TECHNICAL REPORT

Survey of Community Water Supplies for the Occurrence of 2,4,5-T and Related Herbicides

ENVIRONMENTAL PROTECTION AGENCY

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Organization and Name Changes

On December 2, 1970 the Bureau of Water Hygiene of the U.S. Public Health Service was transferred to the newly established Environmental Protection Agency and became the Division of Water Hygiene of the Office of Water Quality. However, since the survey of community water supplies for the occurrence of 2,4,5-T and related herbicides on which this report is based was accomplished prior to the above date, the former names of the Bureau of Water Hygiene and its organizational components in the Public Health Service appear throughout this report.

Disclaimer Clause

Reference in this report to commercial products does not constitute endorsement by the Environmental Protection Agency.

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SUMMARY AND CONCLUSIONS

For a number of reasons, questions have been raised recently as to whether the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) is getting into drinking water supplies where it may constitute a potential hazard to those who consume the water. The report on 2,4,5-T of the Panel on Herbicides of the President's Science Advisory Committee focused attention relative to the occurrence of this herbicide in drinking water supplies. In response to a request of the Surgeon General of the Public Health Service in August 1970, the Bureau of Water Hygiene, in cooperation with State health departments and other concerned groups, conducted a survey of 58 community water supplies to determine the occurrence and levels of concentration of 2,4,5-T and related chlorophenoxy acid compounds, 2,4-dichlorophenoxy-acetic acid (2,4-D) and 2-(2,4,5-trichlorophenoxy) propionic acid (2,4,5-TP), commonly known as Silvex, in raw and finished waters.

The survey, conducted during September through November 1970, was based on a one-time sampling of the community water supplies representing a widespread geographical distribution over the United States. Companion raw and finished water samples or either raw or finished water samples were collected from water supplies located in Arizona, Georgia, Indiana, Louisiana, Massachusetts, New Hampshire, New York, Ohio, Oklahoma, Oregon, Tennessee, Texas, Virginia, Washington, and Puerto Rico.

Laboratory analyses were performed by electron capture gas chromatography of the methyl esters of 2,4,5-T and related chlorophenoxy acid herbicides. In some instances, where quantifiable amounts of a herbicide were detected, the identity of the herbicides was confirmed by microcoulometry. The quantitative reporting level for 2,4,5-T and related herbicides for the analytical method used was 0.5 parts per billion (ppb).

The herbicide 2,4,5-T was detected in 11 or 19.0 percent of the 58 community water supplies examined. However, the herbicide was present in trace amounts only, ranging from less than 0.5 ppb to 0.57 ppb in the raw and/or finished waters.

The herbicide 2,4-D was detected in 18 or 31.0 percent of the 58 community water supplies examined. As with 2,4,5-T, the herbicide 2,4-D was also found in trace amounts only, ranging from less than 0.5 ppb to 3.44 ppb in the raw and/or finished waters.

The herbicide 2,4,5-TP was detected in only 4 or 6.9 percent of the community water supplies examined. The concentration of 2,4,5-TP in these four community water supplies was found to be less than 0.5 ppb.

The levels of concentration at which 2,4,5-T, 2,4-D, and 2,4,5-TP were detected in these community water supplies are extremely low when compared to the present Public Health Service guideline of a maximum permissible concentration of 0.1 mg/liter

(ppm) for either the individual herbicide or the sum of any combination of these herbicides. The trace amounts of these herbicides as found in this survey may be interpreted as being relatively insignificant from a public health standpoint. In view of the conditions under which this survey was conducted, however, the lack of occurrence of 2,4,5-T and related herbicides or their detection in only trace amounts in these community water supplies should be considered as a preliminary finding.

If widespread use of 2,4,5-T and related herbicides is to be continued in the United States, a comprehensive study, taking into consideration all the major factors influencing the occurrence and detection of these herbicides in drinking water supplies, as mentioned in the body of this report, should be conducted. Such a study would be needed to determine the presence of these herbicides in community drinking water supplies during and immediately following their use on watershed and water supply source areas and to evaluate the public health significance of the findings.

INTRODUCTION

The herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) has been widely used in the United States since about 1950 for the control of weeds in crop lands, for the eradication or control of aquatic weeds in ponds, streams, and other bodies of water, and for the control of brushy species of plants along railroad and power line rights-of-way and in managed forested areas. Until recently there has been relatively little concern

over the potential hazards from the use of 2,4,5-T and the exposure of animals and man to 2,4,5-T residues on food crops and in the water, air, and soil environments when the material is used according to directions. The report on 2,4,5-T of the Panel on Herbicides of the President's Science Advisory Committee pointed out that use of this herbicide at the rates of recommended application results in measurable levels of residues in soils, water, air, plants, and animals, which persist for relatively short periods of time following application.

During the past year there has been sharply increased concern over the potential hazards to human health from the use of 2,4,5-T and related chlorophenoxy acid compounds, including 2,4-dichlorophenoxyacetic acid (2,4-D) and 2-(2,4,5-trichlorophenoxy) propionic acid (2,4,5-TP), commonly known as Silvex. This concern has been generated by (1) the findings in recent research studies that 2,4,5-T has markedly increased the incidence of abnormal fetuses in laboratory mice and rats, (2) the alleged potential teratogenic and other harmful effects to human health from the use of 2,4,5-T and related compounds in Viet Nam and the United States, and (3) the results of studies on the persistence of 2,4,5-T in the soil and water environments following its application.

The growing national attention to the use of 2,4,5-T has brought up the question as to whether this herbicide is getting into drinking water supplies where it may constitute a potential hazard to those who consume the water. There is very little information available at the present time to provide a basis for answering this question because monitoring of public water supplies in the United States for 2,4,5-T and related herbicides has been limited. It is generally recognized, however, that the contamination of drinking water supplies represents a potentially significant route for exposure of human beings to this material especially in those areas of the country where there is direct application of the herbicide to water for weed control and to a lesser extent where there is runoff from forested areas treated for brush control.

This survey was carried out during August through November 1970 at the request of the Surgeon General of the U.S. Public Health Service. It represented a considerably reduced approach to an earlier planned and more comprehensive study of the occurrence of 2,4,5-T in public drinking water supplies. The purpose of the survey was to answer the question "Is 2,4,5-T getting into surface and ground waters that serve as sources of public water supplies and into drinking water in those geographical areas of the United States where the herbicide is currently being used or has recently been used?" A secondary purpose of the survey

was to determine the effect of the currently used water treatment practice in removing or reducing the concentration of the 2,4,5-T if it was found in the water supply source.

The current version of the Public Health Service Drinking Water Standards (PHS Publication No. 956, U.S. Government Printing Office, Washington, 1962) does not contain standards for pesticides and herbicides. However, in the evaluation of public drinking water supplies, the present Public Health Service guideline is a maximum permissible concentration of 0.1 mg/liter (ppm) for either 2,4,5-T or the sum of any combination of 2,4,5-T and other related compounds. It was planned that the results of this survey would be assessed in relation to this guideline in the future consideration of an ultimate standard for 2,4,5-T and other related herbicides in drinking water.

FIELD ACTIVITIES AND SAMPLING PROCEDURES

The survey was planned so as to include the sampling of selected public water supplies influenced by watershed or drainage basin areas on which 2,4,5-T had been used or was expected to be used in 1970. The Public Health Service Regional Water Hygiene Representatives were responsible for obtaining information on the use of 2,4,5-T on such areas and for identifying the public water supplies concerned. It was initially planned that the necessary information would be obtained from State Sanitary Engineers, Federal and State agriculture and forestry

agencies, and personnel of railroad and power companies. The identification of areas where 2,4,5-T had been or was currently being used proved to be a difficult task because such information was not generally available from a single source. Representatives of power companies turned out to be especially good sources of information on the use of 2,4,5-T for brush control on power line rights-of-way.

It was originally hoped that two public drinking water supplies in each of the nine Public Health Service regions could be evaluated in the earlier planned study. However, based on contacts by all Regional Water Hygiene Representatives with the States, this was not possible because of generally non-use of 2,4,5-T on watershed areas or lack of information on projected use of the herbicide during 1970. Plans were completed in the earlier planned study for including approximately 15 selected public water supplies representing a widespread geographical distribution.

The initiation in August of the requested survey of community water supplies for the occurrence of 2,4,5-T was late with respect to the general seasonal use of this herbicide especially for control of brushy species of plants. Such operational use of 2,4,5-T is generally begun in March or April and carried out through the early summer months. In addition, the suspension of registration of liquid formulations of 2,4,5-T for use on lakes,

ponds, and water courses apparently curtailed the operational use of the herbicide for aquatic weed control during the summer of 1970. Consequently, difficulty was encountered by the Regional Water Hygiene Representatives in locating watershed or drainage basin areas on which 2,4,5-T was currently being used and in identifying affected community water supplies.

Primarily as a matter of expediency in getting the survey under way, field sampling was initiated in August of the approximately 15 public water supplies selected for inclusion in the earlier planned study. The schedule for sampling provided for the collection of one set of companion raw and finished water samples for 2,4,5-T analyses from each community water supply in August and another set of such samples in September. If the water samples collected in August from a particular community water supply were negative for 2,4,5-T, the Regional Water Hygiene Representative tried to locate an alternate community water supply for sampling in September thus extending the survey to a larger number of community water supplies and providing a broader geographical coverage. For a number of reasons, it became necessary to extend some of the field sampling activities into October and November.

The numbers of community water supplies included in the survey and selected on the basis of information relating to actual or anticipated operational use of 2,4,5-T on the watershed

or drainage basin areas influencing the water supplies are shown below according to PHS Region, as follows:

PHS Region	No. of Community Water Supplies
I	3
II	1
III	4
IV	5
VI	15
IX	1
X	2
Total	31

The opportunity was taken to also include in the survey public drinking water supplies which were under special study for other purposes by the Division of Technical Operations of the Bureau of Water Hygiene. Seven recreational area water supplies in Indiana and Ohio were included from a study of Corps of Engineer reservoir developments which serve as water sources for these supplies. Eighteen community water supplies in Tennessee were included from an evaluation of the State of Tennessee Water Supply Program. Samples of finished water that were collected in these special studies for analyses for chlorinated insecticides were also analyzed for 2,4,5-T and related chlorophenoxy acid herbicides. Although these twenty-five water

supplies were not selected for the survey on the basis of information relating to the use of 2,4,5-T, the results of the analyses do provide useful data on the occurrence of 2,4,5-T and related herbicides in public drinking water supplies.

Also included in the survey were two community water supplies in Puerto Rico. The herbicide 2,4-D had been used periodically throughout the summer directly on the water sources of these two water supplies for the control of water hyacinths. Inclusion of these water supplies in the survey provided an opportunity to determine the extent to which the herbicide could be detected in the water supply systems following periods of direct application to the water sources.

The total numbers of community water supplies included in the survey without regard to the specific basis for inclusion and according to PHS Region are as follows:

PHS Region	No. of Community Water Supplies
I	3
II	3
III	4
IV	23
V	7
VI	15
IX	1
X	2
Total	58

The Regional Water Hygiene Representatives were responsible for making arrangements for the collection of water samples. These arrangements were generally made with representatives of the State Health Departments concerned or through such representatives directly with personnel associated with the community water supplies to be sampled. The field sampling activities were carried out by PHS Regional Office personnel, State Health Department representatives, or personnel of the local water works in accordance with the specific arrangements made.

The collection of the set of companion raw and finished water samples was accomplished on a grab sampling basis following the sampling schedule previously described. In general, both raw and finished water samples were collected at the water treatment facility with the former sample being collected from the raw water intake and the latter sample being collected from the clear well or from the treated water pumped into the distribution system. No effort was made to estimate time of water travel through the treatment facility to provide for sampling of the same general water mass.

Water samples were collected in 1-gallon glass jugs which were provided in styrofoam shipping containers by the Gulf Coast Water Hygiene Laboratory. Each glass jug was fitted with a teflon-lined screw cap. All water sample jugs had been previously treated by washing with a detergent followed by drying and rinsing with

hexane. The filled water sample jugs were returned to the Laboratory in the styrofoam shipping containers generally by air mail parcel post.

LABORATORY PROCEDURES

Analyses of all water samples for 2,4,5-T and related chlorophenoxy acid herbicides were performed by the Gulf Coast Water Hygiene Laboratory. Each water sample was extracted during the day of its arrival; in the few instances when this was not possible, the sample was kept at 1.1 C until extracted.

In accordance with the plan for analyses of companion raw and finished water samples collected from a community water supply, analysis was performed initially on the raw water sample. If no chlorophenoxy acids were found in the raw water sample, the companion finished water sample was generally not analyzed. A herbicides analysis was performed on each raw or finished water sample that was the only sample collected from a water supply.

The procedure followed for the extraction and saponification of 2,4,5-T, 2,4-D, and 2,4,5-TP was that of Goerlitz and Lamar[1]. In this procedure the sample was acidified to pH 2.0 and extracted with ethyl ether. The extract was then saponified to ensure the

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[1] Goerlitz, Donald F. and William L. Lamar. 1967. Determination of Phenoxy Acid Herbicides in Water by Electron-Capture and Microcoulometric Gas Chromatography. U.S. Geological Survey Water-Supply Paper 1817-C.

recovery of the herbicides in the free acid form. The recovery of the free acids was followed by conversion to their respective methyl esters with methanol and sulfuric acid according to Rogozinski[2]. All solvents used were those supplied by the manufacturers (Mallinckrodt or Burdick and Jackson) as suitable for pesticide residue analysis. Reagent grade methanol was distilled in glass prior to its use in the esterification procedure.

The herbicides were identified and quantitated by dual column gas-liquid chromatography of their methyl esters. The instrument used was a Micro-Tek Model 2000 MF equipped with electron capture detectors. Glass, U-shaped columns 6 feet long x 1/4 inch OD were packed with 60/80 mesh Gas Chrom Q coated with either 3% DC-200, a combination of 2% SE-30 and 3% OV-210, or a combination of 1.5% OV-17 and 1.9% QF-1. The carrier gas was nitrogen, and the oven temperature was 156 C. In some instances, as noted in the Appendix, where quantifiable amounts of a herbicide were detected, the identity of the herbicides was confirmed by microcoulometry. The quantitative reporting level for 2,4,5-T and related herbicides for the analytical method used was 0.5 parts per billion (ppb).

Standard samples of the herbicides were obtained from the Food and Drug Administration, Pesticide Repository, Perrine

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(2) Rogozinski, M. 1964. A Rapid Quantitative Esterification Technique for Carboxylic Acids. J. Gas Chromatog. 2:136; H. P. Burchfield and D. E. Johnson. 1965. Guide to the Analysis of Pesticide Residues, Vol. 1, U.S. Dept. of HEW, Washington, D.C.

Primate Research Branch, Perrine, Florida. The efficiency of the extraction procedure used was determined by analyzing water samples previously spiked with known amounts of these standard acids. It was found that the recovery of 2,4,5-T and 2,4-D was 90% while that of 2,4,5-TP was 88.3%. Quantitation was accomplished by comparing the height of unknown peaks with the height of peaks produced by methylation products of known amounts of the standard acids. Values reported were corrected for the loss incurred during the extraction procedure.

RESULTS AND ANALYSIS OF DATA

The results of analyses of community water supplies for the occurrence and levels of concentration of 2,4,5-T and the related chlorophenoxy acid compounds 2,4-D and 2,4,5-TP are presented in Tables 1-5. A tabulation of the analytical results on all community water supply samples examined in the survey is included in the Appendix of this report.

As shown in Table 1, the herbicide 2,4,5-T was detected in 11 or 19.0 percent of the total of 58 community water supplies examined without regard for the basis of their inclusion in the survey. The herbicide was detected in trace amounts only with the range of 2,4,5-T concentration in the raw and/or finished water samples being <0.5 to 0.57 ppb.

Table 1

Occurrence of 2,4,5-T in Community Water Supplies

Description of Group of Water Supplies	No. of Water Supplies Examined	Water Supplies in Which 2,4,5-T Detected		2,4,5-T Concentration in ppb in Raw and/or Finished Water			Water Supplies in Which 2,4,5-T Not Detected	
		No.	Percent	Low	Median	High	No.	Percent
Selected on Basis of Information on Use of 2,4,5-T and/or Related Herbicides	33	6	18.2	<0.5	<0.5	0.57	27	81.8
Included in Evaluation of Tennessee Water Supply Program	18	3	16.7	<0.5	<0.5	<0.5	15	83.3
Included in Study of Corps of Engineer Reservoir Developments in Indiana and Ohio	7	2	28.6	<0.5	<0.5	<0.5	5	71.4
All Community Water Supplies Included in Survey	58	11	19.0	<0.5	<0.5	0.57	47	81.0

The group of 33 community water supplies selected on the basis of available information on use of 2,4,5-T and/or related herbicides on the watershed or water source areas were included in the survey to optimize the likelihood of detecting the herbicide in raw and finished water samples. For several of these water supplies, the PHS Regional personnel were able to verify the use of 2,4,5-T and other herbicides on the watershed or water source areas during the 1970 season. For the majority of these water supplies, however, actual vertification relative to such use of 2,4,5-T and other herbicides was not possible under the conditions of the survey. The herbicide 2,4,5-T was detected in trace amounts in 6 or 18.2 percent of the 33 water supplies in this group.

The groups of 18 Tennessee water supplies and of 7 Indiana and Ohio water supplies were included in the survey without regard to any information on the use of 2,4,5-T and related herbicides on the watershed or water source areas. The herbicide 2,4,5-T was detected in trace amounts in 16.7 and 28.6 percent, respectively, of the water supplies in these two groups.

It is interesting to note from the data in Table 1 that there is relatively little difference in the percentages of the water supplies in which 2,4,5-T was detected among the three groups of water supplies included in the survey. Considering the conditions of the survey and the relatively small number of water supplies

included in the three groups, the percentages would have little statistical significance. However, these data do indicate that traces of 2,4,5-T are getting into the water environment and can be detected in community water supplies.

Table 2 shows the distribution of the community water supplies examined by the groups and total number included in the study according to the 2,4,5-T concentrations found in the raw and/or finished water samples. These data clearly show the relatively high number of water supplies in which 2,4,5-T was not detected. These data also point up the very low concentrations of 2,4,5-T in those water supplies in which the herbicide was detected. Considering all of the water supplies, 47 of the total of 58 showed no 2,4,5-T. In 10 of the water supplies 2,4,5-T was detected in concentrations less than 0.5 ppb, and in 1 water supply the herbicide was found in the range of 0.5-1.0 ppb (0.57 ppb).

It was hoped that the survey would provide information concerning the effectiveness of currently used water treatment practices in removing or reducing the concentration of 2,4,5-T if it was present in the raw water source. However, the conditions under which the survey was carried out and the very small concentrations of 2,4,5-T encountered in the raw water samples precluded the securing of definitive information in this area of inquiry.

Companion raw and finished water samples were collected only from 22 of the 33 community water supplies included in the survey

Table 2

Distribution of Community Water Supplies According to 2,4,5-T Concentrations Found in Raw and/or Finished Waters

Description of Group of Water Supplies	2,4,5-T Concentration (ppb)			Totals
	*	<0.5	0.5-1.0	
Selected on Basis of Information on Use of 2,4,5-T and/or Related Herbicides	27	5	1	33
Included in Evaluation of Tennessee Water Supply Program	15	3	0	18
Included in Study of Corps of Engineer Reservoir Developments in Indiana and Ohio	5	2	0	7
All Community Water Supplies Included in Survey	47	10	1	58

*Not Detected

on the basis of information on the use of 2,4,5-T and related herbicides on watershed or water source areas. In the six water supplies in this group in which a trace of 2,4,5-T was detected in the raw water sample, a trace of the herbicide was also found in the companion finished water sample. This interesting relationship is shown in Table 3 and indicates that the treatment used in the case of these six water supplies did not completely remove the trace amounts of 2,4,5-T from the raw water. No information was obtained regarding the treatment used on these six water supplies.

As shown in Table 4, the herbicide 2,4-D was detected in 18 or 31.0 percent of the total of 58 community water supplies examined without regard for the basis of their inclusion in the survey. The herbicide was detected in trace amounts only with the range of 2,4-D concentration in the raw and/or finished water samples being <0.5 to 3.44 ppb. As can be noted from the data in the Appendix, the 2,4-D concentration was <0.5 ppb in 10 of the 18 water supplies in which the herbicide was detected in raw and/or finished waters.

The herbicide 2,4-D was detected in a slightly greater percentage of water supplies than 2,4,5-T. In several instances, higher concentrations of 2,4-D were found. As in the case with 2,4,5-T, the results of the survey indicate that 2,4-D is getting into the water environment and can be detected in trace amounts in community water supplies.

Table 3

Relationship of 2,4,5-T in Raw and
Finished Waters of Six Water Supplies

2,4,5-T (ppb) in Raw Water Sample	2,4,5-T(ppb) in Companion Finished Water Sample
0.57	0.52
<0.5	<0.5
<0.5	<0.5
<0.5	<0.5
<0.5	<0.5
<0.5	<0.5

The analytical results of water samples collected from two community water supply systems in Puerto Rico are especially interesting. The herbicide 2,4-D had been used intermittently on the water supply sources for water hyacinth control during the summer of 1970. Herbicide spraying operations had been terminated approximately two to three weeks prior to the collection of the water samples. Trace amounts of 2,4-D were detected in three raw water samples and in two companion finished water samples.

As shown in Table 5, the herbicide 2,4,5-TP was detected in only 4 or 6.9 percent of the total of 58 community water supplies examined in the survey. As can be noted from the data in the Appendix, the 2,4,5-TP concentration was <0.5 ppb in all 4 of the water supplies in which the herbicide was detected in raw and/or finished waters. The analytical results of the survey indicate a lesser occurrence of 2,4,5-TP than the other two herbicides in community water supplies.

The occurrence and detection of 2,4,5-T and related herbicides in the raw and/or finished waters of community water supplies depends upon many factors among which are rate of herbicide application, point or area of application in relation to the water supply source, degradation of the herbicide in the soil and water environment, rainfall and runoff, time of water sample collection in relation to herbicide use, and water treatment practices utilized.

Table 4

Occurrence of 2,4-D in Community Water Supplies

No. of Water Supplies Examined	Water Supplies in Which 2,4-D Detected		2,4-D Concentration in ppb in Raw and/or Finished Water			Water Supplies in Which 2,4-D Not Detected	
	No.	Percent	Low	Median	High	No.	Percent
58	18	31.0	<0.5	<0.5	3.44	40	69.0

Table 5

Occurrence of 2,4,5-TP in Community Water Supplies

No. of Water Supplies Examined	Water Supplies in Which 2,4,5-TP Detected		2,4,5-TP Concentration in ppb in Raw and/or Finished Water			Water Supplies in Which 2,4,5-TP Not Detected	
	No.	Percent	Low	Median	High	No.	Percent
58	4	6.9	<0.5	<0.5	<0.5	54	93.1

Consideration of these and other factors was beyond the scope of this survey which should be appropriately regarded as only a one-time sampling of 58 community water supplies for the detection of 2,4,5-T and related herbicides.

Analyses of the survey data show that this one-time sampling of community water supplies which followed generally the period of seasonal use of 2,4,5-T and related herbicides and the other conditions of the survey indicate that only traces of these herbicides could be detected in up to 19 to 31 percent of the water supplies. These trace amounts of 2,4,5-T and related herbicides, generally at concentrations less that 0.5 ppb and ranging up to 0.57 ppb for 2,4,5-T and 3.44 ppb for 2,4-D in the raw and/or finished waters, are extremely low when compared to the present Public Health Service guideline of a maximum permissible concentration of 0.1 mg/liter (ppm) for either the individual herbicide or the sum of any combination of these herbicides.

On the other hand, the survey substantiated the unquestionable fact that the use of 2,4,5-T and related herbicides on watershed areas and water supply sources results in the occurrence of the herbicides in the raw and/or finished waters of community water supplies. The lack of occurrence or the detection of 2,4,5-T and related herbicides at very low concentrations or in trace amounts in community water supplies in this survey could possibly be the source of a false sense of security from the public health standpoint.

The effectiveness of the suspension of registration of liquid formulations of 2,4,5-T for use on water courses in markedly reducing the amount of the herbicide reaching drinking water sources has yet to be evaluated. However, if widespread use of 2,4,5-T and related herbicides is to be continued in the United States, a comprehensive study, taking into consideration the factors mentioned above, is indicated to answer the questions relative to the occurrence of these herbicides in community water supplies and to more definitively evaluate the public health significance.

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Some background information obtained from personal telephone communications with PHS Regional Water Hygiene Representatives and Arizona State Department of Health personnel.

APPENDIX

Results of Analyses for 2,4,5-T and Related Herbicides of Raw and Finished Water Samples Collected from Community Water Supplies

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region I							
6306 (R)[1] 6278 (F)[2]	Manchester Water Works (High Service Pumping Station) Manchester, New Hampshire	8/31/70	*[3]	*	*	----[4]	----	----
6277 (R) 6276 (F)	Manchester Water Works (Low Service Pumping Station) Manchester, New Hampshire	8/31/70	*	*	*	----	----	----
6267 (R)	Amherst Water Department (Atkins Reservoir) Amherst, Massachusetts	11/03/70	*	0.7	*	NS[5]	NS	NS
6268 (R)	Amherst Water Department (Pelham Supply) Amherst, Massachusetts	11/03/70	*	0.9	*	NS	NS	NS
6269 (R)	Holyoke Water Department (McLean Reservoir) Holyoke, Massachusetts	11/03/70	*	0.7	*	NS	NS	NS

[1](R) - Raw Water Sample

[2](F) - Finished Water Sample

[3]* - None Found

[4] ---- Analysis Not Performed

[5]NS No Sample Collected

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region I (cont'd.)							
6270 (R)	Holyoke Water Department (Ashley Reservoir) Holyoke, Massachusetts	11/03/70	*	0.9	*	NS	NS	NS
	PHS Region II							
8441 (R)	Guaynabo Water System	9/02/70	*	*	*			
8442 (R)	(Lake Cidra) Cidra, Puerto Rico	9/02/70	*	*	*			
8443 (F)	Guaynabo Water System	9/02/70				*	0.60	*
8440 (F)	Guaynabo, Puerto Rico	9/02/70				*	<0.5	*
8450 (R)	Guaynabo Water System	9/29/70	*	1.5	*			
8451 (R)	(Lake Cidra) Cidra, Puerto Rico	9/29/70	*	*	*			
8453 (F)	Guaynabo Water System	9/29/70				*	*	*
8452 (F)	Guaynabo, Puerto Rico	9/29/70				*	*	*
8448 (R)	San Juan Water System	9/10/70	*	<0.5	*			
8446 (R)	(Loiza Lake) San Juan, Puerto Rico	9/10/70	*	<0.5				
8447 (F)	San Juan Water System	9/10/70				*	<0.5	*
8449 (F)	(Loiza Filter Plant & Distribution System) San Juan, Puerto Rico	9/10/70				*	<0.5	*

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region II (cont'd)							
1215 (R) 1214 (F)	U.S. Military Academy Water Supply West Point, New York	10/13/70	*	*	*	*	*	*
1222 (R)	U.S. Military Academy Water Supply (Constitution Island Well) West Point, New York	10/19/70	*	*	*			
	PHS Region III							
9579 (R) 9581 (F)	Fairfax County Water Authority Town of Occoquan, Virginia	8/25/70	0.57	<0.5	<0.5	0.52	<0.5	*
9584 (R) 9583 (F)	Appomattox River Water Authority Petersburg, Virginia	8/25/70	<0.5	*	*	<0.5	*	*
9586 (R) 9585 (F)	Charlottesville Water Supply Charlottesville, Virginia	9/15/70	*	*	*	*	*	*
9588 (R) 9589 (F)	Newport News Water Supply Newport News, Virginia	9/21/70	<0.5	*	*	<0.5	*	*

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region IV							
8437 (F) 8444 (R) 8445 (F)	Fayette County Water System Peachtree City, Georgia	8/31/70 9/08/70	NS *	NS <0.5	NS *	* *	<0.5 <0.5	* *
8439 (R) 8438 (F)	Macon Water Works Macon, Georgia	8/25/70	*	*	*	----	----	----
8465 (R) 8464 (F)	Elberton Municipal Water Works Elberton, Georgia	10/15/70	*	*	*	*	*	*
8466 (F)	Gainesville Water Works Gainesville, Georgia	10/15/70	NS	NS	NS	*	*	*
8462 (R) 8463 (F)	LaGrange Water Department LaGrange, Georgia	10/15/70	<0.5	<0.5	*	<0.5	*	*
7206 (F)	Hallsdale-Powell Utility District Halls Crossroads, Tennessee	8/12/70	NS	NS	NS	*	*	*
7160 (F)	Nashville Metropolitan Water & Sewerage Services Nashville, Tennessee	7/21-8/3/70	NS	NS	NS	<0.5	*	<0.5

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region IV (cont'd.)							
7175 (F)	Smith Utility District Carthage, Tennessee	8/4-17/70	NS	NS	NS	*	*	*
7179 (F)	Cookeville Water Department Cookeville, Tennessee	8/4-17/70	NS	NS	NS	*	*	*
6696 (F)	City Water Company of Chattanooga Chattanooga, Tennessee	8/7-20/70	NS	NS	NS	*	*	*
7182 (F)	Sewanee Water Department Sewanee, Tennessee	8/7-20/70	NS	NS	NS	*	*	*
7202 (F)	TAPOCO Inc. Water Supply Calderwood, Tennessee	8/12-25/70	NS	NS	NS	*	*	*
7210 (F)	Knox Chapman Utility District S. Knoxville, Tennessee	8/14-27/70	NS	NS	NS	*	*	*
7163 (F)	Columbia Water System Columbia, Tennessee	Not Shown	NS	NS	NS	<0.5	*	*
7178 (F)	Camden Waterworks Camden, Tennessee	7/24-8/7/70	NS	NS	NS	*	*	*

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region IV (cont'd.)							
7172 (F)	Turnbull Utility District Burns, Tennessee	7/26-8/8/70	NS	NS	NS	*	*	*
6787 (F)	Johnson City Water Works Johnson City, Tennessee	8/31-9/13/70	NS	NS	NS	*	*	*
2673 (F)	East Kingsport Utility District Kingsport, Tennessee	9/1-14/70	NS	NS	NS	*	*	*
2677 (F)	Knoxville Utilities Board Knoxville, Tennessee	9/2-15/70	NS	NS	NS	*	*	*
7221 (F)	Rogersville Water Department Rogersville, Tennessee	9/23-10/7/70	NS	NS	NS	<0.5	*	*
8129 (F)	Pleasant Hill Utility District Pleasant Hill, Tennessee	9/23-10/6/70	NS	NS	NS	*	*	*
2688 (F)	Daisy-Soddy Utility District Soddy, Tennessee	9/28-10/11/70	NS	NS	NS	*	*	*
7349 (F)	Whitwell Water Works Whitwell, Tennessee	9/29-10/13/70	NS	NS	NS	*	*	*

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region V							
6637 (F)	Indiana Dept. of Natural Resources Cagles Mill Reservoir, Indiana	7/30/70	NS	NS	NS	*	*	*
6641 (F)	U.S. Corps of Engineers Cagles Mill Reservoir, Indiana	7/30/70	NS	NS	NS	<0.5	*	*
6683 (F)	U.S. Corps of Engineers Monroe Reservoir, Indiana	7/28/70	NS	NS	NS	*	*	*
6658 (F)	U.S. Corps of Engineers Mansfield Reservoir, Indiana	7/29/70	NS	NS	NS	*	<0.5	*
6678 (F)	Boy Scouts of America Monroe Reservoir, Indiana	7/28/70	NS	NS	NS	*	*	*
9029 (F)	Burr Oak State Park Water Supply, Rt. 1, Gloster County, Ohio	8/18/70	NS	NS	NS	*	*	*
9054 (F)	Dilon State Park Water Supply Nashport, Ohio	8/19/70	NS	NS	NS	<0.5	<0.5	*

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region VI							
6772 (R) 6773 (F)	City of Franklin Water Works Franklin, Louisiana	8/31/70	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
9440 (R) 6770 (F)	Monroe Water Supply Monroe, Louisiana	9/02/70	*	*	*	----	----	----
8404 (R) 8403 (F)	Natchitoches Water Supply Natchitoches, Louisiana	9/30/70	*	*	*	*	*	*
8401 (R) 8402 (F)	City of Houma Water Supply Houma, Louisiana	10/28/70	*	<0.5	<0.5	*	<0.5	<0.5
9437 (R) 3675 (F)	City of Gladewater Water Supply Gladewater, Texas	8/24/70	<0.5	<0.5	*	<0.5	*	*
7301 (R) 9438 (F)	City of Austin Public Water Supply Austin, Texas	8/27/70	*	*	*	----	----	----
8409 (F)	City of Beaumont Water Department Beaumont, Texas	9/24/70	NS	NS	NS	*	*	*
8410 (F)	City of Beaumont Water Department Loeb, Texas	9/24/70	NS	NS	NS	*	*	*

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region VI (cont'd.)							
8412 (R) 8411 (F)	City of Corpus Christi Water Works Corpus Christi, Texas	9/25/70	*	*	*	*	*	*
8405 (R) 8408 (F)	Tulsa City Water Supply Tulsa, Oklahoma	10/18/70	*	0.97[a]	*	*	1.3[a]	*
8407 (R) 8406 (F)	Oklahoma City Water Supply (Lake Draper Treatment Plant) Oklahoma City, Oklahoma	10/27/70	*	2.1[a]	*	*	<0.5	*
9439 (R)	Weyhauser-Valliant Water Supply Valliant, Oklahoma	10/17/70	*	1.4[a]	*	NS	NS	NS
3674 (R)	Eufala City Water Supply Eufala, Oklahoma	10/17/70	*	1.4[a]	*	NS	NS	NS
6774 (R)	Wynnewood Water Supply Wynnewood, Oklahoma	10/17/70	*	3.44[a]	*	NS	NS	NS
6775 (PT)[6]	City of Norman Water Supply Norman, Oklahoma	10/24/70	NS	NS	NS	*	<0.5	*

[6](PT) - Partially Treated Water Sample

[a]Herbicide identification confirmed by microcoulometry

ECA-9 Serial No.	PHS Region Name and Location of Water Supply	Date of Collection	Herbicide Concentration (ppb) in Raw Water Sample			Herbicide Concentration (ppb) in Finished Water Sample		
			2,4,5-T	2,4-D	2,4,5-TP	2,4,5-T	2,4-D	2,4,5-TP
	PHS Region IX							
8866 (F)	City of Globe Water Supply (Cutter Well #1) Globe, Arizona	10/14/70	NS	NS	NS	*	*	*
8867 (F)	City of Globe Water Supply (Pioneer Well #1) Globe, Arizona	10/14/70	NS	NS	NS	*	*	*
	PHS Region X							
8426 (R) 8427 (F)	Pacific City Water System Pacific City, Oregon	9/04/70	*	*	*	*	*	*
8429 (R) 8428 (F)	Pacific City Water System Pacific City, Oregon	9/29/70	*	*	*	*	*	*
8851 (F)	City of Hoquiam Municipal Water Supply Hoquiam, Washington	9/03/70	NS	NS	NS	*	*	*