

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

## Pesticides in Ground Water - Crook County, Wyoming, 2000-01

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. In 2000, baseline monitoring began in Crook 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, has also 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 50 percent of the Nation's population. Concern about pesticides in ground water is especially acute in rural agricultural areas where over 95 percent of the population relies upon ground water for their drink-

ing water (Solley and others, 1998), although application rates and the variety of pesticides used may be greater in urban areas.

### 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). The SMP is required by the U.S. Environmental Protection Agency in order for individuals and organizations to continue using certain pesticides in Wyoming. The SMP includes information relating to individuals and organizations involved with the implementation of the SMP, methods of preventing ground-water contamination, ground-water monitoring, and what the responses will be if pesticides are detected in ground water.

One critical part of the SMP is ground-water monitoring. The ground-water monitoring program has two phases. The first phase involves baseline monitoring, which is designed to determine what pesticides, if any, have leached into the county's ground water. The second phase is problem identification monitoring, which is used to gather more information about the ground water near wells with 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

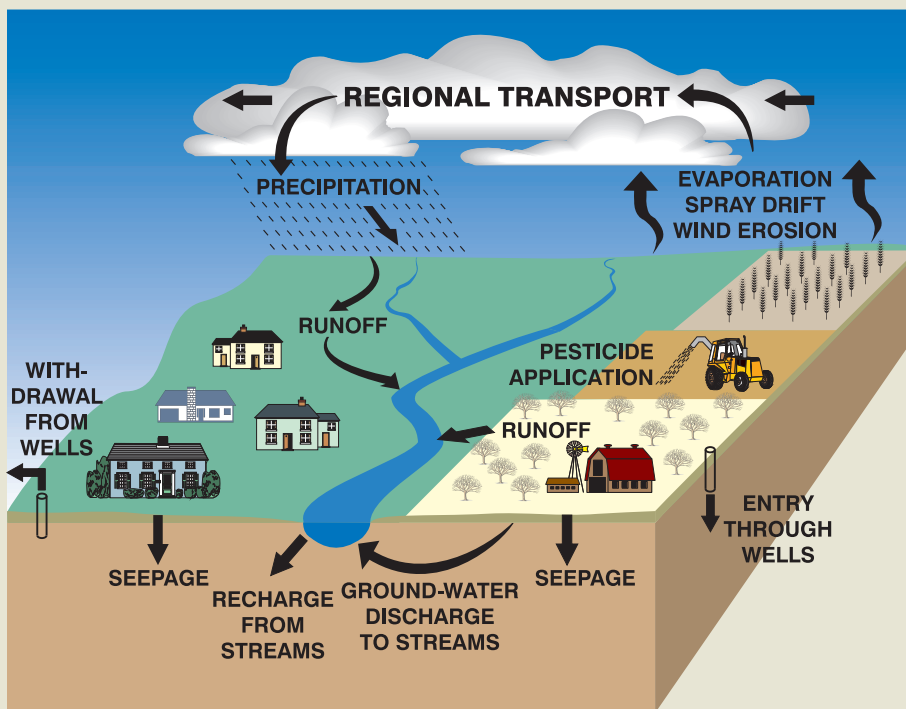


Figure 1. Pathways of pesticide movement in the hydrologic cycle (modified from Barbash and Resek, 1996).

**Table 1.** Baseline monitoring for pesticides in Crook County, late summer 2000 and spring 2001.[ $\mu\text{g/L}$ , micrograms per liter; NA, not applicable; E, estimated]

Pesticide	Pesticide trade name	Pesticide action <sup>1</sup>	Number of detections/ number of samples <sup>2</sup>	Laboratory minimum reporting limit <sup>3</sup> ( $\mu\text{g/L}$ )	Maximum concentration ( $\mu\text{g/L}$ )	Average concentration of detections <sup>4</sup> ( $\mu\text{g/L}$ )	Safe drinking water standard <sup>5</sup> ( $\mu\text{g/L}$ )
<b>Focal pesticides detected in Crook County ground water</b>							
Atrazine	Aatrex	Selective herbicide	3/19	0.007	0.02	E0.01	3
DCPA	Banvel	Herbicide	1/19	0.003	E0.004	NA	16
Picloram	Tordon	Systemic herbicide	4/19	0.09	2	0.7	500
Tebuthiuron	Spike	Herbicide	1/19	0.02	0.3	NA	<sup>6</sup> 500
<b>Non-focal pesticides detected in Crook County ground water</b>							
Prometon	Pramitol	Non-selective herbicide	6/19	0.02	0.1	E0.03	<sup>6</sup> 100
<b>Focal pesticides not detected in Crook County ground water</b>							
Alachlor	Aldicarb Sulfone <sup>7</sup>	Bromacil	Clopyralid	Dicamba	Metolachlor	Simazine	
Aldicarb	Aldicarb Sulfoxide <sup>7</sup>	2,4-D	Cyanazine	Hexazinone	Metribuzin	Telone	
<b>Focal pesticides not analyzed in Crook County ground water (no method of analysis available)</b>							
		Difenzoquat	Metsulfuron				

<sup>1</sup>Meister (1996)<sup>2</sup>Each of 9 wells was sampled twice. One well was only sampled in the summer of 2000.<sup>3</sup>The laboratory minimum reporting limit is the lowest concentration at which a pesticide concentration can be quantified without estimation.<sup>4</sup>The average concentration is noted as E, estimated, if one or more values used in the calculation was an estimated value.<sup>5</sup>EPA Maximum Contaminant Level unless otherwise noted (U.S. Environmental Protection Agency, 1996).<sup>6</sup>EPA Lifetime Health Advisory Level (U.S. Environmental Protection Agency, 1996).<sup>7</sup>Degradation product of Aldicarb.

Wyoming to determine the potential vulnerability of the county's ground water to pesticides. Each county was ranked based on 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).

A ground-water vulnerability map was prepared for the uppermost or shallowest aquifer (Hammerlink and Arneson, 1998). A Geographic Information System was used to overlay seven layers describing hydrogeology and 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 (focal pesticides) and 2 degradation products to be sampled as part of the SMP (table 1). The chemical analysis used to detect the focal pesticides can also detect 66 other pesticides and degradation products. Any additional pesticides 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 and metsulfuron, for which analytical methods were not available.

The goal of the ground-water sampling 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 (1995-96), Park (1997), Washakie (1997-98), Fremont (1998-99), Lincoln (1998-99), Laramie (1998-99), Big Horn (1999-2000), Sheridan (1999-2000), Platte (2000-01), Johnson (2000-01), and Crook (2000-01) Counties. Sampling is currently being conducted in Natrona, Sweetwater, and Teton Counties.

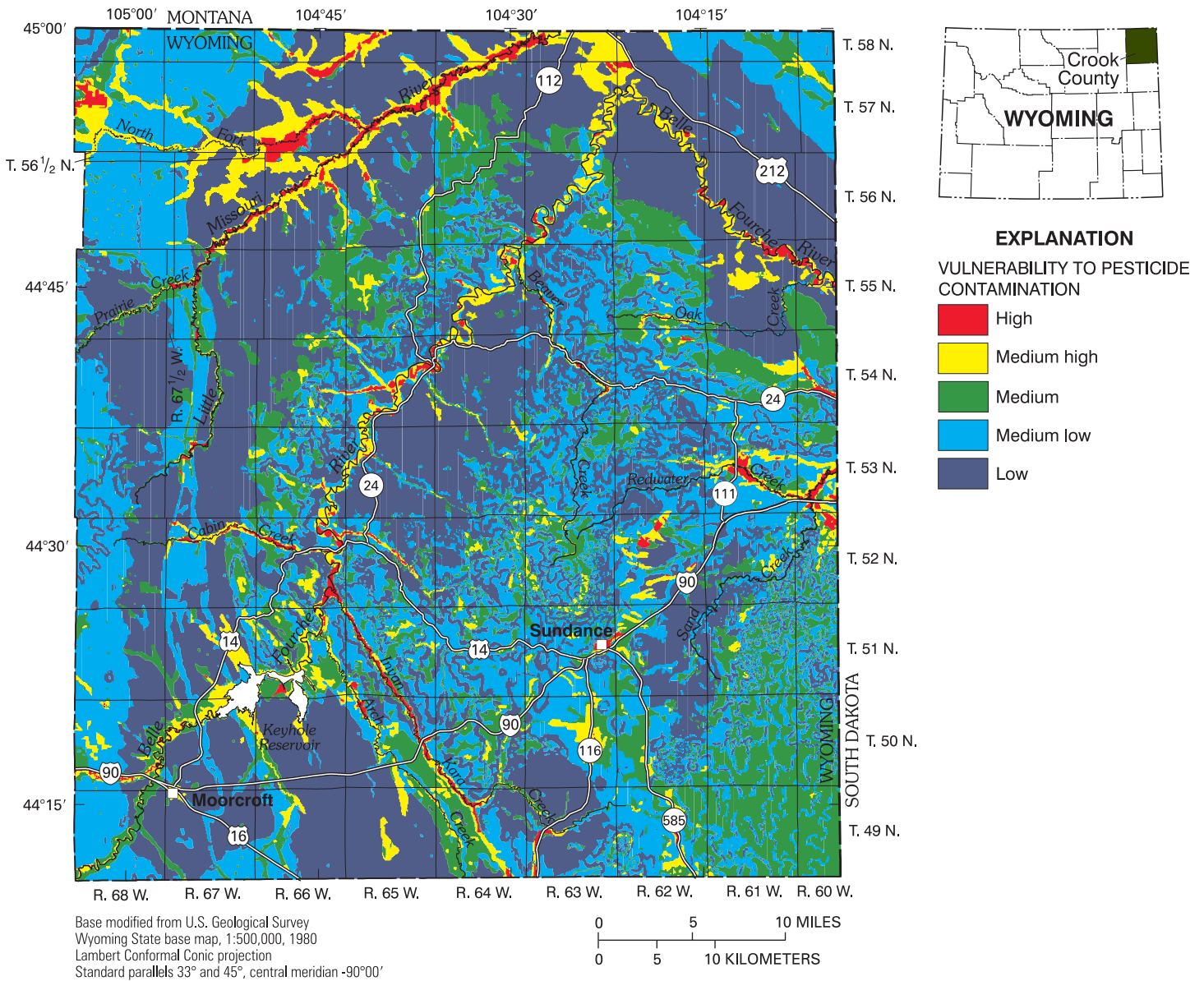
## GROUND-WATER MONITORING IN CROOK COUNTY

The ground water in Crook County was ranked eleventh most vulnerable to pesticide contamination in Wyoming (Wyoming Ground-water and Pesticide Strategy Committee, 1999). The vulnerability map for Crook County (fig. 2) (Hammerlink and Arneson, 1998) identifies shallow alluvial and terrace

deposits as the most vulnerable in the county.

Ten wells were selected in Crook County (fig. 3) for baseline monitoring. All wells were located in the Quaternary deposits deemed most vulnerable (shown as red in fig. 2). The wells were selected with the assistance of the Crook County Conservation District. Nine of the ten wells were sampled twice, in late summer 2000 and spring 2001. One well was only sampled in the late summer 2000, as the well had been taken out of service by spring 2001.

Four of the 18 focal pesticides and 1 non-focal pesticide were detected in Crook County (table 1). Pesticides were detected in 7 of the 10 wells sampled in Crook County; however, the concentrations of each pesticide detected were less than 1/150 of the applicable drinking-water standard (U.S. Environmental Protection Agency, 1996; Wyoming Department of Environmental Quality, 1993) (table 1). Some of the detections were less than the minimum reporting level, at trace concentrations. A trace concentration indicates that the pesticide was detected, but at a concentration too



**Figure 2.** Vulnerability of Crook County ground water to pesticide contamination (from Hammerlink and Arneson, 1998).

small to quantify without estimation. Trace concentrations are qualified with an “E” (table 1).

The most commonly detected pesticide in Crook County was prometon (detected in 6 out of 19 samples), the active ingredient in Pramitol. Prometon is a general-use pesticide and its detection is typically associated with urban land use (Barbash and others, 1999). This is different than most counties sampled for baseline monitoring, where atrazine was the most commonly detected pesticide (Goshen, Park, Washakie, Fremont, Laramie, Big Horn, and Platte Counties).

Picloram was the second most commonly detected pesticide in Crook County (detected in 4 out of 19 samples). Picloram is the active ingredient in the

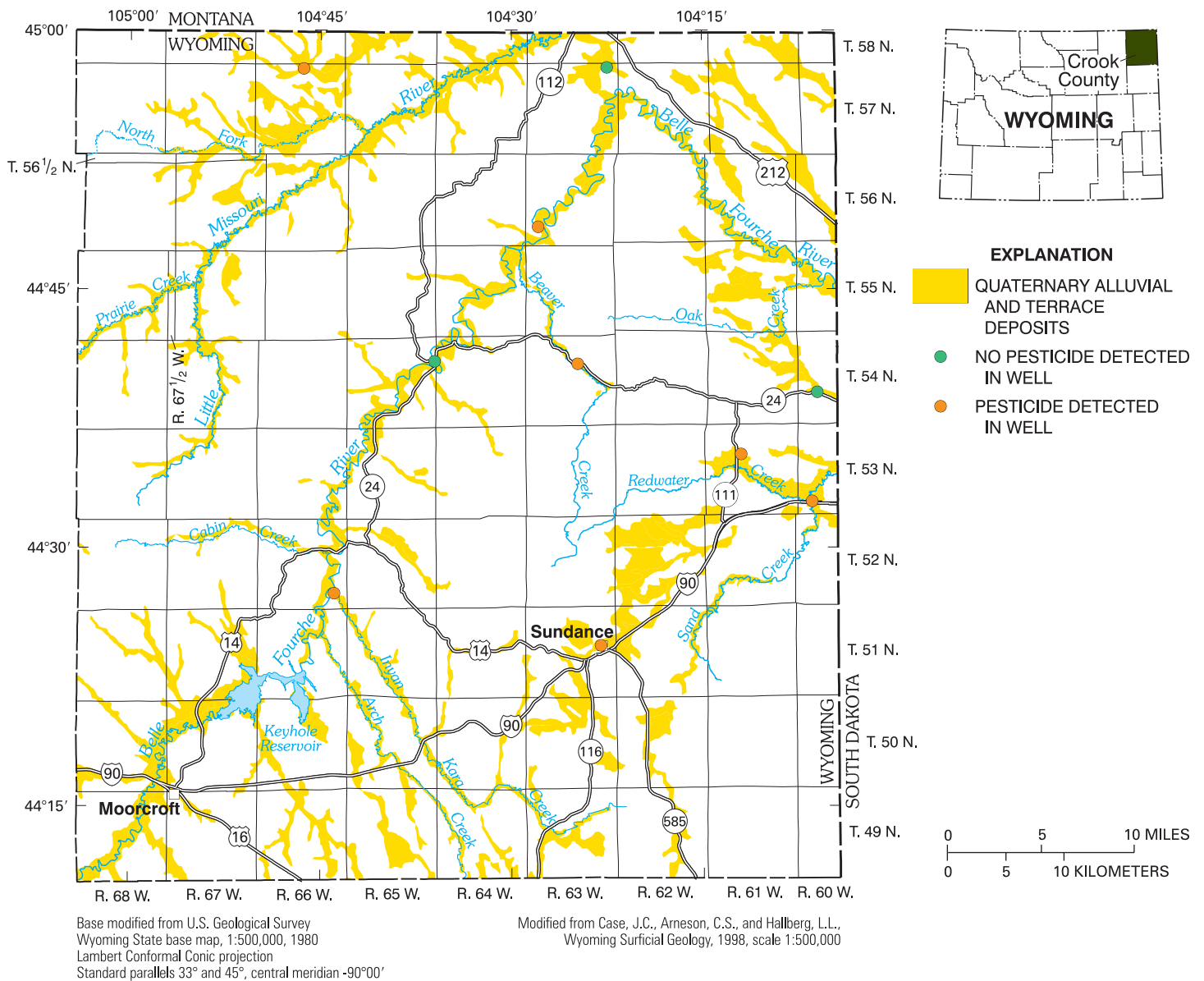
agricultural pesticide, Tordon, and is one of the most commonly used pesticides in Wyoming.

### DATA DISTRIBUTION AND AVAILABILITY

The sampling results have been provided to local groups interested in pesticides in ground water in Crook County. The information can be used by citizens and local governments to help understand current conditions. Analytical results of the Crook County sampling can be found in Mason and others (2001), and Swanson and others (2002). Analytical results and fact sheets for all counties sampled to date are available from the U.S. Geological Survey in Cheyenne, either by phone, email, or the internet (<http://wy.water.usgs.gov/projects/pesticide/>).

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**Figure 3.** Location of wells sampled in Crook County, Wyoming, and notation of pesticide detection in each well.

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