Ground Water Quality Technical Report No. 38

Possible Sources of Nitrate to the Springs of Southern Gooding County, Eastern Snake River Plain, Idaho

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Executive Summary

The purpose of this report is to identify potential contamination sources that may be impacting springs discharging to the Snake River Farms aquaculture facility. Baldwin et al. (2006) identified a statistically significant increasing nitrate trend in springs supplying water to the Snake River Farms facility in southern Gooding County, Idaho. Continued observations at this facility show that nitrate concentrations and flow rates increase during the later portion of each year (October to December), likely caused by upstream irrigation recharge. Recharge that occurs via percolation can transport nitrogen to the regional aquifer, which, in turn, migrates laterally to the discharge sites at these springs.

Due to the geologic setting of the Eastern Snake River Plain (ESRP) springs, it is difficult to collect samples that correlate the differences in nitrate concentrations with depth at Snake River Farms. It is expected that the nitrate concentrations are higher at the top of the water table and attenuate with depth.

Because the springs coalesce into larger water bodies, it is also difficult to isolate individual springs to determine if the nitrate concentrations are variable within spring swarms. However, at Snake River Farms, nitrate concentrations in spring discharge are highly variable within short lateral distances.

The chemical variability among springs observed at the Snake River Farms facility suggests that the complex geology underlying the Snake River Plain has created zones of high transmissivity that potentially channelize water with high nitrate concentrations toward spring discharge outlets north of the Snake River, and, subsequently, into the Snake River Farms facility. These channels of high transmissivity are considered to be directly related to the emplacement of the Snake River Group, where paleo-river channels were buried by advancing basalt flows.

An estimate of nitrogen loading from human, animal, and fertilizer sources was calculated to evaluate potential sources up-gradient of the Snake River Farm springs. These estimated amounts of nitrogen, along with isotope and personal care product and pharmaceutical (PCPP) data, indicate animal and human sources and commercial fertilizer are the most likely sources of nitrogen to springs near Snake River Farms. Because nitrate concentrations at Snake River Farms are much higher than at adjacent springs, the sampling effort was focused to this facility. The land use and nitrate loading within a delineated ground water capture zone that is hydraulically up-gradient from Snake River Farms is the suspected source of elevated nitrate concentrations in these springs.

Presence of PCPPs in springs discharging at Snake River Farms indicates a pathway for contaminants. Increasing concentrations of PCPPs are seen between samples collected in the spring versus in the fall from the same spring. Specific PCPPs detected at Snake River Farms include an animal/human antibiotic (sulfamethoxazole), a human anti-seizure drug (carbamazapine), and the insect repellent known as DEET.

1. Introduction

The Thousand Springs area of south central Idaho is the discharge point for ground water from the Eastern Snake River Plain (ESRP) Aquifer, one of the most voluminous aquifers in the United States. It was designated a sole source aquifer by the U.S. Environmental Protection Agency because it is the only source of drinking water for 200,000 people in southern Idaho (Environmental Protection Agency, 2009).

The Idaho Department of Environmental Quality (DEQ) conducted a review of the water chemistry of springs that discharge from the ESRP Aquifer, in southern Gooding County, to evaluate changes in water quality over time. The primary contaminant of concern for this evaluation was nitrite (NO_2) + nitrate (NO_3) as nitrogen (N). (Nitrite + nitrate will be referred to as nitrate throughout the rest of the report.)

The Idaho Ground Water Quality Rule (IDAPA 58.01.11), adopted in 1997, established an Idaho Ground Water Quality Standard of 10 milligrams per liter (mg/L) for nitrate. Nitrate is considered to be a conservative ion, in that it is transported through the unsaturated zone to the water table with little or no attenuation. Elevated levels of nitrate in ground water can serve as an indicator that other contaminants may be impacting the quality of the ground water as well.

In 2007, through the National Pollution Discharge Elimination Site (NPDES) monitoring program, Clear Springs Foods, Inc. (Snake River Farms site) discovered elevated nitrate concentrations (greater than 5 mg/L) in springs supplying water to the facility. As a result, DEQ began monitoring the water chemistry in an effort to identify possible increasing trends in nitrate at this facility and attempt to locate possible sources of this elevated nitrate, whether human-caused or naturally occurring.

The objective of this project was to gain a better understanding of the quality of ground water-fed springs supplying water to Clear Spring Foods Snake River Farms facility. The objectives for this study were to accomplish the following:

- Determine the spatial and temporal distribution of constituents of concern in and around the Snake River Farms facility
- Identify whether water discharging at Snake River Farms is originating from the local or regional ground water flow system(s)
- Delineate the ground water contribution area supplying water to the facility
- Estimate nitrogen loading using nitrate concentration and flow data from the Snake River Farms facility
- Evaluate nitrogen sources that may contribute to the total nitrate loading at the facility

To determine if nitrate concentrations were increasing significantly at Snake River Farms, a sampling strategy was started by DEQ in 2007. Field parameters, including inorganic chemicals (IOCs) nitrate, chloride, sulfate, metals, isotopes, personal care products, and pharmaceuticals were analyzed.

2. Study Area

The Snake River Farms facility is in the Clear Lakes spring system and is located in southern Gooding County, Idaho, just north of the Snake River and south of Interstate I-84 (Figure 1). The springs located in southern Gooding County are part of the "Thousand Springs area," where hundreds of springs discharge into the Snake River. Thousand springs is also the name given to a smaller set of springs located along the Snake River downstream from the Snake River Farms facility (Figure 1). The Thousand Springs area springs support several aquaculture facilities north of the river. Clear Springs Foods owns several aquaculture facilities in this area, including Snake River Farms. Snake River Farms is fed by several individual springs that coalesce into larger spring swarms.

The springs emanate from a volcanic talus slope, which represents the contact between two successive basalt flows. The spring discharge is channeled under an access road where it is diverted to the Snake River Farms facility. There are several springs upstream and downstream of the Clear Lakes spring system that also support aquaculture practices. This study includes a water quality comparison of Snake River Farms against the springs that discharge upstream (Crystal Springs) and downstream (Box Canyon Spring).

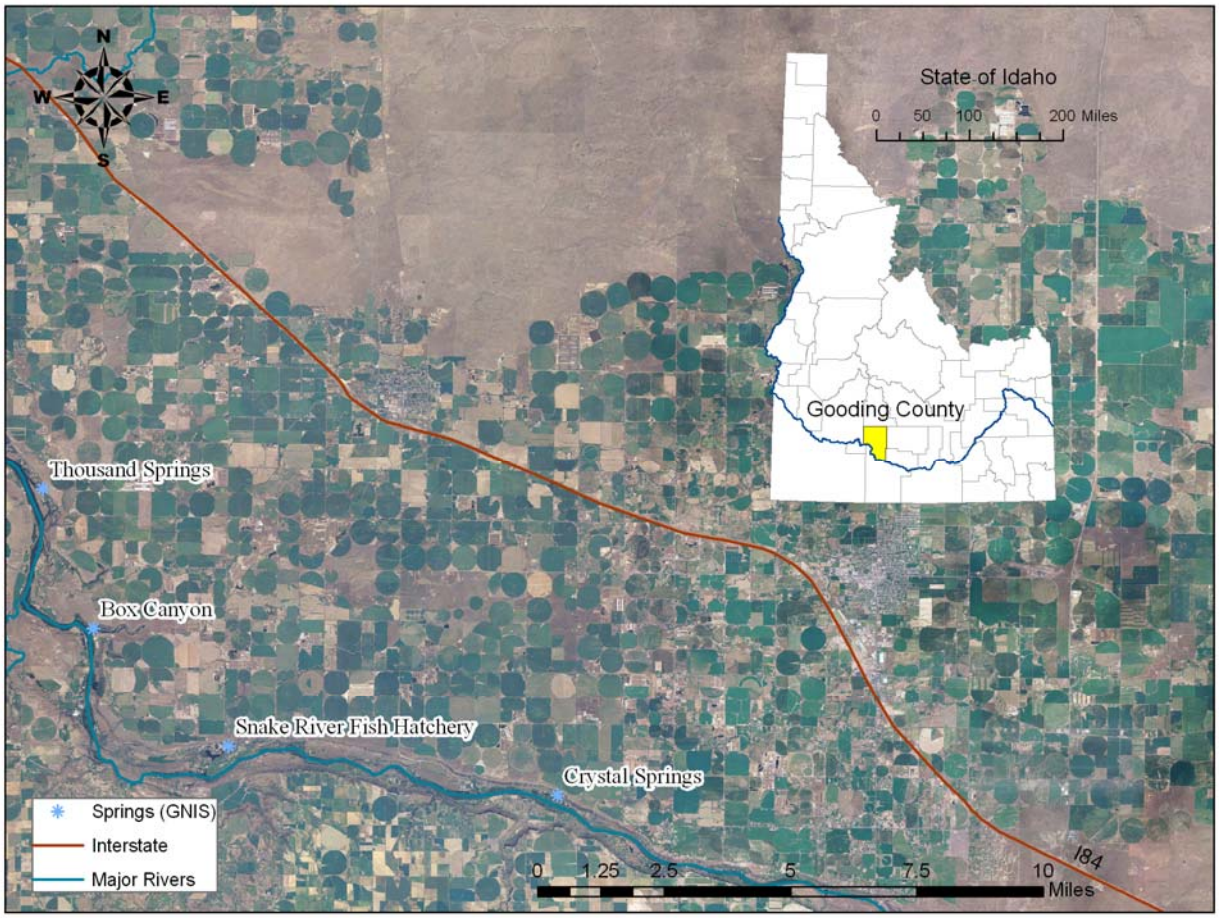

Figure 1. Location of Snake River Fish Hatchery (Snake River Farms) in relation to Crystal Springs (upstream) and Box Canyon Springs (downstream).

Initially, field parameters and a suite of IOCs were measured at ten spring sites that span approximately one mile, encompassing the spring discharge system supplying water to two aquaculture facilities: Idaho Trout processors to the west and Snake River Farms to the east (Figure 2). The Hardy Spring series supplies water to Idaho Trout Processors and the Research and Development (R&D) springs supply water to the Snake River Farms. After leaving the Research and Development facility, the water is transported to the NPDES (SR-1) aquaculture practices monitoring point north of the main raceways. Water chemistry analyses from SR-1 represent spring water before it has been used for aquaculture.

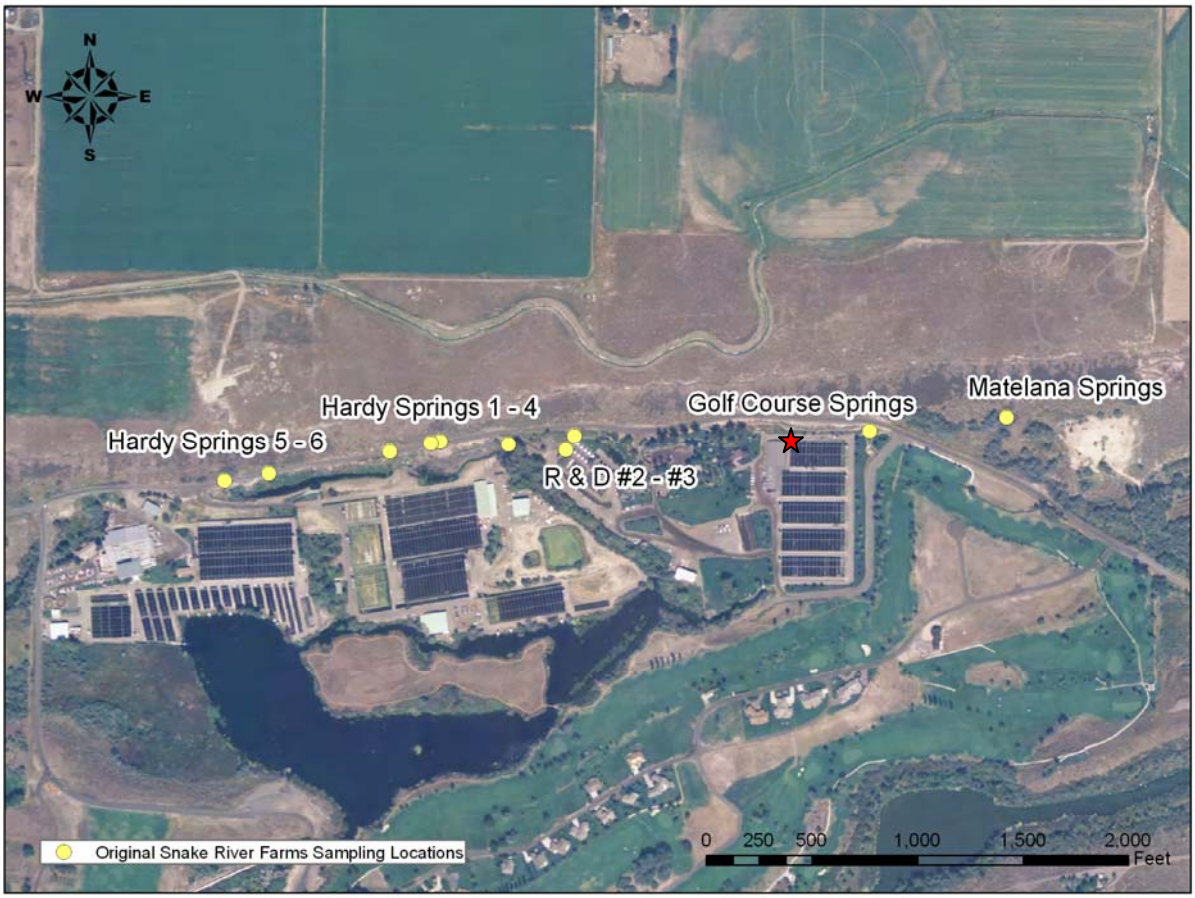

Figure 2. Initial sampling sites in the vicinity of Snake River Farms. Springs are in yellow circles and the NPDES compliance point, SR-1, is denoted by the red star.

After two years of ground water quality monitoring, this suite of sample sites was focused to four sites at Snake River Farms (R&D #1, R&D #2, R&D #3, and SR-1) (Figure 3) that exhibited elevated nitrate concentrations over time (Baldwin et al., 2005). Sites R&D #3A and R&D #3B were added in the winter of 2008, after these sites showed the highest nitrate concentrations recorded at Snake River Farms to date. The flows from sample site R&D #1, R&D #2, and R&D #3 are combined after the springs enter the facility. Sites R&D #3A and R&D #3B are combined and flow through the sampling point, R&D #3. The NPDES monitoring point, SR-1, represents the combined R&D flows.

Figure 3. Subset of sampling sites at Snake River Farms.

2.1 Climate

The climate in Gooding County is semi-arid, with an average annual precipitation of 9.48 inches per year recorded at the weather station in Buhl (Western Regional Climate Center, 2005). Ground water in the study area is recharged by precipitation, canal leakage, and minor amounts of agriculture irrigation. Two major irrigation canals, the Milner-Gooding canal and the North Side canal, divert water from the Snake River at Milner Dam east of Twin Falls and traverse the agricultural areas north of the Snake River Farms facility. Both surface water and ground water are used for irrigation in the study area, typically by sprinkler application.

2.2 Geologic Setting

The study area is within the Eastern Snake River Plain (ESRP), a northeast-southwest trending structural feature dominated by successive Quaternary-age basalt flows of the Snake River Group. The cumulative basalt units are approximately 300 to 400 feet thick along the Snake River, with individual flows approximately 20 feet thick (Whitehead, 1992).

During emplacement, valleys were dammed by the advancing basalt flows, causing the ancestral Snake River to shift its course (Baldwin et. al, 2000). The ponded water from the damming of the

river systems caused the formation of pillow basalt units as the lava flows reached these ponded waters near the present day Snake River. Mapping reveals evidence of north- to northwest-trending structures, such as joints or faults, that are coincident with zones of highly porous, heavily mineralized pillow basalt. These porous pillow basalt zones show evidence of rapid vertical ground water movement (Gillerman and Schiappa, 1994). Covington and Weaver (1990, 1991) concluded that springs with the largest discharge in the Thousand Springs area are emanating from these pillow basalt zones.

Geologic mapping by Whitehead (1992) in the ESRP shows the presence of two successive basalt units of different hydraulic conductivity, which could affect ground water flow. The contact of these units may be an important mechanism for controlling ground water flow and localizing springs (Gillerman and Schiappa, 1994). Features formed during changes in volcanic and structural activity and changing sedimentary facies could possibly be controlling the ground water flow in this area. These features could also be hydraulically connecting upper and lower ground water flow systems, potentially channeling large volumes of impacted water towards discharging springs in the Thousand Springs area.

The ground water is vulnerable to contamination due to the lack of a thick soil cover, lack of clay or any sedimentary aquitards above the water table, and high vertical permeability of the basalt (Gillerman and Schiappa, 1994). The soils up-gradient of Snake River Farms range from loamy fine sands to sandy clay loams (NRCS, 2009). The soils that overlay the basalt flows from which the springs emanate are loamy fine sands with high hydraulic conductivity that are excessively drained and have a low available water capacity (AWC). The soils become slightly more clay-rich and less excessively drained up-gradient of Snake River Farms but still have high hydraulic conductivity and low AWC (NRCS, 2009). The low AWC of these soils implies potential contaminants can easily leach from the unsaturated zone and migrate rapidly towards the aquifer, eventually discharging at Snake River Farms.

Ground water in the ESRP aquifer generally moves from northeast to southwest, but within the study area, the direction of ground water flow is primarily east to west. A study by Whitehead (1992) found the hydraulic parameters of basalts, including flow direction and hydraulic conductivity, can vary widely in short distances within the ESRP aquifer. These highly variable properties may be a significant factor for the variable water chemistry observed at Snake River Farms. The average ground water velocity near Snake River Farms was estimated to be approximately 260 feet/day (Garabedian, 1992). Throughout this report, “flow” refers to the velocity and direction of ground water within the aquifer, and spring “discharge” refers to the volume and rate of ground water released at spring locations.

2.3 Ground water flow systems

Using ground water flow and water chemistry data, Baldwin et al., (2006) determined the Thousand Springs area can be delineated into two ground water flow systems; a regional ground water flow system that includes the northern portions of Gooding, Jerome, Lincoln, and Minidoka Counties, and a local ground water flow system, encompassing the southern portions of these counties (Figure 4). These two ground water flow systems have unique flow and chemical signatures resulting from recharge and land use conditions (Baldwin et al., 2006).

The water chemistry of the local ground water flow system has an average specific conductivity of 715 microsiemens per centimeter (µS/cm), an average nitrate concentration of 4.27 milligrams

per liter (mg/L), and ground water flow paths that travel short distances to the discharge site along the Snake River upstream of Snake River Farms. Ground water in the regional ground water flow system has an average specific conductivity value of 417 µS/cm, an average nitrate concentration of 1.29 mg/L, and flow paths that suggest the recharge area for the regional aquifer is as far as 170 miles to the northeast of the springs. Snake River Farms spring water chemistry has characteristics of the local flow system, with an average specific conductivity value of 729 µS/cm for the four facility sites (R&D #1, R&D #2, R&D #3, and SR-1) and an average nitrate concentration of 3.6 mg/L.

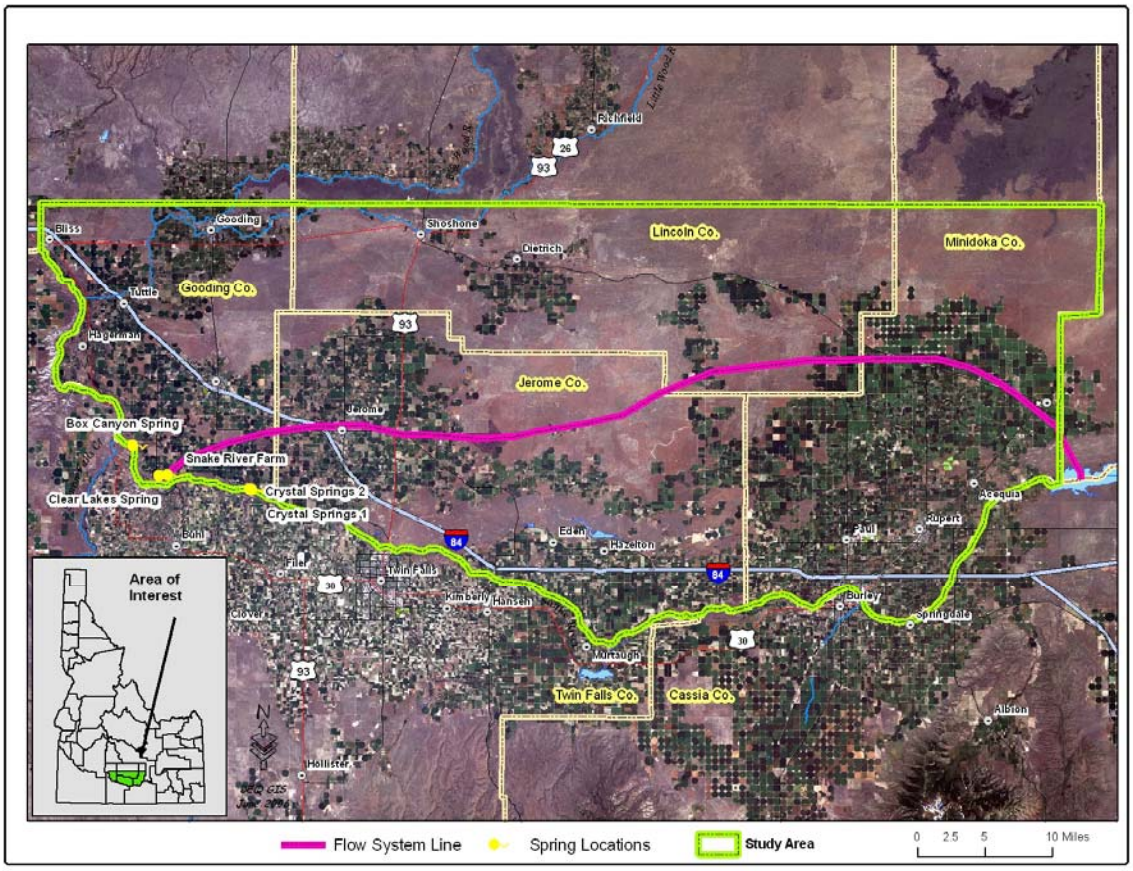

Figure 4. Ground water flow system delineation in Gooding, Jerome, Lincoln and Minidoka Counties. The pink dashed line defines the local flow system to the south and the regional flow system to the north.

The location of Snake River Farms makes it an ideal site for the study of these ground water flow systems and how they, in turn, affect water chemistry in the springs discharging to the Snake River in southern Gooding County. Downstream of the flow system divide and Snake River Farms, the river makes a northerly bend. This bend in the river appears to define where the good quality ground water (regional flow system) and poor quality ground water (local flow system) discharge (Flow System Line in Figure 4). Other researchers, for example, Clark and Ott (1996) and Mann and Low (1994) have deduced the existence of similar ground water flow systems in the same area using isotope tracer studies.

The water chemistry data (e.g., nitrate concentrations and oxygen and deuterium isotope signatures) from Snake River Farms show that individual springs exhibit characteristics of both the regional and local flow systems over the course of the year. This seasonal variation in

irrigation water recharge may influence the location of the division between the two ground water flow systems. It is difficult to determine the exact location of this ground water flow division and quantify exactly how the irrigation season influences water chemistry at Snake River Farms. However, the chemistry at Snake River Farms suggests that irrigation plays an important role in the location of the division of the two ground water flow systems.

3. Methodology

The initial sampling protocol included analysis of a suite of constituents in the spring (April) and fall (October) of 2008. During each sampling event, the field parameters pH, temperature, dissolved oxygen, and specific conductivity were measured with a Horiba Water Checker U-10. In addition to field parameters, the sampling strategy included analyses of IOCs, isotopes, and personal care products and pharmaceuticals (PCPPs). The parameters measured and the corresponding EPA methods and preservation techniques are listed in Table 1.

Ground water samples were analyzed for major ions and nutrients at Magic Valley Laboratories in Twin Falls or at the Idaho State Laboratory in Boise. The isotope analyses were conducted at the University of Arizona and the PCPP analyses were conducted at the University of Iowa Hygienic Laboratory (Appendix A).

Two PCPP sampling events occurred: one in April of 2008 (before irrigation and the agricultural growing season) and another event in October 2008 (after the peak of the irrigation and growing season). The PCPP analysis results can be found in Appendix A.

Table 1. Suite of analytes and parameters, EPA analytical methods, and preservation techniques.

Matrix	Parameter	Analytical Method	Preservative	Holding Time
Water	NO_2+NO_3-N	EPA 300.0	4 °C ± 2 °C	28 Days
Water	Chloride, Sulfate	EPA 300.0	4 °C ± 2 °C	28 Days
Water	Major ions (Ca, Mg, K, Na)*	EPA 200.7	4 °C ± 2 °C	6 months
Water	Total Dissolved Solids (TDS)	EPA 160.1	4 °C ± 2 °C	28 days
Water	Bicarbonate (HCO_3)	EPA 2320 B	4 °C ± 2 °C	14 days
Water	^{15}N*	TP11	Freeze samples	Unlimited if frozen
Water	^{18}O*	TP13	None	None
Water	^{2}H*	TP04	None	None

* Ca – calcium; Mg – magnesium; K – potassium; Na – sodium; ^{15}N – nitrogen isotope; ^{18}O – oxygen isotope; ^{2}H – (deuterium) hydrogen isotope

3.1 PCPP Sample Collection Method

Sampling for contaminants for which concern is emerging (such as PCPPs) requires careful sample collection and handling procedures and is summarized below from Nicholas (2009).

Collection of samples for PCPP analysis was performed using EPA Method 1669 (i.e., "clean hands/dirty hands" procedures) for *Sampling Ambient Water for Trace Metals*. The sample procedures were designed to minimize the potential for contamination of the samples. Using these procedures, roles and responsibilities for each member of the sampling team are established before they don personal protective equipment (PPE) and/or obtain any sample,.

One member of the two-person sampling team was designated as "dirty hands" and the other as "clean hands." The person assuming the "dirty hands" role wore Tyvek coveralls, powder-less nitrile laboratory gloves, and a surgical mask. This PPE reduces the possibility of any PCPP contamination from the samplers. Gloves were changed between samples and sample sites by the "dirty hands" member of the sampling team. The "clean hands" member of the team was responsible for handling the sample after it was collected by the "dirty hands" member. Samples were collected as quickly as was reasonably possible, while carefully preventing any contact between the containers and any surface other than the sampling surface.

The springs at Snake River Farms were sampled directly at the designated sample locations shown in Figure 1. The spring samples were collected as surface water, but the spring discharge is ground water that emanates from the various permeable basalt units north of the river. Samples were stored in coolers with freezer packs to maintain 4 ^{o}C from the time of the sampling event until sample custody was transferred to the University of Iowa Hygienic Laboratory.

4. Water Chemistry at Snake River Farms

The major ion water chemistry at Snake River Farms is not markedly distinct from the springs upstream (Crystal springs) and downstream (Box Canyon), as illustrated in Figure 5. Samples were analyzed for chloride, sulfate [SO_4], the major ions (calcium, magnesium, potassium, sodium), and bicarbonate [HCO_3] to define the geochemistry of ground water discharging to Snake River Farms (Table 1). Water in all of the springs can be classified as calcium-bicarbonate type water.

Previous studies using tritium concentrations (Mann and Low, 1994) have delineated two different ground water flow systems. The local ground water flow system (measured in springs upriver from Snake River Farms) had tritium concentrations indicative of recent (post-1952) water. The regional ground water flow system (measured in springs downriver of Snake River Farms) had pre-1952 tritium concentrations, suggesting the regional ground water residence times are longer than for the local ground water flow system. The division of these flow systems has little effect on the relative proportions of ion concentrations of ground water fed springs. The total dissolved solids concentrations are greater in the local flow system than in the regional flow system (Mann and Low, 1994).

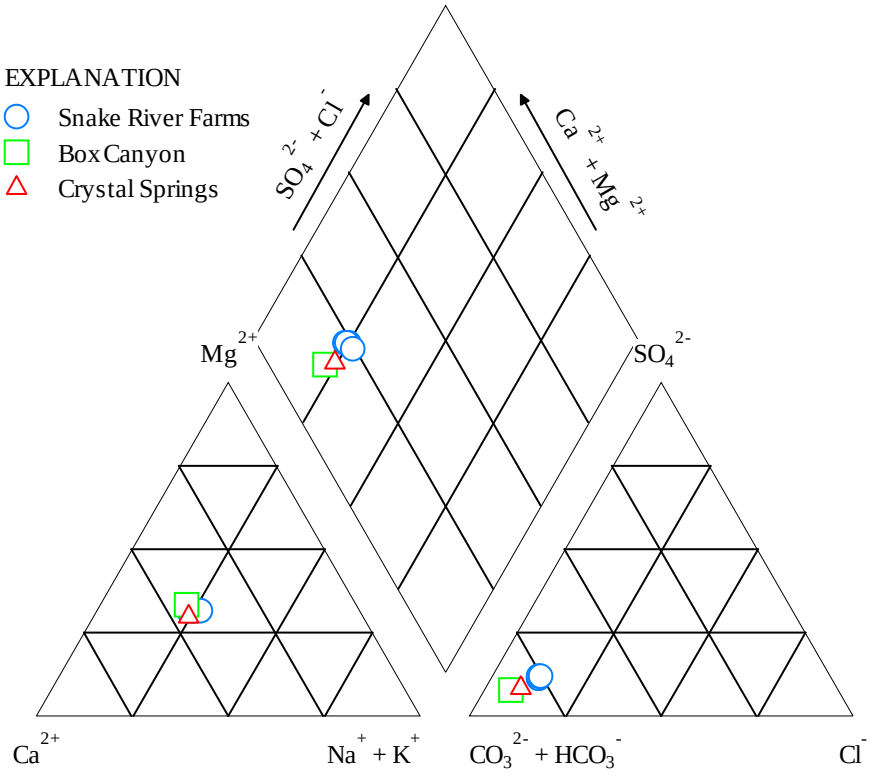

Figure 5. Water chemistry of Snake River Farms sample sites compared to upstream (Crystal springs) and downstream springs (Box Canyon). Data for Box Canyon and Crystal Springs from USGS, 2009.

4.1 Nitrogen Results

Nitrate concentration trends in five major springs discharging to the Snake River were analyzed for statistical significance by Baldwin et al. (2006). The geochemistry data indicate the nitrate concentrations are lowest during the growing season, from April to June, and highest in the fall following the growing season, from September to December (Figure 6). The data used in the trend analysis for Snake River Farms were collected monthly from 1994 to 2004. The statistical analysis performed by Baldwin et al. (2006) suggests that the nitrate concentrations had a statistically significant increasing trend at Snake River Farms between 1999 and 2004 (95% confidence interval). Recently measured nitrate concentrations suggest that the nitrate trends are still increasing. For a discussion of the statistical analysis of the springs nitrate data, see Baldwin et al. (2006).

Average nitrate concentrations for the springs located within the local ground water flow system were calculated for the period January 2000 through October 2007. The average concentrations for Crystal Springs (2.6 mg/L) and Snake River Farms (2.7 mg/L) reflect the elevated nitrate concentrations that define this ground water flow system. The two springs within the regional ground water flow system, Box Canyon Springs (1.0 mg/L) and Thousand Springs (Main) (2.1 mg/L) exhibit lower average nitrate concentrations over the same sampling duration. Snake River Farms water analyses display the greatest temporal variation of the NPDES sites presented in Figure 6.

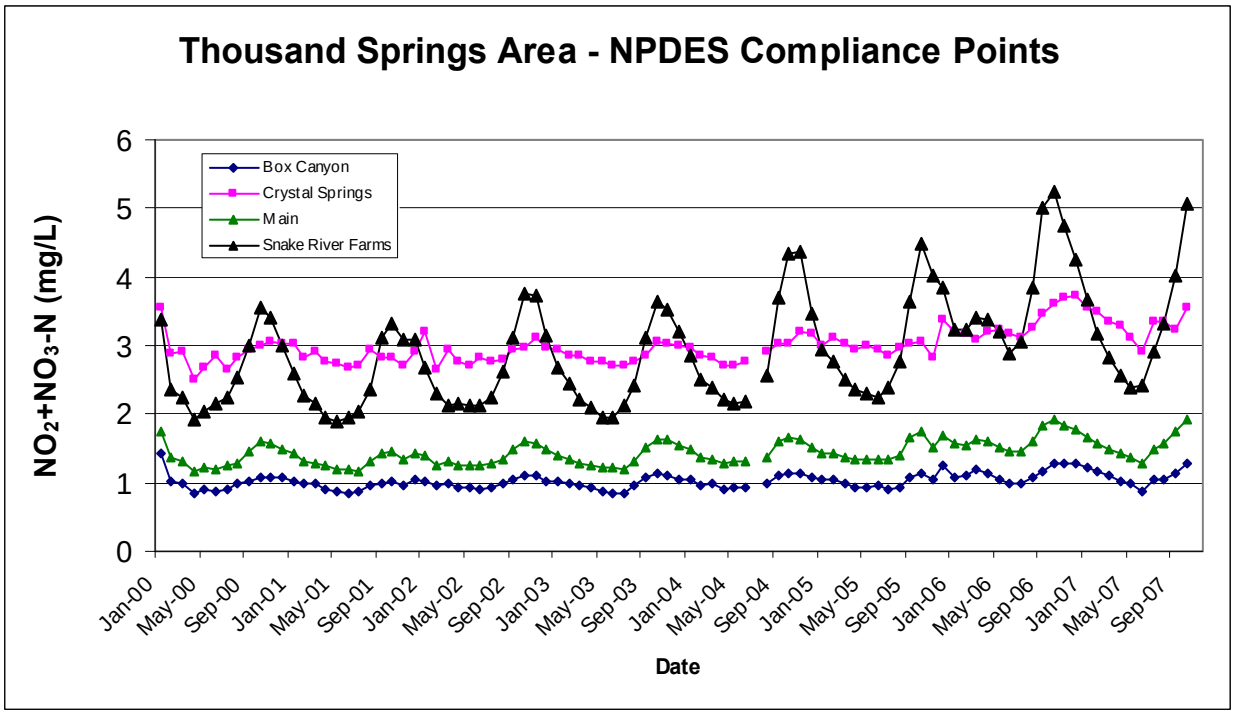

Figure 6. Nitrate data from four springs (NPDES sites) that discharge from the ESRP aquifer to the Snake River in southern Gooding and Jerome Counties.

Baldwin et al. (2006) found that the springs discharging from the local ground water flow system exhibit highly variable nitrate concentrations. This variability was attributed to differing land use activities, local aquifer parameters, or spring discharge elevations. The variability in nitrate concentrations in springs adjacent to one another is evident at Snake River Farms.

The seasonal trend in the data supports evidence collected from other area springs; the highest nitrate concentrations occur in the fall from September to December and the lowest nitrate concentrations occur in the spring and early summer from April to June. It is believed the peak in nitrate concentrations during the fall can be attributed to a lag time between summer irrigation and travel time to the springs. Nitrogen in excess of crop use is transported to the aquifer with the migration of ground water. Water in this part of the aquifer has a high velocity, estimated to be approximately 260 feet per day (Garabedian, 1992), meaning that seasonal nitrate fluctuations are transported to the spring discharge areas within the same year (Baldwin et al., 2006).

When nitrate concentrations at NPDES site SR-1 exceeded 5 mg/L, Snake River Farms began a sampling program at individual springs at their facility. The nitrate concentrations at the R&D #3 site are markedly higher than the other sites at Snake River Farms, some of which are less than 200 feet from R&D #3 (Figure 7). The variable seasonal range in nitrate concentrations is likely controlled by the geology, ground water flow systems, and irrigation and land use practices hydraulically up-gradient of Snake River Farms.

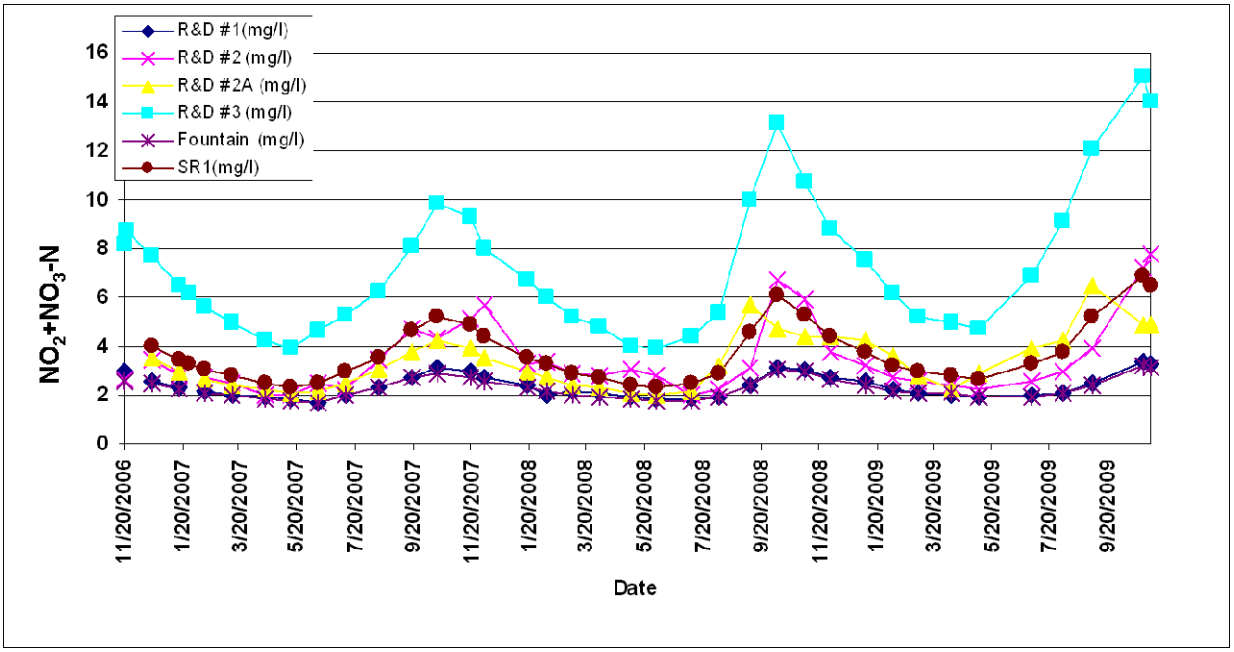

Figure 7. Monthly nitrate concentration data for the Snake River Farms facility. Data were provided by Clear Springs Foods, Inc.

4.2 Nitrogen Isotope Results

Four samples were collected in October 2008 for analysis of the stable isotopes of nitrogen, referred to as ^{15}N. Results are reported in parts per thousand (per mil or ‰) relative to a standard. Table 2 gives the typical ^{15}N values associated with various potential contaminant sources. Using nitrogen isotopes as a tool can potentially aid in determining the source of nitrogen in the ground water. However, isotope results that fall within the organic nitrogen range (+4 to +9 ‰) can indicate a mixture of commercial fertilizer and animal or human sources, or nitrogen derived from soil organic matter, and these results are not useful for source identification.

Table 2. Typical ^{15}N values from Seiler (1996).

Potential Nitrate Source	$\delta^{15}N$ (‰)
Precipitation	-3
Commercial fertilizer	-4 to +4
Organic nitrogen in soil or mixed nitrogen source	+4 to +9
Animal or human waste	Greater than +9

Table 3. ^{15}N values from Snake River Farms samples collected in October 2008.

Snake River Farms sample site	^{15}N (‰)
SR-1	6.8
R & D #1	6.7
R & D #2	7.4
R & D #3	7.5

The nitrogen isotope results from Snake River Farms (Table 3) fall within the range of organic nitrogen in soil (+4 to +9 ‰). This likely represents a mixture of nitrogen from different sources during the travel time from source to spring discharge location. The nitrogen isotope signatures

in samples collected in October, 2008 are inconclusive in fingerprinting a unique nitrogen source at Snake River Farms. However, these nitrogen isotope values suggest that various land use activities, including but not limited to agricultural fertilization, are influencing the nitrogen isotope signatures at the springs.

4.3 Oxygen and Deuterium Isotope Results

Stable isotopic systems are affected by meteorological processes and this can result in a powerful tool for determining provenance of ground water. Analyses of the stable isotopes oxygen and deuterium determine the isotope partitioning behavior (fractionation), or the separation into heavy and light fractions, that occurs from natural processes such as ground water and surface water mixing, evaporation, precipitation events, and ground water recharge that occurs at different elevations and temperatures. Fractionation is measured by comparing a known standard ratio with the sample ratio. For this study, samples were collected to measure the oxygen-deuterium isotopic signatures ($^{18}O/^{16}O$ and $^{2}H/^{1}H$).

Figure 8 shows a plot of isotope values from springs sampled at Snake River Farms. Isotope results from Clark and Ott (1996) are also plotted for comparison.

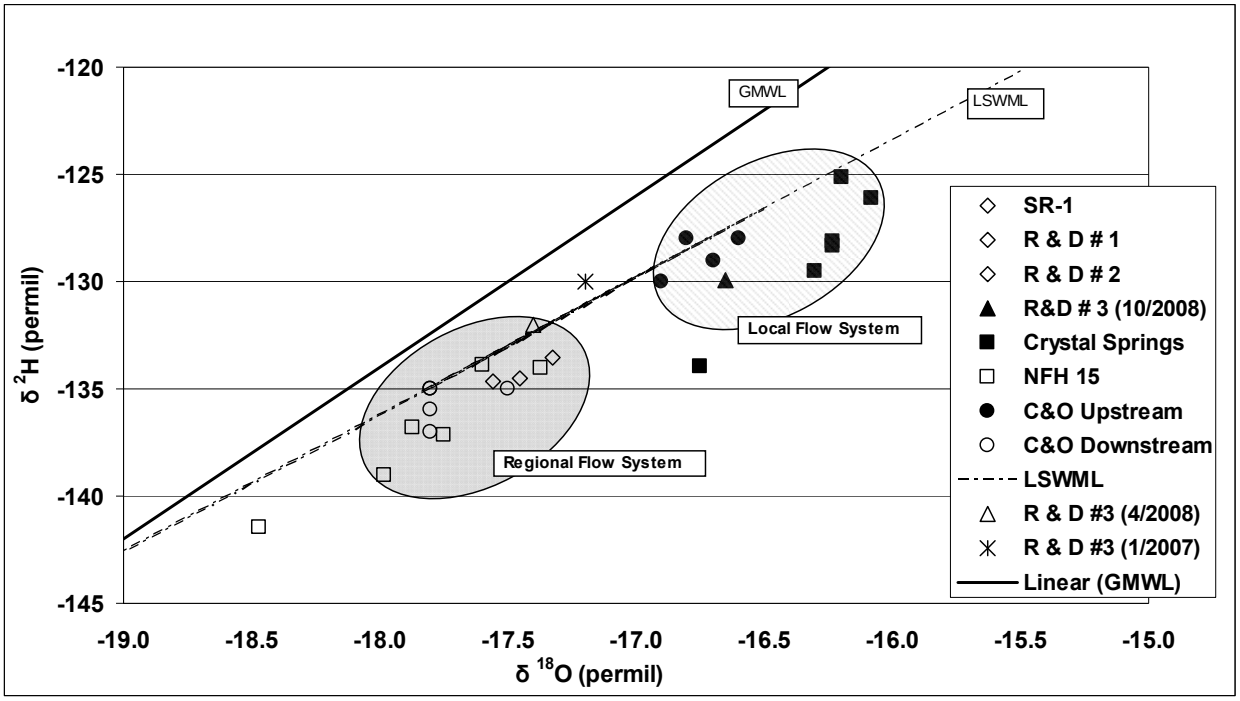

Figure 8. Isotope signatures from Snake River Farms compared to sites upstream and downstream of the facility. C&O data is from Clark and Ott (1996); NFH is national fish hatchery data from Hagerman, Idaho (Mann and Low, 1994); GWML (Craig, 1961); LSWML (Benjamin et al., 2004).

There are two groups of data with distinct isotopic signatures, as illustrated by the hatched and shaded ovals. The solid symbols denote springs upstream from Snake River Farms, which represent springs discharging water from the local ground water flow system. The open symbols denote downstream springs discharging water from the regional ground water flow system. The upstream springs (local ground water flow system) exhibit an enriched (less negative) isotopic signature, indicating the ground water has possibly mixed with surface water (such as canal leakage) or the water has undergone evaporation prior to recharge. The downstream springs'

(regional ground water flow system) isotopic signatures are depleted and are consistent with water that has recharged from higher elevation and/or under cooler climatic conditions (Clark and Fritz, 1997).

The Snake River Farms site R&D #3 shows an isotopic signature distinct from the other Snake River Farms sites and variation over the year, with local ground water flow system chemistry in the fall (R&D #3 10/2008) and a transition to chemistry more consistent with the regional ground water system chemistry (R&D #3 4/2008) through the spring. Nitrate and specific conductivity values throughout the year at R&D #3 are also consistent with a shift in the location of the local and regional ground water flow systems line.

4.4 Personal Care products and Pharmaceuticals (PCPPs)

This study included sampling for a list of selected PCPPs and steroids/hormones in spring discharge at the Snake River Farms facility. The presence of these analytes can provide information about the fate of these chemicals in ground water as well as any potential pathways for contamination. A list of the selected PCPPs can be found in Table 4 and Table 5.

Table 4. List of pharmaceuticals, antibiotics, and personal care products analyzed by LC/MS (liquid chromatography/mass spectrometry).

Analyte	Description	LOQ* (ng/L)	Test Method
Sulfadimethoxine	Antibiotic, animal	1	LC/MS/MS
Sulfamethazine	Antibiotic, animal	1	LC/MS/MS
Sulfamethoxazole	Antibiotic, animal	1	LC/MS/MS
Sulfathiazole	Antibiotic, animal	1	LC/MS/MS
Lincomycin	Antibiotic, animal	1	LC/MS/MS
Tylosin	Antibiotic, animal	1	LC/MS/MS
Carbamazepine	Anti-seizure drug	1	LC/MS/MS
Trimethoprim	Antibiotic, human	1	LC/MS/MS
Acetaminophen	Analgesic	2	LC/MS/MS
Ibuprofen	Analgesic	2	LC/MS/MS
Cotinine	Nicotine metabolite	1	LC/MS/MS
Caffeine	Stimulant	1	LC/MS/MS
1,7-Dimethylxanthine	Caffeine metabolite	2	LC/MS/MS
N,N-dimethyl-m-toluamide (DEET)	Insect repellant	1	LC/MS/MS
Triclosan	Antibacterial in soap	2	LC/MS/MS

* LOQ = limit of quantitation, ng/L = nanograms per liter.

Table 5. List of steroids and hormones analyzed by GC/MS (gas chromatography/mass spectrometry.

Analyte	Description	LOQ* (ng/L)	Test Method
Coprostanol	Fecal steroid	50	GC/MS
Cholesterol	Plant and animal steroid	50	GC/MS
Dihydrocholesterol	Fecal steroid	50	GC/MS
Estriol	Reproductive hormone	250	GC/MS
Testosterone	Reproductive hormone	50	GC/MS
Progesterone	Reproductive hormone	50	GC/MS
Equilenin	Estrogen replacement hormone	50	GC/MS
Stigmastanol	Plant steroid	50	GC/MS
Sitosterol	Plant steroid	50	GC/MS
Stigmastarol	Plant steroid	50	GC/MS

* LOQ = limit of quantitation, ng/L = nanograms per liter.

There were two phases of PCPP sample collection at the Snake River Farms facility. The first round of PCPP sampling and analysis was conducted in the spring (April) of 2008. The second round of sampling was conducted in the fall (October) of 2008. These sampling windows were selected to capture seasonality of ground water flow, nitrate concentrations, and the possible corresponding variations in PCPP constituent concentrations. Sample results are given in Table 6.

Table 6. Analytical results for samples analyzed for PCPPs at the Snake River Farms facility. Results are given in nanograms/liter (ng/L).

Snake River Farms sample sites	Sample date	Caffeine (ng/L)	Sulfamethoxazole (ng/L)	Cholesterol (ng/L)	Carbamazepine (ng/L)	DEET (ng/L)
Crystal Springs 1	4/7/2008	ND*	**1.3**	**760**	ND	ND
SR-1	4/7/2008	ND	**1.2**	**1700**	ND	**25**
R & D #2	4/7/2008	ND	ND	**860**	ND	ND
R & D #3	4/7/2008	ND	**2.3**	**780**	ND	ND
SR-1	10/15/2008	ND	**2.7**	**490**	ND	ND
R & D #1	10/15/2008	ND	**1.4**	**560**	ND	ND
R & D #2	10/15/2008	**17**	**1.6**	**440**	ND	ND
R & D #3	10/15/2008	**2.5**	**9.2**	**540**	**2.5**	ND

* ND = analyte was not detected above the laboratory quantitation limit.

The animal and human antimicrobial sulfamethoxazole was detected at each site (excluding R&D #2 in April 2008) with the highest concentration of 9.2 nanograms per liter (ng/L or parts per trillion) from R&D #3 in the fall of 2008. This antibiotic was detected in other Snake River Farms sites as well as a spring from the Crystal Springs site. Although this compound was detected at low concentrations, the frequency and distribution of the compound appears to represent a real occurrence of the antibiotic in ground water.

Caffeine, found in caffeinated beverages, was detected at a concentration of 17 ng/L in R & D #2 and 2.5 ng/L in R&D #3. DEET, an insect repellant, was detected in SR-1 at a concentration of 25 ng/L in the spring of 2008. Cholesterol detections are considered to reflect background concentrations for ground water in this area. The human anti-seizure medication carbamazepine, was found in low concentrations in R & D #3 during the fall 2008 sampling event.

In general, the concentration of sulfamethoxazole was lower in the spring time. Evidence shows the volume of ground water discharge is higher in the fall due to increased recharge from

irrigation activities. Therefore, you might expect the concentrations of PCPPs to be lower in the fall due to dilution (if you assume the source of PCPPs is constant between the fall and spring). However, the PCPP concentrations in October are not diluted, but are present in greater concentrations than the concentrations measured in April. This suggests that the source(s) of PCPPs are not constant over the year or that increased recharge in the fall is transporting these constituents into the aquifer. While the detection of these constituents does not identify a point source of pollution, it does indicate that PCPPs are detectable in southern Gooding County spring discharge throughout the year and that a pathway exists for these and other constituents.

5. Land Use / Nitrogen Loading

A nitrogen loading analysis for the western part of the ESRP (Baldwin et. al, 2006) found the largest potential source of nitrogen in the area was nitrogen from fertilizer applications (47%). Other substantial sources of nitrogen were from dairy, beef, and other confined animal operations (43%). The remaining 10% of nitrogen sources include legume crops, industrial contribution (wastewater reuse), precipitation, and urban or domestic waste. A majority of the potential nitrogen loading in spring water at Snake River Farms likely comes from agriculture and livestock operations within southeastern Gooding County and the southern part of Jerome County (Baldwin et. al, 2006).

Land use northeast and up-gradient of Snake River Farms is predominately irrigated agriculture and confined livestock operations. Residential housing is associated with the livestock operations, and some rural residential housing also exists. The major sources of nitrogen input in Gooding County include fertilizer, cattle manure, legume crops, precipitation, and residential septic systems (Rupert, 1990). The closest hydraulically up-gradient urban area near Snake River Farms is Jerome, located approximately 14 miles to the east.

An approximation of the yearly total nitrogen load contained within the Snake River Farms springs discharge was made by using flow and nitrate concentrations at the NPDES compliance point, SR-1, north of the raceways, where influent spring water is diverted to the raceways for aquaculture practices. This approximation was possible because there is a positive correlation between flow and nitrate concentration over the year (Figure 9).

The nitrogen loading approximations evaluate the amount of nitrogen entering the facility from up-gradient land practices, based on daily monitoring records of flow and monthly nitrate concentrations provided by Snake River Farms (Table 7). Continuous flow and nitrate data are only available for SR-1 for 2007 and 2008, so the yearly nitrogen load is an approximation from this one site over this period.

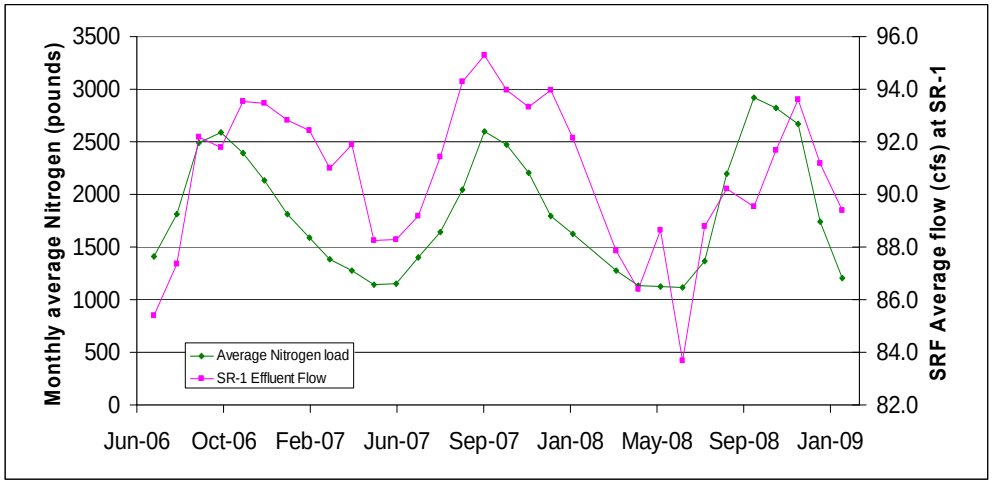

Figure 9. Estimated nitrogen load at Snake River Farms NPDES compliance point, SR-1.

The major agricultural crops raised in this area are potatoes, corn, and alfalfa. The prevalence of sprinkler irrigation in the area, as well as canal leakage, can affect seasonal water level fluctuations, aquifer recharge behavior, and nitrate concentrations (Baldwin et al., 2006). Changing crop rotation and variable fertilizer use, both commercial fertilizer and manure applications, have made estimating the nitrogen load from agricultural sources difficult.

There are 27 confined animal feeding operations (CAFOs), or dairies and feedlots, with approximately 36,500 head of cattle, within a zone determined to be hydraulically up-gradient of the Snake River Farms facility. This zone was defined by the hydraulic conductivity of the aquifer and the ground water flow direction as described by Garabedian (1992).

To determine the influence of land use on ground water quality up-gradient of Snake River Farms, a zone of ground water contribution, or capture zone, was approximated for a one-year time-of-travel (TOT) (Figure 10). (Time-of-travel refers to the time necessary for a particle of water to reach a discharge point within a given ground water capture zone.) The capture zone for Snake River Farms was determined based on public water systems' Source Water Assessment delineations in nearby communities (Idaho Department of Health and Welfare, 1999).

The water within the calculated capture zone will likely reach Snake River Farms within one year. The one-year TOT was considered reasonable given the temporal variation in ground water chemistry observed at Snake River Farms.

Example of average yearly nitrogen load (lbs/year) calculation for SR-1 (This calculation uses values from January, 2007).

$$\text{Discharge}_{SR-1} = 41{,}000\,\text{gpm}_{(\text{January average})} \quad \text{and} \quad \text{Nitrate}_{\text{SR-1 (January)}} = 3.67\,\text{mg/L} \Rightarrow$$

$$\text{Nitrogen Load}_{SR-1} = (0.012018_{conversion\_factor}) \times \text{Discharge}_{SR-1} \times \text{Nitrate}_{\text{SR-1}} = 1800\,\text{lbs}_{\text{Nitrogen}}/\text{day}_{(\text{January})}$$

$$1800\,\text{lbs}_{\text{Nitrogen}}/\text{day} \times \text{number of days in month (31)} = 56{,}000\,\text{lbs}_{\text{Nitrogen}}/\text{month}_{\text{Average}}$$

$$\Sigma_{[\text{January Load} + \text{February Load etc.}]}/\text{month} \rightarrow \sim 630{,}000\,lbs_{\text{Nitrogen}}/\text{year}_{\text{Average}}$$

Table 7. Estimated yearly nitrogen load for Snake River Farms based on flow and nitrate concentration data from SR-1.

Site	Year	Nitrogen Load (lbs/year)
SR-1	2007	630,600
SR-1	2008	609,000

Table 8. Estimated nitrogen load from dairy CAFOs, feedlot CAFOs, commercial fertilizer applications, and human septic tank sources within delineated zone.

Nitrogen Source	Population	Estimated nitrogen input (lbs/animal/year)	Nitrogen load (lbs/year)
Dairy cattle	18,590	129[a]	2,400,000
Feedlot cattle	17,875	55[a]	983,000
Septic Tanks	1,800	14[b]	25,200
Nitrogen Source	**Acres in capture zone**	**Estimated nitrogen input (lbs/acre)**	**Nitrogen load (lbs/year)**
Commercial Fertilizer	23,000	94[c]	2,162,000
Legume crop plowdown	23,000	4.2[b]	96,400
Precipitation	23,000	0.48[d]	11,000
		Total pounds Nitrogen/year	5,677,600

[a]U.S. Department of Agriculture, National Agricultural statistics service, 2002 Census of Agriculture-County Data.
[b]IDEQ, 2005.
[c]U.S. Department of Agriculture, National Agricultural statistics service, 2002 Census of Agriculture-County Data. (Average nitrogen load of predicted crops in Gooding County)
[d]Rupert (1990) (estimated nitrogen concentration in precipitation is 0.225 mg/L).

The nitrogen load calculation for the Snake River Farms NPDES site, SR-1, is representative of the flow (and nitrate concentrations in that flow) into the aquaculture system. This is a conservative approximation for the total nitrogen concentration discharged from the springs into Snake River Farms. From these nitrogen loading calculations, the total nitrogen entering the Snake River Farms facility is approximately 600,000 lbs/year.

The population within the delineated capture zone is approximately 1,800 people, which corresponds to nitrogen loading from septic tanks of 25,200 lbs/year at 14 lbs/person/year (Table 8). The area within the delineated capture zone, comprising approximately 23,000 irrigated acres, corresponds to an estimated nitrogen load of 2,162,000 lbs of nitrogen per year from application of commercial fertilizer (at 94 lbs/acre). The estimated nitrogen contribution is taken from the Department of Agriculture census of typical crops and corresponding nitrogen fertilization rates for southern Idaho (USDA, 2002).

Nitrogen loading from fertilizer and manure exceeds nitrogen loading from precipitation in the study area, which is consistent with previous nitrogen loading evaluations (Nolan and Stoner, 2000; Baldwin et al., 2006). The nitrogen contribution from precipitation is a small fraction (less than 1%) of the overall nitrogen inputs to the capture zone. The total nitrogen load from precipitation falling within the capture zone was estimated at 11,000 pounds per year.

Overall, it is estimated that over 2,800 tons (~5,677,600 lbs) of nitrogen are applied each year to the land within the capture zone up-gradient of Snake River Farms. Of the estimated 2,800 tons

of nitrogen applied to this area, approximately 315 tons of nitrogen is discharged in springs used by the Snake River Farms facility.

Given the relatively small nitrogen contribution from septic tanks within the capture zone, contributions from commercial fertilizer for crop growth and CAFOs within the delineated ground water capture zone are likely the sources that produce most of the observed nitrogen loading at Snake River Farms.

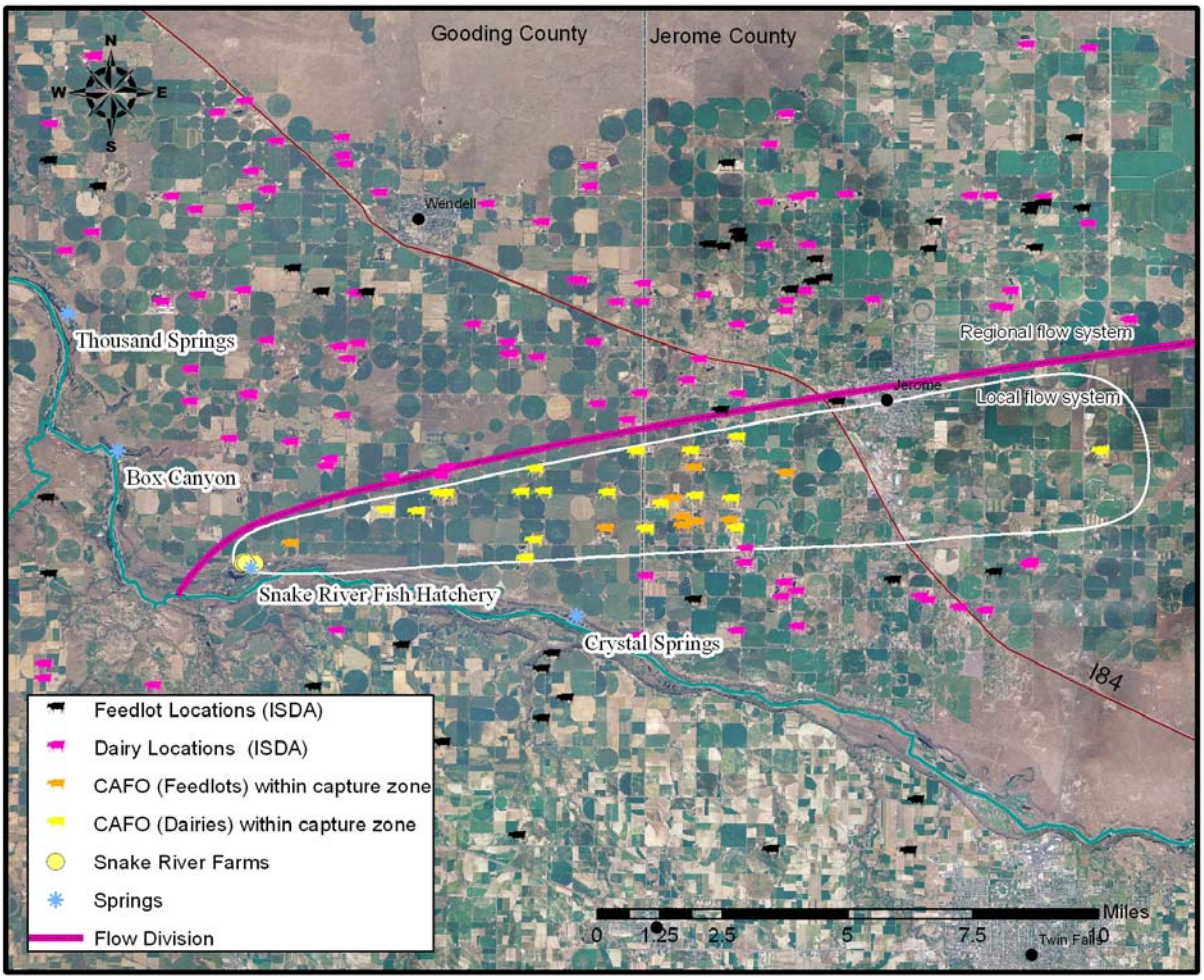

Figure 10. Land use east and hydraulically up-gradient of Snake River Farms using calculated one-year TOT capture zone.

The limitations associated with calculating nitrogen contributions to Snake River Farms include approximating loading rates for various nitrate sources, delineating the capture zone, and characterizing ground water flow velocity and direction. Nitrate loading values for crop fertilizer application and number of confined cattle were based on studies conducted in Gooding County (Baldwin et al., 2006; Rupert, 1990). The capture zone was delineated based on referenced ground water characteristics and previous DEQ source water delineations. However, calculations of the nitrate load discharging to Snake River Farms are independent of any nitrate source loading estimations up-gradient because site-specific flow and nitrate concentrations were used. These nitrate load calculations are considered to be the best estimate for the amount of nitrate flowing through Snake River Farms during any given year.

6. Conclusions

While it is difficult to directly determine the source and geochemical "history" of ground water discharging at Snake River Farms, it is evident that the irrigation season in the ESRP plays a major role in the springs' discharge rate and the quality of the ground water for aquaculture practices. Strong temporal variations are present in the nitrate concentration data, with nitrate concentrations higher in the fall compared to the spring. Distinct chemical characteristics are observed on relatively small spatial scales at Snake River Farms, which appears to be controlled by the complex geologic setting of the facility. Based on nitrate and specific conductance data collected during this project, the springs at Snake River Farms are part of the local ground water flow system.

The water chemistry, including IOCs, field parameters, isotopes, and PCPPs cannot provide direct evidence of a point source of increasing nitrate concentrations at Snake River Farms. By calculating a one-year TOT capture zone up-gradient of Snake River Farms, a calculation of the amount of nitrogen being discharged to the facility was estimated. According to the data collected at Snake River Farms, approximately 315 tons of nitrogen are discharged to the facility during an average year. The amount of nitrogen (pounds) that flows through Snake River Farms is significantly higher than the amount produced by the human population (septic tanks) residing up-gradient of Snake River Farms.

The source of nitrogen to Snake River Farms is likely from agricultural practices, including crop fertilization and CAFOs. Without properly constructed monitoring wells up-gradient of Snake River Farms, it is difficult to predict the migration pathway or to quantify contributions from individual sources of nitrate, either to this facility or southern Gooding County springs in general.

The PCPP results are inconclusive in providing direct evidence for a point source of contamination to Snake River Farms. However, the presence of these PCPPs suggests that a pathway exists and that animal and human byproducts are present in these springs at measurable (above detection limits) concentrations, but still below levels that create human health concerns.

7. Recommendations

It is recommended that monitoring and sampling of springs for nitrate concentrations in southern Gooding County be continued. It would be useful to analyze nitrogen isotopes in spring discharge on a seasonal basis, to identify potential temporal variations in sources of nitrate to the springs. Continued analysis of oxygen and deuterium would also be useful because this isotopic system exhibits seasonal variation and can help delineate the regional and local ground water flow systems.

To determine the source of elevated nitrate at the Snake River Farms facility, it is recommended that a hydrologic tracer test be conducted. Tracer tests can be used as a tool to determine hydrogeologic parameters by introducing a known volume of tracer (i.e., Rhodamine, Fluorescein, xenon) and measuring the occurrence of the tracer at the discharge point. It would be useful to use tracer tests to determine the sources of constituents of concern to springs and aquaculture facilities. Using best management practices to reduce or avoid over-application of (animal and commercial) fertilizer will become necessary to control the amount of nitrogen reaching the aquifer and springs in southern Gooding County.

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Appendix A: Geochemical Data

Inorganic compounds, isotopes, and personal care products and pharmaceuticals (PCPPs)

Golf Course Spring DEQ Site ID: 842

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	13:12	Idaho State Health Laboratory	Chloride	45.5	mg/L
2/12/2007	10:00	Magic Valley Laboratory	Chloride	47.9	mg/L
3/12/2007	10:05	Magic Valley Laboratory	Chloride	44.2	mg/L
4/16/2007	9:40	Magic Valley Laboratory	Chloride	49.6	mg/L
5/14/2007	11:30	Magic Valley Laboratory	Chloride	45.5	mg/L
1/16/2007	13:12	University of Arizona	Deuterium (2H)	-123	per mil
1/16/2007	13:12	Field Parameter	Dissolved Oxygen	7.5	mg/L
2/12/2007	10:00	Field Parameter	Dissolved Oxygen	9.17	mg/L
3/12/2007	10:05	Field Parameter	Dissolved Oxygen	9.23	mg/L
4/16/2007	9:40	Field Parameter	Dissolved Oxygen	9.44	mg/L
5/14/2007	11:30	Field Parameter	Dissolved Oxygen	10.23	mg/L
6/15/2007	9:40	Field Parameter	Dissolved Oxygen	8.24	mg/L
7/13/2007	9:45	Field Parameter	Dissolved Oxygen	6.9	mg/L
9/10/2007	11:15	Field Parameter	Dissolved Oxygen	8.91	mg/L
1/16/2007	13:12	Idaho State Health Laboratory	Nitrate (as N)	2.2	mg/L
2/12/2007	10:00	Magic Valley Laboratory	Nitrate (as N)	2.07	mg/L
3/12/2007	10:05	Magic Valley Laboratory	Nitrate (as N)	2.18	mg/L
4/16/2007	9:40	Magic Valley Laboratory	Nitrate (as N)	2.17	mg/L
5/14/2007	11:30	Magic Valley Laboratory	Nitrate (as N)	2.25	mg/L
6/15/2007	9:40	Magic Valley Laboratory	Nitrate (as N)	2.13	mg/L
7/13/2007	9:45	Magic Valley Laboratory	Nitrate (as N)	2.21	mg/L
9/10/2007	11:15	Magic Valley Laboratory	Nitrate (as N)	2.23	mg/L
1/16/2007	13:12	University of Arizona	Oxygen (18O/16O)	-17.5	per mil
1/16/2007	13:12	Field Parameter	pH	9.99	
2/12/2007	10:00	Field Parameter	pH	7.8	
3/12/2007	10:05	Field Parameter	pH	7.57	
4/16/2007	9:40	Field Parameter	pH	7.63	
5/14/2007	11:30	Field Parameter	pH	7.67	
6/15/2007	9:40	Field Parameter	pH	7.91	
7/13/2007	9:45	Field Parameter	pH	7.56	
9/10/2007	11:15	Field Parameter	pH	8.63	
1/16/2007	13:12	Idaho State Health Laboratory	Phosphorus	0.012	mg/L
2/12/2007	10:00	Magic Valley Laboratory	Phosphorus	0.005	mg/L
3/12/2007	10:05	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
4/16/2007	9:40	Magic Valley Laboratory	Phosphorus	0.018	mg/L
5/14/2007	11:30	Magic Valley Laboratory	Phosphorus	0.044	mg/L
1/16/2007	13:12	Field Parameter	Specific Conductivity	500	uhmos/cm
2/12/2007	10:00	Field Parameter	Specific Conductivity	488	uhmos/cm
3/12/2007	10:05	Field Parameter	Specific Conductivity	486	uhmos/cm
4/16/2007	9:40	Field Parameter	Specific Conductivity	485	uhmos/cm
5/14/2007	11:30	Field Parameter	Specific Conductivity	484	uhmos/cm
6/15/2007	9:40	Field Parameter	Specific Conductivity	483	uhmos/cm
7/13/2007	9:45	Field Parameter	Specific Conductivity	535	uhmos/cm

Golf Course Spring DEQ Site ID: 842

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
9/10/2007	11:15	Field Parameter	Specific Conductivity	511	uhmos/cm
1/16/2007	13:12	Idaho State Health Laboratory	Sulfate	56.4	mg/L
2/12/2007	10:00	Magic Valley Laboratory	Sulfate	57.8	mg/L
3/12/2007	10:05	Magic Valley Laboratory	Sulfate	56.6	mg/L
4/16/2007	9:40	Magic Valley Laboratory	Sulfate	43.6	mg/L
5/14/2007	11:30	Magic Valley Laboratory	Sulfate	55.5	mg/L
1/16/2007	13:12	Field Parameter	Temperature	13.97	°C
2/12/2007	10:00	Field Parameter	Temperature	13.73	°C
3/12/2007	10:05	Field Parameter	Temperature	13.95	°C
4/16/2007	9:40	Field Parameter	Temperature	13.95	°C
5/14/2007	11:30	Field Parameter	Temperature	14.51	°C
6/15/2007	9:40	Field Parameter	Temperature	14.44	°C
7/13/2007	9:45	Field Parameter	Temperature	14.83	°C
9/10/2007	11:15	Field Parameter	Temperature	13	°C
1/16/2007	13:12	Idaho State Health Laboratory	Total Dissolved Solids	354	mg/L
2/12/2007	10:00	Field Parameter	Total Dissolved Solids	230	mg/L
2/12/2007	10:00	Magic Valley Laboratory	Total Dissolved Solids	280	mg/L
3/12/2007	10:05	Field Parameter	Total Dissolved Solids	230	mg/L
3/12/2007	10:05	Magic Valley Laboratory	Total Dissolved Solids	330	mg/L
4/16/2007	9:40	Field Parameter	Total Dissolved Solids	230	mg/L
4/16/2007	9:40	Magic Valley Laboratory	Total Dissolved Solids	310	mg/L
5/14/2007	11:30	Field Parameter	Total Dissolved Solids	230	mg/L
5/14/2007	11:30	Magic Valley Laboratory	Total Dissolved Solids	300	mg/L
6/15/2007	9:40	Field Parameter	Total Dissolved Solids	309	mg/L
7/13/2007	9:45	Field Parameter	Total Dissolved Solids	260	mg/L
9/10/2007	11:15	Field Parameter	Total Dissolved Solids	326	mg/L

Hardy Spring #1 DEQ Site ID: 836

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	13:50	Idaho State Health Laboratory	Chloride	46.2	mg/L
2/12/2007	9:45	Magic Valley Laboratory	Chloride	45.6	mg/L
3/12/2007	9:55	Magic Valley Laboratory	Chloride	42.8	mg/L
4/16/2007	9:30	Magic Valley Laboratory	Chloride	48	mg/L
5/14/2007	11:25	Magic Valley Laboratory	Chloride	42.2	mg/L
1/16/2007	13:50	University of Arizona	Deuterium (2H)	-123	
1/16/2007	13:50	Field Parameter	Dissolved Oxygen	7.71	mg/L
2/12/2007	9:45	Field Parameter	Dissolved Oxygen	9.38	mg/L
3/12/2007	9:55	Field Parameter	Dissolved Oxygen	9.25	mg/L
4/16/2007	9:30	Field Parameter	Dissolved Oxygen	9.02	mg/L
5/14/2007	11:25	Field Parameter	Dissolved Oxygen	8.25	mg/L
6/15/2007	9:30	Field Parameter	Dissolved Oxygen	8.72	mg/L
7/13/2007	9:40	Field Parameter	Dissolved Oxygen	7.1	mg/L
9/10/2007	10:10	Field Parameter	Dissolved Oxygen	8.23	mg/L
1/16/2007	13:50	Idaho State Health Laboratory	Nitrate (as N)	2.3	mg/L
2/12/2007	9:45	Magic Valley Laboratory	Nitrate (as N)	2.01	mg/L
3/12/2007	9:55	Magic Valley Laboratory	Nitrate (as N)	2.02	mg/L

Hardy Spring #1 DEQ Site ID: 836

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
4/16/2007	9:30	Magic Valley Laboratory	Nitrate (as N)	1.92	mg/L
5/14/2007	11:25	Magic Valley Laboratory	Nitrate (as N)	1.88	mg/L
6/15/2007	9:30	Magic Valley Laboratory	Nitrate (as N)	1.83	mg/L
7/13/2007	9:40	Magic Valley Laboratory	Nitrate (as N)	1.88	mg/L
9/10/2007	10:10	Magic Valley Laboratory	Nitrate (as N)	<0.3	mg/L
1/16/2007	13:50	University of Arizona	Oxygen (18O/16O)	-17.7	per mil
1/16/2007	13:50	Field Parameter	pH	10.35	
2/12/2007	9:45	Field Parameter	pH	7.63	
3/12/2007	9:55	Field Parameter	pH	7.44	
4/16/2007	9:30	Field Parameter	pH	7.54	
5/14/2007	11:25	Field Parameter	pH	7.59	
6/15/2007	9:30	Field Parameter	pH	7.83	
7/13/2007	9:40	Field Parameter	pH	7.5	
9/10/2007	10:10	Field Parameter	pH	8.27	
1/16/2007	13:50	Idaho State Health Laboratory	Phosphorus	0.02	mg/L
2/12/2007	9:45	Magic Valley Laboratory	Phosphorus	0.03	mg/L
3/12/2007	9:55	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
4/16/2007	9:30	Magic Valley Laboratory	Phosphorus	0.033	mg/L
5/14/2007	11:25	Magic Valley Laboratory	Phosphorus	0.025	mg/L
1/16/2007	13:50	Field Parameter	Specific Conductivity	502	uhmos/cm
2/12/2007	9:45	Field Parameter	Specific Conductivity	486	uhmos/cm
3/12/2007	9:55	Field Parameter	Specific Conductivity	478	uhmos/cm
4/16/2007	9:30	Field Parameter	Specific Conductivity	474	uhmos/cm
5/14/2007	11:25	Field Parameter	Specific Conductivity	472	uhmos/cm
6/15/2007	9:30	Field Parameter	Specific Conductivity	471	uhmos/cm
7/13/2007	9:40	Field Parameter	Specific Conductivity	518	uhmos/cm
9/10/2007	10:10	Field Parameter	Specific Conductivity	515	uhmos/cm
1/16/2007	13:50	Idaho State Health Laboratory	Sulfate	57	mg/L
2/12/2007	9:45	Magic Valley Laboratory	Sulfate	55	mg/L
3/12/2007	9:55	Magic Valley Laboratory	Sulfate	54.9	mg/L
4/16/2007	9:30	Magic Valley Laboratory	Sulfate	40.8	mg/L
5/14/2007	11:25	Magic Valley Laboratory	Sulfate	52.1	mg/L
1/16/2007	13:50	Field Parameter	Temperature	13.97	°C
2/12/2007	9:45	Field Parameter	Temperature	13.8	°C
3/12/2007	9:55	Field Parameter	Temperature	13.97	°C
4/16/2007	9:30	Field Parameter	Temperature	13.61	°C
5/14/2007	11:25	Field Parameter	Temperature	14.2	°C
6/15/2007	9:30	Field Parameter	Temperature	14.23	°C
7/13/2007	9:40	Field Parameter	Temperature	14.54	°C
9/10/2007	10:10	Field Parameter	Temperature	14.02	°C
1/16/2007	13:50	Idaho State Health Laboratory	Total Dissolved Solids	353	mg/L
2/12/2007	9:45	Field Parameter	Total Dissolved Solids	230	mg/L
2/12/2007	9:45	Magic Valley Laboratory	Total Dissolved Solids	300	mg/L
3/12/2007	9:55	Field Parameter	Total Dissolved Solids	230	mg/L
3/12/2007	9:55	Magic Valley Laboratory	Total Dissolved Solids	280	mg/L
4/16/2007	9:30	Field Parameter	Total Dissolved Solids	230	mg/L
4/16/2007	9:30	Magic Valley Laboratory	Total Dissolved Solids	299	mg/L

Hardy Spring #1 DEQ Site ID: 836

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
5/14/2007	11:25	Field Parameter	Total Dissolved Solids	230	mg/L
5/14/2007	11:25	Magic Valley Laboratory	Total Dissolved Solids	296	mg/L
6/15/2007	9:30	Field Parameter	Total Dissolved Solids	302	mg/L
7/13/2007	9:40	Field Parameter	Total Dissolved Solids	260	mg/L
9/10/2007	10:10	Field Parameter	Total Dissolved Solids	329	mg/L

Hardy Spring #2 DEQ Site ID: 837

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	14:00	Idaho State Health Laboratory	Chloride	45.3	mg/L
1/16/2007	14:00	University of Arizona	Deuterium (2H)	-124	per mil
1/16/2007	14:00	Field Parameter	Dissolved Oxygen	7.66	mg/L
1/16/2007	14:00	Idaho State Health Laboratory	Nitrate (as N)	2.2	mg/L
1/16/2007	14:00	University of Arizona	Oxygen (18O/16O)	-17.6	per mil
1/16/2007	14:00	Field Parameter	pH	9.71	
1/16/2007	14:00	Idaho State Health Laboratory	Phosphorus	0.038	mg/L
1/16/2007	14:00	Field Parameter	Specific Conductivity	491	uhmos/cm
1/16/2007	14:00	Idaho State Health Laboratory	Sulfate	39.8	mg/L
1/16/2007	14:00	Field Parameter	Temperature	14.04	°C
1/16/2007	14:00	Idaho State Health Laboratory	Total Dissolved Solids	341	mg/L

Hardy Spring #3 DEQ Site ID: 838

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	14:20	Field Parameter	Chloride	49	mg/L
1/16/2007	14:20	Field Parameter	Dissolved Oxygen	7.6	mg/L
1/16/2007	14:20	Idaho State Health Laboratory	Nitrate (as N)	2.3	mg/L
1/16/2007	14:20	Field Parameter	pH	10.1	
1/16/2007	14:20	Idaho State Health Laboratory	Phosphorus	0.031	mg/L
1/16/2007	14:20	Field Parameter	Specific Conductivity	489.6	uhmos/cm
1/16/2007	14:20	Idaho State Health Laboratory	Sulfate	70.3	mg/L
1/16/2007	14:00	University of Arizona	Temperature	14.03	°C
1/16/2007	14:20	Idaho State Health Laboratory	Total Dissolved Solids	358	mg/L

Hardy Spring #4 DEQ Site ID: 839

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	14:35	Field Parameter	Chloride	41.1	mg/L
2/12/2007	10:35	Magic Valley Laboratory	Chloride	45	mg/L
3/12/2007	10:15	Magic Valley Laboratory	Chloride	41.1	mg/L
4/16/2007	9:50	Magic Valley Laboratory	Chloride	46.4	mg/L
5/14/2007	11:40	Magic Valley Laboratory	Chloride	42.3	mg/L
1/16/2007	14:20	Idaho State Health Laboratory	Deuterium (2H)	-129	per mil
1/16/2007	14:35	Idaho State Health Laboratory	Deuterium (2H)	-132	per mil
1/16/2007	14:35	Field Parameter	Dissolved Oxygen	7.7	mg/L
2/12/2007	10:35	Field Parameter	Dissolved Oxygen	8.6	mg/L

Hardy Spring #4 DEQ Site ID: 839

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
3/12/2007	10:15	Field Parameter	Dissolved Oxygen	9.18	mg/L
4/16/2007	9:50	Field Parameter	Dissolved Oxygen	8.39	mg/L
5/14/2007	11:40	Field Parameter	Dissolved Oxygen	9.48	mg/L
6/15/2007	9:50	Field Parameter	Dissolved Oxygen	7.64	mg/L
7/13/2007	9:55	Field Parameter	Dissolved Oxygen	7.15	mg/L
9/10/2007	10:30	Field Parameter	Dissolved Oxygen	8.79	mg/L
1/16/2007	14:35	Idaho State Health Laboratory	Nitrate (as N)	1.9	mg/L
2/12/2007	10:35	Field Parameter	Nitrate (as N)	1.84	mg/L
3/12/2007	10:15	Field Parameter	Nitrate (as N)	1.87	mg/L
4/16/2007	9:50	Field Parameter	Nitrate (as N)	1.81	mg/L
5/14/2007	11:40	Field Parameter	Nitrate (as N)	1.79	mg/L
6/15/2007	9:50	Field Parameter	Nitrate (as N)	1.74	mg/L
7/13/2007	9:55	Field Parameter	Nitrate (as N)	1.79	mg/L
9/10/2007	10:30	Field Parameter	Nitrate (as N)	2.54	mg/L
1/16/2007	14:20	University of Arizona	Oxygen (18O/16O)	-17.6	per mil
1/16/2007	14:35	University of Arizona	Oxygen (18O/16O)	-17.8	per mil
1/16/2007	14:35	Field Parameter	pH	9.68	
2/12/2007	10:35	Field Parameter	pH	7.54	
3/12/2007	10:15	Field Parameter	pH	7.33	
4/16/2007	9:50	Field Parameter	pH	7.41	
5/14/2007	11:40	Field Parameter	pH	7.52	
6/15/2007	9:50	Field Parameter	pH	7.95	
7/13/2007	9:55	Field Parameter	pH	7.47	
9/10/2007	10:30	Field Parameter	pH	8.68	
1/16/2007	14:35	Idaho State Health Laboratory	Phosphorus	0.021	mg/L
2/12/2007	10:35	Magic Valley Laboratory	Phosphorus	0.022	mg/L
3/12/2007	10:15	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
4/16/2007	9:50	Magic Valley Laboratory	Phosphorus	0.026	mg/L
5/14/2007	11:40	Magic Valley Laboratory	Phosphorus	0.05	mg/L
1/16/2007	14:35	Field Parameter	Specific Conductivity	469	uhmos/cm
2/12/2007	10:35	Field Parameter	Specific Conductivity	637	uhmos/cm
3/12/2007	10:15	Field Parameter	Specific Conductivity	470	uhmos/cm
4/16/2007	9:50	Field Parameter	Specific Conductivity	488	uhmos/cm
5/14/2007	11:40	Field Parameter	Specific Conductivity	464	uhmos/cm
6/15/2007	9:50	Field Parameter	Specific Conductivity	463	uhmos/cm
7/13/2007	9:55	Field Parameter	Specific Conductivity	511	uhmos/cm
9/10/2007	10:30	Field Parameter	Specific Conductivity	523	uhmos/cm
1/16/2007	14:35	Idaho State Health Laboratory	Sulfate	52.4	mg/L
2/12/2007	10:35	Magic Valley Laboratory	Sulfate	60.4	mg/L
3/12/2007	10:15	Magic Valley Laboratory	Sulfate	53.8	mg/L
4/16/2007	9:50	Magic Valley Laboratory	Sulfate	39.7	mg/L
5/14/2007	11:40	Magic Valley Laboratory	Sulfate	55.9	mg/L
1/16/2007	14:20	University of Arizona	Temperature	14.03	°C
1/16/2007	14:35	University of Arizona	Temperature	13.47	°C
2/12/2007	10:35	Magic Valley Laboratory	Temperature	13.94	°C
3/12/2007	10:15	Magic Valley Laboratory	Temperature	15.94	°C
4/16/2007	9:50	Magic Valley Laboratory	Temperature	14.36	°C

Hardy Spring #4 DEQ Site ID: 839

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
5/14/2007	11:40	Magic Valley Laboratory	Temperature	14.6	°C
6/15/2007	9:50	Magic Valley Laboratory	Temperature	14.82	°C
7/13/2007	9:55	Magic Valley Laboratory	Temperature	13.58	°C
1/16/2007	14:35	Idaho State Health Laboratory	Total Dissolved Solids	327	mg/L
2/12/2007	10:35	Field Parameter	Total Dissolved Solids	310	mg/L
2/12/2007	10:35	Magic Valley Laboratory	Total Dissolved Solids	240	mg/L
3/12/2007	10:15	Field Parameter	Total Dissolved Solids	220	mg/L
3/12/2007	10:15	Magic Valley Laboratory	Total Dissolved Solids	340	mg/L
4/16/2007	9:50	Field Parameter	Total Dissolved Solids	220	mg/L
4/16/2007	9:50	Magic Valley Laboratory	Total Dissolved Solids	296	mg/L
5/14/2007	11:40	Field Parameter	Total Dissolved Solids	220	mg/L
5/14/2007	11:40	Magic Valley Laboratory	Total Dissolved Solids	280	mg/L
6/15/2007	9:50	Field Parameter	Total Dissolved Solids	296	mg/L
7/13/2007	9:55	Field Parameter	Total Dissolved Solids	240	mg/L
9/10/2007	10:30	Field Parameter	Total Dissolved Solids	336	mg/L

Hardy Spring #5 DEQ Site ID: 840

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	14:50	Field Parameter	Chloride	33	mg/L
1/16/2007	14:50	Idaho State Health Laboratory	Deuterium (2H)	-127	per mil
1/16/2007	14:50	Field Parameter	Dissolved Oxygen	7.72	mg/L
1/16/2007	14:50	Idaho State Health Laboratory	Nitrate (as N)	1.5	mg/L
1/16/2007	14:50	University of Arizona	Oxygen (18O/16O)	-17.8	per mil
1/16/2007	14:50	Field Parameter	pH	9.34	
1/16/2007	14:50	Idaho State Health Laboratory	Phosphorus	0.022	mg/L
1/16/2007	14:50	Field Parameter	Specific Conductivity	416.4	uhmos/cm
1/16/2007	14:50	Idaho State Health Laboratory	Sulfate	44.7	mg/L
9/10/2007	10:30	Magic Valley Laboratory	Temperature	14.09	°C
1/16/2007	14:50	Idaho State Health Laboratory	Total Dissolved Solids	320	mg/L

Hardy Spring #6 DEQ Site ID: 841

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/16/2007	15:10	Field Parameter	Chloride	32.6	mg/L
2/12/2007	10:45	Magic Valley Laboratory	Chloride	30.7	mg/L
3/12/2007	10:20	Magic Valley Laboratory	Chloride	29.5	mg/L
4/16/2007	10:00	Magic Valley Laboratory	Chloride	37.5	mg/L
5/14/2007	11:45	Magic Valley Laboratory	Chloride	30	mg/L
1/16/2007	15:10	Idaho State Health Laboratory	Deuterium (2H)	-130	per mil
1/16/2007	15:10	Field Parameter	Dissolved Oxygen	7.81	mg/L
2/12/2007	10:45	Field Parameter	Dissolved Oxygen	8.72	mg/L
3/12/2007	10:20	Field Parameter	Dissolved Oxygen	8.36	mg/L
4/16/2007	10:00	Field Parameter	Dissolved Oxygen	8.89	mg/L
5/14/2007	11:45	Field Parameter	Dissolved Oxygen	9.7	mg/L
6/15/2007	10:10	Field Parameter	Dissolved Oxygen	7.73	mg/L
7/13/2007	10:05	Field Parameter	Dissolved Oxygen	7.22	mg/L

Hardy Spring #6 DEQ Site ID: 841

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
9/10/2007	10:40	Field Parameter	Dissolved Oxygen	8.71	mg/L
1/16/2007	15:10	Idaho State Health Laboratory	Nitrate (as N)	1.6	mg/L
2/12/2007	10:45	Field Parameter	Nitrate (as N)	1.36	mg/L
3/12/2007	10:20	Field Parameter	Nitrate (as N)	1.39	mg/L
4/16/2007	10:00	Field Parameter	Nitrate (as N)	1.26	mg/L
5/14/2007	11:45	Field Parameter	Nitrate (as N)	1.21	mg/L
6/15/2007	10:10	Field Parameter	Nitrate (as N)	1.19	mg/L
7/13/2007	10:05	Field Parameter	Nitrate (as N)	1.16	mg/L
9/10/2007	10:40	Field Parameter	Nitrate (as N)	1.56	mg/L
1/16/2007	15:10	University of Arizona	Oxygen (18O/16O)	-17.8	per mil
1/16/2007	15:10	Field Parameter	pH	10.55	
2/12/2007	10:45	Field Parameter	pH	7.81	
3/12/2007	10:20	Field Parameter	pH	7.63	
4/16/2007	10:00	Field Parameter	pH	7.7	
5/14/2007	11:45	Field Parameter	pH	7.88	
6/15/2007	10:10	Field Parameter	pH	8.04	
7/13/2007	10:05	Field Parameter	pH	7.54	
9/10/2007	10:40	Field Parameter	pH	8.44	
1/16/2007	15:10	Idaho State Health Laboratory	Phosphorus	0.024	mg/L
2/12/2007	10:45	Magic Valley Laboratory	Phosphorus	0.005	mg/L
3/12/2007	10:20	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
4/16/2007	10:00	Magic Valley Laboratory	Phosphorus	0.036	mg/L
5/14/2007	11:45	Magic Valley Laboratory	Phosphorus	0.049	mg/L
1/16/2007	15:10	Field Parameter	Specific Conductivity	407	uhmos/cm
2/12/2007	10:45	Field Parameter	Specific Conductivity	534	uhmos/cm
3/12/2007	10:20	Field Parameter	Specific Conductivity	395	uhmos/cm
4/16/2007	10:00	Field Parameter	Specific Conductivity	389	uhmos/cm
5/14/2007	11:45	Field Parameter	Specific Conductivity	392	uhmos/cm
6/15/2007	10:10	Field Parameter	Specific Conductivity	3.87	uhmos/cm
7/13/2007	10:05	Field Parameter	Specific Conductivity	434	uhmos/cm
9/10/2007	10:40	Field Parameter	Specific Conductivity	422	uhmos/cm
1/16/2007	15:10	Idaho State Health Laboratory	Sulfate	44.4	mg/L
2/12/2007	10:45	Magic Valley Laboratory	Sulfate	22	mg/L
3/12/2007	10:20	Magic Valley Laboratory	Sulfate	43.2	mg/L
4/16/2007	10:00	Magic Valley Laboratory	Sulfate	29.2	mg/L
5/14/2007	11:45	Magic Valley Laboratory	Sulfate	45.9	mg/L
1/16/2007	14:50	University of Arizona	Temperature	13.35	°C
1/16/2007	15:10	University of Arizona	Temperature	13.67	°C
2/12/2007	10:45	Magic Valley Laboratory	Temperature	13.78	°C
3/12/2007	10:20	Magic Valley Laboratory	Temperature	13.72	°C
4/16/2007	10:00	Magic Valley Laboratory	Temperature	14.27	°C
5/14/2007	11:45	Magic Valley Laboratory	Temperature	15.32	°C
6/15/2007	10:10	Magic Valley Laboratory	Temperature	14.75	°C
7/13/2007	10:05	Magic Valley Laboratory	Temperature	14.28	°C
1/16/2007	15:10	Idaho State Health Laboratory	Total Dissolved Solids	292	mg/L
2/12/2007	10:45	Field Parameter	Total Dissolved Solids	260	mg/L
2/12/2007	10:45	Magic Valley Laboratory	Total Dissolved Solids	140	mg/L

Hardy Spring #6 DEQ Site ID: 841

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
3/12/2007	10:20	Field Parameter	Total Dissolved Solids	190	mg/L
3/12/2007	10:20	Magic Valley Laboratory	Total Dissolved Solids	320	mg/L
4/16/2007	10:00	Field Parameter	Total Dissolved Solids	190	mg/L
4/16/2007	10:00	Magic Valley Laboratory	Total Dissolved Solids	256	mg/L
5/14/2007	11:45	Field Parameter	Total Dissolved Solids	190	mg/L
5/14/2007	11:45	Magic Valley Laboratory	Total Dissolved Solids	247	mg/L
6/15/2007	10:10	Field Parameter	Total Dissolved Solids	247	mg/L
7/13/2007	10:05	Field Parameter	Total Dissolved Solids	210	mg/L
9/10/2007	10:40	Field Parameter	Total Dissolved Solids	269	mg/L

Matalena Spring DEQ Site ID:845

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
1/17/2007	11:40	Idaho State Health Laboratory	Chloride	45.5	mg/L
2/12/2007	11:30	Magic Valley Laboratory	Chloride	45.8	mg/L
3/12/2007	10:50	Magic Valley Laboratory	Chloride	42.7	mg/L
4/16/2007	10:30	Magic Valley Laboratory	Chloride	49.2	mg/L
5/14/2007	12:15	Magic Valley Laboratory	Chloride	45.6	mg/L
1/17/2007	11:40	University of Arizona	Deuterium (2H)	-131	per mil
1/17/2007	11:40	Field Parameter	Dissolved Oxygen	9.22	mg/L
2/12/2007	11:30	Field Parameter	Dissolved Oxygen	8.31	mg/L
3/12/2007	10:50	Field Parameter	Dissolved Oxygen	9.75	mg/L
4/16/2007	10:30	Field Parameter	Dissolved Oxygen	8.94	mg/L
5/14/2007	12:15	Field Parameter	Dissolved Oxygen	9.14	mg/L
6/15/2007	10:55	Field Parameter	Dissolved Oxygen	9.11	mg/L
7/13/2007	10:30	Field Parameter	Dissolved Oxygen	6.5	mg/L
9/10/2007	11:10	Field Parameter	Dissolved Oxygen	9.9	mg/L
1/17/2007	11:40	Idaho State Health Laboratory	Nitrate (as N)	2.2	mg/L
2/12/2007	11:30	Magic Valley Laboratory	Nitrate (as N)	2.1	mg/L
3/12/2007	10:50	Magic Valley Laboratory	Nitrate (as N)	2.11	mg/L
4/16/2007	10:30	Magic Valley Laboratory	Nitrate (as N)	2.1	mg/L
5/14/2007	12:15	Magic Valley Laboratory	Nitrate (as N)	1.07	mg/L
6/15/2007	10:55	Magic Valley Laboratory	Nitrate (as N)	2.08	mg/L
7/13/2007	10:30	Magic Valley Laboratory	Nitrate (as N)	2.09	mg/L
9/10/2007	11:10	Magic Valley Laboratory	Nitrate (as N)	2.11	mg/L
1/17/2007	11:40	University of Arizona	Oxygen (18O/16O)	-17.6	per mil
1/17/2007	11:40	Field Parameter	pH	9.6	
2/12/2007	11:30	Field Parameter	pH	7.9	
3/12/2007	10:50	Field Parameter	pH	7.75	
4/16/2007	10:30	Field Parameter	pH	7.77	
5/14/2007	12:15	Field Parameter	pH	7.78	
6/15/2007	10:55	Field Parameter	pH	8.12	
7/13/2007	10:30	Field Parameter	pH	7.66	
9/10/2007	11:10	Field Parameter	pH	8.77	
1/17/2007	11:40	Idaho State Health Laboratory	Phosphorus	0.012	mg/L
2/12/2007	11:30	Magic Valley Laboratory	Phosphorus	0.016	mg/L
3/12/2007	10:50	Magic Valley Laboratory	Phosphorus	<0.005	mg/L

Matalena Spring DEQ Site ID:845

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
4/16/2007	10:30	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
5/14/2007	12:15	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
1/17/2007	11:40	Field Parameter	Specific Conductivity	539	uhmos/cm
2/12/2007	11:30	Field Parameter	Specific Conductivity	651	uhmos/cm
3/12/2007	10:50	Field Parameter	Specific Conductivity	480	uhmos/cm
4/16/2007	10:30	Field Parameter	Specific Conductivity	482	uhmos/cm
5/14/2007	12:15	Field Parameter	Specific Conductivity	485	uhmos/cm
6/15/2007	10:55	Field Parameter	Specific Conductivity	486	uhmos/cm
7/13/2007	10:30	Field Parameter	Specific Conductivity	5.35	uhmos/cm
9/10/2007	11:10	Field Parameter	Specific Conductivity	495	uhmos/cm
1/17/2007	11:40	Idaho State Health Laboratory	Sulfate	56.4	mg/L
2/12/2007	11:30	Magic Valley Laboratory	Sulfate	55.9	mg/L
3/12/2007	10:50	Magic Valley Laboratory	Sulfate	55.2	mg/L
4/16/2007	10:30	Magic Valley Laboratory	Sulfate	42	mg/L
5/14/2007	12:15	Magic Valley Laboratory	Sulfate	55.6	mg/L
1/17/2007	11:40	Field Parameter	Temperature	14	°C
2/12/2007	11:30	Field Parameter	Temperature	13.25	°C
3/12/2007	10:50	Field Parameter	Temperature	13.8	°C
4/16/2007	10:30	Field Parameter	Temperature	13.8	°C
5/14/2007	12:15	Field Parameter	Temperature	15.06	°C
6/15/2007	10:55	Field Parameter	Temperature	15.13	°C
7/13/2007	10:30	Field Parameter	Temperature	16.02	°C
9/10/2007	11:10	Field Parameter	Temperature	13.9	°C
1/17/2007	11:40	Idaho State Health Laboratory	Total Dissolved Solids	354	mg/L
2/12/2007	11:30	Field Parameter	Total Dissolved Solids	310	mg/L
2/12/2007	11:30	Magic Valley Laboratory	Total Dissolved Solids	280	mg/L
3/12/2007	10:50	Field Parameter	Total Dissolved Solids	230	mg/L
3/12/2007	10:50	Magic Valley Laboratory	Total Dissolved Solids	330	mg/L
4/16/2007	10:30	Field Parameter	Total Dissolved Solids	50	mg/L
4/16/2007	10:30	Magic Valley Laboratory	Total Dissolved Solids	317	mg/L
5/14/2007	12:15	Field Parameter	Total Dissolved Solids	230	mg/L
5/14/2007	12:15	Magic Valley Laboratory	Total Dissolved Solids	302	mg/L
6/15/2007	10:55	Field Parameter	Total Dissolved Solids	311	mg/L
7/13/2007	10:30	Field Parameter	Total Dissolved Solids	260	mg/L
9/10/2007	11:10	Field Parameter	Total Dissolved Solids	322	mg/L

R & D #1 DEQ Site ID:848

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
10/15/2008	17:10	University of Iowa	Acetaminophen	<2.0	ng/L
10/15/2008	17:10	University of Iowa	Acetaminophen	<2.0	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Alkalinity	162	mg/L
10/15/2008	17:10	University of Iowa	Caffeine	<10	ng/L
10/15/2008	17:10	University of Iowa	Caffeine	<10	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Calcium	54	mg/L
10/15/2008	17:10	University of Iowa	Carbamazepine	<1.0	ng/L
10/15/2008	17:10	University of Iowa	Carbamazepine	<1.0	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Chloride	48.1	mg/L
10/15/2008	17:10	University of Iowa	Cholesterol	560	ng/L
10/15/2008	17:10	University of Iowa	Cholesterol	1400	ng/L
10/15/2008	17:10	University of Iowa	Coprostanol	<100	ng/L
10/15/2008	17:10	University of Iowa	Coprostanol	<100	ng/L
10/15/2008	17:10	University of Iowa	Cotinine	<2.0	ng/L
10/15/2008	17:10	University of Iowa	Cotinine	<2.0	ng/L
10/15/2008	17:10	University of Iowa	DEET	<20	mg/L
10/15/2008	17:10	University of Iowa	DEET	<20	mg/L
10/15/2008	17:10	University of Iowa	Dihydrocholesterol	<100	ng/L
10/15/2008	17:10	University of Iowa	Dihydrocholesterol	<100	ng/L
10/15/2008	17:10	Field Parameter	Dissolved Oxygen	10.88	mg/L
10/15/2008	17:10	University of Iowa	Equilinen	<100	ng/L
10/15/2008	17:10	University of Iowa	Equilinen	<100	ng/L
10/15/2008	17:10	University of Iowa	Estriol	<250	ng/L
10/15/2008	17:10	University of Iowa	Estriol	<250	ng/L
10/15/2008	17:10	University of Iowa	Ibuprofen	<5	ng/L
10/15/2008	17:10	University of Iowa	Ibuprofen	<5	ng/L
10/15/2008	17:10	University of Iowa	Lincomycin	<5	ng/L
10/15/2008	17:10	University of Iowa	Lincomycin	<5	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Magnesium	23	mg/L
10/15/2008	17:10	Idaho State Health Laboratory	Nitrate (as N)	3.3	mg/L
10/15/2008	17:10	Field Parameter	pH	8.14	
10/15/2008	17:10	Idaho State Health Laboratory	Phosphorus	0.023	mg/L
10/15/2008	17:10	Idaho State Health Laboratory	Potassium	4.6	mg/L
10/15/2008	17:10	University of Iowa	Progesterone	<100	ng/L
10/15/2008	17:10	University of Iowa	Progesterone	<100	ng/L
10/15/2008	17:10	University of Iowa	Sitosterol	<100	ng/L
10/15/2008	17:10	University of Iowa	Sitosterol	<100	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Sodium	31	mg/L
10/15/2008	17:10	Field Parameter	Specific Conductivity	593	umhos/cm
10/15/2008	17:10	University of Iowa	Stigmastanol	<100	ng/L
10/15/2008	17:10	University of Iowa	Stigmastanol	<100	ng/L
10/15/2008	17:10	University of Iowa	Stigmasterol	<100	ng/L
10/15/2008	17:10	University of Iowa	Stigmasterol	<100	ng/L
10/15/2008	17:10	University of Iowa	Sulfadimethoxine	<2.0	ng/L
10/15/2008	17:10	University of Iowa	Sulfadimethoxine	<2.0	ng/L

R & D #1 DEQ Site ID:848

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
10/15/2008	17:10	University of Iowa	Sulfamethazine	<2.0	ng/L
10/15/2008	17:10	University of Iowa	Sulfamethazine	<2.0	ng/L
10/15/2008	17:10	University of Iowa	Sulfamethoxazole	1.4	ng/L
10/15/2008	17:10	University of Iowa	Sulfamethoxazole	1.3	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Sulfate	61	mg/L
10/15/2008	17:10	University of Iowa	Sulfathiazole	<5.0	ng/L
10/15/2008	17:10	University of Iowa	Sulfathiazole	<5.0	ng/L
10/15/2008	17:10	Field Parameter	Temperature	14.4	°C
10/15/2008	17:10	University of Iowa	Testosterone	<100	ng/L
10/15/2008	17:10	University of Iowa	Testosterone	<100	ng/L
10/15/2008	17:10	Idaho State Health Laboratory	Total Dissolved Solids	370	mg/L
10/15/2008	17:10	University of Iowa	Triclosan	<10	ng/L
10/15/2008	17:10	University of Iowa	Triclosan	<10	ng/L
10/15/2008	17:10	University of Iowa	Trimethoprim	<1.0	ng/L
10/15/2008	17:10	University of Iowa	Trimethoprim	<1.0	ng/L
10/15/2008	17:10	University of Iowa	Tylosin	<1.0	ng/L
10/15/2008	17:10	University of Iowa	Tylosin	<1.0	ng/L

R & D #2 DEQ Site ID : 849

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
4/7/2008	12:45	University of Iowa	1,7-Dimethylxanthine	<2.7	ng/L
10/15/2008	16:55	University of Iowa	Acetaminophen	<2.0	ng/L
4/7/2008	12:45	University of Iowa	Acetaminophen	<2.0	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Alkalinity	171	mg/L
10/15/2008	16:55	University of Iowa	Caffeine	17	ng/L
4/7/2008	12:45	University of Iowa	Caffeine	<10	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Calcium	55	mg/L
10/15/2008	16:55	University of Iowa	Carbamazepine	<1.0	ng/L
4/7/2008	12:45	University of Iowa	Carbamazepine	<1.0	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Chloride	52.9	mg/L
2/12/2007	10:15	Magic Valley Laboratory	Chloride	54.6	mg/L
3/12/2007	9:50	Magic Valley Laboratory	Chloride	47.6	mg/L
4/16/2007	9:20	Magic Valley Laboratory	Chloride	52.2	mg/L
5/14/2007	11:15	Magic Valley Laboratory	Chloride	45.3	mg/L
4/7/2008	12:45	Idaho State Health Laboratory	Chloride	44.2	mg/L
10/15/2008	16:55	University of Iowa	Cholesterol	440	ng/L
4/7/2008	12:45	University of Iowa	Cholesterol	860	ng/L
10/15/2008	16:55	University of Iowa	Coprostanol	<100	ng/L
4/7/2008	12:45	University of Iowa	Coprostanol	<250	ng/L
10/15/2008	16:55	University of Iowa	Cotinine	<2.0	ng/L
4/7/2008	12:45	University of Iowa	Cotinine	<2.0	ng/L
10/15/2008	16:55	University of Iowa	DEET	<20	ng/L

R & D #2 DEQ Site ID : 849

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
4/7/2008	12:45	University of Iowa	DEET	<20	ng/L
10/15/2008	16:55	University of Iowa	Dihydrocholesterol	<100	ng/L
4/7/2008	12:45	University of Iowa	Dihydrocholesterol	<100	ng/L
10/15/2008	16:55	Field Parameter	Dissolved Oxygen	11.08	
2/12/2007	10:15	Field Parameter	Dissolved Oxygen	9.12	
3/12/2007	9:50	Field Parameter	Dissolved Oxygen	9.32	
4/16/2007	9:20	Field Parameter	Dissolved Oxygen	9.01	
5/14/2007	11:15	Field Parameter	Dissolved Oxygen	6.95	
6/15/2007	9:15	Field Parameter	Dissolved Oxygen	8.15	
7/13/2007	9:30	Field Parameter	Dissolved Oxygen	7.33	
9/10/2007	10:05	Field Parameter	Dissolved Oxygen	8.74	
4/7/2008	12:45	Field Parameter	Dissolved Oxygen	8.9	
10/15/2008	16:55	University of Iowa	Equilinen	<100	ng/L
4/7/2008	12:45	University of Iowa	Equilinen	<100	ng/L
10/15/2008	16:55	University of Iowa	Estriol	<250	ng/L
4/7/2008	12:45	University of Iowa	Estriol	<100	ng/L
10/15/2008	16:55	University of Iowa	Ibuprofen	<5	ng/L
4/7/2008	12:45	University of Iowa	Ibuprofen	<5	ng/L
10/15/2008	16:55	University of Iowa	Lincomycin	<5	ng/L
4/7/2008	12:45	University of Iowa	Lincomycin	<5	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Magnesium	24	mg/L
10/15/2008	16:55	Idaho State Health Laboratory	Nitrate (as N)	4.8	mg/L
2/12/2007	10:15	Magic Valley Laboratory	Nitrate (as N)	2.47	mg/L
3/12/2007	9:50	Magic Valley Laboratory	Nitrate (as N)	3	mg/L
4/16/2007	9:20	Magic Valley Laboratory	Nitrate (as N)	2.37	mg/L
5/14/2007	11:15	Magic Valley Laboratory	Nitrate (as N)	2.18	mg/L
6/15/2007	9:15	Magic Valley Laboratory	Nitrate (as N)	3.49	mg/L
7/13/2007	9:30	Magic Valley Laboratory	Nitrate (as N)	2.38	mg/L
9/10/2007	10:05	Magic Valley Laboratory	Nitrate (as N)	4.12	mg/L
4/7/2008	12:45	Idaho State Health Laboratory	Nitrate (as N)	2.2	mg/L
10/15/2008	16:55	Field Parameter	pH	8	
2/12/2007	10:15	Field Parameter	pH	7.61	
3/12/2007	9:50	Field Parameter	pH	7.38	
4/16/2007	9:20	Field Parameter	pH	7.59	
5/14/2007	11:15	Field Parameter	pH	7.6	
6/15/2007	9:15	Field Parameter	pH	7.82	
7/13/2007	9:30	Field Parameter	pH	7.43	
9/10/2007	10:05	Field Parameter	pH	8.29	
4/7/2008	12:45	Field Parameter	pH	7.68	
10/15/2008	16:55	Idaho State Health Laboratory	Phosphorus	0.026	mg/L
2/12/2007	10:15	Magic Valley Laboratory	Phosphorus	0.031	mg/L
3/12/2007	9:50	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
4/16/2007	9:20	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
5/14/2007	11:15	Magic Valley Laboratory	Phosphorus	0.045	mg/L
7/13/2007	9:30	Magic Valley Laboratory	Phosphorus	0.015	mg/L

R & D #2 DEQ Site ID : 849

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
4/7/2008	12:45	Idaho State Health Laboratory	Phosphorus	0.023	mg/L
10/15/2008	16:55	Idaho State Health Laboratory	Potassium	4.7	mg/L
10/15/2008	16:55	University of Iowa	Progesterone	<100	ng/L
4/7/2008	12:45	University of Iowa	Progesterone	<100	ng/L
10/15/2008	16:55	University of Iowa	Sitosterol	<100	ng/L
4/7/2008	12:45	University of Iowa	Sitosterol	<100	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Sodium	33	mg/L
10/15/2008	16:55	Field Parameter	Specific Conductivity	622	umhos/cm
2/12/2007	10:15	Field Parameter	Specific Conductivity	682	umhos/cm
3/12/2007	9:50	Field Parameter	Specific Conductivity	512	umhos/cm
4/16/2007	9:20	Field Parameter	Specific Conductivity	488	umhos/cm
5/14/2007	11:15	Field Parameter	Specific Conductivity	486	umhos/cm
6/15/2007	9:15	Field Parameter	Specific Conductivity	529	umhos/cm
7/13/2007	9:30	Field Parameter	Specific Conductivity	542	umhos/cm
9/10/2007	10:05	Field Parameter	Specific Conductivity	560	umhos/cm
4/7/2008	12:45	Field Parameter	Specific Conductivity	501	umhos/cm
10/15/2008	16:55	University of Iowa	Stigmastanol	<100	ng/L
10/15/2008	16:55	University of Iowa	Stigmasterol	<100	ng/L
4/7/2008	12:45	University of Iowa	Stigmasterol	<100	ng/L
10/15/2008	16:55	University of Iowa	Sulfadimethoxine	<2.0	ng/L
4/7/2008	12:45	University of Iowa	Sulfadimethoxine	<2.0	ng/L
10/15/2008	16:55	University of Iowa	Sulfamethazine	<2.0	ng/L
4/7/2008	12:45	University of Iowa	Sulfamethazine	<2.0	ng/L
10/15/2008	16:55	University of Iowa	Sulfamethoxazole	1.6	ng/L
4/7/2008	12:45	University of Iowa	Sulfamethoxazole	<1.0	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Sulfate	67	mg/L
2/12/2007	10:15	Magic Valley Laboratory	Sulfate	65.9	mg/L
3/12/2007	9:50	Magic Valley Laboratory	Sulfate	60	mg/L
4/16/2007	9:20	Magic Valley Laboratory	Sulfate	45.8	mg/L
5/14/2007	11:15	Magic Valley Laboratory	Sulfate	55.4	mg/L
4/7/2008	12:45	Idaho State Health Laboratory	Sulfate	55.6	mg/L
10/15/2008	16:55	University of Iowa	Sulfathiazole	<5.0	mg/L
4/7/2008	12:45	University of Iowa	Sulfathiazole	<5.0	mg/L
10/15/2008	16:55	Field Parameter	Temperature	14.4	°C
2/12/2007	10:15	Field Parameter	Temperature	13.83	°C
3/12/2007	9:50	Field Parameter	Temperature	14.01	°C
4/16/2007	9:20	Field Parameter	Temperature	13.87	°C
5/14/2007	11:15	Field Parameter	Temperature	14.27	°C
6/15/2007	9:15	Field Parameter	Temperature	14.29	°C
7/13/2007	9:30	Field Parameter	Temperature	14.61	°C
9/10/2007	10:05	Field Parameter	Temperature	14.07	°C
4/7/2008	12:45	Field Parameter	Temperature	14	°C
10/15/2008	16:55	University of Iowa	Testosterone	<100	ng/L
4/7/2008	12:45	University of Iowa	Testosterone	<100	ng/L
10/15/2008	16:55	Idaho State Health Laboratory	Total Dissolved Solids	380	mg/L

R & D #2 DEQ Site ID : 849

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
2/12/2007	10:15	Field Parameter	Total Dissolved Solids	330	mg/L
2/12/2007	10:15	Magic Valley Laboratory	Total Dissolved Solids	230	mg/L
3/12/2007	9:50	Field Parameter	Total Dissolved Solids	240	mg/L
3/12/2007	9:50	Magic Valley Laboratory	Total Dissolved Solids	360	mg/L
4/16/2007	9:20	Field Parameter	Total Dissolved Solids	230	mg/L
4/16/2007	9:20	Magic Valley Laboratory	Total Dissolved Solids	316	mg/L
5/14/2007	11:15	Field Parameter	Total Dissolved Solids	230	mg/L
5/14/2007	11:15	Magic Valley Laboratory	Total Dissolved Solids	308	mg/L
6/15/2007	9:15	Field Parameter	Total Dissolved Solids	338	mg/L
7/13/2007	9:30	Field Parameter	Total Dissolved Solids	260	mg/L
9/10/2007	10:05	Field Parameter	Total Dissolved Solids	358	mg/L
4/7/2008	12:45	Idaho State Health Laboratory	Total Dissolved Solids	342	mg/L
10/15/2008	16:55	University of Iowa	Triclosan	<10	ng/L
4/7/2008	12:45	University of Iowa	Triclosan	<10	ng/L
10/15/2008	16:55	University of Iowa	Trimethoprim	<1.0	ng/L
4/7/2008	12:45	University of Iowa	Trimethoprim	<1.0	ng/L
10/15/2008	16:55	University of Iowa	Tylosin	<1.0	ng/L
4/7/2008	12:45	University of Iowa	Tylosin	<1.0	ng/L

R & D #3 (Visitors Spring) DEQ Site ID : 851

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
4/7/2008	13:10	University of Iowa	1,7-Dimethylxanthine	<2.7	ng/L
4/7/2008	13:10	University of Iowa	1,7-Dimethylxanthine	<2.7	ng/L
10/15/2008	16:30	University of Iowa	Acetaminophen	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Acetaminophen	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Acetaminophen	<2.0	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Alkalinity	204	mg/L
10/15/2008	16:30	University of Iowa	Caffeine	<10	ng/L
4/7/2008	13:10	University of Iowa	Caffeine	<10	ng/L
4/7/2008	13:10	University of Iowa	Caffeine	<10	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Calcium	66	mg/L
10/15/2008	16:30	University of Iowa	Carbamazepine	2.5	ng/L
4/7/2008	13:10	University of Iowa	Carbamazepine	<1.0	ng/L
4/7/2008	13:10	University of Iowa	Carbamazepine	<1.0	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Chloride	63	mg/L
4/7/2008	13:10	Idaho State Health Laboratory	Chloride	54.6	mg/L
1/16/2007	12:00	Idaho State Health Laboratory	Chloride	57.9	mg/L
2/12/2007	9:30	Magic Valley Laboratory	Chloride	57.3	mg/L
3/12/2007	9:45	Magic Valley Laboratory	Chloride	54.6	mg/L
4/16/2007	9:15	Magic Valley Laboratory	Chloride	59.8	mg/L
5/14/2007	11:00	Magic Valley Laboratory	Chloride	52.3	mg/L
10/15/2008	16:30	University of Iowa	Cholesterol	540	ng/L

R & D #3 (Visitors Spring) DEQ Site ID : 851

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
4/7/2008	13:10	University of Iowa	Cholesterol	780	ng/L
4/7/2008	13:10	University of Iowa	Cholesterol	950	ng/L
10/15/2008	16:30	University of Iowa	Coprostanol	<100	ng/L
4/7/2008	13:10	University of Iowa	Coprostanol	<250	ng/L
4/7/2008	13:10	University of Iowa	Coprostanol	<250	ng/L
10/15/2008	16:30	University of Iowa	Cotinine	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Cotinine	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Cotinine	<2.0	ng/L
10/15/2008	16:30	University of Iowa	DEET	<20	mg/L
4/7/2008	13:10	University of Iowa	DEET	<20	mg/L
4/7/2008	13:10	University of Iowa	DEET	<20	mg/L
1/16/2007	12:00	University of Arizona	Deuterium (2H)	-130	per mil
10/15/2008	16:30	University of Iowa	Dihydrocholesterol	<100	ng/L
4/7/2008	13:10	University of Iowa	Dihydrocholesterol	<100	ng/L
4/7/2008	13:10	University of Iowa	Dihydrocholesterol	<100	ng/L
10/15/2008	16:30	Field Parameter	Dissolved Oxygen	11.73	mg/L
12/4/2008	14:39	Field Parameter	Dissolved Oxygen	12.29	mg/L
1/21/2009	12:15	Field Parameter	Dissolved Oxygen	10.1	mg/L
2/4/2009	12:00	Field Parameter	Dissolved Oxygen	11.16	mg/L
4/7/2008	13:10	Field Parameter	Dissolved Oxygen	9.48	mg/L
2/12/2007	9:30	Field Parameter	Dissolved Oxygen	8.59	mg/L
3/12/2007	9:45	Field Parameter	Dissolved Oxygen	9.68	mg/L
4/16/2007	9:15	Field Parameter	Dissolved Oxygen	7.84	mg/L
5/14/2007	11:00	Field Parameter	Dissolved Oxygen	8.64	mg/L
6/15/2007	9:00	Field Parameter	Dissolved Oxygen	6.94	mg/L
7/13/2007	9:30	Field Parameter	Dissolved Oxygen	7.18	mg/L
9/10/2007	10:00	Field Parameter	Dissolved Oxygen	8.35	mg/L
10/15/2008	16:30	University of Iowa	Equilinen	<100	ng/L
4/7/2008	13:10	University of Iowa	Equilinen	<100	ng/L
4/7/2008	13:10	University of Iowa	Equilinen	<100	ng/L
10/15/2008	16:30	University of Iowa	Estriol	<250	ng/L
4/7/2008	13:10	University of Iowa	Estriol	<100	ng/L
4/7/2008	13:10	University of Iowa	Estriol	<100	ng/L
10/15/2008	16:30	University of Iowa	Ibuprofen	<5	ng/L
4/7/2008	13:10	University of Iowa	Ibuprofen	<5	ng/L
4/7/2008	13:10	University of Iowa	Ibuprofen	<5	ng/L
10/15/2008	16:30	University of Iowa	Lincomycin	<5	ng/L
4/7/2008	13:10	University of Iowa	Lincomycin	<5	ng/L
4/7/2008	13:10	University of Iowa	Lincomycin	<5	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Magnesium	31	mg/L
10/15/2008	16:30	Idaho State Health Laboratory	Nitrate (as N)	12	mg/L
12/4/2008	14:39	Magic Valley Laboratory	Nitrate (as N)	8.55	mg/L
1/21/2009	12:15	Idaho State Health Laboratory	Nitrate (as N)	6.8	mg/L
2/4/2009	12:00	Idaho State Health Laboratory	Nitrate (as N)	5.9	mg/L
4/7/2008	13:10	Idaho State Health Laboratory	Nitrate (as N)	6.3	mg/L

R & D #3 (Visitors Spring) DEQ Site ID : 851

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
1/16/2007	12:00	Idaho State Health Laboratory	Nitrate (as N)	1.6	mg/L
2/12/2007	9:30	Magic Valley Laboratory	Nitrate (as N)	5.31	mg/L
3/12/2007	9:45	Magic Valley Laboratory	Nitrate (as N)	5	mg/L
4/16/2007	9:15	Magic Valley Laboratory	Nitrate (as N)	4.47	mg/L
5/14/2007	11:00	Magic Valley Laboratory	Nitrate (as N)	3.9	mg/L
6/15/2007	9:00	Magic Valley Laboratory	Nitrate (as N)	5.31	mg/L
7/13/2007	9:30	Magic Valley Laboratory	Nitrate (as N)	5.34	mg/L
9/10/2007	10:00	Magic Valley Laboratory	Nitrate (as N)	7.96	mg/L
1/16/2007	12:00	University of Arizona	Oxygen (18O/16O)	-17.2	per mil
10/15/2008	16:30	Field Parameter	pH	7.94	
12/4/2008	14:39	Field Parameter	pH	7.91	
1/21/2009	12:15	Field Parameter	pH	7.2	
2/4/2009	12:00	Field Parameter	pH	8.67	
4/7/2008	13:10	Field Parameter	pH	7.63	
2/12/2007	9:30	Field Parameter	pH	7.43	
3/12/2007	9:45	Field Parameter	pH	7.29	
4/16/2007	9:15	Field Parameter	pH	7.37	
5/14/2007	11:00	Field Parameter	pH	736	
6/15/2007	9:00	Field Parameter	pH	7.86	
7/13/2007	9:30	Field Parameter	pH	7.24	
10/15/2008	16:30	Idaho State Health Laboratory	Phosphorus	0.065	mg/L
4/7/2008	13:10	Idaho State Health Laboratory	Phosphorus	0.036	mg/L
1/16/2007	12:00	Idaho State Health Laboratory	Phosphorus	0.025	mg/L
2/12/2007	9:30	Magic Valley Laboratory	Phosphorus	0.026	mg/L
3/12/2007	9:45	Magic Valley Laboratory	Phosphorus	<0.005	mg/L
4/16/2007	9:15	Magic Valley Laboratory	Phosphorus	0.056	mg/L
5/14/2007	11:00	Magic Valley Laboratory	Phosphorus	0.042	mg/L
7/13/2007	9:30	Magic Valley Laboratory	Phosphorus	0.034	mg/L
10/15/2008	16:30	Idaho State Health Laboratory	Potassium	5.2	mg/L
10/15/2008	16:30	University of Iowa	Progesterone	<100	ng/L
4/7/2008	13:10	University of Iowa	Progesterone	<100	ng/L
4/7/2008	13:10	University of Iowa	Progesterone	<100	ng/L
10/15/2008	16:30	University of Iowa	Sitosterol	<100	ng/L
4/7/2008	13:10	University of Iowa	Sitosterol	<100	ng/L
4/7/2008	13:10	University of Iowa	Sitosterol	<100	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Sodium	47	mg/L
10/15/2008	16:30	Field Parameter	Specific Conductivity	866	umhos/cm
12/4/2008	14:39	Field Parameter	Specific Conductivity	761	umhos/cm
1/21/2009	12:15	Field Parameter	Specific Conductivity	671	umhos/cm
2/4/2009	12:00	Field Parameter	Specific Conductivity	676	umhos/cm
4/7/2008	13:10	Field Parameter	Specific Conductivity	594	umhos/cm
2/12/2007	9:30	Field Parameter	Specific Conductivity	578	umhos/cm
3/12/2007	9:45	Field Parameter	Specific Conductivity	561	umhos/cm
4/16/2007	9:15	Field Parameter	Specific Conductivity	545	umhos/cm
5/14/2007	11:00	Field Parameter	Specific Conductivity	534	umhos/cm

R & D #3 (Visitors Spring) DEQ Site ID : 851

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
6/15/2007	9:00	Field Parameter	Specific Conductivity	572	umhos/cm
9/10/2007	10:00	Field Parameter	Specific Conductivity	672	umhos/cm
10/15/2008	16:30	University of Iowa	Stigmastanol	<100	ng/L
4/7/2008	13:10	University of Iowa	Stigmastanol	<100	ng/L
4/7/2008	13:10	University of Iowa	Stigmastanol	<100	ng/L
10/15/2008	16:30	University of Iowa	Stigmasterol	<100	ng/L
4/7/2008	13:10	University of Iowa	Stigmasterol	<100	ng/L
4/7/2008	13:10	University of Iowa	Stigmasterol	<100	ng/L
10/15/2008	16:30	University of Iowa	Sulfadimethoxine	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Sulfadimethoxine	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Sulfadimethoxine	<2.0	ng/L
10/15/2008	16:30	University of Iowa	Sulfamethazine	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Sulfamethazine	<2.0	ng/L
4/7/2008	13:10	University of Iowa	Sulfamethazine	<2.0	ng/L
10/15/2008	16:30	University of Iowa	Sulfamethoxazole	9.2	ng/L
4/7/2008	13:10	University of Iowa	Sulfamethoxazole	2.3	ng/L
4/7/2008	13:10	University of Iowa	Sulfamethoxazole	2.6	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Sulfate	83.9	mg/L
4/7/2008	13:10	Idaho State Health Laboratory	Sulfate	68.5	mg/L
1/16/2007	12:00	Idaho State Health Laboratory	Sulfate	71.8	mg/L
2/12/2007	9:30	Magic Valley Laboratory	Sulfate	67.7	mg/L
3/12/2007	9:45	Magic Valley Laboratory	Sulfate	67.2	mg/L
4/16/2007	9:15	Magic Valley Laboratory	Sulfate	52.4	mg/L
5/14/2007	11:00	Magic Valley Laboratory	Sulfate	63.6	mg/L
10/15/2008	16:30	University of Iowa	Sulfathiazole	<5.0	ng/L
4/7/2008	13:10	University of Iowa	Sulfathiazole	<5.0	ng/L
4/7/2008	13:10	University of Iowa	Sulfathiazole	<5.0	ng/L
10/15/2008	16:30	Field Parameter	Temperature	14.7	°C
12/4/2008	14:39	Field Parameter	Temperature	14.6	°C
1/21/2009	12:15	Field Parameter	Temperature	14	°C
2/4/2009	12:00	Field Parameter	Temperature	14.4	°C
4/7/2008	13:10	Field Parameter	Temperature	14.1	°C
2/12/2007	9:30	Field Parameter	Temperature	13.9	°C
3/12/2007	9:45	Field Parameter	Temperature	14	°C
4/16/2007	9:15	Field Parameter	Temperature	13.91	°C
5/14/2007	11:00	Field Parameter	Temperature	14.24	°C
6/15/2007	9:00	Field Parameter	Temperature	15.8	°C
7/13/2007	9:30	Field Parameter	Temperature	14.63	°C
9/10/2007	10:00	Field Parameter	Temperature	14.33	°C
10/15/2008	16:30	University of Iowa	Testosterone	<100	ng/L
4/7/2008	13:10	University of Iowa	Testosterone	<100	ng/L
4/7/2008	13:10	University of Iowa	Testosterone	<100	ng/L
10/15/2008	16:30	Idaho State Health Laboratory	Total Dissolved Solids	510	mg/L
4/7/2008	13:10	Idaho State Health Laboratory	Total Dissolved Solids	403	mg/L
1/16/2007	12:00	Idaho State Health Laboratory	Total Dissolved Solids	417	mg/L

R & D #3 (Visitors Spring) DEQ Site ID : 851

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
2/12/2007	9:30	Field Parameter	Total Dissolved Solids	280	mg/L
2/12/2007	9:30	Magic Valley Laboratory	Total Dissolved Solids	240	mg/L
3/12/2007	9:45	Field Parameter	Total Dissolved Solids	270	mg/L
3/12/2007	9:45	Magic Valley Laboratory	Total Dissolved Solids	470	mg/L
4/16/2007	9:15	Field Parameter	Total Dissolved Solids	260	mg/L
4/16/2007	9:15	Magic Valley Laboratory	Total Dissolved Solids	347	mg/L
5/14/2007	11:00	Field Parameter	Total Dissolved Solids	260	mg/L
5/14/2007	11:00	Magic Valley Laboratory	Total Dissolved Solids	320	mg/L
6/15/2007	9:00	Field Parameter	Total Dissolved Solids	352	mg/L
7/13/2007	9:30	Field Parameter	Total Dissolved Solids	300	mg/L
9/10/2007	10:00	Field Parameter	Total Dissolved Solids	429	mg/L
10/15/2008	16:30	University of Iowa	Triclosan	<10	ng/L
4/7/2008	13:10	University of Iowa	Triclosan	<10	ng/L
4/7/2008	13:10	University of Iowa	Triclosan	<10	ng/L
10/15/2008	16:30	University of Iowa	Trimethoprim	<1.0	ng/L
4/7/2008	13:10	University of Iowa	Trimethoprim	<1.0	ng/L
4/7/2008	13:10	University of Iowa	Trimethoprim	<1.0	ng/L
10/15/2008	16:30	University of Iowa	Tylosin	<1.0	ng/L
4/7/2008	13:10	University of Iowa	Tylosin	<1.0	ng/L
4/7/2008	13:10	University of Iowa	Tylosin	<1.0	ng/L

R & D #3A DEQ Site ID : 850

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
12/4/2008	14:40	Field Parameter	Dissolved Oxygen	11.49	mg/L
12/4/2008	14:40	Magic Valley Laboratory	Nitrate (as N)	9.14	mg/L
12/4/2008	14:40	Magic Valley Laboratory	Nitrate (as N)	9.24	mg/L
12/4/2008	14:40	Field Parameter	pH	7.83	
12/4/2008	14:40	Field Parameter	Specific Conductivity	784	umhos/cm
12/4/2008	14:40	Field Parameter	Temperature	14.6	°C

R & D #3B DEQ Site ID : 852

Sample Date	Sample Time	Laboratory	Analyte	Analysis Result	Units
12/4/2008	14:40	Field Parameter	Dissolved Oxygen	11.17	mg/L
12/4/2008	14:40	Magic Valley Laboratory	Nitrate (as N)	10.3	mg/L
12/4/2008	14:40	Magic Valley Laboratory	Nitrate (as N)	10.2	mg/L
12/4/2008	14:40	Field Parameter	pH	7.87	
12/4/2008	14:40	Field Parameter	Specific Conductivity	808	umhos/cm
12/4/2008	14:40	Field Parameter	Temperature	14.6	°C

SR-1 (NPDES) DEQ Site ID: 847					
Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
4/7/2008	12:08	University of Iowa	1,7-Dimethylxanthine	<2.7	ng/L
4/7/2008	12:08	University of Iowa	Acetaminophen	<2.0	ng/L
4/7/2008	12:08	University of Iowa	Acetaminophen	<2.0	ng/L
4/7/2008	12:08	Idaho State Health Laboratory	Alkalinity	175	mg/L
4/7/2008	12:08	University of Iowa	Caffeine	<10	ng/L
4/7/2008	12:08	University of Iowa	Caffeine	<10	ng/L
4/7/2008	12:08	Idaho State Health Laboratory	Calcium	56	mg/L
4/7/2008	12:08	University of Iowa	Carbamazepine	<1.0	ng/L
4/7/2008	12:08	University of Iowa	Carbamazepine	<1.0	ng/L
4/7/2008	12:08	Idaho State Health Laboratory	Chloride	46.5	mg/L
4/7/2008	12:08	Idaho State Health Laboratory	Chloride	53.3	mg/L
4/7/2008	12:08	University of Iowa	Cholesterol	1700	ng/L
4/7/2008	12:08	University of Iowa	Cholesterol	490	ng/L
4/7/2008	12:08	University of Iowa	Coprostanol	<100	ng/L
4/7/2008	12:08	University of Iowa	Coprostanol	<100	ng/L
4/7/2008	12:08	University of Iowa	Cotinine	<2.0	ng/L
4/7/2008	12:08	University of Iowa	Cotinine	<2.0	ng/L
4/7/2008	12:08	University of Iowa	DEET	0.025	mg/l
4/7/2008	12:08	University of Iowa	DEET	<20	ng/L
4/7/2008	12:08	University of Iowa	Dihydrocholesterol	<100	ng/L
4/7/2008	12:08	University of Iowa	Dihydrocholesterol	<100	ng/L
4/7/2008	12:08	Field Parameter	Dissolved Oxygen	9.35	mg/L
4/7/2008	12:08	Field Parameter	Dissolved Oxygen	11.68	mg/L
4/7/2008	12:08	Field Parameter	Dissolved Oxygen	11.35	mg/L
4/7/2008	12:08	Field Parameter	Dissolved Oxygen	11.17	mg/L
4/7/2008	12:08	University of Iowa	Equilinen	<100	ng/L
4/7/2008	12:08	University of Iowa	Equilinen	<100	ng/L
4/7/2008	12:08	University of Iowa	Estriol	<250	ng/L
4/7/2008	12:08	University of Iowa	Estriol	<250	ng/L
4/7/2008	12:08	University of Iowa	Ibuprofen	<5	ng/L
4/7/2008	12:08	University of Iowa	Ibuprofen	<5	ng/L
4/7/2008	12:08	University of Iowa	Lincomycin	<5	ng/L
4/7/2008	12:08	University of Iowa	Lincomycin	<5	ng/L
4/7/2008	12:08	Idaho State Health Laboratory	Magnesium	25	mg/L
10/15/2008	16:15	Idaho State Health Laboratory	Nitrate (as N)	3.1	mg/L
10/15/2008	16:15	Idaho State Health Laboratory	Nitrate (as N)	5.7	mg/L
10/15/2008	16:15	Magic Valley Laboratory	Nitrate (as N)	2.83	mg/L
10/15/2008	16:15	Idaho State Health Laboratory	Nitrate (as N)	2.5	mg/L
10/15/2008	16:15	Field Parameter	pH	7.62	
10/15/2008	16:15	Field Parameter	pH	7.93	
10/15/2008	16:15	Field Parameter	pH	7.83	
10/15/2008	16:15	Field Parameter	pH	8.97	
10/15/2008	16:15	Idaho State Health Laboratory	Phosphorus	0.025	mg/L
10/15/2008	16:15	Idaho State Health Laboratory	Phosphorus	0.033	mg/L
10/15/2008	16:15	Idaho State Health Laboratory	Potassium	4.6	mg/L
10/15/2008	16:15	University of Iowa	Progesterone	<100	ng/L

SR-1 (NPDES) DEQ Site ID: 847					
Sample Date	Sample Time	Laboratory	Analyte	Analysis Result/ Detection Limits	Units
10/15/2008	16:15	University of Iowa	Progesterone	<100	ng/L
10/15/2008	16:15	University of Iowa	Sitosterol	<100	ng/L
10/15/2008	16:15	University of Iowa	Sitosterol	<100	ng/L
10/15/2008	16:15	Idaho State Health Laboratory	Sodium	35	mg/L
10/15/2008	16:15	Field Parameter	Specific Conductivity	523	umhos/cm
10/15/2008	16:15	Field Parameter	Specific Conductivity	657	umhos/cm
10/15/2008	16:15	Field Parameter	Specific Conductivity	608	umhos/cm
10/15/2008	16:15	Field Parameter	Specific Conductivity	588	umhos/cm
10/15/2008	16:15	University of Iowa	Stigmastanol	<100	ng/L
10/15/2008	16:15	University of Iowa	Stigmastanol	<100	ng/L
10/15/2008	16:15	University of Iowa	Stigmasterol	<100	ng/L
10/15/2008	16:15	University of Iowa	Stigmasterol	<100	ng/L
10/15/2008	16:15	University of Iowa	Sulfadimethoxine	<2.0	ng/L
10/15/2008	16:15	University of Iowa	Sulfadimethoxine	<2.0	ng/L
10/15/2008	16:15	University of Iowa	Sulfamethazine	<2.0	ng/L
10/15/2008	16:15	University of Iowa	Sulfamethazine	<2.0	ng/L
10/15/2008	16:15	University of Iowa	Sulfamethoxazole	1.2	ng/L
10/15/2008	16:15	University of Iowa	Sulfamethoxazole	2.7	ng/L
10/15/2008	16:15	Idaho State Health Laboratory	Sulfate	58.3	mg/L
10/15/2008	16:15	Idaho State Health Laboratory	Sulfate	68.3	mg/L
10/15/2008	16:15	University of Iowa	Sulfathiazole	<5.0	ng/L
10/15/2008	16:15	University of Iowa	Sulfathiazole	<5.0	ng/L
10/15/2008	16:15	Field Parameter	Temperature	14.2	°C
10/15/2008	16:15	Field Parameter	Temperature	14.5	°C
10/15/2008	16:15	Field Parameter	Temperature	14.2	°C
10/15/2008	16:15	Field Parameter	Temperature	14.3	°C
12/4/2008	16:20	University of Iowa	Testosterone	<100	ng/L
12/4/2008	16:20	University of Iowa	Testosterone	<100	ng/L
12/4/2008	16:20	Idaho State Health Laboratory	Total Dissolved Solids	354	mg/L
12/4/2008	16:20	Idaho State Health Laboratory	Total Dissolved Solids	420	mg/L
12/4/2008	16:20	University of Iowa	Triclosan	<10	ng/L
2/4/2009	12:45	University of Iowa	Triclosan	<10	ng/L
2/4/2009	12:45	University of Iowa	Trimethoprim	<1.0	ng/L
2/4/2009	12:45	University of Iowa	Trimethoprim	<1.0	ng/L
2/4/2009	12:45	University of Iowa	Tylosin	<1.0	ng/L
2/4/2009	12:45	University of Iowa	Tylosin	<1.0	ng/L