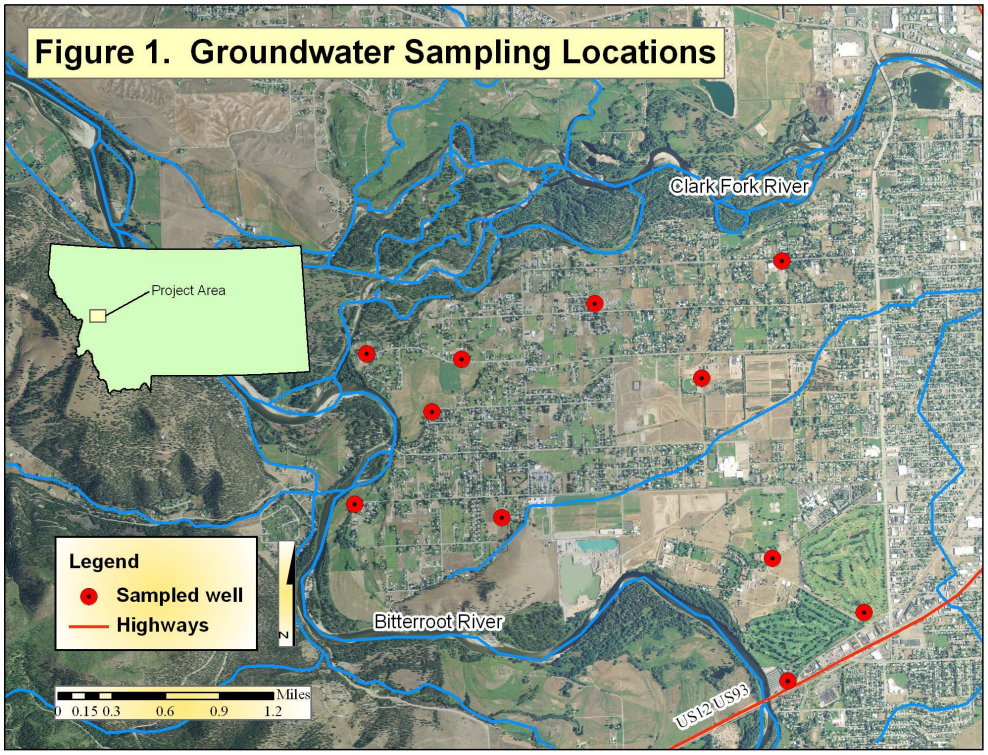
Groundwater Monitoring for Pesticides and Nitrate in the Missoula Aquifer Under Orchard Homes, Missoula County

Montana Department of Agriculture, Groundwater Protection Program

Project Summary

In mid-August, 2010, the Montana Department of Agriculture (MDA) collected eleven groundwater samples from wells that obtain water from the Missoula Aquifer in the Orchards Homes area of Missoula County to test for pesticides and the nutrient nitrate (Figure 1). The Missoula Aquifer is made up of sand, gravel, and cobbles and is the sole source aquifer for residents in the Missoula Valley. Because the aquifer is shallow, permeable, and overlain by permeable soils, it is susceptible to impacts by human activities at the surface.

Pesticides are commonly used in residential and urban settings to control weeds and insects around homes, parks, golf courses, road sides, and other areas. Fertilizers are also commonly used in gardens and lawns. As Orchard Homes is largely a residential community, the MDA decided to collect groundwater samples under this area to monitor for potential impacts from the use of pesticides and fertilizers in residential settings.



Groundwater samples collected during this project were taken to the MDA Analytical Laboratory Bureau at Montana State University and analyzed for 94 pesticide compounds (herbicides, insecticides, and fungicides) and nitrate. A summary of laboratory results are included in Table 1.

Pesticide Results

The most common pesticide detected was atrazine and one of its degradates (break down product), deethyl atrazine. The source of the atrazine is unclear. Atrazine has not had any residential uses since 1993, when the herbicide was largely restricted to corn and soybean crops. It can also still be used for roadsides and in fallowed cereal fields, but these uses are believed to be rare. It may be that once present in groundwater atrazine and its degradates last for long periods without degrading further and the presence of atrazine is from historical uses. Alternatively, there is the possibility that atrazine impacts may be occurring from atmospheric deposition. Atrazine has been detected in air and precipitation samples from other parts of the country (Rawn et al, 1998). Atrazine and its degradates are the most commonly detected pesticides in Montana and across the U.S. If atmospheric deposition is occurring, then atrazine and its degradates may just be ubiquitous in many bodies of water across the state.

The next most commonly detected group of pesticides, including prometon, simazine, and tebuthiuron, are herbicides used in non-crop settings. These three herbicides are commonly associated with residential, urban, and roadside uses. Prometon and simazine are used in areas where long-term weed and vegetation control are desired. Tebuthiuron is a broad spectrum herbicide used in non-crop areas, rangeland, pastures, rights-of-way, and industrial sites. All of the pesticide detections were at very low concentrations, and none of the concentrations exceeded or approached the human health drinking water standard (Table 1).

Table 1. Summary of Pesticide and Nitrate Detections

Pesticide Compound	Number of Samples	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	11	6	55	<0.0022	--	0.0041	3*
Bromacil	11	1	9	--	--	0.2	90
Chlorsulfuron	11	1	9	--	--	<0.0056	1,750
Deethyl Atrazine	11	9	82	<0.0017	0.0052	0.0072	3*
Hexazinone	11	1	9	--	--	<0.0059	400
Imazapyr	11	1	9	--	--	0.043	21,000
Nitrate	11	10	91	0.11 mg/L	1.1 mg/L	1.8 mg/L	10 mg/L
Prometon	11	9	82	<0.0051	0.0089	0.011	100
Simazine	11	4	36	<0.0026	--	0.0053	4
Tebuthiuron	11	7	64	<0.0011	0.0017	0.0049	500

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

Nitrate Results

Nitrate was detected in 10 of the 11 groundwater samples (Table 1). Nitrate has several different potential sources including sewage, fertilizer, cropping practices, and natural sources. No attempt was made to try and determine the source of nitrates detected during this project. The nitrate concentrations during this project were low, with a maximum concentration of 1.8 mg/L and a median of 1.1 mg/L. None of the detections exceeded or approached the drinking water standard of 10 mg/L.

Summary

Four pesticides were frequently detected in the groundwater of the Missoula Aquifer below Orchard Homes. All of the detections were at very low concentrations that did not exceed or approach drinking water standards. Three of the four pesticides – prometon, simazine, and tebuthiuron – are herbicides commonly used on non-crop lands such as urban areas. The source of the fourth, atrazine and its degradates, remains unclear but may be from historical use or from atmospheric deposition. Nitrate, while frequently detected, was at concentrations generally considered below background levels.

References

Rawn, D.F. Halldorson, H.J., and Muir, D.C.G., 1998, Atmoshpheric Transport and Deposition, an Additional Input Pathway for Atrazine to Surface Water: in Triazine Herbicides: Risk Assessment, American Chemical Society Symposium Series, Vol. 683, Chapter 15, pp. 158-176.

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