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Wyoming Department of Agriculture

Wyoming Department of Environmental Quality

In cooperation with the Wyoming Department of Agriculture (WDA) and the Wyoming Department of Environmental Quality (WDEQ)

Pesticides in Ground Water - Carbon County, Wyoming, 2004–2005

In 1991, members of local, State, and Federal governments, as well as industry and interest groups, formed the Ground-water and Pesticide Strategy Committee to prepare the State of Wyoming's generic Management Plan for Pesticides in Ground Water. Part of this management plan is to sample and analyze Wyoming's ground water for pesticides. In 1995, the U.S. Geological Survey, in cooperation with the Ground-water and Pesticide Strategy Committee, began statewide implementation of the sampling component of the State of Wyoming's generic Management Plan for Pesticides in Ground Water. During 2004–2005, baseline monitoring was conducted in Carbon County. This fact sheet describes and summarizes results of the baseline monitoring in Carbon County.

Pesticides in Ground Water

Synthetic organic pesticides are used to control weeds, insects, and other organisms in a wide variety of agricultural and nonagricultural settings. The use of pesticides has helped to make the United States the world's largest producer of food (Barbash and Resek, 1996). Pesticide use, however, also has been accompanied by concerns about potential adverse effects on the environment and human health. A potential pathway for the transport of pesticides is through hydrologic systems, which supply water for both humans and natural ecosystems. Water is one of the primary ways pesticides are transported from an application area to other locations in the environment (fig. 1) (Barbash and Resek, 1996).

Pesticide contamination of ground water is a national issue because of the widespread use of pesticides, the expense and difficulty of remediating ground water, and the fact that ground water is used for drinking water by about one-half the Nation's population. Although application rates and the variety of pesticides used may be greater in urban areas, concern over their presence in ground water is especially acute in rural agricultural areas where more than 95 percent of the population rely upon this resource for drinking water (Hutson and others, 2004).

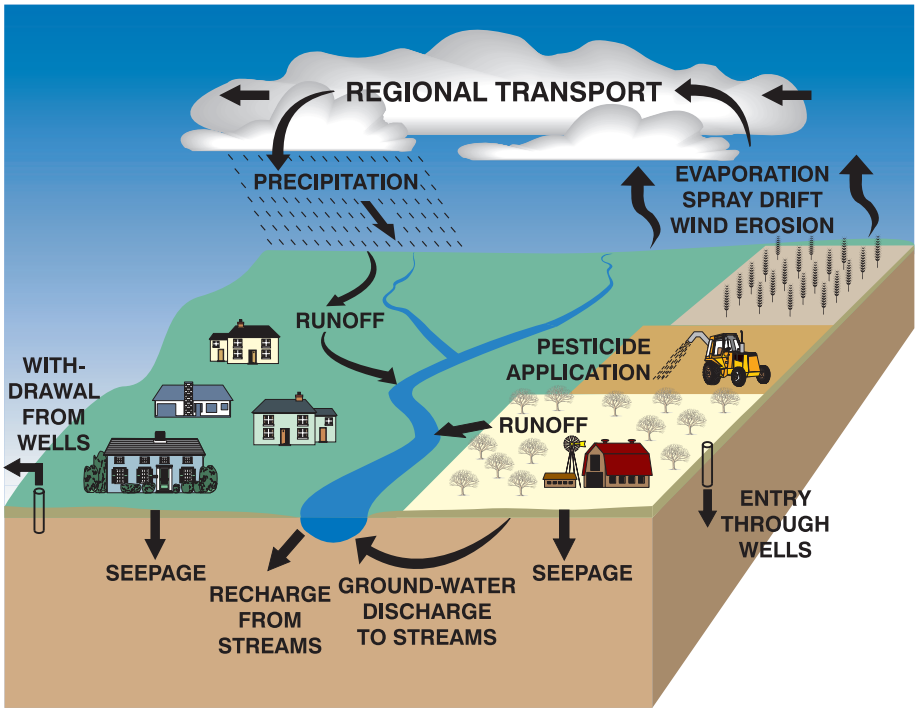

Figure 1. Pathways of pesticide movement in the hydrologic cycle (modified from Barbash and Resek, 1996).

Wyoming's Pesticide Management Plan

The Ground-water and Pesticide Strategy Committee (GPSC) has developed the generic State Management Plan for Pesticides in Ground Water for the State of Wyoming (SMP) (Wyoming Ground-water and Pesticides Strategy Committee, 1999). Wyoming was required by the U.S. Environmental Protection Agency to have an SMP in order for individuals and organizations to continue using certain pesticides in the State. The SMP includes information relating to individuals and organizations involved with implementation of the SMP, methods of preventing ground-water contamination, ground-water monitoring, and the responses required if pesticides are detected in ground water.

One critical part of the SMP is ground-water monitoring. This ground-water monitoring program has two phases. The first phase, baseline monitoring, is designed to determine what pesticides, if any, have entered into the county's ground water. The second phase, problem identification monitoring, is used to gather additional information about the ground water near wells with samples having significant pesticide detections.

Baseline monitoring is prioritized by a county rank and the vulnerability of the county's ground water to pesticides. During the development of the SMP, the GPSC evaluated each county in Wyoming to determine the potential vulnerability of the county's ground water to pesticides. Each county was ranked according to the extent of cropland and urban areas in the county, as well as the amount of pesticides sold within the county in 1991 (Wyoming Ground-water and Pesticides Strategy Committee, 1999).

Table 1. Summary of baseline monitoring for pesticides in Carbon County, September 2004 and April/May 2005.

[µg/L, micrograms per liter; E, value is estimated; C, estimated value used in calculation; --, not applicable]

Pesticide	Pesticide trade name	Pesticide action[1]	Number of detections/ number of samples[2]	Laboratory minimum reporting level[3] (µg/L)	Maximum concentration (µg/L)	Average concentration of detections (µg/L)	Safe drinking water standard[4] (µg/L)
Focal pesticides detected in Carbon County ground water							
Atrazine	Aatrex	Selective herbicide	4/22	0.007	0.2	0.05	3
Bromacil	Hyvar XL	Herbicide	4/22	.03	E.80	C.5	[5]90
2,4-D	2,4-D	Selective herbicide	1/22	.02	E.04	--	70
Simazine	Princep	Selective herbicide	1/22	.005	E.003	--	4
Tebuthiuron	Spike	Herbicide	6/22	.02	.4	C.2	[5]500
Non-focal pesticides detected in Carbon County ground water							
Dichloroprop	Weedone, Polymone	Herbicide	2/22	0.03	0.07	C0.04	--
Diuron	Durashield	Herbicide	2/22	.01	.05	.04	[5]10
Flumetsulam	Broadstrike, Python	Herbicide	2/22	.04	E.08	C.07	--
Prometon	Pramitol	Non-selective herbicide	9/22	.02	3	C.5	[5]100
Sulfometuron	Oust	Herbicide	1/22	.009	.02	--	--
Focal pesticides not detected in Carbon County ground water							
Alachlor, Aldicarb, Aldicarb Sulfone[6], Aldicarb Sulfoxide[6], Clopyralid, Cyanazine, DCPA, Dicamba, Hexazinone, Metalachlor, Metribuzin, Metsulfuron, Picloram, Telone							
Focal pesticide not included in analysis of Carbon County ground water (no method of analysis available)							
Difenzoquat							

[1]Meister (2002)

[2]Each of the 11 wells was sampled twice.

[3]The laboratory minimum reporting level is the lowest concentration at which a pesticide concentration can be quantified without estimation.

[4]U.S. Environmental Protection Agency Maximum Contaminant Level unless otherwise noted (U.S. Environmental Protection Agency, 2004).

[5]U.S. Environmental Protection Agency Lifetime Health Advisory Level (U.S. Environmental Protection Agency, 2004).

[6]Degradation product of aldicarb.

A ground-water vulnerability map was prepared for the uppermost or shallowest aquifer (Hamerlinck and Arneson, 1998). A Geographic Information System was used to overlay seven layers describing hydrogeology and land use. Ground water is vulnerable because of either inherent sensitivity of the hydrogeology or the combination of the sensitivity and associated land use. The map was used to assist in the selection of monitoring sites in each county. The monitoring focuses on areas where the ground water is most vulnerable.

The GPSC selected 18 pesticides and 2 degradation products as the focal pesticides for analysis as part of the SMP (table 1). The analytical methods used to detect the focal pesticides also detects 115 other pesticides and degradation products. Any additional pesticides that were detected are listed in table 1 as non-focal pesticides. Ground water from all wells in the baseline monitoring program was analyzed for the pesticides listed in table 1, with the exception of difenzoquat, for which an analytical method was not available.

The goal of the ground-water monitoring part of the SMP is to collect ground-water samples for pesticide analyses in all 23 Wyoming counties. To date, sampling has been completed in Goshen (1995–1996), Park (1997), Washakie (1997–1998), Fremont (1998–1999), Laramie (1998–1999), Lincoln (1998–1999), Big Horn (1999–2000), Sheridan (1999–2000), Crook (2000-2001), Johnson (2000–2001), Platte (2000–2001), Natrona (2001–2002), Sweetwater (2001–2002), Teton (2001–2002), Uinta (2002–2003), Albany (2003–2004), Converse (2003–2004), Hot Springs (2003-2004), Campbell (2004–2005), Sublette (2004–2005), and Niobrara and Weston (2005–2006) Counties.

Ground-Water Monitoring in Carbon County

Ground water in Carbon County was ranked twentieth most vulnerable to pesticide contamination in Wyoming (Wyoming Ground-water and Pesticide Strategy Committee, 1999). The vulnerability map created by the Spatial Data and Visualization Center (Hamerlinck and Arneson, 1998), identifies unconsolidated Quaternary-age deposits in the county (primarily alluvial and terrace deposits) and Tertiary-age deposits that underlie urban land use as the most vulnerable to pesticides (shown as red on fig. 2). The focus of the sampling was in the alluvial and terrace deposits of the North Platte River, Encampment River, Medicine Bow River, and Rock Creek, and in the Miocene-age deposits that underlie the city of Rawlins (fig. 3).

Eleven wells were selected in Carbon County (fig. 3) for baseline monitoring. Eight wells were located in the Quaternary-age alluvial or terrace deposits and two wells were located in the Miocene-age rocks. The geology on the surface at the well sampled in the Rock Creek area was Quaternary-age alluvial deposits; however, the deposits were not thick enough to provide sufficient water to the well owners, and the well was completed in the underlying Late Cretaceous-age Lewis Shale. All wells were sampled twice, once in September 2004 and once in April or May 2005.

Five of the 19 focal pesticides with available analyses and 5 non-focal pesticides were detected in Carbon County (table 1). At least one pesticide was detected in samples from 9 of the 11 wells sampled in Carbon County; concentrations of each pesticide detected were less than or equal to 1/15 of the applicable drinking-water standard (U.S. Environmental Protection Agency, 2004) (table 1).

The most commonly detected pesticide in Carbon County was prometon (detected in 9 out of 22 samples). Prometon, the active ingredient in the general-use pesticide Pramitol, typically is detected in areas with urban land use (Barbash

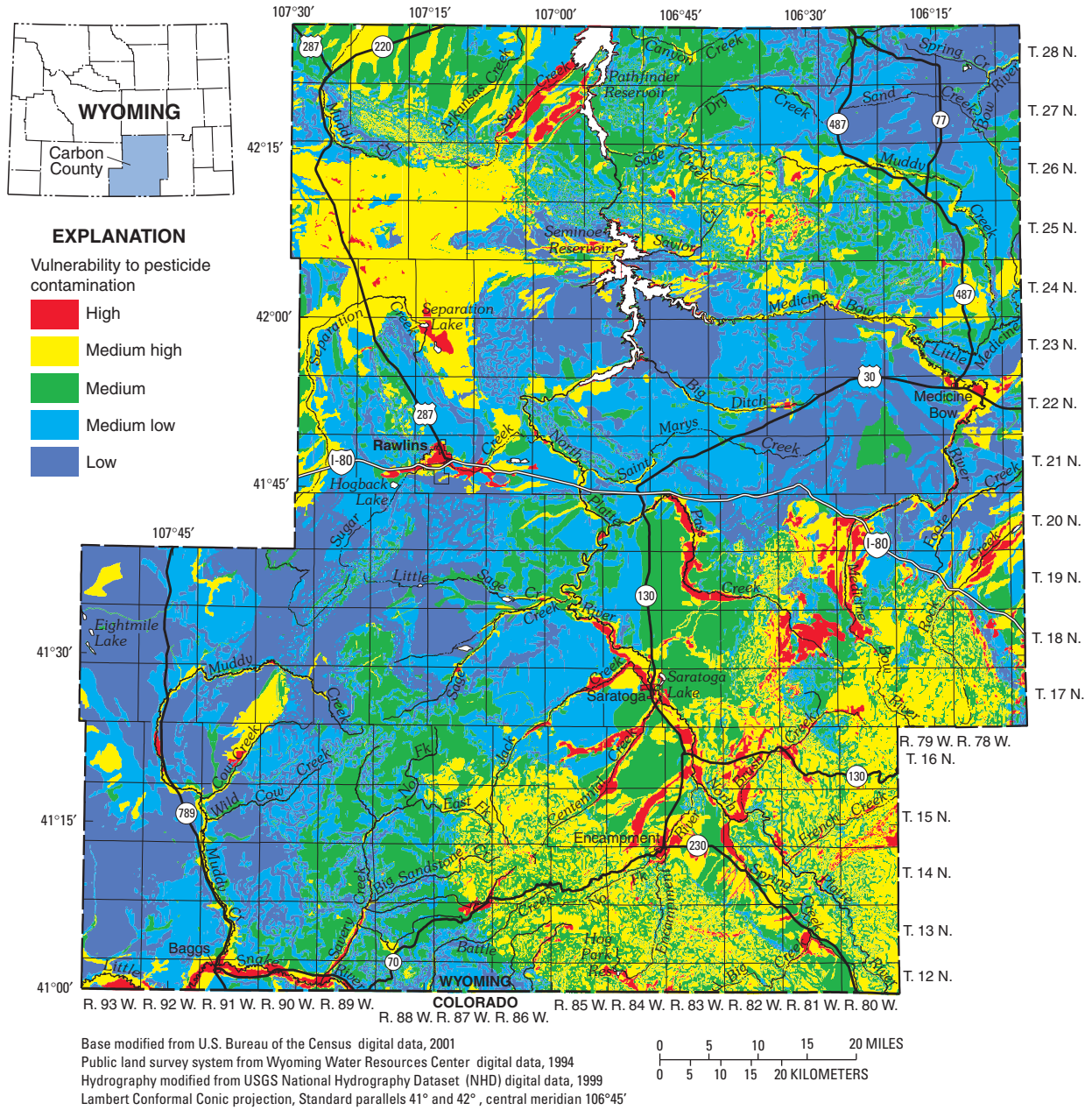

Figure 2. Vulnerability of Carbon County, Wyoming ground water to pesticide contamination (from Hamerlinck and Arneson, 1998).

and others, 1999). Prometon was the most commonly detected pesticide in Albany, Campbell, Converse, Crook, Johnson, Natrona, Sheridan, Sublette, Teton, and Uinta Counties.

The second most commonly detected pesticide (6 of 22 samples) in Carbon County was tebuthiuron. Tebuthiuron is an herbicide used in non-cropland areas, rangeland, and right-of-ways (Meister, 2002). Tebuthiuron was the most commonly detected pesticide in Hot Springs, Sweetwater, and Sublette Counties.

Data Distribution and Availability

Sampling results have been provided to local groups interested in pesticides in ground water in Carbon County. The information can be used by citizens and local governments to help understand current conditions. Analytical results of the Carbon County sampling can be found in Blajszczak and others (2005), and Blajszczak and others (2006) or on the Internet at *http://waterdata.usgs.gov/wy/nwis/qwdata*. Analytical results and fact sheets for all counties sampled to date are available from the U.S. Geological Survey in Cheyenne by phone, email, or on the Internet at *http://wy.water.usgs.gov/projects/pesticide/*.

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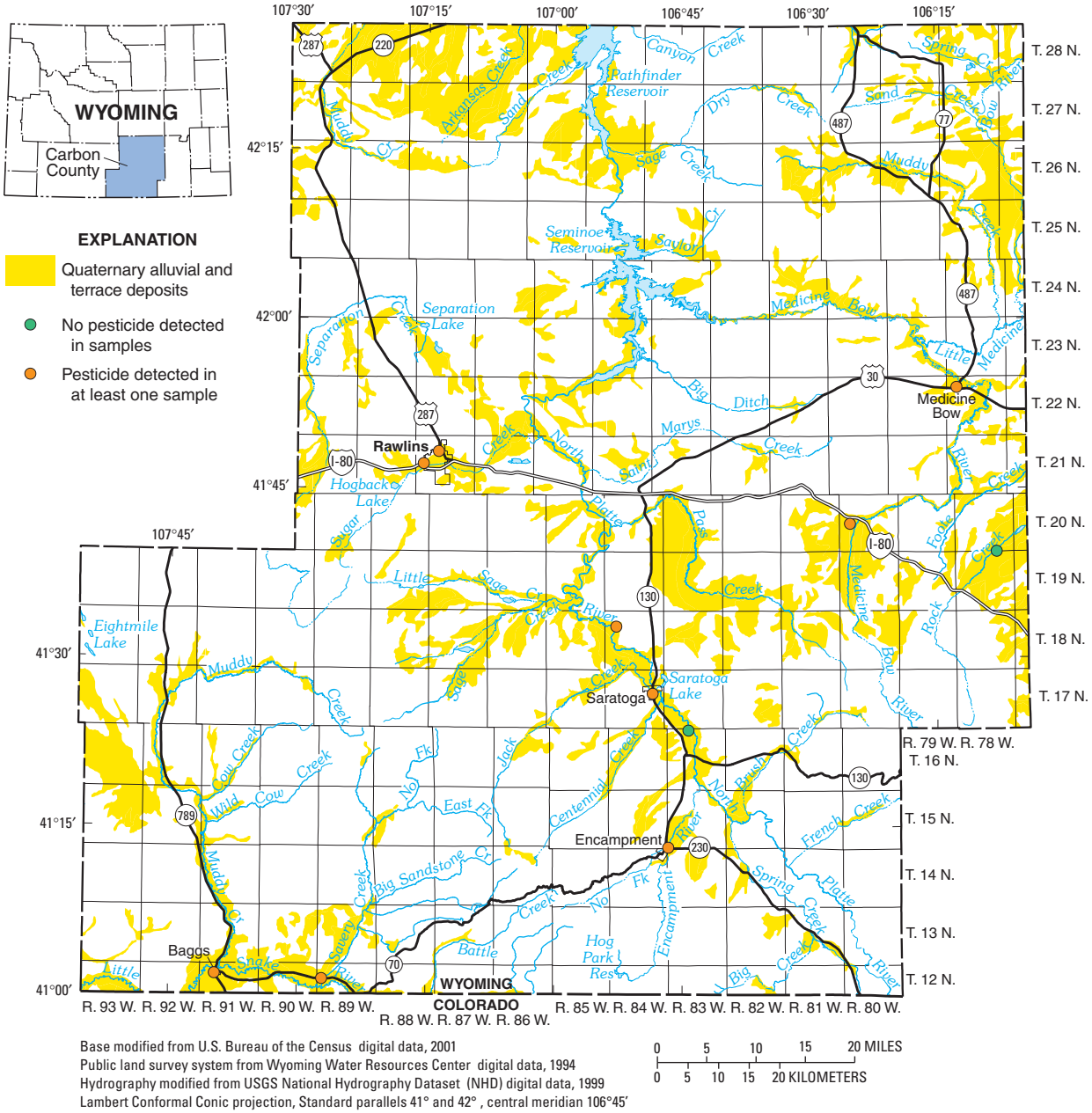

Figure 3. Location of wells sampled in Carbon County, Wyoming, and notation of pesticide detection in samples from each well.

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This fact sheet was prepared by the U.S. Geological Survey (USGS), the Wyoming Department of Agriculture (WDA), and the Wyoming Department of Environmental Quality, Water Quality Division (WDEQ). All agencies are members of the Ground-water and Pesticide Strategy Committee.

This project has been funded in part with a Section 319 grant from the U.S. Environmental Protection Agency to Wyoming Department of Environmental Quality's Non-Point Source Program.

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- *Prepared by* Cheryl A. Eddy-Miller and Kendra J. Remley
- *Layout prepared by* Suzanne C. Roberts

For more information, contact:

Roy Reichenbach
Wyoming Department of Agriculture
2219 Carey Avenue
Cheyenne, Wyoming 82002
(307) 777-6590

Kevin Frederick
Wyoming Department of Environmental Quality, Water Quality Division
Herschler Building West, 4th Floor
Cheyenne, Wyoming 82002
(307) 777-5985

Cheryl Eddy Miller
U.S. Geological Survey
2617 E. Lincolnway, Suite B
Cheyenne, Wyoming 82001
(307) 778-2931
Email: cemiller@usgs.gov