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Wyoming Department of Agriculture (WDA)

Wyoming Department of Environmental Quality (WDEQ), Water Quality Division

In cooperation with the Wyoming Department of Agriculture (WDA), the Wyoming Department of Environmental Quality (WDEQ), the Star Valley and Lincoln County Conservation Districts, and the Lincoln County Weed and Pest District

Pesticides in Ground Water - Lincoln County, Wyoming, 1998-99

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 1998, baseline monitoring began in Lincoln 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 drinking water (Solley and others, 1998), although application rates and the variety of pesticides used may be greater in urban areas.

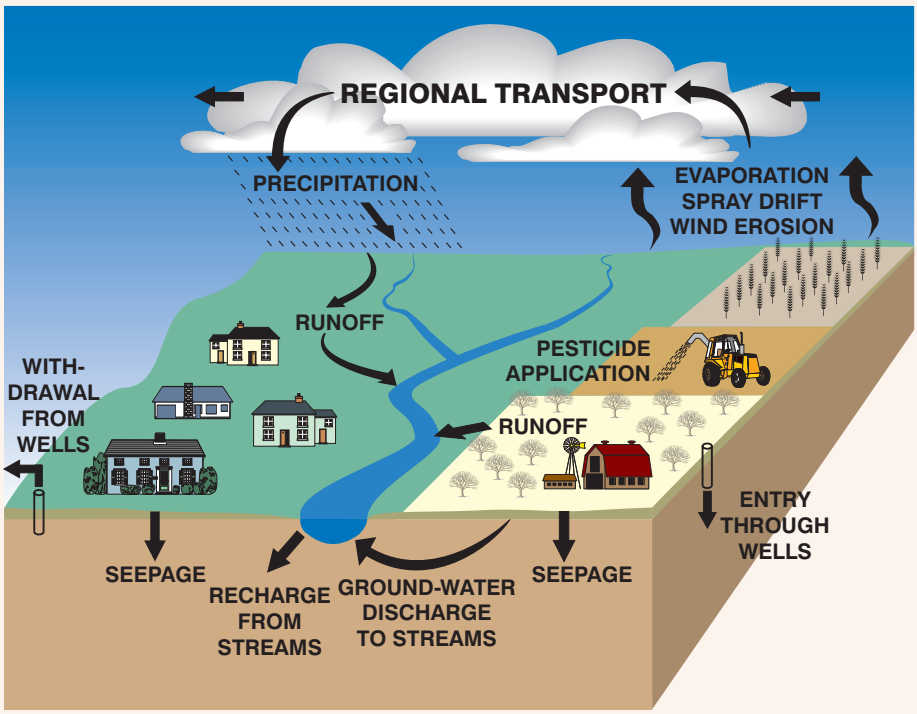

Figure 1. Pathways of pesticide movement in the hydrologic cycle (modified from Barbash and Resek, 1996).

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). The SMP is required by the U.S. Environmental Protection Agency (EPA) in order for organizations and individuals to continue using certain pesticides in Wyoming. The SMP includes information relating to organizations and individuals 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 an initial survey of pesticides in a county's ground water. The second phase is problem identification monitoring, which is used to gather more information about the ground water

Table 1. Baseline monitoring for pesticides in Lincoln County, 1998-99.

[μg/L, micrograms per liter; trace indicates pesticide detected, but at a concentration too small to quantify; NA, not applicable]

Pesticide	Pesticide trade name	Pesticide action[1]	Number of detections/ number of samples[2]	Laboratory minimum reporting limit (μg/L)	Maximum concentration (μg/L)	Average concentration of detections (μg/L)	Safe drinking water standard[3] (μg/L)
Focal pesticides detected in Lincoln County ground water							
Picloram	Tordon	Systemic herbicide	2/30	0.05	0.3	0.2	500
Non-focal pesticides detected in Lincoln County ground water							
Prometon	Pramitol	Non-selective herbicide	1/30	0.02	trace	NA	[4]100
Focal pesticides not detected in Lincoln County ground water							
2,4-D		Aldicarb Sulfone[5]	Bromacil	DCPA	Metolachlor	Tebuthiuron	
Alachlor		Aldicarb Sulfoxide[5]	Clopyralid	Dicamba	Metribuzin	Telone	
Aldicarb		Atrazine	Cyanazine	Hexazinone	Simazine		
Focal pesticides not analyzed in Lincoln County ground water (no method of analysis available)							
Difenzoquat		Metsulfuron					

[1]Meister, R.T., 1996

[2]Each of the 15 wells were sampled twice.

[3]EPA Maximum Contaminant Level unless otherwise noted (EPA, 1996).

[4]EPA Lifetime Health Advisory Level (EPA, 1996).

[5]Degradation product of Aldicarb.

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 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 by the University of Wyoming Spatial Data and Visualization Center (SDVC). A Geographic Information System was used to overlay seven coverages describing hydrogeology and land use. The map produced 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). An additional 66 pesticides and degradation products are included in the U.S. Geological Survey analytical protocol, resulting in possible detections of 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 because analytical methods were not available for their analysis.

The goal of the sampling program is to collect ground-water samples for pesticide analyses in all 23 Wyoming counties. The ground-water sampling part of the SMP began in Goshen County in 1995. Sampling in Park and Washakie Counties was conducted in 1997, and completed by 1998. In August 1998, sampling began in Fremont, Lincoln, and Laramie Counties. The sampling for these three counties was completed in May 1999.

GROUND-WATER MONITORING IN LINCOLN COUNTY

The ground water in Lincoln County was ranked the fifth most vulnerable to pesticide contamination in Wyoming. The vulnerability map for Lincoln County (fig. 2) was created by the SDVC (Hammerlink and Arneson, 1998) . Shallow alluvial and terrace deposits and some of the high mountain areas were identified as the most vulnerable areas in the county. The high mountain areas were not sampled, however, as pesticides are rarely used in these areas.

Fifteen sites were selected for baseline monitoring in Lincoln County (fig. 3). All wells were located in the most vulnerable areas (shown as red or yellow in fig. 2). The wells were inspected and selected with the assistance of the Star Valley and Lincoln County Conservation Districts and the Lincoln County Weed and Pest District. All sites were sampled twice, late summer 1998 and spring 1999. These time periods were selected to correspond with the deepest or shallowest water-table conditions.

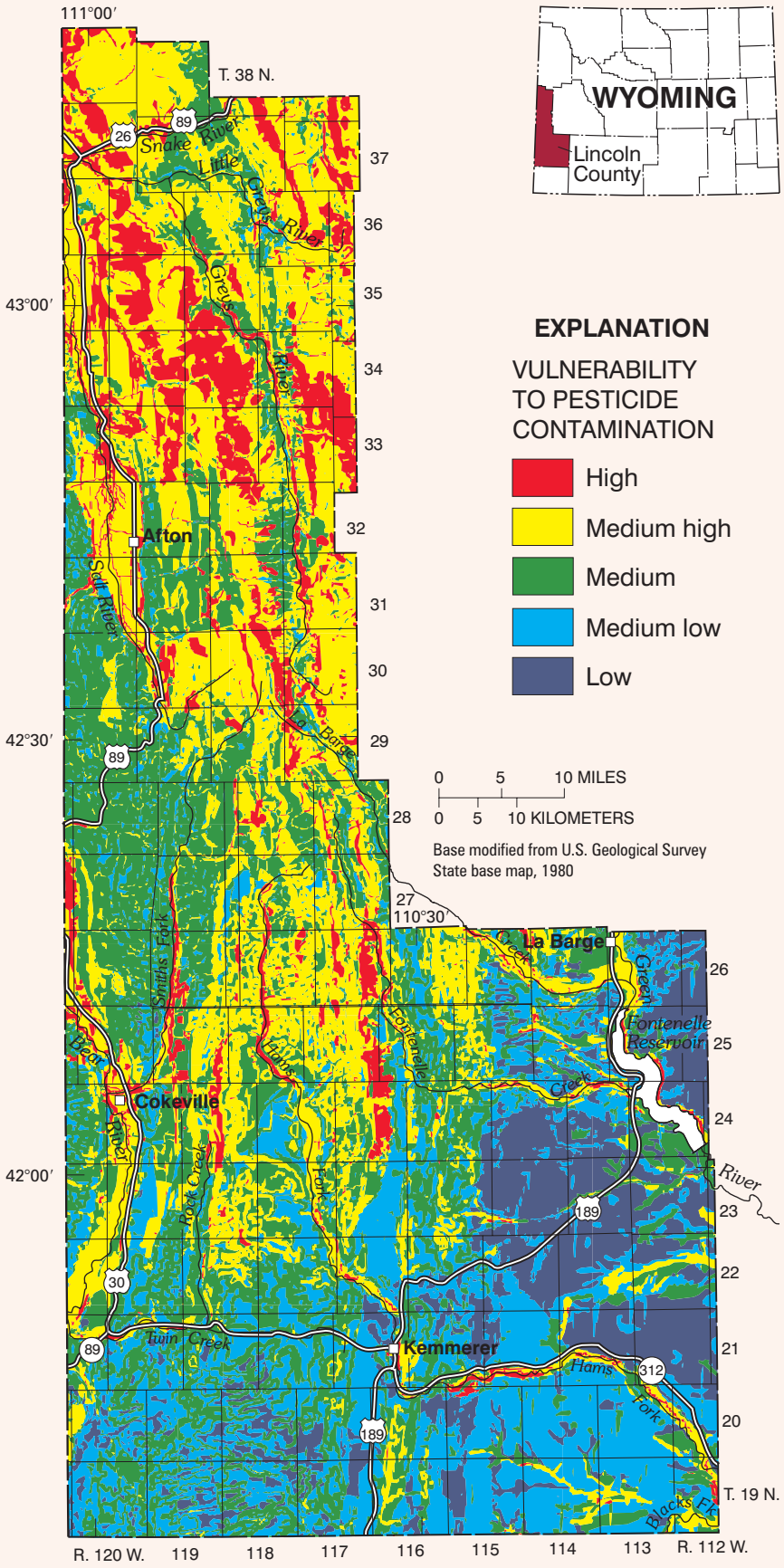

Figure 2. Vulnerability of Lincoln County ground water to pesticide contamination (from Hammerlink and Arneson, 1998).

One of the 18 focal pesticides and 1 non-focal pesticide were detected in Lincoln County (table 1). One pesticide was detected in 3 of the 15 wells sampled in Lincoln County. All concentrations of pesticides were less than the drinking water standards (U.S. Environmental Protection Agency, 1996). The laboratory minimum reporting limit is the lowest concentration at which the pesticide can be quantified. Two of the three detections were trace quantities. A trace quantity indicates the pesticide was detected, but at a concentration too small to quantify.

The most commonly detected pesticide (found in two wells) in Lincoln County was picloram. Picloram was also the pesticide detected at highest concentration in Lincoln County ground water at 0.3 micrograms per liter (parts per billion). Picloram is the active ingredient in Tordon, an herbicide, and is one of the most commonly used pesticides in Wyoming. This is different from other counties where baseline monitoring has been completed (Goshen, Park, Washakie, Fremont, and Laramie Counties), as atrazine was the most commonly detected pesticide in those counties. The other pesticide detected (one well) in Lincoln County was prometon. Prometon is 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).

MONITORING STATUS AND DATA AVAILABILITY

The sampling results have been given to local groups interested in pesticides in ground water in Lincoln County. The information can be used by citizens and local governments to help understand current conditions. Results of the Lincoln County sampling can be found in Mason and others, 1999, and Swanson and others, 2000. Results of all analyses including sampling of all counties to date are available from the U.S. Geological Survey in Cheyenne.

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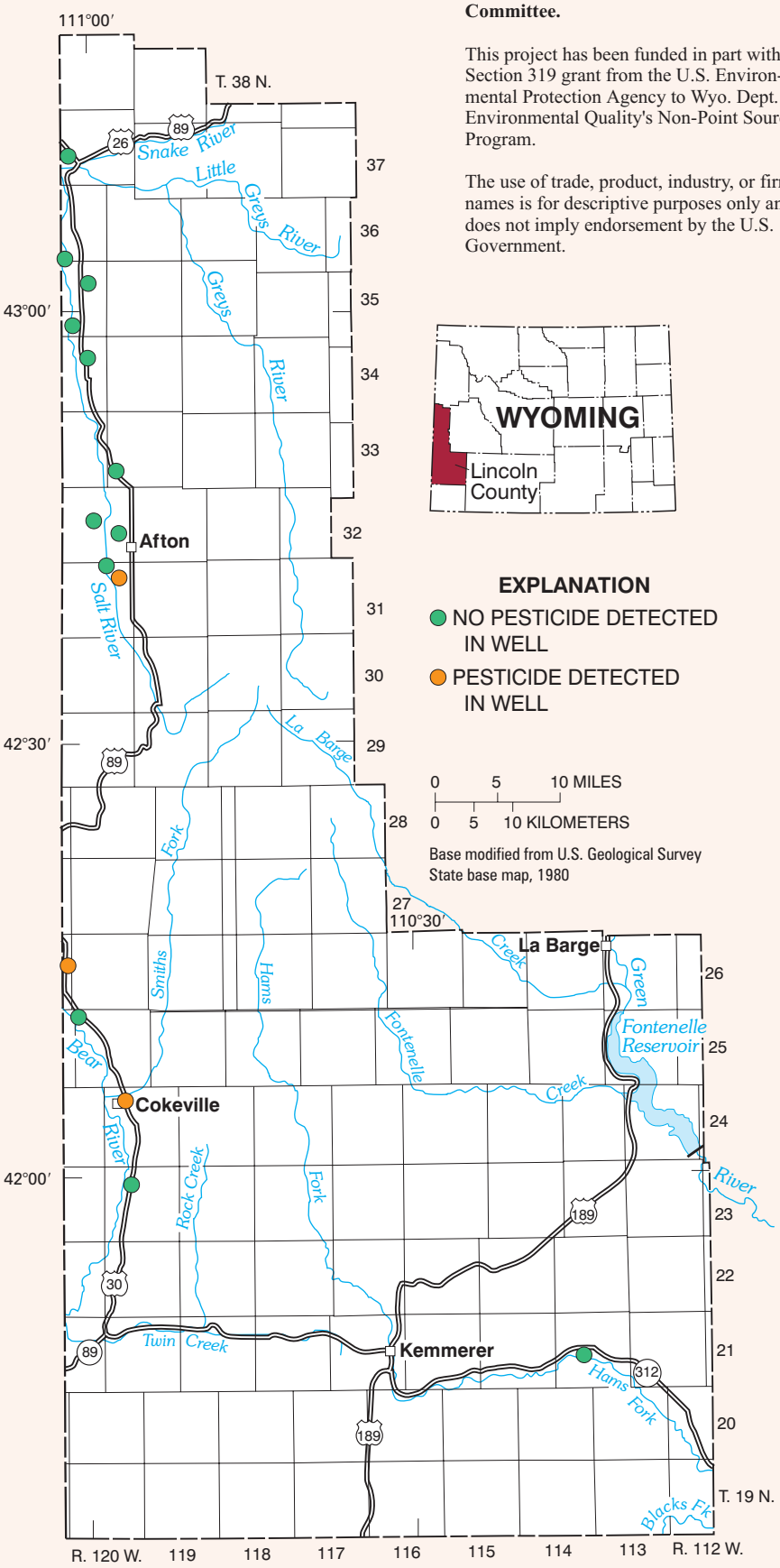

Figure 3. Location of wells sampled in Lincoln County, and notation of pesticide detection in each well.