

In cooperation with the Wyoming Department of Agriculture (WDA)

Pesticides in Surface Water in the Bighorn and North Platte River Basins, Wyoming, 2006

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Introduction

In 2006, the U.S. Geological Survey (USGS), in cooperation with the Wyoming Department of Agriculture, sampled five surface-water sites in Wyoming—three in the Bighorn River Basin (BRB) and two in the North Platte River Basin (NPRB) (fig. 1). The purpose of the sampling was to describe the occurrence of pesticides in these basins during three different times of the year. This fact sheet presents the results of the sampling.

Approach

Three samples were collected from each site, one each in March, May, and September 2006 (table 1; fig. 2). The sampling events corresponded with pre-application of pesticides, post application of pesticides, and late growing season. The samples were collected using standard methods described in the National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, 1997 to 2004) and analyzed at the USGS National Water Quality Laboratory, to determine the presence and concentration of 132 different pesticides and degradation products (table 2) (Furlong and others, 2001, and Sandstrom and others, 2001).

Site Descriptions

Four of the five selected sites were located at the farthest downstream site available on the river in order to integrate drainage from as much land use in the river basin as possible. The fifth site is located on the mainstem of the Bighorn River at Basin (station number 06274300). This additional site on the Bighorn River was selected because of the large drainage area of the river.

All sampling locations in the BRB were located at sites with active streamflow-gaging stations. The sampling site near Torrington (station number 06674500) in the NPRB was located at an active gaging station. The Laramie River sampling site near Wheatland (station number 06664000), is a historic gaging station,

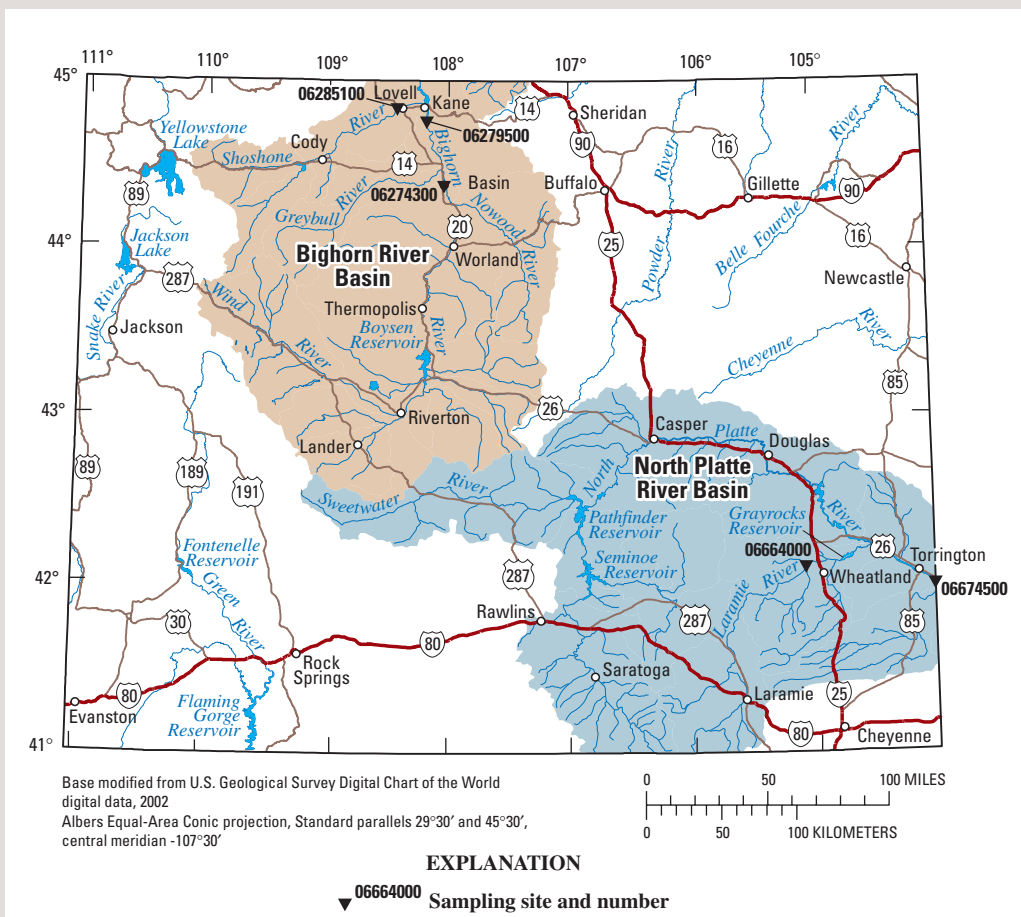


Figure 1. Location of sampling sites in the Bighorn and North Platte River Basins, Wyoming.

but was not active at the time of sampling. This sampling site is the farthest downstream site on the Laramie River with an active or inactive gaging station, that is upstream from Grayrocks Reservoir.

Results

Samples collected in both the BRB and NPRB contained detectable concentrations of pesticides for all three sampling events. Eighteen different pesticides and degradation products were detected (table 1).

Sixteen different pesticides were detected in water samples collected in the BRB. The most commonly detected pesticide was atrazine, a selective herbicide commonly applied to corn, grains, and sorghum (Meister, 2002), detected at low concentrations in all nine samples collected in the BRB. The pesticide with the largest concentration in the BRB was the herbicide MCPA (trade names

Table 1. Pesticides detected in samples from five surface-water sites in the Bighorn and North Platte River Basins—March, May, and September 2006.

[ft³/s, cubic feet per second; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; µg/L, microgram per liter; <, less than, indicates chemical was not detected, and the value following the less than is the laboratory reporting level; E, value is estimated; M, presence verified but not quantified; tan rows, Bighorn River Basin sites; blue rows, North Platte River Basin sites]

Station name and number	Date	Time (24 hour)	Instantaneous discharge (ft ³ /s)	Dissolved oxygen (mg/L)	pH (standard units)	Specific conductance (µS/cm)	Water temperature (degrees Celsius)	Aldicarb sulfoxide (µg/L)	Atrazine (µg/L)	Bentazon (µg/L)	Bromoxynil (µg/L)	Carbo-furan (µg/L)	Chloro-diamino-s-triazine (µg/L)
Bighorn River at Basin, Wyo. 06274300	3/23/2006 5/18/2006 9/14/2006	1200 1030 1030	1,090 1,600 560	11.7 8.4 10.0	8.3 8.1 8.5	982 445 984	6.7 16.5 16.5	<0.022 E.004 E.014	E0.006 E.007 E.006	<0.01 <.02 M	<0.03 E.01 <.04	<0.02 <.02 <.02	<0.04 <.04 <.04
Bighorn River at Kane, Wyo. 06279500	3/23/2006 5/18/2006 9/14/2006	1730 1415 1430	1,230 1,950 710	11.2 7.9 9.6	8.3 8.0 8.5	1,000 539 1,030	8.7 20.0 19.0	<0.022 E.004 E.013	E.006 .01 E.006	<.01 <.02 <.02	<.03 M <.04	<.02 <.02 <.02	<.04 <.04 <.04
Shoshone River near Lovell, Wyo. 06285100	3/24/2006 5/18/2006 9/14/2006	1400 1730 1730	427 430 490	12.0 9.5 10.5	8.2 8.6 8.7	909 676 725	8.5 21.0 17.5	<0.022 E.008 E.012	E.006 E.006 E.006	<.01 <.02 E.01	<.03 E.01 <.04	<.02 <.02 E.014	<.04 <.04 <.04
Laramie River near Wheatland 06664000	3/13/2006 5/26/2006 9/29/2006	1645 1400 1330	18 3.6 6.7	12.5 8.1 9.3	8.3 8.2 8.4	530 790 750	3.0 22.6 15.0	<0.022 <.10 <.10	<.007 <.007 E.007	<.01 <.02 <.02	<.03 <.04 <.04	<.02 <.02 <.02	<.04 <.04 <.04
North Platte River at Wyoming-Nebraska State line 06674500	3/13/2006 5/26/2006 9/29/2006	1215 0930 1100	118 156 260	11.1 8.3 8.9	8.1 8.2 8.3	938 859 920	6.5 17.5 13.0	<0.022 <.10 <.10	E.007 E.008 .009	<.01 <.02 <.02	<.03 <.04 <.04	<.02 <.02 <.02	E.05 <.04 <.04
Bighorn River at Basin, Wyo. 06274300	3/23/2006 5/18/2006 9/14/2006	1200 1030 1030	<0.006 <.014 E.007	<0.006 E.005 <.005	<0.006 E.005 <.005	<0.04 E.06 E.01	<0.004 E.004 <.004	<0.013 <.026 <.026	<0.006 <.006 <.006	<0.006 E.009 <.028	<0.01 <.01 M	<0.005 <.005 <.005	<0.009 <.009 <.009
Bighorn River at Kane, Wyo. 06279500	3/23/2006 5/18/2006 9/14/2006	1730 1415 1430	<0.006 <.014 E.007	<0.006 E.005 <.005	<0.04 E.1 <.04	<0.004 E.004 <.004	<0.004 E.004 <.004	<0.013 <.026 <.026	<0.006 <.006 E.005	<0.006 E.007 <.028	<.01 <.02 .03	<0.005 <.007 <.005	<0.009 <.009 <.009
Shoshone River near Lovell, Wyo. 06285100	3/24/2006 5/18/2006 9/14/2006	1400 1730 1730	<0.006 <.014 <.014	<0.006 <.005 <.005	<0.04 E.02 E.02	<0.004 E.004 <.004	<0.004 E.004 <.004	.013 E.011 <.026	E.005 <.006 <.006	<0.006 .13 <.028	<.01 <.01 <.01	<0.005 <.005 <.005	<0.009 <.009 E.006
Laramie River near Wheatland, Wyo. 06664000	3/13/2006 5/26/2006 9/29/2006	1645 1400 1330	<0.006 <.014 <.014	<0.006 <.005 <.005	<0.04 <.04 <.04	<0.004 E.004 <.004	<0.004 E.004 <.004	<0.013 <.026 <.026	<0.006 <.006 E.009	<0.006 <.028 E.01	<.01 <.01 E.01	<0.005 <.005 .08	<0.009 <.009 <.009
North Platte River at Wyoming-Nebraska State line 06674500	3/13/2006 5/26/2006 9/29/2006	1215 0930 1100	E.011 E.007 <.014	<0.006 <.005 <.005	<0.04 <.04 <.04	<0.004 E.005 <.004	<0.004 E.005 <.004	.014 E.015 E.013	<0.006 E.005 E.007	<0.006 <.028 <.028	E.01 <.01 <.01	<0.005 <.005 <.005	<0.009 <.009 <.009

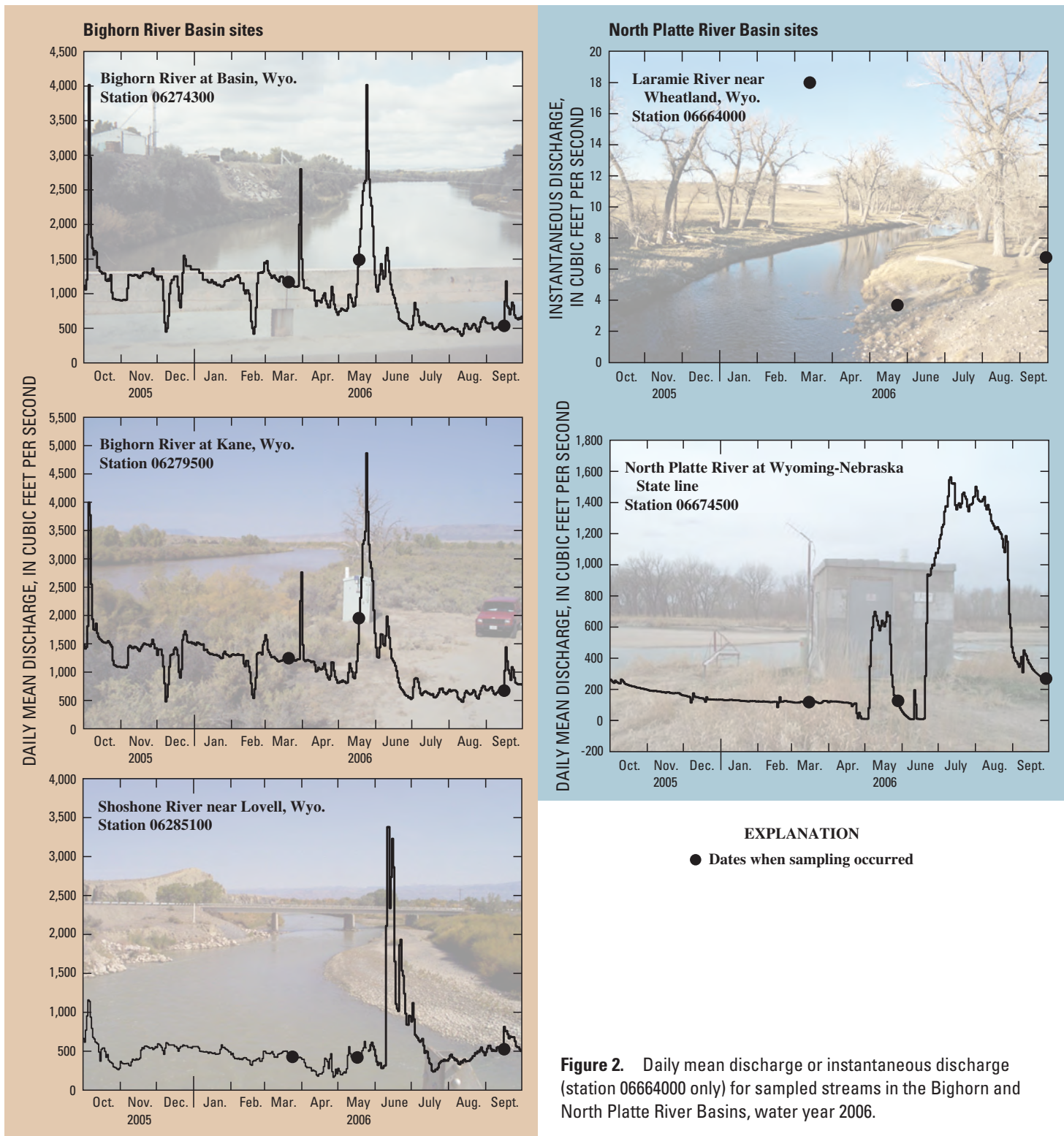


Figure 2. Daily mean discharge or instantaneous discharge (station 06664000 only) for sampled streams in the Bighorn and North Platte River Basins, water year 2006.

Solve and MCP), which was detected in a May sample at a concentration of 0.15 µg/L (micrograms per liter).

Eight different pesticides were detected in water samples collected in the NPRB. The most commonly detected pesticide was atrazine, detected in four of six samples collected in the NPRB. The pesticide with the largest concentration in the NPRB was the selective herbicide simazine (trade names Aquazine and Princep), which was detected in a September sample at a concentration of 0.08 µg/L.

References

- Furlong, E.T., Anderson, B.D., Werner, S.L., Soliven, P.P., Coffey, L.J., and Burkhardt, M.R., 2001, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory--Determination of pesticides in water by graphitized carbon-based solid-phase extraction and high-performance liquid chromatography/mass spectrometry: U.S. Geological Survey Water-Resources Investigations Report 01-4134, 73 p.
- Meister, R.T., 2002, Farm Chemicals Handbook: Willoughby, Ohio, Meister Publishing Co., variable pagination.

Table 2. Pesticides and degradation products analyzed for in samples.

[Pesticide trade names¹ in parentheses if different from pesticide name; pesticides in color were detected in the corresponding basin: tan, Bighorn River Basin; blue, North Platte River Basin; dark red, both basins]

Pesticide name	Pesticide name	Pesticide name	Pesticide name
Acetochlor (Guardian, Harness, Relay)	Cyfluthrin (Decathlon)	Fenamiphos sulfoxide (Fenamiphos degradation product)	Nicosulfuron (Accent, OneHope)
Acifluorfen (Blazer, Tackle 2S, Astic)	Cypermethrin	Fenuron	Norflurazon (Zorial, Solicam)
Alachlor (Alanex, Lasso, Shroud)	2,4-D (Dacamine, Weed-B-Gon)	Fipronil (Regent)	Oryzalin (Surflan)
Aldicarb (Temik)	2,4-D methyl ester	Fipronil sulfide (Fipronil degradation product)	Oxamyl (Vydate)
Aldicarb sulfone (Standak, Aldicarb degradation product)	2,4-DB (Butoxone, Butyrac)	Fipronil sulfone (Fipronil degradation product)	Oxyfluorfen (Offside, Goal)
Aldicarb sulfoxide (Aldicarb degradation product)	Dacthal	Flumetsulam (Broadstrike)	Paraoxon-methyl (Parathion-methyl degradation product)
Atrazine (Aatrex, Atralex)	Dacthal monoacid (Dacthal degradation product)	Fluometuron (Cotoran)	Parathion-methyl (Alkron, Bladan, Fighter)
Azinphos-methyl (Guthion, Crysthion)	Desulfinylfipronil (Fipronil degradation product)	Fonofos (Dyfonate)	Pendimethalin (Prowl, Stomp)
Azinphos-methyl-oxon (Azinphos-methyl degradation product)	Desulfinylfipronil amide (Fipronil degradation product)	Hexazinone (Velpar)	<i>cis</i> -Permethrin (Ambush, Pounce)
Barban	Diazinon (Basudin, Spectracide, Knoxout)	3-Hydroxycarbofuran (Carbofuran degradation product)	Phorate (Thimet, Rampart)
Bendiocarb (Ficam, Garrox, Turcam)	Dicamba (Banvel, Banex)	2-Hydroxy-4-isopropylamino-6-ethylamino-s-triazine {OIET} (Atrazine degradation product)	Phosmet (Imidan)
Benfluralin (Balan, Benefin)	3,4-Dichloroaniline (Chloramben degradation product)	Imazaquin (Scepter)	Picloram (Tordon)
Benomyl (Benlate, Benex)	3,5-Dichloroaniline (Diuron degradation product)	Imazethapyr (New Path, Pursuit)	Prometon (Pramitol, Gesafram)
Bensulfuron-methyl (Escuri, Londax)	Dichlorprop (Weedone, Polymone)	Imidacloprid (Admire, Provado)	Prometryn (Cotton-pro)
Bentazon (Basagram, Bentzone)	Dichlorvos (DDVP)	Iprodione (Kidan)	Propanil (Stamp)
Bromacil (Hyvar X)	Dicrotophos (Bidrin)	Isofenphos (Oftanol, Lighter)	Propargite (Comite, Omite)
Bromoxynil (Buctril, Brominal, Agristar)	Dieldrin (Panoram D-31, Octalox)	lambda-Cyhalothrin (Charge, Karate)	Propham (Chem Hoe)
Carbaryl (Carbatox, Sevin)	2,6-Diethylaniline (Alachlor degradation product)	Linuron (Linurex, Lorox)	Propiconazole (Banner)
Carbofuran (Furadan, Futura)	Dimethoate (Trounce)	Malaoxon (Malathion degradation product)	<i>cis</i> -Propiconazole (Banner)
Chloramben, methyl ester (Chloramben)	Dinoseb (Premerge)	Malathion (Cythion, Malaspray)	<i>trans</i> -Propiconazole (Banner)
Chlordiamino-s-triazine {CAAT} (Atrazine degradation product)	Diphenamid (Dymid, Enide)	MCPA (Solve, MCP)	Propoxur (Baygone, Suncide)
Chlorimuron-ethyl (Classic, Darban, Lory)	Disulfoton (Di-Syston)	MCPB (Butoxone M40, Thistrol)	Propyzamide (Kerb)
2-Chloro-2,6-diethylacetanilide (Alachlor degradation product)	Disulfoton sulfone (Disulfoton degradation product)	Metalaxyl (Apron, Ridamil, Subdue)	Siduron (Tupersan)
2-Chloro-4-isopropylamino-6-amino-s-triazine {CIAT} (Atrazine degradation product)	Diuron (Durashield, Karmex)	Methidathion (Supra)	Simazine (Aquazine, Princep)
2-Chloro-6-ethylamino-4-amino-s-triazine {CEAT} (Atrazine degradation product)	alpha-Endosulfan (Thiodan, Tiovel)	Methiocarb (Mesurol)	Sulfometuron-methyl (Oust)
4-Chloro-2-methylphenol (MCPA degradation product)	Endosulfan sulfate (alpha-Endosulfan degradation product)	Methomyl (Lannate, Nudrin)	2,4,5-T
3(4-Chlorophenyl)-1-methyl urea (Diuron degradation product)	EPTC (Eptam, Eradicane)	Metolachlor (Bicep, Dual)	Tebuconazole (Elite)
Chlorpyrifos (Dursban, Lorsban)	Ethion (Ethanox, Rhodocide)	Metribuzin (Lexone, Sencor)	Tebuthiuron (Graslan, Spike)
Clopyralid (Stinger, Lontrel)	Ethoprophos (Mocap, Prophos)	Metsulfuron methyl (Ally, Escort)	Tefluthrin (Force)
Cyanazine (Bladex)	2-Ethyl-6-methylaniline (Metalachlor degradation product)	Molinate (Hydram, Ordram)	Terbacil (Sinbar, Herbicide 732)
Cycloate (Ro-Neet)	Fenamiphos	Myclobutanil (Eagle, Nova)	Terbufos (Counter, Contraven)
	Fenamiphos sulfone (Fenamiphos degradation product)	1-Naphthol (Carbaryl degradation product)	Terbutylazine (Gardoprim)
		Neburon (Granurex, Propuron)	Thiobencarb (Bolero, Saturn)
			Tribufos (DEF 6)
			Triclopyr (Garlon)
			Trifluralin (Treflan, Trim)

¹The use of trade, product, industry, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government or the Wyoming State Government.

Sandstrom, M.W., Stroppel, M.E., Foreman, W.T., and Schroeder, M.P., 2001, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—Determination of moderate-use pesticides and selected degradates in water by C-18 solid-phase extraction and gas chromatography/mass spectrometry: U.S. Geological Survey Water-Resources Investigations Report 01–4098, 70 p.

U.S. Geological Survey, 1997 to 2004, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, 2 v., variously paged. [Also available online at <http://pubs.water.usgs.gov/twri9A>. Chapters originally were published from 1997–1999; updates and revisions are ongoing and are summarized at: <http://water.usgs.gov/owq/FieldManual/mastererrata.html>]

For additional information on the project, visit the USGS Wyoming Water Science Center web site at <http://wy.water.usgs.gov/projects/pesticide/sw/> or contact:

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