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Idaho Department of Environmental Quality

Ground Water Quality Monitoring Results for Northwest Owyhee County, Idaho

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ISDA Technical Results Summary # 6

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Introduction

In March 1999, the Idaho State Department of Agriculture (ISDA) and Idaho Department of Environmental Quality (IDEQ) Boise Regional Office began a five-year cooperative ground water quality study within a rural area northwest of Marsing, Idaho (Figure 1). The study was initiated as a result of (1) concerns by local residents that several recently developed dairy operations could be negatively impacting ground water and (2) *prior detections of elevated nitrate in ground water within the area.

*In 1991 and 1995, the Idaho Department of Water Resources (IDWR) Statewide Ambient Ground Water Quality Monitoring Program tested a well in the area and found nitrate levels above the Idaho Ground Water Quality Rule Maximum Contaminant Level of 10 milligrams per liter for nitrate (IDAPA 58.01.11) (Neely and Crockett, 1999).

As data becomes available, ISDA and IDEQ will be working to advise residents and officials in the area to reduce ground water contamination and to be aware of possible health risks. Ground water monitoring efforts associated with this project are scheduled to be conducted quarterly through 2003. This Technical Results Summary presents partial water quality monitoring results for the first two years of the study (1999 and 2000). Annual reports regarding the study will be published until the completion of the project.

Description of Study Area

The study area covers approximately 10-square miles in northwest Owyhee County (Figure 1). The area is bounded to the north and east by the Snake River, to the West by Jump Creek, and to the south by State Highway 55. Land surface varies from flat to gently rolling hills with a southeast to northwest topographic high in the west-central portion of the project area. An east to west trending topographic break or decline occurs along the northeastern portion of the project area about one to three miles from the Snake River. In general, land surface slopes from south to north toward the Snake River.

Within the project area, irrigated agriculture is the dominant land use. High value row crops are grown with commercial fertilizer and pesticide applications common on most fields. Irrigation water comes from both canals and ground water wells and is applied by

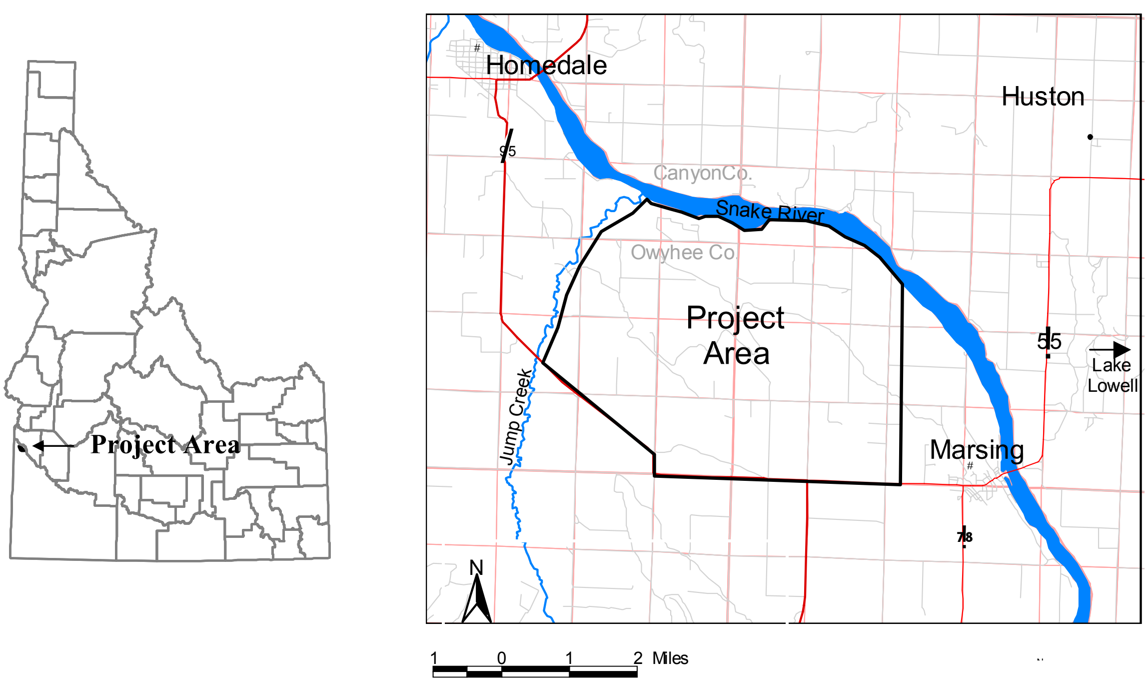

Figure 1. Location of ISDA ground water monitoring project in Owyhee County, Idaho.

gravity methods and through pressurized sprinklers. Chemigation of nutrients and pesticides is common.

In addition, some property owners in the area raise livestock. The size of these operations varies from a few individual animals to several thousand head dairy farms. Thus, fertilizer and animal waste are major potential sources of nitrate entering ground water within the area.

Purpose of the Project

The purpose of this project is to characterize the water quality of the area and determine sources of contaminants. ISDA, IDEQ, and the landowners in the area would like to determine relative contaminant contributions from the potential sources in the area. Information gathered from the project may be used to make regulatory and/or voluntary use changes on lands contributing to the problem.

Hydrogeology

Sediments underlying the project area predominantly are classified within the Idaho Group geologic formation (U.S. Geological Survey, 2000). Sources of these sediments are believed to originate from prehistoric Lake Idaho and from more recent deposition from the Snake River. A characteristic "blue clay" is found on well drillers' reports from IDWR for many of the wells of the study area. These blue clays are of the Glenns Ferry Formation (Othberg, 1994) and their low permeability characteristics can produce confined aquifer conditions. The blue clays also serve as an indicator of anaerobic conditions.

Ground water used for domestic purposes in the project area appears to come from two sources: (1) a shallow system within coarse grained sands and gravels and (2) a deeper system within a characteristic black sand that is separated from the shallow system by a blue-colored clay of varying thickness (Figure 2). Aquifer conditions appear to vary from unconfined to confined at different locations and different depths. Well drillers' reports of wells monitored as part of this project indicate shallow ground water within sands and gravels to be less than 50 feet below land surface. Well driller report data and the geologic cross section indicate the deep system is found at varying depths, generally less than 300 feet (Figure 2 and Table 1). Static water levels are typically less than 60 feet.

Horizontal ground water flow directions in the project area were determined by contouring static water level measurements using Surfer™ computer software (Figure 3). Static water level measurements were obtained from well drillers' reports for wells from this project in addition to wells from another ISDA project being conducted in northern Owyhee County. The accuracy of contouring may be variable due to the time variations in which the measurements were taken. However, the potentiometric surface does correspond with known ground

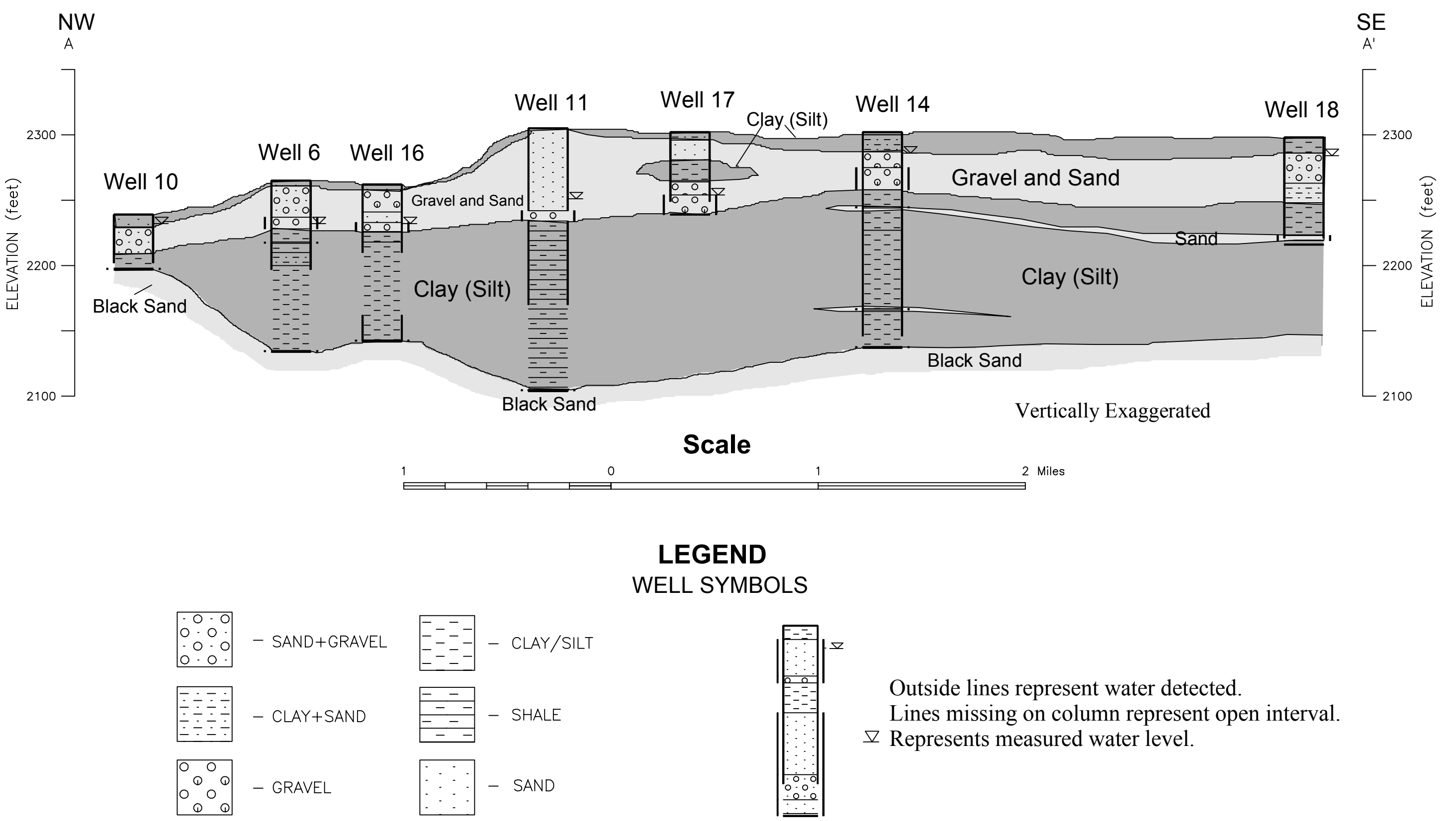

Figure 2. Geologic cross section based on well drillers' reports from project area. Cross section line is displayed on Figure 4 (page 4).

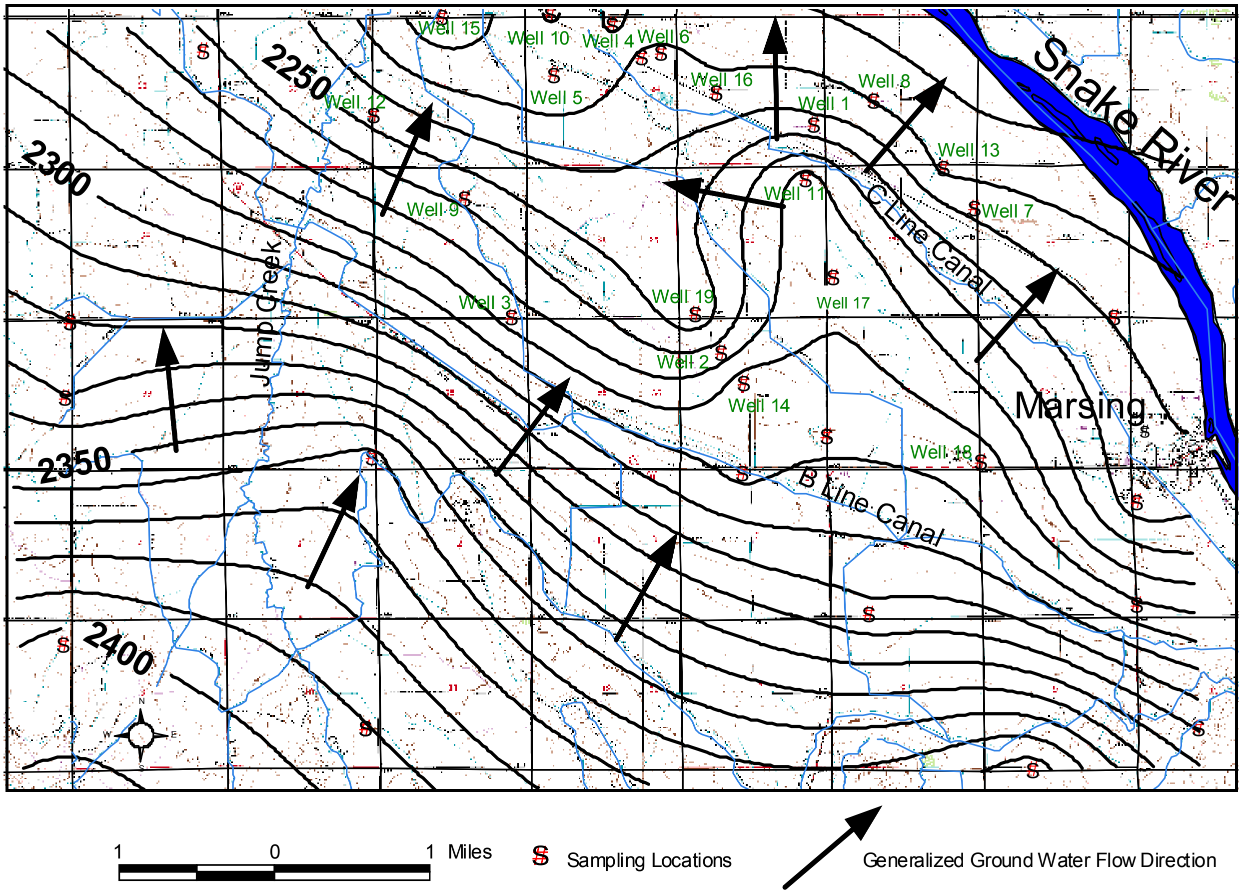

Figure 3. Potentiometric surface map of local ground water aquifer.

water movement characteristics and theory.

General ground water movement appears to be toward the Snake River, an area of probable ground water discharge. In addition, ground water flow direction appears to correspond to topographic slope, another characteristic common to shallow ground water. In general, the map indicates the general direction of ground water movement is to the northeast with a component of flow to the northwest coming off the topographic break in the north central portion of the map.

Other Water Quality Work in the Area

Since the Statewide Ambient Ground Water Quality Monitoring Program network (statewide network) was established in 1991, IDWR has monitored several wells within or in close proximity of the project area. Of these wells, three have shown nitrate concentrations above 2 mg/L with two of the wells testing above the IDAPA MCL of 10 mg. (Figure 4).

Two statewide network wells with elevated nitrate levels are located within project boundaries. The well located in Sec. 25, T3N, R5W tested at 17.0 mg/L for nitrate and 20.0 mg/L for nitrate in 1991 and 1995, respectively (Figure 4). The total depth of this well is 386 feet and is screened in both shallow and deep aquifer systems beneath the project area. Based on the ground water flow direction map, the well is down gradient from a large dairy operation and several agricultural fields. The dairy did not begin operation until 1999. The well was dropped from the statewide network because it mixed ground water from the two aquifers (Ken Neely, 2000).

The other statewide network well located in Sec. 29, T3N, R4W tested at 4.3 mg/L for nitrate in 1992, 2.9 mg/L for nitrate in 1996, and 4.2 mg/L in 2000 (Figure 4). The total depth of this well is 140 feet. The well is uncased from 46 feet below land surface to 140 feet. This well also is down gradient from a large dairy and several farm fields (Figure 4). The nearby dairy began operation in 1994.

A third statewide network well, located just south of the southwest project boundary, has been tested four times since the onset of the statewide program (Figure 4). The original sampling event in 1994 returned a nitrate concentration of 13.0 mg/l from the well. Samples collected from the well in 1996 and 1997 had nitrate concentrations below the laboratory detection limit. However, ammonia levels of 5.4 mg/L and 4.6 mg/L were reported for the two years, respectively. Testing in 1998 indicated concentrations of ammonia to be 4.7 mg/L. The total depth of this well is 242 feet and

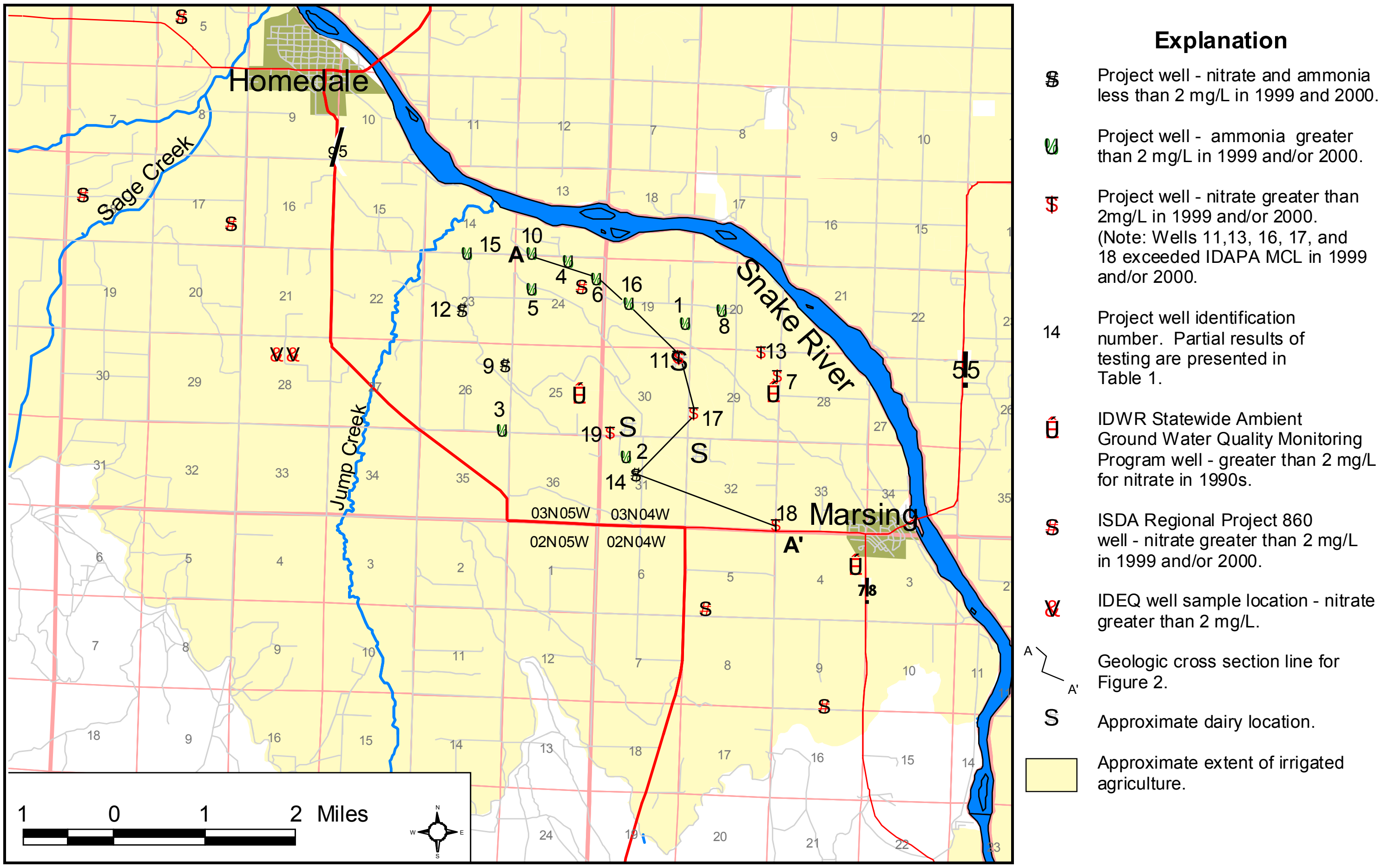

Figure 4. Map of nitrate and ammonia detections in ground water for project area and vicinity. Well identification numbers on map correspond to results in Table 1 and 2.

Table 1. Nitrate and ammonia results from quarterly monitoring through 1999. All concentrations are in mg/L. Last two columns of table indicate static water level (SWL) and total depth.

	Mar-99		Jun-99		Sep-99		Dec-99		Mar-00		June-00		Sept-00			
Well	NO_3	NH_3	NO_3	NH_3	NO_3	NH_3	NO_3	NH_3	NO_3	NH_3	NO_3	NH_3	NO_3	NH_3	SWL	DEPTH
1	BDL	6.60	BDL	4.70	BDL	6.50	BDL	6.10	NS	NS	BDL	6.89	BDL	7.08	15	147
2	BDL	3.80	BDL	2.20	BDL	3.20	BDL	3.10	BDL	3.47	BDL	4.00	BDL	4.17	30	100
3	BDL	2.30	BDL	2.20	BDL	1.80	NS	NS	BDL	2.29	BDL	3.55	BDL	3.47	17	185
4	BDL	7.40	BDL	5.80	BDL	7.30	BDL	7.30	BDL	7.93	BDL	8.07	BDL	9.61	42	285
5	BDL	5.10	BDL	2.90	BDL	5.00	BDL	4.60	BDL	5.81	BDL	6.28	BDL	7.10	17	80
6	BDL	5.20	BDL	2.70	BDL	3.90	BDL	3.90	BDL	4.71	BDL	5.29	0.01	5.71	33	130
7	1.20	BDL	2.60	BDL	2.10	ND	1.90	BDL	1.84	BDL	3.77	BDL	3.45	BDL	31	44
8	BDL	6.40	BDL	4.50	BDL	5.80	BDL	5.70	BDL	6.59	BDL	6.54	BDL	6.86	35	145
9	BDL	0.18	0.36	ND	0.18	0.19	0.23	BDL	0.53	0.13	0.29	0.15	BDL	0.21	12	200
10	BDL	4.90	BDL	5.40	BDL	4.80	BDL	4.90	BDL	5.91	BDL	6.15	BDL	6.46	7	42
11	**26.00**	0.27	**29.00**	0.16	**30.00**	0.22	**31.00**	0.17	**34.80**	0.19	**33.60**	0.18	**28.70**	0.18	54	200
12	0.05	1.10	BDL	1.10	BDL	1.00	BDL	1.10	BDL	1.08	BDL	1.14	BDL	1.14	16	115
13	9.50	0.14	NS	NS	9.50	0.12	9.50	0.15	**11.40**	0.14	**11.80**	0.11	**10.60**	0.11	42	59
14	BDL	1.30	BDL	1.40	BDL	1.40	0.25	1.40	BDL	1.30	BDL	0.05	BDL	1.54	16	164
15	BDL	5.30	BDL	5.50	ND	4.80	BDL	5.50	BDL	6.64	BDL	6.20	BDL	6.46	30	267
16	BDL	3.50	BDL	4.20	0.03	4.00	BDL	3.80	BDL	4.72	BDL	4.98	0.01	5.33	30	120
17	**12.00**	BDL	**10.00**	BDL	**10.00**	BDL	**13.00**	BDL	**14.60**	BDL	**11.90**	BDL	**13.20**	BDL	48	63
18	NS	NS	**24.00**	BDL	**27.00**	BDL	**34.00**	BDL	**25.10**	0.06	**22.40**	BDL	**24.10**	BDL	14	82
19	NS	NS	0.01	6.80	9.60	1.10	**14.00**	BDL	**13.80**	0.53	**14.00**	0.49	**10.40**	0.04	46	530

NS = Not Sampled **BDL = Below Laboratory Detection Limit** **Bold type = Nitrate detections above EPA MCL.**

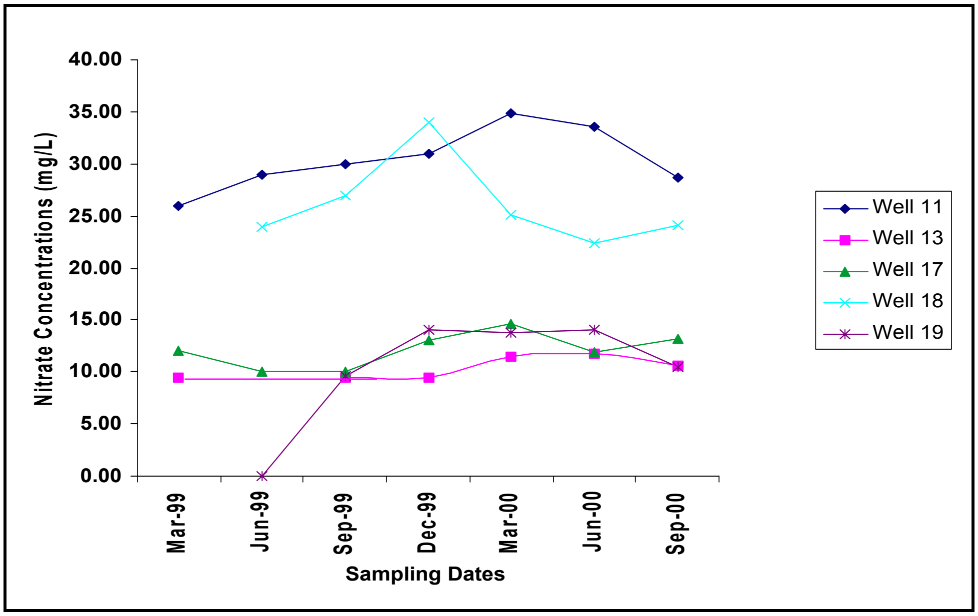

Figure 5. Time series plots of ground water wells having elevated nitrate levels above 10 mg/L in Owyhee County project area.

the well is screened into the deep system.

In 1998, three wells were sampled for nitrate in Sec. 28, T3N, R5W by IDEQ. *(*Figure 4*)*. The reason for monitoring in this section was due to elevated arsenic in an IDWR Statewide network well. Nitrate samples were collected at these sites in addition to the arsenic. The 34 foot deep well, which is cased to 33 feet had a nitrate level of 1.67 mg/L. The 90 foot deep well, which is cased to 40 feet had a nitrate level of 12 mg/L. The 275 foot deep well, which is cased to 50 feet had a nitrate level of 6.05 mg/L

ISDA began a regional scale project (Project 860) in 1999 that encompasses the entire length of northern Owyhee County. Included within the project are several wells within or near the project area. No wells within this project's boundary tested over the IDAPA MCL for nitrate. However, one well within Sec. 24, T3N, R5W tested at 2.5 mg/L for nitrate in 1999. The same well was below the laboratory detection for nitrate in 2000, but had an ammonia level of 5.0 mg/L. Several ISDA Regional Project 860 wells outside the boundary of this study have tested above 2 mg/L for nitrate (several above 10 mg/L for nitrate). The wells are located northwest and southeast of the study area (Figure 4).

Monitoring Results

Since March 1999, ISDA and IDEQ have sampled a total of 19 ground water wells for a variety of parameters including nitrate, ammonia, bacteria, nitrite, ortho-phosphate, chloride, sulfate, fluoride, and arsenic. Partial results of these monitoring events are presented in subsequent sections of this report.

Monitoring results from wells in the shallow and deep systems have distinct ground water quality differences. One primary difference is that many wells located within the shallow system have elevated concentrations of nitrate. Most deeper wells tapping into the black sand aquifer have levels of ammonia above 2 mg/L and nitrate below 2 mg/L.

Nitrogen found in ground water in the form of ammonia rather than nitrate suggests a reducing environment, or lack of oxygen in the ground water. Other areas in southwest Idaho along the Snake River with confined aquifer conditions show the presence of ammonia in ground water. More information needs to be gathered to determine whether ammonia found in the deep system of the study area is naturally occurring, a result of human impacts, or both.

Nitrate

Of the constituents being sampled, nitrate presents the greatest concern because of potential adverse health effects. Although chronic, long term health risks of nitrate consumption are not fully understood; short term effects are well documented. Methemoglobinemia (blue baby syndrome), which is characterized by the reduced ability of the blood to carry oxygen in infants, can afflict infants consuming water with high levels of nitrate (Parliman, 2000). Consumption of large concentrations of nitrate also may be associated with non-Hodgkins lymphoma (Parliman, 2000).

Of the 19 wells tested, five have tested positive for nitrate above the IDAPA MCL of 10 mg/L (Table 1). Concentrations exceeding 30 mg/L have been detected in two of these wells (wells 11 and 18, Figures 3 and 4). Six individual wells have tested above 2 mg/L per liter which is believed to be above any naturally occurring nitrate found in Idaho ground water (Figure 4).

Five of the six wells testing positive for nitrate are down gradient from one or more large dairy operations. In addition, these wells are down gradient from several active crop fields. Each well is screened into the shallow upper aquifer system with the exception of well 11, which is screened into both lower and upper systems.

Well 18 is the only study well testing positive for nitrate that is positioned up gradient from the dairy operations. This well was drilled in the center of a former livestock corral approximately 25 years ago. In addition, a small pig pen was positioned nearby and up gradient approximately 30 years ago. The well currently is down gradient from several large active crop fields located south of Highway 55.

Based on limited water quality data, initial testing results may suggest seasonal fluctuations in ground water nitrate concentrations (Figure 5). Nitrate levels appear highest through the winter months and generally lowest in summer months. Comparison of the nitrate data by month suggests that nitrate levels have increased in four of the five wells from 1999 to 2000. However, more testing over time is needed to develop a more accurate picture of water quality trends in the project area.

Elevated concentrations of nitrate appear to be localized to central portions of the project area just north of State Highway 55. Potential sources of nitrate include: several dairies, crop fields, historic agricultural land use practices, and possibly septic systems in the area.

Ammonia

Ammonia levels above 2 mg/L are seen in wells southwest of wells showing elevated nitrate (Figure 4). Nitrogen found in an anaerobic environment may take the form of ammonia rather than nitrate regardless of the source. Sources of ammonia could either be naturally occurring or the result of human impacts.

Levels of ammonia above 2 mg/L have been detected in 10 of the 19 wells as part of the study (Figure 4). These wells primarily are located near the northern boundary of the study area. Although no health criteria is available for consumption of ammonia in drinking water, levels exceeding 2 mg/L are not typical for Idaho ground water. Wells having ammonia appear to be down gradient from ground water wells showing elevated nitrate levels and are completed in the deeper ground water system (Figure 4).

Bacteria

Each well was tested for total coliform bacteria and Escherichia coli (E. coli) bacteria during every quarterly sampling event. Positive total coliform results may indicate the possibility of mammalian intestinal bacteria being present. A positive detection of E. coli was detected in June 2000 at Well 17. Twelve wells tested positive for total coliform sometime during the 1999 and 2000 sampling events. Results of testing are presented in Table 2.

Sources of bacteria in the ground water could be from septic tanks, domestic animal waste sources, and contaminated surface waters located near the wells sampled. Another source for positive bacteria test results could be from contaminated piping systems.

Sources of bacteria in the ground water also could be associated with nearby dairy operation waste, waste handling systems, or lagoons. A number of the sites with multiple total coliform detections occur in wells down gradient of dairy operations. Well 17 is down gradient from a large dairy and total coliform has been detected in six out of seven sampling event. The detections range from 15 to 178 counts per 100 m/L. Well 11 is a well at a large dairy and total coliform has been detected in every sampling event. Detections range from 170 to 185 counts per 100 m/L. Wells having total coliform bacteria detections also correspond to wells with nitrate detections. Four out of the five down gradient wells testing above 2 mg/L for nitrate had at least one bacteria detection over the period of study. A more thorough investiga-

Table 2. Bacteria results for 2000. Bold face numbers indicate detection and level.

	March 1999		June 1999		September 1999		December 1999		March 2000		June 2000		September 2000	
Well ID	Total coliform (per 100 m/l)	E. coli (per 100 m/l)	Total coliform (per 100 m/l)	E. coli (per 100 m/l)	Total coliform (per 100 m/l)	E. coli (per 100 m/l)	Total coliform (per 100 m/l)	E. coli (per 100 m/l)	Total coliform (per 100 m/l)	E. coli (per 100 m/l)	Total coliform (per 100 m/l)	E. coli (per 100 m/l)	Total coliform (per 100 m/l)	E. coli (per 100 m/l)
1	ND	ND	ND	ND	ND	ND	**4**	ND	NS	NS	**2,400**	ND	**96**	ND
2	ND	ND	ND	ND	**71**	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	ND	ND	ND	ND	**22**	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	ND	ND	ND	ND	**2**	ND	ND	ND	ND	ND	ND	ND	**91**	ND
6	ND	ND	ND	ND	**7**	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**88**	ND	ND	ND
9	ND	ND	ND	ND	**39**	ND	ND	ND	ND	ND	**13**	ND	ND	ND
11	**185**	ND	**150**	ND	**170**	ND	**170**	ND	**130**	ND	**104**	ND	**96**	ND
13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**91**	ND
16	**13**	ND	ND	ND	ND	ND	ND	ND	**4**	ND	ND	ND	ND	ND
17	**178**	ND	**55**	ND	**140**	ND	**15**	ND	ND	ND	**2,400**	**4**	**83**	ND
19	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	**3**	ND	ND	ND

NS = Not Sampled **ND = No Detection.** **Wells not listed had no detections during 1999 or 2000**

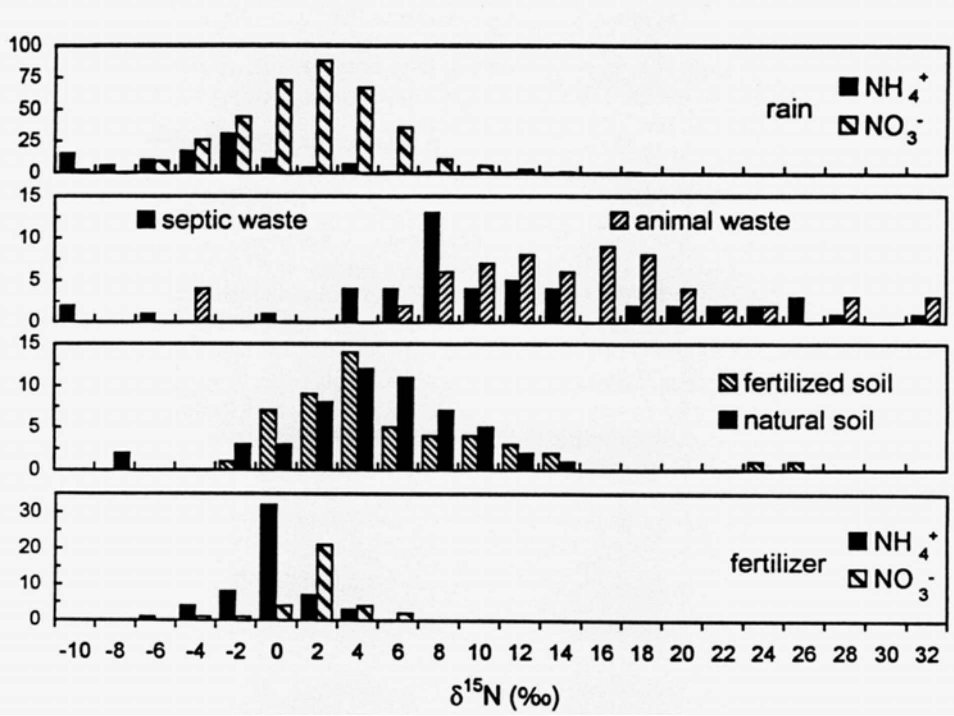

Figure 6. Ranges of $\delta^{15}N$ found in the hydrosphere based on a number of nitrogen isotope studies (after Kendall and McDonnell, 1998).

tion of potential bacteriological sources is needed to better understand the cause and extent of positive bacteria results from project wells.

Nitrogen Isotopes

Overview

The ratio (denoted $\delta^{15}N$) of the common nitrogen isotope ^{14}N to its less abundant counterpart ^{15}N can be useful in determining sources of nitrate. Common sources of nitrate in ground water are from applied commercial fertilizers, animal or human waste, precipitation, and organic nitrogen within the soil. Each of these nitrate source categories has a distinguishable nitrogen isotopic signature. Figure 6 illustrates ranges of $\delta^{15}N$ determined through numerous research studies. Typical $\delta^{15}N$ ranges for fertilizer and waste are –5 to +5 and greater than 10, respectively. Numbers between 5 and 10 generally are believed to indicate an organic or mixed source.

Use of nitrogen isotopes as the sole means to determine nitrate source should be done with great care. $\delta^{15}N$ values of fertilizer and animal waste in ground water can be complicated by several reactions (e.g., ammonia volatilization, nitrification, denitrification, ion exchange, and plant uptake) that can significantly modify the $\delta^{15}N$ values (Kendall and McDonnel, 1998). Furthermore, mixing of sources along shallow flowpaths makes determination of sources and extent of denitrification very difficult (Kendall and McDonnell, 1998).

Findings

ISDA and IDEQ chose to conduct $\delta^{15}N$ testing in order to use it as a possible indicator of source(s) of nitrate and ammonia in the ground water. Because of the cost of testing and limited resources, only a portion of the wells in the area were selected for testing. This included all wells exceeding 10 mg/L for nitrate and a number of spatially distributed wells with elevated ammonia detections. To date, samples have been collected for testing during three separate sample events.

Results of $\delta^{15}N$ testing for the first round of testing in March 2000 returned values that ranged from 2.63 to 16.07 $^{0}/_{00}$ (Table 3). Two values for wells 13 and 16 tested within the fertilizer range for $\delta^{15}N$. Both wells are located along the northern fringe of the study area. One well (well 18) tested above 10 for $\delta^{15}N$. The rest of the $\delta^{15}N$ results tested between five and 10 $^{0}/_{00}$ which suggests an organic or mixed source.

Table 3. $\delta^{15}N$ results for select wells

	$\delta^{15}N$ (0/00)	$\delta^{15}N$ (0/00)	$\delta^{15}N$ (0/00)
Well ID	Mar-00	Jun-00	Sep-00
1	NS	7.88	6.35
4	NS	8.31	5.56
5	6.66	17.14	5.93
8	8.59	8.97	6.33
10	9.48	6.74	7.58
11	5.49	6.19	2.90
13	4.93	8.83	9.01
15	5.42	8.75	7.86
16	2.63	13.28	9.94
17	5.61	10.15	8.90
18	16.07	11.34	8.65
19	3.78	10.71	8.07

Second round testing in June 2000 for $\delta^{15}N$ returned values all greater than 5 $^{0}/_{00}$ for $\delta^{15}N$. Wells 5, 16, 17, 18, and 19 all returned $\delta^{15}N$ values above 10 $^{0}/_{00}$. Wells 17, 18, and 19 are three of the five wells showing nitrate levels above 10 mg/L.

Third round testing in September 2000 for $\delta^{15}N$ returned values all less than 10 $^{0}/_{00}$. One well (well 11) was within the fertilizer range for $\delta^{15}N$. Well 11 is located at one of the large dairies in the area. The remainder of $\delta^{15}N$ test results ranged between five and 10 $^{0}/_{00}$ suggesting an organic or mixed source.

Conclusions

Ground water of the project area is impacted by nitrate, ammonia, and bacteria. Because of high concentrations and the number of nitrate detections, contamination of shallow ground water by nitrate is of concern. Although reported concentrations of ammonia may not pose a significant health threat, detected ammonia in project wells may be from either a natural or human related source or both.

A central portion of the study area just north of State Highway 55 has elevated nitrate levels above the IDAPA MCL of 10 mg/L. Elevated nitrate concentrations are found in a ground water zone typically less than 50 feet below land surface. This shallow ground water zone is situated within sands and gravels that lie above a relatively thick (~ 20 to 150 ft) continuous clay layer. This area of elevated nitrate lies adjacent to and down gradient from several large dairies, numerous crop fields, and several domestic residences. All are potential sources for nitrate entering ground water. In addition, historical agricultural practices may be contributing to present nitrate contamination.

Some wells in the deep ground water system (below the clay zone) show relatively high ammonia. Ammonia levels found in deeper ground water may be naturally occurring, due to human impacts, or both. Confining conditions appear to be, in part, responsible for the deep system being low in oxygen. As a result, nitrogen found in the deep system is in the form of ammonia rather than nitrate. More work is needed to help determine the source of ammonia found in local ground water of the project area.

Some $\delta^{15}N$ test results suggest a possible influence from a human and/or animal waste source, especially in June 2000. Of the five sites tested with high nitrate three returned values above 10 $^0/_{00}$ for $\delta^{15}N$. However, results also indicate a possible contribution from fertilizer. Overall, the majority of test results for $\delta^{15}N$ were within an organic or mixed source range.

Bacteria also appears to be impacting shallow ground water. The bacteria detections could be related to the dairy operations of the area; however, more specialized testing may be required to more accurately assess the source of bacteria found in the local ground water.

Recommendations

To better determine if current agricultural practices are contributing to ground water degradation and to locate potential specific contaminant sources, ISDA and IDEQ recommend continued and more intensive monitoring in the project area. Additional testing should be conducted in the area to better determine the source of ground water quality impacts.

Testing should include, but not be limited to:

- Installation of waste containment monitoring devices (e.g., monitoring wells).
- DNA testing of bacteria
- Continued ground water monitoring for nutrients, common ions, and bacteria.
- Continued nitrogen isotope testing to determine possible nitrate sources.
- Additional isotope testing (e.g., deuterium, oxygen, tritium) to augment nitrogen isotope testing and determine relative ages of ground water.
- Soil sampling and soil pore water sampling.
- Hormone and antibiotic testing
- Human source tracers (e.g., caffeine).

ISDA and IDEQ recommend a variety of actions to be taken by landowners, producers, and agencies to prevent further contamination of the aquifer in the project area. ISDA and IDEQ recommend that:

- Additional inspections and evaluations of local dairies to help determine possible contaminant sources.
- Research of current and historical fertilizer and manure applications.
- Review of on-site septic systems permits and construction.
- Wellhead protection education.
- Agricultural producers in the area with irrigation systems conduct nutrient, and irrigation water management evaluations. Agency staff from ISDA and possibly other agencies can assist with these efforts.
- Agricultural producers follow the Natural Resources Conservation Service (NRCS) Nutrient Management Standard (590).
- Agricultural producers manage animal waste in a manner not to impact ground water. Ground water protection measures are necessary when storing, handling, hauling, and applying animal waste. For technical assistance, ISDA Technical Services Engineers and certified nutrient management planners can assist.

ISDA and IDEQ will continue to implement this project to try and determine source(s) of contamination to ground water within the project area.

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