

SCOTT COUNTY SAMPLING PROJECT

An Environmental Assessment Conducted in Scott County, Kansas, in 2001

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Overview

Ambient air samples were collected in Scott County on 4/17/01 and 4/18/01 for subsequent analysis of pesticides and herbicides, particulate matter, and volatile organic compounds. Drinking water samples were collected in Scott County on 7/9/01 and 7/10/01 for subsequent analysis of pesticides and herbicides, nitrate, and trace metals. Sampling and analytical methods are described, and results are presented and discussed in the following sections.

Determination of Pesticides and Herbicides in Ambient Air

Sampling

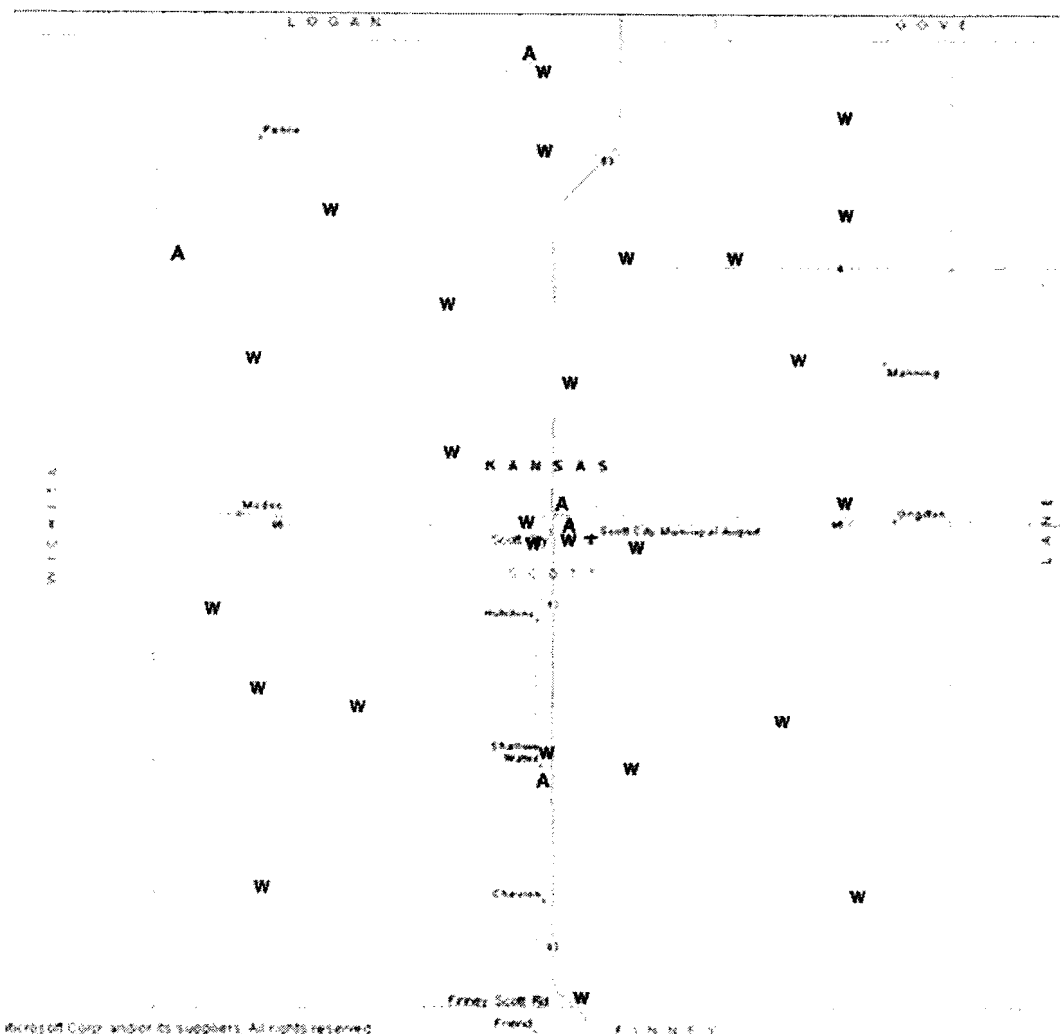
Ambient air samples were collected on 4/17/01 and 4/18/01 for subsequent analysis of pesticides and herbicides. MiniVol samplers were used to provide a 5-L/minute air flow for a 24-hour period through polyurethane foam (PUF) cartridges, in which pesticides and herbicides present in the air were adsorbed. Sampling sites were selected in Scott City, in public access areas of the county, and in areas in which pesticides or herbicides had been applied within the previous few days. Both air and water sampling sites are shown on Figure 1. According to the best available data, no pesticides or herbicides were applied during the sampling periods.

Wind was light and somewhat variable on 4/17/01: Wind speed was less than 10mi/hr the entire 24-hour period; wind direction was primarily northeasterly from midnight to noon, and primarily southeasterly after noon. On 4/18/01, wind speed was in the 10-20mi/hr range for most of the day, but exceeded 25mi/hr with gustiness from approximately 9:00am-4:00pm CDT; wind direction was southerly.

Analytical Methods

Pesticides and herbicides were extracted from the PUF cartridges using the Soxhlet extraction technique and analyzed by gas chromatography/mass spectrometry (GC/MS), as described in EPA method TO-10A (U.S.EPA, 1984). Each PUF cartridge was extracted at 72°C using 5% ethyl ether/95% hexane for a minimum of 16 hours. The extracts were concentrated using a Kuderna-Danish apparatus to a final volume of 2 mL, at which time phenanthrene d-10 was added as an internal standard. The concentrates were analyzed for 15 target compounds (see Table 1) using a Varian 3600 GC/ Saturn 2000 MS equipped with a J&W DB-5ms capillary column (30-m length, 0.25-mm I.D.) using the following temperature program: 115°C for 2 minutes, increase to 180°C at 1.6°C/min, then to 250°C at 9°C/min. Injector temperature was 220°C. Dilutions of a mixed standard containing all 15 target compounds (Ultra Scientific) were used to produce calibration curves. The detection limit (DL)

for each target compound was established at the concentration which produced a signal-to-noise ratio (S/N) of ≥ 3 .



A - ambient air sampling site, W - drinking water sampling site

Figure 1. Ambient Air and Drinking Water Sampling Sites.

Results

None of the target pesticides were detected at the indicated detection limits (see Table 1) in any of the samples collected. Eight of the compounds are classified as hazardous air pollutants (HAPS) by EPA, as noted in Table 1 (U.S.EPA, 2002). Concentrations are provided by EPA in the Integrated Risk Information System (IRIS) in relation to the health effects of inhalation of lindane (U.S.EPA, 2002a); the concentrations producing a one-in-a-million increased risk of cancer, based on breathing air containing those concentrations for a lifetime, are below the detection limits. Such concentrations are not provided for the other target compounds.

Table 1. Analysis of Air Samples for Pesticides and Herbicides: Detection Limits, Health Effects.

Target Compound	Concentration ($\mu\text{g}/\text{m}^3$)	
	Detection Limit	Producing Health Effects
2,4-D, butyl ester ^a	0.3	NA
2,4-D, isopropyl ester ^a	0.3	NA
Alachlor	0.3	NA
Atrazine	0.6	NA
Dacthal (DCPA)	0.3	NA
Dicofol	0.3	NA
Ethyl Parathion ^a	0.9	NA
Lindane, α isomers ^a	0.3	0.0006 ^b
Lindane, β isomers ^a	0.3	0.002 ^b
Lindane, γ isomers ^a	0.3	0.03 ^b
Malathion	0.3	NA
Methoxychlor ^a	0.3	NA
Metolachlor	0.3	NA
Phorate	0.3	NA
Trifluralin ^a	0.3	NA

a - hazardous air pollutant, NA - not assessed

b - concentration producing a one-in-a-million increased risk of cancer

Determination of Particulate Matter in Ambient Air

Sampling

Ambient air concentrations of particulate matter (PM) were determined for the 2.5- μm size range (all PM with a diameter of 2.5 μm or less), using Mini-Vol samplers (Airmetrics, Springfield, Oregon). The Mini-Vol collects PM on 47-mm filters using a 5-L/min sampling rate. Impaction inlets were used to selectively sample the PM_{2.5} size range. The units were capable of remote start-up and shut-down and provided a constant sample flowrate during the 24-hour collection period. Samples were collocated with PUF pesticide/herbicide samplers.

Analytical Methods

All sample collection, handling, and analysis were performed in accordance with standard protocol established by Airmetrics for the Mini-Vol sampler. Filters were weighed before and after sampling using a Cahn C-33 microbalance. Prior to each weighing, filters were placed in separate containers with unique identifiers and desiccated in a temperature-controlled environment for at least 24 hours.

Results

Table 2 shows PM_{2.5} concentrations for the samples collected. EPA has not established a National Ambient Air Quality Standard for PM_{2.5}, but the recommended maximum value is 65 $\mu\text{g}/\text{m}^3$ (U.S.EPA, 2002b). As seen in Table 2, none of the samples collected in Scott County exceeded that value.

Table 2. PM_{2.5} Concentrations in Ambient Air Samples.

Sampling Site, Date	Concentration ($\mu\text{g}/\text{m}^3$)
Fairgrounds, 4/17/01 ^a	9.02
Scott Lake State Park, 4/17/01 ^a	5.87
Field, County Line, 4/17/01 ^a	6.99
Shallow Water, 4/17/01 ^b	17.59
Scott Elementary, 4/17/01 ^{b,c}	6.48
Scott Elementary, 4/17/01 ^{b,c}	10.34
Fairgrounds, 4/18/01 ^a	10.63
Scott Lake State Park, 4/18/01 ^a	12.17
Field, County Line, 4/18/01 ^a	10.62
Shallow Water, 4/18/01 ^b	11.67
Scott Elementary, 4/18/01 ^{b,c}	8.33
Scott Elementary, 4/18/01 ^{b,c}	11.61

a - sample collected at breathing height, b - sample collected on roof

c - collocated sample

Determination of Volatile Organic Compounds in Ambient Air

Sampling

Ambient whole-air samples were collected in six-liter SilcoCanTM stainless steel canisters (Restek Corporation, Bellefonte, Pennsylvania) for the subsequent analysis of volatile organic compounds (VOCs), according to EPA Method TO-14 (U.S.EPA, 1984). The canisters were equipped with calibrated flow controllers, in-line filters for particle removal, and programmable open/close valves. This arrangement allowed for remote sampling with a virtually constant flow rate during the entirety of the 24-hour sample period. Samples were collocated with the pesticide/herbicide samples.

Analytical Methods

Samples were analyzed using gas chromatography/mass spectrometry (GC/MS), using a Varian 3600 GC/Saturn 2000 MS equipped with cryogenic capability. VOCs were preconcentrated cryogenically, then were revolatilized into a stream of carrier gas (helium, 1.0mL/min) and swept into the chromatographic column (Chrompack, 60-meter length, CP-SIL5 stationary phase). The column was held at -10°C for 6 minutes, ramped to 250°C at 7°C/min, then ramped to 300°C at 20°C/min. Concentrations were determined for the compounds listed in Table 3, with a nominal detection limit (DL) of 0.1 $\mu\text{g}/\text{m}^3$ for each compound. Also shown in Table 3 are concentrations potentially producing human health effects (U.S.EPA, 2002 and U.S.EPA, 2002a).

Results

Table 4 shows results for compounds that were detected above the detection limit. Toluene was found in six samples above the DL, benzene in two samples, and xylene and isooctane in one each. None of the other target compounds was found in any of the samples. For toluene, ethylbenzene, and xylene, the range of concentrations detected were below the levels considered by EPA to be important with

respect to human health (400, 1000, and 400 $\mu\text{g}/\text{m}^3$, respectively, as shown in Table 3). No such value is given for isooctane.

Most of the concentrations that potentially could produce human health effects are above the DL (0.1 $\mu\text{g}/\text{m}^3$). However, for the following eight analytes, the concentrations that would produce a one-in-a-million increased risk of cancer, based on breathing air with those concentrations for a lifetime, are below the DL, as shown in Table 3: chloroform, carbon tetrachloride, 1,2-dichloroethane, 1,1-dichloroethylene, hexachlorobutadiene, 1,1,2-TCA, 1,1,2,2-tetrachloride, and 1,2-dibromoethane.

Table 3. VOC Analytes, Health Effects.

Increased Cancer Risks			
VOC	Concentration ($\mu\text{g}/\text{m}^3$) producing risk levels		
	1 in 10,000	1 in 100,000	1 in 1,000,000
benzene	13	1.3	0.13
bromoform	90	9	0.9
carbon tetrachloride	7	0.7	0.07
chloroform	4	0.4	0.04
1,2-dibromoethane	0.5	0.05	0.005
1,2-dichloroethane	4	0.4	0.04
1,1-dichloroethylene	2	0.2	0.02
hexachlorobutadiene	5	0.5	0.05
methylene chloride	200	20	2
1,1,1,2-tetrachloroethane	10	1	0.1
1,1,2,2-tetrachloroethane	2	0.2	0.02
tetrachloroethylene	170	17	1.7
1,1,2-trichloroethane	6	0.6	0.06
trichloroethylene	60	6	0.6
Other Health Effects			
VOC	Minimum concentration ($\mu\text{g}/\text{m}^3$) producing health effects		
chlorobenzene	20		
chloroethane	10,000		
chloromethane	90		
dichlorobenzene isomers	800		
1,1-dichloroethane	500		
ethylbenzene	1000		
naphthalene	3		
styrene	1000		
toluene	400		
1,1,1-trichloroethane	1000		
xylene isomers	400		

Other analytes - dibromomethane, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, and isooctane - were not assessed in Integrated Risk Information System.

Table 4. Selected VOC Results.

Site, Date	Concentration ($\mu\text{g}/\text{m}^3$)			
	Toluene	Ethylbenzene	Xylene	Isooctane
Scott Elementary, 4/17/01 ^{b,c}	ND	ND	ND	ND
Scott Elementary, 4/17/01 ^{b,c}	ND	ND	ND	ND
Fairgrounds, 4/17/01 ^a	3.9	ND	ND	3.3
Scott Lake State Park, 4/17/01 ^a	ND	ND	ND	ND
Field, County Line, 4/17/01 ^a	0.8	ND	ND	ND
Shallow Water School, 4/17/01 ^b	1.7	ND	ND	ND
Scott Elementary, 4/18/01 ^{b,c}	ND	ND	ND	ND
Scott Elementary, 4/18/01 ^{b,c}	1.4	ND	ND	ND
Fairgrounds, 4/18/01 ^a	3.4	ND	ND	ND
Scott Lake State Park, 4/18/01 ^a	ND	ND	ND	ND
Field, County Line, 4/18/01 ^a	2.4	ND	ND	ND
Shallow Water School, 4/18/01 ^b	5.1	1.1	0.9	19.5

a - sample collected at breathing height, b - sample collected on roof, c-collocated samples

ND-not detected (detection limit is nominally 0.1 $\mu\text{g}/\text{m}^3$ for all compounds)

m,p-xylene-result shown is the total of the meta and para isomers

Determination of Pesticides and Herbicides in Drinking Water

Sampling

Drinking water samples were collected on 7/9/01 and 7/10/01 in pre-cleaned glass bottles with TFE-lined caps and refrigerated at 4°C for subsequent analysis of target pesticides and herbicides, as described in Method 6630B of Standard Methods (Clesceri et al., 1998). Samples were collected from points in the Scott City Public Water Supply (PWS) distribution system, at the school in Shallow Water, at Scott Lake State Park, and from private wells throughout Scott County. Private wells were chosen with the objective of having good coverage geographically of the entire county, based on a list of well owners submitted by the County Extension Agent. A list also was received from the County Health Department, containing well owners who had recently submitted questions or complaints about their drinking water. All sampling sites are shown on Figure 1 above. All samples were collected from indoor taps or outdoor pumps.

Analytical Methods

A volume of each water sample (typically 500 mL) was passed through a conditioned solid-phase extraction (SPE) tC18 sep-pak cartridge (Waters). Target compounds extracted were subsequently eluted from the cartridge using 2.0 mL ethyl acetate/ethyl ether solution; phenanthrene-d10 was added as an internal standard; samples were analyzed by GC/MS, using the same methodology as that used for the air samples. Reagent water containing known amounts of target compounds was used to determine recoveries, which were greater than 90% for 10 of the 15 compounds, 80 to 90% for 4 of the 15, and 65% for metolachlor. The detection limit (DL) for each compound was established at the concentration which produced a signal-to-noise ratio of ≥ 3 (see Table 5).

Results

Table 6 shows results for atrazine, dicofol (kelthane), and methoxychlor, the only compounds that were detected above the DL. Methoxychlor was found in 7 of the 26 samples; atrazine and dicofol were each found in 5 of the samples; sample 11 contained all three compounds. None of the target compounds was found at concentrations above the DL in the other 15 samples. For both atrazine and methoxychlor, concentrations detected were below the maximum contaminant level (MCL) (3 and 40 µg/L, respectively), as listed in EPA's Primary Drinking Water Standards (U.S.EPA, 2002a and U.S.EPA, 2002a). The MCL for dicofol is not available. Other available MCLs are above the detection limits and are shown in Table 5.

Table 5. Analysis of Drinking Water Samples for Pesticides and Herbicides: Detection Limits, EPA Drinking Water Standards.

Target Compound	Concentration (µg/L)	
	Detection Limit	EPA Standard
2,4-D, butyl ester	0.1	70
2,4-D, isopropyl ester	0.1	70
Alachlor	0.1	2
Atrazine	0.2	3
Dacthal (DCPA)	0.1	NA
Dicofol	0.1	NA
Ethyl Parathion	0.3	NA
Lindane, α isomer	0.1	0.2
Lindane, β isomer	0.1	0.2
Lindane, γ isomer	0.1	0.2
Malathion	0.1	NA
Methoxychlor	0.1	40
Metolachlor	0.1	NA
Phorate	0.1	NA
Trifluralin	0.1	5

NA - EPA drinking water standard not established for this compound

Table 6. Selected Results from Drinking Water Analysis for Pesticides and Herbicides.

Site #	Concentration (µg/L)		
	Atrazine	Dicofol	Methoxychlor
2	ND	0.8	ND
4	ND	ND	0.2
5	ND	0.3	0.3
9	ND	0.2	0.4
11	0.8	0.1	0.4
14	0.2	ND	ND
16	0.6	ND	0.2
26	0.3	ND	0.2
28	ND	01	ND
29	0.6	ND	ND
34	ND	ND	0.1

Determination of Trace Metals in Drinking Water

Sampling

Drinking water samples were collected on 7/9/01 and 7/10/01 in acid-rinsed borosilicate glass bottles with TFE-lined caps and refrigerated at 4°C for subsequent analysis of trace metals, as described in Method 3010B of Standard Methods (Clesceri et al., 1998). Twenty-six samples were collected at the same sites as were pesticide/herbicide samples, as shown in Figure 1 above.

Analytical Methods

Samples were submitted to the Plasma Analytical Laboratory (KU Geology Department) for analysis by inductively-coupled plasma/mass spectrometry (ICP/MS) for the elements shown in Table 7.

Table 7. Concentrations of Trace Metals in Drinking Water Samples.

Site	Concentration (µg/L)							
	As	Ba	Cd	Cr	Cu	Ni	Pb	Zn
MCL	50 ^a	2000	5	100	1300 ^b	NA	15 ^b	NA
0	7.0	113	0.06	1.0	34	1.0	0.25	2.4
1	7.8	33	0.08	1.2	24	1.3	0.37	11
2	6.1	30	0.02	1.1	3.3	1.0	0.45	44
3	5.5	46	0.01	2.2	0.5	1.1	0.34	6.5
4	3.4	97	0.09	0.7	0.8	1.1	1.2	57
5	4.7	59	0.62	1.1	2.7	1.2	0.43	58
6	5.9	19	0.07	0.7	5.4	1.3	1.3	88
8	7.0	34	0.04	1.3	0.7	1.1	0.60	72
9	6.3	192	0.10	0.3	2.9	1.0	0.53	139
11	7.9	42	0.03	1.2	0.8	1.0	0.32	45
12	1.9	50	0.05	0.7	2.6	3.2	0.23	64
14	2.9	72	0.05	0.6	0.8	1.5	0.11	61
16	2.3	81	0.03	0.5	2.1	3.6	0.08	5.7
17	6.8	48	0.04	1.0	68	0.9	0.40	34
18	4.3	56	0.02	1.3	0.6	0.7	0.34	38
19	13.3	43	0.01	1.4	6.8	1.2	0.17	16
23	6.5	28	0.06	0.8	20	0.7	0.21	63
24	8.0	48	0.02	1.3	3.7	0.8	0.11	3.9
25	9.3	40	0.01	0.7	15	1.0	0.21	12
26	11.2	80	0.01	13	45	1.1	0.21	2.9
28	4.1	76	0.02	0.4	0.9	1.3	0.09	5.7
29	6.7	8.3	0.01	5.1	522	1.0	0.72	13
30	1.8	32	0.08	0.5	0.9	1.7	0.23	110
33	30	78	0.08	0.6	4.8	3.8	0.34	113
34	7.0	36	0.04	1.0	50	0.6	0.13	13
35	6.8	39	0.06	0.5	145	0.7	0.40	123

a - current standard; proposed standard for As is 10µg/L, NA - no MCL exists

b - Lead and copper are regulated by a Treatment Technique relating to the corrosiveness of their water.

Results

Table 7 shows trace metal concentrations for the 26 drinking water samples collected. Maximum contaminant levels (MCLs) have been established for several of these metals and are listed in EPA's Primary Drinking Water Standards (U.S.EPA, 2002c) and also shown in Table 7. There were no concentrations that exceeded current MCLs in the samples collected in Scott County; however, arsenic concentrations in samples from sites 19, 26, and 33 did exceed the proposed standard (10µg/L).

Determination of Nitrate in Drinking Water

Sampling

Drinking water samples were collected on 7/9/01 and 7/10/01 in pre-cleaned glass bottles with TFE-lined caps and refrigerated at 4°C for subsequent analysis of nitrate(NO₃). Twenty-six samples were collected from the same sites as were the pesticide/herbicide samples, i.e., from points in the Scott City PWS distribution system, at the school in Shallow Water, at Scott Lake State Park, and from private wells throughout Scott County.

Analytical Methods

Samples were analyzed by ion chromatography for nitrate, using a Dionex Series 2000i Ion Chromatograph, as described in Method 4110 of Standard Methods (Clesceri et al., 1998).

Results

Table 7 shows results for the eight trace metals listed above for the 26 drinking water samples collected. Maximum contaminant levels (MCLs) have been established for several of these metals and are listed in EPA's Primary Drinking Water Standards (U.S.EPA, 2002c); those values also are shown in Table 7. There were no concentrations that exceeded current MCLs in the samples collected in Scott County; however, arsenic concentrations in samples from sites 19, 26, and 33 did exceed the proposed standard (10µg/L).

Table 8. Nitrate Concentrations in Drinking Water Samples.

Site	NO ₃ -N Conc. (mg/L)	Well Depth (ft)	Distance to Nearest Feedlot (mi)
0	6.2	NA	7
1	3.6	150	6
2	5.8	NA	3.5
3	4.5	120	1.5
4	3.8	140	0.5
5	5.2	195	5
6	1.7	NA	NA
8	4.0	NA	2
9	3.5	NA	NA
11	5.3	NA	NA
12	14.5	85	NA
14	12.0	200	1.5
16	16.0	70	5
17	2.9	168	1.5
18	2.8	70	5
19	5.3	120	4 ^a
23	4.0	NA	NA
24	3.2	NA	0.5
25	3.4	126	2
26	6.4	PWS	PWS
28	15.0	140	3
29	7.3	PWS	PWS
30	3.1	NA	1.5
33	2.0	40	11
34	3.4	235	0 ^b
35	3.0	195	1

a - 10 feet to own animal pens, b - well located at feedlot
PWS - Scott City Public Water Supply, NA - data not available

Summary of Findings

Ambient Air

Ambient air samples were collected in Scott County on 4/17/01 and 4/18/01. Based on the results from analyses of these samples for pesticides and herbicides, particulate matter (PM_{2.5}), and volatile organic compounds (VOCs), no air pollutants were found in concentrations that would produce human health effects.

For most of the target compounds, concentrations that could produce human health effects are above the detection limits (DLs) established during the study. Some of the target compounds have not been thoroughly assessed for human health effects; in other cases, such an assessment has yet to produce a

concentration that would cause health effects. In a few cases (e.g., lindane and several VOCs), concentrations that could produce human health effects are below the DLs established during this study. In those cases, more extensive sampling and further analytical method optimization would be required to establish lower DLs and quantify the target compounds at those lower concentrations. In addition, as was stated previously, no pesticide or herbicide application was being conducted during the sampling periods of this study; a more extensive sampling effort would include sampling during pesticide and/or herbicide application.

Drinking Water

Drinking water samples were collected in Scott County on 7/9/01 and 7/10/01 and analyzed for pesticides and herbicides, trace metals, and nitrate. Arsenic concentrations exceeded the proposed Primary Drinking Water Standard (10µg/L) in three of the samples, one of which was collected from the Scott City PWS distribution system. Chronic exposure to arsenic concentrations below the current Primary Drinking Water Standard (50µg/L) has been associated with an increased incidence of bladder and lung cancer, providing the justification for lowering the standard to the proposed value.

Nitrate concentrations exceeded the current Primary Drinking Water Standard (10mg/L) in four of the samples. Chronic exposure to nitrate and/or nitrite (not determined in this study) at these levels can cause serious illness in infants. Nitrate and nitrite are also precursors to nitrosamines, a probable human carcinogen. The other necessary precursors for nitrosamine formation, organic nitrogen compounds, are typically present in higher concentrations in agricultural areas.

Trace concentrations of three pesticides/herbicides (atrazine, dicofol, methoxychlor) were found in several of the water samples. Concentrations of atrazine and methoxychlor did not exceed the Primary Drinking Water Standards established for those compounds; no standard has been established for dicofol. Standards established for other target compounds are above the DLs determined for those compounds during the study.

Because of the presence of nitrate and arsenic at concentrations above current or proposed Primary Drinking Water Standards, and the fact that Scott County is largely agricultural, it is recommended that users of water from private wells have their water tested for nitrate and nitrite at least once yearly, and for arsenic at least once every three years.

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