REGION V

JOINT FEDERAL/STATE

SURVEY OF ORGANICS & INORGANICS

IN

SELECTED DRINKING WATER SUPPLIES

JUNE 1975

D R A F T

U. S. ENVIRONMENTAL PROTECTION AGENCY
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INTRODUCTION

In response to public concern resulting from publicity about alleged toxic organic compounds in the New Orleans, Louisiana and other municipal drinking water supplies, Region V States asked for assistance in obtaining current data concerning certain drinking water supplies in Region V. The study was designed to provide frequency of occurrence and concentration values of volatile and non-volatile organic compounds, selected pesticides, herbicides and fungicides, polychlorinated biphenyl mixtures, certain phthalate esters. metals and other inorganic parameters in drinking waters. Another interest was to establish baseline concentrations for those organic compounds of health concern or thought to result from chlorination, and therefore to be widely distributed in our water supplies. These compounds include carbon tetrachloride (CCl_4), chloroform ($CHCl_3$), bromodichloromethane ($BrCHCl_2$), dibromochloromethane (Br_2CHCl), bromoform (Br_3CH), 1,2-dichloroethane ($Cl\text{-}CH_2\text{-}CH_2\text{-}Cl$), dichloromethane ($CH_2Cl_2$), aldrin, dieldrin and DDT.

The 83 cities were selected jointly by both State and Federal personnel to get a broad representation of Region V water supply systems. The study evaluates organic pollution in drinking water supplies of most concern to State agencies, provides appropriate background data for quality assurance purposes, and complements the National Reconnaissance Survey in determining the concentrations, sources, and potential danger of organic chemicals in drinking water.

A maximum number of parameters per sample were included to provide a complete description of each water supply and to detect possible relationships between the more traditional inorganic parameters and the organic parameters of current interest. In addition, since many expenses of the study, such as sampling costs, report writing, instrument and other fixed capitol depreciations, transportation, etc., remain constant, the most efficient study includes a maximum number of parameter analyses per sample.

It should be emphasized that this study occurred during winter months when waters were cold, surface streams were generally at higher than normal flows and contained considerable suspended solid materials, agricultural and gardening activities were at a minimum as were certain industrial activities. Therefore, concentrations could vary substantially from values reported in this manuscript for samples collected at different times of the year.

Based on the data presented in Table I, it is clear[1,2] that chloroform, bromodichloromethane, dibromochloromethane and bromoform are consistently higher in treated drinking water than in raw waters at most cities in the Region. The mean concentrations however are quite low.

Table II is a listing of the analytical results from which the summary data in Table I were calculated. All concentrations are in micrograms per liter (ug/l). It is the practice of the Central Regional Laboratory to report detection limits based on each day's quality assurance data. Therefore, different detection limits are given for some parameters in Table II and other places in this report.

Conclusions that may be reached from an examination of the data in Table II are as follows:

a. Clear raw water results in finished water that is relatively free of chloroform and related halogenated compounds. Of the 25 supplies having the lowest concentrations of chloroform, 12 obtain their water from the Great Lakes, 8 from deep wells and only 5 from surface sources.

b. There is a correlation between concentrations of chloroform, bromodichloromethane, dibromochloromethane, and bromoform in the finished water. It appears they result from chlorination of precursors in the raw water. Since there is no pattern to their occurrence,

II. SUMMARY OF RESULTS AND CONCLUSIONS

1. Volatile Organic Compounds

Table I is a summary of the analytical results.

TABLE I

SUMMARY OF ANALYTICAL RESULTS (VOLATILE ORGANICS)

micrograms per liter

Chemical Formula & Name	% of Samples Giving Positive Results		Mean Concentration (μg/l)		Maximum Concentration (μg/l)	
	Finished Water	Raw Water	Finished Water	Raw Water	Finished Water	Raw Water
$CHCL_3$ - Chloroform	95	27	20 μg/l	<1.0	366 μg/l	94 μg/l
$CHBrCL_2$ - Bromodichloromethane	78	5	6 μg/l	<1.0	91 μg/l	11 μg/l
$CHBr_2Cl$ - Dibromochloromethane	60	2	1 μg/l	<1.0	14 μg/l	1.4 μg/l
$CHBr_3$ - Bromoform	14	0	<1 μg/l	<1.0	7 μg/l	<1.0μg/l
CCl_4 - Carbon Tetrachloride	34*	18	*2 μg/l	<1.0	*26 μg/l	20 μg/l
CH_2Cl_2 - Methylene chloride	8	1	<1 μg/l	<1.0	7 μg/l	1 μg/l
$C_2H_4Cl_2$ - 1,2-Dichloroethane	13	14	<1 μg/l	<1.0	26 μg/l	15 μg/l

* Those samples from Minnesota may have been contaminated by being exposed to laboratory air containing carbon tetrachloride.

TABLE II

ANALYTICAL RESULTS (VOLATILE ORGANICS)
(micrograms per liter)

R = Raw F = Finished

City	$CHCl_3$		$BrCHCl_2$		Br_2CHCl		Br_3CH		CCl_4		CH_2Cl_2		$C_2H_4Cl_2$	
	R	F	R	F	R	F	R	F	R	F	R	F	R	F
SURFACE SOURCE														
Cairo, Ill.	2	14	<1	11	<1	4	<1	0.8	2	1	1	<0.5	<1	<1
Carlyle, Ill.	<1	48	<1	20	<1	2	<1	0.6	<1	<1	<1	<0.2	<1	<1
Chicago, Ill.	<1	7	<1	3.4	<1	<1	<1	<1	<1	<1	<1	0	<1	<1
Chester, Ill.	5	182	<1	17	<1	1.1	<1	<0.3	<1	<1	<1	<0.5	<1	<1
Danville, Ill.	6	16	<1	6	<1	1	<1	0.7	<1	<1	<1	<1	<1	<2
Fairfield, Ill.	10	47	3	16	<1	1.4	<1	<0.3	<1	<1	<1	<0.5	<1	<2
Kankakee, Ill.	<1	52	<1	10	<1	1.1	<1	<0.2	<1	1	<1	<0.5	<1	<1
Mt. Carmel, Ill.	<1	52	<1	15	<1	1	<1	<0.2	<1	<0.5	<1	2.6	<1	<1
Newton, Ill.	<1	4	<1	5	<1	4	<1	1.3	<1	<1	<1	<0.5	<1	<2
Quincy, Ill.	<1	58	<1	13	<1	0.5	<1	<0.2	<1	<1	<1	<1	<1	<1
Rock Island, Ill.	94	79	11	8.3	<1	0.4	<1	<0.2	<1	<1	<1	<1	<1	<1
Royalton, Ill.	<1	68	<1	29	<1	6	<1	<0.1	<1	<1	<1	<0.5	<1	<1
Streator, Ill.	<1	35	<1	14	<1	1.7	<1	1.4	<1	1	<1	0.5	2	<1
Bedford, Ind.	5	84	<1	12	<1	0.8	<1	0.8	<1	2	<1	<0.5	<1	<1
Bloomington, Ind.	<1	19	<1	5	<1	0.5	<1	<0.3	<1	1	<1	0.5	<1	<1
Evansville, Ind.	<1	29	<1	12	<1	1.7	<1	1	<1	1	<1	0.5	<1	<2
Fort Wayne, Ind.	4	29	<1	0.7	<1	0.4	<1	1	<1	0.9	<1	1	4	21
Gary, Ind.	<1	7	<1	5	<1	1	<1	<0.5	<1	1	<1	<0.5	<1	<2
Hammond, Ind.	<1	4	<1	<0.5	<1	<0.5	<1	<0.5	<1	1	<1	<0.5	<1	<2
Indianapolis, Ind.	<1	19	<1	6	<1	0.5	<1	0.6	<1	1	<1	2	3	<1
Kokomo, Ind.	9	30	<1	11	<1	1.4	<1	0.3	<1	0.5	<1	0.5	<1	<1
Lafayette, Ind.	<1	5	<1	1	<1	0.3	<1	0.5	<1	<1	<1	<0.5	2	<1

TABLE II
(Cont'd)

City	$CHCl_3$ R	$CHCl_3$ F	$BrCHCl_2$ R	$BrCHCl_2$ F	Br_2CHCl R	Br_2CHCl F	Br_3CH R	Br_3CH F	CCl_4 R	CCl_4 F	CH_2Cl_2 R	CH_2Cl_2 F	$C_2H_4Cl_2$ R	$C_2H_4Cl_2$ F
SURFACE SOURCE (continued)														
Logansport, Ind.	<1	7	<1	1.2	<1	<0.1	<1	<0.1	<1	<1	<1	<0.5	<1	<1
Michigan City, Ind.	<1	5	<1	4	<1	1	<1	<0.5	<1	<0.5	<1	<0.5	<1	<2
Mt. Vernon, Ind.	<1	18	<1	9	<1	1.2	<1	.9	<1	2	<1	1.5	<1	<1
Muncie, Ind.	<1	31	<1	17	<1	1	<1	<0.5	<1	1	<1	0.5	2	<1
New Albany, Ind.	3	41	.4	15	<1	1.4	<1	1	1	1.6	<1	1.3	2	<2
Terre Haute, Ind.	4	5	<1	5	<1	6	<1	3	<1	<1	<1	<0.5	15	<1
Whiting, Ind.	<1	<1	<1	<0.5	<1	<0.5	<1	<0.5	<1	<1	<1	<0.5	<1	<2
Bay City, Mich.	<1	17	<1	19	<1	13	<1	7	<1	<1	<1	<0.5	3	<1
Bessemer Township Mich.	7	312	<1	4	<1	<0.2	<1	<0.5	<1	6.5	<1	<0.5	<1	<1
Cadillac, Mich.	<1	47	<1	8	<1	0.4	<1	<0.1	<1	1	<1	<0.5	2	<2
Detroit, Mich.	<1	5	<1	6	<1	2	<1	0.3	<1	<1	<1	<0.5	<1	<1
Dundee, Mich.	1	170	<1	26	<1	2	<1	0.3	<1	<1	<1	<0.5	<1	<1
Grand Rapids, Mich.	<1	24	<1	10	<1	1	<1	<0.5	<1	1	<1	1	2	<2
Menominee, Mich.	<1	42	<1	5	<1	.6	<1	0.3	<1	1	<1	1	3	<2
Mt. Clemens, Mich.	<1	10	<1	6	<1	1.3	<1	<0.1	<1	<1	<1	<0.5	9	<2
Sault St. Marie, Mich.	<1	27	<1	<0.5	<1	<0.5	<1	<0.5	<1	0.5	<1	0.5	<1	<1
Wyandotte, Mich.	<1	14	<1	7	<1	1	<1	0.4	<1	2.1	<1	<1	<1	<2
Breckenridge, Minn.	<1	128	<1	15	<1	<0.5	<1	<2	4	12	<1	<1	<1	<3
Crookston, Minn.	<1	7	<1	0.8	<1	<0.2	<1	<0.5	<1	5	<1	<0.5	<1	<1
Duluth, Minn.	<1	26	<1	1.5	<1	<0.5	<1	<1	<1	23	<1	1	<1	<1
East Grand Forks, Minn.	<1	22	<1	0.8	<1	<0.2	<1	<0.5	<1	8	<1	0.5	<1	<1
Fairmount, Minn.	9	200	<1	31	<1	0.7	<1	<0.5	<1	<1	<1	<0.5	<1	<5

TABLE II
(Cont'd)

City	$CHCl_3$		$BrCHCl_2$		Br_2CHCl		Br_3CH		CCl_4		CH_2Cl_2		$C_2H_4Cl_2$	
	R	F	R	F	R	F	R	F	R	F	R	F	R	F
SURFACE SOURCE (continued)														
Granite Falls, Minn.	5	5	<1	<0.5	<1	<0.5	<1	<0.2	<1	7	<1	<0.5	<1	<0.5
International Falls, Minn.	<1	26	<1	.3	<1	<0.5	<1	<1	<1	26	<1	1	<1	<1
Minneapolis, Minn.	<1	8	<1	<0.5	<1	<0.2	<1	<0.5	<1	5	<1	<0.5	<1	<1
Oslo, Minn.	3	79	<1	5	<1	<0.2	<1	<0.5	<1	7	<1	<0.5	<1	<5
St. Cloud, Minn.	<1	37	<1	4	<1	<0.2	<1	<0.5	<1	9	<1	0.5	<1	<1
St. Paul, Minn.	4	82	<1	6	<1	<0.2	<1	<0.5	2	12	<1	<0.5	<1	<5
Berea, Ohio	<1	60	<1	26	<1	4	<1	<1	<1	3	<1	<1	<1	<1
Bowling Green, Ohio	<1	160	<1	27	<1	5	<1	<1	<1	< .5	<1	< .5	<1	<1
Cincinnati, Ohio	4	127	<1	29	1.4	3	<1	< .5	1	< .5	<1	< .5	<1	<1
Cleveland, Ohio	<1	10	<1	5	<1	0.7	<1	<1	<1	9	<1	<1	<1	<1
Columbus, Ohio	<1	51	<1	6	<1	0.7	<1	0.5	<1	<1	<1	<0.5	<1	<1
Defiance, Ohio	2	14	<1	6	<1	0.7	<1	<0.2	<1	1	<1	<0.5	<1	<1
East Liverpool, Ohio	<1	5	<1	<0.5	<1	<0.5	<1	<0.5	7	6	<1	<0.5	<1	<1
Fremont, Ohio	1	366	<1	18	<1	1.4	<1	< .5	<1	3	<1	< .5	<1	<1
Piqua, Ohio	<1	102	<1	10	<1	0.7	<1	<0.1	<1	<1	<1	<0.5	<1	<1
Portsmouth, Ohio	2	25	<1	14	<1	4	<1	0.6	2	1	<1	3	2	<1
Toledo, Ohio	<1	62	<1	20	<1	4	<1	<0.2	<1	<0.5	<1	<0.5	<1	<1
Warren, Ohio	<1	138	<1	19	<1	0.8	<1	<0.2	<1	11	<1	<0.5	<1	<1
Green Bay, Wisc.	<1	9	<1	4	<1	<1	<1	< .5	0	<1	<1	< .5	<1	<1
Kenosha, Wisc.	12	3	3	<1	.7	1	<1	<1	1	2	<1	< .5	<1	<1
Manitowoc, Wisc.	<1	14	<1	6	<1	1	<1	< .5	<1	<1	<1	< .5	<1	<1
Marinette, Wisc.	<1	53	<1	6	<1	< .5	<1	< .5	2	3	<1	< .5	<1	<1
Milwaukee, Wisc.	2	2	<1	< .5	<1	< .5	<1	< .5	1	3	<1	< .5	<1	<1

TABLE II
(Cont'd)

City	$CHCl_3$ R	$CHCl_3$ F	$BrCHCl_2$ R	$BrCHCl_2$ F	Br_2CHCl R	Br_2CHCl F	Br_3CH R	Br_3CH F	CCl_4 R	CCl_4 F	CH_2Cl_2 R	CH_2Cl_2 F	$C_2H_4Cl_2$ R	$C_2H_4Cl_2$ F
SURFACE SOURCE (Continued)														
Oshkosh, Wisc.	6	55	<1	5	<1	< .5	<1	< .5	7	<2	<1	< .5	<1	<1
Two Rivers, Wisc.	1	9	<1	4	<1	<1	<1	< .5	10	<2	<1	< .5	<1	<1
GROUND WATER SOURCE														
Galesburg, Ill.	<1	30	<1	13	<1	2	<1	<0.2	<1	1	<1	1	<1	<1
Peoria, Ill.	<1	2	<1	1	<1	0.5	<1	0.4	<1	1.3	<1	<0.5	3	<1
Morocco, Ind.	<1	12	<1	10	<1	3	<1	0.3	<1	<1	<1	<0.5	<1	<1
South Bend, Ind.	<1	11	<1	3.4	<1	3	<1	2	<1	<1	<1	<0.5	<1	<1
Jackson, Mich.	<1	<1	<1	16	<1	14	<1	3	<1	<1	<1	<1	<1	3
Kalamazoo, Mich.	<1	4	<1	<0.5	<1	<0.5	<1	<0.5	<1	<1	<1	<1	<1	<1
Lansing, Mich.	<1	10	<1	0.8	<1	0.7	<1	<1.3	<1	2	<1	<1	4	<2
Mt. Pleasant, Mich.	<1	11	<1	23	<1	15	<1	3	<1	<1	<1	<0.5	<1	<1
Waterford Township Mich.	<1	<1	<1	<0.2	<1	<0.2	<1	<0.2	<1	<1	<1	<0.5	<1	<1
Mankato, Minn.	2	10	<1	9	<1	2	<1	<0.5	3	5	<1	<0.5	<1	<1
Richfield, Minn.	<1	<1	<1	<0.5	<1	<0.5	<1	<0.5	3	<2	<1	<1	<1	<0.5
Willmar, Minn.	<1	2	<1	<0.2	<1	<0.2	<1	<0.5	20	13	<1	<0.5	<1	<0.5
Black River Falls, Wisc.	<1	6	<1	<0.5	<1	< .5	<1	< .5	<1	<2	<1	<1	<1	<2
Eau Claire, Wisc.	<1	50	<1	1	<1	< .5	<1	<1	<1	2	<1	7	<1	3
Mean	2	45	<1	8.5	<1	1.2	<1	0.4	<1	<1	<1	<1	<1	<1
Median	<1	20	<1	6	<1	1	<1	<1	<1	<1	<1	<1	<1	<1

TABLE III

VOLATILE ORGANIC COMPOUND CONCENTRATION RATIOS
(10 HIGHEST CONCENTRATIONS)
micrograms per liter

	$CHCl_3$	$BrCHCl_2$	Br_2CHCl	$CHBr_3$	$\frac{BrCHCl_2}{CHCl_3}$	$\frac{Br_2CHCl}{BrCHCl_2}$
Fremont, Ohio	366	18	1.4	0	4.9*	8
Bessemer Township, Mich.	312	4	0	0	1.2*	0
Fairmount, Minn.	200	31	0.7	0	15.	2
Chester, Ill.	182	17	1.1	0	9.3	6
Dundee, Mich.	170	26	2	0	15.	8
Bowling Green, Ohio	160	27	5	0	17.	19
Warren, Ohio	138	19	0.8	0	14.	4
Breckenridge, Minn.	128	15	0	0	12.	0
Piqua, Ohio	102	10	0.7	0	10.	7
Bedford, Ind.	84	12	0.8	0.8	14	7
				Ave.	13.3	6.1
				Std. Dev.	2.6	5.5

*excluded from calculation of average and standard deviation. If all data in Table II are used, both ratio percentages and the scatter increase as the measurements approach the detection limit

it does not appear that carbon tetrachloride, methylene chloride or 1,2-dichloroethane are produced by a chemical reaction within the treatment process.

c. Using only the more accurate data (higher concentrations can be measured more accurately than lower concentrations) for those cities having over 100 ug/l of chloroform in their finished water, the concentration ratio percentages (see Table III of $BrCHCl_2$ to $CHCl_3$ range from 1.2% to 17%. The range for the $BrCHCl_2/Br_2CHCl$ ratios is 0 to 19%. A careful examination of these ratios suggests that the concentration of $BrCHCl_2$ will be approcimately 13% that of $CHCl_3$ and the concentration of Br_2CHCl will be about 6% that of $BrCHCl_2$. This relatively constant ratio indicates a common precursor or group of precursors of the halogenated pollutants. Since the ratios described above are much higher than the ratio of bromine to chlorine in the chlorine used to purify the raw waters, we conclude that bromination is much faster than chlorination and that the halogen is acting as an electrophile rather than a nucleophile during the chemical reaction producing the subject pollutants. The ratios for Fremont, Ohio; Bessemer Township, Michigan and certain other cities do not follow this general pattern but have an excess of chloroform. We suggest that a source of chloroform is operative that differs from that of most cities studied. At first we suspected an industrial discharge but that conclusion is inconsistent with a zero chloroform concentration for the raw water. Therefore, these supplies may contain a particularly reactive precursor for chloroform. Additional analytical data will be required to identify any such precursor, to establish whether or not these measured values are common throughout the year, and

to suggest a method of removal. It is suggested that check samples be collected to verify results that truly represent these water supplies. The concentrations of brominated compounds are high relative to the concentrations of chlorinated compounds for some cities. If this pattern is repeated in check samples, and should the brominated compounds be discovered to be of significance, the concentration of bromine in the chlorine used for purification should be reduced.

d. The use of carbon treatment is not effective as was practiced by the water treatment plants during the time of this study. (See Table IV) We suspect that most of those cities presently using carbon have chosen to do so to reduce taste and odor problems and that the carbon is much more effective in removing those compounds causing the water to have a taste and odor than it is in removing the halogenated methanes or other organic compounds that react to form chloroform.

Table IV summarizes water supply systems information. Data is reported as it was obtained on field sheets at the time of sample collection. It can be noted from this table that in addition to the characteristics of the raw water, chloroform production also depends upon the amount of chlorine applied. Another important factor is the time of contact. For this study contact time must be considered to be the entire elapsed time from chlorine application until sample analysis (1-5 days). Recent experiments with aliquots of southern Lake Michigan water that were treated with 2 mg/l of chlorine have shown chloroform production to be cut in half when the aliquots were again treated in one hour to remove all remaining chlorine. Chlorine was allowed to react a number of days in the aliquots where it was not removed after one hour.

2. Linear Regressions

Figures I, II, III, and IV show the linear regression equations and associated F ratios calculated from the measurements for chloroform, bromodichloromethane,

dibromochloromethane, and total chlorine dosage in river water systems. Since the F value at the 0.01 probability point is 7, the null hypothesis of no relationship is rejected and it is concluded that significant correlation does exist between the parameters plotted on Figures I, II, III, and IV.

Further research should be directed to determining the rates of reactions of the parameters analyzed in this study with particular attention to the source of raw water used in treatment.

TABLE IV

WATER SUPPLY SYSTEM INFORMATION

City	$CHCl_3$ (ug/l)	Source	Raw Water Characteristics	Activated Carbon	Cl_2 Dose (ppm)/ Detention Time (hr) Prior to Sample Pre-	Post-	Population
SURFACE SOURCE							
Cairo, Ill	14	Ohio River	M/I	Powdered		7.0/6	7,700
Carlyle, Ill.	48	Kaskaskia River	M/I	None	7.3/7		7,200
Chicago, Ill.	7	Lake Michigan	I	Powdered	1.2	0.1	
Chester, Ill.	182	Mississippi R	M/I	None	7.2/4	2.4/1	7,900
Danville, Ill.	16	Vermillion R	M/I	None	1.2/2		50,000
Fairfield, Ill.	47	Little Wabash	M/I-A	None	6.2/6.5	2.5/3.5	10,100
Kankakee, Ill.	52	Kankakee River	A	Anthracite Coal	1.0/2.5	1.0	60,000
Mt. Carmel, Ill.	52	Wabash River	M/I	None	7.1/29	4.0/21	11,500
Newton, Ill.	4	Deep Wells	Clear	None	1.7/37		4,900
Quincy, Ill.	58	Mississippi R	M/I	Powdered	4-20/4	1-3/1.5	50,000
Rock Island, Ill.	79	Mississippi R	M/I	Powdered	8-12/24		52,000
Royalton, Ill.	68	Big Muddy River	M/I	None		3.4/7	3,300
Streater, Ill.	35	Vermillion River	A/I	Powdered		3.3/4	20,000
Bedford, Ind.	84	White River	A	None		4.9/5	17,000
Bloomington, Ind.	19	Monroe River	A	None		2.8/7	50,000
Evansville, Ind.	29	Ohio River	M/I	*			*
Fort Wayne, Ind.	29	St. Joseph River	M/I	None		3.15/6	200,000
Gary-Hobart, Ind.	7	Lake Michigan	I	Powdered	1.4/8	0.4/2	200,000
Hammond, Ind.	4	Lake Michigan	I	Powdered		1.7/10	127,000
Indianapolis, Ind.	19	White River	M/I	None		7.8/6	700,000
Kokomo, Ind.	30	Wildcat Creek	A	Powdered	8.4/2	2.2	53,000

TABLE IV
(Continued)

City	$CHCl_3$ (ug/l)	Source	Raw Water Characteristics	Activated Carbon	Cl_2 Dose (ppm)/ Detention Time (hr) Prior to Sample Pre- Post-	Population
Lafayette, Ind.	5	Deep Wells	Clear	None	.75/0.1	50,000
Michigan City, Ind.	5	Lake Michigan	I	Powdered	1.9/19 0.3/7	40,000
Mt. Vernon, Ind.	18	Ohio River	M/I	Powdered	11.5/6	7,000
Muncie, Ind.	31	White River	M/I	Anthracite Coal	4.5/3	87,000
New Albany, Ind.	41	Ohio River	M/I	None	3.9/9	41,000
Terre Haute, Ind.	5	Deep Wells	Clear	Powdered	10.7/5.5 2.2/0.1	78,000
Whiting, Ind.	<1	Lake Michigan	I	Powdered	3.8/8+Ozone	7,054
Logansport, Ind.	7	Eel River	A	None	2.0/6 1.5/2	19,000
Bay City, Mich.	17	Saginaw Bay	I	Powdered	3.2/2.4 0.03	75,000
Bessemer Township, Mich.	312	Black River	C	Powdered	5.31/0.1	1,000
Cadillac, Mich.	47	Deep Wells	Clear	None	4.5/0.1	9,500
Detroit, Mich.	5	Detroit River	M/I	Powdered	1.3/3 0.2/0.1	4,000,000
Dundee, Mich.	170	River Raisin	M/I	Powdered	9/4	2,500
Grand Rapids, Mich.	24	Lake Michigan	Clear	None	2.0/4	216,000
Menominee, Mich.	42	Lake Michigan	M/C	None	3.1/24	11,000
Mt. Clemens, Mich.	10	Lake St. Clair	M/I	Carbon Filters	4.4/8 1	50,000
Sault St.Marie,Mich.	27	St. Mary's River	Clear	None	1.7/0.1	17,000
Wyandotte, Mich.	14	Detroit River	M/I	Powdered	3.3/8	43,000
Breckenridge, Minn.	128	Otter Tail River	C	None	5.0/24	4,800
Crookston, Minn.	7	Red Lake River	Clear	None	1.6/8	9,000

TABLE IV
(Continued)

City	$CHCl_3$ (ug/l)	Source	Raw Water Characteristics	Activated Carbon	Cl_2 Dose (ppm)/ Detention Time (hr) Prior to Sample Pre-	Post-	Population
Duluth, Minn.	26	Lake Superior	Clear	None		1.3/1	100,000
East Grand Forks, Minn.	22	Red Lake River	A		12.0/24		8,000
Fairmount, Minn.	200	Budd Lake	C	None	10.0/6	3.0/8	11,000
Granite Falls, Minn.	5	Minnesota River	M/A	None		3.5/16	3,500
International Falls, Minn.	26	Rainy River	C	None	0.7/3		
Minneapolis, Minn.	8	Mississippi R	M/I	None	2.9/19	0.36/12	621,000
Oslo, Minn.	79	Red River	CCE	Powdered	1.2/12		500
St. Cloud, Minn	37	Mississippi R	M/I	None		1.3/4	45,000
St. Paul, Minn.	82	Mississippi R	M/I	Powdered	7.0/12		402,000
Berea, Ohio	60	Rock River - Coe Lake	A	Powdered		3.65/1	23,000
Bowling Green, Ohio	160	Maumee River	A/I			4.5/6	21,000
Cincinnati, Ohio	127	Ohio River	M/I	Powdered			
Cleveland, Ohio	10	Lake Erie	Clear	Powdered	3.3/6		
Columbus, Ohio	51	Scioto River	M/I	None	4.3/4	4.3/2	260,000
Defiance, Ohio	14	Maumee River	M/A	Powdered	1.0/1	3.0/0.5	17,000
East Liverpool, Ohio	5	Ohio River	M/I	Powdered		2.3/7	30,000
Fremont, Ohio	366	Sandusky River	A				21,000
Piqua, Ohio	102	Swift Run River	M/I	Carbon Filter	4/5	3/2	22,000
Portsmouth, Ohio	25	Ohio River	M/I				
Toledo, Ohio	62	Lake Erie	M/I	Powdered		1.39/1	455,000

TABLE IV
(Continued)

City	$CHCl_3$ (ug/l)	Source	Raw Water Characteristics	Activated Carbon	Cl_2 Dose (ppm)/ Detention Time (hr) Prior to Sample Pre-	Post-	Population
Warren, Ohio	138	Mosquito River	T/O	Powdered	5.0/6	0.5/0.1	80,000
Green Bay, Wisc.	9	Lake Michigan	Clear	Powdered	0.9/9	.35/3	90,000
Kenosha, Wisc.	3	Lake Michigan	Clear	Powdered			78,000
Manitowoc, Wisc.	14	Lake Michigan	Clear	None	1.4/10		34,000
Marinette, Wisc.	53	Green Bay	M/I	Granular Filter	1.5/6	0.8/4	12,500
Milwaukee, Wisc.	2	Lake Michigan	Clear	None	1.2	0.8	717,000
Oshkosh, Wisc.	55	Lake Winnebago	CCE	Powdered	2.39/6	.84/1	53,000
Two Rivers, Wisc.	9	Lake Michigan	Clear	None	1.40/6	.04/8	13,500
GROUND WATER SOURCE							
Galesburg, Ill.	30	Ranney Well	Clear	None	1.4/24		38,000
Peoria, Ill.	2	San Koty Wells	Clear	None	1.59/6	1.71	165,000
Morocco, Ind.	12	Deep Wells	Clear	None	1.33/0.2		1,200
South Bend, Ind.	11	Deep Wells	Clear	None	2.3/1		125,000
Jackson, Mich.	<1	Deep Wells	Clear	None	4.5/10		52,000
Kalamazoo, Mich.	4	Deep Wells	Clear	None	0.75/0.1		
Lansing, Mich.	10	Deep Wells	Clear	None	2.5/27		140,000
Mt.Pleasant,Mich.	11	Ranny Wells	Clear	None	2.5	2.8	20,500
Waterford Township, Mich.	<1	Deep Wells	Clear	None	2.0/3		48,000
Mankato, Minn.	10	Deep Wells	Clear	None	3.5/5		35,000

TABLE IV
(Continued)

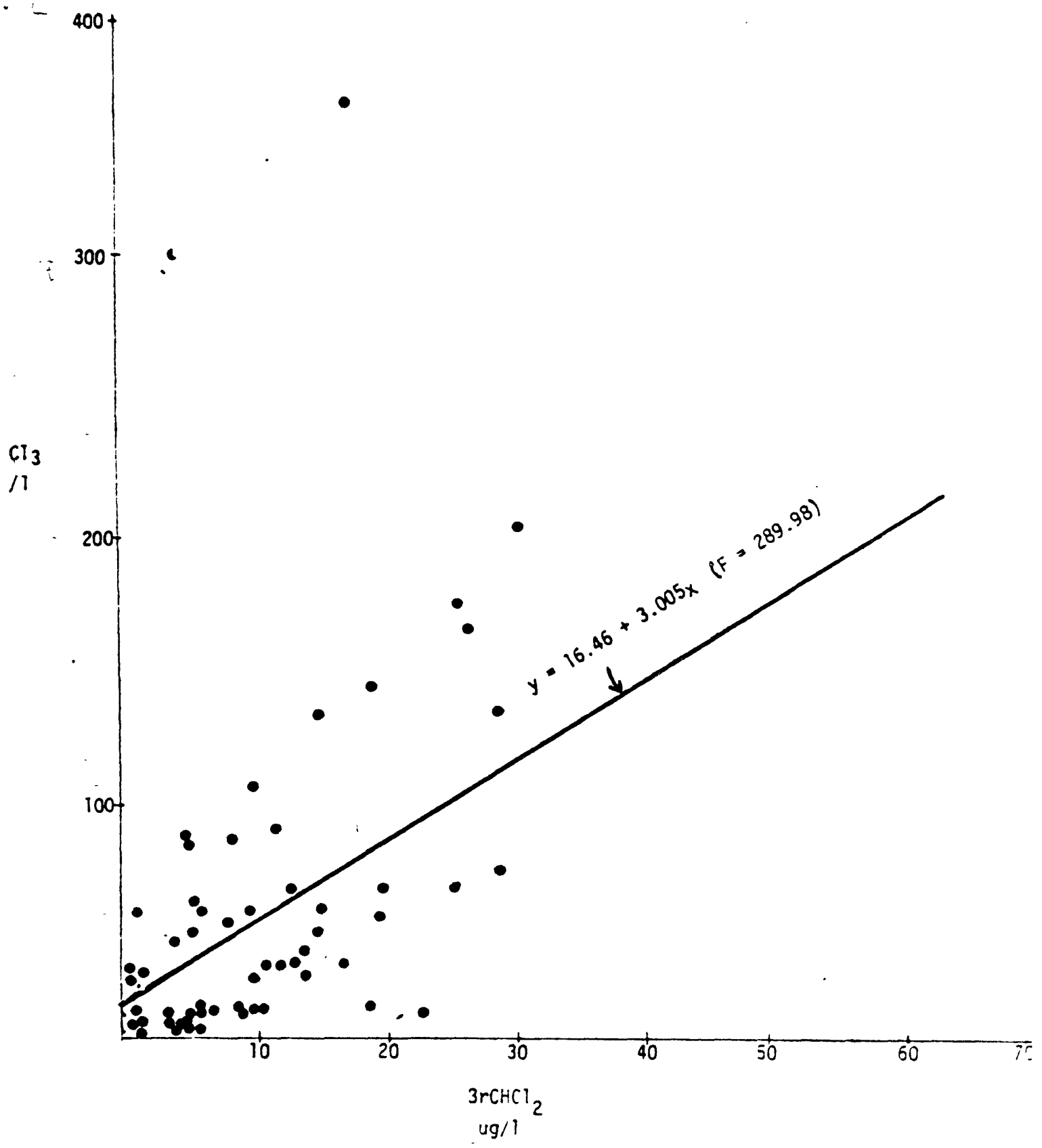
City	$CHCl_3$ (ug/l)	Source	Raw Water Characteristics	Activated Carbon	Cl_2 Dose (ppm)/ Detention Time (hr) Prior to Sample Pre-	Post-	Population
Richfield, Minn.	<1	Deep Wells	Clear	None	1.0/15	1.5/0.1	47,500
Willmar, Minn.	2	Deep Wells	Clear	None	3.5/48		15,000
Black River Falls, Wisc.	6	Wells	Clear	None	0.46/3		3,200
Eau Claire, Wisc.	50	Deep Wells	Clear	None	1.1/18	0.75/0.1	47,000

M = Municipal effluents affect the raw water source.
A = Agricultural runoff affects the raw water source.
I = Industrial effluents affect the raw water source.
C = Color-producing compounds.
T/O = Taste and odor-producing compounds.
CCE = Carbon chloroform extracts have been detected.

FIGURE 1

Plot of $CHCl_3$ vs. $BrCHCl_2$ in ug/l

Region V Organic Survey



Plot of $3rCHCl_2$ vs. Br_2CHCl in ug/l

Region V Organic Survey

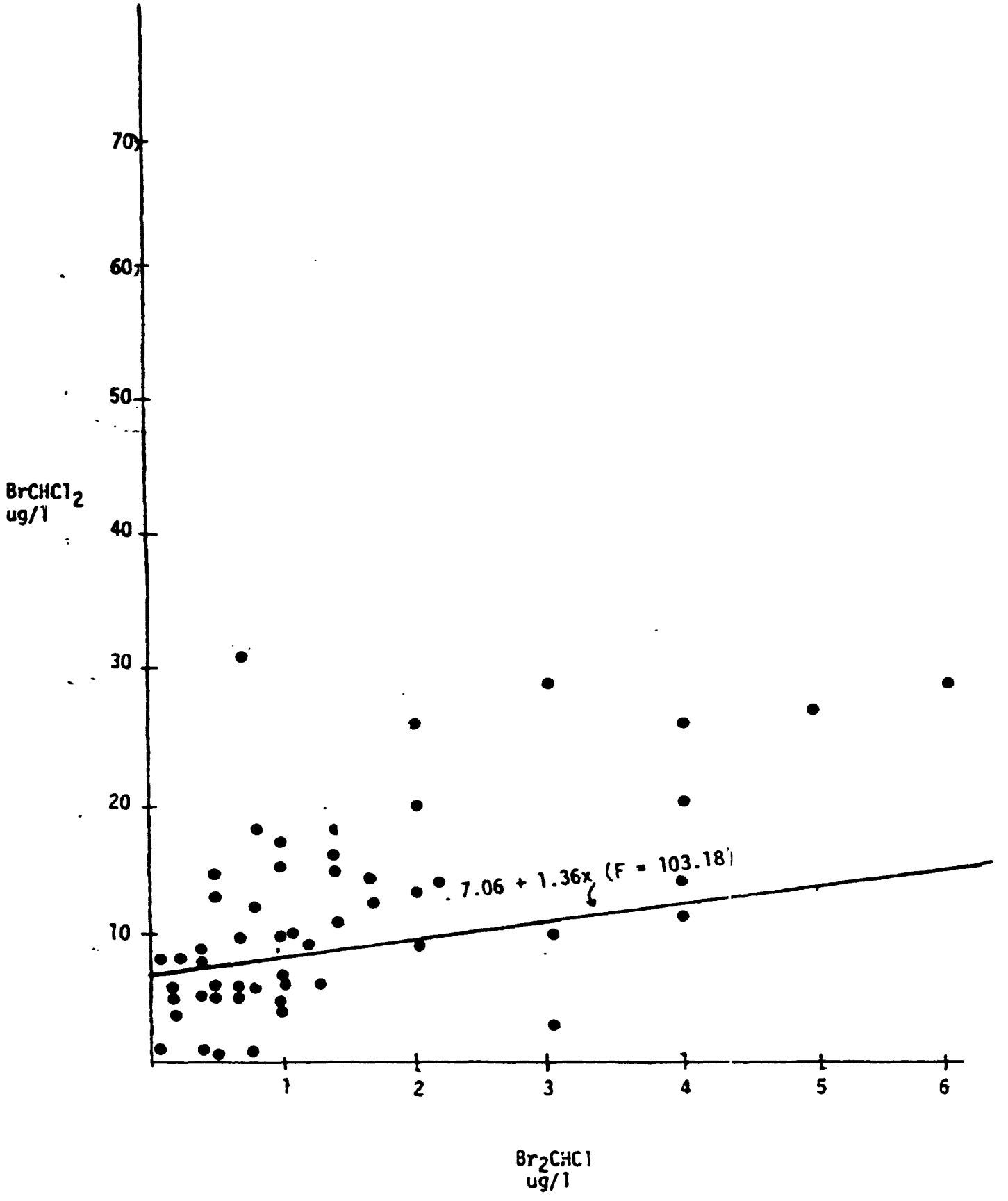


FIGURE III

Plot of $CHCl_3$ (ug/l) vs. Total Cl_2 Dosage (mg/l) for All Water Treatment Facilities

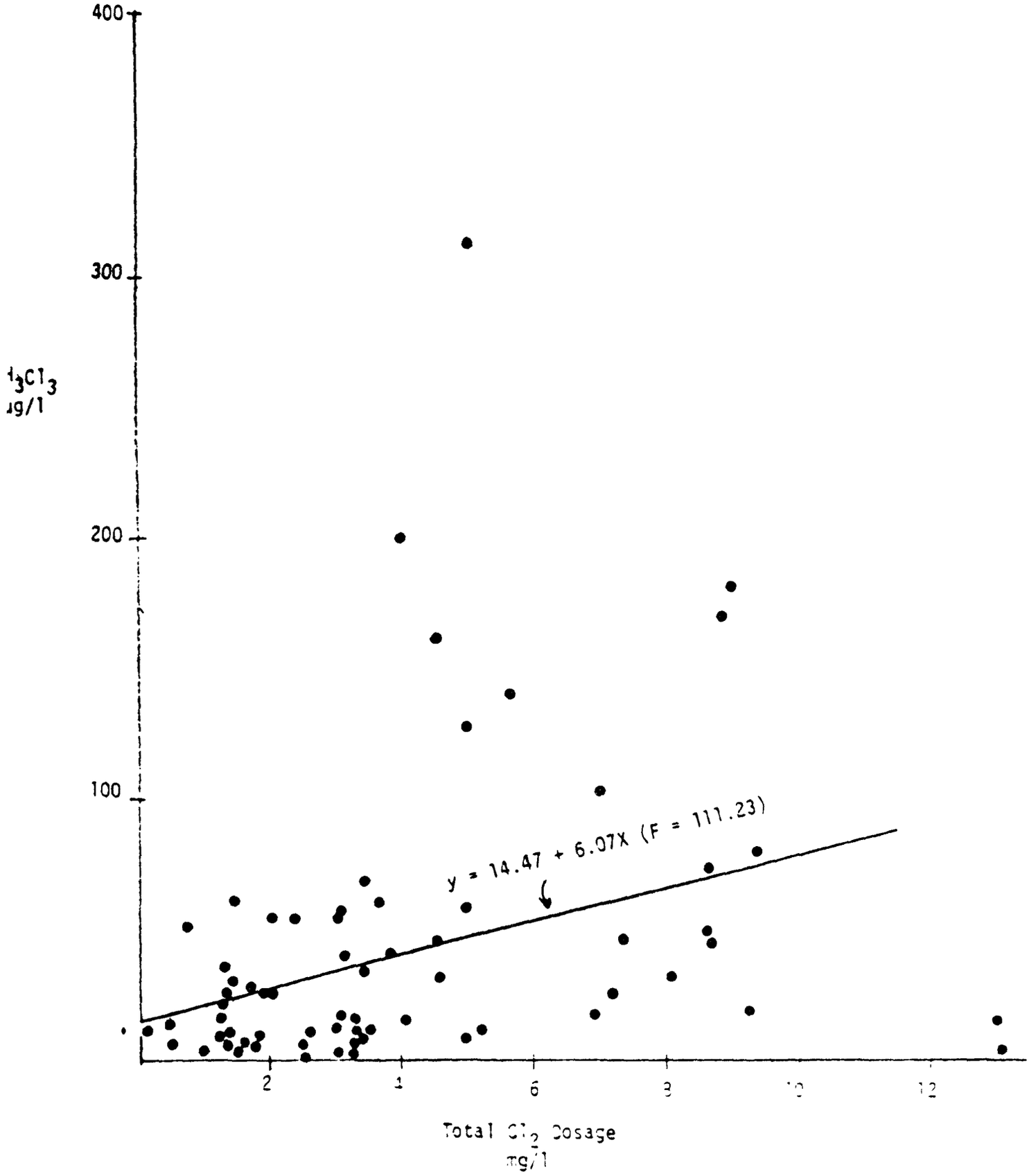


FIGURE IV

Plot of $CHCl_3$ (ug/l) vs. Total Cl_2 Dosage (ug/l) in Water Treatment Systems that Treat River Water

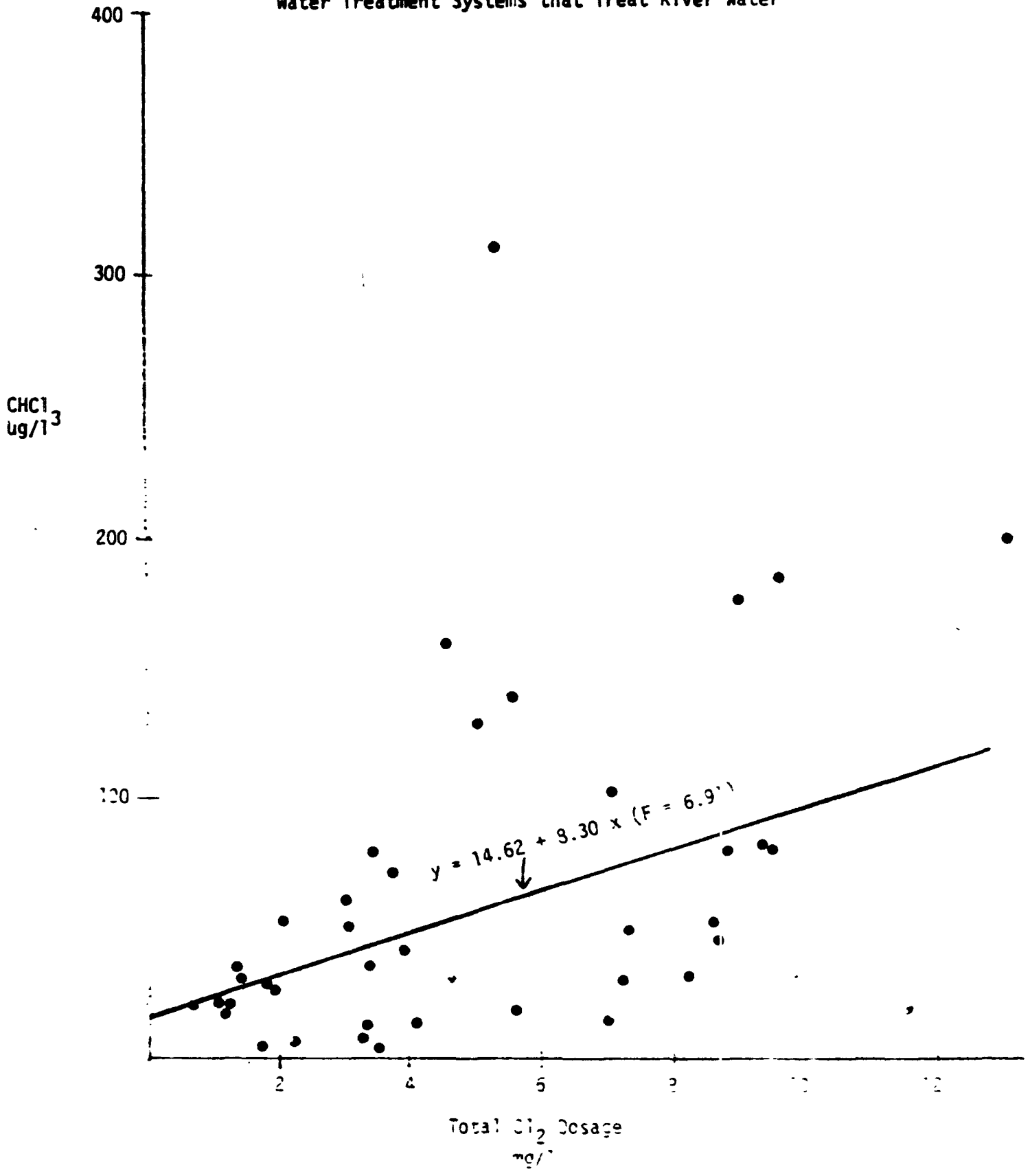
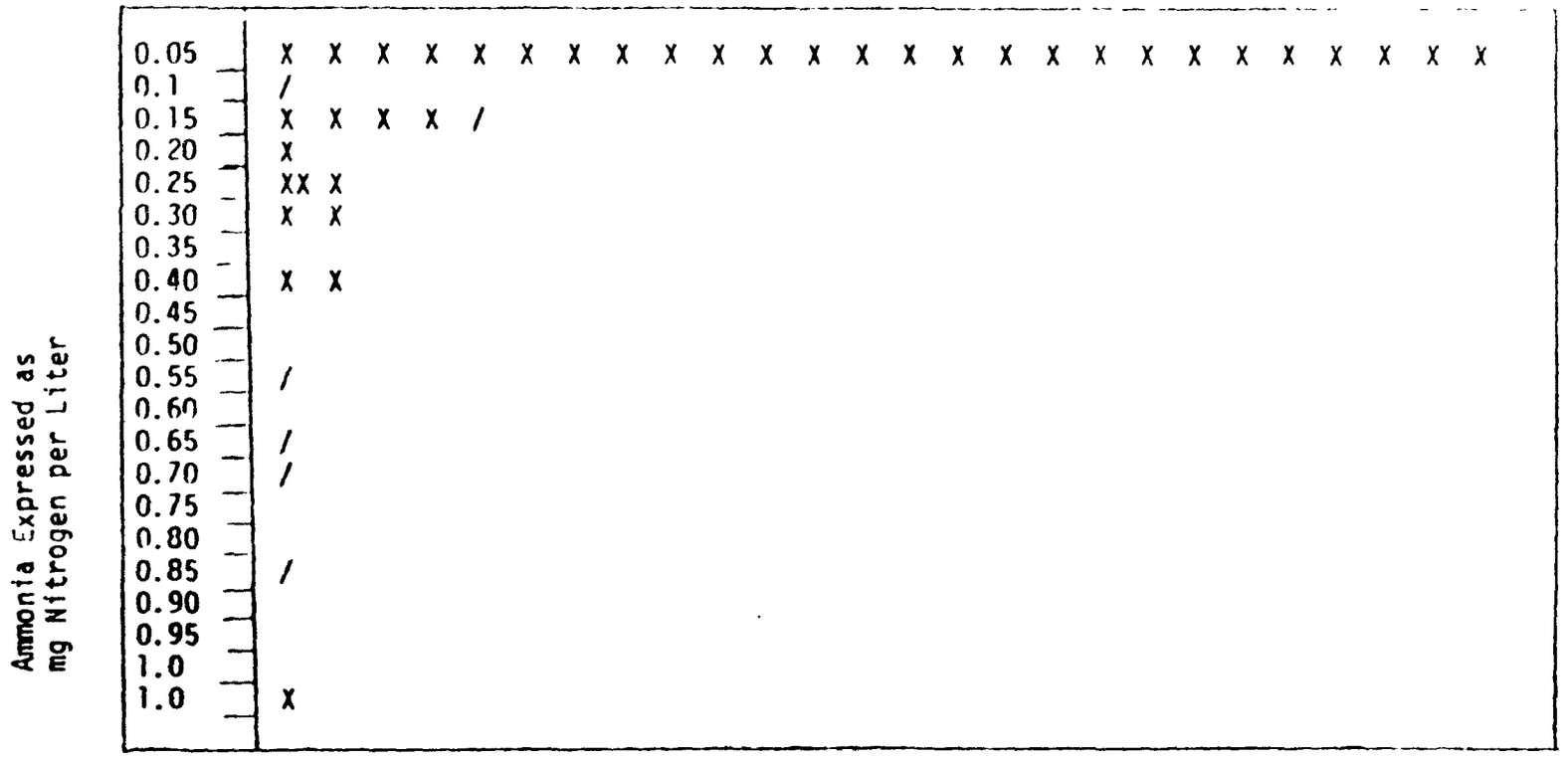


FIGURE V

FREQUENCY DISTRIBUTION FOR AMMONIA IN FINISHED WATER



/ = One Supply

X = Two Supplies

3. Pesticides, PCB's and Phthalates

Table V is a listing of those cities where pesticides, PCB's and/or phthalates were identified. The other samples analyzed did not contain a detectable amount of any of the fifty pesticides included in the survey. All analytical results are included in the appendix and from these we conclude that:

a. A large majority of the samples do not contain these types of compounds in concentrations that can be measured with the procedures used for this study.

b. For this class of compounds, the most commonly found are diethylhexylphthalate, dieldrin, DDT, treflan, aldrin and hexochlorobenzene. The concentrations of all pesticide type compounds identified to date are low. The highest concentrations found were 68 nanograms per liter (ng/l) for DDT, 11 ng/l for dieldrin, 17 ug/l for diethylhexlphthalate and 50 ng/l for treflan. All positive results are given in Table V.

c. Concentrations of PCB's in those samples from Lake Michigan and the Ohio River were too low to detect.

4. Non-Volatile Organic Compounds

Finished water was passed through small carbon filters used for sample collection at Mt. Vernon, Evansville and Indianapolis, Indiana. Raw water samples were also collected at Mt. Vernon. Presently the water from Whiting, Indiana and Mt. Carmel, Illinois are being sampled for carbon filter and extraction analyses. All of the exposed filters have been extracted with hexane, chloroform and methanol. Each of the extracts has been separated in acidic, basic and neutral fractions giving a total of nine concentrates per filter. The following high boiling compounds have been identified in the Mt. Vernon and Evansville supplies:

PESTICIDES - POLYCHLORINATED BIPHENYLS - PHTHALATES

Concentration is nanograms per liter R = Raw F = Finished

City		Diethylhexyl Phthalate	DDT	Dieldrin	Treflan	HCB Hexachloro benzene	Aldrin	Zytron	Lindane	2,4-D(IP) 2,4-D-isopropyl ester	Gamma Chlordane	Total Value #
Bedford, Ind.	R			8								1
	F			6								1
Ft. Wayne, Ind.	R	1000										1
	F	4000		7								2
Gary, Ind.	R	17000										1
	F	5000										1
Hammond, Ind.	R		14									1
	F											
Indianapolis, In.	R											
	F		6									1
Kokomo, Ind.	R		32									1
	F											
Lafayette, Ind.	R						10			50		2
	F						4					1
Logansport, Ind.	R		16									1
	F											
Michigan City, In.	R	3000										1
	F											
Morocco, Ind.	R							40				1
	F											
Muncie, Ind.	R											
	F											
Mt. Vernon, Ind.	R			3								1
	F											
New Albany, Ind.	R			6								1
	F		14									1
South Bend, Ind.	R	4000	6	7								3
	F	2000										1
Cairo, Ill.	R	1000	6	4		10						4
	F	3000										1
Carlyle, Ill.	R		8									1
	F											
Chester, Ill.	R											
	F	3000	68	7							4	4
Galesburg, Ill.	R											
	F					4						1
Kankakee	R				10							1
	F			4								1

All Concentration Values Not Reported Were Below the Detection Limits

PESTICIDES - POLYCHLORINATED BIPHENYLS - PHTHALATES

Concentration is nanograms per liter R = Raw F = Finished

City		Diethylhexyl Phthalate	DDT	Dieldrin	Treflan	HCB Hexachloro benzene	Aldrin	Zytron	Lindane	2,4-D(IP) 2,4-D-isopropyl ester	Gamma Chlordane	Total Value [2]
Mt. Carmel, Ill.	R			11	28							2
	F			6	50							2
Peoria, Ill.	R											
	F											
Streator, Ill.	R			3								1
	F								4			1
Rock Island, Ill.	R											
	F		12									1
Bay City, Mich.	R	1000										1
	F	1000										1
Bessemer Twp. Mich.	R	1000										1
	F											
Cadillac, Mich.	R											
	F											
Detroit, Mich.	R											
	F											
Dundee, Mich.	R		4	5	7							3
	F						6					1
Jackson, Mich.	R	2500										1
	F											
Mt. Pleasant Mich.	R		4									1
	F		6									1
Sault St. Marie Mich.	R											
	F											
Wyandotte, Mich.	R	1000										1
	F											
Crookston, Minn.	R											
	F	1000				6						1
Duluth, Minn.	R	1000										1
	F	2000										1
East Grand Forst Minn.	R	2000				6						2
	F	1000										1
Fairmont, Minn.	R	1000										1
	F											
Minneapolis, Minn.	R	6000										1
	F											
Oslo, Minn.	R					6						1
	F											

PESTICIDES - POLYCHLORINATED BIPHENYLS - PHTHALATES

Concentration is nanograms per liter R = Raw F - Finished

City		Diethylhexyl Phthalate	DDT	Dieldrin	Treflan	HCB Hexachloro benzene	Aldrin	Zytron	Lindane	2,4-D(IP) 2,4-D-isopropyl ester	Gamma Chlordane	Total Values*
Richfield, Minn.	R											
	F	2000										1
St. Cloud, Minn.	R	2000	8				6					3
	F											
Berrea, Ohio	R	4000										1
	F	2000										1
Cincinnati Ohio	R	2000		3								2
	F	17000										1
Cleveland, Ohio	R	1000										1
	F	2000										1
Columbus, Ohio	R	1000										1
	F											
East Liverpool Ohio	R		10									1
	F	1000										1
Portsmouth, Ohio	R											
	F											
Toledo, Ohio	R											
	F	4000										1
Green Bay, Wisc.	R											
	F	2000										1
Kenosha, Wisc.	R	2000										1
	F	1000										1
Marinette, Wisc.	R											
	F	1000										1
Milwaukee Wisc.	R	12000										1
	F											
Oshkosh, Wisc.	R											
	F	1000										1
Two Rivers, Wisc.	R											
	F	6000										1
Total # Values		40	15	14	4	5	4	1	1	1	1	86

Mt. Vernon	Evansville
tri-n-butyl phosphate	tri-n-butyl phosphate
butylphthalate	butylphthalate
dioctyl phthalate	dioctyl adipate
trimethyl benzene	methyl palminate
toluene	farnesol
n-octane and other homologs	n-octane and other homologs
xylene	xylene
ethyl benzene	diphenylether
methyl cyclohexane	

Many more of these high boiling compounds are present, but further purification (we are attempting to accomplish the preparation by high pressure liquid chromatography techniques) will be necessary to identify them. We have not yet attempted to analyze the extracts for any low boiling compounds except for the bis-2-chloroisopropyl and bis-2-chloroethyl ethers. Neither of these compounds gave a gas chromatographic peak above the detection limit and therefore they are not present to the extent they have been in Evansville samples analyzed previously. In general, the current water samples from Evansville contain fewer organic compounds than similar samples analyzed by the Region V laboratory and Indiana State University-Evansville over the previous four years. This reduction in pollution is an expected product of the National Pollutant Discharge Elimination System program and should reduce concern for Evansville water.

5. Inorganic Parameters

All samples were analyzed for the following fourteen metals: silver, arsenic, calcium, cadmium, chromium, copper, iron, potassium, magnesium, manganese, sodium, lead, selenium, and zinc. Concentrations (49 ug/l) of arsenic were found at Kokomo, Indiana and prompted us to resample that plant. It was subsequently found that Kokomo was using Wildcat Creek and several deep wells as sources. The water from Wildcat Creek does not contain a measurable amount of arsenic but water from two of the 15 deep wells contained up to 2000 ug/l. This is apparently a very localized problem affecting only a few wells. With proper treatment and blending the Kokomo water works has been able to maintain

safe concentrations of arsenic in the finished drinking water. It is recommended however that Kokomo analyze for the presence and quantity of arsenic in the finished water at least once per month during periods when Wells #4 or #7 are in use.

The arithmetic mean values for all finished water parameter concentrations are less than drinking water standards with the exception of phenolics (Table VI & VII). Since the detection limit of the analytical method used to measure phenol concentrations is greater than the recommended levels, we do not interpret the measured mean phenolic concentration to be significantly higher than the recommended values.

Table VIII is an abbreviated frequency distribution of the finished water data and shows that the Water Quality Criteria[8] *recommendations* were occasionally exceeded. In addition, the table shows the mean value for each parameter is generally larger than the median value which indicates the data distribution is log normal rather than gaussian. This point is illustrated in Figure 1.

It can be concluded from the data in Table IX that a high chemical oxygen demand (COD) in the raw water is necessary for a high chloroform concentration to result in the finished water. However, the converse is not always true as some supplies had raw water COD's of 30 mg/l or higher but $CHCl_3$ concentrations of 40 ug/l or less. These data suggests that chloroform results from a single or small group of compounds. They also support the concept that the chloroform precursor reduces potassium dichromate and that those supplies having a low COD need not be tested for chloroform.

TABLE VI

DRINKING WATER STANDARDS FOR INORGANIC PARAMETERS [a]

PARAMETER	PUBLIC HEALTH SERVICE (7)	WATER QUALITY CRITERIA (8)	ENVIRONMENTAL PROTECTION AGENCY (6)
Ammonia - N		0.5	
Alkalinity			
Chloride	250	250	
Chemical Oxygen Demand			
Cyanide	0.01, 0.2[b]	0.2	0.2
Dissolved Solids	500		
Fluoride	0.8-1.7[c]	1.4-2.4[c]	1.4-2.4[c]
Mercury	0.0002		0.0002
Nitrate - N	10	10	10
Nitrite - N		1	
pH		5-9	
Phenolics	0.001	0.001	
Silica			
Specific Cond.			
Sulfate	250	250	
Suspended Solids			
Total Phosphorus -P			
Total Kjeldahl Nitrogen - N			

a. Values expressed in mg/l except pH units.

b. 0.01 mg/l acceptable but 0.2 mg/l constitutes grounds for rejection of the supply.

c. Exact limits are temperature dependant. See ref. 6-8.

TABLE VII

SUMMARY OF INORGANIC PARAMETER DRINKING WATER RESULTS.[a]

	RAW WATER		FINISHED WATER	
PARAMETER	MEAN	STD. DEV.	MEAN	STD. DEV.
Ammonia - N	0.154	0.114	0.154	0.356
Alkalinity - $CaCO_3$	141	83	106	78
Chloride	18	17	21	21
COD	15	12	7	5
Cyanide	0.004	0.003	0.004	0.002
Dissolved Solids	267	142	254	129
Fluoride	0.19	0.18	0.87	0.37
Mercury	0.0001	0.0001	0.0001	0.0001
Nitrate & Nitrite - N	1.44	2.02	1.39	1.91
Nitrite - N	0.017	0.024	0.005	0.004
pH, units	7.6	0.3	7.9	0.8
Phenolics	0.003	0.002	0.003	0.001
Silica	7.9	6.4	7.0	5.1
Specific Conductance, µs	426	202	406	198
Sulfate	44	39	56	44
Suspended Solids	33	64	3	5
Total Phosphorus - P	0.11	0.12	0.10	0.18
Total Kjeldahl - N	0.68	0.57	0.39	0.44
Hardness - $CaCO_3$[b]	192	105	156	90

a. Expressed as mg/l, except pH (units) and specific conductance (micro siemens, µs).

b. Obtained from metals section report.

TABLE VIII

FREQUENCY DISTRIBUTIONS OF THE FINISHED WATER RESULTS FOR INORGANIC PARAMETERS

	Percent of Samples Less Than Concentrations Shown					No. Exceeding WQC Rec.
Parameter	50	75	90	95	100	
Ammonia - N	0.05	0.15	0.4	0.65	2.61	5
Alkalinity - $CaCO_3$	90	140	230	290	390	
Chloride	20	24	36	40	179	0
COD	6	8	12	14	28	
Cyanide	0.003	0.004	0.006	0.008	0.012	0
Dissolved Solids	220	300	420	520	700	
Fluoride	1.0	1.2	1.2	1.4	2.2	0
Mercury	0.0001	0.0002	0.0003	0.0003	0.0004	0
Nitrate & Nitrite-N	<0.5	2.0	4.5	5.5	8.0	0
Nitrite - N	<0.005	<0.005	0.005	0.005	0.026	0
pH, units	8.0	8.5	9.5	9.5	10.1	9
Phenolics	<0.003	<0.003	0.005	0.006	0.008	6
Silica	7	9	16	18	22	
Specific Conductance µs	360	500	680	860	925	
Sulfate	48	76	104	152	279	1
Suspended Solids	<2	3	5	7	42	
Total Phosphorus - P	<0.02	0.10	0.28	0.40	0.67	
Total Kjeldahl Nitrogen - N	0.25	0.50	0.75	0.85	3.20	
Hardness - $CaCO_3$	130	180	290	320	430	

a. Expressed as mg/l except pH (units) and specific conductance (micro siemens,

b. Phenolics not considered due to method.

TABLE IX

PERCENTAGE OF RAW WATER COD VALUES EXCEEDING THE MEAN OF 15 mg/l VERSUS $CHCl_3$ CONCENTRATIONS

Number of Samples	$CHCl_3$(ug/l)	%COD 15 mg/l
40	20	20
12	40	42
13	60	77
4	80	75
2	100	100
1	120	100
3	140	100
1	160	100
1	180	100
4	180	100

Numberous drinking water plants add chemicals other than chlorine to the water during the treatment process. Two commonly used chemicals are ammonia and polyphosphate. Fluoride is also added to many supplies.

Twenty-one (21) supplies added ammonia or ammonium ion to maintain acceptable residual chlorine concentrations as chloramines. Nineteen (19) of these supplies had ammonia - N concentrations above the median of 0.05 mg/l for finished water. The average increase of ammonia - N in finished versus raw water was 0.195 mg/l for these supplies compared to the overall average of zero (0) increase for all supplies (Table X)

Thirteen (13) supplies added polyphosphate. Twelve (12) of these supplies were above the median finished water total phosphorus concentration. Also the overall average change in phosphorus from raw to finished water was negative 0.01 mg/l. However, these 13 supplies averaged an increase of 0.168 mg/l.

TABLE X

ADDITIONS OF AMMONIA AND PHOSPHORUS TO FINISHED WATER

SUPPLY	MEAN PHOSPHORUS, mg/l			MEAN AMMONIA - N, mg/l		
	Raw	Finished	Change	Raw	Finished	Change
All supplies	0.11	0.10	0.01	0.154	0.154	0
Added Ammonia				0.155	0.350	0.195
Added Phosphorus	0.125	0.293	0.168			

Most supplies add fluoride. This is evident from the median fluoride concentration of 1.0 mg/l. However, 9 supplies apparently do not add fluoride.

Nine (9) supplies had pH values between 9.0 and 10.1. Of these supplies, six (6) also had $CHCl_3$ concentrations greater than 50 ug/l. No additional relationships were found.

Suspended solids removal was 90 percent based on the mean raw and finished water values. The highest suspended solids value for a finished water was 42 mg/l, the second high was 13 mg/l, and all other values were 8 mg/l or less. No positive correlation exists between suspended solids and the presence of halogenated organic compounds. However, COD removal averaged only 50 percent indicating that significant amounts of organic materials remained in the filtered water. This suggests that the turbidity standard (suspended solids is the cause of turbidity) may not be sufficient to protect water supplies from halogenated organic compounds.

6. Economic Considerations

Table XI gives estimates of resources expended to complete this survey. All dollar estimates are based on the assumption that total expenses, including all overhead, costs $40,000 per position and a year contains 260 working days.

III. SIGNIFICANCE

It is not surprising that trace amounts of various organic chemicals can be detected in drinking water. With the sensitivity available in the gas chromatograph/mass spectrometer-computer equipment it is probable that many such compounds can be found in almost any facet of our environment that one chooses to look. Absolute purity is only a theoretical term and is not attainable in drinking water.

Concentrations that are above a normal background and that do pose a significant health risk should of course be reduced. There are currently not enough data to fully understand either the normal background level or the health significance of the organic compounds included in this study. However, with

TABLE XI

ESTIMATED COST DATA FOR THE REGION V SURVEY

1.	Number of Cities Sampled	83
2.	Number of Samples collected including duplicates for Quality Assurance (QA) purposes	210
3.	Number of Bottles collected	2,940
4.	Number of Analyses per Sample	94
5.	Total Number of Analyses performed *	19,740
6.	Total Number of Analyses reported	15,604
7.	Total Number of QA measurements made	4,136

Resources Required

	Labor @ $40,000/Yr. including Overhead	Man-Days	Cost
1.	Completion of Study Plan by Project Officers and Administration Officials	6	$ 920.00
2.	Sample collection - One man day for preparation and four man days for collection per State	30	4,620.00
3.	Laboratory Analysis - One fourth of the total CRL staff of 33 positions for 7 weeks	289	44,400.00
4.	Preparation, typing and editing of final report	15	2,300.00
	Supplies		
1.	Sampling bottles, caps, teflon liners, etc.		400.00
2.	Organic solvents		2,600.00
3.	Miscellaneous supplies		1,000.00
		Total	$ 56,240.00

	Cost Per Unit	
1.	Cost per City	$ 678.00
2.	Cost per Sample including QA	$ 268.00
3.	Cost per Analysis " "	$ 2.85
4.	Cost per Reported Concentration Value	$ 3.60

* Does not include non-volatile and carbon filter analyses although these are included in the estimation of required resources.

perhaps the exception of chloroform, concentrations of organics analyzed in these drinking waters should not be considered atypical. It is not likely that they will be found to present a significant risk to health. Exposures to these same compounds from ambient levels in other aspects of our environment (smoke, air, food, medicines, etc.) can be expected to be much greater than that from drinking water.

Chloroform, it appears, is affected by chlorine application. Concentrations of chloroform in water supplies with a high chlorine demand may exceed 0.1 milligram per liter (mg/l). However, even at the highest concentration found (0.366 mg/l), chloroform should not be considered to present an imminent risk to health. There is no evidence that chloroform causes tumors in workers, and the allowed occupational exposure to chloroform in air is over 100 times that from drinking water with 0.5 mg of chloroform per liter.

The possibility must be recognized, however that traces of micropollutants in drinking water may indeed contribute to the total exposure of persons to environmental factors that contribute to carcinomas. An ad hoc Study Group of EPA's independent Science Advisory Board in their May 1, 1975 report on the health significance of drinking water chemicals, concluded that "some health risk exists." A portion of the Study Group's summary follows:

> "Based upon recent, reasonably extensive, water quality data for many U.S. water supplies and on extremely limited data from experimental carcinogenesis studies, the Study Group concludes that there may be some cancer risk associated with consumption of chloroform in drinking water. The level of risk, estimated from consideration of the worst case and for the expected cancer site for chloroform (the liver) might be extrapolated to account for up to 40% of the observed liver cancer incidence rate. A more reasonable assumption, based upon current water quality data which show much lower levels than the worst case in the majority of U. S. drinking water supplies, would place the risk of hepatic cancer much lower and possibly nil. Further, it is emphasized that both the experimental carcinogenicity data and the mathematical and biological extrapolation principles used to arrive at the upper estimate of risk are extremely tenuous. Epidemiologic studies do not, thus far, support the conclusion of an increased risk of liver cancer; although hypothesisformulating

studies in southern Louisiana suggest the possibility of an association with contaminated water and overall high cancer incidence. Critical definitive tests of this hypothesis have not been conducted. Although some other organic contaminants contained in the charge to the Study Group have carcinogenic potential, the cancer risk to man is judged to be minor because of their low concentration and/or infrequent occurrences in drinking water."

IN SUMMARY: The study's findings do raise questions about the quality of drinking water and there is a need for a better definition of the health relationships between these substances and man. At this point, though, there is no evidence to justify quantum changes in current water treatment practices. For example, EPA's statement from last November holds true . . . "the benefits of continued use of chlorine for the disinfection of drinking water far outweigh the possible health risks from chlorine-derived organic compounds." While trace organics in drinking water are an important problem which deserves investigation, the situation today is not a crisis to be met with fear and precipitous action.

IV. RECOMMENDATIONS

1. When wells contaminated with arsenic are used in Kokomo, the drinking water should be monitored at least monthly to be certain that it consistently meets drinking water standards. Appropriate precautions should be taken before drilling any new wells in the area.
2. Since our results are based on individual grab samples collected at what may not be normal conditions, the data may not reflect the long term quality of any given supply. Therefore, the finished water of those 31 supplies showing higher chloroform concentrations above 33 ug/l should be re-analyzed for the volatile organic compounds and selected metal and other inorganic parameters. In addition, a complete organic compound analysis should be completed on as many of these water supplies as possible.

3. An effort should be made to identify the precursor(s) that react with chlorine and bromine to produce the pollutants found in the finished water samples. As a first step, raw waters should be analyzed completely and halogenation studies completed on potential precursors. The best treatment for these pollutants may be removal of a precursor rather than removal of the organic compounds found in the finished water supplies. Raw water samples should be taken and analyzed completely at those cities having the highest chloroform concentrations.
4. In addition to treatment methods involving carbon and ozone, aeration should be looked at for removing volatile organic compounds.
5. The relationship of COD (or TOC) and $CHCl_3$ concentrations should be further investigated to include raw water source comparisons and other parameter correlations such as pH to act as indicators for volatile organics.

V. SAMPLE COLLECTION, ANALYTICAL PROCEDURES AND QUALITY ASSURANCE

In general, all samples were collected, preserved and analyzed according to recommended EPA procedures[3]. In cases where official procedures have not been recommended or approved, such as for the volatile organic and carbon filter methods or where superior analytical methods have been developed as for the COD, standard methods in current use in Region V were employed. All of these methods, with corresponding quality assurance data that will permit the reader to estimate the quality of data on a parameter or group of parameters basis are described later in this section.

1. Sampling Procedures

Fourteen bottles of water were collected at each city. These bottles were divided according to sample preservative as described below. In all cases the bottles were filled completely to avoid an air-liquid interface. Raw water samples were collected just prior to chlorination. Finished water samples were collected several hours after chlorination depending on plant flow.

	Bottle	For	Preservative
a)	four one liter glass bottles w/teflon lined caps	two bottles for raw water organics and two bottles for finished water organics	ice
b)	two 500 ml high density polyethylene bottles,	raw and finished water - metals	HNO_3
c)	two 250 ml polyethylene bottles	raw and finished water-nutrients	H_2SO4
d)	two 250 ml polyethylene bottles	raw and finished water cyanides	NAOH
e)	two 250 ml polyethylene bottles	raw and finished water phenolics	$CuSO4/H_3PO4$
f)	two 250 ml polyethylene bottles	raw and finished water (pH, specific conductance, alkalinity, etc.)	ice

Since these types of bottles had been in use in the Region for some time and were known to be clean, they were not washed prior to sample collection. However, to insure that results due to bottle contamination or some other contamination were not reported, the normal set of reagent

blanks (preservative and distilled water in a sampling bottle) were prepared daily by each sampling team and analyzed as the samples were analyzed. No contamination problems associated with sampling were detected.

The maximum holding times for the organic parameters are unknown. Therefore, all organic samples were refrigerated upon collection and either extracted or analyzed as quickly as possible after sample collection; usually within forty eight hours but no later than five days after sample collection. A laboratory standard containing the seven volatile organics of interest was analyzed daily during the study and remained stable for four weeks. Although chlorinated hydrocarbon pesticides are stable, other pesticides are known to degrade with time so only minimum concentration values can be measured for these parameters.

All inorganic parameters were analyzed within those holding times recommended for approval by Region V to the Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, Cincinnati, (Appendix I).

2. Volatile Organics

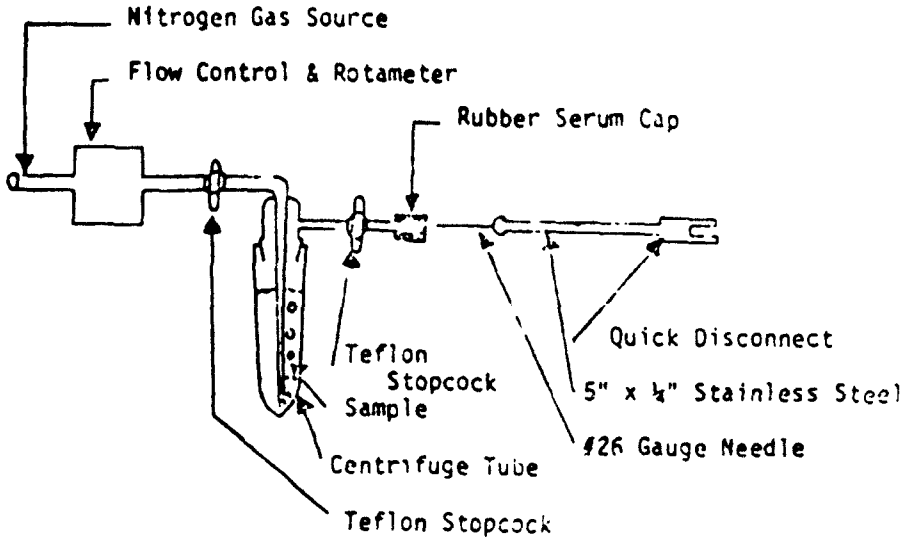
a) Analytical Procedures.

The procedure described below is a modification of methods described by Kleopfer [4] for air studies and by Bellar and Lichtenberg for volatile organics in water.[1,2] We have used the experimental apparatus and organic trap described by Kleopfer, the water sampling method of Bellar and Litchtenberg and have

developed our own gas chromatographic analytical techniques. Quality Assurance data given at the end of this section shows the procedure to give accurate results within the defined experimental scatter.

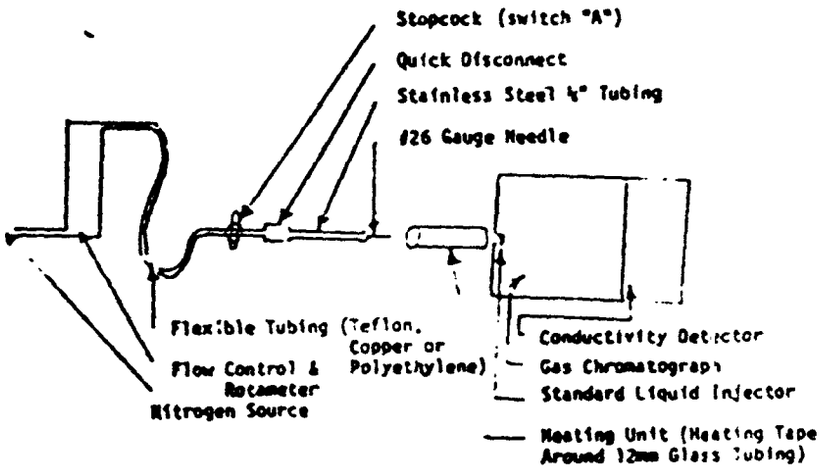
Ten milliters of sample are transferred to a microware centrifuge tube with a 14/20 ground glass joint from a completely filled glass sampling bottle. The centrifuge tube is then placed on the debubbler apparatus held in place by two springs as shown in Figure VI.

FIGURE VI



The needle of a trap that has been cleaned by being heated to 135°C and flushed while hot with nitrogen is inserted into the rubber septum. The stopcocks are opened permitting nitrogen to flow through the debubbler, sample water and into the trap where the organic compounds are adsorbed on the surface of the Tenax. A nitrogen flow rate (Purge) of 80 ml/min for 8 minutes is sufficient to quantitatively transfer those volatile organics studied in this project. The trap is then removed and attached to the gas chromatograph - desorption oven system as shown in Figure VII

FIGURE VII



The trap is placed in the desorption oven with switch "A" (see Figure 3) in the off position and left for 2 minutes while thermal equilibrium is being established. The syringe needle on the trap penetrates the GC injection septum as the trap is placed in the desorption oven. At the end of the 2 minute period, switch "A" is opened and the sample is carried into

the GC column where a standard chromatographic analysis is completed. Quantitative data are obtained by comparing the recorder response of standard solutions to the response of unknowns. Operating conditions of the chromatograph and detector are as follows: oven temperature - 30°C for 3 min. and then raised to 200°C at a rate of 20°C/min; injector temperature - 200°C; detector oven temperature - 800°C; nitrogen carrier gas flow rate - 40 ml/min; detector reducing gas (H_2) flow rate - 80 ml/min; desorption gas (N_2) flow rate - 40 ml/min; column - 6' x 1/8" aluminum packed with 10% by weight FFAP on 60/80 Mesh Anakrom. A typical gas chromatogram of a laboratory quality assurance control standard is shown later.

b) Quality Assurance for Volatile Organics

Before any samples were analyzed for the presence of halogenated volatile organics, extensive analytical quality control data was collected to optimize the analytical conditions and to determine the reproducibility of the method. Table XII lists the responses given by the seven halogenated organics included in this study as a function of purge time. The purge gas flow rate was maintained at 80 ml/min during investigation of the flow time. Preliminary work indicated that longer purging times were required if the purge rate is lowered. The data summarized in Table XII indicates that, with a purging rate of 80 ml/min, a purge time of 8 min. is optimum for the seven compounds of interest.

Table XIII summarizes the data obtained for a standard mixture which was analyzed five different times (three different traps were used to trap the volatiles). The relative standard deviation is larger for methylene chloride and carbon tetrachloride because of time limitations peak heights instead of peak areas were used for quantification check. Since methylene chloride and carbon tetrachloride give broader and more poorly resolved peaks than the other compounds investigated, a larger amount of scatter was observed when the peak height was used for quantification check.

TABLE XII

Gas Chromatograph Detector

Response As A Function Of Purge Time
In Arbitrary Units

RESPONSES

Purging Time	CH_2Cl_2	CCl_4	$CHCl_3$	$C_2H_2Cl_2$	Cl_2BrCH	$ClBr_2CH$	Br_3CH
4 min.	2370	1090	2240	5570	3970	8000	4350
6 min.	2170	1340	2560	6140	4030	8770	5690
8 min.	2370	1150	3260	9150	5500	12030	7870
10 min.	2110	880	2820	7740	4610	9660	7920

TABLE XIII

Reproducibility Of The Analytical Method

(Arbitrary Units Of Detector Response)

Compound	Concentration µg/l	Run #1	Run #2	Run #3	Run #4	Run #5	Average	Relative Std. Deviation
CH_2Cl_2	49	2880	2370	2690	2110	2430	2500	12%
CCl_4	59	1860	1150	1470	770	1380	1320	30%
$CHCl_3$	55	2880	3260	3070	3330	3230	3160	6%
$C_2H_2Cl_2$	54	7360	9150	8060	9280	9730	8720	11%
Cl_2BrCH	73	4740	5500	5180	4860	6270	5310	11%
$ClBr_2CH$	85	10050	12030	11140	11840	12540	11520	10%
Br_3CH	107	6590	7870	7420	7880	7170	7380	8%

Analytical quality control employed during analysis consisted of routinely: 1) analyzing blank traps, 2) analyzing standards, 3) confirming the highest concentrations (10%) qualitatively on the mass-spectrometer and 4) collecting and analyzing 10% of the samples in duplicate.

Blanks were analyzed at random throughout each day of the study. A blank consisted of carrying out the complete analytical procedure but leaving out the 10 ml of sample. Table XIV summarizes the data obtained for the blanks. It should be pointed out that the highest blank values were obtained on two days when methylene chloride, carbon tetrachloride and chloroform were being used as solvents in another part of the laboratory and illustrates the sensitivity and extreme care that must be used when performing these analyses. Figure VIII shows the gas chromatogram of a typical blank.

Standards, made by dissolving approximately seven µl of a mixture containing stoichiometric amounts of the seven halogenated organics in 300 ml of water followed by diluting an aliquot of this to give a final concentration in the 10 to 50 µg/l range for each compound, were analyzed at least three times a day (morning, noon and afternoon). The average response factors were then used to calculate the concentration of the samples. Fresh standards were made at least every 48 hours. Fig .VIII also shows examples of chromatograms for a standard solution.

Even though the Coulson conductivity detector employed is specific and warrants a high degree of confidence, over 10% of the samples giving positive results were qualitatively confirmed using gas chromatography - mass spectroscopy.

FIGURE VIII

Gas Chromatogram of Volatile Organic Compounds

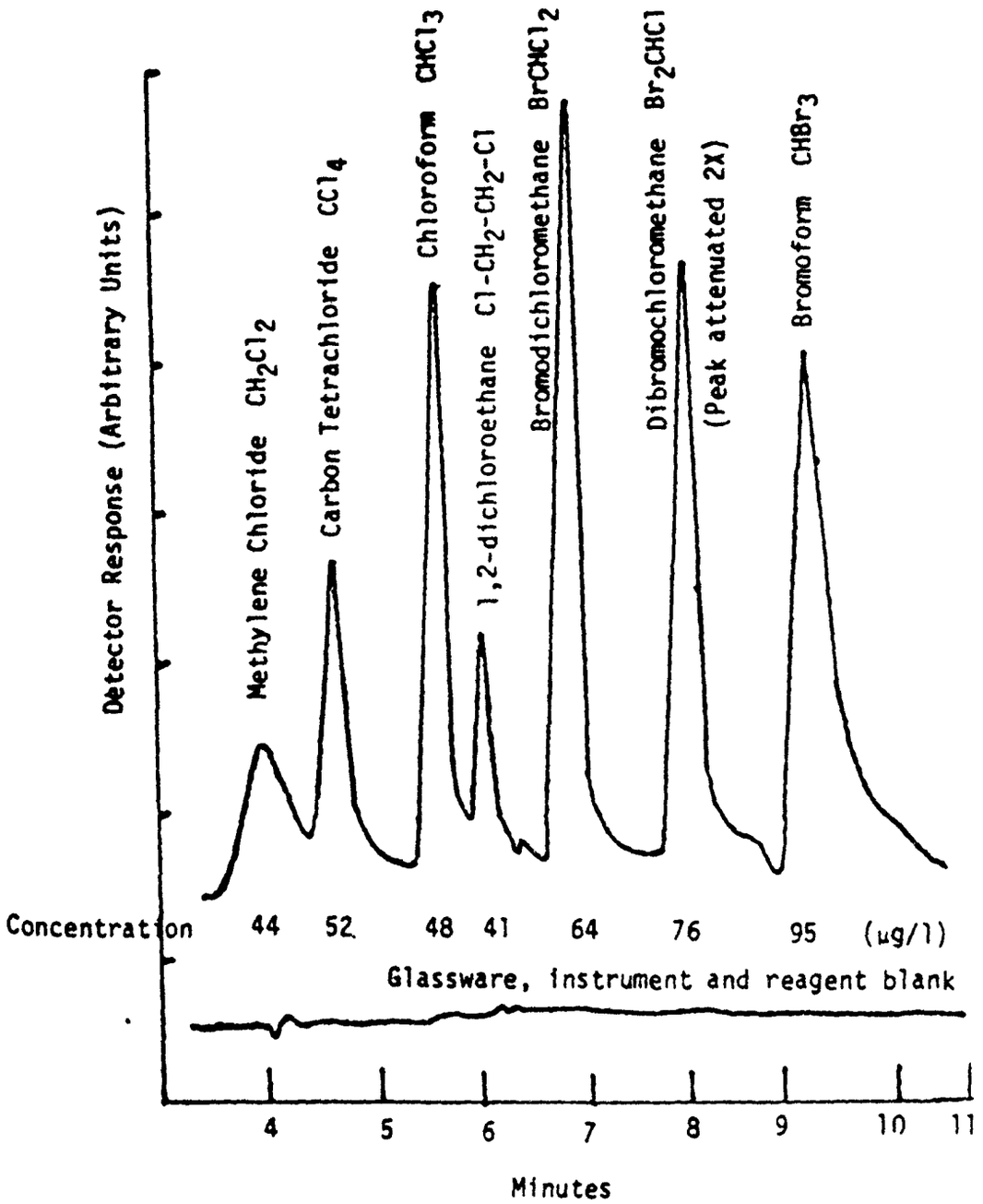


TABLE XIV

Summary of Results Obtained for All Reagent Blanks Analyzed During the Study

Compound	Range Found µg/l	Average µg/l
CH_2Cl_2	0 - 3	< 0.7
CCl_4	0 - 5	< 1
$CHCl_3$	0 - 7	< 2
$C_2H_2Cl_2$	< 1	< 1
Cl_2BrCH	< 0.5	< 0.5
$ClBr_2CH$	< 0.5	< 0.5
Br_3CH	< 0.5	< 0.5

As an overall quality control check, approximately 13% of the cities were sampled in duplicate. The analytical results for the duplicate samples are summarized in Table XV and defines for the reader the precision of the total sample collection and analytical procedures employed.

Fourteen samples were stored in a refrigerator after being analyzed. A month later it was decided to re-analyze the samples. The results are given in Table XVI. Only the data for $CHCl_3$, and $CHCl_2Br$ are reported. The other five compounds of interest were below detection limits. Since there was originally no intention of re-analyzing the samples, they were not tightly stoppered nor were they filled completely to the top (approximately 30 ml were removed when the samples were first analyzed). This we believe is responsible for the lower $CHCl_3$ values obtained at the latter date in those samples containing higher chloroform concentrations. However, the data in Table agrees in sufficient detail to augment the other AQC data and to increase the credibility and the validity of the reported sample concentrations. The data also indicate that refrigerated samples can probably be preserved for over a month prior to analysis.

TABLE IV

Analytical Results (µg/l) of All Samples Collected

In Duplicate

		$MeCl_2$	CCl_4	$CHCl_3$	$Cl_2BrC_2H_4$	Cl_2BrCH	$ClBr_2CH$	Br_3CH
Peoria, Ill.	Raw I	<1	<1	<1	1	<0.5	<0.5	<0.5
	Raw II	< .5	<1	<1	< 1	<0.5	<0.5	<0.5
	Fin I	< .5	1.3	2.0	6.0	1	0.5	0.4
	Fin II	<1	1.3	1.6	< 1	0.6	0.5	0.3
Mt. Vernon, Ind.	Raw I	4	2	3	< 2	< .5	< .5	< .5
	Raw II	<1	<2	<2	< 2	< .5	< .5	< .5
	Fin I	<1	2.4	20	< 1	9	1.5	1.6
	Fin II	2	2	15	< 1	9	1	.3
Gary, Ind.	Raw I	< .5	<1	<1	< 2	< .5	< .5	< .5
	Raw II	< .5	<1	<2	< 4	< .5	< .5	< .5
	Fin I	< .5	1	6	< 2	5	1	< .5
	Fin II	< .5	1	7	< 2	5	1	< .5
Detroit, Mich.	Raw I	< .5	<1	<1	< 1	< .1	< .1	< .1
	Raw II	< .5	<1	<1	< 2	< .5	< .5	< .5
	Fin I	< .5	<1	2	< 1	9	2.4	< .5
	Fin II	< .5	<1	3.4	< 1	10	2	< .5
Menominee, Mich.	Raw I	< .5	<1	<2	3	< .5	< .5	< .5
	Raw II	< .5	<1	6	26	< .5	< .5	< .5
	Fin I	1	1	42	< 2	5	0.6	0.3
	Fin II	1	<1	54	< 2	6	0.4	0.3
Minneapolis, Minn.	Raw I	< .5	3	4	< 1	< .5	< .5	< .5
	Raw II	< .5	<2	<2	< 1	< .5	< .5	< .5
	Fin I	< .5	10	8	< 1	< .5	< .5	< .5
	Fin II	< .5	5	7	< 1	< .5	< .5	< .5
Duluth, Minn.	Raw I	< .5	<2	20	< 1	< .5	< .5	< .5
	Raw II	< .5	3	1	< 1	< .5	< .5	< .5
	Fin I	<1	20	28	< 1	3	< .5	< .5
	Fin II	<1	25	26	< 1	3	< .5	< .5
Cleveland, Ohio	Raw I	< .5	2	<1	< 1	< .5	< .5	< .5
	Raw II	< .5	<2	<1	< 1	<1	<1	<1
	Fin I	<1	4	12	< 1	6	0.8	<1
	Fin II	<1	15	8	< 1	4	0.5	<1

TABLE XV (Cont'd)

		$MeCl_2$	CCl_4	$CHCl_3$	$Cl_2BrC_2H_4$	Cl_2BrCH	$ClBr_2CH$	Br_3
Portsmorth, Ohio	Raw I	2	2	2	2	<.2	<.2	<.
	Raw II	<1	2	6	2	<.2	<.2	<.
	Fin I	3	1	29	<1	15	5	.
	Fin II	3	1	21	<1	14	4	.
Black River Falls, Wisc.	Raw I	<.5	4	3	<1	<.5	<.5	<.
	Raw II	<.5	<2	<1	<2	<.5	<.5	<.
	Fin I	<1	8	8	<1	<.5	<.5	<.
	Fin II	<1	<2	4	<1	<.5	<.5	<.
Green Bay Wisc.	Raw I	Sample Lost during Analysis						
	Raw II	<1	3	1	<1	<.5	<.5	<.
	Fin I	<1	<1	10	<1	11	2	<1
	Fin II	<1	<1	9	<3	3	<1	<1

TABLE XVI

VOLATILE ORGANIC CONCENTRATIONS VERSES TIME

Sample #	$CHCl_3$ Analyzed On 2/20/75	$CHCl_3$ Analyzed On 3/26/75	Cl_2BrCH Analyzed On 2/20/75	Cl_2BrCH Analyzed On 3/26/75
14313	37	36	4	6
14309	2	3.5		
14297	10	10	9	8
14325	22	18	0.8	0.7
14289	7	9		
14321	7	9.4	0.8	0.4
14293	82	78	6	5.4
14337	26	23	0.3	0.9
14853	3	2.5		
14366	8	20	4	5
14345	26	17	3	2.2
14410	366	205	18	19
14317	128	101	15	9.6
14329	79	53	6	5
14825	2	4		
14374	5	4	<1	1.3
14301	200	130	31	16

3. Pesticides, PCB's and Phthalates.

a) Introduction

The procedure used is based on "Methods for Organic Pesticides in Water and Wastewater," 1971, EPA publication from NERC - Cincinnati.[5] The procedure differs from the NERC's in that it has been expanded to include 47 pesticides, 5 PCB mixtures and 2 phthalate esters. Also, the gas chromatograph analysis step has been automated.

b) Experimental Procedures

The samples are received in glass quart bottles with teflon lined screw caps and are transferred into clean two liter separatory funnels. The first portion of the extracting solvent is used to rinse out the sample bottle and then is added to the separatory funnel. The samples are extracted twice with 100 ml of 15% (v/v) ethylether /hexane, then once with hexane, dried over Na_2SO_4, and concentrated to about 5 ml in a Kuderna-Danish concentrator. The volume is reduced to less than 4 ml using a stream of dry filtered air, diluted to exactly 4 ml, and split into two 2 ml portions (I and II).

Portion (I) is spiked with phorate (2 μg), placed in a 2 ml vial fitted with a screw cap, and analyzed for phosphorus-containing compounds. The analysis is performed on a Perkin-Elmer model 900 gas chromatograph using a flame-photometric (phosphorous mode) detector. This instrument is equipped with

an automatic sampler (adjusted for 10 µl injection) and a PEP 1 G.C. data reduction system. A 6' x 1/4" glass column packed with 14% SE-30 and 6% OV-210 on 80/100 mesh gas chrom Q is used for the original analysis and a 6' x 1/4" column packed with 1.95% OV-17 and 1.5% OV 210 on gas chrom Q 80/100 mesh is used for confirmation. The gas chromatograph conditions are as follows: inlet temperature - 250°C, detector temperature - 240°C, oven programmed from 200°C to 265°C at 4°/min, carrier gas - N_2 at 60 ml/min.

Portion (II) is placed on a column of Florisil (18 g. obtained from NERC, RTP, slurry packed with hexane) with 1/2" of Na_2SO_4 at the top and bottom of the florisil.

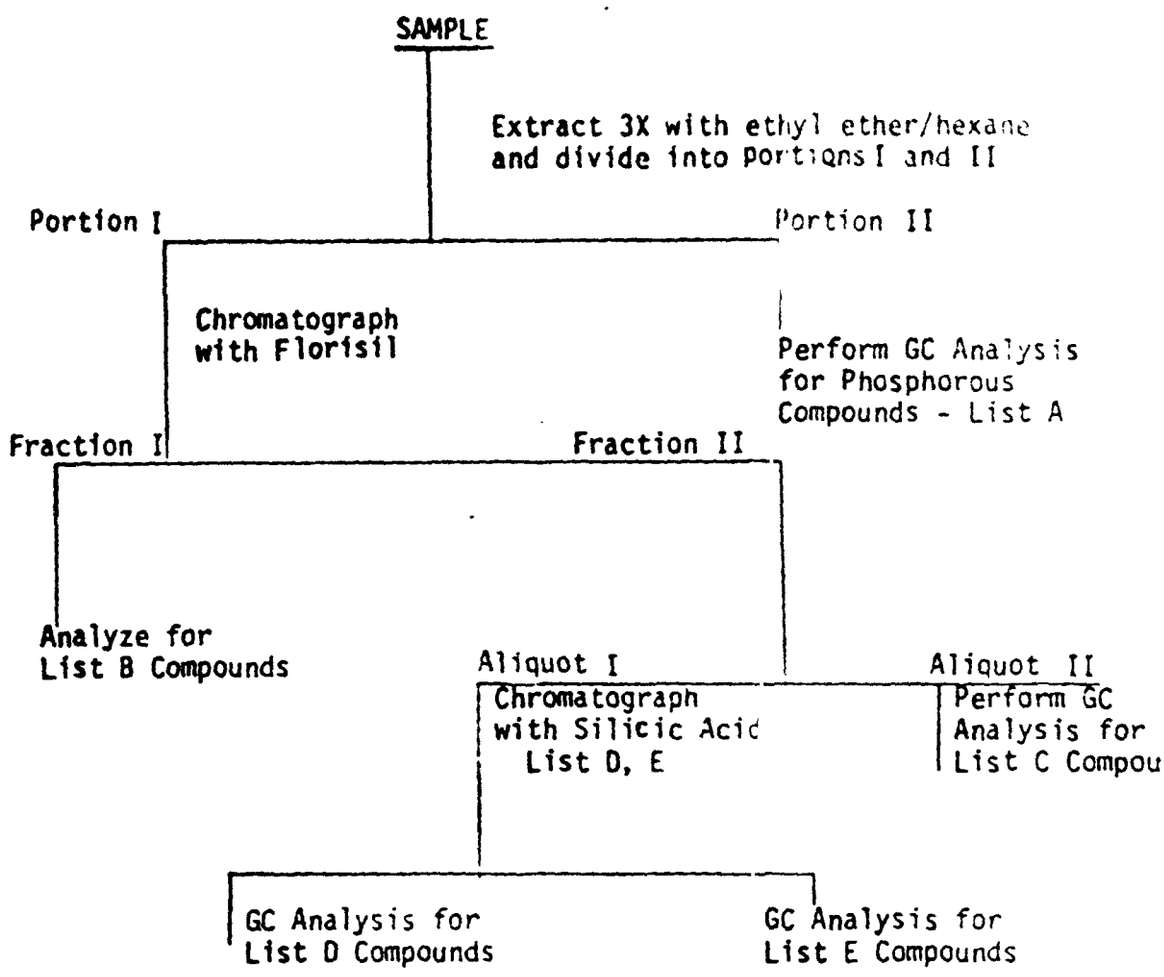
Two fractions are collected; the first is eluted with 200 ml of 6% ethyl ether in hexane, and the second with 200 ml of 50% ethyl ether in hexane. Each fraction is concentrated to less than 2 ml in the same manner as that used for the extract, diluted to 2.0 ml with hexane, spiked with Dieldrin (50% ether fraction) or Aldrin (6% ether fraction) and placed in a 2 ml vial with a septum cap for GC analysis.

Each fraction from the Florisil column is analyzed using a Perkin-Elmer 3920 gas chromatograph equipped with a two-column injector splitter, automatic sampler with 10 µl syringe,

two columns each leading to an electron capture detector, and a PEP-1 data reduction system. The columns are both 6' x 1/4" glass. One is packed with 4% SE-30 and 6% OV-210 and the other with 1.95% OV-17 and 1.5% OV-210 on 80-100 mesh gas - chrom Q. The oven is maintained at 205°; the carrier gas is 5% methane in argon for both columns.

A measured aliquot of each sample from the 6% ether fraction which is thought to contain PCB's, as shown from its chromatogram, is removed from the vial and placed onto a column of deactivated silicic acid (6 g, Bio-Rad Laboratories, 2.0% water content) which has been packed and washed with 60 ml hexane. The first fraction is eluted with hexane (45 ml) and the second with 150 ml of a mixture of 80% methylene chloride, 19% hexane, and 1% acetonitrile. Each fraction is concentrated to less than 2 ml as previously described, diluted with hexane to 2.0 ml, spiked with Dieldrin, and placed in a vial for GC analysis. These fractions are analyzed for PCB's and pesticides on the Perkin-Elmer model 3920 dual-column electron capture system described above.

An overall flow diagram of the analysis scheme is shown below with typical chromatograms and computer printouts for list A & B compounds.



LIST

A	B	C	D	E
Phosphorous	Fraction I	Aliquot II of Fraction II	Aliquot I of Fraction II	
Dyfonate	Di-n-butyl phthalate	Treflan	Aroclor 1221	Treflan
Ethion	Di-(2-ethythexyl) phthalate	Lindane	Aroclor 1242	Lindane
Dursban	Endosulfan I & II	Hexachlorobenzene	Aroclor 1248	Beta BHC
Diazinon	Nitrofen	Isodrin	Aroclor 1254	Zytron
Ronnel	Dilan	Gamma Chlordane	Aroclor 1260	Isodrin
Methyl Parathion	2,4-D: Isopropyl ester	Beta-BHC	Hexachloro-benzene	Heptachlor Epoxide
Ethyl Parathion	DCPA	Aldrin	Aldrin	Gamma Chlorda:
EPN	Dieldrin	Zytron	PP DDE	OP DDE
Malathion	Endrin	Heptachlor Epoxide	Mirex	OP DDD
Phencapton	Chlorobenzilate	O,P - DDE		PP DDD
DEF	2,4,5-T: Isooctyl ester	PP - DDE		OP DDT
Phosalone	Tetradifon	OP - DDD		PP DDT
Azinphos methyl		PP - DDD		Methoxychlor
Azinphos ethyl		OP - DDT		
Carbophenothion		PP - DDT		
Coumaphos		Mirex		
		Methoxychlor		

FIGURE IX

COMPUTER PRINTOUT FOR LIST A COMPOUNDS

THRESHOLDS 1200 200 8 MAR 1975

INST 2 , METHOD 42 , FILE 19, 3:

TIME	AREA	RRT	RF	C	NAME
3.41	7.6124	.341,	.7500,	10.0000,	PHORATE SID:1
4.27	4.4668	.427,	.9880,	7.7300,	DIAZINON:2
4.60	5.9568	.460,	.7655,	7.9868,	DYFONATE:3
5.39	.1156	.539,	1.0000,	.2025,	!
5.71	.2465	.571,	1.0000,	.4318,	!
6.63	9.5539	.663,	1.0539,	17.6360,	RONNEL:4
7.64	2.8457	.764,	1.0070,	5.0190,	DURSBAN:5
8.12	5.3657	.812,	1.0421,	9.7940,	METHYL PARATHION:6
8.55	3.5236	.855,	1.4420,	8.9000,	MALATHION:7
9.03	.0847	.903,	1.0000,	.1484,	!
9.87	6.4339	.987,	.9450,	10.6488,	ETHYL PARATHION:
11.31	3.1529	1.131,	.9172,	5.0650,	DEF:
11.92	.1847	1.192,	1.0000,	.3235,	!
13.67	9.3273	1.367,	.6342,	10.3608,	ETHION:
13.98	4.7611	1.398,	1.1502,	9.5920,	CARBOPHENOTHION:
16.91	1.0771	1.691,	1.0363,	1.9551,	PHENCAPTON:
18.52	6.6851	1.852,	1.0375,	12.1480,	EPN:
19.76	13.0163	1.976,	2.5869,	58.9776,	AZINPHOS METHYL:
20.11	9.5878	2.011,	.7152,	12.0100,	PHOSALONE:
21.04	4.8905	2.104,	1.3901,	11.9074,	AZINPHOS ETHYL:
22.35	1.3280	2.235,	1.0000,	2.3260,	!
25.64	20.4416	2.564,	1.9815,	70.9440,	COUMAPHOS:

Area = Area under respective peak.

RRT = Relative retention time as compared to a standard retention time entered previously in the computer.

RF = Detector response factor (sensitivity factor) based on previously injected primary standard solutions.

C = Calculated concentration using RF of named compound.

Name = Name of standard having same retention time as unknown.

FIGURE X

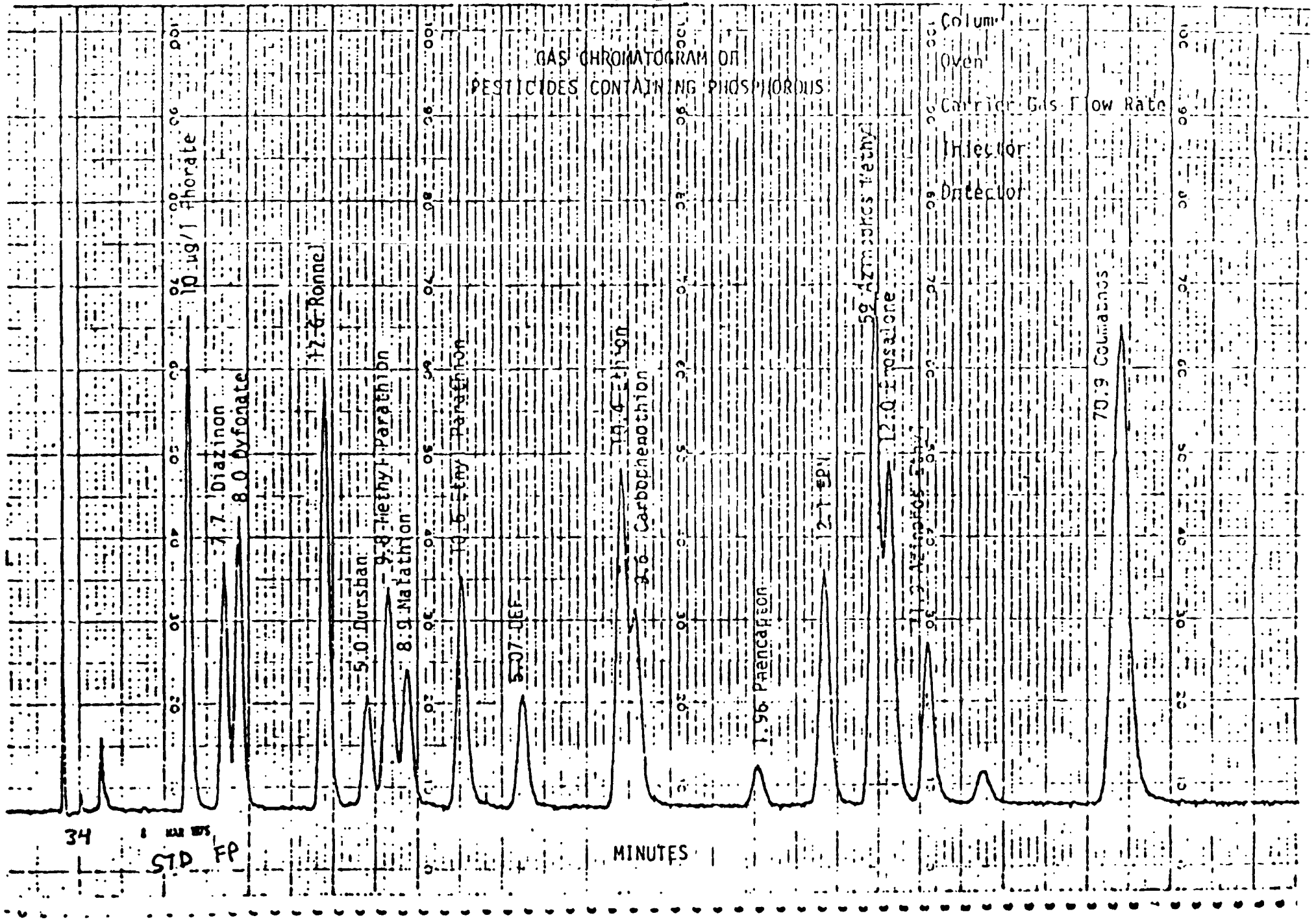

GAS CHROMATOGRAM OF
PESTICIDES CONTAINING PHOSPHOROUS
Column
Oven
Carrier Gas Flow Rate
Injector
Detector
10 µg/1 Phorate
7.7 Diazinon
8.0 Dyfonate
12.6 Ronnel
5.0 Dursban
9.8 Methyl Parathion
8.9 Malathion
10.6 Ethyl Parathion
5.07 DEF
14.4 Ethion
9.6 Carbophenothion
1.96 Phencapton
12.1 EPN
12.0 Fensulfothion
5.9 Azinphos Methyl
70.9 Columbands
34
STD FP
MINUTES

FIGURE XI

COMPUTER PRINTOUT FROM THE SE-30/OV-210 GC COLUMN

OF LIST B COMPOUNDS

THRESHOLDS 300 100

INST 4 , METHOD 54 , FILE 20 3:

TIME	AREA	RRT	RF	C	NAME
2.61	.0653	.237,	1.0000,	.0138,	!
3.14	5.4972	.285,	.3091,	.3614,	2,4-DIP:
3.86	.2740	.350,	1.0000,	.0583,	!
4.04	.0605	.366,	1.0000,	.0128,	!
4.90	.1407	.445,	1.0000,	.0299,	!
5.58	4.7011	.534,	1.0000,	1.0000,	ALDRIN STD:
6.38	9.2758	.579,	1.4430,	2.8472,	DNBP:
6.92	.2119	.628,	1.0000,	.0450,	!
7.67	7.2752	.696,	.0326,	.0504,	DCPA:
9.93	7.0278	.901,	.0508,	.0758,	ENDW I:
11.58	5.5230	1.051,	.0449,	.0556,	DIELDRIN:
13.16	6.5840	1.195,	.0534,	.0746,	ENDRIN:
14.40	20.2240	1.307,	.2802,	1.2058,	ENDW II AND CHL
15.42	11.1398	1.400,	.0476,	.1124,	NITROFEN:
17.83	3.1784	1.619,	1.0000,	.6760,	!
19.89	1.2404	1.806,	1.0000,	.2638,	!
20.85	6.4716	1.893,	.1998,	.2750,	2,4,5-TIO:
25.54	14.2963	2.319,	1.2344,		DEHP: O
33.13	.0734	3.008,	1.0000,	.0156,	!
		3.159,	.0538,		TETRADIFON: O

Dilan .2346

FIGURE XII

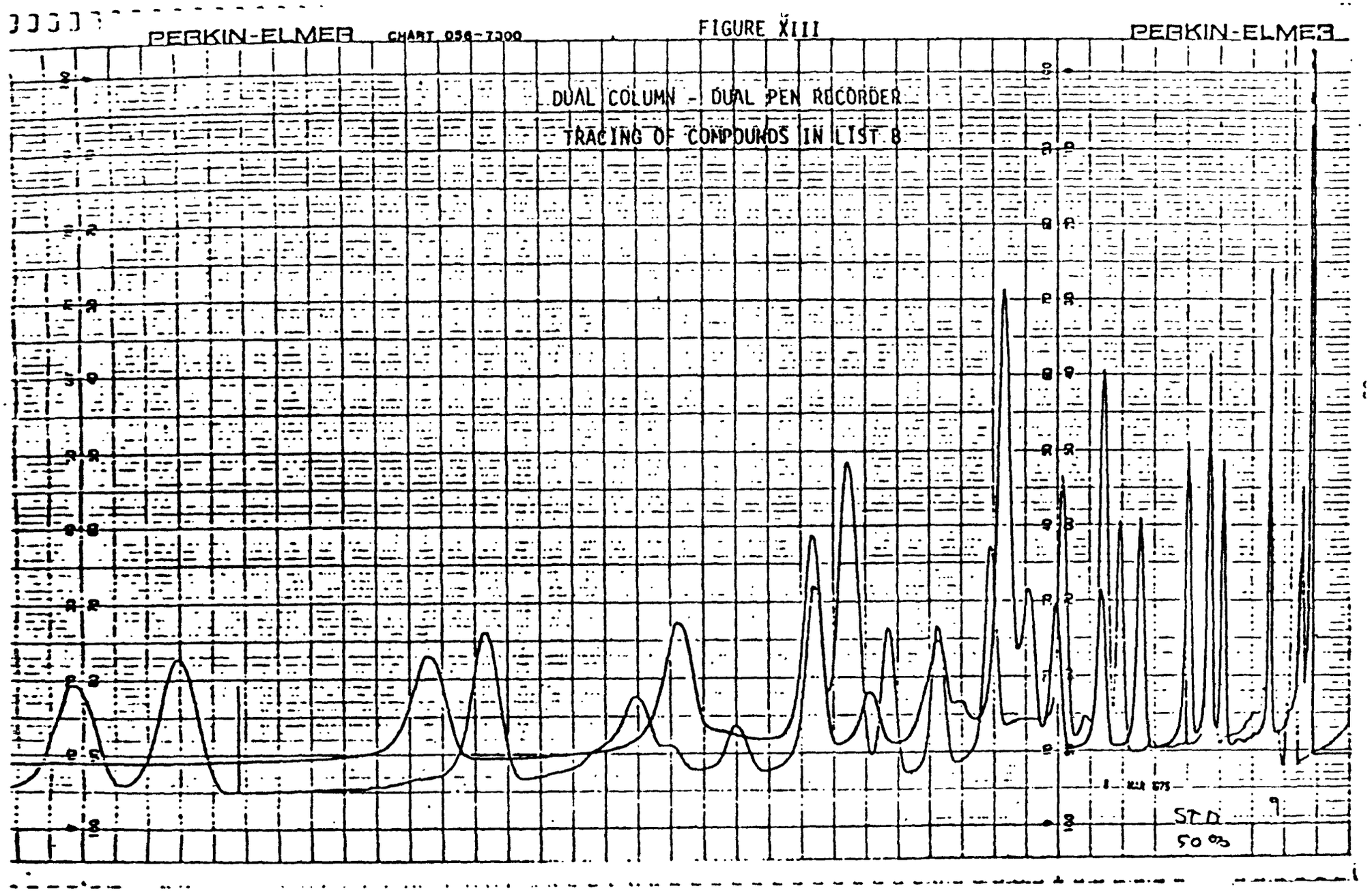
COMPUTER PRINTOUT FROM OV-17/OV-210 COLUMN OF LIST B COMPOUNDS

THRESHOLDS 300 100 MAR 1975

INST 3 , METHOD 53 , FILE 19 3:

TIME	AREA	RRT	RF	C	NAME
1.18	.0000	.106,	1.0000,	.0000,	!
1.83	8.9494	.165,	.2693,	.2877,	2,4-DIM:
2.28	.2575	.206,	1.0000,	.0253,	!
2.74	.1842	.248,	1.0000,	.0219,	!
3.27	8.3747	.296,	1.0000,	1.0000,	ALDRIN STD:
3.68	12.5740	.333,	2.4907,	3.7346,	DMPP:
4.34	11.8739	.392,	.0404,	.0572,	DCPA:
5.81	11.6019	.525,	.0443,	.0612,	ENDO I:
7.02	9.6291	.635,	.0425,	.0428,	DIELDRIN:
8.43	10.2009	.763,	.0536,	.0658,	ENDRIN:
9.29	14.3046	.840,	.0609,	1.1266,	CHLORDENEALATE:
10.07	43.5532	.911,	.0364,	.1888,	ENDO II AND METHOXYCHLOR
11.39	4.8920	1.031,	1.0000,	.5841,	!
12.09	15.6793	1.094,	.1474,	.2758,	2,4,5-TIM:
14.20	6.9388	1.285,	1.0000,	.8285,	!
16.03	25.4771	1.451,	.0638,	.1940,	DILAN:
20.12	21.8291	1.821,	2.1375,	5.5712,	DEMP:
27.80	25.3478	2.516,	.0547,	.1652,	TETRADIFON:

FIGURE XIII


PERKIN-ELMER
CHART 036-7300
PERKIN-ELMER
DUAL COLUMN - DUAL PEN RECORDER
TRACING OF COMPOUNDS IN LIST B
STD
50 ng

c) Quality Assurance For Pesticide Analysis

In order to insure validity of the analytical results, extensive analytical quality control was performed on each step in the analytical scheme. Ten percent of the samples were collected in duplicates for AQC purposes.

In the laboratory, samples were analyzed in groups. A "blank" and a "spike" were analyzed with each group to provide analytical quality control for that group. The "blanks" and "spikes" were prepared using distilled water. The "spike" contained a mixture of the 47 pesticides included in this study. The concentrations of the various compounds in the spike were in the 0 to 5 μg/l range for the phosphate pesticides and 20 to 200 ng/l range for the chlorinated pesticides. A total of ten sets of "blanks" and "spikes" were analyzed. All the AQC samples were treated in the identical manner as the real samples were treated.

In order to evaluate the automatic gas chromatographic system, standards were chromatographed at least every tenth sample. This was used to monitor any change in the retention time and/or in the response factor for each pesticide. If changes were noted, the system was recalibrated and the samples re-analyzed.

Recovery data for the "spikes" are summarized in Table XVII and relates to the reader the precision on a parameter by parameter basis. None of the blanks indicated the presence of pesticides above the detection limits. A normal percentage of the samples collected in duplicate gave identical results within the precision given in Table XX. The only serious problem is the high recovery values for phthalates which probably indicates contamination. We have reported uncorrected phthalate concentrations with quality assurance information to permit the reported data to be evaluated by the user and urge each data user to use the phthalate results with appropriate caution.

TABLE XXII

Recovery Data For

Ten Or More Samples Spiked With Pesticides

COMPOUND	µg/l Added	Average % Recovery *	Standard Deviation of % Recovery
Diazinon	6.0	9[illegible]	33
Dyfonate	6.0	81	38
Ronnel	14.0	98	33
Dursban	4.0	100	30
Methyl parathion	8.0	90	34
Malathion	8.0	88	28
Ethyl parathion	8.0	93	35
DEF	4.0	111	33
Ethion	8.0	100	41
Carbophenathion	8.0	92	32
Phencapton	2.0	107	36
EPN	10.0	92	34
Methyl azinphos	60.0	61	34
Phosalone	10.0	89	36
Ethyl azinophos	10.0	86	37
Coumaphos	60.0	95	25
2,4D,isopropyl-ester	280	36	13
Di-N-butyl-phthalate	2000	73	58

TABLE XVII (Cont'd)

COMPOUND	µg/l Added	Average % Recovery *	Standard Deviation of % Recovery
DCPA	48	70	50
Endo I	60	90	97
Dieldrin	48	78	42
Endrin	64	66	45
Chlorobenzilate	80	52	36
Endo II	80	62	65
Nitroflen	80		
2,4,-5-T-isooctyl ester	240	89	67
Dilan	200	56	47
DEHP	3200	289	200
Tetradifon	120	102	130
Treflan	24-46	98	20
Hexachloro-benzene	12-22	61	20
Lindane	20	70	28
B BHC	56-400	74	33
Aldrin	20-40	76	28
Zytron	80-98	75	22
Isodrin	23	82	29
Heptachlor Epoxide	20-24	78	42
Gamma Chlordane	20-24	103	19

TABLE XVII (Cont'd)

COMPOUND	µg/l Added	Average % Recovery *	Standard Deviation of % Recovery
O-P DDE	60	86	14
P-P DDE	60	86	21
O-P DDD	60	100	11
O-P DDT	60	93	13
P-P DDD	60	100	12
P-P DDT	60	101	22
Mirex	40	77	39
Methoxychlor	200	97	17

* Calculated as follows:

$$\text{Average \% Recovery} = \frac{\text{Original sample concentration + Spike - OSC}}{\text{Spike}}$$

We choose to use this equation because the equation recommended by EPA makes the data appear to be of a higher quality than they really are.

Since the adsorption and desorption efficiency on carbon is not known for most organic compounds, quantitative data can not be obtained and therefore only approximate flow rates need to be obtained. These are easily obtained by using a large (2-5 l) graduated cylinder and stopwatch daily during the sampling period. Using a small stream of water, the sample volume per week is usually between two and four thousand liters for clean waters that do not significantly reduce the flow by depositing foreign material in the filter. The efficiency of adsorption is known to decrease as the flow increases thus a greatly increased flow rate may actually reduce the total quantity of material adsorbed by the carbon. Carbon from the exposed filters is transferred to a soxhlet and extracted for 24 hours with hexane, 24 hours with chloroform and 24 hours with methanol. Each extract is then divided into an acidic basic and neutral fraction by standard techniques using 5% HCl, 5% NaOH and the organic solvent used to extract the solvent or toluene in the case of the methanol extract. The nine resulting extracts are dried over anhydrous sodium sulfate and concentrated to approximately two milliters before a gas chromatographic and mass spectrometric analysis is attempted. Experience to date

shows that the separations described above are usually adequate for all except the neutral chloroform fraction, which contains more compounds than can be separated using gas chromatography. High pressure liquid chromatography techniques for further purification of this fraction are being investigated. Compounds identified to date are shown below. Of significant interest is that bis-2-chloroethyl and isopropyl ethers are below detection limits in these samples.

Mt. Vernon, Indiana	Evansville, Indiana
tri-n-butyl phosphate	tri-n-butyl phosphate
butyl phthalate	butyl phthalate
dioctyl phthalate	dioctyl phthalate
tri methylbenzene	Farnesol
toluene	n-octane
ethyl benzene	methyl palmitate
xylene	xylene
methyl cyclohexane	di-phenyl ether
other hydrocarbons	other hydrocarbons

5. Metals.

a) Analytical Procedures

i) Flame Atomic-Absorption

Procedure

Standard flame atomic absorption procedures were used for the determination of calcium, chromium, copper, iron, magnesium, manganese, potassium, sodium, and zinc (3). The reported results were obtained by direct aspiration of water samples preserved with 0.5% concentrated nitric acid. Thus the listed values represent metal concentrations that were dissolved by the acid preservation, and these will be equal to or lower than total metal concentrations as defined by the US EPA analytical procedures (3).

Analytical Quality Control

The accuracy and precision of the analytical measurements were assessed by the use of duplicate samples, spike recoveries, and intralaboratory control standards. Data supporting the validity of the reported results and that are pertinent to this study are listed in Tables XVIII XIX and XX. The listings are self-explanatory and show that the determinations were performed with good accuracy and precision.

TABLE XVIII

Precision Based On Analysis of Duplicate Samples by Flame AA

Element	Conc. Range (ppm)	No. of Determinations	Std. Dev. of Diff. (ppm)
Ca Calcium	9.0 - 100.0	44	0.36
Cr Chromium	*		
Cu Copper	0.005-0.030	14	0.003
Fe Iron	0.020-0.200	20	0.007
K Potassium	0.5 - 3.0	44	0.04
Mg Magnesium	3.0 - 50.0	44	0.16
Mn Manganese	0.005-0.800	20	0.009
Na Sodium	1.5 - 20.0	44	0.27
Zn Zinc	0.005-0.200	14	0.003
Hardness (Ca & Mg)	38 - 433	44	1.1

* Insufficient data

TABLE XIX

Recovery Data For Spiked Samples Based On Flame AA

Element		Conc. Added (ppm)	% Recovery (Ave.)	No. of Determinations
Ca	Calcium	10.0	99	4
Cr	Chromium	0.25	100	4
Cu	Copper	0.25	100	6
Fe	Iron	0.25	101	3
K	Potassium	1.0	101	4
Mg	Magnesium	10.0	99	4
Mn	Manganese	0.25	95	3
Na	Sodium	10.0	98	4
Zn	Zinc	0.25	101	6

TABLE XX

Statistical Summary of Results From the Laboratory Control Standards by Flame AA

Element		Conc. Mean (ppm)	Std. Dev. (ppm)	Rel. Std. Dev., %	No. Of Determinations
Ca	Calcium	39.9	0.50	1.2	33
Cr	Chromium	0.494	0.014	2.9	15
Cu	Copper	0.530	0.019	3.6	11
Fe	Iron	1.442	0.061	4.2	12
K	Potassium	1.5	0.11	7.3	33
Mg	Magnesium	8.5	0.14	1.6	34
Mn	Manganese	0.507	0.015	2.9	12
Na	Sodium	14.2	0.47	3.3	38
Zn	Zinc	0.759	0.024	3.1	11

ii) Flameless Atomic Absorption

Procedure

Flameless atomic absorption procedures were used for the determination of arsenic, cadmium, lead, selemium, and silver. The Perkin-Elmer HGA-2000 was utilized for this purpose. This unit was mounted on a double-beam atomic absorption spectrophotometer equipped with a deuterium background corrector and interfaced to a strip chart recorder. The technique of standard additions was applied exclusively for sample analysis. At least 3 working standards and a reagent blank were prepared just prior to use from commercial atomic absorption standard concentrates using quality water and high purity acids. The instrumental setup was optimized for the appropriate working range of the element to be determined, and standards were checked for linearity prior to use. Appropriate volumes (10-50 µl) of sample and standard were injected and analyzed by previously established operating conditions. Linear working curves (peak height vs. concentration) were extrapolated graphically to zero absorbance for sample concentration results. Samples outside the linear range were diluted. In addition, acidities were closely controlled, since it has been established in this laboratory that for certain

metals, i.e. arsenic, selemium, signal response is a function of acid type and concentration.

Analytical Quality Control

Table XXI lists appropriate precision data based on the analysis of duplicate samples. These results are consistent with precision and accuracy ranges previously established for this method. Data on recoveries and laboratory control standards were not collected. The use of standard additions provides points on the analytical working curve that are in effect a measure of recovery.

TABLE XXI

Precision Based on the Analysis of Duplicates by Flameless AA

Element		Conc. Range (ppb)	Std. Dev. of Diff. (ppb)	No. of Determinations
Ag	Silver	*		
As	Arsenic	1 - 10	0.8	10
Cd	Cadmium	0.2 - 0.7	0.07	6
Pb	Lead	2 - 25	0.8	12
Se	Selemium			

* Insufficient Data

B. Results and Discussion

Table XXII summarizes the ranges of metals found in the water supplies covered by this study. The results reflect the conformance of the finished drinking waters to the proposed maximum allowable concentrations (6). One water supply approaches the maximum suggested contamination level for arsenic, and subsequent analytical data indicated that this particular source was being polluted by supplemental water originating from deep wells. In order to circumvent potential problems, the mixing ratios of these two supplies should be closely controlled or the use of the wells should be discontinued, or the efficiency of the treatment plant arsenic removal should be greatly increased.

TABLE XXII

Metal Concentration Ranges In Drinking Water

Element	Concentration Range	
	Raw Water	Finished Water mg/l
Ag Silver	<0.0002-0.0003	<0.0002-0.0003
As Arsenic	<0.001 - 0.010	<0.001 - 0.050
Ca Calcium	5.2 - 135.0	4.9 - 108.0
Cd Cadmium	<0.0002-0.012	<0.0002-0.0004
Cr Chromium	<0.005-0.017	<0.005 - 0.006
Cu Copper	<0.005-0.20	<0.005 - 0.20
Fe Iron	<0.02-3.30	<0.02 - 1.10
K Potassium	0.5-7.4	0.5 - 7.7
Mg Magnesium	1.8-62.0	0.8 - 49.0
Mn Manganese	<0.005-0.76	<0.005 - 0.35
Na Sodium	1.1-77.0	1.0 - 91.0
Pb Lead	<0.002-0.030	<0.002 - 0.020
Se Selemium	<0.005	<0.005
Zn Zinc	<0.005-0.21	<0.005 - 0.46
Hardness, (Ca, Mg)	20-492	20-431

6. Inorganic Parameters

a) Analytical Procedures

i) Ammonia - Technicon Co. method no. 154-71 W was modified to analyze samples in the range 0-1 mg/l NH_3-N. The method involves a hypochlorite oxidation of an ammonia - phenol reaction product using nitroprusside as a catalyst. The complexing reagent and wash solutions were modified by the addition of 7.6 ml/l of 10% NaOH and 1 ml/l of concentrated sulfuric acid, respectively, to compensate for the nutrient preservative.

ii) Alkalinity - Unaltered samples were titrated using an automatic Fisher Titralyzer to an electrometrically determined end-point of pH 4.5.

iii) Chloride - Technicon Co. method no. 99-70 W was modified to analyze samples in the range 0-200 mg/l chloride by the addition of a twenty-five fold dilution loop. The method involves the stoichiometric liberation of thiocyanate ion from mercuric thiocyanate to form soluble but unionized mercuric chloride. The free thiocyanate reacts with ferric ion to form ferric thiocyanate proportional to the original chloride concentration.

iv) Chemical Oxygen Demand (COD) - The Central Regional Laboratory semi-automated micro method was used to analyze the drinking water samples for COD. Two and one-half ml of sample, 3.5 ml of sulfuric acid - silver sulfate solution and 2.5 ml of potassium dichromate solution are added to 16 x 100 mm borosilicate screw-top test tubes. The tubes are sealed with a teflon

lined cap and then heated in an oven at 150°C for 2 hours. The amount of Cr(III) produced by the oxidation of the sample is proportional to the COD of the sample. The appearance of Cr(III) is measured at 600 nm with Technicon AA II equipment at 40 samples per hour. The method is described in detail in Appendix II, which is a manuscript that will appear in the July, 1975, issue of Analytical Chemistry.

v) Cyanide - Technicon method no. 315-74W for cyanide analysis was modified to improve sensitivity to 100 μg/l full scale. The improvement was accomplished by addition of a large diameter 13-turn coil to the manifold just before the colorimeter. The method involves an ultra-violet digestion and distillation from acidic solution to separate the cyanide from the sample matrix. Cyanide is converted to cyanogen chloride by reaction with chloramine-T which subsequently reacts with pyridine and barbituric acid to give a red colored complex.

vi) Dissolved and Suspended Solids - The CRL micro technique was used to analyze the drinking water samples for the residue parameters. Ten ml of sample were filtered through a tared nuclepore filter and the residue weighed to the nearest microgram to determine suspended solids. One hundred microliters of filtrate was evaporated on 12 mm aluminum pans and the residue weighed to the nearest micro-

gram to determine dissolved solids. A manuscript, submitted for publication, describing the methods in detail is attached as Appendix III.

vii) Fluoride - The EPA electrode method ("Manual of Methods for Chemical Analysis of Water and Wastes", p. 65, 1974) for fluoride was used without modification.

viii) Mercury - The CRL automated method was used for mercury analysis. The method consists of a persulfate oxidation followed by reduction with stannous chloride using hydroxylamine hydrochloride to reduce any residual chlorine present. The mercury is detected by passing it through a 22 cm cell mounted in a dual-wavelength spectrophotometer. A manuscript, submitted for publication, describing the method is attached as Appendix IV.

ix) Nitrate plus Nitrite - Technicon Co. method no. 100 - 70 W was modified by the addition of a 5 fold dilution loop to analyze samples in the range of 0 - 5 mg/k NO_3 + NO_2-N. In addition, the ammonium chloride buffer and wash solutions were modified by adding 11.5 ml/l of 10% NaOH and 1 ml/l of concentrated sulfuric acid, respectively, to compensate for the nutrient preservative.. Nitrate plus nitrite is determined by reducing the nitrate to nitrite with a copper-cadmium column. The nitrite ion then reacts with sulfanilamide at a low pH to form a diazo compound. This compound then couples with N-1-naph-thylethylene diamine dihydrochloride to form a reddish - purple azo dye which is analyzed at 520 nm.

x) Nitrite - Technicon method no. 102-70 X was used without modification to analyze samples for nitrite. The analytical method is the same as for nitrate plus nitrite except that the copper-cadium column is deleted.

xi) pH - the pH of the drinking water samples was measured with a pH meter equipped with a combination glass-reference electrode.

xii) Phenolics - Technicon method no. 127 - 71 W for analysis of phenolics was modified for samples in the range 0-200 mg/l. The method involves the distillation of phenolics and the subsequent reaction of the distillate with alkaline ferricyanide and 4 - aminoantipyrene to form a red complex which is measured at 505 nm.

xiii) Silica - Technicon Co. method no. 105 71 W was modified by cutting the sample volume in half to analyze samples for silica in the range 0-20 mg/l. This procedure for the determination of soluble silicates is based on the reduction of a silicomolybdate complex in acidic solution to "molybdenum blue" by ascorbic acid.

xiv) Specific Conductance - The specific conductivities were measured with a Radiometer CDM3 conductivity meter. The meter is essentially an ohmmeter, calibrated in reciprocal ohms. A built-in oscillator applies an ac voltage of suitable frequency to the electrodes to avoid false readings from the polarization of the solution.

xv) Sulfate - Technicon Co. method no. 118 - 71 W was used for sulfate analyses. The sample containing sulfate is passed through a cation-exchange column to remove interferences and then reacted with barium chloride and methylthymol blue. Barium chloride and methylthymol blue are added in equal molar amounts so the excess methylthymol blue corresponds to the sulfate concentration.

xvi) Total Phosphorus and Kjeldahl Nitrogen - The CRL methods were used for the analysis of TP and TKN. Ten ml of sample were mixed with 2 ml of the solution described in sections 6.2 and 6.3 of the 1974 EPA Methods Manual for TKN.[3] The solution was evaporated and then digested at 370°C for 1/2 hour. The digestate was cooled and then diluted to 10 ml with distilled water. The resulting solution was analyzed for phosphorus by Technicon Co. method no. 155 - 71 W modified as follows: Five grams per liter of sodium chloride was added to the manifold water line to complex the mercury catalyst and avoid its reduction. Nitrogen was analyzed as ammonia by the method described in paragraph 1. In addition, a five-fold dilution loop with 25 ml of 10 N NaOH per liter was used for both methods. The sampler wash solution consisted of 35 ml of concentrated sulfuric acid per liter. A manuscript describing these methods in detail is being prepared.

Quality Assurance Procedures for Inorganic Parameters.

The accuracy and precision of the analytical data were assessed by the use of daily instrument calibration and the analyses of duplicate samples and intralaboratory quality control standards. The precision and detection limit data in Table XXIII show that all of the methods used (with the exception of phenolics) are much more sensitive than necessary when compared to the drinking water quality standards (Table XXIII).

SUMMARY

The Region V Drinking Water Study has satisfied most of the goals of the project. It has provided the most complete list of parameter concentration values yet reported for so large a group of water supplies. These values were from samples collected approximately two months after the Safe Drinking Water Act[6] became law and therefore they can be used as baseline concentrations from which the effects of the Act can be measured. The study clearly supports the conclusion drawn by Bellar & Lichtenberg[2] that the chlorination water treatment process produces chloroform in finished drinking waters. It also provides experimental evidence of the absence of most pesticides in our drinking water supplies and where these compounds are present the concentrations are very low. It showed that the waters at Evansville, Indiana are not now as contaminated as they were a few years ago. Because we expect these results to be used for a long period of time and to be rigorously evaluated, we have made available a very limited number of copies of all data. Appendix V is a complete listing of the field sheets as they were received and Appendix VI is a complete set of analytical results. Generally these appendices will not accompany this report.

TABLE XXIII

SUMMARY OF QUALITY ASSURANCE DATA FOR INORGANIC PARAMETERS[a]

PARAMETER	PRECISION[b]	DETECTION LIMIT[c]
Ammonia - N	0.0061	0.010
Alkalinity - $CaCO_3$	0.9	10
Chloride	1.0	2
Chemical Oxygen Demand	1.4	3
Cyanide	0.0010	0.002
Dissolved Solids	19.8	40
Fluoride	0.025	0.1
Mercury	0.00005	0.0001
Nitrate & Nitrite - N	0.019	0.03
Nitrite - N	0.0007	0.005
pH	0.04	0.1
Phenolics	0.0003	0.002
Silica	0.07	0.1
Specific Conductance	2.3	5
Sulfate	1.0	3
Suspended Solids	1.7	2
Total Phosphorus - P	0.006	0.02
Total Kjeldahl Nitrogen - N	0.037	0.05

a. Expressed as mg/l, except pH (units) and specific conductance (micro siemens, µs).

b. Precision was determined from the estimated standard deviations of twenty-two duplicate samples for each parameter. $T_{est} = \sqrt{\frac{(X_1 - X_2)^2}{2N}}$

c. Detection limits were calculated as two times the standard deviation of the blank results.

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APPENDIX I

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CENTRAL REGIONAL LABORATORY

SUBJECT: Preservation and Holding Times for Nutrient and Demand Parameters

DATE: October 9, 1974

FROM: Dr. Mark Carter, Chief
Inorganic Section, CRL

TO: Dwight Ballinger, Director
MDQARL

THROUGH: Billy Fairless, Chief, Chemistry Branch, CRL
Thomas E. Yeates, Director, CRL
David A. Payne, Chief, Quality Assurance Branch, CRL

The recommended sample holding times to be appearing in the next edition of "Methods for Chemical Analysis of Water and Wastes," for some nutrient and demand parameters, have caused great concern in Region V. The Surveillance and Analysis Division has been preserving surface and wastewaters with 1 ml H_2SO_4/l of sample for ammonia, nitrate plus nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, chemical oxygen demand (COD), and total organic carbon (TOC) parameters since early 1973. All samples to be analyzed for the above parameters are shipped via ground transportation to the Central Regional Laboratory (CRL) in Chicago while maintained at ambient temperature. In only a few cases have samples been analyzed within the 24 hour holding time you are recommending for the above parameters. Typically, the holding times for sulfuric acid preserved samples have ranged from several days to approximately one month from the time of sample collection.

The CRL has been actively investigating the preservation of samples since January of this year. Although our results are preliminary we feel compelled to release the data now before critically important administrative decisions are being made. Our conclusions and recommendations which follow are based on the sample types studied. All the data we have collected are included in Attachment A.

Conclusions:

1) On the basis of our work, and data in the literature (Howe and Holley, 1969; Charpiot, 1969; Jenkins, 1965) we find no support for your recommended 24 hour holding time for ammonia, nitrate plus nitrite, Kjeldahl nitrogen, total phosphorus, and total organic carbon.

2) The recommended holding time for TOC (24 hours) is inconsistent with the 7 day holding time for chemical oxygen demand. Since the COD method inherently takes into account the oxidation state of a waste, any sample instability will be reflected in the COD <u>before</u> the TOC. In

addition, on the basis of our experimental results the recommended holding time of 7 days for COD measurement is unnecessarily stringent.

3) The recommendation of one holding time for each parameter for all sample types is unnecessarily cautious. Howe and Holley (1969) have shown that the greatest cause of sample instability is biological activity. Our work has verified this observation. The data in Attachment A shows a tremendous difference in stability between samples of high biological activity (raw sewage) and low activity (clean surface water).

Interm Recommendations For Holding Times

In all cases, the samples are assumed to be stored at room temperature. As of yet, we have not found 2 ml/l (sulfuric acid / sample) to be any more effective than 1 ml/l so the latter procedure is also assumed.

1) Ammonia - At least one week for raw sewage and one month for surface waters and industrial wastes low in biological activity.

2) Nitrate plus Nitrite - At least one month for all sample types.

3) Total Kjeldahl Nitrogen - At least one month for raw sewage. For organic nitrogen follow ammonia recommendations.

4) Total and Dissolved Phosphorus - Up to two months for all sample types.

5) COD/TOC - At least two weeks for raw sewage.

These holding times are based on preliminary data and are subject to modification pending the completion of one more study. However, they are supported by data from the literature and are much longer than yours. We request that you make available to us any analytical data or literature references that support your recommendations and hence contradict our results. We believe our preliminary data are accurate and that our interm recommendations outlined above should be accepted in Region V pending further work. We would be most happy to have your input into our one remaining preservation study and hope to discuss this matter with members of the Quality Assurance evaluation team during the visit to the CRL on October 15.

Thanks for your attention and consideration. We would appreciate a response at your earliest convenience.

Mark Carter, Ph.D.

APPENDIX II

Central Regional Laboratory
Environmental Protection Agency
Chicago, Illinois 60609
11-8-74

MICRO SEMI-AUTOMATED ANALYSIS OF SURFACE AND WASTEWATERS FOR CHEMICAL OXYGEN DEMAND

PRELIMINARY
SUBJECT TO REVISION

Andrea M. Jirka* and Mark J. Carter

*Author to whom correspondence should be addressed.

BRIEF

A micro semi-automated spectrophotometric method for determining the chemical oxygen demand of surface and wastewaters is described and compared to the standard method.

ABSTRACT

A micro sample digestion technique for the determination of chemical oxygen demand (COD) is described. An automated spectrophotometric measurement of the appearance of chromium (III) after sample digestion completes the method. Adequate sensitivity at 600 nm is achieved by using a 50 mm flowcell to measure COD values in the range 3-900 mg/l. The semi-automated method is compared to the standard method with respect to precision, accuracy, ease of analysis and comparability of data.

INTRODUCTION

The oxidation of organic and inorganic wastes in a receiving water depletes the dissolved oxygen supply, which can have a profound effect on aquatic life (1). A meaningful determination of the natural oxygen demand of wastewaters has been a problem since the previous century. The biochemical oxygen demand (BOD) test was developed to measure the natural oxygen demand of wastes under laboratory conditions similar to those found in receiving waters (2-4). The advantage of the BOD test is that it is a good indicator of the bio-degradability of a waste. The major disadvantages of the BOD test are the long time required for analysis, the poor precision and the indeterminable accuracy of the method (4,5).

In order to substantially reduce the time required to estimate the ultimate oxygen demand of a wastewater, the chemical oxygen demand (COD) test was developed (6). The addition of silver sulfate (7, 8) and mercuric sulfate (9) to the acidic dichromate digestion solution, increased the realiability of the COD test (10, 11). However, since chemical oxidation does not differentiate between biologically stable and unstable wastes, a correlation between COD and BOD values must be developed for each sample type (12).

Stenger and Van Hall reported a very rapid method for measuring the total organic carbon (TOC) content of water samples, which

can be related to oxygen demand (13). However, the advantage in being able to rapidly determine TOC values is offset by the high initial equipment cost. In addition, the informational content of the TOC analysis is less useful than that gained from the BOD or COD methods (14). The TOC test does not differentiate between compounds with the same number of carbon atoms, but which are in different stages of oxidation and hence have different oxygen demanding potentials. Since the COD and BOD tests measure the amount of oxygen required to stabilize waste samples, their values inherently reflect the original oxidation state of the chemical pollutants.

The standard COD test (4) is widely used because it provides a good balance between the value of the information gained and the speed of analysis when compared to the BOD and TOC tests (12). However, the standard method for determining COD has limitations which are not inherent in the concept of the test. The back-titration of dichromate after sample digestion is an insensitive method of detection. This lack of method sensitivity has been partially alleviated by using two different concentrations of dichromate and a relatively large sample volume. In addition, the consumption of large quantities of expensive reagents, the extensive bench space requirement of the COD hot plates which limits the number of analyses that can be performed in a day, and the difficulty of disposing of large quantities of highly acidic mercury, silver and chromium wastes, are serious problems for most industrial laboratories (15).

Recently, there has been considerable interest in simplifying the rather tedious standard COD method (16-19). Unfortunately, procedures using a much shortened digestion period or lower digestion temperatures produce results equivalent to those obtained by the standard method only for very readily oxidized wastewaters (20-22).

Bloor (23) and Johnson (24) determined the organic content of biological materials using dichromate as an oxidant and then measuring the excess dichromate spectrophotometrically. This procedure eliminated the tedious detection procedure of the standard method. The spectrophotometric procedure has been applied to the analysis of water samples in which the COD was determined by measuring the appearance of Cr (III) after manual digestion (25-27).

Several COD methods which use a spectrophotometric means of detection and automated sample digestion have also been reported. Sample digestion was accomplished using a continuous digestor (28, 29) or high temperature bath (30-32). However, Tift and Cain reported data which show that these automated procedures do not produce results equivalent to the standard method for all sample types (33). The incomparability of data was attributed to incomplete sample oxidation caused by the short digestion times in the automated methods. In addition, the higher concentration of sulfuric acid used in most automated systems requires a smaller amount of mercuric sulfate be used to avoid its precipitation in

the sample lines and flowcell. The lesser amount of mercuric sulfate caused chloride to be more of an interference in these automated methods than in the standard method.

The method reported here combines the advantages of the reliability of the standard digestion procedure (4), with the superior sensitivity and precision of an automated procedure based on the spectrophotometric measurement of Cr (III) (27). Use of the resultant micro semi-automated COD method has increased the productivity of this laboratory three-fold and reduced the consumption of very expensive reagents and the quantities of wastes twenty-fold.

EXPERIMENTAL

Apparatus. Samples were digested in Corning #9949 16x100 mm screwcap (cap #9998) culture tubes. Spectrophotometric measurements were made with the apparatus shown schematically in Figure 1. The automated system was fabricated using Technicon Corporation AutoAnalyzer II equipment consisting of a Sampler IV, Pump III, Colorimeter II, Recorder II, and single channel Digital Printer. The colorimeter was used in the direct mode and equipped with 500 nm interference filters and 50 mm flowcells. The Standard Calibrration control was set at 228 to attain 1000 mg/l COD full scale on the recorder. A glass capillary was used as a sample probe. The sampler was operated at 40 samples/hr with a 3:1, sample to wash ratio.

Wastewater samples with particulate matter were blended with a Teckmar Model SDT homogenizer before taking an aliquot for analysis. An adjustable 0-5 ml Oxford pipette with disposable polypropylene tips was used for aliquoting samples and addition of reagents.

Reagents. Unless otherwise noted, all chemicals were ACS reagent grade. All reagent water was de-ionized and distilled.

Digestion solution was prepared by adding 10.216 g of $K_2Cr_2O_7$ (dried at 105° C), 167 ml of conc H_2SO_4 and 33.3 g of $HgSO_4$ to 500 ml of water and diluting the cooled solution to 1 l.

Catalyst solution was prepared by dissolving 22 g of Ag_2SO_4 in a 9-lb bottle of conc H_2SO_4.

Sampler wash solution was 50% sulfuric acid by volume.

A stock potassium acid phthalate solution, equivalent to 10 g/l COD, was prepared by dissolving 8.500 g of a dried portion of NBS standard reference material 84 h in water and diluting to 1 l. Working standards of 25, 50, 75, 100, 250, 500 and 750 mg/l COD were prepared by diluting 2.5, 5, 7.5, 10, 25, 50 and 75 ml of stock solution to 1 l, respectively.

Procedures. It was necessary to wash all culture tubes and screw caps with 20% H_2SO_4 before their first use to prevent random contamination.

Digestion was carried out by placing 2.5 ml of sample and 1.5 ml of digestion solution in a culture tube. Three and one half ml

of catalyst solution were added carefully down the side of the culture tube so that the acid formed a layer on the bottom. The tube was capped tightly and then shaken to mix the layers. Two blanks and a set of standards were prepared in the same manner and analyzed with each sample set.

All samples, blanks and standards were heated in an oven at 150° C, which is the observed reflux temperature of 50% sulfuric acid. After two hours the tubes were removed from the oven, cooled, and placed in the Sampler IV tray.

The analytical manifold and reagents were set up as indicated in Figure 1. Two digested blanks were analyzed at the beginning of each sample set to zero the baseline. A mid-scale standard was used to calibrate the recorder and printer (34). Standards were rerun periodically during the course of an analysis run to assure that the system remained in calibration. The COD value of unknown samples was obtained by direct printout. A typical recorder trace for standards is shown in Figure 2.

RESULTS AND DISCUSSION

Sample Digestion. It has been shown that COD procedures using a shortened digestion period and/or a reduced digestion temperature do not attain the same degree of sample oxidation as the standard method (20-22, 33). Any alternate test procedure used to analyze wastewaters for COD must produce results equivalent to or better than the current standard method (35). Therefore, to insure data comparability the temperature and length of

sample digestion and concentration of reagents used in the standard method were adopted for use in the semi-automated procedure described here (4).

Since the micro colorimetric detection technique required only 2 ml of digested sample the quantities of sample and reagents used were reduced twenty-fold in comparison to the standard method (4, 11). Use of the standard COD digestion apparatus was eliminated and instead all samples, blanks and standards were digested in small screw-cap culture tubes. The potential for sample contamination from large glass surfaces was consequently reduced.

Screw caps with phenolic resin liners were found to be unacceptable since they were attacked by the digestion solution giving erroneously high COD values. Teflon-lined caps greatly reduced this problem especially if each cap was used only once. Any sample tube which leaked, as evidenced by a black residue on the outside of the tube, was discarded.

Uniform addition of reagents and improved precision was achieved by dissolving all chemicals in one of two solutions. The catalyst solution was prepared by the standard method (4). The oxidizing solution was prepared by combining potassium dichromate with mercuric sulfate and making the solution 6 N with sulfuric acid to solubilize the mercury salt. However, the mercuric sulfate was not completely soluble in the cooled, combined reaction mixture. The height of the sampler probe

was carefully adjusted so as to avoid aspirating the precipitate. Otherwise, aspiration of the particulate matter caused severe baseline noise.

Spectrophotometric Analysis. The COD of wastewater samples has been determined spectrophotometrically, after digestion, by measuring the decrease in Cr (VI) concentration at 352 (32) or 440 nm (19). Alternatively, the increase in Cr (III) concentrationhas been measured at 600 (27) or 650 nm (25). All of these authors found the spectrophotometric procedure to be easier to perform than the manual titration.

Molov and Zaleiko showed that better sensitivity could be achieved by measuring the decrease in Cr (VI) concentration than the increase in Cr (III) concentration (28). However, the precision of a method based on measuring the decrease in Cr (VI) absorbance is very dependent on the reproducibility of reagent addition. This problem was avoided and adequate sensitivity achieved by measuring the appearance of Cr (III) at 600 nm, using a 50 mm flowcell, and the scale expansion capability of the Technicon colorimeter.

In order to increase the sensitivity of the standard method, two different concentrations of oxidizing reagent are commonly used. These correspond to two levels of COD measurement, 5-50 mg/l and 50-800 mg/l (11). Moore and Walker found that the working range of the low level modification was limited by the diminished oxidation potential of the digestion solution after 50% of the dichromate was consumed (36).

Due to the adequate sensitivity of the spectrophotometric semi-automated method, only one set of reagent concentrations was necessary to cover both levels of the standard method. In order to test the linearity of the semi-automated method, standards between 500 and 1000 mg/l COD were analyzed in increments of 25 mg/l. Potassium hydrogen phthalate was chosen for use as a standard because of its stability in solution and its complete oxidation under the conditions of the COD test (4). The results, presented in Figure 3, show the colorimetric method to be linear up to 900 mg/l COD.

Due to the use of 50% sulfuric acid, the original automated manifold was constructed with acidflex tubing. However, the system exhibited very poor hydralic characteristics. This problem was aleviated by replacing the acidflex tubes with tygon pump and transmission tubing. The recorder trace in Figure 2 was undamped. The entire system was cleaned for about 1/2 hour before first use with 50% sulfuric acid to prevent severe baseline drift due to leachable organic matter. Also 1:1 dilution loop was added to the system to reduce the viscosity of the sample stream so that proper debubbling occurred in the flowcell.

Precision, Accuracy and Detection Limit. Since it was difficult to correct the semi-automated results for the small baseline drift, the working detection limit was defined as the mean bias of the blank plus two standard deviations. Eleven blank samples were analyzed to determine the detection limit. The mean value

obtained was 1 mg/l with a standard deviation of 0.8 mg/l COD. These values were used to define the detection limit at 3 mg/l COD. This number compares quite favorably with the detection limit of 5 mg/l COD reported by Moore and Walker for the low level standard COD method (36).

The relative precision of both modifications of the standard and the semi-automated COD methods was determined by performing replicate analyzes on four wastewater samples. Since the standard and semi-automated determinations were performed at different times, two similar sets of water samples were chosen so that the relative standard deviations could be meaningfully compared. The relative standard deviations of both methods for low COD concentrations, as shown in Table I, compare very closely. However, the precision of the semi-automated method at high COD concentrations was approximately seven times better than the standard method.

Adelman pointed out that one of the factors contributing to the poor precision of the standard method was the potential loss of volatile components of the wastewater samples (30). This can be caused by the heat generated by the mixing of the sample with the concentrated acid prior to reflux or during the reflux step. This problem was eliminated in the semi-automated procedure by avoiding mixing the sample and acid layers until the tube is capped and the fact that sample digestion occurs in a completely closed system.

The authors found that the ability to take a representative aliquot of a nonhomogeneous sample was the limiting component of analysis variability regardless of method. Precision data for the standard COD method determined from inter-laboratory analyses of standard-like solutions must be regarded only as a lower limit (5, 37).

The accuracy of the semi-automated method was determined by measuring the recovery of standard addition of potassium hydrogen phthalate to several types of water samples. The mean recovery from 14 water and wastewater samples, shown in Table II, was 101% with a standard deviation of 4%.

Comparison of Semi-Automated and Standard Methods. A variety of surface and wastewater samples were analyzed by both the standard and semi-automated COD methods to determine the comparability of data. These samples included raw and treated sewage, industrial, chemical and food process wastes. Results comparing the two methods are shown in Table III. Initially the largest discrepancies between methods occurred in samples which contained large quantities of particulate matter, e.g., raw sewage. Homogenizing samples of this type greatly improved the comparability of the data. Within the standard deviation of the mean ratio of results, no significant bias in COD values exists between methods.

In addition, several pure organic compounds were analyzed to determine if the semi-automated method achieved a more complete

digestion than the standard method. The experimental results and calculated maximum theoretical COD values are shown in Table IV. The semi-automated values were slightly higher than the standard method results indicating that the former method achieved a more complete sample digestion. The difference could also be due to the fact that no volatile material can excape from the sealed tubes during oxidation in the semi-automated method, while in the standard method, volatile material may escape before sample oxidation is complete.

Interferences. One of the major problems encountered in other automated COD methods is the inability of the techniques to compensate for the positive interference caused by the oxidation of chloride present in wastewater samples (28-32). The standard procedure for eliminating the chloride interference is the addition of mercuric sulfate to form a complex and prevent its oxidation (4, 9). Experiments performed by this laboratory indicate that no interference results up to 2000 mg/l chloride when the standard procedure is used (9).

In other automated techniques, the high acid concentration reduces the solubility of $HgSO_4$ so that the quantity of Hg(II) in solution is not sufficient to complex the same amount of chloride as in the standard method (28-32).

In the semi-automated COD method, the ratio of $HgSO_4$ to sample volume is identical to the standard method. Standards of 500 mg/l COD were spiked with varying amounts of chloride in

order to determine the limiting concentration at which the interference was significant. The results, shown in Figure 4, indicate that chloride does not interfere below 1000 mg/l. Above this concentration, some precipitation occurs when the dilution water combines with the sample stream in the automated system, which results in a noisy recorder trace. If it is necessary to routinely analyze samples containing between 1000 and 2000 mg/l chloride, the dilution loop can be removed. Air spikes will then appear at the beginning and end of each sample peak, due to improper debubbling, but the results are not affected.

Any chemical species remaining after sample digestion, which absorb at 600 nm, cause a positive interference in the semi-automated method. Since almost all organic matter is digested by the COD technique the possible interference from organic compounds was not considered (6, 8, 36).

The presence of Cr (III) in a water sample gives an apparent COD of 1.39 times the concentration of chromium. Also, a potential interference from iron was investigated by spiking standards of 500 mg/l COD with increasing amounts of ferric iron. The results, presented in Figure 5, show no apparent COD below 5 g/l Fe. The positive bias caused by high concentrations of interfering substances is routinely eliminated by diluting samples prior to analysis or correcting the reported COD values from independent determinations of chromium, iron and chloride.

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The mention of trade names or commercial products does not constitute endorsement or recommendation for use by the Central Regional Laboratory or the Environmental Protection Agency.

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TABLE I. COMPARISON OF THE PRECISION OF THE SEMI-AUTOMATED AND STANDARD CHEMICAL OXYGEN DEMAND METHODS

METHOD	SAMPLE NO.	NO. OF DETNS.	[COD], MG/L MEAN	RANGE	STD. DEV.	REL. STD. DEV, %
MANUAL	1	11	40	4	1.4	3.5
	2	10	230	90	28.0	12.2
SEMI-AUTOMATED	3	11	26	4	1.3	5.0
	4	10	270	12	4.6	1.7

TABLE II. RECOVERIES OF POTASSIUM HYDROGEN PHTHALATE ADDED TO WATER SAMPLES WITH SEMI-AUTOMATED METHOD

SAMPLE SOURCE	[COD], MG/L			RECOVERY, %
	SAMPLE	KHP ADDED	SAMPLE +KHP	
ORGANICS INDUSTRY EFFLUENT	13	200	217	102
RAW SEWAGE	164	200	370	103
RIVER WATER	31	100	122	91
HARBOR WATER	16	200	224	104
INDUSTRIAL COOLING WATER	65	200	262	99
RIVER WATER	15	100	116	101
RIVER WATER	28	100	124	96
CHANNEL WATER NEAR DREDGING	52	100	152	100
INDUSTRIAL DISCHARGE	30	100	131	101
INDUSTRIAL DISCHARGE	16	100	116	100
TREATED SEWAGE	40	100	144	104
RECEIVING WATER OF SEWAGE	25	100	127	102
TREATED SEWAGE	14	100	124	110
STEEL MILL EFFLUENT	14	100	112	98
MEAN				101
STANDARD DEVIATION				4

TABLE III. COMPARISON OF SEMI-AUTOMATED AND STANDARD CHEMICAL OXYGEN DEMAND METHODS

SAMPLE SOURCE	[COD], mg/l STANDARD METHOD (S)	SEMI-AUTOMATED METHOD (A)	S/A X 100
RAW SEWAGE	420	421	99.8
PAPER MILL COOLING WATER	39	46	84.8
STEEL MILL WASTE	270	273	98.9
TREATED SEWAGE	50	51	98.0
PRIMARY TREATED SEWAGE	63	51	123.5[A]
BOILER BLOWDOWN	180	133	[illegible]
POTTERY SHOP WASTE	140	156	89.7
CREEK DOWNSTREAM FROM POTTERY SHOP	94	99	94.9
PRIMARY TREATED SEWAGE	90	87	103.4
PAPER MILL WASTE	450	464	97.0
RAW SEWAGE	170	164	103.7
TREATED SEWAGE	36	35	102.9
TREATED SEWAGE	27	27	100.0
TREATED SEWAGE	21	22	95.5
ORGANIC CHEMICAL PLANT WASTE	270	275	98.2
STEEL MILL WASTE	90	89	101.1
CHEMICAL PLANT WASTE	9800	9200	106.5
RAW SEWAGE	150	160	93.8
CHEMICAL PLANT EFFLUENT	1700	1500	100.0
DISTILLERY	[illegible]	[illegible]	92.2
RAW SEWAGE	450	450	100.0
MEAN			98.0
STANDARD DEVIATION			5.2

[A] RESULT REJECTED FOR CALCULATION OF MEAN AND STANDARD DEVIATION.

TABLE IV. COMPARISON OF CHEMICAL OXYGEN DEMAND METHODS ON ORGANIC COMPOUNDS

COMPOUND	[COD], MG/L			
	THEORETICAL	STANDARD METHOD (S)	SEMI-AUTOMATED METHOD (A)	S/A X 100
PHENOL	238	230	240	95.8
SODIUM ACETATE	470	450	462	97.4
ACETONE	221	200	207	96.6
ETHANOL	197	170	180	94.4
DEXTROSE	107	100	113	88.8
METHANOL	150	130	139	93.5
OXALIC ACID	127	120	128	93.8
SODIUM CITRATE	490	470	496	94.8
GLUTAMIC ACID	98	90	98	91.8
GLYCINE	64	60	62	96.8
BENZOIC ACID	197	190	202	94.1
PYRIDINE	223	< 5	< 3	—[A]
3-PICOLINE	239	64	77	83.1[A]
TETRAHYDROFURAN	244	250	242	103.3
MEAN				95.0
STANDARD DEVIATION				3.5

[A] RESULTS REJECTED FOR CALCULATION OF MEAN AND STANDARD DEVIATION.

TITLES FOR FIGURES.

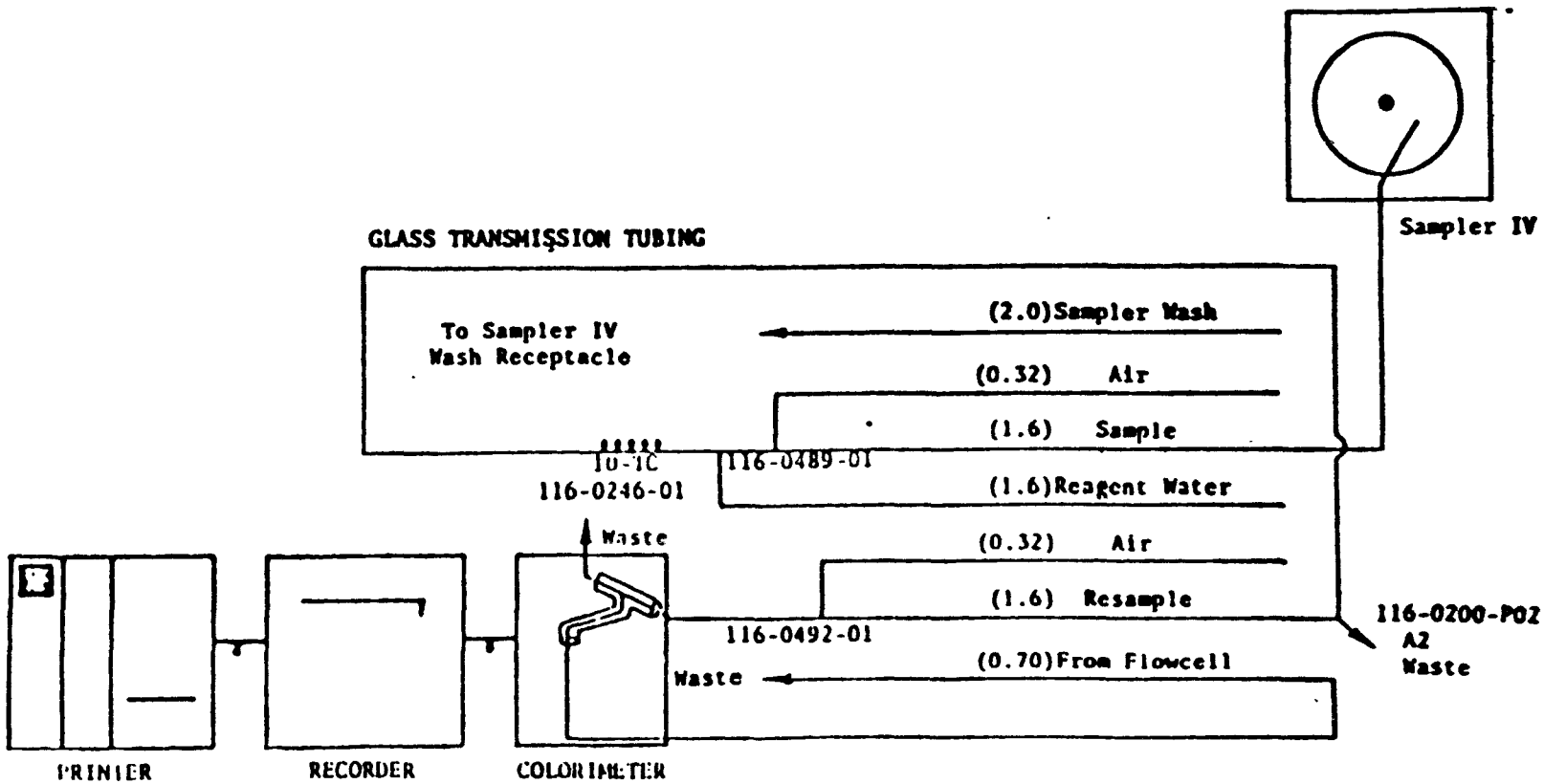
FIGURE 1. AUTOMATED SYSTEM FOR CHEMICAL OXYGEN DEMAND. NUMBERS IN PARENTHESES CORRESPOND TO THE FLOW RATE OF THE PUMPTUBES IN ML/MIN. NUMBERS ADJACENT TO GLASS COILS AND FITTINGS ARE TECHNICON CORP. PART NUMBERS.

FIGURE 2. RECORDER TRACE FOR CHEMICAL OXYGEN DEMAND OF POTASSIUM HYDROGEN PHTHALATE STANDARDS ANALYZED IN DUPLICATE.

FIGURE 3. CALIBRATION CURVE FOR AUTOMATED CHEMICAL OXYGEN DEMAND. EACH POINT IS THE AVERAGE OF DUPLICATE DETERMINATIONS.

FIGURE 4. PLOT OF APPARENT CHEMICAL OXYGEN DEMAND CAUSED BY THE OXIDATION OF CHLORIDE. DATA DETERMINED BY ADDING THE INDICATED AMOUNTS OF CHLORIDE TO A 500 MG/L COD POTASSIUM HYDROGEN PHTHALATE STANDARD.

FIGURE 5. PLOT OF APPARENT CHEMICAL OXYGEN DEMAND CAUSED BY THE ABSORBANCE AT 600 NM FROM FERRIC IRON IN SOLUTION. DATA DETERMINED BY ADDING THE INDICATED AMOUNTS OF IRON TO A 500 MG/L COD POTASSIUM HYDROGEN PHTHALATE STANDARD.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GLASS TRANSMISSION TUBING
To Sampler IV
Wash Receptacle
(2.0)Sampler Wash
(0.32) Air
(1.6) Sample
116-0489-01
(1.6)Reagent Water
116-0246-01
Waste
(0.32) Air
(1.6) Resample
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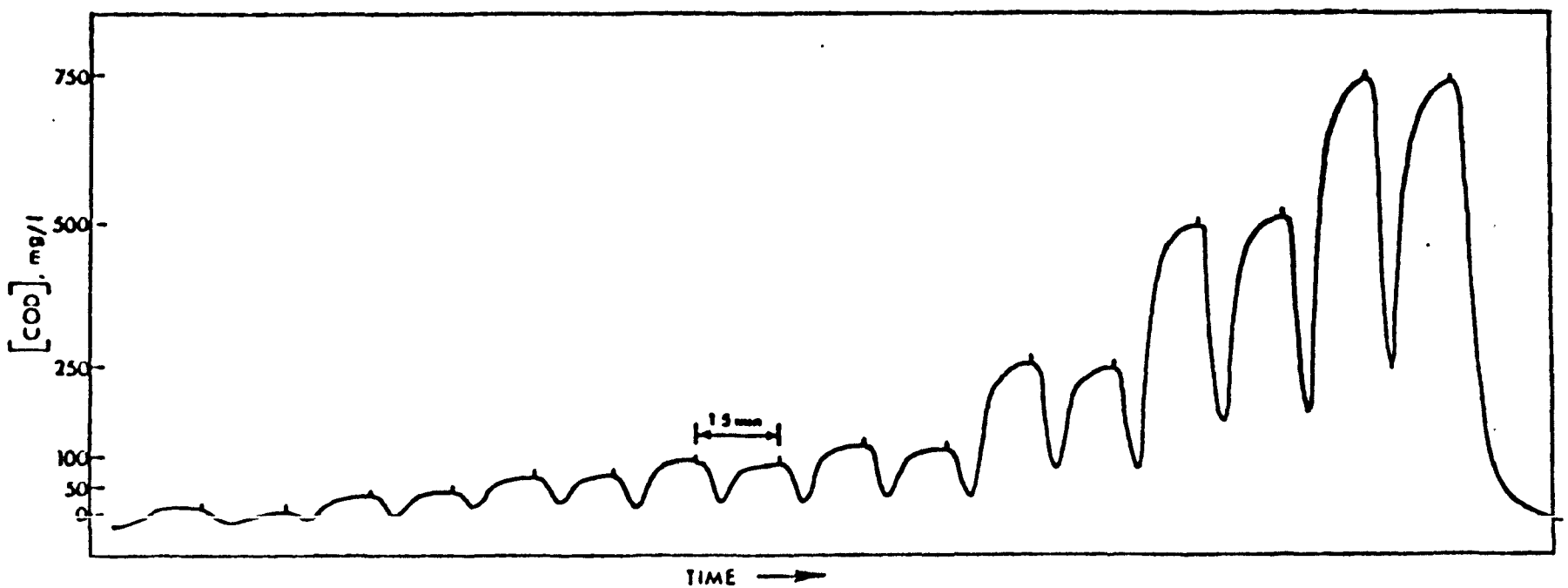
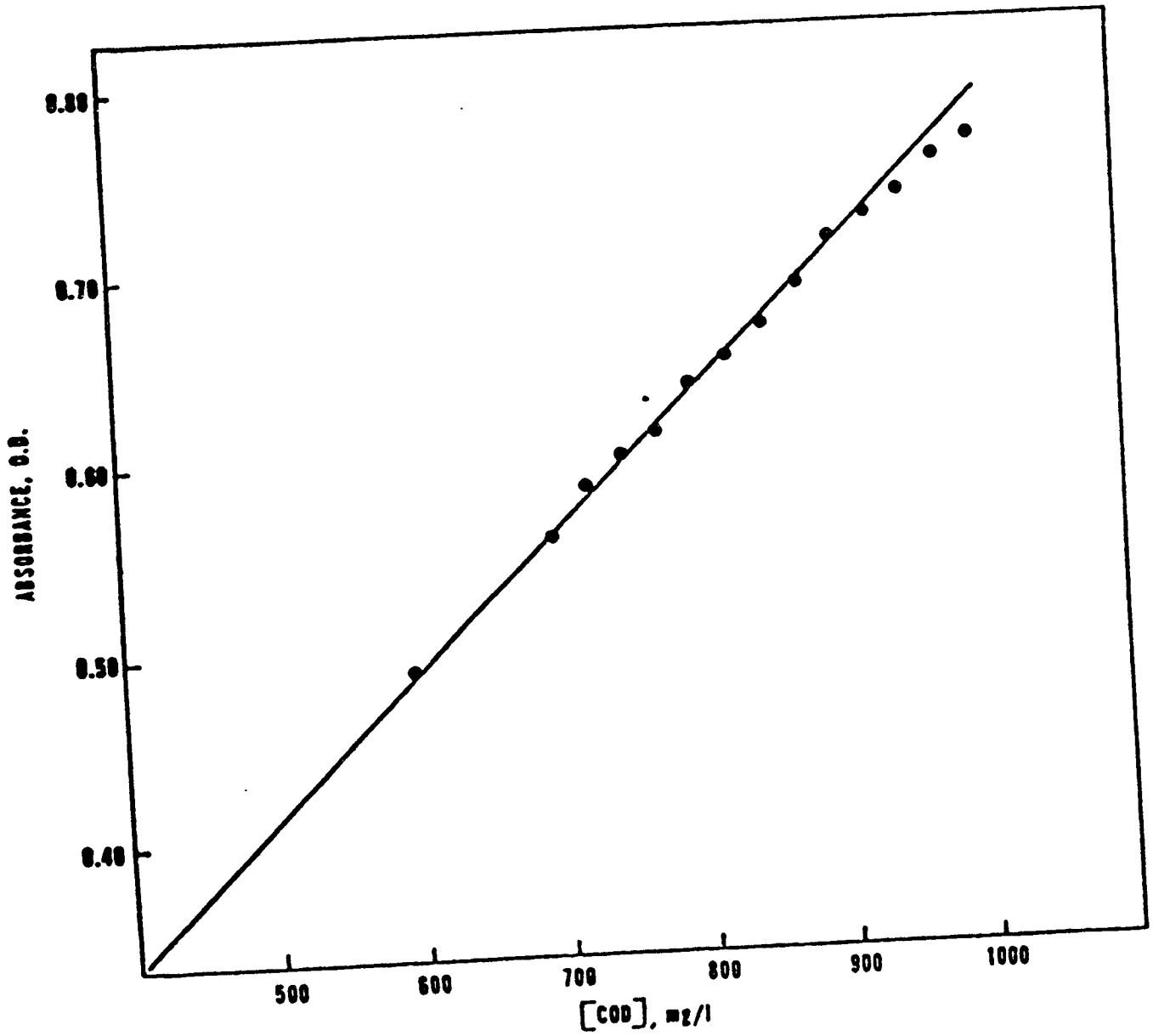
Waste
116-0200-P02
A2
Waste
PRINTER
RECORDER
COLORIMETER


750
500
250
100
50
[COD], mg/l
1.5 min
TIME


0.80
0.70
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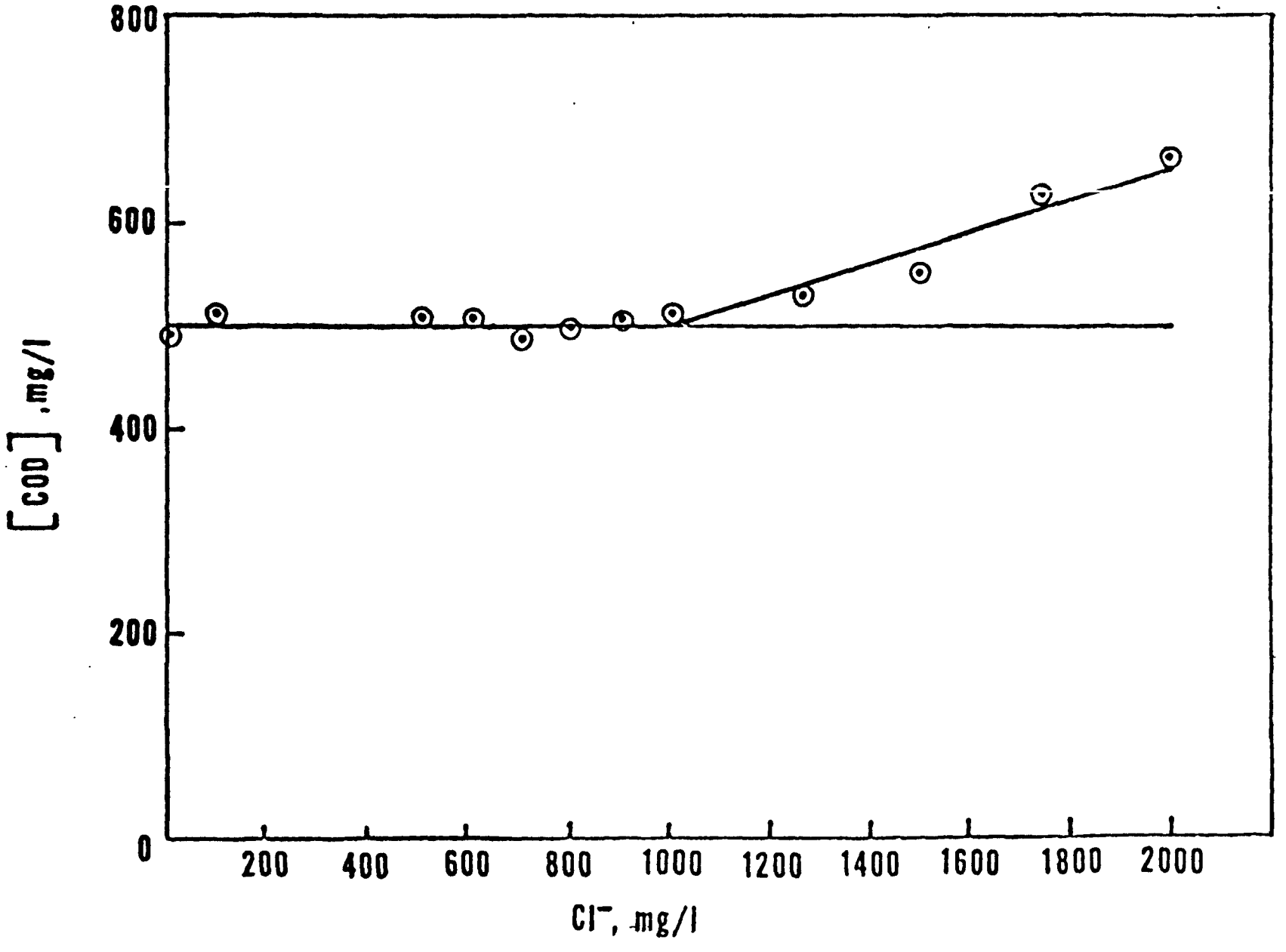
0.50
0.40
ABSORBANCE, O.D.
500
600
700
800
900
1000
[COD], mg/l


800
600
400
200
0
[COD], mg/l
200
400
600
800
1000
1200
1400
1600
1800
2000
Cl⁻, mg/l

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Environmental Protection Agency
Chicago, Illinois 60609
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MICRO SEMI-AUTOMATED ANALYSIS OF SURFACE AND WASTEWATERS FOR CHEMICAL OXYGEN DEMAND

PRELIMINARY
SUBJECT TO REVISION

Andrea M. Jirka* and Mark J. Carter

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BRIEF

A micro semi-automated spectrophotometric method for determining the chemical oxygen demand of surface and wastewaters is described and compared to the standard method.

ABSTRACT

A micro sample digestion technique for the determination of chemical oxygen demand (COD) is described. An automated spectrophotometric measurement of the appearance of chromium (III) after sample digestion completes the method. Adequate sensitivity at 600 nm is achieved by using a 50 mm flowcell to measure COD values in the range 3-900 mg/l. The semi-automated method is compared to the standard method with respect to precision, accuracy, ease of analysis and comparability of data.

INTRODUCTION

The oxidation of organic and inorganic wastes in a receiving water depletes the dissolved oxygen supply, which can have a profound effect on aquatic life (1). A meaningful determination of the natural oxygen demand of wastewaters has been a problem since the previous century. The biochemical oxygen demand (BOD) test was developed to measure the natural oxygen demand of wastes under laboratory conditions similar to those found in receiving waters (2-4). The advantage of the BOD test is that it is a good indicator of the bio-degradability of a waste. The major disadvantages of the BOD test are the long time required for analysis, the poor precision and the indeterminable accuracy of the method (4,5).

In order to substantially reduce the time required to estimate the ultimate oxygen demand of a wastewater, the chemical oxygen demand (COD) test was developed (6). The addition of silver sulfate (7, 8) and mercuric sulfate (9) to the acidic dichromate digestion solution, increased the realiability of the COD test (10, 11). However, since chemical oxidation does not differentiate between biologically stable and unstable wastes, a correlation between COD and BOD values must be developed for each sample type (12).

Stenger and Van Hall reported a very rapid method for measuring the total organic carbon (TOC) content of water samples, which

can be related to oxygen demand (13). However, the advantage in being able to rapidly determine TOC values is offset by the high initial equipment cost. In addition, the informational content of the TOC analysis is less useful than that gained from the BOD or COD methods (14). The TOC test does not differentiate between compounds with the same number of carbon atoms, but which are in different stages of oxidation and hence have different oxygen demanding potentials. Since the COD and BOD tests measure the amount of oxygen required to stabilize waste samples, their values inherently reflect the original oxidation state of the chemical pollutants.

The standard COD test (4) is widely used because it provides a good balance between the value of the information gained and the speed of analysis when compared to the BOD and TOC tests (12). However, the standard method for determining COD has limitations which are not inherent in the concept of the test. The back-titration of dichromate after sample digestion is an insensitive method of detection. This lack of method sensitivity has been partially alleviated by using two different concentrations of dichromate and a relatively large sample volume. In addition, the consumption of large quantities of expensive reagents, the extensive bench space requirement of the COD hot plates which limits the number of analyses that can be performed in a day, and the difficulty of disposing of large quantities of highly acidic mercury, silver and chromium wastes, are serious problems for most industrial laboratories (15).

Recently, there has been considerable interest in simplifying the rather tedious standard COD method (16-19). Unfortunately, procedures using a much shortened digestion period or lower digestion temperatures produce results equivalent to those obtained by the standard method only for very readily oxidized wastewaters (20-22).

Bloor (23) and Johnson (24) determined the organic content of biological materials using dichromate as an oxidant and then measuring the excess dichromate spectrophotometrically. This procedure eliminated the tedious detection procedure of the standard method. The spectrophotometric procedure has been applied to the analysis of water samples in which the COD was determined by measuring the appearance of Cr (III) after manual digestion (25-27).

Several COD methods which use a spectrophotometric means of detection and automated sample digestion have also been reported. Sample digestion was accomplished using a continuous digestor (28, 29) or high temperature bath (30-32). However, Tift and Cain reported data which show that these automated procedures do not produce results equivalent to the standard method for all sample types (33). The incomparability of data was attributed to incomplete sample oxidation caused by the short digestion times in the automated methods. In addition, the higher concentration of sulfuric acid used in most automated systems requires a smaller amount of mercuric sulfate be used to avoid its precipitation in

the sample lines and flowcell. The lesser amount of mercuric sulfate caused chloride to be more of an interference in these automated methods than in the standard method.

The method reported here combines the advantages of the reliability of the standard digestion procedure (4), with the superior sensitivity and precision of an automated procedure based on the spectrophotometric measurement of Cr (III) (27). Use of the resultant micro semi-automated COD method has increased the productivity of this laboratory three-fold and reduced the consumption of very expensive reagents and the quantities of wastes twenty-fold.

EXPERIMENTAL

Apparatus. Samples were digested in Corning #9949 16x100 mm screwcap (cap #9998) culture tubes. Spectrophotometric measurements were made with the apparatus shown schematically in Figure 1. The automated system was fabricated using Technicon Corporation AutoAnalyzer II equipment consisting of a Sampler IV, Pump III, Colorimeter II, Recorder II, and single channel Digital Printer. The colorimeter was used in the direct mode and equipped with 600 nm interference filters and 50 mm flowcells. The Standard Calibration control was set at 228 to attain 1000 mg/l COD full scale on the recorder. A glass capillary was used as a sample probe. The sampler was operated at 40 samples/hr with a 3:1, sample to wash ratio.

Wastewater samples with particulate matter were blended with a Teckmar Model SDT homogenizer before taking an aliquot for analysis. An adjustable 0-5 ml Oxford pipette with disposable polypropylene tips was used for aliquoting samples and addition of reagents.

Reagents. Unless otherwise noted, all chemicals were ACS reagent grade. All reagent water was de-ionized and distilled.

Digestion solution was prepared by adding 10.216 g of $K_2Cr_2O_7$ (dried at 105° C), 167 ml of conc H_2SO_4 and 33.3 g of $HgSO_4$ to 500 ml of water and diluting the cooled solution to 1 l.

Catalyst solution was prepared by dissolving 22 g of Ag_2SO_4 in a 9-lb bottle of conc H_2SO_4.

Sampler wash solution was 50% sulfuric acid by volume.

A stock potassium acid phthalate solution, equivalent to 10 g/l COD, was prepared by dissolving 8.500 g of a dried portion of NBS standard reference material 84 h in water and diluting to 1 l. Working standards of 25, 50, 75, 100, 250, 500 and 750 mg/l COD were prepared by diluting 2.5, 5, 7.5, 10, 25, 50 and 75 ml of stock solution to 1 l, respectively.

Procedures. It was necessary to wash all culture tubes and screw caps with 20% H_2SO_4 before their first use to prevent random contamination.

Digestion was carried out by placing 2.5 ml of sample and 1.5 ml of digestion solution in a culture tube. Three and one half ml

of catalyst solution were added carefully down the side of the culture tube so that the acid formed a layer on the bottom. The tube was capped tightly and then shaken to mix the layers. Two blanks and a set of standards were prepared in the same manner and analyzed with each sample set.

All samples, blanks and standards were heated in an oven at 150° C, which is the observed reflux temperature of 50% sulfuric acid. After two hours the tubes were removed from the oven, cooled, and placed in the Sampler IV tray.

The analytical manifold and reagents were set up as indicated in Figure 1. Two digested blanks were analyzed at the beginning of each sample set to zero the baseline. A mid-scale standard was used to calibrate the recorder and printer (34). Standards were rerun periodically during the course of an analysis run to assure that the system remained in calibration. The COD value of unknown samples was obtained by direct printout. A typical recorder trace for standards is shown in Figure 2.

RESULTS AND DISCUSSION

Sample Digestion. It has been shown that COD procedures using a shortened digestion period and/or a reduced digestion temperature do not attain the same degree of sample oxidation as the standard method (20-22, 33). Any alternate test procedure used to analyze wastewaters for COD must produce results equivalent to or better than the current standard method (35). Therefore, to insure data comparability the temperature and length of

sample digestion and concentration of reagents used in the standard method were adopted for use in the semi-automated procedure described here (4).

Since the micro colorimetric detection technique required only 2 ml of digested sample the quantities of sample and reagents used were reduced twenty-fold in comparison to the standard method (4, 11). Use of the standard COD digestion apparatus was eliminated and instead all samples, blanks and standards were digested in small screw-cap culture tubes. The potential for sample contamination from large glass surfaces was consequently reduced.

Screw caps with phenolic resin liners were found to be unacceptable since they were attacked by the digestion solution giving erroneously high COD values. Teflon-lined caps greatly reduced this problem especially if each cap was used only once. Any sample tube which leaked, as evidenced by a black residue on the outside of the tube, was discarded.

Uniform addition of reagents and improved precision was achieved by dissolving all chemicals in one of two solutions. The catalyst solution was prepared by the standard method (4). The oxidizing solution was prepared by combining potassium dichromate with mercuric sulfate and making the solution 6 N with sulfuric acid to solubilize the mercury salt. However, the mercuric sulfate was not completely soluble in the cooled, combined reaction mixture. The height of the sampler probe

was carefully adjusted so as to avoid aspirating the precipitate. Otherwise, aspiration of the particulate matter caused severe baseline noise.

Spectrophotometric Analysis. The COD of wastewater samples has been determined spectrophotometrically, after digestion, by measuring the decrease in Cr (VI) concentration at 352 (32) or 440 nm (19). Alternatively, the increase in Cr (III) concentrationhas been measured at 600 (27) or 650 nm (25). All of these authors found the spectrophotometric procedure to be easier to perform than the manual titration.

Molov and Zaleiko showed that better sensitivity could be achieved by measuring the decrease in Cr (VI) concentration than the increase in Cr (III) concentration (28). However, the precision of a method based on measuring the decrease in Cr (VI) absorbance is very dependent on the reproducibility of reagent addition. This problem was avoided and adequate sensitivity achieved by measuring the appearance of Cr (III) at 600 nm, using a 50 mm flowcell, and the scale expansion capability of the Technicon colorimeter.

In order to increase the sensitivity of the standard method, two different concentrations of oxidizing reagent are commonly used. These correspond to two levels of COD measurement, 5-50 mg/l and 50-800 mg/l (11). Moore and Walker found that the working range of the low level modification was limited by the diminished oxidation potential of the digestion solution after 50% of the dichromate was consumed (36).

Due to the adequate sensitivity of the spectrophotometric semi-automated method, only one set of reagent concentrations was necessary to cover both levels of the standard method. In order to test the linearity of the semi-automated method, standards between 500 and 1000 mg/l COD were analyzed in increments of 25 mg/l. Potassium hydrogen phthalate was chosen for use as a standard because of its stability in solution and its complete oxidation under the conditions of the COD test (4). The results, presented in Figure 3, show the colorimetric method to be linear up to 900 mg/l COD.

Due to the use of 50% sulfuric acid, the original automated manifold was constructed with acidflex tubing. However, the system exhibited very poor hydralic characteristics. This problem was aleviated by replacing the acidflex tubes with tygon pump and transmission tubing. The recorder trace in Figure 2 was undamped. The entire system was cleaned for about 1/2 hour before first use with 50% sulfuric acid to prevent severe baseline drift due to leachable organic matter. Also 1:1 dilution loop was added to the system to reduce the viscosity of the sample stream so that proper debubbling occurred in the flowcell.

Precision, Accuracy and Detection Limit. Since it was difficult to correct the semi-automated results for the small baseline drift, the working detection limit was defined as the mean bias of the blank plus two standard deviations. Eleven blank samples were analyzed to determine the detection limit. The mean value

obtained was 1 mg/l with a standard deviation of 0.8 mg/l COD. These values were used to define the detection limit at 3 mg/l COD. This number compares quite favorably with the detection limit of 5 mg/l COD reported by Moore and Walker for the low level standard COD method (36).

The relative precision of both modifications of the standard and the semi-automated COD methods was determined by performing replicate analyzes on four wastewater samples. Since the standard and semi-automated determinations were performed at different times, two similar sets of water samples were chosen so that the relative standard deviations could be meaningfully compared. The relative standard deviations of both methods for low COD concentrations, as shown in Table I, compare very closely. However, the precision of the semi-automated method at high COD concentrations was approximately seven times better than the standard method.

Adelman pointed out that one of the factors contributing to the poor precision of the standard method was the potential loss of volatile components of the wastewater samples (30). This can be caused by the heat generated by the mixing of the sample with the concentrated acid prior to reflux or during the reflux step. This problem was eliminated in the semi-automated procedure by avoiding mixing the sample and acid layers until the tube is capped and the fact that sample digestion occurs in a completely closed system.

The authors found that the ability to take a representative aliquot of a nonhomogeneous sample was the limiting component of analysis variability regardless of method. Precision data for the standard COD method determined from inter-laboratory analyses of standard-like solutions must be regarded only as a lower limit (5, 37).

The accuracy of the semi-automated method was determined by measuring the recovery of standard addition of potassium hydrogen phthalate to several types of water samples. The mean recovery from 14 water and wastewater samples, shown in Table II, was 101% with a standard deviation of 4%.

Comparison of Semi-Automated and Standard Methods. A variety of surface and wastewater samples were analyzed by both the standard and semi-automated COD methods to determine the comparability of data. These samples included raw and treated sewage, industrial, chemical and food process wastes. Results comparing the two methods are shown in Table III. Initially the largest discrepancies between methods occurred in samples which contained large quantities of particulate matter, e.g., raw sewage. Homogenizing samples of this type greatly improved the comparability of the data. Within the standard deviation of the mean ratio of results, no significant bias in COD values exists between methods.

In addition, several pure organic compounds were analyzed to determine if the semi-automated method achieved a more complete

digestion than the standard method. The experimental results and calculated maximum theoretical COD values are shown in Table IV. The semi-automated values were slightly higher than the standard method results indicating that the former method achieved a more complete sample digestion. The difference could also be due to the fact that no volatile material can excape from the sealed tubes during oxidation in the semi-automated method, while in the standard method, volatile material may escape before sample oxidation is complete.

Interferences. One of the major problems encountered in other automated COD methods is the inability of the techniques to compensate for the positive interference caused by the oxidation of chloride present in wastewater samples (28-32). The standard procedure for eliminating the chloride interference is the addition of mercuric sulfate to form a complex and prevent its oxidation (4, 9). Experiments performed by this laboratory indicate that no interference results up to 2000 mg/l chloride when the standard procedure is used (9).

In other automated techniques, the high acid concentration reduces the solubility of $HgSO_4$ so that the quantity of Hg(II) in solution is not sufficient to complex the same amount of chloride as in the standard method (28-32).

In the semi-automated COD method, the ratio of $HgSO_4$ to sample volume is identical to the standard method. Standards of 500 mg/l COD were spiked with varying amounts of chloride in

order to determine the limiting concentration at which the interference was significant. The results, shown in Figure 4, indicate that chloride does not interfere below 1000 mg/l. Above this concentration, some precipitation occurs when the dilution water combines with the sample stream in the automated system, which results in a noisy recorder trace. If it is necessary to routinely analyze samples containing between 1000 and 2000 mg/l chloride, the dilution loop can be removed. Air spikes will then appear at the beginning and end of each sample peak, due to improper debubbling, but the results are not affected.

Any chemical species remaining after sample digestion, which absorb at 600 nm, cause a positive interference in the semi-automated method. Since almost all organic matter is digested by the COD technique the possible interference from organic compounds was not considered (5, 8, 36).

The presence of Cr (III) in a water sample gives an apparent COD of 1.39 times the concentration of chromium. Also, a potential interference from iron was investigated by spiking standards of 500 mg/l COD with increasing amounts of ferric iron. The results, presented in Figure 5, show no apparent COD below 5 g/l Fe. The positive bias caused by high concentrations of interfering substances is routinely eliminated by diluting samples prior to analysis or correcting the reported COD values from independent determinations of chromium, iron and chloride.

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The mention of trade names or commercial products does not constitute endorsement or recommendation for use by the Central Regional Laboratory or the Environmental Protection Agency.

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TABLE I. COMPARISON OF THE PRECISION OF THE SEMI-AUTOMATED AND STANDARD CHEMICAL OXYGEN DEMAND METHODS

METHOD	SAMPLE NO.	NO. OF DETNS.	[COD], MG/L MEAN	RANGE	STD. DEV.	REL. STD. DEV, %
MANUAL	1	11	40	4	1.4	3.5
	2	10	230	90	28.0	12.2
SEMI-AUTOMATED	3	11	26	4	1.3	5.0
	4	10	270	12	4.6	1.7

TABLE II. RECOVERIES OF POTASSIUM HYDROGEN PHTHALATE ADDED TO WATER SAMPLES WITH SEMI-AUTOMATED METHOD

SAMPLE SOURCE	[COD], MG/L			RECOVERY, %
	SAMPLE	KHP ADDED	SAMPLE +KHP	
ORGANICS INDUSTRY EFFLUENT	13	200	217	102
RAW SEWAGE	164	200	370	103
RIVER WATER	31	100	122	91
HARBOR WATER	16	200	224	104
INDUSTRIAL COOLING WATER	65	200	262	99
RIVER WATER	15	100	116	101
RIVER WATER	28	100	124	96
CHANNEL WATER NEAR DREDGING	52	100	152	100
INDUSTRIAL DISCHARGE	30	100	131	101
INDUSTRIAL DISCHARGE	16	100	116	100
TREATED SEWAGE	40	100	144	104
RECEIVING WATER OF SEWAGE	25	100	127	102
TREATED SEWAGE	14	100	124	110
STEEL MILL EFFLUENT	14	100	112	98
MEAN				101
STANDARD DEVIATION				4

TABLE III. COMPARISON OF SEMI-AUTOMATED AND STANDARD CHEMICAL OXYGEN DEMAND METHODS

SAMPLE SOURCE	[COD], mg/l STANDARD METHOD (S)	SEMI-AUTOMATED METHOD (A)	S/A X 100
RAW SEWAGE	420	421	99.8
PAPER MILL COOLING WATER	39	46	84.8
STEEL MILL WASTE	270	273	98.9
TREATED SEWAGE	50	51	98.0
PRIMARY TREATED SEWAGE	63	51	123.5[A]
BOILER BLOWDOWN	180	133	[illegible]
POTTERY SHOP WASTE	140	156	89.7
CREEK DOWNSTREAM FROM POTTERY SHOP	94	99	94.9
PRIMARY TREATED SEWAGE	90	87	103.4
PAPER MILL WASTE	450	464	97.0
RAW SEWAGE	170	164	103.7
TREATED SEWAGE	36	35	102.9
TREATED SEWAGE	27	27	100.0
TREATED SEWAGE	21	22	95.5
ORGANIC CHEMICAL PLANT WASTE	270	275	98.2
STEEL MILL WASTE	90	89	101.1
CHEMICAL PLANT WASTE	9800	9200	106.5
RAW SEWAGE	150	180	83.3
CHEMICAL PLANT EFFLUENT	1500	1500	100.0
DISTILLERY	[illegible]	[illegible]	92.2
RAW SEWAGE	450	450	100.0
MEAN			98.0
STANDARD DEVIATION			5.2

[A] RESULT REJECTED FOR CALCULATION OF MEAN AND STANDARD DEVIATION.

TABLE IV. COMPARISON OF CHEMICAL OXYGEN DEMAND METHODS ON ORGANIC COMPOUNDS

COMPOUND	[COD], MG/L			
	THEORETICAL	STANDARD METHOD (S)	SEMI-AUTOMATED METHOD (A)	S/A X 100
PHENOL	238	230	240	95.8
SODIUM ACETATE	470	450	462	97.4
ACETONE	221	200	207	96.6
ETHANOL	197	170	180	94.4
DEXTROSE	107	100	113	88.8
METHANOL	150	130	139	93.5
OXALIC ACID	127	120	128	93.8
SODIUM CITRATE	490	470	496	94.8
GLUTAMIC ACID	98	90	98	91.8
GLYCINE	64	60	62	96.8
BENZOIC ACID	197	190	202	94.1
PYRIDINE	223	< 5	< 3	—[A]
3-PICOLINE	239	64	77	83.1[A]
TETRAHYDROFURAN	244	250	242	103.3
MEAN				95.0
STANDARD DEVIATION				3.5

[A] RESULTS REJECTED FOR CALCULATION OF MEAN AND STANDARD DEVIATION.

TITLES FOR FIGURES.

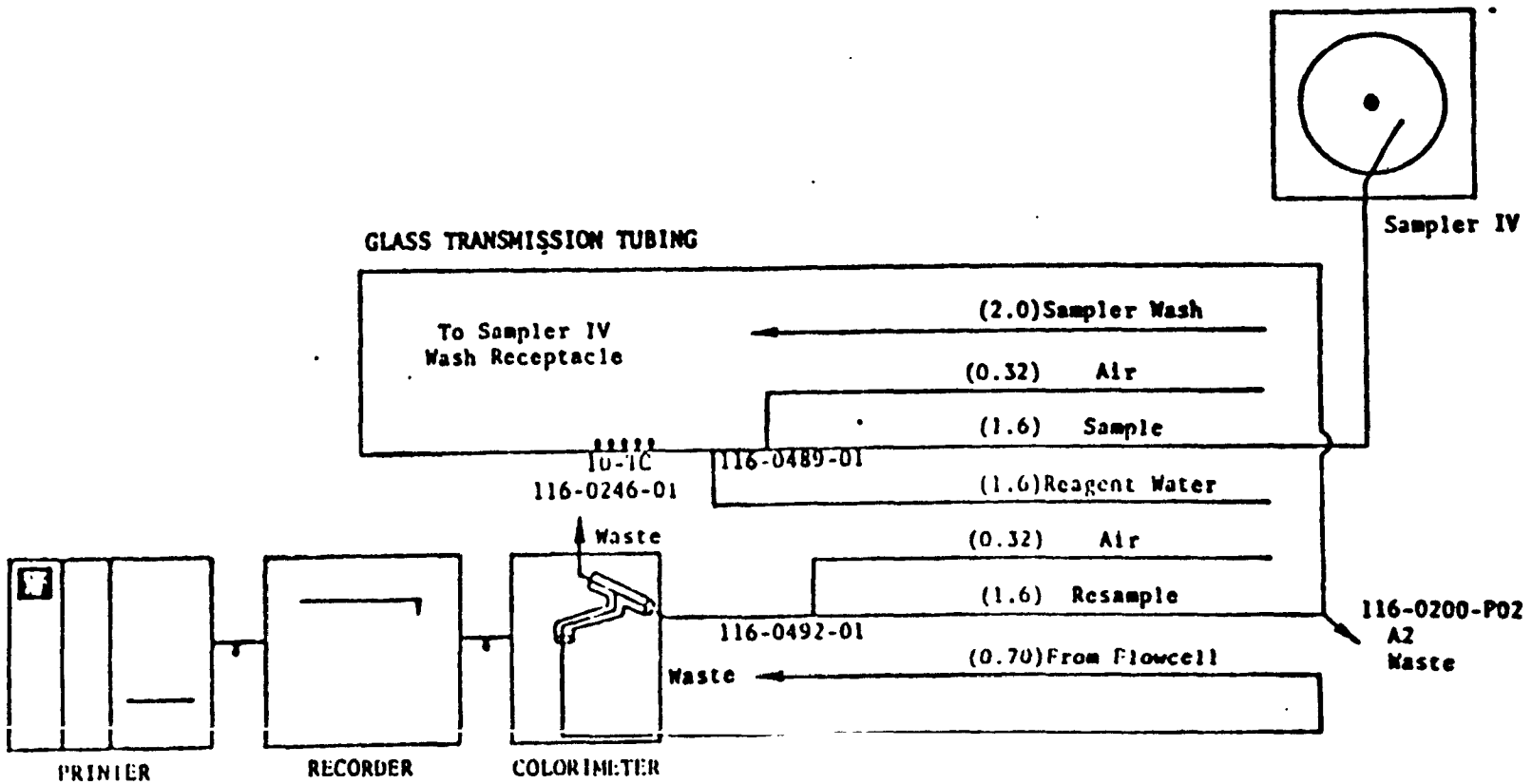
FIGURE 1. AUTOMATED SYSTEM FOR CHEMICAL OXYGEN DEMAND. NUMBERS IN PARENTHESES CORRESPOND TO THE FLOW RATE OF THE PUMPTUBES IN ML/MIN. NUMBERS ADJACENT TO GLASS COILS AND FITTINGS ARE TECHNICON CORP. PART NUMBERS.

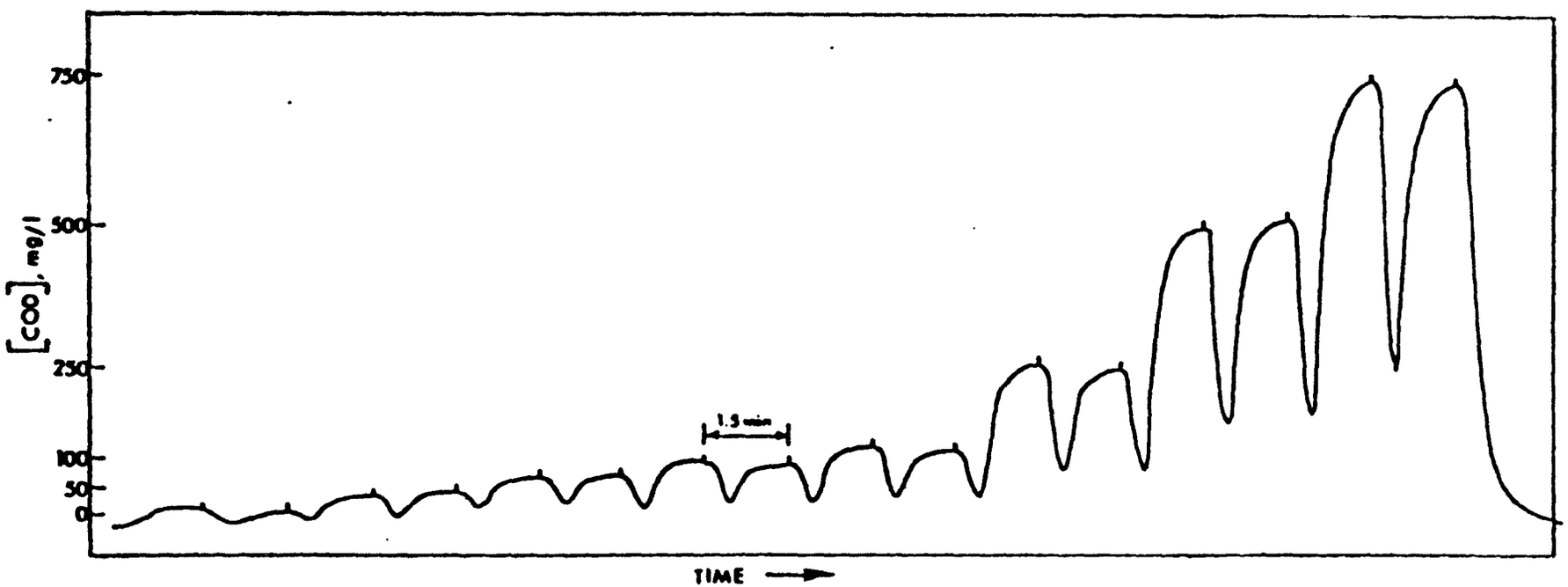
FIGURE 2. RECORDER TRACE FOR CHEMICAL OXYGEN DEMAND OF POTASSIUM HYDROGEN PHTHALATE STANDARDS ANALYZED IN DUPLICATE.

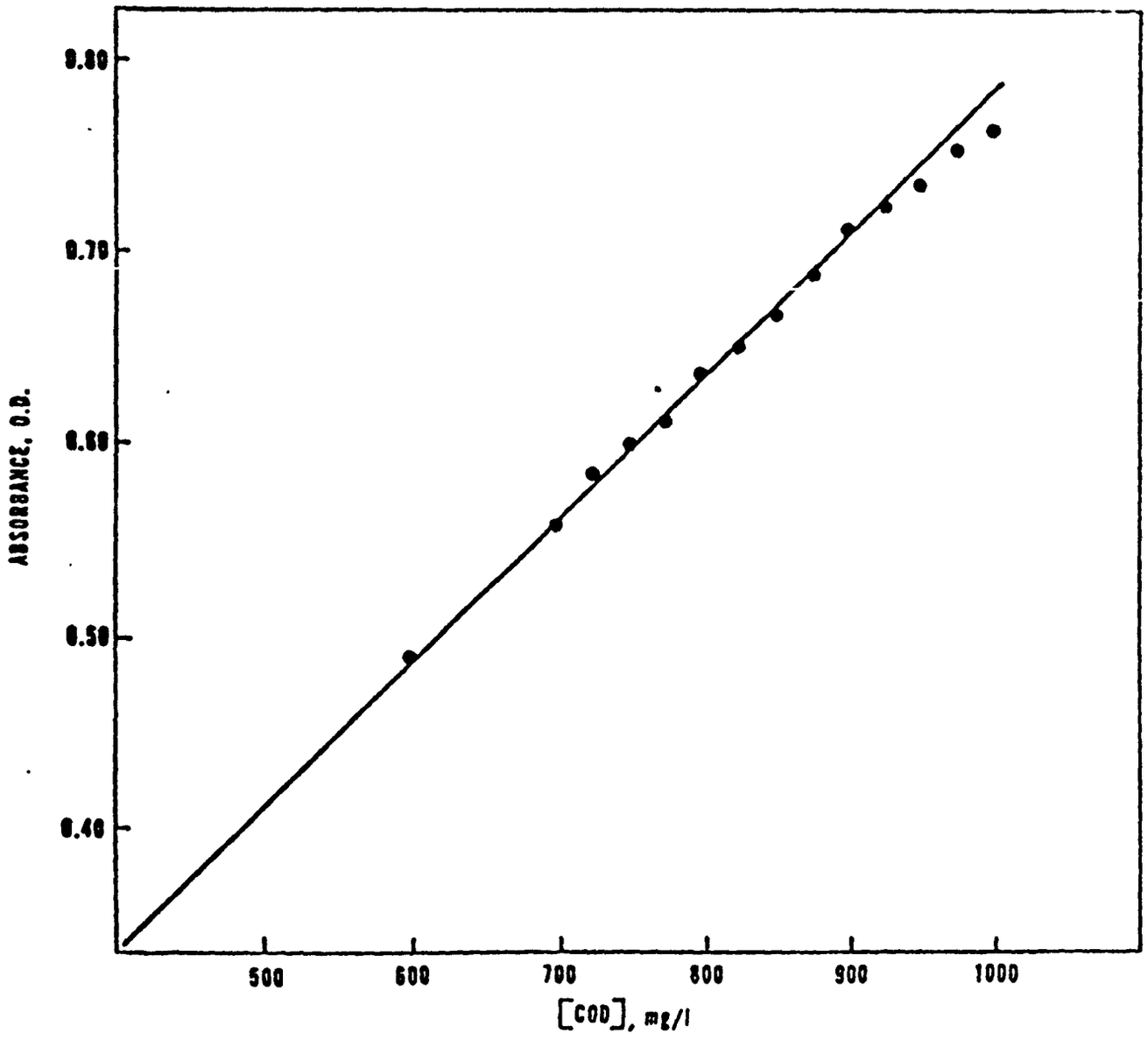
FIGURE 3. CALIBRATION CURVE FOR AUTOMATED CHEMICAL OXYGEN DEMAND. EACH POINT IS THE AVERAGE OF DUPLICATE DETERMINATIONS.

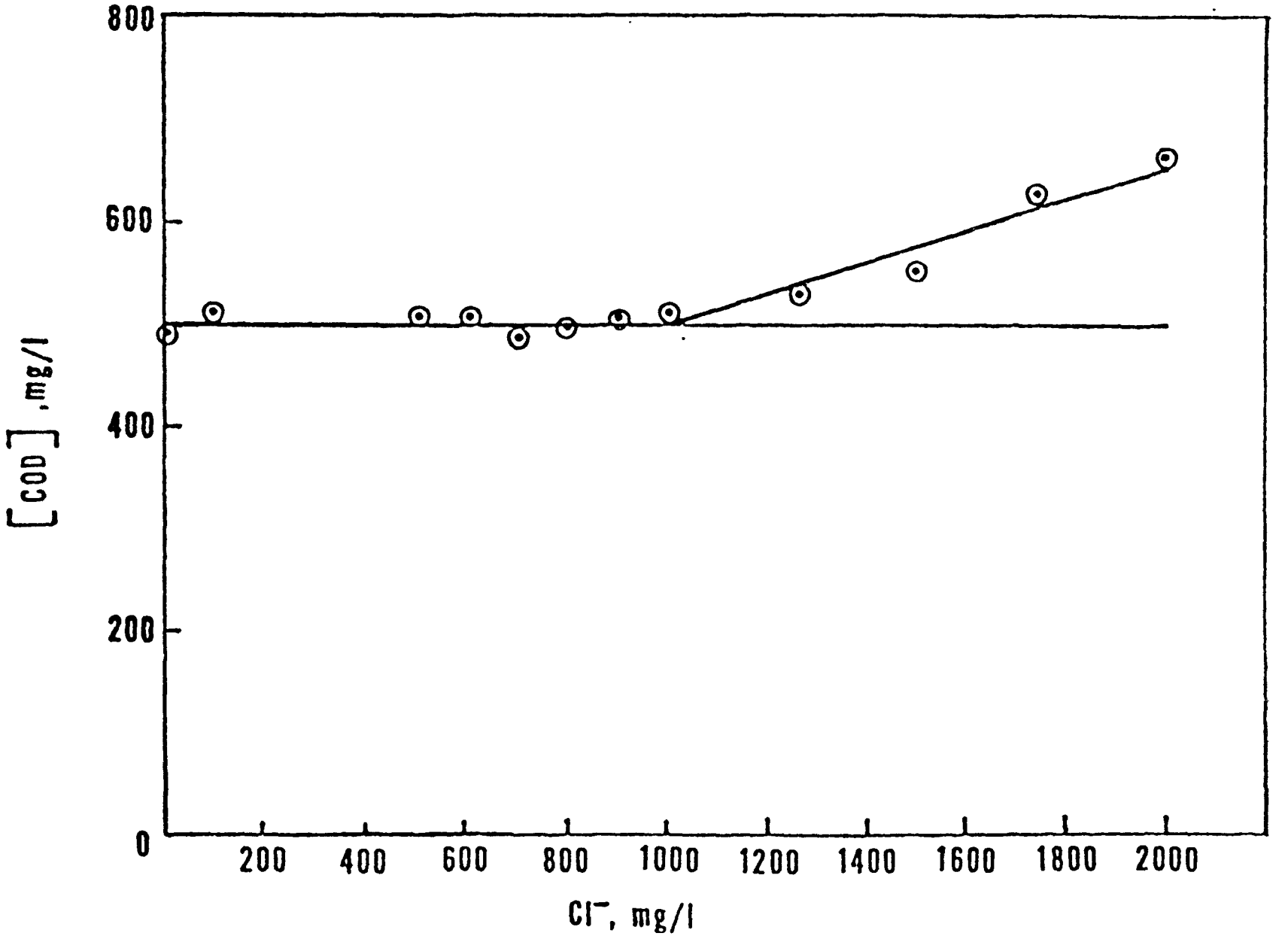
FIGURE 4. PLOT OF APPARENT CHEMICAL OXYGEN DEMAND CAUSED BY THE OXIDATION OF CHLORIDE. DATA DETERMINED BY ADDING THE INDICATED AMOUNTS OF CHLORIDE TO A 500 MG/L COD POTASSIUM HYDROGEN PHTHALATE STANDARD.

FIGURE 5. PLOT OF APPARENT CHEMICAL OXYGEN DEMAND CAUSED BY THE ABSORBANCE AT 600 NM FROM FERRIC IRON IN SOLUTION. DATA DETERMINED BY ADDING THE INDICATED AMOUNTS OF IRON TO A 500 MG/L COD POTASSIUM HYDROGEN PHTHALATE STANDARD.


Sampler IV
GLASS TRANSMISSION TUBING
To Sampler IV
Wash Receptacle
(2.0)Sampler Wash
(0.32) Air
(1.6) Sample
10-TC
116-0246-01
116-0489-01
(1.6)Reagent Water
Waste
(0.32) Air
(1.6) Resample
116-0492-01
(0.70)From Flowcell
Waste
116-0200-P02
A2
Waste
PRINTER
RECORDER
COLORIMETER


750
500
250
100
50
0
[COD], mg/l
1.5 min
TIME


0.80
0.70
0.60
0.50
0.40
ABSORBANCE, O.D.
500
600
700
800
900
1000
[COD], mg/l


800
600
400
200
0
[COD], mg/l
200
400
600
800
1000
1200
1400
1600
1800
2000
Cl⁻, mg/l

APPENDIX III

AN AUTOMATED METHOD FOR THE DETERMINATION OF TOTAL AND INORGANIC MERCURY IN WATER AND WASTEWATER SAMPLES

PRELIMINARY

SUBJECT TO REVISION

BY

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ABSTRACT

An automated method for the determination of total as well as inorganic and organic mercury by the cold vapor method is given. The method is suitable for the analysis of samples in a variety of environmental water matrices. A detection limit of 0.05 μg/l is obtained by the use of a highly sensitive spectrometer. The method is suitable for the analysis of samples with mercury concentrations in the range 0.05 - 6 μg/l and a COD less than 700 mg/l. The use of potassium persulfate, potassium permanganate, potassium dichromate and mixtures of these salts as oxidizing agents for the digestion step is discussed, and a study of sample preservation is given. Twenty samples and/or standards per hour can be analyzed using this method.

INTRODUCTION

In recent years a number of methods have been introduced for the determination of mercury in a variety of matrices.[1-10] The most widely used method utilizes a flameless atomic absorption technique first introduced by Hatch and Ott.[10] Most of these are time consuming,

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[1] K. K. S. Pillay, C. C. Thomas, Jr., J. A. Sondel, and C. M. Hyche; Anal. Chem., 43, 1419 (1971).

[2] V. I. Muscat, T. J. Vickers, A. Andren; ibid., 44, 218 (1972).

[3] E. W. Bretthauer, A. A. Moghissi, S. S. Snyder, and N. W. Mathews; ibid., 46, 445 (1974).

[4] J. J. Bisogni, Jr. and A. Wm. Lawrence; Env. Sc. Tech., 8, 851 (1974).

[5] C. T. Elly; J. Water Pol. Cont. Fed., 45, 940 (1973).

[6] R. F. Overman; Anal. Chem. 43, 616 (1971).

[7] T. J. Rohm, H. C. Nipper, and W. C. Purdy; ibid., 44, 869 (1972).

[8] H. J. Issaq and W. L. Zielinski, Jr. ibid., 46, 1436 (1974).

[9] W. F. Fitzgerald, W. B. Lyons, and C. D. Hunt, ibid., 46, 1882 (1974).

[10] W. R. Hatch and W. L. Ott, ibid., 40, 2085 (1968).

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however, and do not allow for the analysis of a large number of samples, such as is generally encountered by environmental laboratories. The solution to this problem has been to move in the direction of establishing automated procedures, which will allow either continuous monitoring or the analysis of reasonable numbers of samples per day. This increase

in the sample analysis rate should be done without affecting either the sensitivity or the accuracy of the procedure.

Recently a number of automated methods[11-13] for the determination of mercury have appeared in print. These methods are highly suitable for the analysis of clean water samples and other samples with a

[11] B. W. Bailey and F. C. Lo; Anal. Chem. 43, 1525 (1971).

[12] T. B. Bennett, Jr., W. H. McDaniel, and R. N. Hemphill; Advances in Automated Analysis, 1972 Technicon International Congress, Vol. 8; Mediad Incorp., Tarrytown, N.Y.

[13] P. D. Kluckner, "Investigation of an Automated Method for the Determination of Total Mercury in Water and Wastewater" a report to the Chemistry Laboratory Water Resources Service, 3650 Wesbrook Crescent, Vancouver, British Columbia, Canada (1973).

very low content of oxidizable materials. However, for samples with a high content of particulate matter as well as for those with high concentrations of oxidizable impurities, the suitability of these methods is questionable. An automated method that addresses itself to these questions is presented in this paper. The comparability of the described method has been checked against the manual method presently accepted by EPA[14] and has been found suitable for the analysis of mercury in all types of water samples including those samples with a high content of particulate matter and oxidizable impurities.

[14] "Methods For Chemical Analysis of Water and Wastewater", EPA Publication No. EPA-625/6-74-003, U.S. Environmental Protection Agency, Office of Technology Transfer, Washington, D.C., 20460, pp. 118

EXPERIMENTAL

Apparatus. All glassware used in this work was borosilicate glass. Standard mercury solutions were prepared in volumetric flasks with glass stoppers. All glassware was first washed with water, soaked for two hours in a 1% potassium permanganate solution, soaked for an additional two hours in a 1:1 mixture of concentrated nitric and sulfuric acids, and then washed with doubly deionized water. The glassware was then baked for 3-4 hours at 400°C. It was found that for subsequent use of the same glassware, a rinse with conc. HNO_3 followed by several rinses with doubly deionized water was sufficient. No traces of mercury were observed in these flasks. All domestic and industrial waste samples were stored in high density polyethylene, 1-liter screw-cap bottles with polyethylene lined caps and preserved to give a final concentration of 0.5% HNO_3. Liquid transfers for dilution purposes were made with Eppendorf pipets of 0.1, 0.25, 0.5, and 1 ml capacity.

Instrumentation. The instruments used consisted of:

1. Spectro Products Mercury Analyzer Model HG-2
2. Perkin-Elmer Model 56 multi-range chart recorder
3. Harmonically smoothed voltage stabilizer
4. Technicon Auto-Analyzer Unit consisting of:
   a. Sampler IV
   b. Proportioning Pump III
   c. Heating bath with heating coil (20 ft. long and 2.4 mm internal diameter).

5. Gas-Liquid Separator

6. A rotameter to measure the rate of air flow in the gas-liquid separator.

7. High speed blender for sample homogenization

The operating principle of the mercury analyzer is based upon balancing the intensity of the mercury line at 2537 Å from a hollow cathode lamp "A" against the intensity of one or more lines from a reference hollow cathode lamp "B" in the same wavelength region as observed by a single detector. Lamp "A" is a pulsed mercury hollow cathode lamp, and lamp "B" is a pulsed iron hollow cathode lamp. The two lamp sources are pulsed 180° out of phase above a sustaining base current in a square wave mode. The instrument is balanced with the absorption cell swept free of any residual mercury. In the absence of any interfering substance, any observed absorption is solely due to mercury. The net intensity due to mercury absorption is directly obtained from the output of a phase sensitive, lock-in amplifier. The instrument is equiped with an automatic gain control to the lock-in amplifier, so that compensation for the background or extraneous absorption is accomplished automatically. In addition, a 10X scale expansion is provided for the analysis of samples containing low concentration levels of mercury.

It was found necessary to modify the absorption cell supplied with the instrument. The main modifications were: 1. To decrease the internal diameter by a factor of two; 2. To position the inlet and exit tubes as close as possible to the quartz windows so as to decrease

the dead air space in the vicinity of the window. In order to compensate for the factor of four decrease in signal strength caused by these modifications, it was necessary to increase the gain (voltage) on the photomultiplier tube. The present cell's dimensions are: 22 cm long, 7 mm internal diameter, and 11 mm external diameter. The cell is constructed completely from quartz.

The chart recorder is equiped with a variable input voltage, allowing several scale expansions. The recorder was operated at its lowest chart speed of 5 mm/min.

Reagents. All chemicals used are analytical reagent grade or better. The water used was doubly deionized. The reagents and their concentrations are as follows:

1. Concentrated sulfuric acid; obtained from Baker and designated as "suitable for Hg determination".

2. 10% stannous chloride solution; prepared in a solution 10% in HCl.

3. 1% potassium permanganate solution; a fresh stock solution was prepared every three weeks.

4. 2% potassium dichromate solution.

5. 3% hydroxylamine hydrochloride; prepared in a solution 3% in sodium chloride.

6. 4% potassium persulfate; this solution was prepared fresh weekly.

7. Con. nitric acid.

8. A tank of purified nitrogen.

9. Mercury stock solutions; 1 mg/ml (=1000 mg/l) of either mercuric chloride or methyl mercuric chloride.

10. Mercury standard solutions. Mercury standard solutions in the range 0.05 - 6.0 μg/l were prepared by proper dilutions of a 100 μg/l stock solution prepared from

solution 9 above. All standards were prepared in a solution 0.5% in HNO_3 and 0.05% in $K_2Cr_2O_7$ as a preservative.

11. Activated charcoal, as an absorber for elemental Hg.

Procedure. The flow diagrams for the mercury manifold are given in Figures 1 and 2. Figure 1 represents all experiments with $K_2S_2O_8$ as the only oxidizing reagent used for sample digestion. Figure 2 represents all experiments in which $KMnO_4$ or $K_2Cr_2O_7$ is used as an oxidizing agent in addition to $K_2S_2O_8$. In the second system a 3% hydroxylamine-hydrochloride solution is used as a reducing agent for the excess $KMnO_4$ or $K_2Cr_2O_7$ which was not reduced in sample digestion. It should be noted here that all connections, coils, etc. in the sample train past the pump tubes are made of borosilicate glass. The heating bath is set at 100± 2°C, and the mercury analyzer is allowed to stabilize for a one hour warm-up period. The system is then flushed with a 1% HNO_3 solution and the absorption cell is flushed with purified nitrogen gas. The rotameter is set to give a constant gaseous flow rate of 15-25 cm^3/min. The inlet to the segmenting air tube as well as the outlet for the absorption cell are connected to a tube filled with activated charcoal which acts as a mercury absorber. The reagents are then passed through the system in the order: a. H_2SO_4, b. $SnCl_2$, c. NH_2OH-HCl-NaCl, d. $KMnO_4$ or $K_2Cr_2O_7$, e. $K_2S_2O_8$; while the automatic sampler is kept in the wash cycle. The wash is made of a 1% HNO_3 solution. The flow of all reagents is maintained for a period of 15-30 min. or until a stable baseline is obtained. In all experiments done using $K_2S_2O_8$ as the sole oxidizing

agent, both the hydroxylamine and permanganate or dichromate reagent lines are disconnected, and the reagents introduced in the order H_2SO_4, $SnCl_2$, and $K_2S_2O_8$. After a stable baseline is obtained, standards in the range 0.05 - 6.0 µg/l Hg are placed in a sample tube (prerinsed with the same solutions), and transferred to the sampler. For all samples judged to be high in mercury i.e. 0.5 - 6 µg/l, only standards in that range are used. For low level mercury determination i.e. less than 0.5 µg/l, standards in the range 0.05 - 0.5 µg/l are used, and the mercury analyzer is set at its 10X scale expansion. In addition, a recorder scale expansion (a factor of 2) is used for runs with mercury concentrations in the range 0.2 - 3 µg/l. Samples to be analyzed are then placed in the sampler while the standards are running. Standards were prepared fresh daily from the stock solution and analyzed by the system before and after each run in order to provide a calibration curve and to check for the stability of the standards during the analysis period. In some experiments the same standards were run over a period of two to four weeks to check for the effectiveness of the preservatives used (0.05% HNO_3 and 0.05% $K_2Cr_2O_7$). Both mercuric chloride and methyl mercuric chloride standards were used to check for the recovery of organomercury compounds.

All sampling was done using a 20/hour sample cam with 2:1 wash-sample ratio. For recovery studies, arbitrarily selected samples were spiked with the equivalent of 0.3 µg/l Hg for samples with less than 1 µg/l Hg, and with 2-3 µg/l Hg for samples containing 1-4 µg/l Hg.

All samples containing high concentrations of particulate matter were first homogenized using a Techmar Co. high speed homogenizer model SDT. In addition, samples were stirred before and during sampling.

After the analyses are completed, all lines with the exception of the sulfuric acid line are placed in a 1% HNO_3 solution until all reagents are completely flushed out. This is followed by placing the sulfuric acid line in the wash. All the lines are then flushed for 10 min. with 3% $NH_2OH \cdot HCl$ to remove any build-up of manganese oxides. This is then followed by flushing the system with 1% HNO_3 for a period of 20-30 min. The above flushing includes all coils in and outside the high temperature bath. For all experiments, using $K_2S_2O_8$ or $K_2Cr_2O_7$ as oxidizing agents, the system was flushed with a 1% HNO_3 solution for 20-30 min.

SYSTEM DEVELOPMENT

During the early stages in the development of the system, several studies were undertaken to optimize the analysis conditions. These studies included mechanical, electrical, as well as chemical modifications.

Modifications in the Mercury Analyzer. It was observed that the absorption cell provided by the manufacturer was inadequate for our purposes. The position of the inlet and outlet tubes was too far from the quartz windows leaving a dead air space. This resulted in the retention of mercury in the cell and slowed the response time. The response time could not be sufficiently improved by varying the flow rate of the nitrogen carrier gas. In addition, the volume of the cell was too large, requiring a much longer sampling period. In the present cell these problems were corrected as described in the experimental section. As a result of these modifications, we observed an increase in the sensitivity of the system, a decrease in the background level, and a decrease in the time required for the maximum absorption to take place.

Air or Nitrogen flow rate. Table I gives the relationship between the scale reading on the recorder and the flow rate of air used for aspiration, for mercury concentrations of 0.5, 1, 2, 3 and 4 μg/l. Inspection of Table I shows that the scale reading increases with the increase of the flow rate of air up to a maximum. The maximum is reached at a flow rate of 20-25 cm^3/min. Above 30 cm^3/min,

however, the scale reading of the recorder decreases. The variations in the scale reading are more significant at higher mercury levels. It should be noted here that the results will vary from one system to another. The flow rates of the other reagents will, of course, change the molar concentrations of mercury in the solution to be aspirated and hence, the response of the mercury analyzer.

It should be mentioned here, however, that the total area under the peak of a given mercury concentration remained virtually constant up to 30 cm^3/min of air. Peak separation, however, decreases with the decrease in air flow.

Preservation of Samples and Standards. It has been recognized for a number of years[15-16] that aqueous solutions of mercury compounds lose their strength on storage. This result was observed for samples

[15] A. E. Ballard and C. D. W. Thornton; Ind. Eng. Chem. 13, 893 (1949).

[16] S. Shimomura, Y. Nishihara and Y. Tanase; Jap. Anal., 17, 1148 (1968) and 18, 1072 (1969).

stored in glass as well as polyethylene vessels. Although the mechanism for the loss of mercury is currently unknown, several interpretations have been given. The absorption of mercury on the surface of the container is perhaps the most common of these interpretations. The amount of mercury lost from aqueous solutions decreases, however, when the sample is stored in acid solution.[17-18] Feldman[18] showed that mercury

[17] R. V. Coyne and J. A. Collins, Anal. Chem. 44, 1093 (1972).

[18] C. Feldman; ibid., 46, 99 (1974).

standards preserved in a solution 5% HNO_3 + 0.05% $K_2Cr_2O_7$ will maintain their mercury concentrations over a period of 10 days.

In an attempt to establish the stability of the standard mercury solutions, as well as that of mercury in environmental samples, several solutions were prepared and analyzed over a one month period. Table II gives data collected on samples prepared in deionized water, surface water containing industrial waste, sewage treatment plant (STP) effluent and STP influent. Three different sets of solutions were prepared for a given sample type: unpreserved, 0.5% HNO_3 preserved,and 0.5% HNO_3 - 0.05% $K_2Cr_2O_7$ preserved solutions. Both polyethylene and glass bottles were used for the unpreserved samples. All other samples were prepared in polyethylene bottles. The mercury content of all samples was first analyzed. Each sample was then spiked with a known amount of $HgCl_2$, and the total mercury present was determined within 10 minutes of sample preparation. The volume of the samples was measured using a graduated cylinder,and hence a difference of 2-3% between the mercury found at zero time and the sum (Hg present and Hg added) is not significant.

Table II shows that unpreserved standards (samples prepared in deionized water) lost 20% of their strength within 10 minutes of preparation and 60% over a 10 day period. Standards prepared in 0.5% HNO_3 lost 6% and 30% of their strength over a 10 minutes and a 10 day period respectively. The use of sulfuric acid instead of nitric acid as a preservative did not significantly alter the results, although sulfuric acid preserved standards were generally 3-5% higher. This could be attributed to the presence of trace amounts of Hg in sulfuric acid. Increasing the

acid concentration up to 6% resulted in a mercury loss of 20% over a 10 day period. The preservation of standards in a solution containing 0.5% HNO_3 + 0.05% $K_2Cr_2O_7$, however, resulted in no significant mercury loss over a four week period. Similar results were obtained for standards stored in borosilicate glass, with a slight increase in stability over polyethylene bottle stored solutions.

Further inspection of table II shows that all environmental samples studied maintained their mercury content over a one month period when preserved in either 0.5% HNO_3 or 0.5% HNO_3 - 0.05% $K_2Cr_2O_7$. Although unpreserved solutions of the same samples exhibit Hg loss, they do so at a much slower rate than that for standards prepared in deionized water. The rate of loss decreased with the increase in particulate matter in the sample. The stability of these samples, could, thus be attributed to the preferential adsorption of Hg on the particulate matter. The stability of samples preserved in 0.5% HNO_3 - 0.05% $K_2Cr_2O_7$, however, was independent of the particulate matter content. The stability of samples preserved in 0.5% HNO_3 alone, showed a dependence on the particulate matter. The absence of particulate matter will result in lower stability. It is thus suggested that all samples should be preserved in 0.5% HNO_3 - 0.05% $K_2Cr_2O_7$.

Of particular interest is the comparison of the data for unpreserved samples over a 24 hour period. Here we observe that deionized water samples lost 30% of their strength, while environmental samples lost up to 10% of their strength over the same period. This result bears very heavily on the method of sampling. It is suggested that

grab samples are collected followed by immediate preservation with 0.5% HNO_3 - 0.05% $K_2Cr_2O_7$ solution. This is preferred over, say, a 24 hour non-acidified composit sampling method. Any loss of mercury due to surface adsorption in a grab sampling method should be recovered upon the addition of the preservative. Thus it was observed that if a mixture of 0.5% HNO_3 - 0.05% $K_2Cr_2O_7$ was added to a neutral aqueous solution of $HgCl_2$ (2 μg/l) which had been left standing for 24 hours, all the Hg was recovered within 20 minutes. In addition, a comparison (table II) of the Hg concentration in the samples prior to the addition of the spike ($HgCl_2$), shows that the nitric-dichromate values are significantly higher than nitric alone, which in turn are higher than the unpreserved samples. The difference is attributable to the redissolution of Hg adsorbed on the surface of the flask, since the reagents did not show any measurable Hg contamination.

Comparison of Organic and Inorganic Standards. Methyl mercuric chloride and mercuric chloride produced the same standard graphs over the range 0.05 - 6.0 μg/l Hg. All data in the range 0.05 - 0.5 μg/l were run on the 10X scale of the mercury monitor and 1X scale expansion for the chart recorder. All data in the range 0.5 - 6.0 μg/l Hg were run on the 1X scale of the mercury monitor and at the 2X scale expansion of the chart recorder. Two types of standard graphs were attempted. The first is a plot of the percent absorption due to mercury versus the mercury concentration; the second is the absorbance (optical density) versus the mercury concentration. Both graphs gave very good straight lines, and the results (for real samples) calculated from both graphs are indistinguishable. At concentrations of mercury of 10 μg/l or above, however, the % absorption graphs are generally non-linear.

RESULTS AND DISCUSSIONS

Figures III and IV give typical chart recordings of measurements made on standard solutions. Recorder plots of 0.5, 1.0, 2.0, 3.0 and 4.0 μg/l Hg (Fig. III) were obtained on the 1X scale of the mercury monitor and scale expansion of 2X on the chart recorder. Attempts to vary the damping of the instrument (without significantly affecting the response of the monitor) were unsuccessful in decreasing the baseline noise. The present chart recordings are done at a damping control of 10 sec. Figure IV gives the plots of mercury concentrations of 0.05, 0.1, 0.2, 0.3, and 0.4 μg/l, all done on the 10X scale of the mercury monitor, and a 1X scale of the chart recorder. Here again attempts to decrease the noise level of the baseline beyond what is given were unsuccessful. The detection limit of the method (defined as the concentration that gives a signal that is twice the level of the baseline noise) on the range 0 - 0.6 μg/l is 0.05 μg/l. The detection limit could be decreased beyond the 0.05 μg/l level to perhaps 0.02 μg/l if an integrator is coupled with the chart recorder, which would average the baseline noise and hence increase the sensitivity of the procedure. Inspection of Figures III and IV shows that the wash sample ratio of 2:1 is sufficient for our system with a complete return to the baseline between samples. The shape of the peaks is quite characteristic at all levels of mercury, and with a one minute sampling time, a steady state concentration of mercury is reached in

the absorption cell. This was established by sampling for an extended period of time and observing that the percent absorption attained is the same. The reproducibility of the results (precision of the method) was established by replicate analyses of the same sample. Table III gives the standard deviations and the coefficients of variations (percent relative standard deviation) at various levels of mercury. Data for the manual method are also given as a reference. These data were obtained from standards run during the same day as well as over an extended time period. Reproducibility data for real samples were generally within the standard deviation of the standards (for samples with small amounts of particulate matter when run on the same day). Reproducibility data for samples run on different days, however, were within 2-3 standard deviations of the standards. This could be attributed to sample deterioration, preferential adsorption of mercury on particulate matter, or day to day changes in the elasticity of pump tubing. Samples with considerable amounts of particulate matter were sampled representatively by homogenization using a high speed blender. The reproducibility of these samples was within 2-3 standard deviations of the standards.

Since mercury in water can exist as organic mercury, it was necessary to establish the completeness of the digestion procedure, as well as the effectiveness of the various chemicals involved in the break-down of organic mercury compounds to ionic mercury. This is necessary since $SnCl_2$ will not reduce organic mercury under the experimental condition given. It should be mentioned here that it was not

necessary to use potassium permanganate nor potassium persulfate for samples containing inorganic mercury only. In addition, the temperature of the reaction need not be above room temperature.

Standards containing methyl mercuric chloride, however, required high temperature (100°C) and the presence of persulfate. Potassium permanganate alone gave less than 30% recovery of the mercury present. Potassium persulfate alone was sufficient to recover all the mercury present. Variation of the concentration of $K_2S_2O_8$ between 0.5 - 5% did not alter the results obtained for methyl mercuric chloride. Since the variation of the flow rates of reagents and/or the total volume of solution in the reduction step affects the final value obtained for the percent absorption on the chart recorder at a given concentration, all data were obtained relative to mercuric chloride standards. Table IV gives recovery data for methyl mercuric chloride using various reagent combinations. The methyl mercuric chloride standard solution used (obtained from Alpha Inorganic) was found to contain 1% $HgCl_2$. This was established by treating a 100 μg/l sample of CH_3HgCl with $SnCl_2$ and observing an absorbance level 1% of the expected absorbance.

The variation of the concentrations of the various reagents, however, affected the data obtained for real samples. It was thus observed that there is a direct correlation between the chemical oxygen demand (COD) and the amount of persulfate and/or permanganate required to completely oxidize all organic mercury present. The COD of a sample is defined[19] as "the quantity of oxygen required to oxidize

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[19] W. A. Moore, F. J. Ludzack, and C. C. Ruchhoft, Anal. Chem. 23, 1297 (1951)

organic and inorganic matter in a waste sample." This definition is based on acidic dichromate oxidation at the reflux temperature of a 50% H_2SO_4 solution with a Ag_2SO_4 catalyst. Since both $S_2O_8^{-2}$ and MnO_4^- are excellent oxidizing agents, all organic matter oxidized by dichromate should also be oxidized by persulfate or permanganate and hence the correlation between the COD of the sample and the concentration of these reagents. It was thus observed that the suggested concentrations of 0.5% $KMnO_4$ and 0.5% $K_2S_2O_8$ by Bennett et. al.[12], are insufficient for most samples treated in this laboratory. In the present system, a 4% $K_2S_2O_8$ (Fig. I) is sufficient to treat samples with a COD of up to 700 mg/l. Attempts to increase the concentrations of these reagents were judged inadequate for our purposes, because an increase in $KMnO_4$ concentration would require a large increase in the hydroxylamine needed to reduce excess MnO_4^-. Increasing the persulfate concentration by the use of up to 15% $(NH_4)_2S_2O_8$ solutions, resulted in the formation of high levels of ozone after the digestion step, and hence, a need for a high concentration of $SnCl_2$. Since over 90% of water and waste-water samples that come to this laboratory have a COD value of less than 500 mg/l, it was decided that a 1% $KMnO_4$ and/or 4% $K_2S_2O_8$ solutions are sufficient. Samples with much higher COD levels (above 700 mg/l) should therefore be diluted. It was also observed that spiked samples with high COD levels gave a mercury concentration lower than the spike. Here methyl mercuric chloride should be used as the spike.

Table V gives a comparison between the automated method and the manual method for river, lake, sewage, and industrial samples. Data

were included for experiments performed using persulfate alone, persulfate-dichromate, and persulfate-permanganate as digestion solutions. Table VI gives recovery data of spiked real samples using the above solutions. Inspection of the two tables shows that there is no significant difference in the values obtained for the same sample by the various methods studied, and that potassium persulfate is sufficient as a digestion reagent. Perhaps the main purpose for permanganate in these experiments is its five electron oxidation property as compared to the two electron step for persulfate. The electrode potential for the $S_2O_8^{2-}/SO_4^{2-}$ couple is 2.03 V while for the MnO_4^-/Mn^{2+} couple is 1.60, and here it appears that apart from kinetic effects, the persulfate on a thermodynamic basis is a better oxidizing agent. The fact that the use of MnO_4^- alone results in a maximum of 30% recovery of CH_3HgCl eliminates the value of MnO_4^- for the analysis of organic mercury compounds.

It was eluded to by Kopp, et al.[20], that the use of MnO_4^- might

[20] J. F. Kopp, M. C. Longbottom and L. B. Lobring; AWWA; 64, 20(1972).

be required for the oxidation of some interferences such as H_2S. Since persulfate is a strong oxidizing agent, it appears that the permanganate will not be required for this purpose. In addition, it was observed that sulfide concentrations as high as 20 mg/l (as Na_2S) do not interfere with the recovery of inorganic mercury added to distilled water. This result was obtained in experiments using persulfate, persulfate-permanganate

and persulfate-dichromate combinations as digestion solutions. At higher sulfide ion concentrations, however, negative interferences were observed in experiments using persulfate alone. In experiments using persulfate-permanganate or persulfate-dichromate, a positive interference was observed. Other common ions encountered, such as chloride, did not interfere in concentrations of up to 5000 mg Cl^-/l in all three digestion solutions. Residual chlorine results in a positive interference, when the $K_2S_2O_8$ manifold is used. For these samples, a solution 3% in $NH_2OH \cdot HCl$-NaCl is to be added to the sample stream immediately after the digestion step at the rate of 0.3 ml/min. $CuSO_4$ did not interfere in concentrations of up to 1 g/l. Ethyl alcohol, methyl alcohol, glycerol, chloroform, and carbon tetrachloride did not interfere when added in concentrations as high as 0.5%. Major interferences were observed, however, from benzene and toluene. A maximum tolerance of 500μg/l was obtained for these compounds. The above illustrates that the use of $K_2S_2O_8$ as the sole oxidizing reagent in the digestion step is sufficient. The elimination of $KMnO_4$ results in a stable base line and removes interferences caused by the precipitation of manganese oxides in the tubes. In addition, high backgrounds generally observed in Hg determinations using $KMnO_4$ are eliminated.

The present method is suitable for the separate determination of inorganic and organic mercury. For this purpose, the inorganic mercury is determined by the removal of all reagents except for the $SnCl_2$ solution used for the reduction of Hg^{2+}. The temperature of the system is maintained at room temperature, and the inorganic mercury concentration is read off

a calibration curve made of known concentrations of $HgCl_2$ run under the same conditions. Inorganic mercury as determined by this method is defined as all mercury compounds that are reduced to elemental mercury by $SnCl_2$ without predigestion of the sample. The total mercury in the system is then determined, using the normal digestion and reduction steps and read off a calibration curve done under the same conditions. The difference between total and inorganic mercury is the amount of organic mercury in the samples. Table VII gives the date for inorganic and organic mercury content of real as well as artificial mixtures. No attempts were made to analyze for organic mercury independently.

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The authors are greatful for the help received from many of the personnel of the U.S. Environmental Protection Agency, Region V, Central Regional Laboratory.

The mention of trade names or commercial products does not constitute endorsement nor recommendation for use by the Environmental Protection Agency.

TABLE I

Variation of Scale Reading with Rate of Air Flow

Flow Rate[a]	Scale Reading[b]				
cm^3/min	0.5	1.0	2.0	3.0	4.0 μg/l
0					25.0
10	10.8	22.0	32.5	48.0	59.0
15	12.5	24.0	41.0	58.0	69.0
17					72.5
19	13.0	26.0	42.0	58.5	76
22	13.0	25.0	44.0	63	77
24					77
25	12.0	23.0	40.0	60	75
31	10.0	20.0	35.0	55	70
37	9.0	19.0	32.0	50	60

[a]Flow rates are those of the air used for aspiration only.

[b]Full scale 100 division at 50% absorption.

TABLE II

Preservation of Real and Artificial Samples

amples Type	Preservative	Hg µg/l Present	Hg^{2+} µg/l Added	Time (days) 0	0.13	1	3	4	5	8	10	13	17	18	25	32
eionized	None (polyethylene)	0.00	3.00	2.48	2.45	2.15	1.83		1.51		1.00	0.83	0.77		0.82	
ater	0.5% HNO_3	0.00	3.00	2.95	2.80	2.60	2.50		2.43		2.09	2.02	1.83		1.52	
	0.5 HNO_3-0.05% $K_2Cr_2O_7$	0.00	3.00	3.05	3.00	3.02	2.99		2.99		3.06	3.03	2.93		2.98	
urface Water	None (glass)	0.98	2.00	2.89	2.85	2.73		2.25		2.05		1.90		1.55	2.00	2.0
ontaining	None (polyethylene)	0.98	2.00	2.83	2.74	2.58		2.20		2.05		1.80		1.60	1.50	1.9
ndustrial	0.5 HNO_3	1.03	2.00	2.80		2.82		2.80		2.90		2.87		2.81	2.71	2.7
aster	0.5 HNO_3-0.05% $K_2Cr_2O_7$	1.03	2.67	3.51		3.42		3.34		3.42		3.48		3.49	3.46	3.4
ewage	None (glass)	0.12	2.67	2.77	2.64	2.51		2.40		2.14		2.10		2.06	1.99	1.8
reatment	None (polyethylene)	0.12	2.40	2.55	2.46	2.36		2.25		2.08		1.97		1.82	1.63	1.6
lant	0.5% HNO_3	0.18	2.40	2.61		2.76		2.79		2.79		2.72		2.73	2.54	2.5
ffluent	0.5 HNO_3-0.05% $K_2Cr_2O_7$	0.32	2.40	2.71		2.73		2.91		2.85		2.87		2.90	2.82	2.9
aw	None (glass)	1.23	2.67	3.69	3.53	3.45		3.42		3.47		3.31		3.30	3.22	3.0
ewage	None (polyethylene)	1.20	2.40	3.38	3.20	3.15		3.21		3.10		2.91		3.18	2.87	2.9
	0.5% HNO_3	1.66	2.00	3.53		3.33		3.40		3.34		3.34		3.36	3.17	3.3
	0.5% HNO_3-0.05% $K_2Cr_2O_7$	1.66	2.00	3.66		3.66		3.74		3.66		3.60		3.63	3.58	3.7

TABLE III

REPRODUCIBILITY

	Automated		Manual	
Hg, Level µg/l	Standard[c] Deviation	Relative Std. Deviation %	Standard[c] Deviation	Relative Std. Deviation %
0.05[a]	0.005	10 %		
0.10[a]	0.007	7		
0.20[a]	0.01	5		
0.30[a]	0.008	3		
0.40[a]	0.02	5		
0.60[a]	0.04	4		
0.25[b]	0.04	17	0.063	28.0
0.50[b]	0.04	7		
0.75[b]	0.04	5		
1.0[b]	0.04	4	0.083	8.0
2.0[b]	0.09	5		
3.0[b]	0.08	3	0.13	4.0
4.0[b]	0.2	5		
6.0[b]	0.48	8		

[a]Standards run using 10X expansion of the Hg monitor (automated system).

[b]Standards run using 1X scale of the Hg monitor and 2X expansion of the recorder (automated system only).

[c]Based on 10 or more replicates.

TABLE V

COMPARISON OF AUTOMATED AND MANUAL METHODS
(μg/l Hg)

Sample Type	COD	Automated			Manual
		4% $K_2S_2O_8$	4% $K_2S_2O_8$ 1% $KMnO_4$	4% $K_2S_2O_8$ 2% $K_2Cr_2O_7$	
Reagent blank	-	0.07		0.07	<0.2
Reagent blank	-	<0.05	<0.05		<0.2
Well	<3	0.11		0.13	
Stream	90	0.52			0.8
Industrial intake	9	0.15	0.16		<0.2
" " efflu.	24	<0.05	<0.05		<0.2
" " "	26	0.05	=0.05		<0.2
" " "	9		0.45		0.5
" " "	72	0.15	0.20		<0.2
" " "	120	0.10	0.13		<0.2
" " "	38	0.19		0.16	<0.2
" " "	215	0.23		0.26	0.2
" " "	179		0.15		<0.2
" " "	1480*	1.81	1.96		2.4
" " "	4		0.11		<0.2
Raw Sewage	278	0.28			0.2
" "	479	0.20			0.2
" "	521		0.85		1.0
" "	441		0.30		0.4
" "	567		0.18		0.2
" "	292	0.21	0.21		0.2
" "	329	0.55	0.42		0.7
" "	244	0.30			0.3
" "	554	0.10	0.10		<0.2
" "	380	0.22	0.23		0.3
" "		1.17	0.95		1.0
" "	407	0.43	0.43		0.3
" "	441	1.50	1.30		1.7
" "	-	0.54			0.5
" "	434			0.62	0.6
" "	447	0.76			0.9
STP Effluent†	281	0.18	0.18		<0.2
STP Effluent	29	0.10	0.11		<0.2
" "	237	0.33	0.23		0.3
" "	301	0.64			0.7
" "	94	0.24			0.3
" "	225		0.18		0.2
" "	244	0.30	0.24	0.27	0.3
" "	29			0.38	0.2
" "	448			0.68	0.6
" "	199			0.39	0.4
" "	218	0.30	0.32		0.3

*Sample diluted by a factor of three before analysis.

†Sewage treatment plant effluent.

TABLE IV

Recovery of Known Amounts of Methyl Mercuric Chloride by $KMnO_4$, $K_2Cr_2O_7$, and $K_2S_2O_8$ Oxidation Procedures.[a]

CH_3HgCl, Added µg/l	Thermal Decomposition[b] %	1% $KMnO_4$ %	2% $K_2Cr_2O_7$ %	4% $K_2S_2O_8$[c] %
0.5	17.4	27.3	45.5	100.1
1.0	20.0	25.0	40.0	100.5
2.0	18.0	23.4	35.9	98.5
3.0	23.8	29.7	39.2	103
4.0	24.2	31.5	40.6	98.0

[a]Based on $HgCl_2$ standards.

[b]No oxidizing agent added, all other reagents are used, however.

[c]Similar results are obtained using 1% $KMnO_4$ - 4% $K_2S_2O_8$ and 2% $K_2Cr_2O_7$ - 4% $K_2S_2O_8$.

TABLE VI

RECOVERY OF MERCURY FROM SPIKED SAMPLES

Sample Type	COD	µg/l Hg In Sample	µg/l Hg Added	µg/l Hg Found	% Recovery*
Reagent blank	-	<0.05	0.11	0.12	109
Cooling water	30	0.07	0.20	0.28	103
Industrial Effluent	123	0.13	0.30	0.45	105
" " " "	13	<0.05	0.10	0.11	92
" " " "	26	0.05	0.10	0.13	87
" " " "	120	0.13	3.00	3.05	97
" " " "	278	0.28	0.50	0.82	105
" " " "	252	0.08	0.08	0.15	94
" " " "	-	0.08	0.20	0.31	110
" " " "	23	0.80	1.00	1.90	106
Raw Sewage	261	1.30	2.00	2.70	82
" "	168	0.50	2.00	2.40	96
" "	120	2.58	1.30	2.80	98
" "	-	0.54	0.30	0.82	98
" "	448	0.68	1.00	1.59	95
" "	597	0.50	2.00	2.80	112
STP Effluent	40	2.90	1.00	3.98	102
" "	94	0.4	2.00	2.50	103
" "	218	0.32	0.40	0.78	108
" "	199	0.39	1.00	1.34	96

*Defined as the percent total mercury recovered.

TABLE VII

RECOVERIES OF ORGANIC AND INORGANIC MERCURY
(μg/l)

Sample Type	Inorganic Hg Found Before Spiking	Total Hg Found Before Spiking	Inorganic Hg Added	Organic Hg Added	Inorganic Hg Found After Spiking	Total Hg Found After Spiking	% Recovery* Inorganic	% Recove Organic
Raw Sewage	0.13		2.00		2.02		95	
Raw Sewage		2.68		0.60		3.50		107
Raw Sewage	0.19		2.50		2.49		92	
Raw Sewage	0.19		5.00		4.49		85	
Raw Sewage		2.58		1.00		3.44		96
STP Effluent	1.20		4.00		5.67		109	
STP Effluent		2.90		1.00		3.51		90
Artificial Sample	0.00		0.88	2.50	0.80	3.34	91	102
Artificial Sample	0.00		1.00	1.00	0.95	2.10	95	115
Artificial Sample	0.00		0.25	0.50	0.27	0.73	108	95

*Defined as the % total recovered mercury.

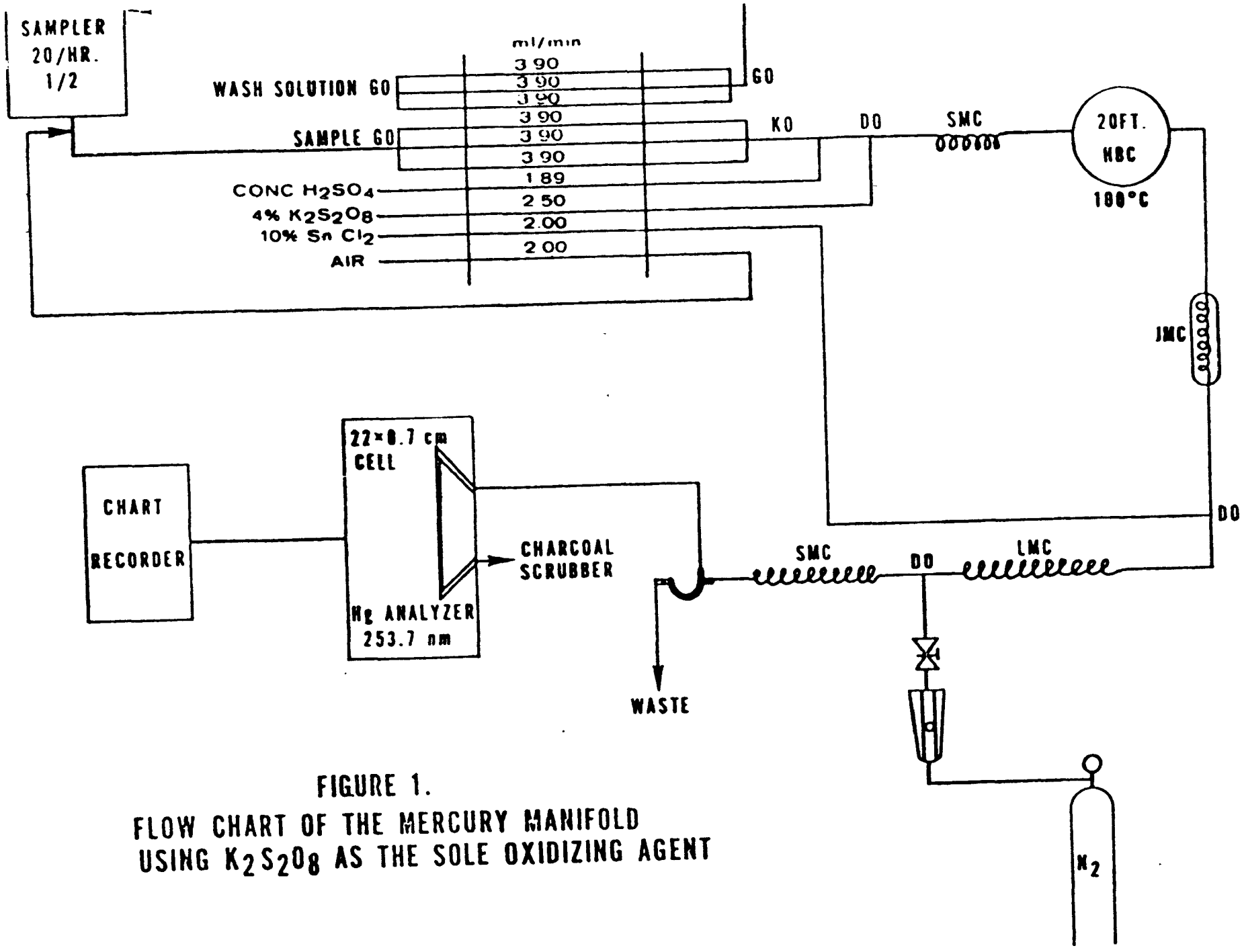

FIGURE 1.
FLOW CHART OF THE MERCURY MANIFOLD
USING $K_2S_2O_8$ AS THE SOLE OXIDIZING AGENT

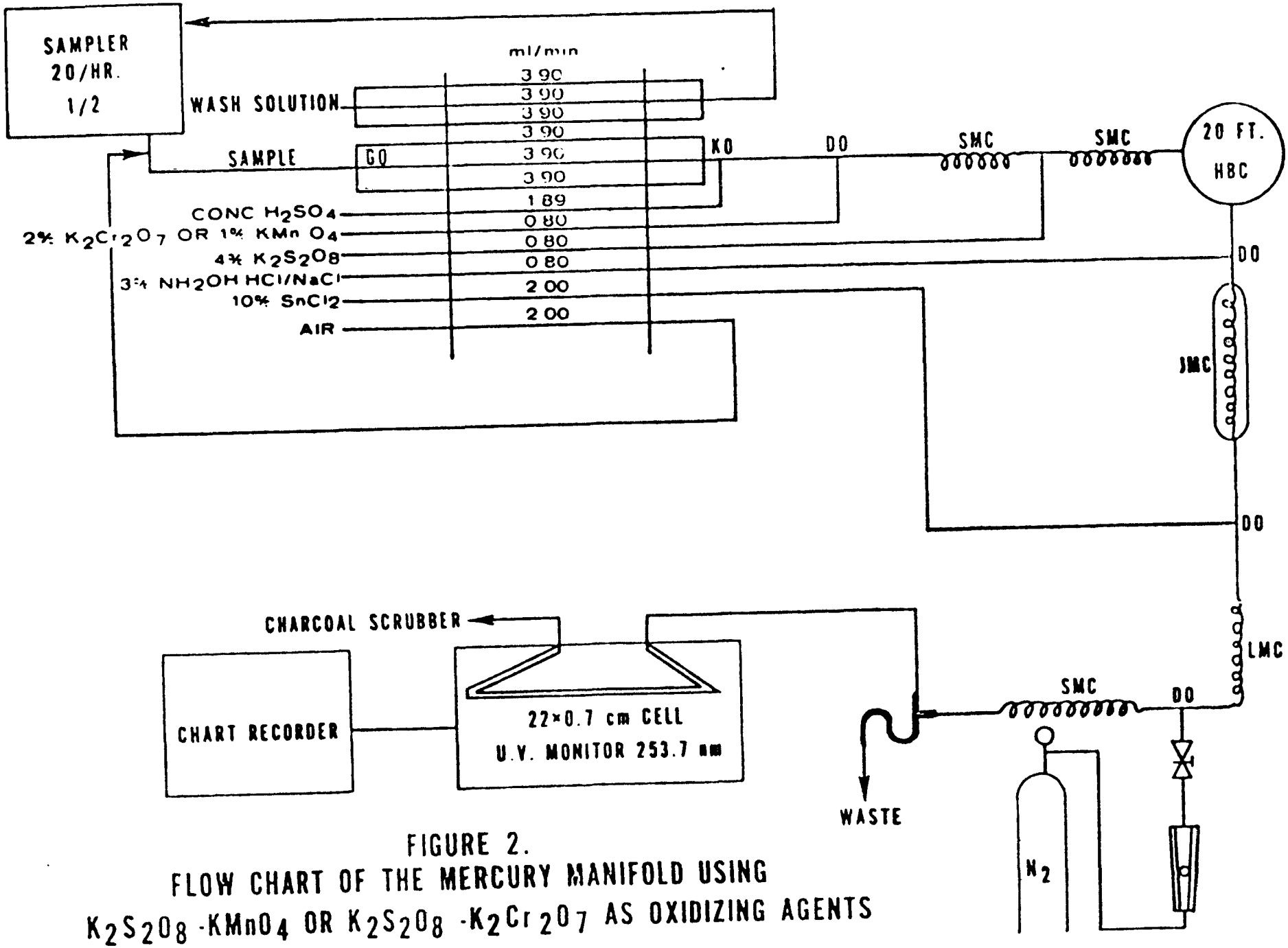

FIGURE 2.
FLOW CHART OF THE MERCURY MANIFOLD USING
$K_2S_2O_8$-$KMnO_4$ OR $K_2S_2O_8$-$K_2Cr_2O_7$ AS OXIDIZING AGENTS

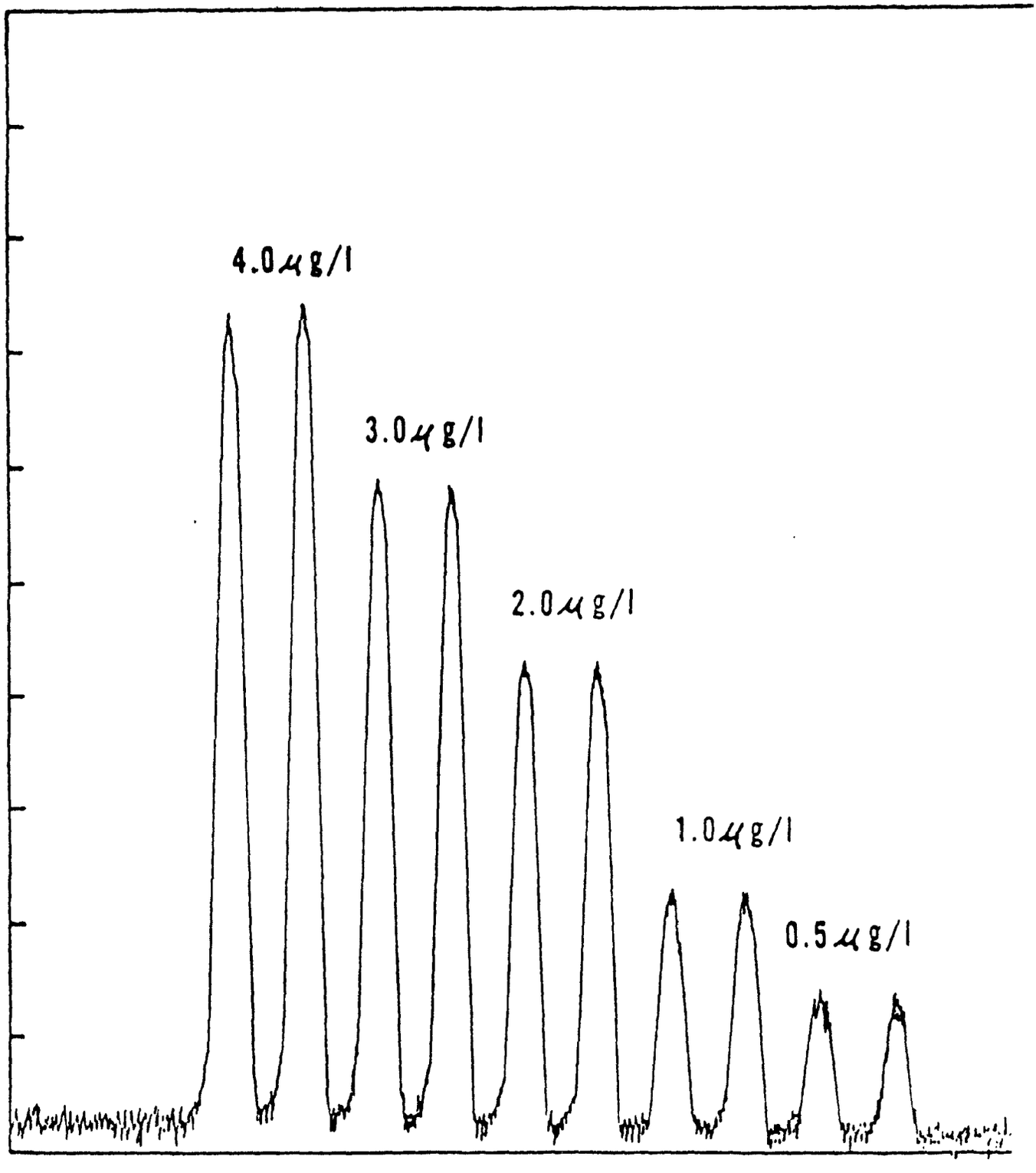

FIGURE 3. RECORDER PLOT WITH STANDARD SOLUTIONS OF MERCI

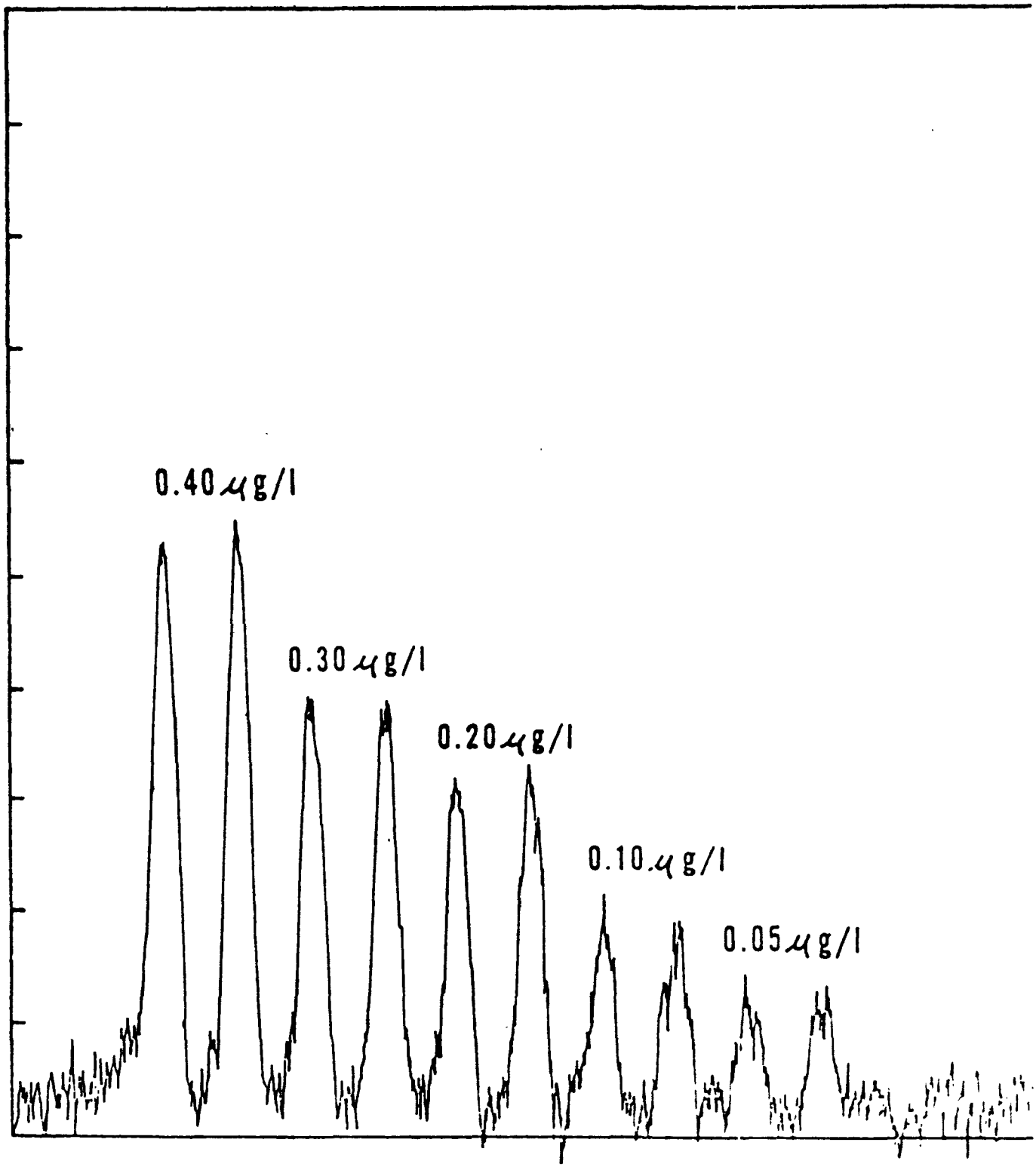

FIGURE 4. RECORDER PLOTS WITH STANDARD SOLUTIONS OF MERCUR

APPENDIX IV

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MICRO METHODS FOR THE DETERMINATION OF NON-FILTRABLE AND FILTRABLE RESIDUES

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April 18, 1975

ABSTRACT

Rapid, micro methods for the determination of non-filtrable and filtrable residues are reported. Non-filtrable residue analysis of wastewaters is accomplished using up to 10 ml of sample for a detection limit of 1 mg/l. Using the suggested sample sizes, all filtration work is completed within ten minutes. Filtrable residues are determined on a 100 µl sample which is dried at 180°C for one-half hour. Thirty samples can be analyzed for both residue parameters in less than three hours. Both micro methods were shown to produce results comparable to the standard methods with better precision.

The determination of non-filtrable and filtrable residues are among the oldest determinations in water analysis. While old, residue analyses remain important in assessing the quality of waste, surface and potable waters. At least one residue parameter is included in a list of significant parameters for assessing the quality of effluents from each of twenty-two major industrial groups identified in a recent EPA report.[1]

The most widely used procedures for determining filtrable residue are given in "Standard Methods".[2] Selection of a drying temperature of 103-105°C[3,4] or 180°C[5] is left to the discretion of the analyst. Howard evaluated both drying temperatures and found that the value for filtrable residue, based on drying at 180°C, agreed best with the sum of the determined constituents for most natural waters.[6] The EPA has adopted the 180°C drying procedure for routine use.[7,8] However, a large sample volume and hence a long drying time are required to achieve good precision with the standard filtrable residue procedure. Another requirement to obtain good precision is the careful desiccation of the weighing dishes after sample evaporation.

Allen and Bacon reported a micro method for determining filtrable residues which requires a substantially smaller sample volume and shorter drying time than the standard method.[9] They eliminated the problem of sample desiccation by placing the weighing chamber

of a Cahn micro balance in a drying oven at 105°C. Unfortunately, this drying technique is not applicable to the 180°C filtrable residue procedure because the maximum operating temperature of the weighing chamber is 110°C.

A substantial amount of work has been performed on improving the standard Gooch crucible-asbestos mat procedure for the determination of non-filtrable residues.[10-14] Chanin et al., have identified the major difficulties with the asbestos mat technique as being due to variations in asbestos quality, preparation of non-uniform mats, mat disturbance during handling, and a slow filtration rate.[10] Degen and Nussberger found that the mat must be carefully washed, before taring and after sample filtration, to avoid erroneous results.[14]

Chanin et al.[10], and Nusbaum[11] simultaneously reported similar non-filtrable residue methods using glass fiber filters which greatly reduced problems with mat preparation. Engelbrecht and McKinney[12] used the membrane filter for non-filtrable residue analysis but reported a slow filtration rate for some samples. Harada et al., also noted this problem using glass fiber filters and reported a procedure utilizing a combination filter mat consisting of both coarse asbestos and a glass fiber disk.[13]

Smith and Greenberg compared and evaluated five of the non-filtrable residue methods in common use, including the standard procedure.[15] Three glass fiber filtration techniques were compared to an asbestos mat and a membrane filter method. They found no

statistically significant bias or different coefficients of variation between the five methods. However, none of the procedures studied combines speedy filtration with ease of filter media preparation. The problem of a slow filtration rate becomes serious when a large volume of sample must be filtered for filtrable residue analysis. A fast, efficient and accurate method for determining non-filtrable residues that combines a minimum of filter handling with rapid filtration is reported in this paper. A rapid method for determining filtrable residues using only 100 µl of sample is also reported.

METHODS

Apparatus. All weighings were performed on a Mettler ME22 electronic microbalance equipped with BE22 control and BA25 digital display units and a Nuclear Products Co. 500 μC Po 210 ionizing source. All of the filters evaluated are listed in Table I. The Nuclepore 25 mm diameter 0.4 μm standard polycarbonate membrane filter was chosen for routine use. Sample filtration was performed with a Millipore thirty-place membrane sampling manifold using 15 x 125 mm culture tubes to receive the filtrate. Liquid transfers for non-filtrable residue analysis were performed with a 1-5 ml or 5-10 ml Oxford Laboratories Macro-Set pipet with disposable tips. A 100 μl Eppendorf pipet with disposable tips was used for liquid transfers for filtrable residue determinations. Cahn 12 mm diameter aluminum pans were used as evaporating dishes for filtrable residue analysis. Coors 03 12-place spot plates were used to hold the aluminum pans. Two control standards for filtrable residue analysis were prepared with NaCl to be 400 and 500 mg/l. Non-uniform samples were homogenized with a Tekmar model SDT.

Non-Filtrable Residue. Weigh the Nuclepore filters to the nearest microgram directly out of the box. Pass the filters about 1 inch over the Po 210 ionizing source in the weighing chamber to reduce the electrostatic charge. Place the weighed filters in numbered 60 mm aluminum weighing dishes until they are to be used. Wash and dry the sample wells and filter supports of the sampling manifold. Load the filtrate receiving rack with 15 x 125 mm culture tubes and assemble the manifold as per Millipore Co. instructions. Place the filters on the

manifold by first dipping each filter in distilled water so they adhere to the support. Homogenize all non-uniform samples. Choose a volume of a surface or wastewater to filter so that no more than 2.0 mg of residue will remain. Discard any sample which does not filter in ten minutes and re-filter a smaller sample volume. Generally, volumes filtered are 10 ml for a surface water or wastewater effluent (up to a concentration of 200 mg/l), and 1 ml for grossly polluted samples (up to a concentration of 2000 mg/l). In addition, analyze one sample in duplicate and the two filtrable residue control standards (also used as blank filters) per set of samples. When filtration is complete, disassemble the sampling manifold, remove the filtrate receiving rack and reassemble the manifold. Wash each filter with two 5 ml portions of distilled water. Remove the filters from the sampling manifold, return them to the numbered aluminum weighing dishes and place in an oven at 103-105°C for 1/2 hr. Remove from the oven at one time only the number of filters that can be weighed before the aluminum pans cool. The final non-filtrable residue values are corrected for the change in blank filter weights. The cause for a blank of more than 0.01 mg should be investigated before reporting the results.

Filtrable Residue. Weigh the Cahn 12 mm diameter aluminum pans to the nearest microgram and place on a numbered Coors spot plate. Transfer one hundred µl of each sample to the residue dishes with an Eppendorf pipet. Analyze the A and B control standards just like the real samples. Carry two blank pans through the drying and weighing process. Correct final filtrable residue values for the change in blank pan weights. The cause for a blank of more than 0.003 mg should

be investigated before reporting the results.

RESULTS AND DISCUSSION

Non-Filtrable Residue Method Development. *The primary considerations* in developing a new non-filtrable residue method were the ease of filter media handling and a rapid filtration rate. Harada et al., solved the filtration rate problem by using a media that was difficult to prepare.[13] Most investigators have found glass fiber and membrane filters easy to use but of limited loading capacity, especially the latter ones. One proposed solution to this problem is to use large diameter filters.[11]

The authors decided the best solution to the media handling and filtration problem was to use glass fiber or membrane filters with a small enough water sample volume that would pass through the media quickly. Initial experiments with grossly polluted wastewaters, using 25 mm glass and membrane filters, showed that no more than 10 and 5 ml, respectively, could be filtered in less than 10 minutes. For monitoring stream and wastewaters the method must be capable of measuring down to 5 mg/l. This means that residues of 0.05 mg (using 10 ml samples) must be determined accurately. Since micro balances measuring to the nearest 0.0001 mg are available, the real limitation of the method is the stability of the filters.

Filter Stability. The two major causes of filter instability are weight loss due to wash-out or "media migration" during filtering[16-18] and the volatilization of filter material during the drying process.[17] The bias introduced by "media migration" during sample filtration can be eliminated by pre-washing the filter.[2,7] However, this involves an extra step in the analytical procedure. The thermal instability problem exists mainly with the membrane-type filters and has only been resolved by drying in a desiccator.[18] However, this procedure is more time consuming and could result in a positive bias when compared to the 105°C drying method.

When filtering small volumes, and hence weighing small amounts of residue, an undetected weight loss from a filter can significantly bias the results. Ten filters were evaluated for their stability upon filtering 10 ml of water and drying at 105°C for 1/2 hour. The results in Table I show the weight losses for three binderless glass fiber filters (Reeve-Angel 934 AH, Gelman type E and Millipore AP40) two glass fiber filters with an acrylic resin binder (Millipore AP15 and AP20) and five different membrane-type filters (Nuclepore, Millipore MF, Gelman TCM, Millipore HATF, Gelman AN1200).

TABLE I

WEIGHT CHANGES FOR TEST FILTERS (In Milligrams)[a]

	Reeve-Angel 934 AH	Gelman Type E	Millipore AP40	Nuclepore	Millipore AP20	Millipor MF
Mean Weight before	25.38	36.69	34.30	4.303	34.45	29.22
Mean weight after	25.27	36.59	34.19	4.301	34.33	28.89
Mean weight change	-0.118	-0.106	-0.117	-0.003	-0.121	-0.328
Std. dev. of weight changes	0.026	0.020	0.023	0.002	0.012	0.013

	Gelman TCM	Millipore AP15	Millipore HATF	Gelman AN1200
Mean weight before	14.25	46.62	28.44	27.85
Mean weight after	14.13	46.51	28.16	27.67
Mean weight change	-0.120	-0.107	-0.286	-0.175
Std. dev. of weight changes	0.008	0.013	0.016	0.006

[a] These values are based on ten replicate experiments with each type of filter. The filters were pre-weighed, exposed to a 10 ml deionized water filtration, dried at 105°C for one-half hour and re-weighed.

The mean weight loss and the standard deviation of weight loss based on ten replicates were very similar for the three binderless glass filters. The weight loss, if unaccounted for, would bias the results by an average of 11 ± 5 mg/l at the 95% confidence level. While the mean weight loss for the bindered and unbindered filters was similar the standard deviation of the weight loss for the former has half that for the latter filters. These experimental results confirmed the visual observation that the bindered filters were structurally sounder and sloughed off less filter material during handling. Except for the Nuclepore filter, the membrane filters exhibited either a larger mean or standard deviation of weight loss than the glass filters. The Nuclepore filters showed the smallest mean and standard deviation of weight loss of all the filters tested.

Table II shows weight loss results from filters which were pre-washed three times with 10 ml of de-ionized distilled water and dried before filtering the test 10 ml aliquot of water. Prewashing the glass fiber filters substantially reduced the mean and standard deviation of weight loss. Prewashing the cellulose membrane filters substantially reduced their weight loss during filtration.

Further experiments were performed to determine the cause of weight loss during the filtration-drying process. Samples of the filters listed in Table I were dried at 105°C for 1/2 hour. The Nuclepore and all of

TABLE II

WEIGHT CHANGES FOR PRE-WASHED TEST FILTERS (In Milligrams)[a]

	Millipore AP15	Millipore AP20	Millipore AP40	Millipore MF	Gelman TCM
Mean weight change	-0.012	-0.012	-0.031	-0.013	-0.015
Std. dev. of weight changes	0.004	0.011	0.007	0.013	0.019

[a] These values are based on ten replicate experiments with each type of filter. The filters were pre-washed three times with 10 ml of water, dried at 105°C for one-half hour and pre-weighed. They then were exposed to a 10 ml water filtration, dried at 105°C for one-half hour and re-weighed.

glass fiber filters were stable to 0.002 mg. The other membrane filters showed substantial weight losses which were less than the total weight losses from the filtering and drying process. Therefore, the glass filters lose weight only during the filtering process whereas the cellulose membrane filters lose weight during both the filtering and drying process. This conclusion was verified by experiments which showed that the cellulose membrane filters continued to lose weight during the drying process even after they were thoroughly washed.

As a results of the above experiments the Nuclepore and the Millipore AP20 bindered glass filter were chosen to evaluate the micro technique. A drying time of 30 minutes was shown to be adequate for both filter types by re-drying a set of particulate laden filters for 24 hours without any addition weight loss. Due to the low heat capacity of the filters, they could be weighed directly from the oven without cooling in a desiccator.

The relative humidity during the course of this work was always below 30% and although a desiccator was not used no filter weight gain from hygroscopic effects was observed. Tierney and Conner showed that at 100% relative humidity clean glass fiber filters will gain about 5% in weight.[19] They also showed weight gains up to 80% for particulate-laden glass filters at 100% relative humidity. However, at relative humidities below 55% the weight gain of three different samples was less than 1%. A weight gain of only 0.24% has been reported for Nuclepore filters immersed in water for 24 hours.[20] This property, combined with the low tare weight of the

filter were the deciding factors in choosing the Nuclepore filter for routine use. If cost is a serious consideration, then pre-washed glass fiber filters can also be substituted. Whichever filter is used, it is desirable to maintain the relative humidity below 50% during the weighing process. It was also determined to be necessary to keep a Po 210 alpha ionizing source in the balance weighing chamber to eliminate an electrostatic charge build-up on the Nuclepore fil

Non-filtrable Residue Methods Comparison. The data in Table III compare results using the micro method and the standard method.[2,7] The ratio of the micro (using the Nuclepore filter) to the standard method results is 1.04 ± 0.37 which is not significantly different from one (T-test, $\alpha = 0.05$). Smith and Greenberg also reported no statistically significant bais in results determined using the standard method with membrane and glass filters.[15] However, their results from the membrane filters were slightly greater than the glass filters.

For the micro method, the ratio of results using Nuclepore and Millipore AP20 filters is 1.07 ± 0.11, which is not significantly different from one (T-test $\alpha = 0.05$). However, the results from the Nuclepore filters are slightly greater than from the glass filters. Cranston and Buckley reported that both Nuclepore and glass filters quantitatively retained 2 μm beads, whereas the retention of 1 μm beads was 98 and 26% respectively.[16] Therefore, filtering the same volume of a wastewater through Nuclepore and glass filters of the same diameter should produce higher results for the former filter. The magnitude of the difference would depend on the particle size distribution of the samples.

TABLE III

COMPARISON OF MICRO AND STANDARD METHODS FOR THE DETERMINATION OF NON-FILTRABLE RESIDUE[a]

Sample Type	Micro Method Nuclepore	Micro Method Millipore AP20	Standard Method
Cooling Water	4,4	<2,4	<5
Industrial Eff.		72,74	72
Industrial Eff.	7,7	2,3	<5
Starch Waste	2,2	9,10	12
Well Water	7,6	9,9	<5
Surface Water	14,15	13,15	15
Raw Sewage	192,186	179,183	190
Raw Sewage	195,204	199,202	184
Treated Sewage	98,102	94,96	106
Raw Sewage	156,157	146,151	162
Treated Sewage	39,43	39,41	
Refinery Eff.	23,20	21,21	
River Water	20,21	21,19	
Well Water	22,24	23,17	
Refinery Waste	20,22	22,19	
Raw Sewage	339,322	327,320	320
Surface Water	14	13,13	9
Steel Eff.	907,910	890,860	880
Food Eff.	20	19,19	
Steel Eff.	11	9	15
Steel Waste	13	11	16
Treated Sewage	12	9	7
Treated Sewage		9	7

[a] All results are expressed in mg/l. Values separated by a comma are results from duplicate determinations.

A paper industry report presented data to show that using the standard method, the larger the volume filtered, the higher the determined non-filtrable residue concentration.[21] Obviously, the larger the volume of water filtered, the greater the amount of residue collected and the more difficult it would be to thoroughly wash the filter. Cranston and Buckley found that a rinse of 25 ml of deionized water was not sufficient to remove trapped inorganic salts from a 25 mm glass fiber filter after filtering sea water.[16] In addition, if enough residue was collected to act as a pre-filter, higher results would be determined for larger volumes filtered.

Several samples were analyzed in triplicate by the micro method using three different sample volumes. The results in Table IV show that, using the micro technique, there is no universal increase in non-filtrable residue results with increasing sample volume. The largest volume filtered corresponds to no more than 3 mg of residue on a 25 mm filter with a maximum filtration time of 10 minutes. No problem was encountered washing the filters. The results reported in the paper industry report correspond to a 10 mg residue on a 21 mm filter with filtration times over 2 hours. Obviously, the paper industry filters could not be washed properly. In order to assure proper washing of the residue, sample volumes are chosen so that the maximum filtration time is 10 minutes. This corresponds to a maximum of 2-3 mg residue depending on the clogging characteristics of the sample. Any filter that becomes clogged must be discarded to avoid erroneous results such as those reported in the paper industry report.[21]

Initial work to define the precision of the method revealed poor duplication of results for samples with non-uniform particulate matter. Thereafter, all samples with non-uniform particulate matter were homogenized with a Tekmar SDT blender. In order to show that the process of homogenization does not alter the non-filtrable residue concentration, a raw sewage sample was analyzed ten times before and after blending. The results (blended, 279.0 ± 4.8 mg/l; unblended, 280.0 ± 8.0 mg/l) show that the mean results are not affected but the precision is improved by blending the samples.

The precision of the micro method on the variety of sample types studied is 3 mg/l below 50 mg/l non-filtrable residue and 9 mg/l above 50 mg/l at the 95% confidence level. The average coefficient of variation for all samples is 4.0%. Smith and Greenberg reported a coefficient of variation of 4.2% using the standard method.[15] The absolute detection limit of the method is 0.01 mg (3σ). This corresponds to 1 mg/l for a 10 ml sample volume.

Filtrable Residue Method Development. The method of Allen and Bacon was evaluated for use in combination with the micro non-filtrable residue method described previously.[9] Their method used 50 µl of sample dried at 105°C for 15 minutes and the residue was weighed to 0.0001 mg with results reported to the nearest 1 mg/l. Initial experiments showed that the extra significant figure gained by weighing

TABLE IV

CONCENTRATION OF NON-FILTRABLE RESIDUE VERSES VOLUME OF SAMPLE

	Non-Filtrable Residue, mg/l[a]		
Sample Volume, ml	5	10	20
Sewage I	74	72	73
Sewage II	141	139	142

[a] Determined using Millipore AP20 glass fiber filters. All filters were washed twice with 5 ml of water.

to 0.0001 mg was at the expense of several minutes extra weighing time per sample. Therefore, a 100 µl sample size was chosen, the residue weighed to 0.001 mg and the results reported to the nearest 10 mg/l. With this sample size, a ten-fold advantage of sample size to evaporating dish weight exists for the micro over the standard method.

Howard showed that the figure for total dissolved solids, based on the weight of residue after drying at 180°C, is close to the sum of the determined constitutents for most natural waters.[6] Therefore, the drying and weighing procedure of Allen and Bacon was modified to accommodate a 180°C drying procedure. Advantage was taken of the very large difference in heat capacities of the aluminum pans and the supporting porcelain spot plate to simplify the weighing process. After drying for 30 minutes (found to be sufficient), the spot plates are removed from the oven. As each aluminum pan is weighed, the remaining ones are kept hot by the spot plate for up to ten minutes. This technique eliminates the need for a desiccator.

Comparison of Filtrable Residue Methods. The micro and standard filtrable residue methods were compared on a variety of sample types (Table V). The mean ratio of micro to standard method results, 0.99 ± 0.18 at the 95% confidence level, is not significantly different from one (T-test, $\alpha = 0.05$).

TABLE V

COMPARISON OF MICRO AND STANDARD METHODS FOR THE DETERMINATION OF FILTRABLE RESIDUE

Sample Type	Filtrable Residue, mg/l		
	Micro[a]	Standard	Spec. Cond., us
Refinery waste	620,590	635	970
Refinery effluent	1930,1940	1930	3370
Well water	720,710	640	1120
River water	370,390	395	580
Refinery effluent	830,820	820	1410
River water	500,520	495	800
Refinery effluent	910,930	870	1460
Steel mill effluent	670,680	670	1050
Steel mill waste	510,510	600	780
Treated Sewage	880,820	800	1230
Lake Water	230,240	270	385
Lake water	240,240	260	370
Food process waste	1530,1530	1480	2350
Well water	350,330	370	610
Starch waste	800,790	710	1180
Industrial waste	370,350	310	510
Industrial effluent	860,850	970	1570
Lake water	250,250	250	410
Raw sewage	1250,1240	1210	2070
Treated sewage	520,520	590	850
Treated sewage	630,630	580	1070
Raw sewage	510,500	580	820

[a] Values separated by a comma are results from duplicate determinations.

The precision of the micro method was determined from the paired results in Table V to be 26 mg/l, at the 95% confidence level. At a mean result of 705 mg/l, this corresponds to a coefficient of variation of 2%. "Standard Methods" quotes a coefficient of variation of 5% for the macro method.[2] The absolute detection limit, based on three times the standard deviation of thirty-two blank values, is 0.0021 mg. This corresponds to a detection limit of 21 mg/l using a 100 µl sample volume.

There is no method of assessing the accuracy of filtrable residue determinations on real samples. Howard[6] and Sokoloff[22] showed that the loss of some chloride and nitrate are unavoidable in the determination of filtrable residues. However, the A and B control standards were used to evaluate day-to-day bias in results. For ten determinations on different days the values of the A and B standards were 506 ± 19 and 411 ± 13 mg/l, respectively. Specific conductance values were also used to assess the consistency of filtrable residue measurements. The ratio of residue to conductivity results in Table V is 0.62 ± 0.08 at the 95% confidence level. This ratio corresponds very closely to that reported by Rainwater and Thatcher, for comparatively dilute solutions.[23] For solutions with dissolved salt concentrations exceeding 2000 to 3000 mg/l or with substantial concentrations of dissolved silica and organic matter, the ratio may be much higher. For waters high in acidity or alkalinity the ratio can be much lower than 0.62. The cause of a filtrable residue to conductivity ratio outside of 0.62 ± 0.1 should be investigated before any results are reported.

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Credits

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The mention of trade names or commerical products does not constitute endorsement or recommendation for use by the Central Regional Laboratory, or the Environmental Protection Agency.

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APPENDIX V

CRLS 05APR DSN=CNCRLS.RGD.IL.DW04 ON TS0009 04/19/75 REV(

----------STUDY DESCRIPTION----------

NPAR	NLOG	AGENCYID	UNLOCKEY	STATTYPE	SMPLDAY	ATLABBY	DUEDATE	ACCOUNT-NUMBE
96	73			77777777	03FEB75	05FEB75	03MAY75	

>>>REGION V DRINKING WATER STUDY - ILLINOIS

----------SAMPLE DESCRIPTIONS----------

LABIDNUM	STORETID	COLLDAY	TIME	STATTYPE	DEEP	T	M	NO	ENDDATE	TIME	PRLU
14045		750203									
14046		750203									
14047		750203									
14048		750203									
14049		750203									
14050		750203									
14051		750203									
14052		750203									
14053		750203									
14054		750203									
14055		750203									
14056		750203									
14057		750203									
14058		750203									
14059		750203									
14060		750203									
14061		750203									
14062		750203									
14063		750203									
14064		750203									
14065		750203									
14066		750203									
14067		750203									
14068		750203									
14069		750203									
14070		750203									
14071		750203									
14072		750203									
14073		750203									
14074		750203									
14075		750203									
14076		750203									
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14078		750203									
14079		750203									
14080		750203									
14081		750203									
14082		750203									
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14090		750203									
14091		750203									
14092		750203									

14093		750203	
14094		750203	
14095		750203	
14096		750203	
14097		750203	
14098		750203	
14099		750203	
14100		750203	
14101		750203	
14102		750203	
14103		750203	
14104		750203	
14105		750203	
14106		750203	
14107		750203	
14108		750203	
14109		750203	
14110		750203	
14111		750203	
14112		750203	
14113		750203	
14114		750203	ILLINOIS
14115		750203	
14116		750203	
14117		750203	
>>>14045	>>	HNO3 REAGENT BLANK	
>>>14046	>>	H2SO4 REAGENT BLANK.	
>>>14047	>>	NAOH REAGENT BLANK	
>>>14048	>>	CUSO4/H3PO4 REAGENT BLANK	
>>>14049	>>	OPEN	
>>>14050	>>	CAIRO RAW WATER SERIES A	— 37.01N 89.09W
>>>14051	>>	CAIRO RAW WATER SERIES B	
>>>14052	>>	CAIRO FINISHED WATER SERIES A	
>>>14053	>>	CAIRO FINISHED WATER SERIES B	
>>>14054	>>	CHESTER RAW WATER SERIES A	— 37.55N 89.50W
>>>14055	>>	CHESTER RAW WATER SERIES B	
>>>14056	>>	CHESTER FINISHED WATER SERIES A	
>>>14057	>>	CHESTER FINISHED WATER SERIES B	
>>>14058	>>	CHESTER RAW WATER SERIES A	
>>>14059	>>	CHESTER RAW WATER SERIES B	
>>>14060	>>	CHESTER FINISHED WATER SERIES A	
>>>14061	>>	CHESTER FINISHED WATER SERIES B	
>>>14062	>>	QUINCY RAW WATER SERIES A	— 39.55N 91.22W
>>>14063	>>	QUINCY RAW WATER SERIES B	
>>>14064	>>	QUINCY FINISHED WATER SERIES A	
>>>14065	>>	QUINCY FINISHED WATER SERIES B	
>>>14066	>>	CARLYLE RAW WATER SERIES A	— 38.39N 89.20W
>>>14067	>>	CARLYLE RAW WATER SERIES B	
>>>14068	>>	CARLYLE FINISHED WATER SERIES A	
>>>14069	>>	CARLYLE FINISHED WATER SERIES B	
>>>14070	>>	ROYALTON RAW WATER SERIES A	— 39.51N 89.03W
>>>14071	>>	ROYALTON RAW WATER SERIES B	
>>>14072	>>	ROYALTON FINISHED WATER SERIES A	
>>>14073	>>	ROYALTON FINISHED WATER SERIES B	
>>>14074	>>	FAIRFIELD RAW WATER SERIES A	— 38.22N 88.23
>>>14075	>>	FAIRFIELD RAW WATER SERIES B	

```
2.      >>>14076    >>   FAIRFIELD FINISHED WATER SERIES A
3.      >>>14077    >>   FAIRFIELD FINISHED WATER SERIES B
4.      >>>14078    >>   MT.CARMEL RAW WATER SERIES A ——— 38.25N 87.481
5.      >>>14079    >>   MT.CARMEL RAW WATER SERIES B
6.      >>>14080    >>   MT.CARMEL FINISHED WATER SERIES A
7       >>>14081    >>   MT.CARMEL FINISHED WATER SERIES B
8       >>>14082    >>   NEWTON RAW WATER SERIES A ——— 38.59N 88.10
9.      >>>14083    >>   NEWTON RAW WATER SERIES B
0.      >>>14084    >>   NEWTON FINISHED WATER SERIES A
1.      >>>14085    >>   NEWTON FINISHED WATER SERIES B
2.      >>>14086    >>   DANVILLE RAW WATER SERIES A ——— 40.09N 87.37W
3.      >>>14087    >>   DANVILLE RAW WATER SERIES B
4.      >>>14088    >>   DANVILLE FINISHED WATER SERIES A
5.      >>>14089    >>   DANVILLE FINISHED WATER SERIES B
6.      >>>14090    >>   PEORIA RAW WATER SERIES A ——— 40.43N 89.38
7.      >>>14091    >>   PEORIA RAW WATER SERIES B
8.      >>>14092    >>   PEORIA FINISHED WATER SERIES A
9.      >>>14093    >>   PEORIA FINISHED WATER SERIES B
0.      >>>14094    >>   PEORIA RAW WATER SERIES A
1.      >>>14095    >>   PEORIA RAW WATER SERIES B
2.      >>>14096    >>   PEORIA FINISHED WATER SERIES A
3.      >>>14097    >>   PEORIA FINISHED WATER SERIES B
.       >>>14098    >>   ROCK ISLAN& RAW WATER SERIES A ——— 41.30N 90.3
.       >>>14099    >>   ROCK ISLAND RAW WATER SERIES B
.       >>>14100    >>   ROCK ISLAND FINISHED WATER SERIES A
.       >>>14101    >>   ROCK ISLAND FINISHED WATER SERIES B
.       >>>14102    >>   STREATOR RAW WATER SERIES A ——— 41.07N 88.5
.       >>>14103    >>   STREATOR RAW WATER SERIES B
.       >>>14104    >>   STREATOR FINISHED WATER SERIES A
.       >>>14105    >>   STREATOR FINISHED WATER SERIES B
.       >>>14106    >>   KANKAKEE RAW WATER SERIES A ——— 41.08N 87.
.       >>>14107    >>   KANKAKEE RAW WATER SERIES B
.       >>>14108    >>   KANKAKEE FINISHED WATER SERIES A
.       >>>14109    >>   KANKAKEE FINISHED WATER SERIES B
.       >>>14110    >>   HNO3 REAGENT BLANK
.       >>>14111    >>   H2SO4 REAGENT BLANK
.       >>>14112    >>   NAOH REAGENT BLANK
.       >>>14113    >>   CUSO4/H3PO4 REAGENT BLANK
.       >>>14114    >>   GALESBURG RAW WATER SERIES A ——— 40.58N
.       >>>14115    >>   GALESBURG RAW WATER SERIES B
.       >>>14116    >>   GALESBURG FINISHED WATER SERIES
.       >>>14117    >>   GALESBURG FINISHED WATER SERIES B
.       ----------------------------SAMPLE/PARAMETER DATA----------------------
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EPA-CRL 1975 SAMPLE LOG NO.	S0003 OA TREFLAN WHL SMPL UG/L	S0001 OA HCBENZ WHL SMPL UG/L	39782 OA LINDANE WHL SMPL UG/L	S0002 OA BBHC WHL SMPL UG/L	S0004 OA DICLONE WHL SMPL UG/L	39330 OA ALDRIN WHL SMPL UG/L	S0005 OA ZYTRON WHL SMPL UG/L	
14050	<0.002	0.010	<0.002	<0.005	<0.01	<0.002	<0.02	6S
14052	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.002	8S
14054	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.002	10S
14056	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.002	12S
14058	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.002	14S
14062	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	18S
14064	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	20S
14066	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	22S
14068	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	24S
14070	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	26S
14072	<0.002	0.003	<0.002	<0.005	<0.01	<0.002	<0.02	28S
14074	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	30S
14076	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	32S
14078	0.028	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	34S
14080	0.050	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	36S
14082	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	38S
14084	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	40S
14086	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	42S
14088	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	44S
14090	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	46S
14092	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	48S
14094	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	50S
14096	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	52S
14098	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	54S
14100	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	56S
14102	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	58S
14104	<0.002	<0.002	0.004	<0.005	<0.01	<0.002	<0.02	60S
14106	0.010	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	62S
14108	<0.002	<0.002	<0.002	<0.005	<0.01	0.018	<0.02	64S
14114	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	70S
14116	<0.002	0.004	<0.002	<0.005	<0.01	<0.002	<0.02	72S
	1P	2P	3P	4P	5P	6P	7P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

PA-CRL 1975 SAMPLE LOG NO.	39430 OA ISODRIN WHL SMPL UG/L	39420 OA HCHLR-EP WHL SMPL UG/L	S0006 OA CHLORDAG WHL SMPL UG/L	S0007 OA DDE OP WHL SMPL UG/L	S0008 OA DDE PP WHL SMPL UG/L	S0009 OA DDD OP WHL SMPL UG/L	S0010 OA DDT OP WHL SMPL UG/L	
050	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	6S
052	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	8S
054	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	10S
056	<0.003	<0.002	0.004	<0.003	<0.003	<0.003	<0.003	12S
058	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	14S
062	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	18S
064	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	20S
066	<0.003	<0.002	<0.002	0.008	<0.003	<0.003	<0.003	22S
068	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	24S
070	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	26S
073	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	28S
074	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	30S
076	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	32S
078	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	34S
080	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	36S
082	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	38S
084	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	40S
086	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	42S
088	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	44S
090	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	46S
092	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	48S
094	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	50S
096	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	52S
098	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	54S
100	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	56S
102	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	58S
104	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	60S
106	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	62S
108	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	64S
114	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	70S
116	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	72S
	8P	9P	10P	11P	12P	13P	14P	

EPA-CRL 1975 SAMPLE LOG NO.	S0011 OA DDD PP WHL SMPL UG/L	S0012 OA DDT PP WHL SMPL UG/L	S0013 OA CARBPHTH WHL SMPL UG/L	S0014 OA MIREX WHL SMPL UG/L	39480 OA MTHXYCLR WHL SMPL UG/L	S0020 OA 2,4-D:IP WHL SMPL UG/L	S0021 OA DNBP WHL SMPL UG/L	
14050	:<0.003	:0.006	:<0.003	:<0.005	:<0.01	:<.02	:<1	: 6
14052	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	: 8
14054	:<0.003	:0.068	:<0.003	:<0.005	:<0.01	:	:	:10
14056	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:12
14058	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:	:	:14
14062	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:18
14064	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:20
14066	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:22
14068	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:24
14070	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:26
14073	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:29
14074	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:30
14076	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:32
14078	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:34
14080	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:36
14082	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:38
14084	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:40
14086	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:42
14088	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:44
14090	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:46
14092	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:48
14094	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:50
14096	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:52
14098	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:54
14100	:<0.003	:0.012	:<0.003	:<0.005	:<0.01	:<.02	:<1	:56
14102	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:58
14104	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:60
14106	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:62
14108	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:64
14114	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:70
14116	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:72
	15P	16P	17P	18P	19P	20P	21P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	39770 OA DCPA WHL SMPL UG/L	S0023 OA ENDOS I WHL SMPL UG/L	39380 OA DIELDRIN WHL SMPL UG/L	39390 OA ENDRIN WHL SMPL UG/L	39460 OA CLRANZLT WHL SMPL UG/L	S0027 OA ENDOS II WHL SMPL UG/L	S0028 OA NITROFEN WHL SMPL UG/L	
14050	:<.003	:<.005	:.004	:<.003	:<.01	:<.005	:<.005	: 6
14052	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 8
14056	:<.003	:<.005	:.007	:<.003	:<.01	:<.005	:<.005	:12
14062	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:18
14064	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:20
14066	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:22
14068	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:24
14070	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:26
14073	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:29
14074	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:30
14076	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:32
14078	:<.003	:<.005	:.011	:<.003	:<.01	:<.005	:<.005	:34
14080	:<.003	:<.005	:.006	:<.003	:<.01	:<.005	:<.005	:36
14082	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:38
14084	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:40
14086	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:42
14088	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:44
14090	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:46
14092	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:48
14094	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:50
14096	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:52
14098	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:54
14100	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:56
14102	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:58
14104	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:60
14106	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:62
14108	:<.003	:<.005	:.004	:<.003	:<.01	:<.005	:<.005	:64
14114	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:70
14116	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:72
	22P	23P	24P	25P	26P	27P	28P	

EPA-CRL 1975 SAMPLE LOG NO.	S0029 OA 245-T:IO WHL SMPL UG/L	S0030 OA PROLAN WHL SMPL UG/L	S0031 OA BULAN WHL SMPL UG/L	S0026 OA DEHP WHL SMPL UG/L	39808 OA TEDION WHL SMPL UG/L	39570 OA DIAZINON WHL SMPL UG/L	S0016 OA DYFONATE WHL SMPL UG/L	
14050	<.01	<.01	<.01	1	<.01	<1	<1	4
14052	<.01	<.01	<.01	3	<.01	<1	<1	8
14054						<1	<1	10
14056	<.01	<.01	<.01	3	<.01	<1	<1	12
14062	<.01	<.01	<.01	<1	<.01	<1	<1	18
14064	<.01	<.01	<.01	<1	<.01	<1	<1	20
14066	<.01	<.01	<.01	<1	<.01	<1	<1	22
14068	<.01	<.01	<.01	<1	<.01	<1	<1	24
14070	<.01	<.01	<.01	<1	<.01	<1	<1	26
14073	<.01	<.01	<.01	<1	<.01	<1	<1	28
14074	<.01	<.01	<.01	<1	<.01	<1	<1	30
14076	<.01	<.01	<.01	<1	<.01	<1	<1	32
14078	<.01	<.01	<.01	<1	<.01	<1	<1	34
14080	<.01	<.01	<.01	<1	<.01	<1	<1	36
14082	<.01	<.01	<.01	<1	<.01	<1	<1	38
14084	<.01	<.01	<.01	<1	<.01	<1	<1	40
14086	<.01	<.01	<.01	<1	<.01	<1	<1	42
14088	<.01	<.01	<.01	<1	<.01	<1	<1	44
14090	<.01	<.01	<.01	<1	<.01	<1	<1	46
14092	<.01	<.01	<.01	<1	<.01	<1	<1	48
14094	<.01	<.01	<.01	<1	<.01	<1	<1	50
14096	<.01	<.01	<.01	<1	<.01	<1	<1	52
14098	<.01	<.01	<.01	<1	<.01	<1	<1	54
14100	<.01	<.01	<.01	<1	<.01	<1	<1	56
14102	<.01	<.01	<.01	<1	<.01	<1	<1	58
14104	<.01	<.01	<.01	<1	<.01	<1	<1	60
14106	<.01	<.01	<.01	<1	<.01	<1	<1	62
14108	<.01	<.01	<.01	<1	<.01	<1	<1	64
14114	<.01	<.01	<.01	<1	<.01	<1	<1	70
14116	<.01	<.01	<.01	<1	<.01	<1	<1	72
	29P	30P	31P	32P	33P	34P	35P	

EPA-CRL 1975 SAMPLE LOG NO.	S0017 OA RONNEL WHL SMPL UG/L	S0032 OA DURSBAN WHL SMPL UG/L	39600 OA MPARATHN WHL SMPL UG/L	39530 OA MALATHN WHL SMPL UG/L	39540 OA PARATHN WHL SMPL UG/L	S0033 OA DEF WHL SMPL UG/L	39398 OA ETHION WHL SMPL UG/L	
14050	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 6
14052	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 8
14054	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:10
14056	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:12
14062	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:18
14064	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:20
14066	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:22
14068	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:24
14070	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:26
14073	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:29
14074	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:30
14076	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:32
14078	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:34
14080	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:36
14082	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:38
14084	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:40
14086	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:42
14088	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:44
14090	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:46
14092	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:48
14094	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:50
14096	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:52
14098	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:54
14100	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:56
14102	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:58
14104	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:60
14106	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:62
14108	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:64
14114	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:70
14116	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:72
	36P	37P	38P	39P	40P	41P	42P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	S0018 OA PHENCAPT WHL SMPL UG/L	S0034 OA EPN WHL SMPL UG/L	39580 OA GUTHION WHL SMPL UG/L	S0035 OA PHOSALON WHL SMPL UG/L	S0036 OA AZINFOSE WHL SMPL UG/L	S0037 OA COUMAFOS WHL SMPL UG/L	39488 OA AROCLOR 1221 UG/L	
14050	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 6S
14052	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 8S
14054	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:10S
14056	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:12S
14062	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:18S
14064	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:20S
14066	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:22S
14068	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:24S
14070	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:26S
14073	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:29S
14074	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:30S
14076	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:32S
14078	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:34S
14080	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:36S
14082	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:38S
14084	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:40S
14086	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:42S
14088	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:44S
14090	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:46S
14092	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:48S
14094	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:50S
14096	:<1	:<1	:<1	:<1	:<1	:<5	:<0.3	:52S
14098	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:54S
14100	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:56
14102	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:58
14104	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:60
14106	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:62
14108	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:64
14114	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:70
14116	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:72
	43P	44P	45P	46P	47P	48P	49P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	39496 OA AROCLOR 1242 UG/L	39500 OA AROCLOR 1248 UG/L	39504 OA AROCLOR 1254 UG/L	39508 OA AROCLOR 1260 UG/L	S0047 OA METHE CL TOT VOL UG/L	S0039 OA CCL4 TOT VOL UG/L	S0038 OA CHCL3 TOT VOLA UG/L	
14050	<0.3	<0.3	<0.3	<0.4				6
14051					1	2	2	7
14052	<0.3	<0.3	<0.3	<0.4				8
14053					<0.5	1	14	9
14054	<0.3	<0.3	<0.3	<0.4				10
14055					<0.5	<1	5	11
14056	<0.3	<0.3	<0.3	<0.4				12
14057					<0.5	<1	182	13
14058	<0.3	<0.3	<0.3	<0.4				14
14062	<0.3	<0.3	<0.3	<0.4				18
14063					<0.5	<2	<2	19
14064	<0.3	<0.3	<0.3	<0.4				20
14065					<1	<1	58	21
14066	<0.3	<0.3	<0.3	<0.4				22
14067					<0.5	<0.5	<1	23
14068	<0.3	<0.3	<0.3	<0.4				24
14069					<0.2	<1	48	25
14070	<0.3	<0.3	<0.3	<0.4				26
14071					<0.5	<1	<1	27
14072	<0.3	<0.3	<0.3	<0.4	<0.5	<1	68	28
14074	<0.3	<0.3	<0.3	<0.4				30
14075					<0.5	<1	10	31
14076	<0.3	<0.3	<0.3	<0.4				32
14077					<0.5	<1	47	33
14078	<0.3	<0.3	<0.3	<0.4				34
14079					<0.5	<2	<2	35
14080	<0.3	<0.3	<0.3	<0.4				36
14081					2.6	<0.5	52	37
14082	<0.3	<0.3	<0.3	<0.4				38
14083					<0.5	<1	<1	39
14084	<0.3	<0.3	<0.3	<0.4				40
14085					<0.5	<1	4	41
14086	<0.3	<0.3	<0.3	<0.4				42
14087					<0.5	<1	6	43
14088	<0.3	<0.3	<0.3	<0.4				44
14089					<1	<1	16	45
14090	<0.3	<0.3	<0.3	<0.4				46
14091					15	<1	<1	47
14092	<0.3	<0.3	<0.3	<0.4				48
14093					<0.5	1.3	2	49
14094	<0.3	<0.3	<0.3	<0.4				50
14095					<0.5	<1	<1	51
14096	<0.3	<0.3	<0.3	<0.4				52
14097					<1	1.3	1.6	53
14098	<0.3	<0.3	<0.3	<0.4				54
14099					<0.5	<1	94	55
14100	<0.3	<0.3	<0.3	<0.4				56
14101					<1	<1	79	57
14102	<0.3	<0.3	<0.3	<0.4				58
14103					<0.5	<1	<1	59
14104	<0.3	<0.3	<0.3	<0.4				60
14105					<0.5	<1	35	61
14106	<0.3	<0.3	<0.3	<0.4				62
14107					<0.5	<2	<3	63
14108	<0.3	<0.3	<0.3	<0.4				64
14109					<0.5	1	52	65
14114	<0.3	<0.3	<0.3	<0.4				70

14115					<0.5	<1	<1	71
14116	<0.3	<0.3	<0.3	<0.4				72
14117					<1	<1	30	73
	50P	51P	52P	53P	54P	55P	56P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	S0056 OA C2H4CL2 TOT VOL UG/L	S0040 OA CHCL2BR TOT VOL UG/L	S0041 OA CHCLBR2 TOT VOL UG/L	S0042 OA CHBR3 TOT VOL UG/L				
14051	<1	<0.2	0.3	0.6				7S
14053	<1	11	4	0.8				9S
055	<2	<0.5	<0.5	<0.5				11S
14057	<1	17	1.1	<0.3				13S
14063	<2	<0.5	<0.5	<0.5				19S
14065	<1	13	0.5	<0.2				21S
14067	<2	<0.5	<0.5	<0.5				23S
14069	<1	20	2	0.6				25S
14071	<1	<0.5	<0.5	<0.5				27S
14072	<1	29	6	<0.1				28S
14075	<2	3	<0.5	<0.5				31S
14077	<2	16	1.4	<0.3				33S
14079	<1	<0.5	<0.5	<0.5				35S
14081	<1	15	1	<0.5				37S
14083	<1	<0.5	<0.5	<0.5				39S
14085	<2	5	4	1.3				41S
14087	<2	<0.5	<0.5	<0.5				43S
14089	<2	6	1	0.7				45S
14091	1	<0.5	<0.5	<0.5				47S
14093	<1	1	0.5	0.4				49S
14095	6	<0.5	<0.5	<0.5				51S
14097	<1	0.6	0.5	0.3				53S
14099	<5	11	<0.5	<0.5				55S
14101	<1	8.3	0.4	<0.2				57S
14103	2	<0.5	<0.5	<0.5				59S
14105	<1	14	1.7	1.4				61S
14107	<2	<0.5	<0.5	<0.5				63S
14109	<1	10	1.1	<0.2				65S
14115	<1	<0.5	<0.5	<0.5				71S
14117	<1	13	2	<0.2				73S
	57P	58P	59P	60P	61P	62P	63P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	01067 MW NICKEL NI,TOT UG/L	00916 MW CALCIUM CA,TOT MG/L	00927 MW MGNSIUM MG,TOT MG/L	00929 MW SODIUM NA,TOT MG/L	00937 MW PTSSIUM K,TOT MG/L	01034 MW CHROMIUM CR,TOT UG/L	01042 MW COPPER CU,TOT UG/L	*J *J *J *J
14050		34.2	11.1	10.8	2.2	<5	5	6S*J
14052		41.4	10.6	10.7	1.8	<5	9	8S*J
54		38.5	14.7	13.1	3.0	<5	5	10S*J
14059		43.4	0.8	16.2	2.9	<5	11	15S*J
14062		51.6	21.6	12.0	2.4	<5	<5	18S*J
14064		35.7	14.9	11.8	2.3	<5	<5	20S*J
14066		54.0	23.3	13.1	2.0	<5	10	22S*J
14068		68.9	23.3	13.5	2.2	<5	<5	24S*J
14070		50.5	8.3	20.6	3.5	<5	<5	26S*J
14072		50.5	7.0	20.9	3.5	<5	<5	28S*J
14074		28.3	7.0	17.4	3.6	<5	6	30S*J
14076		23.4	7.2	17.9	3.6	<5	<5	32S*J
14078		51.9	16.7	7.1	2.3	<5	<5	34S*J
14080		37.3	16.0	7.7	2.2	<5	<5	36S*J
14082		62.5	24.8	7.1	0.5	<5	<5	38S*J
14084		49.9	24.0	7.4	0.5	<5	11	40S*J
14086		55.7	21.8	3.7	1.2	<5	72	42S*J
14088		45.2	22.0	3.7	1.3	<5	<5	44S*J
14090		91.5	49.2	21.3	1.7	<5	<5	46S*J
14092		91.0	49.4	20.8	1.9	<5	15	48S*J
14094		92.7	49.0	20.2	1.7	<5	<5	50S*J
14096		91.4	49.3	19.3	2.0	<5	15	52S*J
14098		52.1	17.7	9.1	1.7	<5	620	54S*J
14100		46.3	17.2	8.5	1.7	<5	<5	56S*J
14102		72.1	34.3	10.3	1.6	<5	<5	58S*J
14104		61.7	34.5	11.1	1.9	<5	7	60S*J
14106		67.2	24.3	6.5	1.8	<5	37	62S*J
14108		29.2	11.6	30.5	1.7	<5	<5	64S*J
14110		<1	<0.1	<0.1	<0.1	<5	<5	66S*J
14114		45.5	19.4	6.0	1.4	<5	<5	70S*J
14116		51.8	20.1	5.1	1.2	<5	<5	72S*J
	64P	65P	66P	67P	68P	69P	70P	**J

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS **J

EPA-CRL 1975 SAMPLE LOG NO.	01045 MW IRON FE,TOT UG/L	01055 MW MANGNESE MN,TOT UG/L	01092 MW ZINC ZN,TOT UG/L	01002 MW ARSENIC AS,TOT UG/L	01051 MW LEAD PB,TOT UG/L	01027 MW CADMIUM CD,TOT UG/L	01077 MW SILVER AG,TOT UG/L	*K *K *K *K
14050	:1790	:240	:25	:2	:13	:0.4	:<0.2	: 6S*K
14052	:<20	:<5	:<5	:<1	:2	:<0.2	:<0.2	: 8S*K
54	:2310	:260	:<5	:9	:15	:1.1	:<0.2	:10S*K
14059	:40	:<5	:5	:<1	:3	:<0.2	:<0.2	:15S*K
14062	:440	:160	:10	:<1	:4	:<0.2	:<0.2	:19S*K
14064	:<20	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:20S*K
14066	:450	:130	:<5	:1	:3	:<0.2	:<0.2	:22S*K
14068	:90	:17	:<5	:<1	:2	:<0.2	:<0.2	:24S*K
14070	:82	:65	:<5	:1	:<2	:<0.2	:<0.2	:26S*K
14072	:<20	:8	:<5	:<1	:3	:<0.2	:<0.2	:28S*K
14074	:1350	:240	:20	:5	:7	:0.3	:<0.2	:30S*K
14076	:<20	:20	:<5	:<1	:<2	:<0.2	:<0.2	:32S*K
14078	:1870	:190	:17	:10	:13	:0.4	:<0.2	:34S*K
14080	:130	:25	:21	:<1	:2	:<0.2	:<0.2	:36S*K
14082	:2810	:320	:<5	:4	:4	:<0.2	:<0.2	:38S*K
14084	:<20	:<5	:5	:<1	:2	:<0.2	:<0.2	:40S*K
14086	:290	:24	:93	:1	:4	:<0.2	:<0.2	:42S*K
14088	:<20	:<5	:8	:<1	:2	:<0.2	:<0.2	:44S*K
14090	:135	:760	:<5	:<1	:<2	:<0.2	:<0.2	:46S*K
14092	:<20	:11	:<5	:<1	:3	:<0.2	:<0.2	:48S*K
14094	:135	:710	:<5	:<1	:<2	:<0.2	:<0.2	:50S*K
14096	:<20	:8	:<5	:<1	:2	:<0.2	:<0.2	:52S*K
14098	:140	:33	:10	:<1	:2	:0.3	:<0.2	:54S*K
14100	:28	:<5	:<5	:<1	:2	:0.3	:<0.2	:56S*K
14102	:130	:<5	:<5	:<1	:2	:<0.2	:<0.2	:58S*K
14104	:130	:<5	:<5	:<1	:5	:<0.2	:<0.2	:60S*K
14106	:740	:92	:<5	:1	:3	:<0.2	:<0.2	:62S*K
14108	:38	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:64S*K
14110	:<20	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:66S*K
14114	:1600	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:70S*K
14116	:85	:<5	:<5	:<1	:2	:<0.2	:<0.2	:72S*K
	71P	72P	73P	74P	75P	76P	77P	**K

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	01147 MW SELENIUM SE,TOT UG/L	01007 MW BARIUM BA,TOT UG/L						
14050	<5							6S
52	<5							8S
14054	<5							10S
14059	<5							15S
14062	<5							18S
14064	<5							20S
14066	<5							22S
14068	<5							24S
14070	<5							26S
14072	<5							28S
14074	<5							30S
14076	<5							32S
14078	<5							34S
14080	<5							36S
14082	<5							38S
14084	<5							40S
14086	<5							42S
14088	<5							44S
14090	<5							46S
14092	<5							48S
14094	<5							50S
14096	<5							52S
14098	<5							54S
14100	<5							56S
14102	<5							58S
14104	<5							60S
14106	<5							62S
14108	<5							64S
14110	<5							66S
14114	<5							70S
14116	<5							72S
	78P	79P	80P	81P	82P	83P	84P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

EPA-CRL 1975 SAMPLE LOG NO.	00530 IM RESIDUE TOT NFLT MG/L	70300 IM RESIDUE DISS-180 C MG/L	00095 IM CNDUCTVY AT 25C MICROMHO	00945 IM SULFATE SO4 MG/L	00940 IM CHLORIDE CL MG/L	00956 IM SILICA SIO2 MG/L	00410 IM T ALK CACO3 MG/L	
14050	:146	:150	:310	:51	:16	:6.8	:68	: 6S*
14052	:<3	:190	:369	:65	:19	:7.3	:72	: 8S*
54	:162	:200	:376	:48	:17	:8.3	:107	:10S*
14056	:<3	:180	:341	:49	:23	:7.7	:63	:12S*
14062	:19	:200	:471	:32	:20	:9.5	:175	:18S*
14064	:<3	:180	:356	:42	:24	:8.5	:92	:20S*
14066	:44	:290	:494	:46	:23	:6.0	:162	:22S*
14068	:4	:290	:578	:96	:28	:5.4	:144	:24S*
14070	:11	:220	:466	:150	:19	:1.8	:45	:26S*
14072	:3	:200	:456	:149	:22	:1.3	:31	:28S*
14074	:153	:160	:323	:60	:33	:6.2	:32	:30S*
14076	:3	:230	:389	:91	:35	:5.4	:30	:32S*
14078	:274	:210	:412	:48	:17	:7.0	:120	:34S*
14080	:<3	:240	:441	:68	:21	:6.7	:106	:36S*
14082	:3	:310	:508	:38	:7	:15.8	:213	:38S*
14084	:<3	:310	:505	:36	:9	:15.8	:201	:40S*
14086	:10	:290	:459	:40	:14	:7.6	:142	:42S*
14088	:<3	:280	:468	:57	:18	:7.6	:115	:44S*
14090	:4	:490	:837	:55	:27	:18.0	:368	:46S*
14092	:<3	:420	:842	:57	:29	:18.3	:364	:48S*
14094	:14	:480	:842	:57	:25	:17.8	:364	:50S*
14096	:<3	:480	:843	:57	:28	:18.2	:354	:52S*
14098	:6	:225	:398	:18	:12	:10.0	:152	:54S*
14100	:<3	:200	:454	:58	:16	:8.0	:134	:56S*
14102	:15	:370	:627	:75	:21	:4.8	:197	:58S*
14104	:6	:350	:638	:75	:24	:5.2	:187	:60S*
14106	:31	:400	:595	:101	:18	:9.4	:166	:62S*
14108	:13	:250	:433	:103	:21	:7.2	:49	:64S*
14114	:4	:280	:453	:22	:7	:18.2	:206	:70S*
14116	:<2	:310	:461	:19	:10	:18.6	:201	:72S*
	85P	86P	87P	88P	89P	90P	91P	**

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS **

EPA-CRL 1975 SAMPLE LOG NO.	00403 IM LAB PH SU	00951 IM FLUORIDE F,TOTAL MG/L	32730 IM PHENOLS UG/L	00720 IM CYANIDE CN MG/L	00630 IN NO2&NO3 N-TOTAL MG/L	00610 IN NH3-N TOTAL MG/L	00625 IN TOT KJEL N MG/L	*N *N *N *N
14045			<3	<0.002	<0.03	<0.010	<0.05	1S*N
14050	7.4	0.16	<3	0.007	1.36	0.121	1.42	6S*N
14052	7.8	1.2	<3	0.002	1.38	<0.010	0.69	8S*N
14054	7.5	0.21	5	0.005	1.75	0.219	2.13	10S*N
14056	10.1	0.83	4	0.003	1.64	0.028	0.17	12S*N
14062	7.8	0.18	6	0.004	1.53	0.107	1.27	18S*N
14064	9.4	1.0	6	0.003	1.53	0.520	0.90	20S*N
14066	7.9	0.20	3	0.003	2.55	0.155	0.84	22S*N
14068	7.5	0.77	3	0.003	2.60	0.010	0.32	24S*N
14070	7.9	1.3	7	0.002	0.55	0.047	0.42	26S*N
14072	8.0	1.2	6	<0.002	0.51	0.014	0.37	28S*N
14074	7.0	0.46	8	0.010	1.09	0.129	1.88	30S*N
14076	6.9	0.52	4	0.003	1.10	<0.010	0.29	32S*N
14078	7.6	0.18	4	0.005	3.54	0.126	1.87	34S*N
14080	7.4	0.42	3	<0.002	3.30	0.024	0.48	36S*N
14082	7.5	0.17	<3	<0.002	2.31	0.043	0.36	38S*N
14084	7.5	0.60	<3	<0.002	2.04	<0.010	0.34	40S*N
14086	7.9	0.17	3	0.003	6.31	0.088	0.92	42S*N
14088	7.2	0.52	3	0.004	6.40	0.014	0.42	44S*N
14090	7.4	0.20	<3	0.002	0.08	0.229	0.46	46S*N
14092	7.3	1.0	<3	0.002	0.03	0.241	0.41	48S*N
14094	7.4	0.20	<3	<0.002	<0.03	0.225	0.26	50S*N
14096	7.2	1.1	<3	0.002	<0.03	0.191	0.26	52S*N
14098	7.7	0.17	13	0.005	0.78	0.034	0.85	54S*N
14100	7.6	0.84	4	0.003	0.80	0.018	0.30	56S*N
14102	8.0	0.27	<3	0.004	6.18	0.034	0.45	58S*N
14104	7.8	0.76	<3	0.004	7.58	0.021	0.28	60S*N
14106	7.7	0.17	<3	0.004	3.90	0.095	0.64	62S*N
14108	9.0	0.97	<3	0.003	4.08	0.033	0.69	64S*N
14111					<0.03	<0.010	<0.05	67S*N
14112				<0.002				68S*N
14113			<3					69S*N
14114	7.4	0.15	<3	<0.002	<0.03	0.072	0.12	70S*N
14116	7.3	0.90	<3	0.002	<0.03	<0.010	<0.05	72S*N
	92P	93P	94P	95P	96P	97P	98P	**N

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS **N

EPA-CRL 1975 SAMPLE LOG NO.	00665 IN PHOS-T P-WET MG/L	00340 IN COD HI LEVEL MG/L	00680 IN T ORG C C MG/L	71900 IN MERCURY HG,TOTAL UG/L	00900 IN TOT HARD CACO3 MG/L	00615 IN NO2-N TOTAL MG/L		
14045	<0.02	<3						1S
14050	0.24	22		0.2	131	0.024		6S
1 2	0.04	8		0.2	147	<0.005		8S
14054	0.45	40		0.2	157	0.078		10S
14056	0.58	9		0.1	112	0.009		12S
14062	0.19	28		0.1	218	0.026		18S
14064	0.19	12		0.3	150	0.011		20S
14066	0.12	19		<0.1	231	<0.005		22S
14068	<0.02	6		0.2	268	<0.005		24S
14070	<0.02	9		<0.1	160	0.013		26S
14072	<0.02	7		0.2	155	<0.005		28S
14074	0.33	43		0.2	100	0.041		30S
14076	0.02	6		0.2	88	<0.005		32S
14078	0.38	37		0.1	198	0.030		34S
14080	<0.02	8		0.3	159	<0.003		36S
14082	0.11	<3		<0.1	258	0.009		38S
14084	<0.02	<3		0.2	223	<0.005		40S
14086	0.12	13		0.3	229	0.045		42S
14088	<0.02	8		0.3	204	<0.005		44S
14090	<0.02	7		0.3	431	<0.005		46S
14092	0.02	<3		<0.1	431	<0.005		48S
14094	<0.02	9		0.1	433	<0.005		50S
14096	<0.02	6		0.3	431	<0.005		52S
14098	0.15	22		0.1	203	0.012		54S
14100	0.03	13		0.2	186	<0.005		56S
14102	0.16	7		0.1	321	0.026		58S
14104	0.12	6		0.2	296	<0.005		60S
14106	0.08	19		0.2	268	0.033		62S
14108	0.02	6		<0.1	121	<0.005		64S
14110				<0.1	<3			66S
14111	<0.02	<3		<0.1	<3			67S
14114	0.13	4		<0.1	193	<0.005		70S
14116	0.02	<3		<0.1	212	<0.005		72S
	99P	100P	101P	102P	103P	104P	105P	

.IL.DW04 REGION V DRINKING WATER STUDY - ILLINOIS

CRLS 05APR DSN=CNCRLS.RGD.IN.DW04 ON TS0009 04/18/75 REV02 T

----------STUDY DESCRIPTION----------

NPAR	NLOG	AGENCYID	UNLOCKEY	STATTYPE	SMPLDAY	ATLABBY	DUEDATE	ACCOUNT-NUMBER
94	90				77777777	03FEB75	05FEB75	03MAY75

>REGION V DRINKING WATER STUDY - INDIANA

----------SAMPLE DESCRIPTIONS----------

LABIDNUM	STORETID	COLLDAY	TIME	STATTYPE	DEEP	T	M	NO	ENDDATE	TIME	PRLU
14118		750203									
14119		750203									
14120		750203									
14121		750203									
14122		750203									
14123		750203									
14124		750203									
14125		750203									
14126		750203									
14127		750203									
14128		750203									
14129		750203									
14130		750203									
14131		750203									
14132		750203									
14133		750203									
14134		750203									
14135		750203									
14136		750203									
14137		750203									
14138		750203									
14139		750203									
14140		750203									
14141		750203									
14142		750203									
14143		750203									
14144		750203									
14145		750203									
14146		750203									
14147		750203									
14148		750203									
14149		750203									
14150		750203									
14151		750203									
14152		750203									
14153		750203									
14154		750203									
14155		750203									
14156		750203									
14157		750203									
14158		750203									
14159		750203									
14160		750203									
14161		750203									
14162		750203									
14163		750203									
14164		750203									
14165		750203									
14166		750203									

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14167                750203
14168                750203
14169                750203
14170                750203
 ' '71               750203
 . .72               750203
14173                750203
14174                750203
14175                750203
14176                750203
14177                750203
14178                750203
14179                750203
14180                750203
14181                750203
14182                750203
14183                750203
14184                750203
14185                750203
14186                750203
14187                750203
14188                750203
14189                750203
14190                750203
14191                750203
14192                750203
14193                750203
14194                750203
14195                750203
14196                750203
14197                750203
14198                750203
14199                750203
14200                750203
14201                750203
14202                750203
14203                750203
14204                750203
14205                750203
14206                750203
14207                750203
>>>14118    >>    HNO3 REAGENT BLANK
>>>14119    >>    H2SO4 REAGENT BLANK
>>>14120    >>    NAOH REAGENT BLANK
>>>14121    >>    CUSO4/H3PO4 REAGENT BLANK
>>>14122    >>    OPEN          750203
>>>14123    >>    MT VERNON RAW WATER SERIES A
>>>14124    >>    MT VERNON RAW WATER SERIES B
>>>14125    >>    MT VERNON FINISHED WATER SERIES A
>>>14126    >>    MT VERNON FINISHED WATER SERIES B
>>>14127    >>    MT VERNON RAW WATER SERIES A
>>>14128    >>    MT VERNON RAW WATER SERIES B
>>>14129    >>    MT VERNON FINISHED WATER SERIES A
>>>14130    >>    MT VERNON FINISHED WATER SERIES B
>>>14131    >>    EVANSVILLE RAW WATER SERIES A
>>>14132    >>    EVANSVILLE RAW WATER SERIES B
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INDIANA

37.55N 87.55W

38.00N 87.33W

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>14133   >>   EVANSVILLE FINISHED WATER SERIES A
>14134   >>   EVANSVILLE FINISHED WATER SERIES B
>14135   >>   NEW ALBANY RAW WATER SERIES A ———— 38.17N 85.50W
>14136   >>   NEW ALBANY RAW WATER SERIES B
>   37   >>   NEW ALBANY FINISHED WATER SERIES A
>14138   >>   NEW ALBANY FINISHED WATER SERIES B
>14139   >>   BEDFORD RAW WATER SERIES A ———— 38.51N 86.30W
>14140   >>   BEDFORD RAW WATER SERIES B
>14141   >>   BEDFORD FINISHED WATER SERIES A
>14142   >>   BEDFORD FINISHED WATER SERIES B
>14143   >>   TERRE HAUTE RAW WATER SERIES A ———— 39.27N 87.24W
>14144   >>   TERRE HAUTE RAW WATER SERIES B
>14145   >>   TERRE HAUTE FINISHED WATER SERIES A
>14146   >>   TERRE HAUTE FINISHED WATER SERIES B
>14147   >>   INDIANAPOLIS RAW WATER SERIES A ———— 39.45N 86.10W
>14148   >>   INDIANAPOLIS RAW WATER SERIES B
>14149   >>   INDIANAPOLIS FINISHED WATER SERIES A
>14150   >>   INDIANAPOLIS FINISHED WATER SERIES B
>14151   >>   KOKOMO RAW WATER SERIES A ———— 40.30N 86.09W
>14152   >>   KOKOMO RAW WATER SERIES B
>14153   >>   KOKOMO FINISHED WATER SERIES A
>14154   >>   KOKOMO FINISHED WATER SERIES B
>14155   >>   LOGANSPORT RAW WATER SERIES A ———— 40.45N 86.25W
>14156   >>   LOGANSPORT RAW WATER SERIES B
>14157   >>   LOGANSPORT FINISHED WATER SERIES A
>14158   >>   LOGANSPORT FINISHED WATER SERIES B
>14159   >>   FORT WAYNE RAW WATER SERIES A ———— 41.05N 85.08W
>14160   >>   FORT WAYNE RAW WATER SERIES B
>14161   >>   FORT WAYNE FINISHED WATER SERIES A
>14162   >>   FORT WAYNE FINISHED WATER SERIES B
>14163   >>   MICHIGAN CITY RAW WATER SERIES A ———— 41.43N 86.54W
>14164   >>   MICHIGAN CITY RAW WATER SERIES B
>14165   >>   MICHIGAN CITY FINISHED WATER SERIES A
>14166   >>   MICHIGAN CITY FINISHED WATER SERIES B
>14167   >>   GARY RAW WATER SERIES A ———— 41.34N 87.20W
>14168   >>   GARY RAW WATER SERIES B
>14169   >>   GARY FINISHED WATER SERIES A
>14170   >>   GARY FINISHED WATER SERIES B
>14171   >>   GARY RAW WATER SERIES A
>14172   >>   GARY RAW WATER SERIES B
>14173   >>   GARY FINISHED WATER SERIES A
>14174   >>   GARY FINISHED WATER SERIES B
>14175   >>   HAMMOND RAW WATER SERIES A ———— 41.37N 87.30W
>14176   >>   HAMMOND RAW WATER SERIES B
>14177   >>   HAMMOND FINISHED WATER SERIES A
>14178   >>   HAMMOND FINISHED WATER SERIES B
>14179   >>   HNO3 REAGENT BLANK
>14180   >>   H2SO4 REAGENT BLANK
>14181   >>   NAOH REAGENT BLANK
>14182   >>   H3PO4 REAGENT BLANK
>14183   >>   OPEN          750203
>14184   >>   SOUTH BEND RAW WATER SERIES A ———— 41.40N 86.15W
>14185   >>   SOUTH BEND RAW WATER SERIES B
>14186   >>   SOUTH BEND FINISHED WATER SERIES A
>14187   >>   SOUTH BEND FINISHED WATER SERIES B
>14188   >>   MUNCIE RAW WATER SERIES A ———— 40.11N 85.22W
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4189   >>   MUNCIE RAW WATER SERIES B
4190   >>   MUNCIE FINISHED WATER SERIES A
4191   >>   MUNCIE FINISHED WATER SERIES B
4192   >>   MOROCCO RAW WATER SERIES A ———————— 40.56N 87.27W
4193   >>   MOROCCO RAW WATER SERIES B
   4   >>   MOROCCO FINISHED WATER SERIES A
4195   >>   MOROCCO FINISHED WATER SERIES B
4196   >>   LAFAYETTE RAW WATER SERIES A ———————— 40.25N 86.54W
4197   >>   LAFAYETTE RAW WATER SERIES B
4198   >>   LAFAYETTE FINISHED WATER SERIES A
4199   >>   LAFAYETTE FINISHED WATER SERIES B
4200   >>   BLOOMINGTON RAW WATER SERIES A ———————— 39.10N 86.31W
4201   >>   BLOOMINGTON RAW WATER SERIES B
4202   >>   BLOOMINGTON FINISHED WATER SERIES A
4203   >>   BLOOMINGTON FINISHED WATER SERIES B
4204   >>   WHITING RAW WATER SERIES A ———————— 41.41N 87.32W
4205   >>   WHITING RAW WATER SERIES B
4206   >>   WHITING FINISHED WATER SERIES A
4207   >>   WHITING FINISHED WATER SERIES B
-------------------------SAMPLE/PARAMETER DATA-------------------------
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EPA-CRL 1975 SAMPLE LOG NO.	S0003 OA TREFLAN WHL SMPL UG/L	S0001 OA HCBENZ WHL SMPL UG/L	39782 OA LINDANE WHL SMPL UG/L	S0002 OA BBHC WHL SMPL UG/L	S0004 OA DICLONE WHL SMPL UG/L	39330 OA ALDRIN WHL SMPL UG/L	S0005 OA ZYTRON WHL SMPL UG/L	*A *A *A *A
14123	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	: 6S*A
14125	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	: 8S*A
14127	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:10S*A
14129	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:12S*A
14133	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:16S*A
14135	:<0.002	:<0.002	:<0.002	:<0.002	:<0.01	:<0.002	:<0.02	:18S*A
14137	:<0.002	:<0.002	:<0.002	:<0.002	:<0.01	:<0.002	:<0.02	:20S*A
14139	:<0.002	:<0.002	:<0.002	:<0.002	:<0.01	:<0.002	:<0.02	:22S*A
14141	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:24S*A
14143	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:26S*A
14145	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:28S*A
14147	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:30S*A
14149	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:32S*A
14150	:<0.002	:0.010	:<0.002	:<0.002	:<0.01	:<0.002	:<0.02	:33S*A
14152	:<0.002	:<0.002	:<0.002	:<0.002	:<0.01	:<0.002	:<0.02	:35S*A
14153	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:36S*A
14156	:<0.002	:<0.002	:<0.002	:<0.002	:<0.01	:<0.002	:<0.02	:39S*A
14157	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:40S*A
14159	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:42S*A
14161	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:44S*A
14163	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:46S*A
14165	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:48S*A
14167	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:50S*A
14169	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:52S*A
14171	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:54S*A
14173	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:56S*A
14175	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:58S*A
14177	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:60S*A
14184	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:67S*A
14186	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:69S*A
14188	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:71S*A
14190	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:73S*A
14192	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:75S*A
14194	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:0.04	:77S*A
14196	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:0.010	:<0.02	:79S*A
14198	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:0.004	:<0.02	:81S*A
14200	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:83S*A
14202	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:85S*A
14204	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:87S*A
14206	:<0.002	:<0.002	:<0.002	:<0.002	:<0.01	:<0.002	:<0.002	:89S*A
	1P	2P	3P	4P	5P	6P	7P	**A

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **A

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EPA-CRL 1975 SAMPLE LOG NO.	39430 OA ISODRIN WHL SMPL UG/L	39420 OA HCHLR-EP WHL SMPL UG/L	S0006 OA CHLORDAG WHL SMPL UG/L	S0007 OA DDE OP WHL SMPL UG/L	S0008 OA DDE PP WHL SMPL UG/L	S0009 OA DDD OP WHL SMPL UG/L	S0010 OA DDT OP WHL SMPL UG/L	*B *A *A *A
14123	<0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	6S*A
14125	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	8S*A
14127	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	10S*A
14129	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	12S*A
14133	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	16S*A
14135	<0.003	<0.002	<0.002	<0.008	<0.003	<0.003	<0.003	18S*A
14137	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	20S*A
14139	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	22S*A
14141	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	24S*A
14143	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	26S*A
14145	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	28S*A
14147	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	30S*A
14149	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	32S*A
14150	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	33S*A
14152	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	35S*A
14153	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	36S*A
14156	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	39S*A
14157	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	40S*A
14159	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	42S*A
14161	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	44S*A
14163	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	46S*A
14165	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	48S*A
14167	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	50S*A
14169	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	52S*A
14171	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	54S*A
14173	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	56S*A
14175	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	0.004	58S*A
14177	<0.003	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	60S*A
14184	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	67S*A
14186	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	69S*A
14188	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	71S*A
14190	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	73S*A
14192	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	75S*A
14194	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	77S*A
14196	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	79S*A
14198	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	81S*A
14200	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	83S*A
14202	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	85S*A
14204	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	87S*A
14206	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	89S*A
	8P	9P	10P	11P	12P	13P	14P	**5

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **B

EPA-CRL 1975 SAMPLE LOG NO.	S0011 OA DDD PP WHL SMPL UG/L	S0012 OA DDT PP WHL SMPL UG/L	S0013 OA CARBPHTH WHL SMPL UG/L	S0014 OA MIREX WHL SMPL UG/L	39480 OA MTHXYCLR WHL SMPL UG/L	S0020 OA 2,4-D:IP WHL SMPL UG/L	S0021 OA DNBP WHL SMPL UG/L	*C *C *C *C
14123	<0.003	<0.003	<0.003	<0.005	<0.01	<0.2	<1	6S*C
14125	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	8S*C
14127	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	10S*C
14129	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	12S*C
14133	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	16S*C
14135	<0.003	<0.003	<0.003	<0.003	<0.01	<.02	<1	18S*C
14137	<0.003	0.014	<0.003	<0.003	<0.01	<.02	<1	20S*C
14139	<0.003	<0.003	<0.003	<0.003	<0.01	<.02	<1	22S*C
14141	<0.003	<0.003	<0.003	<0.003	<0.01	<.02	<1	24S*C
14143	<0.003	<0.003	<0.003	<0.003	<0.01	<.02	<1	26S*C
14145	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	28S*C
14147	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	30S*C
14149	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	32S*C
14150	<0.003	0.006	<0.003	<0.003	<0.01			33S*C
14151						<0.2	<1	34S*C
14152	<0.003	0.032	<0.003	<0.003	<0.01			35S*C
14153	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	36S*C
14156	<0.003	0.016	<0.003	<0.003	<0.01			39S*C
14157	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	40S*C
14159	<0.003	0.020	<0.003	<0.005	<0.01	<.02	<1	42S*C
14161	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	44S*C
14163	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	46S*C
14165	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	48S*C
14167	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	50S*C
14169	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	52S*C
14171	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	54S*C
14173	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	56S*C
14175	<0.003	0.010	<0.003	<0.005	<0.01	<.02	<1	58S*C
14177	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	60S*C
14184	<0.003	0.006	<0.003	<0.005	<0.01	<.02	<1	67S*C
14186	<0.003	0.006	<0.003	<0.005	<0.01	<.02	<1	69S*C
14188	<0.003	0.006	<0.003	<0.005	<0.01	<.02	<1	71S*C
14190	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	73S*C
14192	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	75S*C
14194	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	77S*C
14196	<0.003	<0.003	<0.003	<0.005	<0.01	<.05	<1	79S*C
14198	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	81S*C
14200	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	83S*C
14202	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	85S*C
14204	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	87S*C
14206	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	89S*C
	15P	16P	17P	18P	19P	20P	21P	**C

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **C

EPA-CRL 1975 SAMPLE LOG NO.	39770 OA DCPA WHL SMPL UG/L	S0023 OA ENDOS I WHL SMPL UG/L	39380 OA DIELDRIN WHL SMPL UG/L	39390 OA ENDRIN WHL SMPL UG/L	39460 OA CLRHNZLT WHL SMPL UG/L	S0027 OA ENDOS II WHL SMPL UG/L	S0028 OA NITROFEN WHL SMPL UG/L	*D *D *D *D
14123	:<.003	:<.005	:.003	:<.003	:<.01	:<.005	:<.005	: 6S*D
14125	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 8S*D
14127	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:10S*D
14129	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:12S*D
14133	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:16S*D
14135	:<.003	:<.005	:.006	:<.003	:<.01	:<.005	:<.005	:18S*D
14137	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:20S*D
14139	:<.003	:<.005	:.008	:<.003	:<.01	:<.005	:<.005	:22S*D
14141	:<.003	:<.005	:.006	:<.003	:<.01	:<.005	:<.005	:24S*D
14143	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:26S*D
14145	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:28S*D
14147	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:30S*D
14149	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:32S*D
14151	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:34S*D
14153	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:36S*D
14157	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:40S*D
14159	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:42S*D
14161	:<.003	:<.005	:.007	:<.003	:<.01	:<.005	:<.005	:44S*D
14163	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:46S*D
14165	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:48S*D
14167	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:50S*D
14169	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:52S*D
14171	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:54S*D
14173	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:56S*D
14175	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:58S*D
14177	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:60S*D
14184	:<.003	:<.005	:.007	:<.003	:<.01	:<.005	:<.005	:67S*D
14186	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:69S*D
14188	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:71S*D
14190	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:73S*D
14192	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:75S*D
14194	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:77S*D
14196	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:79S*D
14198	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:81S*D
14200	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:83S*D
14202	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:85S*D
14204	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:87S*D
14206	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:89S*D
	22P	23P	24P	25P	26P	27P	28P	**D

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **D

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EPA-CRL 1975 SAMPLE LOG NO.	S0029 OA 245-T:IO WHL SMPL UG/L	S0030 OA PROLAN WHL SMPL UG/L	S0031 OA BULAN WHL SMPL UG/L	S0026 OA DEMP WHL SMPL UG/L	39808 OA TEDION WHL SMPL UG/L	39570 OA DIAZINON WHL SMPL UG/L	S0016 OA DYFONATE WHL SMPL UG/L	*E *E *E *E
14123	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 6S*E
14125	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 8S*E
14127	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:10S*E
14129	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:12S*E
14133	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:14S*E
14135	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:18S*E
14137	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:20S*E
14139	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:22S*E
14141	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:24S*E
14143	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:26S*E
14145	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:28S*E
14147	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:30S*E
14149	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:32S*E
14151	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:34S*E
14153	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:36S*E
14155	:	:	:	:	:	:<1	:<1	:38S*E
14157	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:40S*E
14159	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:42S*E
14161	:<.01	:<.01	:<.01	:4	:<.01	:<1	:<1	:44S*E
14163	:<.01	:<.01	:<.01	:3	:<.01	:<1	:<1	:46S*E
14165	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:48S*E
14167	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:50S*E
14169	:<.01	:<.01	:<.01	:5	:<.01	:<1	:<1	:52S*E
14171	:<.01	:<.01	:<.01	:17	:<.01	:<1	:<1	:54S*E
14173	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:56S*E
14175	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:58S*E
14177	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:60S*E
14184	:<.01	:<.01	:<.01	:4	:<.01	:<1	:<1	:67S*E
14186	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:69S*E
14188	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:71S*E
14190	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:73S*E
14192	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:75S*E
14194	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:77S*E
14196	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:79S*E
14198	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:81S*E
14200	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:83S*E
14202	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:85S*E
14204	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:87S*E
14206	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:89S*E
	29P	30P	31P	32P	33P	34P	35P	**E **E

.IN.D#04 REGION V DRINKING WATER STUDY - INDIANA -----E

EPA-CRL 1975 SAMPLE LOG NO.	S0017 OA RONNEL WHL SMPL UG/L	S0032 OA DURSBAN WHL SMPL UG/L	39600 OA MPARATHN WHL SMPL UG/L	39530 OA MALATHN WHL SMPL UG/L	39540 OA PARATHN WHL SMPL UG/L	S0033 OA DEF WHL SMPL UG/L	39398 OA ETHION WHL SMPL UG/L	*F *F *F *F
14123	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 6S*F
14125	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 8S*F
14127	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:10S*F
14133	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:16S*F
14135	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:18S*F
14137	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:20S*F
14139	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:22S*F.
14141	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:24S*F
14143	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:26S*F
14145	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:28S*F
14147	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:30S*F
14149	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:32S*F
14151	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:34S*F
14153	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:36S*F
14155	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:38S*F
14157	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:40S*F
14159	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:42S*F
14161	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:44S*F
14163	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:46S*F
14165	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:48S*F
14167	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:50S*F
14169	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:52S*F
14171	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:54S*F
14173	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:56S*F
14175	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:58S*F
14177	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:60S*F
14184	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:67S*F
14186	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:69S*F
14188	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:71S*F
14190	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:73S*F
14192	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:75S*F
14194	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:77S*F
14196	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:79S*F
14198	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:81S*F
14200	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:83S*F
14202	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:85S*F
14204	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:87S*F
14206	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:89S*F
	36P	37P	38P	39P	40P	41P	42P	**F

EPA-CRL 1975 SAMPLE LOG NO.	S0018 OA PHENCAPT WHL SMPL UG/L	S0034 OA EPN WHL SMPL UG/L	39580 OA GUTHION WHL SMPL UG/L	S0035 OA PHOSALON WHL SMPL UG/L	S0036 OA AZINFOSE WHL SMPL UG/L	S0037 OA COUMAFOS WHL SMPL UG/L	39488 OA AROCLOR 1221 UG/L	*G
14123	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 6S*G
14125	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 8S*G
14127	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:10S*G
14129	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:12S*G
14133	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:16S*G
14135	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:18S*G
14137	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:20S*G
14139	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:22S*G
14141	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:24S*G
14143	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:26S*G
14145	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:28S*G
14147	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:30S*G
14149	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:32S*G
14150	:	:	:	:	:	:	:<0.3	:33S*G
14151	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:34S*G
14153	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:36S*G
14155	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:38S*G
14156	:	:	:	:	:	:	:<0.3	:39S*G
14157	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:40S*G
14159	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:42S*G
14161	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:44S*G
14163	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:46S*G
14165	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:48S*G
14167	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:50S*G
14169	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:52S*G
14171	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:54S*G
14173	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:56S*G
14175	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:58S*G
14177	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:60S*G
14184	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:67S*G
14186	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:69S*G
14188	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:71S*G
14190	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:73S*G
14192	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:75S*G
14194	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:77S*G
14196	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:79S*G
14198	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:81S*G
14200	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:83S*G
14202	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:85S*G
14204	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:87S*G
14206	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:89S*G
	43P	44P	45P	46P	47P	48P	49P	**G

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **G

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EPA-CRL 1975 SAMPLE LOG NO.	39496 OA AROCLOR 1242 UG/L	39500 OA AROCLOR 1248 UG/L	39504 OA AROCLOR 1254 UG/L	39508 OA AROCLOR 1260 UG/L	S0047 OA METHE CL TOT VOL UG/L	S0039 OA CCL4 TOT VOL UG/L	S0038 OA CHCL3 TOT VOLA UG/L	*H *H *H *H
14123	<0.3	<0.3	<0.3	<0.4				6S*H
14124					4	2	3	7S*H
14125	<0.3	<0.3	<0.3	<0.4				8S*H
14126					<1	2.4	20	9S*H
14127	<0.3	<0.3	<0.3	<0.4				10S*H
14128					<0.5	<2	<2	11S*H
14129	<0.3	<0.3	<0.3	<0.4				12S*H
14130					2	2	15	13S*H
14133	<0.3	<0.3	<0.3	<0.4				16S*H
14134					<0.5	<1	29	17S*H
14135	<0.3	<0.3	<0.3	<0.4				18S*H
14136					<0.5	1	3	19S*H
14137	<0.3	<0.3	<0.3	<0.4				20S*H
14138					1.3	1.6	41	21S*H
14139	<0.3	<0.3	<0.3	<0.4				22S*H
14140					<0.5	<1	5	23S*H
14141	<0.3	<0.3	<0.3	<0.4				24S*H
14142					<0.5	2	84	25S*H
14143	<0.3	<0.3	<0.3	<0.4				26S*H
14144					<0.5	<1	4	27S*H
14145	<0.3	<0.3	<0.3	<0.4				28S*H
14146					<0.5	<1	5	29S*H
14147	<0.3	<0.3	<0.3	<0.4				30S*H
14148					<0.5	<1	<1	31S*H
14149	<0.3	<0.3	<0.3	<0.4				32S*H
14150	<0.3	<0.3	<0.3	<0.4	2	<1	19	33S*H
14152	<0.3	<0.3	<0.3	<0.4	<0.5	<1	9	35S*H
14153	<0.3	<0.3	<0.3	<0.4				36S*H
14154					<0.5	<0.5	30	37S*H
14156	<0.3	<0.3	<0.3	<0.4	<0.5	<1	<1	39S*H
14157	<0.3	<0.3	<0.3	<0.4				40S*H
14158					<0.5	<1	7	41S*H
14159	<0.3	<0.3	<0.3	<0.4				42S*H
14160					<0.5	<0.5	4	43S*H
14161	<0.3	<0.3	<0.3	<0.4				44S*H
14162					<1	0.9	29	45S*H
14163	<0.3	<0.3	<0.3	<0.4				46S*H
14164					<0.5	<1	<3	47S*H
14165	<0.3	<0.3	<0.3	<0.4				48S*H
14166					<0.5	<0.5	5	49S*H
14167	<0.3	<0.3	<0.3	<0.4				50S*H
14168					<0.5	<1	<1	51S*H
14169	<0.3	<0.3	<0.3	<0.4				52S*H
14170					<0.5	1	6	53S*H
14171	<0.3	<0.3	<0.3	<0.4				54S*H
14172					<0.5	<1	<2	55S*H
14173	<0.3	<0.3	<0.3	<0.4				56S*H
14174					<0.5	1	7	57S*H
14175	<0.3	<0.3	<0.3	<0.4				58S*H
14176					<0.5	<1	<1	59S*H
14177	<0.3	<0.3	<0.3	<0.4				60S*H
14178					<0.5	1	4	61S*H
14184	<0.3	<0.3	<0.3	<0.4				67S*H
.4185					<0.5	<1	<2	68S*H
14186	<0.3	<0.3	<0.3	<0.4				69S*H
14187					<0.5	<1	11	70S*H
14188	<0.3	<0.3	<0.3	<0.4				71S*H

14189					<0.5	<1	<1	72S*H
14190	<0.3	<0.3	<0.3	<0.4				73S*H
14191					<1	<0.5	31	74S*H
14192	<0.3	<0.3	<0.3	<0.4				75S*H
14193					<0.5	<2	<2	76S*H
14194	<0.3	<0.3	<0.3	<0.4				77S*H
14195					<0.5	<1	12	78S*H
14196	<0.3	<0.3	<0.3	<0.4				79S*H
14197					15	<1	<1	80S*H
14198	<0.3	<0.3	<0.3	<0.4				81S*H
14199					<0.5	<1	5	82S*H
14200	<0.3	<0.3	<0.3	<0.4				83S*H
14201					<0.5	<1	<1	84S*H
14202	<0.3	<0.3	<0.3	<0.4				85S*H
14203					<0.5	<1	19	86S*H
14204	<0.3	<0.3	<0.3	<0.4				87S*H
14205					<0.5	<1	<2	88S*H
14206	<0.3	<0.3	<0.3	<0.4				89S*H
14207					<.5	<1	<3	90S*H
	50P	51P	52P	53P	54P	55P	56P	**H

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **H

EPA-CRL 1975 SAMPLE LOG NO.	S0055 OA C2H4CL2 TOT VOL UG/L	S0040 OA CHCL2BR TOT VOL UG/L	S0041 OA CHCLBR2 TOT VOL UG/L	S0042 OA CHBR3 TOT VOL UG/L				
14124	<2	<0.5	<0.5	<0.5				7S
14126	<1	9	1.5	1.6				9S
14128	<2	<0.5	<0.5	<0.5				11S
14130	<1	9	1	0.3				13S
14134	<2	12	1.7	1				17S
14136	2	0.4	<0.2	<0.2				19S
14138	<2	15	1.4	1				21S
14140	<2	<0.5	<0.5	<0.5				23S
14142	<1	12	0.8	0.8				25S
14144	15	<0.5	<0.5	<0.5				27S
14146	<1	15	6	3				29S
14148	3	<0.5	<0.5	<0.5				31S
14150	<1	6	0.5	0.6				33S
14152	<4	<0.5	<0.5	<0.5				35S
14154	<1	11	1.4	0.3				37S
14156	1	<0.5	<0.5	<0.5				39S
14158	<1	1.2	<0.1	<0.1				41S
14160	4	<0.5	<.5	<0.5				43S
14162	21	0.7	0.4	1				45S
14164	<2	<0.5	<0.5	<0.5				47S
14166	<2	4	1	<0.5				49S
14168	<2	<0.5	<0.5	<0.5				51S
14170	<2	5	1	<0.5				53S
14172	<4	<0.5	<0.5	<0.5				55S
14174	<2	5	1	<0.5				57S
14176	<2	<0.5	<0.5	<0.5				59S
14178	<2	<0.5	<0.5	<0.5				61S
14185	<1	<0.5	<0.5	<0.5				68S
14187	<1	3.4	3	2				70S
14189	2	<0.5	<0.5	<0.5				72S
14191	<1	17	1	<0.5				74S
14193	<1	<0.5	<0.5	<0.5				76S
14195	<1	10	3	0.3				78S
14197	2	<0.5	<0.5	<0.5				80S
14199	<1	1	0.3	0.6				82S
14201	<1	<0.5	<0.5	<0.5				84S
14203	<1	5	0.5	<0.3				86S
14205		<0.5	<0.5	<0.5				88S
14207	<2	<0.5	<0.5	<0.5				90S
	57P	58P	59P	60P	61P	62P	63P	

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA

EPA-CRL 1975 SAMPLE LOG NO.	00916 MW CALCIUM CA,TOT MG/L	00927 MW MGNSIUM MG,TOT MG/L	00929 MW SODIUM NA,TOT MG/L	00937 MW PTSSIUM K,TOT MG/L	01034 MW CHROMIUM CR,TOT UG/L	01042 MW COPPER CU,TOT UG/L	01045 MW IRON FE,TOT UG/L	*J *J *J *J
14118	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	: 1S*J
14119	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	: 2S*J
14120	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	: 3S*J
14123	:28.0	:8.6	:11.6	:2.0	:<5	:26	:2530	: 6S*J
14124	:29.4	:8.6	:11.0	:1.7	:<5	:16	:2270	: 7S*J
14125	:30.0	:8.2	:10.6	:1.6	:<5	:24	:70	: 8S*J
14126	:30.2	:8.1	:10.6	:1.6	:<5	:21	:60	: 9S*J
14133	:31.0	:8.4	:11.1	:2.0	:<5	:9	:<20	:14S*J
14135	:32.8	:10.1	:11.6	:2.1	:6	:10	:3280	:18S*J
14137	:27.2	:8.7	:12.2	:2.0	:<5	:8	:<20	:20S*J
14139	:41.9	:12.9	:5.4	:2.9	:<5	:10	:1310	:22S*J
14141	:46.4	:13.1	:5.8	:2.4	:<5	:5	:50	:24S*J
14143	:98.5	:30.5	:20.5	:3.4	:<5	:36	:150	:26S*J
14145	:86.4	:27.2	:82.3	:3.7	:<5	:26	:<20	:28S*J
14147	:69.7	:24.3	:10.6	:1.7	:<5	:24	:320	:30S*J
14149	:68.5	:23.8	:11.4	:2.0	:<5	:8	:<20	:32S*J
14151	:71.0	:20.9	:5.7	:1.2	:<5	:67	:610	:34S*J
14153	:81.6	:24.2	:18.3	:1.3	:<5	:<5	:65	:36S*J
14155	:80.9	:21.1	:7.7	:1.9	:<5	:<5	:230	:38S*J
14157	:79.9	:20.7	:7.9	:2.0	:<5	:<5	:<20	:40S*J
14159	:60.7	:15.9	:7.2	:2.6	:<5	:<5	:1310	:42S*J
14161	:23.0	:3.2	:25.8	:3.0	:<5	:<5	:35	:44S*J
14163	:35.5	:11.2	:5.9	:1.4	:5	:<5	:68	:46S*J
14165	:35.4	:11.2	:5.8	:1.4	:<5	:<5	:48	:48S*J
14167	:35.7	:11.3	:4.0	:1.3	:<5	:25	:130	:50S*J
14169	:34.8	:11.0	:9.2	:1.3	:<5	:<5	:<20	:52S*J
14171	:36.1	:11.3	:4.6	:1.3	:8	:27	:140	:54S*J
14173	:34.8	:11.0	:9.1	:1.3	:<5	:10	:<20	:56S*J
14175	:36.3	:11.3	:5.6	:1.5	:<5	:15	:<20	:58S*J
14177	:34.7	:10.9	:5.3	:1.5	:<5	:77	:<20	:60S*J
14179	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	:62S*J
14180	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	:63S*J
14184	:63.6	:26.2	:6.9	:0.8	:<5	:<5	:1160	:67S*J
14186	:65.9	:26.0	:7.0	:0.7	:<5	:18	:<20	:69S*J
14188	:67.2	:28.1	:6.7	:1.3	:<5	:<5	:300	:71S*J
14190	:69.6	:27.7	:6.6	:1.3	:<5	:<5	:<20	:73S*J
14192	:57.1	:16.9	:14.5	:2.0	:<5	:<5	:1130	:75S*J
14194	:30.0	:8.6	:77.2	:1.4	:<5	:53	:<20	:77S*J
14196	:66.8	:20.2	:11.4	:2.5	:<5	:<5	:840	:79S*J
14198	:79.1	:26.2	:16.2	:3.0	:<5	:<5	:54	:81S*J
14200	:11.4	:4.9	:3.9	:1.6	:<5	:<5	:110	:83S*J
14202	:15.4	:5.2	:3.9	:1.7	:<5	:<5	:<20	:85S*J
14204	:38.0	:11.4	:7.7	:1.7	:10	:200	:86	:87S*J
14206	:34.9	:10.9	:6.1	:1.6	:<5	:200	:<20	:89S*J
	64P	65P	66P	67P	68P	69P	70P	**J

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **J

EPA-CRL 1975 SAMPLE LOG NO.	01055 MW MANGNESE MN,TOT UG/L	01092 MW ZINC ZN,TOT UG/L	01002 MW ARSENIC AS,TOT UG/L	01051 MW LEAD PB,TOT UG/L	01027 MW CADMIUM CD,TOT UG/L	01077 MW SILVER AG,TOT UG/L	01147 MW SELENIUM SE,TOT UG/L	*K *K *K *K
14118	<5	<5	<1	<2	0.5	<0.2	<5	1S*K
14119	<5	<5	<1	<2	<0.2	<0.2	<5	2S*K
14120	<5	<5	<1	4	<0.2	<0.2	<5	3S*K
14123	330	30	8	25	0.5	<0.2	<5	6S*K
14124	300	40	6	22	0.7	<0.2	<5	7S*K
14125	20	20	<1	5	0.4	<0.2	<5	8S*K
14126	18	18	<1	5	0.3	<0.2	<5	9S*K
14133	<5	82	<1	3	<0.2	<0.2	<5	16S*K
14135	470	89	9	15	0.5	<0.2	<5	18S*K
14137	<5	460	<1	<2	<0.2	<0.2	<5	20S*K
14139	120	5	5	7	<0.2	<0.2	<5	22S*K
14141	<5	<5	<1	<2	<0.2	<0.2	<5	24S*K
14143	280	6	<1	<2	<0.2	<0.2	<5	26S*K
14145	19	<5	<1	<2	<0.2	<0.2	<5	28S*K
14147	33	7	1	6	0.4	<0.2	<5	30S*K
14149	<5	<5	<1	<2	<0.2	<0.2	<5	32S*K
14151	28	<5	1	2	<0.2	<0.2	<5	34S*K
14153	9	<5	50	<2	<0.2	<0.2	<5	36S*K
14155	39	<5	2	<2	<0.2	<0.2	<5	38S*K
14157	19	14	<1	<2	<0.2	<0.2	<5	40S*K
14159	41	14	6	3	<0.2	<0.2	<5	42S*K
14161	<5	<5	<1	<2	<0.2	<0.2	<5	44S*K
14163	<5	<5	1	3	<0.2	<0.2	<5	46S*K
14165	<5	<5	<1	20	<0.2	<0.2	<5	48S*K
14167	<5	<5	1	3	<0.2	<0.2	<5	50S*K
14169	<5	<5	<1	<2	<0.2	<0.2	<5	52S*K
14171	7	<5	<1	3	<0.2	<0.2	<5	54S*K
14173	<5	<5	<1	<2	<0.2	<0.2	<5	56S*K
14175	<5	12	1	3	<0.2	<0.2	<5	58S*K
14177	<5	<5	<1	2	<0.2	<0.2	<5	60S*K
14179	<5	<5	<1	<2	0.8	<0.2	<5	62S*K
14180	<5	<5	<1	<2	0.4	<0.2	<5	63S*K
14184	95	<5	8	<2	<0.2	<0.2	<5	67S*K
14186	37	<5	2	<2	<0.2	<0.2	<5	69S*K
14188	26	<5	1	<2	<0.2	<0.2	<5	71S*K
14190	<5	<5	1	<2	<0.2	<0.2	<5	73S*K
14192	180	5	<1	<2	<0.2	<0.2	<5	75S*K
14194	18	<5	<1	<2	<0.2	<0.2	<5	77S*K
14196	640	31	2	<2	<0.2	<0.2	<5	79S*K
14198	350	<5	13	3	<0.2	<0.2	<5	81S*K
14200	21	<5	<1	<2	<0.2	<0.2	<5	83S*K
14202	<5	<5	<1	<2	<0.2	<0.2	<5	85S*K
14204	5	<5	1	4	<0.2	<0.2	<5	87S*K
14206	<5	<5	<1	4	<0.2	<0.2	<5	89S*K
	71P	72P	73P	74P	75P	76P	77P	**K

FPA-CRL 1975 SAMPLE LOG NO.	00530 IM RESIDUE TOT NFLT MG/L	70300 IM RESIDUE DISS-180 C MG/L	00095 IM CNDUCTVY AT 25C MICROMHO	00945 IM SULFATE SO4 MG/L	00940 IM CHLORIDE CL MG/L	C0956 IM SILICA SIO2 MG/L	00410 IM T ALK CACO3 MG/L	*L *L *L *L
14123	:181	:160	:298	:54	:16	:6.5	:51	: 6S*L
14124	:181	:160	:296	:54	:17	:6.5	:53	: 7S*L
14125	:2	:150	:323	:87	:20	:6.3	:24	: 8S*L
14126	:2	:150	:322	:87	:20	:6.4	:23	: 9S*L
14133	:<2	:170	:316	:60	:19	:7.0	:54	:16S*L
14135	:329	:180	:321	:60	:16	:6.3	:59	:18S*L
14137	:<2	:130	:308	:55	:21	:7.0	:45	:20S*L
14139	:140	:220	:354	:33	:12	:7.0	:119	:22S*L
14141	:2	:260	:404	:56	:18	:7.9	:97	:24S*L
14143	:<2	:510	:792	:103	:30	:12.8	:249	:26S*L
14145	:3	:590	:925	:149	:32	:13.8	:288	:28S*L
14147	:24	:370	:595	:52	:26	:7.5	:187	:30S*L
14149	:<2	:380	:587	:64	:31	:7.8	:173	:32S*L
14151	:9	:340	:537	:43	:25	:6.7	:160	:34S*L
14153	:3	:400	:678	:100	:33	:11.3	:171	:36S*L
14155	:15	:380	:605	:81	:19	:8.0	:190	:38S*L
14157	:<2	:390	:600	:107	:21	:8.1	:160	:40S*L
14159	:53	:310	:491	:80	:17	:6.4	:128	:42S*L
14161	:<2	:220	:327	:80	:19	:5.9	:20	:44S*L
14163	:7	:220	:301	:27	:11	:0.5	:114	:46S*L
14165	:<2	:190	:305	:34	:13	:0.6	:103	:48S*L
14167	:5	:200	:293	:24	:10	:<0.2	:114	:50S*L
14169	:<2	:215	:315	:31	:11	:0.6	:111	:52S*L
14171	:7	:190	:295	:22	:9	:<0.2	:112	:54S*L
14173	:<2	:210	:314	:30	:10	:0.6	:111	:56S*L
14175	:7	:200	:301	:24	:10	:0.2	:113	:58S*L
14177	:<2	:180	:304	:28	:11	:<0.2	:107	:60S*L
14184	:2	:270	:555	:34	:25	:14.8	:222	:67S*L
14186	:2	:300	:538	:36	:17	:15.9	:227	:69S*L
14188	:10	:340	:593	:54	:20	:7.1	:215	:71S*L
14190	:2	:360	:592	:62	:24	:7.5	:197	:73S*L
14192	:<2	:330	:507	:47	:35	:11.3	:157	:75S*L
14194	:3	:320	:547	:48	:37	:11.7	:170	:77S*L
14196	:<2	:325	:542	:54	:23	:12.9	:195	:79S*L
14198	:2	:410	:668	:67	:33	:11.8	:230	:81S*L
14200	:<2	:120	:154	:32	:4	:7.6	:27	:83S*L
14202	:<2	:130	:168	:39	:5	:7.8	:25	:85S*L
14204	:5	:140	:316	:28	:13	:0.5	:111	:87S*L
14206	:<2	:140	:309	:32	:13	:0.2	:100	:89S*L
	78P	79P	80P	81P	82P	83P	84P	**L

EPA-CRL 1975 SAMPLE LOG NO.	00403 IM LAB PH SU	00951 IM FLUORIDE F,TOTAL MG/L	32730 IM PHENOLS UG/L	00720 IM CYANIDE CN MG/L	00630 IN NO2&NO3 N-TOTAL MG/L	00610 IN NH3-N TOTAL MG/L	00625 IN TOT KJEL N MG/L	*M *M *M *M
14118			7	<0.002	<0.03	<0.010	<0.05	1S*M
14119			8	0.010	<0.03	<0.010	<0.05	2S*M
14120			3	<0.002	<0.03	<0.010	<0.05	3S*M
14121				0.002				4S*M
14123	7.4	0.13	5	0.006	1.04	0.155	1.25	6S*M
14124	7.3	0.13	7	0.006	0.99	0.158	1.22	7S*M
14125	6.5	0.78	<3	0.003	0.99	<0.010	0.61	8S*M
14126	6.5	0.86	<3	<0.002	0.99	<0.010	0.66	9S*M
14133	7.7	0.93	6	0.003	0.98	0.011	0.72	16S*M
14135	7.2	0.14	3	0.010	1.19	0.153	1.47	18S*M
14137	7.1	0.56	4	0.003	1.10	<0.010	0.71	20S*M
14139	7.3	0.14	5	0.003	2.69	0.064	1.59	22S*M
14141	7.6	2.1	<3	0.003	2.60	0.012	0.80	24S*M
14143	7.5	0.16	3	0.005	2.53	0.281	1.10	26S*M
14145	8.0	0.12	<3	0.003	3.94	<0.010	0.76	28S*M
14147	7.5	0.19	10	0.003	4.86	0.178	0.77	30S*M
14149	7.9	0.76	5	0.010	4.44	0.293	0.64	32S*M
14151	7.5	0.16	7	0.004	9.03	0.090	0.68	34S*M
14153	7.5	1.0	3	0.006	6.53	0.012	0.23	36S*M
14155	7.7	0.20	4	0.003	4.91	0.124	0.88	38S*M
14157	7.6	0.99	5	0.004	4.80	0.687	1.15	40S*M
14159	7.7	0.18	6	0.004	3.45	0.190	1.51	42S*M
14161	9.1	0.83	5	0.004	3.31	0.273	0.58	44S*M
14163	7.9	0.13	5	0.006	0.23	0.075	0.24	46S*M
14165	7.3	0.22	3	0.002	0.22	0.145	0.22	48S*M
14167	7.9	0.12	<3	0.004	0.18	0.014	0.16	50S*M
14169	7.9	0.82	5	<0.002	0.16	0.148	0.23	52S*M
14171	7.9	0.12	<3	<0.002	0.17	0.011	0.16	54S*M
14173	7.9	0.83	5	<0.002	0.16	0.153	0.24	56S*M
14175	7.8	0.14	3	0.005	0.23	0.068	0.20	58S*M
14177	7.5	0.19	8	<0.002	0.16	0.357	0.45	60S*M
14179			5	0.005	<0.03	<0.010	<0.05	62S*M
14180			7	0.008	<0.03	<0.010	<0.05	63S*M
14184	7.8	0.15	<3	0.002	<0.03	0.107	0.11	67S*M
14186	7.9	0.87	<3	<0.002	<0.03	0.015	<0.05	69S*M
14188	7.7	0.19	4	0.003	3.13	0.102	0.50	71S*M
14190	7.6	1.0	4	0.004	3.24	0.016	0.20	73S*M
14192	7.5	0.17	<3	0.003	0.06	0.209	0.41	75S*M
14194	7.9	0.93	<3	0.003	0.12	0.014	0.11	77S*M
14196	8.0	0.23	3	0.002	0.07	0.325	0.42	79S*M
14198	7.6	1.1	7	0.005	0.66	0.142	0.29	81S*M
14200	7.4	<0.10	3	<0.002	0.25	0.026	0.14	83S*M
14202	7.3	0.80	<3	0.002	0.23	<0.010	<0.05	85S*M
14204	7.8	0.16	14	0.015	0.22	0.231	0.41	87S*M
14206	7.2	0.13	5	0.003	0.21	0.375	0.49	89S*M
	85P	86P	87P	88P	89P	90P	91P	**M

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **M

EPA-CRL 1975 SAMPLE LOG NO.	00665 IN PHOS-T P-WET MG/L	00340 IN COD HI LEVEL MG/L	00680 IN T ORG C C MG/L	71900 IN MERCURY HG,TOTAL UG/L	00900 IN TOT HARD CACO3 MG/L	00615 IN NO2-N TOTAL MG/L		*N *N *N *N
14118	<0.02	<3		<0.1	<3			1S*N
14119	<0.02	<3		<0.1	<3			2S*N
14120	<0.02	<3		<0.1	<3			3S*N
14123	0.28	25		0.3	105	0.028		6S*N
14124	0.27	22		0.2	109	<0.005		7S*N
14125	0.03	4		0.3	109	<0.005		8S*N
14126	0.02	5		0.3	109	<0.005		9S*N
14133	0.02	<3		0.2	112	<0.005		16S*N
14135	0.47	35		0.1	134	0.007		18S*N
14137	0.36	5		<0.1	104	<0.005		20S*N
14139	0.31	30		<0.1	158	0.060		22S*N
14141	0.03	10		<0.1	170	<0.005		24S*N
14143	0.02	4		<0.1	372	0.015		26S*N
14145	<0.02	<3		<0.1	328	<0.005		28S*N
14147	0.15	13		0.1	274	0.043		30S*N
14149	0.03	7		0.2	269	<0.005		32S*N
14151	0.08	10		0.1	263	0.040		34S*N
14153	<0.02	3		0.1	303	<0.005		36S*N
14155	0.07	16		0.3	289	0.017		38S*N
14157	<0.02	8		0.2	285	<0.005		40S*N
14159	0.16	32		0.1	217	<0.005		42S*N
14161	<0.02	8		0.2	71	0.026		44S*N
14163	<0.02	5		0.1	135	0.008		46S*N
14165	<0.02	<3		0.3	135	<0.005		48S*N
14167	0.02	3		0.1	136	0.006		50S*N
14169	0.02	<3		<0.1	132	<0.005		52S*N
14171	0.03	6		0.1	137	0.007		54S*N
14173	0.03	<3		<0.1	132	<0.005		56S*N
14175	0.02	<3		<0.1	137	0.023		58S*N
14177	0.02	3		0.3	132	<0.005		60S*N
14179	0.02	<3		<0.1	<3			62S*N
14180	<0.02	<3		0.1	<3			63S*N
14184	0.03	<3		0.2	267	<0.005		67S*N
14186	0.03	<3		0.2	272	<0.005		69S*N
14188	0.09	10		0.1	283	0.026		71S*N
14190	0.05	5		0.1	288	<0.005		73S*N
14192	0.06	6		<0.1	212	<0.005		75S*N
14194	0.03	5		0.2	110	<0.005		77S*N
14196	<0.02	4		0.2	250	<0.005		79S*N
14198	<0.02	<3		0.3	305	<0.005		81S*N
14200	<0.02	3		<0.1	49	0.008		83S*N
14202	<0.02	<3		0.2	60	<0.005		85S*N
14204	0.02	10		<0.1	142	0.010		87S*N
14206	<0.02	9		0.2	132	<0.005		89S*N
	92P	93P	94P	95P	96P	97P	98P	**N

.IN.DW04 REGION V DRINKING WATER STUDY - INDIANA **N

CRLS 05APR DSN=CNCRLS.RGD.MC.DW01 ON TS0009 04/19/75 REV01 T

----------STUDY DESCRIPTION----------

NPAR	NLOG	AGENCYID	UNLOCKEY	STATTYPE	SMPLDAY	ATLABBY	DUEDATE	ACCOUNT-NUMBER
94	77			77777777	03FEB75	05FEB75	03MAY75	

>>>REGION V DRINKING WATER STUDY - MICHIGAN

----------SAMPLE DESCRIPTIONS----------

LABIDNUM	STORETID	COLLDAY	TIME	STATTYPE	DEEP	T	M	NO	ENDDATE	TIME	PRLU
14208		750203									
14209		750203									
14210		750203									
14211		750203									
14212		750203									
14213		750203									
14214		750203									
14215		750203									
14216		750203									
14217		750203									
14218		750203									
14219		750203									
14220		750203									
14221		750203									
14222		750203									
14223		750203									
14224		750203									
14225		750203									
14226		750203									
14227		750203									
14228		750203									
14229		750203									
14230		750203									
14231		750203									
14232		750203									
14233		750203									
14234		750203									
14235		750203									
14236		750203									
14237		750203									
14238		750203									
14239		750203									
14240		750203									
14241		750203									
14242		750203									
14243		750203									
14244		750203									
14245		750203									
14246		750203									
14247		750203									
14248		750203									
14249		750203									
14250		750203									
14251		750203									
14252		750203									
14253		750203									
14254		750203									
14255		750203									
14256		750203									

14257		750203	
14258		750203	
14259		750203	
14260		750203	
14261		750203	
14262		750203	
14263		750203	
14264		750203	
14265		750203	
14266		750203	
14267		750203	
14268		750203	
14269		750203	
14270		750203	
14271		750203	
14272		750203	
14273		750203	
14274		750203	
14275		750203	
14276		750203	
14782		750203	
14783		750203	
14784		750203	
14785		750203	
14786		750203	MICHIGAN
14787		750203	
14788		750203	
14789		750203	
>>>14208	>>	HNO3 REAGENT BLANK	
>>>14209	>>	H2SO4 REAGENT BLANK	
>>>14210	>>	NAOH REAGENT BLANK	
>>>14211	>>	H3PO4 REAGENT BLANK	
>>>14212	>>	OPEN	
>>>14213	>>	DUNDEE RAW WATER SERIES A	41.58N 83.38W
>>>14214	>>	DUNDEE RAW WATER SERIES B	
>>>14215	>>	DUNDEE FINISHED WATER SERIES A	
>>>14216	>>	DUNDEE FINISHED WATER SERIES B	
>>>14217	>>	DETROIT RAW WATER SERIES A	42.23N 83.05W
>>>14218	>>	DETROIT RAW WATER SERIES B	
>>>14219	>>	DETROIT FINISHED WATER SERIES A	
>>>14220	>>	DETROIT FINISHED WATER SERIES B	
>>>14221	>>	DETROIT RAW WATER SERIES A	
>>>14222	>>	DETROIT RAW WATER SERIES B	
>>>14223	>>	DETROIT FINISHED WATER SERIES A	
>>>14224	>>	DETROIT FINISHED WATER SERIES B	
>>>14225	>>	MT.CLEMENS RAW WATER SERIES A	42.35N 82.55W
>>>14226	>>	MT.CLEMENS RAW WATER SERIES B	
>>>14227	>>	MT.CLEMENS FINISHED WATER SERIES A	
>>>14228	>>	MT.CLEMENS FINISHED WATER SERIES B	
>>>14229	>>	JACKSON RAW WATER SERIES A	42.15N 84.24W
>>>14230	>>	JACKSON RAW WATER SERIES B	
>>>14231	>>	JACKSON FINISHED WATER SERIES A	
>>>14232	>>	JACKSON FINISHED WATER SERIES B	
>>>14233	>>	KALAMAZOO RAW WATER SERIES A	42.17N 85.36W
>>>14234	>>	KALAMAZOO RAW WATER SERIES B	
>>>14235	>>	KALAMAZOO FINISHED WATER SERIES A	

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>>14236   >>   KALAMAZOO FINISHED WATER SERIES B
>>14237   >>   LANSING RAW WATER SERIES A ———————— 42.44N 85.34W
>>14238   >>   LANSING RAW WATER SERIES B
>>14239   >>   LANSING FINISHED WATER SERIES A
>>  240   >>   LANSING FINISHED WATER SERIES B
>>..241   >>   GRAND RAPIDS RAW WATER SERIES A ———————— 42.57N 86.40W
>>14242   >>   GRAND RAPIDS RAW WATER SERIES B
>>14243   >>   GRAND RAPIDS FINISHED WATER SERIES A
>>14244   >>   GRAND RAPIDS FINISHED WATER SERIES B
>>14245   >>   MT.PLEASANT RAW WATER SERIES A ———————— 43.36N 84.46W
>>14246   >>   MT.PLEASANT RAW WATER SERIES B
>>14247   >>   MT.PLEASANT FINISHED WATER SERIES A
>>14248   >>   MT.PLEASANT FINISHED WATER SERIES B
>>14249   >>   CADILLAC RAW WATER SERIES A ———————— 44.15N 85.23W
>>14250   >>   CADILLAC RAW WATER SERIES B
>>14251   >>   CADILLAC FINISHED WATER SERIES A
>>14252   >>   CADILLAC FINISHED WATER SERIES B
>>14253   >>    SAULT STE.MARIE RAW WATER SERIES A ———————— 46.29N 84.22W
>>14254   >>   SAULT STE.MARIE RAW WATER SERIES B
>>14255   >>   SAULT STE.MARIE FINISHED WATER SERIES A
>>14256   >>   SAULT STE.MARIE FINISHED WATER SERIES B
>>14257   >>   WATERFORD TOWNSHIP RAW WATER SERIES A ———————— 42.40N 83.24W
>>14258   >>   WATERFORD TOWNSHIP RAW WATER SERIES B
>>14259   >>   WATERFORD TOWNSHIP FINISHED WATER SERIES A
>>14260   >>   WATERFORD TOWNSHIP FINISHED WATER SERIES B
>>14261   >>   MENOMINEE RAW WATER SERIES A ———————— 45.07N 87.37W
>>14262   >>  MENOMINEE RAW WATER SERIES B
>>14263   >>   MENOMINEE FINISHED WATER SERIES A
>>14264   >>  MENOMINEE FINISHED WATER SERIES B
>>14265   >>   MENOMINEE RAW WATER SERIES A
>>14266   >>   MENOMINEE RAW WATER SERIES B
>14267   >>   MENOMINEE FINISHED WATER SERIES A
>14268   >>   MENOMINEE FINISHED WATER SERIES B
>14269   >>   HNO3 REAGENT BLANK
>14270   >>   H2SO4 REAGENT BLANK
>14271   >>   NAOH REAGENT BLANK
>14272   >>   H3PO4 REAGENT BLANK
>14273   >>   BISSEMER TOWNSHIP RAW WATER SERIES A ———————— Bessemer 46.28N
>14274   >>   BISSEMER TOWNSHIP RAW WATER SERIES B
>14275   >>   BISSEMER TOWNSHIP FINISHED WATER SERIES A
>14276   >>   BISSEMER TOWNSHIP FINISHED WATER SERIES B
>14782   >>   BAY CITY RAW WATER SERIES A ———————— 43.35N 83.52W
>14783   >>   BAY CITY RAW WATER SERIES B
>14784   >>   BAY CITY FINISHED WATER SERIES A
>14785   >>   BAY CITY FINISHED WATER SERIES B
>14786   >>   WYANDOTTE RAW WATER SERIES A ———————— 42.11N 83.10W
>14787   >>   WYANDOTTE RAW WATER SERIES B
>14788   >>   WYANDOTTE FINISHED WATER SERIES A
>14789   >>   WYANDOTTE FINISHED WATER SERIES B
----------------------------SAMPLE/PARAMETER DATA----------------------------
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EPA-CRL 1975 SAMPLE LOG NO.	S0003 OA TREFLAN WHL SMPL UG/L	S0001 OA HCBENZ WHL SMPL UG/L	39782 OA LINDANE WHL SMPL UG/L	S0002 OA BBHC WHL SMPL UG/L	S0004 OA DICLONE WHL SMPL UG/L	39330 OA ALDRIN WHL SMPL UG/L	S0005 OA ZYTRON WHL SMPL UG/L	*A *A *A *A
14213	:0.007	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	: 6S*A
14215	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:0.006	:<0.02	: 8S*A
14217	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:10S*A
14219	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:12S*A
14221	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:14S*A
14223	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:16S*A
14225	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.002	:18S*A
14227	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:20S*A
14229	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:22S*A
14231	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:24S*A
14233	:0.003	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:26S*A
14235	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:28S*A
14237	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:30S*A
14239	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:32S*A
14241	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:34S*A
14244	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:37S*A
14245	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:38S*A
14247	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:40S*A
14249	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:42S*A
14251	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:44S*A
14253	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:46S*A
14255	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:48S*A
14257	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:50S*A
14259	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:52S*A
14261	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:54S*A
14263	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:56S*A
14265	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:58S*A
14267	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:60S*A
14273	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:66S*A
14275	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:68S*A
14782	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:70S*A
14784	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:72S*A
14786	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:74S*A
14788	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:76S*A
	1P	2P	3P	4P	5P	6P	7P	**A

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **A

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EPA-CRL 1975 SAMPLE LOG NO.	39430 OA ISODRIN WHL SMPL UG/L	39420 OA HCHLR-EP WHL SMPL UG/L	S0006 OA CHLORDAG WHL SMPL UG/L	S0007 OA DDE OP WHL SMPL UG/L	S0008 OA DDE PP WHL SMPL UG/L	S0009 OA DDD OP WHL SMPL UG/L	S0010 OA DDT OP WHL SMPL UG/L	*B *B *B *B
14213	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	6S*B
14215	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	8S*B
14217	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	10S*B
14219	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	12S*B
14221	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	14S*B
14223	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	16S*B
14225	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	18S*B
14227	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	20S*B
14229	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	22S*B
14231	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	24S*B
14233	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	26S*B
14235	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	28S*B
14237	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	30S*B
14239	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	32S*B
14241	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	34S*B
14245	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	38S*B
14247	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	40S*B
14249	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	42S*B
14251	1.0	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	44S*B
14253	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	46S*B
14255	<0.002	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	48S*B
14257	<0.002	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	50S*B
14259	<0.002	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	52S*B
14261	<0.002	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	54S*B
14263	<0.002	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	56S*B
14265	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	58S*B
14267	<0.002	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	60S*B
14273	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	66S*B
14275	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	68S*B
14782	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	70S*B
14784	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	72S*B
14786	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	74S*B
14788	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	76S*B
	8P	9P	10P	11P	12P	13P	14P	**B

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **B

EPA-CRL 1975 SAMPLE LOG NO.	S0011 OA DDD PP WHL SMPL UG/L	S0012 OA DDT PP WHL SMPL UG/L	S0013 OA CARBPHTH WHL SMPL UG/L	S0014 OA MIREX WHL SMPL UG/L	39480 OA MTHXYCLR WHL SMPL UG/L	S0020 OA 2,4-DIIP WHL SMPL UG/L	S0021 OA DNBP WHL SMPL UG/L	*C *C *C *C
4213	<0.003	0.004	<0.003	<0.005	<0.01	<.02	<1	6S*C
14215	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	8S*C
14217	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	10S*C
14219	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	12S*C
14221	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	14S*C
14223	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	16S*C
14225	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	18S*C
14227	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	20S*C
14229	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	22S*C
14231	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	24S*C
14233	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	26S*C
14235	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	28S*C
14237	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	30S*C
14239	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	32S*C
14241	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	34S*C
14244						<.02	<1	37S*C
14245	<0.003	0.004	<0.003	<0.005	<0.01	<.02	<1	38S*C
14247	0.006	<0.003	<0.003	<0.005	<0.01	<.02	<1	40S*C
14249	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	42S*C
14251	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	44S*C
14253	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	46S*C
14255	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	48S*C
14257	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	50S*C
14259	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	52S*C
14261	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	54S*C
14263	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	56S*C
14265	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	58S*C
14267	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	60S*C
14273	<0.003	<0.003	<0.003	<0.003	<0.01	<.02	<1	66S*C
14275	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	68S*C
14782	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	70S*C
14784	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	72S*C
14786	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	74S*C
14788	<0.003	<0.003	<0.003	<0.005	<0.01	<.02	<1	76S*C
	15P	16P	17P	18P	19P	20P	21P	**C

.VI.D%01 REGION V DRINKING WATER STUDY - MICHIGAN **C

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EPA-CRL 1975 SAMPLE LOG NO.	39770 OA DCPA WHL SMPL UG/L	S0023 OA ENDOS I WHL SMPL UG/L	39380 OA DIELDRIN WHL SMPL UG/L	39390 OA ENDRIN WHL SMPL UG/L	39460 OA CLRBNZLT WHL SMPL UG/L	S0027 OA ENDOS II WHL SMPL UG/L	S0028 OA NITROFEN WHL SMPL UG/L	*D *D *D *D
14213	:<.003	:<.005	:.005	:<.003	:<.01	:<.005	:<.005	: 6S*D
14215	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 8S*D
14217	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:10S*D
14219	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:12S*D
14221	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:14S*D
14223	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:16S*D
14225	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:18S*D
14227	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:20S*D
14229	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:22S*D
14231	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:24S*D
14233	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:26S*D
14235	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:28S*D
14237	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:30S*D
14239	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:32S*D
14241	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:34S*D
14244	:<.003	:<.005	:<.003	:<.003	:<.01	:.005	:<.005	:37S*D
14245	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:38S*D
14247	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:40S*D
14249	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:42S*D
14251	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:44S*D
14253	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:46S*D
14255	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:48S*D
14257	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:50S*D
14259	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:52S*D
14261	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:54S*D
14263	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:56S*D
14265	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:58S*D
14267	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:60S*D
14273	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:66S*D
14275	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:68S*D
14782	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:70S*D
14784	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:72S*D
14786	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:74S*D
14788	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:76S*D
	22P	23P	24P	25P	26P	27P	28P	**D

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **D

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EPA-CRL 1975 SAMPLE LOG NO.	S0029 OA 245-T:IO WHL SMPL UG/L	S0030 OA PHOLAN WHL SMPL UG/L	S0031 OA BULAN WHL SMPL UG/L	S0026 OA DEHP WHL SMPL UG/L	39808 OA TEDION WHL SMPL UG/L	39570 OA DIAZINON WHL SMPL UG/L	S0016 OA DYFONATE WHL SMPL UG/L	*E *E *E *E
14213	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 6S*E
14215	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 8S*E
14217	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:10S*E
14219	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:12S*E
14221	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:14S*E
14223	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:16S*E
14225	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:18S*E
14227	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:20S*E
14229	:<.01	:<.01	:<.01	:2.5	:<.01	:<1	:<1	:22S*E
14231	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:24S*E
14233	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:26S*E
14235	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:28S*E
14237	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:30S*E
14239	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:32S*E
14241	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:34S*E
14244	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:37S*E
14245	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:38S*E
14247	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:40S*E
14249	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:42S*E
14251	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:44S*E
14253	:<.01	:<.01	:<.01	:<1	:<.01	:	:	:46S*E
14255	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:48S*E
14256	:	:	:	:	:	:	:<1	:49S*E
14257	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:50S*E
14259	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:52S*E
14261	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:54S*E
14263	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:56S*E
14265	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:58S*E
14267	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:60S*E
14273	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:66S*E
14275	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:68S*E
14782	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:70S*E
14784	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:72S*E
14786	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:74S*E
14788	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:76S*E
	29P	30P	31P	32P	33P	34P	35P	**E

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **E

FPA-CRL 1975 SAMPLE LOG NO.	S0017 OA RONNEL WHL SMPL UG/L	S0032 OA DURSBAN WHL SMPL UG/L	39600 OA MPARATHN WHL SMPL UG/L	39530 OA MALATHN WHL SMPL UG/L	39540 OA PARATHN WHL SMPL UG/L	S0033 OA DEF WHL SMPL UG/L	39398 OA ETHION WHL SMPL UG/L	*F *F *F *F
4213	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 4S*F
14215	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 8S*F
14217	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:10S*F
14219	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:12S*F
14221	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:14S*F
14223	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:16S*F
14225	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:18S*F
14227	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:20S*F
14229	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:22S*F
14231	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:24S*F
14233	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:26S*F
14235	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:28S*F
14237	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:30S*F
14239	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:32S*F
14241	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:34S*F
14244	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:37S*F
14245	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:38S*F
14247	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:40S*F
14249	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:42S*F
14251	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:44S*F
14255	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:48S*F
14256	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:49S*F
14257	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:50S*F
14259	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:52S*F
14261	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:54S*F
14263	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:56S*F
14265	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:58S*F
14267	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:60S*F
14273	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:66S*F
14275	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:68S*F
14782	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:70S*F
14784	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:72S*F
14786	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:74S*F
14788	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:76S*F
	36P	37P	38P	39P	40P	41P	42P	**F

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **F

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EPA-CRL 1975 SAMPLE LOG NO.	S0018 OA PHENCAPT WHL SMPL UG/L	S0034 OA EPN WHL SMPL UG/L	39580 OA GUTHION WHL SMPL UG/L	S0035 OA PHOSALON WHL SMPL UG/L	S0036 OA AZINFOSE WHL SMPL UG/L	S0037 OA COUMAFOS WHL SMPL UG/L	39488 OA AROCLOR 1221 UG/L	*G *G *G *G
14213	<1	<1	<5	<1	<1	<5	<0.3	6S*G
14215	<1	<1	<5	<1	<1	<5	<0.3	8S*G
14217	<1	<1	<5	<1	<1	<5	<0.3	10S*G
14219	<1	<1	<5	<1	<1	<5	<0.3	12S*G
14221	<1	<1	<5	<1	<1	<5	<0.3	14S*G
14223	<1	<1	<5	<1	<1	<5	<0.3	16S*G
14225	<1	<1	<5	<1	<1	<5	<0.3	18S*G
14227	<1	<1	<5	<1	<1	<5	<0.3	20S*G
14229	<1	<1	<5	<1	<1	<5	<0.3	22S*G
14231	<1	<1	<5	<1	<1	<5	<0.3	24S*G
14233	<1	<1	<5	<1	<1	<5	<0.3	26S*G
14235	<1	<1	<5	<1	<1	<5	<0.3	29S*G
14237	<1	<1	<5	<1	<1	<5	<0.3	30S*G
14239	<1	<1	<5	<1	<1	<5	<0.3	32S*G
14241	<1	<1	<5	<1	<1	<5	<0.3	34S*G
14244	<1	<1	<5	<1	<1	<5		37S*G
14245	<1	<1	<5	<1	<1	<5	<0.3	38S*G
14247	<1	<1	<5	<1	<1	<5	<0.3	40S*G
14249	<1	<1	<5	<1	<1	<5	<0.3	42S*G
14251	<1	<1	<5	<1	<1	<5	<0.3	44S*G
14255	<1	<1	<5	<1	<1	<5	<0.3	48S*G
14256	<1	<1	<5	<1	<1	<5		49S*G
14257	<1	<1	<5	<1	<1	<5	<0.3	50S*G
14259	<1	<1	<5	<1	<1	<5	<0.3	52S*G
14261	<1	<1	<5	<1	<1	<5	<0.3	54S*G
14263	<1	<1	<5	<1	<1	<5	<0.3	56S*G
14265	<1	<1	<5	<1	<1	<5	<0.3	58S*G
14267	<1	<1	<5	<1	<1	<5	<0.3	60S*G
14273	<1	<1	<5	<1	<1	<5	<0.3	66S*G
14275	<1	<1	<5	<1	<1	<5	<0.3	68S*G
14782	<1	<1	<5	<1	<1	<5	<0.3	70S*G
14784	<1	<1	<5	<1	<1	<5	<0.3	72S*G
14786	<1	<1	<5	<1	<1	<5	<0.3	74S*G
14788	<1	<1	<5	<1	<1	<5	<0.3	76S*G
	43P	44P	45P	46P	47P	48P	49P	**G

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **G

EPA-CRL 1975 SAMPLE LOG NO.	39496 OA AROCLOR 1242 UG/L	39500 OA AROCLOR 1248 UG/L	39504 OA AROCLOR 1254 UG/L	39508 OA AROCLOR 1260 UG/L	S0047 OA METHE CL TOT VOL UG/L	S0039 OA CCL4 TOT VOL UG/L	S0038 OA CHCL3 TOT VOLA UG/L	*H
14213	<0.3	<0.3	<0.3	<0.4				6S*H
4214					<0.5	<2	<2	7S*H
14215	<0.3	<0.3	<0.3	<0.4				8S*H
14216					<0.5	<1	170	9S*H
14217	<0.3	<0.3	<0.3	<0.4				10S*H
14218					<0.5	<1	<1	11S*H
14219	<0.3	<0.3	<0.3	<0.4				12S*H
14220					<0.5	<1	2	13S*H
14221	<0.3	<0.3	<0.3	<0.4				14S*H
14222					<0.5	<1	<1	15S*H
14223	<0.3	<0.3	<0.3	<0.4				16S*H
14224					<0.5	<1	3.4	17S*H
14225	<0.3	<0.3	<0.3	<0.4				18S*H
14226					<0.5	<1	<1	19S*H
14227	<0.3	<0.3	<0.3	<0.4				20S*H
14228					<0.5	<1	10	21S*H
14229	<0.3	<0.3	<0.3	<0.4				22S*H
14230					<0.5	<1	<1	23S*H
14231	<0.3	<0.3	<0.3	<0.4				24S*H
14232					<1	<1	<1	25S*H
14233	<0.3	<0.3	<0.3	<0.4				26S*H
14234					<0.5	<1	<1	27S*H
14235	<0.3	<0.3	<0.3	<0.4				28S*H
14236					<1	<1	4	29S*H
14237	<0.3	<0.3	<0.3	<0.4				30S*H
14238					<0.5	<1	<1	31S*H
14239	<0.3	<0.3	<0.3	<0.4				32S*H
14240					<1	2	10	33S*H
14241	<0.3	<0.3	<0.3	<0.4				34S*H
14242					15	<2	<2	35S*H
14244					<1	<1	24	37S*H
14245	<0.3	<0.3	<0.3	<0.4				38S*H
14246					<0.5	<1	<1	39S*H
14247	<0.3	<0.3	<0.3	<0.4				40S*H
14248					<0.5	<1	11	41S*H
14249	<0.3	<0.3	<0.3	<0.4				42S*H
14250					<0.5	<1	<1	43S*H
14251	<0.3	<0.3	<0.3	<0.4				44S*H
14252					<0.5	1	47	45S*H
14253	<0.3	<0.3	<0.3	<0.4				46S*H
14254					<0.5	<0.5	<1	47S*H
14255	<0.3	<0.3	<0.3	<0.4				48S*H
14256					<0.5	<0.5	27	49S*H
14257	<0.3	<0.3	<0.3	<0.3				50S*H
14258					<0.5	0.7	<1	51S*H
14259	<0.3	<0.3	<0.3	<0.4				52S*H
14260					<0.5	<1	<1	53S*H
14261	<0.3	<0.3	<0.3	<0.4				54S*H
14262					<0.5	<1	<2	55S*H
14263	<0.3	<0.3	<0.3	<0.4				56S*H
14264					1	1	42	57S*H
14265	<0.3	<0.3	<0.3	<0.4				58S*H
14266					<0.5	<0.5	6	59S*H
4267	<0.03	<0.3	<0.3	<0.4				60S*H
14268					1	<1	54	61S*H
14273	<0.03	<0.3	<0.3	<0.4				66S*H
14274					<0.5	<0.5	7	67S*H

14275	<0.3	<0.3	<0.3	<0.4				68S*H
14276					<.5	<.5	312	69S*H
14782	<0.3	<0.3	<0.3	<0.4				70S*H
14783					<0.5	<1	<1	71S*H
14784	<0.3	<0.3	<0.3	<0.4				72S*H
14785					<0.5	<1	17	73S*H
14786	<0.3	<0.3	<0.3	<0.4				74S*H
14787					20	1	1	75S*H
14788	<0.3	<0.3	<0.3	<0.4				76S*H
14789					<0.6	2.1	14	77S*H
	50P	51P	52P	53P	54P	55P	56P	**H

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **H

EPA-CRL 1975 SAMPLE LOG NO.	S0056 0A C2H4CL2 TOT VOL UG/L	S0040 0A CHCL2BR TOT VOL UG/L	S0041 0A CHCLBR2 TOT VOL UG/L	S0042 0A CHBR3 TOT VOL UG/L				
14214	<1	<1	<1	<1				7S
14216	<1	26	2	0.3				9S
14218	<1	<0.1	<0.1	<0.1				11S
14220	<1	9	2.4	<.5				13S
14222	<2	<0.5	<0.5	<0.5				15S
14224	<1	10	2	<.5				17S
14226	9	<0.5	<0.5	<0.5				19S
14228	<2	6	1.3	<0.1				21S
14230	<1	<0.5	<0.5	<0.5				23S
14232	3	16	14	3				25S
14234	<1	<0.1	<0.1	<0.1				27S
14236	<1	<0.5	<0.5	<0.5				29S
14238	4	<0.5	<0.5	<0.5				31S
14240	<2	0.8	0.7	1.3				33S
14242	2	<0.5	<0.5	<0.5				35S
14244	<2	10	1	<0.5				37S
14246	<1	<0.5	<0.2	<0.1				39S
14248	<1	23	15	3				41S
14250	2	<0.5	<0.5	<0.5				43S
14252	<2	8	0.4	<0.1				45S
14254	<1	<0.2	<0.2	<0.2				47S
14256	<1	<0.2	<0.2	<0.2				49S
14258	<1	<0.2	<0.2	<0.2				51S
14260	<1	<0.1	<0.1	<0.1				53S
14262	3	<0.5	<0.5	<0.5				55S
14264	<2	5	0.6	0.3				57S
14266	26	<0.5	<0.5	<0.5				59S
14268	<2	6	0.4	0.3				61S
14274	<1	<0.2	<0.2	<0.2				67S
14276	<1	4	<.2	<.5				69S
14783	3	<0.5	<0.5	<0.5				71S
14785	<1	19	13	7				73S
14787	<1	<0.5	<0.5	<0.5				75S
14789	<2	7	1	0.4				77S
	57P	58P	59P	60P	61P	62P	63P	

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN

EPA-CRL 1975 SAMPLE LOG NO.	00916 MW CALCIUM CA,TOT MG/L	00927 MW MGNSIUM MG,TOT MG/L	00929 MW SODIUM NA,TOT MG/L	00937 MW PTSSIUM K,TOT MG/L	01034 MW CHROMIUM CR,TOT UG/L	01042 MW COPPER CU,TOT UG/L	01045 MW IRON FE,TOT UG/L	*J *J *J *J
14208	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	: 1S*J
14214	:58.9	:15.7	:7.4	:3.0	:<5	:11	:940	: 7S*J
14216	:35.4	:2.0	:27.8	:2.8	:<5	:<5	:<20	: 9S*J
14218	:20.9	:7.0	:4.1	:1.0	:<5	:<5	:44	:11S*J
14220	:22.2	:7.1	:3.5	:0.8	:<5	:<5	:<20	:13S*J
14222	:22.1	:7.4	:3.6	:0.9	:<5	:<5	:54	:15S*J
14224	:23.6	:6.9	:3.3	:0.8	:<5	:<5	:<20	:17S*J
14226	:33.5	:7.3	:3.9	:1.1	:<5	:<5	:52	:19S*J
14228	:36.0	:7.6	:6.0	:1.3	:<5	:<5	:<20	:21S*J
14230	:135	:31.7	:25.0	:2.5	:<5	:<5	:180	:23S*J
14232	:108	:35.7	:45.9	:3.6	:<5	:5	:710	:25S*J
14234	:130	:31.8	:21.9	:2.2	:<5	:5	:38	:27S*J
14236	:89.8	:32.1	:24.0	:2.7	:<5	:<5	:560	:29S*J
14238	:114	:31.8	:8.3	:2.4	:<5	:<5	:830	:31S*J
14240	:16.7	:13.4	:17.9	:2.0	:<5	:<5	:<20	:33S*J
14242	:30.6	:11.8	:5.2	:1.4	:<5	:<5	:48	:35S*J
14244	:36.9	:11.8	:5.4	:1.4	:<5	:<5	:<20	:37S*J
14246	:96.4	:25.5	:17.1	:1.5	:<5	:<5	:420	:39S*J
14248	:82.9	:25.3	:16.5	:1.5	:<5	:<5	:390	:41S*J
14250	:33.8	:9.5	:3.9	:0.7	:<5	:<5	:230	:43S*J
14252	:43.8	:11.7	:7.5	:1.2	:6	:<5	:220	:45S*J
14254	:13.4	:2.9	:1.1	:0.6	:<5	:9	:<20	:47S*J
14256	:13.7	:2.9	:1.0	:0.6	:<5	:17	:<20	:49S*J
14258	:62.4	:25.0	:23.4	:1.3	:<5	:7	:1300	:51S*J
14260	:29.3	:9.2	:9.8	:0.7	:<5	:<5	:220	:53S*J
14262	:33.4	:13.2	:3.7	:1.2	:<5	:17	:26	:55S*J
14264	:27.9	:13.2	:3.9	:1.2	:<5	:<5	:<20	:57S*J
14266	:32.5	:13.2	:3.5	:1.2	:<5	:9	:72	:59S*J
14268	:26.6	:13.2	:4.1	:1.3	:<5	:<5	:<20	:61S*J
14269	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	:62S*J
14274	:14.3	:3.7	:2.2	:0.7	:17	:<5	:648	:67S*J
14276	:40.6	:4.1	:31.8	:0.9	:<5	:<5	:<20	:69S*J
14783	:27.1	:9.3	:6.1	:1.1	:<5	:6	:34	:71S*J
14785	:26.0	:7.0	:6.6	:1.1	:<5	:<5	:<20	:73S*J
14787	:20.9	:7.4	:3.5	:0.9	:5	:<5	:170	:75S*J
14789	:33.7	:7.5	:4.5	:0.8	:<5	:<5	:<20	:77S*J
	64P	65P	66P	67P	68P	69P	70P	**J

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **J

EPA-CRL 1975 SAMPLE LOG NO.	01055 MW MANGNESE MN,TOT UG/L	01092 MW ZINC ZN,TOT UG/L	01002 MW ARSENIC AS,TOT UG/L	01051 MW LEAD PB,TOT UG/L	01027 MW CADMIUM CD,TOT UG/L	01077 MW SILVER AG,TOT UG/L	01147 MW SELENIUM SE,TOT UG/L	*K *K *K *K
14208	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	: 1S*K
14214	:46	:24	:2	:5	:<0.2	:<0.2	:<5	: 7S*K
14216	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	: 9S*K
14218	:<5	:<5	:<1	:2	:<0.2	:<0.2	:<5	:11S*K
14220	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:13S*K
14222	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:15S*K
14224	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:17S*K
14226	:<5	:<5	:<1	:3	:<0.2	:<0.2	:<5	:19S*K
14228	:<5	:03	:<1	:3	:<0.2	:<0.2	:<5	:21S*K
14230	:50	:<5	:3	:<2	:<0.2	:<0.2	:<5	:23S*K
14232	:44	:<5	:2	:<2	:<0.2	:<0.2	:<5	:25S*K
14234	:61	:<5	:<1	:2	:<0.2	:<0.2	:<5	:27S*K
14236	:110	:<5	:1	:<2	:<0.2	:<0.2	:<5	:29S*K
14238	:88	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:31S*K
14240	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:33S*K
14242	:<5	:<5	:1	:<2	:<0.2	:<0.2	:<5	:35S*K
14244	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:37S*K
14246	:95	:210	:1	:<2	:<0.2	:<0.2	:<5	:39S*K
14248	:92	:180	:1	:<2	:<0.2	:<0.2	:<5	:41S*K
14250	:35	:<5	:<1	:2	:<0.2	:<0.2	:<5	:43S*K
14252	:38	:130	:<1	:<2	:<0.2	:<0.2	:<5	:45S*K
14254	:<5	:22	:<1	:<2	:<0.2	:<0.2	:<5	:47S*K
14256	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:49S*K
14258	:19	:<5	:6	:2	:<0.2	:<0.2	:<5	:51S*K
14260	:8	:<5	:2	:<2	:0.3	:<0.2	:<5	:53S*K
14262	:<5	:46	:3	:3	:0.5	:<0.2	:<5	:55S*K
14264	:8	:<5	:1	:<2	:<0.2	:<0.2	:<5	:57S*K
14266	:5	:54	:4	:<2	:<0.2	:<0.2	:<5	:59S*K
14268	:5	:<5	:1	:<2	:<0.2	:<0.2	:<5	:61S*K
14269	:<5	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:62S*K
14274	:13	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:67S*K
14276	:10	:<5	:<1	:<2	:<0.2	:<0.2	:<5	:69S*K
14783	:<5	:<5	:<1	:2	:<0.2	:<0.2	:<5	:71S*K
14785	:<5	:<5	:<1	:2	:<0.2	:<0.2	:<5	:73S*K
14787	:<5	:5	:<1	:5	:<0.2	:<0.2	:<5	:75S*K
14789	:<5	:<5	:<1	:<2	:<0.2	:0.3	:<5	:77S*K
	71P	72P	73P	74P	75P	76P	77P	**K

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **K

EPA-CRL 1975 SAMPLE LOG NO.	00530 IM RESIDUE TOT NFLT MG/L	70300 IM RESIDUE DISS-180 C MG/L	00095 IM CNDUCTVY AT 25C MICROMHO	00945 IM SULFATE SO4 MG/L	00940 IM CHLORIDE CL MG/L	00956 IM SILICA SIO2 MG/L	00410 IM T ALK CACO3 MG/L	*L *L *L *L
14214	:67	:350	:516	:64	:23	:6.5	:146	: 7S*L
14216	:7	:260	:404	:84	:27	:6.2	:46	: 9S*L
14218	:<5	:130	:214	:14	:7	:1.6	:75	:11S*L
14220	:<5	:120	:215	:17	:9	:2.0	:69	:13S*L
14222	:7	:120	:212	:14	:8	:1.6	:75	:15S*L
14224	:<5	:140	:214	:15	:8	:2.0	:70	:17S*L
14226	:<5	:170	:217	:15	:9	:1.6	:75	:19S*L
14228	:<5	:180	:246	:23	:14	:2.4	:63	:21S*L
14230	:<5	:470	:842	:124	:44	:14.7	:269	:23S*L
14232	:<5	:690	:1022	:150	:73	:14.7	:288	:25S*L
14234	:<5	:520	:813	:79	:45	:12.9	:286	:27S*L
14236	:6	:535	:808	:66	:54	:13.8	:284	:29S*L
14238	:<5	:480	:687	:65	:9	:11.4	:299	:31S*L
14240	:<5	:130	:301	:61	:18	:9.0	:43	:33S*L
14242	:6	:200	:302	:24	:11	:1.8	:111	:35S*L
14244	:<5	:210	:326	:31	:13	:2.1	:112	:37S*L
14246	:<5	:470	:702	:94	:35	:9.6	:234	:39S*L
14248	:<5	:460	:708	:94	:37	:9.7	:222	:41S*L
14250	:<5	:160	:307	:17	:10	:8.2	:120	:43S*L
14252	:<5	:265	:377	:26	:18	:7.4	:136	:45S*L
14254	:2	:50	:104	:<3	:<2	:2.4	:43	:47S*L
14256	:2	:50	:102	:<3	:2	:3.1	:40	:49S*L
14258	:13	:370	:625	:14	:32	:18.2	:274	:51S*L
14260	:8	:360	:625	:17	:35	:17.3	:263	:53S*L
14262	:<2	:180	:282	:19	:7	:4.7	:113	:55S*L
14264	:<2	:210	:298	:43	:11	:5.1	:84	:57S*L
14266	:<2	:205	:279	:19	:8	:4.5	:113	:59S*L
14268	:<2	:170	:298	:44	:11	:5.1	:85	:61S*L
14274	:12	:80	:114	:6	:2	:14.0	:40	:67S*L
14276	:<2	:240	:390	:111	:7	:5.0	:68	:69S*L
14783	:2	:190	:291	:21	:16	:<0.2	:100	:71S*L
14785	:<2	:200	:261	:33	:17	:0.8	:66	:73S*L
14787	:7	:170	:214	:15	:8	:1.6	:79	:75S*L
14789	:<2	:160	:226	:18	:11	:2.2	:72	:77S*L
	78P	79P	80P	81P	82P	83P	84P	**L

.MI.D#01 REGION V DRINKING WATER STUDY - MICHIGAN **L

EPA-CRL 1975 SAMPLE LOG NO.	00403 IM LAB PH SU	00951 IM FLUORIDE F,TOTAL MG/L	32730 IM PHENOLS UG/L	00720 IM CYANIDE CN MG/L	00630 IN NO2&NO3 N-TOTAL MG/L	00610 IN NH3-N TOTAL MG/L	00625 IN TOT KJEL N MG/L	*M *M *M *M
14209					<0.03	<0.010	<0.05	2S*M
14210				0.002				3S*M
14214	7.8	0.19	5	0.004	3.00	0.228	1.20	7S*M
14216	9.7	1.1	3	0.005	4.10	0.042	0.33	9S*M
14218	8.0	0.10	<3	<0.002	0.36	<0.010	0.15	11S*M
14220	7.6	0.92	<3	<0.002	0.28	<0.010	<0.05	13S*M
14222	8.0	0.11	<3	<0.002	0.28	<0.010	0.20	15S*M
14224	7.7	0.90	<3	0.002	0.27	<0.010	0.11	17S*M
14226	7.9	0.11	<3	0.003	0.29	0.011	0.12	19S*M
14228	7.4	1.0	<3	0.003	0.38	<0.010	<0.05	21S*M
14230	7.7	0.24	<3	0.007	<0.03	0.179	0.31	23S*M
14232	7.5	0.26	<3	0.004	<0.03	<0.010	0.30	25S*M
14234	7.8	0.13	<3	0.004	0.84	0.156	0.28	27S*M
14236	7.9	0.94	<3	0.003	0.63	0.055	0.11	29S*M
14238	7.7	0.41	<3	0.008	<0.03	0.277	0.33	31S*M
14240	9.4	0.40	<3	0.004	0.04	0.218	0.30	33S*M
14242	8.1	0.13	<3	<0.002	0.40	0.34	0.18	35S*M
14244	8.1	1.0	<3	0.003	0.40	<0.010	<0.05	37S*M
14246	7.9	1.1	<3	0.002	0.31	0.080	0.24	39S*M
14248	7.7	1.1	<3	0.004	0.30	<0.010	0.20	41S*M
14250	8.1	<0.10	<3	<0.002	<0.03	0.115	0.22	43S*M
14252	7.9	<0.10	<3	0.006	<0.03	0.022	0.12	45S*M
14254	7.5	<0.10	<3	0.003	0.28	0.040	0.08	47S*M
14256	7.0	1.1	<3	0.003	0.29	0.013	0.05	49S*M
14258	7.7	0.52	<3	0.003	<0.03	0.218	0.35	51S*M
14260	7.8	0.44	<3	0.004	0.13	0.159	0.19	53S*M
14262	7.8	0.12	3	0.004	0.16	0.027	0.32	55S*M
14264	7.2	1.3	<3	0.004	0.16	0.013	0.14	57S*M
14266	7.9	0.13	4	0.003	0.14	0.035	0.31	59S*M
14268	7.7	1.3	<3	<0.002	0.14	0.013	0.18	61S*M
14270					<0.03	<0.010	<0.05	63S*M
14271				<0.002				64S*M
14274	6.9	<0.10	5	0.004	0.17	0.107	0.63	67S*M
14276	7.2	0.14	<3	0.004	0.20	0.030	0.24	69S*M
14783	7.9	0.13	<3	0.003	0.25	0.029	0.20	71S*M
14785	8.4	1.2	<3	0.006	0.26	0.025	<0.05	73S*M
14787	7.9	0.11	<3	0.003	0.23	0.022	<0.05	75S*M
14789	7.5	1.3	<3	0.003	0.30	0.021	<0.05	77S*M
	85P	86P	87P	88P	89P	90P	91P	**M

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN **M

EPA-CRL 1975 SAMPLE LOG NO.	00665 IN PHOS-T P-WET MG/L	00340 IN COD HI LEVEL MG/L	00680 IN T ORG C C MG/L	71900 IN MERCURY HG,TOTAL UG/L	00900 IN TOT HARD CACO3 MG/L	00615 IN NO2-N TOTAL MG/L		
14208				<0.1	<3			1S
14209	<0.02	<3						2S
14214	0.18	25		<0.1	212	0.061		7S
14216	0.14	11		<0.1	97	0.005		9S
14218	<0.02	6		<0.1	81	0.005		11S
14220	0.02	5		<0.1	85	<0.005		13S
14222	<0.02	3		<0.1	86	0.006		15S
14224	<0.02	3		<0.1	87	<0.005		17S
14226	<0.02	10		<0.1	114	0.007		19S
14228	0.11	<3		<0.1	121	<0.005		21S
14230	0.02	11		<0.1	468	<0.005		23S
14232	0.02	<3		0.1	417	<0.005		25S
14234	<0.02	7		<0.1	457	0.016		27S
14236	0.38	<3		<0.1	356	<0.005		29S
14238	<0.02	4		0.1	417	0.005		31S
14240	0.10	4		0.1	97	0.013		33S
14242	0.02	3		<0.1	125	0.005		35S
14244	0.01	<3		<0.1	141	<0.005		37S
14246	0.44	6		<0.1	346	<0.005		39S
14248	0.39	9		<0.1	311	<0.005		41S
14250	0.03	13		<0.1	123	<0.005		43S
14252	1.10	4		<0.1	158	<0.005		45S
14254	0.02	10		0.2	45	<0.005		47S
14256	0.02	7		<0.1	46	<0.005		49S
14258	0.05	3		<0.1	259	<0.005		51S
14260	0.06	4		0.1	111	<0.005		53S
14262	<0.02	16		<0.1	138	<0.005		55S
14264	<0.02	8		<0.1	124	<0.005		57S
14266	0.03	18		<0.1	136	<0.005		59S
14268	<0.02	8		<0.1	122	<0.005		61S
14269				<0.1	<3			62S
14270	<0.02	<3						63S
14274	0.02	38		0.2	51	0.007		67S
14276	<0.02	13		0.1	118	<0.005		69S
14783	0.02	9		0.1	106	0.005		71S
14785	0.02	5		0.1	94	<0.005		73S
14787	0.05	5		0.2	83	0.005		75S
14789	<0.02	5		0.1	115	<0.005		77S
	92P	93P	94P	95P	96P	97P	98P	

.MI.DW01 REGION V DRINKING WATER STUDY - MICHIGAN

CRLS 05APR DSN=CNCRLS.RGD.MN.D#01 ON TS0009 04/19/75 REV01 T

----------STUDY DESCRIPTION----------

NPAR	NLOG	AGENCYID	UNLOCKEY	STATTYPE	SMPLDAY	ATLABBY	DUEDATE	ACCOUNT-NUMBER
94	77			77777777	03FEB75	05FEB75	03MAY75	

>>>REGION V DRINKING WATER STUDY - MINNESOTA

----------SAMPLE DESCRIPTIONS----------

LABIDNUM	STORETID	COLLDAY	TIME	STATTYPE	DEEP	T	M	NO	ENDDATE	TIME	PRLU
14277		750203									
14278		750203									
14279		750203									
14280		750203									
14281		750203									
14282		750203									
14283		750203									
14284		750203									
14285		750203									
14286		750203									
14287		750203									
14288		750203									
14289		750203									
14290		750203									
14291		750203									
14292		750203									
14293		750203									
14294		750203									
14295		750203									
14296		750203									
14297		750203									
14298		750203									
14299		750203									
14300		750203									
14301		750203									
14302		750203									
14303		750203									
14304		750203									
14305		750203									
14306		750203									
14307		750203									
14308		750203									
14309		750203									
14310		750203									
14311		750203									
14312		750203									
14313		750203									
14314		750203									
14315		750203									
14316		750203									
14317		750203									
14318		750203									
14319		750203									
14320		750203									
14321		750203									
14322		750203									
14323		750203									
14324		750203									
14325		750203									

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14326          750203
14327          750203
14328          750203
14329          750203
14330          750203
14331          750203
14332          750203
14333          750203
14334          750203
14335          750203
14336          750203
14337          750203
14338          750203
14339          750203
14340          750203
14341          750203
14342          750203
14343          750203
14344          750203
14345          750203
14346          750203
14347          750203
14348          750203
14349          750203
14350          750203
14351          750203
14352          750203
14353          750203
>>>14277   >>   HNO3 REAGENT BLANK
>>>14278   >>   H2SO4 REAGENT BLANK
>>>14279   >>   NAOH REAGENT BLANK
>>>14280   >>   H3PO4 REAGENT BLANK
>>>14281   >>   OPEN
>>>14282   >>   MINNEAPOLIS RAW WATER SERIES A
>>>14283   >>   MINNEAPOLIS RAW WATER SERIES B
>>>14284   >>   MINNEAPOLIS FINISHED WATER SERIES A
>>>14285   >>   MINNEAPOLIS FINISHED WATER SERIES B
>>>14286   >>   MINNEAPOLIS RAW WATER SERIES A
>>>14287   >>   MINNEAPOLIS RAW WATER SERIES B
>>>14288   >>   MINNEAPOLIS FINISHED WATER SERIES A
>>>14289   >>   MINNEAPOLIS FINISHED WATER SERIES B
>>>14290   >>   ST.PAUL RAW WATER SERIES A
>>>14291   >>   ST.PAUL RAW WATER SERIES B
>>>14292   >>   ST.PAUL FINISHED WATER SERIES A
>>>14293   >>   ST.PAUL FINISHED WATER SERIES B
>>>14294   >>   MANKATO RAW WATER SERIES A
>>>14295   >>   MANKATO RAW WATER SERIES B
>>>14296   >>   MANKATO FINISHED WATER SERIES A
>>>14297   >>   MANKATO FINISHED WATER SERIES B
>>>14298   >>   FAIRMOUNT RAW WATER SERIES A
>>>14299   >>   FAIRMOUNT RAW WATER SERIES B
>>>14300   >>   FAIRMOUNT FINISHED WATER SERIES A
>>>14301   >>   FAIRMOUNT FINISHED WATER SERIES B
>>>14302   >>   GRANITE FALLS RAW WATER SERIES A
>>>14303   >>   GRANITE FALLS RAW WATER SERIES B
>>>14304   >>   GRANITE FALLS FINISHED WATER SERIES A
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MINNESOTA

45.00N 93.15W

45.00N 93.10W

FAIRMOUNT

GRANITE FALLS

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>>>14305   >>   GRANITE FALLS FINISHED WATER SERIES B
>>>14306   >>   WILLMAR RAW WATER SERIES A ———————— 45.06N 95.03W
>>>14307   >>   WILLMAR RAW WATER SERIES B
>>>14308   >>   WILLMAR FINISHED WATER SERIES A
>>>14309   >>   WILLMAR FINISHED WATER SERIES B
>>>14310   >>   ST.CLOUD RAW WATER SERIES A ———————— 45.34N 94.10W
>>>14311   >>   ST.CLOUD RAW WATER SERIES B
>>>14312   >>   ST.CLOUD FINISHED WATER SERIES A
>>>14313   >>   ST.CLOUD FINISHED WATER SERIES B
>>>14314   >>   BRECKENRIDGE RAW WATER SERIES A ———————— 46.14N 96.35W
>>>14315   >>   BRECKENRIDGE RAW WATER SERIES B
>>>14316   >>   BRECKENRIDGE FINISHED WATER SERIES A
>>>14317   >>   BRECKENRIDGE FINISHED WATER SERIES B
>>>14318   >>   CROOKSTON RAW WATER SERIES A ———————— 47.47N 96.36W
>>>14319   >>   CROOKSTON RAW WATER SERIES B
>>>14320   >>   CROOKSTON FINISHED WATER SERIES A
>>>14321   >>   CROOKSTON FINISHED WATER SERIES B
>>>14322   >>   EAST GRAND FORKS RAW WATER SERIES A ———————— 47.56N 96.59W
>>>14323   >>   EAST GRAND FORKS RAW WATER SERIES B
>>>14324   >>   EAST GRAND FORKS FINISHED WATER SERIES A
>>>14325   >>   EAST GRAND FORKS FINISHED WATER SERIES B
>>>14326   >>   OSLO RAW WATER SERIES A ———————— 48.13N 97.08W
>>>14327   >>   OSLO RAW WATER SERIES B
>>>14328   >>   OSLO FINISHED WATER SERIES A
>>>14329   >>   OSLO FINISHED WATER SERIES B
>>>14330   >>   RICHFIELD RAW WATER SERIES A ———————— 44.51N 93.17W
>>>14331   >>   RICHFIELD RAW WATER SERIES B
>>>14332   >>   RICHFIELD FINISHED WATER SERIES A
>>>14333   >>   RICHFIELD FINISHED WATER SERIES B
>>>14334   >>   INTERNATIONAL FALLS RAW WATER SERIES A ———————— 48.35N 93.26W
>>>14335   >>   INTERNATIONAL FALLS RAW WATER SERIES B
>>>14336   >>   INTERNATIONAL FALLS FINISHED WATER SERIES A
>>>14337   >>   INTERNATIONAL FALLS FINISHED WATER SERIES B
>>>14338   >>   DULUTH RAW WATER SERIES A ———————— 46.45N 92.10W
>>>14339   >>   DULUTH RAW WATER SERIES B
>>>14340   >>   DULUTH FINISHED WATER SERIES A
>>>14341   >>   DULUTH FINISHED WATER SERIES B
>>>14342   >>   DULUTH RAW WATER SERIES A
>>>14343   >>   DULUTH RAW WATER SERIES B
>>>14344   >>   DULUTH FINISHED WATER SERIES A
>>>14345   >>   DULUTH FINISHED WATER SERIES B
>>>14346   >>   HNO3 REAGENT BLANK
>>>14347   >>   H2SO4 REAGENT BLANK
>>>14348   >>   NAOH REAGENT BLANK
>>>14349   >>   H3PO4 REAGENT BLANK
>>>14350   >>   OPEN
>>>14351   >>   OPEN
>>>14352   >>   OPEN
>>>14353   >>   OPEN
----------SAMPLE/PARAMETER DATA----------
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EPA-CRL 1975 SAMPLE LOG NO.	S0003 OA TREFLAN WHL SMPL UG/L	S0001 OA HCBENZ WHL SMPL UG/L	39782 OA LINDANE WHL SMPL UG/L	S0002 OA BBHC WHL SMPL UG/L	S0004 OA DICLONE WHL SMPL UG/L	39330 OA ALDRIN WHL SMPL UG/L	S0005 OA ZYTRON WHL SMPL UG/L	
1[illegible]82	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	6S
1[illegible]34	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	[illegible]S
14286	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	10S
14288	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	12S
14290	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	14S
14292	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	16S
14294	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	18S
14296	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	20S
14298	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	22S
14300	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	24S
14302	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	26S
14304	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	28S
14306	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	30S
14308	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	32S
14310	<0.002	<0.002	<0.002	<0.002	<0.002	0.006	<0.02	34S
14312	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	36S
14314	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	38S
14316	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	40S
14318	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	42S
14320	<0.002	0.006	<0.002	<0.002	<0.01	<0.002	<0.02	44S
14322	<0.002	0.006	<0.002	<0.002	<0.01	<0.002	<0.02	46S
14324	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	48S
14326	<0.002	0.006	<0.002	<0.002	<0.01	<0.002	<0.02	50S
14328	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	52S
14330	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	54S
14332	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	56S
14334	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	58S
14336	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	60S
14338	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	62S
14340	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	64S
14342	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	66S
14344	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	68S
14350	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	74S
14352	<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	<0.02	76S
	1P	2P	3P	4P	5P	6P	7P	

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA

EPA-CRL 1975 SAMPLE LOG NO.	39430 OA ISODRIN WHL SMPL UG/L	39420 OA HCHLR-EP WHL SMPL UG/L	S0006 OA CHLORDAG WHL SMPL UG/L	S0007 OA DDE OP WHL SMPL UG/L	S0008 OA DDE PP WHL SMPL UG/L	S0009 OA DDD OP WHL SMPL UG/L	S0010 OA DDT OP WHL SMPL UG/L	*B *H *A *B
282	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	: 6S*B
284	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	: 8S*B
14286	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:10S*B
14288	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:12S*B
14290	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:14S*B
14292	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:16S*B
14294	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:18S*B
14296	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:20S*B
14298	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:22S*B
14300	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:24S*B
14302	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:26S*B
14304	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:28S*B
14306	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:30S*B
14308	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:32S*B
14310	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:34S*B
14312	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:36S*B
14314	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:38S*B
14316	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:40S*B
14318	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:42S*B
14320	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:44S*B
14322	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:46S*B
14324	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:48S*B
14326	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:50S*B
14328	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:52S*B
14330	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:54S*B
14332	:<0.003	:<0.002	:<0.002	:<0.003	:<0.003	:<0.003	:<0.003	:56S*B
14334	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:58S*B
14336	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:60S*B
14338	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:62S*B
14340	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:64S*B
14342	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:66S*B
14344	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:68S*B
14350	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:74S*B
14352	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.01	:76S*B
	8P	9P	10P	11P	12P	13P	14P	**B

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **B

EPA-CRL 1975 SAMPLE LOG NO.	S0011 OA DDD PP WHL SMPL UG/L	S0012 OA DDT PP WHL SMPL UG/L	S0013 OA CARBPHTH WHL SMPL UG/L	S0014 OA MIREX WHL SMPL UG/L	39480 OA MTHXYCLW WHL SMPL UG/L	S0020 OA 2,4-D:IP WHL SMPL UG/L	S0021 OA DNBP WHL SMPL UG/L	*C
14282	:<0.003	:<0.003	:<0.003	:<0.005	:<0.010	:<.02	:<1	:[illegible]
14284	:<0.003	:<0.003	:<0.003	:<0.005	:<0.010	:<.02	:<1	:[illegible]
14286	:<0.003	:<0.003	:<0.003	:<0.005	:<0.010	:<.02	:<1	:[illegible]
14288	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:125*C
14290	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:[illegible]
14292	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:[illegible]
14294	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:[illegible]
14296	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:[illegible]
14298	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:225*C
14300	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:245*C
14302	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:265*C
14304	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:285*C
14306	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:305*C
14308	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:325*C
14310	:<0.003	:0.008	:<0.003	:<0.005	:<0.01	:<.02	:<1	:345*C
14312	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:365*C
14314	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:385*C
14316	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:405*C
14318	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:425*C
14320	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:445*C
14322	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:465*C
14324	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:485*C
14326	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:505*C
14328	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:525*C
14330	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:545*C
14332	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.02	:<1	:565*C
14334	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:585*C
14336	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:605*C
14338	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:625*C
14340	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:645*C
14342	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:665*C
14344	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:685*C
14350	:<0.003	:<0.003	:<0.003	:<0.003	:<0.01	:	:	:745*C
14352	:<0.003	:<0.003	:<0.003	:<0.003	:<0.01	:	:	:765*C
	15P	16P	17P	18P	19P	20P	21P	**C

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **C

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EPA-CRL 1975 SAMPLE LOG NO.	39770 OA DCPA WHL SMPL UG/L	S0023 OA ENDOS I WHL SMPL UG/L	39380 OA DIELDRIN WHL SMPL UG/L	39390 OA ENDRIN WHL SMPL UG/L	39460 OA CLRANZLT WHL SMPL UG/L	S0027 OA ENDOS II WHL SMPL UG/L	S0028 OA NITROFEN WHL SMPL UG/L	*D *D *D *D
14282	:<.003	<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 6S*D
14284	:<.003	<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 8S*D
14286	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:10S*D
14288	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:12S*D
14290	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:14S*D
14292	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:16S*D
14294	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:18S*D
14296	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:20S*D
14298	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:22S*D
14300	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:24S*D
14302	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:26S*D
14304	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:28S*D
14306	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:30S*D
14308	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:32S*D
14310	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:34S*D
14312	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:36S*D
14314	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:38S*D
14316	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:40S*D
14318	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:42S*D
14320	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:44S*D
14322	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:46S*D
14324	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:48S*D
14326	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:50S*D
14328	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:52S*D
14330	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:54S*D
14332	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:56S*D
14334	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:58S*D
14336	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:60S*D
14338	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:62S*D
14340	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:64S*D
14342	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:66S*D
14344	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:68S*D
	22P	23P	24P	25P	26P	27P	28P	**D

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **D

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EPA-CRL 1975 SAMPLE LOG NO.	S0029 OA 245-T:IO WHL SMPL UG/L	S0030 OA PROLAN WHL SMPL UG/L	S0031 OA BULAN WHL SMPL UG/L	S0024 OA DEHP WHL SMPL UG/L	39808 OA TEDION WHL SMPL UG/L	39570 OA DIAZINON WHL SMPL UG/L	S0016 OA DYFONATE WHL SMPL UG/L	*E
14282	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 6S*E
14284	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 8S*E
14286	:<.01	:<.01	:<.01	:4	:<.01	:<1	:<1	:10S*E
14288	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:12S*E
14290	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:14S*E
14292	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:16S*E
14294	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:18S*E
14296	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:20S*E
14298	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:22S*E
14300	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:24S*E
14302	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:26S*E
14304	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:28S*E
14306	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:30S*E
14308	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:32S*E
14310	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:34S*E
14312	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:36S*E
14314	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:38S*E
14316	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:40S*E
14318	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:42S*E
14320	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:44S*E
14322	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:46S*E
14324	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:48S*E
14326	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:50S*E
14328	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:52S*E
14330	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:54S*E
14332	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:56S*E
14334	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:58S*E
14336	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:60S*E
14338	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:62S*E
14340	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:64S*E
14342	:<.01	:<.01	:<.01	:40	:<.01	:<1	:<1	:66S*E
14344	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:68S*E
	29P	30P	31P	32P	33P	34P	35P	**E

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **E

EPA-CRL 1975 SAMPLE LOG NO.	S0017 OA RONNEL WHL SMPL UG/L	S0032 OA DURSBAN WHL SMPL UG/L	39600 OA MPARATHN WHL SMPL UG/L	39530 OA MALATHN WHL SMPL UG/L	39540 OA PARATHN WHL SMPL UG/L	S0033 OA DEF WHL SMPL UG/L	39398 OA ETHION WHL SMPL UG/L	*F
14282	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 4S*F
14284	:<1	:<1	:<1	:<1	:<1	:<5	:<0.3	: 4S*F
14286	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:10S*F
14288	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:12S*F
14290	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:14S*F
14292	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:16S*F
14294	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:18S*F
14296	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:20S*F
14298	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:22S*F
14300	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:24S*F
14302	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:26S*F
14304	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:28S*F
14306	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:30S*F
14308	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:32S*F
14310	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:34S*F
14312	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:36S*F
14314	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:38S*F
14316	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:40S*F
14318	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:42S*F
14320	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:44S*F
14322	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:46S*F
14324	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:48S*F
14326	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:50S*F
14328	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:52S*F
14330	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:54S*F
14332	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:56S*F
14334	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:58S*F
14336	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:60S*F
14338	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:62S*F
14340	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:64S*F
14342	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:66S*F
14344	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:68S*F
	36P	37P	38P	39P	40P	41P	42P	**F

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **F

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EPA-CRL 1975 SAMPLE LOG NO.	S0018 OA PHENCAPT WHL SMPL UG/L	S0034 OA EPN WHL SMPL UG/L	39580 OA GUTHION WHL SMPL UG/L	S0035 OA PHOSALON WHL SMPL UG/L	S0036 OA AZINFOSE WHL SMPL UG/L	S0037 OA COUMAFOS WHL SMPL UG/L	39488 OA AROCLOR 1221 UG/L	*G
4282	<1	<1	<5	<1	<1	<5	<0.3	6S*G
4284	<1	<1	<5	<1	<1	<5	<0.3	8S*G
14286	<1	<1	<5	<1	<1	<5	<0.3	10S*G
14288	<1	<1	<5	<1	<1	<5	<0.3	12S*G
14290	<1	<1	<5	<1	<1	<5	<0.3	14S*G
14292	<1	<1	<5	<1	<1	<5	<0.3	16S*G
14294	<1	<1	<5	<1	<1	<5	<0.3	18S*G
14296	<1	<1	<5	<1	<1	<5	<0.3	20S*G
14298	<1	<1	<5	<1	<1	<5	<0.3	22S*G
14300	<1	<1	<5	<1	<1	<5	<0.3	24S*G
14302	<1	<1	<5	<1	<1	<5	<0.3	26S*G
14304	<1	<1	<5	<1	<1	<5	<0.3	28S*G
14306	<1	<1	<5	<1	<1	<5	<0.3	30S*G
14308	<1	<1	<5	<1	<1	<5	<0.3	32S*G
14310	<1	<1	<5	<1	<1	<5	<0.3	34S*G
14312	<1	<1	<5	<1	<1	<5	<0.3	36S*G
14314	<1	<1	<5	<1	<1	<5	<0.3	38S*G
14316	<1	<1	<5	<1	<1	<5	<0.3	40S*G
14318	<1	<1	<5	<1	<1	<5	<0.3	42S*G
14320	<1	<1	<5	<1	<1	<5	<0.3	44S*G
14322	<1	<1	<5	<1	<1	<5	<0.3	46S*G
14324	<1	<1	<5	<1	<1	<5	<0.3	48S*G
14326	<1	<1	<5	<1	<1	<5	<0.3	50S*G
14328	<1	<1	<5	<1	<1	<5	<0.3	52S*G
14330	<1	<1	<5	<1	<1	<5	<0.3	54S*G
14332	<1	<1	<5	<1	<1	<5	<0.3	56S*G
14334	<1	<1	<5	<1	<1	<5	<0.3	58S*G
14336	<1	<1	<5	<1	<1	<5	<0.3	60S*G
14338	<1	<1	<5	<1	<1	<5	<0.3	62S*G
14340	<1	<1	<5	<1	<1	<5	<0.3	64S*G
14342	<1	<1	<5	<1	<1	<5	<0.3	66S*G
14344	<1	<1	<5	<1	<1	<5	<0.3	68S*G
14350							<0.3	74S*G
14352							<0.3	76S*G
	43P	44P	45P	46P	47P	48P	49P	**G

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **G

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EPA-CRL 1975 SAMPLE LOG NO.	39496 OA AROCLOR 1242 UG/L	39500 OA AROCLOR 1248 UG/L	39504 OA AROCLOR 1254 UG/L	39508 OA AROCLOR 1260 UG/L	S0047 OA METHE CL TOT VOL UG/L	S0039 OA CCL4 TOT VOL UG/L	S0038 OA CHCL3 TOT VOLA UG/L	*H *H *H *H
14282	<0.3	<0.3	<0.3	<0.4				6S*
4283					<0.5	3	4	7S*
14284	<0.3	<0.3	<0.3	<0.4				8S*
14285					<0.5	10	8	9S*
14286	<0.3	<0.3	<0.3	<0.4				10S*
14287					<0.5	<2	<2	11S*
14288	<0.3	<0.3	<0.3	<0.4				12S*
14289					<0.5	5	7	13S*
14290	<0.3	<0.3	<0.3	<0.4				14S*
14291					<0.5	2	4	15S*
14292	<0.3	<0.3	<0.3	<0.4				16S*
14293					<0.5	12	82	17S*
14294	<0.3	<0.3	<0.3	<0.4				18S*
14295					<0.5	3	2	19S*
14296	<0.3	<0.3	<0.3	<0.4				20S*
14297					<0.5	5	10	21S*
14298	<0.3	<0.3	<0.3	<0.4				22S*
14299					<0.5	<2	9	23S*
14300	<0.3	<0.3	<0.3	<0.4				24S*
14301					<0.5	<1	200	25S*
14302	<0.3	<0.3	<0.3	<0.4				26S*
14303					<0.5	<2	5	27S*
14304	<0.3	<0.3	<0.3	<0.4				28S*
14305					<0.5	7	5	29S*
14306	<0.3	<0.3	<0.3	<0.4				30S*
14307					<0.5	20	<1	31S*
14308	<0.3	<0.3	<0.3	<0.4				32S*
14309					<0.5	13	2	33S*
14310	<0.3	<0.3	<0.3	<0.4				34S*
14311					<0.5	<1	<1	35S*
14312	<0.3	<0.3	<0.3	<0.4				36S*
14313					<0.5	9	37	37S*
14314	<0.3	<0.3	<0.3	<0.4				38S*
14315					<0.5	4	<1	39S*
14316	<0.3	<0.3	<0.3	<0.4				40S*
14317					<1	12	128	41S*
14318	<0.3	<0.3	<0.3	<0.4				42S*
14319					<0.5	<2	1	43S*
14320	<0.3	<0.3	<0.3	<0.4				44S*
14321					<0.5	5	7	45S*
14322	<0.3	<0.3	<0.3	<0.4				46S*
14323					<0.5	1	1	47S*
14324	<0.3	<0.3	<0.3	<0.4				48S*
14325					<0.5	8	22	49S*
14326	<0.3	<0.3	<0.3	<0.4				50S*
14327					<0.5	<1	3	51S*
14328	<0.3	<0.3	<0.3	<0.4				52S*
14329					<0.5	7	79	53S*
14330	<0.3	<0.3	<0.3	<0.4				54S*
14331					<0.5	3	<1	55S*
14332	<0.3	<0.3	<0.3	<0.4				56S*
14333					<1	<2	<1	57S*
14334	<0.3	<0.3	<0.3	<0.4				58S*
4335					<0.5	<1	<1	59S*
14336	<0.3	<0.3	<0.3	<0.4				60S*
14337					<1	26	26	61S*
14338	<0.3	<0.3	<0.3	<0.4				62S*

14339					<0.5	<2	20	63S*H
14340	<0.3	<0.3	<0.3	<0.4				64S*H
14341					<1	20	28	65S*H
14342	<0.3	<0.3	<0.3	<0.4				66S*H
14343					<0.5	3	1	67S*H
4344	<0.3	<0.3	<0.3	<0.4				68S*H
14345					<1	25	26	69S*H
14350	<0.3	<0.3	<0.3	<0.4				74S*H
14352	<0.3	<0.3	<0.3	<0.4				76S*H
	50P	51P	52P	53P	54P	55P	56P	**H

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **H

EPA-CRL 1975 SAMPLE LOG NO.	S0056 OA C2H4CL2 TOT VOL UG/L	S0040 OA CHCL2BR TOT VOL UG/L	S0041 OA CHCLBR2 TOT VOL UG/L	S0042 OA CHBR3 TOT VOL UG/L				
14283	<1	<0.5	<0.5	<0.5				7S
4285	<1	<0.5	<0.2	<0.5				9S
14287	<1	<1	<0.5	<0.5				11S
14289	<1	<0.5	<0.2	<0.5				13S
14291	<1	<1	<0.5	<0.5				15S
14293	<5	6	<0.2	<0.5				17S
14295	<0.5	<0.5	<0.5	<0.5				19S
14297	<1	9	2	<0.5				21S
14299	<3	<1	<0.5	<0.5				23S
14301	<5	31	0.7	<0.5				25S
14303	<1	<1	<0.5	<0.5				27S
14305	<0.5	0.5	<0.2	<0.5				29S
14307	<1	<0.5	<0.5	<1				31S
14309	<0.5	<0.2	<0.2	<0.5				33S
14311	<1	<1	<0.5	<0.5				35S
14313	<1	4	<0.2	<0.5				37S
14315	<1	<0.5	<0.5	<1				39S
14317	<3	15	<0.5	<2				41S
14319	<1	<1	<0.5	<0.5				43S
14321	<1	0.8	<0.2	<0.5				45S
14323	<0.5	<0.5	<0.5	<0.5				47S
14325	<1	0.8	<0.2	<0.5				49S
14327	<2	<1	<0.5	<0.5				51S
14329	<5	5.0	<0.2	<0.5				53S
14331	<0.5	<0.5	<0.5	<0.5				55S
14333	<0.5	<0.5	<0.5	<0.5				57S
14335	<1	<1	<0.5	<0.5				59S
14337	<1	0.3	<0.5	<1				61S
14339	<1	<1	<0.5	<1				63S
14341	<1	3	<0.5	<1				65S
14343	<0.5	<0.5	<0.5	<0.5				67S
14345	<1	3	<0.5	<1				69S
	57P	58P	59P	60P	61P	62P	63P	

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA

EPA-CRL 1975 SAMPLE LOG NO.	00916 MW CALCIUM CA,TOT MG/L	00927 MW MGNSIUM MG,TOT MG/L	00929 MW SODIUM NA,TOT MG/L	00937 MW PTSSIUM K,TOT MG/L	01034 MW CHROMIUM CR,TOT UG/L	01042 MW COPPER CU,TOT UG/L	01045 MW IRON FE,TOT UG/L	*J *J *J *J
14277	<0.1	0.3	<0.1	<0.1	<5	<10	<20	1S*J
14282	40.8	13.9	5.5	1.7	<5	<10	210	6S*J
14284	16.3	8.6	6.0	1.8	<5	<10	<20	8S*J
14286	40.8	13.8	4.7	1.7	<5	<10	170	10S*J
14288	16.5	8.4	5.9	1.7	<5	<10	<20	12S*J
14290	42.4	14.6	6.5	1.9	<5	15	46	14S*J
14292	20.5	7.4	7.0	1.9	<5	<10	<20	16S*J
14294	102	40.6	33.3	4.7	6	51	370	18S*J
14296	44.5	7.3	33.6	4.8	<5	29	<20	20S*J
14298	51.4	32.7	9.7	3.7	<5	<10	36	22S*J
14300	24.0	15.4	39.3	4.0	<5	<10	<20	24S*J
14302	95.0	62	35.6	7.4	<5	<10	110	26S*J
14304	77.5	6.0	85	7.7	<5	<10	<20	28S*J
14306	96.0	41.4	24.5	3.1	<5	10	1630	30S*J
14308	97.2	45.6	29.2	3.1	<5	<10	1050	32S*J
14310	47.7	17.0	7.5	2.0	<5	36	220	34S*J
14312	22.0	8.6	7.0	2.0	<5	<10	<20	36S*J
14314	43.1	31.5	10.1	4.0	<5	<10	140	38S*J
14316	18.6	15.8	13.6	4.2	<5	<10	26	40S*J
14318	45.2	15.7	3.8	2.4	<5	<10	62	42S*J
14320	44.3	15.5	3.8	2.3	<5	<10	56	44S*J
14322	45.3	15.6	4.2	2.2	<5	<10	120	46S*J
14324	25.6	2.1	7.4	2.4	<5	<10	<20	48S*J
14326	52.9	22.1	13.0	3.3	<5	<10	140	50S*J
14328	18.7	19.4	28.4	3.4	<5	<10	36	52S*J
14330	62.6	26.4	5.7	1.7	<5	<10	300	54S*J
14332	15.1	8.7	5.8	1.8	<5	<10	<20	56S*J
14334	5.2	1.8	1.3	0.8	<5	<10	24	58S*J
14336	4.9	1.8	7.6	0.7	<5	<10	<20	60S*J
14338	12.5	2.9	1.4	0.6	<5	<10	66	62S*J
14340	12.8	3.0	1.4	0.7	<5	<10	64	64S*J
14342	12.8	2.9	1.4	0.6	<5	<10	70	66S*J
14344	12.4	2.8	1.3	0.6	<5	<10	56	68S*J
14346	<0.1	<0.1	0.1	0.1	<5	11	<20	70S*J
	64P	65P	66P	67P	68P	69P	70P	**J

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **J

EPA-CRL 1975 SAMPLE LOG NO.	01055 MW MANGNESE MN,TOT UG/L	01092 MW ZINC ZN,TOT UG/L	01002 MW ARSENIC AS,TOT UG/L	01051 MW LEAD PB,TOT UG/L	01027 MW CADMIUM CD,TOT UG/L	01077 MW SILVER AG,TOT UG/L	01147 MW SELENIUM SE,TOT UG/L	*K
14277	<5	<5	<1	<2	<0.2	<0.2	<5	1S*K
14282	45	19	<1	<2	<0.2	<0.2	<5	6S*K
14284	<5	<5	<1	<2	<0.2	<0.2	<5	8S*K
14286	32	10	<1	<2	<0.2	<0.2	<5	10S*K
14288	<5	<5	<1	<2	<0.2	<0.2	<5	12S*K
14290	28	120	1	3	<0.2	<0.2	<5	14S*K
14292	<5	<5	<1	3	<0.2	<0.2	<5	16S*K
14294	320	7	<1	<2	<0.2	0.3	<5	18S*K
14296	<5	18	<1	<2	<0.2	0.3	<5	20S*K
14298	180	15	3	5	<0.2	0.3	<5	22S*K
14300	<5	6	1	3	<0.2	0.3	<5	24S*K
14302	120	9	4	<2	<0.2	0.2	<5	26S*K
14304	<5	<5	1	<2	<0.2	0.3	<5	28S*K
14306	95	<5	4	<2	<0.2	<0.2	<5	30S*K
14308	70	<5	<1	<2	<0.2	<0.2	<5	32S*K
14310	72	8	1	<2	<0.2	<0.2	<5	34S*K
14312	6	<5	<1	<2	<0.2	<0.2	<5	36S*K
14314	26	13	3	<2	<0.2	<0.2	<5	38S*K
14316	<5	<5	<1	<2	<0.2	<0.2	<5	40S*K
14318	18	14	1	<2	<0.2	<0.2	<5	42S*K
14320	30	<5	1	<2	<0.2	<0.2	<5	44S*K
14322	20	<5	1	<2	<0.2	<0.2	<5	46S*K
14324	<5	<5	<1	<2	<0.2	<0.2	<5	48S*K
14326	36	7	2	3	<0.2	<0.2	<5	50S*K
14328	5	<5	1	<2	<0.2	<0.2	<5	52S*K
14330	104	7	<1	<2	<0.2	<0.2	<5	54S*K
14332	<5	<5	<1	<2	<0.2	<0.2	<5	56S*K
14334	6	<5	<1	<2	<0.2	<0.2	<5	58S*K
14336	<5	<5	<1	<2	<0.2	<0.2	<5	60S*K
14338	<5	91	<1	<2	<0.2	<0.2	<5	62S*K
14340	<5	170	<1	<2	<0.2	<0.2	<5	64S*K
14342	6	91	<1	<2	<0.2	<0.2	<5	66S*K
14344	<5	170	<1	<2	<0.2	<0.2	<5	68S*K
14346	<5	<5	<1	3	<0.2	0.7	<5	70S*K
	71P	72P	73P	74P	75P	76P	77P	**K

.MN.D#01 REGION V DRINKING WATER STUDY - MINNESOTA **K

EPA-CRL 1975 SAMPLE LOG NO.	00530 IM RESIDUE TOT NFLT MG/L	70300 IM RESIDUE DISS-180 C MG/L	00095 IM CNDUCTVY AT 25C MICROMHO	00945 IM SULFATE SO4 MG/L	00940 IM CHLORIDE CL MG/L	00956 IM SILICA SIO2 MG/L	00410 IM T ALK CACO3 MG/L	*L *L *L *L
14282	:2	:220	:354	:12	:6	:12.9	:158	: 6S*L
14284	:<2	:110	:205	:23	:9	:9.8	:57	: 8S*L
14286	:4	:200	:338	:11	:7	:12.9	:158	:10S*L
14288	:<2	:140	:202	:23	:11	:9.8	:57	:12S*L
14290	:<2	:260	:352	:12	:10	:5.5	:158	:14S*L
14292	:<2	:170	:222	:7	:9	:1.9	:64	:16S*L
14294	:<2	:660	:910	:162	:25	:17.1	:323	:18S*L
14296	:<2	:360	:496	:162	:30	:9.4	:31	:20S*L
14298	:<2	:440	:585	:58	:28	:26.0	:184	:22S*L
14300	:<2	:330	:425	:63	:38	:15.8	:82	:24S*L
14302	:5	:860	:1070	:244	:23	:30.0	:314	:26S*L
14304	:<2	:690	:860	:279	:28	:16.0	:126	:28S*L
14306	:74	:490	:720	:42	:16	:24.0	:394	:30S*L
14308	:42	:520	:815	:62	:16	:22.0	:381	:32S*L
14310	:2	:270	:404	:23	:17	:12.9	:176	:34S*L
14312	:<2	:200	:234	:35	:18	:10.2	:65	:36S*L
14314	:13	:360	:487	:26	:17	:17.4	:234	:38S*L
14316	:<2	:230	:293	:20	:24	:9.6	:100	:40S*L
14318	:6	:270	:355	:14	:14	:9.4	:175	:42S*L
14320	:5	:280	:367	:25	:3	:7.3	:156	:44S*L
14322	:9	:230	:348	:13	:2	:9.1	:168	:46S*L
14324	:2	:160	:182	:17	:5	:7.7	:52	:48S*L
14326	:6	:360	:496	:8	:3	:6.3	:220	:50S*L
14328	:<2	:250	:364	:<3	:2	:0.6	:154	:52S*L
14330	:<2	:330	:525	:17	:4	:17.4	:256	:54S*L
14332	:<2	:130	:198	:28	:4	:9.1	:49	:56S*L
14334	:<2	:40	:54	:<3	:<2	:2.5	:19	:58S*L
14336	:<2	:50	:92	:14	:2	:5.0	:15	:60S*L
14338	:3	:70	:105	:<3	:<2	:1.3	:44	:62S*L
14340	:3	:100	:104	:<3	:<2	:3.2	:39	:64S*L
14342	:4	:50	:103	:<3	:<2	:2.7	:44	:66S*L
14344	:3	:45	:104	:<3	:4	:3.2	:39	:68S*L
	78P	79P	80P	81P	82P	83P	84P	**L

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA **L

EPA-CRL 1975 SAMPLE LOG NO.	00403 IM LAB PH SU	00951 IM FLUORIDE F,TOTAL MG/L	32730 IM PHENOLS UG/L	00720 IM CYANIDE CN MG/L	00630 IN NO2&NO3 N-TOTAL MG/L	00610 IN NH3-N TOTAL MG/L	00625 IN TOT KJEL N MG/L	*M *M *M *M
14278					<0.03	<0.010	<0.05	2S*
14279				<0.002				3S*
14280			<3					4S*
14282	7.7	0.12	<3	0.003	0.41	0.185	0.46	6S*
14284	7.6	1.1	<3	0.003	0.40	0.649	0.83	8S*
14286	7.7	0.11	<3	<0.002	0.40	0.185	0.43	10S*
14288	7.6	1.2	<3	0.003	0.39	0.647	0.82	12S*
14290	7.6	0.12	<3	0.003	0.57	0.100	0.54	14S*
14292	8.1	1.2	<3	0.004	0.37	0.297	0.54	16S*
14294	7.4	0.25	<3	0.005	0.46	0.441	0.56	18S*
14296	7.1	1.2	<3	0.003	0.59	<0.010	<0.05	20S*
14298	7.5	0.37	<3	0.004	0.90	0.339	1.05	22S*
14300	9.4	1.2	<3	0.006	0.88	0.815	1.12	24S*
14302	7.8	0.26	<3	0.005	0.41	0.966	1.84	26S*
14304	8.7	1.3	<3	0.004	0.41	1.50	1.85	29S*
14306	7.3	0.31	<3	0.002	<0.03	1.73	1.93	30S*
14308	7.3	1.1	<3	0.003	<0.03	2.61	3.20	32S*
14310	7.6	0.14	<3	0.003	0.34	0.117	0.35	34S*
14312	8.8	1.0	<3	0.003	0.30	0.122	0.17	36S*
14314	7.8	0.17	<3	0.002	0.14	0.322	0.78	38S*
14316	8.3	0.96	<3	0.003	0.16	0.010	0.17	40S*
14318	7.7	0.12	<3	<0.002	0.03	0.034	0.49	42S*
14320	7.2	0.91	<3	0.006	<0.03	0.292	0.72	44S*
14322	7.6	0.12	<3	0.002	0.05	0.062	0.59	46S*
14324	9.4	1.2	<3	0.004	0.04	0.382	0.74	48S*
14326	7.7	0.15	<3	0.002	0.15	0.218	0.72	50S*
14328	9.2	0.89	<3	0.004	0.14	0.123	0.59	52S*
14330	7.6	0.20	<3	<0.002	<0.03	0.273	0.29	54S*
14332	8.8	1.5	<3	0.002	<0.03	0.374	0.39	56S*
14334	7.2	<0.10	<3	<0.002	0.09	<0.010	0.14	58S*
14336	6.7	0.92	<3	0.003	0.08	0.182	0.24	60S*
14338	7.3	<0.10	<3	0.003	0.25	<0.010	0.13	62S*
14340	7.0	1.1	<3	0.002	0.25	<0.010	0.06	64S*
14342	7.2	<0.10	<3	0.003	0.26	<0.010	<0.05	66S*
14344	7.0	1.1	<3	0.002	0.27	<0.010	<0.05	68S*
14347					<0.03	<0.010	<0.05	71S*
14348				0.002				72S*
	85P	86P	87P	88P	89P	90P	91P	**

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA

EPA-CRL 1975 SAMPLE LOG NO.	00665 IN PHOS-T P-WET MG/L	00340 IN COD HI LEVEL MG/L	00680 IN T ORG C C MG/L	71900 IN MERCURY HG,TOTAL UG/L	00900 IN TOT HARD CACO3 MG/L	00615 IN NO2-N TOTAL MG/L			
14277				<0.1	<3				1S
14278	<0.02	<3							2S
14282	0.08	18		<0.1	159	0.009			6S
14284	<0.02	6		0.1	76	<0.005			8S
14286	0.08	17		<0.1	159	0.010			10S
14288	0.02	10		0.1	76	<0.005			12S
14290	0.06	23		<0.1	166	0.005			14S
14292	0.03	3		0.1	82	0.005			16S
14294	0.03	6		0.1	322	0.008			18S
14296	<0.02	<3		<0.1	141	<0.005			20S
14298	0.18	29		<0.1	263	0.006			22S
14300	0.14	12		<0.1	123	0.006			24S
14302	0.23	33		0.1	492	0.008			26S
14304	0.26	16		<0.1	218	0.007			28S
14306	0.17	10		<0.1	410	<0.005			30S
14308	0.19	7		<0.1	430	0.006			32S
14310	0.09	16		<0.1	189	0.005			34S
14312	0.28	8		<0.1	90	<0.005			36S
14314	0.20	20		<0.1	237	0.007			38S
14316	0.67	12		<0.1	111	<0.005			40S
14318	0.05	30		<0.1	177	0.005			42S
14320	0.06	28		<0.1	174	<0.005			44S
14322	0.03	30		<0.1	177	0.006			46S
14324	0.35	24		<0.1	72	0.008			48S
14326	0.11	29		<0.1	223	0.005			50S
14328	0.04	26		<0.1	127	<0.005			52S
14330	<0.02	3		<0.1	265	<0.005			54S
14332	<0.02	6		<0.1	74	0.014			56S
14334	0.02	20		<0.1	20	<0.005			58S
14336	0.02	14		<0.1	20	<0.005			60S
14338	0.02	3		<0.1	43	<0.005			62S
14340	0.03	6		<0.1	44	<0.005			64S
14342	0.03	6		<0.1	44	<0.005			66S
14344	0.04	5		<0.1	43	<0.005			68S
14346				<0.1	<3				70S
14347	<0.02	<3							71S
	92P	93P	94P	95P	96P	97P	98P		

.MN.DW01 REGION V DRINKING WATER STUDY - MINNESOTA

CRLS 05APR DSN=CNCRLS.RGD.OH.DW04 ON TS0009 04/19/75 REV01 T

----------STUDY DESCRIPTION----------

NPAR	NLOG	AGENCYID	UNLOCKEY	STATTYPE	SMPLDAY	ATLABBY	DUEDATE	ACCOUNT-NUMBER
94	69		77777777	03FEB75	05FEB75	03MAY75		

>>REGION V DRINKING WATER STUDY - OHIO

----------SAMPLE DESCRIPTIONS----------

LABIDNUM	STORETID	COLLDAY	TIME	STATTYPE	DEEP	T	M	NO	ENDDATE	TIME	PPLU
14354		750203									
14355		750203									
14356		750203									
14357		750203									
14358		750203									
14359		750203									
14360		750203									
14361		750203									
14362		750203									
14363		750203									
14364		750203									
14365		750203									
14366		750203									
14367		750203									
14368		750203									
14369		750203									
14370		750203									
14371		750203									
14372		750203									
14373		750203									
14374		750203									
14375		750203									
14376		750203									
14377		750203									
14378		750203									
14379		750203									
14380		750203									
14381		750203									
14382		750203									
14383		750203									
14384		750203									
14385		750203									
14386		750203									
14387		750203									
14388		750203									
14389		750203									
14390		750203									
14391		750203									
14392		750203									
14393		750203									
14394		750203									
14395		750203									
14396		750203									
14397		750203									
14398		750203									
14399		750203									
14400		750203									
14401		750203									
14402		750203									

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14403          750203
14404          750203
14405          750203
14406          750203
14407          750203
14408          750203
14409          750203
14410          750203
14411          750203
14412          750203
14413          750203
14414          750203
14415          750203
14416          750203
14417          750203
14418          750203
14419          750203
14420          750203
14421          750203
14422          750203
>>>14354   >>   HNO3 REAGENT BLANK
>>>14355   >>   H2SO4 REAGENT BLANK
>>>14356   >>   NAOH REAGENT BLANK
>>>14357   >>   H3PO4 REAGENT BLANK
>>>14358   >>   OPEN
>>>14359   >>   CLEVELAND RAW WATER SERIES A
>>>14360   >>   CLEVELAND RAW WATER SERIES B
>>>14361   >>   CLEVELAND FINISHED WATER SERIES A
>>>14362   >>   CLEVELAND FINISHED WATER SERIES B
>>>14363   >>   CLEVELAND RAW WATER SERIES A
>>>14364   >>   CLEVELAND RAW WATER SERIES B
>>>14365   >>   CLEVELAND FINISHED WATER SERIES A
>>>14366   >>   CLEVELAND FINISHED WATER SERIES B
>>>14367   >>   WARREN RAW WATER SERIES A
>>>14368   >>   WARREN RAW WATER SERIES B
>>>14369   >>   WARREN FINISHED WATER SERIES A
>>>14370   >>   WARREN FINISHED WATER SERIES B
>>>14371   >>   EAST LIVERPOOL RAW WATER SERIES A
>>>14372   >>   EAST LIVERPOOL RAW WATER SERIES B
>>>14373   >>   EAST LIVERPOOL FINISHED WATER SERIES A
>>>14374   >>   EAST LIVERPOOL FINISHED WATER SERIES B
>>>14375   >>   COLUMBUS RAW WATER SERIES A
>>>14376   >>   COLUMBUS RAW WATER SERIES B
>>>14377   >>   COLUMBUS FINISHED WATER SERIES A
>>>14378   >>   COLUMBUS FINISHED WATER SERIES B
>>>14379   >>   PORTSMOUTH RAW WATER SERIES A
>>>14380   >>   PORTSMOUTH RAW WATER SERIES B
>>>14381   >>   PORTSMOUTH FINISHED WATER SERIES A
>>>14382   >>   PORTSMOUTH FINISHED WATER SERIES B
>>>14383   >>   PORTSMOUTH RAW WATER SERIES A
>>>14384   >>   PORTSMOUTH RAW WATER SERIES B
>>>14385   >>   PORTSMOUTH FINISHED WATER SERIES A
>>>14386   >>   PORTSMOUTH FINISHED WATER SERIES B
>>>14387   >>   CINCINNATI RAW WATER SERIES A
>>>14388   >>   CINCINNATI RAW WATER SERIES B
>>>14389   >>   CINCINNATI FINISHED WATER SERIES A
```

OHIO

41.30N 81.41W

41.15N 80.49W

40.38N 80.36W

39.59N 83.03W

38.75N 82.59W

39.10N 84.30W

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>>>14390   >>   CINCINNATI FINISHED WATER SERIES B
>>>14391   >>   PIQUA RAW WATER SERIES A
>>>14392   >>   PIQUA RAW WATER SERIES B
>>>14393   >>   PIQUA FINISHED WATER SERIES A
>>>14394   >>   PIQUA FINISHED WATER SERIES B
>>>14395   >>   DEFIANCE RAW WATER SERIES A
>>>14396   >>   DEFIANCE RAW WATER SERIES B
>>>14397   >>   DEFIANCE FINISHED WATER SERIES A
>>>14398   >>   DEFIANCE FINISHED WATER SERIES B
>>>14399   >>   TOLEDO RAW WATER SERIES A
>>>14400   >>   TOLEDO RAW WATER SERIES B
>>>14401   >>   TOLEDO FINISHED WATER SERIES A
>>>14402   >>   TOLEDO FINISHED WATER SERIES B
>>>14403   >>   BOWLING GREEN RAW WATER SERIES A
>>>14404   >>   BOWLING GREEN RAW WATER SERIES B
>>>14405   >>   BOWLING GREEN FINISHED WATER SERIES A
>>>14406   >>   BOWLING GREEN FINISHED WATER SERIES B
>>>14407   >>   FREMONT RAW WATER SERIES A
>>>14408   >>   FREMONT RAW WATER SERIES B
>>>14409   >>   FREMONT FINISHED WATER SERIES A
>>>14410   >>   FREMONT FINISHED WATER SERIES B
>>>14411   >>   HNO3 REAGENT BLANK
>>>14412   >>   H2SO4 REAGENT BLANK
>>>14413   >>   NAOH REAGENT BLANK
>>>14414   >>   H3PO4 REAGENT BLANK
>>>14415   >>   OPEN
>>>14416   >>   OPEN
>>>14417   >>   OPEN
>>>14418   >>   OPEN
>>>14419   >>   OPEN
>>>14420   >>   OPEN
>>>14421   >>   OPEN
>>>14422   >>   OPEN
-----------------------------SAMPLE/PARAMETER DATA-----------------------------
```

40.09 N 84.16

41.17 N 84.21

41.40 N 83.33

41.32 N 83.42

41.21 N 83.05

EPA-CRL 1975 SAMPLE LOG NO.	S0003 OA TREFLAN WHL SMPL UG/L	S0001 OA HCBENZ WHL SMPL UG/L	39782 OA LINDANE WHL SMPL UG/L	S0002 OA BBHC WHL SMPL UG/L	S0004 OA DICLONE WHL SMPL UG/L	39330 OA ALDRIN WHL SMPL UG/L	S0005 OA ZYTRON WHL SMPL UG/L	*A
14359	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	: 6S*A
14361	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	: 8S*A
14363	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:10S*A
14365	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:12S*A
14367	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:14S*A
14369	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:16S*A
14371	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:18S*A
14373	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:20S*A
14375	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:22S*A
14377	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:24S*A
14379	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:26S*A
14381	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:28S*A
14383	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:30S*A
14385	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:32S*A
14387	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:34S*A
14389	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:36S*A
14391	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:38S*A
14393	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:40S*A
14395	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:42S*A
14397	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:44S*A
14399	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:46S*A
14401	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:48S*A
14403	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:50S*A
14405	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:52S*A
14407	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:54S*A
14409	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:56S*A
14415	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:62S*A
14417	:<0.002	:<0.002	:<0.002	:<0.005	:<0.01	:<0.002	:<0.02	:64S*A
	1P	2P	3P	4P	5P	6P	7P	**A

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO **A

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EPA-CRL 1975 SAMPLE LOG NO.	39430 OA ISODRIN WHL SMPL UG/L	39420 OA HCHLR-EP WHL SMPL UG/L	S0006 OA CHLORDAG WHL SMPL UG/L	S0007 OA ODE OP WHL SMPL UG/L	S0008 OA ODE PP WHL SMPL UG/L	S0009 OA DDD OP WHL SMPL UG/L	S0010 OA DDT OP WHL SMPL UG/L	
14359	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	6S
14361	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	8S
14363	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	10S
14365	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	12S
14367	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	14S
14369	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	16S
14371	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	18S
14373	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	20S
14375	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	22S
14377	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	24S
14379	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	26S
14381	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	28S
14383	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	30S
14385	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	32S
14387	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	34S
14389	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	36S
14391	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	38S
14393	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	40S
14395	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	42S
14397	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	44S
14399	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	46S
14401	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	48S
14403	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	50S
14405	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	52S
14407	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	54S
14409	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	56S
14415	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	62S
14417	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	64S
	8P	9P	10P	11P	12P	13P	14P	

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO

EPA-CRL 1975 SAMPLE LOG NO.	S0011 OA DDD PP WHL SMPL UG/L	S0012 OA DDT PP WHL SMPL UG/L	S0013 OA CARBPHTH WHL SMPL UG/L	S0014 OA MIREX WHL SMPL UG/L	39490 OA MTHXYCLR WHL SMPL UG/L	S0020 OA 2,4-D:IP WHL SMPL UG/L	S0021 OA DNBP WHL SMPL UG/L	*C *C *C *C
14359	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	: 6S*C
14361	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	: 8S*C
14363	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:1	:10S*C
14365	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:12S*C
14367	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:14S*C
14369	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:16S*C
14371	:<0.003	:0.010	:<0.003	:<0.005	:<0.01	:<.01	:<1	:18S*C
14373	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:20S*C
14375	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:22S*C
14377	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:24S*C
14379	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:26S*C
14381	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:28S*C
14383	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:30S*C
14385	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:32S*C
14387	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:34S*C
14389	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:36S*C
14391	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:38S*C
14392	:	:	:	:	:	:<.01	:<1	:39S*C
14393	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:40S*C
14395	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:42S*C
14397	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:44S*C
14399	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:46S*C
14401	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:48S*C
14403	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:50S*C
14407	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:54S*C
14409	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:56S*C
14415	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:62S*C
14417	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:64S*C
	15P	16P	17P	18P	19P	20P	21P	**C

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO **C

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EPA-CRL 1975 SAMPLE LOG NO.	39770 OA DCPA WHL SMPL UG/L	S0023 OA ENDOS I WHL SMPL UG/L	39380 OA DIELDRIN WHL SMPL UG/L	39390 OA ENDRIN WHL SMPL UG/L	39460 OA CLRHNZLT WHL SMPL UG/L	S0027 OA ENDOS II WHL SMPL UG/L	S0028 OA NITROFEN WHL SMPL UG/L	*D *D *D *D
14359	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 6S*D
14361	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 8S*D
14363	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:10S*D
14365	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:12S*D
14367	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:14S*D
14369	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:16S*D
14371	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:18S*D
14373	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:20S*D
14375	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:22S*D
14377	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:24S*D
14379	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:26S*D
14381	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:28S*D
14383	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:30S*D
14385	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:32S*D
14387	:<.003	:<.005	:.003	:<.003	:<.01	:<.005	:<.005	:34S*D
14389	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:36S*D
14391	:<.003	:<.005	:.004	:<.003	:<.01	:<.005	:<.005	:38S*D
14392	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:39S*D
14393	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:40S*D
14395	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:42S*D
14397	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:44S*D
14399	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:46S*D
14401	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:48S*D
14403	:<.003	:<.005	:.009	:<.003	:<.01	:<.005	:<.005	:50S*D
14405	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:52S*D
14407	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:54S*D
14409	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:56S*D
14415	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:62S*D
14417	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:64S*D
	22P	23P	24P	25P	26P	27P	28P	**D **D

EPA-CRL 1975 SAMPLE LOG NO.	S0029 OA 245-T:IO WHL SMPL UG/L	S0030 OA PROLAN WHL SMPL UG/L	S0031 OA BULAN WHL SMPL UG/L	S0026 OA DEHP WHL SMPL UG/L	39808 OA TEDION WHL SMPL UG/L	39570 OA DIAZINON WHL SMPL UG/L	S0016 OA DYFONATE WHL SMPL UG/L	*E
14359	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 6S*E
14361	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	: 8S*E
14363	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:10S*E
14365	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:12S*E
14367	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:14S*E
14369	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:16S*E
14371	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:18S*E
14373	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:20S*E
14375	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:22S*E
14377	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:24S*E
14379	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:26S*E
14381	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:28S*E
14383	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:30S*E
14385	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:32S*E
14387	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:34S*E
14389	:<.01	:<.01	:<.01	:17	:<.01	:<1	:<1	:36S*E
14391	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:38S*E
14392	:<.01	:<.01	:<.01	:<1	:<.01	:	:	:39S*E
14393	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:40S*E
14395	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:42S*E
14397	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:44S*E
14399	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:46S*E
14401	:<.01	:<.01	:<.01	:4	:<.01	:<1	:<1	:48S*E
14403	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:50S*E
14405	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:52S*E
14407	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:54S*E
14409	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:56S*E
14415	:<.01	:<.01	:<.01	:4	:<.01	:<1	:<1	:62S*E
14417	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:64S*E
	29P	30P	31P	32P	33P	34P	35P	**E

.OH.D404 REGION V DRINKING WATER STUDY - OHIO **E

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EPA-CRL 1975 SAMPLE LOG NO.	S0017 OA RONNEL WHL SMPL UG/L	S0032 OA DURSBAN WHL SMPL UG/L	39600 OA MPARATHN WHL SMPL UG/L	39530 OA MALATHN WHL SMPL UG/L	39540 OA PARATHN WHL SMPL UG/L	S0033 OA DEF WHL SMPL UG/L	39398 OA ETHION WHL SMPL UG/L	*F
14359	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 6S*F
14361	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 8S*F
14363	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:10S*F
14365	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:12S*F
14367	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:14S*F
14369	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:16S*F
14371	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:18S*F
14373	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:20S*F
14375	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:22S*F
14377	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:24S*F
14379	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:26S*F
14381	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:28S*F
14383	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:30S*F
14385	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:32S*F
14387	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:34S*F
14389	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:36S*F
14391	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:38S*F
14393	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:40S*F
14395	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:42S*F
14397	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:44S*F
14399	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:46S*F
14401	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:48S*F
14403	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:50S*F
14405	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:52S*F
14407	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:54S*F
14409	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:56S*F
14415	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:62S*F
14417	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:64S*F
	36P	37P	38P	39P	40P	41P	42P	**F
.OH.DW04	REGION V DRINKING WATER STUDY - OHIO							**F

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EPA-CRL 1975 SAMPLE LOG NO.	S0018 OA PHENCAPT WHL SMPL UG/L	S0034 OA EPN WHL SMPL UG/L	39580 OA GUTHION WHL SMPL UG/L	S0035 OA PHOSALON WHL SMPL UG/L	S0036 OA AZINFOSE WHL SMPL UG/L	S0037 OA COUMAFOS WHL SMPL UG/L	39488 OA AROCLOR 1221 UG/L	*G *G *G *G
14359	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 6S*G
14361	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 8S*G
14363	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:10S*G
14365	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:12S*G
14367	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:14S*G
14369	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:16S*G
14371	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:18S*G
14373	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:20S*G
14375	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:22S*G
14377	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:24S*G
14379	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:26S*G
14381	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:28S*G
14383	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:30S*G
14385	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:32S*G
14387	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:34S*G
14389	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:36S*G
14391	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:38S*G
14393	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:40S*G
14395	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:42S*G
14397	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:44S*G
14399	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:46S*G
14401	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:48S*G
14403	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:50S*G
14405	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:52S*G
14407	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:54S*G
14409	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:56S*G
14415	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:62S*G
14417	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:64S*G
	43P	44P	45P	46P	47P	48P	49P	**G

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.OH.DW04 REGION V DRINKING WATER STUDY - OHIO -G

EPA-CRL 1975 SAMPLE LOG NO.	39496 OA AROCLOR 1242 UG/L	39500 OA AROCLOR 1248 UG/L	39504 OA AROCLOR 1254 UG/L	39508 OA AROCLOR 1260 UG/L	S0047 OA METHE CL TOT VOL UG/L	S0039 OA CCL4 TOT VOL UG/L	S0038 OA CHCL3 TOT VOLA UG/L	*H
14359	<0.3	<0.3	<0.3	<0.4				6S*H
14360					<0.5	2	<1	7S*H
14361	<0.3	<0.3	<0.3	<0.4				8S*H
14362					<1	4	12	9S*H
14363	<0.3	<0.3	<0.3	<0.4				10S*H
14364					<0.5	<2	<1	11S*H
14365	<0.3	<0.3	<0.3	<0.4				12S*H
14366					<1	15	8	13S*H
14367	<0.3	<0.3	<0.3	<0.4				14S*H
14368					<0.5	<0.5	<1	15S*H
14369	<0.3	<0.3	<0.3	<0.4				16S*H
14370					<0.5	11	138	17S*H
14371	<0.3	<0.3	<0.3	<0.4				18S*H
14372					<0.5	7	<2	19S*H
14373	<0.3	<0.3	<0.3	<0.4				20S*H
14374					<0.5	6	5	21S*H
14375	<0.3	<0.3	<0.3	<0.4				22S*H
14376					<0.5	<1	<1	23S*H
14377	<0.3	<0.3	<0.3	<0.4				24S*H
14378					<0.5	<1	51	25S*H
14379	<0.3	<0.3	<0.3	<0.4				26S*H
14380					2	2	2	27S*H
14381	<0.3	<0.3	<0.3	<0.4				28S*H
14382					3	1	29	29S*H
14383	<0.3	<0.3	<0.3	<0.4				30S*H
14384					<0.5	2	6	31S*H
14385	<0.3	<0.3	<0.3	<0.4				32S*H
14386					3	1	21	33S*H
14387	<0.3	<0.3	<0.3	<0.4				34S*H
14388					<0.5	1	4	35S*H
14389	<0.3	<0.3	<0.3	<0.4				36S*H
14390					<0.5	<0.5	127	37S*H
14391	<0.3	<0.3	<0.3	<0.4				38S*H
14392					<0.5	<0.5	<2	39S*H
14393	<0.3	<0.3	<0.3	<0.4				40S*H
14394					<0.5	<1	102	41S*H
14395	<0.3	<0.3	<0.3	<0.4				42S*H
14396					<0.5	0.7	2	43S*H
14397	<0.3	<0.3	<0.3	<0.4				44S*H
14398					<0.5	1	14	45S*H
14399	<0.3	<0.3	<0.3	<0.4				46S*H
14400					<0.5	<0.5	<1	47S*H
14401	<0.3	<0.3	<0.3	<0.4				48S*H
14402					<0.5	<0.5	62	49S*H
14403	<0.3	<0.3	<0.3	<0.4				50S*H
14404					<0.5	<0.5	<1	51S*H
14405	<0.3	<0.3	<0.3	<0.4				52S*H
14406					<0.5	<0.5	160	53S*H
14407	<0.3	<0.3	<0.3	<0.4				54S*H
14408					<0.5	1	<1	55S*H
14409	<0.3	<0.3	<0.3	<0.4				56S*H
14410					<0.5	3	366	57S*H
14415	<0.3	<0.3	<0.3	<0.4				62S*H
14416					<0.5	<2	<1	63S*H
14417	<0.3	<0.3	<0.3	<0.4				64S*H
14418					<1	3	60	65S*H
	50P	51P	52P	53P	54P	55P	56P	**H

EPA-CRL 1975 SAMPLE LOG NO.	S0056 OA C2H4CL2 TOT VOL UG/L	S0040 OA CHCL2BR TOT VOL UG/L	S0041 OA CHCLBR2 TOT VOL UG/L	S0042 OA CHBR3 TOT VOL UG/L				
14360	<0.5	<0.5	<0.5	<0.5				7S
14362	<1	6	0.9	<1				9S
14364	<1	<1	<0.5	<1				11S
14366	<1	4	0.5	<1				13S
14368	<1	<0.2	0.4	0.9				15S
14370	<1	19	0.8	<0.2				17S
14372	<1	<1	<0.5	<1				19S
14374	<1	<0.5	<0.5	<0.5				21S
14376	<1	<0.2	<0.2	<0.2				23S
14378	<1	6	0.7	0.5				25S
14380	2	<0.2	<0.2	<0.2				27S
14382	<1	15	5	0.8				29S
14384	2	<0.2	<0.2	<0.2				31S
14386	<1	14	4	0.6				33S
14388	<1	<0.2	1.4	<0.2				35S
14390	<1	29	3	<0.5				37S
14392	<2	<0.5	<0.5	<0.5				39S
14394	<1	10	0.7	<0.1				41S
14396	<1	<0.2	<0.2	<0.2				43S
14398	<1	4	0.7	<0.2				45S
14400	<1	<0.2	0.3	<0.2				47S
14402	<1	20	4	<0.2				49S
14404	<1	<0.2	<0.2	<0.2				51S
14406	<1	27	5	<1				53S
14408	<1	<0.5	<0.5	<1				55S
14410	<1	18	1.4	<0.5				57S
14416	<1	<1	<0.5	<1				63S
14418	<2	26	4	<1				65S
	57P	58P	59P	60P	61P	62P	63P	

EPA-CRL 1975 SAMPLE LOG NO.	00916 MW CALCIUM CA.TOT MG/L	00927 MW MGNSIUM MG.TOT MG/L	00929 MW SODIUM NA.TOT MG/L	00937 MW PTSSIUM K.TOT MG/L	01034 MW CHROMIUM CR.TOT UG/L	01042 MW COPPER CU.TOT UG/L	01045 MW IRON FE.TOT UG/L	*J *J *J *J
14354	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	: 1S*J
14360	:31.5	:6.5	:7.7	:1.2	:<5	:<5	:76	: 7S*J
14362	:32.4	:7.6	:8.1	:1.2	:<5	:<5	:<20	: 9S*J
14364	:32.1	:7.5	:6.9	:1.1	:<5	:9	:74	:11S*J
14366	:31.6	:7.5	:8.1	:1.2	:<5	:<5	:<20	:13S*J
14368	:20.8	:6.0	:11.0	:3.0	:<5	:8	:120	:15S*J
14370	:33.5	:5.9	:12.8	:2.6	:<5	:<5	:<20	:17S*J
14372	:31.6	:8.2	:18.1	:2.2	:<5	:10	:2340	:19S*J
14374	:43.4	:7.9	:19.8	:2.1	:<5	:<5	:<20	:21S*J
14376	:40.4	:14.5	:6.0	:2.9	:7	:<5	:1900	:23S*J
14378	:45.6	:10.9	:8.5	:3.1	:<5	:<5	:<20	:25S*J
14380	:22.3	:6.6	:8.9	:1.8	:11	:39	:3110	:27S*J
14382	:27.7	:6.4	:9.7	:1.9	:<5	:<5	:<20	:29S*J
14384	:21.8	:5.7	:9.5	:1.8	:<5	:47	:3190	:31S*J
14386	:27.4	:6.3	:9.5	:1.9	:<5	:6	:<20	:33S*J
14388	:24.3	:7.4	:8.9	:1.7	:<5	:48	:1540	:35S*J
14390	:33.1	:7.4	:10.3	:1.7	:<5	:5	:30	:37S*J
14392	:44.9	:19.0	:7.0	:2.7	:<5	:<5	:620	:39S*J
14394	:29.0	:11.5	:17.1	:2.6	:<5	:<5	:26	:41S*J
14396	:79.4	:21.1	:17.1	:2.8	:7	:<5	:420	:43S*J
14398	:64.8	:7.7	:17.6	:2.8	:<5	:<5	:<20	:45S*J
14400	:43.2	:10.8	:11.1	:2.0	:<5	:16	:760	:47S*J
14402	:17.4	:5.8	:19.9	:1.7	:<5	:<5	:<20	:49S*J
14404	:62.7	:15.9	:11.3	:2.8	:<5	:13	:1370	:51S*J
14406	:34.0	:7.9	:47.5	:2.6	:<5	:<5	:590	:53S*J
14408	:45.7	:12.8	:8.8	:3.0	:<5	:<5	:1310	:55S*J
14410	:52.9	:3.5	:45.0	:2.7	:<5	:<5	:<20	:57S*J
14411	:<1	:<0.1	:<0.1	:<0.1	:<5	:<5	:<20	:58S*J
14416	:49.4	:12.2	:77	:2.8	:<5	:7	:1070	:63S*J
14418	:41.2	:12.4	:91	:3.1	:<5	:<5	:130	:65S*J
	64P	65P	66P	67P	68P	69P	70P	**J

EPA-CRL 1975 SAMPLE LOG NO.	01055 MW MANGNESE MN.TOT UG/L	01092 MW ZINC ZN.TOT UG/L	01002 MW ARSENIC AS.TOT UG/L	01051 MW LEAD PB.TOT UG/L	01027 MW CADMIUM CD.TOT UG/L	01077 MW SILVER AG.TOT UG/L	01147 MW SELENIUM SE.TOT UG/L	
14354	<5	<5	<1	<2	<0.2	<0.2	<5	1S
14360	6	<5	<1	<2	<0.2	0.3	<5	7S
14362	<5	<5	<1	<2	<0.2	<0.2	<5	9S
14364	9	<5	<1	<2	<0.2	<0.2	<5	11S
14366	7	<5	<1	<2	<0.2	<0.2	<5	13S
14368	28	18	<1	<2	<0.2	<0.2	<5	15S
14370	<5	<5	<1	<2	<0.2	<0.2	<5	17S
14372	470	63	3	25	0.4	<0.2	<5	19S
14374	13	<5	<1	<2	<0.2	<0.2	<5	21S
14376	52	35	10	7	<0.2	<0.2	<5	23S
14378	<5	<5	3	<2	<0.2	<0.2	<5	25S
14380	460	72	4	30	0.4	<0.2	<5	27S
14382	<5	<5	<1	<2	<0.2	<0.2	<5	29S
14384	470	66	7	30	0.3	<0.2	<5	31S
14386	<5	<5	<1	<2	<0.2	<0.2	<5	33S
14388	250	46	3	12	<0.2	<0.2	<5	35S
14390	<5	<5	<1	<2	<0.2	<0.2	<5	37S
14392	46	7	3	3	<0.2	<0.2	<5	39S
14394	<5	51	<1	<2	<0.2	<0.2	<5	41S
14396	29	19	1	4	0.4	<0.2	<5	43S
14398	5	<5	<1	<2	<0.2	<0.2	<5	45S
14400	19	<5	3	6	<0.2	<0.2	<5	47S
14402	6	<5	<1	<2	<0.2	<0.2	<5	49S
14404	55	14	5	8	0.3	<0.2	<5	51S
14406	8	<5	<1	<2	<0.2	<0.2	<5	53S
14408	110	52	5	13	12	<0.2	<5	55S
14410	<5	<5	1	<2	<0.2	<0.2	<5	57S
14411	<5	<5	<1	<2	<0.2	<0.2	<5	58S
14416	130	19	<1	11	0.5	<0.2	<5	63S
14418	32	<5	<1	3	0.4	<0.2	<5	65S
	71P	72P	73P	74P	75P	76P	77P	

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO

EPA-CRL 1975 SAMPLE LOG NO.	00530 IM RESIDUE TOT NFLT MG/L	70300 IM RESIDUE DISS-180 C MG/L	00095 IM CNDUCTVY AT 25C MICROMHO	00945 IM SULFATE SO4 MG/L	00940 IM CHLORIDE CL MG/L	00956 IM SILICA SIO2 MG/L	00410 IM T ALK CACO3 MG/L	*L *L *L *L
14360	:3	:160	:282	:20	:19	:<0.2	:85	: 7S*L
14362	:<2	:190	:278	:26	:18	:<0.2	:78	: 9S*L
14364	:3	:170	:270	:20	:16	:<0.2	:86	:11S*L
14366	:<2	:150	:277	:27	:19	:<0.2	:76	:13S*L
14368	:3	:170	:254	:31	:20	:<0.2	:45	:15S*L
14370	:<2	:230	:308	:56	:25	:0.6	:47	:17S*L
14372	:17	:200	:350	:82	:29	:6.3	:30	:19S*L
14374	:<2	:230	:397	:89	:33	:5.4	:50	:21S*L
14376	:203	:265	:391	:53	:18	:6.4	:95	:23S*L
14378	:8	:280	:364	:80	:21	:6.3	:42	:25S*L
14380	:165	:120	:236	:49	:12	:6.2	:29	:27S*L
14382	:<2	:170	:266	:54	:13	:6.4	:35	:29S*L
14384	:165	:145	:233	:53	:13	:6.4	:29	:31S*L
14386	:2	:140	:265	:55	:15	:6.6	:36	:33S*L
14388	:79	:150	:249	:55	:13	:6.6	:38	:35S*L
14390	:<2	:190	:307	:69	:21	:6.0	:40	:37S*L
14392	:68	:290	:441	:42	:19	:6.6	:141	:39S*L
14394	:<2	:230	:374	:43	:25	:6.9	:85	:41S*L
14396	:23	:440	:642	:103	:32	:8.1	:171	:43S*L
14398	:<2	:350	:506	:113	:36	:6.9	:61	:45S*L
14400	:53	:270	:376	:41	:25	:3.2	:97	:47S*L
14402	:<2	:180	:257	:39	:24	:2.8	:31	:49S*L
14404	:127	:380	:510	:79	:26	:7.0	:122	:51S*L
14406	:5	:340	:488	:109	:31	:5.5	:49	:53S*L
14408	:33	:240	:392	:54	:24	:6.6	:78	:55S*L
14410	:<2	:290	:520	:81	:39	:5.8	:100	:57S*L
14416	:34	:390	:780	:70	:142	:6.4	:79	:63S*L
14418	:<2	:480	:845	:82	:179	:6.6	:42	:65S*L
	78P	79P	80P	81P	82P	83P	84P	**L

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO **L

EPA-CRL 1975 SAMPLE LOG NO.	00403 IM LAB PH SU	00951 IM FLUORIDE F,TOTAL MG/L	32730 IM PHENOLS UG/L	00720 IM CYANIDE CN MG/L	00630 IN NO2&NO3 N-TOTAL MG/L	00610 IN NH3-N TOTAL MG/L	00625 IN TOT KJEL N MG/L	*M *M *M *M
14355					<0.03	<0.010	<0.05	2S*
14356				<0.002				3S*
14357			<3					4S*
14360	7.8	0.13	<3	0.004	0.26	0.013	0.32	7S*
14362	7.7	0.13	<3	0.005	0.25	<0.010	0.15	9S*
14364	7.8	0.16	<3	0.003	0.25	0.012	0.25	11S*
14366	7.7	0.13	<3	0.003	0.25	<0.010	<0.05	13S*
14368	7.4	0.13	4	0.005	0.27	0.044	0.64	15S*
14370	7.7	1.0	3	<0.002	0.28	0.019	0.22	17S*
14372	7.2	0.18	6	0.020	1.07	0.293	0.80	19S*
14374	9.4	1.3	<3	0.012	0.25	0.231	0.37	21S*
14376	7.7	0.21	6	0.005	5.31	0.224	2.16	23S*
14378	9.7	0.98	5	0.005	4.62	0.102	0.60	25S*
14380	7.0	0.13	<3	0.010	0.93	0.123	0.69	27S*
14382	8.4	0.96	<3	0.003	1.37	0.032	0.14	29S*
14384	7.0	0.13	<3	0.008	0.90	0.161	0.76	31S*
14386	8.3	0.96	<3	0.005	0.92	0.030	0.13	33S*
14388	7.2	0.13	<3	0.008	1.01	0.047	0.39	35S*
14390	8.2	0.13	<3	0.004	1.00	<0.010	0.08	37S*
14392	7.7	0.20	4	0.004	3.46	0.157	1.16	39S*
14394	7.9	0.19	<3	0.003	3.38	0.020	0.28	41S*
14396	7.8	0.26	3		5.25	0.424	1.33	43S*
14398	8.5	0.74	<3	0.007	5.17	0.121	0.65	45S*
14400	7.8	0.18	3	0.007	3.61	0.157	1.03	47S*
14402	8.9	1.1	<3	0.004	2.72	0.024	0.24	49S*
14404	7.7	0.22	5	0.008	7.15	0.275	1.43	51S*
14406	8.5	1.0	<3	0.009	7.28	0.018	0.48	53S*
14408	7.7	0.21	6	0.006	6.82	0.186	2.09	55S*
14410	9.0	0.96	<3	0.006	5.30	0.022	0.42	57S*
14412					<0.03	<0.010	<0.05	59S*
14413				0.004				60S*
14414			<3					61S*
14416	7.8	0.18	5	0.010	1.11	0.201	0.97	63S*
14418	9.0	0.74	3	0.010	1.18	0.040	0.25	65S*
	85P	86P	87P	88P	89P	90P	91P	**

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO

EPA-CRL 1975 SAMPLE LOG NO.	00665 IN PHOS-T P-ORT MG/L	00340 IN COD HI LEVEL MG/L	00680 IN T ORG C C MG/L	71900 IN MERCURY HG,TOTAL UG/L	00900 IN TOT HARD CACO3 MG/L	00615 IN NO2-N TOTAL MG/L			*N *N *N *N
14354				<0.1	<3			1S	*N
14355	0.31	5						2S	*N
14360	0.03	8		<0.1	106	<0.005		7S	*N
14362	0.02	5		<0.1	112	<0.005		9S	*N
14364	0.04	7		<0.1	111	<0.005		11S	*N
14366	<0.02	5		<0.1	110	<0.005		13S	*N
14368	0.04	20		<0.1	77	<0.005		15S	*N
14370	<0.02	10		<0.1	108	<0.005		17S	*N
14372	0.15	18		<0.1	113	0.025		19S	*N
14374	0.19	7		<0.1	141	0.021		21S	*N
14376	0.39	44		0.1	161	0.150		23S	*N
14378	0.07	12		0.2	117	0.017		25S	*N
14380	0.20	26		0.2	83	0.012		27S	*N
14382	<0.02	4		0.4	95	<0.005		29S	*N
14384	0.21	29		0.2	78	0.016		31S	*N
14386	<0.02	5		0.3	94	0.005		33S	*N
14388	0.14	18		0.2	91	0.014		35S	*N
14390	<0.02	3		0.3	113	<0.005		37S	*N
14392	0.17	25		0.1	190	0.060		39S	*N
14394	0.23	7		<0.1	120	<0.005		41S	*N
14396	0.29	22		0.1	285	0.049		43S	*N
14398	0.26	7		0.3	193	0.010		45S	*N
14400	0.26	19		0.1	152	0.050		47S	*N
14402	0.19	8		0.3	67	0.007		49S	*N
14404	0.36	33		0.2	222	0.059		51S	*N
14406	0.10	6		0.2	117	0.009		53S	*N
14408	0.35	43		<0.1	167	0.072		55S	*N
14410	0.14	7		<0.1	147	<0.005		57S	*N
14411				<0.1	<3			58S	*N
14412	<0.02	<3						59S	*N
14416	0.33	24		<0.1	174	0.032		63S	*N
14418	0.65	9		<0.1	154	<0.005		65S	*N
	92P	93P	94P	95P	96P	97P	98P		**N

.OH.DW04 REGION V DRINKING WATER STUDY - OHIO ----------N

CPLS 05APR DSN=CNCRLS.RGD.WS.DW01 ON TS0009 04/19/75 REV01 T

----------STUDY DESCRIPTION----------

NPAR	NLOG	AGENCYID	UNLOCKEY	STATTYPE	SMPLDAY	ATLABRY	DUEDATE	ACCOUNT-NUMBER
94	53			77777777	03FEB75	05FEB75	03MAY75	

>>>REGION V DRINKING WATER STUDY - WISCONSIN

----------SAMPLE DESCRIPTIONS----------

LABIDNUM	STORETID	COLLDAY	TIME	STATTYPE	DEEP	T	M	NO	ENDDATE	TIME	PRLU
14801		750203									
14802		750203									
14803		750203									
14804		750203									
14805		750203									
14806		750203									
14807		750203									
14808		750203									
14809		750203									
14810		750203									
14811		750203									
14812		750203									
14813		750203									
14814		750203									
14815		750203									
14816		750203									
14817		750203									
14818		750203									
14819		750203									
14820		750203									
14821		750203									
14822		750203									
14823		750203									
14824		750203									
14825		750203									
14826		750203									
14827		750203									
14828		750203									
14829		750203									
14830		750203									
14831		750203									
14832		750203									
14833		750203									
14834		750203									
14835		750203									
14836		750203									
14837		750203									
14838		750203									
14839		750203									
14840		750203									
14841		750203									
14842		750203									
14843		750203									
14844		750203									
14845		750203									
14846		750203									
14847		750203									
14848		750203									
14849		750203									

WISCONSIN

14850		750203	
14851		750203	
14852		750203	
14853		750203	
>>>14801	>>	HNO3 REAGENT BLANK	
>>>14802	>>	H2SO4 REAGENT BLANK	
>>>14803	>>	NAOH REAGENT BLANK	
>>>14804	>>	H3PO4 REAGENT BLANK	
>>>14805	>>	DPPH	
>>>14806	>>	EAU CLAIRE RAW WATER SERIES A	44 50 N 91.30 W
>>>14807	>>	EAU CLAIRE RAW WATER SERIES B	
>>>14808	>>	EAU CLAIRE FINISHED WATER SERIES A	
>>>14809	>>	EAU CLAIRE FINISHED WATER SERIES B	
>>>14810	>>	BLACK RIVER FALLS RAW WATER SERIES A	44.29 N 90.51 W
>>>14811	>>	BLACK RIVER FALLS RAW WATER SERIES B	
>>>14812	>>	BLACK RIVER FALLS FINISHED WATER SERIES A	
>>>14813	>>	BLACK RIVER FALLS FINISHED WATER SERIES B	
>>>14814	>>	BLACK RIVER FALLS RAW WATER SERIES A	
>>>14815	>>	BLACK RIVER FALLS RAW WATER SERIES B	
>>>14816	>>	BLACK RIVER FALLS FINISHED WATER SERIES A	
>>>14817	>>	BLACK RIVER FALLS FINISHED WATER SERIES B	
>>>14818	>>	LA CROSSE RAW WATER SERIES A	43.48 N 91.24 W
>>>14819	>>	LA CROSSE RAW WATER SERIES B	
>>>14820	>>	LA CROSSE FINISHED WATER SERIES A	
>>>14821	>>	LA CROSSE FINISHED WATER SERIES B	
>>>14822	>>	MILWAUKEE RAW WATER SERIES A	43 03 N 87.56 W
>>>14823	>>	MILWAUKEE RAW WATER SERIES B	
>>>14824	>>	MILWAUKEE FINISHED WATER SERIES A	
>>>14825	>>	MILWAUKEE FINISHED WATER SERIES B	
>>>14826	>>	OSHKOSH RAW WATER SERIES A	44.0 N 88.32 W
>>>14827	>>	OSHKOSH RAW WATER SERIES B	
>>>14828	>>	OSHKOSH FINISHED WATER SERIES A	
>>>14829	>>	OSHKOSH FINISHED WATER SERIES B	
>>>14830	>>	MANITOWOC RAW WATER SERIES A	44.05 N 87.40 W
>>>14831	>>	MANITOWOC RAW WATER SERIES B	
>>>14832	>>	MANITOWOC FINISHED WATER SERIES A	
>>>14833	>>	MANITOWOC FINISHED WATER SERIES B	
>>>14834	>>	TWO RIVERS RAW WATER SERIES A	44.10 N 87 33 W
>>>14835	>>	TWO RIVERS RAW WATER SERIES B	
>>>14836	>>	TWO RIVERS FINISHED WATER SERIES A	
>>>14837	>>	TWO RIVERS FINISHED WATER SERIES B	
>>>14838	>>	GREEN BAY RAW WATER SERIES A	44.32 N 88 00 W
>>>14839	>>	GREEN BAY RAW WATER SERIES B	
>>>14840	>>	GREEN BAY FINISHED WATER SERIES A	
>>>14841	>>	GREEN BAY FINISHED WATER SERIES B	
>>>14842	>>	GREEN BAY RAW WATER SERIES A	
>>>14843	>>	GREEN BAY RAW WATER SERIES B	
>>>14844	>>	GREEN BAY FINISHED WATER SERIES A	
>>>14845	>>	GREEN BAY FINISHED WATER SERIES B	
>>>14846	>>	MARINETTE RAW WATER SERIES A	45.06 N 87.39 W
>>>14847	>>	MARINETTE RAW WATER SERIES B	
>>>14848	>>	MARINETTE FINISHED WATER SERIES A	
>>>14849	>>	MARINETTE FINISHED WATER SERIES B	
>>>14850	>>	KENOSHA RAW WATER SERIES A	42.34 N 87 50 W
>>>14851	>>	KENOSHA RAW WATER SERIES B	
>>>14852	>>	KENOSHA FINISHED WATER SERIES A	

>>>14853 >> KENOSHA FINISHED WATER SERIES B

----------SAMPLE/PARAMETER DATA----------

EPA-CRL 1975 SAMPLE LOG NO.	S0003 OA TREFLAN WHL SMPL UG/L	S0001 OA HCBENZ WHL SMPL UG/L	39782 OA LINDANE WHL SMPL UG/L	S0002 OA BBHC WHL SMPL UG/L	S0004 OA DICLONE WHL SMPL UG/L	39330 OA ALDRIN WHL SMPL UG/L	S0005 OA ZYTRON WHL SMPL UG/L	
14806	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	6S
14808	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	8S
14810	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	10S
14812	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	12S
14814	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	14S
14816	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	16S
14822	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	22S
14824	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	24S
14826	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	26S
14828	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	28S
14830	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	30S
14832	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	32S
14834	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	34S
14836	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	36S
14839	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	39S
14840	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	40S
14842	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	42S
14844	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	44S
14846	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	46S
14848	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	48S
14850	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	50S
14852	<0.002	<0.002	<0.002	<0.005	<0.01	<0.002	<0.02	52S
	1P	2P	3P	4P	5P	6P	7P	

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN

EPA-CRL 1975 SAMPLE LOG NO.	39430 OA ISODRIN WHL SMPL UG/L	39420 OA HCHLR-EP WHL SMPL UG/L	S0006 OA CHLORDAG WHL SMPL UG/L	S0007 OA DDE OP WHL SMPL UG/L	S0008 OA DDE PP WHL SMPL UG/L	S0009 OA DDD OP WHL SMPL UG/L	S0010 OA DDT OP WHL SMPL UG/L	
14806	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	6S
14808	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	8S
14810	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	10S
14812	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	12S
14814	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	14S
14816	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	16S
14822	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	22S
14824	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	24S
14826	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	26S
14828	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	28S
14830	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	30S
14832	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	32S
14834	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	34S
14836	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	36S
14839	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	39S
14840	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	40S
14842	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	42S
14844	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	44S
14846	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	46S
14848	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	48S
14850	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	50S
14852	<0.003	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	52S
	8P	9P	10P	11P	12P	13P	14P	

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN

FPA-CRL 1975 SAMPLE LOG NO.	S0011 OA DDD PP WHL SMPL UG/L	S0012 OA DDT PP WHL SMPL UG/L	S0013 OA CARBPHTH WHL SMPL UG/L	S0014 OA MIREX WHL SMPL UG/L	39480 OA MTHXYCLH WHL SMPL UG/L	S0020 OA 2,4-D:IP WHL SMPL UG/L	S0021 OA DNBP WHL SMPL UG/L	*C *C *C *C
14806	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	: 6S*C
14808	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	: 8S*C
14810	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:10S*C
14812	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:12S*C
14814	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:14S*C
14816	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:16S*C
14822	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:22S*C
14824	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:24S*C
14826	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:26S*C
14828	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:28S*C
14830	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:30S*C
14832	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:32S*C
14834	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:34S*C
14836	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:36S*C
14839	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:39S*C
14840	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:40S*C
14842	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:42S*C
14844	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:44S*C
14846	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:46S*C
14848	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:48S*C
14850	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:50S*C
14852	:<0.003	:<0.003	:<0.003	:<0.005	:<0.01	:<.01	:<1	:52S*C
	15P	16P	17P	18P	19P	20P	21P	**C

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **C

EPA-CRL 1975 SAMPLE LOG NO.	39770 OA DCPA WHL SMPL UG/L	S0023 OA ENDOS I WHL SMPL UG/L	39380 OA DIELDRIN WHL SMPL UG/L	39390 OA ENDRIN WHL SMPL UG/L	39460 OA CLRGNZLT WHL SMPL UG/L	S0027 OA ENDOS II WHL SMPL UG/L	S0028 OA NITROFEN WHL SMPL UG/L	*D *D *D *D
14806	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 6S*D
14808	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	: 8S*D
14810	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:10S*D
14812	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:12S*D
14814	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:14S*D
14816	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:16S*D
14822	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:22S*D
14824	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:24S*D
14826	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:26S*D
14828	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:28S*D
14830	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:30S*D
14832	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:32S*D
14834	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:34S*D
14836	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:36S*D
14839	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:39S*D
14840	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:40S*D
14842	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:42S*D
14844	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:44S*D
14846	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:46S*D
14848	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:48S*D
14850	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:50S*D
14852	:<.003	:<.005	:<.003	:<.003	:<.01	:<.005	:<.005	:52S*D
	22P	23P	24P	25P	26P	27P	28P	**D

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **D

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EPA-CRL 1975 SAMPLE LOG NO.	S0029 OA 245-T:IO WHL SMPL UG/L	S0030 OA PROLAN WHL SMPL UG/L	S0031 OA BULAN WHL SMPL UG/L	S0026 OA DEHP WHL SMPL UG/L	39808 OA TEDION WHL SMPL UG/L	39570 OA DIAZINON WHL SMPL UG/L	S0016 OA DYFONATE WHL SMPL UG/L	*E
14806	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	: 6S*E
14808	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	: 8S*E
14810	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:10S*E
14812	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:12S*E
14814	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:14S*E
14816	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:16S*E
14822	:<.01	:<.01	:<.01	:12	:<.01	:<1	:<1	:22S*E
14824	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:24S*E
14826	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:26S*E
14828	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:28S*E
14830	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:30S*E
14832	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:32S*E
14834	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:34S*E
14836	:<.01	:<.01	:<.01	:6	:<.01	:<1	:<1	:36S*E
14839	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:39S*E
14840	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:40S*E
14842	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:42S*E
14844	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:44S*E
14846	:<.01	:<.01	:<.01	:<1	:<.01	:<1	:<1	:46S*E
14848	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:48S*E
14850	:<.01	:<.01	:<.01	:2	:<.01	:<1	:<1	:50S*E
14852	:<.01	:<.01	:<.01	:1	:<.01	:<1	:<1	:52S*E
	29P	30P	31P	32P	33P	34P	35P	**E

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **E

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EPA-CRL 1975 SAMPLE LOG NO.	S0017 OA RONNEL WHL SMPL UG/L	S0032 OA DURSBAN WHL SMPL UG/L	39600 OA MPARATHN WHL SMPL UG/L	39530 OA MALATHN WHL SMPL UG/L	39540 OA PARATHN WHL SMPL UG/L	S0033 OA DEF WHL SMPL UG/L	39398 OA ETHION WHL SMPL UG/L	*F *F *F *F
14806	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 6S*F
14808	:<1	:<1	:<1	:<1	:<1	:<1	:<1	: 8S*F
14810	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:10S*F
14812	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:12S*F
14814	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:14S*F
14816	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:16S*F
14822	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:22S*F
14824	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:24S*F
14826	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:26S*F
14828	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:28S*F
14830	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:30S*F
14832	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:32S*F
14834	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:34S*F
14836	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:36S*F
14839	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:39S*F
14840	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:40S*F
14842	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:42S*F
14844	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:44S*F
14846	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:46S*F
14848	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:48S*F
14850	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:50S*F
14852	:<1	:<1	:<1	:<1	:<1	:<1	:<1	:52S*F
	36P	37P	38P	39P	40P	41P	42P	**F

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **F

EPA-CRL 1975 SAMPLE LOG NO.	S0018 OA PHENCAPT WHL SMPL UG/L	S0034 OA EPN WHL SMPL UG/L	39580 OA GUTHION WHL SMPL UG/L	S0035 OA PHOSALON WHL SMPL UG/L	S0036 OA AZINFOSE WHL SMPL UG/L	S0037 OA COUMAFOS WHL SMPL UG/L	39488 OA AROCLOR 1221 UG/L	*G *G *G *G
14806	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 6S*G
14808	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	: 8S*G
14810	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:10S*G
14812	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:12S*G
14814	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:14S*G
14816	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:16S*G
14822	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:22S*G
14824	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:24S*G
14826	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:26S*G
14828	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:28S*G
14830	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:30S*G
14832	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:32S*G
14834	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:34S*G
14836	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:36S*G
14839	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:39S*G
14840	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:40S*G
14842	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:42S*G
14844	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:44S*G
14846	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:46S*G
14848	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:48S*G
14850	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:50S*G
14852	:<1	:<1	:<5	:<1	:<1	:<5	:<0.3	:52S*G
	43P	44P	45P	46P	47P	48P	49P	**G

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **G

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EPA-CRL 1975 SAMPLE LOG NO.	39496 OA AROCLOR 1242 UG/L	39500 OA AROCLOR 1248 UG/L	39504 OA AROCLOR 1254 UG/L	39508 OA AROCLOR 1260 UG/L	S0047 OA METHE CL TOT VOL UG/L	S0039 OA CCL4 TOT VOL UG/L	S0038 OA CHCL3 TOT VOLA UG/L	*H *H *H *H
14806	<0.3	<0.3	<0.3	<0.4				6S*H
14808	<0.3	<0.3	<0.3	<0.4				8S*H
14809					7	2	50	9S*H
14810	<0.3	<0.3	<0.3	<0.4				10S*H
14811					<0.5	4	3	11S*H
14812	<0.3	<0.3	<0.3	<0.4				12S*H
14813					<1	8	8	13S*H
14814	<0.3	<0.3	<0.3	<0.4				14S*H
14815					<0.5	<2	<1	15S*H
14816	<0.3	<0.3	<0.3	<0.4				16S*H
14817					<1	<2	4	17S*H
14822	<0.3	<0.3	<0.3	<0.3				22S*H
14823					<0.5	1	2	23S*H
14824	<0.3	<0.3	<0.3	<0.3				24S*H
14825					<0.5	3	2	25S*H
14826	<0.3	<0.3	<0.3	<0.3				26S*H
14827					<0.5	7	6	27S*H
14828	<0.3	<0.3	<0.3	<0.3				28S*H
14829					<0.5	<2	55	29S*H
14830	<0.3	<0.3	<0.3	<0.3				30S*H
14831					<0.5	1	<1	31S*H
14832	<0.3	<0.3	<0.3	<0.3				32S*H
14833					<0.5	<1	14	33S*H
14834	<0.3	<0.3	<0.3	<0.3				34S*H
14835					<0.5	10	1	35S*H
14836	<0.3	<0.3	<0.3	<0.3				36S*H
14837					<0.5	<2	9	37S*H
14839	<0.3	<0.3	<0.3	<0.3				39S*H
14840	<0.3	<0.3	<0.3	<0.3				40S*H
14841					<1	<1	10	41S*H
14842	<0.3	<0.3	<0.3	<0.3				42S*H
14843					<0.5	3	<1	43S*H
14844	<0.3	<0.3	<0.3	<0.3				44S*H
14845					<0.5	<1	9	45S*H
14846	<0.3	<0.3	<0.3	<0.3				46S*H
14847					<0.5	2	<1	47S*H
14848	<0.3	<0.3	<0.3	<0.3				48S*H
14849					<0.5	3	53	49S*H
14850	<0.3	<0.3	<0.3	<0.3				50S*H
14851					<0.5	1	12	51S*H
14852	<0.3	<0.3	<0.3	<0.3				52S*H
14853					<0.5	2	3	53S*H
	50P	51P	52P	53P	54P	55P	56P	**H
								**H

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN

EPA-CRL 1975 SAMPLE LOG NO.	S0056 OA C2H4CL2 TOT VOL UG/L	S0040 OA CHCL2BR TOT VOL UG/L	S0041 OA CHCLBR2 TOT VOL UG/L	S0042 OA CHBR3 TOT VOL UG/L				
14809	3	<1	<0.5	<1				9S
14811	<1	<0.5	<0.5	<0.5				11S
14813	<1	<0.5	<0.5	<0.5				13S
14815	<1	<1	<0.5	<0.5				15S
14817	<2	<0.5	<0.5	<0.5				17S
14823	<1	<0.5	<0.5	<0.5				23S
14825	<1.0	<0.5	<0.5	<0.5				25S
14827	<1	<0.5	<0.5	<1				27S
14829	<1	5	<0.5	<0.5				29S
14831	<0.5	<0.5	<0.5	<0.5				31S
14833	<1	6	1	<0.5				33S
14835	<1	<0.5	<0.5	<0.5				35S
14837	<1	4	<1	<0.5				37S
14841	<1	11	2	<1				41S
14843	<0.5	<0.5	<0.5	<0.5				43S
14845	<3	3	<1	<1				45S
14847	<0.5	<0.5	<0.5	<0.5				47S
14849	<1	6	<0.5	<0.5				49S
14851	<1	3	0.7	<1				51S
14853	<1	<1	<1	<1				53S
	57P	58P	59P	60P	61P	62P	63P	

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN

EPA-CRL 1975 SAMPLE LOG NO.	00916 MW CALCIUM CA,TOT MG/L	00927 MW MGNSIUM MG,TOT MG/L	00929 MW SODIUM NA,TOT MG/L	00937 MW PTSSIUM K,TOT MG/L	01034 MW CHPOMIUM CR,TOT UG/L	01042 MW COPPER CU,TOT UG/L	01045 MW IRON FE,TOT UG/L	*J *J *J *J
14801	<0.1	0.1	<0.1	<0.1	<5	<5	<20	1S*J
4806	14.3	6.3	3.2	1.0	<5	<5	28	6S*J
14808	18.2	5.3	3.0	1.0	<5	<5	<20	8S*J
14810	9.2	3.9	5.0	3.0	<5	7	90	10S*J
14812	9.3	3.9	21.0	3.2	<5	<5	40	12S*J
14814	9.0	3.8	5.4	3.0	<5	9	90	14S*J
14816	8.9	3.8	20.7	3.2	<5	<5	40	16S*J
14822	33.8	10.7	4.3	1.1	<5	<5	<20	22S*J
14824	33.8	10.7	4.3	1.2	<5	<5	<20	24S*J
14826	42.0	22.3	6.3	1.9	<5	10	44	26S*J
14828	42.0	22.5	6.5	1.9	<5	<5	<20	28S*J
14830	33.6	11.0	4.6	1.2	<5	10	28	30S*J
14832	32.1	10.3	4.4	1.2	<5	<5	<20	32S*J
14834	33.6	10.7	4.5	1.2	<5	<5	<20	34S*J
14836	33.2	10.6	4.9	1.2	<5	<5	<20	36S*J
14838	34.6	10.7	4.4	1.1	<5	<5	30	38S*J
14840	33.8	10.6	4.2	1.1	<5	<5	<20	40S*J
14842	34.3	10.7	4.2	1.1	<5	<5	<20	42S*J
14844	33.7	10.6	4.3	1.2	<5	<5	<20	44S*J
14846	33.3	11.6	4.3	1.2	<5	<5	38	46S*J
14848	32.4	11.7	9.5	1.2	<5	<5	<20	48S*J
14850	34.4	11.0	5.4	1.2	<5	112	<20	50S*J
14852	34.1	10.7	4.5	1.2	<5	<5	<20	52S*J
	64P	65P	66P	67P	68P	69P	70P	**J

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **J

EPA-CRL 1975 SAMPLE LOG NO.	01055 MW MANGNESE MN.TOT UG/L	01092 MW ZINC ZN.TOT UG/L	01002 MW ARSENIC AS.TOT UG/L	01051 MW LEAD PB.TOT UG/L	01027 MW CADMIUM CD.TOT UG/L	01077 MW SILVER AG.TOT UG/L	01147 MW SELENIUM SE.TOT UG/L	*K
4801	<5	<5	<1	3	<0.2	<0.2	<5	1S*K
4806	<5	<5	<1	<2	<0.2	<0.2	<5	6S*K
14808	<5	<5	<1	<2	<0.2	<0.2	<5	8S*K
14810	40	<5	<1	7	<0.2	<0.2	<5	10S*K
14812	35	<5	<1	<2	<0.2	<0.2	<5	12S*K
14814	30	<5	<1	9	<0.2	<0.2	<5	14S*K
14816	30	<5	<1	<2	<0.2	<0.2	<5	16S*K
14822	5	7	1	<2	<0.2	<0.2	<5	22S*K
14824	<5	<5	<1	4	<0.2	<0.2	<5	24S*K
14826	10	13	<1	7	<0.2	<0.2	<5	26S*K
14828	<5	12	<1	<2	<0.2	<0.2	<5	28S*K
14830	11	7	1	<2	<0.2	<0.2	<5	30S*K
14832	<5	<5	1	<2	<0.2	<0.2	<5	32S*K
14834	6	7	1	<2	<0.2	<0.2	<5	34S*K
14836	<5	<5	<1	<2	<0.2	<0.2	<5	36S*K
14838	<5	6	1	<2	<0.2	<0.2	<5	38S*K
14840	<5	<5	<1	<2	<0.2	<0.2	<5	40S*K
14842	<5	<5	1	<2	<0.2	<0.2	<5	42S*K
14844	<5	<5	<1	<2	<0.2	<0.2	<5	44S*K
14846	<5	<5	1	<2	<0.2	<0.2	<5	46S*K
14848	<5	<5	1	<2	<0.2	<0.2	<5	48S*K
14850	<5	130	<1	2	<0.2	<0.2	<5	50S*K
14852	<5	14	<1	<2	<0.2	<0.2	<5	52S*K
	71P	72P	73P	74P	75P	76P	77P	**K

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN **K

EPA-CRL 1975 SAMPLE LOG NO.	00530 IM RESIDUE TOT NFLT MG/L	70300 IM RESIDUE DISS-180 C MG/L	00095 IM CNDUCTVY AT 25C MICROMHO	00945 IM SULFATE SO4 MG/L	00940 IM CHLORIDE CL MG/L	00956 IM SILICA SIO2 MG/L	00410 IM T ALK CACO3 MG/L	*L *L *L *L
806	:<2	:80	:164	:13	:10	:22.0	:36	: 6S*L
.808	:<2	:90	:169	:<3	:8	:21.0	:55	: 8S*L
14810	:<2	:70	:125	:10	:9	:8.0	:28	:10S*L
14812	:3	:100	:184	:9	:9	:8.7	:59	:12S*L
14814	:5	:70	:120	:9	:9	:7.9	:28	:14S*L
14816	:<2	:90	:182	:9	:10	:8.7	:58	:16S*L
14822	:<2	:170	:274	:18	:9	:1.1	:105	:22S*L
14824	:<2	:170	:283	:26	:10	:1.5	:94	:24S*L
14826	:4	:210	:402	:20	:11	:7.9	:180	:26S*L
14828	:<2	:250	:417	:40	:13	:8.0	:153	:28S*L
14830	:3	:150	:282	:20	:9	:1.1	:107	:30S*L
14832	:<2	:150	:282	:19	:10	:1.6	:100	:32S*L
14834	:2	:190	:277	:19	:9	:1.1	:108	:34S*L
14836	:<2	:190	:286	:19	:10	:1.6	:100	:36S*L
14838	:2	:210	:278	:19	:9	:1.1	:106	:38S*L
14840	:<2	:190	:280	:21	:11	:1.8	:103	:40S*L
14842	:<2	:200	:277	:17	:11	:1.8	:106	:42S*L
14844	:<2	:140	:282	:18	:10	:1.1	:101	:44S*L
14846	:<2	:150	:280	:17	:12	:2.1	:109	:46S*L
14848	:<2	:240	:315	:42	:12	:0.6	:88	:48S*L
14850	:2	:200	:292	:21	:12	:0.5	:107	:50S*L
14852	:<2	:200	:285	:26	:12	:1.5	:100	:52S*L
	78P	79P	80P	81P	82P	83P	84P	**L **L

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN -L

EPA-CRL 1975 SAMPLE LOG NO.	00665 IN PHOS-T P-WET MG/L	00340 IN COD HI LEVEL MG/L	00680 IN T ORG C C MG/L	71900 IN MERCURY HG,TOTAL UG/L	00900 IN TOT HARD CACO3 MG/L	00615 IN NO2-N TOTAL MG/L		
4801				<0.1	<3			1S
4802	<0.02	<3				<0.005		2S
14806	0.10	<3		<0.1	62	<0.005		6S
14808	0.11	3		<0.1	67	0.010		8S
14810	0.08	9		<0.1	39	0.006		10S
14812	0.08	6		<0.1	39	<0.005		12S
14814	0.08	6		<0.1	38	0.006		14S
14816	0.08	5		<0.1	38	<0.005		16S
14822	0.03	<3		<0.1	128	<0.005		22S
14824	<0.02	<3		<0.1	128	<0.005		24S
14826	0.02	17		<0.1	197	0.010		26S
14828	<0.02	11		<0.1	197	<0.005		28S
14830	<0.02	5		<0.1	129	<0.005		30S
14832	<0.02	3		<0.1	123	<0.005		32S
14834	<0.02	4		<0.1	128	<0.005		34S
14836	<0.02	5		<0.1	127	<0.005		36S
14838	<0.02	3		<0.1	130	<0.005		38S
14840	<0.02	3		<0.1	128	<0.005		40S
14842	<0.02	3		<0.1	130	<0.005		42S
14844	<0.02	3		<0.1	129	<0.005		44S
14846	<0.02	10		<0.1	131	0.005		46S
14848	<0.02	4		<0.1	129	<0.005		48S
14850	<0.02	8		<0.1	131	0.008		50S
14852	<0.02	6		<0.1	129	<0.005		52S
	92P	93P	94P	95P	96P	97P	98P	

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN

EPA-CRL 1975 SAMPLE LOG NO.	00403 IM LAB PH SU	00951 IM FLUORIDE F,TOTAL MG/L	32730 IM PHENOLS UG/L	00720 IM CYANIDE CN MG/L	00630 IN NO2&NO3 N-TOTAL MG/L	00610 IN NH3-N TOTAL MG/L	00625 IN TOT KJEL N MG/L	* * * * *
14802					<0.03	<0.010	<0.05	2S*
14803				<0.002				3S*
14804			<3					4S*
14806	6.4	0.10	<3	0.003	2.31	<0.010	0.03	6S*
14808	7.9	0.13	<3	0.002	1.00	0.126	0.22	8S*
14810	6.3	0.12	<3	0.003	0.48	0.023	0.24	10S*
14812	7.4	1.4	<3	0.008	0.48	0.026	0.24	12S*
14814	6.3	0.13	<3	0.002	0.47	0.024	0.23	14S*
14816	7.4	1.4	<3	0.006	0.49	0.023	0.20	16S*
14822	7.9	0.12	<3	0.003	0.23	0.011	0.13	22S*
14824	7.3	0.84	<3	0.002	0.22	0.043	0.15	24S*
14826	8.2	0.19	<3	0.003	0.24	0.050	0.77	26S*
14828	7.4	1.0	<3	0.005	0.20	0.146	0.53	28S*
14830	8.0	0.13	<3	<0.002	0.22	<0.010	<0.05	30S*
14832	7.5	0.86	<3	0.002	0.22	<0.010	<0.05	32S*
14834	7.9	0.12	<3	0.003	0.22	0.024	0.06	34S*
14836	7.5	0.94	<3	0.002	0.23	<0.010	<0.05	36S*
14838	8.0	0.12	<3	<0.002	0.22	<0.010	<0.05	38S*
14840	7.6	1.2	<3	0.002	0.23	<0.010	<0.05	40S*
14842	7.9	0.12	<3	<0.002	0.22	<0.010	0.10	42S*
14844	7.6	1.2	<3	<0.002	0.22	<0.010	<0.05	44S*
14846	7.8	0.11	<3	<0.002	0.10	0.014	0.21	46S*
14848	7.1	0.98	<3	0.003	0.11	0.011	<0.05	48S*
14850	7.9	0.13	<3	0.003	0.28	0.047	0.27	50S*
14852	7.4	1.1	<3	0.003	0.23	0.208	0.27	52S*
	85P	86P	87P	88P	89P	90P	91P	**

.WS.DW01 REGION V DRINKING WATER STUDY - WISCONSIN