Ground Water Technical Report 23

Preliminary Evaluations of Arsenic Detections in Ground Water: A County-Level Arsenic Review

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Preliminary Evaluations of Arsenic Detections in Ground Water: A County-Level Arsenic Review

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Abstract

This report is intended as a management tool for directing resources and to encourage private well owners to have water supplies tested and take appropriate measures as a personal choice. The EPA drinking water standard for arsenic is for total arsenic, not species of arsenic. The toxicity of arsenic may vary with the species.

In Idaho, more than 90% of the population relies on ground water for drinking water. Regulated public water systems rely upon ground water from approximately 3,100 wells and 90 springs that supply drinking water to customers. Public water systems serve an estimated 70% of Idaho's population. Of the estimated 3,190 ground water sources considered public water systems, approximately 1,500 have been analyzed for arsenic.

Conservative estimates from the *Idaho Department of Water Resources* indicate that there are approximately 150,000 private wells used for domestic purposes. About 1,000 of these wells are in the *Statewide Ground Water Monitoring Program*, and another 1,800 wells have been analyzed for arsenic in miscellaneous studies conducted by other agencies. These estimates indicate that approximately 147,000 domestic wells—98% of domestic wells in Idaho—have not been analyzed for arsenic.

The counties with the highest average arsenic analysis are Washington (48.18 µg/l), Owyhee (16.95 µg/l), Payette (13.03 µg/l), Twin Falls (12.95 µg/l), and Canyon (11.98 µg/l). A map of proposed *Areas of Arsenic Detections* is developed and presented.

Introduction

This report is intended as a management tool for directing resources and to encourage private well owners to have water supplies tested and take appropriate measures as a personal choice. The EPA drinking water standard for arsenic is for total arsenic, not species of arsenic. The toxicity of arsenic may vary with the species.

In Idaho, over ninety percent of the population relies on ground water for drinking water. Regulated *public water systems* rely upon approximately 3,100 wells and 90 springs to supply drinking water to customers—roughly 3,200 ground water sources in all (*Idaho Source Water Assessment Plan*, 1999). Of the estimated 3,200 ground water sources considered public water systems, about 1,500 sources have been analyzed for arsenic

The *Idaho Department of Water Resources* (IDWR) conservatively estimates that there are 150,000 private wells used for domestic purposes, and this figure may increase to 200,000 pending inventory completion (Personal Communication Mark Slifka, 11/25/02). (Wells drilled prior to 1987 may not be on record; prior to 1987 a well drilling permit was not required.)

As a part of the *Statewide Ambient Ground Water Monitoring Program*, IDWR, in collaboration with the *United States Geological Survey* (USGS), monitors approximately 1,500 wells statewide for arsenic. Approximately two-thirds—or 1,000—of the wells in the statewide program are used for private domestic purposes. No governmental regulations exist that require private domestic wells to be analyzed for arsenic or any other constituents.

In this effort, ground water sources that are used for drinking water have been investigated. Of the estimated 150,000 private domestic wells in Idaho, approximately 1,000 are in the Statewide Ground Water Monitoring Program. An additional 1,800 private wells have been analyzed for arsenic in miscellaneous studies by the Department of Environmental Quality (DEQ), the USGS or other agencies, leaving an estimated 147,000 private domestic wells—ninety-eight percent—of private domestic wells in Idaho unanalyzed (See *Appendix A: Analysis of Arsenic Monitoring in Idaho*, page 30).

Data Analysis

The data used in this analysis was obtained from several agencies, with a variety of analytical methods used to determine results. A discussion of the sources, analytical methods, and regulatory requirements for public water systems is provided in the following.

Ground Water Data Sources

Ground water monitoring efforts for arsenic, obtained from various agencies, were compiled by DEQ. Included are results from the *Statewide Ambient Ground Water Monitoring Program* and other USGS studies. Analytical results from the Statewide Ambient Ground Water Monitoring Program date from 1991-2001. Analytical results from USGS studies (not included in the Statewide Program) are generally older, dating from the late 1950's. These results were combined with results from DEQ regional/local monitoring projects and from monitoring of public water systems.

Results from public water systems are included in this evaluation. Regional/local monitoring projects for arsenic (generally, individual private wells) conducted by the Boise Regional Office of DEQ include a 1995 arsenic study in Washington County (Howarth 1995), a 1998 follow-up study (Boyle 1999), and data generated from monitoring during 1996-1997 in the Arena Valley area. For this evaluation, the most recent sample result was selected for wells with multiple sample events.

> **Note:** Data from public water systems include sampling dates as early as 1974, but the majority of water quality monitoring efforts for public water systems began in the 1990s. The data continue up through 2001, with some 2002 data.

Analytical Methods

Several analytical methods have been used to determine arsenic concentrations throughout the years. Each analytical method has a unique minimum detection limit and not all of the data sources reported the limit. If the result was reported below the detection limit, it calculated as zero (0.00) for this evaluation. Actual statistical values may be slightly higher. All results are for total arsenic analysis.

Regulatory Requirements

For public water systems, the maximum contaminant level for arsenic established by the *Environmental Protection Agency* (EPA), in January 2001, is 10 micrograms per liter (µg/l) or parts per billion (ppb). This limit, which becomes effective in 2006 for existing public water systems, supercedes the previous maximum contaminant level of 50.00 µg/l.

Currently, only *community* water systems are required to be in compliance with the 50.00 µg/l arsenic standard. However, the new arsenic rule will require both community water

systems and *non-community, non-transient* water systems to be in compliance with the maximum contaminant level of 10 µg/l. In 2006, non-community non-transient water systems will also be required to sample for arsenic. Currently there is no required testing for arsenic in non-community, transient systems (such as restaurants, rest areas and campgrounds), or in private wells.

A *community water system* is a system that has at least 15 connections or serves at least 25 residents year round, such as municipalities and homeowner associations.

- *Non-community, non-transient* water systems regularly serve at least 25 of the same individuals over 6 months of the year. Examples of non-community, non-transient water systems include schools and offices.
- *Transient, non-community* systems do not serve at least 25 of the same people over 6 months each year. Examples of transient, non-community water systems include campgrounds, motels, and gas stations.

Results

For each county in Idaho, the *maximum*, *average*, *median*, and *mode* arsenic concentrations, in µg/l, for ground water, using the most recent analysis were calculated. The complete results were tabulated and are presented in Appendix B. A summary of the results is presented in the following.

Overall

Five Idaho counties (Table 1, Figure 1) exceed the maximum contaminant level of 10.00 µg/l for average levels of arsenic. Five additional Idaho counties exceed one half the maximum contaminant level—or 5.00 µg/l—but are at less than 10.00 µg/l. Eighteen other Idaho counties have an average arsenic level greater than 2.00 µg/l. No background or natural arsenic level has been established.

Table 1. Counties with the highest average arsenic levels.

Results are reported in micrograms per liter (µg/l), which is equivalent to parts per billion (ppb)

County	Average Arsenic Level (µg/l)	Maximum Arsenic Level (µg/l)	Number of Samples
Washington	48.18	920.00*	84
Owyhee	16.95	131.00	221
Payette	13.03	46.00	61
Twin Falls	12.95	63.00	202
Canyon	12.29	118.00	420

*(Howarth, 1995)

The five counties that exceed the 10.00 µg/l level are consistent with the mean values calculated by IDWR, using arsenic results from the Statewide Ambient Ground Water Quality Monitoring Program only. The same five counties were calculated to have the largest percentage of results over the maximum contaminant level of 10 ug/l. (Neely, 2002)

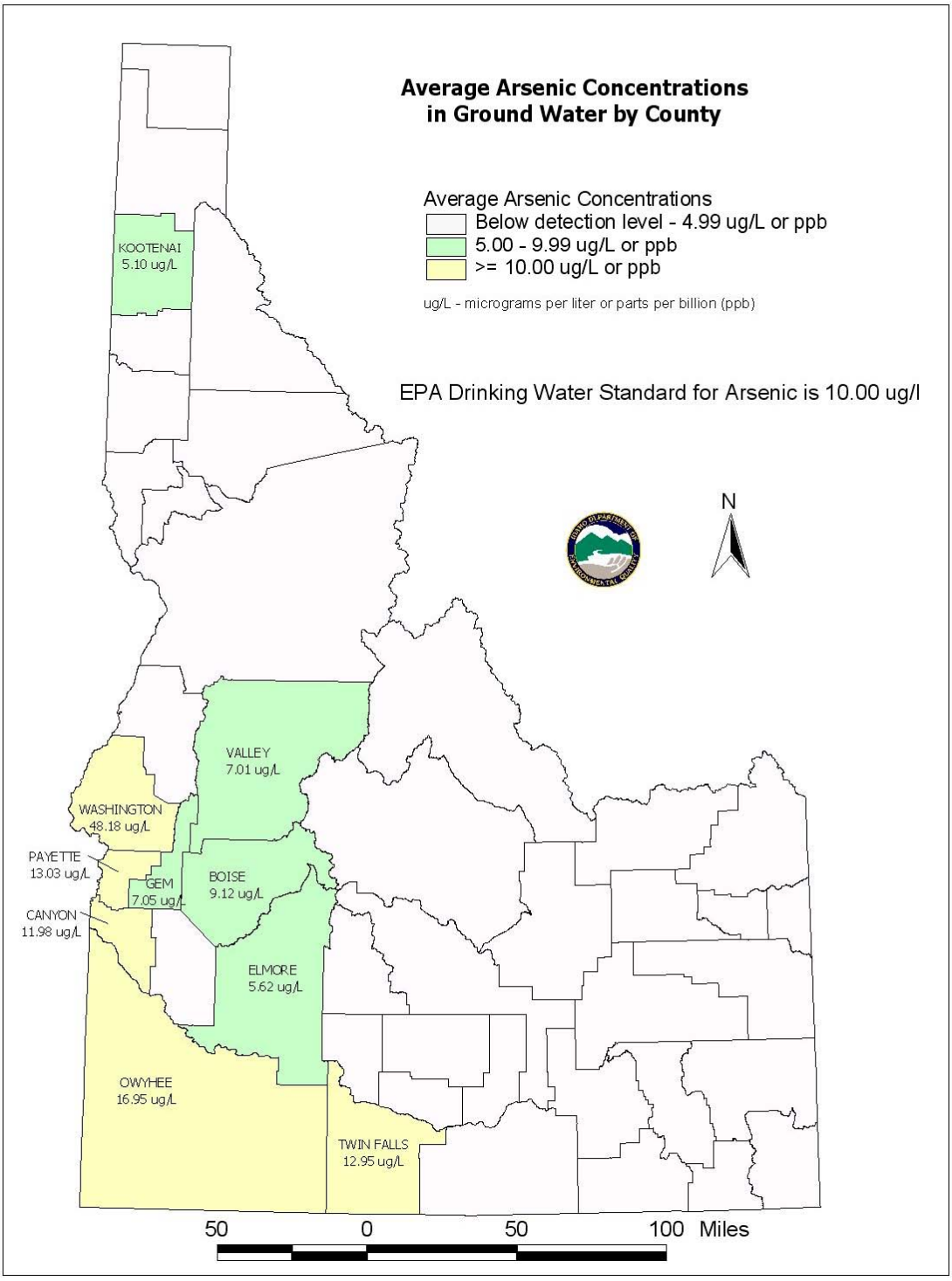

Figure 1. Average arsenic concentrations in ground water by county.

Trends in Arsenic Concentrations

A preliminary review of some wells indicates a possible cyclical pattern or fluctuation in arsenic concentrations. Public water supply wells that had arsenic analysis over several years and a well log available were reviewed for Ada, Canyon and Washington Counties (Table 2, page 12). Arsenic concentrations were plotted over time for this review.

Ada County

Arsenic concentrations for some public water supply wells in Ada County that had a spike, or increase, in arsenic concentration during 1997 are shown in Figure 2. In general, the concentration increase occurred in wells that are 300 feet deep, or deeper—except for E0006393, which is 110 feet deep. (Well E0006850 is 84 feet deep and did not have an arsenic concentration spike in 1997, however the concentration for E0006850 remained consistently over 10.00 ug/l.)

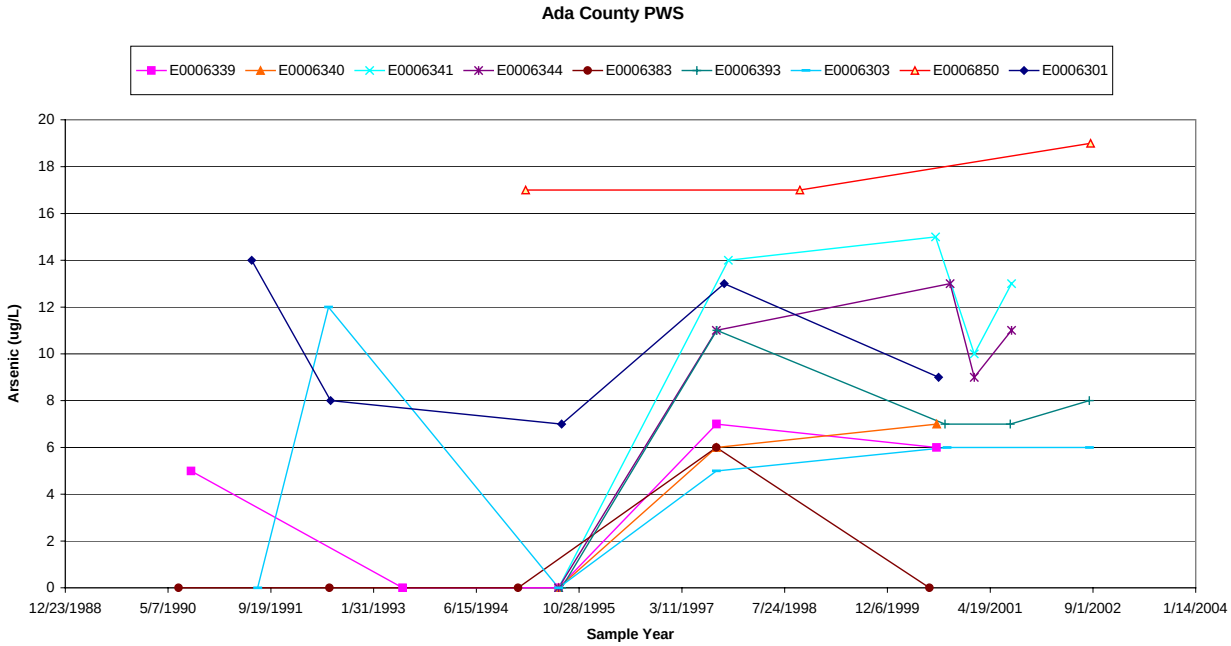

Figure 2. Ada County public water supply wells, 1997 arsenic increase.

Figure 3 shows a graph of other public water supply wells in Ada County for which the increase in arsenic concentration occurred during 1998. Again, this spike occurred in wells that are deeper than 300 feet.

Generally, most of the wells in Ada County (in this review) with an arsenic concentration increase in 1997 or 1998 occurred in wells over 300 feet deep, except well E0006393, which is 110 feet deep. The graphs indicate that all spikes in concentration occurred in wells with historic arsenic values less than 16.00 µg/L. Well E0006850 has historic values greater than 16.00 µg/L, and did not show a spike in the 1998 sample.

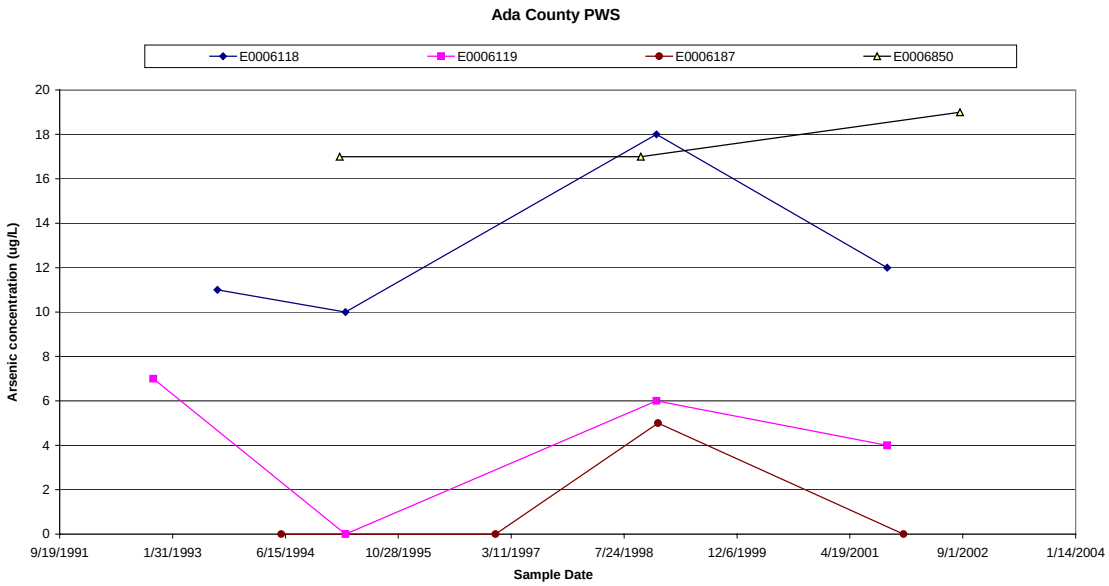

Figure 3. Ada County public water supply wells, 1998 arsenic increase.

Canyon County

Arsenic concentrations in some Canyon County public water supply wells were observed to determine if wells with historically high arsenic concentrations experienced the spike in arsenic observed in some of the Ada County public water supply wells. Figure 4 presents arsenic concentration plots for some Canyon County public water supply wells.

A spike in arsenic concentrations is observed during 1998 in some wells. It is also observed that well E0006487, which is 245 feet deep, had a spike in 1998, along with high historical arsenic concentrations.

Wells E0006441 and E0006625 (88 feet deep and 400 feet deep, respectively) are relatively stable in concentrations.

The rest of the wells, ranging from 107 feet deep to 245 feet deep, had spikes in arsenic concentrations during 1998.

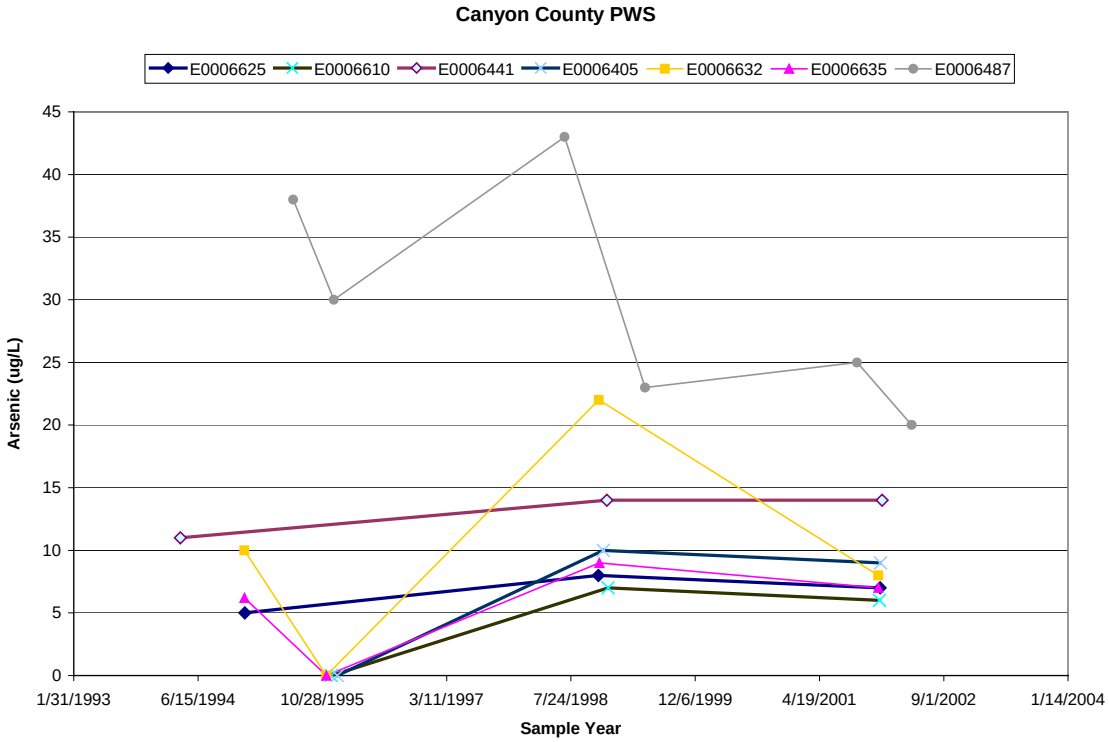

Figure 4. Canyon County public water supply wells, 1998 arsenic increase.

Washington County

Arsenic levels for public water supply wells in Washington County are shown in Figure 5. The wells that experienced a spike in arsenic concentration in 1998 had historic concentrations greater than 10.00 µg/L.

E0006214, with a depth of 963 feet, had historic concentrations of less than 10.00 µg/L and actually decreased in concentration in 1998.

The three wells with an increase in arsenic concentration in 1998 ranged in depth from 204 feet to 929 feet.

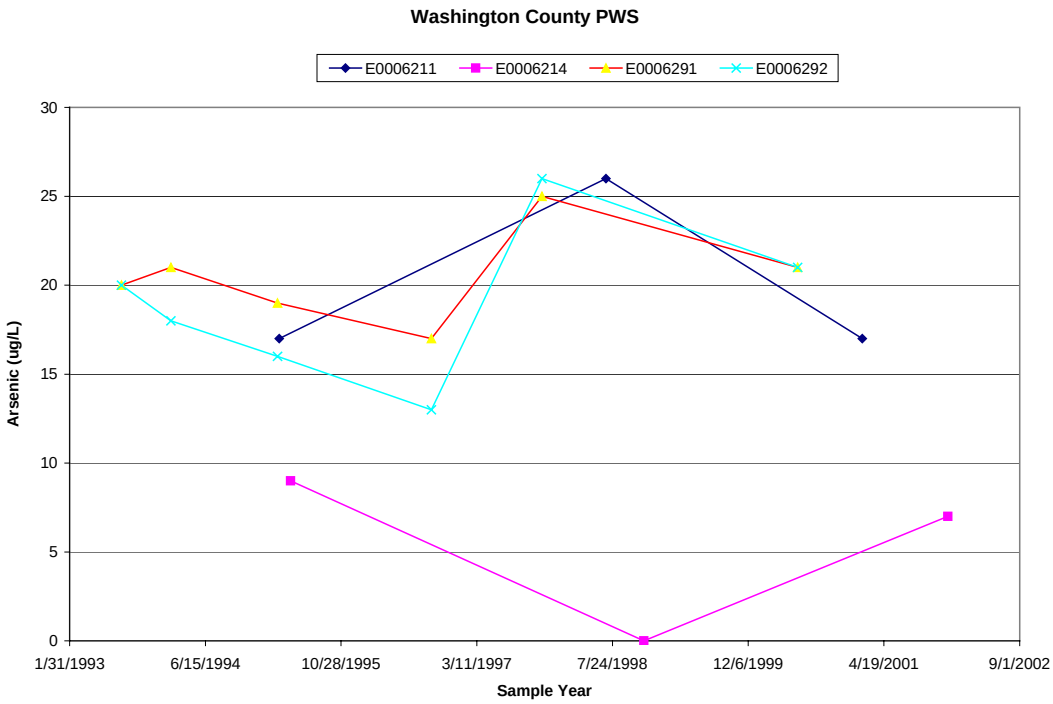

Figure 5. Washington County public water supply wells, 1998 arsenic increase.

Analysis of Results

The arsenic plots for the three counties did not reveal any conclusive correlation between arsenic concentration fluctuation and well depth. A variety of factors could play roles in the increased concentrations at various time periods; such factors could include the following:

- Changes in ground water levels due to amounts of precipitation or irrigation and subsequent oxidation state variations of the aquifer materials
- Arsenic species
- Well construction
- Other seasonal affects or geologic conditions

Additional time series data would be helpful in establishing a better understanding of arsenic concentration trends.

Table 2. Arsenic concentration of public water system wells used for trend review.

WELL ID - TAG	ARSENIC CONCENTRATION (µg/L)	DATE SAMPLED	TOTAL DEPTH (ft)	COUNTY
E0006118	11.00	8/18/1993	487	ADA
E0006118	10.00	3/8/1995	487	ADA
E0006118	18.00	12/14/1998	487	ADA
E0006118	12.00	10/1/2001	487	ADA
E0006119	7.00	11/6/1992	472	ADA
E0006119	0.00	3/8/1995	472	ADA
E0006119	6.00	12/14/1998	472	ADA
E0006119	4.00	10/1/2001	472	ADA
E0006187	0.00	5/27/1994	401	ADA
E0006187	0.00	12/31/1996	401	ADA
E0006187	5.00	12/21/1998	401	ADA
E0006187	0.00	12/13/2001	401	ADA
E0006301	14.00	6/18/1991	750	ADA
E0006301	8.00	7/6/1992	750	ADA
E0006301	7.00	8/4/1995	750	ADA
E0006301	13.00	10/3/1997	750	ADA
E0006301	9.00	8/11/2000	750	ADA
E0006303	0.00	7/17/1991	645	ADA
E0006303	12.00	6/26/1992	645	ADA
E0006303	0.00	7/20/1995	645	ADA
E0006303	5.00	8/25/1997	645	ADA
E0006303	6.00	9/21/2000	645	ADA
E0006303	6.00	8/15/2002	645	ADA
E0006339	5.00	8/27/1990	524	ADA
E0006339	0.00	6/21/1993	524	ADA
E0006339	0.00	7/20/1995	524	ADA
E0006339	7.00	8/26/1997	524	ADA
E0006339	6.00	8/1/2000	524	ADA
E0006340	0.00	7/20/1995	455	ADA
E0006340	6.00	8/26/1997	455	ADA
E0006340	7.00	8/2/2000	455	ADA
E0006341	0.00	7/20/1995	944	ADA
E0006341	14.00	10/23/1997	944	ADA
E0006341	15.00	7/27/2000	944	ADA
E0006341	10.00	1/31/2001	944	ADA
E0006341	13.00	8/1/2001	944	ADA

WELL ID - TAG	ARSENIC CONCENTRATION (µg/L)	DATE SAMPLED	TOTAL DEPTH (ft)	COUNTY
E0006344	0.00	7/20/1995	642	ADA
E0006344	11.00	8/25/1997	642	ADA
E0006344	13.00	10/6/2000	642	ADA
E0006344	9.00	1/31/2001	642	ADA
E0006344	11.00	8/1/2001	642	ADA
E0006383	0.00	6/27/1990	305	ADA
E0006383	0.00	6/30/1992	305	ADA
E0006383	0.00	1/4/1995	305	ADA
E0006383	6.00	8/25/1997	305	ADA
E0006383	0.00	6/28/2000	305	ADA
E0006393	0.00	8/4/1995	110	ADA
E0006393	11.00	8/28/1997	110	ADA
E0006393	7.00	9/11/2000	110	ADA
E0006393	7.00	7/25/2001	110	ADA
E0006393	8.00	8/14/2002	110	ADA
E0006850	17.00	2/10/1995	84	ADA
E0006850	17.00	10/6/1998	84	ADA
E0006850	19.00	8/20/2002	84	ADA
E0006405	0.00	12/27/1995	107	CANYON
E0006405	10.00	12/1/1998	107	CANYON
E0006405	9.00	12/21/2001	107	CANYON
E0006441	11.00	4/5/1994	88	CANYON
E0006441	14.00	12/16/1998	88	CANYON
E0006441	14.00	12/27/2001	88	CANYON
E0006487	38.00	7/3/1995	245	CANYON
E0006487	30.00	12/13/1995	245	CANYON
E0006487	43.00	6/29/1998	245	CANYON
E0006487	23.00	5/19/1999	245	CANYON
E0006487	25.00	9/17/2001	245	CANYON
E0006487	20.00	4/25/2002	245	CANYON
E0006610	0.00	12/3/1995	393	CANYON
E0006610	7.00	12/21/1998	393	CANYON
E0006610	6.00	12/17/2001	393	CANYON
E0006625	5.00	12/20/1994	400	CANYON
E0006625	8.00	11/12/1998	400	CANYON
E0006625	7.00	12/19/2001	400	CANYON
E0006632	10.00	12/19/1994	185	CANYON
E0006632	0.00	11/13/1995	185	CANYON
E0006632	22.00	11/13/1998	185	CANYON
E0006632	8.00	12/12/2001	185	CANYON

WELL ID - TAG	ARSENIC CONCENTRATION (µg/L)	DATE SAMPLED	TOTAL DEPTH (ft)	COUNTY
E0006635	6.20	12/19/1994	140	CANYON
E0006635	0.00	11/13/1995	140	CANYON
E0006635	9.00	11/16/1998	140	CANYON
E0006635	7.00	12/12/2001	140	CANYON
E0006211	17.00	3/14/1995	929	WASHINGTON
E0006211	26.00	6/30/1998	929	WASHINGTON
E0006211	17.00	1/29/2001	929	WASHINGTON
E0006214	9.00	4/25/1995	963	WASHINGTON
E0006214	0.00	11/17/1998	963	WASHINGTON
E0006214	7.00	12/11/2001	963	WASHINGTON
E0006291	20.00	8/10/1993	247	WASHINGTON
E0006291	21.00	2/8/1994	247	WASHINGTON
E0006291	19.00	3/8/1995	247	WASHINGTON
E0006291	17.00	9/25/1996	247	WASHINGTON
E0006291	25.00	11/6/1997	247	WASHINGTON
E0006291	21.00	6/5/2000	247	WASHINGTON
E0006292	20.00	8/10/1993	204	WASHINGTON
E0006292	18.00	2/8/1994	204	WASHINGTON
E0006292	16.00	3/8/1995	204	WASHINGTON
E0006292	13.00	9/25/1996	204	WASHINGTON
E0006292	26.00	11/6/1997	204	WASHINGTON
E0006292	21.00	6/5/2000	204	WASHINGTON

Draft Areas of Arsenic Detections

In 2000, DEQ established a policy memorandum to define and delineate areas that may have degraded ground water quality (PM-004).

Based on ground water quality, similar hydrogeologic conditions, and land use type, DEQ has identified and delineated several geographic areas in Idaho with elevated arsenic concentrations. The identification of such areas will assist DEQ in project planning, coordination with other agencies, and to prioritize resources in terms of monitoring, outreach and other activities.

Ground water quality results for arsenic were plotted geographically and are shown in Figure 6. Clusters of elevated arsenic results that averaged 5.00 micrograms per liter (µg/L), or one half of the drinking water standard with at least five sample sites and similar aquifer systems were identified and delineated (Figure 7). The delineations were refined by overlaying a series of Geographic Information System (GIS) coverages, such as aquifer systems (hydrogeology), geology and land use as shown in Figure 8, Figure 9, and Figure 10 using areas in the Canyon County vicinity as an example. The areas are not restricted to geographic boundaries, such as county lines.

The proposed *Areas of Arsenic Detections*, based on average arsenic concentration are shown in Figure 11. The areas are separated into two categories: 1) areas with average arsenic concentrations between 50% and 100% of the drinking water standard and 2) areas that exceed the standard. Also identified are the independent arsenic sample results that are outside the draft Areas of Arsenic Detections. In Figure 12, the areas are labeled with a geographic name. The area names are for locational purposes only and do not represent water quality for any one water system or community. Figure 13 illustrates the areas in which the average arsenic concentration is equal to or over the drinking water standard.

Appendix C lists the geographic areas, with corresponding surficial geology, aquifer geology, land use, and preliminary average calculations. Defining the areas of arsenic detections based on hydrogeologic conditions is a more scientific approach than using county boundaries.

In 2001, DEQ, in consultation with the *Ground Water Monitoring Technical Committee* (GWMTC), developed a *Nitrate Priority Ranking Process* that provides a rationale for numerically ranking areas in Idaho with identified ground water degradation from nitrates. In developing the criteria to rank degraded nitrate areas, the GWMTC designed the process for application to other constituents; DEQ may use or adopt this process to evaluate the areas of arsenic detections as a management tool in prioritizing resources.

For additional information regarding the Nitrate Priority Ranking Process, see the following:

http://www.deq.state.id.us/water/gw/nitrate/Ranking_Final.pdf

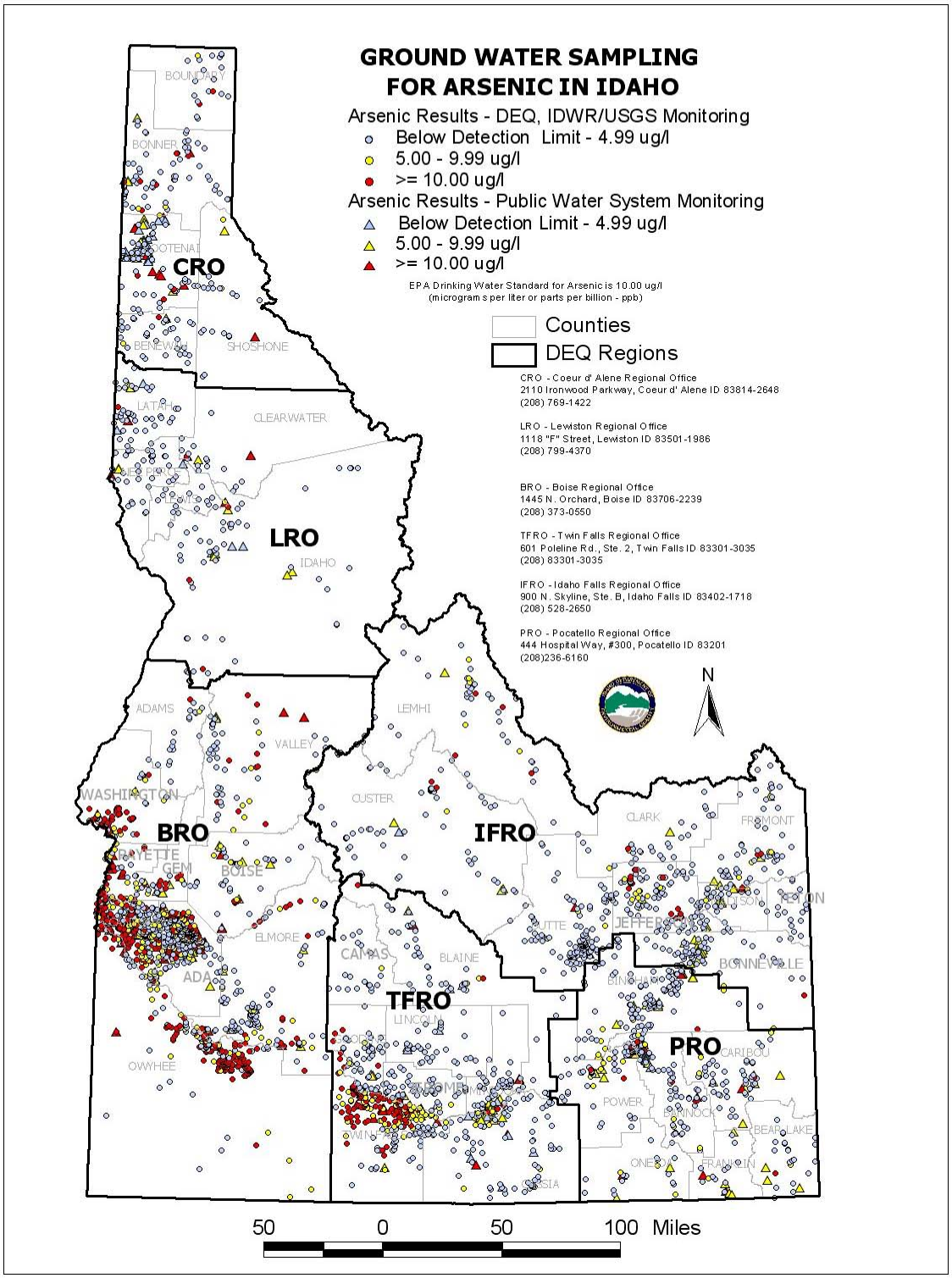

Figure 6. Ground water sampling results for arsenic in Idaho.

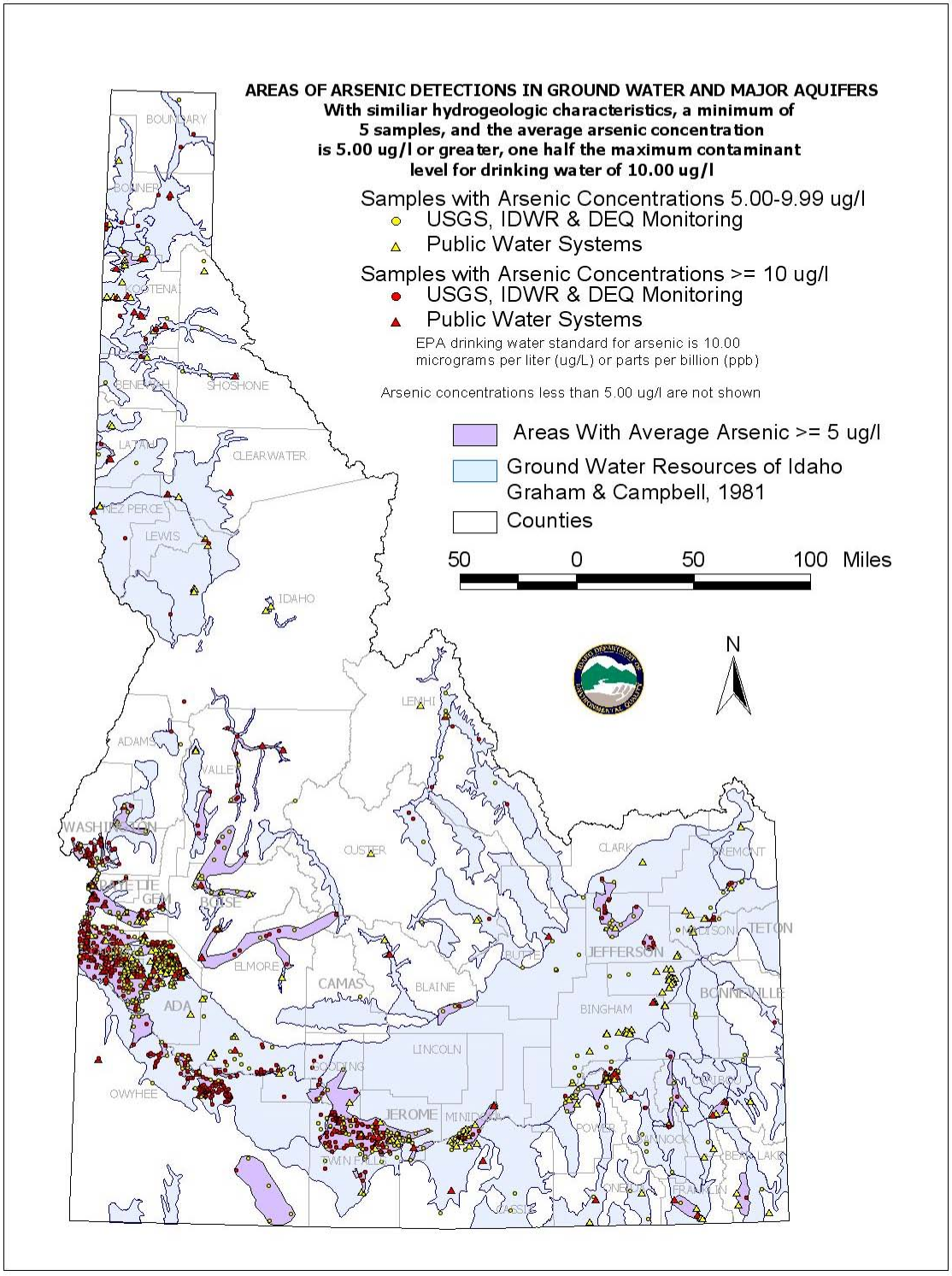

Figure 7. Areas of arsenic detections in groundwater and major aquifers.

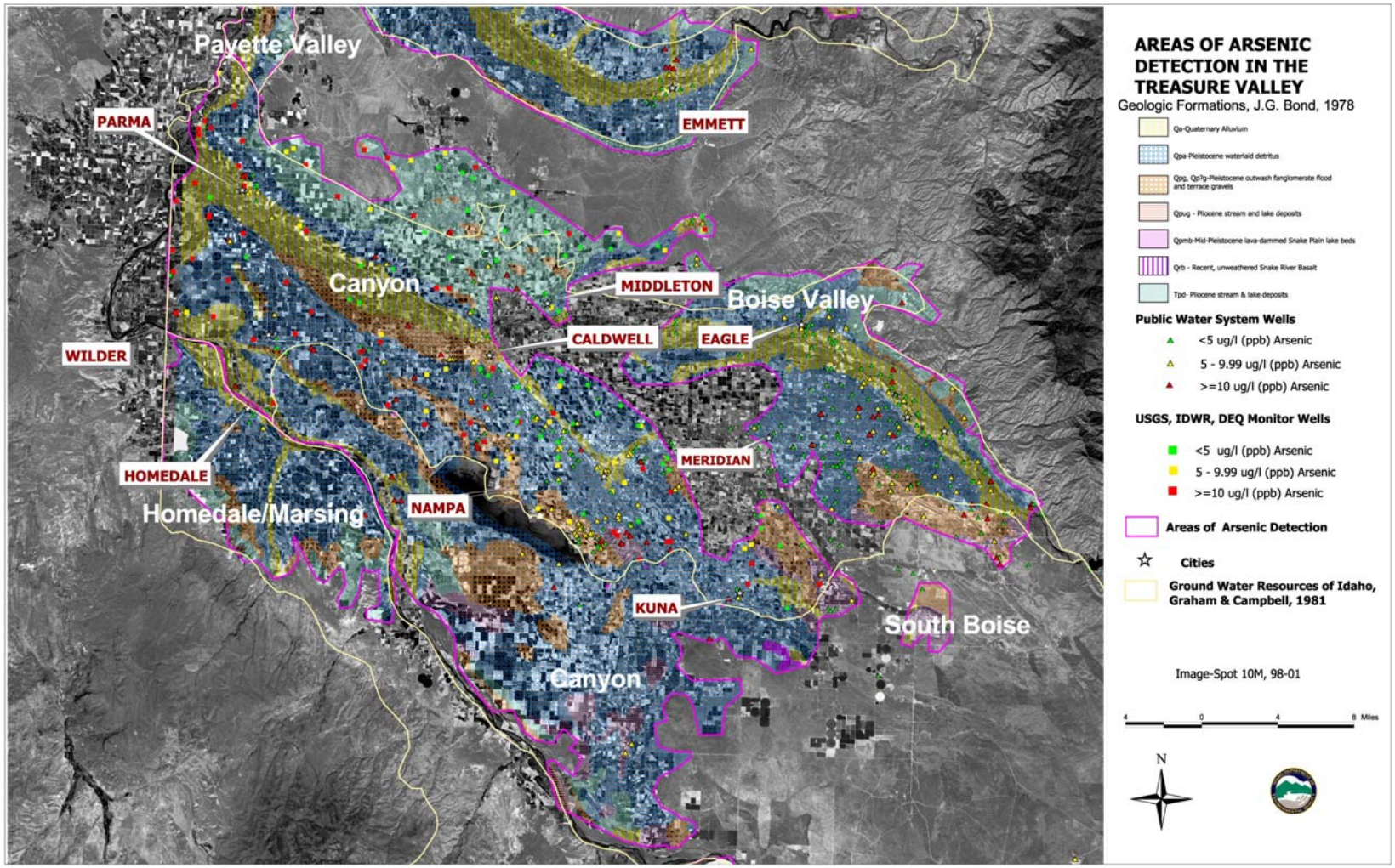

Figure 8.Areas of arsenic detection in the Treasure Valley by geologic formation and surface features.

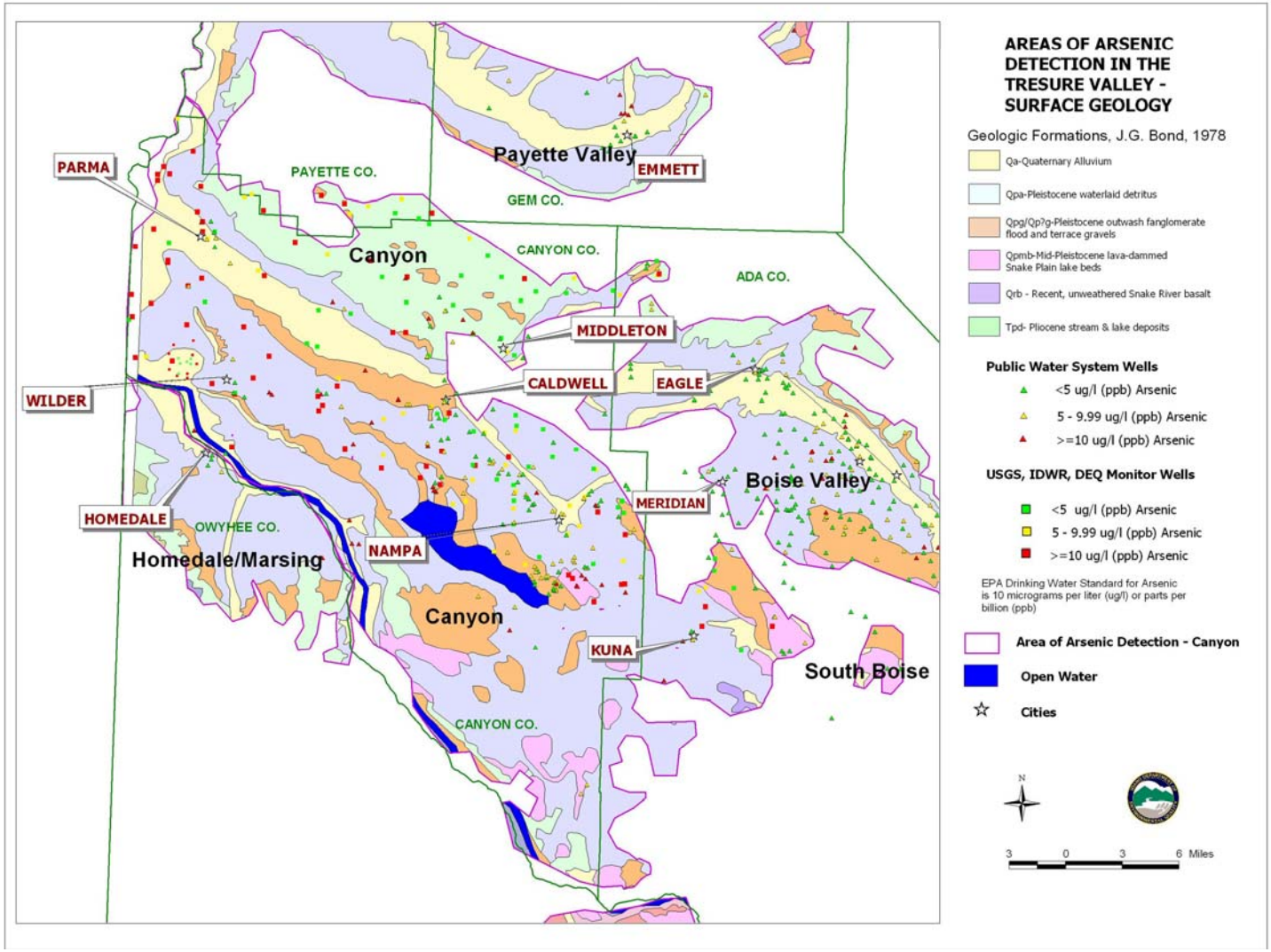

Figure 9. Areas of arsenic detection in the Treasure Valley by geologic formation.

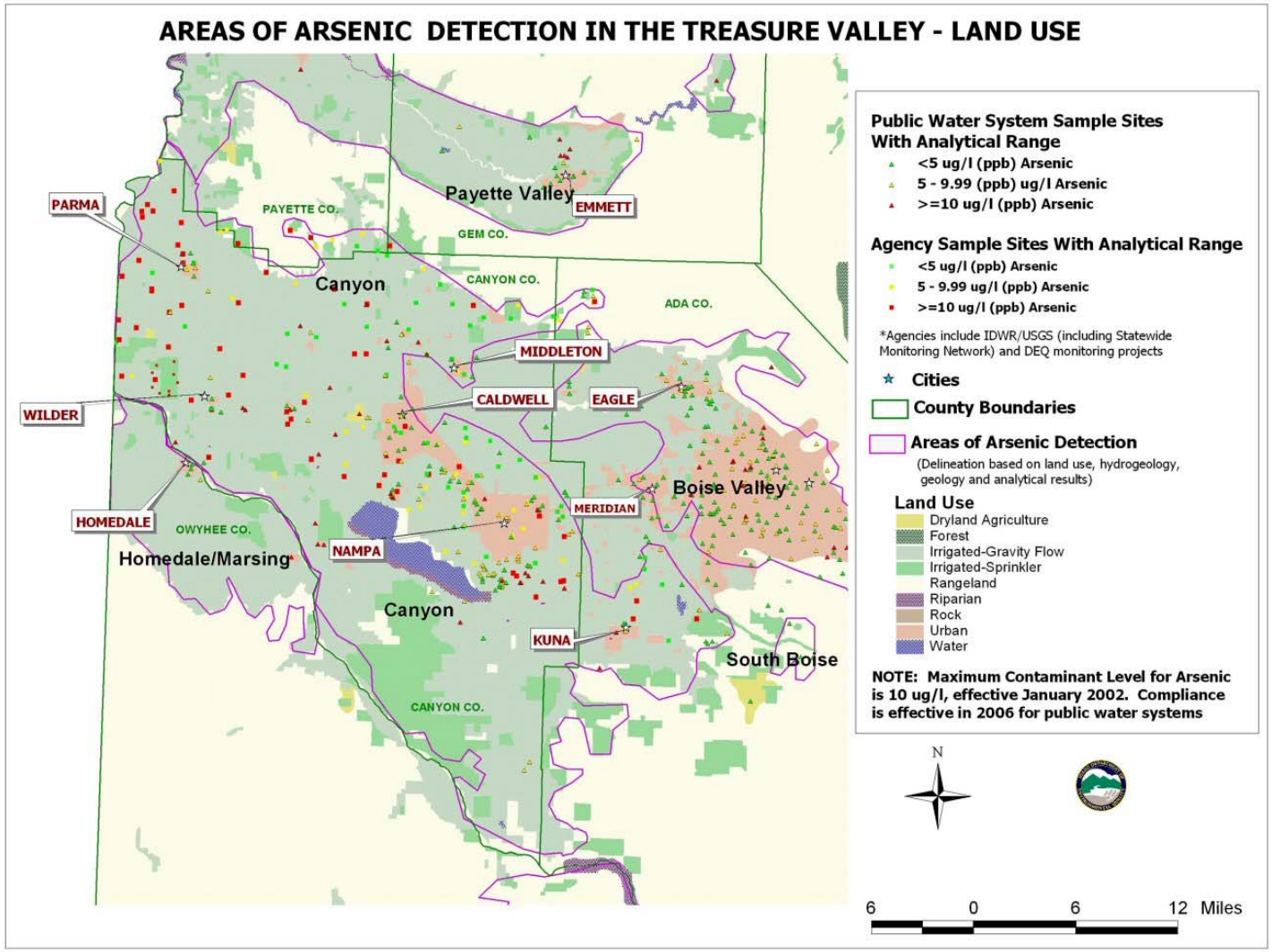

Figure 10. Areas of arsenic detection in the Treasure Valley by land use

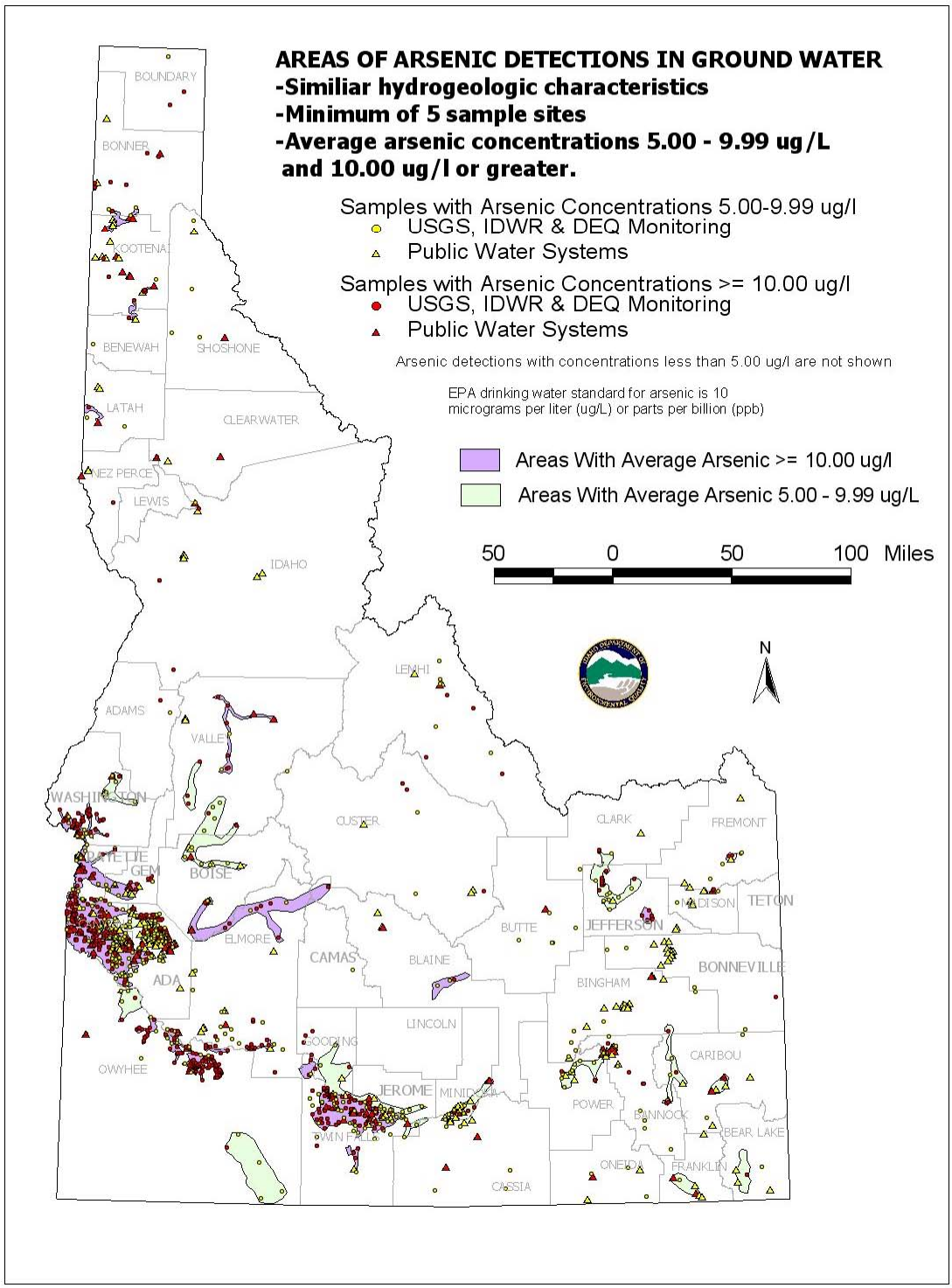

Figure 11. Areas of Arsenic Detections over ½ the Drinking Water Standard by Concentration Range.

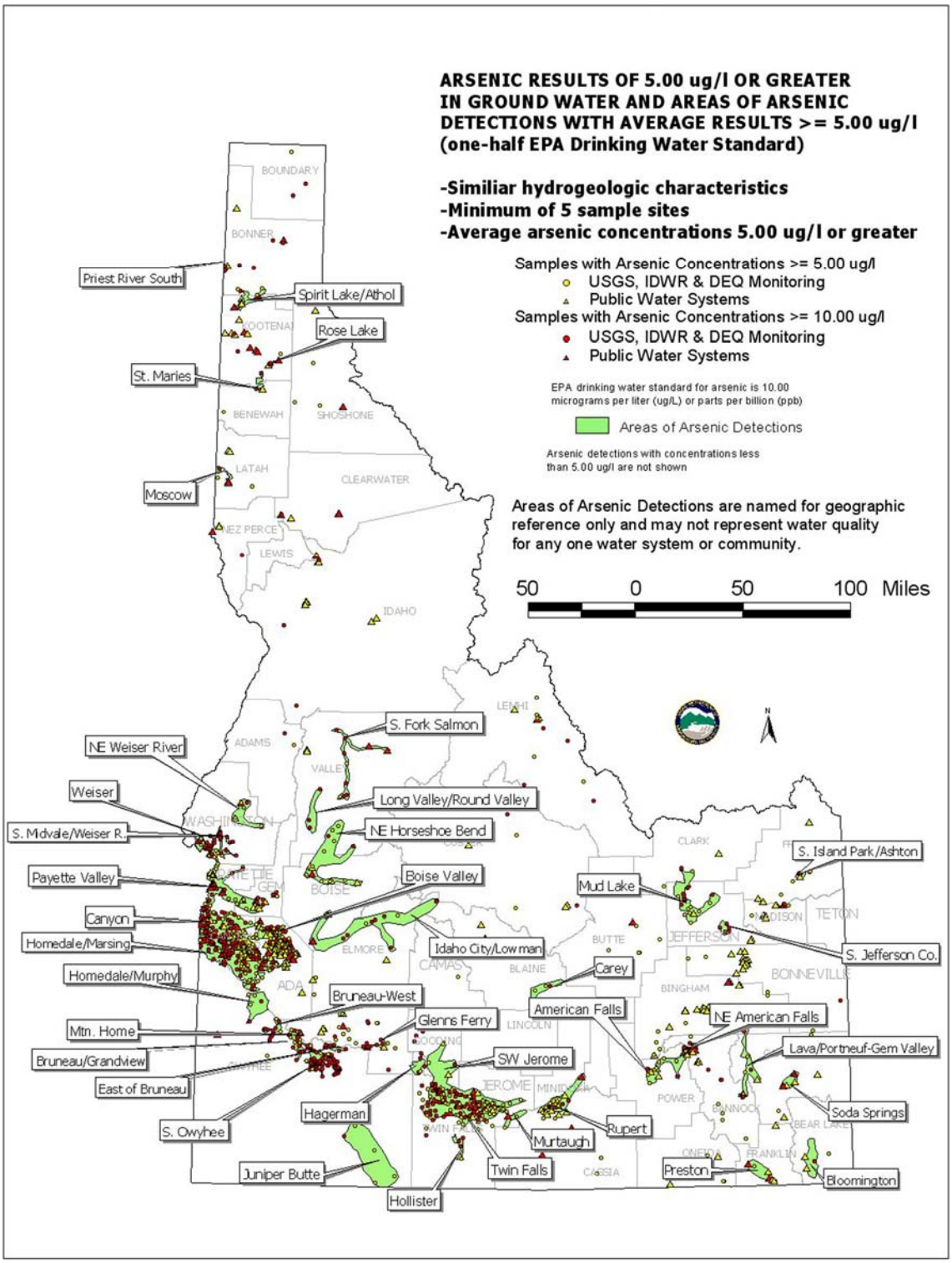

Figure 12. Areas of arsenic detections by concentration range.

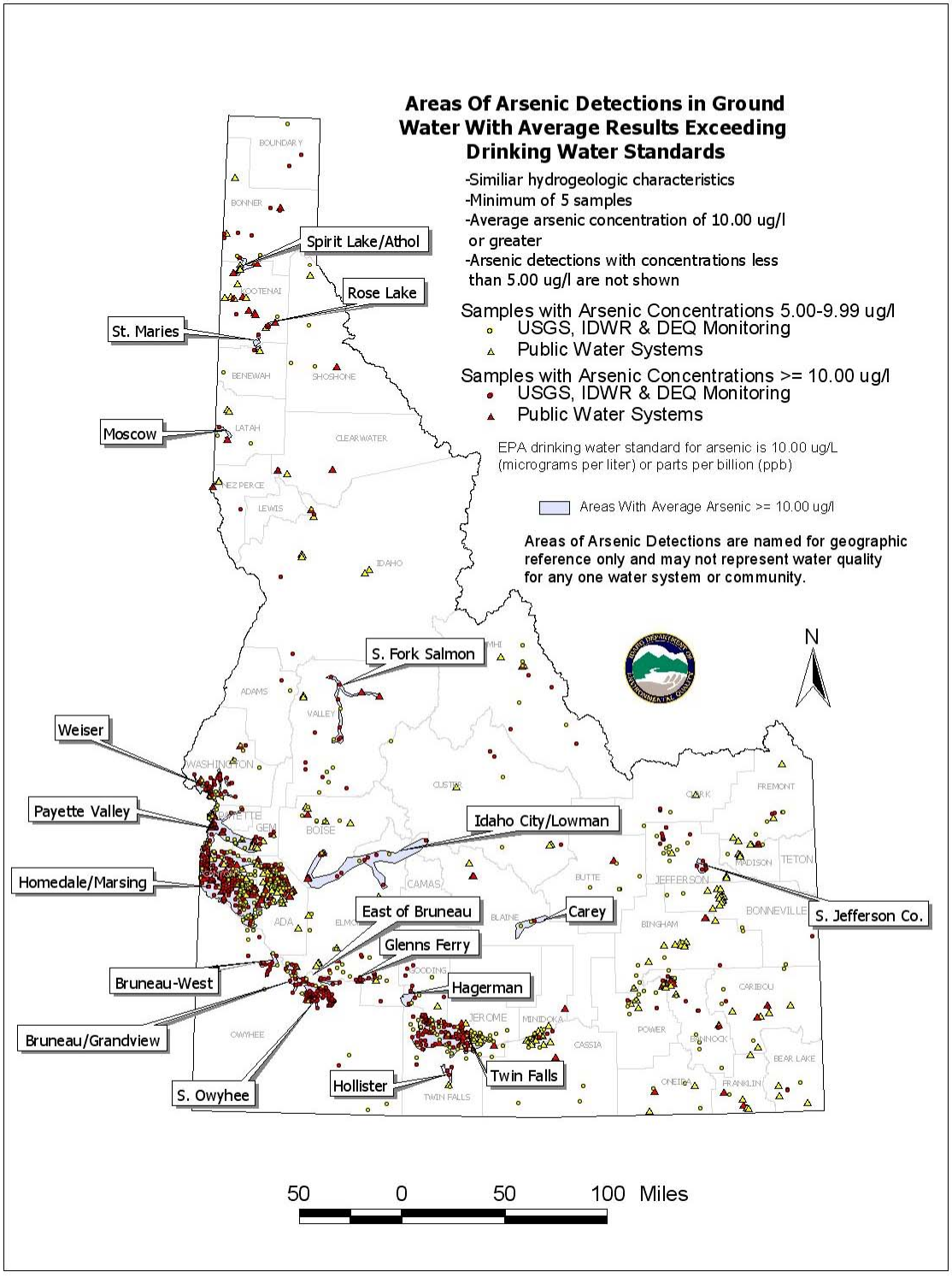

Figure 13. Areas of arsenic detections with average results exceeding drinking water standards.

Conclusions

Conclusions stemming from this review of arsenic concentrations in ground water include the following:

- Out of 44 counties in Idaho, 37 counties have had at least one sample with a maximum arsenic analysis above 10.00 µg/l.
- Five Idaho counties exceed the maximum contaminant level of 10.00 µg/l for average levels of arsenic results by county.
- Five Idaho counties exceed one half the maximum contaminant level or 5.00 µg/l, but are less that 10.00 µg/l.
- Eighteen other Idaho counties have an average arsenic level greater that 2.00 µg/l.
- No background or natural arsenic level has been established.
- Idaho has several ground water areas with significant concentrations of arsenic present in the ground water, primarily in the southwest part of the state.
- South Central Idaho also has numerous wells with high arsenic concentrations.

Recommendations

Future investigations or monitoring projects should be directed to the areas of the state with elevated arsenic detections. The objectives of future monitoring projects and outreach activities should be oriented towards:

- Refining the extent of elevated arsenic concentrations
- Providing water quality information to private well owners in *Areas of Arsenic Detections*
- Providing information to IDWR for the *Areas of Drilling Concern Program*
- Providing information to local health and elected officials for land development decision making
- Evaluating unusual or isolated results
- Evaluating arsenic speciation in relation to geologic formations
- Supporting additional research regarding arsenic speciation in relation to the hydrogeologic environment, as well as toxicological analysis for arsenic species

Arsenic results were accumulated by county to investigate emerging public health trends. The countywide approach combined both low and high arsenic results within county boundaries. Combining the results within county boundaries resulted in associations of low and elevated arsenic values in different geologic units. It is recommended that the more refined approach used to delineate the Areas of Arsenic Detections, be expanded and further evaluated.

Additionally, private well owners should be encouraged to analyze their drinking water. An environmental health specialist at the local health district can provide guidance regarding sampling, information regarding well maintenance, treatment options, and other general information intended for private wells (See Figure 14). The Idaho Department of Health and Welfare, in collaboration with other agencies, has published a brochure for private well owners in Idaho, offering a variety of useful information and contacts. Copies of this brochure can be obtained from DEQ, local health districts, IDWR, USGS and the Idaho State Department of Agriculture, or online at the following address:

http://www.deq.state.id.us/water/water1.htm#groundwater

Other helpful information can be found in the EPA publication, *Drinking Water From Household Wells* (EPA 816-K-02-003 January 2002):

http://www.epa.gov/safewater/privatewells/publications.html

The Idaho Southwest Health District has published a brochure with information specific to arsenic:

http://www.publichealthidaho.com/brochures.asp

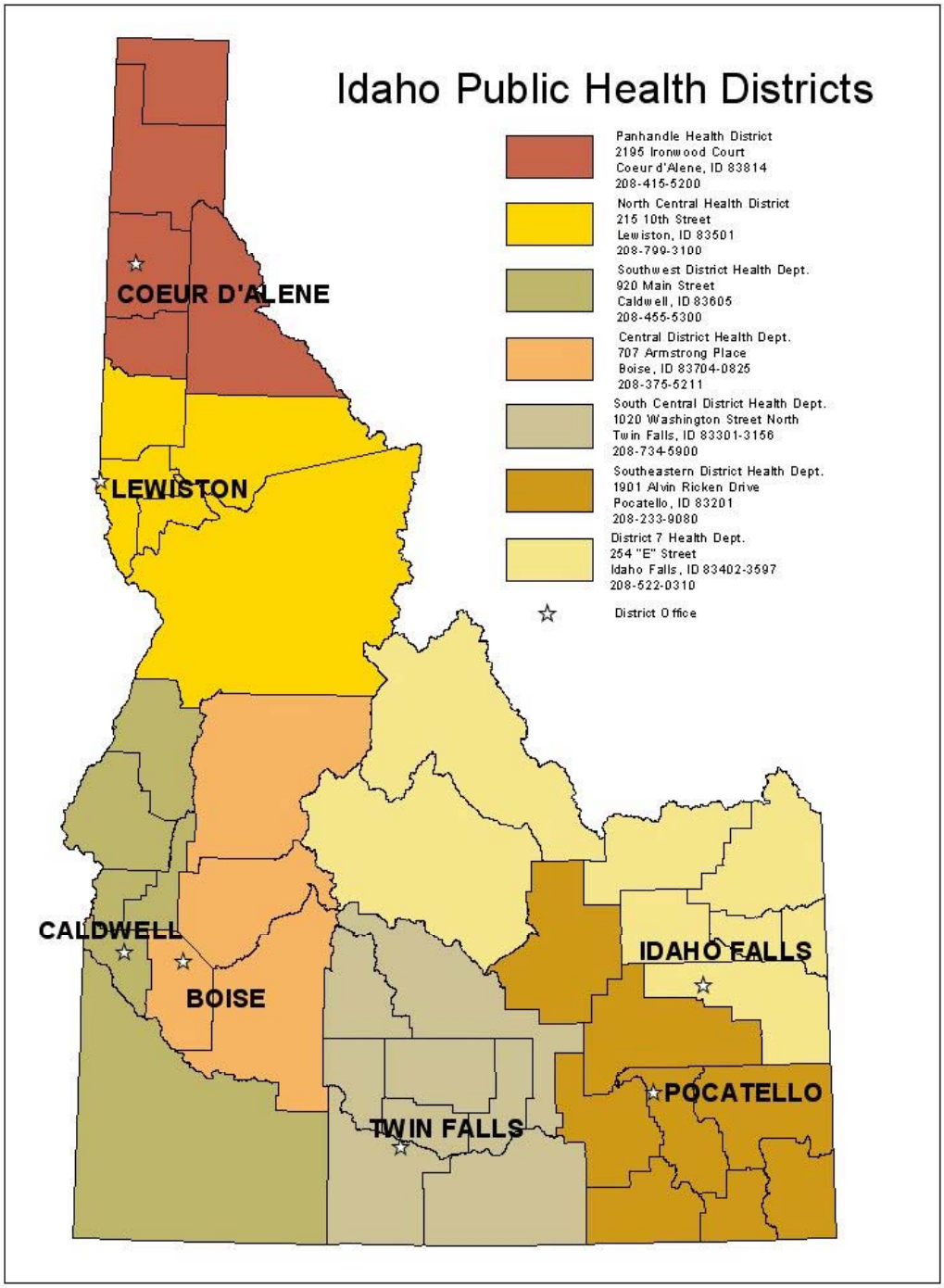

Figure 14. Idaho public health districts.

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References

Bond, J.G., 1978, Geology of Idaho (digitized), USGS, http://www.esri.com/metadata/esriprof80.html

Boyle, L., 1999, 1998 Follow-up Studies to Ground Water Contamination Detections, Idaho Division of Environmental Quality, Water Quality Summary Report No. 33, 29p.

Graham, W.G. and Campbell, L.J., 1981, Ground Water Resources of Idaho, Idaho Dept. of Water Resources, http://www.insideidaho.org/data/statewide/idwr/imap/geolitho_id_idwr.shp.xml

Howarth, R., 1995, An Evaluation of Arsenic in Ground Water in a Portion of Washington County, Idaho, Idaho Division of Environmental Quality, Ground Water Technical Report No. 6, 30p

Idaho Department of Health and Welfare, Environmental Health Education and Assessment Program, Bureau of Community and Environmental Health, Division of Health, 2003, Idaho Private Well Owner Brochure, http://www.deq.state.id.us/water/water1.htm#groundwater

Idaho Ground Water Quality Plan. Adopted 1991 and amended 1996. http://www.idwr.state.id.us/hydrologic/info/statewide/statewide_march_2001.htm

IDWR Personal Communication, Mark Slifka, 11/25/02.

Idaho Source Water Assessment Plan, Idaho Division of Environmental Quality, 1999.

Idaho Division of Environmental Quality, 2000, DEQ Policy Memorandum PM00-04, Policy for Addressing Degraded Ground Water Quality Areas, http://www.deq.state.id.us/policies/pm00_4.htm

Idaho Department of Environmental Quality, 2002, Priority One Nitrate Ranking Process, http://www.deq.state.id.us/water/gw/nitrate/Ranking_Final.pdf

Neely, K.W., 2002, Arsenic Results from the Statewide Program, Idaho Department of Water Resources, Technical Summary, 41p.

Southwest District Health Department, 2001, Arsenic in Drinking Water, http://www.publichealthidaho.com/brochures.asp

State of Idaho, Administrative Rules, 58.01.11 Ground Water Quality Rule, http://www2.state.id.us/adm/adminrules/rules/idapa58/0111.pdf

U. S. Bureau of the Census, provided by Idaho Department of Commerce, Idaho County Population , 2000 Census. http://www.idoc.state.id.us or http://www.idoc.state.id.us/data/census/index.html

U. S. Environmental Protection Agency, Drinking Water From Household Wells, EPA 816-K-02-003 January 2002 http://www.epa.gov/safewater/privatewells/publications.html

U. S. Environmental Protection Agency, National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring; Final Rule [Federal Register: January 22, 2001 (Volume 66, Number 14)] [Rules and Regulations] [Page 6975-7066] 40 CFR Parts 9, 141, and 142 From the Federal Register Online via GPO Access [wais.access.gpo.gov] [DOCID:fr22ja01-29] [[Page 6975]], http://www.epa.gov/safewater/ars/arsenic_finalrule.html

Appendix A: Analysis of Arsenic Monitoring in Idaho

Ground Water Sources in Idaho

Approximately 2100 Public Water Systems

Rely upon 3100 wells and 90 springs (SOURCES)	3,190
Conservative estimate of private domestic wells (IDWR*)	150,000
Total estimated ground water drinking water sources (Private springs are not included)	**153,190**

Ground Water Sources Analyzed for Arsenic

Statewide Monitoring (IDWR/USGS)	1,005
DEQ Monitoring	65
Weiser 1995 Monitoring (16)	
1998 Follow-up Monitoring (29)	
Arena Valley Study 1996-97 (20)	
Estimated Other Agencies	+1,810
Total Project Sites Sampled – private wells	**2,880**
Public Water Systems	**+1,482**
Total Sites Sampled for Arsenic	**4,362**

Estimated Ground Water Sources (Wells) for Drinking Water in Idaho, Without Arsenic Analysis (as of 2002)

Total Private Sources*	150,000	Total Public Sources	3,190
Total Sampled	- 2,880	Total Sampled	- 1,482
Total Not Sampled	147,120	Total Not Sampled (currently)	1,708
Percent Not Sampled (Private excluding springs)	98.1%	Percent Not Sampled (Public)	53.5 %

*IDWR estimate of private domestic wells per Mark Slifka 11/25/02

According to the 2000 census, the population in Idaho is 1,293,953.

Based on the *Idaho Source Water Assessment Plan*, 70% of the population is served by public water systems, which calculates to 905,767 persons.

The remaining 30% of the population—388,186 people—are NOT served by regulated public water systems.

Appendix B: Arsenic by County and Average

Table 3. Arsenic Results by County.

COUNTY	2000 POP	# SAMPLE SITES	MAX. As ug/l	AVE. As ug/l	MEDIAN As ug/l	MODE As ug/l	# PWS	PWS AVE. As ug/l
ADA	300904	525	**38.70**	4.34	2.00	0.00	267	3.03
ADAMS	3476	36	**13.00**	1.31	0.90	0.00	12	0.00
BANNOCK	75565	110	**38.30**	2.84	0.90	0.00	48	1.31
BEAR LAKE	6411	36	**29.40**	1.95	0.75	0.00	14	0.64
BENEWAH	9171	51	**15.00**	1.10	0.90	0.90	16	0.31
BINGHAM	41735	152	**19.00**	2.21	2.00	0.00	59	1.31
BLAINE	18991	80	**83.00**	2.28	0.90	0.00	35	0.29
BOISE	6670	57	**114.00**	**9.12**	2.20	0.90	16	**11.31**
BONNER	36835	122	**21.70**	1.80	0.85	0.00	56	0.36
BONNEVILLE	82522	133	**14.00**	1.55	0.95	0.00	73	1.27
BOUNDARY	9871	28	**21.60**	2.01	0.90	0.90	8	0.00
BUTTE	2899	181	**10.00**	1.81	2.00	2.00	10	0.71
CAMAS	991	22	**5.00**	1.49	0.95	0.90	1	0.00
CANYON	131441	420	**118.00**	**11.98**	**6.00**	0.00	162	6.35
CARIBOU	7304	69	**42.00**	2.23	0.90	0.90	20	1.55
CASSIA	21416	109	**9.20**	1.95	1.00	0.00	32	1.16
CLARK	1022	35	**13.20**	2.90	1.90	2.00	6	1.00
CLEARWATER	8930	24	**30.00**	3.86	0.90	0.90	8	7.75
CUSTER	4342	74	**23.00**	1.64	1.00	0.90	16	0.38
ELMORE	29130	166	**113.00**	**5.62**	2.00	0.00	41	1.66
FRANKLIN	11329	31	**20.00**	2.07	0.00	0.00	19	2.00
FREMONT	11819	89	**16.00**	2.34	1.00	0.00	23	1.96
GEM	15181	53	**51.00**	**7.05**	3.00	0.00	25	5.48
GOODING	14155	62	**37.00**	3.88	2.20	2.00	19	1.92
IDAHO	15511	91	**86.10**	2.82	0.90	0.00	40	1.38
JEFFERSON	19155	121	**110.00**	4.97	2.00	2.00	26	1.42
JEROME	18342	65	**46.00**	3.60	2.20	2.00	9	1.44
KOOTENAI	108685	176	**330.00**	**5.10**	0.00	0.00	127	3.06
LATAH	34935	87	**35.00**	1.25	0.10	0.00	46	1.46
LEMHI	7806	60	**22.00**	3.36	1.00	0.90	11	2.45
LEWIS	3747	26	0.90	0.42	0.30	0.90	10	0.00
LINCOLN	4044	43	4.00	1.74	2.00	2.00	6	0.33
MADISON	27467	53	**14.00**	1.78	0.90	0.00	23	1.70
MINIDOKA	20174	75	**15.20**	3.31	3.00	0.00	22	1.55
NEZ PERCE	37410	58	**5.00**	0.74	0.90	0.90	23	0.22
ONEIDA	4125	25	**8.00**	2.24	2.00	2.00	6	1.83
OWYHEE	10644	221	**131.00**	**16.95**	**13.00**	1.00	11	**12.91**
PAYETTE	20578	61	**46.00**	**13.03**	**9.40**	0.00	28	**17.18**
POWER	7538	83	**57.00**	4.42	2.00	2.00	17	1.65
SHOSHONE	13771	50	**21.00**	1.09	0.00	0.00	30	0.70
TETON	5999	26	**5.00**	0.83	0.90	0.90	7	0.71
TWIN FALLS	64284	202	**63.00**	**12.95**	**9.55**	3.00	33	**12.02**
VALLEY	7651	67	**50.00**	**7.01**	1.00	0.90	7	**15.14**
WASHINGTON	9977	84	**920.00**	**48.18**	**12.40**	0.90	14	**12.43**

Arsenic results >= 10 ug/l are red

Arsenic results 5-9.99 ug/l are green

Table 4. Arsenic Results by Average.

COUNTY	2000 POP	# SAMPLE SITES	MAX. As ug/l	AVE. As ug/l	MEDIAN As ug/l	MODE As ug/l	# PWS	PWS AVE. As ug/l
WASHINGTON	9977	84	920.00	48.18	12.40	0.90	14	12.43
OWYHEE	10644	221	131.00	16.95	13.00	1.00	11	12.91
PAYETTE	20578	61	46.00	13.03	9.40	0.00	28	17.18
TWIN FALLS	64284	202	63.00	12.95	9.55	3.00	33	12.02
CANYON	131441	420	118.00	11.98	6.00	0.00	162	6.35
BOISE	6670	57	114.00	9.12	2.20	0.90	16	11.31
GEM	15181	53	51.00	7.05	3.00	0.00	25	5.48
VALLEY	7651	67	50.00	7.01	1.00	0.90	7	15.14
ELMORE	29130	166	113.00	5.62	2.00	0.00	41	1.66
KOOTENAI	108685	176	330.00	5.10	0.00	0.00	127	3.06
JEFFERSON	19155	121	110.00	4.97	2.00	2.00	26	1.42
POWER	7538	83	57.00	4.42	2.00	2.00	17	1.65
ADA	300904	525	38.70	4.34	2.00	0.00	267	3.03
GOODING	14155	62	37.00	3.88	2.20	2.00	19	1.92
CLEARWATER	8930	24	30.00	3.86	0.90	0.90	8	7.75
JEROME	18342	65	46.00	3.60	2.20	2.00	9	1.44
LEMHI	7806	60	22.00	3.36	1.00	0.90	11	2.45
MINIDOKA	20174	75	15.20	3.31	3.00	0.00	22	1.55
CLARK	1022	35	13.20	2.90	1.90	2.00	6	1.00
BANNOCK	75565	110	38.30	2.84	0.90	0.00	48	1.31
IDAHO	15511	91	86.10	2.82	0.90	0.00	40	1.38
FREMONT	11819	89	16.00	2.34	1.00	0.00	23	1.96
BLAINE	18991	80	83.00	2.28	0.90	0.00	35	0.29
ONEIDA	4125	25	8.00	2.24	2.00	2.00	6	1.83
CARIBOU	7304	69	42.00	2.23	0.90	0.90	20	1.55
BINGHAM	41735	152	19.00	2.21	2.00	0.00	59	1.31
FRANKLIN	11329	31	20.00	2.07	0.00	0.00	19	2.00
BOUNDARY	9871	28	21.60	2.01	0.90	0.90	8	0.00
BEAR LAKE	6411	36	29.40	1.95	0.75	0.00	14	0.64
CASSIA	21416	109	9.20	1.95	1.00	0.00	32	1.16
BUTTE	2899	181	10.00	1.81	2.00	2.00	10	0.71
BONNER	36835	122	21.70	1.80	0.85	0.00	56	0.36
MADISON	27467	53	14.00	1.78	0.90	0.00	23	1.70
LINCOLN	4044	43	4.00	1.74	2.00	2.00	6	0.33
CUSTER	4342	74	23.00	1.64	1.00	0.90	16	0.38
BONNEVILLE	82522	133	14.00	1.55	0.95	0.00	73	1.27
CAMAS	991	22	5.00	1.49	0.95	0.90	1	0.00
ADAMS	3476	36	13.00	1.31	0.90	0.00	12	0.00
LATAH	34935	87	35.00	1.25	0.10	0.00	46	1.46
BENEWAH	9171	51	15.00	1.10	0.90	0.90	16	0.31
SHOSHONE	13771	50	21.00	1.09	0.00	0.00	30	0.70
TETON	5999	26	5.00	0.83	0.90	0.90	7	0.71
NEZ PERCE	37410	58	5.00	0.74	0.90	0.90	23	0.22
LEWIS	3747	26	0.90	0.42	0.30	0.90	10	0.00

Arsenic results >= 10 ug/l are red

Arsenic results 5-9.99 ug/l are green

Appendix C: Arsenic Concentrations by Areas

(See: Bond, J.G., 1978, Geologic Formations of Idaho for definitions of the geological symbols used in the following table.)

Table 5. Draft areas of arsenic detections, average concentration in each area.

Arsenic >=10ug/l **red text**, 5-9.99 ug/l **green text**

ARSENIC AREA	AQUIFER SYSTEM	AQ GEO.	GEOLOGIC FM.	LAND USES	TOTAL GW SITES	MAX AS µg/L	AVE AS µg/L	# SITES >=10 µg/L As	% Sites >= 10 µg/L As	# SITES >= 5 µg/L As	% Sites >= 5 µg/L As	# PWS	MAX PWS As µg/L	PWS AVE As µg/L	# PWS>= 10µg/L As
S. Midvale/Weiser R.	Weiser River	Tcr	Tmb, Tmd*, Tm?b, Qa*	Range, some Irrigated Ag.	5	170.00	**60.00**	4	80	4	80	0	0.00	0.00	0
Rose Lake	Coeur d'Alene River	Qs	Y1n, Tpd*, Qa*	Riparian, some Forest	7	330.00	**54.56**	4	57	5	71	2	16.00	11.00	1
Weiser	Weiser-Scott Crk./Mann	QTs	Tmd, Tmb, Qpg, Qp?g, Qg, Qa	Irrigated Ag., some Urban	73	920.00	**52.12**	50	68	63	86	18	67.00	16.11	11
East of Bruneau	Bruneau/Grandview	Qts	Qpmb, Qpmd, QTs, Qp?g, Qa	Range; Irrigated Ag.	6	126.00	**37.05**	6	100	6	100	0	0.00	0.00	0
Homedale/Marsing	Homedale/Murphy	QTs	Tpd, Qp?g, Qpa, Qa	Irrigated Ag., Little Range	26	131.00	**30.42**	17	65	20	77	6	80.00	16.67	2
Spirit Lake/Athol	Rathdrum Prairie	Qs	Ki?, Qpg*, Qa*	Dry Ag, Urban	24	480.00	**24.40**	4	16	11	41	19	480.00	28.74	3
Idaho City/Lowman	Mores Crk/S.F. Boise/Be	Qs	Kii, Tei, Qpt, Qa	Forest, some Ramge	26	154.00	**24.34**	14	54	17	65	4	154.00	67.75	3
S. Fork Salmon	South Fork of Salmon Ri	Qs	PC, Kii, Qpc, Qg	Forest	10	50.00	**23.70**	7	70	9	90	1	50.00	50.00	1
Bruneau-West	Bruneau/Grandview	QTs	QTs, Qpmd, Qa	Irrigated Ag.	16	80.80	**22.49**	12	75	14	88	0	0.00	0.00	0
Glenns Ferry	Mountain Home Plateau	Qsr	Qpug, Qp?g, QTs, Qa	Range, Irrigated Ag.	18	11.00	**22.00**	11	61	13	72	2	35.00	17.50	1
S. Jefferson Co.	Snake Plain	Qsr	Qpu3b, Qs	Irrigated Ag., Riparian	11	110.00	**20.66**	7	64	9	82	2	7.00	7.00	0
S. Owyhee	Bruneau/Grandview	Qts	Qpmd, Tpd, Qp?g, Qts, Qa	Range; Irrigated & some dry Ag	89	80.00	**20.15**	73	82	80	90	1	13.00	13.00	1
St. Maries	Coeur d'Alene/St. Marie	Qs,	Tm2b*, Y?n, Qpw, Qa*	Dry Ag., Forest	5	73.00	**19.08**	2	40	3	60	2	5.00	2.50	1
Twin Falls	Salmon Falls/Rock Creek	QTb	Tpb, Tpf, Qmpd, Qp?g, QTb, Q	Irrigated Ag., Urban, Riparian	133	63.00	**16.90**	91	68	129	97	28	27.00	15.15	22
Payette Valley	Payette Vallley	Tpd	Tpd, Qp?g, Qpa, Qa	Irrigated Ag., Urban, Riparian	82	80.00	**13.25**	36	44	52	63	44	80.00	16.32	23
Canyon	Mountain Home Plateau, Boise Valley	Qsr, QTs	Tpd, Qrb, Qpmb, Qp?g, Qpa, Q, Qa, Qpa, Qpg	Irrigated Ag., Range, Urban	438	111.00	**12.99**	177	40	222	51	171	87.00	9.51	54

Table 5, continued

Arsenic >=10ug/l **red text**, 5-9.99 ug/l **green text**

ARSENIC AREA	AQUIFER SYSTEM	AQ GEO.	GEOLOGIC FM.	LAND USES	TOTAL GW SITES	MAX AS µg/L	AVE AS µg/L	# SITES >=10 µg/L As	% Sites >= 10 µg/L As	# SITES >= 5 µg/L As	% Sites >= 5 µg/L As	# PWS	MAX PWS As µg/L	PWS AVE As µg/L	# PWS>= 10µg/L As
Hagerman	Bruneau/Grandview	QTs	Qplg, QTs, Qa	Irrigated Ag., Very Little Range	5	18.90	12.80	14	80	5	100	4	0.00	0.00	0
Carey	Snake Plain	Qsr	PPNc, Mc*, Qpu?b, Qa*	Range, Irrigated Ag.	9	83.00	12.21	1	11	3	33	1	2.00	2.00	0
Mtn. Home	Mountain Home Plateau	Qsr	QTs, Qa	Irrigated Ag.	10	28.00	11.53	5	50	8	80	1	10.00	10.00	1
Bruneau/Grandview	Bruneau/Grandview	QTs	QTs, Qpmd, Qa	Irrigated Ag., minor Range	28	31.00	10.97	13	46	19	68	2	21.00	10.50	1
Hollister	Salmon Falls/Rock Creek	QTb	Tpb*, Qa	Range w/Irrigated Ag., Dry Ag.	8	32.00	10.71	3	38	5	63	1	5.00	5.00	0
Moscow	Moscow Basin	Qs	Kii	Dry Ag.	7	44.00	10.70	3	43	3	43	3	44.00	20.33	2
Juniper Butte	NA	NA	Tpb*, Tpf*	Range, some Riparian	5	16.00	9.80	1	20	5	100	0	0.00	0.00	0
Bloomington	Bear River/Dingle Swamp	Qs	Z2s, C, Ou, TRI, Tpd, Ted, Q	Range, Irrigated Ag., Sm. Ripari	5	29.40	9.08	1	20	3	60	2	8.00	7.00	0
NE Weiser River	Weiser River	Tcr	Tmd, Tmb, Qa	Forest, Irrigated Ag., Range	11	26.00	8.79	3	27	8	73	3	26.00	11.67	1
Long Valley/Round Valley	Long Valley	Qs	Kii, Qpg*, Qd, Qa*	Irrigated Ag, some Forest, Ripar	10	39.00	7.92	3	30	3	30	0	0.00	0.00	0
Mud Lake	Snake Plain	Qsr	Tpf, Tpd, Qpu2b, Qrw, Qs*, Q	Irrigated Ag., Riparian, Range	43	28.70	7.13	11	26	23	54	4	12.00	4.50	1
American Falls	Rockland Valley	QTs	Qpg, Qpa	Dry & Irrigated Ag.	7	13.00	6.71	1	14	6	86	4	13.00	6.25	1
Homedale/Murphy	Homedale/Murphy	QTs	Qpmg, Qpmb, Tpd, Qp?g, Qrw,	Range, Irrigated Ag.	13	19.10	6.69	2	15	8	61	1	5.00	5.00	0
Murtaugh	Goose Creek	Qd	QTb, Qd, Qa	Irrigated Ag.	6	10.00	6.32	1	17	4	67	1	10.00	10.00	1
Lava/Portneuf-Gem Valley	Portneuf/Gem Valley	QTb	PPNc,O,OC,TR, Tpd,Tpv, Qpmb,	Dry & Irrigated Ag., Minor Range	16	37.00	6.19	3	19	6	38	2	6.00	3.00	0
Preston	Cache Valley	QTs	Zs, Tpd, Qpd, Qg, Qa	Irrigated Ag., Some Dry & Range	12	20.00	6.17	2	17	7	58	8	20.00	7.88	2
Rupert	Snake Plain	Qsr	Qpg, Qs, Qa	Irrigated Ag, Urban, Range	35	20.00	5.88	8	23	20	57	22	20.00	5.09	3
S. Island Park/Ashton	Snake Plain	Qsr	Qplf, Qpub, Qpg	Irrigated Ag.	6	13.00	5.85	2	33	2	33	2	5.00	2.50	0
Soda Springs	Soda Springs	QTb	O,S, Tpd, Qpmb, Qa	Dry Ag., Minor Irrigated, Ripari	20	42.00	5.58	2	10	5	25	10	27.00	5.90	2

Table 5, continued

Arsenic >=10ug/l **red text**, 5-9.99 ug/l **green text**

ARSENIC AREA	AQUIFER SYSTEM	AQ GEO.	GEOLOGIC FM.	LAND USES	TOTAL GW SITES	MAX AS µg/L	AVE AS µg/L	# SITES >=10 µg/L As	% Sites >= 10 µg/L As	# SITES >= 5 µg/L As	% Sites >= 5 µg/L As	# PWS	MAX PWS As µg/L	PWS AVE As µg/L	# PWS>= 10µg/L As
Priest River South	Pend Orielle River	Qs	Qpg	Dry Ag.	8	21.70	5.57	2	25	3	38	5	6.00	1.20	0
Boise Valley	Boise Valley	QTs	Tpd, Qpmb, Qpa, Qa	Urban, Irrigated Ag.	372	43.00	5.52	69	19	173	46	209	43.00	4.70	37
SW Jerome	Snake Plain	Qsr	Tpb, Qpu?b, QTb, Qpmd, Qrb,	Irrigated Ag., Riparian, Range	59	46.00	5.45	7	12	19	32	15	30.00	5.74	3
NE Horseshoe Bend	Deadwood River/Garden V	Qs	Kii*, Qd, Qg	Forest, Some Irrigated Ag., Rang	26	16.00	5.32	3	11	17	65	8	16.00	5.13	1
NE American Falls	Arbon Valley	QTs	Qp?g, Qpug, Qpa, Qw, Qa	Irrigated & Dry Ag., Range	35	57.00	5.00	9	26	23	66	8	30.00	11.76	3