Monitoring for Agricultural Chemicals in the Groundwater of the Flaxville Formation in Northeastern Montana, 2010

Montana Department of Agriculture, Groundwater Protection Program

Project Summary

During the summer of 2010, the Montana Department of Agriculture (MDA) collected 24 groundwater samples from 12 wells that obtain water from the Flaxville Formation to test for pesticides and the nutrient nitrate (Figure 1). The Flaxville Formation is made up of gravels deposited by intermittent desert streams from 2.5-10 million years ago. These deposits once covered much of the western Great Plains but have subsequently been eroded and only small remnants now remain. In Montana, these remnants are referred to as the Flaxville Formation and exist in the northeastern part of the state (Figure 1). Land use in these areas is largely devoted to dryland small grain production, mostly wheat, grown in a crop-fallow rotation. Because the Flaxville Formation has high permeability and generally contains shallow groundwater (<50 ft deep), aquifers in the Flaxville Formation are susceptible to impacts from the application of agricultural chemicals.

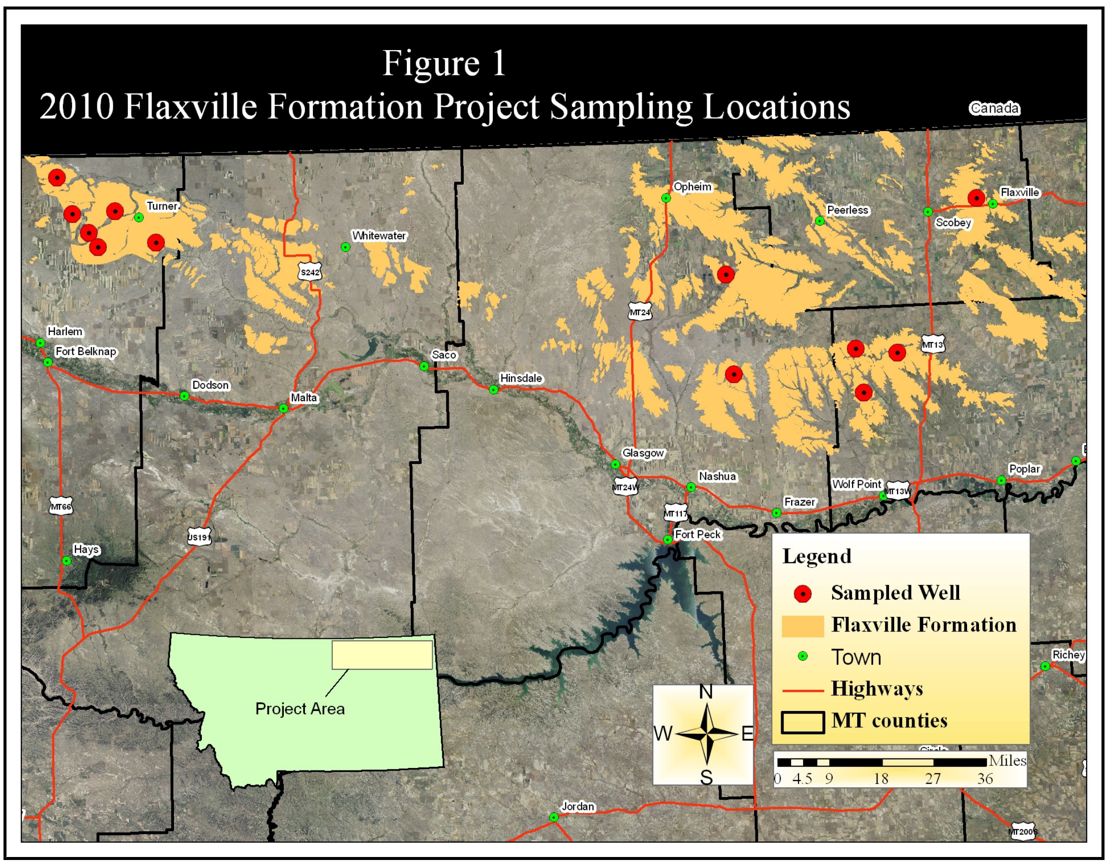


Figure 1
2010 Flaxville Formation Project Sampling Locations

Groundwater samples collected during this project were taken to the MDA Analytical Laboratory Bureau and analyzed for 94 pesticide compounds (herbicides, insecticides, and fungicides) and nitrate. Samples were collected in late April and again in late July, 2010.

Pesticide Results

Laboratory results indicated the presence of eleven pesticide compounds, all of which were herbicides (Table 1). The most common detections were of atrazine and its degradates, or break down products, deethyl atrazine, deisopropyl atrazine, and hydroxy atrazine. At present, atrazine is largely used in corn and soybean crops. It also has the potential to be used post-harvest in small grains and in fallowed small grain fields. The second most common detection was prometon which is pesticide used in non-crop areas. Prometon is a non-selective herbicide used in areas where long-term weed and vegetation control are desired. Prometon is commonly applied with simazine, another herbicide detected during this project. Chlorsulfuron and triasulfuron are herbicides commonly used in wheat crops. Imazapyr is another non-selective herbicide used in non-crop areas. None of the pesticide concentrations exceeded the human health standard for drinking water.

Table 1. Summary of Pesticide Detections

Pesticide Compound	Number of Samples Collected	Number of Detections	Percent of Samples with Detections	Summary of Detections			Human Health Standard for Drinking Water (µg/L)
				Minimum Concentration (µg/L)	Median Concentration (µg/L)	Maximum Concentration (µg/L)	
Atrazine	24	5	21	<0.0022	0.074	0.73	3*
Chlorsulfuron	24	4	17	<0.0056	--	0.091	1,750
Deethyl atrazine	24	8	33	<0.0017	0.013	0.59	3*
Deisopropal atrazine	24	2	8	0.031	0.037	0.042	3*
Hydroxy atrazine	24	2	8	<0.0064	--	0.012	70
Imazapry	24	2	8	<0.011	--	0.019	21,000
Metolachlor ESA	24	1	4	--	--	<0.0025	100
Picloram	24	1	4	--	--	0.14	500
Prometon	24	5	25	<0.0051	0.037	0.086	100
Simazine	24	2	13	<0.0026	--	0.0073	4
Triasulfuron	24	1	8	<0.026	--	0.1	70

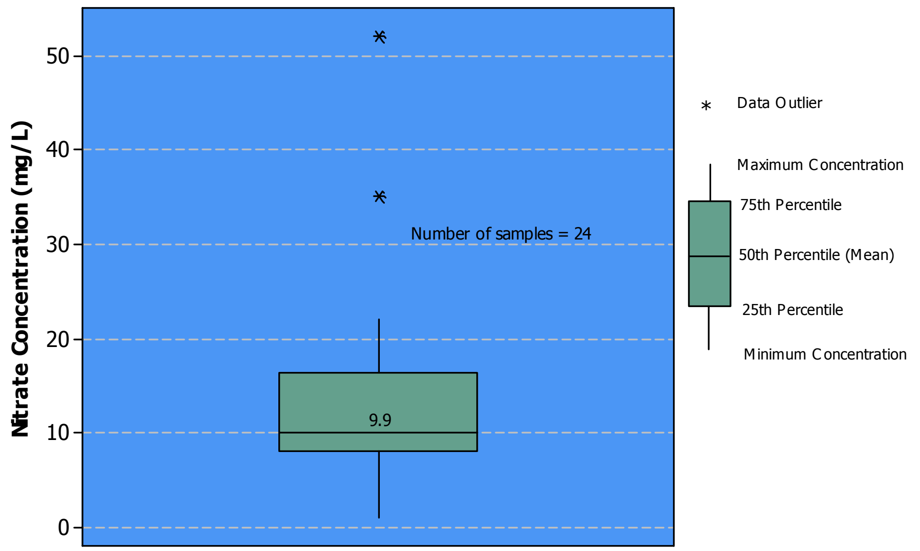
* Parent compound and metabolite concentrations are added together before being compared to the drinking water standard

Nitrate Results

Nitrate was detected in all 24 groundwater samples collected. Concentrations ranged from 1.0-52.0 mg/L with a mean concentration of 9.9 mg/L (Figure 2). Nitrate concentrations exceeded the human health standard for drinking water of 10 mg/L in 11 of 24 samples and at six of the 12 sites sampled.

Previous work by others has also found elevated nitrate concentrations in the groundwater of the Flaxville Formation. The Montana Bureau of Mines and Geology (MBMG) routinely collects groundwater samples from around the state to test for nitrates, and have collected 118 samples from wells completed in the Flaxville Formation. The mean nitrate concentration for these samples is 11.2 mg/L (data from the MBMG Groundwater Information Center database). Nimick and Thamke, 1998, collected

Figure 2. Summary of Nitrate Concentrations



63 groundwater samples from the Flaxville Formation on the Ft. Peck Indian Reservation. The mean nitrate concentration during this study was 17.7 mg/L.

Nimick and Thamke, 1998, also used nitrogen and oxygen isotope testing to try and determine the source of nitrate. Nitrate has several potential sources including fertilizer, animal waste, sewage, soil nitrogen, and natural sources. They found the source to be predominantly soil nitrogen which was being created by the summer fallowing of wheat fields. When wheat fields are left fallow, the left over stubble and root masses from the previous year's crop will decompose. This decomposition releases nitrogen into the soil, which is converted to nitrate (NO_3) by microorganisms in the soil. The nitrate is then leached to groundwater by snow melt or precipitation.

Summary

All of the pesticides detected during this project were not at concentrations of concern when compared to drinking water standards. The number and frequency of pesticide compounds detected was relatively low when compared with data from other areas of the state. Nitrate was frequently detected at concentrations that were either elevated or above the drinking water standard of 10 mg/L. Nitrate concentrations are commonly elevated in groundwater below areas where cereal crops are grown in a crop/fallow rotation, which is one of the predominate land uses above the Flaxville Formation.

References

Nimick, D.A, and Thamke, J.N., 1998, Extent, magnitude, and sources of nitrate in the Flaxville and underlying aquifers, Fort Peck Indian Reservation, northeastern Montana: U.S. Geological Survey Water-Resources Investigations Report 98-4079, 45 p.

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