked 1st in overall cancer rate in TN . . . When can we expect this protection to begin?”

Answer 6:

Before this public health assessment was performed, no one knew that Loudon County’s cancer incidence rate was #1 for the mean rate for all cancers combined for both sexes during the years 1991-2000. Before anything can be done to lower the rate, the causes must be determined. After the causes are identified, then a plan can be made and implemented to help lower cancer incidence rates. We have already begun to look into identifying the many possible causes of cancer in Loudon County.

Comment 7:

“The statement, ‘A person’s exposure depends on the concentration within a location (microenvironment) and how long a person spends in each microenvironment’ is correct. The preceding sentence, ‘Actual exposure (often called the dose) is principally defined by the concentration to which the individual is exposed’ is redundant (and not as well-stated), and should be deleted. The following sentence, ‘This report will examine the inhalation route of exposure in detail’ is not accurate (and also belated, coming after the main analyses). As no exposure assessment was performed, this sentence should be deleted.”

Answer 7:

The first part of the comment deals with writing style. The paragraph will essentially remain as written. The main analysis begins in the discussion. The preceding section laid out the background for analysis and discussion. The format is specified by ATSDR. As stated in the answer about the differences in risk assessment and health assessments, this report is about hazardous air pollutants and the likelihood of them causing a public health hazard through the inhalation route of exposure. As the comment states, no exposure assessment was done. However, a detailed analysis of the inhalation exposure pathway and likelihood of a public health hazard was indeed performed.

Comment 8:

“Franklin County is comparable to Loudon County in several important respects, but this table omits an important difference: the percentage of residents in older age groups, who are at much greater risk of being diagnosed with aging-related diseases such as cancer, is higher in Loudon County than in Franklin County. According to the National Cancer Institute’s State Cancer Profiles, Loudon County ranks 7th in Tennessee in percent of residents older than 50, while Franklin County ranks 36th.

Other commenters want to know if Loudon and Franklin Counties have comparable growth rates and if the growth rate in Loudon County (especially among older retirees) is skewing the analysis of health outcome data.

Answer 8:

According to the 2000 census, at that time, the age distributions of Loudon and Franklin Counties matched very well: 13.2% in Loudon County versus 12.8% in Franklin County for people aged 65 to 84 and 1.4% versus 1.5% for people aged 85+. For statistical comparisons this is an excellent match. The 2005 population projections from TDH show that 7,456 (17.9%) people aged 65 to greater than 85 years are expected to live in Loudon County compared to 6,241 (15.3%) in Franklin County. It can be seen that both counties are increasing in the proportion of older people. These numbers are population estimates. Health outcome data used in the public health assessment included only the early 2000s, with the cancer data ending with the year 2000. No health data for 2004 or 2005 was available for review. As people move into Loudon County it is possible that older people are making up a larger portion of the population. That is one of the topics EEP wants to investigate further.

The idea of comparing growth rate differences between the comparison counties is very good. That can certainly be a part of our next steps is trying to find out why the cancer incidence rates in Loudon County are higher.

Comment 9:

Several people commented on the lack of age-adjustment of health data and the differences in crude and mean rates.

Answer 9:

Please Appendix H for a detailed discussion of methodology and age-adjustment.

The draft Loudon Public Health Assessment released for public comment included mean disease rates for all years in which data was available. The reason for this was to address the community question: Do the disease rates for Loudon County differ significantly over time when compared to Franklin County and the State of Tennessee? Given the data limitations, the statistical method that most appropriately targets this question is the student t-test where variance among annual rates is taken into account. This method calculates a mean rate from annual disease rates and compares how annual disease rates differ from the mean. It also calculates a p-value to indicate how significant differences are from the mean. The data available for such analyses at that time consisted of:

1. *death certificate information from 1990 through 2003,*
2. *in-patient hospital discharge data from 1997 through 2002 and provisional data for 2003;*
3. *out-patient hospital discharge data from 1998 through 2001; and*
4. *Tennessee Cancer Registry (TCR) incidence case data from 1991 through 2000. The formula used to calculation mean rates is:*

$$Mean = \left[\sum\left(\frac{Number\ of\ Events\ in\ Specific\ Year}{Population\ for\ Specific\ Year} \times 100{,}000\right)\right] \div Number\ of\ Years$$

From comments received at the public meeting and during the comment period, two other questions arose about the health data. The first question was: Relatively speaking, how does the health experience differ between Loudon County, Franklin County and the state of Tennessee? While this seems similar to the initial question raised, it is less concerned with change over time and more interested in broader, big picture, difference. The second question was: Why were mean rates instead of crude rates used? Crude rates can sometimes be more sensitive to changes in population structure than mean rates so in response to these questions we have added crude rates to the final report. We also added relative risk ratios (more properly referred to as rate ratios under these circumstances) to the final analyses. The formulas used for these tasks are:

$$Crude\ Rate = \frac{Total\ Number\ of\ Events\ for\ all\ Years}{Total\ Population\ for\ all\ Years} \times 100{,}000$$

$$Rate\ Ratio = \frac{\dfrac{Total\ Number\ of\ Events\ for\ all\ Years\ for\ Area\ 1}{(Total\ Population\ for\ all\ Years\ for\ Area\ 1) - (Total\ Number\ of\ Events\ for\ all\ Years\ for\ Area\ 1)}}{\dfrac{Total\ Number\ of\ Events\ for\ all\ Years\ for\ Area\ 2}{(Total\ Population\ for\ all\ Years\ for\ Area\ 2) - (Total\ Number\ of\ Events\ for\ all\ Years\ for\ Area\ 2)}}$$

Additional data became available during the editing of the final report. Data analyzed for the final report consisted of:

1. *death certificate information from 1990 through 2003;*
2. *inpatient hospital discharge data from 1997 through 2003 (final for all years);*
3. *outpatient hospital discharge data from 1998 through 2003 with 2003 data being provisional; and*
4. *Tennessee Cancer Registry (TCR) incidence case data from 1991 through 2000.*

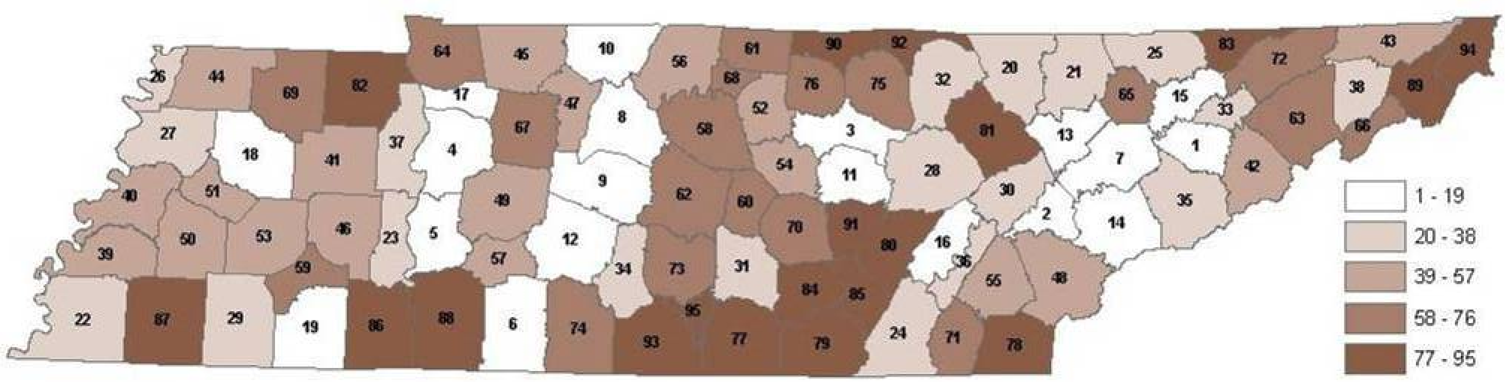
However, since rates for all cancers ranked Loudon County as the highest in Tennessee with respect to mean rates and second highest with respect to crude ranks, we compared ranked age-adjusted cancer rates for all counties in Tennessee. The additional formula used to calculate age-adjusted rates is:

$$Age\text{-}Adjusted\ Rate = \sum\left[Age\ Proportion\left(\frac{Total\ Number\ of\ Events\ for\ all\ Years\ for\ Specific\ Age\ Group}{Total\ Population\ for\ all\ Years\ for\ Specifc\ Age\ Group} \times 100{,}000\right)\right]$$

The age groups and corresponding proportions used for this formula and used by the Tennessee Department of Health, Office of Policy, Planning and Assessment, routinely, are:

Age Group	*Age Range, Years*	*US 2000 Population*
1	*< 1*	*0.013818*
2	*1-4*	*0.055317*
3	*5-14*	*0.145565*
4	*15-24*	*0.138646*
5	*25-34*	*0.135573*
6	*35-44*	*0.162613*
7	*45-54*	*0.134834*
8	*55-64*	*0.087247*
9	*65-74*	*0.066037*
10	*75-84*	*0.044842*
11	*≥ 85*	*0.15508*

Total TCRI Cases Ranked by Age-Adjusted Rate



ALL CANCERS TOTAL TCRI CASES 1991-2000

County	Rank	Number	Age-adjusted Rate
Jefferson	1	1907	462.17 (441.43-482.92)
Loudon	2	1985	460.42 (440.16-480.67)
Putnam	3	2659	456.72 (439.36-474.08)
Humphreys	4	881	455.31 (425.24-485.37)
Perry	5	389	446.18 (401.84-490.51)
Lawrence	6	1823	441.21 (420.95-461.46)
Knox	7	16062	440.17 (433.36-446.98)
Davidson	8	22084	439.40 (433.61-445.2)
Williamson	9	3582	434.97 (420.73-449.22)
Robertson	10	1935	430.78 (411.59-449.98)
White	11	1056	420.67 (395.29-446.04)
Maury	12	1156	420.56 (396.31-444.8)
Anderson	13	3522	417.08 (403.3-430.85)
Blount	14	4442	414.65 (402.45-426.84)
Grainger	15	825	414.65 (386.36-442.95)
Rhea	16	1192	414.57 (391.03-438.1)
Houston	17	389	414.04 (372.89-455.19)
Gibson	18	2423	413.29 (396.84-429.75)
McNairy	19	2620	413.02 (397.2-428.83)
Scott	20	782	412.19 (383.3-441.08)
Campbell	21	1754	411.90 (392.62-431.17)
Shelby	22	30310	411.26 (406.63-415.89)
Decatur	23	599	411.11 (378.18-444.03)
Hamilton	24	13014	410.75 (403.69-417.81)
Claiborne	25	1207	409.48 (386.38-432.58)
Lake	26	326	406.15 (362.06-450.24)
Dyer	27	1550	405.04 (384.87-425.2)
Cumberland	28	2302	402.32 (385.88-418.75)
Hardeman	29	1063	401.75 (377.6-425.9)
Roane	30	2395	401.68 (385.59-417.77)
Coffee	31	1963	401.15 (383.41-418.9)
Fentress	32	676	400.80 (370.59-431.02)
Hamblen	33	2288	398.02 (381.71-414.33)
Marshall	34	3343	397.58 (384.1-411.06)
Sevier	35	2601	397.04 (381.78-412.3)
Meigs	36	396	396.93 (357.83-436.02)
Benton	37	803	395.62 (368.25-422.98)
Washington	38	4222	391.99 (380.16-403.81)
Tipton	39	1526	391.37 (371.74-411.01)
Lauderdale	40	995	390.29 (366.03-414.54)
Carroll	41	1359	390.21 (369.46-410.95)
Cocke	42	1318	389.02 (368.02-410.02)
Sullivan	43	6755	386.96 (377.73-396.18)
Obion	44	1415	386.75 (366.6-406.9)
Montgomery	45	3195	385.13 (371.78-398.49)
Henderson	46	999	381.49 (357.84-405.15)
Cheatham	47	975	381.19 (357.26-405.12)
Monroe	48	1401	380.46 (360.53-400.38)
Hickman	49	765	378.98 (352.12-405.83)
Haywood	50	781	378.72 (352.16-405.28)
Crockett	51	629	378.33 (348.76-407.9)
Smith	52	643	373.19 (344.34-402.03)
Madison	53	1036	372.98 (350.27-395.69)
DeKalb	54	682	371.53 (343.65-399.42)
McMinn	55	943	370.15 (346.53-393.78)
Sumner	56	4020	369.70 (358.27-381.13)
Lewis	57	419	368.36 (333.09-403.64)
Wilson	58	2546	365.34 (351.15-379.53)
Chester	59	535	364.05 (333.2-394.9)
Cannon	60	466	362.35 (329.45-395.25)
Macon	61	1839	362.20 (345.64-378.75)
Rutherford	62	4067	362.02 (350.89-373.15)
Greene	63	2415	360.75 (346.37-375.14)
Stewart	64	473	359.53 (327.13-391.94)
Union	65	519	354.61 (324.11-385.12)
Unicoi	66	774	353.18 (328.3-378.06)
Dickson	67	1349	352.76 (333.93-371.58)
Trousdale	68	259	351.96 (309.09-394.82)
Weakley	69	1280	351.81 (332.54-371.09)
Warren	70	1351	348.05 (329.49-366.61)
Bradley	71	2690	340.27 (327.41-353.13)
Hawkins	72	1800	339.69 (323.99-355.38)
Bedford	73	1217	339.30 (320.24-358.37)
Giles	74	1067	337.28 (317.04-357.51)
Overton	75	734	334.14 (309.97-358.32)
Jackson	76	402	332.31 (299.83-364.8)
Franklin	77	1392	331.27 (313.86-348.67)
Polk	78	548	326.96 (299.58-354.34)
Marion	79	615	325.69 (299.95-351.43)
Bledsoe	80	351	324.45 (290.51-358.4)
Morgan	81	579	319.98 (293.91-346.04)
Henry	82	1235	318.93 (301.14-336.71)
Hancock	83	235	310.16 (270.51-349.82)
Grundy	84	454	306.81 (278.59-335.03)
Sequatchie	85	312	304.78 (270.96-338.6)
Hardin	86	871	303.24 (283.1-323.38)
Fayette	87	826	300.59 (280.09-321.09)
Wayne	88	505	293.53 (267.93-319.13)
Carter	89	1737	278.57 (265.47-291.67)
Clay	90	252	277.59 (243.32-311.86)
Van Buren	91	145	255.15 (213.62-296.68)
Pickett	92	140	234.56 (195.71-273.41)
Lincoln	93	748	218.94 (203.25-234.63)
Johnson	94	409	213.50 (192.81-234.19)
Moore	95	106	173.99 (140.86-207.11)
Tennessee	96	209625	394.93 (393.24-396.62)

Comment 10:

"As mentioned previously, the cancer incidence data quoted here could not be verified on the TCR website. Age-adjusted cancer incidence data by primary site in Loudon County (1997-2000 data) indicated that prostate cancer has the highest incidence, although it can obviously occur only in men. Brain cancer is not in the top ten cancer sites. Breast (not ovary) is the leading cancer site for women.

Answer 10:

EEP used both the TCR website (1997-2000) and the raw data (1990 – 2000) in this public health assessment. Analysis of more years of data would be expected to change details of the rankings. All use of the health data was checked by the Office of Policy, Planning and Assessment and found to be correct.

Comment 11:

Several comments referred to the problems with the HAPs monitor leading to the conclusion that the HAPs data is unreliable.

Answer 11:

The Division of Air Pollution Control (APC) was very open about the initial problem with the acetonitrile leaking from a component of the cartridge into the canister portion of the monitor. This was discussed briefly in the Discussion section. APC sought the aid of the U.S. EPA and the manufacturer of the monitor in finding the cause of the problem and in solving it. Shortly after solving the acetonitrile problem, the concentrations of formaldehyde and acetaldehyde dropped. The concentrations of some other HAPs, also, dropped, but not as dramatically. Again, APC has sought the aid of the U.S. EPA and the manufacturer. Although no one knows precisely why the concentrations dropped and stayed at the lower values, APC believes that the initial formaldehyde and acetaldehyde data is questionable. APC, the U.S. EPA, and TDH believe that the later monitoring is accurate.

Comment 12:

Several people commented that the public health assessment did not adequately address children and sensitive populations.

Answer 12:

EEP discussed the toxicity of the chemicals of concern as related to sensitive populations as adequately as possible, given the state of current toxicologic knowledge. It is impossible to consider individuals and their particular risks in this type of assessment. EEP tried to find information about toxic and reproductive effects on sensitive groups in order to draw conclusions valid for these sensitive groups. See the discussions of formaldehyde, benzene, and carbon disulfide.

Even though children were not specifically mentioned in the conclusions, the conclusions are valid for children and everyone else. Benzene measured at the monitor is at extremely low concentrations, so it is highly unlikely to cause any health effects to anyone in Loudon County. The same conclusion is applicable to acetaldehyde. Although evidence suggests that acetaldehyde may act as a promoter of cancer, the extremely low concentrations found in Loudon County make it highly unlikely that the acetaldehyde in ambient air could act as a promoter or an initiator of cancer.

Comment 13:

At the Open House, members of APC did not make themselves available.

Answer 13:

EEP is sorry that you felt that way. The Open House lasted from before 9:00 AM until after 7:00 PM. APC staff were present and available during the entire time. Toward the end of the day, when they were sitting down, they may have given the impression they were having a meeting, but they were not. Other members of the community complemented the good access to APC staff.

Comment 14:

Some people could not find the document on the TDH website.

Answer 14:

EEP is sorry to hear that you could not find the document on the TDH Internet site. We are glad that you told us. In the future, we will try to make Internet use easier and will explain to staff who answer the main telephone how to help people access our documents.

Comment 15:

Several people were concerned:

- that the only way a true assessment can be made on the environment in Loudon County, is to engage a third party, independent of the government to perform a study to ascertain what pollutants are involved and where they are coming from,
- only 2 out of 6 staff have a Ph.D. in the appropriate fields, and
- one year to write the public health assessment is excessive.

Answer 15:

EEP is sorry that community members feel this way. EEP staff are experts in their various fields, with four Master's of Science degrees, one Ph.D., and two professional certifications among the five staff members. They are qualified for this work. EEP did not want to take a whole year to write this public health assessment. However, given the complexity of the site and *the many community needs, it took EEP longer than expected to produce the public health assessment.*

We understand some people do not trust government. Although the EEP staff was qualified to perform the assessment, EEP would be responsive to a third party performing an assessment.

Comment 16:

Several people were concerned with air pollution in Lenoir City. Others were concerned about air pollution from all the cars and trucks on the many high ways in Loudon County.

Several commenters wanted to know HAPs levels in other parts of Loudon County and wanted to know why there was only one HAPs monitor.

Answer 16:

The HAPs monitoring program across the U.S.A. is the first time that hazardous air pollutants have been measured consistently over time and space. While it is difficult to draw conclusions about health effects in a county from one monitor, it is a very good first step to have the monitor. EEP hopes that the HAPs monitoring program will grow, eventually becoming routine and less expensive so that better estimates of health risk can be made and better decisions to protect public health can be made. EEP agrees that it is a good idea to do some air sampling where traffic is heavy. An additional HAPs monitor in Loudon County would be helpful.

Comment 17:

"We would like to know the link between hazardous air pollutants, toxins in the environment, and the health of residents in Loudon County."

Answer 17:

As stated in the document under the Purpose, Discussion, Health Implications, and Conclusions sections, no associations between the HAPs and health outcome data can be drawn. The HAPs data and the health outcome data come from different time periods. A well-designed analytical epidemiologic would be necessary to show causation between exposures and health effects. In Loudon we do not have individual exposure data, which would be necessary before trying to show cause-and-effect; nor do we have evidence of exposures that would lead to adverse health effects of a magnitude that would be identifiable by epidemiologic studies. To obtain funding for a study (estimated in excess of $1,000,000), a very high likelihood of adverse health effects from exposures would be necessary.

Comment 18:

Please name all sources of facts and emissions data used in this draft copy.

Answer 18:

All data from the HAPs monitor came from the Division of Air Pollution Control, Tennessee Department of Environment and Conservation. All health outcome data came from the Office of Policy, Planning and Assessment, Tennessee Department of Health. All facts and data are explicitly referenced in the report, with details of the source in the References Section. Also, please refer to the Comment and Answer #1.

Comment 19:

How were TDEC and DuPont involved in the public health assessment? Who else was involved?

Answer 19:

TDEC APC asked EEP to do the public health assessment. They asked for an interpretation of the HAPs data they were collecting and if the chemicals measured could cause adverse health effects. APC provided the data for HAPs, particulates, ozone, and carbon disulfide. They also provided us access to the air modeling done by the University of Tennessee and to the APC files. Other divisions with TDEC, also, provided EEP with access to their files. TDEC commented on the draft document just like everyone else. EEP asked APC to be available at the open house because many people had detailed questions that only APC could answer.

EEP did not ask DuPont to participate in the public health assessment process. DuPont participated in the same way as the rest of the community. They were welcome at the open house, and they sent in comments during the comment period. They chose to bring their comments to us so that they could explain them.

Other members of the Loudon County community asked to meet face-to-face with EEP (in Nashville) and did.

EEP talked with Dr. Guider, a concerned local pediatrician, and with school nurses, at the suggestion of the community.

EEP asked the Office of Policy, Planning and Assessment to provide health outcome data. They did so, and the data was analyzed using SAS computer software.

No one has or has attempted to unduly influence the report. EEP has written a public health assessment that is accurate and truthful.

Comment 20:

Some commenters wanted to know why the public health assessment did not address the use of coal by area industries and the releases of mercury and sulfur dioxide from burning coal.

Answer 20:

The purpose of the public health assessment was to look at the data on HAPs and draw conclusions about the likelihood of public health hazards from exposure to the HAPs. We have no data on the amount of mercury and sulfur dioxide released in Loudon County to provide any health-based conclusions.

Comment 21:

"Please address the collective concentrations of toxic (hazardous air pollutants) found in Loudon County's ambient air that are also found cigarette smoke."

One person commented that he is dying from lung cancer and believes that the industrial pollution is the cause of the cancer; he has not smoked for more than 50 years.

Answer 21:

An explanation of cigarette smoke was provided with the toxicity of the various chemicals in the Discussion section. Cigarette smoke contains about 4000 chemicals and more than 20 – 60 carcinogenic chemicals. If a pack of cigarettes is smoked by 5 people in 30 minutes in a room 14 feet on each side and 8 feet tall, the resulting concentration of formaldehyde in the room air will be about 330 $\mu g/m^3$ (approximately 270 ppb) (WHO 1989). This represents a level more than 100 times the formaldehyde found at the HAPs monitor.

Another way to make comparisons is to consider the worst case scenario used in the public health assessment – a person stands by the monitor 24 hours a day, seven days a week for 70 years. This exposure to formaldehyde would be on the order of 57 µg of formaldehyde per day. A person who smoked a pack of cigarettes each day would be exposed to about 1,000 µg of formaldehyde per day (WHO 1989). There is less quantitative information available about concentrations of other chemicals in cigarettes. But this comparison with formaldehyde indicates that the exposures at the monitor in Loudon County are much less than exposures from smoking. In addition, inside air contains more formaldehyde than outside air due to sources such as particle board, gas stoves, kerosene heaters, household products, and environmental tobacco smoke. It has been estimated that Americans spend about 10% of our time outside and about 65% of our time in our homes.

The toxicity of a chemical is dependent upon the amount of the chemical to which a person is exposed, how often he is exposed, and the amount of time of the exposure. For instance, pharmaceuticals (such as aspirin) have no effect at very low doses (say a tenth of a baby aspirin each day for an adult), has a metabolic effect at low doses (one baby aspirin each day), can ease aches and pains at a higher dose (2 regular strength aspirin), and can kill people at still higher doses (a whole bottle taken a one time). HAPs function the same way. Even though formaldehyde and acetaldehyde are classified as probable or possible carcinogens, review of human epidemiology and animal studies strongly indicate that those chemicals have a threshold – a level with no effects for carcinogenic activity and non-cancer activity. So it is not only *possible, but likely, that the low levels of chemicals found at the monitor are without adverse health effect. But the same chemicals at much higher doses, as in cigarettes, can be harmful.*

While the staff of EEP are concerned about anyone having cancer, it is impossible for us to determine definitively what caused any one person's cancer.

A commenter noted that CDC considers the east Tennessee Region to have a high rate of smoking. The CDC study quoted (MMWR 2001) did not include Loudon County. CDC does not have sufficient Loudon County smoking data to make any rate adjustments for smoking.

Comment 22:

Why did the public health assessment ignore residential neighborhoods close to Blair Bend Industrial Park? Why did the assessment discuss issues in Tellico Village and not for other retirees in Loudon County? Why did the health assessment assume that everyone in Loudon County has an air conditioner?

Answer 22:

EEP did not ignore the closer neighborhoods. There was discussion of acetaldehyde in the area of the downtown schools. EEP used results of the air modeling for acetaldehyde done by UT. It would have been better to have actual measurements elsewhere in the community, but the only real data EEP had was from the HAPs monitor.

EEP discussed odors in Tellico Village because community members asked us about odors there. Since other areas of Loudon are closer to the schools, EEP assumes that odors could be detected there when the wind blows that way.

EEP did not intentionally ignore other areas of Loudon County. Since EEP only had the data from one monitor and air modeling by U.T. to use, it is not possible to make more than general statements about HAPs in parts of Loudon away from the monitor. In general, the closer to the monitor people live or work, the closer the concentrations of HAPs they are exposed to will match the monitoring data. EEP did not mean to imply that everyone has air conditioning, but for those who do, using the proper filter and changing it on schedule can help them with indoor air pollution.

Comment 23:

Why didn't TDH recommend supervised testing to better define the odorous emissions and their potential health effects?

Answer 23:

APC is working to define odors in a regulatory manner. Area industries are putting controls in place to lower emissions, which should also lower odors. Odors are often present at *concentrations much lower than what is thought to be cause adverse health effects. EEP did suggest that odors can affect the quality of life.*

Comment 24:

Does exposure to acetaldehyde cause larynx cancer and/or tumors of the vocal cords?

Answer 24:

Studies in rats did not show any increase in tumors, except for nasal tumors when the rats were exposed to 1,350,000 µg/m^3 (750,170 ppb) or more acetaldehyde. In Syrian golden hamsters, which inhaled 4,500,000 µg/m^3 (2,500,568 ppb) acetaldehyde at nine weeks with the concentration gradually decreasing to 2,970,000 µg/m^3 (1,650,375 ppb) at 52 weeks, an increase in laryngeal tumors after a 29 week recovery period was observed. In another Syrian golden hamster experiment, the hamsters inhaled 2,700,000 µg/m^3 (1,500,341 ppb) of acetaldehyde seven hours a day, 5 days a week for 52 weeks, and then were given a 26-week recovery period. There were no tumors of the respiratory tract (includes the nose and trachea) in exposed animals. Animals recovered from all lesions in the nasal epithelium during the recovery period (WHO 1995).

While acetaldehyde may cause laryngeal tumors in hamsters at very high doses, it seems that there is a threshold below which tumors do not form. The World Health Organization has recommended guidelines for air for both threshold and non-threshold assumptions. Both recommendations are above the levels of formaldehyde found in Loudon County.

Comment 25:

Several people commented that the mixture of chemicals must have an effect on cancer rates and cause other health problems. They were also concerned that Loudon County was ranked number 1 for cancer incidence in Tennessee.

Answer 25:

The HAPs measured were at very low levels, below levels of concern. While each individual chemical is highly unlikely to cause adverse health effects, much less is known about a mixture of them. The conclusion that there is an indeterminant health hazard from the mixture of pollutants is warranted. We cannot say that mixture has or will cause a public health hazard nor can we say that the mixture has not or will not cause a public health hazard. We do not know.

In addition, EEP will continue to try to find the causes of the high cancer incidence rates in Loudon County. EEP is currently looking more closely at the rates and at other factors that could influence the rates.

In EEP's cancer ranking comparison, Loudon County was ranked number 1 for new cases of cancer occurring. Loudon was not significantly different from the other top counties in cancer incidence. It is likely that in rankings of counties in different years, the numerical ranking would *change. So it is appropriate to think of Loudon County as one of the worst counties for cancer incidence rates, but, not necessarily the worst.*

Comments 26:

One commenter was concerned that the report addressed hospitalization rates for asthma, rather than the incidence of asthma.

Answer 26:

EEP also would like to know the incidence rate of asthma in Loudon County. Unfortunately, no one keeps records of how many people have asthma and are not hospitalized. The only information EEP had about asthma rates was from hospitalization records. EEP hopes that in the future, there will be ways to find the number of people who have been diagnosed with asthma, but did not go to the hospital.

Comment 27:

"Is the odor harmful, yes or no?"

Answer 27:

No, the odor itself is not harmful, but the odor can have an adverse effect on the quality of life, making it uncomfortable to be outside.

Comment 28:

TDEC granted a construction permit to Tate & Lyle / DuPont for a facility which will add well over 400 tons of additional pollution each year. TDEC needs to reduce, not increase, air pollution in Loudon County.

Answer 28:

This comment is beyond the scope of this public health assessment. However, a recent article in the Maryville Daily Times stated that Tate & Lyle expects a 50% reduction in allowable emissions, an 80% reduction in allowable volatile organic compound emissions, and a 67% reduction in acetaldehyde emissions (Pierce 2005).

Comment 29:

"Sulfur dioxide emissions that contribute to $PM_{2.5}$ levels have not been sufficiently addressed."

Answer 29:

The main purpose of this public health assessment was to examine the HAPs data and to discuss the likelihood of the HAPs causing adverse health effects. Some discussion of particulate matter *was necessary, however. No one knows yet if Loudon County will be out of compliance with* $PM_{2.5}$ *standards, since three years of data is not available to determine compliance. Local, state, and federal environmental agencies are responsible for seeing that sulfur dioxide and particulate emissions are meeting all applicable standards.*

Comment 30:

The charge to EEP was to discuss the health impact of HAPs measured at the special monitor and to try to understand the HAPs' impact on public health. There were many comments and questions that were beyond the scope of the public health assessment. These are:

- in-depth discussion of area sewage treatment plants
- emissions from smoke-stacks other than the HAPs
- RCRA sites in Lenoir City
- burning bans
- vehicle emissions testing
- finding the source of PCB in the sediments of the Tennessee River system
- finding local solutions to air pollution
- defining levels of air pollution at which outdoor workers should stop working
- compliance with air regulations
- safety issues (see Community Concern #14: Loudon's future, Appendix I Community Concerns for a discussion of safety issues at industrial facilities)
- policy issues at the state and federal level

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Appendix K

Glossary of Terms

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Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Age-adjusted rate
A measure of the overall burden of a disease in a population that considers the impact of age and is derived by the formula:

$$Age\text{-}Adjusted\ Rate = \sum \left[Age\ Proportion \left(\frac{Total\ Number\ of\ Events\ for\ all\ Years\ for\ Specific\ Age\ Group}{Total\ Population\ for\ all\ Years\ for\ Specifc\ Age\ Group} \times 100{,}000 \right) \right]$$

The age groups and corresponding proportions used for this formula and used by the Tennessee Department of Health, Division of Health Statistics routinely, are:

AGE GROUP	AGE RANGE	US 2000 proportion
12	Less than 1	0.013818
13	1-4	0.055317
14	5-14	0.145565
15	15-24	0.138646
16	25-34	0.135573
17	35-44	0.162613
18	45-54	0.134834
19	55-64	0.087247
20	65-74	0.066037
21	75-84	0.044842
22	85 and older	0.015508

Ambient
Surrounding (for example, *ambient* air).

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Attainment area
A geographic area in which levels of a criteria air pollutant meet the health-based primary standard (national ambient air quality standard, or NAAQS) for the pollutant. An area may have on acceptable level for one criteria air pollutant, but may have unacceptable levels for others. Thus, an area could be both attainment and nonattainment at the same time. Attainment areas are defined using federal pollutant limits set by EPA.

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Causal
Of, relating to, or constituting a cause; for instance, the *causal* agent of a disease

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Complete carcinogen
A complete carcinogen is a chemical that has both initiator and promotion properties.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Conditional major source permit
The purpose of the conditional major permit is to restrict the source's potential to emit regulated air pollutants below the major source threshold. Once approved, the source would not be required to obtain an operating permit under Title V of the Clean Air Act.

Confidence interval
Considers how much variation in a measure naturally occurs; for example, a 95% confidence interval for a rate indicates a range of values that would be expected to occur 95% of the time

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Criteria air pollutants
A group of very common air pollutants regulated by EPA on the basis of criteria (information on health and/or environmental effects of pollution). Criteria air pollutants are widely distributed all over the country.

Crude Rate
A measure of the overall burden of a disease in a population that does not consider the impact of age and is derived by the formula:

$$Crude\ Rate = \frac{Total\ Number\ of\ Events\ for\ all\ Years}{Total\ Population\ for\ all\ Years} \times 100{,}000$$

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An

"exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Emission: Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts. Release of pollutants into the air from a source. We say sources emit pollutants.

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Excess cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower. Excess cancer refers to the extra cancers that might occur with exposure, above the number that would normally occur without exposure. Example: the background rate of a particular cancer is 110 per 100,000 people or 1,100 per million people. Exposure to a particular chemical at the 1 in a million risk level, might add 1 more cancer to the 1,100 people who have gotten the cancer without the exposure.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Fetoxic
Toxic to fetuses.

Fugitive emissions
Emissions are those emissions not caught by a capture system.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Half-life ($t_{½}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous air pollutants (HAPs)
Chemicals that cause serious health and environmental effects. Health effects include cancer, birth defects, nervous system problems and death due to massive accidental releases such as occurred at the pesticide plant in Bhopal, India. Hazardous air pollutants are released by *sources* such as chemical plants, dry cleaners, printing plants, and motor vehicles (cars, trucks, buses, etc.)

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Incidence
The number of people who develop a disease within a year, does not include people previously diagnosed.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Initiator
It is believed that chemical carcinogenesis is a two stage process that involves an initiator and a promotor. An initiator is a substance which possesses metabolites that directly binds to DNA to cause a mutation. Examples of chemical initiators are aflatoxin B1, vinyl chloride, nitrosamines, and aromatic amines.

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

Intratracheal instillation
The placement of a liquid onto the trachea of a test animal.

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Mean
A value that is computed by dividing the sum of a set of values by the number of values.

Mean rate
A measure of the overall burden of a disease in a population that represents the mathematical average of all of the rates considered; for example, in this public health assessment the mean rate for 1990-2003 would be the sum of the crude rates for each year divided by 14 years; derived by the formula:

$$Mean\ Rate\ = \left[\sum \left(\frac{Total\ Number\ of\ Events\ for\ a\ Specific\ Year}{Total\ Population\ for\ a\ Specifc\ Year} \times\ 100{,}000\right)\right] \div Number\ of\ Years$$

Mechanism of Action
The mechanism by which chemicals produce their toxic effects, i.e., the mechanism by which a chemical alters normal cellular biochemistry and physiology. Mechanisms can include; interference with normal receptor-ligand interactions, interference with membrane functions, interference with cellular energy production, and binding to biomolecules.

Median
A value in an ordered set of values below and above which there is an equal number of values or which is the arithmetic mean of the two middle values if there is no one middle number.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Monitoring: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or **NPL)**
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Ozone
A gas which is a variety of oxygen. The oxygen gas found in the air consists of two oxygen atoms stuck together; this is molecular oxygen. Ozone consists of three oxygen atoms stuck together into an ozone molecule. Ozone occurs in nature; it produces the sharp smell you notice near a lightning strike. High concentrations of ozone gas are found in a layer of the atmosphere -- the stratosphere -- high above the Earth. Stratospheric ozone shields the Earth against harmful rays from the sun, particularly ultraviolet B. Smog's main component is ozone; this ground-level ozone is a product of reactions among chemicals produced by burning coal, gasoline and other fuels, and chemicals found in products including solvents, paints, hairsprays, etc.

p-Value
More formally called the probability value; indicates the probability of something occurring for reasons other than just by chance; as a p-value becomes smaller, the event is less likely to occur just by chance; p-values smaller than 0.05 are usually considered statistically significant.

Particulate matter
A criteria air pollutant. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems.

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Promoter
A promotor is a chemical that needs to be given in multiple doses or over a prolonged period of time to cause tumors to grow by activating enzymes and other components involved in cell division. A promoter does not cause DNA damage directly; it enhances the likelihood that mutations resulting from DNA damage will not be fixed during cell replication, thus resulting in cancer.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in

draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting
A public forum with community members for communication about a site.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Scorecard
A website developed by the Environmental Defense Fund that uses information from the Toxic Release Inventory to interactively compile reports on pollution by county.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistical significance
When something occurs for reasons other than just by chance, usually at least 95% of the time; indicated by a p-value (i.e. probability value) of 0.05 or smaller

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

t-Test
A statistical procedure that compares the difference between individual values and the mean of all the values studied

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Title V
Title V of the federal Clean Air Act requires major stationary sources of air pollution and a limited group of non-major sources to obtain operating permits that assure compliance with all applicable federal air pollution control requirements.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Toxic release inventory
Database of toxic releases in the United States compiled from SARA Title III Section 313 reports.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when toxicity knowledge is incomplete. Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between using a lowest effect level and a no

effect level. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people.

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.