

[Idaho Department of Water Resources](#)
Technical Summary

**Nitrate Results From The Statewide Program,
1991-2000**

[Ken Neely](#)
208.327.5455

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Introduction

From 1991 through 2000, 1,553 monitoring sites were sampled for nitrate as part of the Statewide Ambient Ground Water Quality Monitoring Program (Statewide Program). Most of the sites have been sampled more than once during this 10-year time period. This report is a summary of the maximum nitrate value recorded for each site from 1991 through 2000. Statewide Program results indicate that nitrate has impacted the ground water quality throughout Idaho with the ground waters in the southern part of the state affected by nitrate more than the ground waters in the central and northern parts of Idaho. About six percent of the Statewide Program sites had at least one sampling event in the time period from 1991 to 2000 where the nitrate concentration exceeded the maximum contaminant level (MCL) of 10 milligrams per Liter. The MCL is the standard set by the U.S. Environmental Protection Agency for public drinking water supplies.

What is nitrate?

[Nitrate](#) (NO₃) is an oxidized form of nitrogen that typically comes from inorganic fertilizers, decaying organic matter, wastewater from commercial operations, animal manure and human sewage (Figure 1). The largest use of nitrates is in fertilizer ([EPA, 2001](#)). In rare cases, nitrate can also originate from geologic formations. Nitrate is mobile in water and thus can easily move into ground water. Nitrate is the most

widespread of the preventable contaminants in Idaho's ground-water supplies and therefore is an important indicator of ground-water quality impacts.

Nitrate is significant because of the health concerns associated with elevated levels. It can cause blue baby syndrome, also known as methemoglobinemia ([Skipton and Hay, 1996](#); [Ziebarth, 1995](#)), which is an oxygen deficiency that can induce illness and death in infants. This risk may be greatly increased by bacteria and other microbes in drinking water. Boiling the water is not a viable treatment for nitrate; in fact, it will likely increase the concentration of nitrate in the water. Health officials recommend that water with greater than 10 milligrams per liter (mg/l) nitrate not be used for drinking, cooking or formula preparation for infants six months of age and younger, or for pregnant women. Water with nitrate concentrations greater than 10 mg/l can also be a factor in health concerns for elderly infirm.

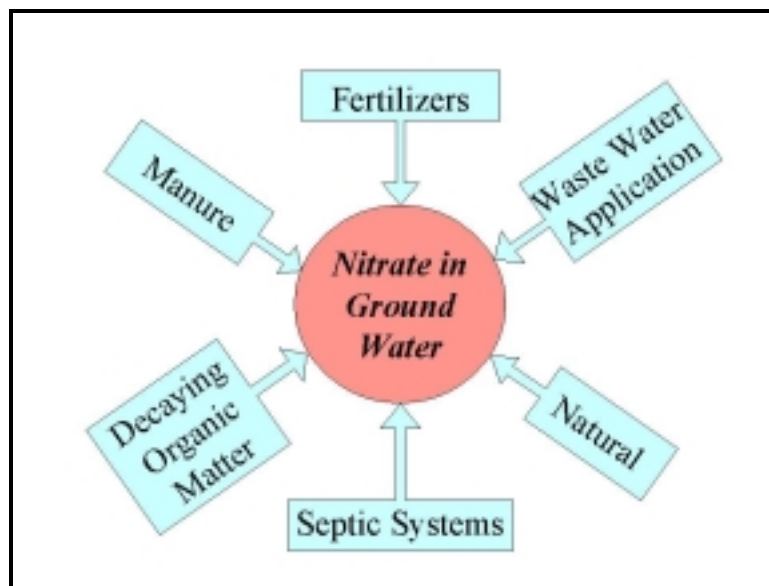


Figure 1. Nitrate sources in ground water.

Statewide Program Overview

The Statewide Program has been in existence since 1990. Over 1,500 monitoring sites (existing wells and springs) have been sampled for a wide variety of ground water quality parameters, such as common ions (calcium, magnesium, etc.), trace elements (iron, copper, etc.), bacteria, nutrients, radioactivity, volatile organic compounds, and pesticides. Most of the monitoring sites (67%) are used for domestic purposes; other uses include irrigation, public supply, stock, commercial, industrial, and a few other minor uses. Most monitoring sites are currently scheduled for sampling on a once-every-five-years basis. About 100 sites, called Annual Sites, are sampled every year.

A more complete description of the Statewide Program can be found on IDWR's website: <http://www.idwr.state.id.us/planpol/techserv/gwmon/statewide.htm>.

Statewide Nitrate Results

The Idaho Department of Water Resources completed a [technical summary of nitrate](#) data in 1999. This summary showed that ground water in Idaho had been impacted by nitrate, especially in the southern part of the state. This summary also indicated that nitrate levels had increased by 1 milligram per Liter (mg/L) or more at twice as many sites as the number of sites where the nitrate concentrations decreased at 1 mg/L or more between the First Round of sampling (1991-1994) and the Second Round (1995-1998).

This technical summary was designed to analyze and report the **maximum nitrate value** for each site during the years 1991 – 2000. Some sites only had one sampling event during that time period, and some sites had as many as seven sampling events. However, only the maximum nitrate value for each site was considered for this summary. Additional nitrate and other ground water quality data for each site can be obtained through IDWR's website (<http://www.idwr.state.id.us/usbr/default.htm>), or by contacting [Ken Neely](#) (327.5455), [Ed Hagan](#) (327.5445) or [Lin Campbell](#) (327.7965).

Statistical results for the 1553 Statewide Program sites are shown in Table 1. IDWR considers the median value more representative of the center of the data than the mean since the nitrate data are strongly skewed to the right. Figure 2 shows four ranges of nitrate concentrations and the percent of sites in each range. The maximum contaminant level (MCL) for nitrate for public drinking water supplies is 10 milligrams per Liter, as established by the [Environmental Protection Agency](#). IDWR considers nitrate levels of 2 mg/L and greater to indicate that impact to the ground water quality has occurred from one or more nitrogen sources. Forty-two percent of the Statewide Program sites had the maximum nitrate result equal to or greater than 2 mg/L for the years 1991 – 2000.

Table 1. Summary statistics for the maximum nitrate value recorded at each Statewide Program monitoring site for the years 1991 – 2000.

Number of Monitoring Sites with at least one nitrate analysis	1553
Minimum concentration	0.01 mg/L
Maximum concentration	110 mg/L
Median	1.5 mg/L
Mean	3.4 mg/L
Standard Deviation	7.4 mg/L
Variance	54.6 mg/L

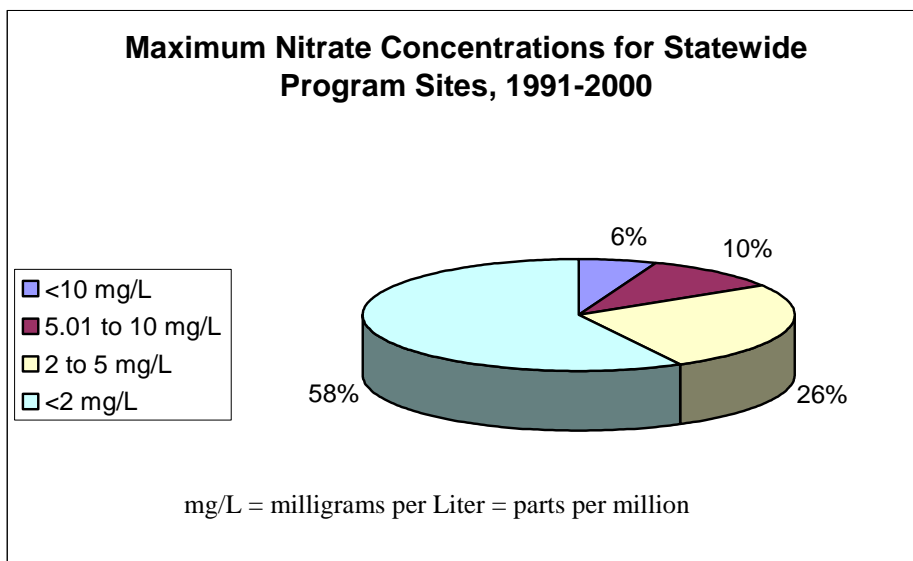


Figure 2. Four ranges of nitrate concentrations and the percentage of sites with the maximum value in these ranges.

Figure 3 shows the percent of sites in each county where the maximum nitrate value was greater than 5 mg/L. Two hundred and seventy-eight of the 1553 sites (16%) had a maximum nitrate value that was greater than 5 mg/L. The southwest, south central, and the southeast parts of the state had the highest percentage of sites with nitrate greater than 5 mg/L. Twin Falls County had the highest percentage of sites (42%) with maximum nitrate values over 5 mg/L.

Figure 4 shows the percent of sites in each county where the maximum nitrate value was greater than the MCL of 10 mg/L. The southwest part of the state showed the greatest impact with respect to percent of sites with nitrate over 10 mg/L. Owyhee County had the highest percentage of sites with maximum nitrate values over 10 mg/L (29%).

Results from statistical tests (regression analysis and Pearson Correlation) did not show strong correlations between well depths and nitrate concentrations. These tests were conducted for all of the sites collectively, and separately for the sites in each region. The strongest Pearson Correlation coefficient was -0.144 for one of the Reporting Regions (Pearson coefficients can range from -1 to $+1$ with the two end members indicating perfect correlation, and a "0" for a coefficient indicating no correlation).

Statistical analyses using the Mann-Whitney rank sum test showed that median nitrate value for domestic wells (1.4 mg/L) was significantly lower than median for irrigation wells (1.9 mg/L) at the 95 percent confidence level. However, the median nitrate value for domestic wells was not significantly different than the median values for commercial (1.0 mg/L), production (1.0 mg/L), or stock (1.5 mg/L) site use categories at the 95 percent confidence level.

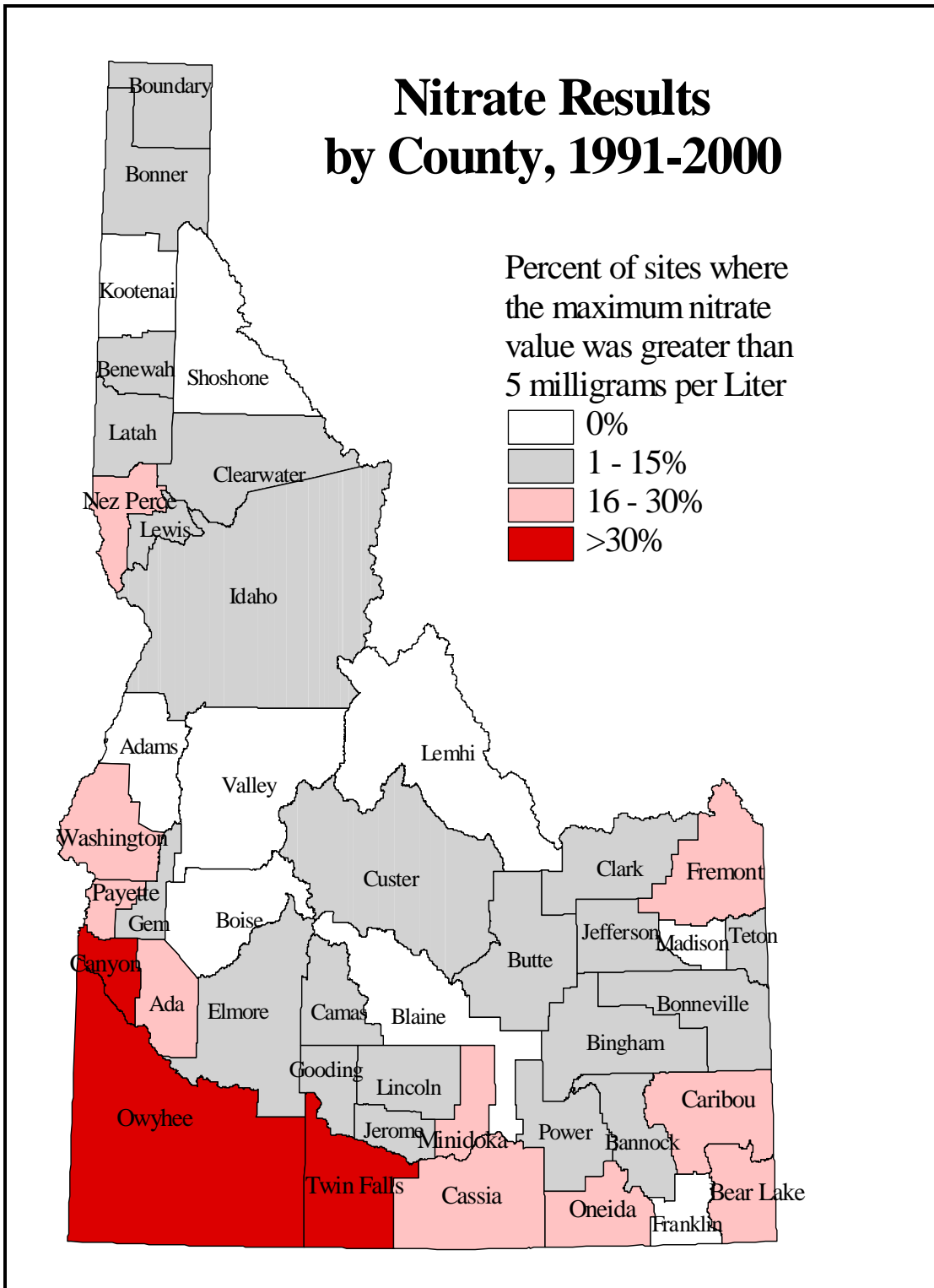


Figure 3. Percent of sites in each county with nitrate concentrations greater than 5 milligram per liter (based on the maximum nitrate data for each site for the years 1991 – 2000).

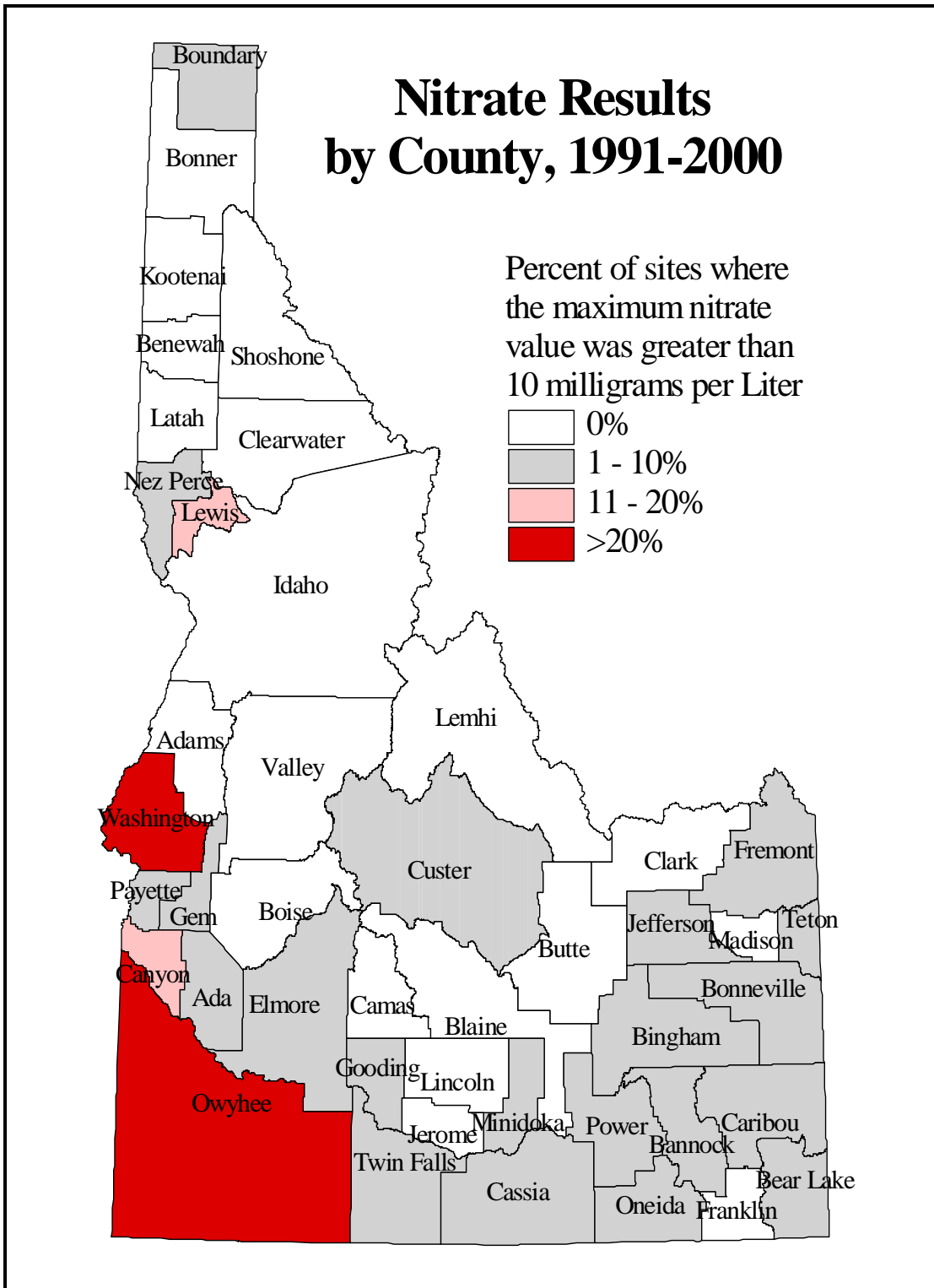


Figure 4. Percent of sites in each county with nitrate concentrations greater than 10 milligram per liter (based on the maximum nitrate data for each site for the years 1991 – 2000).

Nitrate results for each county can be selected from the [statewide map](#), or in the individual sections listed as follows for each reporting region.

Nitrate Results in Seven Reporting Regions

Figure 5 shows the Reporting Regions where detailed nitrate information can be found.

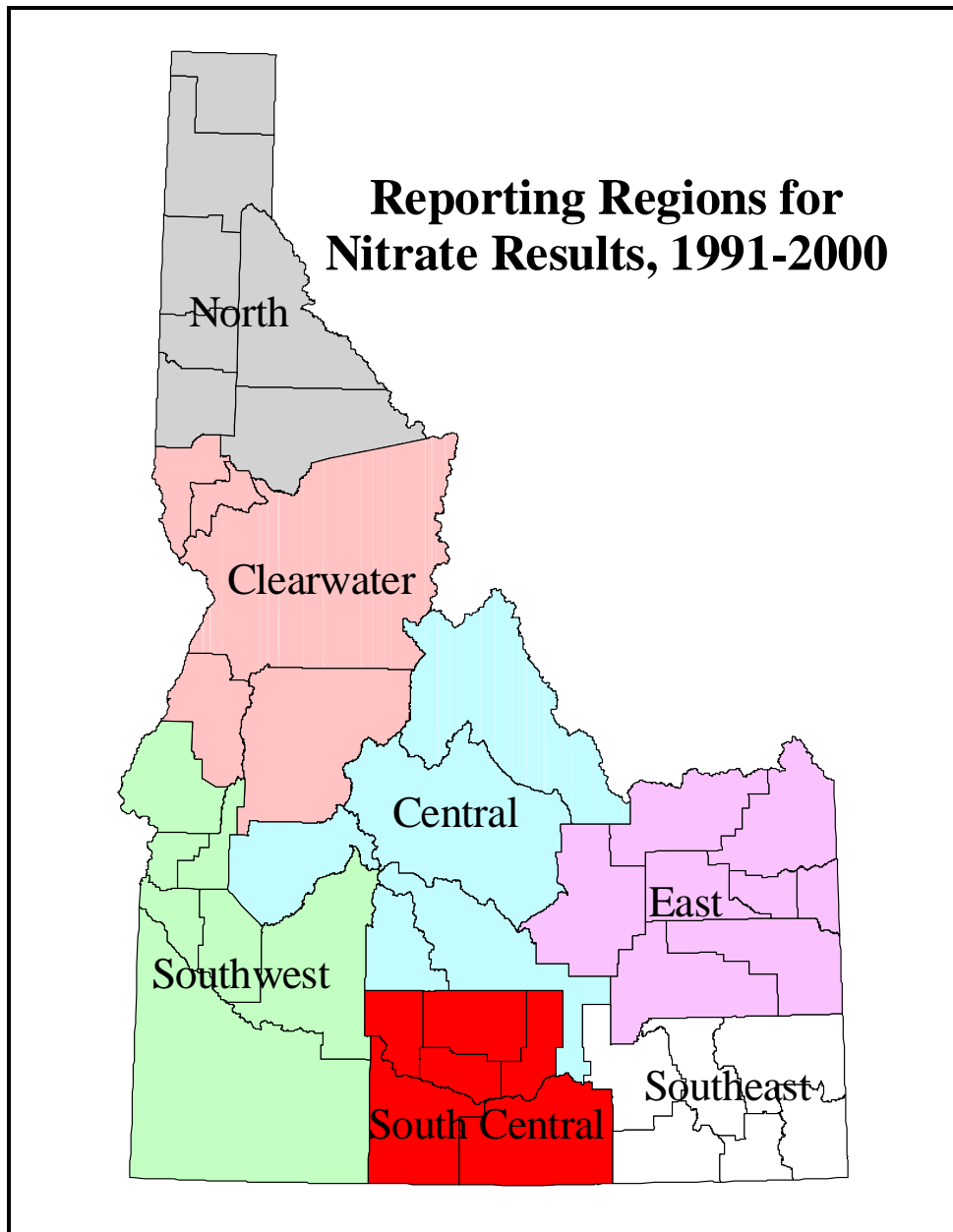


Figure 5. Reporting regions for the nitrate data collected in the years 1991 – 2000.

Median nitrate values for the seven regions ranged from 0.2 to 2.5 mg/L (Figure 6). The four regions in the southern part of the state had the highest median nitrate values, showing that impact to ground water from nitrate has been more extensive in this part of the state than in the north.

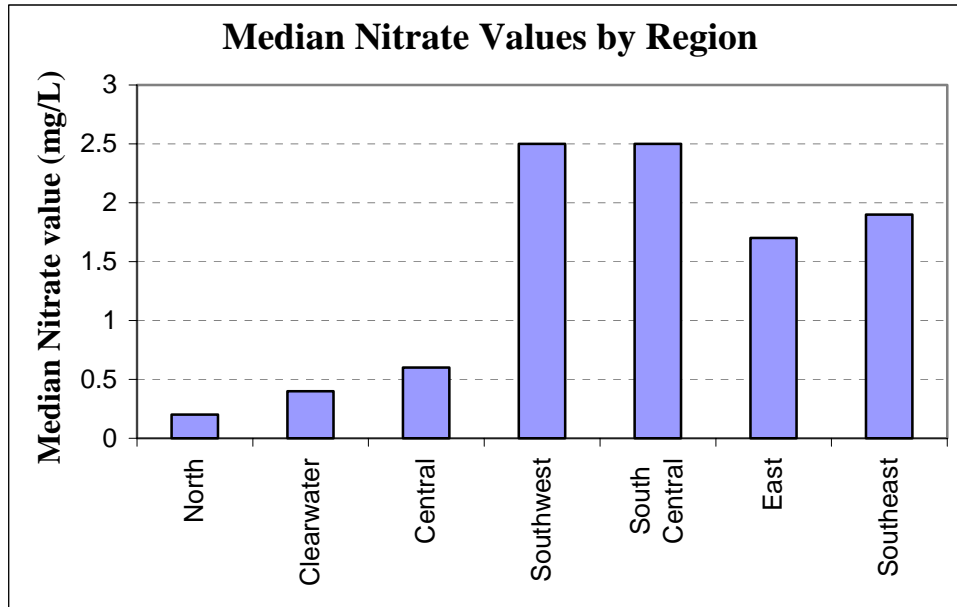


Figure 6. Median nitrate values by region, based on the maximum nitrate data for each site for the years 1991 – 2000.

Click on the region of interest

- [North](#)
- [Clearwater](#)
- [Central](#)
- [Southwest](#)
- [South Central](#)
- [East](#)
- [Southeast](#)

North Region

The North Region encompasses the part of Idaho that is north of the Clearwater River (Figure 7). Agriculture, domestic, dry land, and urban land uses are common in this region. Also, large parts of the North Region are covered by forests.

The North Region is characterized by alluvial aquifers made up of cobbles, sand, gravel, silt and clay. These alluvial aquifers are sediments that filled river valleys or were deposited by the Lake Missoula flood (i.e., the Rathdrum Prairie aquifer in Kootenai County). Other minor aquifers are found in granitic and basalt rocks.

There were 199 Statewide Program sites in the North Region with one or more nitrate results. Well depths for the 188 North Region sites with well depth information ranged from 30 to 1458 feet with the average well depth being 190 feet.

Only one site (<1%) had a maximum nitrate concentration that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the value was 16.0 mg/L. Six sites (3%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

Overall, the ground water quality in the North region showed very little impact from nitrate to the ground water quality (Figure 8). Although there is agriculture throughout the region, very little, if any, of it is irrigated. Furthermore, the Rathdrum Prairie aquifer has both a high ground water velocity and a large volume of flow which helps to dilute contaminants and flush them through the aquifer rapidly.

Click on the county of interest for a detailed map of the nitrate results: [Benewah](#), [Bonner](#), [Boundary](#), [Clearwater](#), [Kootenai](#), [Latah](#), [Shoshone](#).

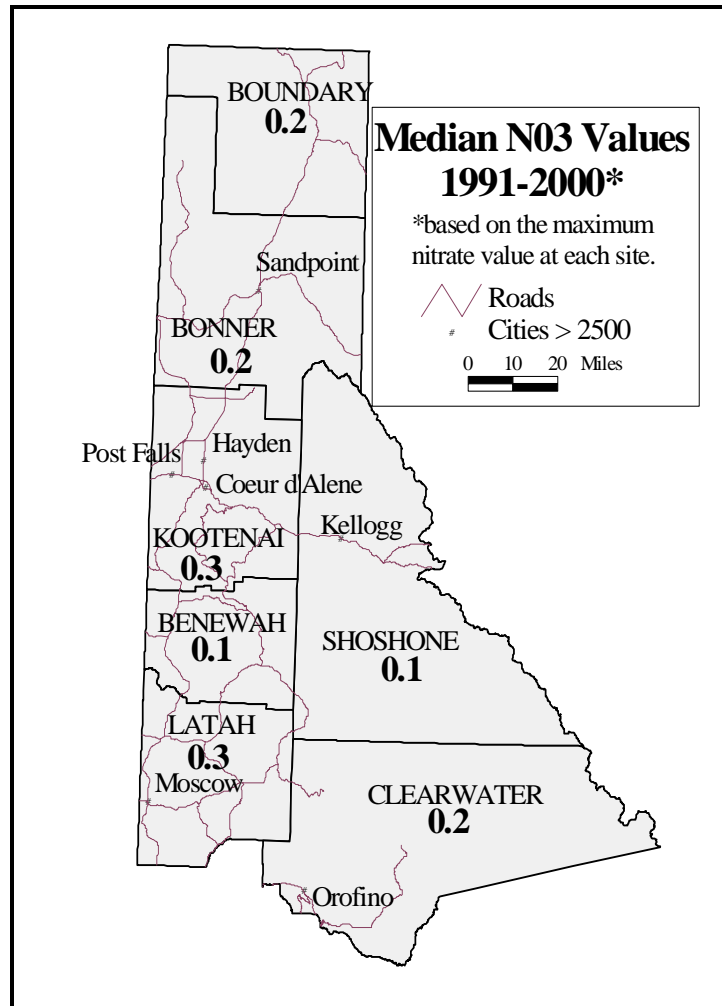


Figure 7. Median nitrate values for the counties in the North Region, based on the maximum nitrate value at each site for the years 1991 – 2000.

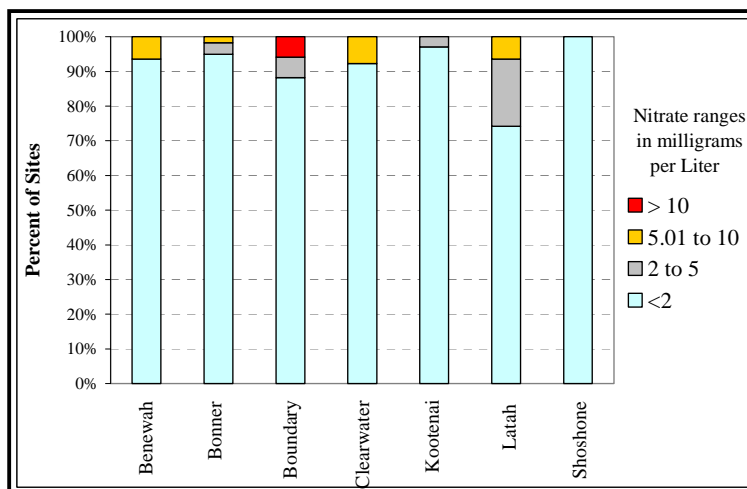


Figure 8. Percent of sites in four nitrate concentration ranges by county for the North Region.

Clearwater Region

The Clearwater Region consists of five counties that are south of the Clearwater River and extend as far south as the lower reaches of the Payette and Weiser Rivers (Figure 9). Dryland agriculture, urban and domestic land uses are common in this region.

The northern part of the Clearwater Region is characterized by the basalt aquifers of the Columbia River Basalt. The southern part of the Clearwater Region contains alluvial aquifers that have filled valleys (mostly in Valley County) and some Columbia River Basalt (Adams County).

There were 104 Statewide Program sites in the Clearwater Region with one or more nitrate results. Well depths ranged from 10 to 758 feet with the average well depth being 213 feet.

Four sites (4%) had maximum nitrate concentrations that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the highest value was 79.5 mg/L. Six sites (6%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

The Clearwater Region has experienced more nitrate impacts to ground water quality than the North Region, but overall, nitrate impacts in this region have been lower than the regions further to the south. Lewis and Nez Perce Counties showed the most nitrate impacts of the five counties in this region (Figure 10).

Click on the county of interest for a detailed map of the nitrate results: [Adams](#), [Idaho](#), [Lewis](#), [Nez Perce](#), [Valley](#).

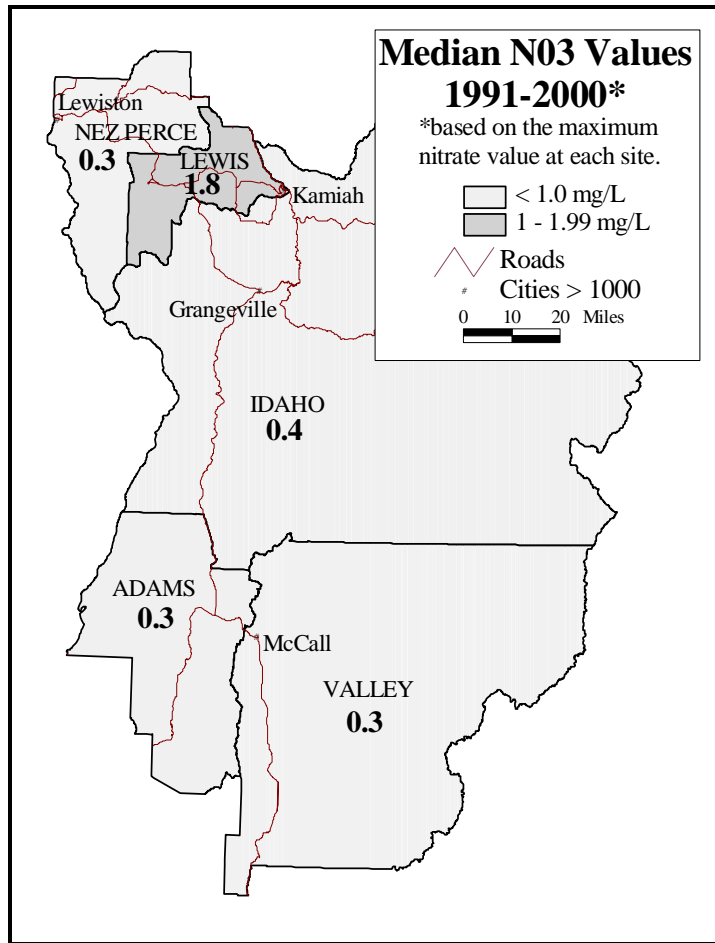


Figure 9. Median nitrate values for the counties in the Clearwater Region, based on the maximum nitrate data for each site for the years 1991 – 2000.

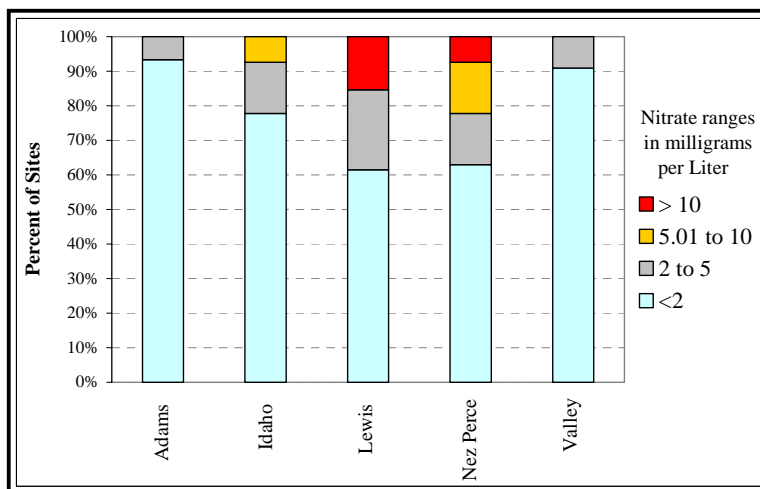


Figure 10. Percent of sites in four nitrate concentration ranges by county for the Clearwater Region.

Central Region

The Central Region consists of five counties in central Idaho that are typified by mountain ranges, river valleys and a couple plateaus. Dryland agriculture, urban, domestic, and rangeland are common land uses in this region.

Aquifers in this region are found in alluvial sediments in the river valleys and, to a lesser extent, in granitic rocks of the Idaho Batholith.

There were 104 Statewide Program sites in the Central Region with one or more nitrate results. Well depths for the 102 Statewide Program sites with well depth information ranged from 30 to 1020 feet with the average well depth being 145 feet.

Two sites (2%) had maximum nitrate concentrations that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the highest value was 12.0 mg/L. Two sites (2%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

Ground water in the Central Region has been impacted more by nitrate than the two regions to the north, but considerably less than the four regions to the south (Figure 6). Camas and Custer Counties contained the sites with nitrate concentrations greater than 5 mg/L (Figure 12).

Click on the county of interest for a detailed map of the nitrate results: [Blaine](#), [Boise](#), [Camas](#), [Custer](#), [Lemhi](#).

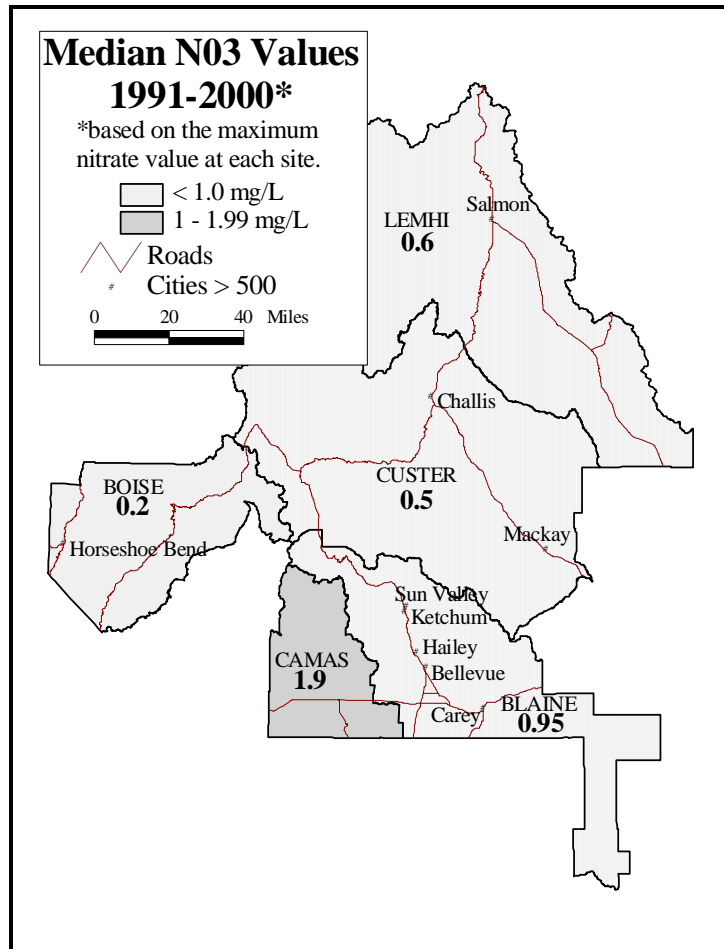


Figure 11. Median nitrate values for the counties in the Central Region, based on the maximum nitrate data for each site for the years 1991 – 2000.

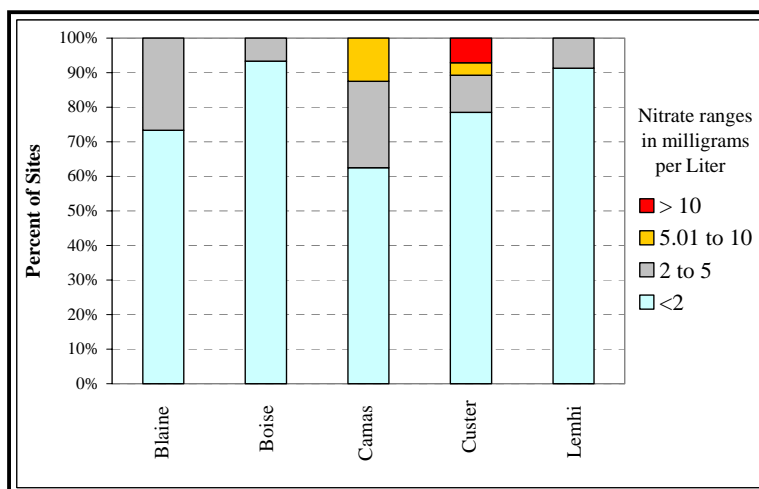


Figure 12. Percent of sites in four nitrate concentration ranges by county for the Central Region.

Southwest Region

The Southwest Region consists of seven counties in the western part of the Snake River Plain (Figure 13). The [Snake River Plain](#) is a large arc-like feature that extends from near the Idaho/Montana/Wyoming borders in the east, southward through central Idaho, and to the northwest into Oregon. In addition to a portion of the Snake River, the Southwest Region includes areas that are in the drainage basins of the Boise, Payette, and Weiser Rivers. Irrigated agriculture, urban, industrial, domestic, rangeland, and animal feeding operations are common land uses in this region.

Aquifer systems in the Southwest Region are highly variable and complex. In Washington, Payette, and Gem Counties, alluvial aquifers are the most common. These aquifers consist of unconsolidated gravels and sands, and they are fairly close to the land surface.

The [hydrologic setting in Ada and Canyon Counties](#) (also known as the Treasure Valley) is a tiered system with a Shallow Aquifer, which is underlain by a Deep Aquifer, which overlies a geothermal aquifer in some places.

The Shallow and Deep aquifers are used for drinking, irrigation, and other non-thermal applications. The Shallow Aquifer generally occurs at depths up to about 250 feet, and/or above a lithologic layer known as the “blue clay”. The Deep Aquifer is underneath the Shallow Aquifer, and it consists of sands that are finer grained than that Shallow Aquifer and thick sections of clay, usually blue or gray in color. The Deep Aquifer is part of the Idaho Group.

The aquifers in Elmore and Owyhee Counties occur mostly in volcanic rocks, although some sedimentary aquifers are present, too. The Bruneau Formation is common in these counties.

There were 449 Statewide Program sites in the Southwest Region with one or more nitrate results. Well depths for the 444 Statewide Program sites with well depth information ranged from 19 to 1,250 feet with the average well depth being 241 feet.

Forty-seven sites (10%) had maximum nitrate concentrations that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the highest value was 110.0 mg/L. Sixty-one sites (14%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

The Southwest Region was one of the most impacted areas in Idaho with respect to nitrate in ground water (Figure 6). All seven counties in this Region had sites where the maximum nitrate concentration exceeded 10 mg/L (Figure 14).

Nitrate impacts were strongly evident in the Treasure Valley. Median nitrate values for the Shallow Aquifer for these two counties were over two times higher than for the Deep Aquifer, respectively (Table 2). Factors such as the well depths, occurrence and thickness of clay layers, and well construction are likely contributors to the vulnerability

of the Shallow Aquifer to nitrate impacts in Ada and Canyon Counties. A recent review of the [Treasure Valley water quality](#) is located on the IDWR website.

Click on the county of interest for a detailed map of the nitrate results: [Ada-Shallow](#), [Ada-Deep](#), [Canyon-Shallow](#), [Canyon-Deep](#), [Elmore](#), [Gem](#), [Owyhee](#), [Payette](#), [Washington](#).

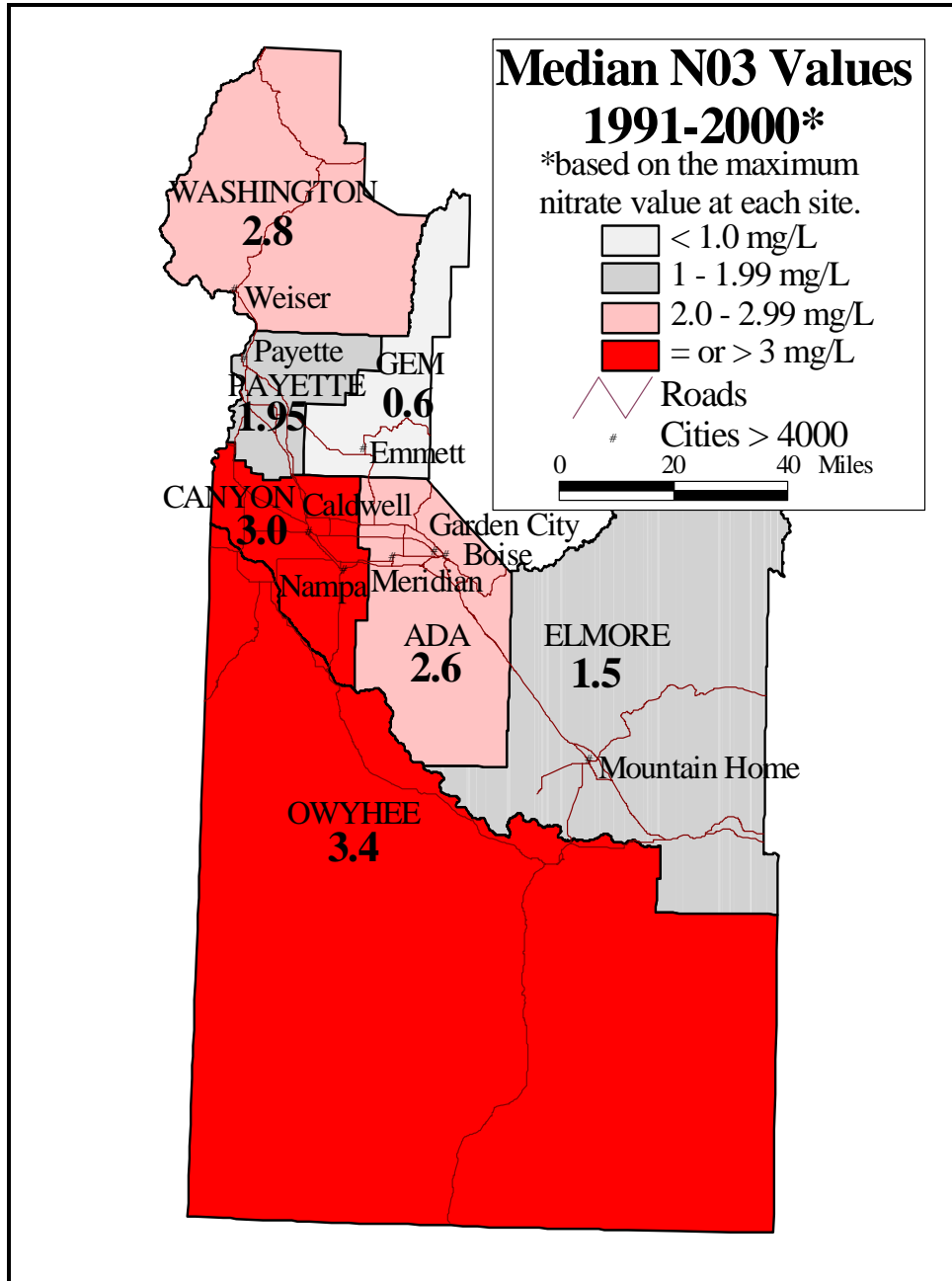


Figure 13. Median nitrate values for the counties in the Southwest Region, based on the maximum nitrate data for each site for the years 1991 – 2000.

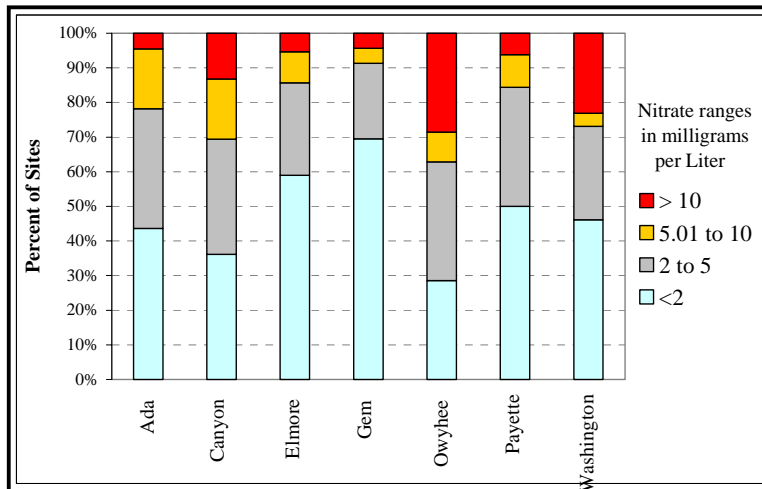


Figure 14. Percent of sites in four nitrate concentration ranges by county for the Southwest Region.

Table 2. Median nitrate values for Ada and Canyon Counties, Shallow and Deep Aquifers.

County – Aquifer	Median Nitrate Value
Ada – Shallow	3.7 mg/L
Ada – Deep	1.6 mg/L
Canyon – Shallow	4.1 mg/L
Canyon – Deep	1.7 mg/L

South Central

The South Central Region consists of six counties in the central part of the Snake River Plain (Figure 15). This part of the [Snake River Plain](#) is known as the Magic Valley. Irrigated agriculture, dairy, and animal feeding operations are common throughout this area, as well as urban settings and some rangeland.

Aquifers in this region include the Eastern Snake River Plain Aquifer, the Idavada Formation, the Banbury Basalt, the Glens Ferry Formation, the basalt flows of the Snake River Group, the Raft River Formation, and unconsolidated alluvial sediments.

The Eastern Snake River Plain Aquifer (ESRPA) is the sole aquifer north of the Snake River in Gooding, Jerome, Lincoln, and Minidoka Counties. The ESRPA is a series of basalt layers that are occasionally interbedded with sedimentary deposits ([Johnson, et al., 1998](#); [USGS, 2001](#); [IDWR, 1999](#)). This aquifer holds a vast quantity of water, is highly productive, and extends to the northeast almost to the Idaho/Montana border. Ground water flow in the ESRPA is from northeast to southwest. Therefore, the four counties in the South Central Region are in the most downgradient position of all the counties that overlay the ESRPA.

Aquifers in Twin Falls County are the Idavada Volcanics, Banbury Basalt, Glens Ferry Formation, and basalt flows of the Snake River Group. A recent report by IDWR for the [Twin Falls](#) area summarizes the aquifers and the ground water quality results. Aquifers in Cassia County are mostly in sedimentary rocks and alluvial sediments.

There were 250 Statewide Program sites in the South Central Region with one or more nitrate results. Well depths for the 246 Statewide Program sites with well depth information ranged from 29 to 1,285 feet with the average well depth being 313 feet.

Thirteen sites (5%) had maximum nitrate concentrations that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the highest value was 100.0 mg/L. Forty-seven sites (19%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

The South Central Region was one of the most impacted areas in Idaho with respect to nitrate in ground water (Figure 6). Four of the six counties in this Region had sites where the maximum nitrate concentration exceeded 10 mg/L (Figure 16). This region had high nitrate impacts despite having the deepest average well depth for the seven regions. Twin Falls County had the most extensive nitrate impacts in the South Central Region, and was also the highest impacted county in the state with respect to nitrate in ground water.

Click on the county of interest for a detailed map of the nitrate results: [Cassia](#), [Gooding](#), [Jerome](#), [Lincoln](#), [Minidoka](#), [Twin Falls](#).

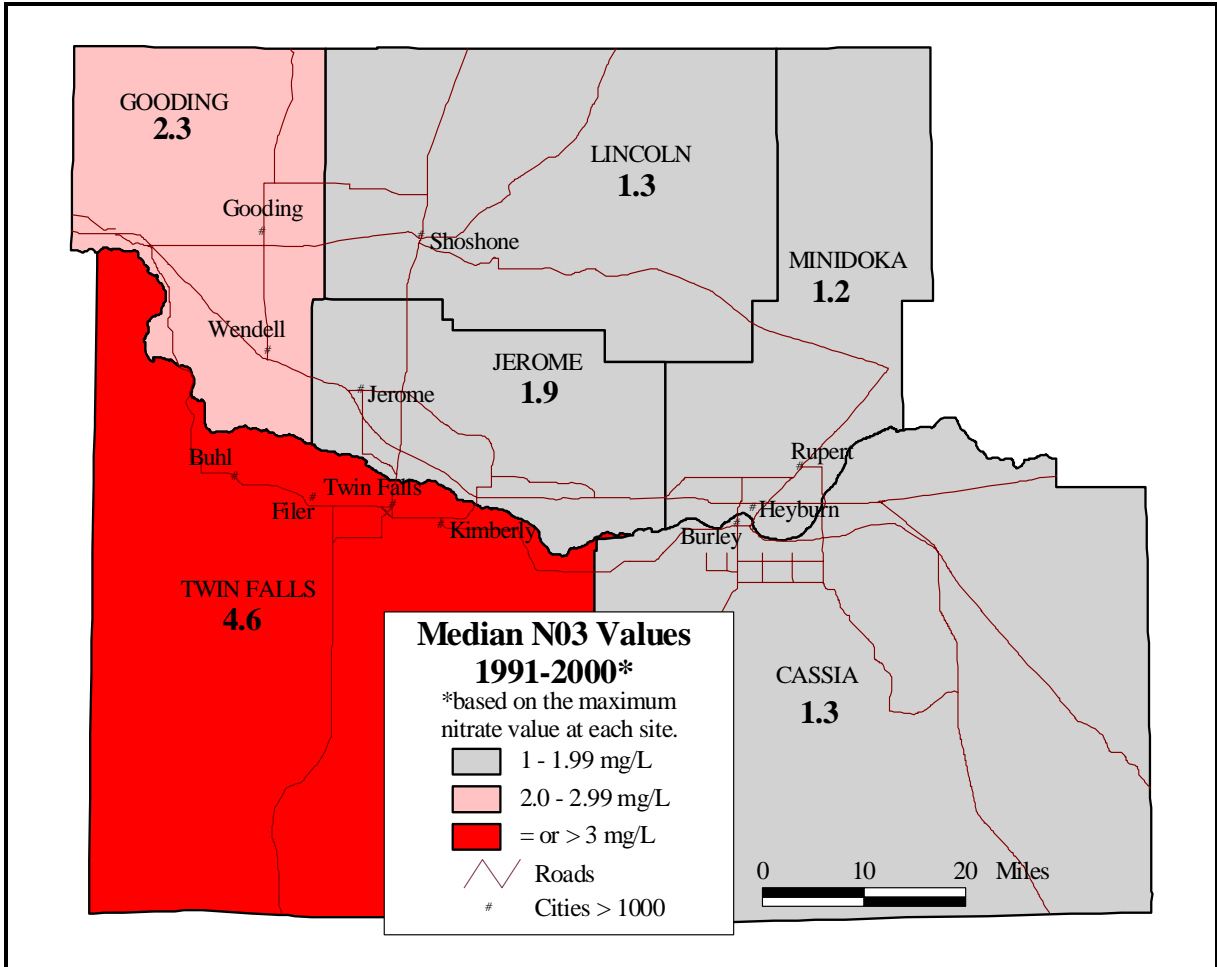


Figure 15. Median nitrate values for the counties in the South Central Region, based on the maximum nitrate value at each site for the years 1991 – 2000.

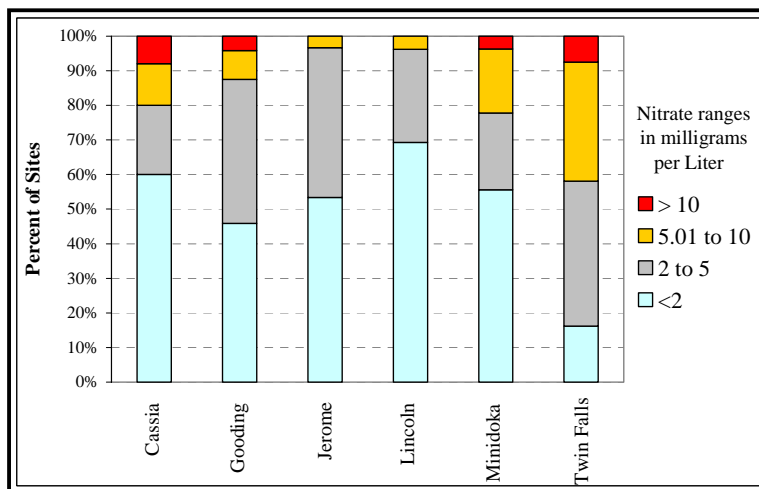


Figure 16. Percent of sites in four nitrate concentration ranges by county for the South Central Region.

East Region

The East Region consists of eight counties in the upper part of the [Snake River Plain](#) (Figure 17). Irrigated agriculture, domestic, dryland, rangeland, and urban are common land uses in this region.

Aquifers in the East Region are found in the Eastern Snake River Plain Aquifer (ESRPA), and in sedimentary and volcanic rock formations. The ESRPA underlies the western half of this region. Sedimentary and volcanic aquifers are found in formations such as the Falls River Basalt, Huckleberry Ridge Tuff, Lava Creek, Gerrit Basalt, and Wayan in places in Fremont, Madison, Teton, and Bonneville Counties.

Well depths for the 269 Statewide Program sites in the East Region ranged from 21 to 1,340 feet with the average well depth being 236 feet.

Fifteen sites (6%) had maximum nitrate concentrations that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the highest value was 69.9 mg/L. Twenty sites (7%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

The East Region had variable degrees of nitrate impact in the eight counties (Figure 17). Five counties had sites where the maximum nitrate concentration exceeded 10 mg/L (Figure 18). Over 50 percent of the sites in Madison County had maximum nitrate concentrations in the 2 to 5 mg/L range; however, there were no sites in this county with nitrate greater than 5 mg/L. Madison County had the highest nitrate median, but Fremont County showed the most impact in the upper concentration ranges (greater than 5 mg/L).

Click on the county of interest for a detailed map of the nitrate results: [Bingham](#), [Bonneville](#), [Butte](#), [Clark](#), [Fremont](#), [Jefferson](#), [Madison](#), [Teton](#).

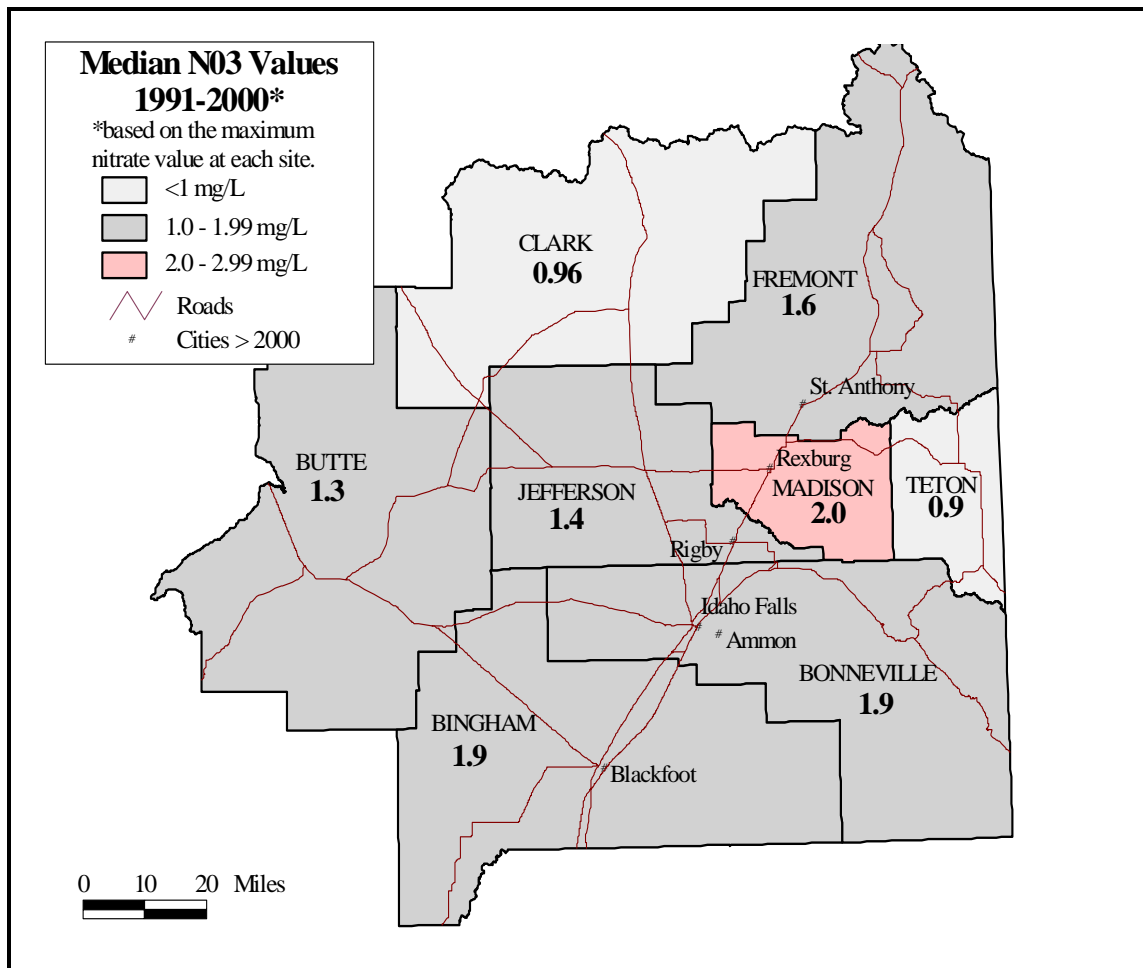


Figure 17. Median nitrate values for the counties in the East Region, based on the maximum nitrate data for each site for the years 1991 – 2000.

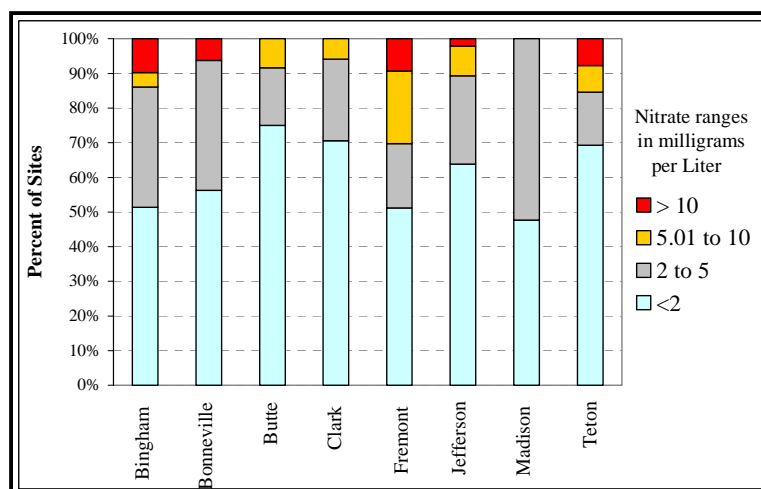


Figure 18. Percent of sites in four nitrate concentration ranges by county for the East Region.

Southeast Region

The Southeast Region consists of six counties in the southeast corner of Idaho (Figure 19). This region is typified by mountain ranges and river valleys, with irrigated agriculture, domestic, dryland, and urban land uses being common.

Aquifers in the Southeast Region are found in alluvial sediments, and in sedimentary and volcanic rocks. Some of the water-bearing geologic formations include: Big Hole Basalt, Michaud Gravel, Neeley, Salt Lake, Sunbeam, as well as undifferentiated volcanic units of the Snake River Group, and alluvium of various ages.

Well depths for the 178 Statewide Program sites in the Southeast Region ranged from 25 to 600 feet with the average well depth being 164 feet.

Eight sites (4%) had maximum nitrate concentrations that exceeded the MCL of 10 mg/L for the years 1991 – 2000; the highest value was 69.9 mg/L. Seventeen sites (10%) had maximum nitrate levels that were in the range from 5.01 to 10 mg/L.

The Southeast Region ranked third of the seven regions with respect to nitrate impacts to the ground water (Figure 6). However, the degree of nitrate impact was variable throughout the region (Figure 19). Five of the six counties in this region had sites where the maximum nitrate concentration exceeded 10 mg/L (Figure 20). Caribou County had over 60 percent of the sites with the maximum nitrate being greater than 2 mg/L. Caribou County also had the second highest median nitrate value of the 44 Idaho counties.

Click on the county of interest for a detailed map of the nitrate results: [Bannock](#), [Bear Lake](#), [Caribou](#), [Franklin](#), [Oneida](#), [Power](#).

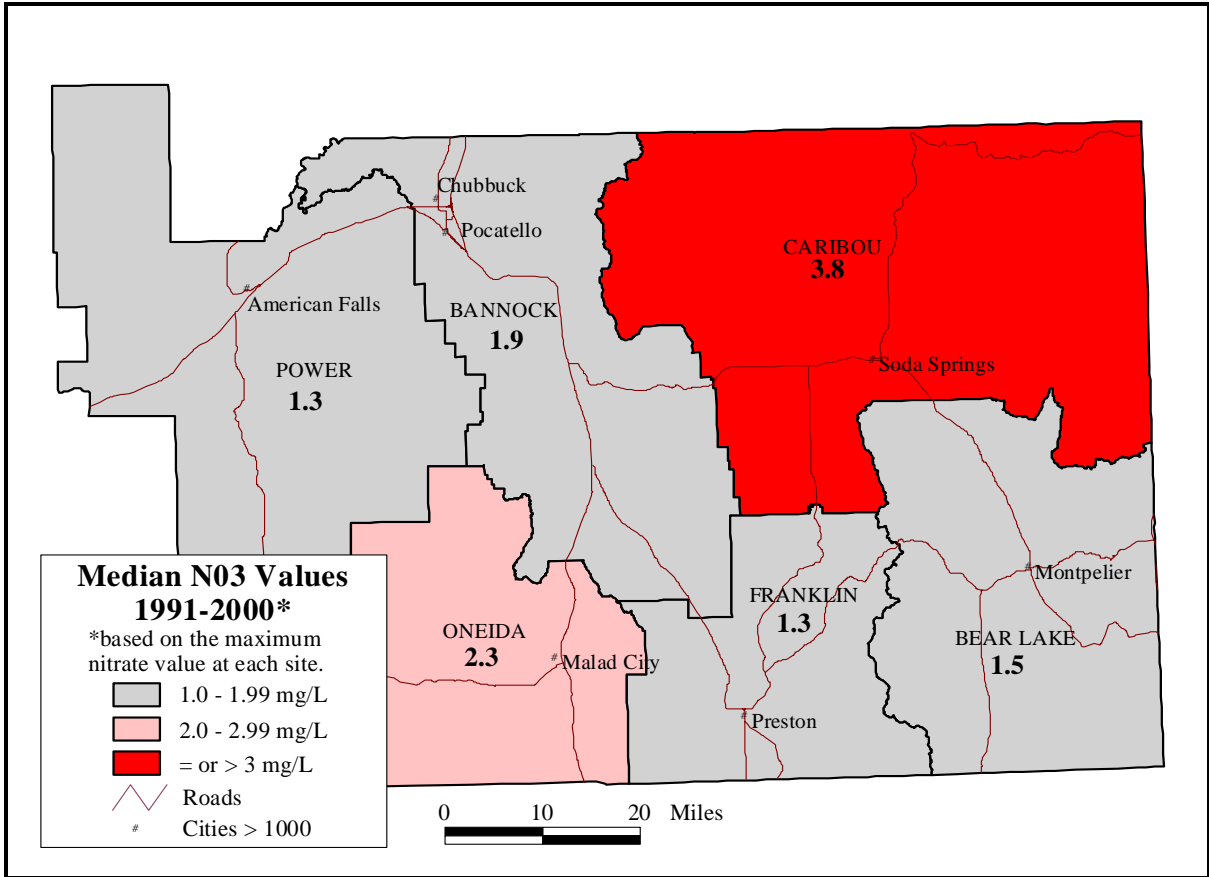


Figure 19. Median nitrate values for the counties in the Southeast Region, based on the maximum nitrate data for each site for the years 1991 – 2000.

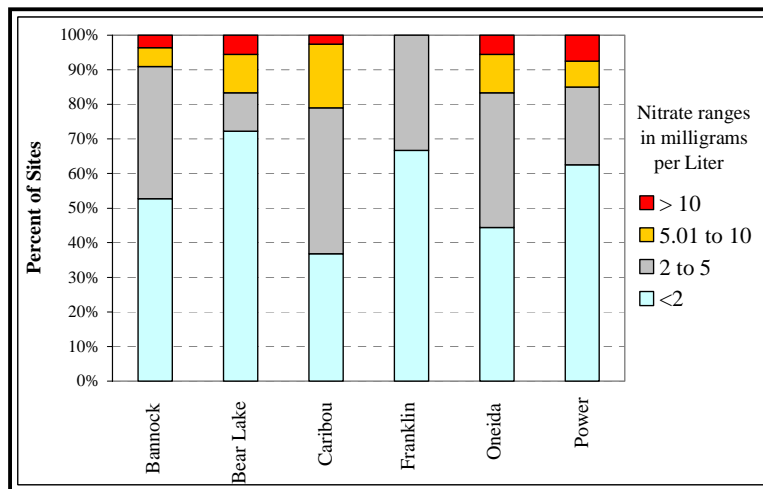


Figure 20. Percent of sites in four nitrate concentration ranges by county for the Southeast Region.

Discussion

The data from the Statewide Ambient Ground Water Quality Monitoring Program show that nitrate has impacted ground water quality in Idaho, especially in the southern part of the state. Overall, six percent of the Statewide Program sites had a maximum nitrate concentration in the years 1991 – 2000 that exceeded the MCL of 10 mg/L. An additional 10 percent of the sites had a maximum nitrate concentration during this time period that was in the 5.01 to 10 mg/L range.

How does Idaho compare with the rest of the United States with respect to nitrate impacts to the ground water? The author is not aware of any study that definitively answers this question. However, the USGS ([Nolan, et al., 1998](#)) found that the risk of nitrate contamination to shallow ground water (less than 100 feet from land surface) was related to the amount of nitrogen input, and the vulnerability of the aquifers to contamination from nitrate leaching and accumulation.

In the USGS report, it was noted that: 1) nitrate risk is variable throughout the country, and 2) nitrate occurrence in ground water generally increases with higher nitrogen inputs and greater vulnerability. Do these conclusions match the Statewide Program data collected in Idaho? [Figure 1](#) in the USGS report shows that some areas in southern Idaho and a small area in northern Idaho are in the higher risk categories for nitrate contamination to shallow water. The areas on Figure 1 of the USGS report appear to coincide with Figure 2 of this summary, which shows the percentage of sites greater than 5 mg/L.

In another study, Rupert (1997) examined the relationships between nitrate concentrations in ground water and four “probability” categories that were developed to predict the potential for nitrate contamination in the ground water of the Upper Snake River Basin (the four probability categories were low, medium, high and very high). Rupert found that the nitrate levels were significantly different between categories at the 99 percent confidence level. The median nitrate values increased as the probability rating increased; i.e., the medium category had a higher nitrate median than the low category; the high category had a higher nitrate median than the medium category, and the very high category had a higher nitrate median than the high category. These results show agreement with the USGS report on risk and nitrate occurrence throughout the United States.

In conclusion, it seems fairly obvious that nitrate is present in Idaho’s ground water because: 1) there are some large nitrogen inputs in the state, and 2) some of the aquifers are in vulnerable settings. If the citizens of Idaho want to see nitrate levels decrease in the ground water, then it is likely that nitrogen inputs must be managed carefully, especially in areas that are more vulnerable to leaching and accumulation of this constituent.

Recommendations for Well Owners

One of the most common questions that we get at IDWR related to ground water quality is “Should I have my water tested?”. IDWR recommends that homeowners with private wells have their water tested for nitrate and for total coliform bacteria. For bacteria references, see [EPA, 2001](#); [Minnesota Department of Health, 1996](#); [Virginia Cooperative Extension, 1996](#).

Before having your water tested, you may want to contact IDWR to see if ground water quality data are available for your area. Figure 21 shows the areas of responsibilities for the three hydrogeologists working on the Statewide Program. In addition to providing data to you for your area of interest, these people can help you with other ground water quality questions, and can provide a list of laboratories that are able to perform chemical analyses on your water sample.

When you receive your water test results, the hydrogeologists listed on Figure 21 can assist you with understanding the information you receive from the laboratory. Based on the results from your water tests, you can obtain recommendations as to the frequency of future sampling, and whether sampling for other types of constituents is warranted.

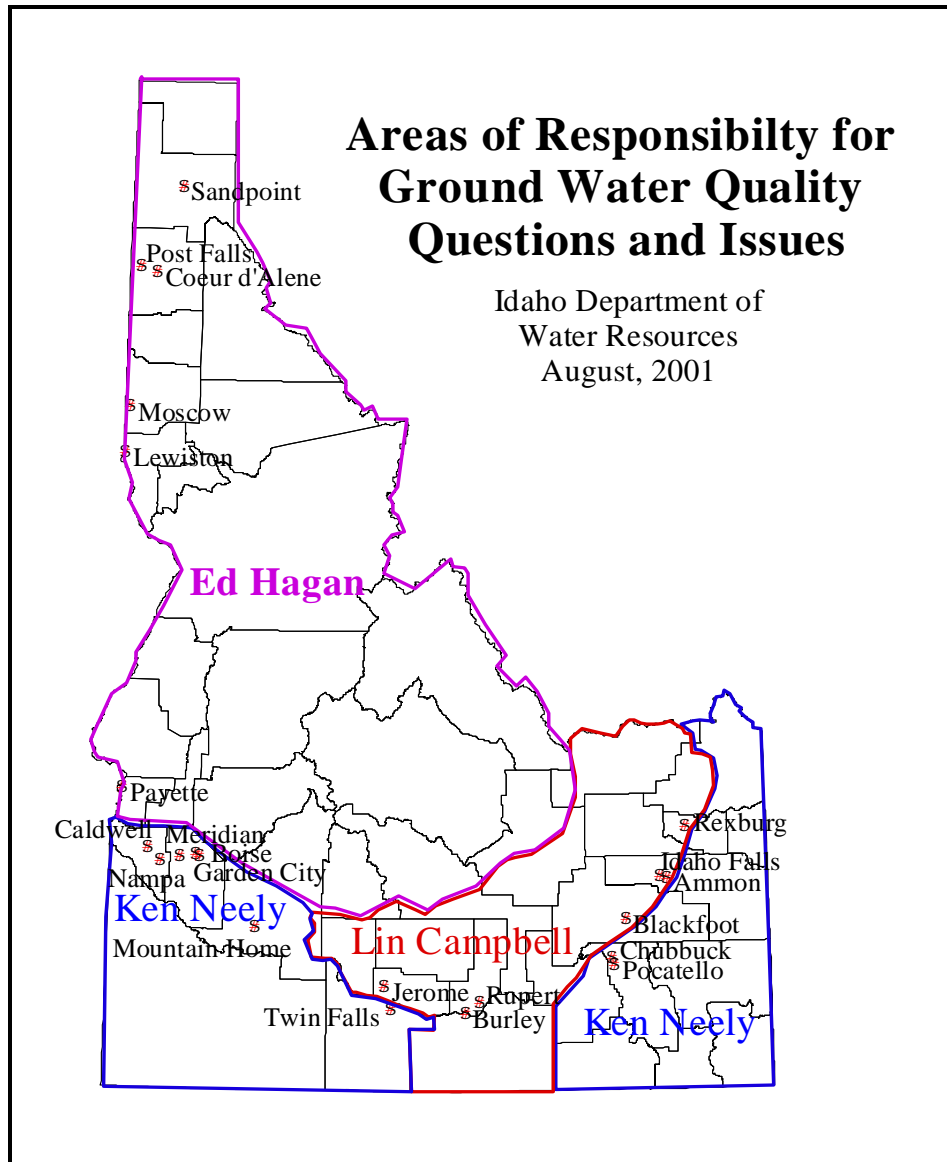


Figure 21. Hydrogeologists and their associated areas of responsibility for the Statewide Program and for general ground water quality questions.

Contact the person who is responsible for the area where you have a question:

[Lin Campbell](#) (208.327.7965)

[Ed Hagan](#) (208.327.5445)

[Ken Neely](#) (208.327.5455)

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