PESTICIDE DATA FOR SELECTED WYOMING STREAMS, 1976-78

By David L. Butler

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GLOSSARY

Water-resource terms are defined in the GLOSSARY and are italicized when first used in this report.

amine.--An organic compound formed by replacement of one or more hydrogen atoms of ammonia with a hydrocarbon or other organic molecular group. Amines are basic and react with acids to form salts.

ester.--An organic compound produced by reaction of an organic acid and an alcohol. Some acid herbicides, such as 2,4-D and silvex, commonly are used in various ester forms.

homolog.--An organic compound or series of compounds where the members differ structurally by some constant group or radical, such as a methylene (CH_2) group.

LC50.--The concentration of a toxicant that is lethal to 50 percent of a population of the test organisms. It is a measure of the toxicity of a compound in water or air and is expressed in units of concentration such as milligrams per liter or milligrams per cubic meter. If expressed for a particular time period it is equivalent to TLm.

LD50.--The dose of a toxicant that is lethal to 50 percent of a population of the test organisms. It is expressed as the weight of chemical per unit body weight in milligrams per kilogram.

microgram per gram (µg/g).--A unit of concentration with 1 microgram (µg) or 10^{-6} gram in a mass of 1 gram (g).

microgram per kilogram (µg/kg).--A unit of concentration with 1 microgram (µg) or 10^{-6} gram in a mass of 1 kilogram (kg) or 1,000 grams.

microgram per liter (µg/L).--A unit of concentration with 1 microgram (µg) or 10^{-6} gram of solute per volume of 1 liter (L).

milligram per kilogram (mg/kg).--Unit of concentration with 1 milligram (mg) or 10^{-3} gram in a mass of 1 kilogram (kg) or 1,000 grams.

milligram per liter (mg/L).--A unit of concentration with 1 milligram (mg) or 10^{-3} gram of solute per volume of 1 liter (L).

TLm.--The median tolerance limit expressed as a concentration of a chemical at which 50 percent of a population of test organisms survive a particular period of exposure (usually 24, 48, or 96 hours).

total in bottom material.--The total quantity of a particular constituent in a bottom sample. This term indicates at least 95 percent of the constituent present is recovered in the analytical method.

total water sample.--The total quantity of a constituent in a suspended-sediment water sample. This term indicates at least 95 percent of the constituent present is in either dissolved or suspended phases of the sample. It not only indicates a suspended-sediment water sample but also that the analytical method accounts for the various chemical forms of the constituent in the sample.

CONVERSION FACTORS

For those readers who prefer to use metric units rather than inch-pound units, conversion factors for terms in this report are listed below:

Multiply	*By*	*To obtain*
cubic foot per second (ft^3/s)	28.32	liter per second
mile	1.609	kilometer
quart	1.057	liter

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) by the following equation:

$$°C = 5/9\ (°F-32)$$

The use of trade or product names in this report is for identification purposes only, and does not constitute endorsement by the U.S. Geological Survey.

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ABSTRACT

In 1976, the U.S. Geological Survey, in cooperation with the Wyoming Department of Agriculture, started a monitoring program to determine pesticide concentrations in Wyoming streams. This program was incorporated into the water-quality data-collection system already in operation. Samples were collected at 20 sites for analysis of various insecticides, herbicides, polychlorinated biphenyls, and polychlorinated napthalenes.

The results through 1978 revealed small concentrations of pesticides in water and bottom-material samples throughout Wyoming. The insecticides detected most commonly in bottom-material samples were DDE (39 percent of the concentrations equal to or greater than the minimum reported concentrations of the analytical methods), DDD (20 percent), dieldrin (21 percent), and polychlorinated biphenyls (29 percent). The herbicides most commonly found in water samples were 2,4-D (29 percent of the concentrations equal to or greater than the minimum reported concentrations of the analytical method) and picloram (23 percent). Most concentrations were significantly less than concentrations thought to be harmful to freshwater aquatic life based on available toxicity data. However, for some pesticides, U.S. Environmental Protection Agency water-quality criteria for freshwater aquatic life are based on bioaccumulation factors that result in criteria concentrations less than the minimum reported concentrations of the analytical methods. It is not known if certain pesticides were present at concentrations less than the minimum reported concentrations that exceeded these criteria.

INTRODUCTION

The U.S. Geological Survey, in cooperation with the Wyoming Department of Agriculture, began a pesticide sampling program in the fall of 1976 to monitor pesticide concentrations in selected Wyoming streams. Initially, samples were collected for analyses of common insecticides, herbicides, PCB (polychorinated biphenyls) and PCN (polychlorinated napthalenes). The herbicides picloram and dicamba were added to the analysis schedule in 1978 because of increased use of these chemicals to control the spread of leafy spurge and other noxious weeds into Wyoming range and cropland.

Sampling was done twice yearly, in the spring or early summer and in the fall. It was attempted to sample before and after the pesticide application season in each area.

SITE SELECTION

Twenty sites were selected from U.S. Geological Survey surface-water or water-quality stations. Sites were selected to include as many of the major drainage basins in Wyoming as possible. Sampling sites were selected in the Bighorn, Powder, North Platte, Green, Wind, Bear, and Snake River basins. The major river basins without a sampling site were the Cheyenne, Tongue, and Belle Fourche River basins. The location of the sampling sites is shown in figure 1, and the station numbers with corresponding station names are listed in table 1.

METHODS OF SAMPLE COLLECTION AND ANALYSIS

Total water samples were collected using a DH48 sampler. This sampler uses a Teflon nozzle to prevent contamination of the sample or loss of organic compounds due to adsorption. Depth-integrated water samples were collected using the equal-transit method. Prior to sample collection at each site, the nozzle and sampler bottles were rinsed in pesticide-grade acetone followed by rinsing with stream water. The samples were transferred to 1-L (liter) narrow-mouth glass bottles fitted with Teflon-lined or aluminum-lined lids and kept chilled until shipment. The samples were then shipped to the laboratory in styrofoam containers to prevent breakage. In addition to each water sample, bottom-material samples were collected from areas of the streambottom with adequate deposits for sampling. These areas generally were in backwater pools, near the streambank, or other parts of the stream with slow velocities where stream sediments can collect. Bottom samples were collected in wide-mouth glass bottles and kept chilled until shipment. The samples were mailed to the laboratory in styrofoam containers. Two water samples (one for insecticide and PCB analysis, and one for herbicide analysis) and one bottom-material sample were required for each analysis.

Except for chilling, no sample treatment was done at the sampling site. All samples were sent to the U.S. Geological Survey laboratory in Denver, Colo., for analysis. After receipt at the laboratory, the herbicide samples were acidified to a pH of 2 with redistilled sulfuric acid.

All sample containers were provided by the U.S. Geological Survey laboratory in Denver, Colo. Before shipment, sample containers were washed with Alconox, rinsed with distilled water, and heated overnight at 300°C (Celsius) at the laboratory. Lids for sample bottles were lined either with Teflon or aluminum foil.

The samples were initially analyzed for common insecticides, common herbicides, and PCB and PCN by methods described in Goerlitz and Brown (1972). The herbicide method was modified when dicamba and picloram were added to the analysis schedule. The laboratory uses the boron-trifluoride esterification in the routine herbicide analysis. However, because dicamba is not methylated by boron trifluoride, the diazomethane esterification, also described in Goerlitz and Brown, had to be used. Recovery studies were done using spiked samples of distilled water and actual water samples from Wyoming. As described in the method, the microcolumn cleanup step consists of collecting

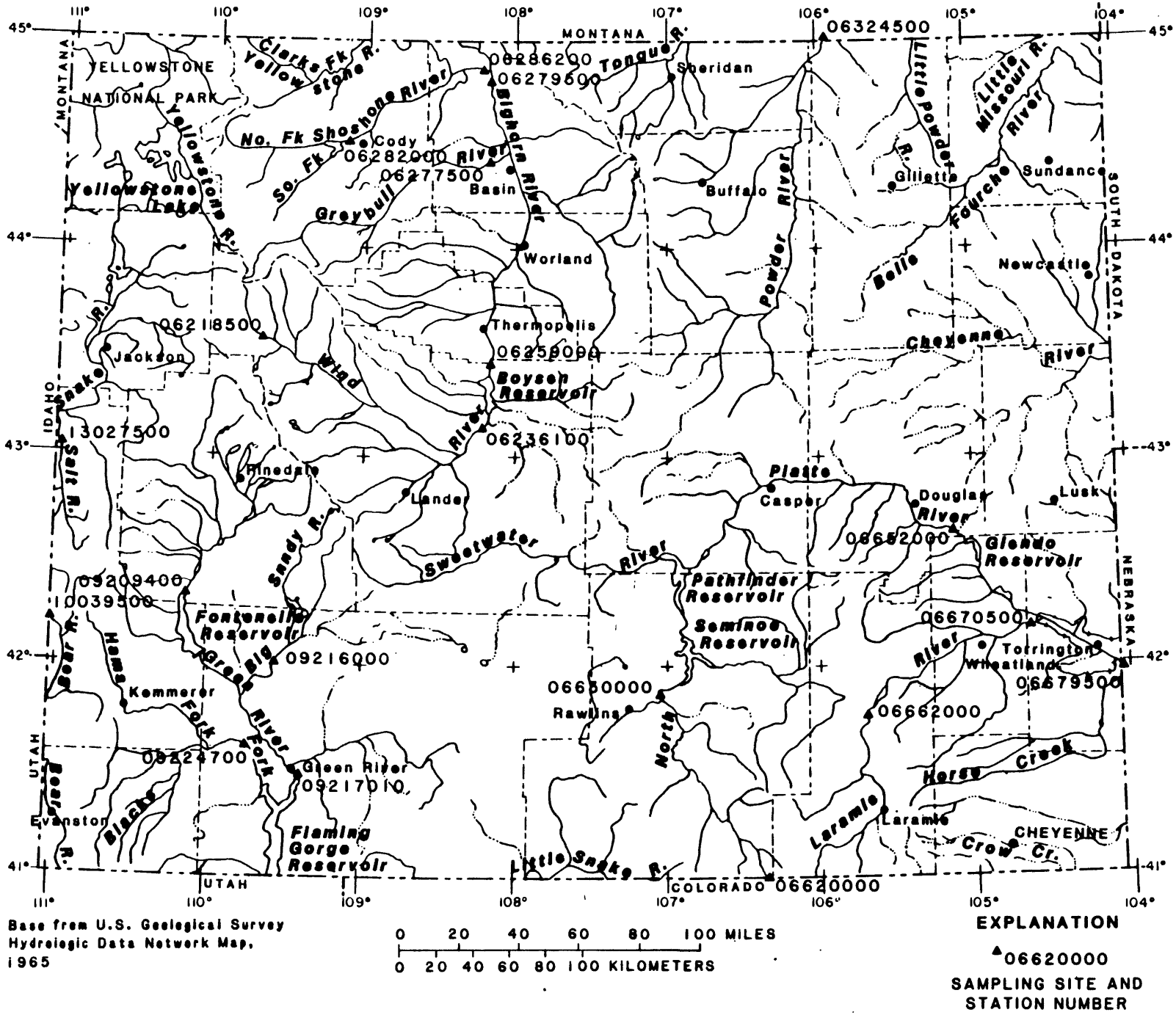

Figure 1.--Location of sampling sites.

Table 1.--*Station numbers and names of sampling sites*

Station number	Station name
06218500	Wind River near Dubois, Wyoming
06236100	Wind River above Boysen Reservoir, near Shoshoni, Wyoming
06259000	Wind River below Boysen Reservoir, Wyoming
06277500	Greybull River near Basin, Wyoming
06279500	Bighorn River at Kane, Wyoming
06282000	Shoshone River below Buffalo Bill Reservoir, Wyoming
06286200	Shoshone River at Kane, Wyoming
06324500	Powder River at Moorhead, Montana
06620000	North Platte River near Northgate, Colorado
06630000	North Platte River above Seminoe Reservoir, near Sinclair, Wyoming
06652000	North Platte River at Orin, Wyoming
06662000	Laramie River near Lookout, Wyoming
06670500	Laramie River near Fort Laramie, Wyoming
06679500	North Platte River at Mitchell, Nebraska
09209400	Green River near LaBarge, Wyoming
09216000	Big Sandy River below Eden, Wyoming
09217010	Green River below Green River, Wyoming
09224700	Blacks Fork near Little America, Wyoming
10039500	Bear River at Border, Wyoming
13027500	Salt River above reservoir, near Etna, Wyoming

a 2.0-mL (milliliter) benzene-elution fraction. That fraction will contain 2,4-D; 2,4-DP; silvex; 2,4,5-T; and dicamba. A second 2.0-mL fraction consisting of 20-percent ethyl ether in benzene is needed to recover picloram. Both fractions are analyzed on the same gas-chromatographic system.

The minimum reported concentrations from the laboratory are 0.01 µg/L (*microgram per liter*) for water samples except 0.1 µg/L for chlordane, PCB, and PCN and 1 µg/L for toxaphene. For bottom-material samples, the minimum reported concentration is 0.1 µg/kg (*microgram per kilogram*) for all compounds except chlordane, toxaphene, PCB, and PCN, which have a minimum reported concentration of 1 µg/kg. These minimum reported concentrations are not equivalent to an analytical-detection limit. A detection limit is a concentration less than that which can be detected by the analytical instrument and which is not distinguishable from background concentrations. The actual detection limits for many of these pesticides probably are significantly less than these minimum reported concentrations, in many instances an order of magnitude less. The minimum reported concentrations are somewhat arbitrarily chosen, more for the convenience of large-scale sample production than for any other reason. Actual detection limits are different for many of the pesticides and can even be different for the same compound from different samples, depending on interferences present in the samples or on the complexity of the sample matrices.

Therefore, attempting to use real detection limits for each individual compound in a pesticide analysis schedule becomes impractical, and one or two larger concentrations are used as minimum limits for the analytical method.

RESULTS AND DISCUSSION

Pesticide, PCB, and PCN data for all samples collected during 1976-78 are summarized in table 2 for each compound. A nonzero value (NZ) refers to a value equal to or greater than the minimum reported concentration(s) of the analytical method. For example, the minimum reported concentration for most pesticides in water is 0.01 µg/L. Therefore, concentrations from 0.005 µg/L to 0.009 µg/L are reported as 0.01 µg/L, and concentrations less than 0.005 µg/L are reported as zero. So in practice, an NZ value is any concentration greater than 0.005 µg/L because of the rounding to significant figures. The date of collection, streamflow, water temperature, and pesticide results for each sample are listed in table 10 in the "Supplemental Data" section at the end of the report.

Polychlorinated Biphenyls (PCB) and Polychlorinated Napthalenes (PCN)

PCB, an industrial chemical, is known by the trade name of Aroclor, or more specifically, by such names as Aroclor 1248 and Aroclor 1254, with the last two digits representing the percent of chlorine in the molecule. PCB commonly are included in a pesticide study even though they are not a pesticide because they are analyzed by the same method used for organochlorine insecticides. PCB are only slightly water soluble and tend to attach to sediments or bottom muds where they can remain for years. Because PCB are heat resistant, nonconductive, and chemically stable, they are used as dielectric fluids or coolants in capacitors and transformers, and as heat exchangers, hydraulic fluids, and plasticizers. The use of PCB in plasticizers was discontinued in 1969 due to problems in disposing of the used products. In 1976, the U.S. Environmental Protection Agency banned all nonenclosed use of the chemical and began a 2½-year phaseout of its production and use.

PCB tend to accumulate in the tissue and fat of animals, birds, and aquatic life. Concentrations 3,000 to 100,000 times greater than the concentrations in water have been observed in many organisms (U.S. Environmental Protection Agency, 1976, p. 197). Minnows exposed to PCB for 8 weeks bioaccumulated concentrations of 100,000 to 200,000 times the concentration in the water (National Academy of Science, National Academy of Engineering, 1974, p. 177). The U.S. Environmental Protection Agency (1976, p. 195) states a criteria of 0.001 µg/L of PCB for freshwater aquatic life. This concentration is derived from toxicity data, bioaccumulation factors, and U.S. Food and Drug Administration fish-tissue residue guidelines. This concentration represents what is considered a safe, long-term exposure concentration to PCB for aquatic life. This concentration is 100 times less than the minimum reported concentration of 0.1 µg/L for water analysis used in this study.

Table 2.--*Summary of pesticide results*

[N, number of samples; NZ, number of nonzero values (equal to or greater than the minimum reported concentration(s) of the analytical method); Pct, percentage of samples (equal to or greater than the minimum reported concentration of the analytical method); Max, maximum concentration detected in samples; --, no data; µg/L, micrograms per liter; µg/kg, micrograms per kilogram]

Compound	Water samples				Bottom-material samples			
	N	NZ	Pct	Max (µg/L)	N	NZ	Pct	Max (µg/kg)
PCB	92	0	0.0	0.0	89	26	29.2	20
PCN	92	0	.0	.0	88	0	.0	0
Aldrin	92	0	.0	.00	89	1	1.1	.1
Chlordane	92	0	.0	.00	89	6	6.7	3
Chlorpyrifos	42	0	.0	.00	--	--	--	--
DDD	92	0	.0	.00	89	18	20.2	1.7
DDE	92	0	.0	.00	89	35	39.3	7.2
DDT	92	0	.0	.00	89	6	6.7	1.9
Diazinon	93	1	1.1	.11	--	--	--	--
Dieldrin	92	0	.0	.00	89	19	21.3	1.2
Endosulfan	70	0	.0	.00	72	0	.0	.0
Endrin	92	0	.0	.00	89	3	3.3	.2
Ethion	93	0	.0	.00	--	--	--	--
Ethyl parathion	93	0	.0	.00	--	--	--	--
Ethyl trithion	93	0	.0	.00	--	--	--	--
Heptachlor	92	0	.0	.00	89	1	1.1	.1
Heptachlor epoxide	92	0	.0	.00	89	5	5.6	.7
Lindane	92	0	.0	.00	89	4	4.5	.3
Malathion	93	1	1.1	.04	--	--	--	--
Methyl parathion	93	0	.0	.00	--	--	--	--
Methyl trithion	93	0	.0	.00	--	--	--	--
Mirex	21	0	.0	.00	17	0	.0	.0
Parathion	93	1	1.1	.01	--	--	--	--
Perthane	75	0	.0	.00	71	0	.0	.0
Toxaphene	92	0	.0	0	88	1	1.1	7
Trithion	93	0	.0	.00	--	--	--	--
2,4-D	99	29	29.3	1.20	44	1	2.3	4.0
2,4,5-T	99	5	5.1	.02	44	0	.0	.0
Silvex	99	0	.0	.00	44	0	.0	.0
2,4-DP	99	3	3.0	.04	44	1	2.3	3.0
Dicamba	43	6	14.0	.02	44	4	9.1	7.4
Picloram	43	10	23.3	.09	44	1	2.3	.7

The acute toxicity of PCB is not as great to freshwater fish as many of the insecticides. A 96-hour *LC50* for cutthroat trout of 1,170 to 50,000 µg/L and greater than 1,500 µg/L for rainbow trout is reported (U.S. Environmental Protection Agency, 1976, p. 194). It appears that marine animals are more sensitive than freshwater fish to PCB. No drinking-water standards have been established for PCB but the U.S. Food and Drug Administration has recommended a concentration of less than 5 µg/g (*micrograms per gram*) in fish tissue (U.S. Environmental Protection Agency, 1976, p. 197).

PCB were not detected in water samples from the 20 sites, but concentrations were detected in 26 of the 89 bottom-material samples analyzed. Sixteen of the 20 stations had at least 1 bottom-material sample containing PCB. The concentrations were very small; all samples had PCB concentrations of 4 µg/kg or less except station 06282000, where 4 of 5 bottom-material samples had PCB concentrations ranging from 7 to 20 µg/kg. This station is on the Shoshone River 5.5 miles downstream from Buffalo Bill Reservoir.

PCN are chemically and structurally quite similar to PCB, and can be used as a substitute. There are no water-quality criteria for PCN concentrations in water or in fish tissue. PCN were not detected in any water or bottom-material sample.

Organochlorine Insecticides

An insecticide can be defined as any substance used to destroy, control, or repel insects. The organochlorine insecticides included in this report are aldrin, chlordane, DDD, DDE, DDT, dieldrin, endosulfan, endrin, heptachlor, heptachlor epoxide, lindane, mirex, perthane, and toxaphene.

These are highly chlorinated organic compounds, which are either cyclic or polycyclic hydrocarbon derivatives. They are highly toxic and highly carcinogenic, insoluble or nearly insoluble in water, and resistant to environmental degradation. The compounds are chemically stable and, therefore, resist reactions by bacteria or chemicals that would tend to break down the molecule. These pesticides commonly are referred to as persistent, which means the parent compound or a harmful degradation product will remain in the environment for at least 1 or 2 years. Because of their relative insolubility in water, the organochlorines tend to attach to sediments in streams or in bottom muds where they can remain for years.

Another major concern is the bioaccumulation of these compounds in the food chain. Very small concentrations in the water can accumulate to harmful pesticide concentrations in the fat and tissues of aquatic animals and fish. For example, DDT can bioaccumulate by factors of a thousand or tens of thousands in some aquatic life.

Many of these compounds have been used in insect control since 1940, when DDT was first used. Many of them are now limited to certain applications or have been banned entirely. Mirex is used almost exclusively on fire ants in the southeast United States; toxaphene is used mainly on cotton crops. The U.S. Environmental Protection Agency has banned or greatly restricted the production and use of DDT, aldrin, chlordane, dieldrin, and heptachlor. DDD, very similar to DDT, was used as a DDT substitute at times. DDE is a degradation product of DDT, and heptachlor epoxide is an oxidation product of heptachlor. Perthane and endosulfan are still in general use. Lindane and endrin uses are more restricted.

The toxicity of a chemical in water can vary, depending on water conditions, type of fish or test organisms and its age, health, and size, and the formulation of the chemical that is tested. The organochlorines generally are quite toxic to fish and mammals. A range of *LD50* concentrations for rats are presented in table 3 because differing values of toxicities are found in the literature. Some concentrations toxic to rainbow trout are listed in table 4. As evident from data in table 4, some of these compounds are toxic to rainbow trout at small concentrations, with many LC50 or *TLm* values less than 10 µg/L. The U.S. Environmental Protection Agency has established drinking-water standards for some of the compounds. These permissible concentrations range from 1 µg/L for endrin to 56 µg/L for lindane (Lawless and others, 1975, p. 34).

Table 3.--*Range of LD50 concentrations for organochlorine insecticides*

[Developed from Berg, 1977; Lawless and others, 1975, p. 35-39; McKee and Wolfe, 1963, p. 355-391; Shih and DalPorto, 1975, p. 20; Thomson, 1977, p. 3-18, 73-77; and U.S. Environmental Protection Agency, 1976; mg/kg, *milligrams per kilogram*]

Compound	LD50, rat (mg/kg)
Aldrin	38 - 67
Chlordane	250 - 590
DDD	3,400
DDT	113 - 250
Dieldrin	40 - 87
Endosulfan	30 - 70
Endrin	5 - 48
Heptachlor	40 - 188
Lindane	88 - 600
Mirex	306
Perthane	8,170 - 9,340
Toxaphene	49 - 90

Table 4.--*Toxicities of organochlorine insecticides to rainbow trout*

[h, hour; µg/L, micrograms per liter]

Compound	Test		Concentration (µg/L)
Aldrin	96 h	LC50	[1]17.7
	48 h	TLm	[2]3
Chlordane	96 h	LC50	[1]44
	48 h	TLm	[3]10
DDD	48 h	TLm	[2]9
DDT	96 h	LC50	[1]7
	96 h	TLm	[4]23.7-74
Dieldrin	96 h	LC50	[1]10
Endosulfan	96 h	LC50	[5].3
	96 h	LC50	[1]2.6
Endrin	96 h	LC50	[1 5].6
Heptachlor	96 h	LC50	[1]19
	48 h	TLm	[2]9
Lindane	96 h	LC50	[1]27
	48 h	TLm	[2]18
Perthane	48 h	LC50	[2]7
Toxaphene	96 h	LC50	[1]11
	96 h	TLm	[4]13.5-16.5

[1]National Academy of Science, National Academy of Engineering (1974, p. 420-422).
[2]Lawless and others (1975, p. 43-46).
[3]Shih and DalPorto (1975, p. 20).
[4]McKee and Wolfe (1963, p. 369, 390).
[5]U.S. Environmental Protection Agency (1976, p. 145, 147).

The data in table 5 show that freshwater criteria of several of the insecticide compounds are less than 0.01 µg/L. As was the case with PCB, several of these concentrations are less than the minimum reported concentrations used by the laboratory. The concentrations listed in table 5 are for a long-term exposure to the compound in water by aquatic life. These concentrations are derived from toxicity data and bioaccumulation factors of the most sensitive organisms to that compound.

Table 5.--*Criteria for freshwater aquatic life for selected insecticides*

[U.S. Environmental Protection Agency, 1976, p. 128-177; µg/L, micrograms per liter]

Compound	Criteria (µg/L)
Aldrin	0.003
Chlordane	.01
DDT	.001
Dieldrin	.003
Endosulfan	.003
Endrin	.004
Heptachlor	.001
Lindane	.01
Malathion	.1
Mirex	.001
Parathion	.04
Toxaphene	.005

In the samples collected for pesticide analysis, no organochlorine insecticides were found in the total water phase. Even though all concentrations were reported as zero, there is the possibility that some very small concentrations were present at less than the minimum reported concentrations.

All compounds except endosulfan, mirex, and perthane were detected at least once in bottom-material samples. Aldrin, heptachlor, and toxaphene were found only once each. The greatest frequency of occurrence was for the DDT family (DDT, DDD, DDE) and dieldrin. DDE was reported in 39 percent of all bottom-material samples, but other than a concentration of 2.2 µg/kg in a sample collected September 18, 1977, and a concentration of 7.2 µg/kg in a sample collected September 12, 1978, both at station 06679500 (North Platte River at Mitchell, Nebraska), all DDE concentrations were less than 1.0 µg/kg. That same sample also had the maximum dieldrin concentration (1.2 µg/kg) and the only nonzero toxaphene concentration (7 µg/kg).

At least one member of the DDT family was detected at 16 of the 20 stations and in every river basin except the Powder River basin. Concentrations of DDD and DDE were largest in samples from the North Platte River (station 06679500) and the Shoshone River (station 06286200). The largest dieldrin concentrations (in addition to the maximum concentration found in a sample from the North Platte River) were found in samples from the Greybull and Bighorn Rivers in the Bighorn River basin. However, most of the pesticide concentrations were less than 1.0 µg/kg, which is about equal to the minimum reported concentrations.

Organophosphate Insecticides

The compounds in this group are chlorpyrifos, diazinon, ethion, ethyl parathion, ethyl trithion, malathion, methyl parathion, methyl trithion, parathion, and trithion. These phosphorous-containing compounds have various structures depending on which alcohol and phosphorus acid they are derived from. The trithions and chlorpyrifos are chlorinated, the other compounds are not. Like the organochlorines, the organophosphates are nearly insoluble in water (less than 0.1 percent solubility in water).

Most organophosphates are more toxic to mammals but are less persistent in the environment than the organochlorine insecticides. They tend to break down to harmless products in several months instead of in several years as is the case of some organochlorines. The phosphates are less likely to bioaccumulate in animal or fish tissue because they are metabolized. Because of their less persistent nature, the use of organophosphates is increasing and they are replacing some of the organochlorine insecticides.

Malathion and diazinon are the most commonly used and recognized insecticides of this group. They are widely used for many insect-control purposes around home and garden areas. Parathion and trithion are used mainly for field crops, and chlorpyrifos, known more commonly as Dursban or Lorsban, is used for house parasites and on some crop insects. Ethyl parathion is another name for parathion and ethyl trithion is another name for trithion. Methyl parathion and parathion as well as methyl trithion and trithion are *homologs*. They are chemically and structurally very similar and can be used in various mixtures and formulations. Parathion is potentially the most dangerous chemical of this pesticide group because of its toxicity to mammals. Methyl parathion is sometimes used in place of parathion since it is chemically similar but not quite as toxic.

Ranges of LD50 concentrations developed from several references are listed in table 6. Toxicities to rainbow trout for some organophosphates are listed in table 7. Organophosphates do not appear to be as lethal to fish as the organochlorines but could be more dangerous to birds, bees, or mammals if misused. The U.S. Environmental Protection Agency has recommended a drinking-water limit of 100 µg/L of total organic phosphates (Lawless and others, 1975, p. 34).

Only water samples were analyzed for organophosphates, with three samples having concentrations equal to or greater than the minimum reported concentrations. Diazinon, malathion, and parathion occurred one time each. The maximum concentration was 0.11 µg/L of diazinon from station 06279500 on the Bighorn River. Parathion was detected once, in a sample collected at station 06286200 located on the Shoshone River. Malathion was detected in one sample from station 06670500 at a concentration of 0.04 µg/L.

Table 6.--*Range of LD50 concentrations for organophosphate insecticides*

[Developed from Berg, 1977; Lawless and others, 1975, p. 35-39; McKee and Wolfe, 1963, p. 355-391; Shih and DalPorto, 1975, p. 20; Thomson, 1977, p. 123-183; mg/kg, milligrams per kilogram]

Compound	LD50, rat (mg/kg)
Chlorpyrifos	97 - 276
Diazinon	100 - 850
Ethion	13 - 96
Malathion	1,000 - 2,800
Methyl parathion	9 - 25
Methyl trithion	200
Parathion	3.6 - 15
Trithion	30 - 32.2

Table 7.--*Toxicities of some organophosphate insecticides to rainbow trout*

[h, hour; µg/L, micrograms per liter]

Compound	Test	Concentration (µg/L)
Chlorpyrifos	96 h LC50	[1]11
	48 h TLm	[2]20
Ethion	96 h LC50	[1]560
Malathion	96 h LC50	[3]68
	96 h LC50	[1]170
	lethal dose	[4]5,000
Methyl parathion	96 h LC50	[1]2,750
Parathion	96 h [5]LC50	[3]1,760

[1]National Academy of Science, National Academy of Engineering (1974, p. 424-425).
[2]Lawless and others (1975, p. 45).
[3]U.S. Environmental Protection Agency (1976, p. 160, 171).
[4]McKee and Wolfe (1963, p. 379, 382).
[5]For brook trout.

Herbicides

A herbicide can be defined as any chemical used for killing, preventing, or regulating the growth of plants. The herbicides included in this report are 2,4-D; 2,4,5-T; silvex; 2,4-DP; dicamba; and picloram. These herbicides are all chlorinated organic-acid derivatives. Picloram differs from the other compounds in that it contains nitrogen in its molecular structure.

These are selective herbicides used on a variety of broad-leaved weeds and woody plants. Their uses can be for the residential lawn to larger scale uses on crops, rangeland, roads and other rights-of-way, or irrigation ditches. The herbicide 2,4-D is the most commonly used of these herbicides and is available in many commerical weed killers. Dicamba is being used in Wyoming for some weed-control purposes, and it is in some weed killers sold for public use. Picloram, commonly known as Tordon, is being used in Wyoming to control the spread of leafy spurge and other noxious weeds in cropland and rangeland. In the acid form, these compounds are not very water soluble (a few hundred *milligrams per liter*), so they commonly are used in a variety of *ester*, *amine* salt, or other salt forms that are much more water soluble.

The herbicides are less dangerous to animal and fish life than many insecticides. There is more likely a danger to crops or plants if misused. These herbicides do not bioaccumulate in animal or fish tissue and are not considered persistent in nature. A range of LD50 concentrations compiled from several sources is listed in table 8, and some fish toxicities are listed in table 9. These toxic concentrations can vary considerably depending upon which form (acid, ester, amine salt, other salt) of the chemical was being tested.

Table 8.--*Range of LD50 concentrations for herbicides*

[Developed from Berg, 1977; Lawless and others, 1975, p. 35-39; McKee and Wolfe, 1963, p. 355-391; Shih and DalPorto, 1975, p. 20; and U.S. Environmental Protection Agency, 1976; mg/kg, milligrams per kilograms]

Compound	LD50, rat (mg/kg)
2,4-D	370 - 1,200
2,4,5-T	300 - 800
Silvex	650 - 1,070
2,4-DP	800
Dicamba	800 - 2,900
Picloram	8,200

Table 9.--*Selected herbicide toxicities for fish*

[Developed from Lawless and others, 1975, p. 47-49; National Academy of Sciences, National Academy of Engineering, 1974, p. 429, 432; h, hour; µg/L, micrograms per liter]

Compound	Fish	Test		Concentration (µg/L)
2,4-D	rainbow trout	48 h	TLm	960
	bluegill	48 h	TLm	800 - 2,100 (various esters)
2,4,5-T	bluegill	48 h	TLm	560 - 16,700 (range of 3 esters)
Silvex	rainbow trout	48 h	TLm	650
	bluegill	48 h	LC50	16,000 - 83,000 (ester, potassium salt)
2,4-DP	bluegill	48 h	TLm	1,100
Dicamba	bluegill	48 h	LC50	20,000
Picloram	rainbow trout	48 h	TLm	2,500

The U.S. Environmental Protection Agency (1976, p. 137) has set domestic water-supply standards of 100 µg/L for 2,4-D and 10 µg/L for silvex. These standards are expressed somewhat differently by Lawless and others (1975, p. 34), where the criteria are stated as 100 µg/L for the total of 2,4-D, silvex, and 2,4,5-T. The U.S. Environmental Protection Agency has issued a stop order on the sale and use of 2,4,5-T and silvex. In the case of 2,4,5-T, it was decided that excessive quantities of the poisonous byproduct TCDD (commonly but erroneously called dioxin) were being found in the production of the herbicide.

In water samples analyzed for herbicides, 2,4-D was detected most commonly, with 29 percent of the concentrations equal to or greater than the minimum reported concentrations of the analytical method. A maximum concentration of 1.2 µg/L was found in a water sample from the Shoshone River at station 06286200. Thirteen of the 20 sites had at least 1 sample with 2,4-D, and the herbicide was found in all major river basins except the Bear and Snake River basins. Since 2,4-D has been widely used for many years, these results are not unexpected. All the sites in the Bighorn River basin had at least two samples with 2,4-D. In contrast, 2,4,5-T was found in only 5 percent of the herbicide samples and 2,4-DP was found in only 3 percent of the samples. Dicamba was found in 14 percent of the samples analyzed for it. All three of the compounds were found at very small concentrations (0.04 µg/L maximum). Silvex was not detected in any water sample. Picloram was detected at very small concentrations (0.09 µg/L maximum) in 23 percent of the samples analyzed. These samples were from scattered areas in Wyoming, but were from basins where picloram was being used near streambanks in conjunction with a noxious-weed spraying program being conducted by the Wyoming Weed and Pest Control Districts in cooperation with the Wyoming Department of Agriculture.

Picloram, 2,4-D, and 2,4-DP were detected in one bottom-material sample each and silvex and 2,4,5-T were not detected in any bottom-material samples. Dicamba was detected in four bottom-material samples collected at different locations. The maximum herbicide concentration in bottom material was 7.4 µg/kg of dicamba in a sample from the Big Sandy River at station 09216000.

SUMMARY

Only three insecticides were detected in water samples, and these were one-time occurrences of four organophosphates at very small concentrations. The compounds PCB and PCN were not detected in the water phase. The herbicides were detected much more commonly, especially 2,4-D and picloram. This distribution of pesticides in water is to be expected since herbicides are formulated into water-soluble compounds, while PCB and the insecticides are used in very insoluble forms. The concentrations of compounds detected were significantly less than toxic concentrations to fish and animals. However, evaluation of long-term effects of PCB and the organochlorine insecticides cannot be made from the data. The U.S. Environmental Protection Agency's criteria for longterm exposure to some of these compounds for freshwater aquatic life are less than the minimum concentrations reported by the laboratory. Therefore, it is unknown whether those criteria are being exceeded.

In the bottom-material samples, organochlorine insecticides and PCB were detected more commonly than herbicides. The DDT group and dieldrin were the insecticides detected most often; DDE in 39 percent, DDD in 20 percent, and dieldrin in 21 percent of all bottom-material samples collected for insecticide analysis. The remaining insecticides were not often detected. The concentrations reported in bottom samples are not considered significant for these compounds. Sixteen of the 20 stations in the pesticide sampling network had at least 1 sample with PCB, and 29 percent of all bottom-material samples had PCB identified. PCB concentrations also were very small, but the station at Shoshone River downstream from Buffalo Bill Reservoir had larger reported concentrations than the other stations. Dicamba, with four concentrations equal to or greater than the minimum reported concentrations of the analytical method, was the only herbicide found more than once in bottom-material samples. All herbicide concentrations were very small. The pesticide distribution for bottom-material samples is as expected, because PCB and insecticides tend to sorb to stream sediments or bottom muds while the herbicides do not. There are no standards or criteria established for pesticides in bottom material.

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SUPPLEMENTAL DATA

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*

[Streamflow: A, mean daily discharge; E, estimated; h, hours; ft^3/s, cubic feet per second; °C, degrees Celsius; µg/L, micrograms per liter; µg/kg, micrograms per kilogram; --, no data]

Station number	Date of sample	Time (h)	Streamflow, instantaneous (ft^3/s)	Temperature (°C)	PCB, total (µg/L)	PCB, total in bottom material (µg/kg)	PCN, total (µg/L)	PCN, total in bottom material (µg/kg)	Aldrin, total (µg/L)	Aldrin, total in bottom material (µg/kg)	Chlordane, total (µg/L)	Chlordane, total in bottom material (µg/kg)
06218500	76-10-04	1645	123	7.0	0.0	0	0.0	0	0.00	0.0	0.00	0
	77-07-11	1005	62	10.5	.0	1	.0	0	.00	.0	.00	0
	77-11-01	1540	46	1.0	--	0	--	0	--	.0	--	0
	78-05-31	0920	363	6.0	.0	0	.0	0	.00	.0	.00	0
	78-11-01	1250	A66	3.5	.0	0	.0	0	.00	.0	.00	0
06236100	76-09-22	1010	690	--	.0	0	.0	0	.00	.0	.00	0
	77-06-08	0800	--	20.5	.0	2	.0	0	.00	.0	.00	0
	77-10-19	0800	E800	7.0	.0	0	.0	0	.00	.0	.00	0
	78-05-11	1800	E700	16.0	.0	0	.0	0	.00	.0	.00	0
	78-10-24	1600	--	10.0	.0	4	.0	0	.00	.0	.00	0
06259000	76-09-22	1115	A1,200	--	.0	0	.0	0	.00	.0	.00	0
	77-06-08	0900	1,050	14.0	.0	0	.0	0	.00	.0	.00	0
	77-10-19	0900	284	11.5	.0	0	.0	0	.00	.0	.00	0
	78-05-11	1615	1,060	11.0	.0	0	.0	0	.00	.0	.00	0
	78-10-25	0815	1,650	12.0	.0	4	.0	0	.00	.0	.00	0
06277500	76-09-04	1630	12	24.0	.0	0	.0	0	.00	.0	.00	3
	77-07-11	1815	9.0	--	.0	1	.0	0	.00	.0	.00	3
	77-10-03	1845	E10	12.0	.0	4	.0	0	.00	.0	.00	2
	78-05-14	1700	E1.5	24.0	.0	0	.0	0	.00	.0	.00	0
	78-09-17	1700	139	14.5	.0	0	.0	0	.00	.0	.00	0
06279500	76-09-23	0915	1,850	--	.0	0	.0	0	.00	.0	.00	0
	77-06-08	1330	2,160	24.0	--	1	--	0	--	.0	--	0
	77-10-19	1400	860	10.0	.0	0	.0	--	.00	.0	.00	0
	78-05-11	1145	2,420	13.0	.0	0	.0	0	.00	.0	.00	0
	78-10-25	1215	2,470	8.0	.0	0	.0	0	.00	.0	.00	0
06282000	76-09-05	1530	1,190	18.0	--	0	--	0	--	.0	--	0
	77-07-11	1630	1,040	17.0	.0	20	.0	0	.00	.0	.00	0
	77-10-03	1700	572	14.5	.0	7	.0	0	.00	.0	.00	0
	78-05-14	1410	935	11.0	.0	8	.0	0	.00	.0	.00	0
	78-09-17	1510	887	15.5	.0	19	.0	0	.00	.0	.00	0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Chlorpyrifos, total (µg/L)	DDD, total (µg/L)	DDD, total in bottom material (µg/kg)	DDE, total (µg/L)	DDE, total in bottom material (µg/kg)	DDT, total (µg/L)	DDT, total in bottom material (µg/kg)	Diazinon, total (µg/L)	Dieldrin, total (µg/L)	Dieldrin, total in bottom material (µg/kg)	Endosulfan, total (µg/L)
06218500	76-10-04	--	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	--
	77-07-11	0.00	.00	.1	.00	.0	.00	.0	.00	.00	.0	0.00
	77-11-01	--	--	.1	--	.2	--	.0	--	--	.0	--
	78-05-31	.00	.00	.1	.00	.2	.00	.0	.00	.00	.0	.00
	78-11-01	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
06236100	76-09-22	--	.00	.0	.00	.1	.00	.0	.00	.00	.0	--
	77-06-08	--	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	77-10-19	.00	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	78-05-11	.00	.00	.1	.00	.1	.00	.0	.00	.00	.0	.00
	78-10-24	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
06259000	76-09-22	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
	77-06-08	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-10-19	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-05-11	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-10-25	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
06277500	76-09-04	--	.00	.0	.00	.1	.00	.0	.00	.00	.4	--
	77-07-11	.00	.00	.0	.00	.0	.00	.0	.00	.00	.8	.00
	77-10-03	.00	.00	.0	.00	.0	.00	.0	.00	.00	.2	.00
	78-05-14	.00	.00	.0	.00	.2	.00	.1	.00	.00	.1	.00
	78-09-17	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
06279500	76-09-23	--	.00	.0	.00	.1	.00	.0	.00	.00	.3	--
	77-06-08	--	--	.0	--	.0	--	.0	--	--	.3	--
	77-10-19	.00	.00	.0	.00	.1	.00	.0	.11	.00	.4	.00
	78-05-11	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-10-25	--	.00	.0	.00	.0	.00	.0	.00	.00	.1	.00
06282000	76-09-05	--	--	.0	--	.0	--	.0	.00	--	.0	--
	77-07-11	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-10-03	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-05-14	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-09-17	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Endosulfan, total in bottom material (µg/kg)	Endrin, total (µg/L)	Endrin, total in bottom material (µg/kg)	Ethion, total (µg/L)	Ethyl parathion, total (µg/L)	Ethyl trithion, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor, total in bottom material (µg/kg)	Heptachlor epoxide, total (µg/L)	Heptachlor epoxide, total in bottom material (µg/kg)
06218500	76-10-04	--	0.00	0.0	0.00	0.00	0.00	0.00	0.0	0.00	0.0
	77-07-11	0.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-11-01	.0	--	.0	--	--	--	--	.0	--	.0
	78-05-31	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-11-01	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06236100	76-09-22	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-08	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-19	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-24	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06259000	76-09-22	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-08	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-19	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-25	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06277500	76-09-04	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-07-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.7
	77-10-03	.0	.00	.0	.00	.00	.00	.00	.0	.00	.2
	78-05-14	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-09-17	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06279500	76-09-23	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-08	.0	--	.0	--	--	--	--	.0	--	.0
	77-10-19	.0	.00	.1	.00	.00	.00	.00	.0	.00	.1
	78-05-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-25	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06282000	76-09-05	--	--	.0	.00	.00	.00	--	.0	--	.0
	77-07-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-03	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-14	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-09-17	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Lindane, total (µg/L)	Lindane, total in bottom material (µg/kg)	Malathion, total (µg/L)	Methyl parathion, total (µg/L)	Methyl trithion, total (µg/L)	Mirex, total (µg/L)	Mirex, total in bottom material (µg/kg)	Parathion, total (µg/L)	Perthane, total (µg/L)	Perthane, total in bottom material (µg/kg)
06218500	76-10-04	0.00	0.0	0.00	0.00	0.00	--	--	0.00	--	--
	77-07-11	.00	.0	.00	.00	.00	--	--	.00	0.00	0.0
	77-11-01	--	.0	--	--	--	--	--	--	--	.0
	78-05-31	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-11-01	.00	.0	.00	.00	.00	0.00	0.0	.00	.00	.0
06236100	76-09-22	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-08	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-19	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-24	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06259000	76-09-22	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-08	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-19	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-25	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06277500	76-09-04	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-07-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-03	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-14	.00	.1	.00	.00	.00	--	--	.00	.00	.0
	78-09-17	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06279500	76-09-23	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-08	--	.0	--	--	--	--	--	--	--	.0
	77-10-19	.00	.0	.00	.00	.00	--	--	.00	.00	--
	78-05-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-25	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06282000	76-09-05	--	.0	.00	.00	.00	--	--	.00	--	--
	77-07-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-03	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-14	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-09-17	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Toxaphene, total (µg/L)	Toxaphene, total in bottom material (µg/kg)	Trithion, total (µg/L)	2,4-D, total (µg/L)	2,4-D, total in bottom material (µg/kg)	2,4,5-T, total (µg/L)	2,4,5-T total in bottom material (µg/kg)	Silvex, total (µg/L)	Silvex, total in bottom material (µg/kg)	2,4-DP, total (µg/L)
06218500	76-10-04	0	0	0.00	0.00	--	0.00	--	0.00	--	0.00
	77-07-11	0	0	.00	.00	--	.00	--	.00	--	.00
	77-11-01	--	0	--	.00	--	.00	--	.00	--	.00
	78-05-31	0	--	.00	.00	0	.00	0	.00	0	.00
	78-11-01	0	0	.00	.00	0	.00	0	.00	0	.00
06236100	76-09-22	0	0	.00	--	--	--	--	--	--	--
	77-06-08	0	0	.00	--	--	--	--	--	--	--
	77-10-19	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-11	0	0	.00	.00	0	.00	0	.00	0	.00
	78-10-24	0	0	.00	.00	0	.02	0	.00	0	.04
06259000	76-09-22	0	0	.00	.06	--	.00	--	.00	--	.00
	77-06-08	0	0	.00	.04	--	.00	--	.00	--	.00
	77-10-19	0	0	.00	.08	--	.00	--	.00	--	.00
	78-05-11	0	0	.00	.06	0	.00	0	.00	0	.00
	78-10-25	0	0	.00	.00	0	.00	0	.00	0	.00
06277500	76-09-04	0	0	.00	.09	--	.00	--	.00	--	.00
	77-07-11	0	0	.00	.12	--	.00	--	.00	--	.00
	77-10-03	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-14	0	0	.00	.05	0	.00	0	.00	0	.00
	78-09-17	0	0	.00	.00	0	.00	0	.00	0	.00
06279500	76-09-23	0	0	.00	.02	--	.01	--	.00	--	.00
	77-06-08	--	0	--	.25	--	.00	--	.00	--	.01
	77-10-19	0	0	.00	.01	--	.00	--	.00	--	.00
	78-05-11	0	0	.00	.09	0	.00	0	.00	0	.00
	78-10-25	0	0	.00	.00	0	.01	0	.00	0	.00
06282000	76-09-05	--	0	.00	.00	--	.02	--	.00	--	.00
	77-07-11	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-03	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-14	0	0	.00	.06	0	.00	0	.00	0	.00
	78-09-17	0	0	.00	.13	0	.00	0	.00	0	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	2,4-DP, total in bottom material (µg/kg)	Dicamba, total (µg/L)	Dicamba, total in bottom material (µg/kg)	Picloram, total (µg/L)	Picloram, total in bottom material (µg/kg)
06218500	76-10-04	--	--	--	--	--
	77-07-11	--	--	--	--	--
	77-11-01	--	--	--	--	--
	78-05-31	0.0	0.00	0.0	0.00	0.0
	78-11-01	0	.00	0	.00	0
06236100	76-09-22	--	--	--	--	--
	77-06-08	--	--	--	--	--
	77-10-19	--	--	--	--	--
	78-05-11	.0	.00	.0	.00	0
	78-10-24	0	.01	0	.00	0
06259000	76-09-22	--	--	--	--	--
	77-06-08	--	--	--	--	--
	77-10-19	--	--	--	--	--
	78-05-11	.0	.02	0	.08	0
	78-10-25	0	.02	0	.00	0
06277500	76-09-04	--	--	--	--	--
	77-07-11	--	--	--	--	--
	77-10-03	--	--	--	--	--
	78-05-14	0	.00	0	.00	0
	78-09-17	0	.00	0	.00	0
06279500	76-09-23	--	--	--	--	--
	77-06-08	--	--	--	--	--
	77-10-19	--	--	--	--	--
	78-05-11	0	.00	0	.01	0
	78-10-25	0	.01	0	.01	0
06282000	76-09-05	--	--	--	--	--
	77-07-11	--	--	--	--	--
	77-10-03	--	--	--	--	--
	78-05-14	0	.00	0	.00	0
	78-09-17	0	.01	0	.00	0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

[Streamflow: A, mean daily discharge; h, hours; ft^3/s, cubic feet per second; °C, degrees Celsius; µg/L, micrograms per liter; µg/kg, micrograms per kilogram; --, no data]

Station number	Date of sample	Time (h)	Streamflow, instantaneous (ft^3/s)	Temperature (°C)	PCB, total (µg/L)	PCB, total in bottom material (µg/kg)	PCN, total (µg/L)	PCN, total in bottom material (µg/kg)	Aldrin, total (µg/L)	Aldrin, total in bottom material (µg/kg)	Chlordane, total (µg/L)	Chlordane, total in bottom material (µg/kg)
06286200	76-09-23	1030	--	--	0.0	0	0.0	0	0.00	0.0	0.00	0
	77-06-08	1420	--	25.5	.0	1	.0	0	.00	.0	.00	0
	77-10-19	1430	--	11.0	.0	0	.0	0	.00	.0	.00	0
	78-05-11	1215	--	12.5	.0	0	.0	0	.00	.0	.00	0
	78-10-25	1300	--	8.0	.0	0	.0	0	.00	.0	.00	0
06324500	76-09-03	1400	25	--	.0	0	.0	0	.00	.0	.00	0
	77-07-09	1615	99	--	.0	0	.0	0	.00	.0	.00	0
	77-10-01	1740	321	9.0	.0	0	.0	0	.00	.0	.00	0
	78-06-09	1430	3,800	18.0	.0	--	.0	--	.00	--	.00	--
	78-09-15	1410	211	18.5	.0	0	.0	0	.00	.0	.00	0
06620000	76-09-14	0730	340	12.0	.0	0	.0	0	.00	.0	.00	0
	77-06-11	1600	545	--	.0	1	.0	0	.00	.0	.00	0
	77-06-20	0930	153	15.5	--	--	--	--	--	--	--	--
	77-10-10	0930	112	2.0	.0	0	.0	0	.00	.0	.00	0
	77-11-07	1430	110	6.0	--	--	--	--	--	--	--	--
	78-05-22	0820	1,480	7.0	.0	0	.0	0	.00	.0	.00	0
	78-07-31	0830	795	14.5	--	--	--	--	--	--	--	--
	78-08-29	0830	162	9.0	--	--	--	--	--	--	--	--
	78-09-26	0830	130	7.0	.0	--	.0	--	.00	--	.00	--
06630000	76-09-20	1430	280	--	.0	0	.0	0	.00	.0	.00	0
	77-07-26	1600	A824	--	.0	0	.0	0	.00	.0	.00	0
	77-10-14	1120	238	--	.0	0	.0	0	.00	.0	.00	0
	78-06-15	1300	8,780	15.0	.0	1	.0	0	.00	.0	.00	0
	78-10-24	1115	382	6.0	.0	1	.0	0	.00	.0	.00	0
06652000	76-09-24	1030	2,360	--	.0	0	.0	0	.00	.0	.00	2
	77-07-06	1545	1,720	24.0	--	4	--	0	--	.0	--	0
	77-10-20	1630	1,040	13.0	.0	0	.0	0	.00	.0	.00	0
	78-05-12	1100	3,770	12.0	.0	2	.0	0	.00	.0	.00	1
	78-10-26	1445	1,490	9.0	.0	1	.0	0	.00	.0	.00	0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Chlorpyrifos, total (µg/L)	DDD, total (µg/L)	DDD, total in bottom material (µg/kg)	DDE, total (µg/L)	DDE, total in bottom material (µg/kg)	DDT, total (µg/L)	DDT, total in bottom material (µg/kg)	Diazinon, total (µg/L)	Dieldrin, total (µg/L)	Dieldrin, total in bottom material (µg/kg)	Endosulfan, total (µg/L)
06286200	76-09-23	--	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	--
	77-06-08	--	.00	1.7	.00	.5	.00	1.4	.00	.00	.1	0.00
	77-10-19	0.00	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	78-05-11	.00	.00	.2	.00	.1	.00	.1	.00	.00	.0	.00
	78-10-25	--	.00	.0	.00	.0	.00	.0	.00	.00	.1	.00
06324500	76-09-03	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
	77-07-09	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-10-01	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-06-09	--	.00	--	.00	--	.00	--	.00	.00	--	.00
	78-09-15	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
06620000	76-09-14	--	.00	.0	.00	.2	.00	.0	.00	.00	.0	--
	77-06-11	--	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	77-06-20	--	--	--	--	--	--	--	--	--	--	--
	77-10-10	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-11-07	--	--	--	--	--	--	--	--	--	--	--
	78-05-22	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-07-31	--	--	--	--	--	--	--	--	--	--	--
	78-08-29	--	--	--	--	--	--	--	--	--	--	--
	78-09-26	--	.00	--	.00	--	.00	--	.00	.00	--	.00
06630000	76-09-20	--	.00	.2	.00	.2	.00	.0	.00	.00	.0	--
	77-07-26	--	.00	.4	.00	.2	.00	.0	.00	.00	.0	.00
	77-10-14	.00	.00	.2	.00	.2	.00	.0	.00	.00	.0	.00
	78-06-15	--	.00	.0	.00	.1	.00	.6	.00	.00	.1	.00
	78-10-24	--	.00	.1	.00	.0	.00	.0	.00	.00	.0	.00
06652000	76-09-24	--	.00	.5	.00	.5	.00	.0	.00	.00	.0	--
	77-07-06	--	--	.0	--	.0	--	.0	--	--	.1	--
	77-10-20	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-05-12	.00	.00	.4	.00	.2	.00	.2	.00	.00	.1	.00
	78-10-26	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Endosulfan, total in bottom material (µg/kg)	Endrin, total (µg/L)	Endrin, total in bottom material (µg/kg)	Ethion, total (µg/L)	Ethyl parathion, total (µg/L)	Ethyl trithion, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor, total in bottom material (µg/kg)	Heptachlor epoxide, total (µg/L)	Heptachlor epoxide, total in bottom material (µg/kg)
06286200	76-09-23	--	0.00	0.0	0.00	0.00	0.00	0.00	0.0	0.00	0.0
	77-06-08	0.0	.00	.0	.00	.00	.00	.00	.1	.00	.1
	77-10-19	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-25	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06324500	76-09-03	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-07-09	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-01	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-06-09	--	.00	--	.00	.00	.00	.00	--	.00	--
	78-09-15	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06620000	76-09-14	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-20	--	--	--	--	--	--	--	--	--	--
	77-10-10	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-11-07	--	--	--	--	--	--	--	--	--	--
	78-05-22	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-07-31	--	--	--	--	--	--	--	--	--	--
	78-08-29	--	--	--	--	--	--	--	--	--	--
	78-09-26	--	.00	--	.00	.00	.00	.00	--	.00	--
06630000	76-09-20	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-07-26	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-14	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-06-15	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-24	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06652000	76-09-24	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-07-06	.0	--	.0	--	--	--	--	.0	--	.0
	77-10-20	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-12	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-26	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Lindane, total (µg/L)	Lindane, total in bottom material (µg/kg)	Malathion, total (µg/L)	Methyl Parathion, total (µg/L)	Methyl Trithion, total (µg/L)	Mirex, total (µg/L)	Mirex, total in bottom material (µg/kg)	Parathion, total (µg/L)	Perthane, total (µg/L)	Perthane, total in bottom material (µg/kg)
06286200	76-09-23	0.00	0.0	0.00	0.00	0.00	--	--	0.00	--	--
	77-06-08	.00	.0	.00	.00	.00	--	--	.01	0.00	0.0
	77-10-19	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-25	.00	.0	.00	.00	.00	0.00	0.0	.00	.00	.0
06324500	76-09-03	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-07-09	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-01	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-06-09	.00	--	.00	.00	.00	--	--	.00	.00	--
	78-09-15	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06620000	76-09-14	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-06-20	--	--	--	--	--	--	--	--	--	--
	77-10-10	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-11-07	--	--	--	--	--	--	--	--	--	--
	78-05-22	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-07-31	--	--	--	--	--	--	--	--	--	--
	78-08-29	--	--	--	--	--	--	--	--	--	--
	78-09-26	.00	--	.00	.00	.00	.00	--	.00	.00	--
06630000	76-09-20	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-07-26	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-14	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-06-15	.00	.1	.00	.00	.00	.00	.0	.00	.00	.0
	78-10-24	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06652000	76-09-24	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-07-06	--	.0	--	--	--	--	--	--	--	.0
	77-10-20	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-12	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-26	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Toxaphene, total (µg/L)	Toxaphene, total in bottom material (µg/kg)	Trithion, total (µg/L)	2,4-D, total (µg/L)	2,4-D, total in bottom material (µg/kg)	2,4,5-T, total (µg/L)	2,4,5-T total in bottom material (µg/kg)	Silvex, total (µg/L)	Silvex, total in bottom material (µg/kg)	2,4-DP, total (µg/L)
06286200	76-09-23	0	0	0.00	0.04	--	0.00	--	0.00	--	0.00
	77-06-08	0	0	.00	1.2	--	.00	--	.00	--	.00
	77-10-19	0	0	.00	.01	--	.00	--	.00	--	.00
	78-05-11	0	0	.00	.00	0	.00	0	.00	0	.00
	78-10-25	0	0	.00	.00	0	.00	0	.00	0	.00
06324500	76-09-03	0	0	.00	.00	--	.00	--	.00	--	.00
	77-07-09	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-01	0	0	.00	.00	--	.00	--	.00	--	.00
	78-06-09	0	--	.00	.02	0	.00	0	.00	0	.00
	78-09-15	0	0	.00	.00	0	.00	0	.00	0	.00
06620000	76-09-14	0	0	.00	.00	--	.00	--	.00	--	.00
	77-06-11	0	0	.00	.00	--	.00	--	.00	--	.00
	77-06-20	--	--	--	.00	0	.00	0	.00	0	.00
	77-10-10	0	0	.00	.00	--	.00	--	.00	--	.00
	77-11-07	--	--	--	.09	0	.00	0	.00	0	.00
	78-05-22	0	0	.00	.00	0	.00	0	.00	0	.00
	78-07-31	--	--	--	.04	0	.00	0	.00	0	.00
	78-08-29	--	--	--	.00	0	.00	0	.00	0	.00
	78-09-26	0	--	.00	.00	4	.00	0	.00	0	.00
06630000	76-09-20	0	0	.00	.00	--	.00	--	.00	--	.00
	77-07-26	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-14	0	0	.00	.00	--	.00	--	.00	--	.00
	78-06-15	0	0	.00	.75	0	.00	0	.00	0	.02
	78-10-24	0	0	.00	.00	0	.00	0	.00	0	.00
06652000	76-09-24	0	0	.00	.00	--	.00	--	.00	--	.00
	77-07-06	--	0	--	.00	--	.00	--	.00	--	.00
	77-10-20	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-12	0	0	.00	.00	0	.00	0	.00	0	.00
	78-10-26	0	0	.00	.00	0	.00	0	.00	0	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	2,4-DP, total in bottom material (µg/kg)	Dicamba, total (µg/L)	Dicamba, total in bottom material (µg/kg)	Picloram, total (µg/L)	Picloram, total in bottom material (µg/kg)
06286200	76-09-23	--	--	--	--	--
	77-06-08	--	--	--	--	--
	77-10-19	--	--	--	--	--
	78-05-11	0.0	0.00	0.0	0.00	0.0
	78-10-25	.0	.00	.0	.00	.0
06324500	76-09-03	--	--	--	--	--
	77-07-09	--	--	--	--	--
	77-10-01	--	--	--	--	--
	78-06-09	.0	.00	.0	.01	.0
	78-09-15	.0	.00	.0	.00	.0
06620000	76-09-14	--	--	--	--	--
	77-06-11	--	--	--	--	--
	77-06-20	.0	.00	.0	.00	.0
	77-10-10	--	--	--	--	--
	77-11-07	3.0	.00	.0	.00	.0
	78-05-22	.0	.00	.0	.00	.0
	78-07-31	.0	.00	.0	.00	.0
	78-08-29	.0	.00	.0	.00	.0
	78-09-26	.0	.00	.0	.00	.7
06630000	76-09-20	--	--	--	--	--
	77-07-26	--	--	--	--	--
	77-10-14	--	--	--	--	--
	78-06-15	.0	.00	.0	.09	.0
	78-10-24	.0	.00	.0	.01	.0
06652000	76-09-24	--	--	--	--	--
	77-07-06	--	--	--	--	--
	77-10-20	--	--	--	--	--
	78-05-12	.0	.00	.0	.01	.0
	78-10-26	.0	--	1.7	--	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*

[Streamflow: A, mean daily discharge; E, estimated; h, hours; ft^3/s, cubic feet per second; °C, degrees Celsius; µg/L, micrograms per liter; µg/kg, micrograms per kilogram; --, no data]

Station number	Date of sample	Time (h)	Streamflow, instantaneous (ft^3/s)	Temperature (°C)	PCB, total (µg/L)	PCB, total in bottom material (µg/kg)	PCN, total (µg/L)	PCN, total in bottom material (µg/kg)	Aldrin, total (µg/L)	Aldrin, total in bottom material (µg/kg)	Chlordane, total (µg/L)	Chlordane, total in bottom material (µg/kg)
06662000	76-09-20	0930	26	--	0.0	0	0.0	0	0.00	0.0	0.00	0
	77-06-06	0945	250	17.0	.0	0	.0	0	.00	.0	.00	0
	77-10-17	0915	37	3.5	.0	0	.0	0	.00	.0	.00	0
	78-05-24	1230	111	16.0	.0	0	.0	0	.00	.0	.00	0
	78-10-23	0845	25	1.0	.0	4	.0	0	.00	.0	.00	0
06670500	77-07-06	1245	43	24.0	--	0	--	0	--	.0	--	0
	77-09-28	1215	20	15.0	.0	0	.0	0	.00	.0	.00	0
	78-05-09	1115	183	10.0	.0	0	.0	0	.00	.0	.00	0
	78-09-12	1230	19	15.0	.0	0	.0	0	.00	.0	.00	0
06679500	77-07-06	1015	445	--	.0	1	.0	0	.00	.0	.00	0
	77-09-28	1000	775	13.0	.0	1	.0	0	.00	.0	.00	0
	78-05-09	0915	230	--	.0	0	.0	0	.00	.0	.00	0
	78-09-12	1030	447	13.0	.0	0	.0	0	.00	.1	.00	0
09209400	76-09-21	1600	901	--	.0	0	.0	0	.00	.0	.00	0
	77-06-06	1700	1,510	22.0	.0	0	.0	0	.00	.0	.00	0
	77-10-18	1145	582	7.0	--	0	--	0	--	.0	--	0
	78-05-21	1110	3,040	12.0	.0	0	.0	0	.00	.0	.00	0
	78-10-24	1030	744	7.0	.0	0	.0	0	.00	.0	.00	0
09216000	76-09-15	1100	66	13.0	.0	0	.0	0	.00	.0	.00	0
	77-06-07	1015	28	18.0	.0	1	.0	0	.00	.0	.00	0
	77-10-11	1100	28	4.0	.0	0	.0	0	.00	.0	.00	0
	78-05-24	1145	A22	13.0	.0	0	.0	0	.00	.0	.00	0
	78-09-27	1100	46	10.0	.0	--	.0	--	.00	--	.00	--
09217010	76-09-21	1330	950	--	.0	0	.0	0	.00	.0	.00	0
	77-06-07	1215	400	21.0	.0	0	.0	0	.00	.0	.00	0
	77-10-17	1500	E490	10.0	.0	1	.0	0	.00	.0	.00	0
	78-05-22	0930	E2,500	12.5	.0	1	.0	0	.00	.0	.00	1
	78-10-23	1345	765	8.0	.0	0	.0	0	.00	.0	.00	0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Chlor-pyrifos, total (µg/L)	DDD, total (µg/L)	DDD, total in bottom material (µg/kg)	DDE, total (µg/L)	DDE, total in bottom material (µg/kg)	DDT, total (µg/L)	DDT, total in bottom material (µg/kg)	Diaz-inon, total (µg/L)	Diel-drin, total (µg/L)	Dieldrin, total in bottom material (µg/kg)	Endo-sulfan, total (µg/L)
06662000	76-09-20	--	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	--
	77-06-06	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	0.00
	77-10-17	0.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-05-24	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-10-23	--	.00	.2	.00	.0	.00	.0	.00	.00	.0	.00
06670500	77-07-06	--	--	.0	--	.0	--	.0	--	--	.0	--
	77-09-28	.00	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	78-05-09	.00	.00	.1	.00	.1	.00	.0	.00	.00	.1	.00
	78-09-12	--	.00	.1	.00	.0	.00	.0	.00	.00	.0	--
06679500	77-07-06	.00	.00	.0	.00	.7	.00	.0	.00	.00	.2	.00
	77-09-28	.00	.00	.4	.00	2.2	.00	1.9	.00	.00	.3	.00
	78-05-09	.00	.00	.1	.00	.3	.00	.0	.00	.00	.0	.00
	78-09-12	--	.00	.0	.00	7.2	.00	.0	.00	.00	1.2	--
09209400	76-09-21	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
	77-06-06	--	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	77-10-18	--	--	.0	--	.0	--	.0	--	--	.0	--
	78-05-21	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-10-24	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
09216000	76-09-15	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
	77-06-07	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-10-11	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-05-24	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-09-27	--	.00	--	.00	--	.00	--	.00	.00	--	.00
09217010	76-09-21	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	--
	77-06-07	--	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	77-10-17	.00	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	78-05-22	.00	.00	.5	.00	.3	.00	.0	.00	.00	.0	.00
	78-10-23	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Endosulfan, total in bottom material (µg/kg)	Endrin, total (µg/L)	Endrin, total in bottom material (µg/kg)	Ethion, total (µg/L)	Ethyl parathion, total (µg/L)	Ethyl trithion, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor, total in bottom material (µg/kg)	Heptachlor epoxide, total (µg/L)	Heptachlor epoxide, total in bottom material (µg/kg)
06662000	76-09-20	--	0.00	0.0	0.00	0.00	0.00	0.00	0.0	0.00	0.0
	77-06-06	0.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-17	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-24	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-23	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06670500	77-07-06	.0	--	.0	--	--	--	--	.0	--	.0
	77-09-28	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-09	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-09-12	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
06679500	77-07-06	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-09-28	.0	.00	.1	.00	.00	.00	.00	.0	.00	.0
	78-05-09	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-09-12	.0	.00	.2	.00	.00	.00	.00	.0	.00	.0
09209400	76-09-21	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-06	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-18	.0	--	.0	--	--	--	--	.0	--	.0
	78-05-21	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-24	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
09216000	76-09-15	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-07	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-24	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-09-27	--	.00	--	.00	.00	.00	.00	--	.00	--
09217010	76-09-21	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-07	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-17	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-22	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-23	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Lindane, total (µg/L)	Lindane, total in bottom material (µg/kg)	Malathion, total (µg/L)	Methyl parathion, total (µg/L)	Methyl trithion, total (µg/L)	Mirex, total (µg/L)	Mirex, total in bottom material (µg/kg)	Parathion, total (µg/L)	Perthane, total (µg/L)	Perthane, total in bottom material (µg/kg)
06662000	76-09-20	0.00	0.0	0.00	0.00	0.00	--	--	0.00	--	--
	77-06-06	.00	.0	.00	.00	.00	--	--	.00	0.00	0.0
	77-10-17	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-24	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-23	.00	.3	.00	.00	.00	0.00	0.0	.00	.00	.0
06670500	77-07-06	--	.0	--	--	--	--	--	--	--	.0
	77-09-28	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-09	.00	.0	.04	.00	.00	--	--	.00	.00	.0
	78-09-12	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
06679500	77-07-06	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-09-28	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-09	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-09-12	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
09209400	76-09-21	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-06	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-18	--	.0	--	--	--	--	--	--	--	.0
	78-05-21	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-24	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0
09216000	76-09-15	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-07	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-24	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-09-27	.00	--	.00	.00	.00	.00	--	.00	.00	--
09217010	76-09-21	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-07	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-17	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-05-22	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-23	.00	.0	.00	.00	.00	.00	.0	.00	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Toxaphene, total (µg/L)	Toxaphene, total in bottom material (µg/kg)	Trithion, total (µg/L)	2,4-D, total (µg/L)	2,4-D, total in bottom material (µg/kg)	2,4,5-T, total (µg/L)	2,4,5-T total in bottom material (µg/kg)	Silvex, total (µg/L)	Silvex, total in bottom material (µg/kg)	2,4-DP, total (µg/L)
06662000	76-09-20	0	0	0.00	0.00	--	0.00	--	0.00	--	0.00
	77-06-06	0	0	.00	.02	--	.00	--	.00	--	.00
	77-10-17	0	0	.00	.01	--	.00	--	.00	--	.00
	78-05-24	0	0	.00	.08	0	.00	0	.00	0	.00
	78-10-23	0	0	.00	.00	0	.01	0	.00	0	.00
06670500	77-07-06	--	0	--	--	--	--	--	--	--	--
	77-09-28	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-09	0	0	.00	.07	0	.00	0	.00	0	.00
	78-09-12	0	0	.00	.00	0	.00	0	.00	0	.00
06679500	77-07-06	0	0	.00	.04	--	.00	--	.00	--	.00
	77-09-28	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-09	0	0	.00	.00	0	.00	0	.00	0	.00
	78-09-12	0	7	.00	.00	0	.00	0	.00	0	.00
09209400	76-09-21	0	0	.00	.00	--	.00	--	.00	--	.00
	77-06-06	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-18	--	0	--	.00	--	.00	--	.00	--	.00
	78-05-21	0	0	.00	.00	0	.00	0	.00	0	.00
	78-10-24	0	0	.00	.00	0	.00	0	.00	0	.00
09216000	76-09-15	0	0	.00	.03	--	.00	--	.00	--	.00
	77-06-07	0	0	.00	.12	--	.00	--	.00	--	.00
	77-10-11	0	0	.00	.01	--	.00	--	.00	--	.00
	78-05-24	0	0	.00	.00	0	.00	0	.00	0	.00
	78-09-27	0	--	.00	.00	0	.00	0	.00	0	.00
09217010	76-09-21	0	0	.00	.00	--	.00	--	.00	--	.00
	77-06-07	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-17	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-22	0	0	.00	.03	0	.00	0	.00	0	.00
	78-10-23	0	0	.00	.00	0	.00	0	.00	0	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	2,4-DP, total in bottom material (µg/kg)	Dicamba, total (µg/L)	Dicamba, total in bottom material (µg/kg)	Picloram, total (µg/L)	Picloram, total in bottom material (µg/kg)
06662000	76-09-20	--	--	--	--	--
	77-06-06	--	--	--	--	--
	77-10-17	--	--	--	--	--
	78-05-24	0.0	0.00	0.0	0.00	0.0
	78-10-23	.0	.00	.0	.00	.0
06670500	77-07-06	--	--	--	--	--
	77-09-28	--	--	--	--	--
	78-05-09	.0	.00	.0	.04	.0
	78-09-12	.0	.00	.0	.00	.0
06679500	77-07-06	--	--	--	--	--
	77-09-28	--	--	--	--	--
	78-05-09	.0	.00	.0	.02	.0
	78-09-12	.0	.00	.0	.00	.0
09209400	76-09-21	--	--	--	--	--
	77-06-06	--	--	--	--	--
	77-10-18	--	--	--	--	--
	78-05-21	.0	.00	.0	.00	.0
	78-10-24	.0	.00	.0	.00	.0
09216000	76-09-15	--	--	--	--	--
	77-06-07	--	--	--	--	--
	77-10-11	--	--	--	--	--
	78-05-24	.0	.00	.0	.00	.0
	78-09-27	.0	.00	7.4	.00	.0
09217010	76-09-21	--	--	--	--	--
	77-06-07	--	--	--	--	--
	77-10-17	--	--	--	--	--
	78-05-22	.0	.00	.0	.00	.0
	78-10-23	.0	.00	.0	.00	.0

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

[Streamflow: A, mean daily discharge; h, hours; ft^3/s, cubic feet per second; °C, degrees Celsius; µg/L, micrograms per liter; µg/kg, micrograms per kilogram; --, no data]

Station number	Date of sample	Time (h)	Streamflow, instantaneous (ft^3/s)	Temperature (°C)	PCB, total (µg/L)	PCB, total in bottom material (µg/kg)	PCN, total (µg/L)	PCN, total in bottom material (µg/kg)	Aldrin, total (µg/L)	Aldrin, total in bottom material (µg/kg)	Chlordane, total (µg/L)	Chlordane, total in bottom material (µg/kg)
09224700	76-09-21	1100	13	--	0.0	0	0.0	0	0.00	0.0	0.00	0
	77-06-07	0915	7.8	17.0	.0	--	.0	--	.00	--	.00	--
	77-10-18	0930	15	2.0	.0	0	.0	0	.00	.0	.00	0
	78-05-21	1330	1,320	14.5	.0	0	.0	0	.00	.0	.00	0
	78-10-23	1445	36	9.0	.0	0	.0	0	.00	.0	.00	0
10039500	76-09-17	1645	220	16.0	.0	--	.0	--	.00	--	.00	--
	77-06-10	1430	58	19.0	.0	1	.0	0	.00	.0	.00	0
	77-10-13	1545	39	11.0	.0	--	.0	--	.00	--	.00	--
	78-05-26	1430	1,200	10.0	.0	0	.0	0	.00	.0	.00	0
	78-09-30	1330	217	12.0	.0	--	.0	--	.00	--	.00	--
13027500	76-09-18	0800	786	11.0	.0	0	.0	0	.00	.0	.00	0
	77-06-11	0830	313	10.0	.0	2	.0	0	.00	.0	.00	0
	77-10-14	0730	344	7.0	.0	--	.0	--	.00	--	.00	--
	78-05-27	0830	A2,660	6.0	.0	0	.0	0	.00	.0	.00	0
	78-10-01	0730	665	8.0	.0	--	.0	--	.00	--	.00	--

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Chlorpyrifos, total (µg/L)	DDD, total (µg/L)	DDD, total in bottom material (µg/kg)	DDE, total (µg/L)	DDE, total in bottom material (µg/kg)	DDT, total (µg/L)	DDT, total in bottom material (µg/kg)	Diazinon, total (µg/L)	Dieldrin, total (µg/L)	Dieldrin, total in bottom material (µg/kg)	Endosulfan, total (µg/L)
09224700	76-09-21	--	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	--
	77-06-07	--	.00	--	.00	--	.00	--	.00	.00	--	0.00
	77-10-18	.00	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	78-05-21	.00	.00	.0	.00	.1	.00	.0	.00	.00	.0	.00
	78-10-23	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
10039500	76-09-17	--	.00	--	.00	--	.00	--	.00	.00	--	--
	77-06-10	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-10-13	.00	.00	--	.00	--	.00	--	.00	.00	--	.00
	78-05-26	.00	.00	.0	.00	.1	.00	.0	.00	.00	.1	.00
	78-09-30	--	.00	--	.00	--	.00	--	.00	.00	--	.00
13027500	76-09-18	--	.00	.0	.00	.1	.00	.0	.00	.00	.0	--
	77-06-11	--	.00	.0	.00	.0	.00	.0	.00	.00	.0	.00
	77-10-14	.00	.00	--	.00	--	.00	--	.00	.00	--	.00
	78-05-27	.00	.00	.0	.00	.1	.00	.0	.00	.00	.1	.00
	78-10-01	--	.00	--	.00	--	.00	--	.00	.00	--	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Endosulfan, total in bottom material (µg/kg)	Endrin, total (µg/L)	Endrin, total in bottom material (µg/kg)	Ethion, total (µg/L)	Ethyl parathion, total (µg/L)	Ethyl trithion, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor, total in bottom material (µg/kg)	Heptachlor epoxide, total (µg/L)	Heptachlor epoxide, total in bottom material (µg/kg)
09224700	76-09-21	--	0.00	0.0	0.00	0.00	0.00	0.00	0.0	0.00	0.0
	77-06-07	--	.00	--	.00	.00	.00	.00	--	.00	--
	77-10-18	0.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-05-21	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-10-23	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
10039500	76-09-17	--	.00	--	.00	.00	.00	.00	--	.00	--
	77-06-10	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-13	--	.00	--	.00	.00	.00	.00	--	.00	--
	78-05-26	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	78-09-30	--	.00	--	.00	.00	.00	.00	--	.00	--
13027500	76-09-18	--	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-06-11	.0	.00	.0	.00	.00	.00	.00	.0	.00	.0
	77-10-14	--	.00	--	.00	.00	.00	.00	--	.00	--
	78-05-27	.0	.00	.0	.00	.00	.00	.00	.0	.00	.1
	78-10-01	--	.00	--	.00	.00	.00	.00	--	.00	--

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Lindane, total (µg/L)	Lindane, total in bottom material (µg/kg)	Malathion, total (µg/L)	Methyl parathion, total (µg/L)	Methyl trithion, total (µg/L)	Mirex, total (µg/L)	Mirex, total in bottom material (µg/kg)	Parathion, total (µg/L)	Perthane, total (µg/L)	Perthane, total in bottom material (µg/kg)
09224700	76-09-21	0.00	0.0	0.00	0.00	0.00	--	--	0.00	--	--
	77-06-07	.00	--	.00	.00	.00	--	--	.00	0.00	--
	77-10-18	.00	.0	.00	.00	.00	--	--	.00	.00	0.0
	78-05-21	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-23	.00	.0	.00	.00	.00	0.00	0.0	.00	.00	.0
10039500	76-09-17	.00	--	.00	.00	.00	--	--	.00	--	--
	77-06-10	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-13	.00	--	.00	.00	.00	--	--	.00	.00	--
	78-05-26	.00	.1	.00	.00	.00	--	--	.00	.00	.0
	78-09-30	.00	--	.00	.00	.00	.00	--	.00	.00	--
13027500	76-09-18	.00	.0	.00	.00	.00	--	--	.00	--	--
	77-06-11	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	77-10-14	.00	--	.00	.00	.00	--	--	.00	.00	--
	78-05-27	.00	.0	.00	.00	.00	--	--	.00	.00	.0
	78-10-01	.00	--	.00	.00	.00	.00	--	.00	.00	--

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	Toxaphene, total (µg/L)	Toxaphene, total in bottom material (µg/kg)	Trithion, total (µg/L)	2,4-D, total (µg/L)	2,4-D, total in bottom material (µg/kg)	2,4,5-T, total (µg/L)	2,4,5-T total in bottom material (µg/kg)	Silvex, total (µg/L)	Silvex, total in bottom material (µg/kg)	2,4-DP, total (µg/L)
09224700	76-09-21	0	0	0.00	0.00	--	0.00	--	0.00	--	0.00
	77-06-07	0	--	.00	.00	--	.00	--	.00	--	.00
	77-10-18	0	0	.00	.00	--	.00	--	.00	--	.00
	78-05-21	0	0	.00	.00	0	.00	0	.00	0	.00
	78-10-23	0	0	.00	.00	0	.00	0	.00	0	.00
10039500	76-09-17	0	--	.00	.00	--	.00	--	.00	--	.00
	77-06-10	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-13	0	--	.00	.00	--	.00	--	.00	--	.00
	78-05-26	0	0	.00	.00	0	.00	0	.00	0	.00
	78-09-30	0	--	.00	.00	0	.00	0	.00	0	.00
13027500	76-09-18	0	0	.00	.00	--	.00	--	.00	--	.00
	77-06-11	0	0	.00	.00	--	.00	--	.00	--	.00
	77-10-14	0	--	.00	.00	--	.00	--	.00	--	.00
	78-05-27	0	0	.00	.00	0	.00	0	.00	0	.00
	78-10-01	0	--	.00	.00	0	.00	0	.00	0	.00

Table 10.--*Pesticide concentrations in Wyoming streams, 1976-78*--Continued

Station number	Date of sample	2,4-DP, total in bottom material (µg/kg)	Dicamba, total (µg/L)	Dicamba, total in bottom material (µg/kg)	Picloram, total (µg/L)	Picloram, total in bottom material (µg/kg)
09224700	76-09-21	--	--	--	--	--
	77-06-07	--	--	--	--	--
	77-10-18	--	--	--	--	--
	78-05-21	0.0	0.00	0.0	0.04	0.0
	78-10-23	.0	.00	.0	.00	.0
10039500	76-09-17	--	--	--	--	--
	77-06-10	--	--	--	--	--
	77-10-13	--	--	--	--	--
	78-05-26	.0	.02	.0	.00	.0
	78-09-30	.0	.00	3.8	.00	.0
13027500	76-09-18	--	--	--	--	--
	77-06-11	--	--	--	--	--
	77-10-14	--	--	--	--	--
	78-05-27	.0	.00	.0	.00	.0
	78-10-01	.0	.00	2.5	.00	.0

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