Clearwater Plateau Nitrate Groundwater Data Analysis

Groundwater Technical Report #20

Lewis and Idaho County, Idaho

Prepared by:
Alyssa Douglas
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Idaho Department of Environmental Quality
Lewiston Regional Office

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ABSTRACT

This report summarizes the status of nitrate concentrations in the Clearwater Plateau Hydrogeologic Subarea as determined from data collected through the Statewide Ambient Ground Water Quality Monitoring Program, the Camas Prairie Report, the Public Water System, and the Idaho State Department of Agriculture. Nitrate is commonly found as a ground water contaminant in public water supply systems throughout Idaho. Several studies have addressed the concern of nitrates in the ground water in an attempt to identify the reasons for the elevated nitrate levels.

The federal drinking water Maximum Contaminant Level (MCL) and Idaho ground water quality concentration standard for nitrate is set at 10 mg/L. Idaho's drinking water is mostly supplied by ground water; therefore, the leaching of nitrates and the associated health risks are major concerns. The Clearwater Plateau study area is considered a Nitrate Priority Area by the Idaho Department of Environmental Quality due to nitrate concentrations that exceed the MCL in more than 20% of the wells within the study area

This report summarizes the results of the previous studies conducted within the study area and attempts to correlate well properties with associated nitrate concentrations.

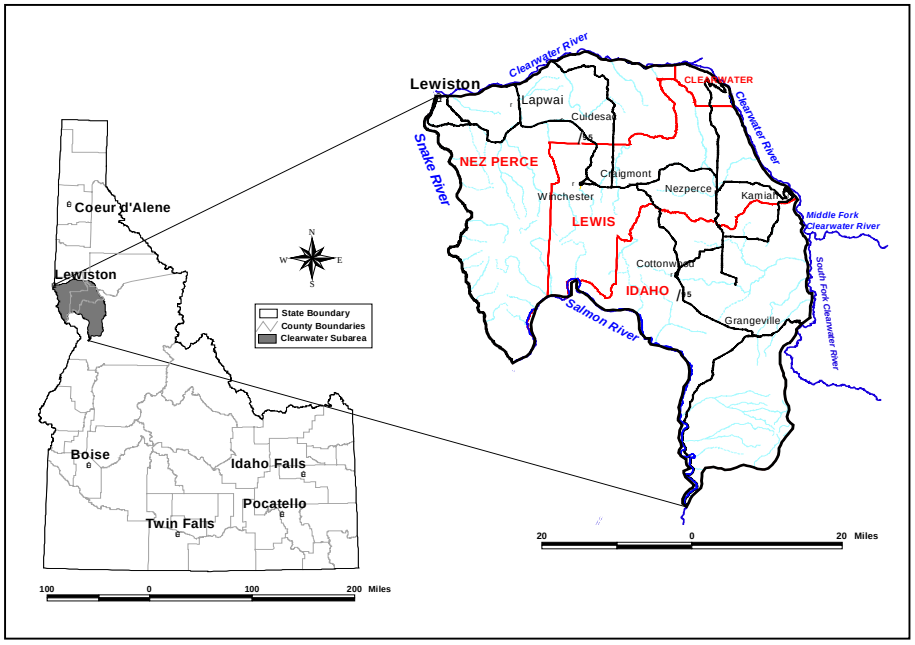
Based on the results of this study, recommendations are as follows:

- Ensure that the required well logs are readable.
- Improve well logs database access.
- Well casing requirement should be extended to entire well depth.
- A positive displacement bentonite slurry seal should be placed from well bottom to top.
- Require annular seal on all new wells.
- Extend seal to water level.
- Continue nitrogen isotope samples analysis.
- Continue annual nitrate ground water sampling.

INTRODUCTION

The Clearwater Plateau Subarea stretches across 1.2 million acres in north-central Idaho. The Subarea is bordered by the Clearwater River to the north, northeast, and east, the Salmon River to the south, with the Snake River existing as the western boundary and the Salmon River to the southwest (Figure 1).

Figure 1. Location of the Clearwater Plateau Subarea (Hagan, 2003)



The Clearwater Plateau has been the subject of ground water quality investigations since the IDEQ designated the area a Nitrate Priority Area. Twenty percent of the sampled wells have nitrate levels above the standard MCL limit. High nitrate concentrations in drinking water have been connected to methemoglobinemia (blue baby syndrome), which reduces the ability of the blood to carry oxygen. High nitrate concentrations are also associated with non-Hodgkin's lymphoma, which is a cancer of the body's natural defense to infection (Rupert, 1990). Nitrate concentration exceedence is not uniform within the study area; however nitrate is more frequently detected in wells located in irrigated agricultural areas where nitrate usage is more common (West, 2000). The nitrogen levels that are present in the groundwater come from human imposed sources, with measurements of 2 mg/L or higher considered anthropegnic. The typical sources of the nitrates in this region include fertilizer, human waste, and animal wastes.

Existing available nitrate concentration data and well construction information were collected and analyzed from four sources within the Clearwater Plateau Subarea. These sources are the Statewide Ambient Ground Water Quality Monitoring Program, the Camas Prairie Report, the Public Water System, and the Idaho State Department of Agriculture. Upon further investigation, the high nitrate levels do not seem to correlate with lithologies, well depth, or well location. Though total well depth does not create a trend when compared to nitrate levels, screened/open intervals may be an important pathway for surface imposed nitrates to reach the groundwater.

The area primarily consists of dry-land farming practices that lie within a semi-arid region. With low precipitation and no added source of recharge from irrigation, the fact that recently (<100yrs) deposited nitrates are measured in high levels in deep wells indicates the potential for extremely rapid transport processes, most likely due to poor well head construction.

If a surface seal is poorly constructed or improperly placed, poor quality shallow ground water could quickly migrate into deeper ground water systems through the unnatural pathway created during well construction. Likewise, if a well is only cased in the upper portion of the bore hole, contaminated shallow ground water can cascade into the bore hole and contaminate the deeper ground water within that well.

Purpose and Objectives

The purpose of this study was to compile all of the nitrate data for wells sampled in the Clearwater Plateau study area and create a map displaying all of the combined well locations.

The specific objectives of this study include:

1.) Review and summarize existing information on the basin

2.) Create maps of all of the combined data locations and concentration levels throughout the study area.

3.) Evaluate the adequacy of the nitrate data

4.) Identify any potential trends in the data through statistical analysis

Subarea Review and Data Sources

In 1989, the Idaho State Legislature passed the Ground Water Quality Protection Act, which authorized a comprehensive approach for improving and maintaining Idaho's ground water quality. From this Act, the Ground Water Quality Council was created, and in turn produced the Idaho Ground Water Quality Plan in 1992. This plan stressed the importance of ground water quality monitoring at the statewide, regional, and local levels. The Idaho Department of Water Resources (IDWR) became responsible for implementing a statewide ambient ground water quality monitoring network. Regional and local monitoring responsibilities were assigned to the Idaho Department of Environmental Quality (IDEQ) and the Idaho State Department of Agriculture (ISDA).

Statewide Ambient Ground Water Quality Monitoring Program

There are 61 Statewide Program sites (Appendix A, Table 1, 2) that have available nitrate data in the Clearwater Plateau Subarea. Nine sites have been dropped from the program and 11 sites were added during 2001-2002. Thus, 52 sites in the study area are currently being monitoring through this program.

Camas Prairie Ground Water Report

In 1998, the Department of Environmental Quality developed a plan to investigate ground water quality of the Camas prairie. The goal of the study was to collect nitrate data from available

sources and sample new private wells to assess the ground water quality. Fifty-five domestic wells (Appendix B, Table 3) were selected and sampled within the designated study area. These samples were analyzed for nitrate plus nitrite as nitrogen. Results from this report indicated that there were no precise conclusions as to specific contaminant sources; however, elevated nitrate concentrations indicated that the Camas Prairie ground water was vulnerable to nitrate contamination.

Public Water System Data

Public water system data (Appendix C, Table 4) for this study are divided into two categories. These two categories are: systems with greater than twenty-five connections and systems with less than twenty-five connections. DEQ is responsible for regulating systems with more than 25 connections, and the North Central District Health Department is responsible for regulating systems with 25 connections or less. However, samples for the public water system wells are possibly collected after treatment and storage. Therefore, determining exactly what the water quality indicates from these samples can create interpretation problems.

Idaho State Department of Agriculture

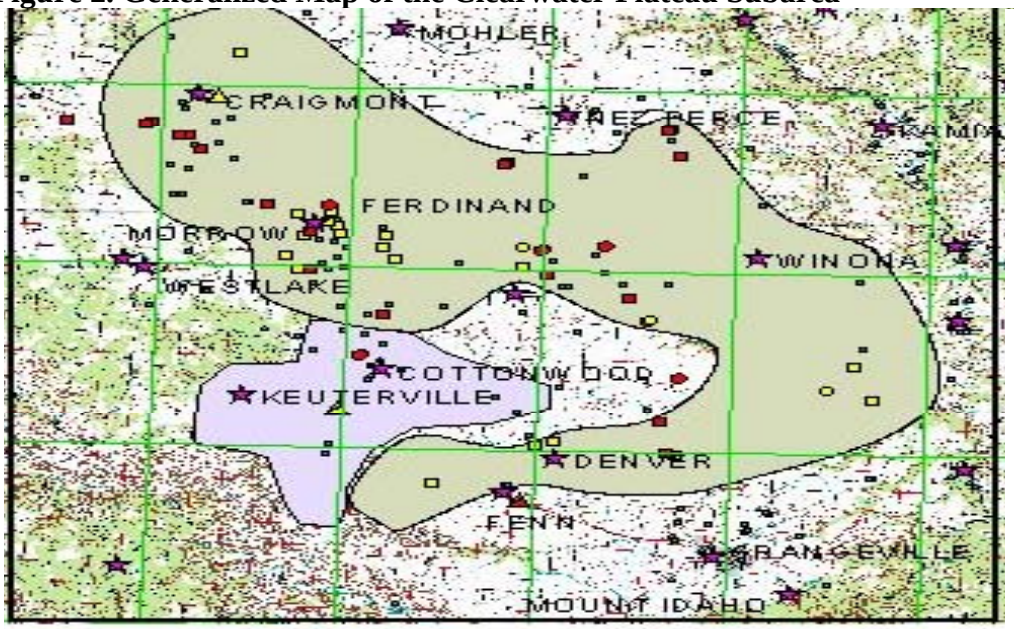
As a follow up to previous monitoring by the Idaho Department of Water Resources and the Department of Environmental Quality, the Idaho State Department of Agriculture began its own ground water quality monitoring program in 2001, entitled the Southern Clearwater Plateau Volcanic Aquifer. Currently 72 domestic wells (Appendix D, Table 5, 6) in the Clearwater Plateau Subarea are included in the regional ground water quality monitoring project and are sampled for nitrates and pesticides.

STUDY AREA

Location

Located in north central Idaho, the Clearwater Subarea (Figure 2) stretches across an estimated 1.2 million acres. The Clearwater Subarea study area includes the Camas Prairie, which is part of the 1700 square mile Clearwater Plateau, and is bounded on the north, northeast and east by the Clearwater River and on the southeast by the South Fork Clearwater River. The Snake River borders the Subarea to the west, with the Salmon River bordering the on the southwest. The southern boundary is not distinctly defined, but is estimated to be near Slate Creek. The major counties include Idaho County, Lewis County, Nez Perce County, and the Clearwater County (Hagan, 2003).

Figure 2. Generalized Map of the Clearwater Plateau Subarea



Climate

Average annual temperature ranges from a low of 47 F in Grangeville to a high of 53 F in Lewiston. The Clearwater Plateau Subarea experiences hot dry summers and moderately cold winters with a climate that is arid to semi-arid. Average annual precipitation ranges from 20 inches to 24 inches (Castelin, 1976).

Land Use

Agriculture, specifically dry land farming, is the primary land use within the study area. Rangeland and grazing also are commonly found located throughout the Subarea.

Geography

The Clearwater Plateau Subarea is divided into six physiographic features, which are the Lewiston Basin, the Soldiers Meadow Slope, the Nezperce Plateau, the Camas Prairie, Whitebird Basin, and the Dairy Mountain Slope (Bond 1963). The Salmon River, Clearwater River, South Fork of the Clearwater River and the Snake River Watersheds are all encountered in the Clearwater Plateau Subarea.

Hydrology and Hydrogeology

The geology of the Clearwater Plateau Subarea is characterized by the Columbia River Basalts. The Subarea lies within the Clearwater Embayment, which is the easternmost portion of the Columbia River Basalt flows (Hagan, 2003). The Clearwater Embayment consists of basalt units that formed when lava flows filled in the pre-existing basement rock topography during the Miocene era (Stevens et. al, 2003). The basement rocks consist of volcanics associated with the Seven Devils Complex, granitoids associated with the Idaho Batholith, and metasedimentary units associated with the Belt Supergroup (Hagan, 2003). Majority of the area is capped with a thin layer of loess.

Ground water existing in the Clearwater Plateau Subarea is most commonly found in the basalt aquifers and occasionally in the alluvial valley aquifers and basement rocks. More specifically, ground water occurs in fractures in the rock bodies, pore spaces of sedimentary material, and interflow zones of basalt flows (Castelin, 1976). Unconfined and confined conditions are found in both the regional and local flow systems. The regional direction of ground water flow is from higher elevations in the southern and southeastern sections of the Subarea toward the north, where ground water eventually discharges into the Clearwater River (Hagan, 2003). Local flow systems are more unpredictable, as they are controlled by faults, fractures, and buried stream channels.

Well depths (Appendix E, Table 7) throughout the basin range from 39 feet to 1238 feet below ground surface (bgs). In general, well depths vary throughout the Subarea, with a median well depth of about 250 feet. Casing depths vary from 15 feet to 640 feet (bgs). Depth to water varies from above the ground surface (artesian) to 530 feet (bgs). Table 8 provides a statistical summary of well depths, casing depths, and depths to water for each source. A majority of the wells are completed within the Columbia River Basalt Group.

Table 8. Well Characteristics

Well Depth (ft)	IDWR	CP	PWS	AG	All
MAX	630	640	1238	640	1238
MIN	58	39	107	50	39
MEDIAN	194	200	472	290	250
AVE	247.9	247.7	508.7	283.8	297.1
Casing Depth (ft)					
MAX	630	640	-	640	640
MIN	15	16	-	18	15
MEDIAN	58	180	-	150.5	130
AVE	107.3	230.8	-	197.7	170.1
Depth To Water (ft)					
MAX	530	390	-	432	530
MIN	-5	2	-	-2	-5
MEDIAN	88.5	60	-	110.5	75
AVE	127.4	101.9	-	146.7	125.9

Water Levels

Figures 3, 4, and 5 illustrate the water levels at different depths within the study area. Figure 3 displays the water level contours for wells with depths > 200 feet. Figures 4 and 5 display the water levels contours for wells with depths between 200 - 400 feet, and greater than 400 feet, respectively. Note: the occurrence of 'bulls-eyes" in the water level maps suggest that strong vertical gradients exist in the study area and not the convergence of ground water flow at those locations.

Figure 3. Water Level Contours for Wells with Total Depths < 200 ft

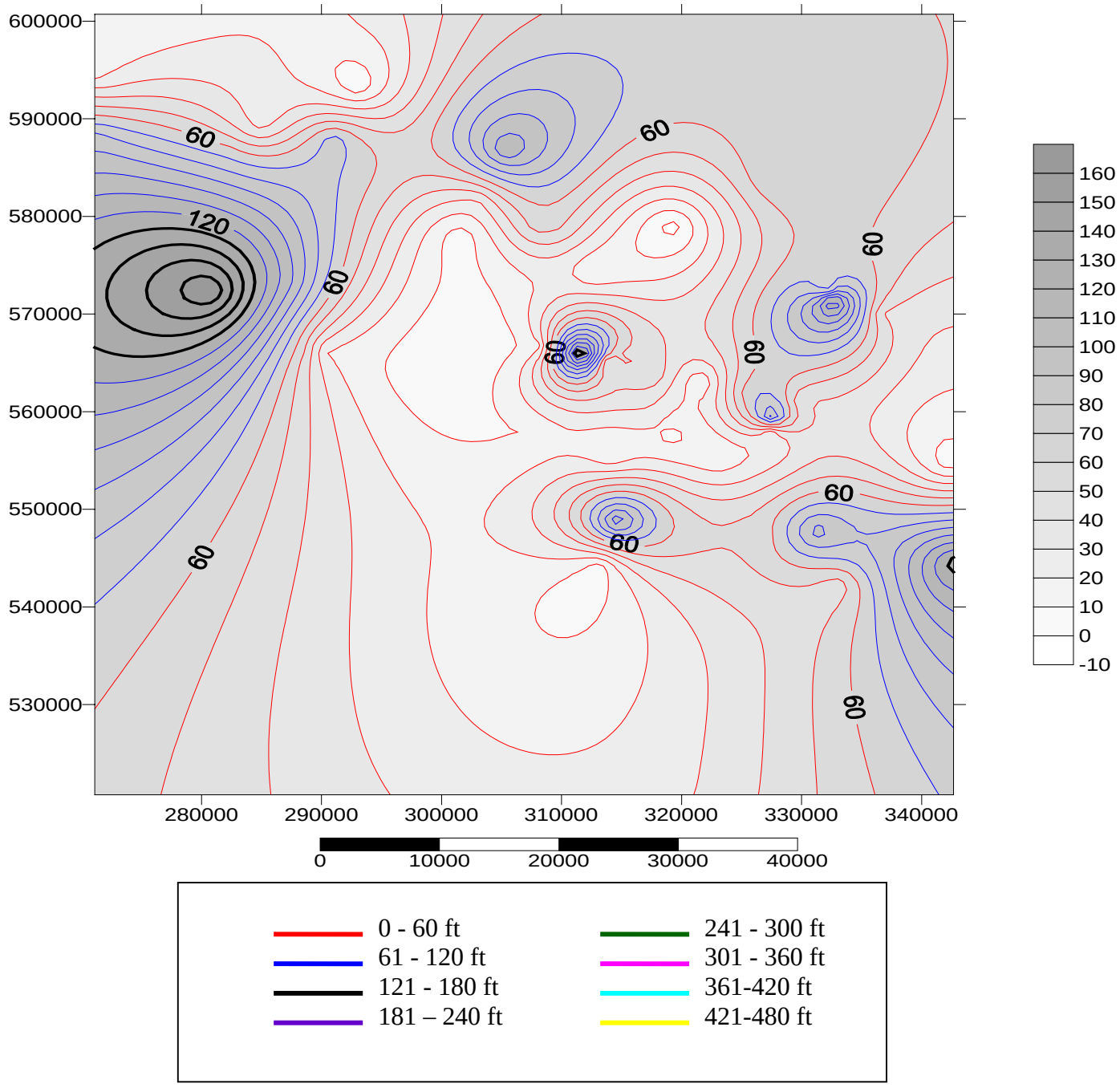


Figure 4. Water Level Contours for Wells with Total Depths 200-400 ft

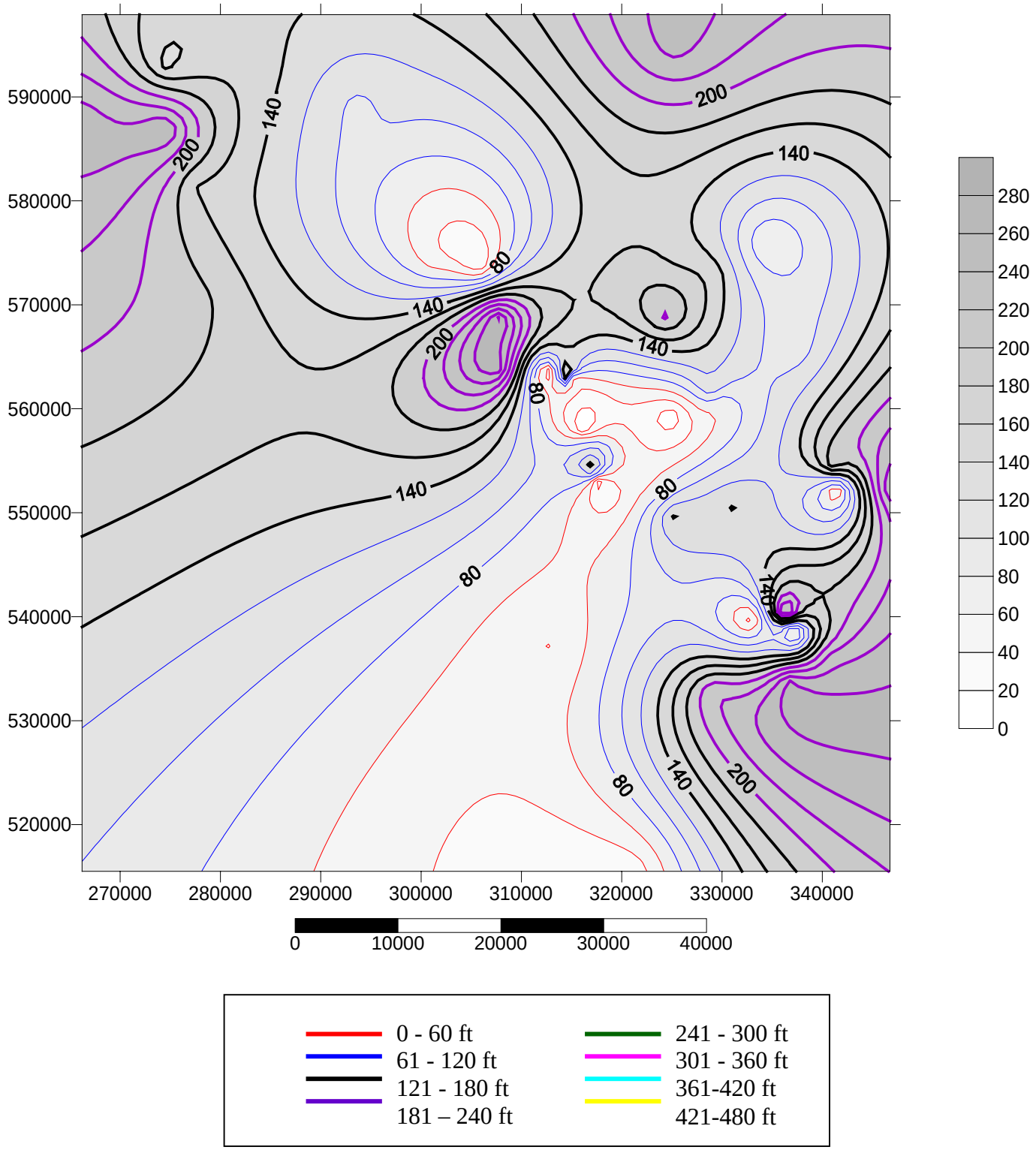
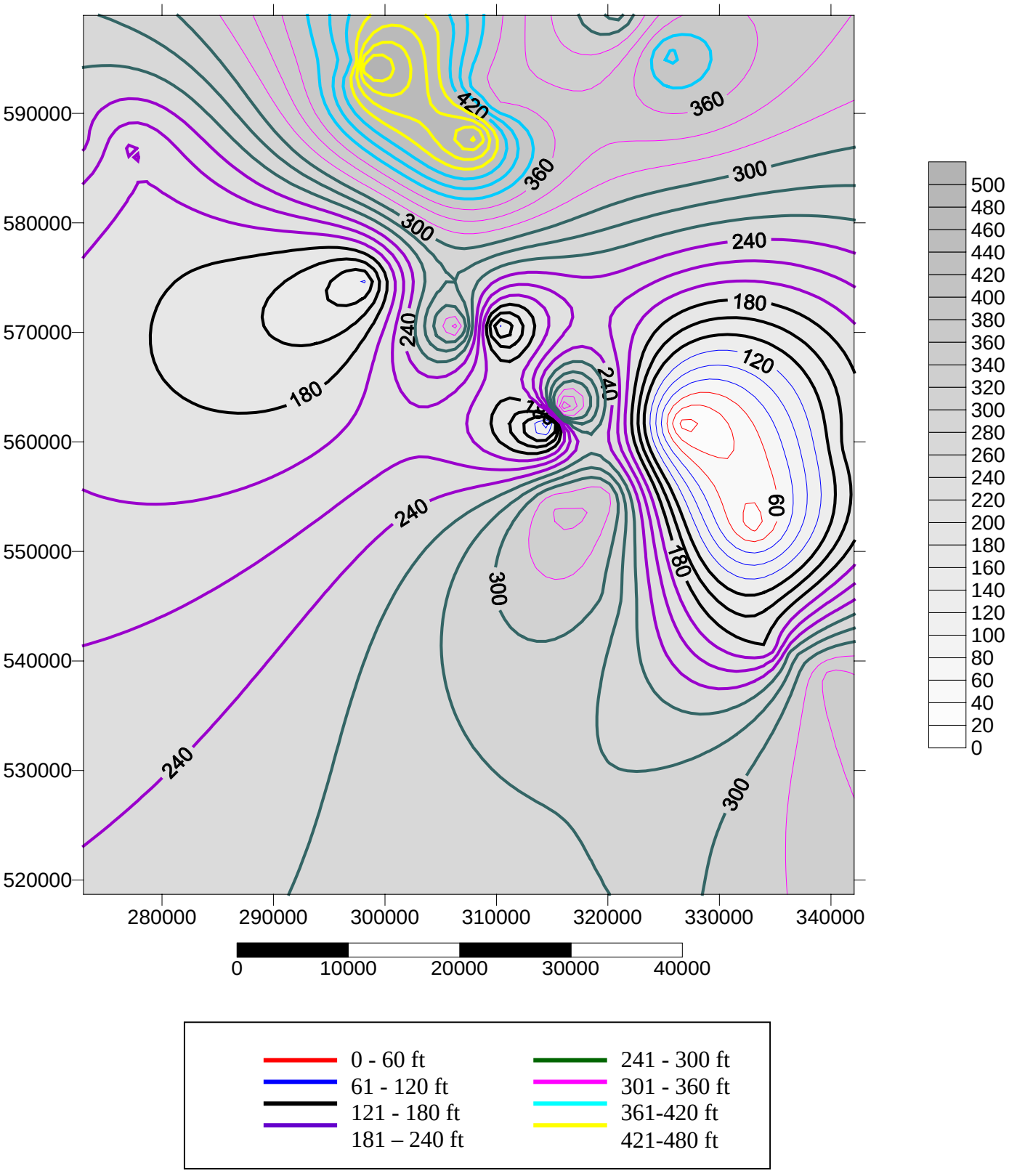


Figure 5. Water Level Contours for Wells with Total Depths >400 ft



RESULTS AND DISCUSSION

Nitrate Samples

Nitrate data from the Statewide Ambient Monitoring Program, Idaho Department of Environmental Quality, Idaho State Department of Agriculture, and the Public Water System Data were compiled and analyzed. The total number of wells included for this study is 222, with 209 having nitrate concentration data (Figure 6). Some of these wells have been sampled more then once for a total of 453 nitrate samples from all the wells. There are currently 61 wells from the Statewide Ambient Monitoring Program through the Idaho Department of Water Resources (IDWR), 55 wells from the Camas Prairie Ground Water report by the Department of Environmental Quality (DEQ), 34 Public Water System Wells (PWS), and 72 Idaho State Department of Agriculture (ISDA) wells. Nitrate concentrations are contoured for each source of data separately and as a combined data set, figures 7 to 10. It is evident from all of these contour maps that nitrate concentrations are highest in the northeast portion of the Subarea.

Figure 6. Clearwater Plateau Nitrate Monitoring Area.

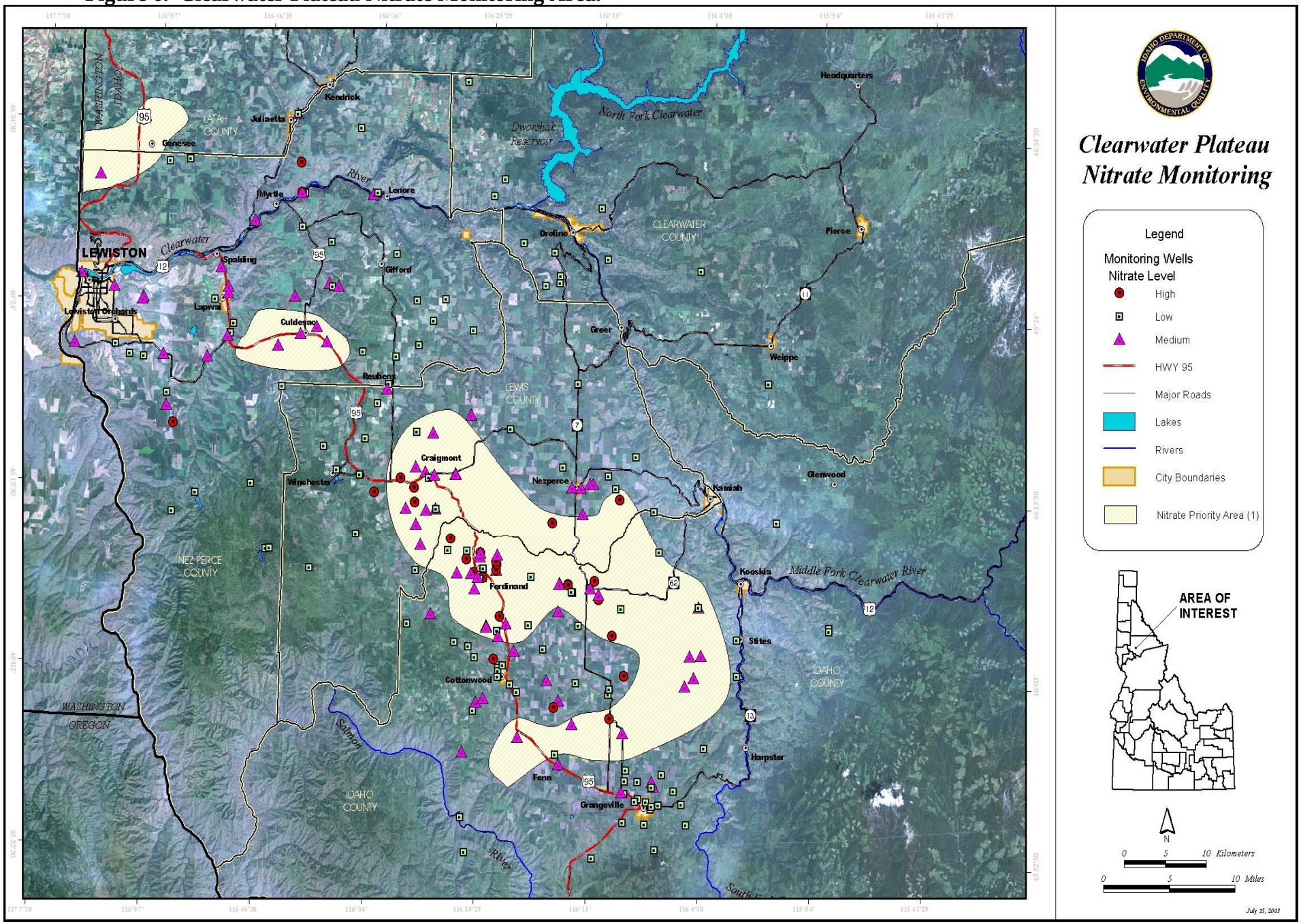


Figure 7. IDWR Nitrate Contour and Shaded Cell Maps

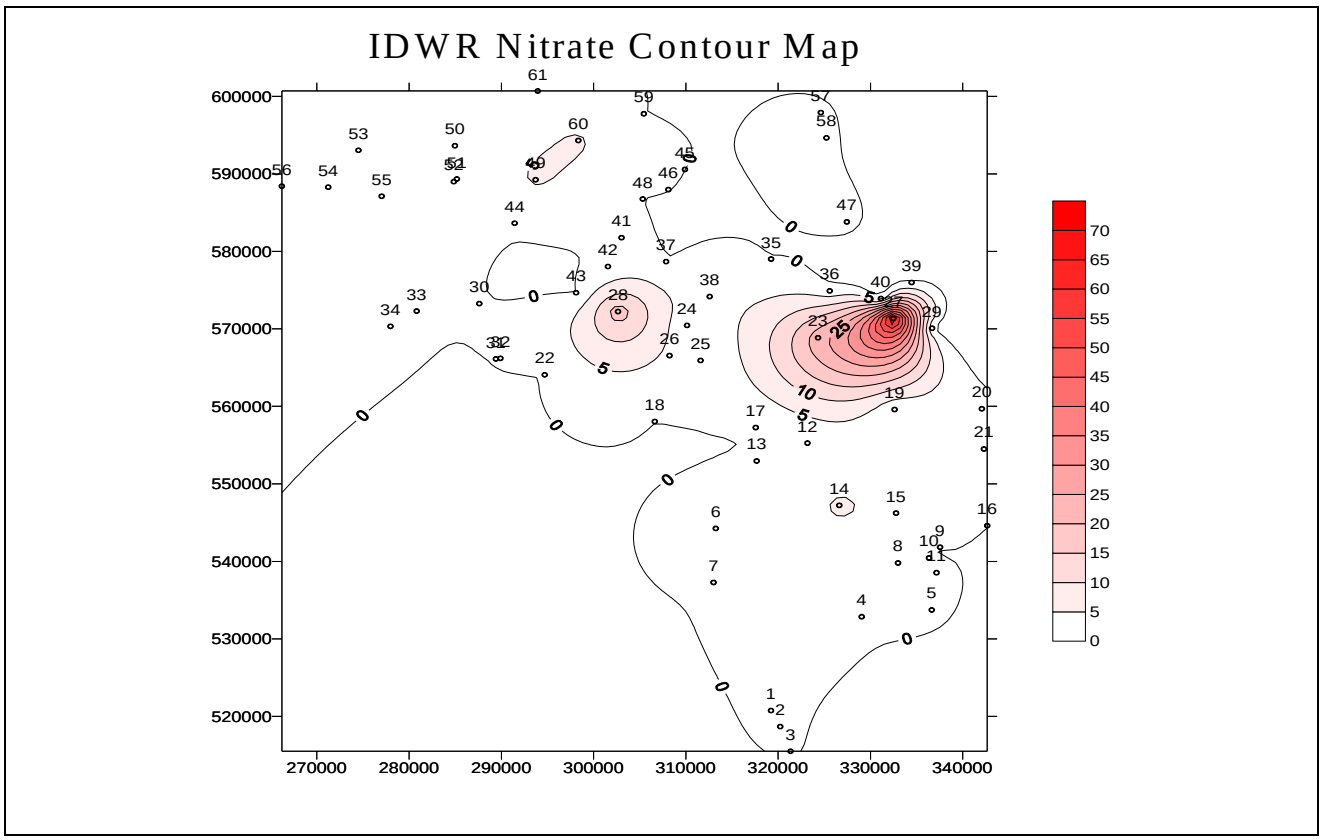


Figure 8. Camas Prairie Nitrate Contour and Shaded Cell Maps

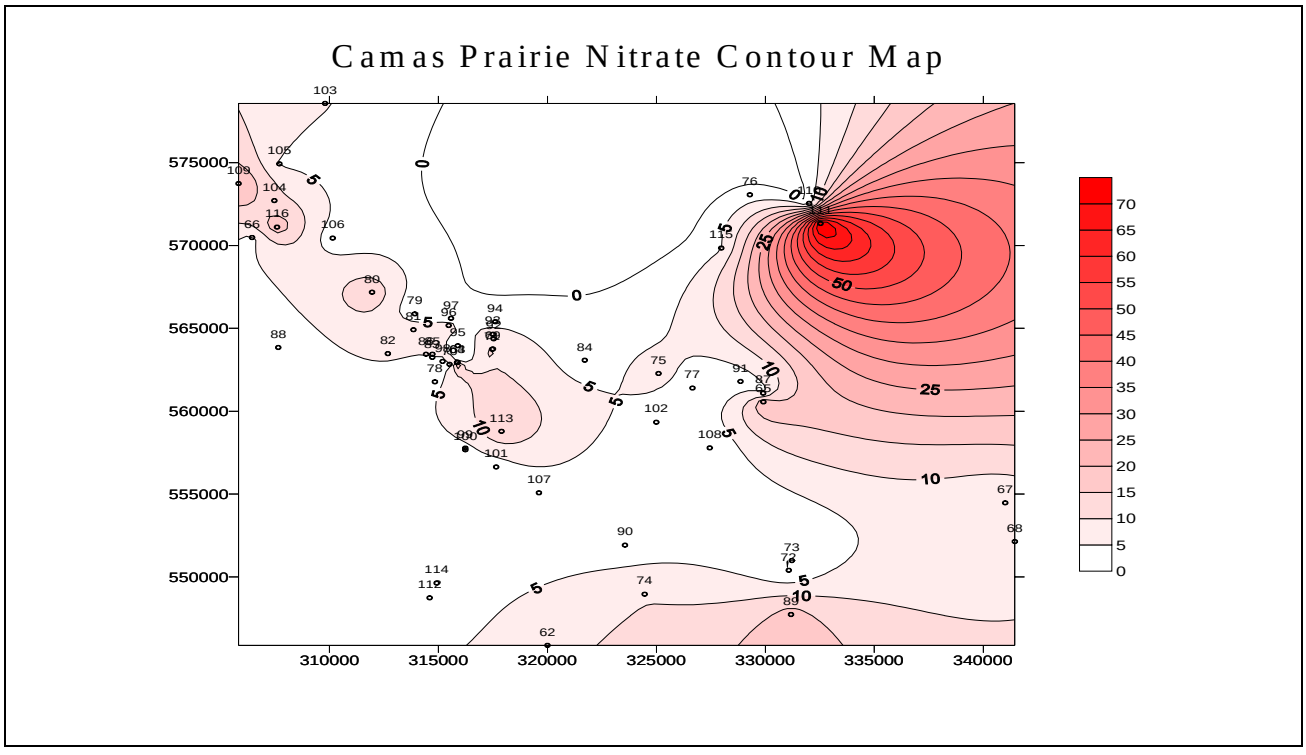


Figure 9. Department of Agriculture Nitrate Contour and Shaded Cell Maps

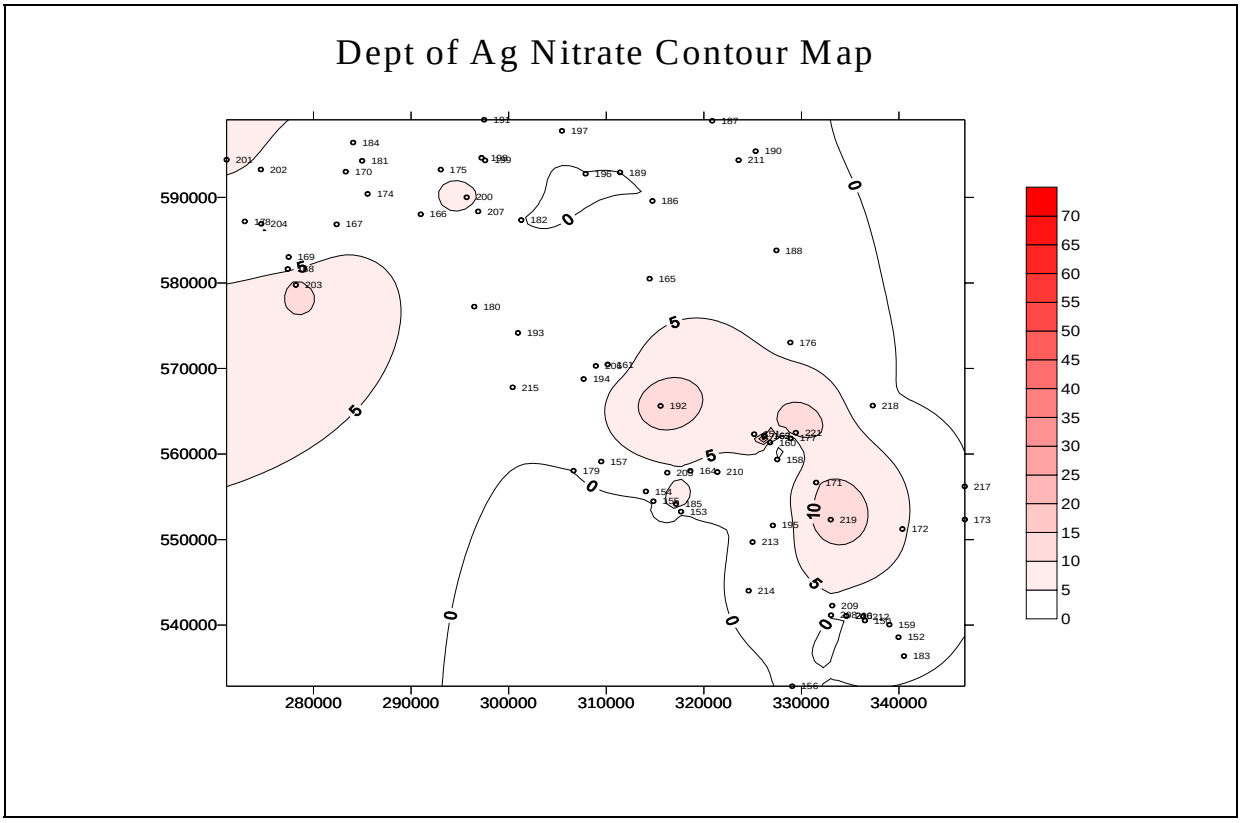
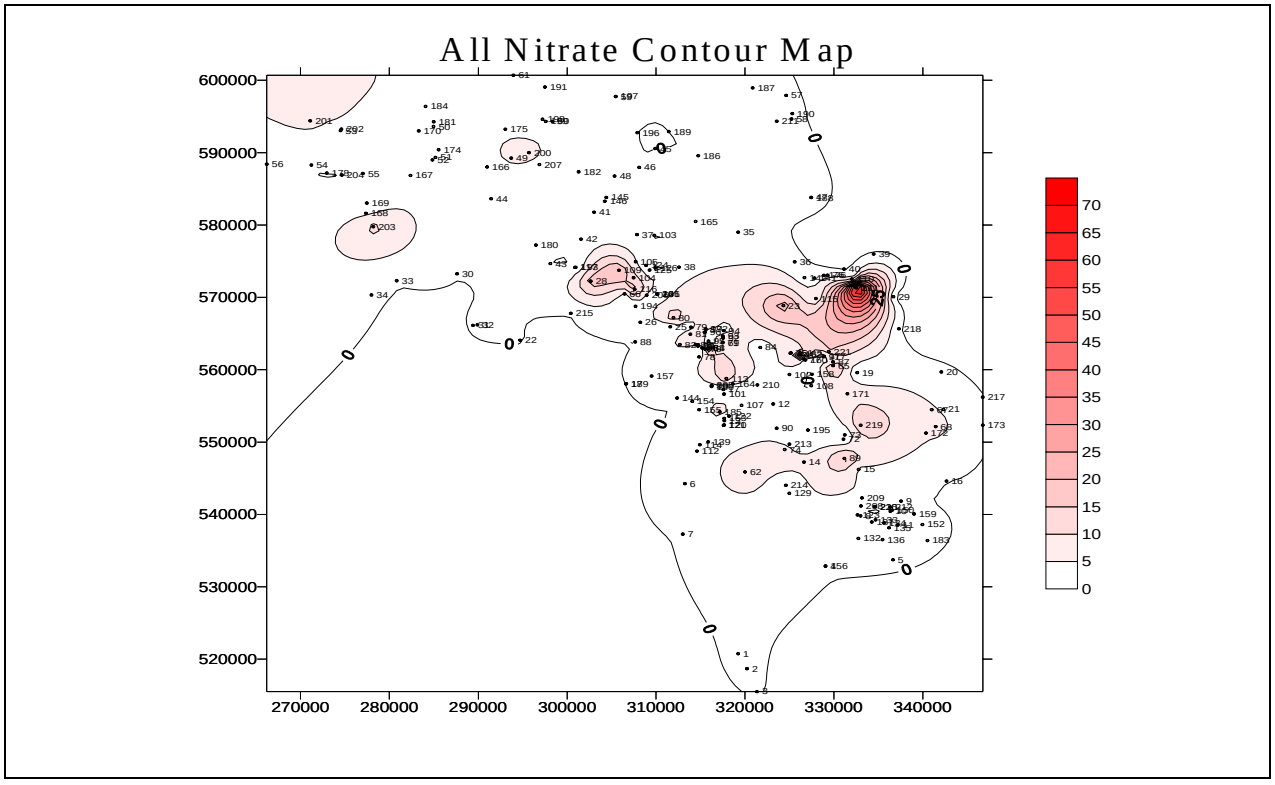


Figure 10. All Data Sources Nitrate Contour and Shaded Cell Maps



Nitrate concentrations were categorized into 4 ranges of concentration levels. These levels are less than 2 mg/L, 2-4.99 mg/L, 5-9.99 mg/L, and greater than or equal to 10 mg/L. Nitrate levels greater then 2 mg/L are indicative that land use activities are impacting the water quality (Crockett, 1995.) Nitrate concentrations greater then 5 mg/L are suggestive of more severe impacts (Hagan, 2003). The Maximum Contaminant Level (MCL) for nitrate is 10 mg/L which is defined by the U.S. Environmental Protection Agency (EPA) as the water quality standard imposed on all ground water sources to protect human health and the environment.

Monitoring data for the individual wells show that 45% or 95 out of the 209 wells have nitrate concentrations exceeding 2 mg/L, indicating that these wells are impacted by human influence (Figure 11). In comparing individual samples, 175 of the 453 samples contain nitrate concentrations greater than 2mg/L (Figure 12). These analyses indicate that around 40% of the ground water in the study area has been impacted by human influence. This influence could be imposed through a variety of sources, such as: septic systems, agricultural practices, feedlots, and/or landfills. The data do not allow a determination of the exact nature of the sources of nitrate; to accomplish this, more isotopic data must be collected.

Figure 11. Histogram of All Wells

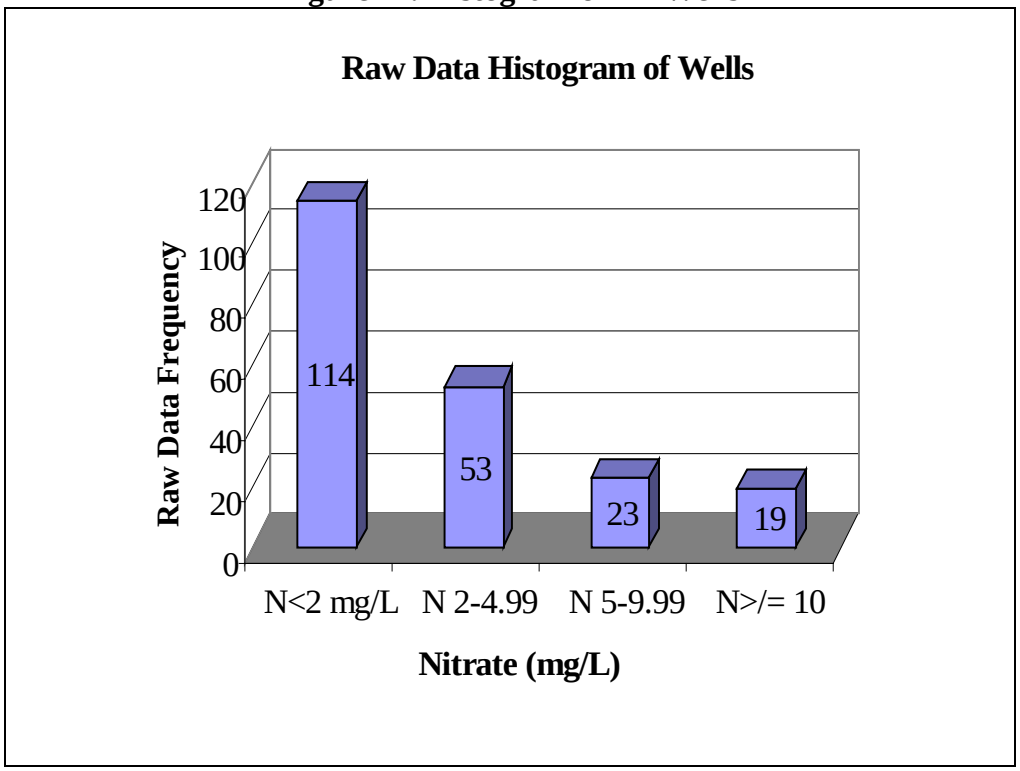


Figure 12. Histogram of All Nitrate Samples

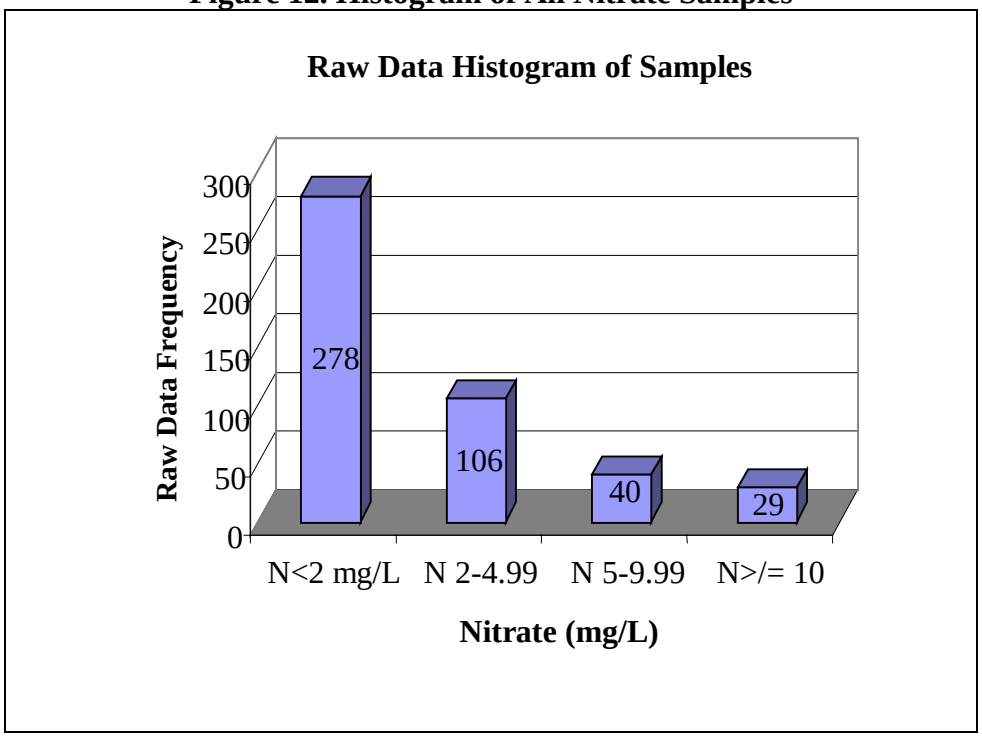
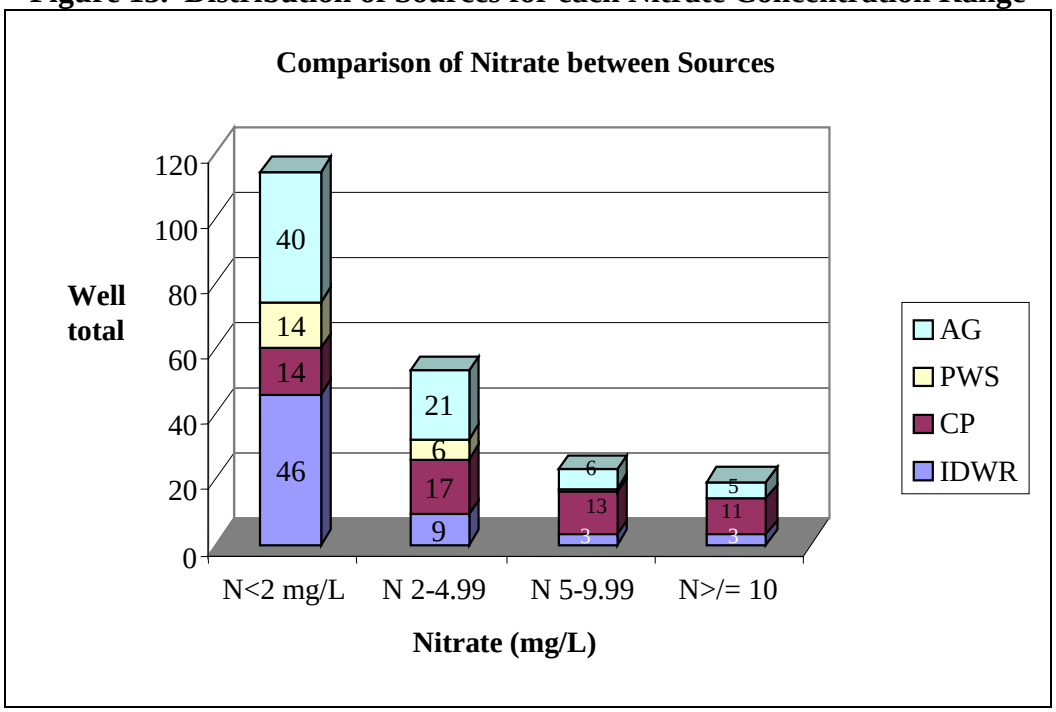


Figure 13 illustrates the distribution of wells for each nitrate concentration. For each source, except for the Camas Prairie wells, most of the ground water samples show nitrate concentrations less than 2 mg/L.

Figure 13. Distribution of Sources for each Nitrate Concentration Range



Nitrogen Isotopes

The sources responsible for the presence of nitrate in the ground water are unknown. These potential sources of nitrogen are the application of commercial fertilizers, human or animal waste, organic nitrogen in the soil, and precipitation. Analysis of nitrogen isotope ratios in ground water samples is one method that can determine the source of nitrate in the ground water. The nitrogen ratio examines the nitrogen isotopes ^{14}N and ^{15}N. The ratio for these two isotopes is unique for different sources of nitrogen, and therefore can be used to identify the source.

Table 9. Nitrogen Sources Associated with ^{15}N Values (Seiler, 1996)

Nitrogen Source	*^{15}N ($^{0}/_{00}$)*
Precipitation	-3
Commercial Fertilizer	-4 to 4
Organic Nitrogen in Soil	4-9
Animal or Human Waste	> 10

The IDWR has completed a nitrogen isotope analysis on seven of the Statewide Program sites for the Clearwater Plateau study area (Hagan 2003). Results of this study showed that one sample may have resulted from commercial fertilizer and two samples from human or animal waste. Nitrates in the remaining samples were derived from natural or mixed sources. Another nitrogen isotope study was conducted in Craigmont, Idaho. Findings of this study suggested that the shallow alluvial aquifer underlying the area appeared to contain the highest concentration of nitrate (Craigmont, 2001). Nitrogen isotopes indicated that the primary source of nitrate was inorganic chemical fertilizer. Interpreting nitrogen isotope ratios for ground water analysis is a difficult process. The natural nitrogen cycle modifies nitrogen isotopes allowing them to remain the environment for long periods of time. Additional samples will need be taken throughout the Subarea and then analyzed to further understand these results.

Statistical Analysis

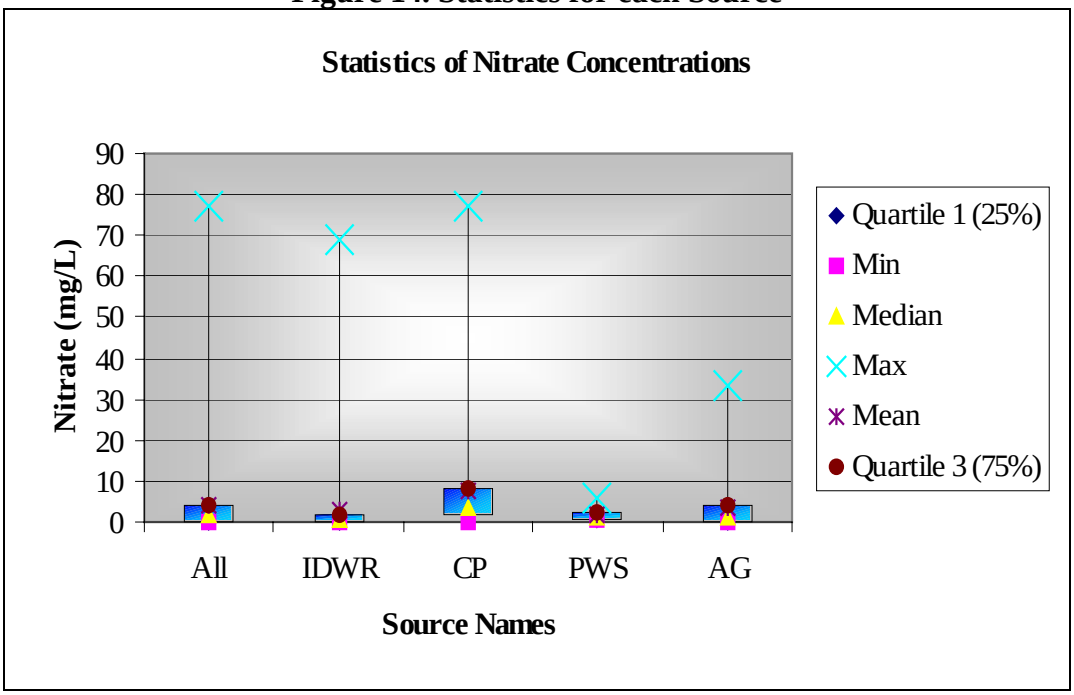
Basic statistical values were calculated for the nitrate concentration data. Table 10 provides a summary of the statistics displaying the quartiles, minimum, maximum, median, and mean nitrate concentration for each source. Overall, the highest nitrate concentration is 77.1 mg/L with the lowest concentration being below detection limits (BDL).

Table 10. Statistics for Each Data Source (mg/L)

	All	**IDWR**	**CP**	**PWS**	**AG**
Quartile 1 (25%)	0.27	0.10	1.98	0.73	0.15
Min	BDL	BDL	BDL	0.3	BDL
Median	1.63	0.42	3.63	1.06	1.45
Max	77.1	68.8	77.1	5.88	33.5
Mean	4.09	2.89	7.45	1.68	3.25
Quartile 3 (75%)	4.15	1.77	8.40	2.43	4.16

Figure 14 graphically illustrates the basic statistical analysis of the nitrate concentration data. Figure 14 shows a box plots for the combined total data, as well as for each individual source. For each source, there are evidently outliers on the high end of the nitrate concentration scale, which are far above the MCL of 10 mg/L. However, the bulk of the data for each plot is below the MCL of 10 mg/L.

Figure 14. Statistics for each Source



Nitrate Data Source Analysis

In an attempt to specifically examine precisely which wells contained nitrate concentrations above 2 mg/L, each individual data source was evaluated. A "data source" in this section refers to the report or state agency that has sampled a well for nitrate. The following figures show the distribution of nitrate concentrations for each data source separated into total number of sample for the data source and wells. The Camas Prairie data only has one sample for each well, thus only one distribution chart was created for this data source.

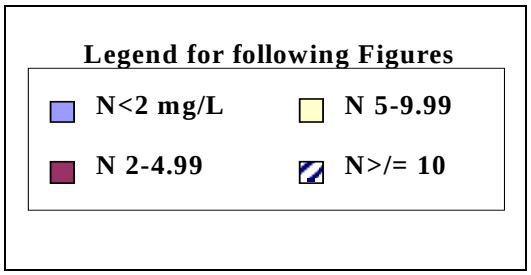


Figure 15. Camas Prairie Data

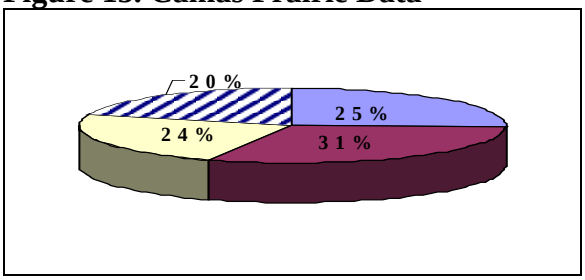


Figure 16. IDWR Sample Data

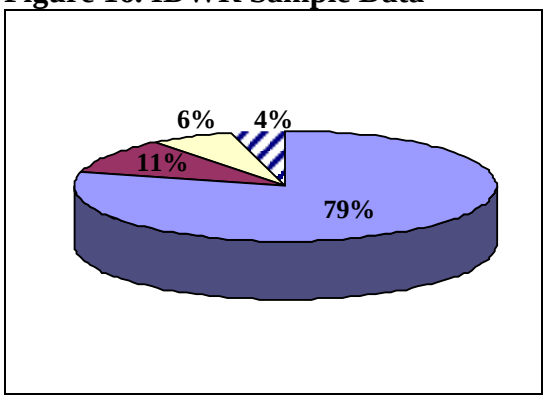


Figure 17. IDWR Well Data

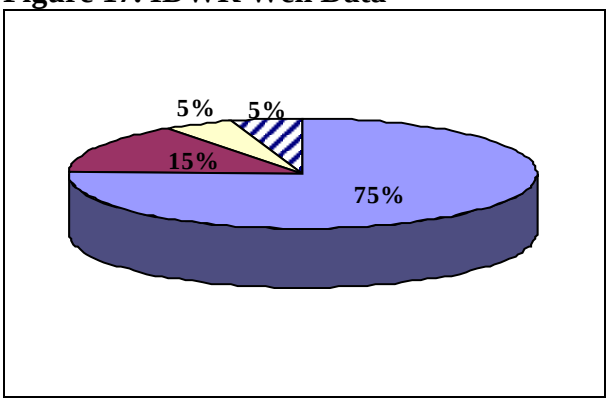


Figure 18. Dept. of Ag. Sample Data

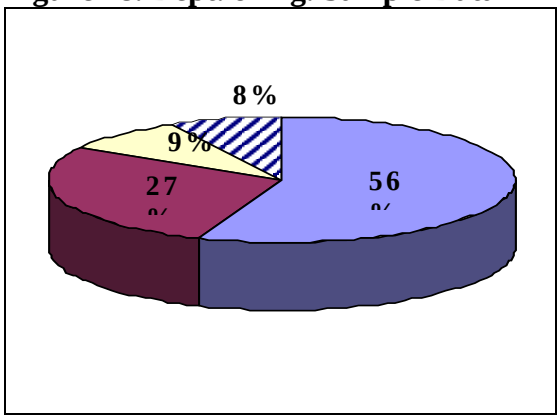


Figure 19. Dept. of Ag. Well Data

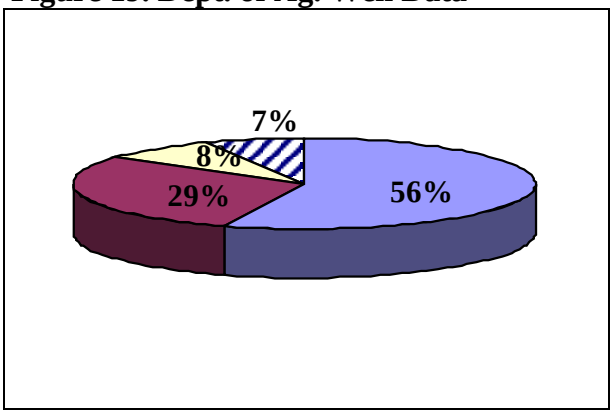


Figure 20. PWS Well Data

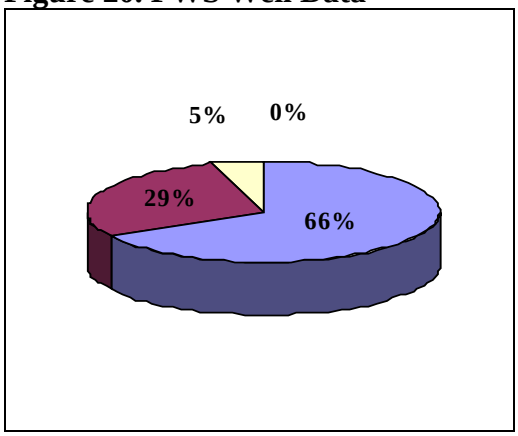
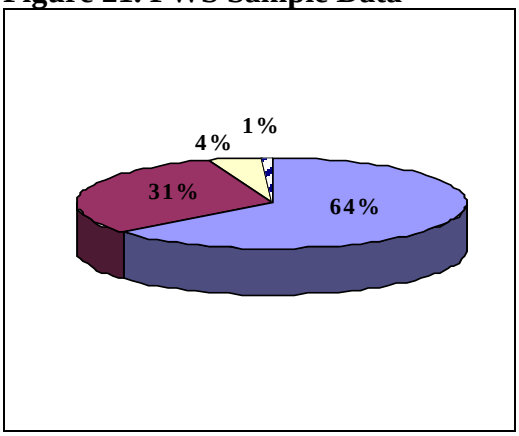


Figure 21. PWS Sample Data



For the Idaho Department of Water Resources wells, over 75% of the wells and samples contained nitrate concentrations greater than 2 mg/L. The Department of Agriculture wells are on the lower end, with about 44 % of the wells and samples having a nitrate concentration greater than 2 mg/L. In the Public Water System, over 64% of the wells contain nitrate concentrations greater then 2 mg/L, and the Camas Prairie wells are more evenly distributed with 75% containing nitrate concentrations greater than 2 mg/L.

Analyses of all of the samples and wells are presented in Figures 22 and 23. Most of the data fall into the range of a nitrate concentration < 2 mg/L; however, there is a significant percentage of wells and samples that contain nitrate concentrations greater than 2 mg/L, which indicates the presence of human influence on the ground water quality.

Figure 22. All Wells

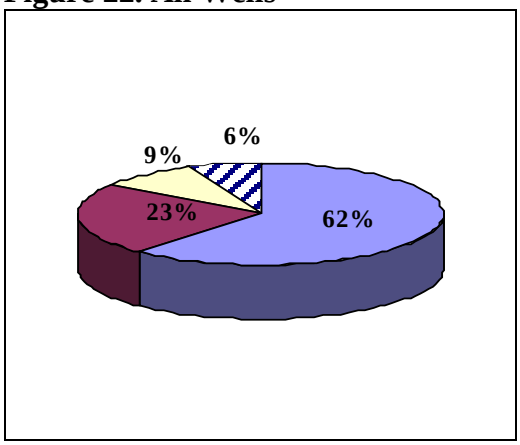
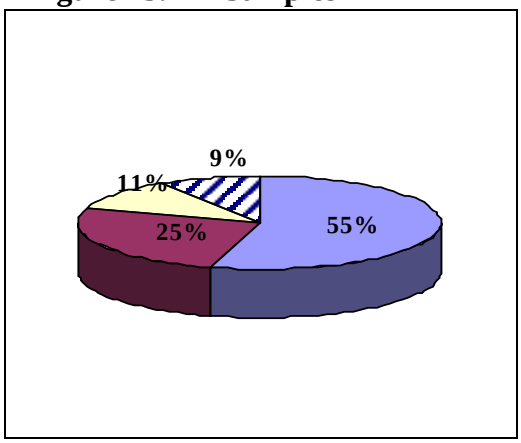


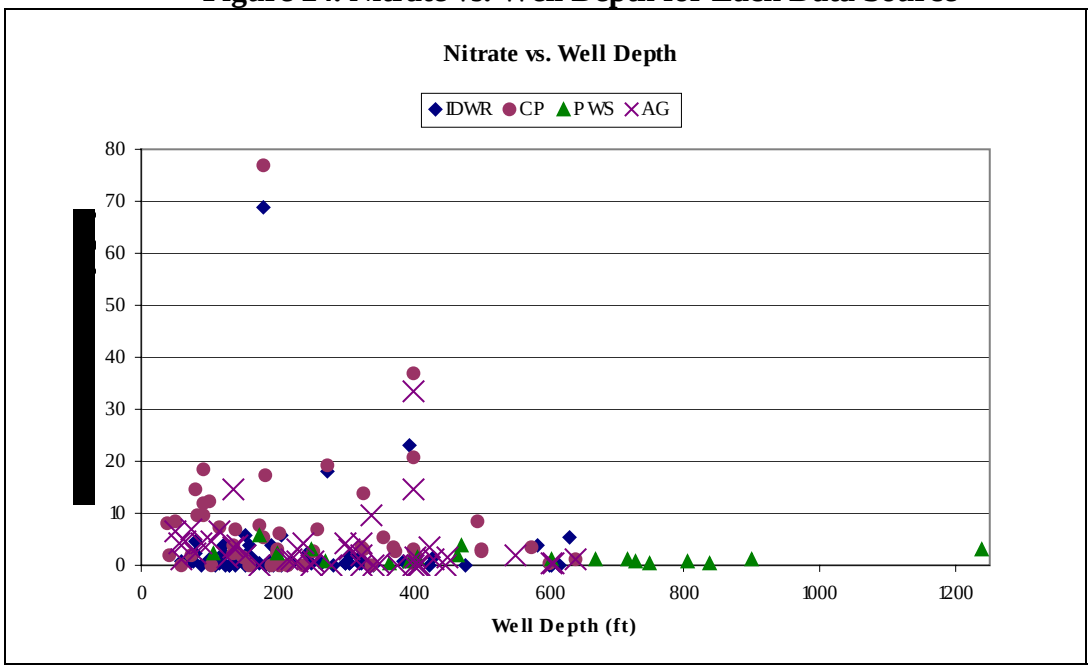
Figure 23. All Samples



Well Log Analysis

The relationship between nitrate concentration and well depth has been examined in previous reports (Bentz (1998), Hagan (2003)). Correlation tests indicate that there is no direct relationship between nitrate concentrations and well depth. Figure 24 displays the nitrate concentration and well depth for data each source. Normally, it is expected that deeper wells have lower nitrate concentrations from increased chemical and physical interactions in the subsurface and also related to longer flow paths providing greater protection. However, it is apparent from Figure 24 that this is not the case, and that there is not a distinct correlation between nitrate concentration and depth.

Figure 24. Nitrate vs. Well Depth for Each Data Source



Given that higher nitrate concentrations are also found in deeper wells, this potentially suggests that preferential pathways in the basalts are allowing the nitrates to move rapidly through the subsurface into the deeper ground water (Hagan, 2003). This could be a result of poorly sealed wells, inadequate well construction, and/or a short casing depth, allowing the wells to act as conduits allowing water from a contaminated shallow aquifers to flow down into a deeper aquifer (Hagan, 2003). Therefore, a more in depth analysis of the well construction information was completed in an attempt to reveal any potential trends.

The well construction information for all of the wells was examined to determine casing depths and static water levels in wells. All available well construction data (well depths, casing depths, and depths to water) are provided in Table 7 (Appendix E). Casing depth was inferred as the total casing, which includes only the steel casing, or also including the entire casing depth down to the screened interval, depending on the individual well conditions. Specifically, the well logs for the Camas Prairie wells and Department of Agriculture wells were analyzed more carefully to determine seal information, such as

seal type and depth of seal (Appendix F, Table 11). It should be noted that well information for some of the wells was not obtained, either because of the incompleteness in the well log or the information was not available at the time.

A shorter casing depth may be cause for potential nitrate contamination to the well. Nitrate potentially could enter a well from the surface and leak down the bore hole into the ground water. Nitrates could also enter wells that are exposed to shallow aquifers. Many of the wells in the study area have large portions of the bore holes that are open to the surrounding strata. If the bore hole is open through a shallow aquifer, the bore hole then becomes a preferential flow path for the ground water, and creates an unnatural mixing of shallow and deep ground water. This could potentially explain some of the deeper wells that have high nitrate concentrations. Water in wells with long casings and adequate seals are possibly more protected from surface contaminants than wells with shorter casing depths or large open hole exposures.

This relationship between casing depth and nitrate concentration was examined by categorizing wells into casing depths greater and less than the arbitrary chosen length of 50 feet (Table 12). Results show that 72 wells had casing depths less than 50 feet and 166 wells had casing depths greater than or equal to 50 feet. Nitrate concentration was divided into concentrations greater than or equal to 2 mg/L and less than 2 mg/L. Results show that 278 samples had a nitrate concentrations less than 2 mg/L and 175 samples contained nitrate concentrations greater than or equal to 2 mg/L. Of the wells that had casing information available and a nitrate concentration less than 2 mg/L, 47 out of 149 samples have a casing depth less than 50 ft. Samples from wells with known casing specifications showed that nitrate concentrations greater than or equal to 2 mg/L existed in 23 of the 73 samples having casing depths less than 50 ft.

Table 12. Nitrate and Casing Depth Data for Wells Sources

	IDWR	CP	PWS	AG	TOTALS
N < 2	112	14	72	80	**278**
N 2-4.99	15	17	35	39	**106**
N 5-9.99	9	13	5	13	**40**
N >/= 10	6	11	1	11	**29**
CD < 50	52	8	0	12	**72**
CD > 50	85	30	19	32	**166**
N < 2 & CD < 50	41	1	0	5	**47**
N < 2 & CD > 50	69	9	7	17	**102**
N > 2 & CD < 50	12	4	0	7	**23**
N > 2 & CD > 50	16	21	2	14	**53**

*N = Nitrate Concentration (mg/L) CD = Casing Depth (ft)

When comparing all of the samples, out of 453 samples, only 225 samples also had well data (Figure 25). Forty-seven wells or 20.9% of the samples that had nitrate concentrations less than 2 mg/L had casing depths less than 50 feet and 102 wells or 45.3% had casing depths greater than or equal to 50 feet. For samples that had nitrate concentrations greater than or equal to 2 mg/L, 23 wells or 10.2 % had casing depths less than 50 ft and 53 wells or 23.6% had casing depths greater than 50 feet.

Figure 25. Comparison between Nitrate Concentration and Casing Depth

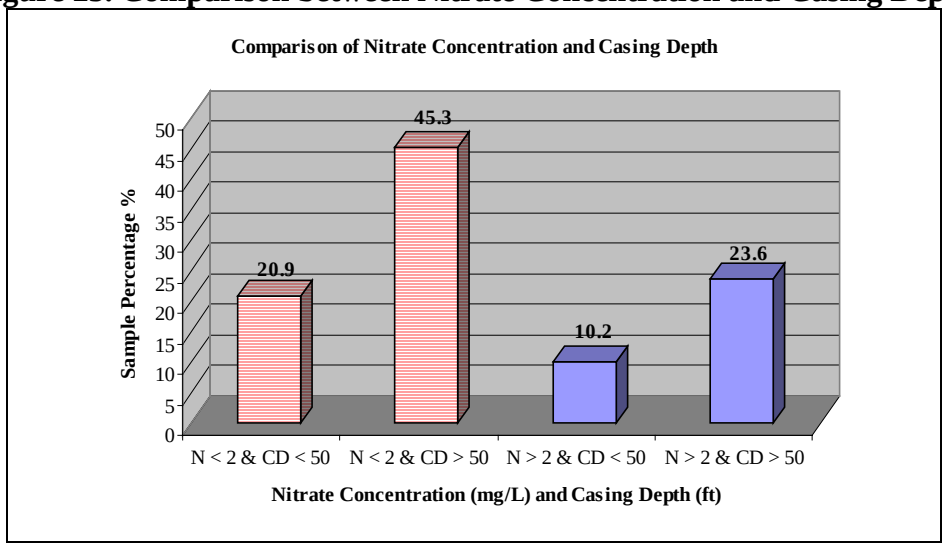
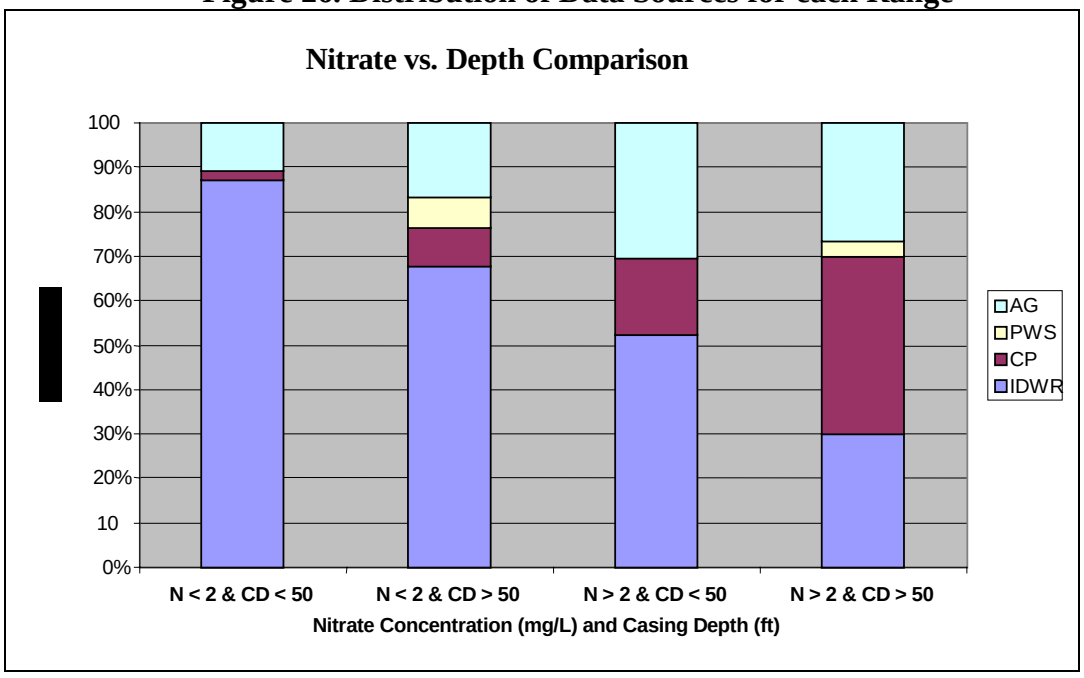


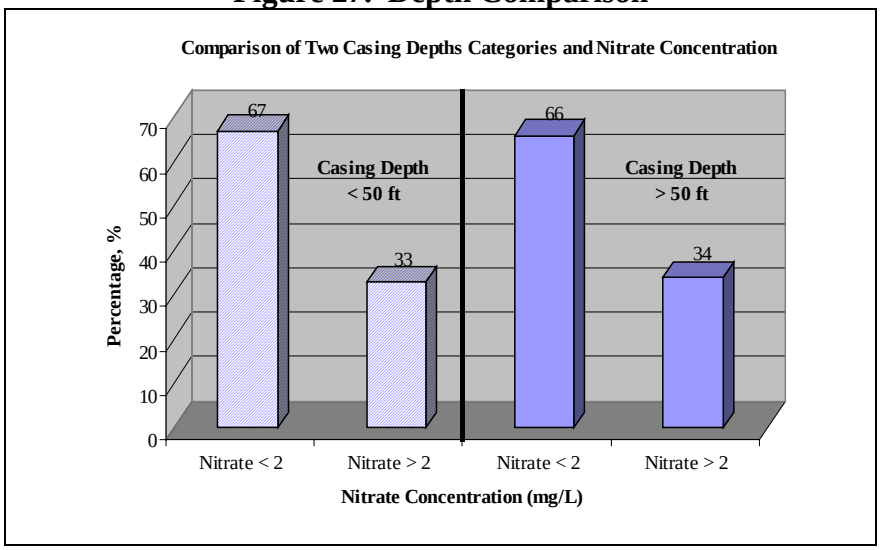
Figure 26 displays the distribution each source comprises for each nitrate concentration range and casing depth in Figure 25. It is evident that the IDWR wells make up most of each range.

Figure 26. Distribution of Data Sources for each Range



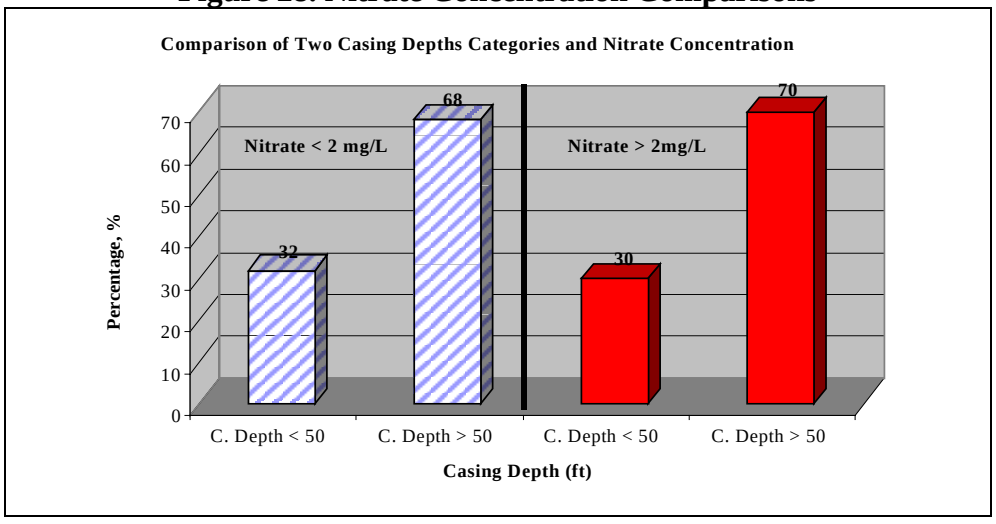
In comparing the two casing depth classifications, nitrate concentrations appeared to be similar for each of the two depth divisions. Figure 27 shows that 67% of the wells with casing depths less than 50 feet, have a nitrate concentration less than 2 mg/L. For wells with a casing depth greater than or equal to 50 feet, 66% had a nitrate concentration less than 2 mg/L.

Figure 27. Depth Comparison



To further examine this relationship, the nitrate concentrations were divided into two classifications: greater than or equal to 2 mg/L and less than 2 mg/L. Figure 28 shows nitrate concentrations for the two classifications. Results show that around 30% of the wells with concentrations over 2mg/L have a casing depth less than 50 feet. Both of these comparisons indicate that there is no direct correlation with nitrate concentration and casing depth. Therefore, these relationships suggest that the casing depth is not directly related to the nitrate concentrations in the well.

Figure 28. Nitrate Concentration Comparisons



Seal Depth

Seal depth was the next variable examined to try and correlate any relationship between nitrate levels and well conditions. This analysis was only conducted on the Department of Agriculture and Camas Prairie Wells as well logs for the Idaho Department of Water Resources and Public Water System wells were not available at the time. State regulations require that a well seal depth be at least 18 feet deep. Figure 29 displays the wells for each data source that have the minimum seal depth of 18 feet and is divided into two nitrate concentration ranges.

Figure 29. Nitrate Concentration vs. Seal Depth of 18 ft

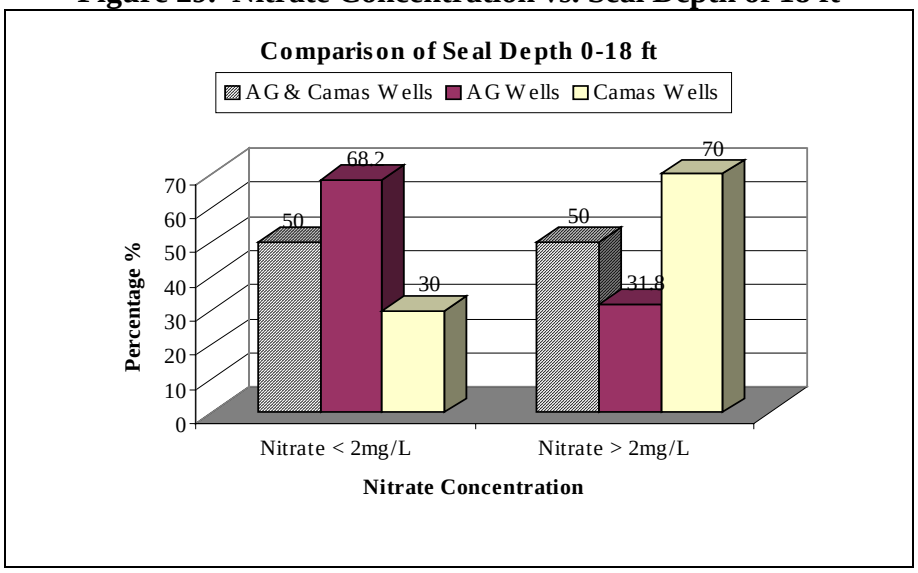
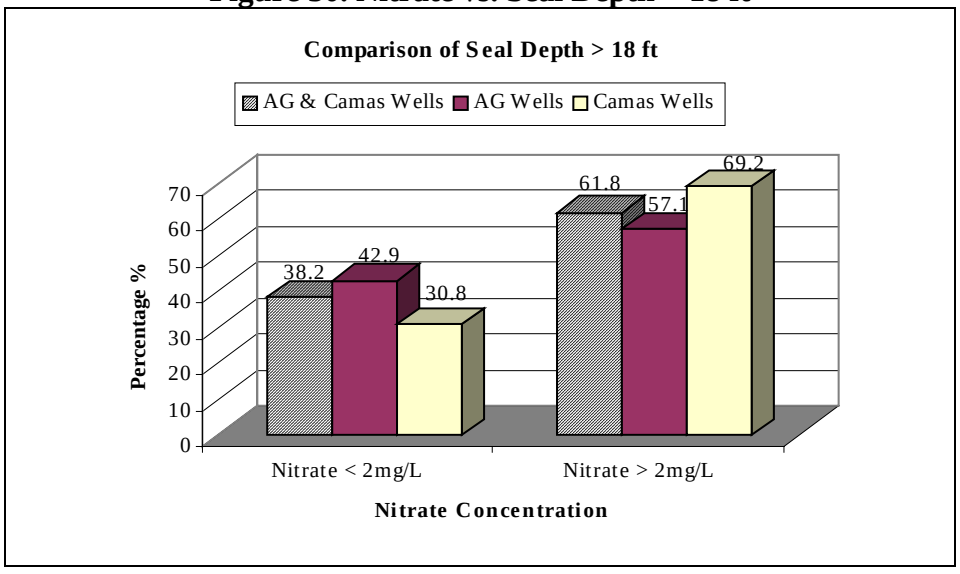


Figure 30 displays the distribution of wells with a seal depth greater than 18 feet. The results show that 38% of the wells have a nitrate concentration less than 2 mg/L.

Figure 30. Nitrate vs. Seal Depth > 18 ft



Thus examination of seal depths in inconclusive and more detailed examination of other wells should be analyzed before any direct correlations can be made.

Seal Type

The most common seal material used is bentonite. Other seal materials are rarely used such as pudding clay or cement. However, if bentonite seals are not properly installed, they can prove to be faulty. For a bentonite seal to function correctly, it must be continuously hydrated. If dry bentonite is placed down the well to the seal depth of 18 ft, it is assumed that there is enough moisture in the soil to keep the seal wet. However, if this does not happen, or if the bentonite becomes dry, it could possibly crack and provide a path for surface water to migrate down into a well. Figures 31 and 32 compare three different seal types for the wells of the study area. The seal divisions are bentonite, bentonite (pour), and other. Seals classified in the "bentonite" category have been listed on the well log as dry bentonite, or just plain bentonite with no indication as to whether the bentonite was applied dry or poured. Bentonite (pour) is not much different then a bentonite dry seal; however, poured bentonite was specifically divided out to look for any potential trends. "Other" contains all of the well seal materials that are not bentonite such as the pudding clay or cement. From the figures below, 39% of the wells with bentonite seals have a concentration less than 2 mg/L. The same relationship is shown in the Camas Wells. The Department of Agriculture wells show an inverse relationship between concentration and annular seal. For the bentonite (pour) seal, approximately 60% of the wells had nitrate concentrations less than 2 mg/L. For the analysis of the "other" seal type, no direct correlation could be determined. Therefore, more information is needed before further correlations can be made.

Figure 31. Nitrate Concentration < 2 mg/L vs. Seal Types

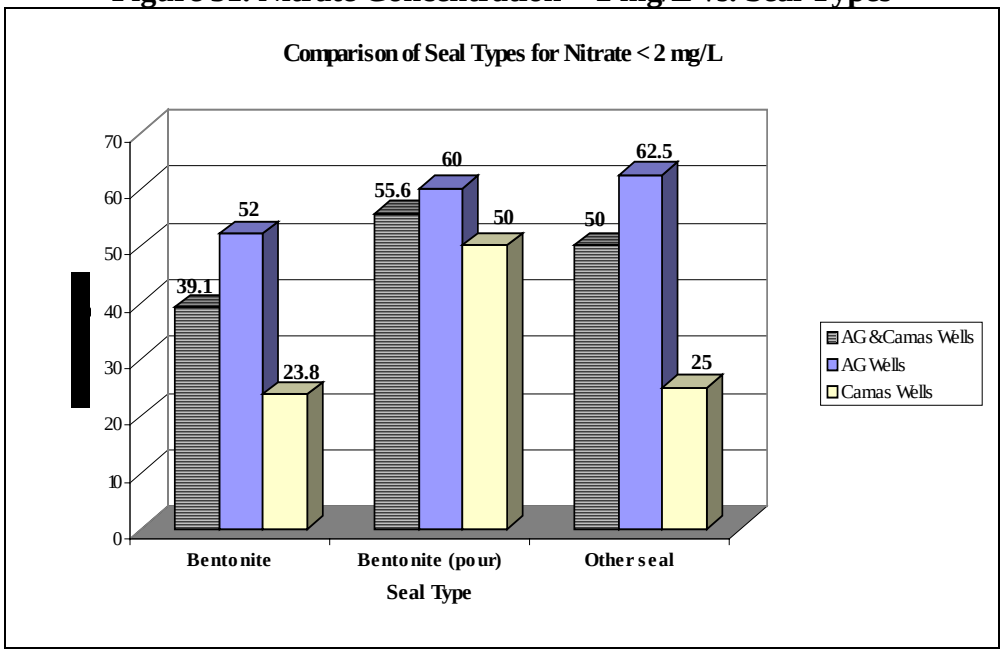
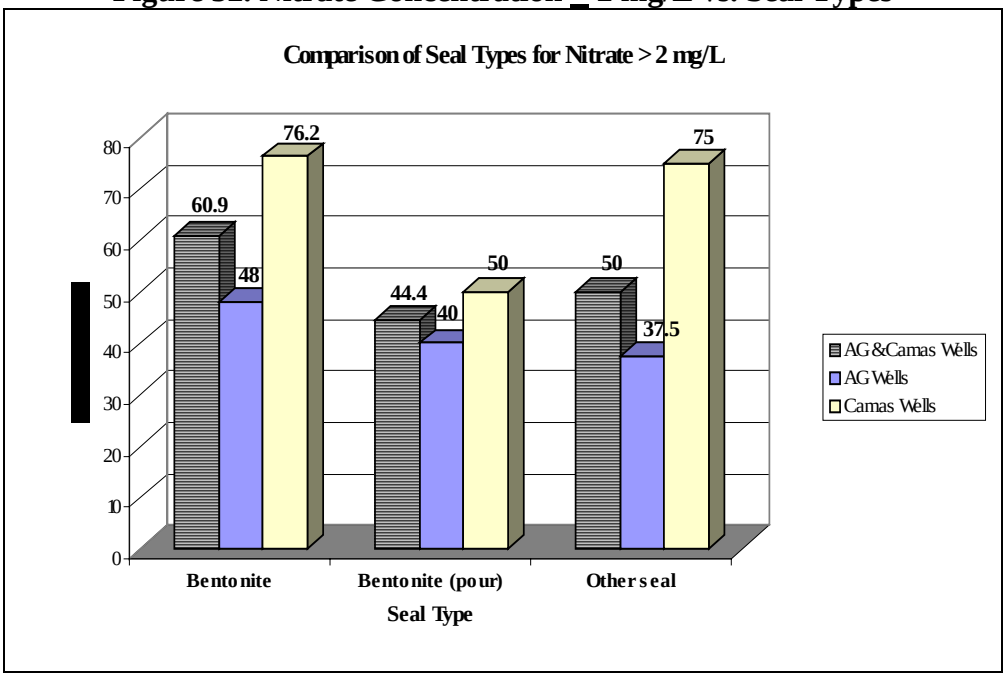


Figure 32. Nitrate Concentration ≥ 2 mg/L vs. Seal Types



CONCLUSIONS

Overall it is evident that nitrate concentrations in the Clearwater Plateau Subarea vary unpredictably throughout the study area. Analysis of well construction details indicates there are no apparent trends in relationship between well construction and nitrate concentrations. Therefore, each well must be treated as an individual situation. However, it is important to note that well logs were very difficult to interpret based on uncertainty and readability in the information and values given.

Recommendations
Based on the results of this study, recommendations are as follows:

- Ensure that the required well logs are readable.
- Improve well logs database access.
- Well casing requirement should be extended to entire well depth.
- A positive displacement bentonite slurry seal should be placed from well bottom to top.
- Require annular seal on all new wells.
- Extend seal to water level.
- Continue nitrogen isotope samples analysis.
- Continue annual nitrate ground water sampling.

This study was limited in analysis and was primarily a summary of currently available data. This report is intended to provide a foundation for further studies to be developed and pursued.

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APPENDIX A

APPENDIX A. Well Attributes for the Idaho Department of Water Resources.

Table 1. IDWR NITRATE CONCENTRATIONS

Idaho Department of Water Resources

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	STATION	SAMPLING DATE	N15 per mil	Nitrate (mg/L)	Nitrite (mg/L)
IDWR-1	454553116192901	45.7647	-116.3247	319225.94229	520754.63961	28N 01E 15CBB1	9/1/1993		0	0
							8/20/1997		0.154	0
							8/30/2001		0.032	0
IDWR-2	454450116182601	45.7464	-116.3111	320225.38670	518687.50069	28N 01E 22DCA1	9/1/1993		0.072	0
							8/20/1997		0	0
							7/30/2002		0.08	0.008
IDWR-3	454305116174401	45.7181	-116.2956	321344.61205	515505.22627	28N 01E 35CAD1	8/10/1994		0	0
							7/22/1998		0.088	0
IDWR-4	455234116121001	45.8761	-116.2028	329049.45699	532861.55037	29N 02E 04DDA1	9/1/1993		0.21	0
							8/18/1997		0.225	0
							7/30/2002		0.18	0.008
IDWR-5	455309116061901	45.8858	-116.1053	336644.50936	533737.16291	29N 03E 05ABD1	8/11/1994		0.24	0
							7/22/1998		0.309	0
IDWR-6	455828116243901	45.9744	-116.4108	313234.08792	544253.06006	30N 01W 02AAA1	9/5/1991		2	0
							8/8/1995		3	0
							7/13/1999		0	0
IDWR-7	455442116244001	45.9117	-116.4111	313001.36761	537279.84824	30N 01W 26ADD1	8/10/1994		0.08	0
							7/24/1998		0.396	0.039
IDWR-8	455621116091601	45.9394	-116.1544	332991.02425	539795.19295	30N 02E 13CBA1	8/29/2001		0.506	0
IDWR-9	455732116054701	45.9589	-116.0964	337547.76193	541836.13382	30N 03E 09BBC1	8/9/1990		0	
							9/11/1993		0	0
							8/19/1997		0	0
							7/30/2002		0.05	0.008
IDWR-10	455646116064101	45.9461	-116.1114	336347.78178	540446.93463	30N 03E 17BAB1	9/11/1993		0	0
IDWR-11	455545116060101	45.9292	-116.1003	337159.29895	538542.10035	30N 03E 20AAC1	9/4/1991		0.57	0
							7/20/1995		0.47	0
IDWR-12	460434116171201	46.0761	-116.2867	323177.13738	555265.29717	31N 01E 02AAA1	8/11/1994		0.65	0
							8/19/1998		1.01	0
IDWR-13	460314116212501	46.0539	-116.3569	317670.25840	552955.24680	31N 01E 08ABB3	9/4/1991		0	0
							8/8/1995		0.61	0
							8/6/1996		0.68	0
							8/19/1997		0.704	0.01
							8/19/1998		0.281	0
							7/13/1999		0.925	0
							8/1/2000	2.84	0.071	0
							8/29/2001		0.458	0
							7/31/2002		0.05	0.008
IDWR-14	460017116142101	46.0047	-116.2392	326626.88691	547229.04185	31N 02E 29BBA1	8/10/1994		5.4	0
							8/19/1998		6.02	0
IDWR-15	455950116093401	45.9972	-116.1594	332777.47010	546225.21387	31N 02E 35ADB1	9/5/1991		4.3	0
							7/21/1995		6.5	0
							7/12/1999		0.894	0
IDWR-16	455906116015301	45.9850	-116.0314	342658.61535	544606.56151	31N 03E 36BCA1	9/18/1992		0	0
							7/20/1995		0	0
							8/7/1996		0.06	0
							8/19/1997		0	0

Table 1. IDWR NITRATE CONCENTRATIONS, continued

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	STATION	SAMPLING DATE	N15 per mil	Nitrate (mg/L)	Nitrite (mg/L)
							7/23/1998		0.074	0
							7/12/1999		0	0
							8/2/2000		0	0
							8/29/2001		0	0
							8/1/2002		0.02	0.008
IDWR-17	460533116213601	46.0927	-116.3600	317562.14499	557268.64249	32N 01E 20CDC1	7/31/2002		0.32	0.008
IDWR-18	460548116300601	46.0967	-116.5017	306623.95335	558050.25318	32N 01W 19DBC1	9/14/1992		0	0
							8/6/1996		0.08	0
							8/1/2000		0	0
IDWR-19	460702116095801	46.1174	-116.1662	332618.49584	559594.17220	32N 02E 14ACA1	7/31/2002		0.35	0.008
IDWR-20	460714116023801	46.1206	-116.0439	342077.43485	559692.68960	32N 03E 11DCC1	9/23/1992		0.39	0
							7/17/1996		3.7	0
							8/2/2000		0.802	0
IDWR-21	460426116022101	46.0739	-116.0392	342309.09813	554498.02563	32N 03E 35AAC1	9/9/1993		4.5	0
IDWR-22	460850116393001	46.1474	-116.6584	294700.11122	564077.58685	32N 03W 01BBC1	8/21/2002		0.11	0.008
IDWR-23	461155116163701	46.1986	-116.2769	324319.70338	568854.12993	33N 01E 13CAC1	9/18/1992		6	0
							8/6/1996		45	0
							7/26/2000	15.43	18.1	0
IDWR-24	461233116274101	46.2092	-116.4614	310124.96911	570452.36578	33N 01W 09DCC1	8/9/1994		1.2	0
							8/19/1998		2.09	0
IDWR-25	461008116262601	46.1689	-116.4406	311594.13576	565927.37359	33N 01W 27DBC1	8/11/1993		0.71	0
							8/19/1997		1.03	0
							8/29/2001		1.01	0
IDWR-26	461025116290401	46.1736	-116.4844	308223.19501	566556.87835	33N 01W 29BDD1	8/11/1993		3.4	0
							7/16/1997		3.94	0
							8/21/2002		4.7	0.008
IDWR-27	461323116101901	46.2231	-116.1719	332495.32934	571343.57936	33N 02E 11BAA1	8/23/1994		61.6	0.85
							7/23/1998		65.3	1.75
							8/19/1998		79.5	0.051
IDWR-28	461323116333201	46.2231	-116.5590	302647.61745	572237.16823	33N 02W 10AAB1	8/8/2002		18	0.008
IDWR-29	461246116070201	46.2128	-116.1172	336684.88619	570087.29174	33N 03E 07DAD1	10/15/1990		0.1	
IDWR-30	461340116451501	46.2278	-116.7542	287612.00917	573262.58345	33N 03W 06DBD1	8/12/1994		0	0
							8/13/1998		0.177	0
IDWR-31	460951116434001	46.1642	-116.7278	289403.99251	566124.84752	33N 03W 32ABA1	8/12/1993		0.12	0
							7/16/1997		0.103	0
							8/27/2001		0.06	0
IDWR-32	460954116431701	46.1650	-116.7214	289900.47428	566200.12991	33N 03W 33BBB1	9/3/1991		0.32	0
IDWR-33	471301116503001	46.2169	-116.8417	280821.50566	572296.32180	33N 04W 09DBB1	8/12/1993		0.26	0
							7/16/1997		0.253	0
							8/27/2001		0.206	0
IDWR-34	461154116523901	46.1983	-116.8775	277983.00627	570328.32554	33N 04W 18DDB1	8/11/1994		0.6	0
							8/13/1998		0.718	0
IDWR-35	461719116204801	46.2886	-116.3467	319235.69780	579010.52299	34N 01E 16CBB1	9/25/2001		0.107	0
IDWR-36	461512116154601	46.2533	-116.2628	325585.68018	574902.65266	34N 01E 25DDD1	8/14/1991		1.4	0
							7/19/1995		1.7	0
							7/14/1999		1.8	0
IDWR-37	461657116293801	46.2825	-116.4942	307852.68587	578678.79819	34N 01W 18DDD1	9/25/2001		0.099	0
IDWR-38	461436116255201	46.2433	-116.4311	312577.10705	574175.72956	34N 01W 34DAD1	8/14/1991		3.7	0.02

Table 1. IDWR NITRATE CONCENTRATIONS, continued

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	STATION	SAMPLING DATE	N15 per mil	Nitrate (mg/L)	Nitrite (mg/L)
IDWR-39	461555116085301	46.2653	-116.1481	334464.05806	575984.39313	34N 02E 25ABB1	8/12/1993		0.27	0
							7/17/1997		0.452	0
							8/19/2002		0.6	0.008
IDWR-40	461445116112601	46.2458	-116.1906	331129.23065	573912.98669	34N 02E 34BDD1	8/10/1994		0.24	0
IDWR-41	461832116332901	46.3089	-116.5581	303025.53180	581767.85546	34N 02W 10ACA1	8/25/1993		0.94	0
							7/17/1997		1.09	0
							9/24/2001	5.74	1.18	0
IDWR-42	461630116343201	46.2750	-116.5756	301555.60794	578046.11783	34N 02W 22BCC1	8/9/1994		0.87	0
							8/13/1998		0.965	0
IDWR-43	461437116370801	46.2436	-116.6189	298101.92106	574667.92785	34N 02W 31DAA1	8/11/1993		0	0
							7/16/1997		0	0
							9/25/2001		0.026	0
IDWR-44	461920116423301	46.3222	-116.7092	291440.89250	583635.89855	34N 03W 04ABD1	9/14/1992		0.44	0
							8/7/1996		0.36	0
							7/27/2000		0.41	0
IDWR-45	462324116282101	46.3900	-116.4725	309895.16161	590570.59221	35N 01W 08DAA1	8/24/1994		0	0
							8/19/1998		0	0
IDWR-46	462158116294101	46.3661	-116.4947	308103.04933	587969.85817	35N 01W 19AADC1	9/15/1992		0	0
							8/7/1996		0.08	0
							7/27/2000		0.055	0
IDWR-47	462002116143101	46.3339	-116.2419	327445.30090	583807.89231	35N 02E 32BCC1	8/25/1993		1.2	0
							7/17/1997		1.79	0
							8/19/2002		2.32	0.008
IDWR-48	462116116314901	46.3544	-116.5303	305326.34570	586760.09172	35N 02W 25BBA1	8/9/1994		0	0
							8/13/1998		0	0
IDWR-49	462224116405601	46.3733	-116.6822	293707.99432	589243.95417	35N 03W 15DAD1	8/9/1994		5.5	0
							8/13/1998		5.68	0
IDWR-50	462436116475201	46.4100	-116.7978	284964.66401	593626.15584	35N 04W 02ABD1	8/8/1994		1.9	0
							8/18/1998		2.39	0
IDWR-51	462217116473501	46.3716	-116.7931	285177.28474	589341.21146	35N 04W 14DDD1	8/8/2002		0.77	0.008
IDWR-52	462206116475001	46.3683	-116.7972	284843.91580	588994.78003	35N 04W 23ABA1	8/7/1990		2.4	
IDWR-53	462405116560001	46.4014	-116.9333	274511.31874	593047.21867	35N 05W 02CCA1	8/26/2001	4.77	2.46	0
IDWR-54	462127116582501	46.3575	-116.9736	271231.69869	588286.43655	35N 05W 21CDB1	8/8/1990		0	
							8/8/2002		0.05	0.008
IDWR-55	462056116535201	46.3489	-116.8978	277030.24212	587113.31764	35N 05W 25ADD1	10/17/1990		2.2	
							9/15/1992		1.3	0
							8/9/1996		7.5	0
							7/26/2000	8.46	4.95	0
IDWR-56	462125117022001	46.3569	-117.0389	266208.11848	588415.04592	35N 06W 24CCA2	8/10/1993		2.1	0
							7/15/1997		5.44	0
							8/15/1997		0	0
							8/8/2002		0.5	0.008
IDWR-57	462736116170201	46.4600	-116.2839	324621.29926	597912.24292	36N 01E 13CCB1	10/16/1990		0.4	
IDWR-58	462551116162901	46.4308	-116.2747	325232.13711	594650.82867	36N 01E 25CDA1	8/10/1994		0.34	0
IDWR-59	462712116320001	46.4533	-116.5333	305443.75957	597755.16398	36N 02W 24BBC1	8/24/1994		0	0
							8/13/1998		0.104	0
IDWR-60	462513116372701	46.4203	-116.6242	298345.65609	594310.74044	36N 02W 31DBA1	8/27/2001	6.95	5.57	0
IDWR-61	462835116410301	46.4764	-116.6842	293946.94797	600699.89701	36N 03W 10DAD1	8/27/2001		0.572	0

Table 2. IDWR CHEMISTRY DATA

Idaho Department of Water Resources

NUMBER	SITE_ID	SAMPLING DATE	pH	OrthoP (mg/l)	K (mg/l)	Radon (pCi/l)	Spec. Cond (uS/cm)	Se (ug/l)	Silica (mg/l)	Na (mg/l)
IDWR-1	454553116192901	9/1/1993	8.7	0	1.2	0	692	0	33	130
		8/20/1997	8.6	0	2.3		610	0	34	117
		8/30/2001	8.5	0	2.6		752	0	34.3	139
IDWR-2	454450116182601	9/1/1993	9	0.02	1.8	0	352	0	48	75
		8/20/1997	8.9	0.01	2.5		347	0	45	76.4
		7/30/2002	8.9	0.02	2.83		4	0.3	44.4	80.5
IDWR-3	454305116174401	8/10/1994	8.2	0	3	0	422	0	40	44
		7/22/1998	8.1	0.017	3.3		452	0	36	43
IDWR-4	455234116121001	9/1/1993	7.3	0.15	2.6	0	114	0	71	6.1
		8/18/1997	7.1	0.148	1.7		117	0	70	6
		7/30/2002	7.2	0.15	2.08		111	0.4	66.1	5.87
IDWR-5	455309116061901	8/11/1994	7.1	0.17	3.3	470	196	0	56	5.5
		7/22/1998	7.2	0.167	3.7		203	0	54	5.5
IDWR-6	455828116243901	9/5/1991	6.6	0.11	2.3	550	162	0	58	9.2
		8/8/1995	7.73	0.1	2.3	0	171	0	59	9.1
		7/13/1999	7.2	0.049	2.4		175	0	55	9.5
IDWR-7	455442116244001	8/10/1994	9.6	0.02	2.1	0	989	0	44	190
		7/24/1998	9.6	0.041	1.9		1100	0	42	207
IDWR-8	455621116091601	8/29/2001	7.1	0.063	2.12		280	0.9	44.8	19.3
IDWR-9	455732116054701	8/9/1990	8.06	0.03	3.5		298	0	47	29
		9/11/1993	8	0.03	3.9	0	319	0	48	28
		8/19/1997	7.7	0.031	3.7		346	0	53	29.1
		7/30/2002	7.7	0.01	4.49		335	0.3	46.3	29.9
IDWR-10	455646116064101	9/11/1993	8.3	0.03	3.5	0	308	0	44	33
IDWR-11	455545116060101	9/4/1991	7.47	0.07	3.6	0	262	0	46	21
		7/20/1995	7.41	0.05	3.2	0	269	0	55	21
IDWR-12	460434116171201	8/11/1994	7.5	0.07	1.7	0	266	0	57	18
		8/19/1998	7.2	0.087	1.7		260	0	59	18
IDWR-13	460314116212501	9/4/1991	7.6	0.05	2.1	0	293	0	53	18
		8/8/1995	7.59	0.03	1.5	0	328	0	55	22
		8/6/1996	7.8	0.04	1.7		325	0	55	22
		8/19/1997	7.3	0.04	1.7		318	0	60	20.9
		8/19/1998	7.6	0.064	1.8		302	0	56	18
		7/13/1999	7.9	0.033	1.8		208	0	49	16
		8/1/2000	7.4	0.044	2		315	0	56	18.7
		8/29/2001	7.3	0.027	1.96		272	0	48.8	16.6
		7/31/2002	7.5	0.05	2.46		288	0.3	54.4	17.3
IDWR-14	460017116142101	8/10/1994	7.8	0.05	3	990	341	0	53	20
		8/19/1998	7.4	0.07	3		358	0	54	20
IDWR-15	455950116093401	9/5/1991	7.53	0.05	2.9	720	355	0	44	20
		7/21/1995	7.65	0.04	2.7	0	393	0	51	22
		7/12/1999	7.5	0.027	3.3		393	0	39	22
IDWR-16	455906116015301	9/18/1992	7.78	0.03	3.2	0	333	0	0.2	19
		7/20/1995	8.58	0.03	3.1	0	329	0	54	19
		8/7/1996	7.8	0.03	3.4		326	0	52	19
		8/19/1997	7.6	0.04	3.1		319	0	58	18.6
		7/23/1998	7.5	0.035	3.2		316	0	51	18
		7/12/1999	7.7	0.034	3.3		312	0	50	19
		8/2/2000	7.3	0.025	3.2		314	0	52.8	18.4

Table 2. IDWR CHEMISTRY DATA, continued

NUMBER	SITE_ID	SAMPLING DATE	pH	OrthoP (mg/l)	K (mg/l)	Radon (pCi/l)	Spec. Cond (uS/cm)	Se (ug/l)	Silica (mg/l)	Na (mg/l)
		8/29/2001	7.3	0.009	3.07		320	0	47.6	19.8
		8/1/2002	7.7	0.03	3.48		316	0.3	51.2	18.4
IDWR-17	460533116213601	7/31/2002	7	0.02	0.64		359	2.8	34.6	29.1
IDWR-18	460548116300601	9/14/1992	7.62	0.04	1.6	280	219	0	47	15
		8/6/1996	8.5	0.04	1.5		221	0	46	15
		8/1/2000	7.7	0.049	1.5		212	0	46.9	15.1
IDWR-19	460702116095801	7/31/2002	8	0.01	3.75		448	0.3	43.5	38.8
IDWR-20	460714116023801	9/23/1992	7.39	0.04	5.3	803	693	0	37	49
		7/17/1996	7.7	0.06	5.2		697	0	41	53
		8/2/2000	6.8	0.034	4.8		589	0	35.6	41.1
IDWR-21	460426116022101	9/9/1993	7.2	0.05	2.7	340	412	0	53	29
IDWR-22	460850116393001	8/21/2002	6.9	0.06	1.92		158	0.3	41.8	5.95
IDWR-23	461155116163701	9/18/1992	7.72	0.02	6.7	0	476	2	47	34
		8/6/1996	7.5	0.03	3.7		1013	0	53	39
		7/26/2000	7.3	0.038	3.3		654	1.9	57.5	31.5
IDWR-24	461233116274101	8/9/1994	7.7	0.11	3.6	1000	329	0	56	24
		8/19/1998	7.4	0.131	3.4		349	0	56	24
IDWR-25	461008116262601	8/11/1993	7.6	0.07	2.1	1300	254	0	43	19
		8/19/1997	7.1	0.074	2		257	0	48	18.7
		8/29/2001	6.9	0.071	2.05		256	0.3	41	20.7
IDWR-26	461025116290401	8/11/1993	7.9	0.07	2.2	1000	286	0	54	16
		7/16/1997	7.2	0.066	2.1		291	0	57	17
		8/21/2002	6.9	0.06	2.16		292	0.4	51.5	16.7
IDWR-27	461323116101901	8/23/1994	7.9	0	3.5	0	550	0	39	24
		7/23/1998	7.3	0.034	3.9		1260	0	48	28
		8/19/1998	7.2	0.041	0		1330	0	0	0
IDWR-28	461323116333201	8/8/2002	7.1	0.07	2.1		502	0.3	50.1	12.8
IDWR-29	461246116070201	10/15/1990	7.92	0.04	5.3		0	0	45	25
IDWR-30	461340116451501	8/12/1994	8.8	0	2.6	0	222	0	47	7.6
		8/13/1998	7.9	0.058	2.7		222	0	46	7.8
IDWR-31	460951116434001	8/12/1993	7.2	0.07	0.1	0	110	0	45	4.7
		7/16/1997	6.6	0.06	1.5		103	0	44	4.5
		8/27/2001	6.7	0.041	1.54		96	0	43.3	4.6
IDWR-32	460954116431701	9/3/1991	6.31	0.06	1.3	0	84	0	33	4.1
IDWR-33	471301116503001	8/12/1993	7.3	0.03	1.6	0	78	0	32	3.4
		7/16/1997	6.9	0.036	1.4		73	0	31	3.3
		8/27/2001	6.8	0.03	1.49		75	0	31.3	3.3
IDWR-34	461154116523901	8/11/1994	8	0	1.2	0	181	0	36	6.6
		8/13/1998	8.2	0.017	6.1		193	0	35	6.4
IDWR-35	461719116204801	9/25/2001	7.9	0.029	4.6		358		47.4	26.7
IDWR-36	461512116154601	8/14/1991	7.7	0.09	1.9	660	351	0	46	27
		7/19/1995	7.99	0.07	1.9	0	381	0	51	25
		7/14/1999	7.7	0.087	1.9		379	0	46	28
IDWR-37	461657116293801	9/25/2001	7.3	0.026	0.91		292	0	49.3	17.1
IDWR-38	461436116255201	8/14/1991	7.63	0.07	1.9	310	387	0	42	28
IDWR-39	461555116085301	8/12/1993	7.5	0.12	2	0	208	0	55	13
		7/17/1997	7.1	0.129	2.1		224	0	60	13.6
		8/19/2002	6.7	0.12	1.94		221	0.6	52	12.9
IDWR-40	461445116112601	8/10/1994	7.9	0.01	2.9	0	428	0	39	30
IDWR-41	461832116332901	8/25/1993	7.4	0.06	3.2	0	478	0	51	17

Table 2. IDWR CHEMISTRY DATA, continued

NUMBER	SITE_ID	SAMPLING DATE	pH	OrthoP (mg/l)	K (mg/l)	Radon (pCi/l)	Spec. Cond (uS/cm)	Se (ug/l)	Silica (mg/l)	Na (mg/l)
		7/17/1997	7.3	0.064	3.4		480	0	53	18
		9/24/2001	7.1	0.066	3.16		499	0.8	52.9	18.8
IDWR-42	461630116343201	8/9/1994	7.4	0.07	1.8	720	391	0	56	16
		8/13/1998	7.2	0.077	1.6		401	0	57	18
IDWR-43	461437116370801	8/11/1993	7.7	0.07	2.4	0	291	0	60	16
		7/16/1997	7.2	0.08	2.8		315	0	65	17.9
		9/25/2001	7.5	0.05	2.66		296	0	59.9	18.8
IDWR-44	461920116423301	9/14/1992	7.5	0.04	3.2	511	238	0	57	9.4
		8/7/1996	7.93	0.04	3.5		244	0	51	8.4
		7/27/2000	7.6	0.039	3.2		245	0	54.6	9.1
IDWR-45	462324116282101	8/24/1994	8.2	0.01	1.9	0	234	0	50	16
		8/19/1998	8	0.033	1.8		234	0	51	16
IDWR-46	462158116294101	9/15/1992	7.52	0.09	8.9	976	332	0	52	23
		8/7/1996	7.94	0.07	9.6		333	0	49	23
		7/27/2000	7.6	0.085	8.7		333	0	50.6	22.6
IDWR-47	462002116143101	8/25/1993	7.7	0.08	3.5	0	314	0	54	18
		7/17/1997	7.3	0.078	3.8		332	0	58	18.9
		8/19/2002	7.2	0.09	3.37		327	0.9	53.8	17.2
IDWR-48	462116116314901	8/9/1994	7.8	0.04	5.8	530	451	0	62	26
		8/13/1998	7.6	0.057	5.6		452	0	0	26
IDWR-49	462224116405601	8/9/1994	7.6	0.05	3.6	0	302	0	53	13
		8/13/1998	7.5	0.06	3.5		296	0	57	13
IDWR-50	462436116475201	8/8/1994	7.7	0.05	3.2	490	256	0	53	12
		8/18/1998	7.3	0.054	3.1		261	0	54	12
IDWR-51	462217116473501	8/8/2002	7.4	0.06	4.44		263	0.5	52.9	12.7
IDWR-52	462206116475001	8/7/1990	7.43	0.09	3.8		338	0	50	13
IDWR-53	462405116560001	8/26/2001	8	0.015	7.14		603	2.1	46.7	61.5
IDWR-54	462127116582501	8/8/1990	8.03	0.01	0		0	0	49	40
		8/8/2002	7.9	0.01	16		548	0.2	45.8	40.6
IDWR-55	462056116535201	10/17/1990	8.23	0.01	0		0	0	45	53
		9/15/1992	7.94	0.02	7.4	0	652	0	52	46
		8/9/1996	8	0.04	7.1		637	2	46	54
		7/26/2000	7.8	0.02	6		520	1.1	53.3	50.7
IDWR-56	462125117022001	8/10/1993	7.9	0	8.7	330	710	1	50	50
		7/15/1997	7.8	0.015	7.5		555	0	61	42.5
		8/15/1997	7.7	0	8.2		591	2	64	44.5
		8/8/2002	7.8	0.02	8.16		345	0.4	60.3	36.1
IDWR-57	462736116170201	10/16/1990	7.65	0.05	2.3		0	0	46	31
IDWR-58	462551116162901	8/10/1994	7.3	0.12	2.6	0	181	0	53	13
IDWR-59	462712116320001	8/24/1994	8	0.03	3.6	620	340	0	58	17
		8/13/1998	7.8	0.046	4.4		280	1	57	17
IDWR-60	462513116372701	8/27/2001	7.4	0.064	1.17		305	0.3	60.6	15.9
IDWR-61	462835116410301	8/27/2001	7.4	0.056	3.45		233	0.2	60.2	13.4

APPENDIX B

APPENDIX B. Well attributes for the Camas Prarie

Table 3. Camas Prairie Nitrate Concentrations

Camas Prairie Wells

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	STATION	SAMPLING DATE	NITRATE (mg/L)
CP-1	1	45.9908	-116.3242	320000.62449	545874.46094	31N 01E 27CB	07/16/98	8.35
CP-2	2	46.1433	-116.3840	315875.07012	562954.82841	32N 1E 6CD	07/16/98	0.318
CP-3	3	46.1432	-116.3843	315852.97818	562939.92290	32N 2E 6DD	07/17/98	36.8
CP-4	4	46.1255	-116.2016	329908.74549	560563.73246	32N 2E 10CC	07/17/98	19.3
CP-5	5	46.2084	-116.5090	306447.30823	570480.84196	33N 1W 18BA	07/17/98	3.57
CP-6	6	46.0734	-116.0560	341003.79640	554472.71268	32N 3E 34DD	07/20/98	5.48
CP-7	7	46.0525	-116.0496	341444.31224	552138.81553	31N 3E 2DC	07/20/98	7.02
CP-8	8	46.1510	-116.3633	317498.36024	563759.24494	32N 1E 5AC	07/20/98	7.83
CP-9	9	46.1421	-116.3887	315508.77544	562830.16460	32N 1E 6BC	07/20/98	0.112
CP-10	10	46.1508	-116.3637	317468.38779	563739.00834	31N 2E 14BB	07/22/98	12.2
CP-11	11	46.0344	-116.1829	331072.52275	550404.52367	31N 2E 10DD	07/22/98	<.005
CP-12	12	46.0397	-116.1813	331213.25633	550989.95850	31N 2E 18CB	07/22/98	0.005
CP-13	13	46.0198	-116.2678	324461.62928	548961.56946	31N 1E 24AA	07/22/98	9.46
CP-14	14	46.1397	-116.2644	325097.33460	562277.93659	32N 1E 1CD	07/22/98	7.48
CP-15	15	46.2377	-116.2141	329289.34030	573060.09077	33N 2E 4BB	07/22/98	2.83
CP-16	16	46.1322	-116.2440	326654.83987	561399.77065	32N 2E 7DD	07/24/98	0.968
CP-17	17	46.1324	-116.3970	314836.85562	561775.04648	32N 1W 12BB	07/27/98	3.24
CP-18	18	46.1691	-116.4105	313915.22042	565875.35356	33N 1W 35SENE	07/27/98	<.005
CP-19	19	46.1803	-116.4364	311952.57426	567183.04866	33N 1W 22DC	07/27/98	13.9
CP-20	20	46.1604	-116.4109	313852.09966	564916.43318	33N 1W 35AD	07/27/98	9.8
CP-21	21	46.1471	-116.4256	312676.70077	563475.38529	32N 1W 3AC	07/27/98	6.19
CP-22	22	46.1457	-116.3991	314716.82423	563253.26867	32N 1E 6BB	07/30/98	0.338
CP-23	23	46.1460	-116.3085	321712.38979	563079.27332	32N 1E 3DD	07/30/98	1.84
CP-24	24	46.1474	-116.3991	314722.53071	563442.14767	?	07/31/98	10.8
CP-25	25	46.1473	-116.4029	314428.73517	563439.91040	?	07/31/98	5.42
CP-26	26	46.1302	-116.2019	329898.58965	561089.94702	32N 2E 9AD	07/31/98	3.77
CP-27	27	46.1491	-116.4908	307650.61918	563846.73281	32N 1W 5BB	08/04/98	<.005
CP-28	28	46.0104	-116.1806	331175.98603	547736.52617	31N 2E 23CB	08/04/98	17.5
CP-29	29	46.0461	-116.2805	323558.75463	551921.79980	31N 1E 12BB	08/04/98	2.2
CP-30	30	46.1363	-116.2156	328859.16021	561797.11848	32N 2E 4CD	08/04/98	2.66
CP-31	31	46.1565	-116.3631	317532.76372	564369.84268	33N 1E 32CB	08/04/98	8.25
CP-32	32	46.1590	-116.3636	317502.42613	564648.75584	33N 1E 32NWSW	08/04/98	8.45
CP-33	33	46.1658	-116.3626	317602.12041	565401.97625	33N 1E 29CC	08/04/98	2.09
CP-34	34	46.1523	-116.3842	315889.54727	563951.90721	33N 1E 31CC	08/04/98	<.005
CP-35	35	46.1632	-116.3901	315469.53908	565173.34452	33N 1W 36AA	08/04/98	6.91
CP-36	36	46.1671	-116.3889	315576.09604	565607.17781	33N 1W 25DD	08/04/98	2.15
CP-37	37	46.1436	-116.3929	315188.61041	563005.50031	32N W 1AC	08/04/98	3.63
CP-38	38	46.0969	-116.3774	316231.06679	557776.47826	32N 1E 19BD	08/06/98	3.62
CP-39	39	46.0959	-116.3773	316234.19301	557674.07711	32N 1E 19DB	08/06/98	3.12
CP-40	40	46.0870	-116.3586	317647.87631	556637.80436	32N 1E 29BD	08/06/98	2.29
CP-41	41	46.1132	-116.2647	324995.69743	559336.37286	32N 1E 13CC	08/06/98	3.17
CP-42	42	46.2821	-116.4689	309798.01277	578573.37856	34N 1W 16CC	08/10/98	5.4
CP-43	43	46.2287	-116.4967	307470.32952	572709.59350	33N 1W 6DA	08/10/98	11.8
CP-44	44	46.2487	-116.4946	307701.34290	574924.42825	34N 1W 31AA	08/10/98	4.43
CP-45	45	46.2091	-116.4611	310147.09824	570443.89424	33N 1W 9DC	08/10/98	1.87
CP-46	46	46.0735	-116.3327	319609.30773	555078.71580	32N 1E 32CA	08/10/98	2.72
CP-47	47	46.0999	-116.2324	327447.86087	557789.21948	32N 1E 20BD	08/10/98	<.005
CP-48	48	46.2375	-116.5184	305827.21517	573738.04712	33N 2W 1AA	08/10/98	20.8
CP-49	49	46.2337	-116.1787	332006.47053	572540.05994	33N 2E 2BC	08/14/98	<.005

Table 3. Camas Prairie Nitrate Concentrations, continued

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	STATION	SAMPLING DATE	NITRATE (mg/L)
CP-50	50	46.2229	-116.1715	332528.77570	571324.87307	33N 2E 11AB	08/14/98	77.1
CP-51	51	46.0152	-116.3950	314596.64347	548744.60943	31N 1W 24AB	08/14/98	1.66
CP-52	52	46.1064	-116.3563	317892.68764	558787.86841	32N 1E 20BA	08/14/98	14.5
CP-53	53	46.0233	-116.3912	314917.84742	549635.70008	31N 1W 13DD	08/24/98	3.22
CP-54	54	46.2084	-116.2300	327974.35803	569843.38534	33N 2E 17AB	08/26/98	4.45
CP-55	55	46.2144	-116.4944	307593.64699	571108.64825	33N 1W 8BC	08/26/98	18.6

APPENDIX C

APPENDIX C. **Well attributes for the Public Water System Wells.**

Table 4. Public Water System Wells Nitrate Concentrations

Public Water System Wells

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	NAME	STATION	SAMPLING DATE	NITRATE (mg/L)	SOURCE NAME	SYSTEM NAME
PWS-1	2310008	46.23972	-116.58269	300878.52585	574144.16536	cadillac		12/22/1999	0.024	S WELL	CADILLAC RANCH RESTAURANT
								12/18/1997	0.6	S WELL	CADILLAC RANCH RESTAURANT
PWS-2	2250126	46.03431	-116.32705	319918.82460	550711.74744	east	31N 1E 8 AB			EAST WELL	COTTONWOOD SALES YARD
PWS-3	2250126	46.04129	-116.33741	319139.90580	551510.75233	north	31N 1E 8 AB			NORTH WELL	COTTONWOOD SALES YARD
PWS-4	2250013	46.04856	-116.35687	317658.12553	552362.90277	#2	31N 1E 8 AB	6/24/2002	0.90000	WELL #2 W BIG	COTTONWOOD WATER DEPT
								11/6/2001	1.00000		
								11/30/1999	0.80000		
								11/17/1998	0.80000		
								9/11/1997	1.30000		
								12/12/1996	0.90000		
								9/19/1995	0.80000		
								10/12/1994	1.70000		
								5/10/1993	0.90600		
PWS-5	2250013	46.04811	-116.35782	317583.14715	552315.08428	#3	31N 1E 8 AB	9/11/1997	0.8	WELL #3 W SMALL	COTTONWOOD WATER DEPT
								10/12/1994	0.5		
								5/10/1993	0.892		
PWS-6	2250013	46.05959	-116.35025	318206.49251	553573.22468	#4	31N 1E 8 AB	10/12/1994	0.5	WELL #4 NORTH	COTTONWOOD WATER DEPT
PWS-7	2250014	45.94059	-116.15884	332653.40906	539932.19086	main well		9/26/2001	2.90000	WELL	COUNTRY COURT MHP
								10/11/2000	2.50000		
								12/27/1999	2.40000		
								9/15/1998	2.60000		
								11/24/1997	2.10000		
								12/16/1996	2.08000		
								12/12/1995	2.00000		
								9/12/1994	2.58000		
								8/16/1993	2.71000		

Table 4. Public Water System Wells Nitrate Concentrations, continued

								6/13/1994	3.51		
								12/20/1993	3.35		
PWS-9	2310001	46.2388	-116.47385	309266.50944	573774.34592	#3	34N/1W/32 DD	1/14/1997	1.96	WELL #3 SOUTH	CRAIGMONT CITY OF
								10/25/1995	0.4		
								12/20/1993	0.82		
PWS-10	2310001	46.24166	-116.46545	309924.01311	574071.93735	#2	34N/1W/33 BB	5/24/2002	2.4	WELL #2 EAST	CRAIGMONT CITY OF
								1/14/1997	8		
								10/25/1995	6.1		
								6/13/1994	6.29		
								12/20/1993	6.61		
PWS-11	2350003	46.37566	-116.66309	295187.96655	589453.12219	#1 lower				WELL #1 LOWER	CULDESAC CITY OF
PWS-12	2350003	46.37861	116.662117	295273.59668	589778.37950	#2 upper				WELL #2 UPPER	CULDESAC CITY OF
PWS-13	2250018	45.96555	-116.25878	324985.11472	542920.03256	main well	30N 2E 6 CB	12/28/1999	0.15000	WELL #1	FENN COMMUNITY SYSTEM
								3/9/1998	0.11000		
								12/2/1996	0.11000		
								7/10/1995	0.26000		
								1/4/1995	22.30000		
								6/14/1994	0.13000		
								9/20/1993	3.93000		
PWS-14	2250019	46.1545	-116.39135	315344.79106	564212.94271	#1				WELL	FERDINAND CITY OF
PWS-15	2250019	46.15442	-116.39134	315345.29551	564204.03102	#2				WELL 2-WEST	FERDINAND CITY OF
PWS-16	2250021	45.91136	-116.15647	332749.26561	536679.69731	main well		10/18/2000	0.74000	WELL #1	GRANGEVILLE GOLF AND COUNTRY CLUB
								9/14/1999	0.73000		
								8/4/1998	0.75000		
								8/26/1997	0.78000		
								9/23/1996	0.83000		
								8/30/1995	0.81000		
								10/19/1994	0.95000		
								11/10/1993	0.91000		
PWS-17	2250008	45.93493	-116.13244	334682.99945	539248.25314	depot		12/30/1998	0.3	WELL #1	THE DEPOT
PWS-18	2250023	45.93155	-116.12007	335631.97874	538847.14356	park		8/13/2002	0.86	PARK WELL	GRANGEVILLE WATER DEPT
								10/18/2000	0.74		
								9/14/1999	0.38		

Table 4. Public Water System Wells Nitrate Concentrations, continued

								8/4/1998	1.2		
								8/26/1997	0.41		
								9/23/1996	0.47		
								8/30/1995	1.16		
								5/10/1994	0.53		
								4/5/1993	0.48		
PWS-19	2250023	45.92548	-116.11261	336192.46697	538157.39531	cash		8/20/2001	1.28000	CASH WELL	GRANGEVILLE WATER DEPT
								10/18/2000	1.55000		
								9/14/1999	1.9		
								8/4/1998	1.78		
								8/26/1997	1.69		
								9/23/1996	1.52		
								8/30/1995	0.96		
								5/10/1994	1.12		
								4/5/1993	1.07		
PWS-20	2250023	45.91048	-116.12143	335464.24581	536509.02409	spencer		8/13/2002	0.86	SPENCER WELL	GRANGEVILLE WATER DEPT
PWS-21	2250023	45.93214	-116.13791	334250.63029	538949.63766	eimers		10/18/2000	1.51	EIMERS	GRANGEVILLE WATER DEPT
								9/14/1999	2.38	EIMERS	
								8/4/1998	1.85	EIMERS	
								8/26/1997	1.83	EIMERS	
								9/23/1996	1.37	EIMERS	
								8/30/1995	0.67	EIMERS	
								5/10/1994	0.59	EIMERS	
								4/5/1993	0.44	EIMERS	
PWS-22	2250023	45.92775	-116.11086	336334.83505	538406.00316	myrtle				MYRTLE ST. WELL	GRANGEVILLE WATER DEPT
PWS-23	2250045	46.02704	-116.37918	315860.61761	550023.33969	southeast well		8/13/2001	2.30000	SOUTHEAST WELL	MONASTERY OF ST GERTRUDES
								10/16/2000	2.70000	SOUTHEAST WELL	
								11/4/1999	2.50000	SOUTHEAST WELL	
								11/17/1998	2.20000	SOUTHEAST WELL	
								10/2/1997	2.90000	SOUTHEAST WELL	

Table 4. Public Water System Wells Nitrate Concentrations, continued

								4/7/1997	7.30000	SOUTHEAST WELL	
								11/13/1995	3.54000	SOUTHEAST WELL	
								10/25/1994	1.62000	SOUTHEAST WELL	
								11/30/1993	2.08000	SOUTHEAST WELL	
								10/7/1992	2.14000	SOUTHEAST WELL	
PWS-25	2250045	46.03163	116.394278	314707.30527	550568.35946					Southwest Well	MONASTERY OF ST GERTRUDES
PWS-26	2310005	46.23371	-116.23309	327812.72740	572657.83068	#4	250	11/27/2000	3.60000	WELL #4 E 5TH	NEZ PERCE WATER DEPT
								11/16/1999	4.40000	WELL #4 E 5TH	
								9/30/1998	3.40000	WELL #4 E 5TH	
								11/19/1997	0.30000	WELL #4 E 5TH	
								12/17/1996	3.73000	WELL #4 E 5TH	
								9/27/1995	3.00000	WELL #4 E 5TH	
								1/5/1994	4.40000	WELL #4 E 5TH	
PWS-27	2310005	46.23395	-116.24775	326683.11625	572716.43286	#1		11/27/2000	2.5	WELL #1 W 5TH	NEZ PERCE WATER DEPT
								12/17/1996	3.78	WELL #1 W 5TH	
								9/27/1995	0.3	WELL #1 W 5TH	
PWS-28	2250041	46.07963	116.426942	312342.55424	555977.91866					East Well #3	NORTH IDAHO CORRECTIONAL INSTITUTE
PWS-29	2250041	46.0806	-116.4267	312364.40112	556085.12316	#5		12/9/1997	0.20000	NORTH WELL #5	NORTH IDAHO CORRECTIONAL INSTITUTE
								10/2/1995	0.37800	NORTH WELL #5	
								10/2/1995	0.38400	NORTH WELL #5	

Table 4. Public Water System Wells Nitrate Concentrations, continued

								12/28/1993	0.43000	NORTH WELL #5	
PWS-30	2310006	46.32766	-116.54115	304394.52382	583811.42138	#2		7/10/2000	1.4	WELL #2 RR	REUBENS CITY OF
								7/26/1999	2		
								3/4/1996	0.6		
								6/13/1994	0.56		
								11/8/1993	0.41		
PWS-31	2310006	46.32292	-116.54302	304233.66696	583289.39330	#1		7/26/1999	1.70000	WELL I STEEPLE	REUBENS CITY OF
								6/22/1998	2.60000		
								3/17/1997	0.20000		
								3/4/1996	2.90000		
								6/13/1994	2.15000		
								11/8/1993	1.56000		
PWS-32	2310007	46.24148	-116.62935	297287.70265	574457.96578	#7				WELL #7 S W	WINCHESTER WATER DEPT
PWS-33	2310007	46.24234	-116.62829	297372.58998	574550.80699	#4				WELL #4 N W	WINCHESTER WATER DEPT
PWS-34	2310007	46.24352	-116.62016	298003.68533	574661.16364	#10				WELL #10 N E	WINCHESTER WATER DEPT

APPENDIX D

APPENDIX D. Well attributes for the Department of Agriculture.

Table 5. Department of Agriculture Nitrate Concentrations

Idaho State Department of Agriculture Wells

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	Sampling Date	NITRATE (mg/L)	NITRITE (mg/L)
AG-1	9500101	45.9470	-116.1094	336506.99507	540542.78068	8/20/2002	3.1	ND
						9/12/2001	3.50	ND
						9/12/2001		
AG-2	9500201	46.1400	-116.2636	325163.41722	562318.30726	8/14/2002	6.6	ND
						10/18/2001	6.80	ND
AG-3	9500301	45.9303	-116.0643	339949.04309	538594.85353	8/20/2002	1.6	ND
						9/12/2001	1.30	ND
AG-4	9500401	46.0567	-116.3572	317662.49293	553267.95318	8/15/2002	ND	ND
						9/12/2001	ND	ND
AG-5	9500501	46.0770	-116.4045	314066.44584	555631.94854	8/15/2002	1.5	BDL
						9/12/2001	0.68	ND
AG-6	9500601	46.0668	-116.3941	314835.89201	554479.99527	8/15/2002	BDL	ND
						9/12/2001	0.051	ND
AG-7	9500701	45.8761	-116.2027	329052.62256	532863.68669	2002	0.17	ND
						2001	0.210	ND
AG-8	9500801	46.1071	-116.4650	309492.93838	559123.87997	8/15/2002	2.2	ND
						9/13/2001	2.10	ND
AG-9	9500901	46.1141	-116.2319	327527.69620	559364.80285	8/27/2002	ND	BDL
						9/13/2001	BDL	ND
AG-10	9501001	45.9433	-116.0769	339015.97251	540063.29206	8/20/2002	BDL	ND
						9/19/2001	0.39	ND
						9/19/2001		
AG-11	9501101	46.1317	-116.2422	326793.34120	561349.15807	8/14/2002	0.95	ND
						9/19/2001	1.00	ND
AG-12	9501201	46.2093	-116.4611	310146.34832	570469.49651	8/15/2002	1.5	ND
						8/15/2002		
						9/19/2001	1.40	ND
AG-13	9501301	46.1389	-116.2502	326194.73810	562160.01433	8/14/2002	10	ND
						9/19/2001	8.60	ND
AG-14	9501401	46.1382	-116.2498	326226.67733	562086.83292	8/14/2002	38	ND
						9/19/2001	29.00	ND
AG-15	9501501	46.0998	-116.3466	318618.49824	558036.90632	8/13/2002	4.7	ND
						9/19/2001	4.20	ND
AG-16	9501601	46.3006	-116.4094	314441.99994	580490.04289	8/27/2002	3.2	ND
						9/19/2001	2.70	ND
AG-17	9501701	46.3615	-116.7170	290990.32522	588021.87933	2002	2.5	ND
						2001	4.90	ND
AG-18	9501801	46.3482	-116.8283	282371.97916	586845.48300	2002	5.1	ND
						2001	2.20	ND
AG-19	9501901	46.2996	-116.8909	277363.39371	581616.27728	2002	4	ND
						2001	4.30	ND
AG-20	9502001	46.3123	-116.8903	277455.11257	583030.30471	2002	ND	ND
						2001	ND	ND
AG-21	9502101	46.4039	-116.8191	283302.56623	593003.25803	2002	1.1	ND
						2001	1.10	ND
AG-22	9502201	46.0909	-116.1794	331518.36841	556669.97632	8/27/2002	9.9	ND
						8/27/2002		
						10/3/2001	9.50	ND
						10/3/2001		
AG-23	9502301	46.0442	-116.0634	340351.25397	551243.17569	8/26/2002	5.3	ND

Table 5. Department of Agriculture Nitrate Concentrations, continued

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	Sampling Date	NITRATE (mg/L)	NITRITE (mg/L)
						10/3/2001	5.70	ND
AG-24	9502401	46.0555	-115.9812	346743.41155	552344.75586	8/26/2002	0.11	ND
						10/3/2001	0.20	ND
AG-25	9502501	46.3811	-116.7888	285544.80269	590395.08908	2002	1.5	ND
						2001	1.50	ND
AG-26	9502601	46.4091	-116.6927	293040.29757	593242.23755	2002	4.2	ND
						2001	4.10	ND
AG-27	9502701	46.2374	-116.2195	328869.75439	573038.46286	8/27/2002	3.2	BDL
						10/4/2001	3.00	ND
AG-28	9502801	46.1366	-116.2153	328886.38313	561830.82873	8/13/2002	1.1	ND
						8/13/2002		
						10/4/2001	0.72	ND
AG-29	9502901	46.3482	-116.9507	272955.41024	587181.59490	2002	BDL	ND
						2001	BDL	ND
AG-30	9503001	46.0967	-116.5014	306643.52239	558057.42219	8/15/2002	ND	ND
						10/10/2001	BDL	ND
AG-31	9503101	46.2661	-116.6411	296473.11835	577226.84538	2002	2	ND
						2001	1.90	ND
AG-32	9503201	46.4157	-116.7979	284981.82038	594262.99469	2002	4.9	ND
						2001	4.60	ND
AG-33	9503301	46.3585	-116.5829	301290.36069	587339.84604	2002	ND	ND
						2001	BDL	ND
AG-34	9503401	45.9106	-116.0563	340513.60596	536390.08406	8/20/2002	0.47	ND
						10/11/2001	0.52	ND
AG-35	9503501	46.4346	-116.8107	284069.74111	596396.83644	2002	5.2	ND
						2001	4.20	ND
AG-36	9503601	46.0646	-116.3641	317151.08066	554164.96533	8/15/2002	9.2	ND
						10/18/2001	10.00	ND
AG-37	9503701	46.3824	-116.4092	314736.36010	589578.17425	2002	ND	ND
						2001	ND	ND
AG-38	9503801	46.4683	-116.3332	320859.75228	598941.84671	2002	1.2	ND
						2001	1.00	ND
AG-39	9503901	46.3338	-116.2420	327439.63016	583798.04509	8/27/2002	2.1	ND
						9/25/2001	1.50	ND
AG-40	9504001	46.4115	-116.4536	311420.18828	592916.47637	2002	ND	ND
						2001	ND	ND
AG-41	9504101	46.4375	-116.2740	325309.57768	595391.43276	2002	0.49	ND
						2001	0.480	ND
AG-42	9504201	46.4628	-116.6374	297490.42745	599064.36573	2002	1.1	ND
						2001	1.30	ND
AG-43	9504301	46.1672	-116.3890	315568.74400	565619.63176	8/21/2002	13	ND
						9/26/2001	16.00	ND
AG-44	9504401	46.2399	-116.5817	300954.62294	574158.37033	8/21/2002	BDL	ND
						9/26/2001	BDL	ND
AG-45	9504501	46.1934	-116.4923	307685.37026	568769.12411	8/21/2002	1.9	ND
						9/26/2001	2.10	ND
AG-46	9504601	46.0446	-116.2350	327074.32267	551655.23013	8/20/2002	ND	ND
						9/27/2001	ND	ND
AG-47	9504701	46.4091	-116.4995	307886.23607	592754.69860	2002	BDL	ND

Table 5. Department of Agriculture Nitrate Concentrations, continued.

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	Sampling Date	NITRATE (mg/L)	NITRITE (mg/L)
						2001	ND	ND
AG-48	9504801	46.4534	-116.5331	305464.92205	597767.83225	2002	0.26	ND
						2001	0.33	ND
AG-49	9504901	46.4227	-116.6389	297224.28266	594617.25879	2002	2	ND
						2001	2.20	ND
AG-50	9505001	46.4201	-116.6340	297588.24034	594320.36285	2002	0.33	ND
						2001	0.37	ND
AG-51	9505101	46.3807	-116.6567	295697.58040	590001.05044	2002	6.9	ND
						2001	7.20	ND
AG-52	9505201	46.4124	-116.9784	271096.01104	594398.82841	2002	6.4	ND
						2001	6.60	ND
AG-53	9505301	46.4033	-116.9323	274601.27481	593251.93745	2002	4.2	ND
						2001	4.00	ND
AG-54	9505401	46.2832	-116.8793	278189.62796	579759.40072	2002	11	ND
						2001	12.00	ND
AG-55	9505501	46.3463	-116.9285	274653.50269	586909.33498	2002	ND	ND
						2001	BDL	ND
AG-56	9505601	46.0973	-116.3771	316254.10567	557822.49478	8/15/2002	4.1	ND
						10/11/2001	4.30	ND
AG-57	9505701	46.2075	-116.4768	308933.50819	570302.61319	8/13/2002	4	ND
						10/11/2001	4.90	ND
AG-58	9505801	46.3663	-116.6407	296875.84815	588353.17114	2002	2.8	ND
						2001	3.10	ND
AG-59	9505901	45.9518	-116.1544	333035.06669	541166.01064	8/20/2002	ND	ND
						10/12/2001	0.15	ND
AG-60	9506001	45.9619	-116.1531	333159.91298	542284.48224	8/26/2002	4.4	ND
						10/12/2001	NA	NA
AG-61	9506101	46.0993	-116.3108	321388.54126	557897.91525	8/21/2002	3.3	ND
						10/12/2001	1.90	ND
AG-62	9506201	46.4276	-116.2963	323563.78376	594340.99698	2002	1.3	ND
						2001	1.30	BDL
AG-63	9506301	45.9512	-116.1117	336341.00716	541010.80073	8/20/2002	2.2	ND
						10/17/2001	2.20	ND
						10/17/2001		
AG-64	9506401	46.0266	-116.2611	324995.05918	549713.62623	8/20/2002	ND	ND
						10/17/2001	2.30	ND
AG-65	9506501	45.9754	-116.2642	324593.05402	544021.96147	8/20/2002	1.9	ND
						10/18/2001	0.082	ND
AG-66	9506601	46.1825	-116.5861	300409.14623	567796.35421	8/21/2002	0.15	ND
						8/21/2002		
						10/18/2001	0.11	ND
AG-67	9506701	45.9514	-116.1340	334611.18302	541085.79435	8/21/2002	BDL	ND
						10/19/2001	ND	ND
AG-68	9506801	46.0903	-115.9825	346736.17641	556214.91117	8/26/2002	0.18	ND
						8/26/2002		
						10/19/2001	0.16	ND

Table 5. Department of Agriculture Nitrate Concentrations, continued

NUMBER	SITE_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	Sampling Date	NITRATE (mg/L)	NITRITE (mg/L)
AG-69	9506901	46.1731	-116.1076	337309.09465	565659.94016	8/26/2002	0.59	ND
						10/19/2001	0.59	ND
AG-70	9507001	46.0522	-116.1586	333007.40655	552330.85508	8/21/2002	13	ND
						10/19/2001	16.00	ND
AG-71	9507101	45.9513	-116.1340	334609.30568	541073.61456	8/20/2002	BDL	ND
						8/20/2002		
						10/19/2001	0.054	ND
AG-72	9508601	46.1427	-116.2086	329422.84106	562497.49518	10/4/2001	15.0	ND

Table 6. Department of Agriculture Chemistry Data

NUMBER	SITE_ID	Sampling Date	OrthoP02	Chloride	Sulfate	Ammonia	Bromide	Fluoride
AG-1	9500101	8/20/2002	BDL	2.3	11	BDL	BDL	0.47
		9/12/2001	ND	2.30	12.00	BDL	ND	0.52
		9/12/2001						
AG-2	9500201	8/14/2002	BDL	4.6	18	BDL	BDL	0.83
		10/18/2001	ND	4.30	18.00	BDL	BDL	0.85
AG-3	9500301	8/20/2002	0.15	1.3	3.6	BDL	ND	0.46
		9/12/2001	0.52	1.20	3.40	BDL	ND	0.54
AG-4	9500401	8/15/2002	ND	1.3	3.5	BDL	ND	0.36
		9/12/2001	ND	1.20	3.50	BDL	ND	0.42
AG-5	9500501	8/15/2002	ND	0.69	23	BDL	ND	0.15
		9/12/2001	ND	0.47	20.00	BDL	ND	0.15
AG-6	9500601	8/15/2002	BDL	2.5	16	BDL	ND	0.33
		9/12/2001	ND	2.60	17.00	BDL	ND	0.38
AG-7	9500701	2002	0.14	0.41	1.7	BDL	ND	0.24
		2001	0.14	0.33	1.30	BDL	ND	0.30
AG-8	9500801	8/15/2002	BDL	1.8	9.4	BDL	ND	BDL
		9/13/2001	BDL	1.50	9.90	BDL	ND	BDL
AG-9	9500901	8/27/2002	ND	6.1	34	BDL	BDL	0.52
		9/13/2001	ND	6.90	920.00	BDL	BDL	0.51
AG-10	9501001	8/20/2002	ND	1.4	34	BDL	BDL	0.46
		9/19/2001	BDL	1.50	27.00	0.11	ND	0.54
		9/19/2001						
AG-11	9501101	8/14/2002	ND	3	14	BDL	BDL	0.33
		9/19/2001	BDL	2.60	14.00	BDL	BDL	0.33
AG-12	9501201	8/15/2002	0.10	1.9	4.9	BDL	ND	0.45
		8/15/2002						
		9/19/2001	BDL	1.80	4.90	BDL	ND	0.52
AG-13	9501301	8/14/2002	BDL	4.8	36	BDL	ND	1
		9/19/2001	BDL	4.10	34.00	BDL	ND	1.00
AG-14	9501401	8/14/2002	BDL	21	30	BDL	BDL	0.44
		9/19/2001	BDL	12.00	29.00	BDL	BDL	0.35
AG-15	9501501	8/13/2002	BDL	4.7	14	BDL	ND	0.28
		9/19/2001	BDL	2.90	15.00	BDL	ND	0.27
AG-16	9501601	8/27/2002	BDL	1.6	3.8	BDL	ND	0.42
		9/19/2001	BDL	1.10	3.40	BDL	ND	0.44
AG-17	9501701	2002	ND	1.5	4.8	BDL	ND	0.23
		2001	BDL	1.40	6.90	0.26	ND	0.31

Table 6. Department of Agriculture Chemistry Data, continued.

NUMBER	SITE_ID	Sampling Date	OrthoP02	Chloride	Sulfate	Ammonia	Bromide	Fluoride
AG-18	9501801	2002	BDL	7.4	16	BDL	BDL	0.36
		2001	BDL	3.80	9.20	BDL	ND	0.35
AG-19	9501901	2002	BDL	11	23	BDL	0.22	0.41
		2001	BDL	9.10	21.00	BDL	0.20	0.40
AG-20	9502001	2002	ND	6.4	19	0.12	BDL	0.34
		2001	BDL	6.20	19.00	BDL	BDL	0.34
AG-21	9502101	2002	BDL	2.70	6.5	BDL	ND	0.36
		2001	BDL	2.40	6.60	BDL	ND	0.36
AG-22	9502201	8/27/2002	ND	4.2	23	BDL	BDL	0.26
		8/27/2002						
		10/3/2001	ND	3.80	23.00	BDL	BDL	0.32
		10/3/2001						
AG-23	9502301	8/26/2002	BDL	10	25	BDL	0.22	0.62
		10/3/2001	ND	8.70	26.00	BDL	0.20	0.69
AG-24	9502401	8/26/2002	0.12	1	7.2	BDL	ND	0.37
		10/3/2001	ND	1.10	11.00	BDL	BDL	0.39
AG-25	9502501	2002	BDL	2	5	BDL	ND	0.38
		2001	ND	1.90	4.90	BDL	ND	0.40
AG-26	9502601	2002	BDL	0.88	7.4	BDL	ND	0.47
		2001	ND	0.79	7.50	BDL	BDL	0.56
AG-27	9502701	8/27/2002	BDL	3	13	BDL	BDL	0.63
		10/4/2001	ND	2.50	13.00	BDL	BDL	0.70
AG-28	9502801	8/13/2002	BDL	4.1	21	BDL	BDL	0.7
		8/13/2002						
		10/4/2001	ND	3.90	22.0	BDL	BDL	0.72
AG-29	9502901	2002	BDL	17	45	BDL	0.21	0.33
		2001	ND	19.00	48.00	BDL	0.22	0.32
AG-30	9503001	8/15/2002	ND	0.80	17	BDL	ND	0.15
		10/10/2001	ND	0.88	18.00	BDL	BDL	0.17
AG-31	9503101	2002	BDL	9.7	6.4	BDL	ND	0.36
		2001	ND	7.00	6.40	BDL	ND	0.43
AG-32	9503201	2002	BDL	2	5.4	BDL	ND	0.36
		2001	ND	1.90	5.20	BDL	BDL	0.38
AG-33	9503301	2002	BDL	0.64	6.7	BDL	ND	0.18
		2001	ND	0.58	6.70	BDL	ND	0.22
AG-34	9503401	8/20/2002	0.16	0.52	1.4	BDL	ND	0.16
		10/11/2001	0.15	0.50	1.30	BDL	ND	0.17
AG-35	9503501	2002	BDL	5.2	9	BDL	BDL	0.36
		2001	BDL	4.50	7.30	BDL	BDL	0.37
AG-36	9503601	8/15/2002	BDL	14	21	BDL	BDL	0.32
		10/18/2001	ND	13.00	22.00	BDL	ND	0.38
AG-37	9503701	2002	BDL	1.3	8	BDL	ND	0.37
		2001	ND	1.10	8.30	BDL	ND	0.44
AG-38	9503801	2002	BDL	4	7.5	BDL	ND	0.33
		2001	ND	3.60	7.50	BDL	ND	0.40
AG-39	9503901	8/27/2002	BDL	1.3	6.2	BDL	ND	0.49
		9/25/2001	BDL	0.87	5.00	BDL	ND	0.52
AG-40	9504001	2002	BDL	0.76	2.8	BDL	ND	0.25
		2001	ND	0.65	2.80	BDL	ND	0.29
AG-41	9504101	2002	ND	5.8	16	BDL	ND	0.45
		2001	ND	5.20	16.00	BDL	ND	0.47

Table 6. Department of Agriculture Chemistry Data, continued.

NUMBER	SITE_ID	Sampling Date	OrthoP02	Chloride	Sulfate	Ammonia	Bromide	Fluoride
AG-42	9504201	2002	0.11	0.89	2.5	BDL	ND	0.27
		2001	BDL	0.92	2.80	BDL	ND	0.30
AG-43	9504301	8/21/2002	BDL	17	33	.13	BDL	0.73
		9/26/2001	BDL	12.00	41.00	BDL	0.16	0.78
AG-44	9504401	8/21/2002	BDL	0.60	2.3	BDL	ND	0.33
		9/26/2001	ND	0.53	2.60	BDL	ND	0.41
AG-45	9504501	8/21/2002	BDL	1.1	4.4	BDL	ND	0.29
		9/26/2001	BDL	1.20	4.80	BDL	ND	0.36
AG-46	9504601	8/20/2002	BDL	9.6	28	BDL	BDL	0.39
		9/27/2001	ND	13.00	36.00	BDL	BDL	0.44
AG-47	9504701	2002	ND	0.46	2.9	BDL	ND	0.23
		2001	ND	0.52	3.10	BDL	ND	0.25
AG-48	9504801	2002	BDL	0.95	12	BDL	ND	0.18
		2001	ND	0.83	18.00	BDL	ND	0.23
AG-49	9504901	2002	BDL	1.2	3.9	BDL	ND	0.32
		2001	BDL	1.00	4.10	0.11	ND	0.38
AG-50	9505001	2002	ND	1.3	4.8	BDL	ND	0.24
		2001	ND	1.20	5.00	BDL	ND	0.31
AG-51	9505101	2002	0.12	6.6	14	BDL	BDL	0.28
		2001	BDL	5.10	14.00	BDL	BDL	0.34
AG-52	9505201	2002	BDL	32	96	BDL	0.30	0.61
		2001	0.13	34.00	110.0	BDL	0.30	0.70
AG-53	9505301	2002	BDL	26	58	BDL	0.33	0.41
		2001	BDL	30.00	75.00	BDL	0.34	0.44
AG-54	9505401	2002	BDL	8	27	BDL	0.15	0.59
		2001	ND	6.50	24.00	BDL	BDL	0.55
AG-55	9505501	2002	BDL	7	24	BDL	BDL	0.38
		2001	ND	6.80	23.00	0.11	BDL	0.35
AG-56	9505601	8/15/2002	BDL	0.56	6.6	BDL	ND	0.30
		10/11/2001	ND	0.49	7.10	BDL	ND	0.33
AG-57	9505701	8/13/2002	BDL	4.8	17	BDL	BDL	0.46
		10/11/2001	ND	4.00	18.00	BDL	BDL	0.51
AG-58	9505801	2002	BDL	7.4	7.4	BDL	ND	BDL
		2001	BDL	4.90	7.90	BDL	BDL	0.14
AG-59	9505901	8/20/2002	BDL	1.7	11	BDL	BDL	0.38
		10/12/2001	ND	2.00	12.00	BDL	BDL	0.45
AG-60	9506001	8/26/2002	BDL	1.1	4.7	BDL	ND	0.36
		10/12/2001	NA	NA	NA	NA	NA	NA
AG-61	9506101	8/21/2002	ND	2.6	15	BDL	BDL	0.43
		10/12/2001	BDL	2.80	17.00	BDL	ND	0.49
AG-62	9506201	2002	BDL	0.83	0.91	BDL	ND	0.18
		2001	BDL	0.69	0.91	BDL	ND	0.23
AG-63	9506301	8/20/2002	BDL	1.6	15	BDL	BDL	0.36
		10/17/2001	ND	1.50	16.00	BDL	ND	0.39
		10/17/2001						
AG-64	9506401	8/20/2002	BDL	2.7	15	BDL	BDL	0.57
		10/17/2001	ND	1.50	15.00	BDL	ND	0.39

Table 6. Department of Agriculture Chemistry Data, continued.

NUMBER	SITE_ID	Sampling Date	OrthoP02	Chloride	Sulfate	Ammonia	Bromide	Fluoride
AG-65	9506501	8/20/2002	BDL	4.4	15	BDL	BDL	0.55
		10/18/2001	ND	4.50	22.00	BDL	BDL	0.53
AG-66	9506601	8/21/2002	ND	0.89	1.9	BDL	ND	BDL
		8/21/2002						
		10/18/2001	ND	0.87	1.60	BDL	ND	0.14
AG-67	9506701	8/21/2002	BDL	4.9	22	BDL	BDL	0.46
		10/19/2001	ND	2.50	16.00	BDL	ND	0.60
AG-68	9506801	8/26/2002	BDL	1.8	6.9	BDL	ND	0.31
		8/26/2002						
		10/19/2001	ND	1.70	7.70	BDL	ND	0.35
AG-69	9506901	8/26/2002	0.59	0.95	1.4	BDL	ND	0.25
		10/19/2001	ND	0.78	1.40	BDL	ND	0.28
AG-70	9507001	8/21/2002	ND	8.8	25	BDL	0.22	0.59
		10/19/2001	ND	11.00	22.00	BDL	0.19	0.68
AG-71	9507101	8/20/2002	BDL	3.5	16	BDL	BDL	0.4
		8/20/2002						
		10/19/2001	ND	3.40	17.00	BDL	ND	0.46
AG-72	9508601	10/4/2001	BDL	7.60	49	BDL	BDL	0.58

APPENDIX E

APPENDIX E. Well Information

Table 7. Well Information for All Data Sources

Map ID	Number	SITE_ID	EASTING	NORTHING	Ave. Nitrate (mg/L)	well depth	casing depth	depth to water
1	IDWR-1	454553116192901	319225.94229	520754.63961	0.062	195	28	27
2	IDWR-2	454450116182601	320225.38670	518687.50069	0.0507	425	73	280
3	IDWR-3	454305116174401	321344.61205	515505.22627	0.044	205	37	26
4	IDWR-4	455234116121001	329049.45699	532861.55037	0.205	325	77	219
5	IDWR-5	455309116061901	336644.50936	533737.16291	0.2745	320	21	265
6	IDWR-6	455828116243901	313234.08792	544253.06006	1.67	163	31	5
7	IDWR-7	455442116244001	313001.36761	537279.84824	0.238	220	18	39
8	IDWR-8	455621116091601	332991.02425	539795.19295	0.506	250	250	29
9	IDWR-9	455732116054701	337547.76193	541836.13382	0.0125	283	169	198
10	IDWR-10	455646116064101	336347.78178	540446.93463	0	342	90	263
11	IDWR-11	455545116060101	337159.29895	538542.10035	0.52	300	300	33
12	IDWR-12	460434116171201	323177.13738	555265.29717	0.83	58	58	11
13	IDWR-13	460314116212501	317670.25840	552955.24680	0.420	301	270	11
14	IDWR-14	460017116142101	326626.88691	547229.04185	5.71	154	18	53
15	IDWR-15	455950116093401	332777.47010	546225.21387	3.898	192	192	80
16	IDWR-16	455906116015301	342658.61535	544606.56151	0.0171	184	144	136
17	IDWR-17	460533116213601	317562.14499	557268.64249	0.32	100	?	?
18	IDWR-18	460548116300601	306623.95335	558050.25318	0.0267	130	97	10
19	IDWR-19	460702116095801	332618.49584	559594.17220	0.35	175	?	?
20	IDWR-20	460714116023801	342077.43485	559692.68960	1.6307	430	19	178
21	IDWR-21	460426116022101	342309.09813	554498.02563	4.5	81	21	4
22	IDWR-22	460850116393001	294700.11122	564077.58685	0.11	125	?	?
23	IDWR-23	461155116163701	324319.70338	568854.12993	23.03	396	20	204
24	IDWR-24	461233116274101	310124.96911	570452.36578	1.645	405	19	112
25	IDWR-25	461008116262601	311594.13576	565927.37359	0.9167	190	76	151
26	IDWR-26	461025116290401	308223.19501	566556.87835	4.013	160	150	17
27	IDWR-27	461323116101901	332495.32934	571343.57936	68.8	180	180	133
28	IDWR-28	461323116333201	302647.61745	572237.16823	18	275	?	?
29	IDWR-29	461246116070201	336684.88619	570087.29174	0.1	110	110	40
30	IDWR-30	461340116451501	287612.00917	573262.58345	0.0885	130	130	100
31	IDWR-31	460951116434001	289403.99251	566124.84752	0.0943	87	18	40
32	IDWR-32	460954116431701	289900.47428	566200.12991	0.32	114	18	21
33	IDWR-33	471301116503001	280821.50566	572296.32180	0.2397	194	192	170
34	IDWR-34	461154116523901	277983.00627	570328.32554	0.659	385	234	186
35	IDWR-35	461719116204801	319235.69780	579010.52299	0.107	154	53	-5
36	IDWR-36	461512116154601	325585.68018	574902.65266	1.633	320	320	150
37	IDWR-37	461657116293801	307852.68587	578678.79819	0.099	140	140	53
38	IDWR-38	461436116255201	312577.10705	574175.72956	3.7	122	122	10
39	IDWR-39	461555116085301	334464.05806	575984.39313	0.4407	265	23	56
40	IDWR-40	461445116112601	331129.23065	573912.98669	0.24	154	28	70
41	IDWR-41	461832116332901	303025.53180	581767.85546	1.07	100	47	30
42	IDWR-42	461630116343201	301555.60794	578046.11783	0.9175	75	15	4
43	IDWR-43	461437116370801	298101.92106	574667.92785	0.00867	600	36	116
44	IDWR-44	461920116423301	291440.89250	583635.89855	0.40333	404	191	260

Table 7. Well Information for All Data Sources, continued

Map ID	Number	SITE_ID	EASTING	NORTHING	Ave. Nitrate (mg/L)	well depth	casing depth	depth to water
45	IDWR-45	462324116282101	309895.16161	590570.59221	0	477	58	365
46	IDWR-46	462158116294101	308103.04933	587969.85817	0.045	615	25	510
47	IDWR-47	462002116143101	327445.30090	583807.89231	1.77	154	56	70
48	IDWR-48	462116116314901	305326.34570	586760.09172	0	166	142	110
49	IDWR-49	462224116405601	293707.99432	589243.95417	5.59	207	24	94
50	IDWR-50	462436116475201	284964.66401	593626.15584	2.145	80	58	27
51	IDWR-51	462217116473501	285177.28474	589341.21146	0.77	78	?	?
52	IDWR-52	462206116475001	284843.91580	588994.78003	2.4	122	47	28
53	IDWR-53	462405116560001	274511.31874	593047.21867	2.46	244	244	133
54	IDWR-54	462127116582501	271231.69869	588286.43655	0.025	190	88	83
55	IDWR-55	462056116535201	277030.24212	587113.31764	3.9875	585	333	197
56	IDWR-56	462125117022001	266208.11848	588415.04592	2.01	307	37	248
57	IDWR-57	462736116170201	324621.29926	597912.24292	0.4	307	37	248
58	IDWR-58	462551116162901	325232.13711	594650.82867	0.34	307	37	248
59	IDWR-59	462712116320001	305443.75957	597755.16398	0.052	605	26	432
60	IDWR-60	462513116372701	298345.65609	594310.74044	5.57	630	630	530
61	IDWR-61	462835116410301	293946.94797	600699.89701	0.572	132	130	24
62	CP-1	1	320000.62449	545874.46094	8.35	495	495	296
63	CP-2	2	315875.07012	562954.82841	0.318	600	600	390
64	CP-3	3	315852.97818	562939.92290	36.8	402	402	25
65	CP-4	4	329908.74549	560563.73246	19.3	275	38	61
66	CP-5	5	306447.30823	570480.84196	3.57	575	18	350
67	CP-6	6	341003.79640	554472.71268	5.48	358	358	190
68	CP-7	7	341444.31224	552138.81553	7.02	260	16	35
69	CP-8	8	317498.36024	563759.24494	7.83	175	175	50
70	CP-9	9	315508.77544	562830.16460	0.112	202	202	53
71	CP-10	10	317468.38779	563739.00834	12.2	100	170.5	
72	CP-11	11	331072.52275	550404.52367	<.005	240		
73	CP-12	12	331213.25633	550989.95850	0.005	215	115.5	142
74	CP-13	13	324461.62928	548961.56946	9.46	90		50
75	CP-14	14	325097.33460	562277.93659	7.48	115	115	62
76	CP-15	15	329289.34030	573060.09077	2.83	375	25	152
77	CP-16	16	326654.83987	561399.77065	0.968	640	640	12
78	CP-17	17	314836.85562	561775.04648	3.24	500	500	74
79	CP-18	18	313915.22042	565875.35356	<.005	160		
80	CP-19	19	311952.57426	567183.04866	13.9	327		
81	CP-20	20	313852.09966	564916.43318	9.8	82	82	34.5
82	CP-21	21	312676.70077	563475.38529	6.19	203	38	10
83	CP-22	22	314716.82423	563253.26867	0.338	400	400	200
84	CP-23	23	321712.38979	563079.27332	1.84	75	138	10
85	CP-24	24	314722.53071	563442.14767	10.8			
86	CP-25	25	314428.73517	563439.91040	5.42			
87	CP-26	26	329898.58965	561089.94702	3.77	135	135	40
88	CP-27	27	307650.61918	563846.73281	<.005	340	340	275
89	CP-28	28	331175.98603	547736.52617	17.5	182	26.5	96

Table 7. Well Information for All Data Sources, continued

Map ID	Number	SITE_ID	EASTING	NORTHING	Ave. Nitrate (mg/L)	well depth	casing depth	depth to water
90	CP-29	29	323558.75463	551921.79980	2.2	200	200	71
91	CP-30	30	328859.16021	561797.11848	2.66	255	255	116
92	CP-31	31	317532.76372	564369.84268	8.25	39		
93	CP-32	32	317502.42613	564648.75584	8.45	50		
94	CP-33	33	317602.12041	565401.97625	2.09	40		
95	CP-34	34	315889.54727	563951.90721	<.005	60		
96	CP-35	35	315469.53908	565173.34452	6.91	140		53.4
97	CP-36	36	315576.09604	565607.17781	2.15	135	138	46
98	CP-37	37	315188.61041	563005.50031	3.63	370	300	60
99	CP-38	38	316231.06679	557776.47826	3.62	325	325	2
100	CP-39	39	316234.19301	557674.07711	3.12	400	400	44
101	CP-40	40	317647.87631	556637.80436	2.29	200	200	90
102	CP-41	41	324995.69743	559336.37286	3.17	327	327	6
103	CP-42	42	309798.01277	578573.37856	5.4	180	180	50
104	CP-43	43	307470.32952	572709.59350	11.8	90		19
105	CP-44	44	307701.34290	574924.42825	4.43			
106	CP-45	45	310147.09824	570443.89424	1.87	405	405	300
107	CP-46	46	319609.30773	555078.71580	2.72	500	480	340
108	CP-47	47	327447.86087	557789.21948	<.005	103	103	20
109	CP-48	48	305827.21517	573738.04712	20.8	400		20
110	CP-49	49	332006.47053	572540.05994	<.005	192		61
111	CP-50	50	332528.77570	571324.87307	77.1	180	180	138
112	CP-51	51	314596.64347	548744.60943	1.66	150	150	110
113	CP-52	52	317892.68764	558787.86841	14.5	80	80	25
114	CP-53	53	314917.84742	549635.70008	3.22	200	19.5	
115	CP-54	54	327974.35803	569843.38534	4.45			
116	CP-55	55	307593.64699	571108.64825	18.6	90		
117	PWS-1	2310008	300878.52585	574144.16536	0.312			?
118	PWS-2	2250126	319918.82460	550711.74744		476		260
119	PWS-3	2250126	319139.90580	551510.75233		268		268
120	PWS-4	2250013	317658.12553	552362.90277	1.012	604		312
121	PWS-5	2250013	317583.14715	552315.08428	0.731	270		245
122	PWS-6	2250013	318206.49251	553573.22468	0.5	836		?
123	PWS-7	2250014	332653.40906	539932.19086	2.43	107		?
124	PWS-8	2310000	308870.58356	574415.07878	2.52			
125	PWS-9	2310001	309266.50944	573774.34592	1.06	900		60
126	PWS-10	2310001	309924.01311	574071.93735	5.88	173		?
127	PWS-11	2350003	295187.96655	589453.12219		448		?
128	PWS-12	2350003	295273.59668	589778.37950		555		420
129	PWS-13	2250018	324985.11472	542920.03256	3.856	472		390
130	PWS-14	2250019	315344.79106	564212.94271		242		142
131	PWS-15	2250019	315345.29551	564204.03102		250		184
132	PWS-16	2250021	332749.26561	536679.69731	0.8125	395		?
133	PWS-17	2250008	334682.99945	539248.25314	0.3	365		?
134	PWS-18	2250023	335631.97874	538847.14356	0.692	806		633
135	PWS-19	2250023	336192.46697	538157.39531	1.43	406		?

Table 7. Well Information for All Data Sources, continued

Map ID	Number	SITE_ID	EASTING	NORTHING	Ave. Nitrate (mg/L)	well depth	casing depth	depth to water
136	PWS-20	2250023	335464.24581	536509.02409	0.86	728		622
137	PWS-21	2250023	334250.63029	538949.63766	1.33	715		622
138	PWS-22	2250023	336334.83505	538406.00316		628		117
139	PWS-23	2250045	315860.61761	550023.33969	2.928	1238		326
140	PWS-25	2250045	314707.30527	550568.35946				
141	PWS-26	2310005	327812.72740	572657.83068	3.261	250		233
142	PWS-27	2310005	326683.11625	572716.43286	2.193	200		?
143	PWS-28	2250041	312342.55424	555977.91866				
144	PWS-29	2250041	312364.40112	556085.12316	0.348	750		270
145	PWS-30	2310006	304394.52382	583811.42138	0.994	670		?
146	PWS-31	2310006	304233.66696	583289.39330	1.852	467		?
147	PWS-32	2310007	297287.70265	574457.96578		460		323
148	PWS-33	2310007	297372.58998	574550.80699		473		331
149	PWS-34	2310007	298003.68533	574661.16364		600		340
150	AG-1	9500101	336506.99507	540542.78068	3.3	425	425	275
151	AG-2	9500201	325163.41722	562318.30726	6.7	115	115	62
152	AG-3	9500301	339949.04309	538594.85353	1.45	450	450	350
153	AG-4	9500401	317662.49293	553267.95318	0			
154	AG-5	9500501	314066.44584	555631.94854	1.09	60	18	8
155	AG-6	9500601	314835.89201	554479.99527	0	407	181	338
156	AG-7	9500701	329052.62256	532863.68669	0.19			
157	AG-8	9500801	309492.93838	559123.87997	2.15	80	38	21
158	AG-9	9500901	327527.69620	559364.80285	0	175	175	95
159	AG-10	9501001	339015.97251	540063.29206	0	325	18	160
160	AG-11	9501101	326793.34120	561349.15807	0.975	640	640	13
161	AG-12	9501201	310146.34832	570469.49651	1.45	405	405	300
162	AG-13	9501301	326194.73810	562160.01433	9.3			
163	AG-14	9501401	326226.67733	562086.83292	33.5	402	402	25
164	AG-15	9501501	318618.49824	558036.90632	4.45	102	80	6
165	AG-16	9501601	314441.99994	580490.04289	2.95	308		132
166	AG-17	9501701	290990.32522	588021.87933	3.7	141	26	75
167	AG-18	9501801	282371.97916	586845.48300	3.65	137	137	63
168	AG-19	9501901	277363.39371	581616.27728	4.15	300	58	160
169	AG-20	9502001	277455.11257	583030.30471	0			
170	AG-21	9502101	283302.56623	593003.25803	1.1	220	220	154
171	AG-22	9502201	331518.36841	556669.97632	9.7			
172	AG-23	9502301	340351.25397	551243.17569	5.5			
173	AG-24	9502401	346743.41155	552344.75586	0.155	378	378	260
174	AG-25	9502501	285544.80269	590395.08908	1.5	128	33	25
175	AG-26	9502601	293040.29757	593242.23755	4.15	57	19	2
176	AG-27	9502701	328869.75439	573038.46286	3.1			
177	AG-28	9502801	328886.38313	561830.82873	0.91	255	255	116
178	AG-29	9502901	272955.41024	587181.59490	0	448	147	245
179	AG-30	9503001	306643.52239	558057.42219	0			
180	AG-31	9503101	296473.11835	577226.84538	1.95			
181	AG-32	9503201	284981.82038	594262.99469	4.75			
182	AG-33	9503301	301290.36069	587339.84604	0			

Table 7. Well Information for All Data Sources, continued

Map ID	Number	SITE_ID	EASTING	NORTHING	Ave. Nitrate (mg/L)	well depth	casing depth	depth to water
183	AG-34	9503401	340513.60596	536390.08406	0.495	352	315	220
184	AG-35	9503501	284069.74111	596396.83644	4.7	65	30	24
185	AG-36	9503601	317151.08066	554164.96533	9.6	340	340	160
186	AG-37	9503701	314736.36010	589578.17425	0			
187	AG-38	9503801	320859.75228	598941.84671	1.1	430	29	270
188	AG-39	9503901	327439.63016	583798.04509	1.8	154	154	70
189	AG-40	9504001	311420.18828	592916.47637	0			
190	AG-41	9504101	325309.57768	595391.43276	0.485	608	240	408
191	AG-42	9504201	297490.42745	599064.36573	1.2			
192	AG-43	9504301	315568.74400	565619.63176	14.5	135	138	46
193	AG-44	9504401	300954.62294	574158.37033	0	250	250	51
194	AG-45	9504501	307685.37026	568769.12411	2	323	54	282
195	AG-46	9504601	327074.32267	551655.23013	0			
196	AG-47	9504701	307886.23607	592754.69860	0	401		370
197	AG-48	9504801	305464.92205	597767.83225	0.295	605	410	432
198	AG-49	9504901	297224.28266	594617.25879	2.1	550	550	416
199	AG-50	9505001	297588.24034	594320.36285	0.35			
200	AG-51	9505101	295697.58040	590001.05044	7.05	74	58	41
201	AG-52	9505201	271096.01104	594398.82841	6.5	50	38	17
202	AG-53	9505301	274601.27481	593251.93745	4.1	238	238	135
203	AG-54	9505401	278189.62796	579759.40072	11.5			
204	AG-55	9505501	274653.50269	586909.33498	0	343	343	260
205	AG-56	9505601	316254.10567	557822.49478	4.2	325	38	-2
206	AG-57	9505701	308933.50819	570302.61319	4.45			
207	AG-58	9505801	296875.84815	588353.17114	2.95	230	38	105
208	AG-59	9505901	333035.06669	541166.01064	0	280	280	75
209	AG-60	9506001	333159.91298	542284.48224	4.4	89	82	44
210	AG-61	9506101	321388.54126	557897.91525	2.6			
211	AG-62	9506201	323563.78376	594340.99698	1.3			
212	AG-63	9506301	336341.00716	541010.80073	2.2			
213	AG-64	9506401	324995.05918	549713.62623	1	215	115	142
214	AG-65	9506501	324593.05402	544021.96147	0.991			
215	AG-66	9506601	300409.14623	567796.35421	0.13			
216	AG-67	9506701	334611.18302	541085.79435	0			
217	AG-68	9506801	346736.17641	556214.91117	0.17			
218	AG-69	9506901	337309.09465	565659.94016	0.59	230	280	87
219	AG-70	9507001	333007.40655	552330.85508	14.5	400	60	29
220	AG-71	9507101	334609.30568	541073.61456	0	410	400	183
221	AG-72	9508601	329422.84106	562497.49518	15			

APPENDIX F

APPENDIX F. WELL LOG DETAILS

Table 11. Casing and Seal Depth Data for Camas Prairie and Dept. of Ag. Wells

Number	SITE_ID	Nitrate (mg/L)	Total Depth	Static W.L.	Depth Flow Enc.	Casing: 8 inch From	To	Casing: 6 inch From	To	Casing: 4 inch From	To	Seal Type	Amt (sacks or lbs	Seal: From	To	Screen: From	To	Comments	Casing Depth
CP-1	1	8.35	495	276	-			-2	18	5	495	B		0	18	475	495		495
CP-2	2	0.318	600	390	560			-2	58	-		B (dry)	500	0	50	560	600		600
CP-3	3	36.8	402	25	-			-1	57	5	402	Cement grout	-	0	57	362	402	*well seal can be removed	402
CP-4	4	19.3	275	61	-			-2	38	-		B	-	0	22	-			38
CP-5	5	3.57	575	350	-			-2	18	-		B	-	0	18	-			18
CP-6	6	5.48	358	190	234	-2	29					B (dry)	800	0	30	318	358		358
CP-7	7	7.02	260	35														*well log is vague	
CP-8	8	7.83	175	50				-1	19	6	175	Pudding Clay	-	0	20	-			175
CP-9	9	0.112	202	53	-			-2	18	5	202	B (top pour)	150	0	18	180	202		202
CP-10	10	12.2	187	?				-1.5	171			Cement grout			148	135	147		170.5
CP-11	11	<.005																no well log	
CP-12	12	0.005	215	142				-1.5	116			Pudding Clay			115				115
CP-13	13	9.46																no well log	
CP-14	14	7.48	115	62		-1	46					B			45	80	115	*well seal can be removed	115
CP-15	15	2.83																no well log	
CP-16	16	0.968	640	12	-			-2	168	100	640	B (top pour)	350	0	18	600	640	*seal was tested	640
CP-17	17	3.24	500	74	450			-2	38			B (dry)	500	0	40	460	500		500
CP-18	18	<.005																no well log	
CP-19	19	13.9																no well log	
CP-20	20	9.8	82	?	-			-2	18	10	82	B			18	60	80		82
CP-21	21	6.19	203	10	-			-2	38			B			20				38
CP-22	22	0.338	400	200	350	0	18					B (top pour)	2 sacks	0	18	350	400	*removable well cap	400
CP-23	23	1.84	75	10	65			2	138			B (dry)	350	0	25	50	70		138
CP-24	24	10.8																*no well log	
CP-25	25	5.42																*no well log	
CP-26	26	3.77	135	40	-			-2	44	15	135	B (top pour)	750	0	44	115	135		135
CP-27	27	<.005	340	?				-2	129	120	340	B (top pour)	300	0	21	?	340	*well log was cut off	340
CP-28	28	17.5																*no well log	
CP-29	29	2.2	200	71	170			-2	18			B (dry)	200	0	20	160	200		200
CP-30	30	2.66	255	116	-			-2	18	15	255	B (top pour)	150	0	18	225	255		255

Table 11. Casing and Seal Depth Data for Camas Prairie and Dept. of Ag. Wells, continued.

Number	SITE_ID	Nitrate (mg/L)	Total Depth	Static W.L.	Depth Flow Enc.	Casing: 8 inch From	To	Casing: 6 inch From	To	Casing: 4 inch From	To	Seal Type	Amt (sacks or lbs	Seal: From	To	Screen: From	To	Comments	Casing Depth
CP-31	31	8.25																*no well log	
CP-32	32	8.45																* no well log	
CP-33	33	2.09																* no well log	
CP-34	34	<.005																* no well log	
CP-35	35	6.91																* no well log	
CP-36	36	2.15	142	46	-			-2	138			?			30	98	138		138
CP-37	37	3.63	310	60	-			-2	76	10	300	B			76	330	370		300
CP-38	38	3.62	325	2	-			-2	38			B (top pour)	450	0	36	295	325	*artesian pressure = 2.3 lb	325
CP-39	39	3.12	400	44	350			-2	18			B (dry)	250	0	20	260	400		400
CP-40	40	2.29	200	90	185			-2	18			B (dry)	200	0	20	180	200		200
CP-41	41	3.17	327	6	-			2	79	7	327	B				200	327		327
CP-42	42	5.4	180	50	-			-1	19	9	180	B			19				180
CP-43	43	11.8																*no well log	
CP-44	44	4.43																*no well log	
CP-45	45	1.87	405	300	-			-1	19	10	405	B			18	345	405		405
CP-46	46	2.72	500	340	450			-2	38			B (dry)	600	0	30	440	480		480
CP-47	47	<.005	102	20	-			-2	103			B			19	70	103	*well seal can be removed	103
CP-48	48	20.8																*no well log	
CP-49	49	<.005																*no well log	
CP-50	50	77.1	180	138	-			-2	18	12	180	B			18				180
CP-51	51	1.66	150	110	135			-2	18			B (dry)	200	0	20	120	150		150
CP-52	52	14.5	80	25	-			-2	18	10	80	B (top pour)	150	0	18	50	80		80
CP-53	53	3.22	200	?	-			-1.5	19.5			B							19.5
CP-54	54	4.45																*no well log	
CP-55	55	18.6																*no well log	
AG-1	9500101	3.3	425	275	-			-2	18	5	425	B (top pour)	150	0	18	390	425		425
AG-2	9500201	6.7	115	62		-1	46					B			45	80	115		115
AG-3	9500301	1.45	450	350	-	-2	18	4	268	4	450	B			18	410	450		450
AG-4	9500401	0																no well log	
AG-5	9500501	1.09	60	8	-			-2	18			B			18	-			18
AG-6	9500601	0	407	338	-			-2	18			B			18	-			181
AG-7	9500701	0.19																no well log	
AG-8	9500801	2.15	80	21	-			-2	38			B			20				38

Table 11. Casing and Seal Depth Data for Camas Prairie and Dept. of Ag. Wells, continued.

Number	SITE_ID	Nitrate (mg/L)	Total Depth	Static W.L.	Depth Flow Enc.	Casing: 8 inch From	To	Casing: 6 inch From	To	Casing: 4 inch From	To	Seal Type	Amt (sacks or lbs	Seal: From	To	Screen: From	To	Comments	Casing Depth
AG-9	9500901	0	175	95	-			-2	49	35	175	B (top pour)	9	0	45	160	175		175
AG-10	9501001	0	325	160	-			-2	18			B			18	-			18
AG-11	9501101	0.975	640	13				-2	168	100	640	B (top pour)	350	0	18	600	640	*seal was tested with air pressure	640
AG-12	9501201	1.45	405	300	-			-1	19	10	405	B			18	345	405		405
AG-13	9501301	9.3																no well log	
AG-14	9501401	33.5	402	25	-			-1	57	5	402	Cement Grout			57	362	402		402
AG-15	9501501	4.45	102	6	-			-2	82			Pudding Clay			30	48	80		80
AG-16	9501601	2.95	308	132	-													*well log is missing a lot	
AG-17	9501701	3.7	141	75	-			-2	26			B			20	-			26
AG-18	9501801	3.65	137	63	-			-2	30	10	137	B			30	97	137		137
AG-19	9501901	4.15	300	160				-2	58			B			22				58
AG-20	9502001	0																no well log	
AG-21	9502101	1.1	220	154	-			-2	25	20	220	B (top pour)	500	5	23	200	220		220
AG-22	9502201	9.7																no well log	
AG-23	9502301	5.5																no well log	
AG-24	9502401	0.155	378	260	-			-2	103	4	378	B			18	320	378		378
AG-25	9502501	1.5	128	25	-			-2	33			B			18	-			33
AG-26	9502601	4.15	57	2	-			2	19			B			20	-			19
AG-27	9502701	3.1																no well log	
AG-28	9502801	0.91	255	116	-			-2	18	15	255	B (top pour)	150	0	18	225	255		255
AG-29	9502901	0	448	245	-	1	147					B			104				147
AG-30	9503001	0																no well log	
AG-31	9503101	1.95																no well log	
AG-32	9503201	4.75																no well log	
AG-33	9503301	0																no well log	
AG-34	9503401	0.495	352	220		-2	78	15	315			B			22				315
AG-35	9503501	4.7	65	24	-			1	30			B			30				30
AG-36	9503601	9.6	340	160	-			-2	91	80	340	B			19	320	340		340
AG-37	9503701	0																no well log	
AG-38	9503801	1.1	430	270	-			-1.5	29			Pudding Clay			29				29
AG-39	9503901	1.8	154	70				-2	56	6	154	B			19	108	154		154

Table 11. Casing and Seal Depth Data for Camas Prairie and Dept. of Ag. Wells, continued.

Number	SITE_ID	Nitrate (mg/L)	Total Depth	Static W.L.	Depth Flow Enc.	Casing: 8 inch From	To	Casing: 6 inch From	To	Casing: 4 inch From	To	Seal Type	Amt (sacks or lbs	Seal: From	To	Screen: From	To	Comments	Casing Depth
AG-40	9504001	0																no well log	
AG-41	9504101	0.485	608	408				1	94	1	240	Pudding Clay			92	-			240
AG-42	9504201	1.2																no well log	
AG-43	9504301	14.5	135	46	-			-2	138			B			30	98	138		138
AG-44	9504401	0	250	51	225			2	198			B (dry)	400	0	40	210	250		250
AG-45	9504501	2	323	282	-			1.5	54			Pudding Clay			54				54
AG-46	9504601	0																no well log	
AG-47	9504701	0	401	370														no casing or well seal, rotary method	
AG-48	9504801	0.295	605	432	-			1	26	3	410	Pudding Clay			26	555	605	5in casing from 405 to 605	410
AG-49	9504901	2.1	550	416	525	-2	56					B (dry)	800	0	56	510	550		550
AG-50	9505001	0.35																no well log	
AG-51	9505101	7.05	74	41	-	-2	58					B (top pour)	500	1	19	-			58
AG-52	9505201	6.5	50	17				-2	38			Pudding Clay			38				38
AG-53	9505301	4.1	238	135	-	-1	26	9	238			B			26	190	238		238
AG-54	9505401	11.5																no well log	
AG-55	9505501	0	343	260	-	28	228	3	343			B (overbore?)	8	0	18	300	343	10in casing from -1 to 18	343
AG-56	9505601	4.2	325	-2	-			-2	38			B (top pour)	450	0	36	295	325	Artesian pressure = 2.3 lbs	38
AG-57	9505701	4.45																no well log	
AG-58	9505801	2.95	230	105	-			-2	38			B			21	-			38
AG-59	9505901	0	280	75	-			-2	18	3	280	B			18	220	280		280
AG-60	9506001	4.4	89	44	-			-2	82			B			30				82
AG-61	9506101	2.6																no well log	
AG-62	9506201	1.3																no well log	
AG-63	9506301	2.2																no well log	
AG-64	9506401	1	215	142	-			-1.5	116			Pudding Clay				115			115
AG-65	9506501	0.991																no well log	

Table 11. Casing and Seal Depth Data for Camas Prairie and Dept. of Ag. Wells, continued.

Number	SITE_ID	Nitrate (mg/L)	Total Depth	Static W.L.	Depth Flow Enc.	Casing: 8 inch From	To	Casing: 6 inch From	To	Casing: 4 inch From	To	Seal Type	Amt (sacks or lbs	Seal: From	To	Screen: From	To	Comments	Casing Depth
AG-66	9506601	0.13																no well log	
AG-67	9506701	0																no well log	
AG-68	9506801	0.17																no well log	
AG-69	9506901	0.59	230	87	-			-2	18	20	280	B (top pour)	200	0	19	160	180		280
AG-70	9507001	14.5	400	29	-			-2	56			B (top pour)	300	0	18	50	60		60
AG-71	9507101	0	410	183	-			-2	18	10	400	B (top pour)	246	0	18	390	410		400
AG-72	9508601	15																no well log	